BOOK 1 OF 2

PRELIMINARY ENGINEERING REPORT AND FEASIBILITY ANALYSES FOR WATER SYSTEM SOURCE IMPROVEMENTS

NORTH CENTRAL MISSOURI
Regional Water Commission

NORTH CENTRAL MISSOURI REGIONAL WATER COMMISSION
SULLIVAN COUNTY, MISSOURI

Original Approved Version: September 3, 2013
Revised Version: May 29, 2015

PREPARED BY:

OLSSON ASSOCIATES

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STATE OF MISSOURI
5/29/15
CHAD W. SAYRE
NUMBER PE-27878
REGISTERED PROFESSIONAL ENGINEER

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SUMMARY OF REPORT CONCLUSIONS

1. The current North Central Missouri Region to be served by the proposed reservoir meets the criteria of a disadvantaged community as established by MDNR-SRF criteria. (executive summary)

2. The region is extremely susceptible to drought and has suffered under an acute water shortage for decades due to a lack of suitable aquifers and rivers (Section IV A).

3. The lack of available water sources in the region is a significant factor leading to some of the highest water rates in the Missouri concomitant with extreme economic disadvantage.

4. This combination of low income and high water rates makes the North Central Region one of the most critical and underserved regions of the state for development of new water sources.

5. Groundwater is not a viable option due to poor yield and quality caused by glacial movements and natural geologic limitations.

6. There are no available existing free-flowing existing surface sources that can meet the long term, regional demands.

7. A proposed reservoir is the only viable option to meet the current and future demand for the region.

8. The North Central Missouri Regional Water Commission and the East Locust Creek Water Supply Reservoir are critical elements of the Missouri Department of Natural Resource's strategic water supply consolidation plan (executive summary).

9. Construction of the proposed reservoir will provide an economic "net-benefit" to the region and state provide a tremendous strategic resource in the state's water resource portfolio.

10. The proposed reservoir is well supported by the local community, with 82% of the voters supporting a ½ cent sales tax increase to fund a portion of the proposed reservoir (executive summary).

11. The proposed reservoir is projected to provide vast economic benefits (Table 1).

12. The pioneering Lake Authority legislation will provide the authority needed to improve water quality in the basin and protect valuable natural resources.

13. The proposed reservoir will beneficially impact distressed streams and wetlands in the region.

14. The streams most directly impacted are already impaired, distressed, and classified and the construction of the reservoir will beneficially impact these impaired streams.

15. This location is well situated to help alleviate the high drinking water prices for residents and businesses.

16. The impacts to the streams and wetlands will be permitted and mitigated.

17. The North Central Missouri Regional Water Commission should proceed towards the ultimate goal of 7.0 MGD average daily design flow demand using a phased distribution plan that accounts for the current water treatment capacity and the most likely early connections (Table 8).

18. The planning, design, and construction of the new reservoir should be integrated into the East Locust Creek Watershed improvement plan and MDNR – Our Missouri Waters initiative Lower Grand pilot project to maximize the benefits of the new reservoir to the regions ecosystem, and regional and state economy.

19. Final mitigation of impacts should be incorporated into the overall watershed based impact assessment.

20. MDNR, USDA-RD, State of Missouri, and USDA-NRCS should be a combined funding source for the project's main costs. The project will provide benefits to all of North Central Missouri and the burden should not be placed on the Sullivan County tax-payers beyond the level of the specific local benefits. This undue burden further explains why the area is disadvantaged, underserved, and impoverished and has the highest water rates per MHI of any region in the state.

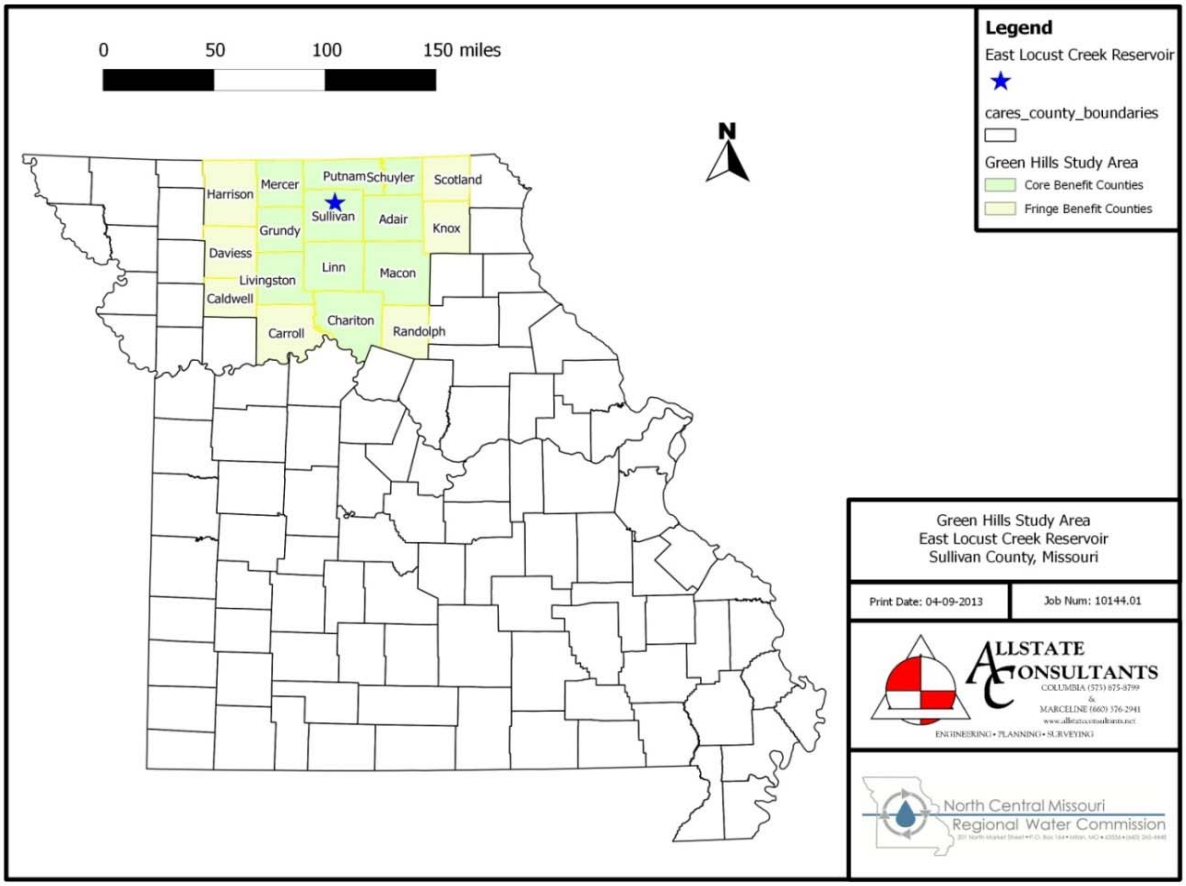
21. A centrally located reservoir will provide a least cost alternative and create the lowest carbon/greenhouse gas footprint per gallon of water used by requiring the least amount of pumping hours over the selected design life.

EXECUTIVE SUMMARY

The Acute Need for a Water Supply Solution

The East Locust Creek Water Supply Reservoir was sized and sited to address the most acute and chronic water shortage in the State of Missouri. Because of the geology, topography and climate of the 10 county region around Sullivan County, Missouri, there is a distinct shortage of available raw water. Without ready access to suitable streams and the lack of an adequate fresh water aquifer (underlying deep well water is brackish), the area has lived under the threat of drought for decades, leaving only a regional surface water impoundment as the only viable cost effective option for water supply to the 10 county service area.

The $97 million, 2,356 acre East Locust Creek Reservoir is Block in A designed to provide 7 million gallons of water per day to over 54,000 people and businesses. The total footprint for the Reservoir land acquisition will be approximately 4,300 acres. As of the date of this report, approximately 80% of the land is acquired and in possession of the Water Commission. The plan for the Reservoir also incorporates 22 floodwater retarding structures; modification of 7 existing FWR structures; 5 sediment/debris basins. The Reservoir was sited some 5 miles north of Milan Missouri, extending some 7 miles north to Pollock, Missouri.

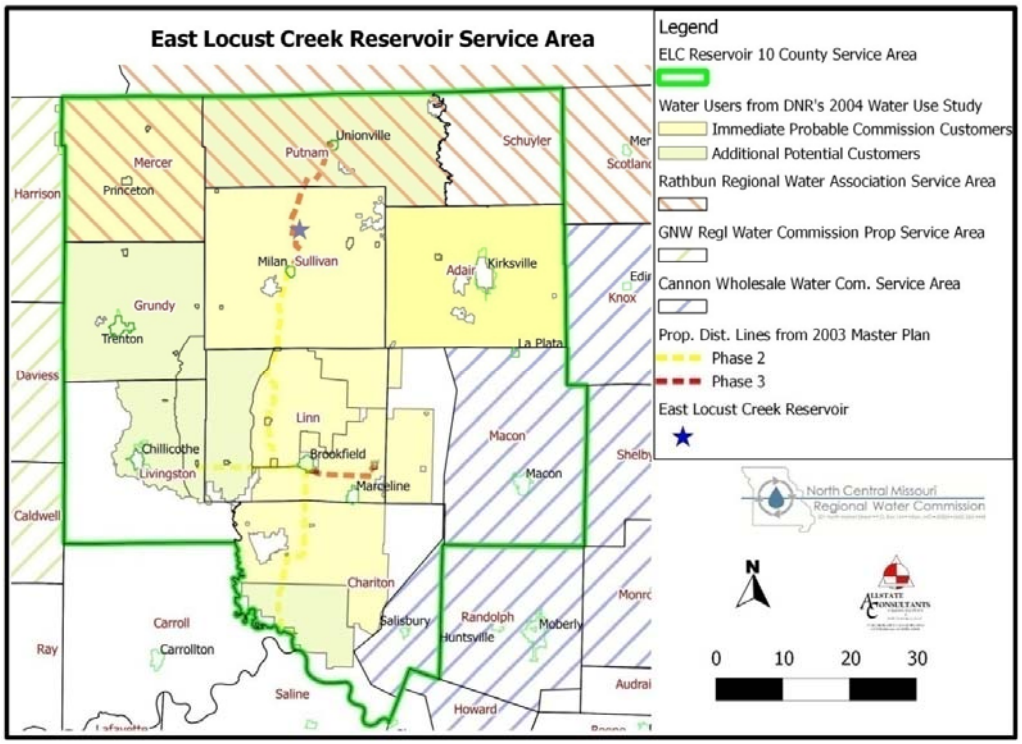


General Service Area

The Conduit for Pursuing the Ultimate Solution

The formation of the North Central Missouri Water Commission in 2001 was a part of the Missouri Department of Natural Resources (MDNR) strategic consolidation and the Reservoir is viewed as the ultimate solution to address the water supply shortage in this 10 county service region. Currently, the North Central Regional Water Commission (The Commission), a seller of wholesale water, provides nearly 700,000 gallons of treated water per day to over 3,000 customers, in addition to raw water sold large employers. The current source of water is the 200 acre Elmwood Lake, augmented by pump station lines from Locust Creek and Old City Lake, as well as an emergency treated water line from Trenton. These augmentation resources were most recently exhausted in the Spring of 2013 to record dangerous low levels.

MDNR supports the regionalization of small rural community water systems in order to address sustainable, cost effective drinking water solutions for the state and to enable water supplier to keep up with the increasingly stringent water regulations. There are thirty-four (34) small water supply systems within this North Central Missouri, 10-county area of need. These aging systems limit sustainable water quantities for current users, restrict population growth, and are costly to maintain individually to meet Federal and State drinking water guidelines. The Reservoir and eventual Regional Water Treatment plant expansion can enhance and or/or replace all of these systems producing an economic efficient, regional, sustainable water source and supply for the long term solution.



Primary Planning Region

In 2001 local steering committee efforts led to the creation of the North Central Missouri Regional Water Commission to serve as a regional wholesale water cooperative. The NCMRWC received a State HUD grant in 2002 which allowed them to hire Burns and McDonnell to complete a feasibility study and master plan for this regional project. **(Appendices**

A & B) The NRCS received a request in 2004 from NCMRWC to assist in the planning and construction of a rural water supply reservoir through the PL-566 watershed program. A special congressional authorization and appropriation was provided to complete planning activities on this project due to size limitations originally identified within the PL-566 Watershed Program.

A Revised PL-566 Watershed Plan and Environmental Impact Statement (EIS) was completed in January, 2007 **Appendix P**. This Revised Plan incorporated a large multiple purpose reservoir, primarily designed to provide a sustainable water supply for North Central Missouri. The project purposes listed in the EIS were:

- ***To provide a reservoir capable of producing 7.0 million gallons of raw water per day for the residents and communities of north central Missouri.***
- ***To provide water-based recreational opportunities.***
- ***To reduce flood damages on the floodplains of East Locust Creek, Little East Locust Creek, and the common floodplain area of Locust Creek.***

Special cost share rates have been authorized by Public Law 109-108, H.R.2744, Section 726, which states: ***"Notwithstanding any other provision of law, the Natural Resources Conservation Service shall provide financial and technical assistance through the Watershed and Flood Prevention Operations program to carry out the East Locust Creek Watershed Plan Revision in Missouri, including up to 100 percent of the engineering assistance and 75 percent cost share for construction cost of site RW1".***

Since the Revised Plan's completion, NRCS has obligated funding in 3 primary agreements. Approximately, $2.8 Million is obligated to a land-rights agreement, which provides NRCS's cost share contribution for the land acquisition and relocation. The second obligation is funding a $1.5 million contract for Phases 1 thru 4 of an 8 phase Final Design contract. Both the agreement and contract end September 2014. In the fall of 2014, a third agreement was executed, providing $2.5 million for creation of a Supplemental Environmental Impact Statement, 404 Permitting, and for phases 5 thru 7 of the final design.

A History of Unparalleled Local Support

The Commission is made up of 3 members (and 3 Alternates) from each customer entity including the City of Milan, City of Green City, the City of Green Castle and Sullivan County Public Water Supply District #1. The City members are appointed by the mayors of the respective communities and in the case of Green City and Green Castle, the Mayor's themselves serve. This arrangement provides a platform for enhanced communication to the community at-large. This communication and the Commission's commitment to transparency has resulted in unparalleled community support.

In April of 2010, the Commission petitioned the Sullivan County Commission to place a ½ cent retail sales tax before the voters of Sullivan County for the purpose of supporting the construction of the East Locust Creek Reservoir. In a high-turnout for an April election, some 81.25% of voters supported the ballot initiative. This landslide victory occurred during the worst economic times since the great depression. Subsequent to the ballot issue, the Commission voted unanimously to raise water rates by $1.00. These two revenue sources service the $10 million bond that is being used to acquire the land necessary for the reservoir. As a part of the bond financing, approval from each of the respective communities and the water district was needed. In every instance, these boards voted unanimously in support of issuing the bond.

On several occasions the Commission has needed various the support and/or approval from the County Commission, the Assessor, Sullivan County Public Water Supply District #1 or the City of Milan as we work through the many issues associated with the East Locust Creek Reservoir construction. In every instance these organizations have responded to our request enthusiastically.

Stakeholder Involvement

The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) is the Federal sponsor for the Reservoir project and East Locust Creek Reservoir represents the largest ever undertaken by NRCS. The Commission is the local sponsor and they will own and operate the Reservoir. Providing active financial support to date include MDNR, the Environmental Protection Agency, and, indirectly, the U.S. Army Corps of Engineers (USACE).

There are two other Federal stakeholders who will play oversight and/or financial support roles; the USDA's Rural Development Administration and the US Fish and Wildlife Service. On the State level there are four other stakeholders who will play oversight and/or financial support roles; the Missouri Department of Conservation, the Missouri Department of Transportation, the Missouri Department of Health and Senior Services and the Missouri Department of Economic Development.

Project Financing

The first phase of project financing occurred in 2006 with a $6 Million Municipal Bond that funded the purchase of the water plant and acquisition of the property needed for the siting of the dam.

The second phase of project financing began in August 2011 with a $10 million Municipal Bond for the primary purpose of providing initial funds for land acquisition processes. As of July 2013, approximately 2,300 acres of the 4,300 acres has been acquired. Debt service on the bond will be provided through, 1) a ½ cent retail sales tax adopted in April, 2010 (passed by 81.25% of voters), 2) a $1.00 per thousand gallon increase, 3) operating funds. In addition to these sources of funds, the Commission drafted "Lake Authority" legislation which was signed into law in July, 2011. This Lake Authority Legislation enabled the Commission to; 1) "Control" activities in the Watershed, to protect water quality, 2) Allow for landowners to retain land closer to water's edge, 3) To reduce the footprint of the Reservoir by 1,500 acres (saving $3 million), 4) Ultimately create a Tax Increment Financing District which is estimated to produce between $8 and $22 million for the project depending on the rate of development around the Reservoir (these funds are currently uncommitted).

Additional funding has been provided to date for various purposes including

- Over $600,000 in EPA Targeted Brownfields assessments (including 63 phase I assessments and 34 phase II assessments to date).
- $4 Million in state funding for land acquisition
- $2.5 Million from NRCS for Supplemental Environmental Impact Statement, 404 Permitting and Dam Design
- $93,000 in EPA Brownfield Cleanup Grant to remove hazardous waste from buildings
- $200,000 from USACE and $200,000 from MoDNR for a Locust Creek Watershed Study
- $75,000 from MoDNR for updated Economic Impact and Water Rate studies.

East Locust Creek Reservoir

Obligated Project Funding by Source as of March 2015

Citizens of Sullivan County (57%)

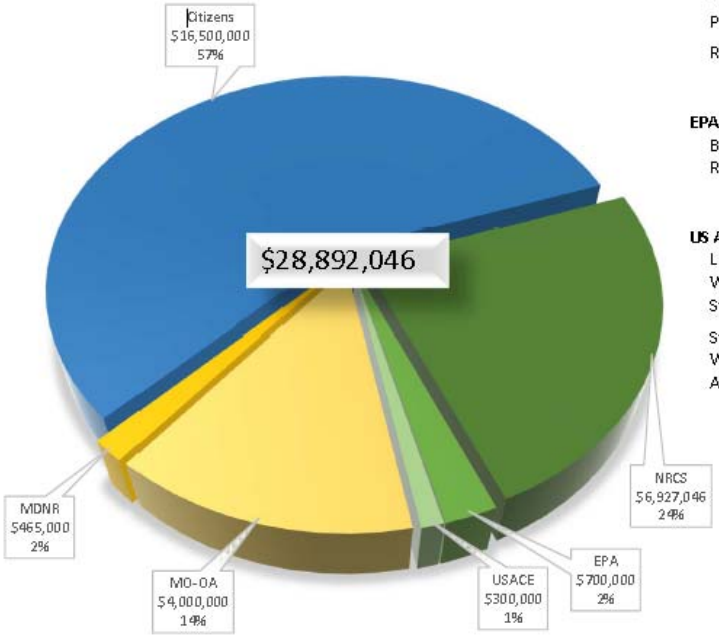
Bonds	$16,500,000
	$16,500,000

MDNR (2%)

Locust Creek Watershed Study (PAS1)	$200,000
Strategic Water Needs Assessment (PAS2)	$100,000
Preliminary Engineering Report	$90,000
Water Rate Study	$37,500
Economic Impact Study	$37,500
	$465,000

MO- OA (14%)

Land	$4,000,000
	$4,000,000



NRCS (24%)

Land Acquisition	$1,612,000
Phases 1-4	$1,498,803
Phases 5-7	$850,000
Permitting	$1,500,000
Relocation	$1,466,243
	$6,927,046

EPA (2%)

Brownfields Redevelopment	$700,000
	$700,000

US ACE (1%)

Locust Creek Watershed Study (PAS1)	$200,000
Strategic Water Needs Assessment (PAS2)	$100,000
	$300,000

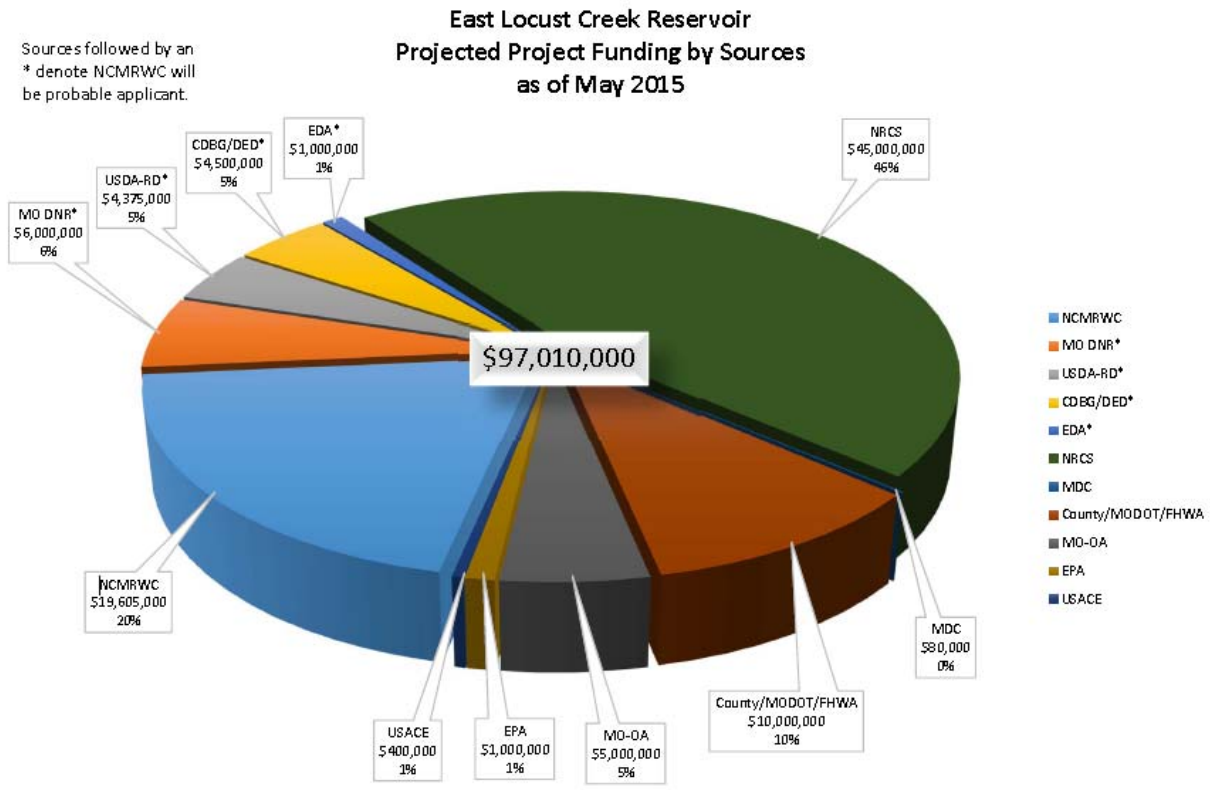
General Funding Targets

The final phase of project financing is projected to come in 2015/2016 through a low-interest USDA loan/grant and MDNR SRF loan/grant. The Project Team plans to restructure/refinance the 2006 and 2011 interim financing bonds as well as "round out" any remaining project funding through the USDA RD loan program or SRF programs.

Debt Service Coverage and Underwriting

The general debt service coverage will be financially "backstopped" and secured by the State of Missouri. This funding approach will serve to provide more affordable and stable water rates for this impoverished area and secure a component of a State of Missouri emergency or designated water supply reserve portfolio. Similar to Clarence Cannon Wholesale Water Commission's annual State of Missouri contract, the North Central Missouri Regional Water Commission intends to complete an agreement to cover the "core" debt service amount annually of approximately $1,000,000.00, initially, that will be modeled to decrease as new regional customers connect to the NCMRWC system. This approach will target 2% of MHI as the base water rate to maintain. Currently, water rates range from 3.5% to 6.16%. The MHIs are from 35.4% to 73.3% of the state's average for all communities currently served. Two current funding instruments are targeted that are the "Water Development Fund" and the "Water

Resources Fund." The annual state appropriation could be allocated to use one of these two existing tools for the funding obligation.



A Model Approach

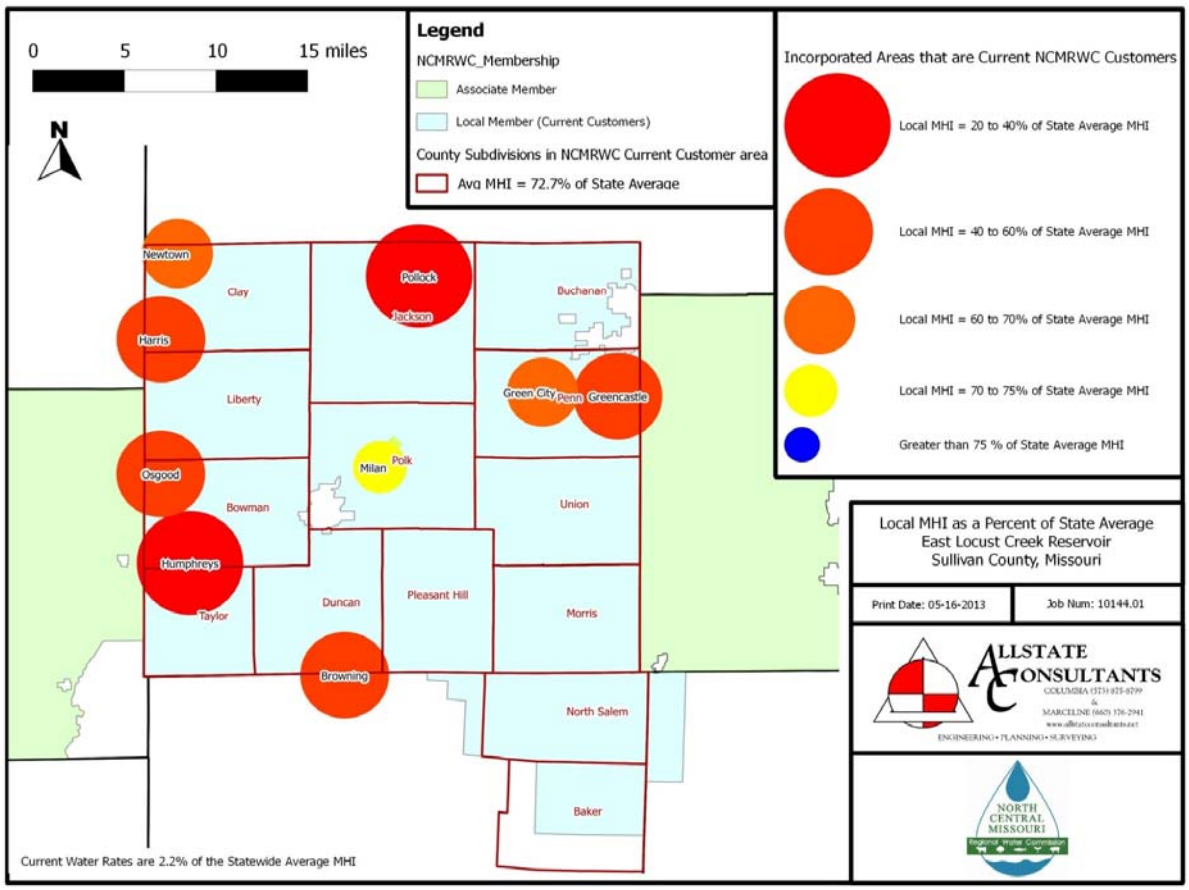
The Reservoir incorporates a number of unique or novel approaches including:

- Multi-level State and Federal Funding
- Lake Authority Legislation
- Control of Activities in the Watershed Supplying the Reservoir
- Private Ownership Benefits near the Water's Edge With Dock Access and Easements and Dock Licenses
- A ½ cent County Sales Tax to Support Reservoir Construction.
- Missouri's Largest Tax Increment Financing District Focused on Long Term Regional Drinking Water.
- A Regional Sewer Project to Remove the Threat of Contamination of the Lake and Watershed.
- A Smart Lake Design (C-STARS) to Promote Environmental Mitigation and Restore Distressed Systems.

A Disadvantaged Service Area

The North Central Missouri Regional Water Commission's (NCMRWC) current service area is one of the "poorest" and underserved regions in Missouri with multiple communities having Median House Income (MHI) of less than 50% of the state average (2006-2010 American Community Survey) and poverty rates that are notable in Missouri as some of the highest.

DNR's definition of a disadvantaged community is "any community with a population of less than 3,300, whose user rates will be at or above 2% of the state MHI, and the MHI is at or below 75% of the state average MHI." As shown in Table 2, all incorporated areas within the Commission service area fit the definition and meet the criteria to be designated a "disadvantaged" community. Analysis of the county subdivisions predominantly served by the Commission indicates that their average MHI is 72.7% of the state average.



Further comparison of statewide user rates as reported in the Missouri Rural Water Association's 2012 User Rate Survey to MHI show that the proposed service area is clearly in need of a reduction in short term and long term water rates. **Figure 12** below shows the statewide ratio of water rate to MHI. **Figure 13** superimposes the ratio of water rate to MHI on a display of the available statewide water sources to show the relationship between availability of water sources and affordability of water.

An Economic Engine for North Central Missouri: East Locust Reservoir

A joint DNR/NRCS IMPLAN Economic Impact analysis, **Appendix Y,** was performed in 2005. While providing relatively accurate impact projections it does not capture the full impact of the "near-water" design of the lake nor does it gauge the reliance of agriculture on an adequate water supply. It does however illuminate the need for all three project purposes defined in the EIS. The North Central Region is a major contributor to State, National and International beef and pork production; industries that are particularly susceptible to water supply shortages. This report is currently being updated and revised by MDNR and MU Commercial Agricultural economists.

It was projected that the Reservoir will have a $23 million economic impact during construction with 831 jobs created. Over the life of the project the Reservoir will have a $49 million economic impact and create 1,969 jobs. It will also mitigate flood damage by approximately $265,000 annually. A significant beneficial impact is the economic generation that will occur from both the construction and long-term operation of the Reservoir. Some of those benefits are contained and quantified herein.

While the economic impact from recreational activities stands out as an economic generator, what is as significant is the immutable fact that this Region cannot expect existing industry expansion or new industry location unless a new regional raw water resource is secured.

A ½ cent retails sales tax was voted on in April of 2010 and passed by 81.25 %. Those funds combined with a $1.00 per thousand gallons of water rate increase service the debt on a $10 million bond that is currently being used to purchase the 4,300 acres on which the Reservoir will reside.

Value Added Impact is defined as employee compensation, proprietary income, property type income and indirect business taxes and is quantified in dollars.

Table 1. Economic Impacts			
Regional Impact During Period of Construction			
	6 Year Period of Const.	Annually	Jobs
Dam & Res Construction	$18,972,233	$3,782,800	681
Water Supply Construction	$2,254,448	$449,500	84
Recreational Facilities	$1,672, 541	$335,500	66
Grand Total	$22,899,222	$4,567,800	831
Value Added Impact to the Region			
	100 Year Life	Annual	New Jobs
Recreational Activities*	$32,555,294	$1,759,200	1,157
Industry Expansion**	$15,336,134	$828,700	766
Dam Op. & Maint.	$801,418	$43,300	30
Rec. Facil. Op. & Maint.	$436,622	$23,600	16
Grand Total	$49,129,468	$2,654,800	1,969
*Based on unmet demand for recreation - 72,035 user days of different recreational activities			
** Without more raw water supply Farmland in Milan cannot expand its operations.			
Total Annual Flood Damage Reduction			$265,500

An Ecological Engine for North Central Missouri: A Holistic Approach to Reservoir Design – "The Smart Lake"

With the capabilities, expertise and experience of the NRCS and the open-minded, progressive approach being pursued by the Commission, the East Locust Creek project has the potential to set the standard for reservoir design, construction and operation. The East Locust Creek Reservoir will not only address the acute water shortage in the region, but act as an economic and ecologic engine in the region.

The Commission and the East Locust Creek Reservoir team has embraced a holistic planning and design approach and a transparent, inclusive and iterative process. This model approach is entitled "Smart Lake". The Smart Lake approach seeks balance between ecological restoration, preservation economies and economic generation. It is a balance, but a balance on a higher paradigm that subsequently limits (and hopefully eliminates) inherent conflicts and bridges gaps between oversight agencies. It requires coordination cooperation and an open mind to a new approach. It requires discretion and flexibility. Finally, it requires progressive design and the employment of technology.

The Commission has partnered with several of the state and federal entities that have oversight responsibilities and/or will be involved in the efficient operation of the Reservoir. These "partners" include the U.S. Army Corps of Engineers, the U.S. Department of Agriculture-Rural Development, the Missouri Department of Natural Resources, the Missouri Department of Conservation, The Missouri Department of Natural Resources, the Missouri Department of Economic Development, the Green Hills Regional Planning Commission and the Sullivan County Commission. In addition we hope to forge a working partnership with the U.S. Fish and Wildlife Service and the Environmental Protection Agency.

