Water System Feasibility Study

prepared for

The North Central Missouri Regional Water Commission

2003
32598

Mission Statement

The Mission of the Commission is to provide an abundant source of low-cost, pure, quality water for the residents of North Central Missouri

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August 1, 2003

North Central Missouri Regional Water Commission
P.O. Box 266
Unionville, MO 63565
ATTN: Mr. Don Summers

WATER SYSTEM FEASIBILITY STUDY
BURNS & MCDONNELL PROJECT NO. 32598

Dear Mr. Summers:

Enclosed is the final draft of the *Water System Feasibility Study* which has been prepared for the North Central Missouri Regional Water Commission. We were assisted in the study by Rhodes Engineering Company of Brookfield, Missouri.

This report develops estimates of current and projected water use within the study area and evaluates source water alternatives that would allow the North Central Missouri Regional Water Commission to provide water to this area. The recommended alternative is to develop a reservoir on the East Fork Locust Creek just north and east of Milan.

We appreciate this opportunity to be of service to the North Central Missouri Regional Water Commission. We wish to express our appreciation for the assistance provided by you and the City of Milan, the City of Green City and Sullivan Public Water Supply District No. 1. The next phase of service is to develop a Master Plan for the recommended alternative.

Twenty-two copies of the feasibility study have been included for the Water Commission and three copies have been forwarded to the National Resources Conservation Service in Columbia, Missouri. Please feel free to contact any of the undersigned at 816-333-9400 with any questions.

Sincerely,

Donald J. Novak, P.E.
Project Engineer

Fred Pinkney, P.E.
Project Engineer

Dave Silverstein, P.E.
Project Engineer

Cc: NRCS
Rhodes Engineering Company

Enclosure

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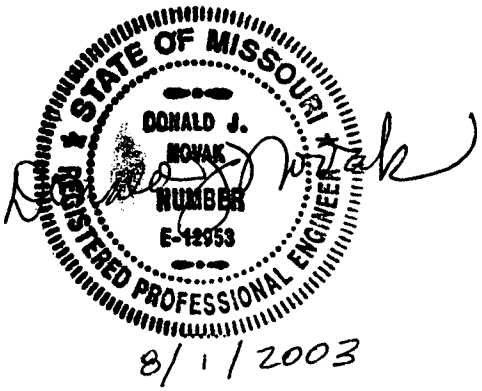
FEASIBILITY STUDY

Prepared For
NORTH CENTRAL MISSOURI REGIONAL WATER COMMISSION

INDEX AND CERTIFICATION

ENGINEERING CERTIFICATION



8/1/2003

Donald J. Novak, P.E.

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EXECUTIVE SUMMARY

A. INTRODUCTION

A regional water commission was formed in North Central Missouri to develop a reliable supply of water for the area. The water utilities of the cities of Milan and Green City and Public Water Supply District No. 1 of Sullivan County organized in 2002 as the "North Central Missouri Regional Water Commission", hereafter called the "Commission". They adopted the following Mission Statement:

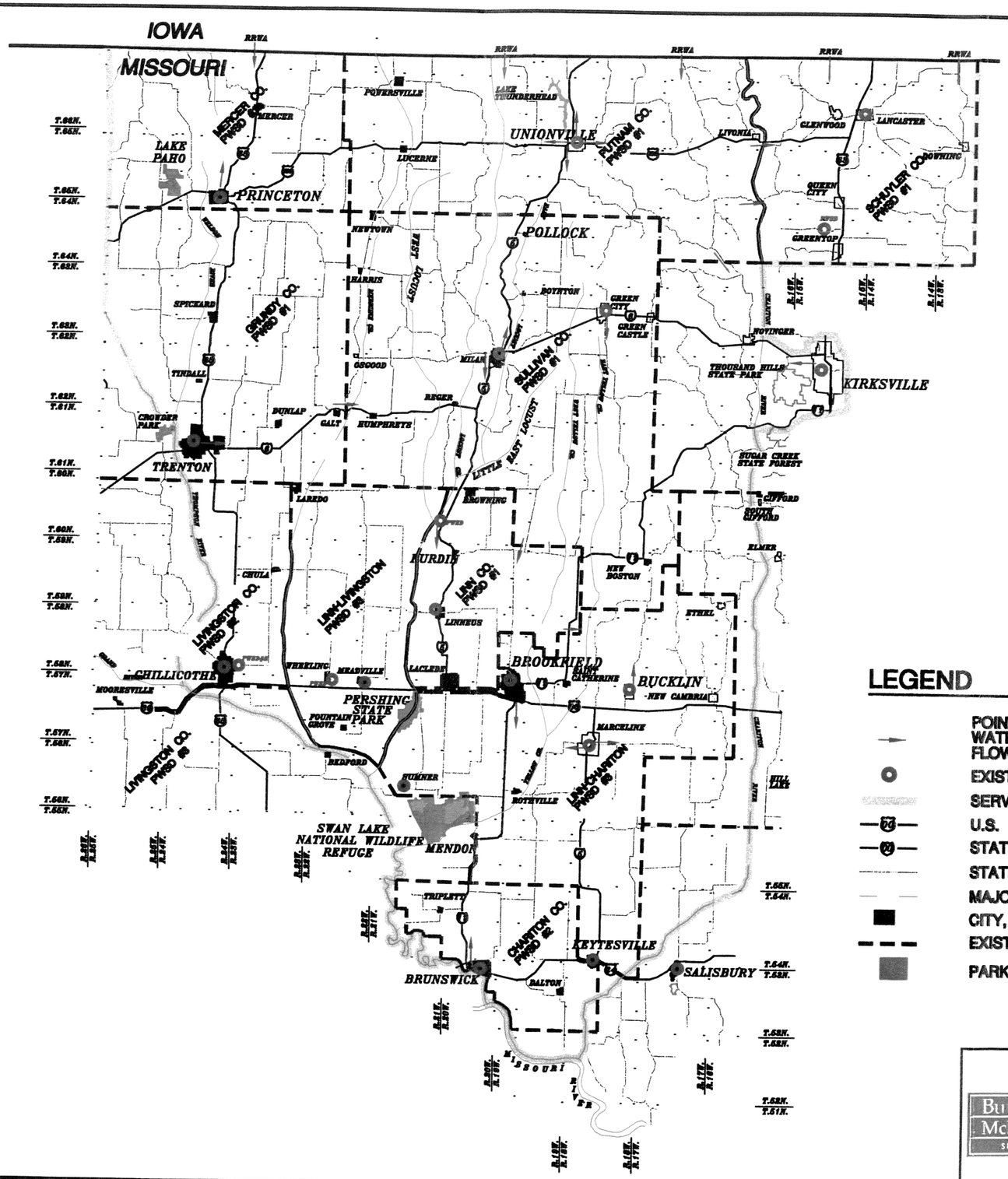
The Mission of the Commission
is to provide an abundant source
of low-cost, pure, quality water for the
residents of North Central Missouri.

The area proposed for service by the Commission is often referred to as the "Green Hills" Region of North Missouri. The purpose of this report is to present a Feasibility Study for a regional water supply source to serve the future needs of the Green Hills area. The study area is defined by the boundaries shown on Figure ES-1 and covers approximately 4900 square miles with 98,000 population.

The Green Hills area has been plagued by regular droughts in recent years. The area is currently under a "Category 3" drought as established by the Missouri Department of Natural Resources (MDNR). This level drought requires water conservation practices and is just one step below the emergency "Category 4".

B. WATER REQUIREMENTS

There are currently 35 municipal water utilities and all or portions of ten public water supply districts in the Green Hills area. Many of these water suppliers have a need for additional or supplemental water sources to reliably serve their customers. As an example, Green City has been ordered by MDNR to abandon their existing water plant; thus they became a charter member of the Commission.



LEGEND

- POINTS OF INTERCONNECTION BETWEEN WATER SUPPLIES, INDICATING FLOW DIRECTION
- EXISTING WATER TREATMENT PLANT
- SERVICE AREA BOUNDARY
- U.S. ROUTE
- STATE ROUTE (HIGH TRAFFIC)
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ES-1

NORTH CENTRAL MISSOURI REGIONAL WATER COMMISSION
GREEN HILLS STUDY AREA

Existing water usage in the Green Hills area is reported in the *Department of Natural Resources Census of Public Water Supply Systems 2001*. Prior census information was used to aid in projecting future water use. The MDNR Regional office also provided information and several communities were contacted, responding by letter. Public meetings were held monthly, and water use was discussed with the charter members of the Commission and the public.

Existing average usage in the Green Hills area is approximately 12,440,000 gallons daily. Individual private farm supplies exist that are not included in the MDNR statistics. With a service population of approximately 98,000 persons, the average water use is around 127 gallons per capita per day (not including private farm supplies).

In 2002, the three charter members of the Commission (Milan, Green City, and Sullivan PWSD No. 1) had the following water supply statistics:

- Population served of 7,600
- 2.92 MGD average daily demand
- 3.6 MGD maximum daily demand

A major water supply development should be designed for 50 years into the future. Projections of the water needs for the Green Hills region that could logically be served by the Commission by 2060 were made with the following results:

- Predicted population served of 21,000
- 5.75 MGD average daily demand
- 7.5 MGD maximum daily demand

The population served of 21,000 represents over 34% of the rural population (total population less larger cities) projected in the Green Hills area in the year 2060.

C. ALTERNATIVES EVALUATED

Several alternatives were evaluated for a source of water for the Commission. Evaluations where conducted in the following manner:

- Water Yield – Yield of all alternatives was evaluated first. Based on 50-year design, if an alternative could not provide 5.75 MGD on an average day and 7.5 MGD on a maximum day, that alternative was not considered further.

- Social Considerations – For each alternative that satisfied water yield, social and other considerations were evaluated. Although some water sources had adequate yield, development of that source would infringe upon other water suppliers and their future plans, thus eliminating these alternatives from a social standpoint.
- Cost-Effectiveness – Alternatives that did not have a fatal flaw from a yield and social standpoint were evaluated for cost-effectiveness. A present worth analysis was prepared that takes into account both capital cost and operation and maintenance expenses.
- Environmental Impacts – Alternatives that were too expensive on a present worth basis were eliminated from further consideration. The remaining alternatives were subjected to an environmental analysis, using a desktop survey and field reconnaissance.

Table ES-1 summarizes the alternatives considered and presents the matrix used to eliminate alternatives:

Table ES-1
Evaluation Matrix
Water Supply Alternatives
North Central Missouri Regional Water Commission

Raw Water Source Alternative		Adequate Yield	Social Acceptance	Present Worth *	Environmental Acceptance
No Action		No			
Groundwater	Glacial Aquifers	No			
	Bedrock Aquifers	No			
	Missouri River Alluvium	Yes	Yes	$1.88	**
	Aquifer Storage/Recovery	No			
Streams	Chariton River	Yes	No		
	Yellow Creek	No			
	Big Locust Creek	No			
	Medicine Creek	No			
	Thompson River	Yes	No		
	Missouri River	Yes	Yes	$1.92	**
Existing Suppliers	Rathbun Rural Water (Iowa)	Yes	Yes	$1.70	**
	Kirksville (Missouri)	No			
	Trenton (Missouri)	No			
	Chillicothe (Missouri)	No			
Reservoirs	East Fork Locust Creek	Yes	Yes	$1.19	Yes
	Big Locust Creek	Yes	Yes	$1.51	Yes
	Little East Fork Locust Creek	Yes	Yes	$1.49	Yes
	West Fork Locust Creek	Yes	Yes	$1.31	Yes
	Yellow Creek	Yes	Yes	$1.35	Yes
Reuse		Yes	No		
Conservation		No			

Notes on Matrix: * Average Annual Present Worth in millions of dollars over 50-year period

** Not cost effective, no environmental analysis

As is evident by the matrix in Table ES-1, water sources that are long distances from the point of use are not cost-effective. The most economical solutions are reservoirs near Milan, with the exception of Big Locust Creek, which is oversized for the water need.

The environmental analysis indicates that any of the reservoir sites can be accommodated on an environmental basis. No fatal flaws are evident.

D. SELECTED PLAN

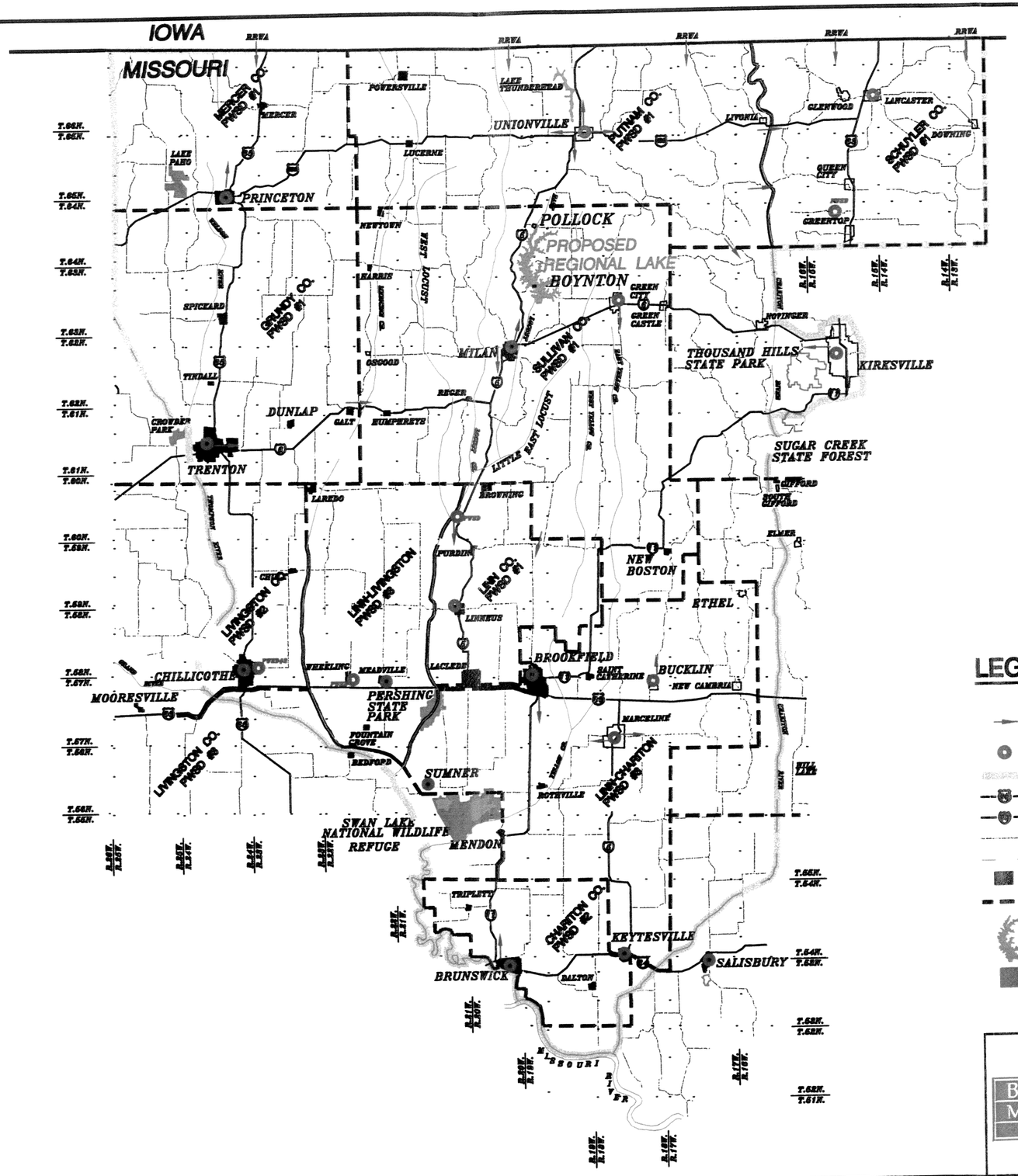
Since there is no fatal flaw from an environmental standpoint on any reservoir site, it is reasonable for the selected plan to also be the most cost-effective. Deleting the most expensive Big Locust Creek site, the chronological average annual present worth over 50-year period of the other four reservoirs is as follows:

- East Fork Locust Creek Reservoir ..... $ 1.19 million
- West Fork Locust Creek Reservoir ..... $ 1.31 million
- Yellow Creek Reservoir ..... $ 1.35 million
- Little East Fork Locust Creek Reservoir ..... $ 1.49 million

It should be noted that capital costs for the reservoirs fall in the same order. The average annual present worth should not be confused with actual construction costs of the projects. Present worth takes into account the cost of power and water treatment. Capital cost for this analysis are rough estimates determined only to compare alternatives, and are not representative of the actual opinion of cost for each project.

It is the recommendation of the Feasibility Study that a reservoir be developed by constructing a dam across the East Fork Locust Creek north and east of the City of Milan (See Figure ES-2). A Master Plan for the reservoir development should be initiated as soon as comments are received from government agencies contacted during this study. The Master Plan should include:

- Project design criteria
- Discussions with the Natural Resource Conservation Service (NRCS) regarding coordination with the local Watershed District
- Opinion of cost for the complete project
- Evaluation of purchase of the Milan Water Plant
- Development of cost of service and estimated Commission water rates



NOT TO SCALE

LEGEND

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ES-2

NORTH CENTRAL MISSOURI REGIONAL WATER COMMISSION
PROPOSED REGIONAL LAKE SITE
GREEN HILLS STUDY AREA

Part I

Introduction

PART I
INTRODUCTION

A. PURPOSE

This section of the report presents the purpose and scope of services for a Feasibility Study for a regional water supply source to serve the future needs of the study area. The study area is designated as the Green Hills Area of North Central Missouri.

B. SCOPE

Burns & McDonnell was authorized by the North Central Missouri Regional Water Commission, under Authorization No. 1 dated November 26th 2002, to provide this Feasibility Study. Upon completion of this feasibility study, a Water Supply Master Plan for the selected new water supply and associated infrastructure for the North Central Missouri Regional Water Commission will be developed.

As a part of this Feasibility Study, the Engineer is to perform tasks and provide information on:

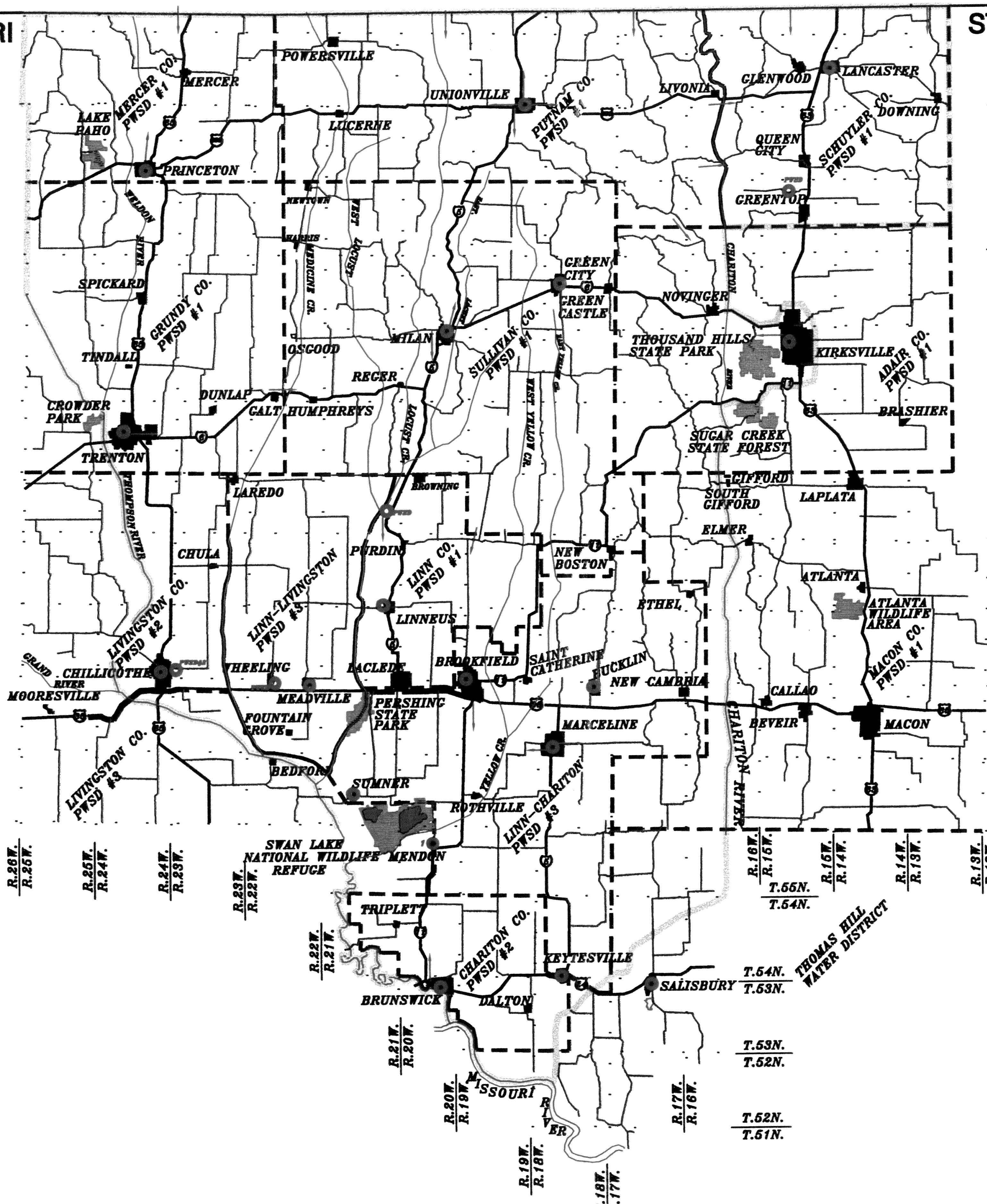
- History and Background of the Green Hills Study Area
- Public Water Supplies in the Study Area
- Population and Water Use Projections
- Evaluation of Alternatives to Provide a New Water Supply
- Recommendations

C. AREA DESCRIPTION

The area evaluated for water service by the North Central Regional Water Commission can generally be described as the area south of the Missouri/Iowa State Line bordered on the west by the Thompson river; on the east by the Chariton River; and extending south to the Missouri River. Dimensions of the study area are approximately 70 miles east-west and 85 miles north-south and encompass approximately 4900 square miles as shown in Figure I-1.

STATE OF IOWA

STATE OF MISSOURI



STATE OF IOWA

STATE OF MISSOURI

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NOT TO SCALE

LEGEND

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Figure I-1

NORTH CENTRAL MISSOURI REGIONAL WATER COMMISSION STUDY AREA BOUNDARIES

PART II

History and Background of the Green Hills Area

PART II

HISTORY AND BACKGROUND OF THE GREEN HILLS STUDY AREA

A. GENERAL

A cursory review of existing water sources in the study area is provided in this Part II of the Feasibility Study. The general history and development of the water supplies in the area is also summarized.

B. HISTORY AND BACKGROUND

1. Groundwater

Groundwater in much of the Green Hills region of North Missouri is found in small quantities. Many groundwater investigations have been performed in this area in an effort to find large quantities of usable groundwater with little positive results to date. Shallow wells have been constructed in the flood plain of some streams where alluvial deposits or glacial drifts produce small quantities of water. Construction of deep wells in the area has been determined to not be possible due to the low yield and the non-palatable groundwater they produce. The quality of groundwater from deep wells in the Green Hills Region is highly mineralized.

Some small communities in the study area use groundwater from shallow wells, which produce very hard water. With the exception of the City of Chillicothe and two Public Water Supply Districts, the shallow groundwater supplies in the Green Hills Region have individual well yields of less than 50 gallons per minute.

2. Surface Water

Due to the limited quantity and generally poor chemical quality of the groundwater in the Green Hills Region, surface water is the primary source of raw water. Surface water can be treated to meet current drinking water standards and most surface water treatment plants in the region are conventional coagulation – sedimentation – filtration systems.

Throughout the Green Hills Region there are many natural streams. However, most of these streams flow intermittently throughout the year. These intermittent streams have little or no flow during dry periods and a zero flow condition typically occurs on an annual basis; therefore diversion from these streams does not constitute a reliable water

source in this area. Only the larger rivers, the Missouri to the south, the Thompson to the west, and the Chariton to the east are reliable.

3. Raw Water Storage

The Green Hills Region cannot depend on large quantities of raw water from either wells or streams, so man-made surface water reservoirs are constructed to provide the quantity of water required. Clay soils exist throughout the Green Hills Region and are accessible for the construction of earthen dams. Earthen dams are typically constructed across intermittent streams that provide large quantities of surface runoff during rainfall events. The earthen structure creates a reservoir of water that is used for storage of raw water, which can be piped to a water treatment plant for processing prior to distribution.

Many rural systems and cities in the Green Hills Region rely upon man-made surface water reservoirs for a supply of raw water for their water treatment plants. Some of the older raw water supply reservoirs are too small to meet the present day public, industrial, commercial, and residential demands. In addition to not being large enough, the reservoirs often do not have sufficient catchment area to meet present day demands. During periods of drought, the raw water supply reservoirs in the Green Hills area are severely stressed. During the late 1980's and most recently in the period of 1999 through 2000, a drought plagued North Central Missouri. Numerous raw water supply reservoirs became depleted and water usage had to be restricted in the area. As of March 2003, much of the Green Hills region is experiencing an extreme drought, classified as "Category 3" by the Missouri Department of Natural Resources. Category 3 indicates that water conservation must be enacted and is only one step away from "emergency" status.

4. Public Water Supply Districts and Treatment Facilities

The development of public water supply districts in rural areas has increased the number of individuals depending on public drinking water supplies. Since the beginning of these water districts, the usage of water per individual has increased. Increased individual water usage has created a larger burden on the older existing raw water supplies.

The 1980's drought prompted a secondary interconnect in 1989 of Sullivan County Public Water Supply District #1 water mains to the City of Milan to replace some areas

served by Green City. The late 1980's drought also resulted in Schuyler County Consolidated Public Water Supply District interconnecting with Putnam County Public Water Supply District #1 for an additional water source. An improvement to raise the Elmwood Lake Dam was undertaken in 1991 to provide more raw water storage as this lake had proven to be inadequate for the City of Milan's water needs. The severe water supply shortage of 1999-2000 prompted a connection to the City of Trenton's water supply by Sullivan County PWSD #1.

With the development of new drinking water quality standards, treatment of raw water has become more complex. Public awareness and intricate laboratory equipment have allowed larger numbers of pollutants to be monitored to lower levels of concentrations. With the Safe Drinking Water Act, larger burdens have been placed on water treatment plants. Figure I-1 notes the location of existing water treatment facilities in the study area. A plant at Mendon has recently been taken out of service.

Routine water plant operation and maintenance costs have increased considerably. Keeping qualified water plant operators on staff has also become more costly as training requirements increase. The salaries and working conditions for the operators must be kept competitive for quality drinking water to be maintained by qualified employees at each water treatment facility.

Since the cost for maintaining a quality drinking water supply for the public has become more costly, larger regional water supplies are becoming more predominant. Larger water supplies tend to be more efficient and the finished water is typically of higher quality than the finished water produced at smaller water treatment plants. Larger or regional water treatment facilities require fewer operators than several small water treatment facilities. With financial resources pooled for one large facility, a high quality finished water is more easily maintained.

Recent industrial expansion to the Green Hills Region has also created the need for larger water supplies. Since good quality groundwater is not available in much of the region, potable water is somewhat of a limiting factor for the location and establishment of some types of industrial facilities. Most industries in the region are agriculturally-oriented, such as meat processing facilities.

Water impoundments can also provide recreation and a basis for economic development. Portions of the Green Hills Region have historically had a high unemployment rate. Income created by a new water supply from potential industrial, commercial, residential, and tourism growth could reduce the current unemployment rates. A new, reliable water supply could become a vital contributor to the Green Hills Region in many ways.

PART III

Public Water Supplies in the Study Area

PART III
PUBLIC WATER SUPPLIES IN THE STUDY AREA

A. INTRODUCTION

This section of the report describes the existing water supplies and treatment facilities in the Green Hills study area. The descriptions are divided into the service areas of the ten Public Water Supply Districts that comprise the study area. Cities that are located in the service area of the Public Water Supply Districts, but that have their own water supply and treatment facilities, are also described.

Current average daily water usage for the areas encompassed by each Public Water Supply District boundary is provided in tabular form. Water usage is as reported in the *Department of Natural Resources Census of Public Water Supply Systems 2001.*

B. SULLIVAN COUNTY PUBLIC WATER SUPPLY DISTRICT NO. 1

The primary source of raw water for Sullivan County PWSD No.1 is three water supply impoundments: Elmwood Lake, Milan City Lake, and Green City Reservoir. Sullivan PWSD No. 1 has the opportunity, by pipeline, to buy treated water from the Trenton Water Treatment Plant. The Thompson River west of Trenton is the source of this water.

1. Water Treatment Facilities

Water treatment facilities that serve Sullivan Public Water Supply District No. 1 are owned by the cities of Milan and Green City. The water treatment plants utilize a conventional surface water coagulation - clarification - filtration treatment process to meet quality standards.

A new water treatment facility was recently constructed at Milan designed to process 2.88 MGD. This facility serves the City of Milan's customers and also provides processed water to Sullivan PWSD No 1. Raw water for this treatment plant is obtained from Elmwood Lake and Milan City Lake, which are both located near the City of Milan.

Located near Milan are Premium Standard Farms and the existing Con Agra Industrial Complexes. Premium Standard Farms utilizes their own water treatment plant capable of producing 1.73 MG. Currently Premium Standard Farms is operating with a single shift.

The Premium Standards Farms water plant was designed to provide an emergency backup water supply to the City of Milan. Their water treatment plant also obtains raw water from Elmwood Lake, as does the City of Milan.

Con Agra closed their Milan food processing facility in 2002. It is anticipated the existing complex will be purchased and returned to operation by another owner. When in operation, Con Agra had a comparable daily average water demand to that of Premium Standard Farms. It is also anticipated once the plant returns to operation, the new industry will both slaughter and process at the facility.

Green City's water treatment plant was built in 1977 and is capable of processing water at the rate of 0.432 MGD. Raw water for this facility is obtained from the Green City Reservoir. This water treatment plant currently serves Green City, Green Castle and wholesales processed water to Sullivan PWSD No. 1. During the drought periods of the late 1980's, 1999 and 2002-03, the Green City Reservoir water levels became dangerously low. Plans are currently underway to retire Green City's plant and connect to Sullivan PWSD No. 1 in order to meet water quality regulations.

2. Distribution

Sullivan County PWSD No. 1 receives processed water from the City of Milan, the City of Green City, and has an emergency connection to the City of Trenton. From these supplies, the District serves customers along rural water mains located throughout Sullivan county. The Rural Water District also provides water service to the communities of Boynton, Browning, Humphreys, Harris, Newton, Osgood, Reger, Pollock, Winigan, and New Boston.

3. Water Demands

Approximate average daily usage for the area encompassed by Sullivan County PWSD No. 1 are noted in Table III-1.

TABLE III-1

AVERAGE DAILY WATER USAGE FOR SULLIVAN COUNTY PWSD NO. 1 AND ENVIRONS

Description/Location	Average Usage (MGD)
Milan	0.350
Green City	0.130
Green Castle	0.033
Sullivan County PWSD No. 1*	0.328
Browning	0.030
Humphreys	0.007
Newtown	0.016
Premium Standard Farms	0.725
Con Agra	0.725
Total	**2.344**

*Includes small communities not listed

C. LINN-LIVINGSTON PUBLIC WATER SUPPLY DISTRICT NO. 3

Water supply for Linn-Livingston Public Water Supply District No. 3 is obtained from two wells located near the City of Wheeling. A large glacial drift serves as the aquifer for this raw water supply. Adjacent to the well field, the District operates an iron removal/lime softening plant. This plant has the capacity to produce 0.432 MGD of treated water.

Linn-Livingston PWSD No. 3 provides potable water to rural customers, and also supplies the communities of Laredo, Wheeling and Linneus.

1. Distribution System

Water storage and system pressure is maintained through the use of two standpipes owned by the District. One standpipe is located near Eversonville and the other standpipe is located south of the Community of Haseville. Water storage is also provided by an elevated tank owned by the City of Laredo and an elevated tank located in Wheeling. The total available elevated finished water storage located within the entire system is 330,000 gallons.

2. **Water Demands**

Approximate average daily usage for the area encompassed by Linn-Livingston PWSD No. 1 is as follows in Table III-2.

TABLE III-2

AVERAGE DAILY WATER USAGE FOR LINN-LIVINGSTON PWSD NO. 3 AND ENVIRONS

Description/Location	Average Usage (MGD)
Linn-Livingston PWSD No. 3	0.096
City of Laredo	0.018
City of Wheeling	0.020
City of Linneus	0.028
Total	**0.162**

D. CHARITON-LINN PUBLIC WATER SUPPLY DISTRICT NO. 3

Finished water for Chariton-Linn Public Water Supply District No. 3 is obtained from water supplies at the City of Brookfield, the City of Marceline and the City of Bucklin. These cities all utilize a surface water clarification - treatment process to provide finished water.

The City of Brookfield has two basic raw water supply sources. Brookfield City Lake is located approximately one mile east of the Brookfield City limits. The second source includes three ground storage reservoirs located just east of Brookfield. The supply for these three reservoirs is maintained by pumping water from Yellow Creek during periods of sufficient stream flow.

The City of Marceline has two lakes that supply raw water to the city water treatment plant. The old city reservoir is located approximately one mile northeast of the city limits and the primary raw water supply reservoir is located approximately three miles southwest of Marceline. An auxiliary raw water supply can be obtained from a nearby intermittent stream, Mussel Fork Creek, during higher stream flows.

