FINAL REPORT

Galena/Sinsinawa Rivers Watershed TMDL Stage 1 Report

FINAL Report for Public Review

Prepared for Illinois EPA

October 2014

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Acronyms

BMPs	best management practices
CAFO	Concentrated Animal Feeding Operation
cfs	cubic feet per second
cfu	colony forming units
CRP	Conservation Reserve Program
CWA	Clean Water Act
DMR	discharge monitoring report
DO	dissolved oxygen
fIBI	fish Index of Biotic Integrity
GIS	geographic information system
IDA	Illinois Department of Agriculture
Illinois EPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
ISWS	Illinois State Water Survey
LA	Load Allocation
LC	Loading Capacity
LRS	load reduction strategy
MBI	Macroinvertebrate Biotic Index
mg/L	milligrams per liter
mIBI	macroinvertebrate Index of Biotic Integrity
µg/L	micrograms per liter
mL	milliliters
MOS	Margin of Safety
NA	not applicable
NASS	National Agricultural Statistics Service
NCDC	National Climatic Data Center
ND	non-detect
NED	National Elevation Dataset
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
RC	Reserve Capacity
SSURGO	Soil Survey Geographic
TMDL	total maximum daily load
TSS	total suspended solids
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
VSS	volatile suspended solids
WLA	Waste Load Allocation

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Section 1

Goals and Objectives for the Galena/Sinsinawa Rivers Watershed

1.1 Total Maximum Daily Load Overview

A total maximum daily load, or TMDL, is a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards. TMDLs are a requirement of Section 303(d) of the Clean Water Act (CWA). To meet this requirement, the Illinois Environmental Protection Agency (Illinois EPA) must identify water bodies not meeting water quality standards and then establish TMDLs for restoration of water quality. Illinois EPA develops a list known as the "303(d) list" of water bodies not meeting water quality standards every 2 years, and it is included in the Integrated Water Quality Report. Water bodies on the 303(d) list are then targeted for TMDL development. The Illinois EPA's most recent draft Integrated Water Quality Report was issued in December 2012 and is currently awaiting approval by United States Environmental Protection Agency (USEPA). In accordance with USEPA's guidance, the report assigns all waters of the state to one of five categories; 303(d) listed water bodies make up category five in the integrated report (Appendix A of the draft 2012 Integrated Report).

In general, a TMDL is a quantitative assessment of water quality impairments, contributing potential sources, and pollutant reductions needed to attain water quality standards. The TMDL specifies the amount of pollutant or other stressor that needs to be reduced to meet water quality standards, allocates pollutant control or management responsibilities among sources in a watershed, and provides a scientific and policy basis for taking actions needed to restore a water body.

Water quality standards are laws or regulations that states authorize to enhance water quality and protect public health and welfare. Water quality standards provide the foundation for accomplishing two of the principal goals of the CWA. These goals are:

- Restore and maintain the chemical, physical, and biological integrity of the nation's waters
- Where attainable, to achieve water quality that promotes protection and propagation of fish, shellfish, and wildlife, and provides for recreation in and on the water

Water quality standards consist of three elements:

- The designated beneficial use or uses of a water body or segment of a water body
- The water quality criteria necessary to protect the use or uses of that particular water body
- An antidegradation policy

Examples of designated uses are primary contact (swimming), protection of aquatic life, and public and food processing water supply. Water quality criteria describe the quality of water that will support a designated use. Water quality criteria can be expressed as numeric limits or as a narrative statement. Antidegradation policies are adopted so that water quality improvements are conserved, maintained, and protected.

1.2 TMDL Goals and Objectives for the Galena/Sinsinawa Rivers Watershed

The Illinois EPA has a three-stage approach to TMDL development. The stages are:

Stage 1 – Watershed Characterization, Data Analysis, Methodology Selection

Stage 2 – Data Collection (optional)

Stage 3 – Model Calibration, TMDL Scenarios, Implementation Plan

This report addresses Stage 1 TMDL development for the Galena/Sinsinawa Rivers watershed. Stages 2 and 3 will be conducted upon completion of Stage 1. Stage 2 is optional as data collection may not be necessary if additional data are not required to establish the TMDL.