It is the desire of the Commission to understand the "goals" of each governing agency as much as understand their requirements. Being in the enviable position of having; 1) a clean slate, 2) available resources and, 3) a commitment to a progressive approach, the Commission is attempting to look over the horizon in order to anticipate and plan to meet or exceed various federal and state agency stream and wetland mitigation and water quality requirements.

Far from being an intrusion on the ecosystem, the "Smart Lake" design being pursued will actually enhance the ecosystem by mitigating or eliminating distressed areas. The Lake will become an "ecological engine" for long term ecosystem improvement. .

A list of impacts/benefit targets which Smart Lake™ is likely to consider includes:

- **Water quality** – enhancing reservoir water quality and the benefits of quality water in the reservoir and in contributing and receiving streams.
- **Runoff quantity** – minimizing changes in the total quantity of storm runoff that occur as a result of this project
- **Hydrology** – attempting to mimic pre-project hydrology to the best of our ability through low impact development in the benefit district, best management practices applied to reservoir inputs and technologically advanced reservoir outflow control.
- **Channel stability** – managing the impacts of the reservoir on the geomorphology of Locust Creek.
- **Energy usage** – managing the energy required for construction and operation of the reservoir and using renewable energy where possible.
- **Erosion** – controlling erosion and preventing sediment from entering streams will be crucial elements during construction of the reservoir, construction of facilities within the benefit district and after construction is complete. As opportunities arise, the project may also contribute to soil conservation efforts.
- **Limnological health** – considering the impacts of all project decisions on the aquatic health in the reservoir.
- **Stream health** - Considering the impacts of all project decisions on the aquatic health in the contributing and receiving streams.
- **Lake access** – allowing human access to the reservoir in ways that minimize pollutant entry.
- **Human environment** – creating a high quality development for human activity
- **Recreation** – creating opportunities for recreation including fishing, boating, hiking, and exercising.

- **Human health** – providing a facility that encourages active lifestyles.
- **Water temperature** – considering the impacts of project decisions on temperature in the reservoir and on Locust Creek.
- **Greenhouse gases** – managing the production of greenhouse gases during construction and operation of the reservoir. Developing the water distribution system to minimize pumping energy needed.
- **Life-cycle costs** – calculating and accounting for the life cycle costs in all significant project decisions from pavement selection to landscaping design.
- **Reservoir density** – Because there are some reservoir impacts which can't be avoided, it would be inappropriate to create a reservoir on every stream the size of East Locust Creek in the region. Insofar as is possible, we will configure this reservoir to negate the need for a high density of reservoirs in north-eastern Missouri. In other words, this reservoir will be configured to meet the needs for a large enough area (10 counties) to keep the total density of reservoirs in the region low. This will help keep the overall level of unavoidable impacts to an acceptable level and will be viewed as a tradeoff between an acceptable level of reservoir density and acceptable water distribution impacts.
- **Social aspects** – the project is being considered as an amenity which can be utilized by the community for social activities.
- **Light pollution** – the project will consider placing reasonable limitations on the amount of unnecessary lighting that escapes the site to help in keeping the night time skies dark for wildlife, campers and star-gazers.
- **Project costs and funding** – all project decisions will involve consideration of costs and benefits. The project has a limited budget and will have to be developed within the budget.

Examples of potential Smart Lake™ components for which credit standards may be developed

- Minimum lacustrine buffer width
- Lake input control
- Water from outside the Benefit District treated with forebays designed for ease of maintenance (The Benefit District consists of the properties near the lake that are expected to directly benefit from the lake).
- Affordable Low Impact Development or sustainability credits required for sites in Benefit District
- Walking Trails
- Innovative reservoir outlet design
- Balance hydrology, stream stability, water quality, flood control etc.
- Active outlet structure controls (with on-site renewable energy source)
- Lake forebays, pre-treatment wetlands, perimeter interception swales
- Downstream dissolved oxygen monitoring and supplementation
- Managed lake access – runoff interception

- Managed littoral vegetation
- East Locust Quad-athalon (running/walking, canoeing, biking, swimming)
- Fisheries management
- Public outreach and education
- Sanitary system improvements to remove septic systems
- Modify reservoir grading plan to produce habitat
- Spillway pool designed to allow access for fishing and safe forms of recreation

PART I – REGIONAL WATER SUPPLY HISTORY AND GENERAL BACKGROUND

I - INTRODUCTION AND SERVICE AREA

A. The Green Hills Region Location and Introduction

For generations, North Central Missouri has struggled with an inadequate raw water supply from which potable drinking water can be derived. The "Green Hills" region of Missouri is largely rural with agriculture, agribusiness and specialized manufacturing being central to the economy. The Green Hills terrain is well suited for agricultural production, farming, livestock production, dairy production, assembly, manufacturing, processing, and product development to utilize the labor base, available lands, and infrastructure.

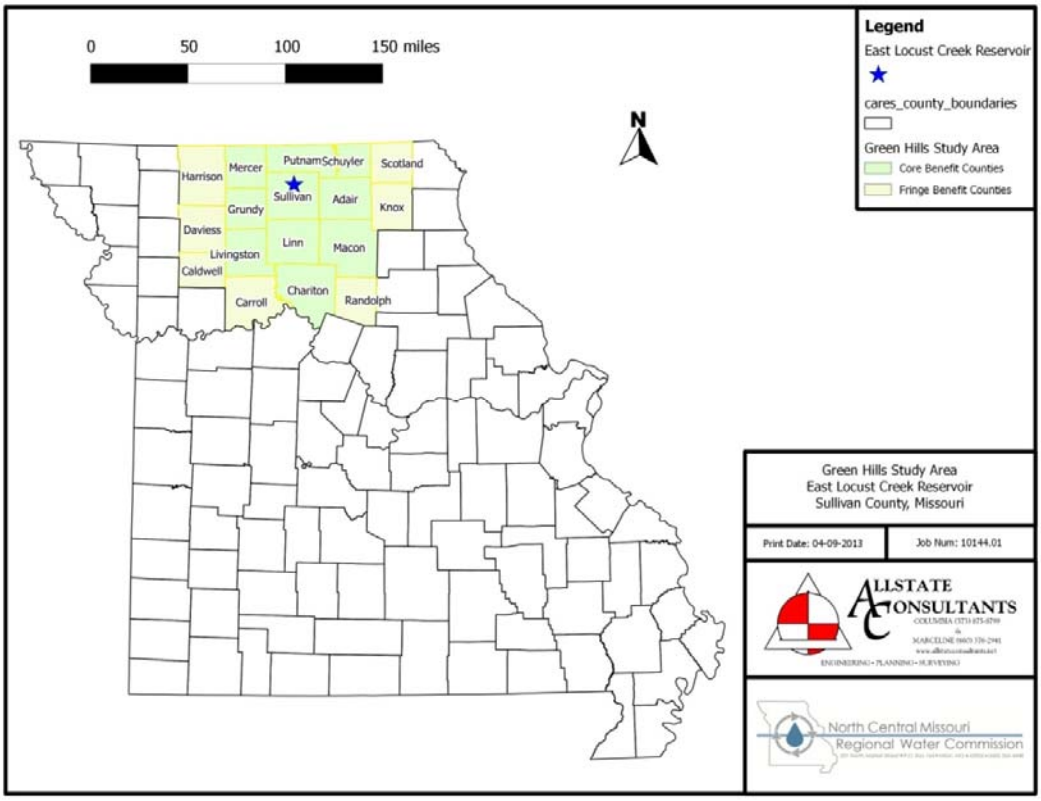


Figure 1 Green Hills Study Area East Locust Creek Reservoir Sullivan County, Missouri

"Direct" Benefit Counties: Putnam, Sullivan, Linn, Livingston, Adair, Macon, Chariton, Schuyler, Mercer, and Grundy.

"Indirect Benefit" Counties: Harrison, Daviess, Caldwell, Carroll, Randolph, Knox, and Scotland. Many indirectly benefited Counties have planned partial services from other commissions.

B. General Attributes of the Green Hills

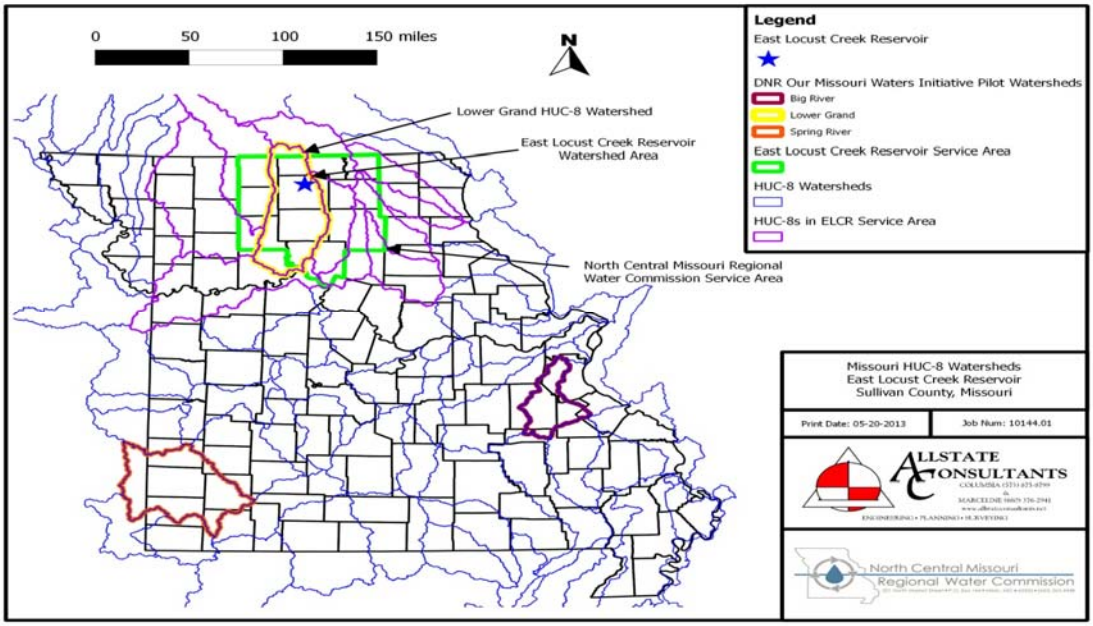


Figure 2 Watershed Summary

The Green Hills region is a substantial contributor to Missouri's economy and a significant export product provider from the State of Missouri that includes not only agricultural products such as grains and livestock products, but also a range of specialized, manufactured products that range from but not limited to, wire rope, to book publishing, to fabrication specialties.

Transportation infrastructure serving the area includes US Hwy. 63, US Hwy. 36, US Hwy. 65, US Hwy. 24, and MO Hwy. 6. There are numerous railways that serve North Central Missouri and an available water port in south Chariton County to complement existing infrastructure. An adequate, affordable and sustainable potable drinking water supply for the residents, businesses, and industries is critical to meet current demands and to allow for economic development in the future.

C. General Purpose of Report

The general purpose of this report is to summarize, re-evaluate the alternatives for a regional raw water source for the North Central Missouri Regional Water Commission (NCMRWC) and to

provide recommendations for meeting future raw and potable water needs, estimate future expenses, and to determine possible funding sources for the selected option. This report is intended to provide the basis for a single report for reference of need, demand, alternatives analysis, cost-benefit, and location determination. It will be continually supplemented.

D. Current Water Commission Members Summary

Information and data contained in this report is based upon existing aerial photography, plans, information provided by North Central Missouri Regional Water Commission (NCMRWC) officials and records, the Missouri Department of Natural Resources (MDNR), National Resource Conservation Service (NRCS), public water supply district records, reports prepared by credentialed professionals and investigations by personnel from Olsson Associates and Allstate Consultants LLC.

The North Central Missouri Regional Water Commission) was formed with directives and assistance from MDNR, as well as local water district members, and associate members in 2001. They include, the City of Milan, City of Green City, Sullivan Public Water Supply District #1, City of Green Castle, City of Kirksville (Associate), Grundy County PWSD #1(Associate), and Adair County PWSD #1. A “Water System Feasibility Study” dated 2003 was developed as an initial report on regional demand and need. Please reference **Appendix A**. **Appendix B** is the original water system master plan approved by MDNR and adopted by the Commission. Other communities such as Marceline, Missouri are currently evaluating a membership status to assist in their long-range water plans. A copy of the Commission’s Formation Document is included in **Appendix C** along with a membership list.

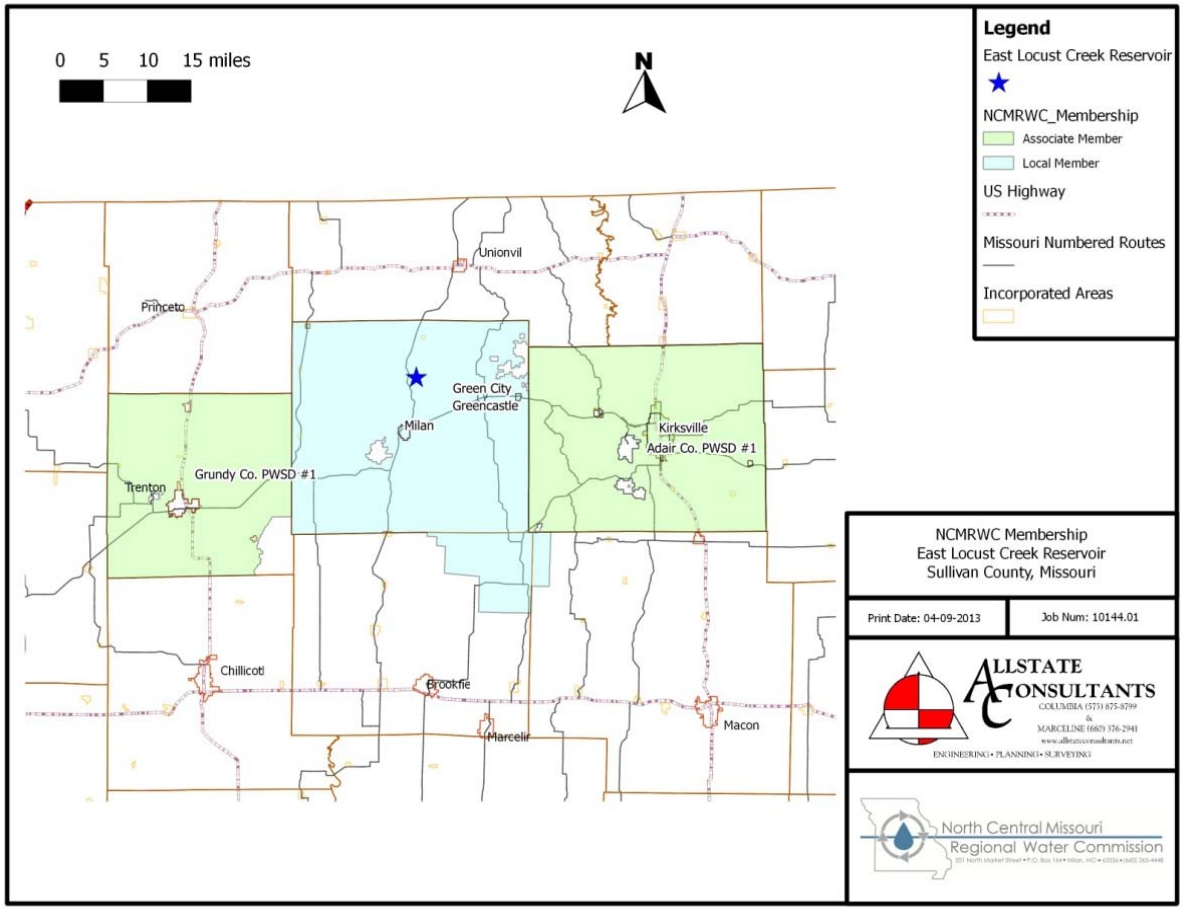


Figure 3 NCMRWC Membership East Locust Creek Reservoir Sullivan County, Missouri

E. Regional Service Territories of North Missouri

A more detailed service area orientation map is shown below that depicts current service areas shown by other regional water providers to the north, east, and west. Please note "Rathbun" is located in the State of Iowa. The area in green is the MDNR recommended targeted service area for the NCMRWC. This map also shows the areas suggested as likely future waters customers in the 2004 MDNR "Water Use Study". The complete study is located in **Appendix D**. Please note this is the MDNR "parent" document that provides basis for Regional Water Demand and Design Guidelines to the NCMRWC.

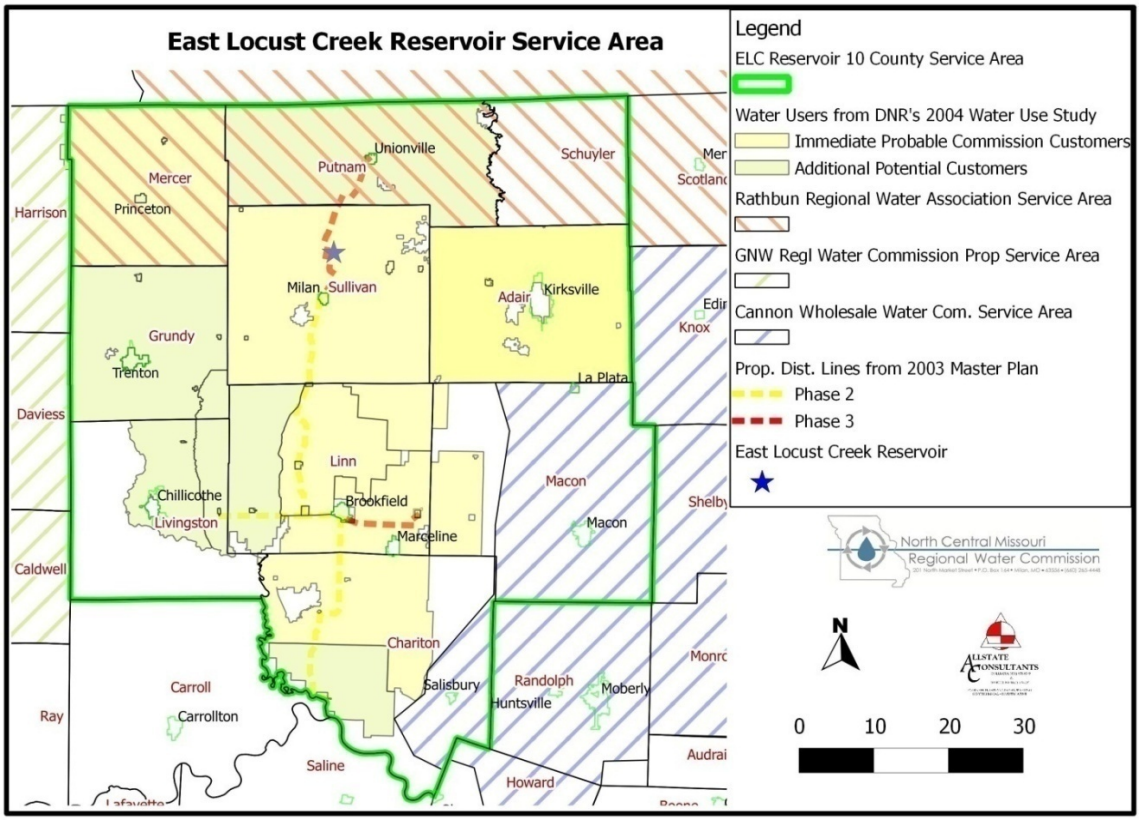


Figure 4 East Locust Creek Reservoir Service Area

II. REPORT GOALS

1. To promulgate an engineering summary document that provides an assembly of past and current credentialed studies and technical references for scientific validation that irrefutably show the need for a regional long- term water resource in North Central Missouri.

2. To provide a 30 year, 40 year, 50 year, 60 year assessment for Potable Water Needs that includes quantifiable, documentable, scientific and economic conclusions for the construction of a “50 year” range, source plan for affordable, potable drinking water for North Central Missouri that is practical, economically viable and supports the resident and business sustainability well into the future.

3. To provide data and analyses to support a regional surface water source that will have the best “cost to benefit” and “return on investment” for Missouri and federal taxpayers that is practical to implement for long-term benefit of the entire region.

4. To provide an evaluation, project scope, and path forward for the selected alternative with cost estimates and funding needs to assist and mitigate the current disadvantaged community conditions for long term water rate stability in the current service area and planned regional service areas.

5. To provide a detailed project budget and funding pathway.

III. BACKGROUND AND HISTORY OF DROUGHT SUSCEPTIBILITY & CONCLUSION

A. Background and History

For decades, the North Central Region of Missouri has struggled to develop a robust, sustainable, practical, and affordable regional potable water supply. This area of the state, for generations, survived on surface water supplied cisterns, inadequate local supply of tanked and hauled water, shallow low yield wells, and other unhealthy and disease ridden supplies of drinking water. In the 1970's and 1980's major efforts were undertaken after the formation of Missouri Department of Natural Resources and continued focus and education by the Missouri Department of Health, elected leaders, and local officials to construct a regional water supply for drinking water for the citizens of North Central Missouri. As rural water districts expand and usage demand rises, local supplies continue to fail to recover as the weather patterns and climatic changes are realized.

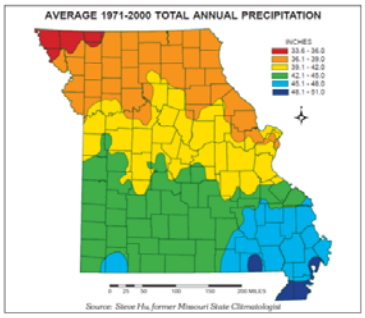
A letter report from the Missouri State Climatologist indicated the clear need for a regional source of water to satisfy the current and long-term needs for water in the NCMRWC service area. See Appendix I.

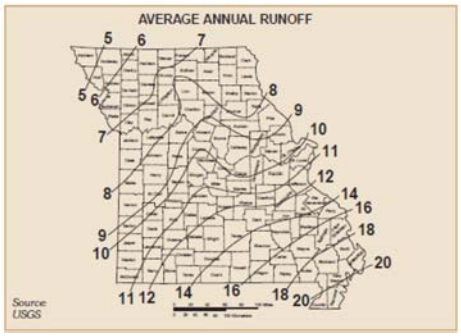
B. The Missouri Drought Statewide Study and Plan

In response to the quantification of drought propensity, susceptibility and impacts, as well as water resource management, an effort was made to mitigate the impacts of drought and to take steps to alleviate them altogether where possible. As a result the 2002 Missouri Drought Plan was developed and published. See **Appendix E** for a complete copy of the drought plan study. Below is general content and key, applicable portions of the results of the Drought Assessment and Plan.

- *Missouri is hydrologically and geologically diverse. The average annual rainfall ranges from about 34 inches in northwest Missouri to about 51 inches in southeast Missouri. The average annual runoff from precipitation varies from less than 5-inches to more than 20-inches per year.*

- *The average annual lake evaporation ranges from less than 36-inches a year in the northeast part of the state to more than 44-inches a year in the southwest part. Compared to most western states, even the driest areas of Missouri have enviable amounts of rainfall; however, some areas of the state are still water-short in terms of rainfall in relation to needs and uses.*





<u>*Northern And West-Central Missouri*</u>

Most of west-central and northern Missouri are underlain by rocks that contain water that is generally too mineralized for most uses. There are some domestic water supplies that get their water from the upper portion of the bedrock but usually the well yield and quality are marginal. The most widely used aquifer in this region is the glacial drift. The glacial drift can yield from less than a gallon of water a minute, to as much as 500 gpm. Average yields are probably less than 5 gpm. During times of drought, domestic wells located on hills and ridges will be affected more than wells located in the valley bottoms. During times of prolonged drought the upland wells may not be adequate for domestic water supply.

Most streams in northern Missouri do not receive appreciable groundwater recharge. During periords of drought, these streams are generally reduced to a series of pools or may become completely dry. Streams and water improundments are the major sources of water and when a drought is prolonged, these resources are at risk. This may be particualry true where treated

wastewater constitutes a significant percentage of the base flow of streams during drought periods.

Agricultural producers in west-central and northern Missouri are usually the first to feel the effects of drought. Row cropping is more extensive in this part of the state and except on the floodplains of major rivers, where alluvial groundwater resources are adequate, irrigation is generally not feasible. Farm ponds generally supply the water needs of livestock in northern Missouri. These water sources typlically become inadequate during prolonged drought.

Prior to any detailed planning and determination of available alternatives, the state should be divided into regions prioritized according to drought susceptibility.

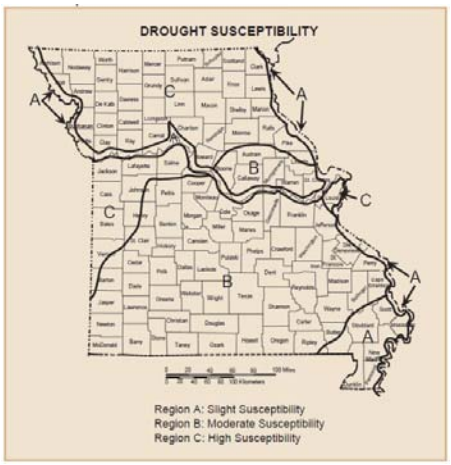
Region A *has minor surface and groundwater supply drought susceptibility. It is a region underlain by saturated sands and gravels (alluvial deposits). Surface and groundwater resources are generally adequate for domestic, municipal, and agricultural needs.*

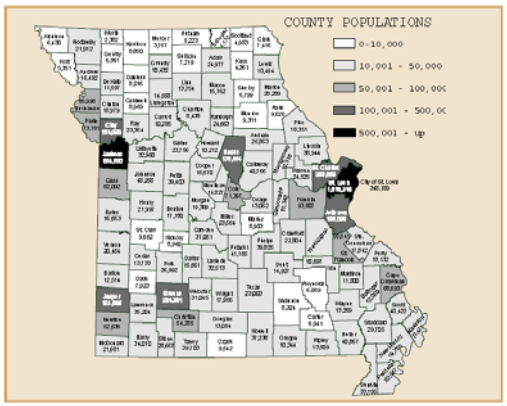
Region B *has moderate surface and groundwater supply drought susceptibility. Groundwater resources are adequate to meet domestic and municipal water needs, but due to required well depths, irrigation wells are very expensive. The topography generally is unsuitable for row-crop irrigation.*

Region C *has severe surface and groundwater supply drought vulnerability. Surface water sources usually become inadequate during extended drought. Groundwater resources are naturally of poor quality and typically only supply enough water for domestic needs. Irrigation is generally not feasible. When irrigation is practical, groundwater withdrawal may affect other users. Surface water sources are used to supplement irrigation supplied by groundwater sources.*

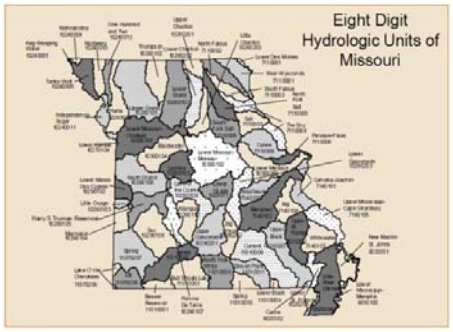
Since the areas in this region with poor groundwater yield and quality that rely on surface water resources for public water supply are the areas that appear to be the most vulnerable to drought, they should be the focus of drought planning activities. They should be designated Priority Drought Management Areas and be given a high priority relative to drought mitigation and water supply regionalization activities. The borders of the management area can be expanded if drought affected areas enlarge. The delineations of these regions also need to be considered from a perspective of:

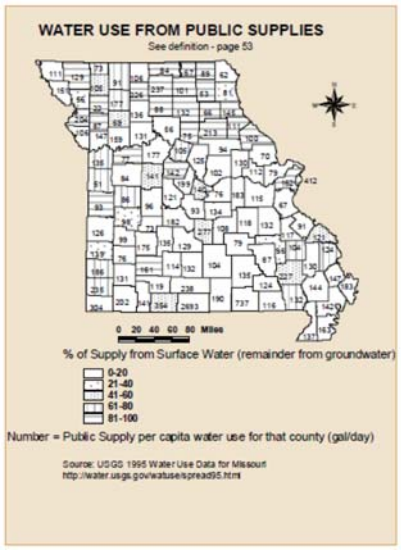
1) *Historical drought occurrences in an area/region*
2) *Actual annual and seasonal rainfall amounts*
3) *Current and projected water demands and uses within an area*
4) *Sources of water available for use*
5) *Water reserves and accessibility to addtional water supplies and*
6) *Current populations and projected population trends that are linnked to water use amounts. Specific locations within each of these regions may be more or less susceptible to drought because of local water supplies or use patterns.*

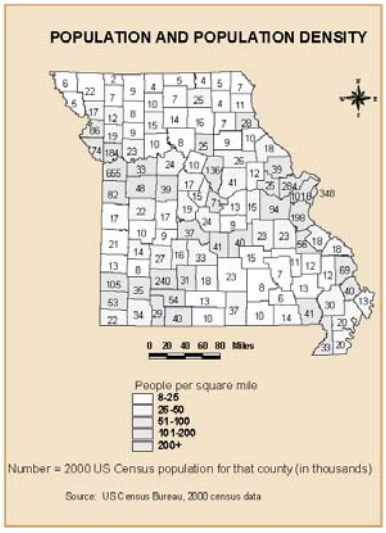

DROUGHT SUSCEPTIBILITY
A
B
C
Region A: Slight Susceptibility
Region B: Moderate Susceptibility
Region C: High Susceptibility


COUNTY POPULATIONS
0-10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 500,000
500,001 - up


Major
Rivers and Lakes
in Missouri


Eight Digit
Hydrologic Units of
Missouri


WATER USE FROM PUBLIC SUPPLIES
See definition - page 53
0 20 40 60 80 Miles
% of Supply from Surface Water (remainder from groundwater)
0-20
21-40
41-60
61-80
81-100
Number = Public Supply per capita water use for that county (gal/day)
Source: USGS 1995 Water Use Data for Missouri
http://water.usgs.gov/watuse/spread95.html


POPULATION AND POPULATION DENSITY
0 20 40 60 80 Miles
People per square mile
8-25
26-50
51-100
101-200
200+
Number = 2000 US Census population for that county (in thousands)
Source: US Census Bureau, 2000 census data

C. The Sullivan County Drought – A Case Study of MDNR

The Drought Study highlighted Sullivan County and specifically Milan, Missouri which gets its water from Elmwood Reservoir as one of the current water supply systems most susceptible to drought conditions.

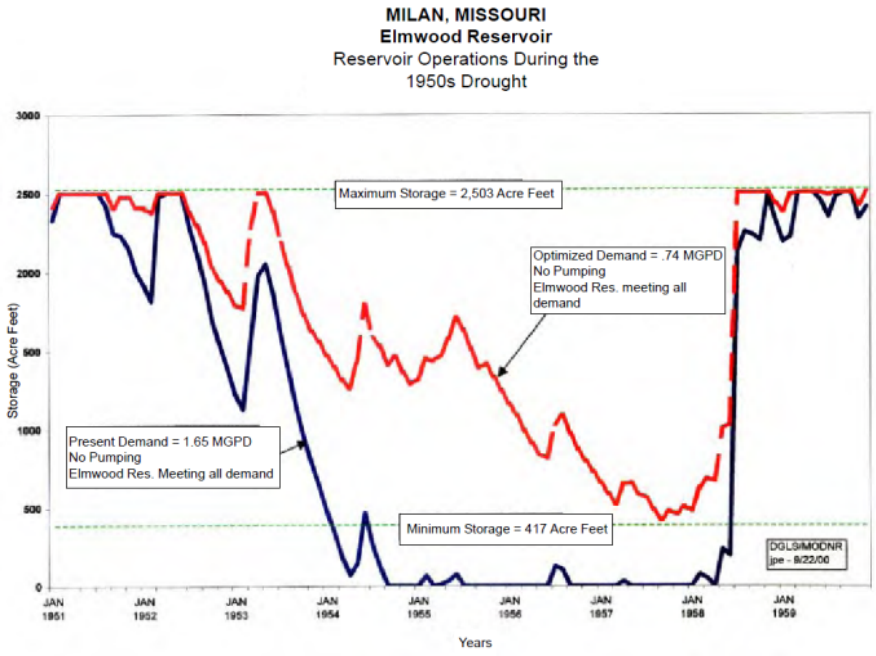


Figure 5 Milan, MO Elmwood Reservoir Operations During 1950's Drought

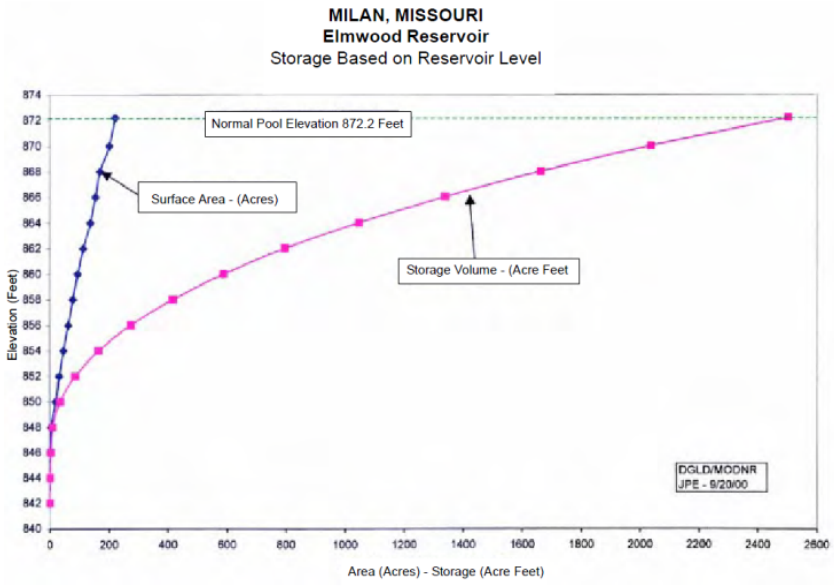
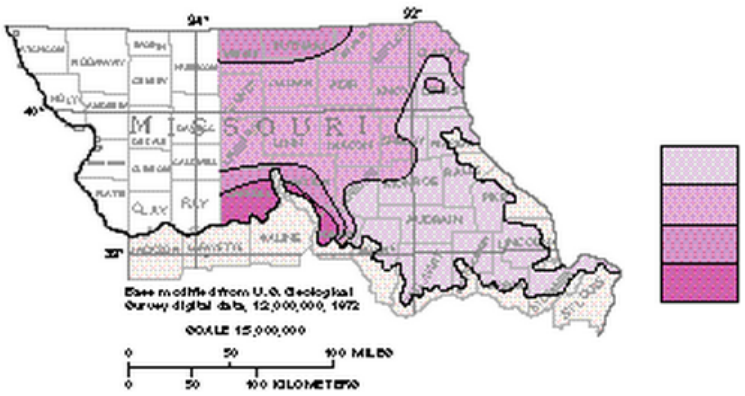


Figure 6 Milan, MO Elmwood Reservoir Storage Based on Reservoir Level

D. Hydro-geologic Limitations that Eliminate Deep Wells as a Solution

The drought study figures above clearly quantify susceptibility to drought of the NCMRWC service area and the need for a long-term solution. This surface water and regional susceptibility coupled with geologic limitations on groundwater availability as described in USGS. (1997) *Groundwater Atlas of the United States - Kansas, Missouri and Nebraska (excerpted below)*, creates an extraordinary need in the north central region.