1. **Water Treatment Facilities**

The water treatment plant at Brookfield is capable of processing water at the rate of 2.16 MGD. Marceline's water treatment plant processes water at the rate of 1.347 MGD. Bucklin's water treatment capable of processing water at the rate of 0.36 MGD.

2. **Distribution**

Chariton-Linn PWSD NO. 3 provides potable water to rural customers and to the cities of Ethel, New Cambria, Mendon, and Rothville. The District distributes 400,000 gallons of water per day throughout its distribution system. Approximately 180,000 gallons per day are purchased from each of the cities of Brookfield and Marceline, while the remaining 40,000 gallons per day are purchased from Bucklin. In addition, the District also has the flexibility to provide an emergency water supply to the cities of Keytesville and Sumner.

Water storage and pressure throughout the distribution system is maintained by the following storage structures described in Table III-3.

TABLE III-3

CHARITON-LINN PWSD NO. 3 STORAGE STRUCTURES

Number/Description	Storage Volume (MG)
(2) Elevated tanks at Brookfield	1.250
(1) Finished water storage at Marceline	0.490
(1) Standpipe at New Cambria	0.064
(1) Standpipe north of Bucklin	0.042
(1) Standpipe near St. Catherine	0.023
(1) Standpipe southwest of Ethel	0.042
(1) Standpipe southeast of Rothville	0.042
(1) Standpipe located at Ethel	0.050
(1) Standpipe located at Lake Nehai	0.042
(1) Standpipe northwest of Marceline	0.042
Total	**2.087**

3. Water Demands

Approximate average daily usage for the area within the boundary of Chariton-Linn PWSD No. 3 are noted in Table III-4

TABLE III-4

AVERAGE DAILY WATER USAGE FOR CHARITON-LINN PWSD NO. 3 AND ENVIRONS

Description/Location	Average Usage (MGD)
Chariton-Linn PWSD No. 3	0.400
Rural Distribution System	(0.346)*
Ethel	(0.009)*
New Cambria	(0.021)*
Rothville	(0.006)*
Mendon	(0.018)*
Brookfield	0.542
Marceline	0.220
Bucklin	0.039
Total	**1.201**

*Figures in parentheses not included in total to prevent duplication

E. LINN COUNTY CONSOLIDATED PUBLIC WATER SUPPLY DISTRICT NO. 1

The primary raw water supply for Linn County Consolidated Public Water Supply District No. 1 is obtained from four shallow wells located between Browning and Purdin in the Locust Creek Valley.

Located adjacent to the well sites is a 200 gpm lime softening plant constructed in 1998. The four wells and water treatment plant are owned and operated by the District and provide all of the water distributed throughout the Consolidated Water Supply District.

The Water District provides an average of 73,000 gallons of water per day to customers within the distribution system. An emergency connection, located at the community of Shelby, enables Sullivan County PWSD No. 1 to provide water on a limited basis to Linn Consolidated PWSD No. 1 if needed.

Approximate average daily usage for the Linn Consolidated PWSD No. 1 area is as follows in Table III-5.

TABLE III-5

AVERAGE DAILY WATER USAGE FOR LINN COUNTY CONSOLIDATED PWSD NO. 1 AND ENVIRONS

Description/Location	Average Usage (MGD)
Linn County No. 1*	0.073
Laclede	0.031
Linneus	0.028
Total	**0.132**

*Purdin receives their water from Linn County No. 1

F. PUTNAM COUNTY PUBLIC WATER SUPPLY DISTRICT NO. 1

One source of water supply for Putnam County Public Water Supply District No. 1 is from the City of Unionville. Unionville utilizes a 750,000 GPD surface water clarification plant, which treats reservoir water from two different locations near Unionville. The two sources of raw water include Lake Thunderhead and the Unionville City Reservoir. The City Reservoir serves as the main raw water supply source while Lake Thunderhead serves as an auxiliary supply source during extended dry periods. On an average daily basis, Unionville supplies 135,000 gallons of water to Putnam County PWSD No. 1.

The second source of finished water is the Rathbun Regional Water Association, a private, not-for-profit water association headquartered in Iowa. Two transmission mains, which extend from Iowa, can supply Putnam County PWSD No. 1 with up to 244,000 GPD of finished water.

Putnam County PWSD No. 1 currently delivers an average of 285,000 GPD to customers within the Water District boundaries. The District also wholesales water to Adair County PWSD No.1 and Schuyler County PWSD No. 1. Approximate average daily water usage for the area within this District is as follows in Table III-6.

TABLE III-6

AVERAGE DAILY WATER USAGE FOR PUTNAM COUNTY PWSD NO. 1 AND ENVIRONS

Description/Location	Average Usage (MGD)
Purchased from Unionville by Putnam No. 1	0.135
Purchased from Rathbun Regional Water Association by Putnam No. 1	0.150
Wholesale to Adair County PWSD No. 1 by Putnam No. 1	(0.039)
Wholesale to Schuyler County PWSD No. 1 by Putnam No. 1	(0.100)
Unionville	0.225
Total	**0.510**

*Figures in parentheses not included in total to prevent duplication

G. MERCER COUNTY PUBLIC WATER SUPPLY DISTRICT NO. 1

Mercer County PWSD No. 1 is generally divided into two service areas; east and west. The average consumption of Mercer County Public Water Supply District No. 1 – East is approximately 136,000 GPD. The District purchases water from the Rathbun Regional Water Association, which obtains raw water from Lake Rathbun located near Centerville, Iowa. Elevated storage includes a reservoir with a capacity of 90,000 gallons for finished water.

Mercer County PWSD No. 1 – West obtains finished water from the City of Princeton. The west portion of the Water Supply District has an average daily consumption of 67,000 gallons per day. Princeton obtains raw water from eight wells and has a plant capacity rated at 518,000 GPD. The average daily usage for the City of Princeton is 123,000 GPD.

Approximate average daily usage for the Mercer County PWSD No. 1 area is as follows in Table III-7.

TABLE III-7

AVERAGE DAILY WATER USAGE FOR MERCER COUNTY PWSD NO. 1 AND ENVIRONS

Description/Location	Average Usage (MGD)
Mercer PWSD No.1	0.203
Princeton	0.123
Mercer	0.024
Total	**0.350**

H. GRUNDY COUNTY PUBLIC WATER SUPPLY DISTRICT NO. 1

Grundy County Public Water Supply District No. 1 includes the rural areas from just south of Princeton to south of Trenton and extends to the east to include Galt. The District can be divided into basically three sections of Dunlap, Edinburg, and Spickard. All three sections of the District purchase and distribute water processed by the City of Trenton.

1. Water Treatment Facilities

Raw water for the Trenton water treatment plant is obtained from the Thompson River, which is located west of Trenton. During high stream flows, the raw water is pumped from the river into two storage reservoirs. The raw water supply is dependent upon the stream flow and storage capacity of the raw water storage reservoirs. Average daily production for the plant is approximately 1.95 MGD and the City of Trenton has 2.393 MG of finished water storage.

2. Distribution

Water storage and pressure throughout the distribution system is maintained by the following storage structures show in Table III-8.

TABLE III-8

GRUNDY PWSD NO. 1 STORAGE STRUCTURES

Number/Description	Storage Volume (MG)
Dunlap	0.070
Edinburg	0.064
Spickard	0.070
Trenton	2.393
Total	**2.597**

3. Water Usage

Approximate average daily usage in the Grundy County PWSD No. 1 area are as follows in Table III-9.

TABLE III-9

AVERAGE DAILY WATER USAGE FOR GRUNDY PWSD NO. 1 AND ENVIRONS

Description/Location	Average Usage (MGD)
Dunlap Section	0.087
Edinburg Section	0.144
Spickard Section	0.071
Trenton	1.950
Total	**2.252**

I. ADAIR COUNTY PUBLIC WATER SUPPLY DISTRICT NO. 1

Adair Public Water Supply District No. 1 encompasses the rural areas around the City of Kirksville. The District's boundaries generally extend from the City of Greentop on the north, to the City of La Plata on the south and are bordered by a north-south line on the west near the City of Green Castle and a north-south line to the east of the City of Brashear. The District purchases potable water from the City of Kirksville and has an average daily water consumption of around 550,000 gallons per day. Adair County PWSD No. 1 has 430,000 gallons of finished water storage.

1. Water Treatment Facilities

Raw water for the City of Kirksville water treatment plant is obtained from two man-made surface water supply reservoirs that are supplied from surface runoff. The average daily production at the water treatment plant is approximately 2.59 MGD and Kirksville has the capacity to store 3.9 MG of finished water.

2. Water Demands

Approximate average daily water usage for the Adair County areas are as follows in Table III-10.

TABLE III-10

AVERAGE DAILY WATER USAGE FOR ADAIR COUNTY PWSD NO. 1 AND ENVIRONS

Description/Location	Average Usage (MGD)
Adair County No. 1	0.550
Kirksville	2.590
Novinger	0.030
Brashear	0.019
Total	**3.189**

J. MACON COUNTY PUBLIC WATER SUPPLY DISTRICT NO. 1

Macon County Public Water Supply District No. 1 obtains processed water from the City of Macon. The District has an average daily usage of 700,000 GPD. The City of Macon obtains raw water from the Macon City Lake and has an auxiliary raw water intake located at Long Branch Lake.

Approximate average daily usage in the Macon County PWSD No. 1 area are as follows in Table III-11.

TABLE III-11

AVERAGE DAILY WATER USAGE FOR MACON COUNTY PWSD NO. 1 AND ENVIRONS

Description/Location	Average Usage (MGD)
Macon County No. 1	0.700
La Plata	0.120
Elmer	0.007
Atlanta	0.020
Callao	0.024
Bevier	0.056
Total	**0.927**

K. LIVINGSTON COUNTY PUBLIC WATER SUPPLY DISTRICT NO. 2

Livingston County Public Water Supply District No. 2 contains two sections – the North Section and the Lowes Acres Section. Both of the sections obtain finished water from both the City of Chillicothe and the District-owned water treatment plant. Included within the District boundaries are customers located near the City of Chillicothe and south along the Grand River, which includes the Village of Bedford. The District-owned water treatment

plant is located east of Chillicothe and just north of Highway 36. Raw water for this plant is obtained from two glacial drift wells that are located near the plant. The north section has an average daily consumption of 120,000 gallons and the Lowes Acres Section has an average daily consumption of 80,000 gallons.

Approximate average daily water usage for the area in and around Livingston PWSD No. 2 are as follows in Table III-12.

TABLE III-12

AVERAGE DAILY WATER USAGE FOR LIVINGSTON COUNTY PWSD NO. 2 AND ENVIRONS

Description/Location	Average Usage (MGD)
Livingston County No. 2	0.200
Chillicothe	1.164
Chula	0.012
Total	**1.376**

L. SUMMARY

The study area defined in Figure I-1 had an approximate population of 98,000 in 2001. The 2002 average daily water demand is 12.4 MGD based on the total for all public water supplies in each district area as defined in this Part. For the area as a whole, the average use represents 127 gallons per capita per day. The totals do not include any individual domestic farm wells.

TABLE III-13

SUMMARY OF AVERAGE DAILY WATER DEMANDS IN THE STUDY AREA

Description/Location	Average Usage (MGD)
Sullivan County PWSD No. 1 and Environs	2.344
Linn-Livingston PWSD No. 3 and Environs	0.162
Chariton-Linn PWSD No. 3 and Environs	1.201
Linn County PWSD No. 1 and Environs	0.132
Putnam County PWSD No. 1, Unionville and Environs	0.510
Mercer County PWSD No. 1 and Environs	0.350
Grundy County PWSD No. 1 and Environs	2.252
Adair County PWSD No. 1 and Environs	3.189
Macon County PWSD No. 1 and Environs	0.927
Livingston County PWSD No. 2 and Environs	1.376
Total	**12.443**

PART IV

Population and Water Use Projections

PART IV
POPULATION AND WATER USE PROJECTIONS

A. INTRODUCTION

Historical and current population data along with historical and current water demand information are available from governmental agencies. Currently no agency provides projections of population or water use, so this information had to be developed for this study.

Population and water use were based on information obtained from the State of Missouri. Population data was obtained from the Official Census Manuals from the State of Missouri and water use data was obtained from the Missouri Department of Natural Resources Census of Missouri Public Water Systems - 2001 and from interviews with Cities and Public Water Supply Districts.

The study area population is generally in decline due to factors such as transportation, water supply, and jobs. However, some growth is expected in certain areas. These areas usually contain water systems with adequate supplies and areas with recent improvements to the transportation systems, such as the four-lane improvements to Highway 36, which passes through the south portion of the area. These improvements and systems where taken into consideration to calculate population projections in these areas. See Table A-1 in Appendix A for population projection data.

Current water supply demand and population data were used to calculate a per capita water usage. This data, along with projected population data, was used to project future water usage demand for cities and rural systems. See Table A-1 in Appendix A for water usage projections.

B. POPULATION SERVED AND WATER USE PROJECTIONS

The base year for total population served and water use projections is 2001. Major water supply development projects should be designed to serve for 50-years because they are difficult to expand and there are significant economies of scale. By contrast, a facility that can be easily expanded, such as a water treatment plant, can be designed for 10 to 20 years, depending somewhat on the means of financing. The new water supply for the study area is

assumed to be completed and in operation by 2010. Thus, all projections for a major water supply are based on fifty years, which gives a design year of 2060.

Population growth has been determined from current census data and is included in the projections for all city and rural water systems. Current water use has been determined for city and rural water systems from the water use data. Included in all systems is an annual growth of one-half gallon per person per day with the exception of the current North Central Missouri Regional Water Commission. For Commission members, an annual growth of one gallon per person per day was projected. This is because the charter governmental entities represented by the North Central Missouri Regional Water Commission will be the first to receive a new water supply, which should spur industrial growth. Having a reliable supply of water available should lead to higher per capita water use for the current Commission members.

The base year for the projections and water use include all current Commission members and water system users including:

- Sullivan County Public Water Supply District No. 1
- City of Milan
- City of Green City
- City of Green Castle
- Premium Standard Farms
- Existing ConAgra Industrial Complex

1. 2010 Estimate

Currently, Premium Standard Farms is operating with a single shift. The Plant Manager has indicated Premium Standard Farms would like to operate two shifts, but this would almost double its current water use. Premium Standard Farms is also currently facing a raw water shortage, as is Milan with which it shares Elmwood Lake. The current drought has caused Premium Standard Farms to search for an alternative source of water to operate under current single-shift production conditions. Premium Standard Farms has drilled test wells in the Milan area, but to date the highest well yield discovered is only 5 gpm. This yield is not adequate to supplement their water supply. In 2010, it is projected Premium Standard Farms will be operating under two shifts, which is a direct result of

having adequate water available. This increase in production requires doubling existing water supply for the industry. This additional demand is included in the North Central Missouri Regional Water Commission projections.

Con Agra has closed its existing complex in Milan in 2002. By 2010, or sooner, it is anticipated the existing ConAgra Industrial Complex will be purchased and returned to operation. This is due to the growing number of food processing industries that are moving to and investing in rural areas of the country. Food processing industries need to be located near the source of raw materials. Meat cannot be economically shipped to other nations and urban areas are not prone to accept food processing facilities. It is projected that the new industry will not only process as before, but will slaughter animals at the complex. This change in the process will require a doubling in the amount of water the previous Con Agra facility was using on a daily basis.

2. 2020 Estimate

Starting in 2020, the water demand for Chariton-Linn Public Water Supply District No. 3 is added to the projection. Chariton-Linn No. 3 currently purchases water from other sources, principally on the basis of lowest cost and hydraulics. It is anticipated the water from this project will allow Chariton-Linn No. 3 to purchase water from the North Central Missouri Regional Water Commission for a lower cost than they are being charged currently. The extra water supplied to Chariton-Linn No. 3 will also help increase water pressure in the system and add extra supply to the northeast region of the district, which is currently deficient.

Chariton Public Water Supply District No. 2 purchases water from both Chariton-Linn No. 3 and from the City of Brunswick. Currently Chariton No. 2 is having problems with the hardness of water from Brunswick and the cost of water from Chariton-Linn No. 3. It is projected that due to cost and quality of water offered to Chariton-Linn No. 3, they will now be able to provide more water to Chariton No. 2. Starting in 2020, half of the daily demand from Chariton No. 2 is added to the water demands.

Due to the renovation of Highway 36 from two lanes to four lanes, current water suppliers will struggle to serve growing demands due to increased usage along the Highway 36 corridor. Starting in 2020, one-half of the water demands for Livingston

Public Water Supply District No. 2, Linn-Livingston Public Water Supply District No. 3 and Linn Public Water Supply District No. 1 are added to the projection. This generally represents their service areas north of Highway 36. Water is assumed to supplement these water supply districts to provide for the increasing water demands anticipated in the future.

The City of Laclede does not operate a water treatment plant and currently purchases water from the City of Brookfield. Laclede is looking for a new source of water. It is projected, due to the cost and amount of water available, Laclede will receive their water from the North Central Missouri Regional Water Commission by 2020.

3. 2030 and 2050 Estimates

Starting in 2030, water is supplemented to the cities of Brookfield, Meadville, Bucklin and Unionville. Meadville relies on groundwater to meet its raw water needs. Many groundwater systems in north Missouri are being depleted and wells are producing less yield. Currently water supplies are strong, but could be overstressed in 30 to 50 years due to overpumping of the groundwater systems, just as they have been in the past 50 years in northwest Missouri.

The City of Bucklin only operates their water treatment plant four hours per day and is looking for ways to stop operating the plant. Currently Bucklin has an outstanding Federal Loan on the water treatment plant that must be paid before operation can cease at the plant. It is projected in 2030 the loan will be paid in full and the City of Bucklin will receive water from the North Central Missouri Water Commission. Water in general will be supplied to the Brookfield and Unionville municipalities to help ease the increasing water demand in the area and due to the cost and time associated with locating and securing additional raw water supplies.

C. CONCLUSIONS

Listed in Table IV-1 are the projections for population served and the water supply demand for the Green Hills study area. Figures IV-1, IV-2 and IV-3 are included and represent a graphical interpretation of this data.

It has been estimated in 2060, the average daily water demand provided by the Commission will be 5.74 million gallons per day and the maximum day water demand for the entities served will reach 7.5 million gallons per day. These values for average and maximum day are the basis for selection of various alternatives for a future raw water supply in this feasibility study.

It has been estimated that the total population within the Green Hills potential service area, excluding large cities that will continue using their own systems, is approximately 60,900 in the year 2060. It is projected the North Central Missouri Regional Water Commission will serve nearly 21,000 or over 34% of the population in the Green Hills Region in the year 2060.

TABLE IV-1

PROJECTED AVERAGE DAY AND MAXIMUM DAY WATER DEMAND

Year	Population Served	Average Day Water Demand (MGD)	Maximum Day Water Demand (MGD)
2002[1]	7601	2.92	3.59
2010[2]	13420	4.06	5.08
2020[3]	16163	4.45	5.59
2030[4]	20651	5.11	6.62
2040	20755	5.27	6.82
2050	20860	5.57	7.31
2060	20965	5.74	7.53

1. Existing members of the North Central Missouri Regional Water Commission
2. Increased water demand from Premium Standard Farms
3. Addition of supplemental water for Livingston No. 2, Linn-Livingston No. 3, Linn Public No. 1 and the City of Laclede. Addition of Linn-Chariton No. 3, and Chariton No. 2
4. Addition of supplemental water for the cities of Brookfield, Meadville, Bucklin and Unionville

Figure IV-1
Projected Population Served by the North Central Missouri Regional Water Commission

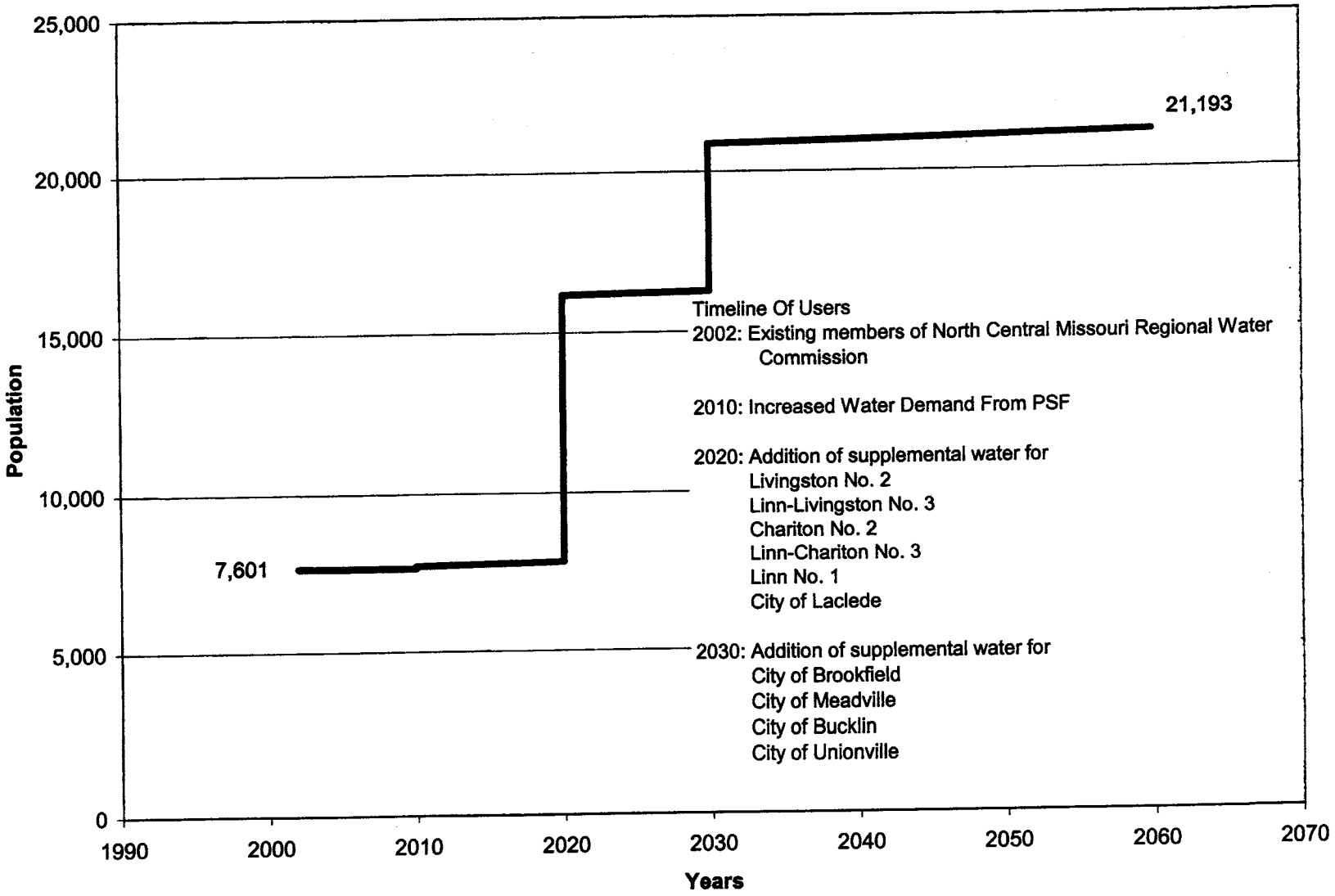


Figure IV-2
Projected Average Daily Water Use for the Service Area

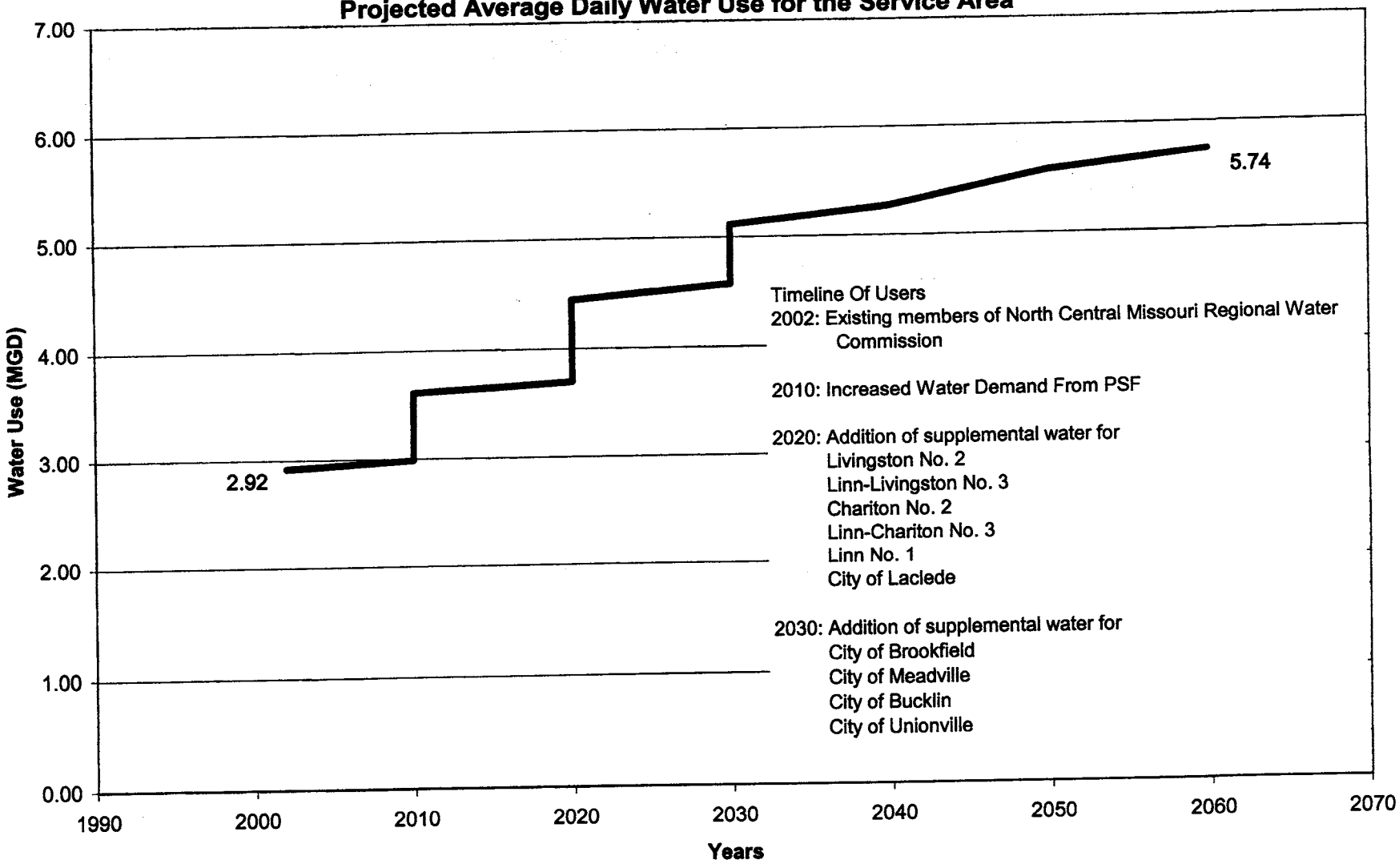
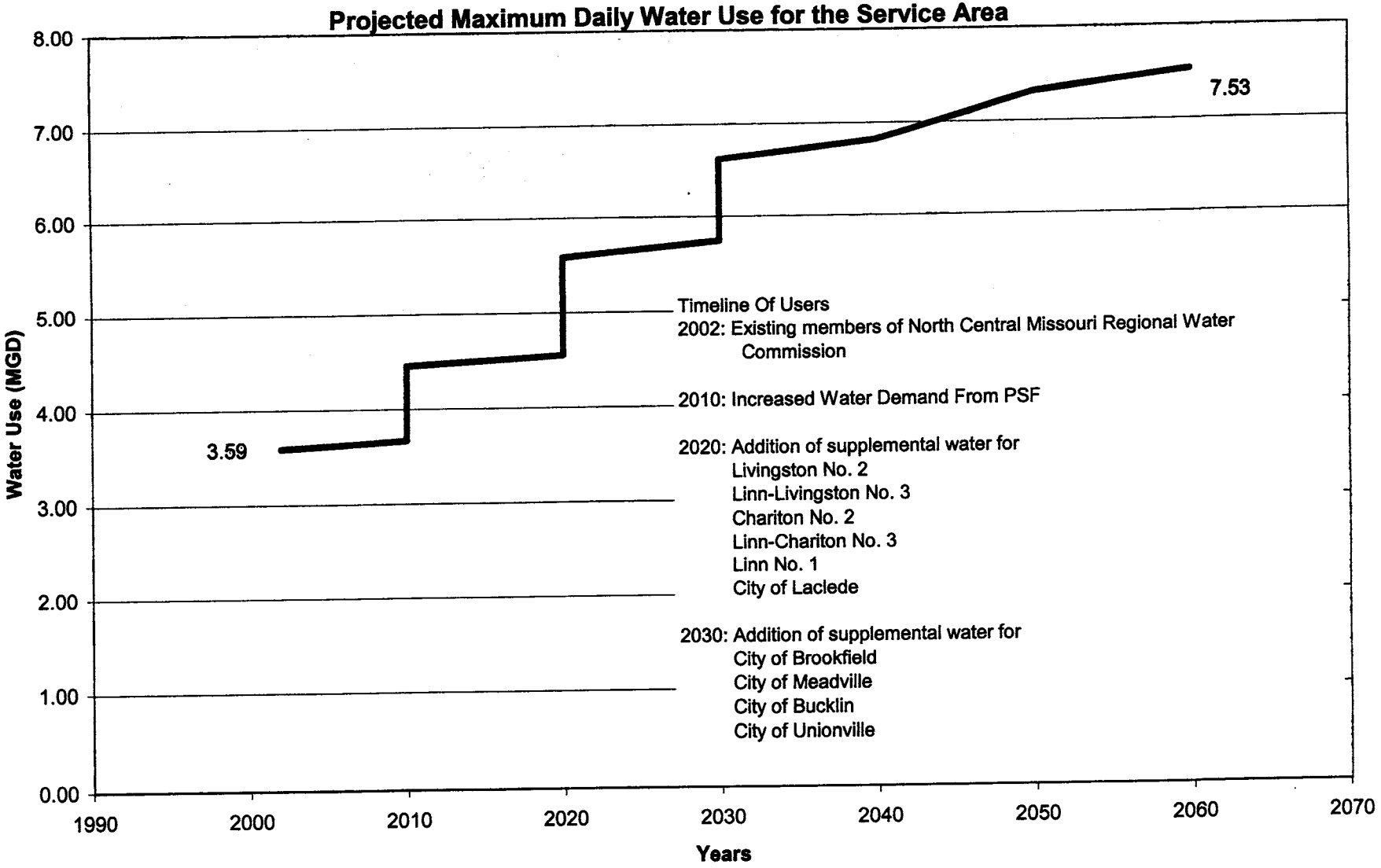


Figure IV-3
Projected Maximum Daily Water Use for the Service Area



Part V

Alternatives

PART V
ALTERNATIVES

A. INTRODUCTION

Several alternatives were evaluated for a source of water for the North Central Missouri Regional Water Commission (Commission). These alternatives were evaluated based on each of the following parameters:

- **Water Yield:** Yield of all alternatives was evaluated first. Based on 50-year design, if an alternative could not provide 5.75 MGD on an average day and 7.5 MGD on a maximum day, that alternative was not considered further.
- **Social Considerations:** For each alternative that satisfied water yield, social and other considerations were evaluated. Although some water sources had adequate yield, development of that source would infringe upon other water suppliers and their future plans, thus eliminating these alternatives from a social standpoint.
- **Cost-Effectiveness:** Alternatives that did not have a fatal flaw from a yield and social standpoint were evaluated for cost-effectiveness. A present worth analysis was prepared that takes into account both capital cost and operation and maintenance expenses.
- **Environmental Impacts:** Alternatives that were too expensive on a present worth basis were eliminated from further consideration. The remaining alternatives were subjected to an environmental analysis, using a desktop survey and field reconnaissance.

When a major deficiency or fatal flaw occurs for any alternative related to any of the above parameters, the alternative is not considered viable, and is removed from consideration. For example, if an alternative will reliably yield only 1.0 MGD, it is obviously not a viable alternative and is removed from further consideration.

B. ALTERNATIVES

Following is a list of water supply alternatives for the Green Hills area considered in this Feasibility Study.

- **No Action**
- **Groundwater**
  - ✓ Glacial Aquifers
  - ✓ Bedrock Aquifers
  - ✓ Stream Alluvium (Missouri River)

OTHER THAN THE NO ACTION
A DESCRIPTION OF ... 20 OTHER
ALTERNATIVES WERE EVALUATED
BY THE BURNS & MCD
FEASIBILITY STUDY

- Aquifer Storage and Recovery (ASR)

- **Streams**
  - Chariton River
  - Yellow Creek
  - Locust Creek
  - Medicine Creek
  - Thompson River
  - Missouri River
- **Existing Suppliers**
  - Rathbun (Iowa) Water Association
  - City of Kirksville, Missouri
  - City of Trenton, Missouri
  - City of Chillicothe, Missouri
- **Reservoirs (Streams and Nearest City):**
  - East Fork Locust Creek Site (Boynton)
  - Big Locust Creek Site (Milan)
  - Little East Locust Creek Site (Browning)
  - West Fork Locust Creek Site (Milan)
  - Yellow Creek Site (Winigan)
- **Reuse**
- **Conservation**

C. NO ACTION

The "no-action" alternative defines what would occur if a water supply alternative was not developed by the North Central Missouri Regional Water Commission.

If a supplemental or new source of water supply were not developed, the existing utilities in the area would not be able to meet their projected water needs. Several major impacts would occur if these water supply needs are not met.