Following this process, the TMDL goals and objectives for the Galena/Sinsinawa Rivers watershed will include developing TMDLs for all impaired water bodies within the watershed, describing all of the necessary elements of the TMDL, developing an implementation plan for each TMDL, and gaining public acceptance of the process. Following are the impaired water body segments in the Galena/Sinsinawa Rivers watershed:

- Sinsinawa River (MS)
- Frentress Lake (RMA)
- Galena River (MQ-01)

These impaired water body segments are shown on **Figure 1-1**. There are three impaired water body segments within the Galena/Sinsinawa Rivers watershed for which TMDLs and/or load reduction strategies (LRSs) are being developed. **Table 1-1** lists the water body segment, water body size, and potential causes and sources of impairment for the water body.

Sinsinawa River

Frentress Lake

Galena River

Table 1-1 Impaired Water Bodies in Galena/Sinsinawa Rivers Watershed

Segment ID	Segment Name	Potential Causes of Impairment	Designated Use	Potential Sources (as identified by the 2012 303(d) list)
MS	Sinsinawa River	*Sedimentation/Siltation*	Aquatic Life	Agriculture
RMA	Frentress Lake	*Turbidity*	Aesthetic Quality	Littoral/shore Area Modifications (Non-riverine), Sediment Resuspension (Clean Sediment)
		Total Phosphorus	Aquatic Life, Aesthetic Quality	Agriculture, Urban Runoff/Storm Sewers
		Dissolved Oxygen	Aquatic Life	Agriculture, Urban Runoff/Storm Sewers
		Total Suspended Solids	Aquatic Life, Aesthetic Quality	Agriculture, Urban Runoff/Storm Sewers
MQ-01	Galena River	**Zinc**	Aquatic Life	Impacts from Abandoned Mine Lands (inactive), Urban Runoff/Storm Sewers
		Sedimentation/Siltation	Aquatic Life	Livestock (Grazing and Feeding Operations)
		Total Suspended Solids	Aquatic Life	Livestock (Grazing and Feeding Operations), Urban Runoff/Storm Sewers
		Fecal Coliform	Primary Contact Recreation	Source Unknown

Bold Causes of Impairment have numeric water quality standards and TMDLs will be developed. Italicized Causes of Impairment do not have numeric water quality standards and an LRS will be developed where appropriate. Some italicized causes of impairment will not have an LRS developed as it is likely that implementing strategies to reduce the loading of other parameters of concern (e.g. reducing phosphorus loading to lakes) will result in reduced loading of additional parameters of concern (e.g. Total Suspended Solids and/or turbidity in lakes).

Illinois EPA is currently only developing TMDLs for parameters that have numeric water quality standards. For potential causes that do not have numeric water quality standards as noted in Table 1-1, TMDLs will not be developed at this time. However, LRSs will be developed where target values have been established by Illinois EPA. In addition, some of these potential causes may be addressed by implementation of controls for the pollutants with numeric water quality standards.

The TMDL for the segments listed above will specify the following elements:

- Loading Capacity (LC) or the maximum amount of pollutant loading a water body can receive without violating water quality standards
- Waste Load Allocation (WLA) or the portion of the TMDL allocated to existing or future point sources
- Load Allocation (LA) or the portion of the TMDL allocated to existing or future nonpoint sources and natural background
- Margin of Safety (MOS) or an accounting of uncertainty about the relationship between pollutant loads and receiving water quality
- Reserve Capacity (RC) or a portion of the load explicitly set aside to account for growth in the watershed

These elements are combined into the following equation:

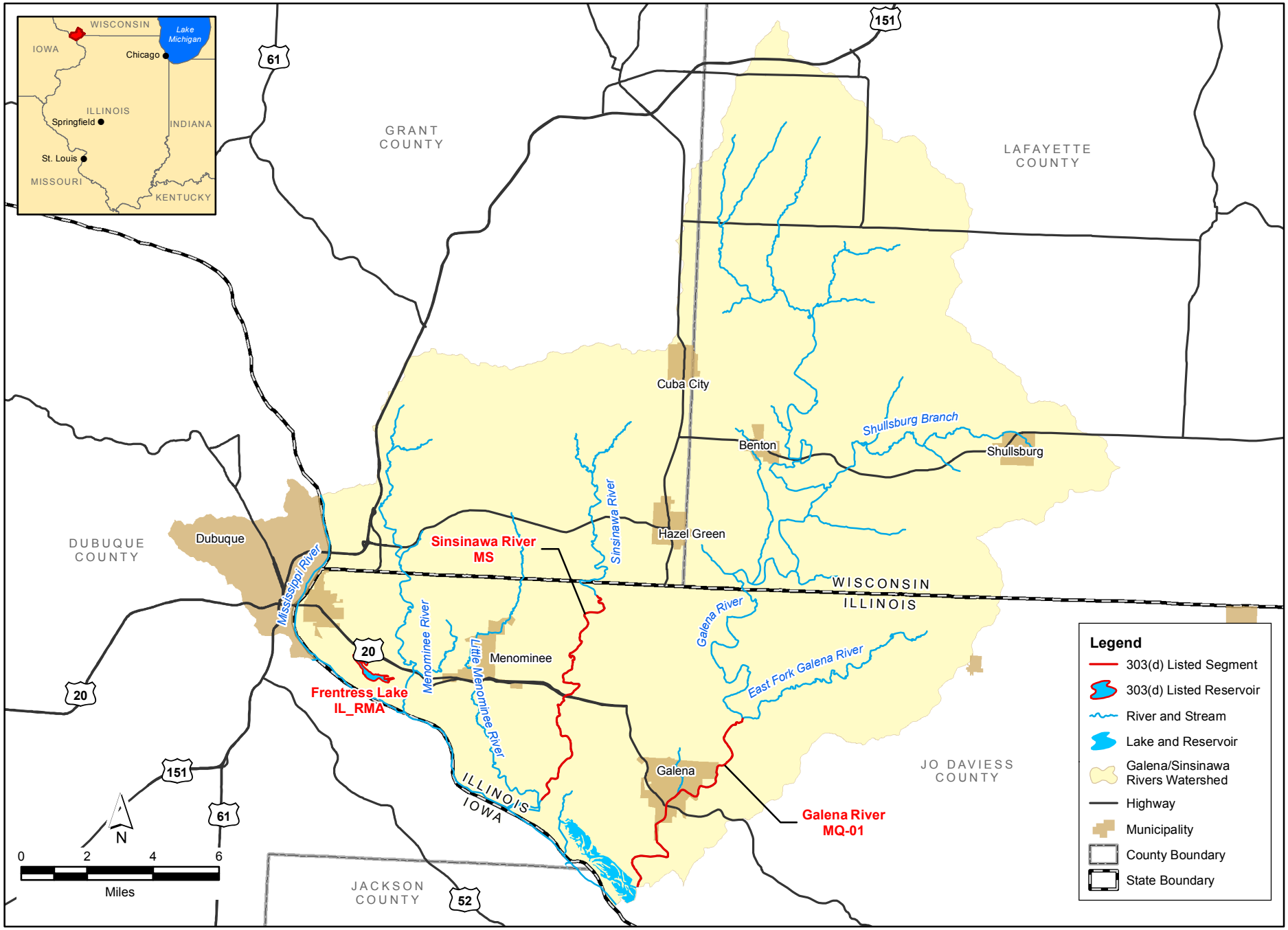
$$\mathbf{TMDL = LC = \Sigma WLA + \Sigma LA + MOS + RC}$$

Where target criteria are available for parameters without established numeric criteria, LRSs will be developed that include a LC, reductions needed to meet the LC, and a MOS and/or RC where applicable. LRSs differ from TMDLs in that the allowable load is not broken out between point and nonpoint sources. Both TMDL and LRS development will also take into account the seasonal variability of pollutant loads so that water quality standards are met during all seasons of the year. Also, reasonable assurance that the TMDLs and LRSs will be achieved will be described in the implementation plan. The implementation plan for the Galena/Sinsinawa Rivers watershed will describe how water quality standards and targets will be met and attained. This implementation plan will include recommendations for implementing best management practices (BMPs), cost estimates, institutional needs to implement BMPs and controls throughout the watershed, and a timeframe for completion of implementation activities.