Modified from Imes, J.L., 1985, The ground-water flow system in northern Missouri with emphasis on the Cambrian–Ordovician aquifer: U.S. Geological Survey Professional Paper 1305, 61 p.

Figure 117. The Mississippian aquifer contains freshwater only in its eastern one-third. The area of water that contains more than 10,000 milligrams per liter of dissolved solids is the result of upward leakage of saline water from deeper aquifers.

Figure 7 from USGS (1997). *Groundwater Atlas of the United States - Kansas, Missouri and Nebraska.* United States Geologic Survey.

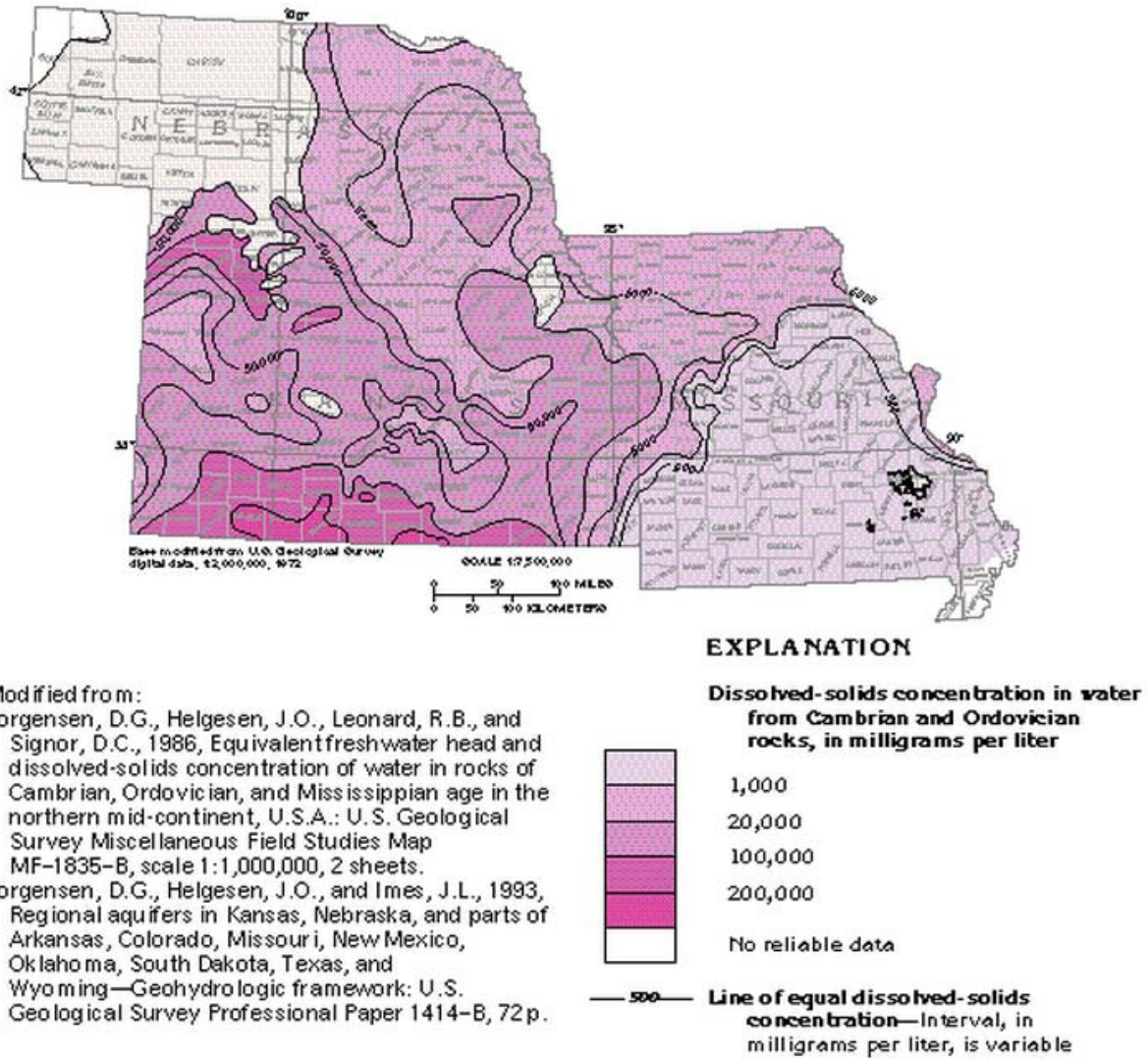


Figure 92. The Ozark Plateaus aquifer system contains fresh-water, whereas the water in the Western Interior Plains aquifer system is slightly saline to briny. Water in the Cambrian–Ordovician aquifer is fresh to slightly saline. The freshwater is in areas of vigorous ground-water circulation, and the more highly mineralized water is in places where ground-water movement is slow.

Figure 8 from USGS (1997). *Groundwater Atlas of the United States - Kansas, Missouri and Nebraska.* United States Geologic Survey.

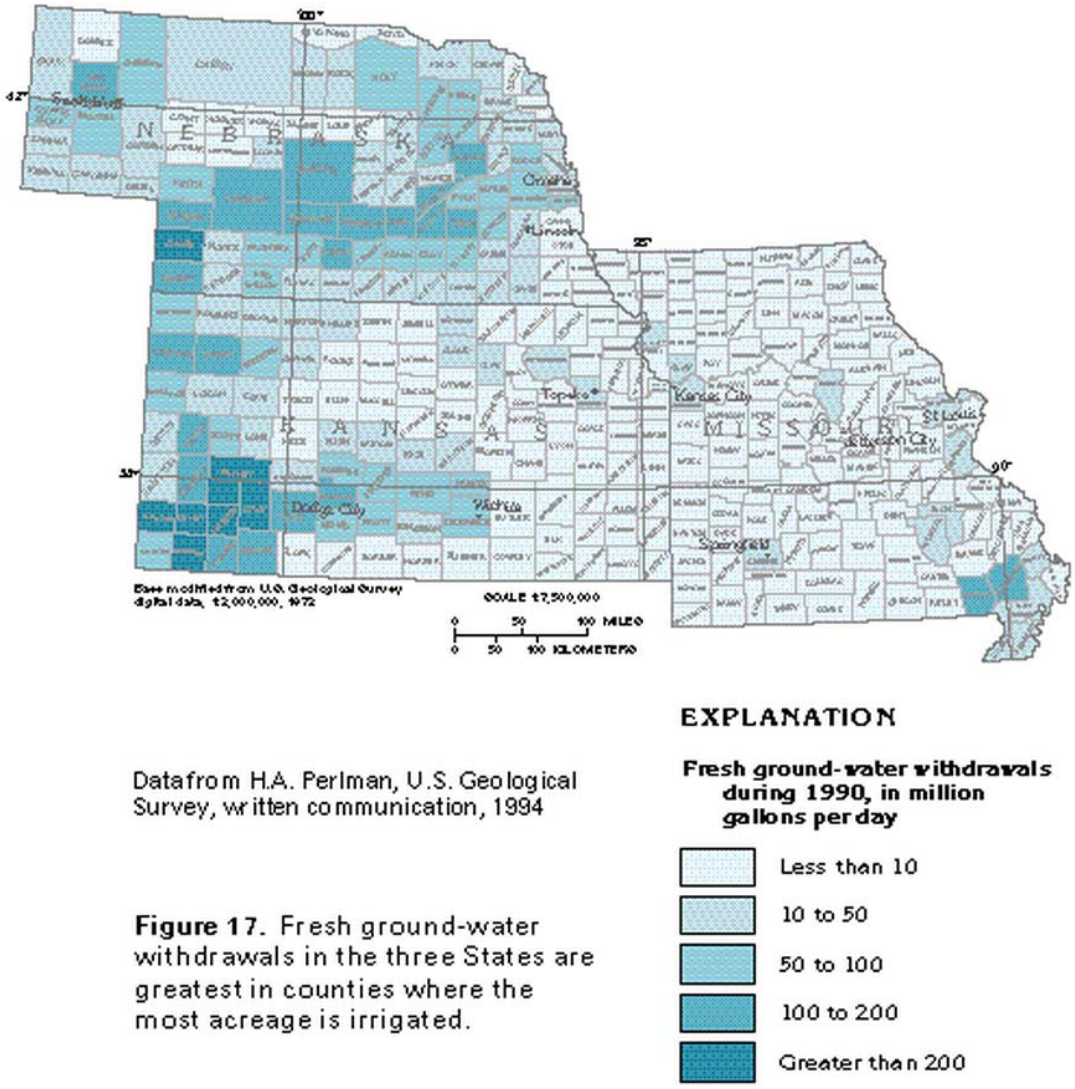


Figure 17. Fresh ground-water withdrawals in the three States are greatest in counties where the most acreage is irrigated.

Figure 9 from USGS (1997). *Groundwater Atlas of the United States - Kansas, Missouri and Nebraska.* United States Geologic Survey.

Figure 11. The surficial aquifer system consists of stream-valley aquifers along major drainages, the Mississippi River Valley alluvial aquifer in the Missouri bootheel, and glacial-drift aquifers in northern Missouri, eastern Nebraska, and northeastern Kansas. All three aquifers consist of unconsolidated deposits of sand and gravel.

Figure 12. The High Plains aquifer primarily consists of unconsolidated sand and gravel of the Ogallala Formation in Nebraska and western Kansas and of Quaternary beds in south-central Kansas. The aquifer underlies and is hydraulically con-nected to parts of the surficial aquifer system in Kansas and Nebraska.

Figure 13. The Mississippi embayment aquifer system directly underlies and is hydraulically con-nected to the surficial aquifer system in southeastern Missouri. The Great Plains aquifer system in Kansas and Nebraska underlies much of the High Plains aquifer and is separated from parts of it by a thick confining unit of shale.

Figure 14. The Ozark Plateaus aquifer system in southern Missouri is a large freshwater system in Paleozoic rocks. Equivalent rocks of the Western Interior Plains aquifer system, however, contain no fresh- water. The Mississippian aquifer of northern Missouri is in rocks equivalent to those of the upper part of the Ozark Plateaus aquifer system but has little or no hydraulic connection to that system.

Figure 15. The Cambrian–Ordovician aquifer consists of dolomite and sandstone beds equivalent to part of the Ozark Plateaus aquifer system but is hydraulically separate from that system in some places. The aquifer is overlain and underlain by confining units.

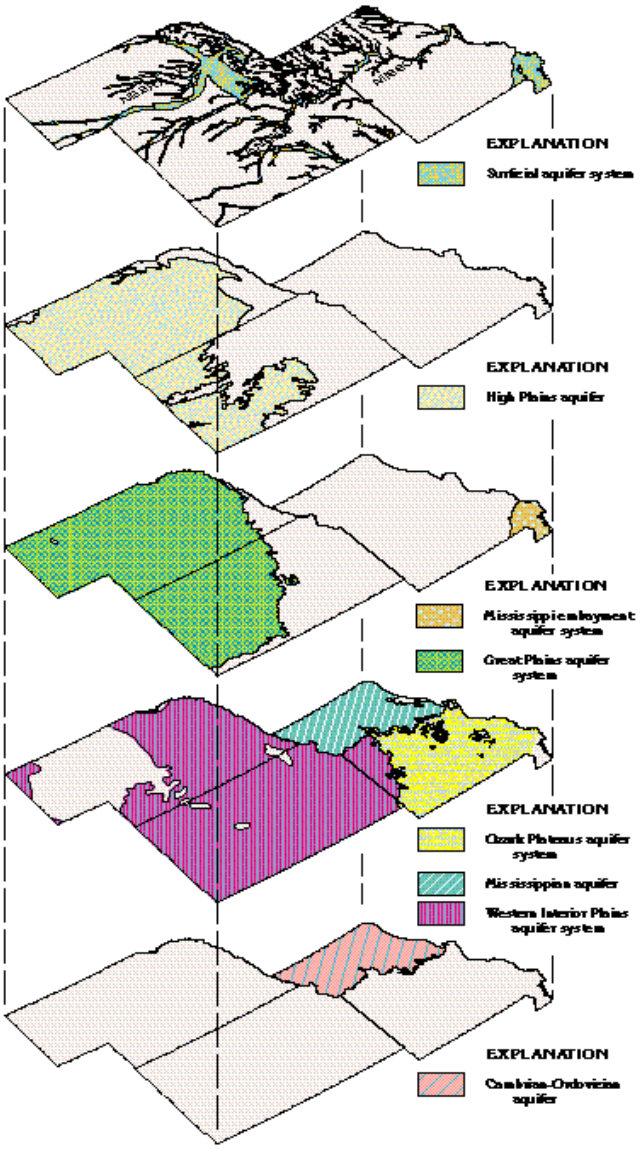


Figure 10 from USGS (1997). *Groundwater Atlas of the United States - Kansas, Missouri and Nebraska.* United States Geologic Survey.

The entire summary reference can be found in **Appendix F** from the USGS Study.

E. Missouri's Current Climate Trends

Appendix AE contains a PowerPoint presentation made by Pat Guinan, from the Missouri Climate Center, at the 2014 Governor's Conference on Natural Resources. This presentation includes the following two slides, which show that Missouri has seen above average precipitation since 1983 and below average evaporation since 1992. However, the drought events which have garnered the current level of overwhelming support occurred in the years

2000, 2003, 2011 and 2012. Even during these recent short duration droughts, it became necessary to implement emergency measures such as adding a water line to pump water from Trenton (35 Miles away) and adding an intake in Locust Creek 3.1 miles away. During an extended drought, it is unlikely that either of these emergency sources will remain viable. As Mr. Guinan points out in his summary slide "The 2012 drought resulted in numerous impacts, affecting many sectors in Missouri. However, it was a young drought when compared to other historic droughts, i.e. 1952-56. An important question we all need to consider is how prepared are we when the next 1950's drought affects the Show Me State?"

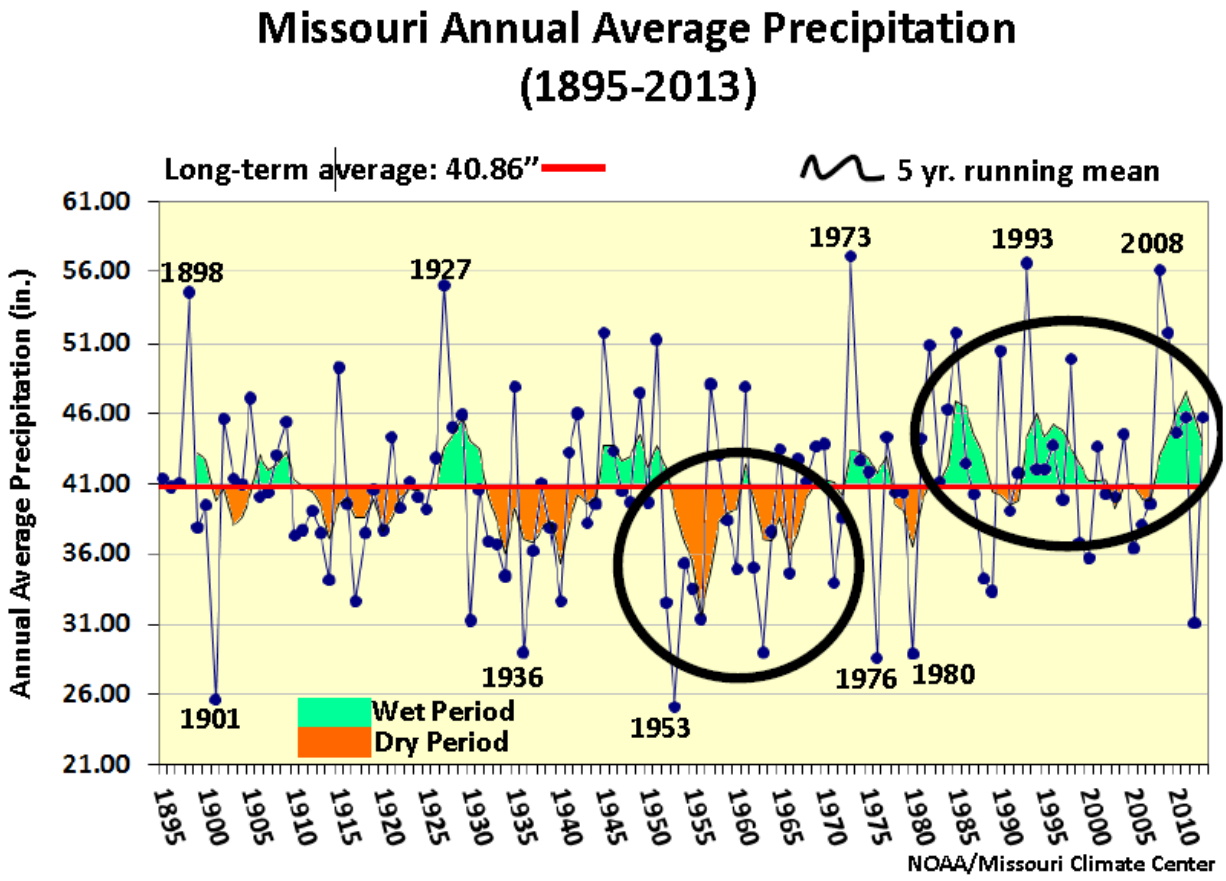


Figure 10b. Pat Guinan, Missouri Climate Center

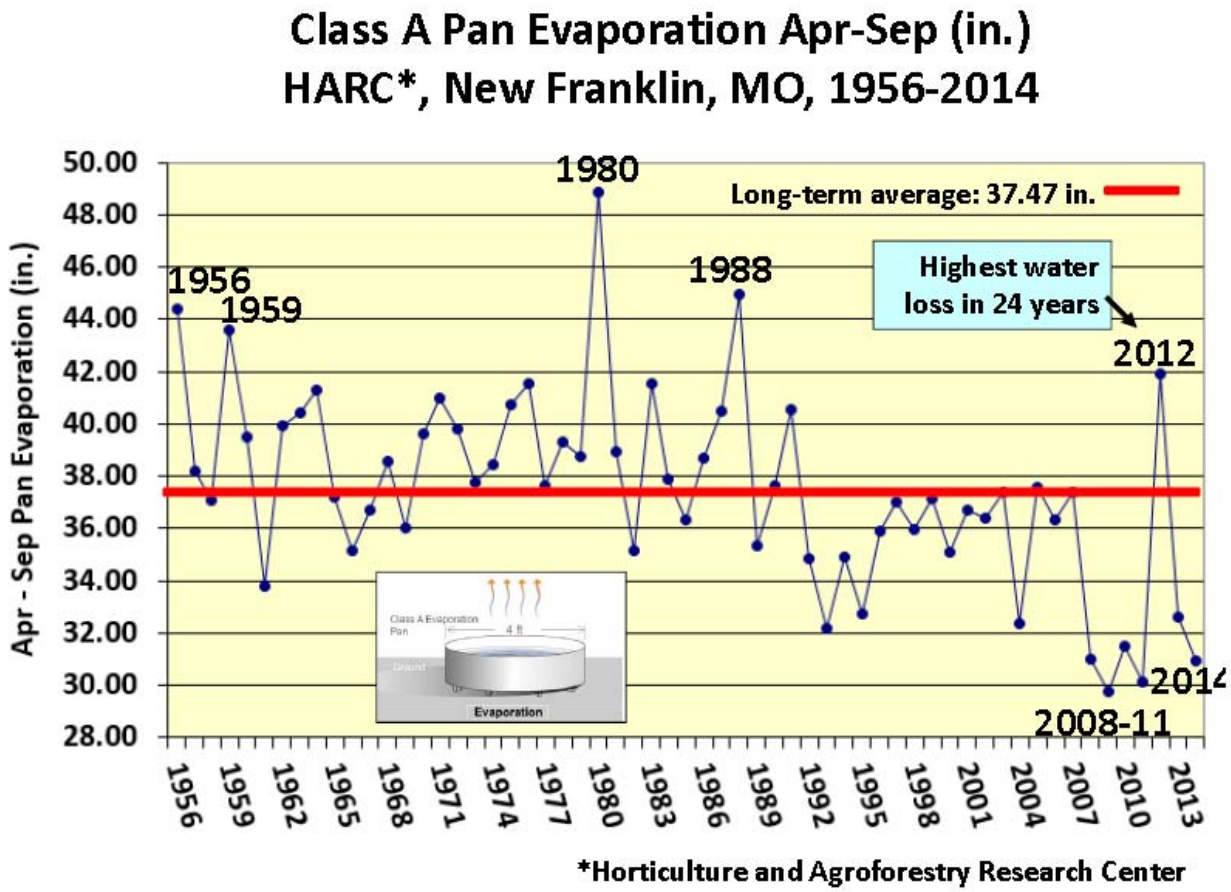


Figure 10c Pat Guinan, Missouri Climate Center

F. Missouri's Climate Future

The United States Geological Survey maintains a website, "The National Climate Change Viewer," that compiles the results from 30 climate change models and applies them to a simple water-balance model to simulate projected changes in the surface water balance into the future. (http://www.usgs.gov/climate_landuse/clu_rd/nccv.asp) The 30 models compiled are part of the 5th Climate Change Model Intercomparison Program (CMIP5) which provides climate change information for the 2014 Fifth assessment report of the Intergovernmental Panel on Climate Change (IPCC). The project details past and predicted future climate through the year 2099 for two scenarios. The two scenarios, termed Representative Concentration Pathways (RPCs), are

- RCP4.5 which assumes that the world takes fairly progressive action on climate change and stabilizes greenhouse gas emissions at a point that results in a

radiative equivalent of 4.5 Watts/m^2 by the year 2100. This is equivalent to about 650 ppm CO_2 equivalent.

- RCP8.5 which assumes that the world takes no action on climate change resulting in a radiative equivalent of 8.5 Watts/m^2 by the year 2100. This is equivalent to about 1370 ppm CO_2 equivalent.

(For reference, the current concentration of CO_2 equivalent is around 400 ppm.)

The results of this compilation and the water balance are presented interactively online or as a summary report (Appendix AF) for regions as small as an individual county or 8 digit Hydrologic Unit Code (HUC). Because the Lower Grand HUC incorporates most of the ELCR 10 county service region, the summary report for it was included in Appendix AD. The summary report for the entire Missouri River Basin is also included because the Missouri River's importance to the southern portions of the 10 county region.

The results provided on the website and in the summary report are significant for the ELCR Project because:

- They indicate that the needs for surface water storage (reservoirs) are going to increase as
  - Precipitation patterns change to more infrequent larger storms (as shown in recent trends (since the 1950s) in appendix AE)
  - Precipitation patterns change to wetter winter/spring seasons and drier summer/fall seasons
  - Annual Runoff Volume decreases (Even though total precipitation is projected to increase)
  - Evaporation increases
- They illustrate that progressive action to reduce greenhouse gas emissions will help minimize the impacts of climate change on the operation of the East Locust Creek Reservoir. Accordingly, reduction of greenhouse gas emissions should be considered an important part of a comprehensive water plan for the future.

G. Conclusions

This constant struggle with inadequate subsurface supplies (both shallow and deep), maintaining EPA/MDNR regulatory compliance in smaller local treatment plants to treat local surface water supplies continues to limit sustainable, marketable economic growth in North-Central Missouri. Deep wells are not scientifically feasible or even possible because of hydro-geologic conditions as shown above. The waters are brackish and not conventionally treatable to drink. Shallow wells

do not produce enough water in any form in certain areas can sustain local demands. The entire project region is extraordinarily susceptible to drought and has been documented for generations. Conventional methods for non-surface water sourcing in Missouri, do not work in this entire region. Deep wells are eliminated as an alternative and, therefore, the most economic, lower impact option conventionally, for Missouri is not even a possibility. Only surface water options are a practical feasible alternative to provide a solution for North Central Missouri to meet the existing and future demands to sustain the region at minimal impact.

IV. GENERAL REGIONAL CURRENT CONDITIONS

The susceptibility to water shortages, as the aforementioned sections have described, are acute, profound, limiting and documented A permanent solution is needed to allow the entire region, its people and its economy to thrive. Deep wells are not a physical, even potential, option. Surface water sources are the only feasible option or those under the influence of surface water.

A. 2012 Drought – Data Review "A case of proof"

- The NCMRWC area was in a severe drought through 2012 and into spring of 2013. Surface water sources including lakes, creeks, and rivers were low and completely dry in the entire region with several dropping below current usable design levels because of intake area of usable volumes. Many communities were being forced to take emergency measures to provide for basic water needs and ration the use of water. One example is the Elmwood Reservoir in Milan, MO, which got to as low as 84'' below normal pool even after pumping all usable water from all the other sources. Businesses were forced to curtail usage and cut back production.

B. Summary of Basic Conditions for the Project Area

- As was detailed earlier, deep wells will not produce potable water in the NCMRWC service area because of inadequate and non-useable hydro-geologic formations. The water is brackish with high concentrations of dissolved solids and not suitable for drinking. See **Appendix E and F** and aforementioned sections. Deepwells are not an option.

- Shallow wells are viable in isolated low demand and low lying floodplain areas, usually riverbed locations, though significantly influenced by river levels. They are locally sustainable, but do not have the capacity to sustain regional supplies and demands as more extreme trends or conditions become more probable in occurrence. These trends effect and influence the aquifers reliability at current demands, production, and long term resource value as the sole source for potable drinking water. Shallow wells do not have the Regional Capacity needed and are not an option for regional supply.

- Surface water Improvements: Local public lakes as sources of impounded raw water exist and have been in use as the primary source of local supplies. As regional needs have expanded and developed to farms, dairy farms, regional rural businesses and agricultural employers, coupled with climatic change, small local lake sources have proven to be increasingly susceptible to drought, and average lower performance. Many water suppliers have had to add supplemental creek and river pumps to augment their water supply lakes such as Milan, Green City, Green Castle, Kirksville, Trenton, Brookfield, and Marceline. All have surface water sources that are of concern for viability of affordable long term solutions and or have already been abandoned.

C. Disadvantaged Community Status – (DHC) Current Regional User Rate Analysis In Comparison To State Average User Rates

1. General Community Status

The NCMRWC service area is one of the "poorest" impoverished regions of the state with multiple communities having a Median Household Income (MHI) of less than 50% of the state average of (MHI. (2006-2010 American Community Survey)

2. Evaluation of DAC criteria

DNR's definition of a disadvantaged community is "any community with a population of less than 3,300, whose user rates will be at or above 2% of the state Median Household Income, and the MHI is at or below 75% of the state average MHI." As shown in table 2 and Figure 11 and 12, all incorporated areas within the NCMRWC service area fit the definition of "disadvantaged". Analysis of the county subdivisions predominantly served by NCMRWC indicates that their average MHI is 72.7% of the state average MHI with a range of 35.4% of state average MHI to peak of 73.3% of state average MHI of all incorporated areas served by

the water district. The current water rates alone are up to 6.55% of the local MHI in one community.

Table 2. Incorporated Areas in the NCMRWC Service Area

Name	Population 2012	User Rates as percent of State MHI	User Rates as percent of Local MHI	Percent of State Average MHI	Disadvantaged?
Browning	265	2.18%	3.88%	56.2%	Yes
Green City	657	2.18%	3.62%	60.3%	Yes
Greencastle	275	2.18%	4.49%	48.6%	Yes
Harris	61	2.18%	4.67%	46.7%	Yes
Humphreys	118	2.18%	6.55%	33.3%	Yes
Milan	1960	2.18%	2.98%	73.3%	Yes
Newtown	183	2.18%	3.59%	60.8%	Yes
Osgood	48	2.18%	3.67%	59.4%	Yes
Pollock	89	2.18%	6.16%	35.4%	Yes
Combined	3,656	2.18%	3.53%	64.39%	NA

a) 2010 Census

b) NCMRWC rates are currently $84.17 per 5,000 gallons average

c) 2006-2010 American Community Survey

Further comparison of statewide user rates as reported in the Missouri Rural Water Association's 2012 User Rate Survey to MHI show that the proposed service area is clearly in need of a reduction in short term and long term water rates. Figure 12 below shows the statewide ratio of water rate to MHI. Figure 13 superimposes the ratio of water rate to MHI showing the correlation between available statewide water resources and the affordability of water.

Population trends indicate that migration of population is a way from the Designated DAC areas and the Green Hills region. This could be associated with user notes, inadequate water, MHI, Poverty Rates, expensive water which negatively effects long term perception of sustainability of jobs. Please see figure 12A, an excerpt from the Missouri Department of Economic Development's population projections for the period 2000-2030 (http://www.missourieconomy.org/indicators/population/pop_proj_2030.stm).

To illustrate the difference that a regional reservoir can make, Figure 14 shows the proposed East Locust Creek Reservoir service area and the Clarence Cannon Wholesale Water Commission (CCWWC) service area. Both areas have similar availability of water sources with few reliable productive wells and few streams large enough to supply adequate drinking water, yet the region served by Clarence Cannon only has one county with a ratio of water rate to MHI above 1.5 (but less than 2.0) (one county not having adequate data for this calculation). By Comparison, the East Locust Creek Reservoir service area has 3 counties with ratios above 2 and four counties with ratios between 1.5 and 2.0. Review of the population projections reveals that the 10 counties that make up the NCMRWC service area are projected to suffer an average loss of population of 11.2% whereas the 9 counties that are predominantly served by CCWWC are projected to grow by 0.8%.