Public water supply districts, cities, towns, and industries would be forced to develop additional water sources on an individual basis. Each water utility would need to expand or construct new water supplies and treatment facilities to meet their increasing water needs and

more stringent water quality requirements for public and industrial demand. The overall result would be that many water utilities would do nothing, as non-regional solutions would be cost prohibitive. Economic development would continue to decline in the area with resultant loss of jobs and income.

Well construction is generally not as expensive as other alternatives. The use of groundwater in the Green Hills Region would continue and expand if the water utilities are unable to satisfy the area's increasing water demands with other sources. Groundwater use within the region needs to be controlled to ease the stress on the regional groundwater aquifers now supplying several public water suppliers. Water rights are not required in Missouri.

Water shortfalls during drought situations would continue. State Category 3 and 4 droughts would necessitate significant conservation or forced emergency water supply development or rationing. Decisions would have to be made during Drought Category 4 regarding what water use would be curtailed or cut off. The choices would be irrigation, livestock, industries, or domestic use.

The "no action" alternative is not a viable alternative for this region.

D. GROUNDWATER

Sullivan County is located in the eastern part of the Northwest Missouri Groundwater Province (Miller and Vandike 1997). Groundwater resources in much of Northwest and North Central Missouri are poor.

1. Glacial Aquifers

Significant amounts of groundwater are sometimes available from glacial deposits scattered over the Green Hills area. Depending on the thickness, extent, texture, and surface water recharge, yields up to 500 gpm are potentially possible; however, average yield of wells drilled is probably around 5 gpm. In pre-glacial valleys, filled with drift or outwash sands from glacial actions, yield will be the highest; probably ranging from 100 to 500 gpm. The Missouri Geological Survey has estimated that less than 8 percent of northwestern Missouri has glacial outwash thick enough to provide yields of over 100 gpm. About 25 percent of the area has glacial deposits sufficient to provide 20 to 25 gpm of water. The geology in these areas is complex and typically many test holes are

required to define the extent of the aquifer and estimate the potential yield. Water quality is reported to have total dissolved solids (TDS) values ranging from 400 to over 1,500 mg/L.

The cities of Chillicothe, Princeton, and Livingston PWSD #2 rely on glacially formed or alluvial aquifers alone, and their supplies are nearly fully developed. In order to be a good neighbor, the North Central Missouri Regional Water Commission has decided not to infringe on the aquifers in these areas. At an average yield of 25 gpm per well, the Commission's projected water use of 7.5 MGD would require over 200 wells and pumps. The potential for shallow glacial and alluvial groundwater development for a regional supply is not present in the area.

NO

2. Bedrock Aquifers

The carbonate aquifers of southern Missouri are present in the area; however, they are at great depth and the water is highly mineralized with TDS values ranging from 2,000 to over 30,000 mg/L. The upper bedrock formations contain some usable water. Quantities are low, in the range of domestic well yields and water quality is marginal, at best. The potential for deep rock wells is not a viable alternative for a regional water supply in the Green Hills area.

NO

3. Missouri River Alluvium

The Missouri River is located at the south edge of the study area. Wells can be developed in the alluvium of the Missouri River that yield 1000 to 3000 gallons per minute. A well field consisting of several Missouri River valley alluvial wells could be developed that would produce the 7.5 MGD (5,210 gpm) required for the 50-year maximum day. Missouri River valley wells are highly mineralized, and require water treatment systems to reduce iron, manganese, and perhaps hardness. Nonetheless, well yields are adequate and treatment systems are readily available so that the Missouri River alluvium is a potential source of groundwater that should be further considered.

YES

4. Aquifer Storage and Recovery

Aquifer storage and recovery (ASR) is becoming a popular alternative in water short areas. When declining groundwater levels are a problem; ASR is a potential solution. However, the most productive wells of the Green Hills area are relatively shallow.

Although groundwater levels may be dropping slightly, it is not as drastic as some of the deeper aquifers in the Western USA, where ASR is practiced. In North Central Missouri, ASR would normally provide only 20 to 30 feet of aquifer recovery, compared to 200 to 300 feet in areas where ASR is used. The problem in North Central Missouri is generally with well yields and not with major declines in the water table, although water level declines can occur. Any surface water used as a source of recharge would require a conventional treatment system to clean the water before introduction into the ground. Little additional water supply could be developed, and at very high costs. Because ASR is not practiced in Missouri, there would be a significant amount of first-time permitting development with the state. It is concluded that ASR is not a viable alternative to increase groundwater yields to the levels required to serve the study area.

E. STREAMS

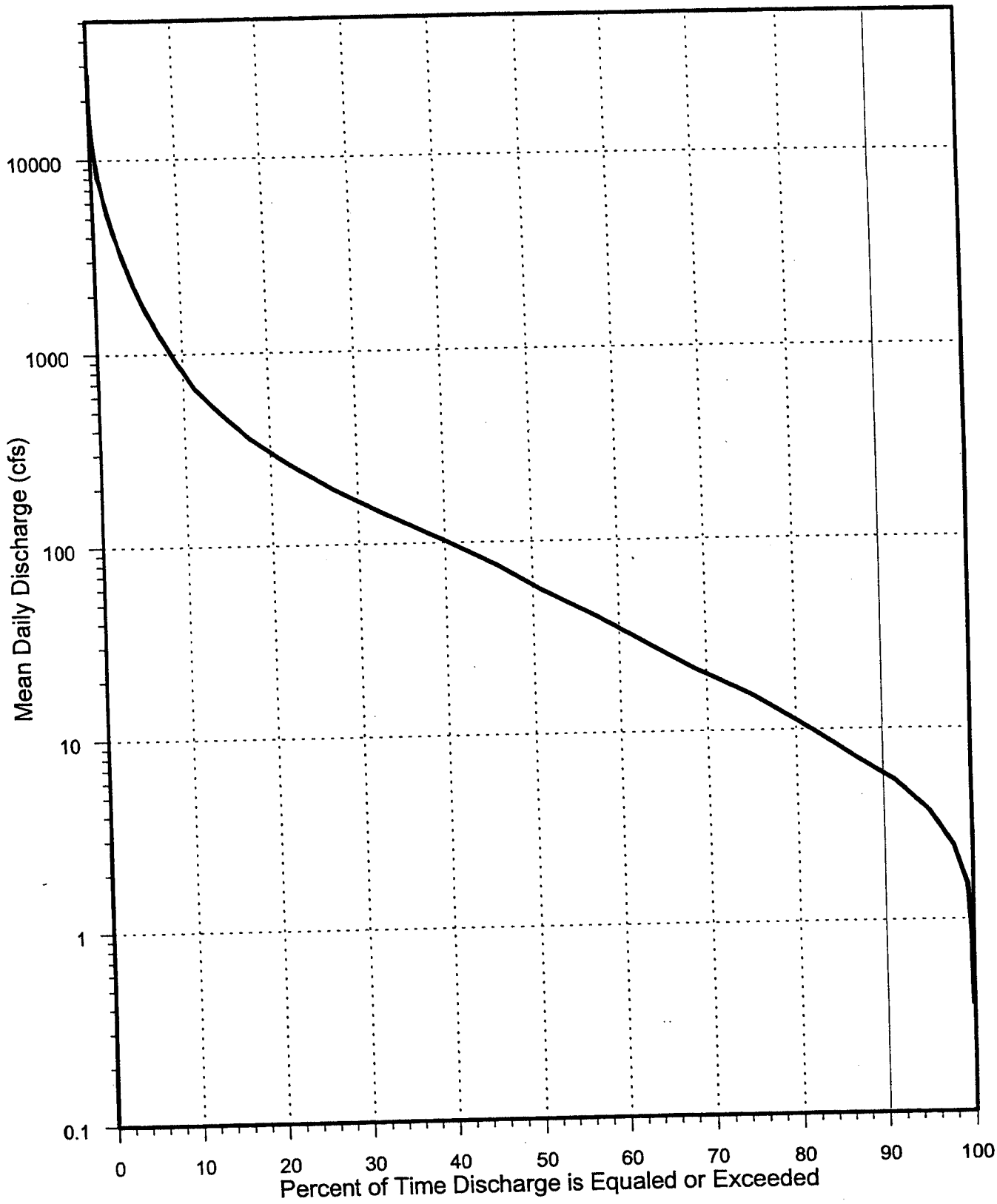
Within the study area there are several streams and rivers that were evaluated as a source of raw water for direct use without storage. These sources include: Chariton River, Yellow Creek, Locust Creek, Medicine Creek, Thompson River, and Missouri River.

1. Locust, Yellow, and Medicine Creeks

There is a stream gauging station at Linneus on Locust Creek. Yellow Creek and Medicine Creek have smaller contributory watersheds than Locust Creek. Streamflow records indicate that minimum flows in Locust Creek at Linneus often approach zero during dry periods. Figure V-1 is the flow duration curve at this site, which drains 550 square miles. The records are for a period from April 1, 1929 to September 30, 1972 at USGS Station 06901500. Using a log-Pearson Type III analysis, low flows for Locust Creek at this gauging station are as follows:

- 2-year, 1-day average low flow = 3.6 cfs (cubic feet per second)
- 2-year, 7-day average low flow = 4.1 cfs
- 5-year, 1-day average low flow = 1.5 cfs
- 5-year, 7-day average low flow = 1.7 cfs
- 10-year, 1-day average low flow = 0.9 cfs
- 10-year, 7-day average low flow = 1.0 cfs

To remove water directly from a flowing stream with an intake requires that the stream flow always exceed design capacity. In this instance, the maximum daily design flow



Notes:

1. Derived from discharge records at USGS Station 06901500.
2. Period of Record: 4/1/1929 - 9/30/1972.
3. Drainage area: 550 square miles.

Burns & McDonnell
SINCE 1898

Figure V-1

FLOW DURATIONS
LOCUST CREEK
NEAR LINNEUS, MO

must be met, particularly during dry times. This would be 7.5 MGD, or 11.6 cubic feet per second. As evidenced by the low flow statistics above, Locust Creek does not have adequate yield to provide a reliable water supply, as all low flow conditions are well below 11.6 cfs. Since Yellow and Medicine Creeks have smaller contributory watersheds and similar climate and land use characteristics, their low flow conditions would be less than Locust Creek.

2. Thompson River

The Chariton, Thompson, and Missouri Rivers are the only dependable supplies of surface water in the area that do not have a tendency to reach zero flow conditions during extended dry periods. Currently, the City of Trenton obtains its raw water from the Thompson River. According to the MDNR, the river has adequate yield to serve Trenton's plant capacity. However, any increase beyond plant capacity would require a reservoir to store raw water. Placing an intake in the Thompson above Trenton would place Trenton's water supply in jeopardy during low flows. An intake below Trenton on the Thompson would not have enough yield to serve the Commission after Trenton withdraws water for their use. Thus, the Thompson is not considered as a source for the Committee because of yield and social effects toward Trenton's historical development of a water supply.

3. Chariton River

Upstream from the study area in Iowa, a Corps of Engineers reservoir named Rathbun is located on the Chariton River. There is enough contributory drainage area between the Rathbun dam and the study area to provide adequate yield to serve design flows. However, the Chariton River can also be used by the City of Kirksville to expand their water supply, if necessary. As with the City of Trenton/Thompson River, it is more socially and politically acceptable for any excess capacity in the Chariton River to be reserved for the City of Kirksville, the largest city in the study area. For this reason, the Chariton will not be considered a viable alternative for a water source

4. **Missouri River**

The Missouri River is used as a water supply for many water utilities along its bank. In the state of Missouri alone, it serves major metropolitan areas with either surface water (Kansas City) or ground water (Columbia). Without analysis of any published data, it is obvious that the Missouri would not be adversely affected if an intake were constructed to remove the design flows to serve the Commission from this surface source.

On the basis of stream flow characteristics, the Chariton, Thompson, and Missouri Rivers all have acceptable yields to serve the Commission's projected water demands. However, because of social ramifications in regard to the Commission's neighbors at Trenton and Kirksville, the Thompson and Chariton are not considered viable alternative water sources.

5. **Summary**

Only the Missouri River surface supply will be evaluated further regarding cost and present worth analyses. The costs will be very similar regarding capital costs and pumping between Missouri River groundwater and surface water. It is anticipated that the surface water treatment plant would be slightly more expensive to construct, but perhaps less expensive to operate than a groundwater treatment plant, if softening is provided.

F. EXISTING SUPPLIERS

1. **Rathbun Regional Water Association (Iowa)**

Rathbun Regional Water Association (RRWA) provides water to nearly 16,000 customers, including rural families, industries, and communities. In addition to the water treatment plant and the intake facility on the south bank of the Chariton River, the system includes 30 elevated storage tanks, 33 pumping stations and nearly 6,500 miles of pipeline. The RRWA treatment plant can process as much as 8.8 million gallons of water per day and average production at the plant during 2001 was 4.37 million gallons per day.

Interviews were conducted on February 26, 2003 at the Rathbun Water Treatment Plant with Rathbun representatives. They were questioned about their system's ability to provide water to North Central Missouri. There are currently five crossings of the Iowa-Missouri state line to serve water users in the northern tier of counties in Missouri. None

of the pipelines crossing the state line are large enough to serve the study area design flows. Rathbun representatives stated they currently have 2 MGD of excess water and are planning to sell this water to new customers within the State of Iowa. A new lake, pipeline and treatment facility expansion would have to be constructed for Rathbun to provide an additional 7.5 MGD daily maximum demand at their current facility. Representatives indicated that they are considering a second lake, if water sales merit the addition.

RRWA was formed several years ago to provide water to a large area of southeast Iowa that had a need similar to North Central Missouri. They have expanded over the years to serve the area crossing the state line into Missouri to serve the northern edge of the study area for this feasibility study. The RRWA is a potential water supplier for the Commission. This alternative will be carried through to the cost evaluation phase.

2. Kirksville

The City of Kirksville's raw water is drawn from Forest Lake and Hazel Creek Lake. The raw water is pumped approximately 6 to 7 miles to the plant and stored in a raw water pond with a storage capacity of about two days. There are three treatment filters at the Kirksville plant and a forth filter will be completed in the future. Each filter can process about 1.5 million gallons of water per day. In addition to the water treatment facility, the City of Kirksville can store around four million gallons of water in its above ground tank and the city's four water towers. Kirksville does not currently have adequate excess water capacity to take on the Commission's anticipated demands and will not be evaluated further.

3. Trenton

The City of Trenton's raw water is drawn from the Thompson River. The raw water is pumped from the Thompson River to a storage reservoir, which is then pumped to the water treatment plant. The treatment plant has the capacity to produce 4.5 million gallons of water per day. In addition to the water treatment facility the City of Trenton can also store 1.7 million gallons of finished water in the distribution system. Trenton also possesses a finished water line connected to Sullivan Public Water Supply District No.1 to provide water in the event of a shortage in the Northeast region of the study area.

Trenton does not currently have adequate water production and source water to serve the Commission's anticipated demands and will not be evaluated further.

4. Chillicothe

The City of Chillicothe's raw water is pumped from four alluvial wells. The water treatment plant has the capability of providing 6 million gallons of water per day. The water treatment facility of the City of Chillicothe furnishes finished water for their own system plus Livingston PWSD No. 2. Chillicothe is currently searching for additional groundwater supply in the Grand River Valley to meet their existing demands. Chillicothe does not have adequate water supply to add the demands of the Commission. Because of lack of supply, Chillicothe will not be evaluated further as an alternative water supply.

ND

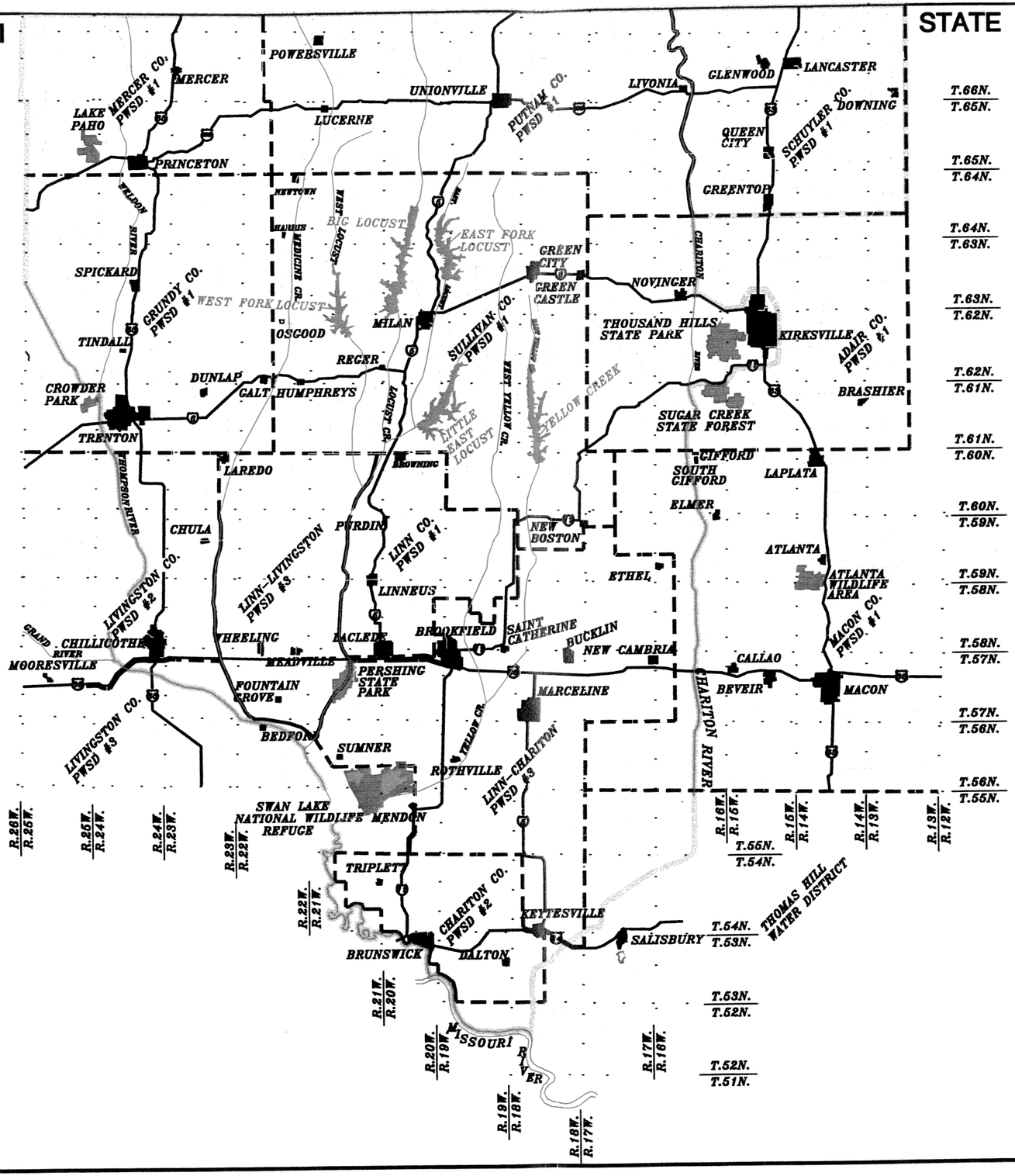
G. RESERVOIRS

Five reservoir locations have been taken into consideration for a new raw water supply in North Central Missouri. The approximate location of each of the proposed reservoir locations are show on Figure V-2. To assess each of the reservoirs, design criteria had to be determined for screening purposes and general assumptions were developed to support these criteria on the basis of hydrologic analyses. A cursory hydrologic analysis of the site referred to as the "East Locust Creek Site" was conducted and described in a letter report by Burns & McDonnell dated March 13, 2002. (See Appendix) Because all reservoir alternatives are in the same general area, it is assumed that all would have similar climate, land use, and hydrologic characteristics. It is concluded that a reservoir must have a drainage area of at least 20 square miles or greater to supply the design average day flow of 5.75 MGD. The reservoirs described in the following articles all meet this contributory drainage criterion.

1. East Fork Locust Creek Site

The East Fork Locust Creek site north and east of Milan has been evaluated for a water supply in prior studies (Rhodes, 1995). Three dam sites were considered, and one site was selected as the best regarding hydrologic balance of the watershed and other considerations. The chosen dam site is located 1.25 miles south of Boynton. This facility would inundate Boynton, which currently includes several residences. The reservoir will flood Route N and one county gravel road south of Boynton. The total storage and permanent pool depth is dependent on the final height of the dam.

STATE OF IOWA
STATE OF MISSOURI



STATE OF IOWA
STATE OF MISSOURI

NOT TO SCALE

LEGEND

- U.S. ROUTE
- STATE ROUTE (HIGH TRAFFIC)
- STATE ROUTE (LOW TRAFFIC)
- MAJOR DRAINAGE FEATURES
- CITY, TOWN, OR VILLIAGE
- EXISTING WATER DISTRICT BOUNDARIES
- SERVICE ARE BOUNDARIES
- PROPOSED REGIONAL SITE LOCATION
- PARK

RHODES ENGINEERING CO., INC.
CONSULTING ENGINEERS
401 WEST HELM
BROOKFIELD, MISSOURI 64628

Figure V-2

NORTH CENTRAL MISSOURI
REGIONAL WATER COMMISSION
PROPOSED REGIONAL LAKE
SITE LOCATIONS

Two options were evaluated in previous studies of this site to produce a pool with a permanent height of 900 or 920 feet. It is estimated that a water supply reservoir at these elevations will provide 3.8 or 8.25 million gallons per day, respectively. (See Appendix) An intermediate pool elevation of approximately 910 feet is anticipated to be adequate to provide the required capacity. The drainage area of the reservoir is approximately 32 square miles. The approximate length of dam is 0.42 miles. Borings were conducted in the vicinity of the dam centerline. Soils were found to be suitable for earthen dam construction. The valley contains some sands and gravels in the alluvium of East Locust Creek that will necessitate a cut off trench as a component of the dam. It is anticipated that similar soils would be found at all alternative reservoir sites. The reservoir volume is about 56,000 acre-feet with a surface area of 2,340 acres at elevation 920 U.S.G.S.

The dam site is only a couple miles north of the recently constructed Milan water treatment plant. This plant is envisioned as being the first water production facility for the Commission. This reservoir site has the advantage of being able to transmit water to the Milan Water Treatment Plant site by gravity flow, without pumping.

2. Big Locust Creek Site

This proposed reservoir site would be developed by creating an impoundment structure on Big Locust Creek, approximately 2.5 miles west of Milan. The normal pool depth would be approximately 50 feet deep with a water surface elevation of approximately 850 feet. The earthen dam would cross Locust Creek in an east-west direction and would be approximately 0.75 miles long. At normal pool, the reservoir would create a water supply of approximately 106,000 acre-feet and contain a water surface area of approximately 5,850 acres.

The drainage area for the reservoir extends into the State of Iowa. There is approximately 222 square miles of drainage area for this proposed dam site, or over 10 times more contributory watershed than necessary. This reservoir site would be the shallowest and widest, and water level would remain relatively stable, being undersized for the watershed. Currently, much of the Big Locust Creek bottom is row cropland. Some of the flatter land out of the Big Locust Creek flood plain is also currently farmed. Since large portions of the land required for this reservoir is considered prime farmland,

land purchase price would be higher than the other alternatives. The use of pesticides and herbicides on agricultural land within a water supply watershed is also a concern in regard to water quality at this site.

Two existing State maintained blacktop roads, Route OO and Route BB, would be flooded with the construction of this reservoir. Portions of five county gravel roads would also be inundated with the impounded water.

3. Little East Locust Creek

The proposed reservoir site would be developed by a dam across Little East Locust Creek, which would be located two miles north, and one mile east of Browning. The dam would be approximately 0.70 miles in length with a permanent pool depth of 70 feet. The elevation of the normal pool would be 820 feet. This structure would create an impoundment with 3,650-acres of surface area at the permanent pool and a volume of approximately 64,000 acre-feet of water. The drainage area of the reservoir is approximately 39 square miles.

Most of the drainage area for this lake site is in pasture, which is good from a water quality aspect. Very little pesticides or herbicides should be present in the runoff water from pasture and timberland.

Initial observations indicate the construction of this reservoir site would not inundate a single permanent residence and limited other infrastructure. Impounded water would cross over five county gravel roads and State Route UU in one spot. The location the water would cross over Route UU would be near where State maintenance ends and the township maintenance begins.

If this potential lake site were constructed, at least one section of a petroleum pipeline would have to be relocated from the bottom of the reservoir. The pipeline is currently located approximately two miles north and two miles east of Browning.

4. **West Fork Locust Creek Site**

This impoundment would flood the West Fork Locust Creek flood plain. The proposed dam would be 0.45 miles long with a permanent pool depth of 50 feet. The dam location is approximately 4 miles west and one mile south of Milan. The 3,860-acre reservoir would contain approximately 80,900 acre-feet of water at normal pool elevation of 860 feet. The drainage area contributing to the reservoir is approximately 78 square miles. This reservoir would flood two roads maintained by the State Highway and Transportation Department, Route P and E. Six county and township maintained roads would also be inundated in at least one location at the normal pool elevation.

5. **Yellow Creek Site**

Impounding water on Yellow Creek near the Linn-Sullivan County Line would create this reservoir site. The dam location would be approximately two miles west and one mile south of the City of Winigan. The 3,210-acre lake would contain approximately 82,700 acre-feet of water at a normal pool elevation of 910 feet. The contributory drainage area is approximately 34 square miles. This reservoir would inundate at least six county and township maintained roads, and water would be backed up against State Route V in several locations.

H. REUSE

It is estimated that about 70% of the water demand of the cities in the area are discharged from residences and businesses as wastewater. After wastewater treatment and further treatment for reuse, about 50% of the original water usage is estimated to be available for reuse. It is possible to reuse this water for cooling or irrigation applications or, if the proper treatment facilities are available, it can be used as raw water for treatment to drinking water.

There is currently no system to collect and return rural, city, town and industrial water to one single point, as all wastewater is treated and discharged in the immediate locale where it is generated. Septic tank discharges are not available for reuse.

Of the total current water use of 12.4 MGD for the study area, 8.4 MGD is from cities and towns that may have wastewater treatment systems. Thus, as much as 4.2 MGD should be available in the study area for reuse. This is not enough total water to serve future demands,

but it would reduce the stress on existing water supplies by a factor of 50%, which may be adequate.

The major suppliers of reuse water for the area would be Chillicothe, Trenton, Unionville, Kirksville, Brookfield, and Milan. In order to connect these major wastewater discharges, a pipe loop of over 220 miles would be needed to collect potential reuse water from these cities and other towns located between the cities. This type of infrastructure and the anticipated costs are not feasible to develop a reuse supplemental supply.

At public meetings conducted during development of this feasibility study, it became obvious that reuse is not socially acceptable to the public, as is typical in most Midwestern areas. Reuse is not considered further.

I. CONSERVATION

The current drought within the region has the area classified as "Category 3" by the Missouri Department of Natural Resources. Category 3 indicates that water conservation must be enacted and is only one step away from "emergency" Category 4 status. People are currently conserving water in the area and it is estimated that only 2 to 5% more of the water use could be eliminated. At this time it is not possible to predict the total impact of water conservation for the Green Hills Region. Conservation measures in one area can be offset by growth in domestic or industrial demands. Conservation could help in the short term but is not a long-term solution to the raw water source problem and is not considered further.

J. YIELD AND SOCIAL EVALUATION OF ALTERNATIVES

Several alternatives can be eliminated on the basis of yield analysis or lack of social acceptance, and are listed in Table V-1. Those alternatives remaining were evaluated on an economic basis to arrive at the most cost-effective alternatives for the Commission. If an alternative did not have adequate yield or was not socially acceptable, it was not considered further. All remaining alternatives were evaluated to arrive at the recommended solution. Those alternatives that were cost-effective were assessed in regard to environmental considerations.

Table V-1
Yield and Social Considerations
Water Supply Alternatives
North Central Missouri Regional Water Commission

Raw Water Source Alternative		Adequate Yield	Social Acceptance
No Action		No	
Groundwater	Glacial Aquifers	No	
	Bedrock Aquifers	No	
	Missouri River Alluvium	Yes	Yes
	Aquifer Storage/Recovery	No	
Streams	Chariton River	Yes	No
	Yellow Creek	No	
	Big Locust Creek	No	
	Medicine Creek	No	
	Thompson River	Yes	No
	Missouri River	Yes	Yes
Existing Suppliers	Rathbun Rural Water (Iowa)	Yes	Yes
	Kirksville, Missouri	No	
	Trenton, Missouri	No	
	Chillicothe, Missouri	No	
Reservoirs	East Fork Locust Creek	Yes	Yes
	Big Locust Creek	Yes	Yes
	Little East Locust Creek	Yes	Yes
	West Fork Locust Creek	Yes	Yes
	Yellow Creek	Yes	Yes
Reuse		Yes	No
Conservation		No	

K. COST EFFECTIVENESS

All alternatives that meet the criteria for yield and social considerations were evaluated for cost effectiveness. A total first cost was calculated for each alternative.

These order-of-magnitude first costs were determined only to compare alternatives, and are not representative of the actual opinion of cost for each project. This cost will be determined in the master plan phase for the selected alternative, which is to follow this study. As an example, water treatment plant capital costs are assumed to be $1.50 per gallon per day for treatment of raw water from a reservoir. For a treatment plant to handle well water or river water, the capital costs are assumed to be $2.00 per gallon per day of treatment. This increase in cost of treatment is due to the assumption that well water or river water will contain more TDS or TSS, which will have to be removed. With these figures, a 3-MGD plant is estimated to cost $4.5 million for lake water and $6.0 million for well or river water.

Pipeline capital costs are based on $3.00 per inch diameter per foot of pipeline. The unit cost of land per acre for a reservoir is assumed to be the same for all sites. A 20% contingency is added to construction costs to allow for final design details.

The present worth analysis is based on a 6% discount rate. Inflation is assumed to be 3%. It is assumed that the cost to operate and maintain similar treatment systems will be similar. The term of the present worth analyses is 50-years. Water treatment facilities are expanded on 20-year intervals. Pumping costs are based on electrical charges of $0.08 per kilowatt-hour and increases in power consumption are based on the initial water use and the water use projected in 50-years.

According to Table V-1, the alternatives remaining after consideration of yield and social acceptance are the following:

- Well Supply, Missouri River Valley Alluvium
- Stream Supply, Missouri River
- Rathbun Regional Water Association (Iowa)
- East Fork Locust Creek Reservoir
- Big Locust Creek Reservoir
- Little East Locust Creek Reservoir
- West Fork Locust Creek Reservoir
- Yellow Creek Reservoir

1. **Missouri River Supplies**

   Both alternatives involving the Missouri River are identical with the exception of the water supply. One alternative is groundwater and one is surface water. The construction cost and cost to operate and maintain a new water treatment plant will be different, depending on water supply. The cost to construct high service pumping and transmission pipelines to move 7.5 MGD from the Missouri River to the Milan area will be identical. The water supply development cost is different; one being a well field and one being a river intake. Water plant expansions are included after 10-years and 30-years. The transmission pipeline size is calculated to be 30-inch and it is approximately 80 miles long. The difference in elevation between the Missouri River and the City of Milan is approximately 205 feet (Milan elevation 865 minus river elevation 660).

2. **Rathbun Regional Water Association (Iowa)**

Rathbun Regional Water Association (RRWA) would charge the North Central Missouri Regional Water Commission (the Commission) a rate that would be developed on the basis of their costs of service. It is assumed that the cost of service would be developed from the cost to supply and treat lake water. The costs to construct and operate the pumping and transmission line are assumed to be borne by the Commission. The transmission pipeline is calculated to be 30-inch and the difference in elevation between Rathbun and Milan is 145 feet (Milan elevation 865 minus Rathbun elevation 720).

3. **Reservoirs**

The following assumptions are made for each reservoir in the cost-effective analysis:

- All lake intakes will be comparable in design and cost.
- Cost per acre is the same for all lake land purchased.
- All dams will have 20-foot wide crest, 3:1 side slopes, and 15-foot berm on the backside.
- The cost of an overflow structure for East Fork Locust Creek was calculated and the costs of other overflow structures were proportioned on a ratio of drainage areas.
- A new 30-inch pipeline will be built from any reservoir to Milan. A booster pimp station is included, if necessary.
- The Commission will purchase the Milan water treatment plant with other facilities that currently provide supplemental water. The 2.9 MGD plant will have to be expanded in 10-years and again in 30-years to the ultimate capacity of 7.5 MGD.
- The cost to relocate residents, reconstruct and reroute roads, relocate pipelines, and other associated costs is the same for all reservoir sites.
- The cost of water production at the Milan treatment plant is the same for all alternatives, and is not entered into the evaluations.
- A contingency of approximately 20% is added to construction costs.

Table V-2 summarizes the approximate capital costs, O & M costs, and present worth value for all water supply alternatives remaining for consideration.

Table V-2
Present Worth Evaluation
Water Supply Alternatives
North Central Missouri Regional Water Commission

Alternative	Present Worth Value ($ Million)		
	Capital Costs	O & M Costs	Total
Missouri River Groundwater	49.8	3.9	53.6
Missouri River Surface Water	51.6	3.9	55.4
Rathbun Rural Water Association	25.8	38.4	64.2
East Fork Locust Creek	24.4	0.1	24.5
Big Locust Creek	46.8	0.4	47.2
Little East Locust Creek	40.1	2.16	42.3
West Fork Locust Creek	40.1	1.02	41.1
Yellow Creek	39.7	0.5	40.6

It is evident from Table V-2 that the alternatives located a long distance from where the water is required are the most expensive, both on a first cost and present worth basis. These include the two alternatives for the Missouri River and the Rathbun Regional Water Association in Iowa. The most cost-effective alternatives are those that use a reservoir close to the Milan Water Treatment Plant for a source of water. Because of the size of the lake and dam, the Big Locust Creek site is an expensive alternative; however, it will be included in the environmental analysis, along with the four other alternatives that remain. On the basis of first costs and present worth, the following defined reservoirs are the most cost-effective and are listed in chronological order, with lowest cost first.