1.3 Report Overview

The remaining sections of this report contain:

- **Section 2 Galena/Sinsinawa Rivers Watershed Characteristics** provides a description of the watershed's location, topography, geology, land use, soils, population, and hydrology.
- **Section 3 Public Participation and Involvement** discusses public participation activities that will occur throughout TMDL development.
- **Section 4 Galena/Sinsinawa Rivers Watershed Water Quality Standards** defines the water quality standards and water quality guidelines for the impaired water bodies.
- **Section 5 Galena/Sinsinawa Rivers Watershed Characteristics** presents the available water quality data needed to develop TMDLs and LRSs, discusses the characteristics of the impaired stream segments in the watershed, and also describes the point and nonpoint sources with potential to contribute to the watershed load.
- **Section 6 Approach to Developing TMDL and Identification of Data Needs** makes recommendations for the models and analysis that are needed for TMDL and LRS development and also suggests segments for Stage 2 data collection.



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Galena/Sinsinawa Rivers TMDL Watershed

FIGURE 1-1

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Section 2

Galena/Sinsinawa Rivers Watershed Description

2.1 Galena/Sinsinawa Rivers Watershed Location

The Galena/Sinsinawa Rivers watershed (Figure 1-1) is located in northwestern Illinois and southwestern Wisconsin, flows in a southerly direction, and drains approximately 211,000 acres within the states of Illinois and Wisconsin. Approximately 77,000 acres (37 percent of the total watershed) lie in Jo Daviess County in Illinois, with the remaining 134,000 acres (63 percent of the total watershed) in Grant and Lafayette Counties in Wisconsin. This report focuses on the Illinois portion of the watershed.

The watershed is located in an area of northwest Illinois and southwest Wisconsin that is unique to the states and the Midwest region. According to Jo Daviess County (www.jodaviess.org), "the county is part of the Wisconsin Driftless Region bypassed by continental glaciers of the Ice Age. This region covers parts of southern Minnesota and Wisconsin, Northwestern Illinois, and Northeastern Iowa. Glaciated areas were leveled, strewn with glacial debris or "drift," and dotted with lakes and ponds. The driftless areas, on the other hand, have bedrock close to the surface into which deep valleys have been carved by millions of years of weather and erosion. In Jo Daviess County, streams are numerous and the only two lakes are man-made. The relief from the higher ridges to the valley floors is typically 300 feet or more creating a rugged and scenic landscape."

2.2 Topography

Topography is an important factor in watershed management because stream types, precipitation, and soil types can vary dramatically by elevation. As mentioned above, this region is considered the "driftless" area noted for its deeply carved river valleys. The terrain is a result of the area having escaped glaciation during the last glacial period. National Elevation Dataset (NED) coverages containing 30-meter grid resolution elevation data are available from the U.S. Geological Survey (USGS) for each 1:24,000-topographic quadrangle in the United States. Elevation data for the Galena/Sinsinawa Rivers watershed were obtained by overlaying the NED grid onto the geographic information system (GIS)-delineated watershed. **Figure 2-1** shows the elevations found within the watershed. Elevation in the Galena/Sinsinawa Rivers watershed ranges from 1,250 feet above sea level in the northeastern portion of the watershed to 580 feet at the Mississippi River.

2.3 Land Use

Land use data for the Galena/Sinsinawa Rivers watershed were extracted from the U.S. Department of Agriculture's (USDA) National Agriculture Statistics Service (NASS) 2013 Cropland Data Layer (CDL), The CDL is a raster based, geo-referenced, crop-specific land cover data layer created to provide acreage estimates to the Agricultural Statistics Board for the state's major commodities and to produce digital, crop-specific, categorized geo-referenced output products. This information is made available to all agencies and to the public free of charge and represents the most accurate and up-to-date land cover datasets available at a national scale. The most recent available CDL dataset was produced in 2013 and includes 34 separate land use classes applicable to the watershed. The available resolution of the land cover dataset is 30 square meters. The 2013 CDL and extensive metadata are available at http://www.nass.usda.gov/research/Cropland/SARS1a.htm.

Land use characteristics of the watershed were determined by overlaying the Illinois and Wisconsin Statewide 2013 CDL data layers onto the GIS-delineated watershed. **Table 2-1** contains the land uses contributing to the Galena/Sinsinawa Rivers watershed, based on the 2013 CDL land cover categories and also includes the area of each land cover category and percentage of the watershed area. **Figure 2-2** illustrates the land uses of the watershed.