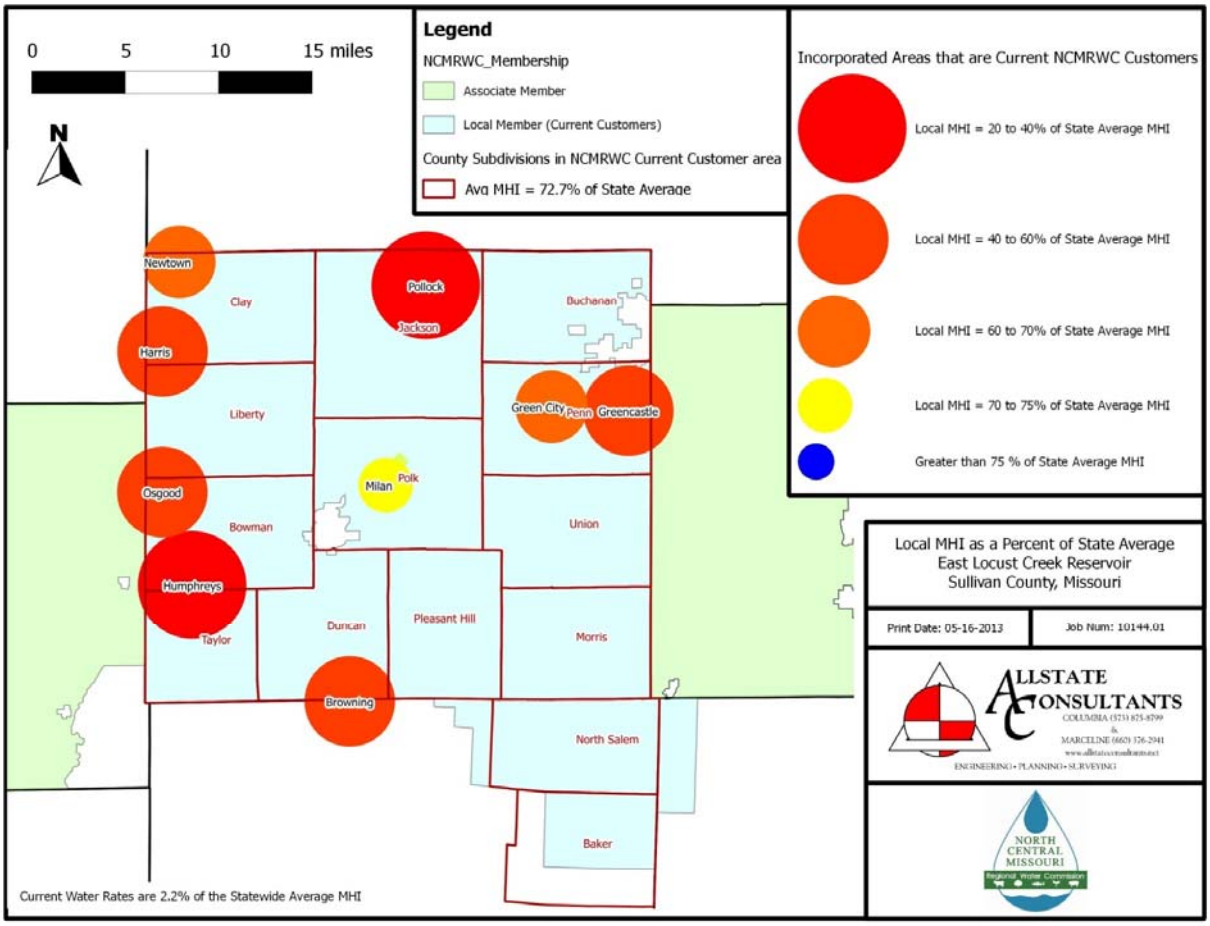


Figure 11 Local MHI as a Percent of State Average

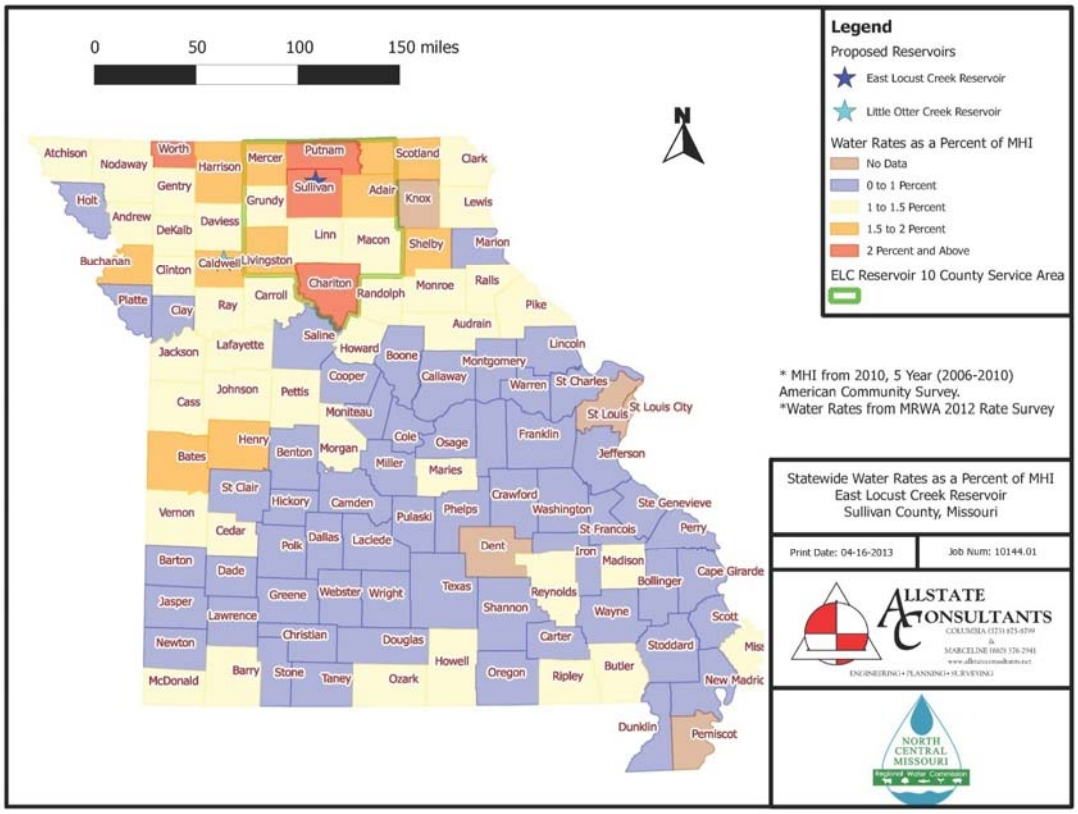


Figure 12 Statewide Water Rates as a Percent of MHI

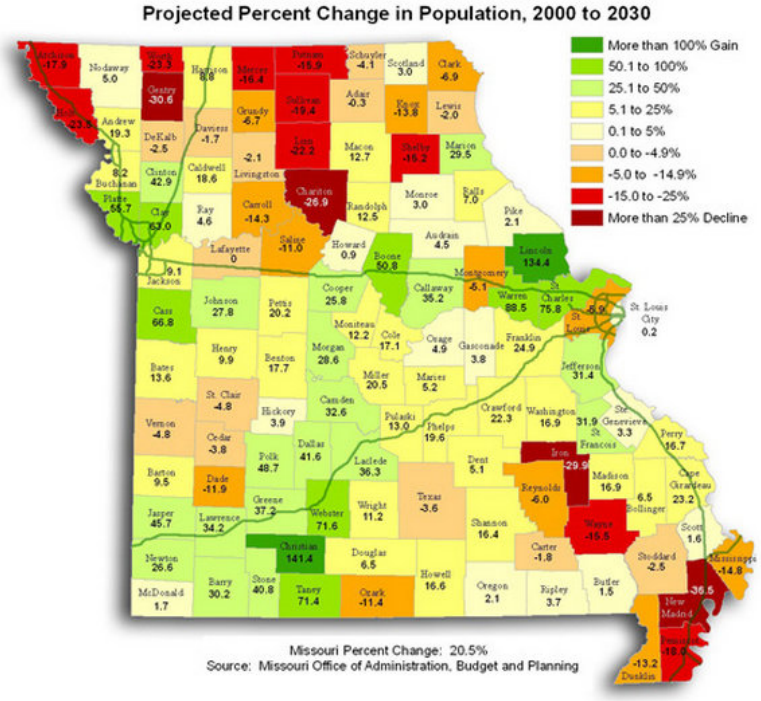


Figure 12A Projected Population Change 2000 to 2030 (MERIC)

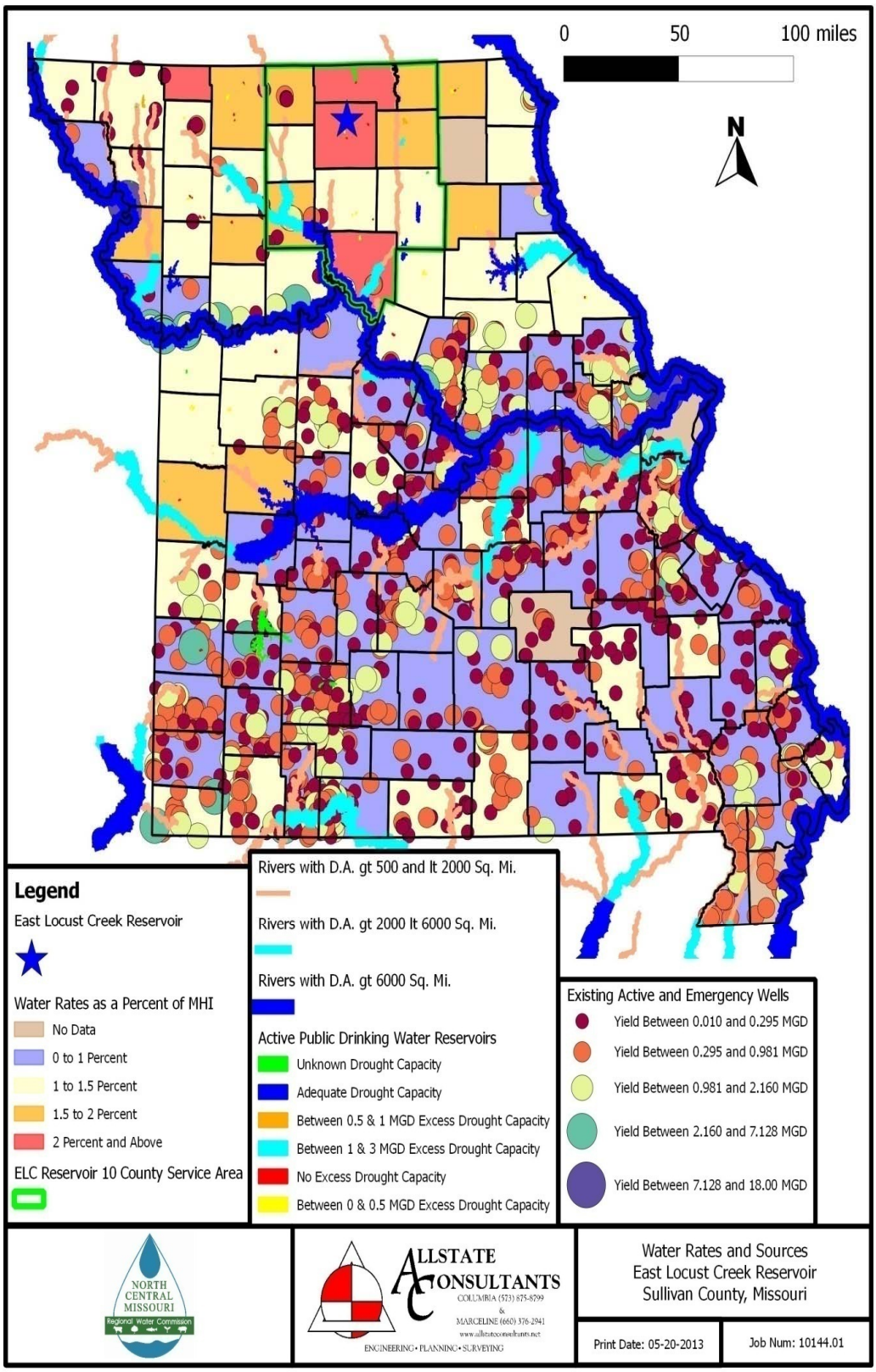


Figure 13 Superposition of Water Rate, MHI and Water Source Data

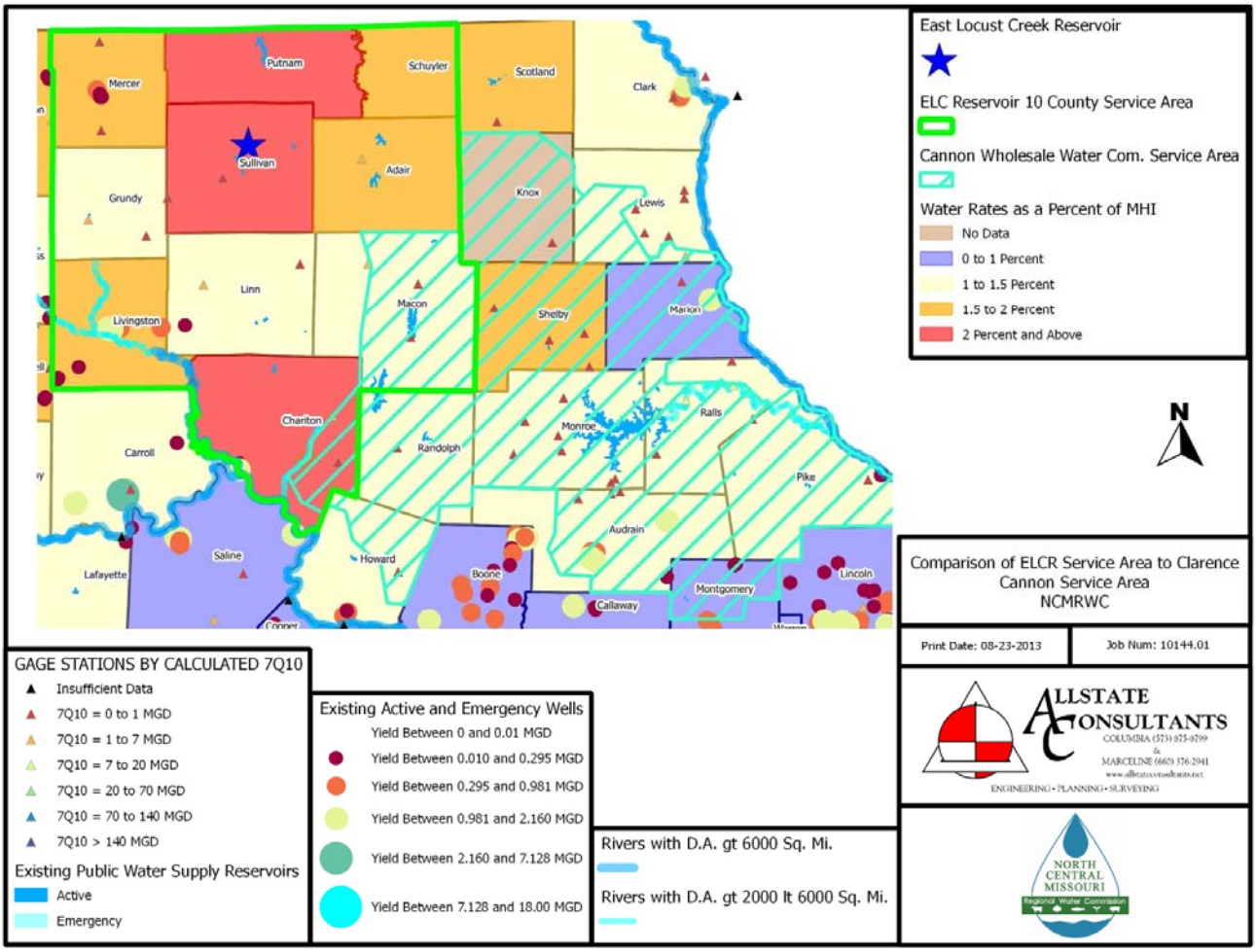


Figure 14 Comparison of ELCR Service Area to Clarence Cannon Service Area

D. Conclusions

As climatic conditions become more severe and regulations continue to evolve, local sources will not be able to sustain and serve increasing demands and maintain affordability. The current service area is a disadvantage community and is severely impoverished. Wells are not an option to meet demands. Regional user rates are the highest in the state. The only practical proven affordable solution is a regional reservoir impoundment that has adequate water to sustain business and commerce. We believe that the lack of a viable, economic, practical plan for long term water is putting the entire region at a socio-economic disadvantage.

PART II – REGIONAL WATER SUPPLY DEMANDS AND REVIEWS OF PAST ASSESSMENTS AND EVALUATIONS OF ALTERNATIVES

V. NCMRWC REGIONAL PROJECT SERVICE AREA DEMAND FOR WATER & CONCLUSION ON DESIGN FLOW

A. Water Demand Planning Projection

The table below develops planning targets for NCMRWC Service Area Water Supply Demands. The projections were referenced from **Appendix A, B, and D**. Please note the MDNR minimum recommended design demand projection range was referenced by the Commission.

NCMRWC Regional Service Area Design Flow and Raw Water Demand Estimates

2013 Current	1.65 MGD
2023	2.5 MGD
2033	3.5 MGD
2043	4.5 MGD
2053	5.5 MGD
2063 – 2073	6.5 MGD – 7.5 MGD

Please note the above chart does not include major cities in North-Central Missouri, including, Chillicothe, Macon, Marceline, or Kirksville for example. If these communities are included, demand needs could range up to 20 MGD for a 40 year projection. Currently local, non-regional sources for these large, rural communities are assured by MDNR to be adequate. Please refer to **Appendix G** for the detailed regional projections. Letters of support are included in **Appendix H** from regional suppliers and customers.

B. Regional Demand Analysis

In August 2003, Burns and McDonnell published a feasibility study (Burns and McDonnell, 2003) for the North Central Missouri Regional Water Commission (NCMRWC) in which they determined that the region needs to a 5.75 MGD average daily demand and a 7.5 MGD maximum daily demand to provide a 50 year design demand. In the related master plan (Burns and McDonnell,

2003) the size of the recommended alternative, East Locust Creek Reservoir, was set at 1,600 acres.

In May, 2004, the MDNR published a Water Use Study for North Central Missouri Water Commission (MDNR, 2004) which indicated that the needs of the area were greater than described in the Burns and McDonnell studies and that the supply capacity should be increased to meet a 60 year design average daily demand of 6.715 MGD.

C. Conclusion on Design Flow and Phases

For the purposes of this study we will use 7,000,000 gallons (7MGD) per day design demand for evaluation. This design level is acceptable to MDNR, NRCS, and NCMRWC. The lake planning should target 7 MGD with the following Design Phases overtime for capital improvement planning. Please note the current water treatment plant has a 2.5 – 2.8 MGD general design capacity as it currently exists.

Recommended NCMRWC Regional Service Area Design Flow and Raw Water Demands

2013 Current	1.65 MGD
2023	2.5 MGD
2033	3.5 MGD
2043	4.5 MGD
2053	5.5 MGD
2063 – 2073	7 MGD

VI. EXISTING REGIONAL WATER SOURCES

A. Shallow Well Sources Available for Demand (under the influence of surface water)

As was shown in aforementioned sections, wells of any kind are not available for practical or affordable regional supply of the needed water supply in this region. Current practice clearly indicates that wells exist in only a few locations for local sources not regional demand needs. As shown in **Figure 15** below, note the lack of wells in the subject region compared to central and southern areas and areas locally along rivers.

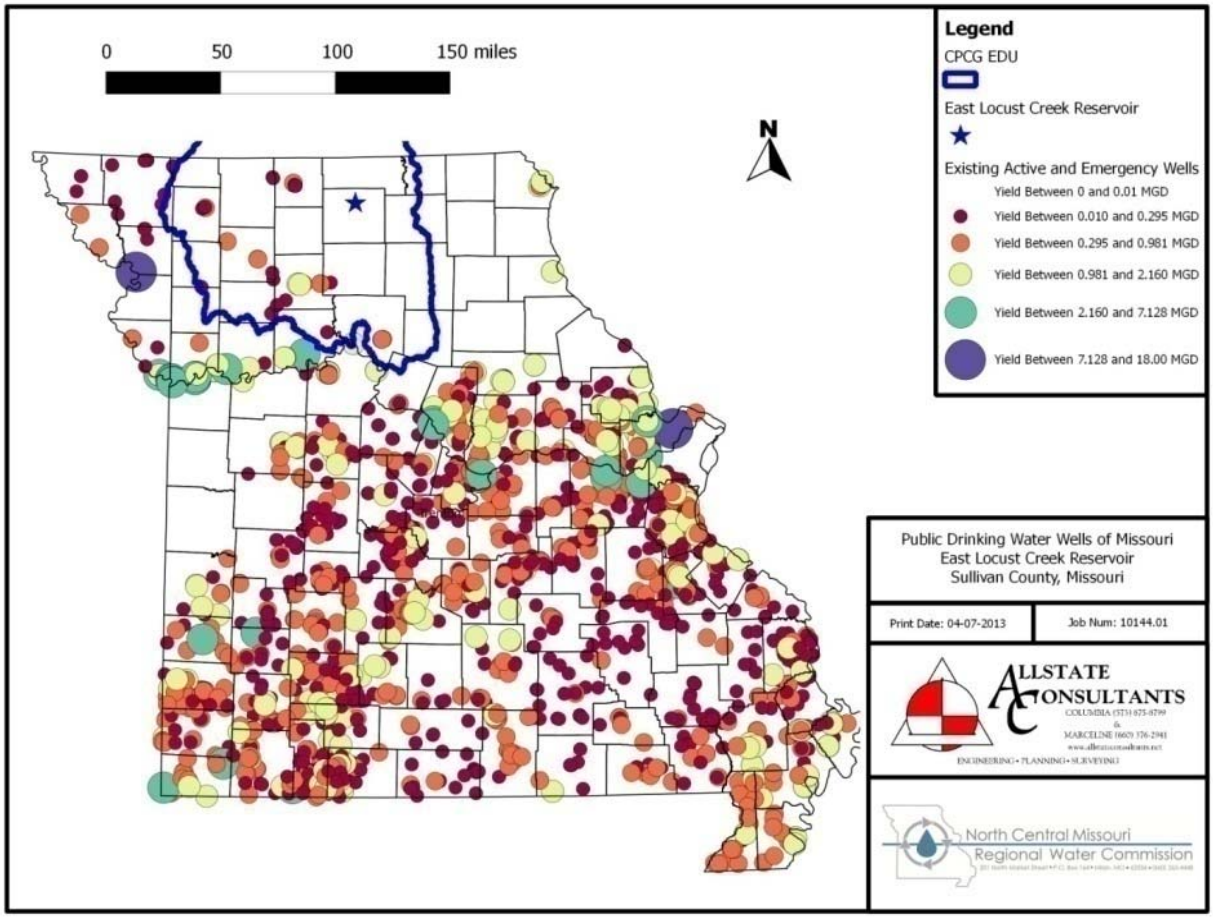


Figure 15 Public Drinking Water Wells of Missouri East Locust Creek Reservoir Sullivan County, MO

The lack of well water supply is has been firmly established through scientific evaluation. The reason for this is the inadequate water quality from attainable formations and subsurface aquifers. As can be seen in **Figure 7**, exploration and evaluation has determined high salinity, dissolved solids, create brackish and non-potable supplies.

B. Surface Water Sources Alternatives Analysis

The following shows rivers and creeks that are a primary source or supplement to surface water supplies in service. The exhibit is color coordinated to depict an estimate of available practical capacity based on USGS gage stations of baseflow of recent sustained useable drought flows. Our assumption is that 6000 square miles of tributary area is needed in this region for the design flow of 7MGD.

In 2007, the Natural Resources Conservation Service (NRCS) published the Environmental Impact Statement (NRCS, 2007) which set one of the project purposes as "provide a reservoir capable of producing 7.0 million gallons of raw water per day to the residents and communities of north central Missouri. This estimate of need was based as follows. "Yields needed by 2025 for probable customers and potential customers were examined and ranged from 4.5 MGD to 8.5 MGD. The Commission and MDNR decided to use a 7.0 MGD yield for project planning purposes." To provide this quantity of raw water NRCS increased the size of the proposed reservoir from 1,600 acres to approximately 2,400 acres and developed the EIS accordingly.

While both the Burns and McDonnell studies and the Environmental Impact Statement evaluated some alternatives, this independent study is intended to review the possibility of obtaining the water from alternative existing sources including some sources not previously considered. Because this study focuses on existing sources it does not re-evaluate alternative new reservoir locations. Alternative reservoir locations were adequately investigated in earlier studies and were approved by MDNR and NRCS.

1. River Sources

Traditionally, rivers have been a common source for public water supplies in northern Missouri with few regulatory limitations on the use of water. However, recent trends indicate a future in which practical limits should be set on the mining of water from river sources for the protection of the source. For example, the Missouri Department of Conservation (MDC) recently proposed an internal policy with a presumptive standard requiring extensive study if a proposed project changed flow in a stream at any instant by more than 10%. This policy would not have the force of regulation, but it is indicative of the current thinking with regards to what might constitute minimal impacts to stream flow. To reduce the risk of water rights disagreements between the public drinking water industry and environmental concerns it seems appropriate to limit new river intakes to situations in which the projected demand will represent a relatively small percentage of total river flow even in times of drought.

In May of 2013 The United States Geological Survey (USGS) released publication SIR 2013-5090, "Computed Statistics At Streamgages, And Methods For Estimating Low Flow Frequency Statistics And Development Of Regional Regression Equations For Estimating Low-Flow Frequency Statistics At Ungaged Locations In Missouri". This document provides low flow

regression equations for ungaged sites in Missouri, including an equation for the 7 day, 10 year low flow rate (7Q10) which is commonly used for regulatory purposes. The equations vary for the three regions of the state which are: Region 1, Central Lowlands, which makes up the northern half of the state; Region 2, Ozark Plateau, which makes up most of the southern half of the state and; Region 3, Mississippi Alluvial Plain which is the boot heel portion of the state. Region 1, which includes all of the Central Plains Grand Chariton Ecological Drainage Unit and all of the proposed reservoir's service areas tends to produce lower 7Q10 values for an equivalent drainage area than the other two regions.

The regression equations relate contributing drainage area, length to divide and a stream variability index that was derived from the gage data to low flow frequency predictions.

$$7Q10\ R1 = 0.057\ (DRNAREA)^{2.379}\ (LFPLENGTH)^{-1.554} e^{(STREAM\_VAR*-6.650)}$$

$$7Q10\ R2 = 2.197\ (DRNAREA)^{1.244}\ e^{(STREAM\_VAR*-10.807)}$$

$$7Q10\ R3 = 8.182\ (DRNAREA)0^{.989}\ e^{(STREAM\_VAR*-11.228)}$$

Where:
DRNAREA = Contributing drainage area in miles
LFPLENGTH = Longest contributing flow path length in miles
STREAM_VAR = a dimensionless factor representing the steepness of the flow duration curve

The report includes the data necessary to apply the regression equations for 496 gauging stations in Missouri and surrounding states. Figure 16 shows the statewide distribution of 7Q10 at these gauging stations. This plot demonstrates that streams in northern Missouri tend to have lower base flow rates than the rest of the state. It also shows that the only gage site in the service area where there is clearly enough water to supply 7 MGD is the Grand River at Sumner. Figure 17 below shows the 7Q10 regression equation results for all of the gaging stations as a plot of contributing drainage area vs. 7Q10 for the entire state and Figure 18 shows the same for region 1 only. These plots show that in the southern half of the state there can be expected to be great variability in the relationship between drainage area and 7Q10. In the northern portion of the state the relationship is less volatile, but still highly variable. Based on these plots and on other reports described below, we believe that to provide 7 MGD during periods of drought in a scenario in which we are allowed to use a significant fraction of the stream's water during a drought the stream would need to have a drainage area of at least 2,000 square miles. However, to do so in

a scenario in which we wish to have only a minimal impact on the stream during a drought of the severity that occurs once in ten years we would need to have at least 6,000 square miles of contributing drainage area.

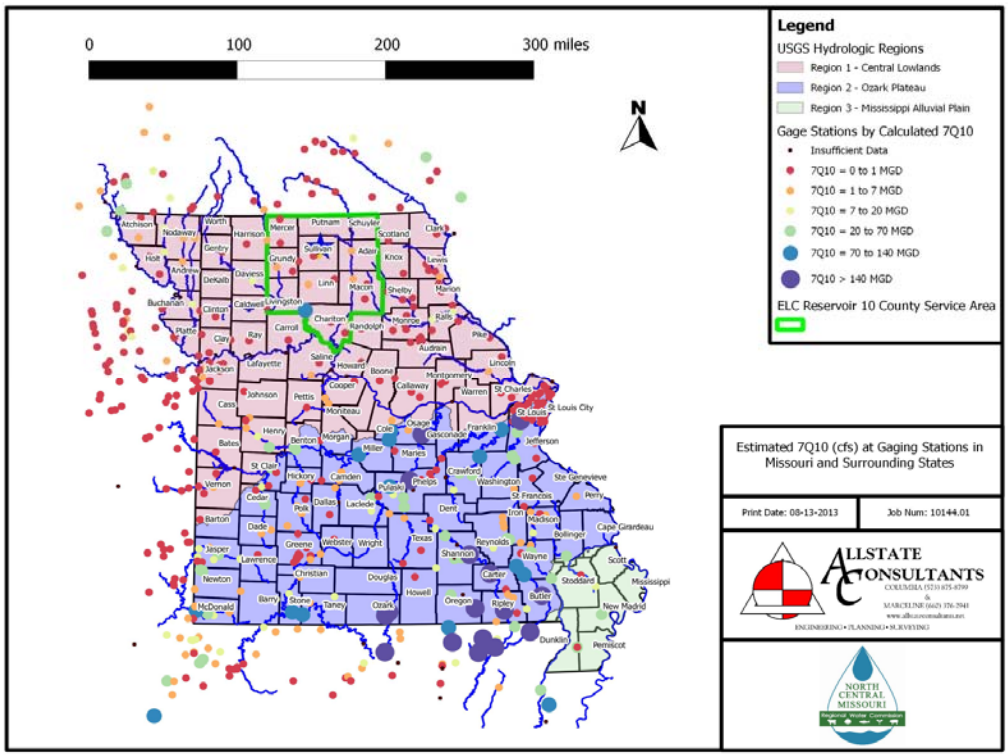


Figure 16 Estimated 7Q10 at Select Gages in Missouri

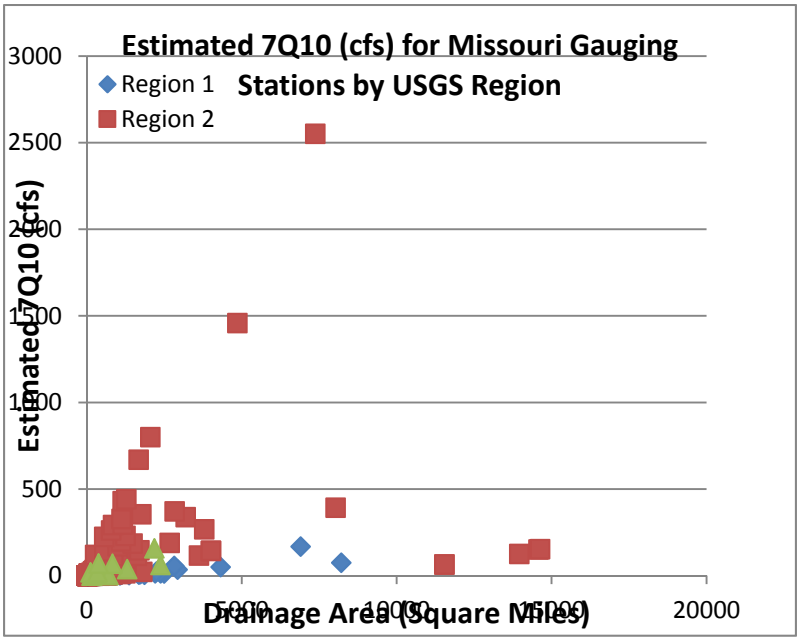


Figure 17 Estimated 7Q10

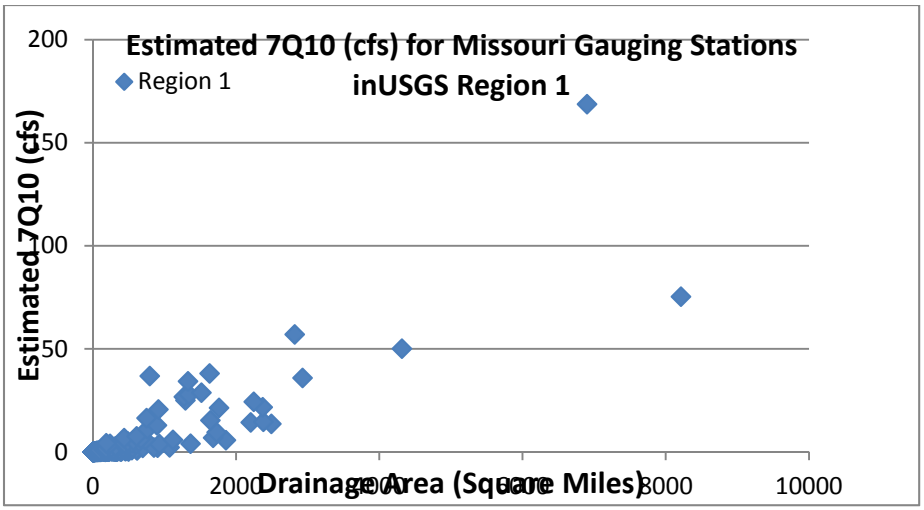


Figure 18 Estimated 7Q10 vs. Drainage Area for Region 1

As a further check, a review of USGS river gauge data in the Central Plains Grand Chariton Drainage unit was conducted to estimate the amount of drainage area that is needed to provide a reliable source of drinking water that can produce sufficient water during a drought without reducing flow in the river below acceptable levels. The percentage of days in each gauge's record with stream flow below 7MGD and 20 MGD was reported in Table 1. These numbers were selected for comparison because the 7MGD number is an estimate of the percentage of the time that no water would be left for the stream after the drinking water withdrawal and the 20 MGD represents a number at which the 7MGD withdrawal might seem reasonable. There is no particular meaning for the 20 MGD threshold as it is difficult to predict what would be an acceptable percentage of the flow to withdraw in the future. In fact after this analysis was conducted, the Missouri Department of Conservation (MDC) released a draft internal policy that would require that MDC ask for detailed analysis if the intake removes more than 10% of the flow at any time. However, for purpose of the Preliminary Engineering Report, which is just to develop a display showing rivers that might have sufficient water, the 20 MGD threshold seems as reasonable as any. Based on the data in Table 1, we have selected a threshold of 500 square miles as the minimum area for which a surface intake might be possible and a second threshold of 2,000 square miles above which a fairly drought resistant intake might be possible. A third threshold of 6,000 square miles is shown, because it seems apparent that above 6,000 square miles an all-weather surface water intake would be viable for certain, and that it's impacts on the stream would be minimal. It is our opinion that for any drainage between 2,000 and 6,000 square

miles, a hydrologic study would be warranted to determine whether an intake would be appropriate.