- East Fork Locust Creek (Northeast of Milan)
- West Fork Locust Creek (West of Milan)
- Yellow Creek (Southwest of Winigan)
- Little East Locust Creek (Northeast of Browning)
- Big Locust Creek (West of Milan)

L. ENVIRONMENTAL EVALUATION

This section of the report contains environmental and permitting information on each of the five reservoir sites being considered in the North Central Missouri Regional Water Commission Feasibility Study. Included is a description of the desktop survey and of the field reconnaissance completed for the project, general results of the surveys, reservoir site descriptions, environmental evaluation, and conclusion of the environmental analysis.

1. Data Collection

The methodology used in the environmental analysis consisted of a desktop survey and a field reconnaissance of the general area of each of the proposed reservoir sites. Following is a description of both surveys.

a. Desktop Survey

The reservoir sites were evaluated using U.S. Geological Survey 7.5-minute topographic maps, DeLorme Street Atlas USA, and U.S. Fish and Wildlife Service National Wetland Inventory (NWI) maps. The topographic maps were used to locate existing facilities such as water bodies, cities/communities, residences and structures, transmission lines, pipelines, oil and gas wells or fields, observable cultural resources (i.e., cemeteries, historic structures), parks or recreational areas, and roads and highways, in addition to the general topography. Wetlands that would be disturbed or lost with project development were evaluated using the NWI maps.

b. Field Reconnaissance

A field reconnaissance of the five reservoir sites was conducted in early spring of 2003. The purpose of the field reconnaissance was to obtain first-hand information about each reservoir site and surrounding areas and to confirm, where possible, information collected from the desktop survey. The field reconnaissance consisted of a windshield survey along public roads in the general area of each site, which included frequent stops to record wetland, cultural resource, threatened and endangered species, and infrastructure/social aspects or components of the area. The field reconnaissance was conducted to help visually compare and contrast the reservoir sites.

2. General Results

The general results of the desktop survey and the field reconnaissance for the five reservoir sites are included in this section. The general descriptions of the existing land use and infrastructure, wetlands, threatened and endangered species, and cultural resources observed or potentially found in the reservoir site areas are described below.

a. Land Use and Existing Infrastructure

Generally, the five reservoirs are located approximately 12 to 15 miles around Milan, Missouri in the north-central region of the state. Small rural towns are scattered throughout the study area.

The topography of the area is very similar for all five sites, being comprised of rolling hills and intermittent streams. The land use for all of the sites is also very similar, being either agricultural (pasture or cropped) or wooded. The quantity of area in either land use category is about equal.

State Highways 5 and 6 are major highways in the area. The roads in the study area are two-lane asphalt and gravel all-weather roads. In all cases, the proposed reservoirs would inundate light-duty roads likely requiring them to be relocated or abandoned. Other infrastructure in the study area that has the potential to be rerouted or relocated includes buried cable (phone/fiber optic), electrical transmission and distribution lines, water pipelines and gas pipelines.

b. Wetlands

According to the NWI maps of each of the sites and the field reconnaissance, emergent, scrub-shrub, and forested wetlands are present. Based on the limited survey of each reservoir site, emergent wetlands are dominated by bulrush, cattails, and reed canary grass, while scrub-shrub wetlands are dominated by reed canary grass, silver maple, and various willow species; forested wetlands are vegetated by black willow, silver maple, and elm. Determining the quality and abundance of each of the wetland types will require a more detailed study.

In general, the field reconnaissance identified that the primary agricultural plant communities expected to be inundated by any of the reservoirs would be pastures or

cropland. Most of the pastures that were observed within the proposed reservoir inundation zones are dominated by cool season grasses (smooth brome and tall fescue); however, some native pastures and ungrazed prairies could also be present at each of the reservoir sites.

c. Threatened and Endangered Species

According to the U.S. Fish and Wildlife Service and the Missouri Department of Natural Resources Heritage database, the only protected species known to occur in Sullivan County are the state and federally endangered Indiana bat (*Myotis sodalis*) and the state endangered greater prairie chicken (*Tympanuchus cupido*). During the winter, Indiana bats hibernate in caves or abandoned mines. In the spring, Indiana bats migrate to their summer habitats where they usually roost under loose bark on dead or dying trees. During the summer months, males usually roost alone or in small groups, while females roost in larger groups of up to 100 bats or more. Indiana bats also forage in or along the edges of forested areas. The riparian areas along the streams and the wooded areas that dot the landscape of the reservoir sites may provide potential roosting and foraging habitats for the Indiana bat.

Greater prairie chickens characteristically inhabit tallgrass prairies and eat insects like grasshoppers, ants, and leafhoppers. None of the potential reservoir areas visited contained prairie habitats suitable for greater prairie chickens.

d. Cultural Resources

Generally, all of the proposed reservoir sites have a moderate to high probability for the occurrence of archaeological sites and a low probability for significant architectural features. Streams and unnamed tributaries within most of the reservoir sites are small and deeply incised. Each of the tributaries has flood plains that likely contain deep alluvial deposits. The major streams – East Fork and Little East Locust Creeks, Big Locust Creek, West Fork Locust Creek and Yellow Creek - have well-developed terraces that have the potential to contain significant archaeological deposits. There are also prominent hills and toe ridges that have eroded into the flood plain creating alluvial fans. Some of the hills are isolated within the flood plain providing a high probability setting for containing archaeological sites both on the hill and on or under the associated alluvial fans.

The more level portions of the flood plains for each of the proposed sites have been or are currently cultivated. While this disturbance does not remove the probability of discovering archaeological sites, it does tend to lessen the probability of locating a large number of significant sites. The only sites in these areas that would likely be significant and potentially require mitigation would be those with intact features that extend below the plow zone. Alluvial fans with deep soils may contain buried archaeological sites that are difficult to detect. These alluvial deposits will require evaluation by a geomorphologist and will need to undergo deep testing using an auger or a backhoe.

With the exception of the reservoir site on East Fork Locust Creek, each of the reservoir sites appears to be about equal in their probability for containing significant cultural resources. As discussed in Section 4 below, the East Fork Locust Creek may have a greater potential for cultural resource features due to fewer disturbances.

3. Reservoir Site Descriptions

Each of the five reservoir sites is briefly described below. These descriptions summarize the findings of the desktop survey and the field reconnaissance. Included are descriptions of the potential impact to wetlands, threatened and endangered species and their habitat, public lands, cultural resources, natural areas, homes and structures, existing communities, recreational activities, access, and other components of the existing infrastructure. Lastly, an assessment of the ease/difficulty that would be expected in obtaining the state and federal permits required for project construction and operation is provided.

a. Big Locust Creek

The Big Locust Creek site is located approximately 2.5 miles west of Milan, Missouri. Constructing an earthen dam on Big Locust Creek would be used to form the reservoir. According to the topographic maps, approximately 14 homes and 17 structures are located within the reservoir area and would be relocated or lost. In addition, the desktop survey revealed that no public lands, observable cultural resources, natural areas, existing communities, or recreational areas would be impacted in the reservoir area. There are approximately 10 all-weather roads and a quarry that would be inundated by reservoir development. In addition, the NWI

maps indicate that emergent, scrub-shrub, and forested wetlands are present in the reservoir area. Big Locust Creek has a low probability of potential greater prairie chicken habitat and a low to moderate probability for potential Indiana bat habitat. There is a moderate to high probability for the reservoir area to contain archaeological sites and a low probability for architectural features. Development of the reservoir as a municipal and industrial water supply would require that state and federal permits be issued.

b. Little East Locust Creek

The Little East Locust Creek site is located approximately two miles north and one mile east of Browning, Missouri. An earthen dam constructed on Little East Locust Creek would be used to form the reservoir. According to the topographic maps, approximately five homes and six structures are located in the reservoir area and would be relocated or lost. In addition, the desktop survey revealed no public lands or natural areas would be impacted in the reservoir area. The Hickory Grove cemetery is located in the reservoir area and would be relocated or lost. In addition, the Mt. Morah Church could potentially be in the inundation area for the reservoir and would be relocated or lost. There is a potential for the reservoir to impact the very small town of Paw Paw. According to the topographic maps, there is an established jeep trail that currently provides some recreational function that would be relocated or lost. There are approximately seven light duty roads and an existing electric transmission line on the south end or the lake crossing the proposed dam site location that would be inundated by reservoir development. In addition, based on the NWI maps for the reservoir site, emergent, scrub-shrub, and forested wetlands are present in the reservoir area. The site has a low probability of potential for greater prairie chicken habitat and a low to moderate probability for potential Indiana bat habitat. There is a moderate to high probability of the reservoir site to contain archaeological sites and a low probability of the reservoir site containing architectural features. Development of the reservoir as a municipal and industrial water supply would require that state and federal permits be issued.

c. East Fork Locust Creek

The East Fork Locust Creek site is located slightly north of Milan, Missouri. An earthen dam would be constructed on East Fork Locust Creek to form the reservoir. According to the topographic maps, approximately 10 homes and 13 structures are located in the reservoir area and would be relocated or lost. In addition, the desktop survey revealed no public lands or natural areas located in the reservoir area. The reservoir would impact the small community of Boynton including the local church. If this alternative is selected the town of Boynton would need to be relocated. There are approximately 17 light duty roads, State Route RA, and State Route N that would be inundated by the reservoir development. Topographic maps show that the Burlington Northern railroad traverses across the reservoir area. However, based on current information, the railroad is abandoned and would not be impacted.

Based on the NWI maps for the reservoir site, emergent, scrub-shrub, and forested wetlands are present in the reservoir area. The site has a low probability of potential greater prairie chicken habitat and a moderate probability for potential Indiana bat habitat. The probability of Indiana bat habitat is considered to be greater at this site because much of the site has retained the historic Oak/Hickory forest and had less disturbance by agricultural activities, which would make it more suitable for the Indiana bat. There is a high probability that the reservoir site contains archaeological sites and a low to moderate probability that the reservoir site contains architectural features. This site has a higher probability of intact cultural resources because of the lesser disturbance by agricultural activities and a greater potential to impact historic structures with inundation of the town of Boynton. East Fork Locust Creek appears to be the only alternative to have the potential to inundate a community, and therefore, may require a historical evaluation and possibly mitigation of a number of historic structures. Development of the reservoir as a municipal and industrial water supply would require that state and federal permits be issued.

d. West Fork Locust Creek

The West Fork Locust Creek site is located west of Milan, Missouri. As with the other reservoir sites, an earthen dam would be constructed to form the reservoir. The resulting dam and reservoir would be located on West Fork Locust Creek. According to the topographic maps, approximately 20 homes and 10 structures are located

within the reservoir area and would be relocated or lost. In addition, the desktop survey revealed no public lands, observable cultural resources, natural areas, existing communities, recreational areas, or existing infrastructure located in the reservoir area. There are approximately three light duty roads, State Route E, and State Route PP that would be inundated by reservoir development. In addition, based on the NWI maps for the reservoir site, emergent, scrub-shrub, and forested wetlands are present. The site has a low probability of greater prairie chicken habitat and a low to moderate potential for Indiana bat habitat. There is a moderate to high probability of the reservoir site containing archaeological sites and a low probability of architectural features. Development of the reservoir as a municipal and industrial water supply would require that state and federal permits be issued.

e. Yellow Creek

The Yellow Creek is located southeast of Milan, Missouri on Yellow Creek just west of the town of Winigan and near the Linn-Sullivan County Line. An earthen dam would be constructed to form the water supply reservoir. According to the topographic maps, approximately 15 homes and 20 structures are located within the reservoir area and would be relocated or lost. In addition, the desktop survey revealed no public lands, observable cultural resources, natural areas, recreational areas, or existing infrastructure located in the reservoir area. The very small town of Bute has the potential to be impacted by the reservoir and would be relocated or lost. There are approximately seven light duty roads that would be inundated by reservoir development. In addition, based on the NWI maps for the reservoir site, emergent, scrub-shrub, and forested wetlands are present. The site has a low probability of greater prairie chicken habitat and a low to moderate potential for Indiana bat habitat. There is a moderate to high probability of the reservoir site containing archaeological sites and a low probability of architectural features. Development of the reservoir as a municipal and industrial water supply would require that state and federal permits be issued.

4. Environmental Evaluation

A total of eleven environmental and social criteria were evaluated. Nine of the criteria were given a score from 1 to 5 depending on the probability of low to high impacts. The other two criteria were also scored from 1 to 5 based on how many residential structures

or roads are potentially impacted. The evaluation was based on both quantitative and qualitative information, and professional judgement.

a. Environmental Impacts:

Each of the environmental resources listed below are evaluated and given a score based on the probability that they would be impacted by reservoir development. The value assigned to a given resource was as follows: 1= low impact, 2= low to moderate impact, 3= moderate impact, 4= moderate to high impact, and 5 = high impact

- **Wetlands** – Wetlands were evaluated for each dam and reservoir site, assessing the type of wetlands present, and whether that wetland could be disturbed or lost by project development.
- **Threatened and Endangered Species Habitat** – Identified the potential habitat for the state and federally endangered Indiana bat and the state endangered greater prairie chicken in the specific dam and reservoir area and whether the habitat would be disturbed or lost through development and operation.
- **Public Lands** – Public lands include Wildlife Management Areas, State Parks, State Forests, etc. as defined on the topographic maps and other available sources.
- **Cultural Resources** – Evaluates the probability of archaeological sites or architectural features occurring in a specific dam and reservoir area.

b. Social Impacts:

The following features were scored depending upon the number of structures impacted.

Residences/Structures

- 1= 0-12 residences/structures
- 2= 13-24 residences/structures
- 3= 25-36 residences/structures
- 4= 37-48 residences/structures
- 5= 49-60 residences/structures

Public Access

- 1= 0-5 Public Access Points Lost
- 2= 6-10 Public Access Points Lost
- 3= 11-15 Public Access Points Lost
- 4= 16- 20 Public Access Points Lost
- 5= 21-15 Public Access Points Lost (or any major roads defined as state or US)

- **Natural Areas** – Includes all areas with potential significant or unique geologic or biologic resources as defined on the topographic maps or other available sources.
- **Residences/Structures** – Both residences and structures were identified and counted from the topographic maps. The number of residences identified was multiplied by two to increase the significance of the impact to residential structures and this number was added to the number of structures identified. The score in the table equals the score assigned to the range.
- **Existing Communities** – This includes existing communities as identified by the topographic maps and the field reconnaissance.
- **Recreational Areas** – This includes areas identified as established systems including trails, lakes, golf courses, etc. identified on the topographic maps or other available resources.
- **Public Access** – This criterion considers the major state, county, or local roads that may potentially be impacted by the reservoir as identified by topographic maps and DeLorme Street Atlas USA. A score was assigned based on a range of the number of light-duty paved roads. However, any major road defined as state or U.S. was automatically given a score of 5 to assign greater impact. The score in the table equals the score assigned to the range.
- **Displacement of Existing Infrastructure** – This evaluation factor includes any fiber lines, pipelines, distribution lines, railroads, oil and gas wells or fields, mining operations, etc. defined from the desktop survey and field reconnaissance.

c. **Obtain State/Federal Permits:**

Several state and federal permits will be required to construct and operate the proposed dam and reservoir regardless of its location. This evaluation was made to determine how difficult or complex the effort to obtain the required permits for each site would be. Similar permits will be required for each site; however, the Missouri Department of Conservation has identified the main stem of Locust Creek as one of the most diverse and high quality streams in north-central Missouri. While permitting the reservoirs does not appear to be a fatal flaw, obtaining the necessary permits for a dam and reservoir development on Locust Creek would be more difficult.

The results from the desktop evaluation and the field reconnaissance were tabulated and ranked in Table V-3. In addition to the scores in the table, there are also ranks assigned for each parameter and dam and reservoir development. The rank is based on how each reservoir compared to the other for each parameter. The total of the assigned ranks was used to determine the final rating of each reservoir site. Based on the environmental evaluation, Big Locust Creek Reservoir ranked was evaluated to be the easiest dam and reservoir site to development. Reservoir locations at Little East Locust Creek, West Fork Locust Creek, and Yellow Creek were tied for second, and the Reservoir at East Fork Locust Creek was last or the most difficult to develop. While there is a numerical difference between the five dam and reservoir sites, there is no fatal flaw identified for any of the five dam and reservoir sites as a result of the desktop evaluation and reconnaissance field survey.

5. **Environmental Conclusion**

In conclusion, no fatal flaws were identified for any of the five dam and reservoir sites identified during the preliminary environmental analysis.

- None of the reservoir sites seem to have significantly larger or lesser environmental impacts relative to potential wetland disturbance or loss. Knowing the quantity of NWI wetlands (by type and total amount) at each site could assist in identifying a preferred dam and reservoir site if one would have substantially less wetland area impacted.
- None of the five dam and reservoir areas appear to support neither greater prairie chicken habitats nor populations.

Table V-3

Environmental Evaluation of the Proposed Reservoir Sites
North Central Missouri Regional Water Commission

Evaluation Criteria		Big Locust Creek			Little East Locust Creek			East Fork Locust Creek			West Fork Locust Creek			Yellow Creek		
		Notes	Score	Rank	Notes	Score	Rank	Notes	Score	Rank	Notes	Score	Rank	Notes	Score	Rank
Environmental Impacts	Wetlands		4	1		4	1		4	1		4	1		4	1
	Threatened & Endangered Species Habitat [1]		2	1		2	1	Appears to retain much of the historic Oak/Hickory forest, lesser disturbed by agricultural activities (more suitable habitat for the Indiana bat)	2.5	2		2	1		2	1
	Public Lands	none defined	1	1	none defined	1	1	none defined	1	1	none defined	1	1	none defined	1	1
	Cultural Resources [2]		2.5	1	Hickory Grove cemetery, could impact Mt. Morah Church	2.5	1	Church in town of Boynton, Campbell Cemetery, and could impact to Fairview Church [3]	3.5	2		2.5	1		2.5	1
	Natural Areas	none defined	1	1	none defined	1	1	none defined	1	1	none defined	1	1	none defined	1	1
Social Impacts	Homes/Structures	14 homes, 17 structures	4	2	5 homes, 6 structures	2	1	10 homes, 13 structures	5	3	20 homes, 10 structures	5	3	15 homes, 20 structures	5	3
	Existing Communities	none defined	1	1	Could impact very small town of Paw Paw	2	2	Small town of Boynton would be impacted	5	3	none defined	1	1	Could impact very small town of Bute	2	2
	Recreational Activities	none defined	1	1	Established Jeep trail identified on topography maps	3	2	none defined	1	1	none defined	1	1	none defined	1	1
	Access Issues	10 light duty roads	2	1	7 light duty roads	2	1	SR RA and SR N, 7 light duty roads	5	2	SR E and SR PP, 3 light duty roads	5	2	7 light duty roads	2	1
	Displacement of Existing Infrastructure	Quarry	5	2	Transmission line on south end of lake crossing dam site location	5	2	Chicago Burlington and Quincy Railroad abandoned (approximately 9 miles)	1	1	none defined	1	1	none defined	1	1
Compliance	Permitability		4	1		4	1		5	2		4	1		4	1
	Total		27.5	13		28.5	14		34	19		27.5	14		25.5	14

[1] All of the reservoir sites have a low probability of potential for greater prairie chicken habitat and all of the sites, except reservoir site #3, have a low to moderate probability for potential Indiana bat habitat.
[2] All of the reservoir sites, except reservoir site #3, have a moderate to high probability of containing archaeological sites and have a low probability of containing architectural features
[3] Reservoir site #3 has a high probability of containing archaeological sites with low to moderate probability of containing architectual features. This reservoir site appears to be the least disturbed by agricultural activities increasing the probability of intact cultural resources and the potential to inundate the town of Boynton increases the potential to impact historic structures.

Rank #	Reservoir Site #
1	1
2	2, 4, and 5
3	3

- Within each of the five potential dam and reservoir areas, the riparian communities along the streams and the wooded areas may provide potential roosting and foraging habitats for the Indiana bat.
- Each of the dam and reservoir sites appears to be similar in their potential for significant cultural resource features. However the reservoir site on East Fork Locust Creek appears to be the least disturbed by agricultural activities thereby increasing the possibility that in fact significant cultural resources may be present.
- In all cases, each of the five dams and reservoirs would inundate existing county roads, producing a need for them to be relocated or abandoned.
- The town of Boynton could be inundated by the reservoir on East Fork Locust Creek. The Little East Locust Creek and Yellow Creek sites have a low to moderate potential to impact the small communities of Paw Paw and Bute.
- If the Little East Locust Creek, East Fork Locust Creek, or Yellow Creek sites are selected, the mentioned communities would likely require a historic evaluation and may require relocation.
- Each of the five dams and reservoirs have other forms of environmental and social infrastructure (phone/fiber optic cable, transmission and distribution lines, gas pipelines) that would be impacted and relocated.

M. SELECTED ALTERNATIVE FOR MASTER PLAN

The environmental analysis indicates that there is no fatal flow with any of the five reservoir sites evaluated. The selected alternative should be the most cost-effective solution. The East Fork Locust Creek site is the most cost-effective (See Table V-2) from both a first cost and present worth basis. The second-rated site on a cost basis is the West Fork Locust Creek site. This runner-up is approximately 29% more expensive first cost and 31% more costly present worth.

The East Fork Locust Creek site has been a favorite with the public at open meetings held monthly during the development of this feasibility study. Meetings were held on a rotating basis at the Milan Community Hall, Green City Community Building, and Sullivan County PWSD No. 1 offices. Residents of Boynton, the community that would be inundated by the reservoir, have been present and have not objected to the plan. Approximately eight residences will have to be moved from Boynton.

Another advantage the East Fork Locust Creek site offers is that it is located where flow to the Milan Water Treatment Plant is possible without pumping. The Commission and the Milan City Council are considering the Committee purchase the Milan Water Treatment Plant to begin service to the charter members; Milan, Green City, and Sullivan County PWSD No. 1. Design of a pipeline is underway to connect the City of Green City to the other two Committee Members, so that Green City can abandon their lake and treatment plant as directed by the Missouri Department of Natural Resources.

It is the recommendation of this Feasibility Study that a reservoir be developed by constructing a dam across the **East Fork Locust Creek** north and east of the City of Milan. It is further recommended that a **Master Plan** for the reservoir development be initiated as soon as comments are received from government agencies contacted during this study. The scope of the Master Plan should include discussions with the Natural Resource Conservation Service (NRCS) who, through the East Locust Creek Watershed District, has some existing structures and future flood protection planned for the proposed reservoir site. The Master Plan should include development of design criteria and a preliminary opinion of costs for the proposed construction. It should also include evaluation of purchase by the Committee of the Milan Water Plant from the City of Milan.

APPENDICES

APPENDIX I
Water Usage

TABLE A-1
WATER USE AND POPLUATION PROJECTIONS
FOR THE GREEN HILLS REGION
NORTH CENTRAL MISSOURI REGIONAL WATER COMMISSION FEASIBILITY STUDY

Name	Year	Population	Average Usage	Max Day	Per Capita Use	Ratio
Brookfield w/Laclede	2002	5184	0.54	0.88	105	1.62
	2010	5184	0.56	0.91	109	
	2020	5184	0.59	0.96	114	
	2030	5184	0.61	1.00	119	
	2040	5184	0.64	1.04	124	
	2050	5184	0.67	1.08	129	
	2060	5184	0.69	1.12	134	
Bucklin	2002	524	0.039	0.045	74	1.15
	2010	524	0.041	0.067	78	
	2020	524	0.044	0.071	83	
	2030	524	0.046	0.075	88	
	2040	524	0.049	0.079	93	
	2050	524	0.052	0.084	98	
	2060	524	0.054	0.088	103	
Chariton Co PWSD No. 2	2002	1565	0.06	0.08	38	1.33
	2010	1565	0.07	0.00	42	
	2020	1565	0.07	0.00	47	
	2030	1565	0.08	0.00	52	
	2040	1565	0.09	0.00	57	
	2050	1565	0.10	0.00	62	
	2060	1565	0.11	0.00	67	
Chariton-Linn CO PWSD #3	2002	4960	0.40	0.55	81	1.38
	2010	4960	0.42	0.68	85	
	2020	4960	0.44	0.72	90	
	2030	4960	0.47	0.76	95	
	2040	4960	0.49	0.80	100	
	2050	4960	0.52	0.84	105	
	2060	4960	0.54	0.88	110	
Chillicothe	2001	8968	1.16	1.89	130	1.15
	2002	8969	1.17	1.90	130	
	2010	8977	1.21	1.96	134	
	2020	8987	1.25	2.03	139	
	2030	8997	1.30	2.11	144	
	2040	9007	1.34	2.18	149	
	2050	9017	1.39	2.26	154	
	2060	9027	1.44	2.33	159	
Laclede	2002	565	0.03	0.05	54	1.64
	2010	565	0.03	0.05	58	
	2020	565	0.04	0.06	63	
	2030	565	0.04	0.06	68	
	2040	565	0.04	0.07	73	
	2050	565	0.04	0.07	78	
	2060	565	0.05	0.08	83	

TABLE A-1 CONT
WATER USE AND POPLUATION PROJECTIONS
FOR THE GREEN HILLS REGION
NORTH CENTRAL MISSOURI REGIONAL WATER COMMISSION FEASIBILITY STUDY

Name	Year	Population	Average Usage	Max Day	Per Capita Use	Ratio
Linn Co PWSD #1	2002	1267	0.073	0.10	58	1.37
	2010	1267	0.078	0.00	62	
	2020	1267	0.084	0.00	67	
	2030	1267	0.091	0.00	72	
	2040	1267	0.097	0.00	77	
	2050	1267	0.103	0.00	82	
	2060	1267	0.110	0.00	87	
Linn-Livingston PWSD #3	2002	1550	0.16	0.22	102	1.36
	2010	1550	0.16	0.00	106	
	2020	1550	0.17	0.00	111	
	2030	1550	0.18	0.00	116	
	2040	1550	0.19	0.00	121	
	2050	1550	0.20	0.00	126	
	2060	1550	0.20	0.00	131	
Livingston PWSD #2	2002	1350	0.20	0.27	148	1.35
	2010	1350	0.21	0.00	152	
	2020	1350	0.21	0.00	157	
	2030	1350	0.22	0.00	162	
	2040	1350	0.23	0.00	167	
	2050	1350	0.23	0.00	172	
	2060	1350	0.24	0.00	177	
Green City/Castle	2002	945	0.064	0.084	68	1.31
	2010	949	0.072	0.000	76	
	2020	954	0.082	0.000	86	
	2030	959	0.092	0.000	96	
	2040	964	0.102	0.000	106	
	2050	969	0.112	0.000	116	
	2060	974	0.122	0.000	126	
Milan	2002	1958	0.35	0.40	179	1.14
	2010	1958	0.37	0.00	187	
	2020	1958	0.39	0.00	197	
	2030	1958	0.40	0.00	207	
	2040	1958	0.42	0.00	217	
	2050	1958	0.44	0.00	227	
	2060	1958	0.46	0.00	237	
Meadville	2002	457	0.040	0.055	88	1.38
	2010	457	0.042	0.000	92	
	2020	457	0.044	0.000	97	
	2030	457	0.046	0.000	102	
	2040	457	0.049	0.000	107	
	2050	457	0.051	0.000	112	
	2060	457	0.053	0.000	117	

TABLE A-1 CONT
WATER USE AND POPLUATION PROJECTIONS
FOR THE GREEN HILLS REGION
NORTH CENTRAL MISSOURI REGIONAL WATER COMMISSION FEASIBILITY STUDY

Name	Year	Population	Average Usage	Max Day	Per Capita Use	Ratio
Sullivan CO PWSD #1	2002	4698	0.328	0.37	70	1.13
	2010	4770	0.37	0.00	78	
	2020	4860	0.43	0.00	88	
	2030	4950	0.49	0.00	98	
	2040	5040	0.54	0.00	108	
	2050	5130	0.61	0.00	118	
	2060	5220	0.67	0.00	128	
Unionville	2002	2041	0.24	0.45	117	1.89
	2010	2057	0.25	0.00	121	
	2020	2076	0.26	0.00	126	
	2030	2096	0.27	0.00	131	
	2040	2115	0.29	0.00	136	
	2050	2134	0.30	0.00	141	
	2060	2154	0.31	0.00	146	
Milan Premium Standard Farms	2002		0.73	0.91		1.26
	2010		1.35	0.00		
	2020		1.35	0.00		
	2030		1.35	0.00		
	2040		1.35	0.00		
	2050		1.35	0.00		
	2060		1.35	0.00		
Existing Con Agra Complex	2002		1.45	1.82		1.26
	2010		1.45	0.00		
	2020		1.45	0.00		
	2030		1.45	0.00		
	2040		1.45	0.00		
	2050		1.45	0.00		
	2060		1.45	0.00		

TABLE A-2
HISTORICAL AND EXISTING WATER DEMANDS AND DATA
FOR WATER SYSTEMS WITH TREATMENT PLANTS
NORTH CENTRAL MISSOURI REGIONAL WATER COMMISSION FEASIBILITY STUDY

Water Systems and Treatment Plants	Population Served	2001 Average MGD	2002 Average MGD	2002 Maximum MGD	Plant Capacity MGD	Water Source
Brookfield, MO (with Laclede)	5,184	0.514	0.542	0.880	1.550	Streams & Lake
Brunswick, MO	925	0.084	0.095	0.142	0.430	Wells
Bucklin, MO	524	0.035	0.039	0.045	0.360	Streams & Lake
Green City, MO (with Greencastle)	945	0.130	0.064	0.084	0.430	Lake
Keytesville, MO	53	0.054	0.048	0.060	0.172	Wells
Kirksville, MO	16,988	2.000	2.040	3.580	6.000	Lake
Linn County PWSD No. 1	1,267	0.068	0.073	0.100	0.018	Wells
Linn-Livingston PWSD No. 3 (with Laredo)	1,550	0.083	0.158	0.215	0.360	Wells
Livingston PWSD No. 2	1,350	0.098	0.200	0.270	0.250	Wells
Marceline, MO	2,558	0.273	0.220	0.330	0.922	Wells
Meadville, MO	457	0.040	0.040	0.055	0.072	Wells
Milan, MO	1,958	0.650	0.350	0.400	1.728	Lake
Preimum Standards Farms	NA	NA	0.725	0.910	1.200	Lake
Princenton, MO (with Mercer)	1,389	0.158	0.123	0.187	0.518	Wells
Salisbury, MO	1,726	0.200	0.200	0.300	0.504	Wells
Summer, MO	142	0.014	0.014	0.018	0.036	Wells
Trenton, MO	6,216	1.370	1.950	2.420	4.500	River
Unionville	2,041	0.225	0.238	0.450	0.900	Lakes

TABLE A-3
HISTORICAL AND EXISTING WATER DEMANDS AND DATA
FOR WATER SYSTEMS WITHOUT TREATMENT PLANTS
NORTH CENTRAL MISSOURI REGIONAL WATER COMMISSION FEASIBILITY STUDY

Water Systems and Treatment Plants	Population Served	2001 Average MGD	2002 Average MGD	2002 Maximum MGD	Plant Capacity MGD	Water Source
Adair County PWSD No. 1 (with Novinger)	7,694	0.545	0.550	0.720	0.000	Streams & Lake
Chariton Coutny PWSD No. 2	1,565	0.035	0.060	0.080	0.000	Wells
Chariton-Linn PWSD No. 3	4,960	0.320	0.400	0.550	0.000	Streams & Lake
Grundy County PWSD No. 1	3,425	0.200	0.302	0.375	0.000	Lake
Mercer County PWSD No. 1	2,340	0.120	0.203	0.250	0.000	Wells
Putnam County PWSD No.1	4,565	0.191	0.275	0.350	0.000	Lake
Sullivan County PWSD No. 1	4,698	0.250	0.328	0.370	0.000	Wells

APPENDIX II
Reservoir Yield

Burns & McDonnell
SINCE 1898

February 20, 2002

Mr. Don Summers
North Central Missouri Regional Water District
P.O. Box 266
Unionville, Missouri 63565

North Central Missouri Regional Water District
Draft Report on Yield Analysis for
Proposed Regional Water Supply Reservoir
Project 29698

Dear Mr. Summers:

Burns & McDonnell has completed yield analyses for Sites 3B and 3C and we are currently revising the draft report. Based on the results of the analyses, we are able to offer some conclusions and recommendations for consideration at tonight's steering committee meeting. These conclusions and recommendations are essentially the same as those Don Novak discussed with the commissioners this past Saturday.

CONCLUSIONS

1. The proposed Dam Site 3C produces a firm yield of approximately 14.1 MGD with a top of conservation pool elevation of 920' (surface area of 3626 acres), but the analysis indicates a steady drawdown during the 1950 to 1970 simulation period. Further analyses are required to determine both the initial fill time and the recovery time for a TOC pool elevation of 920'

2. A TOC pool elevation of 900'(surface area of 2126 acres) at Dam Site 3C produces a firm yield of 8.45 MGD and the analysis indicates adequate reservoir recovery during the 1950 to 1970 simulation period.

3. Proposed Dam Site 3B produces a firm yield of approximately 8.9 MGD with a top of conservation pool elevation of 920' (surface area of 2183 acres), and a reasonable though not complete recovery time.

4. A TOC pool elevation of 900'(surface area of 1123 acres) produces a firm yield of 4.5 MGD at Site 3B and the analysis indicates adequate reservoir recovery during the 1950 to 1970 simulation period.

5. Detailed analyses taking into account factors such as seepage and minimum discharges are necessary to finalize siting and reservoir yield estimates.