Table 2-1 Land Cover and Land Use in Galena/Sinsinawa Rivers Watershed

USDA/NASS Land Use Cropland Category	Acres	Percentage
Pasture/Hay	75,675	35.9%
Corn	61,302	29.1%
Deciduous Forest	23,785	11.3%
Soybeans	17,930	8.5%
Alfalfa	9,166	4.4%
Developed/Open Space	8,689	4.1%
Open Water	4,481	2.1%
Developed/Low Intensity	4,259	2.0%
Woody Wetlands	1,899	0.9%
Developed/Med Intensity	723	0.3%
Grassland Herbaceous	663	0.3%
Oats	604	0.3%
Winter Wheat	308	0.15%
Evergreen Forest	213	0.10%
Herbaceous Wetlands	186	0.09%
Shrubland	177	0.08%
Developed/High Intensity	163	0.08%
Barren	156	0.07%
Other Hay/Non Alfalfa	97	0.05%
Other	30	0.02%
Total	210,506	100%

The land cover data reveal that 165,111 acres, representing 78 percent of the total watershed area, are devoted to agricultural activities. Forests, woodland, grasslands, and shrubs cover 12 percent of the watershed (24,839 acres). Approximately 7 percent of the watershed area (13,991 acres) is developed, urbanized land. The remaining watershed (3 percent of land area) is wetland and open water.

Agricultural land use in the Sinsinawa River watershed

2.4 Soils

Soils data are available through the Soil Survey Geographic (SSURGO) database. For SSURGO data, field mapping methods using national standards are used to construct the soil maps. Mapping scales generally range from 1:12,000 to 1:63,360 making SSURGO the most detailed level of soil mapping done by the Natural Resources Conservation Service (NRCS).

Attributes of the spatial coverage can be linked to the SSURGO databases, which provide information on various chemical and physical soil characteristics for each map unit and soil series. Of particular interest for TMDL development are the hydrologic soil groups as well as the K-factor of the Universal Soil Loss Equation (USLE). The following sections describe and summarize the specified soil characteristics for the Galena/Sinsinawa Rivers watershed.

2.4.1 Galena/Sinsinawa Rivers Watershed Soil Characteristics

Appendix B contains a table of the SSURGO soil series for the Galena/Sinsinawa Rivers watershed. A total of 262 soil types exist in the watershed. The most common type—Tama silt loam (2 to 6 percent slopes, moderately eroded)—covers 10 percent of the watershed. All other soil types each represent less than 5 percent of the total watershed area. The table in Appendix B also contains the area, dominant hydrologic soil group, and k-factor range. Each of these characteristics is described in more detail in the following paragraphs.

Figure 2-3 shows the hydrologic soils groups found within the Galena/Sinsinawa Rivers watershed. Hydrologic soil groups are used to estimate runoff from precipitation. Soils are assigned to one of four groups according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms:

- Group A: Soils in this group have low runoff potential when thoroughly wet. Water is transmitted freely through the soil.
- Group B: Soils in this group have moderately low runoff potential when thoroughly wet. Water transmission through the soil is unimpeded.
- Group C: Soils in this group have moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted.
- Group D: Soils in this group have high runoff potential when thoroughly wet. Water movement through the soil is restricted or very restricted.

While hydrologic soil groups A, B, C, D, B/D, and C/D are all found within the Galena/Sinsinawa Rivers watershed, group B soils are the most common type representing 87 percent of the watershed. Group B is defined as having "moderately low runoff potential when thoroughly wet and water transmission through the soil that is unimpeded." Figure 2-3 shows that Group D soils, which have high potential for runoff and the high potential for erosion, are located along tributaries and streams that drain to the impaired stream segments in Jo Daviess County.

A commonly used soil attribute is the K-factor. The K-factor:

> *Indicates the susceptibility of a soil to sheet and rill erosion by water. (The K-factor) is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion. Losses are expressed in tons per acre per year. These estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.02 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water (NRCS 2005).*

The distribution of K-factor values in the Galena/Sinsinawa Rivers watershed range from 0.02 to 0.49 (**Figure 2-4**).

2.5 Population

The Census 2010 TIGER/Line data from the U.S. Census Bureau were retrieved. Geographic shapefiles of census blocks were downloaded for the entire state of Illinois. All census blocks that have geographic center points (centroids) within the watershed were selected and tallied in order to provide an estimate of populations in all census blocks both completely and partially contained by the watershed boundary. Approximately 20,712 people reside in the Galena/Sinsinawa Rivers watershed. The major municipalities in the watershed are shown in Figure 1-1. The largest urban development in the watershed is the city of Galena, with a population of approximately 3,401 people. The population remains similar to that recorded during the 2000 Census when 3,565 people resided in Galena.