The USGS Open-file report 82-1014, Hydrology of Area 38 (USGS, 1983) (includes Grand, Chariton, and Thompson rivers) provides an equation with which base flow can be predicted for un-gauged sites.

$Q=0.733A^{0.97}$

Where Q is average annual flow in CFS and A is drainage area in miles^2. This represents the average flow rate in the stream during typical times and the flow rates can be expected to be much lower than this value during a drought. However, the number is reported in Table 1 for comparison. Report 82 doesn't provide an equation to calculate 7Q10, but figure 4.3-3 from the report shows 7Q10 values as a function of drainage area for gages in the report area. Review of this graph (below) reveals that it is somewhat consistent with the thresholds that were selected from the gage data. For example the three points that are closest to 2,000 square miles all have 7Q10 below 10 CFS (6.5 MGD) and as such they would be unlikely to provide sufficient water in droughts. Likewise, the 2 points that have a drainage area near 6,000 square miles have 7Q10 values around 20-30 cfs (13 to 20 MGD). This suggests that the 6,000 square mile threshold might be a little low, but for this purpose it is acceptable.

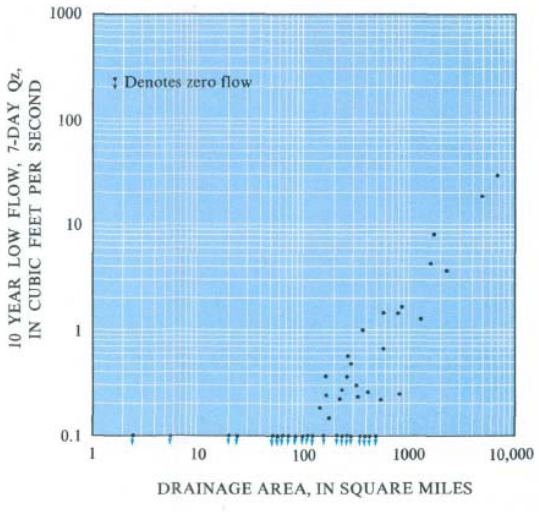


Figure 4.3-3 Relationship between drainage area and 7-day 10-year low flow.

Table 3. Summary of Flow Statistics for Major Gages in CPGC EDU						
Gage ID #	Gage Station	Drainage Area (mi^2)	Predicted Annual Average Flow (MGD)[a]	% of Days in Record with Avg Flow below 7 MGD[b]	% of Days in Record with Avg Flow below 20 MGD[b]	Estimated 7Q10 MGD[c]
06902000	GRAND RIVER NEAR SUMNER MO	6,880	2,490	0.0%	0.3%	109.0
06897500	GRAND RIVER NEAR GALLATIN MO	2,250	842	2.9%	11.3%	15.7
06905500	CHARITON RIVER NEAR PRAIRIE HILL, MO.	1,870	704	0.7%	5.9%	4.1
06899500	THOMPSON RIVER AT TRENTON MO	1,670	631	1.5%	10.4%	6.1
06904500	CHARITON RIVER AT NOVINGER MO	1,370	520	4.6%	13.6%	2.5
06898100	THOMPSON RIVER AT MOUNT MORIAH MO	891	343	1.0%	14.2%	1.4
06904050	CHARITON RIVER AT LIVONIA, MO.	864	333	0.0%	8.0%	NC
06901500	LOCUST CREEK NEAR LINNEUS, MO	550	215	17.8%	35.5%	1.9
06899000	WELDON RIVER AT MILL GROVE MO	494	194	30.0%	50.6%	0.8
06903000	YELLOW CREEK NEAR	405	160	28.7%	41.9%	NC

Table 3. Summary of Flow Statistics for Major Gages in CPGC EDU						
Gage ID #	Gage Station	Drainage Area (mi^2)	Predicted Annual Average Flow (MGD)[a]	% of Days in Record with Avg Flow below 7 MGD[b]	% of Days in Record with Avg Flow below 20 MGD[b]	Estimated 7Q10 MGD[c]
	ROTHVILLE, MO.					
06899700	SHOAL CREEK NEAR BRAYMER MO	391	154	28.0%	44.1%	0.3
06906000	MUSSEL FORK NEAR MUSSELFORK, MISSOURI	267	107	32.4%	51.0%	0.2
06901000	LOCUST CREEK NEAR MILAN, MO.	225	90	31.5%	55.5%	0.2
a) Equation from USGS 1982, section 4.2						
b) Gage Data						
c) USGS Regression Equations						
NC - not calculated because longest flow path data not published.						

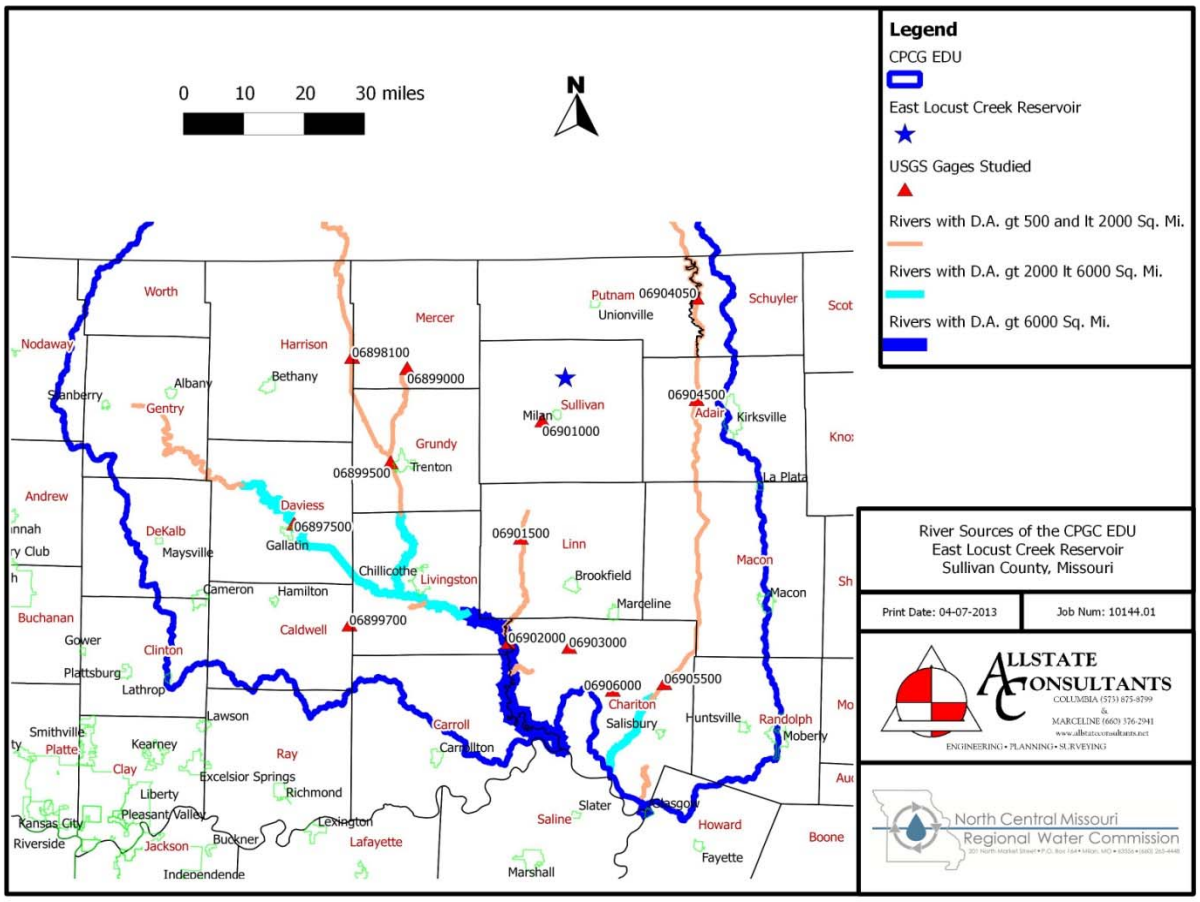


Figure 19 River Sources of the Central Plains Grand Chariton EDU (CPGC EDU)

The Thompson River, for example as one of the larger streams, is not developed within its watershed until it is approximately 9 miles downstream of Trenton, where the river currently serves as the primary source for Trenton. When evaluating an additional 4 MGD to 7 MGD raw water demand on the available Thompson water flows. It is apparent that this river would not provide a long term solution. This does not take into account evaluations of available minimum base flows to satisfy environmental permitting concerns.

2. Existing Lake Sources

The majority of public drinking water lakes in Missouri are documented in DNR's water supply study as being barely able to meet current demand (MoDNR, 2011). The exceptions are:

- The two drinking water supply lakes near Kirksville that currently have a reported excess capacity of 2.85 MGD

- Mark Twain Lake which has adequate supply ready to be allocated to drinking water, but would have to be pumped at multiple locations to transport the water to the north central. Carbon/GHG footprint would be much higher than a centrally location reservoir.

- Long Branch Lake which may or may not have adequate supply in the pool but does not have sufficient supply allocated for drinking water. A re-allocation would be required.

- Rathbun Lake (Iowa) which has claimed excess capacity but would not be a source that could be controlled locally and would have a negative statewide and regional economic impact along with a larger, long term carbon/GHG footprint due to high energy usage for constant pumping of waters.

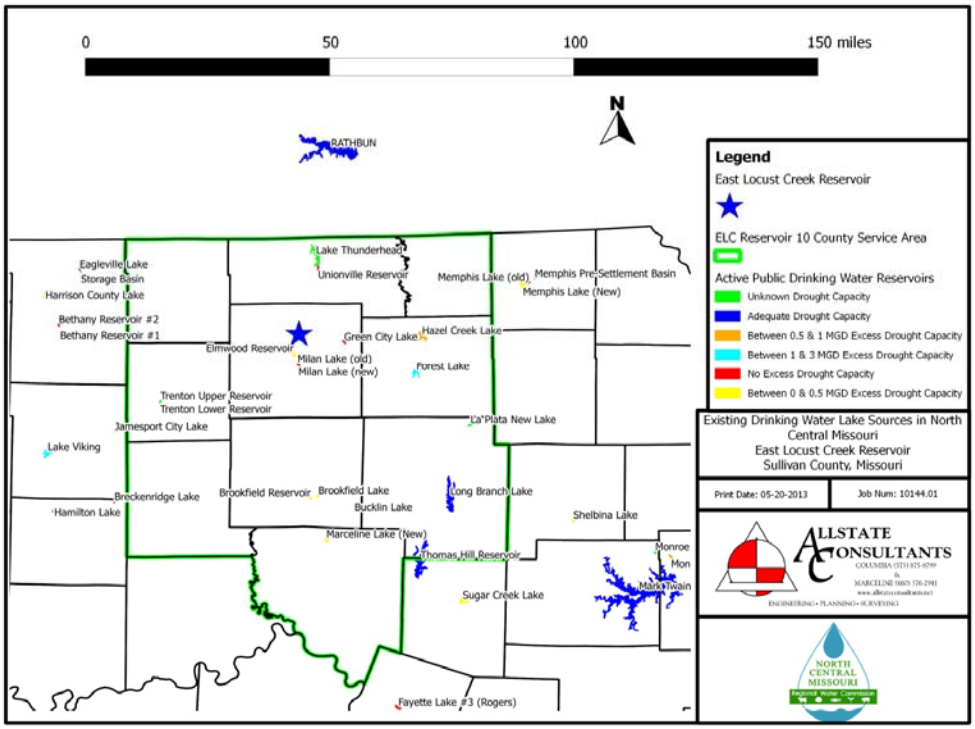


Figure 20 Existing Reservoirs of North Central Missouri

NONE OF THE EXISTING PUBLICALLY OWNED AND CONTROLLED SUPPLY LAKES HAVE THE NEEDED CAPACITY THAT CAN BE DELIVERED IN A PRACTICABLE, ENVIRONMENTALLY SUSTAINABLE MANNER. When evaluating creeks and rivers available for supplemental pumping, current base flow data does not provide support for using

the regional or subregional creeks or rivers as a primary source reliance for the service area. This includes Elmwood, Marceline Lake, Brookfield Lake, Kirksville Lakes, Thunderhead Lake, etc.

C. East Locust Creek Watershed Description and Update

1. Background Information

The East Locust Creek Reservoir contributing drainage area makes up the upper 32.8 mi^2 of the 49.4 mi^2 Headwaters East Locust Creek HUC-12 (102801030601) which, combined with the East Locust Creek HUC-12 (102801030603) and the Little East Locust Creek HUC-12 (102801030602), make up the 124 mi^2 East Locust Creek HUC-10 (1028010306). The East Locust Creek HUC-10 is in the upper reaches of the 647 mi^2 Locust Creek Watershed, which lies in the in the upper reaches of the 2,359 mi^2 Lower Grand HUC-8 (10280103). The Lower Grand HUC-8 is one of 4 HUC-8s in the Central Plains Grand Chariton Ecologic Drainage Unit (CPGC EDU). Figure 21 shows these watersheds.

Numerous sources are available which provide data on these watersheds. The Center for Applied Research and Environmental Systems (CARES) at the University of Missouri provides watershed profiles for 8, 10 and 12 digit Hydrologic Units via their Watershed Evaluation and Comparison Tool. These profiles provide a wealth of data including land use, hydrologic data, census data and impaired streams. CARES Watershed Evaluation and Comparison Tool profiles are provided in **Appendix T** for the Headwaters of East Locust Creek HUC-12, the East Locust Creek HUC-10 and the Lower Grand HUC-8.

The Locust Creek Basin Management Plan (**Appendix U**), developed by Missouri Department of Conservation (MDC) in 1994 describes the Locust Creek Basin and includes discussion of problems (sediment, channelization, riparian clearing) and opportunities. Management objectives identified in this study include:

I. Improve aquatic habitat conditions, including water quality and quantity, of the Locust Creek Basin to meet the needs of native aquatic species while accommodating society's demands for water and agricultural production.

II. Maintain ecologically balanced communities of native aquatic organisms while accommodating angler demands for quality fishing
III. Increase the recreational potential of the aquatic resources in the Locust Creek Basin without degrading populations of native aquatic organisms.

The Grand River Watershed Inventory and Assessment (**Appendix V**) which was completed sometime around the year 2000 by the Missouri Department of Conservation (MDC) and supersedes the Locust Creek Basin Management plan provides similar information for the entire Grand River Watershed. It includes information on historical land use and channelization history as well as habitat and biologic information. It also includes a section on Management Problems and Opportunities which sets out the following goals for the Grand River Watershed.

I. Improve water quality and maintain or improve water quantity in the Grand River Basin so all streams are capable of supporting high quality aquatic communities.
II. Improve Riparian and aquatic habitat conditions of the Grand River Basin to meet the needs of native aquatic species while accommodating society's demands for water and agricultural production.
III. Maintain diverse and abundant populations of native aquatic organisms while accommodating angler demands for quality fishing.
IV. Increase recreational use of streams in the Grand River Basin.
V. Increase public appreciation for stream resources throughout the Grand River Basin.

2. Our Missouri Waters Initiative by MDNR

In November 2011, the Missouri Department of Natural Resources unveiled the Our Missouri Waters initiative (OMW) which is intended to "create a coordinated, holistic approach to protect water resources and preserve our Missouri waters." The announcement of OMW included the selection of three pilot HUC-8 watersheds, one of which is the Lower Grand HUC-8, which is the home of the proposed reservoir. The OMW states that

> "The Lower Grand River Watershed in north-central Missouri is in an area of the state with water quantity problems, where drought conditions can threaten the drinking water supply for many communities. This watershed contains areas of diverse wet prairie and bottomland forest that are remnants of the natural wetland habitat once common in northern Missouri. The watershed also contains streams impacted by channelization, sedimentation, and nonpoint source runoff. The department is building partnerships to

identify opportunities to address water quantity and water quality problems in this watershed."

The proposed East Locust Creek Reservoir is arguably the most important component of the plan to address the water quantity problems for the Green Hills Region. Figure 22 shows the location of the OMW pilot projects relative to the proposed reservoir.

3. The Locust Creek Healthy Watershed Initiative

The Locust Creek Healthy Watershed Initiative (LCHWI) (**Appendix X**) is a cooperative watershed project that includes twelve 12-digit HUCs including the Headwaters of East Locust Creek. The initiative was funded by the Mississippi River Basin Initiative (MRBI) Cooperative Conservation Partners Initiative (MRBI-CCPI) the purpose of which is to reduce nutrient and sediment loading to the Gulf of Mexico. The LCHWI project was awarded funding for conservation practices due to the high levels of sediment and nutrient runoff in the basin.

The Locust Creek Healthy Watershed Initiative is sponsored by the Linn and Sullivan County Soil and Water Conservation Districts and will be implemented in 12 small watersheds encompassing 311,667 acres in Linn, Sullivan, Putnam, Chariton, and Livingston counties in north central Missouri. The goal of the Locust Creek Healthy Watershed Initiative is to implement wise soil and nutrient management, protect critical plant and wildlife habitat, and facilitate sustainable agricultural production in the Locust Creek and greater Mississippi River basins.

Within the project area, Pershing State Park in Linn County features the largest complex of natural bottomland wetlands remaining in northern Missouri. This wetland complex contains numerous federal and state listed aquatic and terrestrial species of concern which have been adversely affected by excessive siltation from upstream soil erosion. The financial assistance obtained through the federal Mississippi River Basin Healthy Watersheds Initiative (MRBI) funding will be leveraged with existing state and local resources to accelerate technical assistance and implementation of conservation practices that will address these important local and regional aquatic resource concerns, in addition to those in the Gulf of Mexico. Critical watersheds within the project area have been identified which will be targeted more intensely for application of conservation practices. The success of this project in reducing nutrient and sediment runoff will be measured using watershed modeling and a three-tiered water quality monitoring strategy that includes edge-of-field assessments of runoff water.

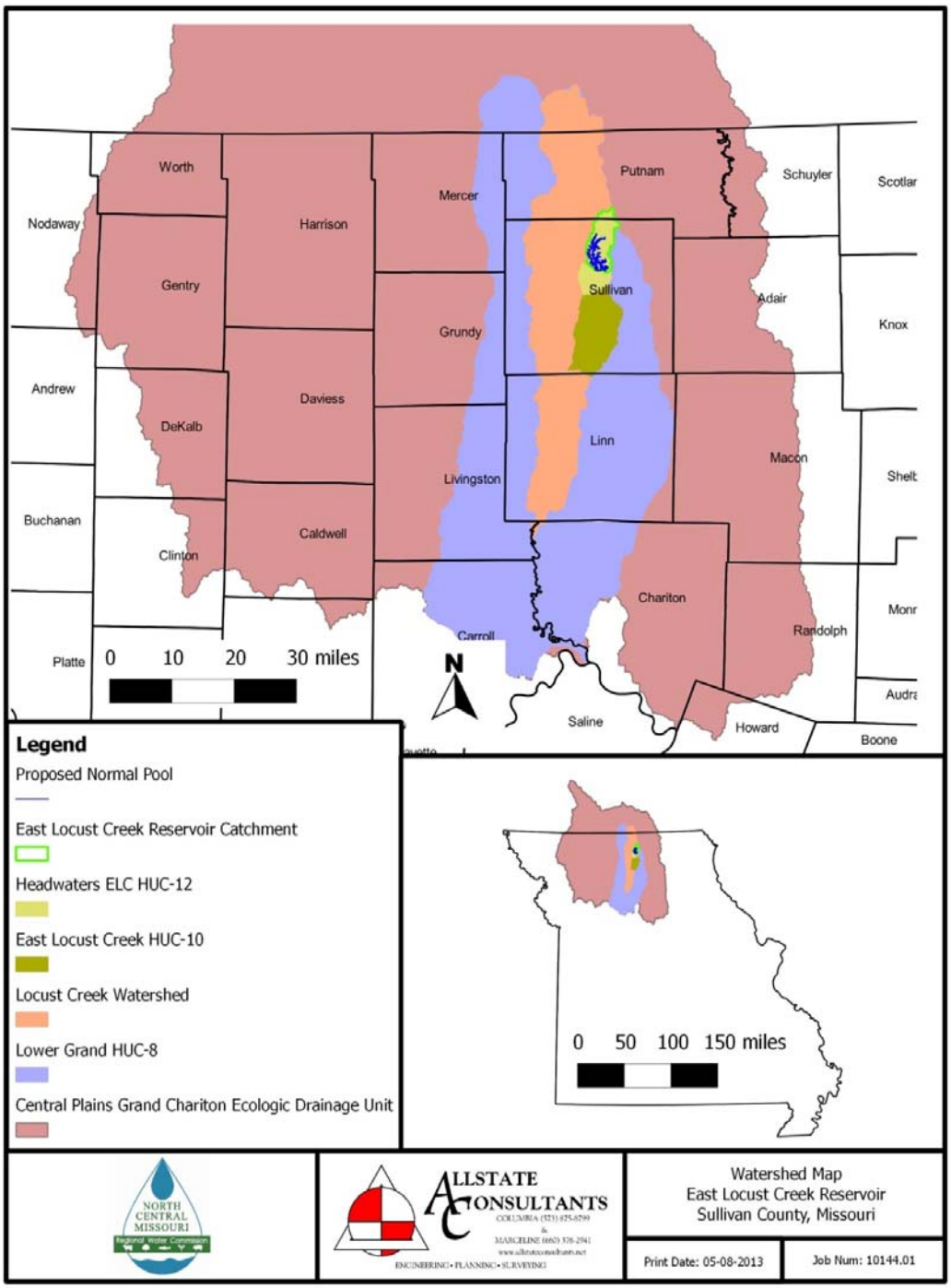


Figure 21 Watershed Map

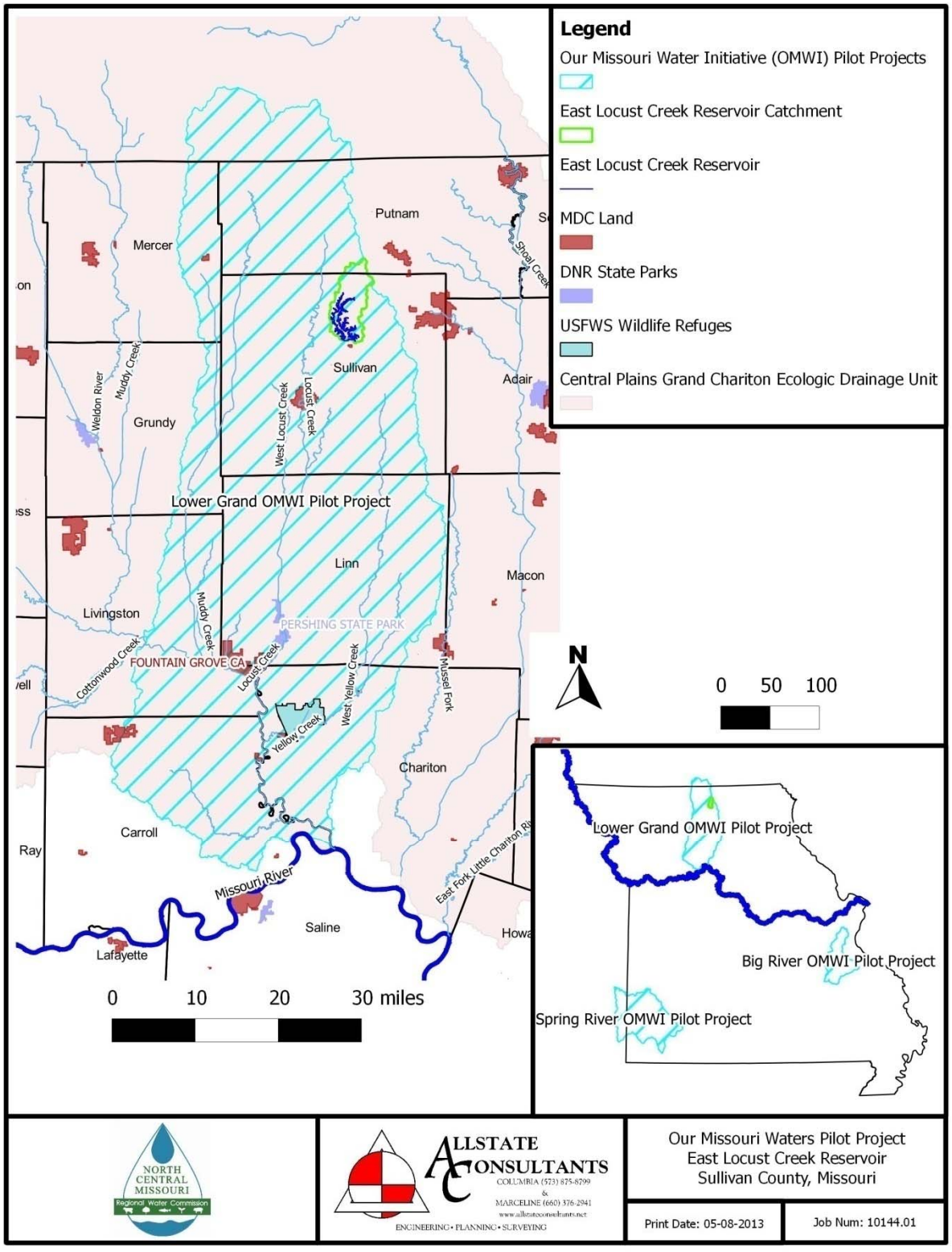


Figure 22 Our Missouri Waters Pilot Project and East Locust Creek Reservoir

4. General Assessment of Stream Impact

Within the Lower Grand HUC-8 there are 279 miles of Class C stream and 407 miles of Class P stream. The east locust Creek reservoir would inundate 8.9 miles of Class C stream and impact another 6.8 miles that is either upstream or downstream of the proposed reservoir. There is no Class P stream inundated by the proposed reservoir and there is 92 miles of Class P stream downstream of the reservoir in the HUC-8.

The stream impacts of the proposed reservoir can be more closely examined by looking at a more detailed view of the streams impacted. In 2005, the Missouri Resource Assessment Partnership (MoRAP) published "A Gap Analysis for Riverine Ecosystems of Missouri". This report classifies all 100,000 scale NHD streams by 5 and 8 digit "Valley Segment Types" (VST). The 5 digit VST code is made up of one digit each representing water temperature (cold, warm), size (headwater, creek, river, major river), flow (permanent, intermittent), slope (low, medium or high for the stream size) and size discrepancy (an indicator of the relative size of the segment and the segment just downstream). The study divides the state into three major Aquatic Sub-regions (Central Plains, Ozarks and Mississippi Alluvial) which are further subdivided into Ecologic Drainage Units (EDU) that "Stratify each of the Aquatic Sub-regions within Missouri into relatively distinct zoogeographic subunits that also fit the definition of an ecosystem. Embedded within Aquatic Sub-regions are geographic variations in taxonomic composition (species- and genetic-level) resulting from geographically distinct evolutionary histories of the major drainages with each Sub-region EDUs account for these differences in taxonomic composition."

The Aquatic Gap report also identifies Aquatic Ecosystem Types (AES types) which are "hydrologic units that are relatively similar with regard to nutrient and energy sources/dynamics, physical habitat, water chemistry, hydrologic regimes, and also contain functionally similar biological assemblages." Each AES Type is named after a stream that typifies the AES. In the case of the East Locust Creek the proposed project, the AES Type is named after East Locust Creek. East Locust Creek AES watersheds are found in four of the five EDUs in the Central Plains Aquatic Subregions including the CPGC EDU. The combination of VST5, and AES type have been used to identify stream segments within the CPGC EDU that are similar to those being directly impacted by the proposed reservoir either by inundation or by isolation, where the stream segment is upstream of the normal pool. The combinations of VST and AES impacted by the proposed reservoir occur in other EDUs, but this analysis was limited to those in the CPGC EDU.

The analysis also excludes any East Locust Creek AES type streams found in Iowa because the AES portion of the study did not extend into Iowa. Figures 23 through 27 show the locations of the similar stream types. The following table details the lengths impacted.