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Kansas City, Missouri 64114-3319
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Based on the limited analyses performed to date and the following preliminary observations noted below, Burns & McDonnell believes that Site 3B with a TOC pool elevation of 920' is the preferable location for the proposed dam.

- The yield and recovery time for Site 3B is similar to Site 3C with a TOC pool elevation of 900 feet.
- Although the surface area for a yield of approx. 8.5 MGD is similar at both locations, the total required land area (including buffer areas) would be larger for Site C. Approx. 1400 acres below Site 3B will not have to be acquired.
- The required length of the dam at Site B is shorter than that required at Site C.

If you have any questions, please feel free to contact Gene Foster (816/822-3167) or me at (816/822-3211).

Sincerely,

David P. Silverstein
Project Manager

RESERVOIR YIELD SUMMARY

Normal Pool	Firm Yield			
	Site C		Site B	
(feet NGVD)	(AFY)	(MGD)	(AFY)	(MGD)
865		0.00		0.00
870	2,850	2.54		0.00
875	3,590	3.20		0.00
880	4,430	3.95	1,900	1.70
885	5,420	4.84	2,640	2.36
890	6,680	5.96	3,390	3.02
895	8,010	7.15	4,170	3.72
900	9,470	8.45	5,090	4.54
905	11,120	9.92	6,150	5.49
910	12,820	11.44	7,280	6.49
915	14,770	13.18	8,580	7.65
918	15,560	13.88		
920	15,880	14.17	9,930	8.86

March 13, 2002

Mr. Don Summers
North Central Missouri Regional Water District
P.O. Box 266
Unionville, Missouri 63565

North Central Missouri Regional Water District
Draft Report on Yield Analysis for
Proposed Regional Water Supply Reservoir
Project 29698

Dear Mr. Summers:

Burns & McDonnell is pleased to present our final report on the yield analyses for a proposed regional water supply reservoir to the North Central Missouri Regional Water District (District).

PROJECT OBJECTIVE AND SCOPE OF SERVICES

The District is evaluating the feasibility of developing a new water supply reservoir in North Central Missouri that will serve as a regional water source to municipal and rural water districts. The general location of this proposed reservoir is shown in Figure 1. The Natural Resource Conservation Service (NRCS) has already completed some preliminary yield and other analyses for one alternative regional supply reservoir, but the overall size of this alternative reservoir was limited by NRCS policies. As another alternative, the District wishes to determine the maximum yield possible in the subject watershed for reservoirs not subject to the NRCS size limitation.

The reservoir sites under consideration for this study are located in Sullivan County, upstream of Milan on the East Fork of Locust Creek. These reservoir sites were identified in earlier studies performed by Rhodes Engineering Company (Rhodes)[1] as dam sites 3B and 3C. A map showing the location of the proposed dam sites is included as Figure 2.

The scope of services to be provided to the District by Burns & McDonnell includes completion of the following major tasks.

- Estimate historic inflow to proposed reservoirs
- Estimate historic lake evaporation rates
- Collect physical data for proposed reservoirs

[1] "Preliminary Engineering Report for North Central Missouri Regional Water Supply," Rhodes Engineering Company, Inc., Brookfield, Missouri, 1995.

Source: U.S. Census Bureau
TIGER 2000

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SINCE 1898

Figure 1
PROJECT
LOCATION
MAP

- Conduct yield analyses for the proposed reservoirs with various top-of-conservation (TOC) pool elevations.

Each of the above listed tasks is described in detail below.

RESERVOIR INFLOW

There are various methods available to estimate the yield of a reservoir, but all require estimates of natural stream discharge at the specified dam axis. The data sources and methodology used to estimate the inflow to the proposed reservoirs are described below.

Historic Streamflow Data

In the United States, stream discharge data are collected primarily by the U.S. Geological Survey (USGS). Although the USGS maintains a network of stream gaging stations located throughout the country, there are no records of natural discharge for the East Fork Locust Creek at either of the alternative dam axes. For this reason, the historic discharge at these locations was estimated using streamflow data recorded by the USGS at nearby gaging stations. The gaging stations used in this analysis are listed in Table 1, along with other pertinent data.

Table 1: USGS Stream Gaging Stations

Station No.	Station Name	Location (Latitude/ Longitude	Drainage Area (miles^2)	Period of Record
06901000	Locust Creek near Milan, MO	40° 11' 00" 93° 10' 13"	225	10/01/21–09/30/33
06901500	Locust Creek near Linneus, MO	39° 53' 45" 93° 14' 10"	550	04/01/29–09/30/72

The historic streamflow data available for these gages were obtained from the National Water Information System (NWIS-W) via the Internet. These records of mean daily discharge in cubic feet per second (cfs) were totaled by month to yield monthly discharge volumes in acre-feet (AF).

Inflow Estimates

Yield estimates require estimates of natural discharge over a relatively long period. Natural discharge is the discharge that would have occurred in a stream without any man-made influences, such as construction of a reservoir or withdrawals for water supply or irrigation. Estimating natural discharge from recorded discharge at a particular gaging station requires detailed records on the historic operation of any upstream reservoirs and withdrawals. Such records are usually difficult or impossible to obtain. However, given that there are no major reservoirs in the upper reaches of Locust Creek, the discharges

recorded at the two gaging stations used in this analysis are considered to be reasonably close to natural discharge.

Absent of better information, discharge estimates at ungaged locations — such as the proposed dam axes above Milan — are normally developed using unit discharges from a nearby gaged stream. Unit discharges are calculated by dividing monthly discharge volumes by the associated drainage area. These unit discharges are then multiplied by the drainage area at the ungaged locations to develop the required discharge estimates. The validity of this methodology was tested by comparing the overlapping periods of record at the two gaging stations listed in Table 1 (04/01/29–09/30/33). The Milan and Linneus gages have drainage areas of 225 and 550 square miles, respectively, yielding a drainage area ratio of 0.409. A linear regression analysis using monthly discharge volumes at these gages yielded a best-fit coefficient of 0.387 with a coefficient of determination (R^2) of 0.955. These two coefficients, or ratios, are close enough to lend confidence to this methodology.

The drainage area of the East Fork Locust Creek at Site 3B is reported by Rhodes to be 20,603.2 acres, or 32.19 square miles. For Site 3C, the corresponding drainage area is 24,543.2 acres, or 38.35 square miles. A quick review of the drainage area value at Site 3C was made by Burns & McDonnell. This review yielded a very similar estimate (24,611 acres); therefore, the drainage area values reported by Rhodes were used in these analyses.

Historic discharge data at the proposed dam axes were estimated using data recorded at the Milan gage, when available, and supplemented with those at the Linneus gage. From these two gages, the estimated historic inflow to the proposed reservoir covers a period from October 1921 to September 1972. The variability of this inflow is shown in Figure 3, which is a plot of annual reservoir inflow for calendar years 1950 – 1970[2] at Site 3C. The annual inflow at Site 3B is approximately 14 percent less than the annual values shown in Figure 3.[3] This plot clearly demonstrates the drought period of the mid-1950's and additional dry years in the 1964 and 1966. The average annual reservoir inflow for this 21-year period is 16,070 acre-feet per year (AFY) at Site 3C and 13,480 AFY at Site 3B.

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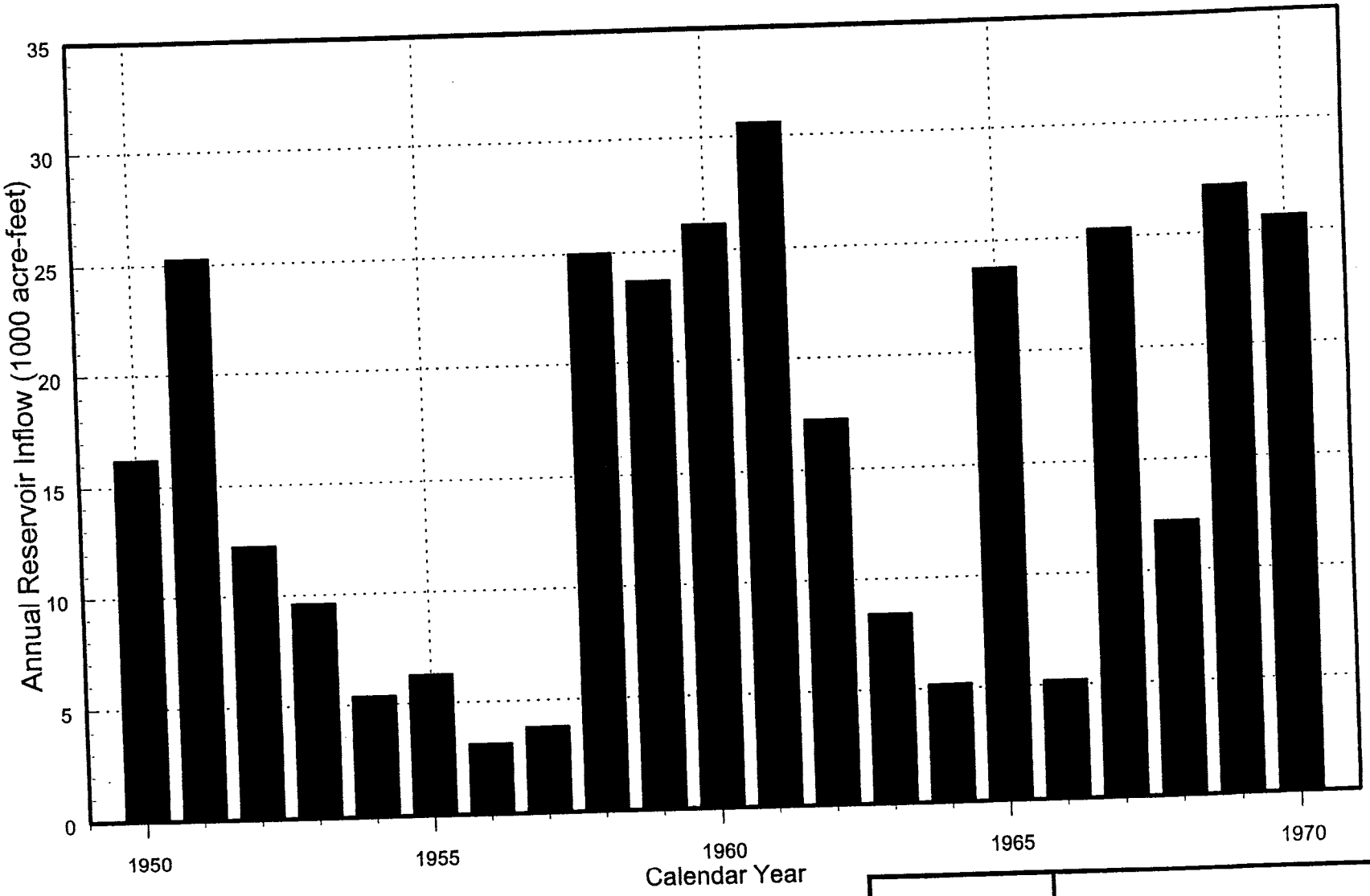
[2] This 21-year period corresponds to the simulation period for the operations model that was used to develop yield estimates.

[3] The reservoir inflow estimates at the two dam axes are proportionate to their respective drainage areas. Therefore, the ratio of the inflow at Site 3B to that at Site 3C is 32.19 miles^2/38.35 miles^2, or approximately 0.839.



Notes

1. Reservoir inflow estimated from recorded streamflow for Locust Creek at gages near Linneus.

nflow for Site 3B is approximately 84 percent of values shown.

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Figure 3

ANNUAL RESERVOIR INFLOW
DAM SITE 3C

RESERVOIR EVAPORATION

The yield analyses for the proposed reservoirs also required estimates of net reservoir evaporation rates since evaporation represents a major loss to the system. The development of historic evaporation rate estimates is discussed in the following sections.

Climatic Data

There are no known pan evaporation records in the vicinity of the proposed reservoirs and few such records in general. For this reason, evaporation rates for the proposed reservoirs were estimated using available climatic data. Both average monthly[4] and actual monthly climatic data were obtained from published sources and the National Climatic Data Center (NCDC) via the Internet. The long-term monthly data used are listed in Table 2. These data are an average of the data for Columbia, Missouri and Des Moines, Iowa. In addition to these data, daily precipitation data for Milan and temperature data for Kirksville were also utilized. These latter data are available for calendar years 1950 – 1970.

Table 2: Average Monthly Climatic Data

Month	Solar Radiation (Langleys)	Possible Sunshine (percent)	Relative Humidity (percent)	Wind Speed (mph)	Barometric Pressure (millibars)
Jan	174	50.5	76.0	11.20	986.4
Feb	252	52.0	78.5	11.35	985.1
Mar	333	53.0	78.0	12.40	980.8
Apr	418	55.0	77.0	12.20	981.1
May	505	59.5	80.5	10.15	980.0
Jun	558	68.0	81.5	9.45	980.9
Jul	555	71.0	83.0	8.55	982.5
Aug	491	68.0	85.0	4.30	983.2
Sep	410	64.0	85.0	8.90	983.9
Oct	298	61.5	80.5	9.95	984.4
Nov	206	48.5	79.5	10.95	983.9
Dec	151	44.5	79.0	11.05	984.7

Evaporation Model

Reservoir evaporation rate estimates were calculated for the proposed reservoirs using Burns & McDonnell's ETCALC computer model. This model uses a form for the Penman Equation to estimate evaporation depths. In general, the ETCALC model uses the following procedure to estimate evaporation rates.

[4] Long-term averages by month.

- Advective Losses: The ETCALC model contains a number of relationships to estimate advective losses from a reservoir surface. Advective losses occur as water evaporates from a reservoir into the air immediately above the water surface, when this air is unsaturated with water vapor (that is, has a relative humidity less than 100 percent). This moister air is then carried away by the wind and replaced with drier air so the process can continue. The principal factors affecting the rate of advective losses are wind speed, air temperature and relative humidity.

- Energy Budget: A substantial amount of heat energy is required to transform water into water vapor. The ETCALC model also contains relationships to estimate the amount of evaporation that would occur using an energy budget, or heat balance, methodology. The principal source of heat energy that controls evaporation is the Sun. Incident solar radiation at the reservoirs varies seasonally, based on the inclination of the Earth's axis and its distance from the Sun, and with the amount of cloud cover (percent possible sunshine).

- Weighting Function: The Penman Equation uses a weighting function to estimate lake evaporation from the separate advective loss and energy balance estimates. This weighting function is based on the slope of the saturation-vapor-pressure versus temperature curve at the given air temperature.[5]

Model Calibration

The ETCALC model must be calibrated to yield accurate evaporation estimates. The model was calibrated using an estimate of the average annual and summertime (May – October) free water surface evaporation at the reservoir. These target evaporation rates were obtained from a National Weather Service publication that contains an evaporation atlas for the United States.[6] This atlas was developed using data for the period 1956 – 1970. From the maps contained in this publication, the average annual evaporation at each of the proposed reservoirs is estimated to be 39.75 inches, and the average May-October evaporation is 29.5 inches.

The ETALC model has two calibration coefficients that are used to adjust the resulting evaporation estimates. Using the same period of record on which the target evaporation rates are based, 1956 – 1970, these calibration coefficients were adjusted by trial and error until the estimated evaporation rates approximately matched the corresponding target rates.

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[5] Linsley, Kohler and Paulus, 1982. Hydrology for Engineers, McGraw-Hill Book Company, New York, New York, 508 pages.
[6] NOAA, 1982. Evaporation Atlas for the Contiguous United States, NOAA Technical Report NWS 33.

Evaporation Rate Estimates

Once the ETCALC model was successfully calibrated, it was re-executed to estimate monthly evaporation rates for the entire simulation period, calendar years 1950 – 1970. The evaporation rates estimated by the ETCALC model are gross rates. Precipitation that falls directly on the surface of the proposed reservoirs will tend to offset some of the gross evaporation from the reservoirs. The resulting evaporation — gross evaporation less direct precipitation — is referred to as net evaporation. Not all of the precipitation that strikes the surface of a reservoir is considered to reduce evaporation. In the absence of a reservoir, some of this precipitation would have run off from the reservoir area and contribute to the discharge in the East Fork Locust Creek. This direct runoff is included in the lake inflow estimates discussed above. Therefore, to avoid double counting this water, monthly net evaporation estimates are calculated by ETCALC assuming that runoff equals 30 percent of total precipitation.

The estimated annual gross and net evaporation depths are plotted in Figure 4. Since these evaporation estimates are based on regional climatic data, these same estimates apply to both reservoir locations. Review of Figure 4 shows that gross evaporation is fairly predictable, ranging from 38.4 to 41.0 inches per year, and averages about 39.8 inches. Net evaporation is much more variable since it depends on precipitation totals, which can vary significantly from year to year. Estimated annual net evaporation ranges from 9.7 to 17.2 inches per year, and averages 14.8 inches.

RESERVOIR DATA AND OPERATING ASSUMPTIONS

Certain physical data for the proposed reservoirs and other operating assumptions are necessary in any type of yield analysis. These data are described in this section.

The size of the proposed reservoir at each dam site is represented by the elevation-area-storage data listed in Table 3. Graphs of these same data are included as Figures 5 and 6 for Sites 3B and 3C, respectively. These data, specifically the relationship between reservoir pool elevation and surface area, were estimated from the topographic data provided to Burns & McDonnell by the District.

The dead storage pool for the reservoir was assumed to have a volume of 1,150 acre-feet for Site 3C and 629 acre-feet for Site 3B. This storage volume corresponds to a pool elevation of only 858 feet, or a reservoir depth of only about 8 feet, at Site 3C. For Site 3B, the top of the dead storage pool is at elevation 870 feet, or a reservoir depth of about 10 feet.

The tops of the assumed dead storage pools correspond to the assumed elevation of the water supply intake, or lowest lake outlet. The actual level of this intake would not be known until further design studies are completed but could end up being higher than this assumed value. For example, environmental agencies could lobby for a larger permanent

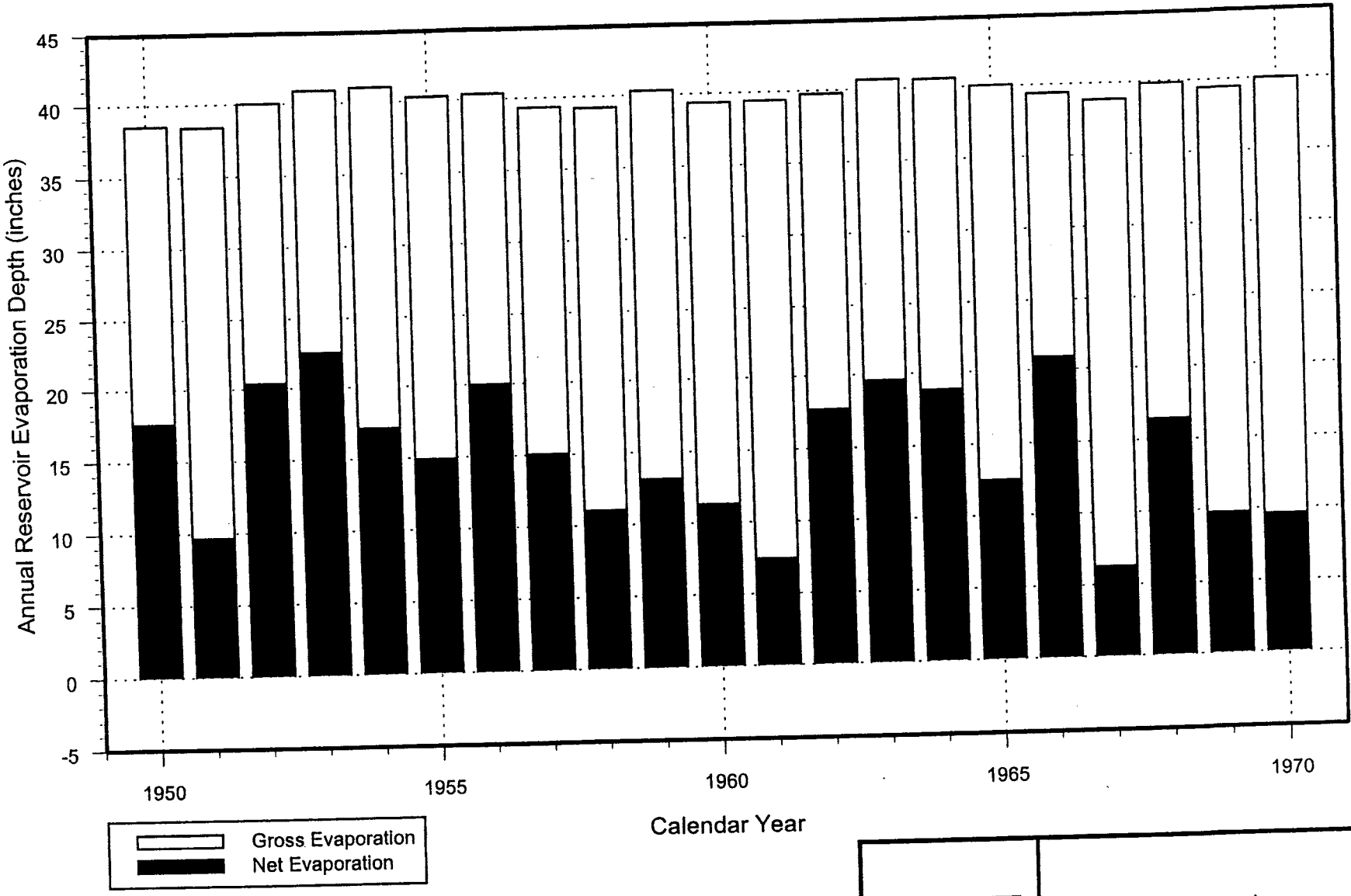

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Figure 4
ANNUAL RESERVOIR EVAPORATION

Note

Evaporation estimates calculated by Burns & McDonnel's ETCALC evaporation model.

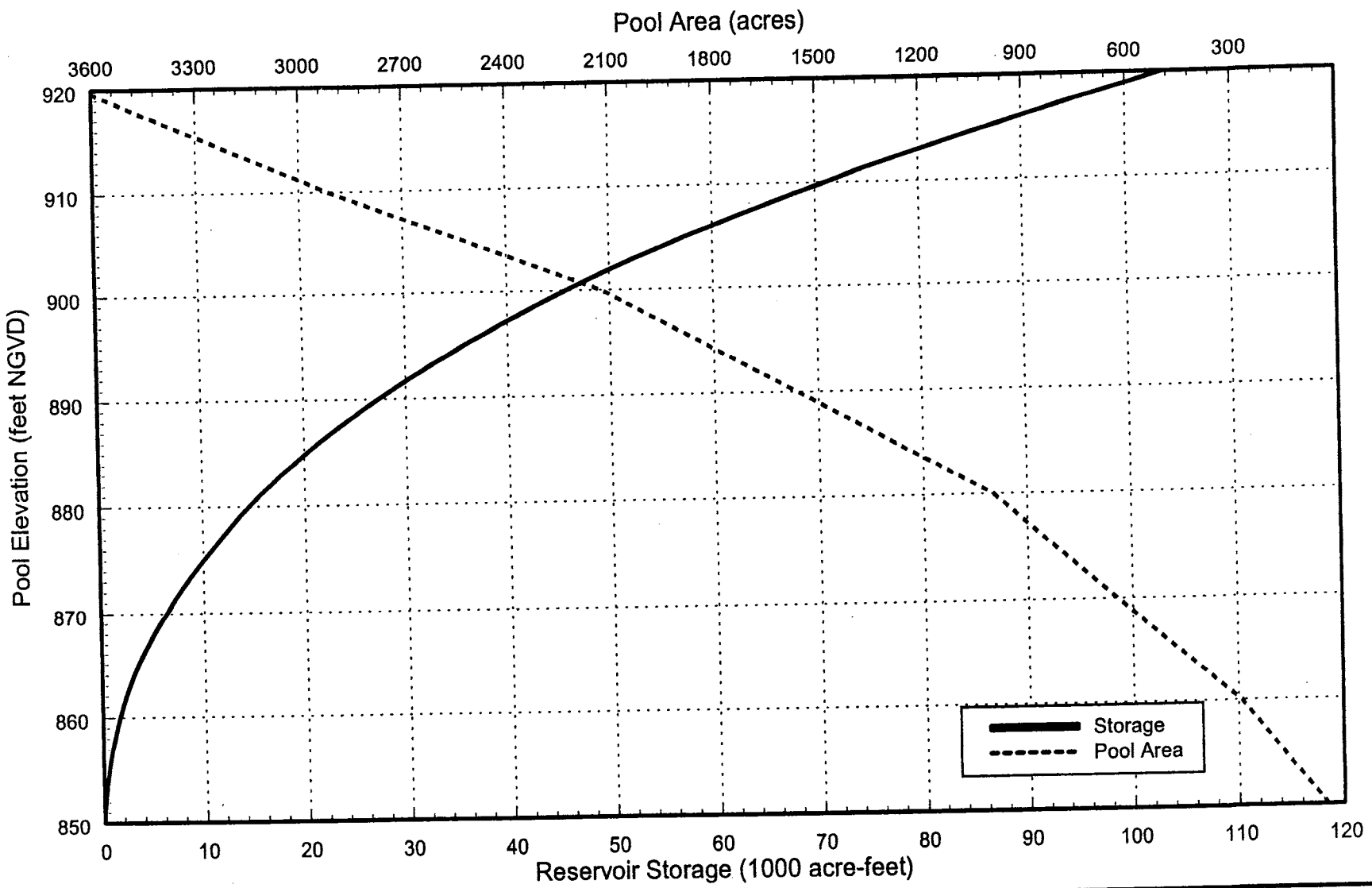

Figure 5

PROPOSED RESERVOIR
ELEVATION-AREA-STORAGE
DAM SITE 3C

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Note:

Developed from topographic data provided by District.

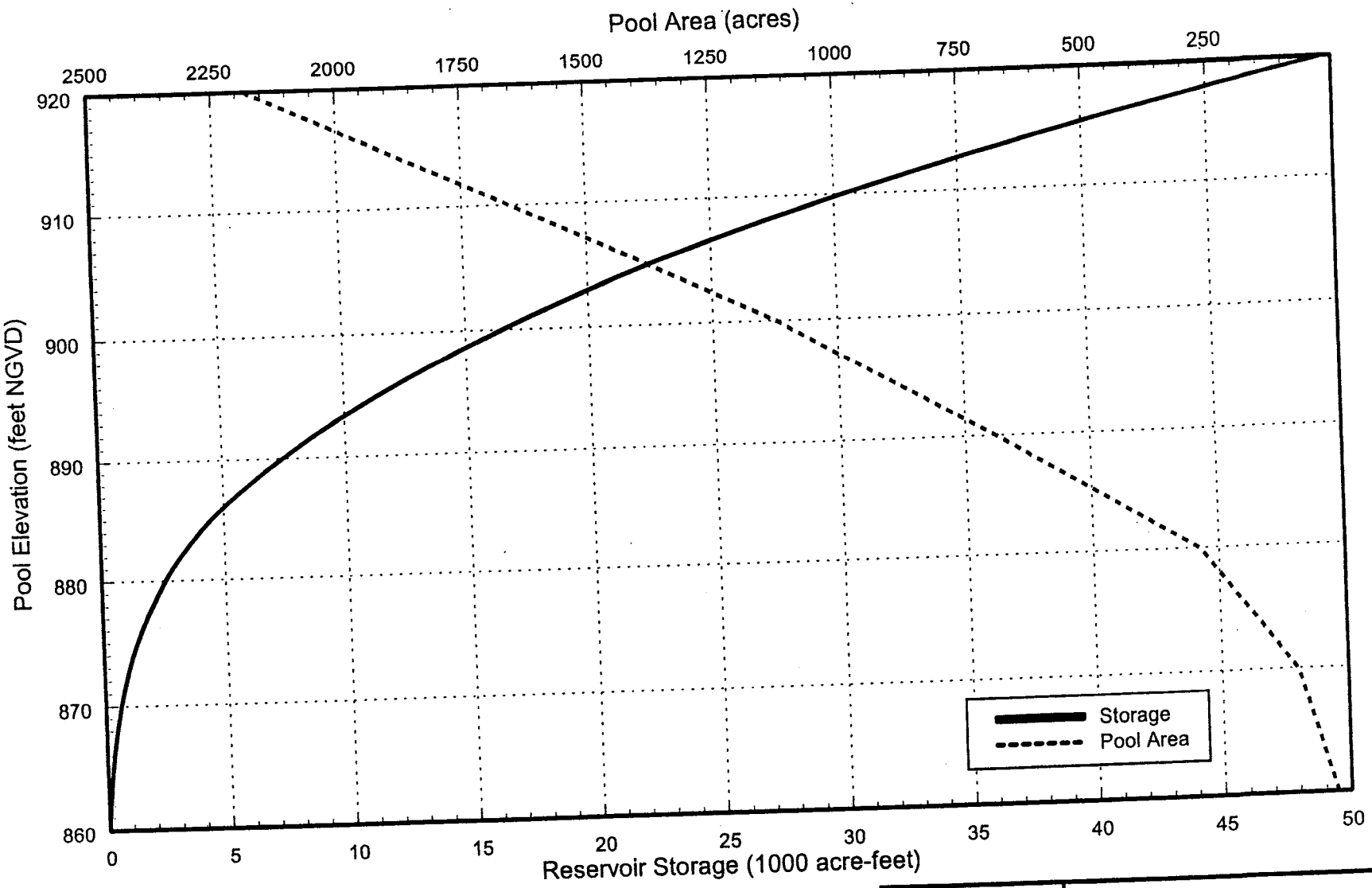


Figure 6

PROPOSED RESERVOIR
ELEVATION-AREA-STORAGE
DAM SITE 3B

Note:

Developed from topographic data provided by District.

Table 3: Elevation-Area-Storage Data

Pool Elevation (feet NGVD)	Dam Site 3B		Dam Site 3C	
	Pool Area (acres)	Storage (acre-feet)	Pool Area (acres)	Storage (acre-feet)
850	---	---	45	0
860	25	0	292	1,684
870	100	630	644	6,362
880	709	4,670	997	14,564
890	689	11,660	1,561	27,351
900	1,123	20,719	2,126	45,784
910	1,652	34,593	2,918	70.999
920	2,183	53,767	3,626	103,720

pool to help support a reservoir fishery or other recreation. Any increase in the assumed top of the dead storage pool would reduce the net water supply yield of the reservoir.

Any reservoir seepage, or other non-water supply releases from the reservoir, would also reduce the available water supply yield. The amount of seepage from the reservoir will depend on the design of the embankment, the characteristics of available construction materials, the geology of the dam foundation, and other construction details that will require additional investigation. Based on past experience with similar size reservoirs, a constant seepage allowance of 1.0 cfs was assumed.[7]

Any mandated minimum releases that may be imposed by regulatory authorities would also reduce the net water supply yield of this reservoir. The required minimum release from the proposed reservoir will depend largely on the quality of existing aquatic and riparian habitat in and along the creek, and the amount and timing of stream discharges required to maintain this habitat. For study purposes, an additional 1.0-cfs minimum release allowance was also incorporated into the yield analyses.

The other major operating assumption that was used in the yield analyses was to assume that the reservoir was full — that is, the current pool elevation was at the specified top of conservation pool (TOC) elevation — at the beginning of the simulation period. Given the relatively short simulation period available for these analyses, this initial starting condition can have a significant impact of the estimated yield. This issue will be discussed further in a subsequent section.

[7] One cubic foot per second is equivalent to approximately 450 gallons per minute.

FIRM YIELD ANALYSES

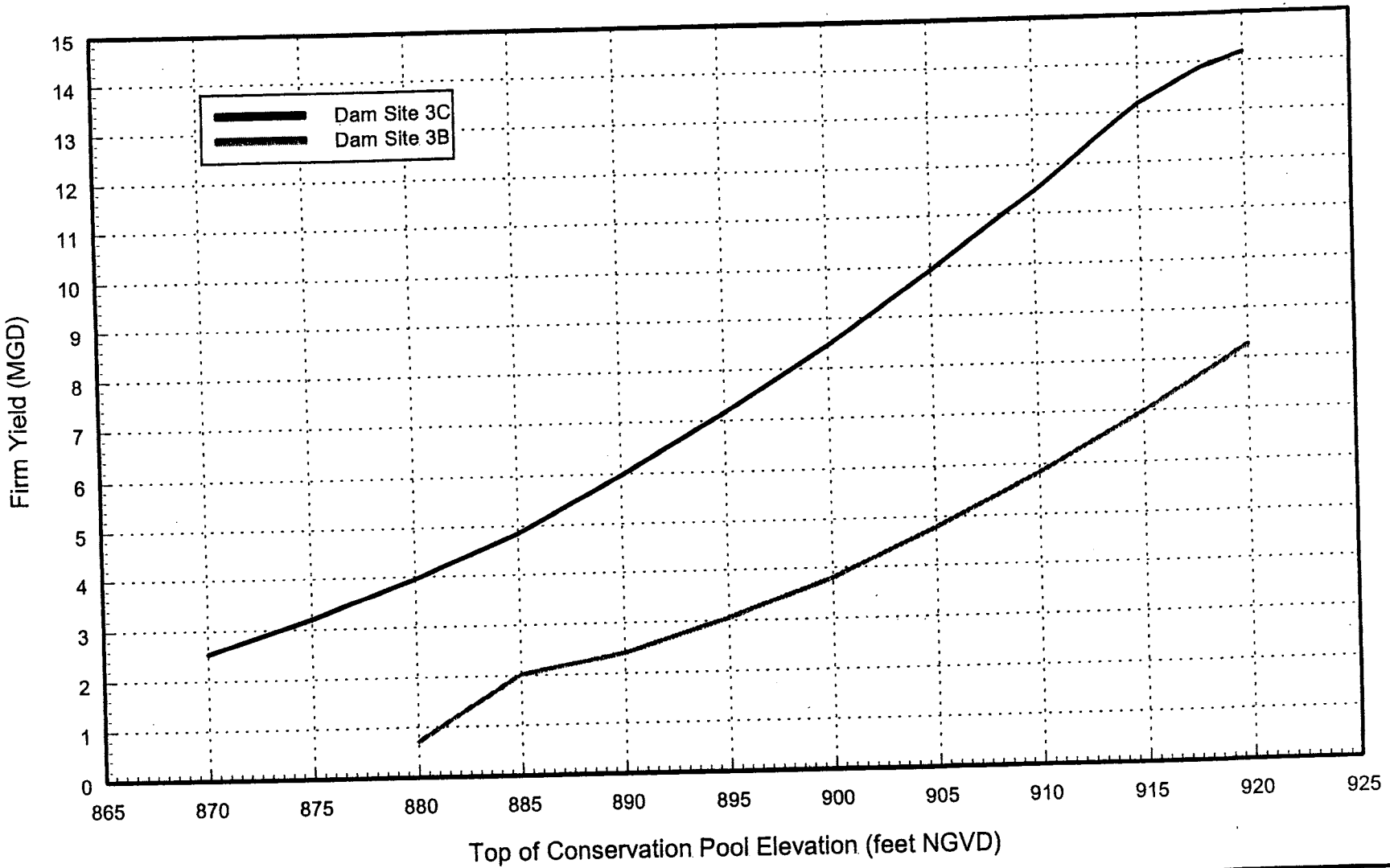
The firm yield of a reservoir is defined as the maximum constant draft it can sustain through the critical drought of record. The firm yield is determined by performing computer simulations of a reservoir using the inflow, evaporation and other data already discussed, and adjusting the draft placed on the reservoir until the maximum value is determined.