City of Galena, Illinois

2.6 Climate, Pan Evaporation, and Streamflow

2.6.1 Climate

Northwest Illinois has a temperate climate with hot summers and cold, moderately snowy winters. Monthly temperature and precipitation data from the Dubuque Regional Airport in Dubuque, Iowa (station id. 94908) were extracted from the National Climatic Data Center (NCDC) database for the years 1951 through 2013. This station was selected due to its proximity to the watershed (Approximately 6 miles west) and completeness of its dataset. A similar NCDC climate station is located within the watershed in Galena, IL; however, temperature data were not available from 1927 through 2011 and an alternative station was selected. The data station at the Dubuque Regional Airport is in close proximity to the watershed and is expected to be representative of precipitation throughout the watershed.

Table 2-2 contains the average monthly precipitation along with average high and low temperatures for the period of record. The average annual precipitation is 37.4 inches. July and August are historically the wettest months while January and February are the driest.

Table 2-2 Average Monthly Climate Data for Dubuque, Iowa

Month	Average Total Precipitation (inches)	Average Daily Maximum Temperature (degrees F)	Average Daily Minimum Temperature (degrees F)
January	1.3	25.5	9.7
February	1.4	30.7	14.5
March	2.6	42.6	25.2
April	4.0	57.9	37.5
May	4.3	69.1	48.1
June	4.2	78.4	57.8
July	4.4	82.1	62.0
August	4.4	80.0	60.0
September	3.7	72.3	51.2
October	2.7	60.6	40.3
November	2.4	44.5	27.9
December	1.9	30.3	15.3
Total	37.4		

2.6.2 Pan Evaporation

Through the Illinois State Water Survey (ISWS) website, pan evaporation data are available from nine locations across Illinois (ISWS 2007). The DeKalb, Illinois station was chosen to be representative of pan evaporation conditions for the Galena/Sinsinawa Rivers watershed. The DeKalb station is located approximately 130 miles east southeast of the Galena/Sinsinawa Rivers watershed. This station was chosen due to being the closest pan evaporation station to the Galena/Sinsinawa Rivers watershed. The average annual pan evaporation at the DeKalb station for the years 1980 to 2000 is 36.8 inches. Actual evaporation is typically less than pan evaporation, so the average annual pan evaporation was multiplied by 0.75 to calculate an average annual evaporation of 27.6 inches (ISWS 2007).

2.6.3 Streamflow

Analysis of the Galena/Sinsinawa Rivers watershed requires an understanding of flow throughout the drainage area. One active USGS gage and 5 inactive USGS Gages are located within the watershed (**Figure 2-5**). **Table 2-3** summarizes the station information.