Table 4. STREAM TYPES IMPACTED BY THE EAST LOCUST CREEK RESERVOIR

				Inundated by Proposed Pool			Above the Proposed Dam		
VST 5	Stream Type	Length in EDU (mi)	Length in EDU and AES (mi)	Length (mi)	Percent of Total Length in EDU	Percent of Total Length in EDU and AES	Length (mi)	Percent of Total Length in EDU	Percent of Total Length in EDU and AES
22110	Warm water, Creek, Permanent flow Gradient=Low, size discrepancy=None	1289.5	575.1	5.4	0.42%	0.94%	0.0	0.00%	0.00%
22210	Warm water, Creek, Intermittent flow Gradient=Low, size discrepancy=None	331.1	125.1	2.8	0.86%	2.27%	2.5	0.77%	2.04%
21220	Warm water, Headwater, Intermittent flow Gradient=Medium, size discrepancy=None	3284.8	1295.2	6.7	0.20%	0.52%	12.8	0.39%	0.99%
21210	Warm water, Headwater, Intermittent flow Gradient=Low, size discrepancy=None	3371.4	1513.9	3.9	0.11%	0.26%	7.8	0.23%	0.51%
21230	Warm water, Headwater, Intermittent flow Gradient=High, size discrepancy=None	2437.2	721.4	0.4	0.02%	0.06%	3.4	0.14%	0.48%
Total	All 5 Types Impacted	10714.1	4230.7	19.2	0.17%	0.44%	26.6	0.24%	0.60%
Total	All Types in EDU	16966.4	6705.5	19.2	0.11%	0.29%	26.6	0.16%	0.40%

Data from Missouri Aquatic Gap Study

EDU= Ecological Drainage Unit = Central Plains/Grand/Chariton

AES= Aquatic Ecosystem Type = East Locust Creek

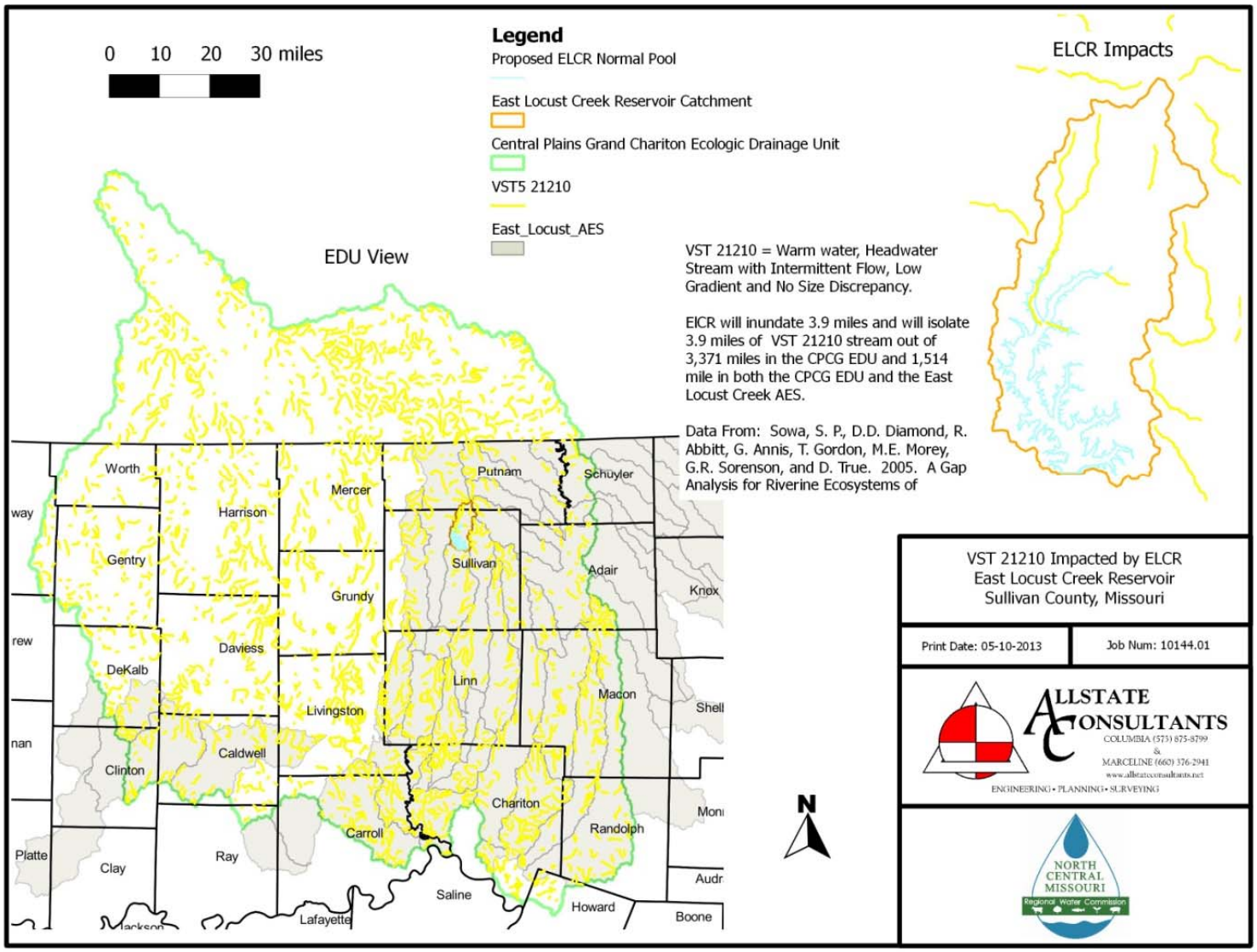


Figure 23 VST 21210 Streams in CPGC EDU

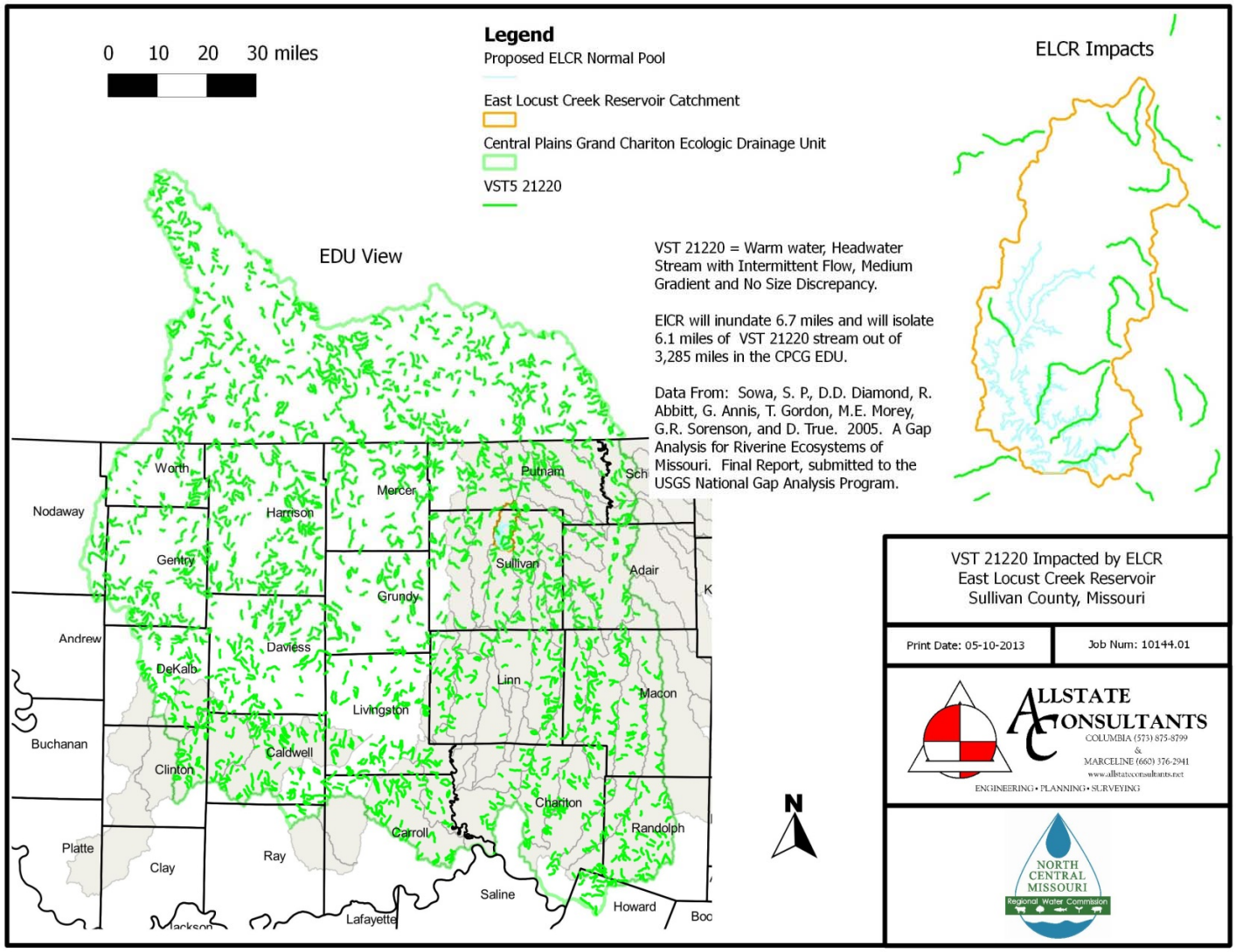


Figure 24 VST 21220 Streams in CPGC EDU

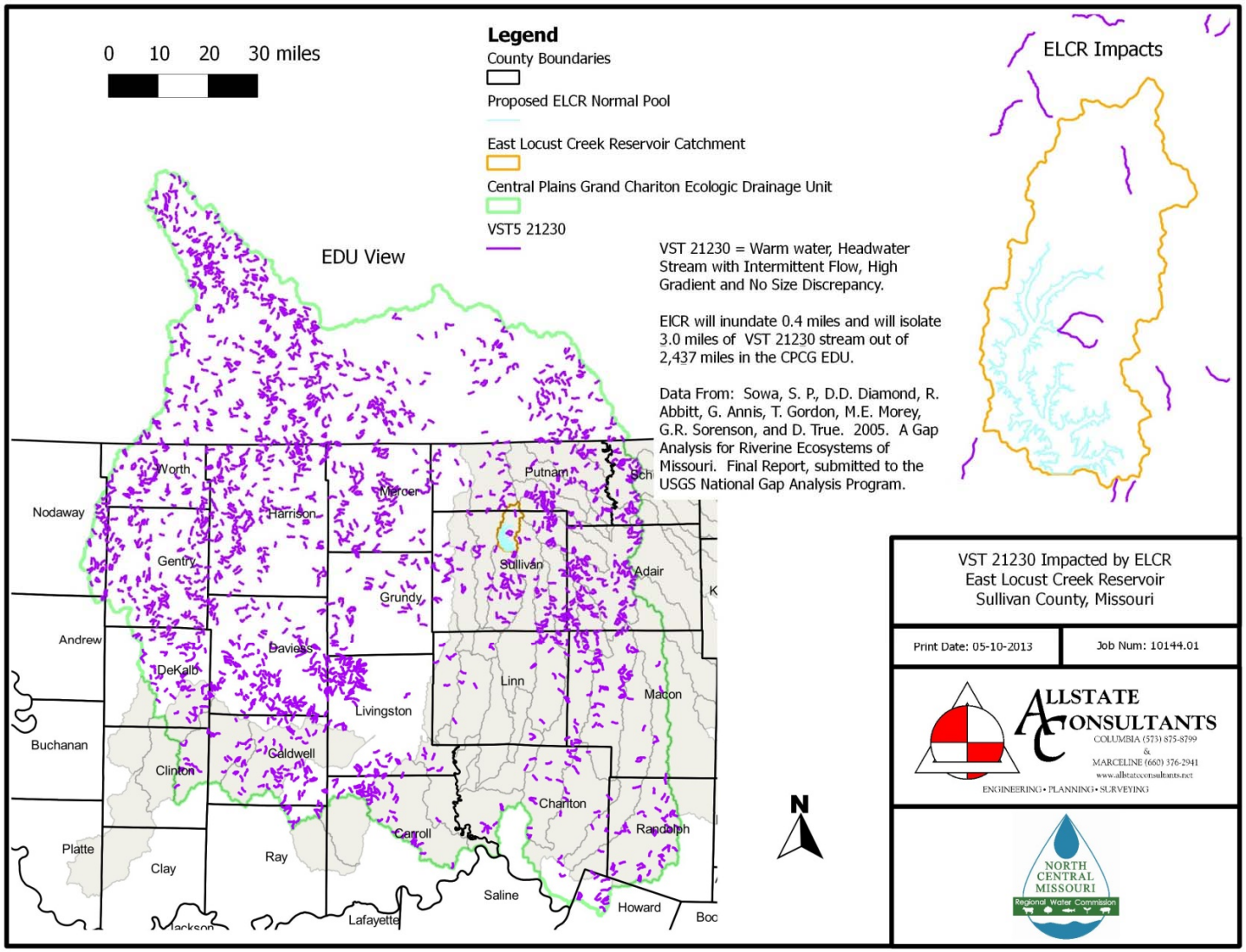


Figure 25 VST 21230 Streams in CPGC EDU

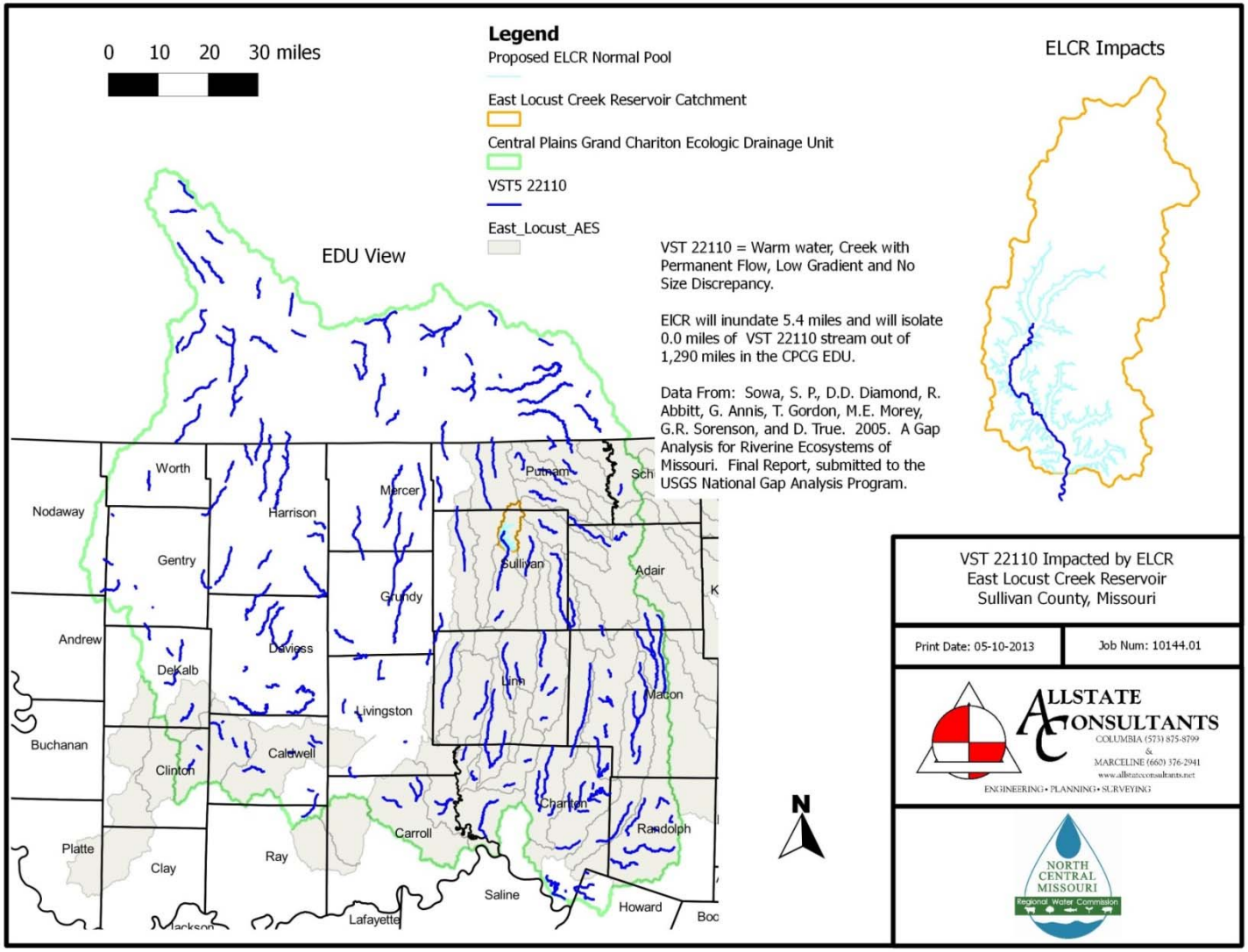


Figure 26 VST 22110 Streams in CPGC EDU

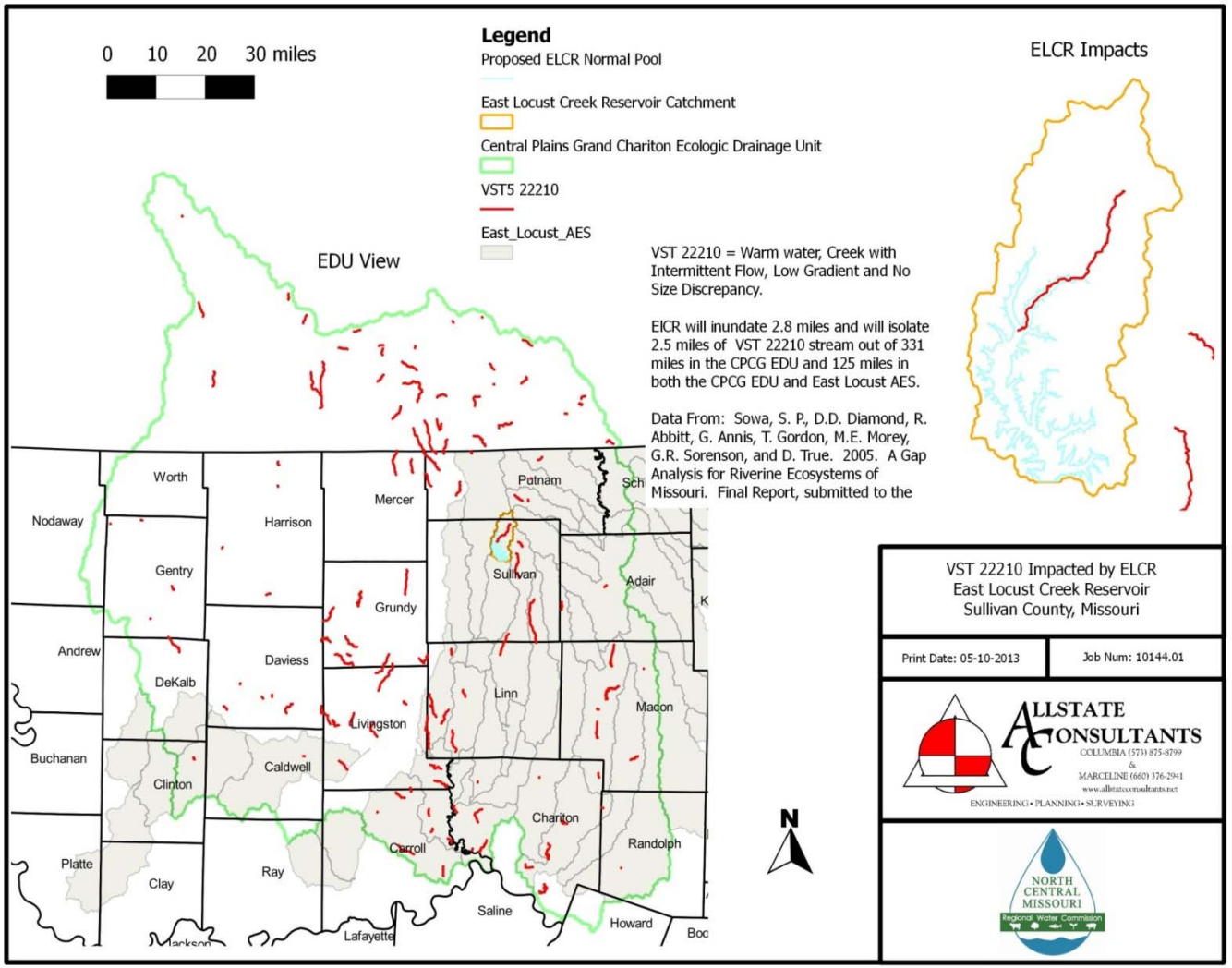


Figure 27 VST 22210 Streams in CPGC EDU

5. General Assessment of Wetlands Impact

Although wetland delineation hasn't been completed for the entire area, the National Wetlands Inventory can be used to obtain an order of magnitude projection kinds of wetlands will requiring mitigation. Further, there are 179 acres of wetlands in the WRP program that will have to be separately mitigated. To that end the wetland inventory for the Central Plains Grand Chariton Ecologic Drainage Unit and the East Locust Creek Aquatic Ecosystem Type (as defined by the Aquatic Gap Project) were assessed to provide preliminarily quantification of the wetland impacted by the proposed reservoir. The wetlands will have to be field verified and have jurisdictional determinations completed by the Corps of Engineers before a 404 permit can be issued for the project. The wetland types beginning with "PEM" are palustrine emergent wetlands. The types beginning with PF are palustrine forested wetlands. The types starting with PUB are ponds. For the most part, the ponds are farm ponds, but "PUBF" ponds are naturally occurring ponds. As the table below shows, none of the wetlands being impacted are rare in this region. For a complete explanation of the wetland types refer to the National Wetlands Inventory http://www.fws.gov/wetlands/Documents/Wetlands-and-Deepwater-Habitats-Classification-chart.pdf.

Table 5. National Wetland Inventory - ELCR impacts

Wetland Type	Inundated by ELCR (ac)	Total In EDU[a] and AES[b] (ac)	Total In EDU (ac)	% of EDU and AES	% of EDU
PEMA	56.3	6,784	16,703	0.83%	0.34%
PEMAd	34.3	4,486	7,405	0.76%	0.46%
PEMB	4.8	1,164	5,046	0.41%	0.09%
PEMC	6.0	2,728	7,611	0.22%	0.08%
PEMCd	4.1	1,560	3,115	0.27%	0.13%
PEMCh	0.2	516	4,027	0.04%	0.01%
PEMF	1.2	303	885	0.39%	0.13%
PFO1A	102.3	70,705	143,828	0.14%	0.07%
PFO1C	4.7	3,911	7,379	0.12%	0.06%
PSS1A	0.8	1,887	5,035	0.04%	0.02%
PUBF	10.0	1,170	2,344	0.86%	0.43%

Table 5. National Wetland Inventory - ELCR impacts					
Wetland Type	Inundated by ELCR (ac)	Total In EDU[a] and AES[b] (ac)	Total In EDU (ac)	% of EDU and AES	% of EDU
PUBFh	0.6	1,988	8,444	0.03%	0.01%
PUBGh	1.5	14,909	37,787	0.01%	0.00%
Subtotal	226.8	112,112	249,608	0.20%	0.09%
Other	0.0	40,136	81,715	0.00%	0.00%
Total	227	152,247	331,323	0.15%	0.07%

a) EDU = Central Plains Grand Chariton Ecologic Drainage Unit

b) AES = East Locust Creek Aquatic Ecosystem Type

6. Assessment of Water Quality Impacts – Existing Impaired Classified and Distressed Streams

The classified portion of East Locust Creek from its headwaters to the junction with Locust Creek has been assigned the beneficial uses of "whole body contact, class B", "protection of aquatic life", and "livestock and wildlife watering". Upstream of Elmwood branch it is class C and downstream it is class P. The 14.8 mile stretch of East Locust Creek between Milan and Pollock that includes 9.8 miles upstream of the proposed dam is impaired for protection of aquatic life due to low dissolved oxygen. The same stretch is also impaired for whole body contact due to high Escherichia coli (E. coli). Both of these impairments are attributed to rural non-point sources. Downstream of Milan, East Locust Creek is also impaired for whole body contact due to high E. coli. This impairment is attributed to municipal point sources and rural non-point sources. According to 10CSR20-7, Table K, East Locust Creek has been assigned site specific criteria for dissolved oxygen. The daily average may not fall below 3.6 mg/l (compared to 5 mg/l for typical streams with aquatic life beneficial uses) and the daily minimum may not fall below 0.9 mg/l. Figures 28 and 29 show the impaired streams within the Lower Grand HUC-8 by pollutant and by source of pollutant.

An analysis of the 2012 Impaired Waters List for the Lower Grand HUC-8 shows a total of 428 miles of impaired stream. However, this figure double counts streams that are impaired for two reasons. In the 428 mile total and the following totals, East Locust Creek above the proposed

dam has 9.78 miles of stream impaired for aquatic life and 9.78 miles of stream impaired for whole body contact. Even though these are both the same 9.78 miles of stream, the total length reported is 19.56 miles. For the purposes of this report, this is deemed acceptable as each type of impairment represents a separate problem that needs be addressed. With this assumption, the proposed reservoir will directly affect 19.56 miles of stream due to isolation and inundation by the reservoir. Within the HUC-8, there are 111 miles of impaired stream downstream from the proposed reservoir and 293 miles of impaired stream at other points that are not downstream from the proposed reservoir. These 293 miles are referred to as "offline" because they don't contribute flow to or receive flow from the proposed reservoir.

Table 6. Impaired Streams in the Lower Grand HUC-8 and Their Location Relative to the Proposed Reservoir

Location - Impaired Use - Pollutant - Source of Impairment	Length (mi)
Upstream - AQL - Oxygen, Dissolved (W) - Rural NPS	9.8
Upstream - WBC B - Escherichia coli (W) - Rural NPS	9.8
Downstream - AQL - Benthic-Macroinvertebrate Bioassessments (W) - Channelization	5.0
Downstream - AQL - Fishes Bioassessments (W) - Channelization	3.0
Downstream - AQL - Oxygen, Dissolved (W) - Rural NPS	4.9
Downstream - SCR - Escherichia coli (W) - Rural NPS	38.0
Downstream - WBC A - Escherichia coli (W) - Rural NPS	38.0
Downstream - WBC B - Escherichia coli (W) - Municipal Point Source Discharges, Nonpoint Source	17.4
Downstream - WBC B - Escherichia coli (W) - Rural NPS	4.9
Offline - AQL - Aquatic Macroinvertebrate Bioassessments (W) - Source Unknown	19.8
Offline - AQL - Cause Unknown (W) - Source Unknown	17.6
Offline - AQL - Fishes Bioassessments (W) - Agriculture	19.4
Offline - AQL - Fishes Bioassessments (W) - Channelization	8.5
Offline - AQL - Oxygen, Dissolved (W) - Rural NPS	0.1
Offline - AQL - Oxygen, Dissolved (W) - Source Unknown	32.6
Offline - SCR - Escherichia coli (W) - Rural NPS	55.8
Offline - WBC A - Escherichia coli (W) - Rural NPS	18.1
Offline - WBC B - Escherichia coli (W) - Rural NPS	121.4
*AQL=Aquatic Life, SCR=Secondary Contact Recreation, WBC= Whole Body Contact	

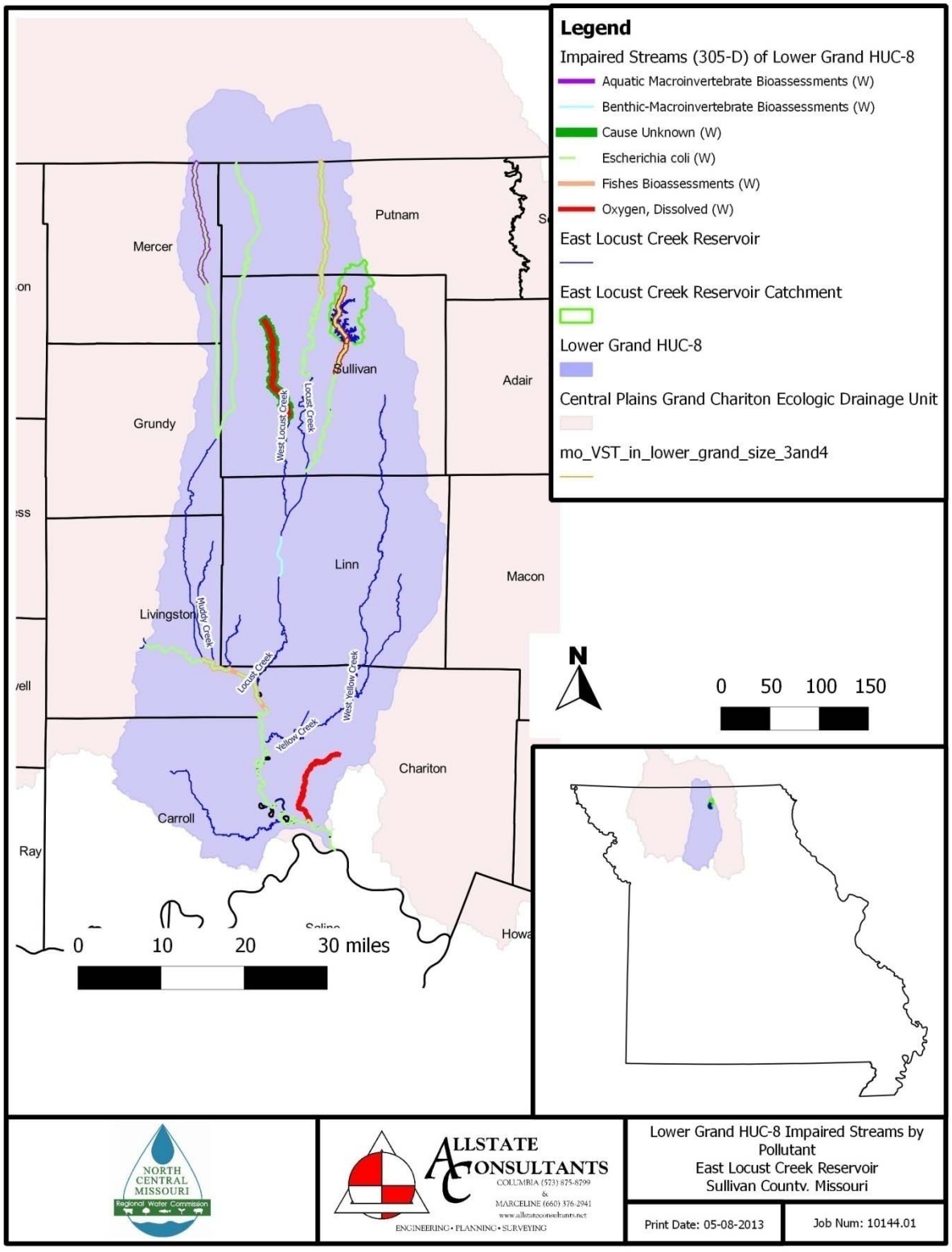


Figure 28 Impaired Streams of the Lower Grand HUC-8 by Pollutant

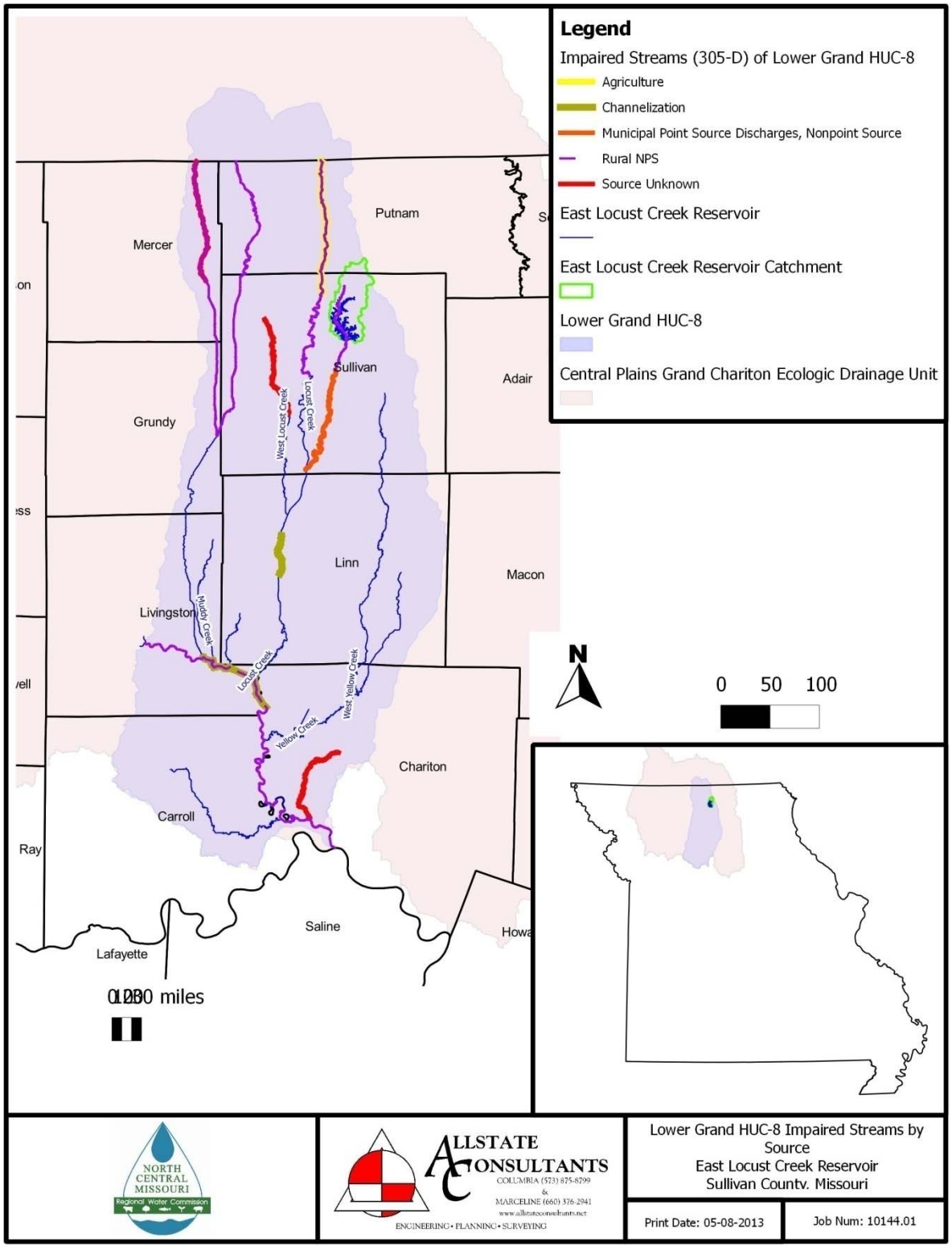


Figure 29 Impaired Streams of the Lower Grand HUC-8 by Source

Appendix W., USGS Data Series 734 - Quality of Surface Water in Missouri Water Year 2011, tabulates general water quality conditions in various physiographic and land use regions for Missouri, including data from 12 small and 4 large watersheds in the Dissected Till Plains (DTP) physiographic region which includes all of the CPGC-EDU. This report shows the following issues of significance

- DTP streams have a wider range, and higher peak levels of suspended solids than streams in the rest of the state.

- The median value of E. coli for small streams in the DTP region is approximately equal to the criteria for class B, whole body contact.

- The median values of total phosphorous in the DTP region are similar to the rest of the state, but the region also has the highest single measurement levels of total phosphorous, indicating that total phosphorous can be a problem.

- Several pesticides (CIAT, Acetochlor, Atrazine, Metalaxyl, Metolachlor, etc.) have been found in the study streams in the DTP region, but the concentrations have typically been within the allowable range.

D. North Central Missouri Locust Creek Watershed Study Final Report

In November of 2013, HDR Engineering, Inc. completed a study of the Locust Creek Watershed (which includes the entirety of the East Locust Creek Watershed) “to provide watershed planning for purposes of identifying watershed problems and restoration opportunities. For restoration opportunities the study evaluates various conceptual restoration actions and alternatives; implementation strategies; and planning level cost estimates.”

The cover of the watershed study has the following statement. "Pre-decisional, not for implementation or for public release until further determination and formal designation as such by USACE-KCD and MDNR. This work for preliminary planning purposes only." Accordingly, only the cover of the study is included as appendix AA. Those interested in seeing a copy of the study should contact DNR water resources or the Kansas City District of the Corps Planning

department. For the purposes of this white paper, we are interpreting this cover statement to indicate a policy decision (or an appropriate and necessary delay of a policy decision) rather than an indication of any technical shortcomings in this seemingly sound analysis. In any case, it is the most current and thorough discussion of watershed needs available. In our opinion, illumination of relevant issues and approaches for the ELCR project constitutes one of the best possible uses of this study, caveats notwithstanding.