The firm yield analyses for the proposed reservoirs were completed using Burns & McDonnell's Reservoir Network (RESNET) simulation model. This model calculates a water balance for the reservoirs for each month during a simulation period of calendar years 1950 –1970. This simulation period was used for these analyses because it includes the historic drought of record during the 1950's and matches the period of record for the available lake evaporation estimates. For each monthly time step, the RESNET model considers the following:

- Reservoir inflow
- Reservoir evaporation losses, a function of average pool area and the current month's evaporation depth
- Seepage allowance
- Water supply withdrawals
- Spills
- Changes in reservoir storage

The RESNET model was used to estimate yields for the proposed reservoirs over a range of possible reservoir sizes. The top-of-conservation pool elevation for each reservoir was varied from 870 to 920 feet, in increments of five feet. A reservoir with a TOC pool elevation of 920 feet is likely to be the largest reservoir that can practically be developed at these sites. The resulting yield estimates are listed in Table 4 and shown graphically in Figure 7. Review of Table 4 shows that the estimated firm yield of the reservoir Site 3B ranges from about 0.7 million gallons per day (MGD) with a TOC pool elevation of 880 feet to 8.25 MGD with a TOC pool elevation of 920 feet. A reservoir at Site 3C is larger so it would have correspondingly larger firm yields. At TOC pool elevations of 880 and 920 feet, the firm yield for a reservoir at Site 3C would range from almost 4 MGD to just over 14 MGD. Figure 7 shows that this relationship between TOC pool elevation and estimated yield is fairly linear.

As the size of the reservoir is increased, the assumption that the reservoir would be full at the start of the simulation period becomes more and more suspect. Figure 8 is a plot of simulated pool elevations at Site 3C with TOC pool elevations of 900 and 920 feet. Examination of this figure shows that the pool elevation for the larger reservoir has a definite downward trend. Given the simulation period utilized in this analysis, it is unclear whether the reservoir would ever refill. Therefore, the reported yield of 14.17



Notes:

1. Yields based on simulation for calendar years 1950-1970.
2. Proposed dam site located on East Fork Locust Creek above Milan, MO.
3. Yield estimates include 1 cfs minimum release plus 1 cfs seepage allowance.

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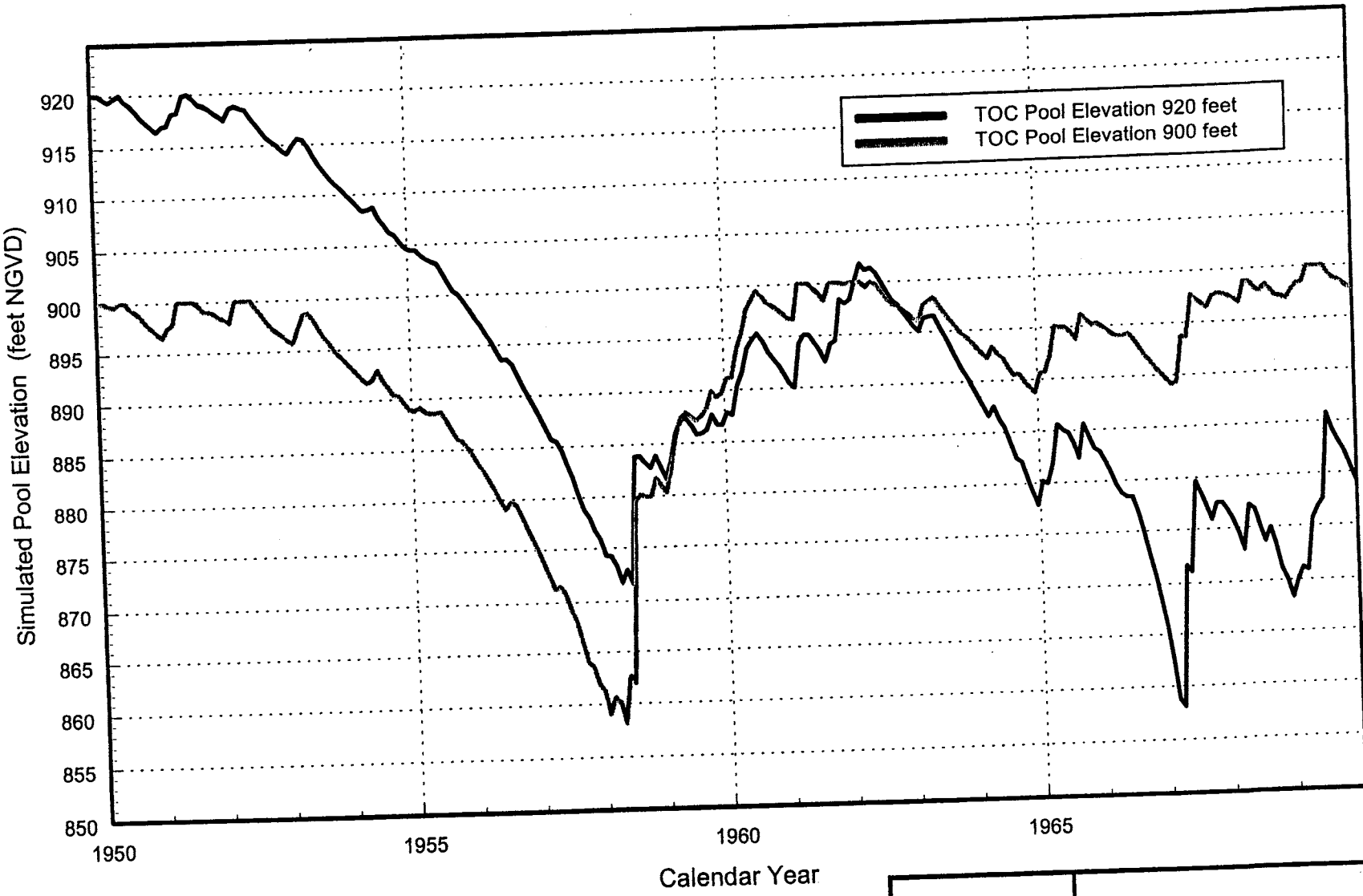
Figure 7

FIRM YIELD
PROPOSED RESERVOIR



Notes:

1. Pool elevations derived from operations simulation for period 1950-1970.
2. Simulations assume water supply demands of 14.17 mgd (4.54 MGD) with TOC pool elevation of 920 feet (900 feet) plus seepage and minimum flow allowances of 1 cfs each.
3. Dead storage pool assumed to contain 1,150 acre-feet at approximate elevation 858 feet.

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Figure 8

SIMULATED
POOL ELEVATIONS
DAM SITE 3C

MGD for this reservoir with a TOC pool elevation of 920 feet is probably optimistic. With a TOC pool elevation of 900 feet, the reservoir is shown to reach a low point during the mid-1950's drought and then recover within a reasonable time frame, about three years. One should give more credence to the yield estimates for this and smaller

Table 4: Reservoir Firm Yield Summary

TOC Pool Elevation (feet NGVD)	Dam Site 3B		Dam Site 3C	
	(AFY)	(MGD)	(AFY)	(MGD)
870	---	---	2,850	2.54
875	---	---	3,590	3.20
880	800	0.71	4,430	3.95
885	2,260	2.02	5,420	4.84
890	2,690	2.40	6,680	5.96
895	3,420	3.05	8,010	7.15
900	4,260	3.80	9,470	8.45
905	5,360	4.78	11,120	9.92
910	6,530	5.83	12,820	11.44
915	7,820	6.98	14,770	13.18
920	9,250	8.25	15,880	14.17

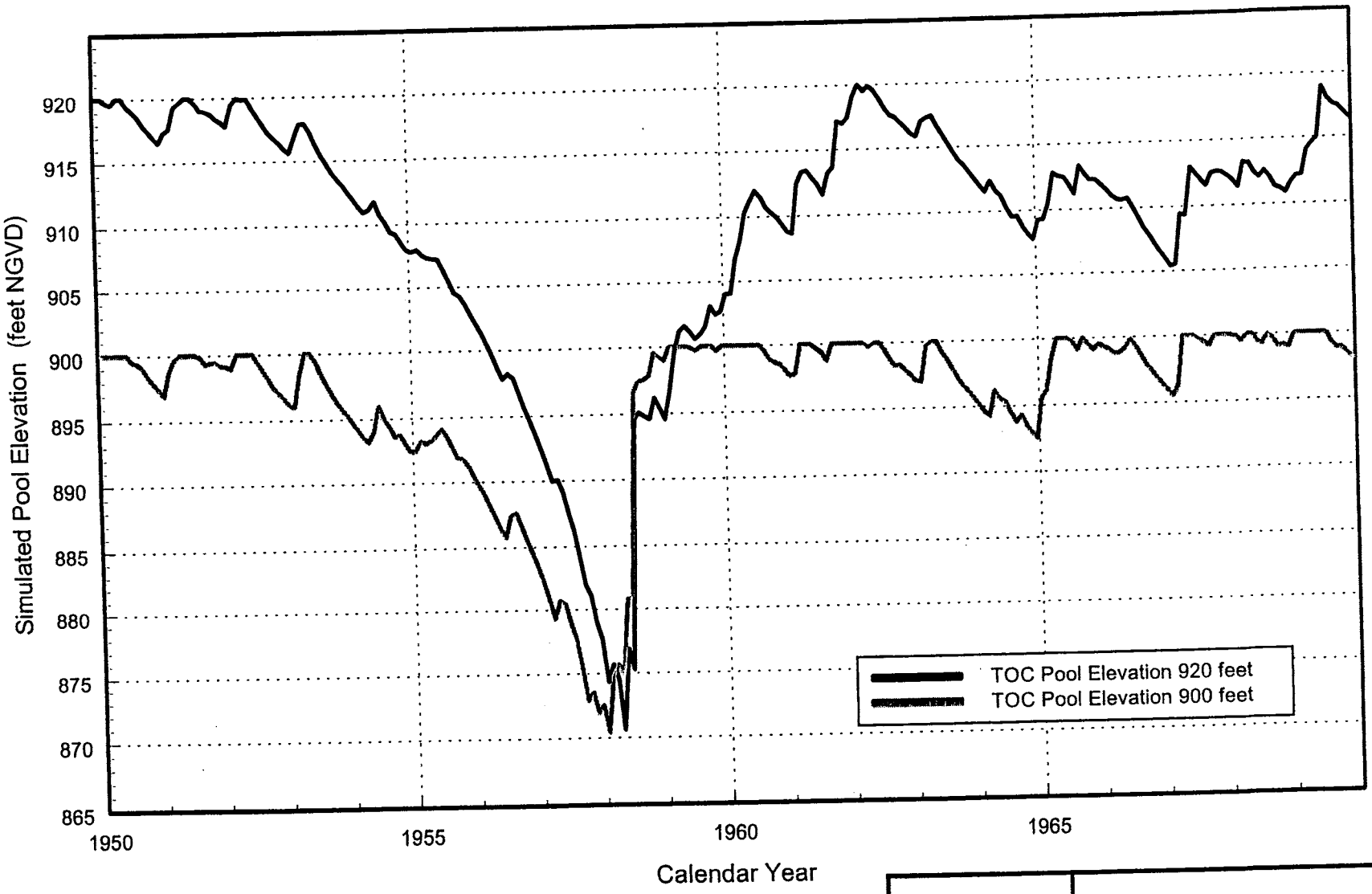
alternative reservoirs.

For Site 3B, simulated pool elevations are shown in Figure 9. With a TOC pool elevation of 920 feet, a reservoir at this site would have a much more stable reservoir surface, staying above 910 feet during all but the more extreme dry periods. With a lower TOC pool elevation of 900 feet, a reservoir at Site 3B would stay very nearly full except during the 1950's drought.

The credibility of these yield estimates for larger alternative reservoirs can be improved with further analyses. These could include synthesis of a longer simulation period, or use of probabilistic techniques that strive to eliminate the influence of the initial storage assumption.

CONCLUSIONS

1. The proposed Dam Site 3C produces a firm yield of approximately 14 MGD with a top of conservation pool elevation of 920', but the analysis indicates a steady drawdown during the 1950 to 1970 simulation period. Further analyses are required to determine both the initial fill time and the recovery time for a TOC pool elevation of 920'



Notes:

1. Pool elevations derived from operations simulation for period 1950-1970.
2. Simulations assume water supply demands of 8.25 mgd (3.80 MGD) with TOC pool elevation of 920 feet (900 feet), plus seepage and minimum flow allowances of 1 cfs each.
3. Dead storage pool assumed to contain 629 acre-feet at approximate elevation 870 feet.

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Figure 9

SIMULATED
POOL ELEVATIONS
DAM SITE 3B

2. A TOC pool elevation of 900' at Site 3C produces a firm yield of 8.45 MGD and the analysis indicates reservoir recovery during the 1950 to 1970 simulation period.

3. At Site 3B, a reservoir with a top of conservation pool elevation of 920 feet would have a firm yield of about 8.2 MGD. This reservoir would have a much more stable pool elevation than a similar reservoir at Site 3C.

4. Detailed analyses taking into account factors such as seepage and minimum discharges are necessary to finalize siting and reservoir yield estimates.

5. Given that the District's target yield for the proposed reservoir is likely under 8 MGD, it appears that Site 3B is a more logical choice for location of the dam's axis.

We appreciate this opportunity to be of service to the North Central Missouri Regional Water District. If you have any questions, please feel free to contact Gene Foster (816/822-3167), or me (816/822-3211).

Sincerely,

David P. Silverstein
Project Manager

Burns & McDonnell
SINCE 1898

Date: March 24, 2003

To: Don Novak
Andy Slotterback

From: Gene Foster

Re: North Central Regional Water District
Feasibility Study for Regional Water Supply
Screening Criteria for Reservoir Alternatives
Project 32598

As requested, I have developed some criteria that can be used to screen reservoir alternatives for the proposed regional water supply. These criteria are based on review of the prior yield analyses completed for the proposed reservoir on East Fork Locust Creek above Milan, Missouri.[1] In order to use the results for this prior study to develop these criteria, one must accept the following general assumptions.

- The alternative reservoirs are located in reasonably close proximity to the reservoir cited above, which is located in central Sullivan County, Missouri.
- Precipitation amounts and evaporation depths are relatively uniform across the region.
- Land use and runoff characteristics for the contributing drainage basins of each alternative reservoir are also similar.
- There are no significant man-made influences on stream discharge, such as reservoirs or diversions for water supply or irrigation, in the basins above any of these alternative reservoirs.

The proposed reservoir above Milan (Site 3B) has a drainage area of about 32.2 square miles and an upper-limit estimated yield of 8.25 MGD.[2] The estimated average annual inflow to this reservoir site is 13,500 acre-feet (AF), or about 12.0 MGD. This yield represents approximately 69 percent of the average reservoir inflow (8.25 MGD/12.0 MGD*100). Experience has shown that yield as a percentage of mean flow usually ranges from 50 to 70 percent, with 90 percent considered to be a practical upper limit.[3] In this analysis, 75 percent of the average flow was selected as a reasonable value for screening purposes.

---

[1] Silverstein, D. P. (13 March 2002). "Report on Yield Analysis for Proposed Regional Water Supply Reservoir." Letter to Don Summers, North Central Missouri Regional Water District. Burns & McDonnell, Kansas City, MO.

[2] For a reservoir with a normal pool elevation of 920 feet and about 53,000 acre-feet of conservation storage.

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The target average-day yield for this project is 5.75 MGD. From the example above, the average unit flow is 12.0 MGD/32.2 square miles, or 0.37 MGD/square mile. Seventy-five percent of this value is 0.37 MGD/square mile * 0.75 = 0.28 MGD/square mile. Therefore, a reservoir required to yield 5.75 MGD would need a minimum contributing drainage area of 5.75 MGD / 0.28 MGD/square mile = 20.5 square miles.

My recommendation is that you eliminate any reservoir alternatives with a drainage area of 20 square miles or less. Also note that in order to satisfy the target yield with a minimum contributing drainage area, a reservoir will need between 30,000 and 40,000 AF of conservation storage.

[3] McMahon, T. A. and R. G. Mein. (1986). *River and Reservoir Yield.* Water Resources Publications: Littleton, CO. Page 100.

APPENDIX III
Letters of Support

Missouri Climate Center
The School of Natural Resources
Department of Soil and Atmospheric Sciences
www.mcc.missouri.edu

University of Missouri-Columbia

100 Gentry Hall
Columbia, MO 65211
Phone: (573) 882 - 8599
Fax: (573) 884 - 5133

October 30, 2000

The Honorable Donald W. Summers
State Representative
State Capitol Building, Room 101-B
Jefferson City, MO 65101

Dear Representative Summers:

I am writing this letter in response to your request to support constructing a new lake in Sullivan County as a supplemental water source during future droughts such as the drought of 1999-2000 when the shortage threatened public drinking water facilities.

Unlike Southern Missouri where ground water supplies are resourceful and annual average rainfall totals range from 44" to 52", Northern Missouri mostly relies on surface water supply, which is fed by an annual total rainfall ranging from 31" to 40". On average, 37.28 inches of rainfall occurs annually according to 30-yr National Climatic Data Center records in the City of Milan, Sullivan County. In 1999, 28.42 inches of rainfall (8.86" below normal) was observed in Milan. As of October 30, Milan weather station recorded 29.85 inches of precipitation since the beginning of 2000 while the 30-yr average rainfall amount suggests that this period's total should have been 2.78 inches more. The precipitation deficit becomes more significant (11.04" below normal) when the actual total rainfall since July 1999 (41.24") is compared with the 30-yr average (52.28") for the period from July 1, 1999 to October 30, 2000. Furthermore, the long-term forecast does not suggest above normal precipitation for the next 3 months to make up the difference. Even if 11.04 inches (equivalent to the total rainfall deficit since July 1999) above normal precipitation fell in November 2000, hydrological drought would prevail since most water would be lost by surface runoff unless adequate facilities exist to regulate the excessive water.

Climatology of Missouri shows that the probability of severe summer drought in Missouri is 20% or once every 5 years. Thus, Northern Missouri is more susceptible to drought than the rest of the state. In fact, it has been noted during each Drought Assessment Committee, formed by the request of the honorable Mel Carnahan, that the public water system in Sullivan County has been problematic since July 1999 when the current drought first began.

Because of the issues mentioned above, I endorse any action to construct a new water supply lake in Sullivan County to serve as a regional public water supply source.

STATE OF MISSOURI
Mel Carnahan, Governor • Stephen M. Mahfood, Director
DEPARTMENT OF NATURAL RESOURCES
OFFICE OF THE DIRECTOR
P.O. Box 176 Jefferson City, MO 65102-0176

OCT 5 2000

The Honorable Donald W. Summers
State Representative
State Capitol Building, Room 101-B
Jefferson City, MO 65101

Dear Representative Summers:

This is in response to your request for a letter of support for a new water supply lake in Sullivan County to serve as a possible regional water supply source. The Department of Natural Resources supports the development of a long-term reliable drinking water source for this area as a means to improve the health and quality of life of the citizens of north central Missouri.

Several of the existing public water systems within the area are prone to water shortages during the recurring droughts of the area. Also, small surface water systems of the area face significant technical, managerial, and financial challenges in meeting more stringent drinking water standards now being proposed. Studies have shown that Milan's water supply lakes and Green City's water supply lake do not provide adequate capacity to meet even current water demands during extreme periods of drought such as occurred in the years 1953-1958. Because of drought conditions over the past 18 months in Sullivan County, the city of Milan, Green City, and the Sullivan Co. PWSD #1 are curtailing normal water uses. Each of the public water systems is seeking temporary alternative sources to prevent outages. However, these alternatives are temporary at best.

A reliable high quality source of drinking water is long overdue for north central Missouri. Construction of a new lake to serve as a regional water supply source would be one long-term option to eliminate the water shortage problems in the future. A new regional water supply source would also allow the area water systems to meet increased water demands associated with anticipated and needed future economic growth in the area. Without an additional water supply source, any economic growth will be hampered.

The evaluation of alternative long-term sources of drinking water for the area is necessary for the citizens of the area to receive the best water quality possible at affordable prices. The effort of regional cooperation in north central Missouri is encouraged and supported by the department.

Thank you for your dedication to providing safe and adequate drinking water to the citizens of Missouri.

If you need additional information, please contact Ms. Deana Cash of the Public Drinking Water Program at (573) 751-5331.

Sincerely,

DEPARTMENT OF NATURAL RESOURCES

Stephen Mahfood
Director

SM:dcj

c: Everett Baker, NERO
Steve McIntosh, WRP
Jerry Lane, PDWP

Never hesitate to contact
us if you need us.
Thanks

THE CITY OF MILAN

201 NORTH MARKET, MILAN, MISSOURI 63556 (660) 265-4491

August 21, 2000

Mr. Don Summers
R.R. #4, Box 209
Unionville, MO 63565

Dear Don:

This letter expresses the City of Milan's complete support for the planning and construction of a reservoir large enough to serve not only the future of the city of Milan and Sullivan County, but also the North Central Missouri region. It is our understanding that numerous communities and water districts in the area have inadequate reserves to withstand either prolonged drought, or future growth.

While we endeavor to meet our current needs with numerous methods, the only answer for the long term future and success of our community hinges on the construction of such an impoundment.

If the city of Milan can be of further assistance, please feel free to contact me at 660-265-4420.

Sincerely,

David T. Wilson

David T. Wilson
Mayor

Public Water Supply District #1
of Mercer County, Missouri
P O Box 676
Mercer, Mo. 64661
(660) 382-4776

Mr. Pat Wilson
North Central Missouri Regional Water Commission
P O Box 266
Unionville, MO. 63565

Dear Mr. Wilson:

We are writing to express our support of your efforts to promote a regional water supply for the northern area of Missouri.

Mr. Don Summers was present at our January board meeting to explain and inform us of the proposed 2700 acre lake and the plan to be able to serve water to the systems in need in our area.

We have an adequate water supply at this time, however we are always looking for another good second source of water which we feel would supply our district should the need arise.

Yours Truly,

Jack S. Goodin, President
Board of Directors
Public Water Supply District #1
Mercer County, Missouri

City Of **Brookfield**

116 W. BROOKS • BROOKFIELD, MO 64628-0328 • (660) 258-3377

February 4, 2002

North Central Missouri Regional Water Commission
Pat Wilson, President
P.O. Box 266
Unionville, MO 63565

Dear Mr. Wilson:

Mr. Don Summers was present at the January 22 Brookfield City Council Meeting and presented proposed plans for building a new lake in northern Missouri.

I am writing to express the interest of the Council in your efforts to establish a regional water supply source in our area. Although we currently have an adequate primary source of water for the foreseeable future, we are interested in the idea of having a back up, secondary source of water.

We support any effort to improve the quality of life in North Central Missouri and will discuss the merits of our opportunity to become an associate member. We wish you much success while you work to improve the quality of life and quantity of water in our region of the state.

Sincerely,

William J. Dorsey
Mayor

City of Marceline

February 28, 2002

North Central Missouri Regional Water Commission
Pat Wilson, President
PO Box 266
Unionville MO 63565

Dear Mr. Wilson:

I am writing to express our interest and support for your efforts to secure a regional water supply and the network to deliver it to systems of need in Northern Missouri.

As we are all aware, having a plentiful, affordable, and local source of safe drinking water, as well as water for other uses, is vital for our future. We do commend you in this cause. Although we currently have an adequate primary source of water for the foreseeable future, we are interested in the idea of having a back up, secondary source of water.

We support any effort to improve the quality of life in North Central Missouri and wish you much success while you work to improve the quality of life and quantity of water in our region of the state.

Sincerely,

Elizabeth Cupp
City Manager

PUBLIC WATER SUPPLY DISTRICT NO. 2
R.R. 2, Box 30
Brunswick, MO 65236
660/548-3565

February 25, 2002

Mr. Don Summers
North Central Missouri Regional Water Commission
P.O. Box 266
Unionville, MO 63565

Dear Mr. Summers:

Thank you for your presentation to the board of directors February 14, 2002. This letter is to inform you of our support of your plans for a water reservoir to supply the needs of the north central region of Missouri.

This project is vital to the future endeavors of industry and growth in this region. We are becoming increasingly aware of water as a precious resource. We need to look ahead and plan for the future to assure quality and adequate supply. This project is a step toward this goal.

Public Water Supply District #2 is currently looking at other sources of water. It is reassuring to know that if the need arises, your project is a potential supplier of our water district in the future.

We want to convey our best wishes in your efforts toward this regional water source.

Sincerely,

Robert Kistler

Robert Kistler
Superintendent

vb

CITY OF PRINCETON

Office of City Clerk

Princeton, Missouri 64673

February 14, 2002

North Central Missouri
Regional Water Commission
Pat Wilson, President
P.O. Box 266
Unionville, MO 63565

Dear Mr. Wilson:

Mr. Don Summers attended our February 5th Council Meeting to discuss the proposed plan to secure a regional water supply in North Central Missouri.

To attract jobs to our area and maintain a high quality of life for residents, there must be a plentiful and affordable source of water. We applaud your efforts to develop an abundant source of low cost water supply for the residents of North Central Missouri.

Although the City of Princeton would not likely purchase water from the NCMRWC, we recognize your project is important to economic development in the region. We will discuss at a later date the benefits of an associate membership.

Please consider us a supporter of your efforts to improve the quality of life in North Central Missouri. Feel free to contact us if we can be of further assistance.

Sincerely,

Michael Greenlee
Mayor

PUBLIC WATER SUPPLY DISTRICT NO. 1
OF PUTNAM COUNTY

RT. 3 BOX 402 • UNIONVILLE, MISSOURI 63565-9802 • 660-947-3616

February 14, 2002

North Central Missouri Regional Water Commission
Pat Wilson, President
P. O. Box 266
Unionville, MO 63565

Dear Mr. Wilson

The Pubic Water Supply District #1 of Putnam County Board of Directors is writing this letter to express our support of your organization's efforts to secure a regional water supply system. An affordable, plentiful source of water is an absolute necessity not only to the citizens residing in the area but also to the economic development of the future. Recent water shortages in the north Missouri region have demonstrated the express need for this type of system.

While our rural water district does not anticipate use of the regional water supply system at this time, we appreciate your willingness to include outlying systems in the process of procurement. We would be interested in receiving information on exploring the benefits of an associate membership after which the Board would make a decision on the feasibility of becoming an associate member.

Please feel free to call on us for any support we can provide.

Sincerely,

Bobby K. Jones
President, Board of Directors

KIRKSVILLE
MISSOURI

201 S. Franklin
Kirksville, Missouri 63501

(660) 627-1224
Fax: (660) 665-0940

October 31, 2001

Pat Wilson, President
North Central Missouri Regional Water Commission
Post Office Box 266
Unionville, MO 63565

Dear Mr. Wilson:

We are writing to express our support of your efforts to secure a regional water supply and the network to deliver it to systems of need in our region.

To attract jobs to our area and maintain a high quality of life for our residents, (there must be) a plentiful, pure and affordable source of water. We commend you on your mission statement focusing on the supply and affordability of water for this region.

Although the City of Kirksville will not likely purchase water from the NCMRWC, it could serve as a secondary source to the Adair County Rural Water District. This will also help the development of the region. We understand that the Adair County Rural Water District and the City of Kirksville may be associate members with the opportunity to monitor your progress and eventually secure an option for full membership at the associate's choice in the future.

Whether a water provider needs to procure a secondary source of supply or needs all of their water supplied as some do, it makes sense to cooperate with your commission and take the opportunity to have a say in our region's future.

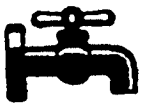
Please consider us a supporter of your efforts to improve the quality of life in North Central Missouri.

Sincerely,

William R. Murray
Mayor

vlb

CONSOLIDATED PUBLIC WATER SUPPLY
District #1 of Schuyler County, Mo 63561
P.O. Box 295
Queen City, MO. 63561
Phone & Fax 660-766-2497



December 4, 2001

North Central Missouri Regional Water Commission
Pat Wilson, President
P.O. Box 266
Unionville, MO. 63565

Dear Mr. Wilson:

Mr. Don Summers was at our November 6 Board meeting to discuss the proposed plans for building a new lake with the Water District Board members.

We are writing to express our interest in your efforts to secure a source of regional water supply in our region. Although we do not need a primary source of water in the foreseeable future, we like the idea of having a back up, secondary source of water.

Please consider us a supporter of your efforts to improve the quality of life in North Central Missouri. We will discuss and decide later about our opportunity to become associate members. We wish you much success while you work to improve the quality of life in our region of the state.

Sincerely,

James Werner
President of the Board

Chief Plant Operator
660-459-2474

Angela Baldwin
Office Manager
660-459-2266

Don Edwards
Chief Distribution System Operator
660-459-2266

Clean Clear Water Provided By

LINN-LIVINGSTON PWSD #3

P.O. Box 109
Wheeling, MO 64688

March 13, 2002

North Central Missouri
Regional Water Commission
Pat Wilson, President
PO Box 266
Unionville, MO 63565

Dear Mr. Wilson:

We are writing to express our interest and support for your efforts to secure a regional water supply and the network to deliver it to the systems of need in the North Central Missouri region.

Whether a system needs a backup source of supply, or needs all their water supplied, it makes sense to look at the region's needs and resources in order to maintain the quality of life for residents who depend on a plentiful, affordable source of water in North Central Missouri.

We recognize that your project is an important step in the North Central Missouri Region but feel at this time; we do not need your services in the present and near future.

Please consider us a supporter of your efforts to improve the quality of life in North Central Missouri.

Sincerely,

Tom Burtch

Tom Burtch, President
Linn-Livingston PWSD #3

January 29, 2002

To: North Central Missouri Regional Water Commission
Pat Wilson, President
P.O. Box 266
Unionville, MO 63565

Dear Mr. Wilson:

In response to the information given to the Lancaster City Council by Mr. Don Summers recently, I would like to offer our support and encouragement to your Commission in your efforts to provide an additional water supply in our area.

As we are all aware, having a plentiful, affordable, and local source of safe drinking water, as well as water for other uses, is vital for our future. We do commend you in this cause.

Please accept my personal apology for the delay in getting this letter of support to you. I had intended to put it in the mail a month ago, and somehow let it slip by without getting done.

As with any project of this size, there is a lot of hard work ahead. Good luck with your plans.

Sincerely yours,

Linda Bruner

Linda Bruner
Mayor of Lancaster, MO

pc: file

MACON MUNICIPAL UTILITIES

Since 1890

106 West Bourke
P.O. Box 589
Macon, Missouri 63552-0589

Telephone (660) 385-3173
Fax (660) 385-6554

March 2, 2002

Pat Wilson
North Central Missouri Regional Water Commission
P.O. Box 266
Unionville, MO 63565

Dear Mr. Wilson:

We are writing to express our support for your efforts to secure a regional water supply and the network to deliver it to systems in the North Central Missouri region.

The completion of Interstate 72 will bring prospective employers to the area, which will contribute to the economic growth and development of the North Central Missouri region. Having a safe, abundant supply of affordable water is a key element of attracting businesses to the area. Although the City of Macon will not be a likely purchaser of water from the North Central Missouri Regional Water Commission, we support your efforts to help the development of the overall region.

We wish you the best in your efforts to improve the quality of life in our part of the great state of Missouri.

Sincerely,

Vern Kincheloe
General Manager, Macon Municipal Utilities

PUBLIC WATER SUPPLY DISTRICT NO. 3

of CHARITON & LINN COUNTY, MISSOURI
814 W. Helm • 660-258-5606
Brookfield, Missouri 64628

To: North Central Missouri Water Commission
Pat Wilson,President
PO Box 266
Unionville,MO. 63565

Dear Mr. Wilson

We are writing to tell you of our interest and support for your plans to build and maintain a regional water supply in North Central Missouri. We also wish you well in your vision of a affordable water supply to systems in need in the North Central Missouri region.

Whether a system needs a backup source of supply,or a quote to serve a potential industrial user, it makes sence to look at our region's needs and resources. We hope to monitor your progress as you work toward your goal.