Table 2-3 Streamflow Gages in the Galena/Sinsinawa Rivers Watershed

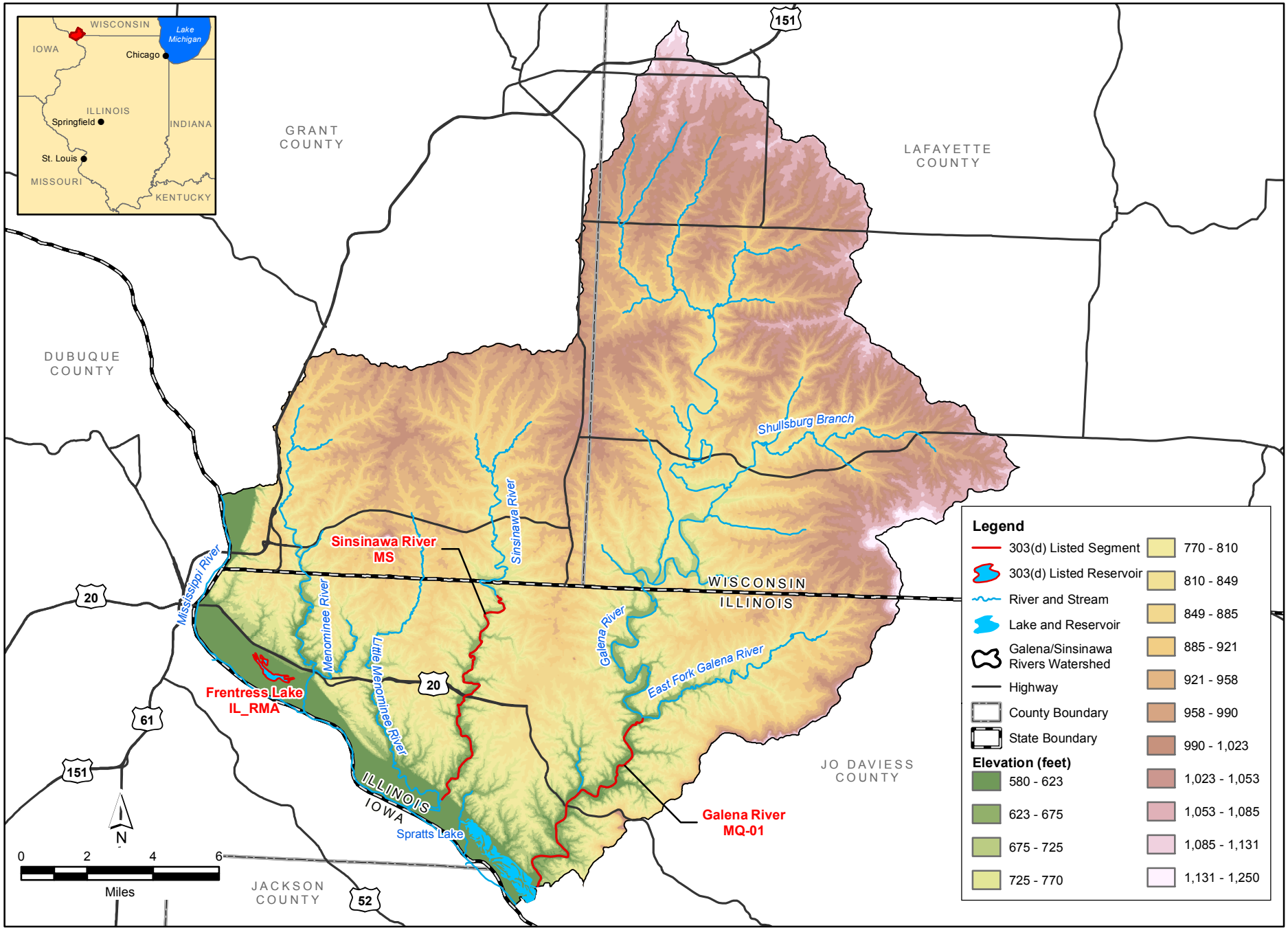
Gage Number	Name	Available Data Type	POR
5414820	SINSINAWA RIVER NEAR MENOMINEE, IL	Daily Discharge, Gage height	1967-2013
5414800	SINSINAWA RIVER NEAR HAZEL GREEN, WI	Daily Discharge	1987-1990
5415000	GALENA RIVER AT BUNCOMBE, WI	Daily Discharge	1939-1992
5414920	MADDEN BRANCH NEAR MEEKERS GROVE, WI	Daily Discharge	1980-1982
5414915	MADDEN BRANCH TRIBUTARY NEAR BELMONT, WI	Daily Discharge	1980-1982
5414894	PATS CREEK NEAR BELMONT, WI	Daily Discharge	1980-1982

Based on the only currently active stream gage in the watershed (USGS 05414820 Sinsinawa River near Menominee, IL), the average monthly flows in Sinsinawa River range from 21.27 cubic feet per second (cfs) in November to 41.74 cfs in March (see **Figure 2-6**). The gage drains an area of 53 square miles. Data from this gage will be used to estimate flow values for other impaired waterbodies in the Galena/ Sinsinawa Rivers watershed using the drainage area ratio method, represented by the following equation:

$$Q_{gaged}\left(\frac{Area_{ungaged}}{Area_{gaged}}\right) = Q_{ungaged}$$

where Q_{gaged} = Streamflow of the gaged basin
$Q_{ungaged}$ = Streamflow of the ungaged basin
$Area_{gaged}$ = Area of the gaged basin
$Area_{ungaged}$ = Area of the ungaged basin

The assumption behind the equation is that the flow per unit area is equivalent in watersheds with similar characteristics. Therefore, the flow per unit area in the gaged watershed multiplied by the area of the ungaged watershed estimates the flow for the ungaged watershed.