The study takes a broad based view of the 647 square mile Locust Creek Watershed in terms of identifying watershed problems and opportunities for watershed health improvements. The Proposed ELCR Reservoir Watershed makes up the upper 32 square miles of the 49 square mile Headwaters East Locust Creek (HELC) HUC-12 watershed (102801030601) which is also part of the Locust Creek Watershed.

Appendix AB contains Allstate Consultants' analysis of the "Overlap of Issues and Opportunities for the Locust Creek Watershed and the East Locust Creek Reservoir Project". The purpose of this paper is to provide a brief review of the Locust Creek Watershed Study from the perspective of the East Locust Creek Reservoir with the intent of finding where the goals, problems and opportunities of the East Locust Creek Reservoir Project overlap with the goals, problems and opportunities described in the study. The intent is to use this report as a guidance document for development of the ELCR project to help avoid missing any win-win opportunities with various partners within the watershed.

Even though the recommended alternative in the Watershed Study shows construction of the East Locust Creek Reservoir as the only recommended action/practice for the Headwaters of East Locust Creek HUC, consideration should still be given to implementing the following practices for the health of ELCR and the watershed:

- The actions/practices that achieve the common goals of the Locust Creek Watershed and the ELCR should still be considered for implementation in the ELCR watershed due to their positive effects on ELCR including
  - Improved lake quality (recreational perspective)
  - Reduced drinking water treatment costs
  - Extended reservoir life
- Any such actions/practices that are implemented in the ELCR watershed should provide additional benefits to the Locust Creek Watershed.

E. Conclusion

The region is disadvantaged and has to have affordability as a leading criteria in the funding and siting of the new reservoir. Existing or new wells are not a feasible option. Existing creeks or rivers do not have the needed capacity for regional supply. Existing lakes are not a practicable alternative and are not feasible. The conclusion is that a new regional drinking water impoundment sized at 7 MGD is the only practical, affordable solution to provide a long term supply to the targeted service area.

PART III EVALUATION OF NEW REGIONAL DRINKING WATER RESERVOIR AND ALTERNATIVE EVALUATION

VII. SCOPE OF FINAL REPORT FOR NEW REGIONAL RESERVOIR

This section of the report includes information, cost estimates, and recommendations for the raw water source that will be utilized as the NCMRWC's primary regional water source. The main focus of this section will be to evaluate and recommend options for water sources to provide adequate flows for drinking water in the event of drought in the proposed service area. This report will evaluate the existing treatment system capabilities and provide alternatives to meet the necessary source requirements. If needed, the proposed improvements will be to help meet both the raw water demands of the NCMRWC and the surrounding area. For this comparison, the existing water treatment facility will remain in service for each of the options presented and the capacity of the existing water treatment plant is assumed to be adequate for each option for the primary phase of planning.

VIII. DESCRIPTION OF NEED

As demonstrated in the recent past, the current local sources of water have proven to be inadequate in the event of even a minor drought. The needs for a New Regional Water Supply Reservoir are documented in north central Missouri. In order to address the future needs for the district and surrounding area, the NCMRWC has authorized the completion of this Preliminary Engineering Report. According to the Missouri Department of Natural Resources Missouri Drought Plan located in **Appendix E**, drought primarily affects rural drought susceptible communities such as the communities in north central Missouri. In 1999 to 2000, northern Missouri experienced a drought that reached Stage 3, prompting communities to conserve water by restricting water usage. In 2012, portions of the area were in a Stage 4 drought according to NCMRWC.

The MDNR s has developed a classification system to help assess the drought susceptibility of a given area. The NCRWC district falls within Region C of this classification, which is the most

vulnerable of the categories. These classifications are based on water supply availability, water use, population growth, and historical drought data among other factors. Many drinking water sources in northern Missouri were severely depleted in the drought of 1999-2000 and droughts of years past indicating that existing water sources are inadequate and additional sources of water should be investigated. Previously, in earlier section of this report, need is justified for surface water supply because of hydro geologic conditions and the fact that deep wells are not an option.

IX. LOCATION AND OPERATION OF A NEW DRINKING WATER RESERVOIR

A. General

The NCMRWC Commission acquired the Milan water treatment facility which has a total capacity of approximately 2.8 MGD and currently treats approximately 0.62 MGD. This water treatment plant is a surface water treatment facility which consists of rapid sand filtration, sedimentation, coagulation and flocculation as well as chemical mix chambers and chemical injection. Post disinfection is provided by gaseous chlorination. Raw water is mainly drawn from Elmwood Reservoir and Golf Course Lake. At the time of this report, the commission operates 2 pump stations, 9 miles of 10-inch water line, 18 miles of 8-inch water line and various other small diameter service lines.

B. Population to Be Served

The commission currently serves the cities of Milan, Green City, Green Castle, Sullivan County Public Water District No. 1, and major users such as Dairies, factory's and Farmland Foods, Inc. Additional users have expressed interest in consolidating and pooling economic resources in order to create a more stable source for drinking water. According to the Missouri Department of Natural Resources Water Use Study of North Central Missouri Regional Water Commission dated May 20, 2004, sixteen (16) communities, water districts and customers are considering immediate connection to the North Central Missouri Regional Water Commission system with an additional eighteen (18) communities, water districts and customers that are considering changing water sources. A copy of the water use study can be found in **Appendix D** of this report as was described in earlier sections.

X. EXISTING WATER FACILITIES

A. Water Supply, Treatment and Distribution Facilities

The NCMRWC owns and operates its own water treatment facility and distribution system and leases raw water rights from the City of Milan from Elmwood Reservoir and other city lakes. The current treatment system was constructed in 2001 and is located within the jurisdiction of the Missouri Department of Natural Resources Northeast Region. In 2006 NCMRWC acquired the water treatment plant from the City of Milan. A report prepared by Burns and McDonnell (2004) detailed the options and recommendations for acquiring the water treatment facility. A copy of the Report on the Findings Relating to Possible Acquisition of the City of Milan Water Treatment Plant can be found in **Appendix J**.

The sources of the existing water supply system are Elmwood Lake, Golf Course Lake, and in severe drought years, Shatto Lake. Pumping directly from Locust Creek is done to replenish the Elmwood reservoir levels in situations when the flow of the creek downstream can be maintained at required levels. The Missouri Department of Natural Resources completed a water source study in 2009 that details the location of source water intakes; surface water drainage areas and potential contaminate sources within the drainage areas of each intake. A copy of the MDNR water source study can be found in **Appendix K** of this report.

The existing water treatment plant is permitted under ID MO2021537 and the current capacity of the water treatment plant is approximately 2.8 million gallons per day. Presently, when the East Locust Creek intake is operational, the commission can supply up to 1,350,000 gallons per day. Furthermore, the current plant is in need of enhancements and compliance improvements for trihalomethanes to maintain the 2.8 MGD capacity. A summary of these enhancements is included in **Appendix L**.

B. Trenton Municipal Utilities

NCMRWC also has an agreement with the City of Trenton (MDNR PWSD ID No. 2010796) through an emergency connection agreement or Consecutive Connection agreement. This connection is intended to provide a source of finished water only in an emergency and is not a regular source of water for the NCMRWC. As was mentioned previously the primary raw water

source for Trenton is the Thompson River. This surface source is not adequate for the long term design flow for the purposes of this regional study to supply 7 MGD.

XI. WATER SUPPLY FROM LOCAL SURFACE WATER SOURCES

A. Existing Flows Available

According to the MDNR Water Supply Studies, the potable water demand for the existing NCMRWC system was approximately 1.65 million gallons per day during the drought experienced in the year 2000 and the existing water supply reservoirs were capable of supplying an average of approximately 0.85 MGD. Portions of the MDNR Water Supply Studies document can be located in **Appendix M**, and the entire document can be found at the Missouri Department of Natural Resources website http://www.dnr.mo.gov/env/wrc/resop/MissouriWaterSupplyStudies.pdf. Based on these flow estimates and in the event of a Stage 4 drought in the district, it appears that the existing reservoirs would not be able to supply water to customers without utilizing other sources of water or without recharging the reservoirs.

The following table summarizes the total annual water usage and supply by NCMRWC from 2007 to 2013.

Table 7. North Central Missouri Regional Water Commission
Annual Water Supply

	Finished Water Supply				Raw Water Supply
Year	Green City Water Usage (Gallons)	Milan Water Usage (Gallons)	Sullivan Co. PWSD No. 1 Water Usage (Gallons)	Total Water Usage (Gallons)	Farmland Foods Water Usage (Gallons)
2007	26,843,400	82,020,400	116,766,080	225,629,880	275,823,999
2008	23,775,000	66,805,500	118,834,000	209,414,500	292,444,000
2009	24,391,000	66,682,500	122,473,300	213,546,800	279,084,000
2010	22,091,000	70,842,600	125,044,800	217,978,400	271,914,000
2011	21,541,200	63,225,800	115,358,000	200,125,000	284,342,053
2012	22,638,900	60,248,700	119,986,000	202,873,600	280,584,000
2013*	4,440,600	17,734,000	26,309,000	48,483,600	

Table 7. North Central Missouri Regional Water Commission Annual Water Supply					
	Finished Water Supply				Raw Water Supply
Year	Green City Water Usage (Gallons)	Milan Water Usage (Gallons)	Sullivan Co. PWSD No. 1 Water Usage (Gallons)	Total Water Usage (Gallons)	Farmland Foods Water Usage (Gallons)
2007 to 2012 Average Total Annual Usage (Gallons)	23,546,750	68,304,250	119,743,697	211,594,697	280,698,675
2007 to 2012 Average Daily Water Usage (Gallons per Day)	64,512	187,135	328,065	579,711	769,037

* December 24, 2012 to March 18, 2013

B. Projected Flows and Regional Drinking Water Demand

For comparison of each option presented, it was assumed that the Commission boundaries will remain the same and that the population will increase slightly. A population estimate using an estimated population growth rate of 1.5% per year for Sullivan County, Missouri has been generated and can be found in **Appendix N**. The estimated demand for the current district area is approximately 1.65 MGD if no additional major water users are added to the system.

Major water users from the food processing industries have expressed interest in expanding operations in the area, but are limited by the amount of reliable water that is available. Due to the scarcity of adequate water resources in the area, the number of potential new customers and development and economic opportunities in the surrounding area is limited. Expansion of the commission service area boundaries could include the surrounding counties of Mercer, Putnam, Schuyler, Adair, Grundy, Livingston, Linn, Macon, Chariton and Carroll which will increase the required storage capacity in the future. According to the MDNR Water Resources Report the projected required daily flow would be approximately 4.3 million gallons per day if all likely potential existing customers are connected to the system.

Table 8. Recommended Design Flow by Phase		
Recommend Design Flows	**ADF**	**Peak**
Phase 1	2.8 MGD	4.2 MGD
Phase 2	4.3 MGD	6.45 MGD
Phase 3	7.0 MGD	10.5 MGD

XII. SURFACE WATER SUPPLY ALTERNATIVES OR WELLS UNDER THE INFLUENCE OF SURFACE WATER

A. Local Alternatives for Regional Demand

1. Expand Existing Reservoirs

To increase the capacity of the existing water storage system, the existing reservoirs could be expanded or deepened to provide more usable storage capacity. This would involve the purchase of more land around the existing reservoirs, some of which is developed. The amount of storage would be limited to the maximum height that the dam could be raised and also to the size of the drainage area that could support a healthy productive, sustainable lake. Expenses could be highly variable as purchasing land around the existing reservoirs may be difficult due to development near the lake. Also, the amount of storage gained compared to the investment is small since the reservoir height may be near the maximum height that the topography will allow.

In 1991, Elmwood Lake was expanded to increase the capacity of the reservoir and to provide water for two meat processing facilities in the area. Based on preliminary estimates and assuming that the current normal pool elevations for Elmwood Lake, Golf Course Lake and Shatto Lake can be raised by 10 feet, 10 feet and 5 feet respectively, approximately 1.1 billion gallons of storage can be gained. This option is not feasible to satisfy 7 MGD flow.

2. Rehabilitation of Existing Water Storage Facilities

To increase the useable volume of the existing system, the sediment could be removed from the existing storage facilities. According to the Missouri Department of Natural Resources Water Resources Study in 2005, Golf Course Lake and Elmwood Lake have storage volumes of approximately 555 acre-feet and 2,503 acre-feet respectively. Preliminarily the sediment storage volume of a drinking water reservoir was assumed to be 5% to 10% of the total lake volume. Therefore, it is estimated that if the sediment in the existing reservoirs is removed, an increase of approximately 152.9 acre-feet to 305.8 acre-feet (250,000 cubic yards to 500,000 cubic yards) or 50.5 million gallons to 101 million gallons of storage could be recovered. A tract of land would be purchased or leased to dehydrate and store or dispose of the dredged materials. Depending on the type and amount of material that is recovered in the dredging process, material that is generated could be sold as topsoil, sand or fill for other construction projects in the area.

A more detailed analysis would need to be performed in order to determine if there is a potential cost recovery from this option and if there would be a need for the material in the area. For the purpose of this report, the recovered cost from this potential source was not estimated due to the lack of available data and the widely variable conditions associated with the demand for the material. Although removing the sediment from the existing storage facilities is a good maintenance practice, this option is not recommended because the amount of storage that would be gained is minimal when compared to the amount of storage that is required to meet the projected demands of the service area.

3. Construction of a New Regional Lake

To reduce the impact of a severe drought, the commission could construct a new reservoir that would have the capacity to store water for a prolonged period of time and to provide an adequate water supply for an expanded service area. This reservoir could be sized to provide enough capacity for the surrounding counties in the affected area as well as providing flood protection to residents living downstream. According to the Water Use Study of North Central Missouri Regional Water Commission dated May 24, 2004, there are currently sixteen (16) communities, districts and major water users that would immediately utilize the source water when it becomes available. A copy of the study can be found in **Appendix D**. An additional eighteen communities, districts and major water users could potentially utilize the water source at later dates. The needs of the current

Commission customers could be met with the construction of a new storage reservoir. A preliminary cost estimate for the construction of a multi-purpose reservoir and an operation and maintenance estimate can be found in **Appendix O**.

B. Non-Local Regional Alternatives

1. Construction of Alluvial Wells And Raw Water Line

Another option to increase the availability of raw water for treatment and use as a water supply source would be to construct a water line to the large river floodplains and install alluvial aquifer wells under the influence of rivers and surface waters. Shallow wells in the alluvial floodplain could be constructed and operated in conjunction with a transmission main that would transport water long distance to treatment and storage facilities. The river flow would need to be monitored to ensure that pumping from the shallow alluvial aquifer would not be detrimental to downstream wildlife habitat. As stated and analyzed earlier, though there are many streams are located in northern Missouri, many are unusable during periods of drought because stream flow typically depends on rainfall runoff to recharge. A cost estimate and an operation and maintenance estimate for installing shallow alluvial aquifer wells and a raw waterline to the existing water treatment plant can be found in **Appendix O** of this report.

Three large river locations were analyzed in this study. All of these have in excess of 6,000 square miles of tributary area. The following locations were analyzed by profiling terrain, developing hydraulic grade performance criteria, and determining pumping horse powers required to meet long term demands of regional water. Treatment costs were assumed to be equivalent for all options. Constants for all aspects of design, construction, acquisitions, legal, operations, and maintenance were used to make evaluations equivalent. All information in detail is included in **Appendix O**. Cost curves for each of the below options were developed:

a. Sumner to Milan (Grand River)
b. Chillicothe to Milan (Grand River)
c. Brunswick to Milan (Missouri River)

A present worth analysis comparison was performed and is included in **Appendix O** and in a table below.

2. Construction of Raw Water Line to Existing Non-Local Regional Lakes

Another option would be to install large diameter mains to existing regional lakes which are non-local and may have available raw water capacity that is not allocated to a different use. These uses would include water supply, flood control, environmental base flow for downstream habitats, power generation, recreation, etc. We assumed all of the alternates evaluated below could be modified to supply 7 MGD. The following locations were analyzed with the same or similar assumptions as the alluvial well options to allow a comparative, least cost present worth analyses to be developed:

a. Purchase And Pump Water From Rathbun Regional Water Association - Iowa

Another option would be to purchase water from the Rathbun Regional Water Association (RRWA) in south central Iowa. RRWA currently has a stated available capacity of 8.8 million gallons of raw water per day and the source of drinking water is Rathbun Lake which receives its source water from the Chariton River. The drainage area of the lake is approximately 549 square miles, making it a more reliable source of water than the current local surface water storage system. In times of drought or increased demand, water purchased from RRWA could supply the existing water system. In order to connect to the RRWA system, a large capacity waterline would be required which would traverse over 60 miles and would require NCMRWC to obtain easements for waterline construction and pumping would be required. This option is not recommended since the commission would not have control over the source water and would rely on the decisions and actions of the RRWA. An estimate for the construction and operation and maintenance for a proposed water line from RRWA to the NCMRWC district territory can be located in **Appendix O**.

b. Mark Twain Lake To Milan

Due to the large size of Mark Twain Lake, the Clarence Cannon Wholesale Water Commission (CCWWC) has adequate water to supply the required demand but its existing mains do not have the capacity to deliver the water to Milan. Purchase of water from CCWWC would require construction of approximately 130 miles of new large water main. This option is not recommended since the commission would not have control over the source water and would rely on the decisions and actions of the

CCWWC. An estimate for the construction and operation and maintenance for a proposed water line from Mark Twain Lake to Milan can be located in **Appendix O**.

c. Kirksville To Milan

While Kirksville does not appear to be able to supply over 2 MGD – 3 MGD, it was still analyzed for comparison purposes due to its proximity. At thirty miles from Milan it presents a more reasonable option in terms of water main construction and pumping costs. Despite the inability to provide the necessary volume of water, this option is still worthy of consideration in the long term solution because it would provide valuable redundancy in the system and allow future two way transfer of water as needed. An estimate for the construction and operation and maintenance for a proposed water line from Kirksville to Milan can be located in **Appendix O**.

C. Alternatives, Discussion, Economic Comparison

The selection of the recommended alternative for this report is based on affordability, practicality, sustainability, need, carbon/greenhouse gas footprint, and welfare of the surrounding area. Some of the options presented would only slightly increase the useable storage or would provide limited capacity if the area were to experience a long term drought. These are not practical.

Based on the current and future needs for north central Missouri, the most viable option for a potable water source is to construct an additional local multi-purpose storage facility that will provide the required 50 year capacity of 7 MGD to adequately serve the residents during a stage 4 drought, as well as provide flood control and economic opportunities for the surrounding area. The current system is inadequate and even with rehabilitation or supplemental sources, likely would not be able to provide enough water for future needs as population and demand increase. Ground water in the area is too mineralized to utilize for drinking water sources and would not be practical to develop enough wells with the required capacity and quality. Most stream flow in North Central Missouri is highly dependent on surface run off and generally cannot be relied upon in the event of a major drought. Regional water sources for North Central Missouri are desperately needed and a large surface water

reservoir would provide adequate amounts of water for many communities and future generations. The existing storage facilities should remain in place and could be utilized as a water source for the industrial customers in the area.

	Table 9. NCMRWC Water Supply Alternatives - Present Worth Summary								
	Sumner to Milan	Chillicothe to Milan	Rathbun to Milan	Brunswick to Milan	Mark Twain Lake to Milan	Kirksville to Milan*	East Locust Creek Reservoir Pumped to Milan (excluding reservoir cost)	East Locust Creek Reservoir Gravity fed to Milan (including reservoir cost)	East Locust Creek Reservoir Pumped to Milan (including Reservoir Cost)
Length (mi)	47.7	49.7	50.5	64.3	129.8	29.6	4.15	4.15	4.15
Number of Pump Stations	3	3	2	4	7	2	1	0	1
Construction Cost	$56,781,769	$59,032,265	$58,986,373	$75,935,179	$150,738,476	$35,838,998	$6,843,927	$71,062,033	$71,896,711
Engineering Cost	$7,608,757	$7,910,324	$7,904,174	$10,175,314	$20,198,956	$4,802,426	$917,086	$9,522,312	$9,634,159
Legal Cost	$2,750,006	$2,861,319	$2,876,446	$3,691,035	$7,379,520	$1,722,854	$292,302	$1,961,973	$1,983,674
Total Capital Cost	$67,140,532	$69,803,908	$69,766,993	$89,801,528	$178,316,952	$42,364,278	$8,053,315	$82,546,319	$83,514,545
Initial Annual O&M (Less Pump Power)	$426,000	$436,000	$408,000	$508,000	$817,000	$322,000	$201,000	$248,000	$266,000
Initial Annual Pumping Power Cost	$548,048	$582,900	$392,510	$548,267	$917,596	$230,020	$60,695	$0	$60,695
Initial Total O&M	$974,048	$1,018,900	$800,510	$1,056,267	$1,734,596	$552,020	$261,695	$248,000	$326,695
NPV 50 years of pumping power	$14,149,118	$15,048,903	$10,133,547	$15,051,015	$24,658,184	$5,938,495	$1,566,981	$0	$1,566,981
Net Present Value of Project (50 years)	$251,365,070	$261,403,756	$147,199,859	$326,424,769	$359,644,826	$93,965,181	$27,802,300	$140,187,020	$145,246,004

* Kirksville only has enough excess capacity to meet NCMRWC's phase 1 demands of 2.8 MGD. An additional source would be needed to supply 7MGD.

The least cost practical alternative is to construct a new reservoir locally to supply 7 MGD to the entire service area.

D. Conclusion

When evaluating options and alternatives that can produce 7 MGD in an affordable practicable manner, the summary indicates the most feasible option is a new reservoir that is placed in a location that can gravity feed the water treatment plant. In addition the long term affordability criteria and economic impact criteria of each option must be included to mitigate high user rates, DAC and sustainability.

XIII. CURRENT INFORMATION, JUSTIFICATION, AND STUDIES ON THE SELECTED SITE OF THE EAST LOCUST CREEK RESERVOIR (ELCR)

The East Locust Creek Watershed Revised Plan and Environmental Impact Statement (EIS) has been completed by the United States Department of Agriculture (USDAP – Natural Resources Conservation Service (NRCS), which details the construction, benefits and impacts of a multipurpose reservoir in the East Locust Creek Watershed. A copy of the EIS can be found in **Appendix P**.

A. NRCS Environmental Impact Statement

A substantial amount of work, reports, analyses, evaluations, and acquisition has occurred in the development of the ELCR. The Commission has proceeded following the Federal Record of Decision issued by NRCS in 2006. This is **Appendix Q**. NRCS is the current project sponsor and funding administrator. NRCS is administering the design and construction of ELCR project as it progresses.

In the fall of 2014, NRCS released funding to allow the Commission to contract for a Supplemental Environmental Impact Statement (SEIS). The Commission has selected a consultant team including Olsson Associates, Spencer Fane Britt & Browne LLP and Allstate Consultants LLC to complete the SEIS and completion is projected for 2016.

B. Land Acquisition

Acquisition of 176 acres for the dam site was completed in 2009 and 2010.

Acquisition of the remaining 4,124 acres of the property required for the reservoir pool, operations, maintenance and public access from 82 different property owners on 103 different existing parcels began

in the summer of 2012 and continues with approximately 70% of the necessary land acquired and the remainder expected to be acquired in 2015. The majority of the remaining acquisitions are on track to close voluntarily during the first half of calendar year 2015. While it is the Commission's policy that we will close voluntarily whenever possible, it appears likely that there will be at least two properties that will have to go to condemnation.

The process for setting the required acquisition boundary (referred to as the "base boundary") was based on

- Acquiring the minimum amount of property that met both of the following two criteria
- NRSC PL-566 program rules that require that we buy all land below the top of dam elevation
- DNR Drinking Water Guidelines that require that we have at least a 100' buffer around the lake.

In addition to the base boundary it is necessary for the Commission to acquire land for maintenance and operations and public access. It is crucially important to the success of the project that there be adequate public access and amenities around the lake to facilitate recreational uses. To fulfill these purposes, two sites outside of the base boundary were selected based on the following criteria. These sites are both necessary for operations, maintenance and adequate public access. These sites are included in the 4,124 acres of property that is currently being acquired.

Proximity to population centers and major roads

- Topography
- Water depth
- Costs
- Cost to provide access to existing roads
- Environmental considerations
- Wind considerations

The average per acre base price of the 3,043 acres that have been acquired since 2012 is $1,862. For acquisitions exceeding 5 acres in size, the per acre price for the land has ranged from $982 to $2,102. For smaller parcels including those in Boynton and Pollock, the price for land has been as high as $3,513.

Overall, homestead and heritage value have added an additional $324 per acre to the acquisition cost. Improvements have added a cost of $164.7 per acre on average.

Because the reservoir will create some isolated sub-parcels, it has also been necessary to pay damages on sub-parcels that remain with the original owner but lose access due to the reservoir. Payment of these damages has resulted in an average of $32.9 per total acre acquired in increased cost.

In order to make property owners whole, it has also been necessary to reimburse them for the costs of providing fencing and livestock watering facilities when such elements were pre-existing on the property and their functionality was demonstrably impacted by the acquisition. So far, this has included reimbursement of fencing costs for 26.2 miles of fence at an average cost (including materials, installation, clearing and drainage crossings) of $3.79 per foot. Fencing has added $172 per acre to acquisition costs (overall average). To replace watering structures, so far the Commission has funded 5 new ponds and 2 new pumping systems. These costs have added an average of $34.7 per acre to the acquisition costs (overall).

C. Preliminary Concept Plans

A current set of schematic design plans for the lake and exhibits are included in **Appendix R**. These concepts have been developed for the purpose of guiding the land acquisition process and envisioning the future operational capabilities and amenities of the reservoir area. These plans currently include two significantly sized public access areas with facilities as well as other boat launches scattered around the lake.

D. Dam and Outlet Works Plans

Appendix AF includes a report completed by URS Corporation in January of 2014, summarizing the results of phases one through four of the dam design. These phases of design were focused on the geologic investigation and preliminary design of the reservoir outlet works. As part of this work, the dam centerline was moved approximately 300' north to take advantage of better subsurface conditions.

The URS report includes specific recommendations for construction of the dam fill as well as a spillway configuration that includes a notched concrete labyrinth spillway at the east abutment to serve as the primary and flood spillway and a separate outlet works consisting of a multi-gated intake tower for water supply and stream flow augmentation. The report did not change any of the previously proposed outlet elevations, principal pool elevation, auxiliary pool elevation, etc.

Phases 5 through 7 of the dam and outlet works plans were partially funded by NRCS in the fall of 2014 and the Commission has contracted with the team of Olsson Associates and Allstate Consultants LLC to complete these three phases which will produce biddable plans by early 2016.E. Transportation Infrastructure Improvements

In addition to providing a suitable source for drinking water for the residents of the Green Hills region of North Central Missouri, improved access for residents of the area will be achieved by constructing a bypass for State Route N on the south end of the proposed reservoir and constructing an access road that will bisect the lake near the current terminus of State Route VV. Alternative routes and pavement options will be reviewed by the Missouri Department of Transportation, Sullivan County Department of Public Works and the NCMRWC to determine the most desirable alignment to meet the needs of the residents of the area. A display showing the possible transportation alternatives can be found below.

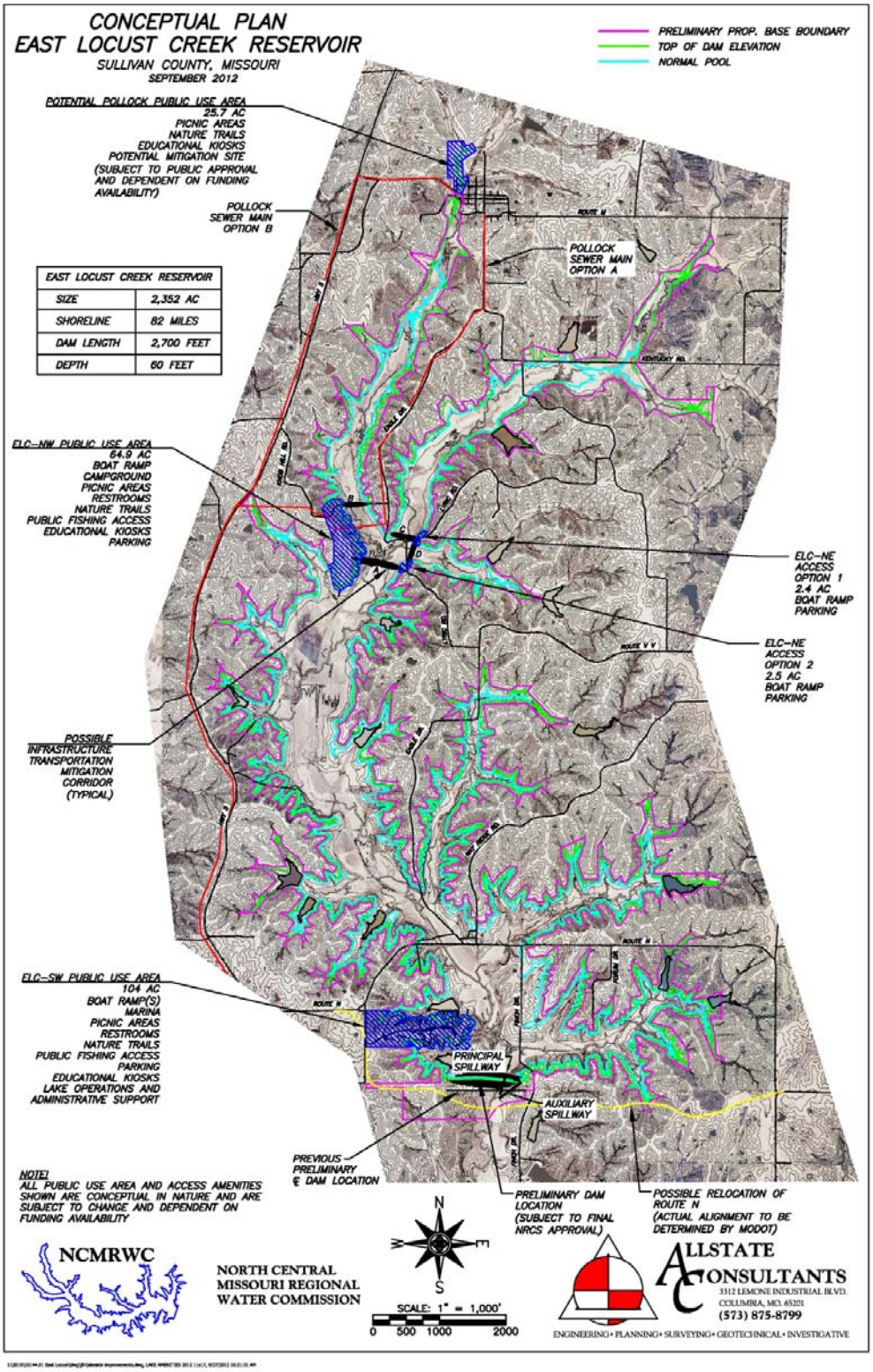


Figure 30. Conceptual Plan

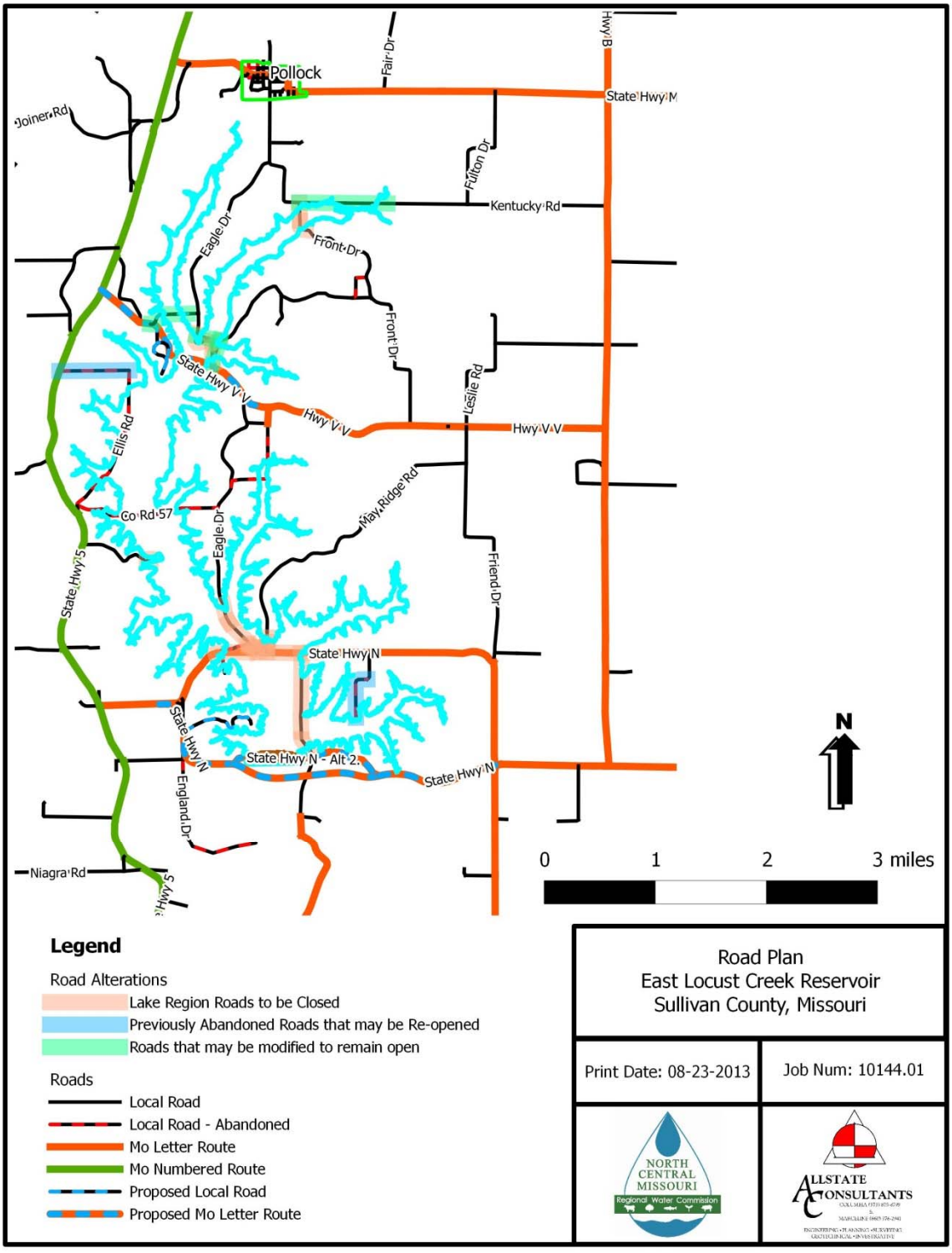


Figure 31. Proposed Roadway Improvements

1. *Proposed Roadway Improvements - Approach - Description*

Our approach in evaluating roadway options has been to take a broader view and ask ourselves "what functions can the roadways provide?"