While we do not need your services at the present time, We may in the future. We recognize that your project is important to our region's growth.

Please write or call if we can be of futher assistance.

Sincerely,

Dan Downey
Chairton-Linn PWSD#3

City of Chillicothe

Office of Mayor & CEO
Phone 660-646-2267

December 13, 2001

Pat Wilson
North Central Missouri Regional Water Commission
PO Box 266
Unionville, MO 63565

Dear Mr. Wilson:

We are writing to express our interest and support for your efforts to secure a regional water supply and the network to deliver it to systems of need in our region.

The completion of Interstate 72 will bring prospective employers to our area. Being able to assure them that there is abundant, affordable water available is a must. Although the City of Chillicothe will not likely purchase water from the NCMEWC, it will help the development of the region and attract jobs through potential new industrial users.

We wish you the best in your endeavors to secure a regional water source.

Sincerely,

Mayor Jeffery Curtis Foli

715 N. Washington • Chillicothe, MO 64601 • Fax 660-646-6811

Consolidated Public Water Supply District #1
of Linn County Missouri
P.O. Box 111
Purdin, Missouri 64674

Kay Fowler
Clerk

Office: 660-244-7345
Home: 660-244-7585

November 15, 2001

North Central Missouri Regional Water Commission
Pat Wilson, President
P.O. Box 266
Unionville, MO 63565

Dear Mr. Wilson,

We are writing to inform you of our support for your 2700 acre water supply lake. It is a project we feel will benefit the whole region of North Central Missouri.

While we at C.P.W.S.D. #1 of Linn County do not anticipate any need for surface water in the foreseeable future, having adequate reserves in the region to use as a backup seems prudent.

We appreciate also your commitment to keep the water you produce affordable for those who need it.

We wish you the best in your endeavors to secure a regional water source.

Sincerely,

C P W S D #1 of LINN CO.

C.P.W.S.D.#1 of Linn Co.

kf

Adair County Public Water Supply District No. 1

1120 North Green
Post Office Box Q
Kirksville, Missouri 63501
Phone (660) 665-8378

November 13, 2001

North Central Missouri Regional Water Commission
P.O. Box 266
Unionville, MO 63565

Dear Mr. Wilson:

Our Board of Directors voted recently to express our interest and support of your efforts to work toward getting a regional water supply for the northern portion of Missouri. We further support the network that you have developed to deliver the water to those who need that water.

It is clear that the purposes that you propose, in addition to water for the region, such as the ability to attract jobs through potential new industrial users are meaningful. An abundant source of low-cost, pure, quality water for all in North Central Missouri is vital.

Allowing those who presently have their own water source, and those who intend to supplement their source with water from the new water supply, to participate while maintaining their own identity on the commission is important. The organization is such that neighboring districts such as ours could participate as associate members for support. This fact is also important.

We support your desire to secure a reliable, low cost, pure, quality water source for North Central Missouri. Our region's future depends upon forward thinking persons such as your commission.

Sincerely, Brent Lee Motter

Brent Motter
Board of Directors, President

DH/GM

CITY OF TRENTON
MISSOURI

Discover your heart...
in the Green Hills

October 18, 2001

Pat Wilson
North Central Missouri Regional Water Commission
PO Box 266
Unionville MO 63565

Dear Mr. Wilson:

We are writing to express our interest and support for your efforts to secure a regional water supply and the network to deliver it to systems of need in our region.

Our ability to attract jobs to our area as well as maintaining the quality of life for our residents depends on a plentiful, affordable source of water. We commend you on your mission statement focusing on the supply and affordability of water for our region.

We understand that members of your commission represent retail water systems that obtain part or all of the water they need from NCMRWC, and yet retain their sovereignty. We also commend your allowing associate members the opportunity to monitor your progress as well as securing an option for full membership at the associate's choice in the future.

Whether a water provider needs to procure a secondary source of supply or needs all of their water supplied as some do, it makes sense to cooperate with your commission and take the opportunity to have a say in our region's future.

Please consider us a supporter of your efforts to improve the quality of life in North Central Missouri.

Sincerely,

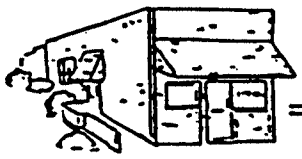
Tim Whitaker
Mayor

TW:rdm

1100 Main Street • P.O. Box 188
Trenton, MO 64683
(660) 359-4310

FAX (660) 359-2284

Trenton Municipal Utilities
P.O. Box 108 • Trenton, MO 64683
(660) 359-2281



City of Unionville
1611 Grant • P.O. Box 255 • Unionville, MO 63565

November 1, 2001

North Central Missouri Regional Water Commission
Pat Wilson, Pres.
P. O. Box 266
Unionville, MO 63565

Dear Mr. Wilson

We are writing to express our interest and support for your efforts to secure a regional water supply and the network to deliver it to systems of need in our region.

Our ability to attract jobs to our area as well as maintaining the quality of life for our residents depends on a plentiful, affordable source of water. We commend you on your mission statement focusing on the supply and affordability of water for our region.

We understand that members of your commission represent retail water systems that obtain part or all of the water they need from NCMRWC, and yet retain their sovereignty. We also commend your allowing associate member the opportunity to monitor your progress as well securing an option for full membership at the associate's choice in the future.

Whether a water provide need to procure a secondary source of supply or needs al of their water supplied as some, it makes sense to cooperated with your commission and take the opportunity to have a say in our region's future.

Please consider Unionville as a support of your efforts to improve the quality of life in North Central Missouri.

Sincerely

Ralph Halferty

Ralph Halferty
Mayor Pro Tem

APPENDIX VI
Environmental Agency Contact

NORTH CENTRAL MISSOURI REGIONAL RESERVOIR
FEASIBILITY AND MASTER PLAN
AGENCY CONTACT LIST

FEDERAL

Mr. Roy Pierce, Field Office Director
U.S. Department of Housing and Urban Development
St. Louis Field Office
1222 Spruce Street, Suite 3207
St. Louis, Missouri 63103-2836

U.S. Army Corps of Engineers
Kansas City District
601 East 12th Street
Kansas City, Missouri 64106

Lyn MacLean
U.S. Fish and Wildlife Service
BHW Federal Building
1 Federal Drive
Fort Snelling, MN 55111-4056

Mr. Charlie Scott, Field Supervisor
U.S. Fish and Wildlife Service
Columbia Ecological Services Field Office
608 East Cherry Street, Room 200
Columbia, Missouri 65201-7712

U.S. Environmental Protection Agency
Region 7
901 North 5th Street
Kansas City, Kansas 66101

USDA Forest Service
P.O. Box 96090
Washington, D.C. 20090-6090

Roger A. Hansen, State Conservationist
Natural Resource Conservation Service
Parkade Center, Suite 250
601 Business Loop 70 West
Columbia, Missouri 65203-2546

Michael Slifer
U.S. Geological Survey
1400 Independence Road, Mail Stop 100
Rolla, Missouri 65401

Advisory Council on Historic Preservation
Old Post Office Building, Suite 809
1100 Pennsylvania Avenue NW
Washington, D.C. 20004

Mr. John Miller, Regional Director
Federal Emergency Management Agency
2323 Grand Boulevard, Suite 900
Kansas City, Missouri 64108-2670

Mr. Willie R. Taylor, Director
U.S. Department of Interior
Office of Environmental Policy and Compliance
Main Interior Building MS 2340
1849 C. Street, NW
Washington, D.C. 20204

cc: Robert F. Stewart, Environmental Officer
P.O. Box 25007 (D-108)
Denver Federal Center
Denver, Colorado 80225-0007

Department of Energy
Kansas City Area Office
P.O. Box 410202
Kansas City, Missouri 64141-0202

Nick Chevance
National Park Service
1709 Jackson
Omaha, Nebraska 68102

NORTH CENTRAL MISSOURI REGIONAL RESERVOIR
FEASIBILITY AND MASTER PLAN
AGENCY CONTACT LIST

STATE

Mr. Brian A. Williams, P.E., Area Engineer
Missouri Department of Transportation
North Central District
P.O. Box 8
Kirksville, Missouri 63501

Missouri Department of Conservation
Administrative Office
2901 West Truman Boulevard
Jefferson City, Missouri 65109

Mr. Mike Anderson, Fisheries Management Biologist
Missouri Department of Conservation
Northeast Regional Office
2500 South Halliburton
Kirksville, Missouri 63501

Brian D. Canaday, Policy Coordinator
Missouri Department of Conservation
2901 West Truman Boulevard
Jefferson City, Missouri 65102-0180

Tim Rickabaugh, Project Development
Missouri Department of Economic Development
301 West High Street, Room 680
Jefferson City, Missouri 65102

Mr. Stephen M. Mahfood, Director
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, Missouri 65102

Mark A. Miles
Interim Director and Deputy State Historic Preservation Officer
State Historic Preservation Office
P. O. Box 176
Jefferson City, MO 65102

Mr. George Riedel, Floodplain Management Mangager
State Emergency Management Agency
P.O. Box 116
Jefferson City, Missouri 65102

Mr. Ewell Lawson, Director
Missouri Federal Assistance Clearinghouse
Office of Administration
Room 840 Truman Building
Jefferson City, Missouri 65101

Joseph E. Francka, Division Director
Missouri Department of Agriculture
P.O. Box 630
Jefferson City, Missouri 65102-0630

cc: Mr. Paul Andre
Missouri Department of Agriculture
P.O. Box 630
Jefferson City, Missouri 65102-0630

Mr. Harold Kernes
Fisheries Regional Supervisor
MO Department of Conservation
701 NE College Drive
St. Joseph, MO 64507

32508
Agency Corr.

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

APR 22 2003

Mr. Fred C. Pinkney, PhD.
Project Manager
Burns & McDonnell
9400 Ward Parkway
Kansas City, Missouri 64114-3319

Dear Mr. Pinkney:

Thank you for your letter requesting input on the Feasibility Study of the North Central Missouri Regional Water Supply Project. As you may know, the Office of Environmental Policy and Compliance (OEPC) has the overall responsibility of carrying out the policy of the National Environmental Policy Act of 1969, for the Department of the Interior (DOI).

OEPC delegates non-Interior scoping activities to the appropriate Interior bureaus for early coordination. Due to the project location and type, early coordination and scoping should be coordinated through the following field level offices:

U.S. Fish and Wildlife Service (Lyn MacLean; 612-713-5330)
Address: BHW Federal Building, 1 Federal Drive, Fort Snelling, MN 55111-4056
National Park Service (Nick Chevance; 402-221-7286)
Address: National Park Service, 1709 Jackson, Omaha, Nebraska 68102
U.S. Geological Survey (Michael Slifer; 573-308-3667)
Address: 1400 Independence Road, Mail Stop 100, Rolla, Missouri 65401)

You are encouraged to establish contact with our field level offices. Our Environmental Officer in Denver, Robert F. Stewart serves as the regional representative for this office. You may contact him at, 303-445-2500. We have also enclosed a copy of our environmental review process should you eventually need to acquire DOI's review of project documents.

We appreciate the opportunity to participate in the early planning processes of the Missouri Regional Water Supply Project.

Sincerely,

Willie R. Taylor

Willie R. Taylor
Director
Office of Environmental Policy
and Compliance

Enclosure

32508 Agency Corr.

United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240

ENVIRONMENTAL REVIEW PROCESS

December 12, 2002

In order to expedite requests to the Department of the Interior for the review of environmental documents under the National Environmental Policy Act (NEPA); Section 4(f) of the Department of Transportation Act; project planning, design, and application documents under various Federal authorities; and requests for coordination and consultation early in project planning; please note the following.

Appendix III to the Council on Environmental Quality's (CEQ) regulations (49 FR 49778; December 21, 1984) lists the Director, Office of Environmental Project Review (now the Office of Environmental Policy and Compliance), as the individual responsible for receiving and commenting on other agencies' environmental documents. If properly followed, this process results in your agency receiving one set of comments on behalf of the Department. Therefore, please send all officially approved documents requesting environmental and other project review to the following address for review and comment by the Department of the Interior:

Director, Office of Environmental Policy and Compliance
Department of the Interior
Main Interior Building, MS 2342
1849 C Street, NW
Washington, DC 20240

It is unnecessary to send copies of environmental and other project review requests to any other bureau or office within Interior. However, a sufficient number of copies must be sent to the Office of Environmental Policy and Compliance (OEPC) to allow distribution of the document to those Interior bureaus being requested to participate in the review. The requested numbers of copies allow for simultaneous review throughout each bureau thus producing the Department's consolidated review in the shortest possible time. A review can be initiated with less than the stated number, but this may lead to a longer review time. The following numbers of copies should be provided:

Twelve (12) copies of a draft and six (6) copies of a final document for projects in the Eastern United States including MN, IA, MO, AR, and LA. The same numbers of copies should be provided for projects in AS, GU, HI, PR, VI, and the Trust Territories.

Eighteen (18) copies of a draft and nine (9) copies of a final document for projects in the Western United States westward of the western boundaries of MN, IA, MO, AR, and LA.

Eighteen (18) copies of a draft and nine (9) copies of a final document for review requests which are national in scope (e.g. agency regulations, scientific reports, special reports, program plans, and other interagency documents).

Sixteen (16) copies of a draft and eight (8) copies of a final document for projects in AK.

When a review document does not have draft and final versions, the larger number of copies is requested.

Copies of environmental and project review documents that are available in CD-ROM, on the Internet, or by any other widely used electronic method may be furnished in lieu of paper copies. When this is the case, we would still appreciate receiving one paper copy for our official file. Please provide the CDs or the Internet address to this office.

Appendix II to the CEQ regulations (49 FR 49754; December 21, 1984) lists Interior bureaus and offices with jurisdiction by law or special expertise on environmental quality issues. Appendix II should be used to determine appropriate Interior contacts for coordination during early planning, NEPA scoping, and other preliminary activities. Since this document is out of date, it is recommended that one consult the following Internet address for the latest bureau contacts. http://ceq.eh.doe.gov/nepa/nepanet.htm.

All early coordination and scoping requests, environmental assessments or reports not accompanied by project planning or design documents, findings of no significant impact, preliminary or working draft or final environmental impact statements, and similar material of a regional nature should be sent directly to Interior bureaus at the field level. It is not necessary to send copies of these documents to the OEPC in Washington, DC. Please note that our Regional Environmental Officers (REO) serve as representatives of OEPC and should be contacted if there are any questions about these procedures at the field level. An REO list is attached.

Representatives of your organization should establish direct working relationships with Interior's field level offices, which welcome such contact. This type of relationship is important not only during early project coordination, but also to expedite the early resolution of environmental issues that would otherwise surface during the formal review of a project document. In many cases, Interior's comments on an environmental review will designate an office at the field level for follow-up activities.

We recommend that you make a wide distribution of this information within your organization. Such a distribution will greatly assist our agencies in better meeting our obligations under existing laws and in planning projects that will be mutually beneficial.

Attachment (REO List)

U.S. DEPARTMENT OF THE INTERIOR

OFFICE OF ENVIRONMENTAL POLICY and COMPLIANCE

REGIONAL ENVIRONMENTAL OFFICES

DIRECTOR
WILLIE R. TAYLOR
1849 C STREET, NW ,MS 2342, WASHINGTON, DC 20240 PHONE 202-208-3891/FAX 202- 208-6970

DEPUTY DIRECTOR
MARY JOSIE BLANCHARD

BOSTON - CT,MA,ME,NH,NJ,NY,RI,VT

Andrew L. Raddant

Valerie Ketton (Temp)

Phone 617-223-8565
Fax: 617-223-8569
408 Atlantic Avenue,Room 142
Boston, MA 02210-3334

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32508 Agency Corr.

MISSOURI DEPARTMENT OF CONSERVATION

Headquarters
2901 West Truman Boulevard, P.O. Box 180, Jefferson City, Missouri 65102-0180
Telephone: 573/751-4115 ▲ Missouri Relay Center: 1-800-735-2966 (TDD)

JOHN D. HOSKINS, Director

April 22, 2003

Fred C. Pinkney, PhD.
Project Manager
Burns & McDonald
9400 Ward Parkway
Kansas City, Missouri 64114-3319

Dear Dr. Pinkney:

Re: North Central Regional Reservoir Feasibility Study and Master Plan
Request for Resource Information and Issue Identification
NCMOWSP – 32508

Thank you for your letter of March 20, 2003, regarding species of conservation concern and sensitive or unique biological communities in the proposed study area.

A review of our records shows that species of conservation concern and sensitive or unique biological communities are known to occur in the counties of the proposed study area. Details are provided in the enclosed Heritage Database report and reflect the information we currently have in those north Missouri counties. Please be advised, this is **not a clearance letter.** Rather, this letter provides an indication of whether or not species of conservation concern and sensitive or unique biological communities are known to occur in the study counties.

Incorporating information from our Heritage Database into project plans is an important step that can help reduce unnecessary impacts to Missouri's sensitive natural resources. However, the Heritage Database is only one reference which should be used to evaluate potential adverse impacts. Other types of information, such as wetland and soils maps and on-site inspections or surveys, should be considered. Reviewing current landscape and habitat information and species biological characteristics would additionally ensure that species of conservation concern are appropriately identified and addressed.

Thank you for the opportunity to review and comment.

Sincerely,

Brian D. Canaday

BRIAN D. CANADAY
POLICY COORDINATOR

BDC:dcl

Enclosure

FEDERAL OR STATE LISTED SPECIES AND HIGH-QUALITY NATURAL COMMUNITIES KNOWN FROM NORTH CENTRAL MISSOURI APRIL 21, 2003
PRINTOUT OF THE MISSOURI NATURAL HERITAGE PROGRAM

SCIENTIFIC NAME	COMMON NAME	FED STATUS	STATE STATUS
*** ADAIR			
ASCLEPIAS MEADII	MEAD'S MILKWEED	T	E
RALLUS ELEGANS	KING RAIL		E
TYMPANUCHUS CUPIDO	GREATER PRAIRIE-CHICKEN		E
MYOTIS SODALIS	INDIANA BAT	E	E
DRY-MESIC LOESS/GLACIAL TILL FOREST			
DRY-MESIC LOESS/GLACIAL TILL WOODLAND			
FRESHWATER MARSH			
*** CHARITON			
SISTRURUS CATENATUS CATENATUS	EASTERN MASSASAUGA	C	E
STERNA ANTILLARUM ATHALASSOS	INTERIOR LEAST TERN	E	E
MYOTIS SODALIS	INDIANA BAT	E	E
SPILOGALE PUTORIUS INTERRUPTA	PLAINS SPOTTED SKUNK		E
CREEKS AND SMALL RIVERS (PRAIRIE REGION)			
LARGER RIVERS (PRAIRIE REGION)			
DRY-MESIC LOESS/GLACIAL TILL PRAIRIE			
DRY-MESIC LOESS/GLACIAL TILL SAVANNA			
FRESHWATER MARSH			
SHRUB SWAMP			
WET BOTTOMLAND FOREST			
WET BOTTOMLAND PRAIRIE			
WET-MESIC BOTTOMLAND FOREST			
*** GRUNDY			
NOTROPIS TOPEKA	TOPEKA SHINER	E	E
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	T	E
TYTO ALBA	BARN OWL		E
MESIC LOESS/GLACIAL TILL PRAIRIE			
WET BOTTOMLAND PRAIRIE			
*** LINN			
SISTRURUS CATENATUS CATENATUS	EASTERN MASSASAUGA	C	E
BOTAURUS LENTIGINOSUS	AMERICAN BITTERN		E
CIRCUS CYANEUS	NORTHERN HARRIER		E
MYOTIS SODALIS	INDIANA BAT	E	E
CREEKS AND SMALL RIVERS (PRAIRIE REGION)			
OXBOWS AND SLOUGHS (PRAIRIE REGION)			
RIVERFRONT FOREST			
WET BOTTOMLAND FOREST			
WET BOTTOMLAND PRAIRIE			
WET-MESIC BOTTOMLAND FOREST			
*** LIVINGSTON			
SCAPHIRHYNCHUS ALBUS	PALLID STURGEON	E	E
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	T	E
TYTO ALBA	BARN OWL		E
OXBOWS AND SLOUGHS (BIG RIVERS)			
DRY LIMESTONE/DOLOMITE WOODLAND			
DRY-MESIC LOESS/GLACIAL TILL PRAIRIE			
MESIC SANDSTONE FOREST			
MOIST SANDSTONE CLIFF			
SHRUB SWAMP			
WET-MESIC BOTTOMLAND FOREST			

SCIENTIFIC NAME	COMMON NAME	FED STATUS	STATE STATUS
*** MACON			
BOTAURUS LENTIGINOSUS	AMERICAN BITTERN		E
CIRCUS CYANEUS	NORTHERN HARRIER		E
TYMPANUCHUS CUPIDO	GREATER PRAIRIE-CHICKEN		E
MYOTIS SODALIS	INDIANA BAT	E	E
CREEKS AND SMALL RIVERS (PRAIRIE REGION)			
DRY-MESIC LOESS/GLACIAL TILL PRAIRIE			
DRY-MESIC LOESS/GLACIAL TILL SAVANNA			
FRESHWATER MARSH			
MESIC BOTTOMLAND FOREST			
WET-MESIC BOTTOMLAND FOREST			
*** MERCER			
MYOTIS SODALIS	INDIANA BAT	E	E
DRY-MESIC LOESS/GLACIAL TILL PRAIRIE			
DRY-MESIC LOESS/GLACIAL TILL WOODLAND			
FRESHWATER MARSH			
WET-MESIC BOTTOMLAND FOREST			
WET-MESIC BOTTOMLAND PRAIRIE			
WET-MESIC BOTTOMLAND WOODLAND			
*** PUTNAM			
NOTROPIS TOPEKA	TOPEKA SHINER	E	E
HEADWATERS (PRAIRIE REGION)			
SHRUB SWAMP			
WET BOTTOMLAND FOREST			
WET-MESIC BOTTOMLAND FOREST			
*** RANDOLPH			
DRY LOESS/GLACIAL TILL WOODLAND			
DRY-MESIC LOESS/GLACIAL TILL FOREST			
MESIC LOESS/GLACIAL TILL FOREST			
*** SCHUYLER			
CREEKS AND SMALL RIVERS (PRAIRIE REGION)			
GLACIAL FEN			
*** SULLIVAN			
TYMPANUCHUS CUPIDO	GREATER PRAIRIE-CHICKEN		E
MYOTIS SODALIS	INDIANA BAT	E	E
SPILOGALE PUTORIUS INTERRUPTA	PLAINS SPOTTED SKUNK		E
DRY LOESS/GLACIAL TILL WOODLAND			
DRY-MESIC LOESS/GLACIAL TILL FOREST			
DRY-MESIC LOESS/GLACIAL TILL PRAIRIE			
MESIC LOESS/GLACIAL TILL FOREST			

32508
Ag. Cor.

MISSOURI DEPARTMENT OF CONSERVATION

Headquarters
2901 West Truman Boulevard, P.O. Box 180, Jefferson City, Missouri 65102-0180
Telephone: 573/751-4115 ▲ Missouri Relay Center: 1-800-735-2966 (TDD)

JOHN D. HOSKINS, Director

REPLY TO: Northeast Regional Office
2500 S. Halliburton
Kirksville, MO 63501
Telephone: 660-785-2424
Fax: 660-785-2553

April 21, 2003

Mr. Fred C. Pinkney, PhD.
Burns & McDonnell
9400 Ward Parkway
Kansas City, MO 64114-3319

Dear Mr. Pinkney:

I enjoyed speaking with you this morning about the North Central Regional Reservoir Feasibility Study and Master Plan. Your initial project area covers the Grand River, Locust Creek and Chariton River basins.

I have provided you a copy of the Locust Creek Basin Management Plan. The Grand River and Chariton River Watershed Inventory and Assessments can be found by visiting our website at www.state.mo.us and then click on the 'Rivers and Their Watersheds' link. You should be able to locate environmental and natural resource information that you requested from these documents.

If you need additional information, please feel free to call me at the number listed above, or you can e-mail me at anderm@mdc.state.mo.us.

Sincerely,

Mike Anderson

Mike Anderson
Fisheries Management Biologist

Enclosure

32508
Agency C

MISSOURI
DEPARTMENT OF ECONOMIC DEVELOPMENT

Bob Holden
Governor

COMMUNITY DEVELOPMENT BLOCK GRANT PROGRAM

Joseph L. Driskill
Director

Community Development
301 W. High Street
P.O. Box 118
Jefferson City, MO 65102
573-751-4146
573-526-4157 (FAX)

Sallie Hemenway
Director

April 17, 2003

Dr. Fred Pinkney, Ph.D.
Burns and McDonnell
9400 Ward Parkway
Kansas City, MO 64114-3319

RE: North Central Regional Reservoir Feasibility Study and Master Plan

Dear Dr. Pinkney:

Thank you for giving us the opportunity to submit comments regarding the above referenced project. We have already had some initial contact with the North Central Missouri Regional Water Commission and look forward to assisting with the project in anyway we can.

As a development agency for the State of Missouri we want to make sure that all the business and community development needs are addressed in the feasibility study. The service area includes several incorporated areas that have particular needs concerning water supply. We hope that the different water needs will be identified.

The Department of Economic Development/Community Development Block Grant program has been very instrumental in providing funding for the basic water/wastewater infrastructure in the area. We expect that the Commission will take this into account and utilize the infrastructure that is already in place to reduce the potential costs of this undertaking. We can provide you with any information that you may need regarding any water infrastructure that CDBG may have participated in.

We also recommend that you incorporate the water use plan established by the Interagency Task Force (IATF). According to the Missouri Water Resources Law (sections 640.400 to 640.435 RSMo), the state water resources plan is to address water needs for the following uses: drinking, agriculture, industry, recreation and environmental impact. The IATF has established a water usage plan for the Northwestern part of Missouri. The Missouri Department of Natural Resources/Water Resources Program can provide a copy of the report.

Again, thank you for this opportunity. If you have any questions or if additional information is needed please do not hesitate to contact me at 573/751-4146.

Sincerely,

Tim Rickabaugh

Tim Rickabaugh
Project Development
Missouri CDBG Program

32508
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Bob Holden
Governor

Jacquelyn D. White
Commissioner

State of Missouri
OFFICE OF ADMINISTRATION
Intergovernmental Relations
Post Office Box 809
Jefferson City, 65102
573/751-4834

April 18, 2003

Fred C. Pinkney
Project Manager
Burns & McDonnell
9400 Ward Parkway
Kansas City, MO 64114-3319

Dear Dr. Pinkney:

Subject: 0300358 - North Central Regional Reservoir
Feasibility Study

The Missouri Federal Assistance Clearinghouse, in cooperation with state and local agencies interested or possibly affected, has completed the review on the above project application.

None of the agencies involved in the review had comments or recommendations to offer at this time. This concludes the Clearinghouse's review.

A copy of this letter is to be attached to the application as evidence of compliance with the State Clearinghouse requirements.

Sincerely,

Ewell Lawson

Ewell Lawson, Director
Intergovernmental Relations

EL:ab

cc: Green Hills Regional Planning Commission
Northeast Missouri Regional Planning Commission

32508
Agency Corr.

United States Department of Agriculture

NRCS
Natural Resources Conservation Service
Parkade Center, Suite 250, 601 Business Loop 70 West
Columbia, Missouri 65203

March 13, 2003

Mike Mills, Deputy State Director
Office of Constituent Services
c/o Senator Christopher S. Bond
308 E. High Street, Suite 202
Jefferson City, Missouri 65101

Dear Mike:

The purpose of this letter is to clarify some of the issues associated with building a large water supply reservoir on East Locust Creek under Public Law 83-566 authority. Presently this reservoir is sponsored by the North Central Missouri Regional Water District. To date they have operated independently of the existing East Locust Creek Watershed project, which is sponsored by the Locust Creek Watershed District. The proposed reservoir will inundate numerous sites already constructed. We would encourage more cooperation between the two groups to resolve issues.

The Watershed Protection and Flood Prevention Act of 1954 gave NRCS authority to assist sponsors in developing projects for various purposes including flood prevention, fish and wildlife recreation, and water supply. This act limited the capacity of reservoirs which NRCS could assist to a total storage at the auxiliary spillway of 25,000 ac-ft. The size of the proposed reservoir would be considerably outside of this statutory limit. In order for NRCS to assist with planning, design, and construction of this lake, an exemption to the law would need to be granted by Congress (which, according to our national office, has been done on other projects).

Assuming an exemption could be obtained, the minimum time required is estimated as follows:

- Preparing a draft supplement to the East Locust Creek Watershed plan and EIS – one year
- Interagency review of the draft plan and EIS – one year.
- Congressional approval of the plan and EIS – one year.
- Sponsors acquiring land rights – two years. The site chosen by the sponsors will require re-locating a state highway, relocating the town of Boynton, and acquiring a land area estimated to be at least twice the size of the permanent pool.
- Hiring consultant to design lake because of presence of municipal and industrial water supply – one to two years.
- Consulting with the Corps of Engineers, Missouri Department of Natural Resources, US Fish and Wildlife Service, Missouri Department of Conservation, and other resource agencies to determine final mitigation requirements – one year.
- Construction of the project – one to two years.

Some of this work would occur concurrently. For a project of this size and scope, however, a timeframe of 5-10 years would be needed.

At this point it is impossible to estimate cost share allocations, but several issues will limit NRCS in the cost allocation process:

- A water supply reservoir of this size would be considered for municipal and industrial (M&I) use. NRCS does not cost share on M&I water.
- Since most of the water would be allocated to water supply, the cost share for recreation would be relatively small in comparison to the total cost.
- Numerous small floodwater retarding dams have already been constructed in the East Locust Creek project. This dam and reservoir would inundate several of these. This would reduce the cost share provided under flood prevention.

46 proposed
26 built
15 below 9

There are likely other issues that will arise if this project is carried forward, but the issues covered in this letter are the major aspects we face to begin to implement the project under NRCS authority.

Please feel free to call me or Harold Deckerd if you have any questions.

Sincerely,

Roger A Hansen

ROGER A. HANSEN
State Conservationist

cc: Harold Deckerd, Assistant State Conservationist (Water Resources)

32508
Agency Corr.

Bob Holden
Governor

Jacquelyn D. White
Commissioner

State of Missouri
OFFICE OF ADMINISTRATION
Intergovernmental Relations
Post Office Box 809
Jefferson City, 65102
March 26, 2003

Mr. Fred C. Pinkney
Project Manager
Burns & McDonnell
9400 Ward Parkway
Kansas City, MO 64114-3319

RE: Feasibility Study for the North Central Missouri Regional Water Commission

Dear Mr. Pinkney:

I am writing to respond to your inquiry regarding input to the feasibility study for the North Central Missouri Regional Wholesale Water Commission. The information you supplied has been added to a grant and program index for review. This index is maintained by the Missouri Federal Assistance Clearinghouse and is e-mailed weekly to approximately 60 persons around the state who have interest in any of the categories of federal grant applications and environmental assessments.

The Agency Contact List you have supplied is also an excellent representation of parties able to identify issues and concerns related to the Water Supply Project. Please change the name and address of your contact for the Missouri Federal Assistance Clearinghouse from Ms. Lois Pohl to:

Mr. Ewell Lawson, Coordinator
Missouri Federal Assistance Clearinghouse
Office of Administration
Room 840 Truman Building
Jefferson City, MO 65101

At the end of the index comment period, which is approximately three weeks, you will receive a letter from the Clearinghouse. If comments have been made, they will be included in our letter.

If I can be of further assistance, please feel free to contact me at (573) 751-4834.

Sincerely,

Ewell Lawson, Director
Intergovernmental Relations

M:Igr/A95

32508
Agency Corr.

Missouri
Department
of Transportation

MoDOT

Brian Williams, Area Engineer

North Central District
P.O. Box 8
Kirksville, MO 63501
(660) 785-2470
Fax (660)665-8982

April 3, 2003

Mr. Fred C. Pinkney, Project Manager
Burns & McDonnell
9400 Ward Parkway
Kansas City, MO 64114-3319

North Central Regional Reservoir Feasibility Study and Master Plan

Dear Mr. Pinkney,

In response to your letter to Mike Bruemmer dated March 20, 2003, I will be your point-of-contact for the Missouri Department of Transportation (MoDOT) for the above referenced project.

Initially the concern I have is how this project will impact State Routes in the area. This would include issues such as right of way, access, increases in traffic volume, etc. As this project progresses I am sure there will be additional concerns that will arise.

If you have any questions, contact me at (660) 785-2470 or (660) 785-2490 or by email at willib@mail.modot.state.mo.us.

Sincerely,

Brian A. Williams

Brian A. Williams, P.E.
Area Engineer

Copy: Mike Bruemmer
File

32508
Agency Corr.

DEPARTMENT *of* AGRICULTURE
STATE OF MISSOURI
JEFFERSON CITY

BOB HOLDEN
GOVERNOR

LOWELL MOHLER
DIRECTOR

Serving, promoting and protecting the agricultural producers, processors and consumers of Missouri's food, fuel and fiber products.

April 3, 2003

Fred C. Pinkney, Ph.D.
Project Manager
Burns & McDonnell
9400 Ward Parkway
Kansas City, MO 64114-3319

Dear Dr. Pinkney:

This is in response to your letter of March 20, 2003, requesting input for conducting a feasibility study and preparing a master plan report for the North Central Missouri regional water supply project.

You asked for environmental or natural resource information or data that is available. The information I have enclosed concerning endangered or threatened species and the EPA interim re-registration eligibility decision (IRED) for the pesticide Atrazine has probably been or will be provided you by the Missouri Department of Conservation and the U.S. Environmental Protection Agency (EPA) – Region 7. However, this is information that should be of concern to you.

The person in our Department who works on water quality issues and endangered species is Paul Andre. He can be reached at the address on this letterhead.