Functions

- Provide transportation connectivity across the middle of the lake for the benefit of the traveling public in terms of reduced delay, expense, safety, emergency services, energy usage and greenhouse gas emissions. It will also provide a benefit for the NCMRWC in terms of reduced access claims.
- Provide a utility corridor across the lake to facilitate utility distribution efficiency
- Provide maximum flexibility in independently controlling lake levels for different branches of the lake
- Encourage settlement of sediment in the upper reaches of the lake for the benefit of drinking water quality
- Provide MDC with a fixed boundary for managing boat access to sensitive areas of the lake
- Provide aquatic habitat for spawning
- Develop controlled wetlands in upper reaches for filtering of organics and sediment
- Utilize upper portions of lake for detention as appropriate
- Earn credits for stream and wetland mitigation

Challenges

- Managing lake level options in an environment of conflicting needs (water supply vs. spawning, etc.).
- Stabilizing water levels in one portion of the lake will require tradeoffs in water level stability in other parts of the lake
- Ensuring that the proposed crossing doesn’t create flooding problems
- Facilitating fish passage
- Added cost

Constraints

- Isolate individual branches of the lake separately so that they can be controlled independently.
- Do not cause any increase in flooding depth, frequency or duration for any area that is above the top of dam.

- Build the roadway high enough so that it provides a reasonable level of access (at least 25 yr - 100 year overtopping frequency).
- Build control structures to create a range of elevations for which slow managed drawdown can be achieved (probably from 18" above normal pool down to normal pool). Construct wetlands in appropriate locations to take advantage of slow drawdown. Include flexibility to allow MDC to modify drawdown rate and possibly even range of elevations over which slow drawdown occurs.
- Provide a way to more rapidly draw down the upper pools if needed
- Provide a means by which upper pool water can be used for water supply in cases of extreme drought.

To provide these functions we have developed preliminary planning level cost estimates for multiple options using the following assumptions.

Table 10. Local Roadway Preliminary Planning Assumptions
• Openings sized using FHWA HY8 Culvert modeling program with following assumptions
○ Assumed tailwater conditions because we don't have the final Reservoir outlet structure details
○ Freeboard = 0 in the 25 year storm. In other words, 25 year overtopping design
○ Cause no more than 1' of backwater in the 100 year event.
• Bridge deck size based on an assumption of 3:1 end slopes and an opening bottom width of 2/3 the required culvert span.
• Bridge Length assumes that instead of vertical abutments we build 3:1 end slopes but make the bottom of the opening 2/3 of the culvert span length.

Table 10. Local Roadway Preliminary Planning Assumptions (continued)	
Cost assumptions - Unit prices From MoDOT 2010 Bid Price Book (except bridge cost and R/W acquisition)	
Concrete $/cy	$ 360.00
Steel $/lb	$ 0.90
Bridge $/sf	$ 120.00
Embankment in Place $/cy	$ 3.00
Riprap protection of embankment (type 2 rock blanket) $/cy	$ 50.00
Misc and Contingency (%)	10%
Design cost (%)	8%
Thickness of embankment protection (ft)	3
R/W Acquisition ($/ac)	$ 2,100
The total cost includes the less expensive of the bridge or the culvert	

2. Proposed Roadway Improvements

Based on these assumptions, the following table details our preliminary planning cost estimates for the following roadway improvements as shown on figures 30 and 31.

a) Extend Route V V to the west to tie into Highway 5
or
b) Raise three existing county roads above normal pool to provide
and
c) Relocate Route N to the South of the Lake
and
d) Raise Kentucky Road to auxiliary spillway level.

Table 11. Estimated Roadway Project Costs

Name	VV extension [a]	Knob Hill Road (Pollock Branch) [b]	East Pollock Peninsula Crossing [b]	Crossing 3 [b]	Route N Relocation [c]	Kentucky Road Improvements [d]
Label in Figure	A	B	C	D	NA	
Contributing Drainage Area (ac)	12,996	4,508	7,498	990	NA	
Time of Conc. (hr)	3.5	2.8	3.5	1.1	NA	
Length of crossing (ft)	1,420	925	860	650	NA	
Culvert Option Estimate						
Length of Culvert (ft)	234	158	170	175	NA	
Size of Culvert (#Barrels-span-rise)	5-16X21	2-19X18	3-16X20	1-17X18	NA	
Cost Culvert	$1,680,000	$550,000	$770,000	$360,000	NA	$10,000
Bridge Option Estimate						
Deck width (ft)	40	30	30	30	40	NA
Estimated deck length (ft)	178	133	151	119	200	NA
Cost Bridge	$850,000	$480,000	$540,000	$430,000	$960,000	NA
Roadway Costs						
Cost Fill	$430,000	$120,000	$190,000	$110,000	NA	$0
Cost Fill Protection	$1,454,000	$464,000	$615,000	$415,000	NA	$14,000
Estimated Cost of Roadway $/ft	$270	$124	$124	$124	$270	$124
Roadway Costs	$2,840,000	$120,000	$150,000	$150,000	$5,060,000	$90,000
Subtotal	$4,724,040	$704,030	$955,030	$675,030	$5,060,040	$114,000
Cost of R/W	$40,000	NA	NA	NA	$80,000	NA
Contingency	$472,000	$70,000	$96,000	$68,000	$506,000	$11,000
Design	$416,000	$62,000	$84,000	$59,000	$445,000	$10,000
Estimated Total Cost for Crossing and Roadway	$5,652,040	$836,030	$1,135,030	$802,030	$6,011,040	$135,000

a) and b) - Crossings marked with (a) and (b) represent two alternative options for providing lake crossings. We would not build both the (a) and (b) crossings.

c) The Route N relocation has not been determined by MoDOT and such determination is outside the control of NCMRWC so this alignment has been estimated on a per mile planning basis. d) Kentucky Road would need to be raised approximately 3' to get it to the auxiliary pool level. The culvert at Kentucky road will be small and so was not detailed.

F. Utility and Sewer Improvement

To provide the residents of The Village of Pollock and other ELC watershed communities with improved sanitary sewer service and to enhance and protect the water quality of the source water for the proposed reservoir, an improved sewage collection and transportation system will be constructed and routed to the Milan Wastewater Treatment Facility. Relocation of existing waterlines, communication lines, and power lines in the undated area will be required. Coordination with local utilities and local governments will be necessary to establish service routes that will best serve the current and projected communities and development around the reservoir. Improved utilities and updated systems will be constructed to support the increased population that is anticipated due to the construction of a dependable water supply. USDA has funded a PER to serve Pollock with Sewer. A copy can be provided upon request.

G. Stream and Wetland Mitigation Approved Purpose Statement

As part of the requirements for the construction of the East Locust Creek Reservoir, impacts to streams and wetlands must be avoided, minimized or mitigated in accordance with the Clean Water Act as implemented by the United States Environmental Protection Agency (EPA) and United States Army Corps of Engineers (USACE) requirements. For water supply projects in areas where groundwater and stream intake options are inadequate, the options for avoidance and minimization are limited to reducing the size of the reservoir. However, reducing the size of the reservoir also reduces the amount of water available for human use. A short sighted reduction in reservoir size will eventually lead to the need for additional reservoirs if demand increases faster than predicted. This leads to increased impacts to streams because one reservoir can provide a given amount of water with less stream impact than two smaller reservoirs capable of producing the same volume.

In addition to being a requirement, mitigation upstream of the reservoir is also good practice for protecting water quality of the reservoir and reducing drinking water treatment costs. Wetland areas trap and absorb incoming sediments, pollutants and excess nutrients that can adversely affect the quality of the drinking water source.

Mitigation procedures and processes for the proposed reservoir will be negotiated with the Corps of Engineers. A portion of the funding that has been allocated towards the Supplemental Environmental Impact Statement (SEIS) will go to discussions with the USACE regarding mitigation. We are currently seeking additional funding for the design of mitigation, which will need to occur after the SEIS is substantially complete. We currently recommend that a functional assessment of overall impact be considered for comparison to the Missouri Stream Mitigation Method, which was configured with smaller projects in mind and which may be prohibitively expensive.

XIV. PROPOSED COST ESTIMATE OF NEW REGIONAL RESERVOIR

Revised Probable Capital Cost

The total estimated probable capital cost to construct the East Locust Creek Reservoir as described throughout this PER and supplemental reports by URS, NRCS, and others is $97,009,747. As noted previously, the lead primary funding agency is the United States Department of Agriculture-National Resource Conservation Service. The North Central Missouri Regional Water Commission is the continuing authority and whom grants and loans for the project have been and will be awarded. The NCMRWC has received to date nearly four million dollars in Federal funding, over two million dollars in State funding and secured loans, supported by citizens, for over twelve million dollars.

Land	$18,505,644
Relocation Payments and Assurances	$300,000
Infrastructure	$6,841,000
Technical Services	$10,517,903
Mitigation Construction	$7,350,000
Construction of Multi-Purpose Reservoir	$53,495,200
Subtotal	$97,009,747
5% Contingencies	$4,850,487
Total Project Probable Capital Cost	**$101,860,234**

*Items followed by an * denote a subtotal of indented and italicized detailed budget items directly below.*

Land

Item	*Description*	*Item Subtotal*
Multiple Purpose Reservoir		$14,762,000
	Land Acquisition	
Environmental Assessments		$730,244

5 Small Sediment & Debris Basins		$13,400
WRP Relocation Land Acquisition		$450,000
Relocation Payment to Existing Utilities		$3,000,000
Includes: Design/Const. of water, fiber, elec., etc.		
	Total	**$18,505,644**

Relocation Payments & Assurances

Item *Description*		*Item Subtotal*
Relocation of Property Owners		$300,000
	Total	**$300,000**

Infrastructure

Item *Description*		*Item Subtotal*
Inundated Structures Payment		$341,000
Waterplant		$6,500,000
Existing '06 Bond amount for WTP purchase, etc.		
	Total	**$6,841,000**

Technical Services

Item *Description*		*Item Subtotal*
Phases 1-4 COMPLETED		$1,498,803
Design (Phases 5-7 and Preconstruction Items)		$4,149,100
Multiple Purpose Reservoir		
Phases 5-7	$700,000	
Lagoon Decommissioning	$10,000	
Railroad Bed Cleanup	$130,000	
Roadway Improvements	$1,350,000	
7 Modified Small Structures	$100,000	
5 Small Sediment & Debris Basins	$27,200	
Recreational Facilities	$309,600	
Water Intake Tower	$675,800*	
ELCR Water Quality Monitoring Plan	*$100,000*	
Ecological Flows	*$300,000*	
Basic Design	*$250,800*	
Special Services, etc.	*$25,000*	
Raw Water Line to Water Treatment Plant	$772,500	
Building Demolition	$50,000	
Ravine Cleanup	$24,000	
Cistern/Well Capping	$25,000	
WRP Relocation Land Design	$150,000	
Permitting		$2,225,000
Multiple Purpose Reservoir	$1,375,000*	
Legal Consulting	*$125,000*	

	Engineering Consult	*$1,250,000*	
	Floodplain Development Permit	$50,000	
	Pre-Lake Water Quality Monitoring	$50,000	
	Environmental/ Cultural	$500,000	
	ESA, CR, Avian, etc.		
	Jurisdictional Determination	$250,000	
Planning			$2,345,000
	Multiple Purpose Reservoir	$500,000*	
	Legal Consult	*$150,000*	
	Engineering Consult	*$350,000*	
	Forest Management Plan	$100,000	
	Locust Creek Watershed Study (PAS1)	$400,000	
	Strategic Water Needs Assessment (PAS2)	$400,000	
	Water Rate Study	$37,500	
	Economic Impact Analysis	$37,500	
	PER (2013 ed.)	$150,000	
	PER (2015 ed.)	$60,000	
	Lake & Watershed Water Quality Assurance Plan	$460,000*	
	Lake Authority Formation/Implementation	*$360,000*	
	Non-point Source Watershed Protection Plan	*$50,000*	
	Point Source Watershed Protection Plan	*$50,000*	
	NRCS Technical Assistance	*$150,000*	
	Infrastructure Study	*$50,000*	
Phase 8			$300,000
	Includes: Bid, Award, CA, Special Services, etc.		
		Total	**$10,517,903**

Mitigation Construction

Item	*Description*	*Item Subtotal*
Real Property		$1,837,500
Restoration Efforts		$4,777,500
Engineering		$735,000
	Total	**$7,350,000**

Reservoir Construction

Item	*Description*	*Item Subtotal*
Dam Structure and appurtenances		$30,000,000
Construction Management		$900,000
Required Reservoir & System Improvements		$22,595,200
	7 Modified Small Structures	$201,500
	5 Small Sediment & Debris Basins	$195,100
	Recreational Facilities	$2,609,400
	Water Intake Tower	$2,000,000

Raw Water Line	$3,511,200	
Water Treatment Plant Enhancements	$2,000,000	
Roadway Improvements	$9,000,000	
Environmental Hazard Abatement	$3,078,000*	
Property Demolition	*$500,000*	
Building Hazard Waste Cleanup	*$250,000*	
Ravine Cleanup	*$240,000*	
Forest Management and Water Quality Clearing	*$288,000*	
Cistern/Well Capping	*$250,000*	
Lagoon Decommissioning	*$50,000*	
Railroad Bed Cleanup	*$650,000*	
Lake and Watershed Water Quality BMP	*$200,000*	
Fence	*$650,000*	
WRP Relocation Construction		$1,500,000
	Total	**$53,495,200**

*Items followed by an * denote a subtotal of indented and italicized detailed budget items directly below.*

XV. OPERATION AND MAINTENANCE

NCMRWC will be evaluating the renovations or additions to the existing potable water source system and the construction of the proposed East Locust Reservoir to select the most cost effective solution to meet the future needs.

A. Proposed Ownership

The North Central Missouri Regional Water Commission (NCMRWC) is the proposed owner of the new lake.

B. Maintenance, Operations and Protection of Water Quality

The East Locust Creek Reservoir Lake Authority will develop, implement and maintain policies to govern the operations of the East Locust Creek Reservoir. Though separate from and subservient to the North Central Missouri Regional Water Commission, the Lake Authority first and foremost will manage the operation of the Reservoir to ensure high water quality, while being attentive to environmental impacts and economic generation. The East Locust Creek Reservoir is designed to be an economic and ecological engine that requires balance oversight to maximize both. As designed, the Reservoir's revenue generation through the Tax Increment Finance District and through fees, leases and easement payments will be critical paying for

reservoir infrastructure, debt retirement or in keeping water rates low by subsidizing plant and Commission operations.

The Lake Authority (Appendix Z) will be responsible for day to day operations of the lake as well as protection of water quality. Their duties will include:

- Managing access to the lake
- Managing dock and access licenses
- Inspecting fences, docks, NCMRWC funded watering structures, and forebays
- Developing water quality protection policies
- Managing leases for lakeside amenities such as marinas, campgrounds, etc.
- Collaborate with MDNR and watershed district and USDA to educate and implement watershed improvements that control and insure regional lake water quality

C. Estimated Annual Operations Costs

The anticipated additional annual operation and maintenance costs for the recommended project are approximately $322,500. The following table represents estimated monthly costs for maintaining the proposed reservoir and the additional components for the project:

Reservoir	$ 97,500.00
Recreational Facilities	$ 40,000.00
Transportation Facilities	$120,000.00
Wetland and Mitigation Features	$ 50,000.00
Floodwater Retarding Structures	$ 15,000.00
Total Per Year	**$ 322,500.00**

XVI. PROJECT FINANCING AND COSTS

A. Summary of Project Costs

The following is a summary of Preliminary costs for the water source reservoir project:

Land	$18,505,644
Relocation Payments and Assurances	$300,000
Infrastructure	$6,841,000
Technical Services	$10,517,903
Mitigation Construction	$7,350,000
Construction of Multi-Purpose Reservoir	$53,495,200
Subtotal	$97,009,747
5% Contingencies	$4,850,487
Total Project Probable Capital Cost	**$101,860,234**

B. Anticipated Funding for the Project

Project financing is anticipated through the Missouri Department of Natural Resources, Missouri Department of Conservation, USDA – Natural Resources Conservation Service, Rural Development and or Community Development Block Grant, and local loans. The following is a summary of anticipated financing the Commission will apply for based on private loans, USDA-NRCS and USDA-CDBG or MDC assistance program funds:

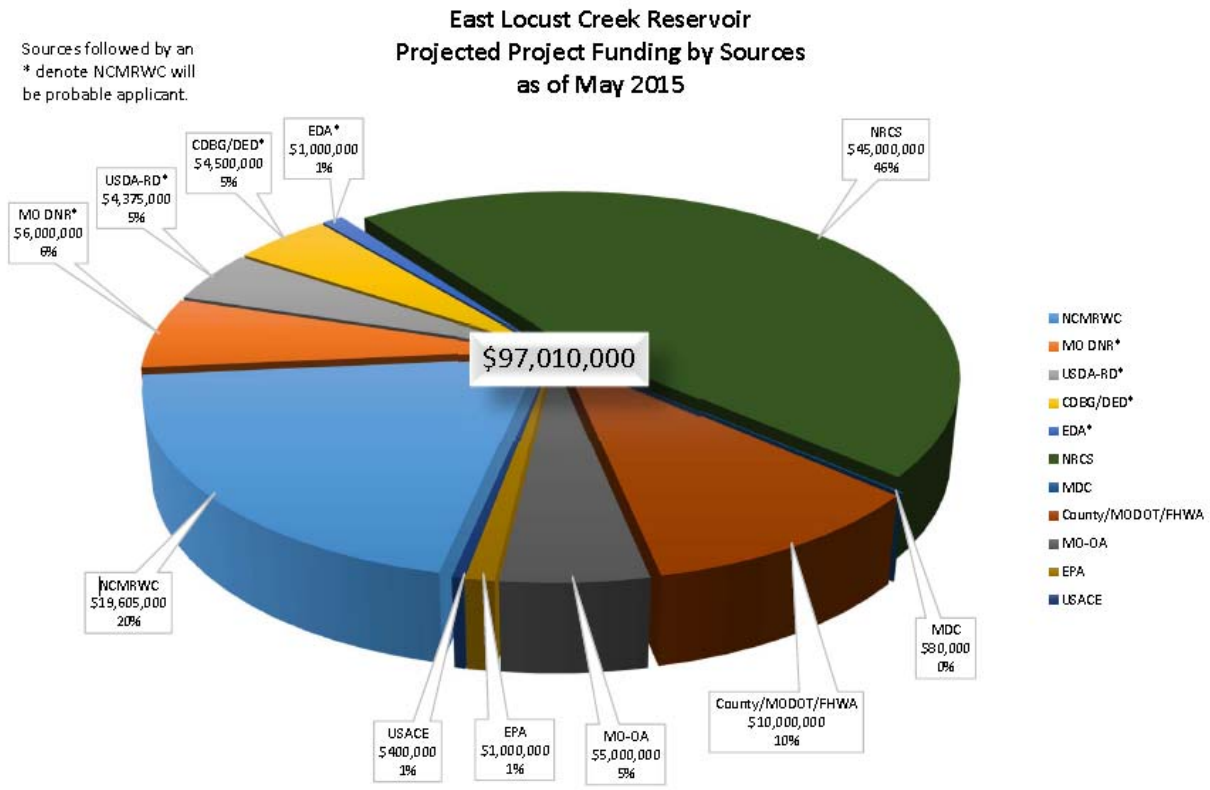
FUNDING SUMMARY*

EDA - Infrastructure	$1,000,000
EPA – Brownfields	$1,000,000
MDNR - SRF/State of Missouri Grant	$6,000,000
MOA – Land Acquisition	$5,000,000
MoDOT/FHWA – Roads	$10,000,000
USDA – RD Grant	$5,000,000
USDA – RD Loan (DAC criteria)	$25,000,000
USDA – NRCS	$45,000,000
Estimated of Probable Costs and Funding Targets	$98,000,000

**Supplemental Funding may come from an array of sources including MDNR, MDC, State, Federal, USDA, EDA, US Fish & Wildlife, MoDOT.*

**Priority to mitigate DAC status shall be a focus of loan/grant %*

**Some components of the costs and projected budgets may be funded locally.*



Sullivan County residents have approved a ½ cent sales tax on April 6, 2010, to fund the construction of the East Locust Creek Reservoir. Final user costs will be determined by actual grant and loan terms and conditions to be finalized at a later date by the funding agencies. A preliminary Master Finance Plan was created by Piper Jaffray & Co. in 2006 that details the proposed funding package source and use.

C. Water User Rates

The following illustrates the existing water user rates for customers of the following entities:

Sullivan County Public Water District #1

First 1,000 Gallons $ 20.50

Second 1,000 Gallons	$ 20.50
Third 1,000 Gallons	$ 10.70
Each Additional 1,000 Gallons	$ 10.70
Total for 5,000 Gallons	$ 73.10

City of Milan

First 1,000 Gallons	$ 18.49
Each Additional 1,000 Gallons	$ 8.24
Total for 5,000 Gallons	$ 51.45

City of Green Castle

First 1,000 Gallons	$ 19.63
Next 1,000 Gallons	$ 10.80
Next 1,000 Gallons	$ 10.84
Each Additional 1,000 Gallons Increases by	$ 10.48
Total for 5,000 Gallons	$ 62.23

City of Green City

First 1,000 Gallons	$ 21.57
Each Additional 1,000	$ 6.67
Total for 5,000 Gallons	$ 48.25

We recommend that a regional water rate study be completed to leverage and lower the regions long term rate to mitigate the DAC status.

D. Financial Assumptions

The above user rates are based on the assumption that this project is eligible for the Department of Economic Development – Community Development Block Grant program and that costs will

be shared with the United States Department of Agriculture – Natural Resources Conservation Service or the Missouri Department of Natural Resources. Also, the 1/2 cent sales tax was not included in this cost analysis, which would lower the typical user rate depending on the amount of revenue generated from sales tax. If the Commission does not receive funding from these grants or other cost sharing programs, a total of approximately $900,000 in additional loans would need to be secured or other grants obtained.

Funding for the construction, operation and maintenance of the proposed reservoir system will be generated from sales tax, license and usage fees in addition to the proposed water sales and user rates that will vary with the number of communities that choose to utilize the water source. Proposed funding for the project may be through USDA or through loans.

XVII. ENVIRONMENTAL REVIEW

The proposed project is to construct a reservoir in the East Locust Creek Watershed and to allow the North Central Missouri Regional Water Commission to store additional raw water, as well as, to provide a much needed water source to surrounding communities and other customers. Construction activities will include necessary site preparation, earthworks, and standard construction practices to construct the facilities. Following construction the disturbed areas will be finished graded, seeded, and mulched to limit erosion and storm water pollution. As part of the design, smaller flood water retention basins are planned and included in the cost estimate for the proposed option and could be utilized to assist in the stabilization of the larger multi-purpose reservoir. Mitigation will occur in compliance with necessary regulations to replace habitat that is disturbed or displaced by the construction of a reservoir.

In 2010, the Linn and Sullivan Counties Soil and Water Conservation Districts produced the Locust Creek Healthy Watershed Initiative document that details the existing conditions and current actions that are used to address water quality issues within the proposed project area. A copy of the report can be found in **Appendix X**. The current practices for improving water quality will be expanded and improved in the proposed project area as part of the proposed mitigation package that will accompany the project.

Short-term impacts include disturbing areas for construction, noise and dust from activities, erosion, and other common construction practices. Long-term detrimental impacts are not

expected with this project. In fact, any long-term impacts to the environment should be favorable with the creation of enhanced wildlife areas. Irreversible or irretrievable resources used in the project will include raw materials required to manufacture products utilized in construction, as well as, fuels required to power vehicles and tools. The environmental impacts of this proposed project will be reviewed by the following agencies:

1. Missouri Department of Natural Resources
    a. Public Drinking Water Program
    b. Water Pollution Control
    c. Division of Geology and Land Survey
    d. Division of Parks
    e. Historic Preservation
    f. Air Pollution Control Program
2. Missouri Department of Conservation
3. U.S. Fish and Wildlife
4. Missouri Office of Administration – A95 Clearinghouse
5. United States Army – Corps of Engineers
6. Missouri Department of Transportation
7. Others As Required

In the long term the proposed reservoir is intended to reap environmental benefits due to our need to 1) protect the quality of water entering the reservoir in order to keep treatment costs down and 2) build a reputation of the NCMRWC as an environmental steward to help facilitate the appropriate permitting discussions. To that end, the NCMRWC is in the process of implementing the following policies/activities. It is anticipated that this list will grow over time.

- Require and fund high quality fencing along the NCMRWC boundary with any property containing livestock.
- When the land acquisition blocks an agricultural water supply source, our preferred response is to provide a replacement pond with a gravity fed watering device, but require that the pond be fenced and that we receive access easements to verify that livestock be excluded from direct access.
- When the acquisition land locks a portion of a property on which it makes sense to build a forebay with a dam across which we can grant agricultural access, we negotiate the deal into our land acquisition. Our intent is to consider this on branches of the lake that drain at

least 100 acres, because by addressing all 20 branches with 100 acres drainage area, we could treat 72% of the area draining to the lake.

- Requested and received EPA assistance in evaluating potential pollutants on all properties prior to purchase. All property purchased has had at least a phase I environmental assessment and a phase II when necessary. All recognized environmental concerns and other significant observations are being tracked so that we can make sure we address them prior to inundation.
- All buildings are being inspected for asbestos and being removed for proper disposal under an assumption that they contain lead based paint.
- Begun planning to connect the Village of Pollock to the Milan sanitary sewer system.
- We have enacted Lake Authority Legislation (appendix Z) which gives the NCMRWC the authority to address water quality problems anywhere in the contributing watershed. This authority gives us something like zoning authority, but we plan to use this power to the minimum degree we can while still addressing significant water quality problems.

XVIII. PRELIMINARY PROJECT TIMELINE

The following is a projected timeline for the completion of construction and an estimated of the fully operational date the proposed facilities. The length of time for construction completion and reservoir filling will depend on weather conditions at that time.

Date: Description:

2006: Commission purchases the water treatment facilities from the City of Milan.

2009: Commission purchases the dam site and the projected primary borrow site.

2011: Preliminary Engineering and Planning for Mitigation, Land Acquisition, Relocations, and Preliminary Design Phases begin.

2012: Land Acquisition, Relocation, Engineering, Mitigation Solution and Utility Relocation Solutions Developed, Long Term Funding Options are Developed.

2013: Mitigation, Engineering, Long Term Funding Options are Reviewed and Secured.

2014: Engineering, Watershed Management.

2015: Engineering, Watershed Management.

2016: Construction, Engineering, Long Term Funding Reviewed

2017: Construction, Engineering

2018: Construction, Engineering, Water Supply Reservoir Filling and Discharge Management.

2019: Water Supply Reservoir Filling and Discharge Management.

First target year for Commercial operations for new water source for large customers.

2020: Model year for complete target year for operations and marketable supply to large customers.

XIX CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

1. The North Central Missouri Region to be served by the proposed reservoir meets the criteria of a disadvantaged community as established by MDNR-SRF criteria. (executive summary)
2. The region is extremely susceptible to drought and has suffered under an acute water shortage for decades due to a lack of suitable aquifers and rivers (Section IV A).
3. The lack of available water sources in the region is a significant factor leading to some of the highest water rates in the Missouri concomitant with extreme economic disadvantage.
4. This combination of low income and high water rates makes the North Central Region one of the most critical regions of the state for development of new water sources.
5. Groundwater is not a viable option due to poor yield and quality caused by glacial movements and geologic limitations.
6. There are no available existing free-flowing existing surface sources that can meet the demand
7. A proposed reservoir is the only viable option to meet the current and future demand for the region.
8. The North Central Missouri Regional Water Commission and the East Locust Creek Water Supply Reservoir are critical elements of the Missouri Department of Natural Resource's strategic water supply consolidation plan (executive summary).
9. Construction of the proposed reservoir will provide an economic "net-benefit" to the region and state provide a tremendous strategic resource in the state's water resource portfolio.
10. The proposed reservoir is well supported by the local community, with 82% of the voters supporting a ½ cent sales tax increase to fund a portion of the proposed reservoir (executive summary).
11. The proposed reservoir is projected to provide vast economic benefits (Table 1).
12. The pioneering Lake Authority legislation will provide the authority needed to improve water quality in the basin and protect valuable natural resources.
13. The proposed reservoir will beneficially impact distressed streams and wetlands in the region.
14. The streams most directly impacted are already impaired, distressed, and classified and the construction of the reservoir will beneficially impact these impaired streams.
15. This location is well situated to help alleviate the high drinking water prices for residents and businesses.
16. The impacts to the streams and wetlands will be mitigated.

17. The North Central Missouri Regional Water Commission should proceed towards the ultimate goal of 7.0 MGD average daily design flow demand using a phased distribution plan that accounts for the current water treatment capacity and the most likely early connections (Table 8).
18. The planning, design, and construction of the new reservoir should be integrated into the East Locust Creek Watershed improvement plan and MDNR – Our Missouri Waters initiative Lower Grand pilot project to maximize the benefits of the new reservoir to the regions ecosystem, and regional and state economy.
19. Final mitigation of impacts should be incorporated into the overall watershed based impact assessment.
20. MDNR, USDA-RD, State of Missouri, and USDA-NRCS should be a combined funding source for the project's main costs. The project will provide benefits to all of North Central Missouri and the burden should not be placed on the Sullivan County tax-payers beyond the level of the specific local benefits. This undue burden further explains why the area is disadvantaged, impoverished and has the highest water rates per MHI of any region in the state.

Water source improvements are necessary to promote a healthier and more sustainable environment for the residents of North Central Missouri. The need for an adequate water source is critical to allow the community to continue to grow and to ensure the health and welfare of the residents in future times of need. If no action is taken by the Commission, water shortage issues and drinking water source concerns will continue to arise in the event of a drought.

B. Recommendations

In our opinion, the following is a general project development plan we recommend the North Central Missouri Regional Water Commission should follow for the water source reservoir construction project:

1. The North Central Missouri Regional Water Commission should fully review the Preliminary Engineering Report and proceed with a supplemental environmental impact statement and final environmental permit.

2. Complete all land acquisition and relocations.

3. The Commission should evaluate all water source options, costs of operation and maintenance of the proposed facilities, and anticipated user rates for customers. The

recommended improvements for this project consist of a surface water storage reservoir in the East Locust Creek drainage area.

4. The Commission should continue to evaluate all potential options for the new water sources and meet with adjacent property owners and other interested parties.

5. The Commission should authorize the Engineer to submit a final draft copy of the Preliminary Engineering Report to the Missouri Department of Natural Resources and the United States Department of Agriculture for review.

6. The Commission should move forward with securing grant and loan funds for construction of the new facilities, as well as, continue to explore all avenues of additional sources for financing the project.

7. Once the funding package for the improvements is secure, the Commission should order the preparation of construction plans and documents.

8. The Commission should prepare for the necessary public participation meetings and hearings. The required public meetings include the following:

   A. Public Meeting – Facility Plan & Engineering Alternatives
   B. Public Hearing – Environment Impact
   C. Public Meeting – User Rates

9. The Commission should begin drafting a water use ordinance and water rate charge ordinance. User rates should be adjusted to match the final funding package.
10. Develop, create lake authority commission and complete operations and source water protection plan.