If I can be of further service, please feel free to call.

Sincerely,

Joseph E. Francka

Joseph E. Francka
Division Director

JEF:lw

Division of Plant Industries
Ph. (573) 751-2462 • 1616 Missouri Boulevard • P.O. Box 630 • Jefferson City, MO 65102-0630 • FAX (573) 751-0005
www.mda.state.mo.us

United Environmental Protection Agency
Office of Public Affairs
Washington, D.C. 20460
www.epa.gov/newsroom

EPA Environmental News

FOR RELEASE: FRIDAY, JANUARY 31, 2003

EPA ADOPTS AGGRESSIVE MEASURES ON HERBICIDE ATRAZINE

Approach Ensures Protection of Nation's Most Vulnerable Drinking Water Sources

CONTACT: David Deegan, 202-564-7839

EPA announced today an innovative and aggressive program to protect vulnerable community drinking water systems from contamination by atrazine, an herbicide used widely in the U.S. on a variety of crops and nonagricultural uses. The program announced by the Agency involves intensive, targeted monitoring of raw water entering certain community water systems in areas of atrazine use. Under conditions spelled out in the document, when atrazine is detected in water above Agency safety standards the use will be prohibited in that specific watershed area. These and other measures are contained in EPA's "Interim Reregistration Eligibility Decision" (IRED), the result of several years of concentrated analysis of the best and most recently available scientific studies.

"After the most extensive analysis ever conducted on atrazine, EPA has designed a protective, early alert system to implement rigorous monitoring and fine-tuned safeguards to protect drinking water in the communities where atrazine is used," said Stephen L. Johnson, EPA's Assistant Administrator for the Office of Prevention, Pesticides, and Toxic Substances. "For the most vulnerable watersheds, if the testing shows higher levels of atrazine than we consider acceptable, use of the product will be prohibited in that area."

In this document, the Agency has concluded that atrazine may continue to be used, provided all the precautions and the new specific measures are implemented to reduce risks to drinking water. These new measures will help ensure the continued protection of drinking water. The Agency has concluded that risks associated with exposures from food are not of concern. Exposure from residential uses and exposure to workers are low and have been addressed by changes in product use conditions.

The provisions of this action, contained in the IRED, have also been incorporated into an agreement with the principal registrant of atrazine, Syngenta. Under this approach, Syngenta is required to conduct a specialized testing program in vulnerable watersheds on a weekly basis to monitor "raw" drinking water during high-use periods for this pesticide. If the Agency's regulatory safety standards are exceeded in raw drinking water, atrazine use is cancelled in that geographic area. This more stringent approach requiring weekly monitoring of "raw" drinking water during certain times of the year augments monitoring conducted under the Safe Drinking Water Act (SDWA) of "finished" drinking water. For all other areas where atrazine might be used, monitoring of finished drinking water for atrazine is rountinely required under the Safe Drinking Water Act (SDWA). For these systems, detections approaching the Maximum Contaminant Level (MCL) for atrazine will trigger additional monitoring and regulatory oversight. The Agency's existing MCL remains protective and

in place. If the MCL is violated, the pesticide manufacturer is required to take the steps necessary to assist the community water system return to compliance with the atrazine MCL.

In this way EPA is allowing flexibility to account for local conditions while assuring that the Agency's safety standards are met. The costs involved in this program will be the responsibility of atrazine manufacturers as part of their product stewardship.

The Agency is continuing to evaluate the potential effects of atrazine on amphibians, which continue to be the subject of additional research and analysis. EPA intends to submit the issue of atrazine effects on amphibians for independent scientific peer review by the FIFRA Scientific Advisory Panel in June, and the Agency anticipates completion of an amended IRED, including consideration of effects on amphibians, by Oct. 31, 2003.

EPA's work on atrazine is based on a thorough review of an extensive body of the best available scientific data and studies, and has been the subject of public and stakeholder participation, including independent scientific peer review. Atrazine is being reviewed as part of EPA's ongoing program to evaluate older pesticides to ensure that they meet current health and environmental safety standards, including the health protective measures called for in the Food Quality Protection Act. In addition to the significant ccomplishment represented by this action on atrazine, today's action fulfills an obligation to the Natural Resources Defense Council (NRDC) and others under a consent agreement.

First registered in 1958, atrazine is estimated to be the most heavily used herbicide in the U.S. The largest uses are on corn, sugarcane and residential lawns. Extensive additional information on EPA's review of atrazine is available at: http://www.epa.gov/oppsrrd1/reregistration/atrazine/ .

# # #

R036

United States Environmental Protection Agency | Prevention, Pesticides And Toxic Substances (7506C) | January 31, 2003

Questions & Answers

Atrazine
Interim Reregistration
Eligibility Decision

EPA is completing its interim reregistration eligibility decision (IRED) for the pesticide atrazine, a herbicide primarily used to control broadleaf and some grassy weeds for a variety of major and minor crops and nonagricultural uses. First registered in 1958, and used extensively throughout the country, atrazine is being reviewed as part of EPA's program to ensure that older pesticides meet current health and environmental safety standards. As part of this effort, EPA has reviewed an extensive body of data and studies, conferred with independent scientific experts in a variety of disciplines, and encouraged public and stakeholder participation. The IRED document identifies the various conditions and risk mitigation measures necessary to ensure that approved uses of atrazine meet federal safety standards. EPA prepared this document after close consultation with our federal, state, and tribal regulatory partners. This Q&A document provides technical and general information about atrazine and its current regulatory status under pesticide and water laws.

What is atrazine and how is it used?

Atrazine, which may be applied both before and after planting to control broadleaf and grassy weeds, was first registered for use as a herbicide on December 1, 1958. Atrazine is currently one of the most widely used agricultural pesticides in the United States, with estimated production of 76 to 85 million pounds annually. Approximately 76.5 million pounds of active ingredient are applied domestically per year. The main use sites for applying atrazine include the following:

Agricultural sites:

- corn
- sugarcane
- sorghum
- minor crops including: guava, hay, macadamia nuts, pasture, and winter wheat

Non-agricultural sites:

- ornamental sod (farms)
- golf courses (turf)
- rangeland
- residential lawns
- Bermuda grass
- grasses grown for seed
- landscape maintenance
- ornamental trees

- forests
- Christmas trees
- recreational areas
- rights-of-way
- industrial areas

Where is atrazine used most heavily?
Atrazine is estimated to be the most heavily used herbicide in the United States. Its primary uses are on corn and sugarcane and on residential lawns in Florida and the Southeast. Currently, the heaviest atrazine uses per unit area occur in portions of Delaware, Iowa, Illinois, Indiana, Ohio, and Nebraska.

What are atrazine's potential effects on human health?
In EPA's refined risk assessment, issued in May 2002, the Agency reviewed extensive data relating to the potential human health effects of atrazine exposure. EPA found, in consultation with an independent scientific advisory panel, that it is not likely to be carcinogenic to humans. However, there is concern that atrazine has been associated with causing imbalances in hormone levels in laboratory animals, possibly disrupting reproductive and developmental processes. EPA considered these effects, and the exposure levels that created such concerns, in determining what types of risk mitigation measures are necessary to meet Federal safety standards.

What action is EPA currently taking with atrazine?
EPA is completing its Interim Reregistration Eligibility Decision (IRED) for the pesticide atrazine, outlining the label changes and risk reduction steps necessary for the pesticide to meet health and environmental safety standards under EPA's pesticide reregistration program. This program ensures that older pesticides meet current health and environmental safety standards. In developing this decision, EPA conducted a comprehensive scientific review of atrazine's use, risks, and benefits, and sought frequent input from the broader scientific community. EPA sought public comment and participation throughout the process, and conducted extensive consultations with its federal, state, and local regulatory partners, the registrant community, the affected pesticide user communities, public interest groups, and other stakeholders.

How did EPA come to this decision?
This is the latest step in a process to review atrazine and other older pesticides against current standards. The process includes updating available data on the pesticide being reviewed. To date, EPA has completed the following steps as part of the atrazine review.

- EPA released the Preliminary Human Health Risk Assessment for Atrazine in February 2001 and the Preliminary Environmental Fate and Effects Risk Assessment in September 2001. To ensure transparency and opportunities for public involvement, the public was invited to comment on these documents and these comments have been considered in atrazine's revised risk assessments.
- In April 2002 the Agency completed the revised Human Health Risk Assessment and the Environmental Fate and Effects Risk Assessment. The revised assessment and supporting documents may be found at: http://www.epa.gov/oppsrrd1/reregistration/atrazine.

How many community water systems are there, and how many are we concerned about?
There are approximately 50,000 community drinking water systems in the United States. Of

these, 40,000 are served by ground water, and 10,000 are served by surface water.

Surface water is our focus in this action. For the 10,000 community water systems served by surface water, the Agency has identified 3,600 systems where atrazine is used and monitoring information is available.

- The current monitoring has identified 200 community water systems where detections have approached or exceeded the MCL for atrazine.
- Of the 200, eight of these community water systems have annual average readings that significantly exceed the MCL.

What are the new and innovative measures being implemented as part of the IRED?

Human Health Measures

The IRED includes measures to address risks to workers, risks associated with residential uses, and risks from drinking water. EPA has put in place enforceable requirements, including:

- An intensive monitoring program for raw water – including weekly sampling during the pesticide use season and biweekly for the rest of the year – to ensure that the 200 most vulnerable watersheds are routinely monitored so atrazine levels do not reach levels of concern.
- For the eight highly vulnerable water systems, if atrazine is detected above the level of concern, use will be prohibited in the specific watershed area.
- For the remaining systems, there will be intense monitoring; then if there is another detection that exceeds the level of concern, site-specific mitigation plans will be put in place. Further, if atrazine is detected again above the level of concern, use of atrazine will be prohibited in that specific geographic area.
- In addition, for all others watersheds where atrazine is used, the Safe Drinking Water Act requires routine monitoring of finished drinking water for atrazine. For these systems, if atrazine is detected at levels approaching the MCL, then additional monitoring and regulatory oversight will be triggered.
- In these cases, it would be considered a highly vulnerable watershed category for regulatory purposes.
- If the MCL is violated, the pesticide manufacturer is required to take steps necessary to assist the community water supply to come into compliance with the MCL.
- In addition, the manufacturers will conduct an education program with farmers to ensure that atrazine is used according to more restrictive management practices. These practices have been shown to reduce atrazine contamination to safe levels for ground and surface water.

In addition, to confirm that rural drinking water wells are not expected to have atrazine levels that exceed the Agency's level of concern, the Agency will require that the registrant(s) conduct a rural well monitoring study in atrazine use areas.

EPA also is requiring changes to better protect workers and people who may be exposed to

atrazine used in residential settings.

Ecological Measures
To mitigate risks to the environment from atrazine residues, the Agency is establishing a tiered ecological assessment process that will identify waterbodies affected by atrazine and determine which of these waterbodies are candidates for atrazine monitoring and/or mitigation. Waterbodies that may be identified for mitigation are waters officially listed by a state as impaired and/or waters with measured exceedences of the Agency's level of concern. Monitoring programs to determine if mitigation is required may be based on such factors as frequency, duration, and level of atrazine concentrations; atrazine use in the watershed; and environmental vulnerability. The plan will be completed in spring 2003.

In which states are there watersheds where intensive monitoring is going to begin now?
EPA has identified approximately 200 community water systems in the following states where monitoring will begin now: Alabama, Ohio, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Missouri, Texas.

Does this IRED address endangered species issues?
The ecological assessment is the baseline of information from which we conduct our assessment specific to threatened and endangered species. Although some uses of atrazine have been assessed and consulted on in the past, an updated endangered species assessment will follow completion of the ecological assessment. The measures in the IRED will serve as protective measures in the interim.

Why is EPA taking this action now?
EPA has long considered its review of atrazine to be a high priority in the reregistration and tolerance reassessment program, and has been working to complete the scientific analysis and public consultation necessary to release a well-grounded decision as quickly as possible. In addition, EPA agreed in a Consent Decree with a number of public interest groups to complete this portion of the atrazine review by January 31, 2003.

- **EPA has Completed an Extensive Review:** This IRED is a product of years of scientific analysis of both ecological and health risks. We have also ensured that the process incorporated appropriate opportunities for expert and stakeholder consultation and to allow for the use of sound scientific analysis.

- **FIFRA Requires Reregistration Review of Older Pesticides:** EPA's review of atrazine as part of the Agency's comprehensive effort to ensure that older pesticides meet current Federal health and safety standards. As part of that effort, we are considering a wide range of scientific data and public input to ensure that any final risk management decision is grounded in sound science and informed by all perspectives.

- **Completing the IRED Fulfills an Obligation in the NRDC Consent Decree:** This deadline is imposed by a Consent Decree that resolved lawsuits brought against the Environmental Protection Agency by the Natural Resources Defense Council (NRDC), the United Farmworkers of America, the AFL-CIO, and other farmworker/environmental groups with respect to pesticide tolerance reassessment and pesticide reregistration.

What are the public health benefits we expect from this action related to drinking water?

- We are announcing a new, watershed-based action that will better protect people from potential risks associated with the use of atrazine–one of the most widely used herbicides in the United States.

- By providing for an early alert system, these actions will better protect all water supply systems in areas where atrazine contamination can be a problem.

- This new approach will substantially increase the monitoring for vulnerable water supply systems–so when we detect atrazine at levels of concern–use of the pesticide will be prohibited in that specific geographical area.

- The Agency's existing MCL remains protective and in place. If the MCL is violated, the pesticide manufacturer will take steps necessary to assist the community water system to become compliant with the MCL for atrazine.

By implementing an intensive monitoring program when certain levels of atrazine are detected in water supplies, and by prohibiting atrazine uses in watersheds that result in exceedences, EPA will be able to ensure that exposures to atrazine in drinking water do not reach levels that pose a risk to public health. The study of rural wells will similarly provide a level of assurance that unacceptable exposure to atrazine is not occurring by this means.

Are there other health benefits to be gained from this action?
Other measures included in the IRED, such as changes to the way atrazine is handled and its use in residential settings, including reducing application rates, changing the application method to spot treatments, and requiring that grass be watered after application. Label changes for residential use, which take effect in 2004, will reduce potential exposure and risk to workers and people in residential situations.

What are the environmental benefits we expect from this action?
To mitigate risks to the environment from atrazine residues, the Agency is establishing a tiered ecological assessment process that will identify waterbodies affected by atrazine and determine which of these waterbodies are candidates for atrazine monitoring and/or mitigation. Waterbodies that may be identified for mitigation are waters officially listed by a state as impaired and/or waters with measured exceedences of the Agency's level of concern. Monitoring programs to determine if mitigation is required may be based on such factors as frequency, duration, and level of atrazine concentrations; atrazine use in the watershed; and environmental vulnerability.

What about atrazine in rural well water - will monitoring assure that all home wells are O.K.?
Current atrazine products contain requirements that are intended to prevent contamination of residential wells. Based on the limited available well monitoring data only 8 of 1505 wells sample had levels of atrazine that exceeded the level of concern. In each of those 8 wells additional samples were taken and found that levels no longer exceeded the level of concern. While the Agency does not believe that there is a risk of concern, in general, for rural wells it believes that a more intensive monitoring study is needed to confirm this conclusion. This study will be required as part of the IRED and will be designed specifically to determine if rural wells are at risk. In the event that this study leads the Agency to believe that there are risks of concern in rural wells, the Agency will require additional, appropriate mitigation measures.

Recent studies and journals have raised new concerns regarding the potential effects of atrazine on frogs. Does the IRED address potential amphibian (frog) risk?
EPA is in the process of evaluating data relating to potential effects of atrazine on amphibians from researchers representing eight universities. EPA is considering a number of additional new studies on potential amphibian risk. Where possible, raw data from these studies are being analyzed and study methods are being documented in order to perform our own, independent quality review of the studies. Additional information is expected to be submitted in the coming months, and the Consent Decree obligates EPA to review data relevant to these issues that is submitted before February 28, 2003 for an amendment to the IRED to be issued no later than January 31, 2003. OPP is planning to summarize all these studies in preparation for a FIFRA Science Advisory Panel (SAP) meeting where the potential effects of atrazine on amphibians will be discussed, and EPA will seek SAP guidance on the Agency's assessment of these data and on other scientific issues concerning atrazine. The Agency's amended IRED will incorporate the results of the SAP consultation on these issues.

For additional information: Please visit the Agency's Web site for more information about atrazine at: http://www.epa.gov/pesticides/reregistration/atrazine/ or visit EPA's Office of Pesticide Programs home page at http://www.epa.gov/pesticides/ .

Watersheds in IRED MOU – Final Draft – From Syngenta – 02/19/03

BARING
BUCKLIN
CAMERON
CLARENCE CANNON WTP
CLINTON
CONCORDIA
CREIGHTON
DEARBORN
EDINA
GLASGOW
HANNIBAL
JAMESPORT
MARCELINE
MIDDLE FORK WATER CO
MONROE, CITY OF
SHELBINA WATER TREATMENT PLANT
SMITHVILLE
UNIONVILLE WATER TREATMENT PLANT
VANDALIA
WELLSVILLE
WYACONDA

CWS to add to the list?

Drexel
Higginsville
LaBelle
Macon
Maysville
Moberly
Queen City
Sedalia

DNRMAIL.nrscotd@l
ms.state.mo.us

03/26/2003 08:56

To:
<Paul_Andre@mail.mda.state.mo.us>
cc:
<DNRMAIL.nrtimmt@lms.state.mo.us>
Subject:

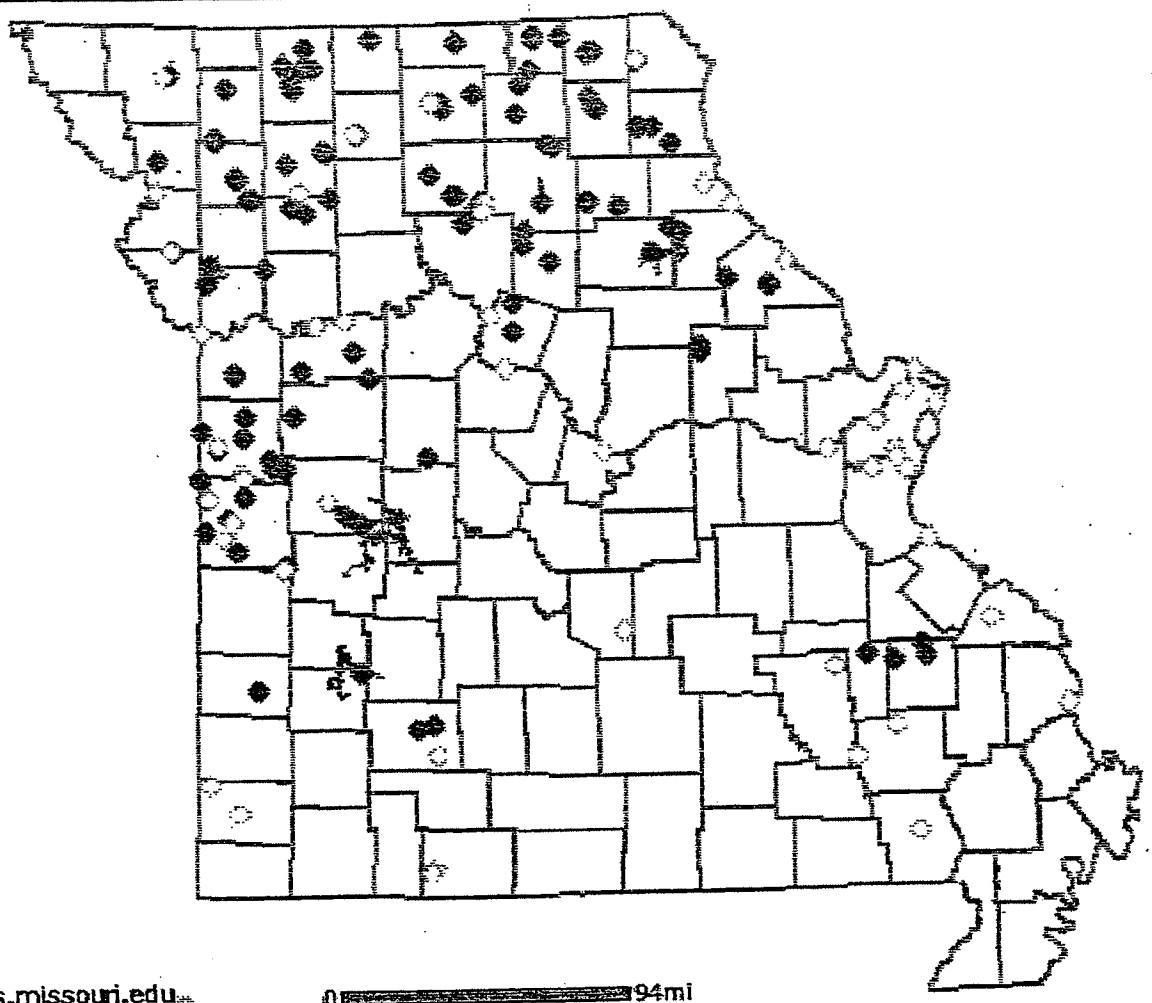
MDAHOST-ANDREP *

" - *Timmons, Terry"

atrazine violations

The 10 systems that had atrazine violations back in '94/'95 were:
Adrian
Dearborn
Drexel
Hamilton
Higginsville
Jamesport
Odessa
Monroe City
Clarence Cannon Wholesale Water Commission

Drinking Water Surface Water Intakes



www.cares.missouri.edu

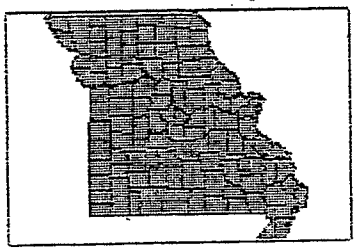
0 94mi

Legend

Public Drinking Water Intakes

- Lake
- River
- County Boundaries
- Public Drinking Water Lakes

Location Map



Map prepared by:
http://www.cares.missouri.edu,
3/26/2003.

TERMS AND DEFINITIONS

deral Status

e federal status is derived from the provisions of the Endangered Species Act of 1973, as amended, which is ministered by the U.S. Fish and Wildlife Service. Passage of the Endangered Species Act of 1973 gave the United tates one of the most far-reaching laws ever enacted by any country to prevent the extinction of imperiled animals nd plants. Protecting endangered and threatened species and restoring them to the point where their existence is no ger jeopardized is the primary objective of the Fish and Wildlife Service's Endangered Species Program.

E = ENDANGERED

Any species which is in danger of extinction throughout all or a significant portion of its range.

T = THREATENED

Any species which is likely to become endangered within the foreseeable future.

C = CANDIDATE

lants or animals which the Service is reviewing for possible addition to the list of endangered and threatened cies.

PE = PROPOSED ENDANGERED

PT = PROPOSED THREATENED

pecies officially proposed for listing as endangered or threatened. Final ruling not yet made.

tate Status

ule 3CSR10-4.111 of the *Wildlife Code of Missouri* and certain state statutes apply to state *Code* listed species. The ate status "endangered" is determined by the Department of Conservation under constitutional authority.

lobal Rank

numeric rank (G1 through G5) of relative endangerment based primarily on the number of occurrences of the lement (i.e., species, subspecies, or variety) globally. Other factors in addition to the number of occurrences are considered when assigning a rank, so the numbers of occurrences suggested for each numeric rank below are not bsolute guidelines.

1 = Critically imperiled globally because of extreme rarity or because of some factor(s) making it especially vulnerable to extinction. (typically or fewer occurrences or very few remaining individuals or acres)

2 = Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction throughout its range. (6 to 20 ccurrences or few remaining individuals or acres)

3 = Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range. (21 o 100 occurrences)

4 = Widespread, abundant, and apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.

hus, the element is of long-term concern. (usually more than 100 occurrences)

G5 = Demonstrably widespread, abundant, and secure globally, though it may be quite rare in parts of its range, especially at the periphery.

G#G# =Numeric range rank: A range between two of the numeric ranks. Denotes range of uncertainty about the exact rarity of the element.

G? = Unranked: element is not yet ranked globally.

GU = Unrankable: Possibly in peril range-wide but status uncertain; need more information.

GH = Historical: Of historical occurrence throughout its range, i.e., formerly part of the established biota, with the expectation that it may be rediscovered (e.g., Bachman's warbler).

GX = Extinct: Believed to be extinct throughout range (e.g., passenger pigeon) with virtually no likelihood that it will be rediscovered.

Subrank:

T = Taxonomic subdivision: rank applies to a subspecies or variety.

Qualifiers:

? = Inexact: denotes inexact numeric rank.

Q = Questionable taxonomy: taxonomic status is questionable; numeric rank may change with taxonomy.

State Rank

A numeric rank (S1 through S5) of relative endangerment based primarily on the number of occurrences of the element (i.e., species, subspecies, or variety) within the state. Other factors considered when assigning a rank include: abundance, population trends, distribution, number of protected sites, degree of threat, suitable habitat trends, level of survey effort and life history. Thus, the number of occurrences suggested for each numeric rank below are not absolute guidelines. Missouri species of conservation concern typically do not fall within the range of S4-S5.

S1 = Critically imperiled in the state because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from the state. (typically 5 or fewer occurrences or very few remaining individuals)

S2 = Imperiled in the state because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state. (6 to 20 occurrences or few remaining individuals or acres)

S3 = Rare and uncommon in the state. (21 to 100 occurrences)

S4 = Widespread, abundant, and apparently secure in state, with many occurrences, but the species is of long-term concern. (usually more than 100 occurrences)

S5 = Demonstrably widespread, abundant, and secure in the state, and essentially ineradicable under present conditions.

S#S# = Numeric range rank: A range between two of the ranks. Denotes range of uncertainty about the exact rarity of the element.

S? = Unranked: Species is not yet ranked in the state.

SU = Unrankable: Possibly in peril in the state, but status uncertain; need more information.

E = Exotic: An exotic established in the state; may be native in nearby regions (e.g., house finch or catalpa in eastern U.S.)

A = Accidental: Accidental or casual in the state (i.e., infrequent and far outside usual range).

P = Potential: Potential that element occurs in the state but no occurrences reported.

R = Reported: Element reported in the state but without persuasive documentation which would provide a basis for either accepting or ecting (e.g., misidentified specimen) the report.

RF = Reported falsely: Element erroneously reported in the state and the error has persisted in the literature.

H = Historical: Element occurred historically in the state (with expectation that it may be rediscovered). Perhaps having not been verified in e past 20 years, and suspected to be still extant.

X = Extirpated: Element is believed to be extirpated from the state.

Qualifiers:

? = Inexact or uncertain: for numeric ranks, denotes inexactness; for SE denotes uncertainty of exotic status. (The ? qualifies the aracter immediately preceding it in the SRANK.)

L: http:// www.conservation.state.mo.us /nathis/endangered/checklst/terms.htm
st modified: Monday, 16-Jul-2001 10:42:00 CDT

ritage database

eritage database: Results for SULLIVAN county

Common Name	Scientific Name	state rank	global rank	state status	federal status
URICULATE FALSE OXGLOVE	AGALINIS AURICULATA	S2	G3		*
ALE GERARDIA	AGALINIS SKINNERIANA	S3	G3		*
ENSLOW'S PARROW Species Info.	AMMODRAMUS HENSLOWII	S2	G4		*
PLAND SANDPIPER Species Info.	BARTRAMIA LONGICAUDA	S3	G5		
	DRY-MESIC FOREST				
	DRY-MESIC PRAIRIE				
	DRY-MESIC SAVANNA				
RASSY MINNOW Species Info.	HYBOGNATHUS HANKINSONI	S3	G5		
	MESIC FOREST				
IANA BAT Species Info.	MYOTIS SODALIS	S1	G2	E	E
TROUT-PERCH Species Info.	PERCOPSIS OMISCOMAYCUS	S1?	G5		
IED-BILLED GREBE Species Info.	PODILYMBUS PODICEPS	S2	G5		
WARF CHINQUAPIN AK	QUERCUS PRINOIDES VAR PRINOIDES	S3?	G5		
EGAL FRITILLARY	SPEYERIA IDALIA	S3	G3		*
REATER PRAIRIE-HICKEN Species Info.	TYMPANUCHUS CUPIDO	S1	G4	E	
	WET BOTTOMLAND FOREST				

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MDC Home Page | Missouri State Homepage | Hunting

Bob Holden
Governor

STATE OF MISSOURI

Jerry B. Uhlmann
Director

EMERGENCY MANAGEMENT AGENCY

DEPARTMENT OF PUBLIC SAFETY
OFFICE OF THE ADJUTANT GENERAL

P.O. Box 116, Jefferson City, Missouri 65102
Phone: 573/526-9100 Fax: 573/634-7966
E-mail: mosema@mail.state.mo.us

May 5, 2003

Mr. Fred C. Pinkney, Ph D.
Project Manager
Burns & McDonnell
9400 Ward Parkway
Kansas City, Missouri 64114-3319

Dear Mr. Pinkney:

I apologize for the delay in sending comments. We very much appreciate the opportunity to comment on the environmental impacts of natural resources for the Feasibility Study for the North Central Missouri Regional Water Supply Project.

There appears to be several communities that participate in the National Flood Insurance Program (NFIP) that could be impacted by this project. If any of this proposed project is within a special flood hazard area as identified by the Federal Emergency Management Agency (FEMA) and participate in the NFIP, that community must review the project and issue a floodplain development permit. This permit must be issued before the project begins.

There are also several communities (counties) that do not participate in the NFIP and have not been mapped by FEMA. Therefore, there are not requirements to meet with regards to the NFIP. However, this office would recommend that the community look at the effect of this project to ensure no harm to any properties.

If you have any questions of need further assistance, please feel to contact me at (573) 526-9141.

Sincerely,

George Riedel
Floodplain Management Manager

GR:wt

cc: Connie Wisniewski, Mitigation Specialist, FEMA Region VII
File - Burns & McDonnell

32508
Email

From: "Harold Kerns" <kernsh@mdc.state.mo.us>
To: <jomeyer@burnsmcd.com>
Date: 5/5/03 4:02PM
Subject: Re: North Central Regional Reservoir Feasibility StudyandMasterPlan

Hi Justin,

Thanks for your response. After I responded to you I was "filled in" on the details from my Conservation Department counterparts.

Thanks for the information,
Harold

>>> "Justin Meyer" <jomeyer@burnsmcd.com> 05/05/03 02:02PM >>>
Dear Mr. Kerns,

Thanks for responding to our letter requesting resource information pertaining to the North Central Regional Reservoir Feasibility Study and Master Plan. The letter was sent to you per the request of Mr. Mike Anderson, Fisheries Management Biologist, of the Missouri Department of Conservation. I would like to apologize for the incorrect date on the letter, as we obviously forgot to revise it since the first mailing.

In addition to Mr. Anderson, Mr. Brian D. Canaday, Policy Coordinator for the Conservation Department has also reviewed and responded to our letter. To date the Conservation Department has provided us with a copy of the Locust Creek Basin Management Plan as well as a list of Federal or State listed species and high-quality natural communities that occur with in the study area.

I would like to further thank you for initiating the identification of a point of contact within your agency. We look forward to working with the Conservation Department of this project. If you have any comments or questions please don't hesitate to let us know.

Sincerely,

Justin Meyer
Burns & McDonnell Engineering Company, Inc
9400 Ward Parkway
Kansas City, MO 64114
ph: 816-822-3481
fx: 816-822-3515
email: jomeyer@burnsmcd.com

>>> "Harold Kerns" <kernsh@mdc.state.mo.us> 04/24/03 12:03PM >>>
Dear Dr. Pinkney (Burns and McDonnell),

I received your letter today requesting input from the Missouri Department of Conservation (MDC) on resource information and issue identification regarding a North Central Regional Reservoir Feasibility
Study and Master Plan. Additionally you requested a point-of-contact within the Missouri Department of Conservation for this study/plan.

I have initiated contact within MDC to determine who will serve as your
point-of-contact within this agency. Your letter stated a list of letter recipients would be enclosed. This list was not enclosed, so I do not know who (if anyone) within MDC received your letter, besides me.
The area shown on your enclosed map delineates areas found in both the
Northeast and Northwest regions of MDC, with the proposed lake site shown in MDC's Northeast Region. We will contact you regarding our agency's official representative for this study/plan.

Your letter states "submit any information to us by February 14, 2003".
I assume this is a typographical error, and the time line for submission will include a deadline of February 14, 2004.

We will be in touch,

Harold Kerns

Fisheries Regional Supervisor
Missouri Department of Conservation
701 NE College Drive
St. Joseph, MO 64485-2298

Tel. (816)-271-3100

32508
Feas. Report

From: Fred Pinkney
To: Coleman, Christina; Meyer, Justin
Date: 4/21/03 10:26AM
Subject: MO Dept of Conservation, NC MO

Received a call this morning from Fisheries Biologist, MO Dept. of Conservation, Kirksville, MO. Is sending some information on watershed plans developed for Locust Creek-Grand River, and for Locust Creek-Sheraton River. Main stem of Locust Creek is high quality and one of most diverse streams in NC MO. East Locust Creek would be a great location for development - since stream is relatively channelized and of low diversity/quality. A watershed plan for East Locust Creek has also been developed and a copy is being forwarded to us. The MO Conservation Area south of Milan is described in the watershed plan and could be an area that is suitable for potential location of mitigation opportunities.

Suggested that we send the letter to one other person in MO Dept. of Conservation -
Mr. Harold Kernes
Fisheries Regional Supervisor
MO Dept. of Conservation
701 NE College Drive
St. Joseph, MO 64507
Mention could be made that we had originally sent letter to Jefferson City, but that we wanted to make sure he was aware of the potential project. Would you make sure that this is letter is sent out? Thanks -