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Galena/Sinsinawa Rivers Watershed Elevation

FIGURE 2-1

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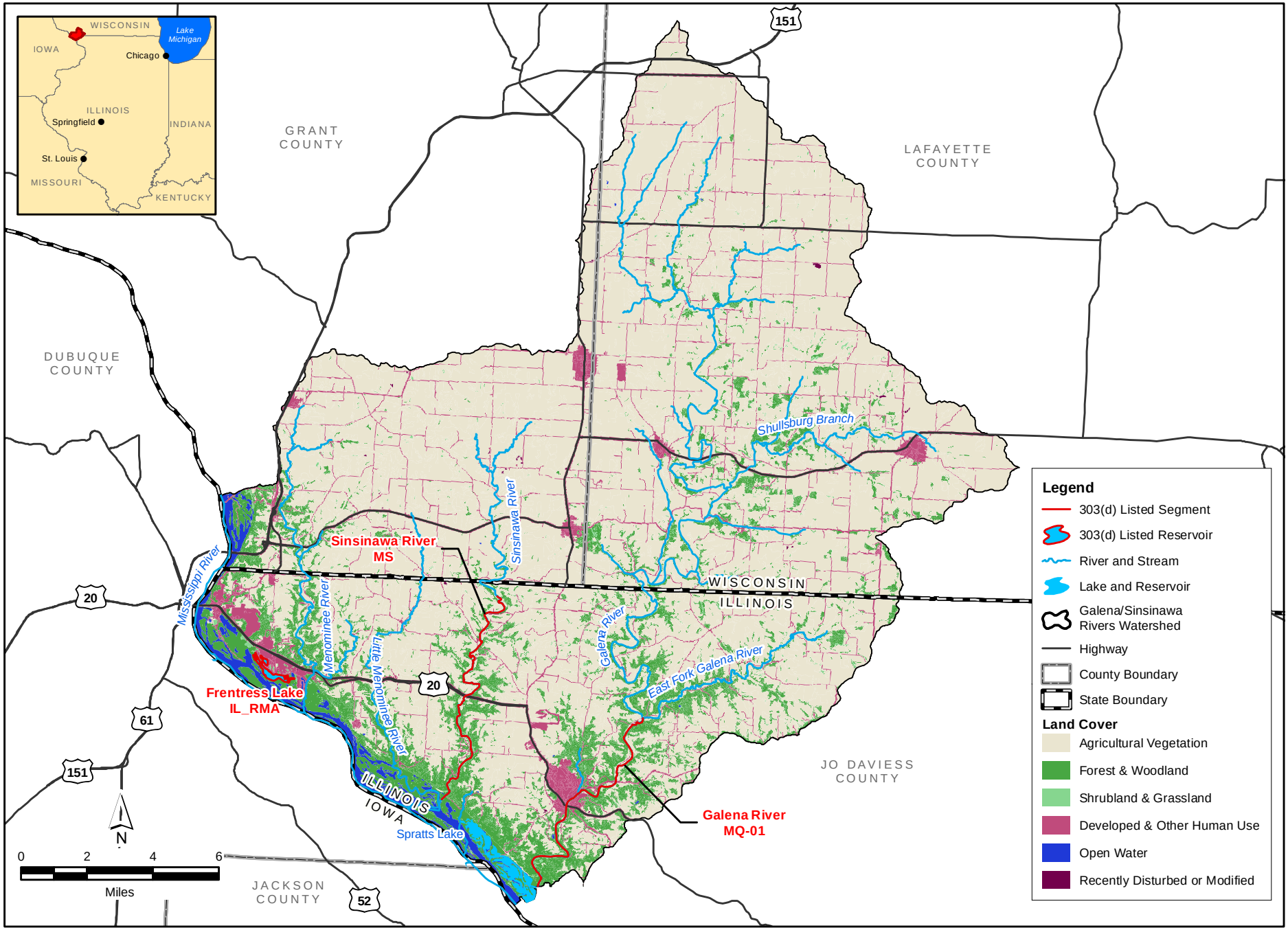

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CDM Smith

Galena/Sinsinawa Rivers Watershed Land Use

FIGURE 2-2

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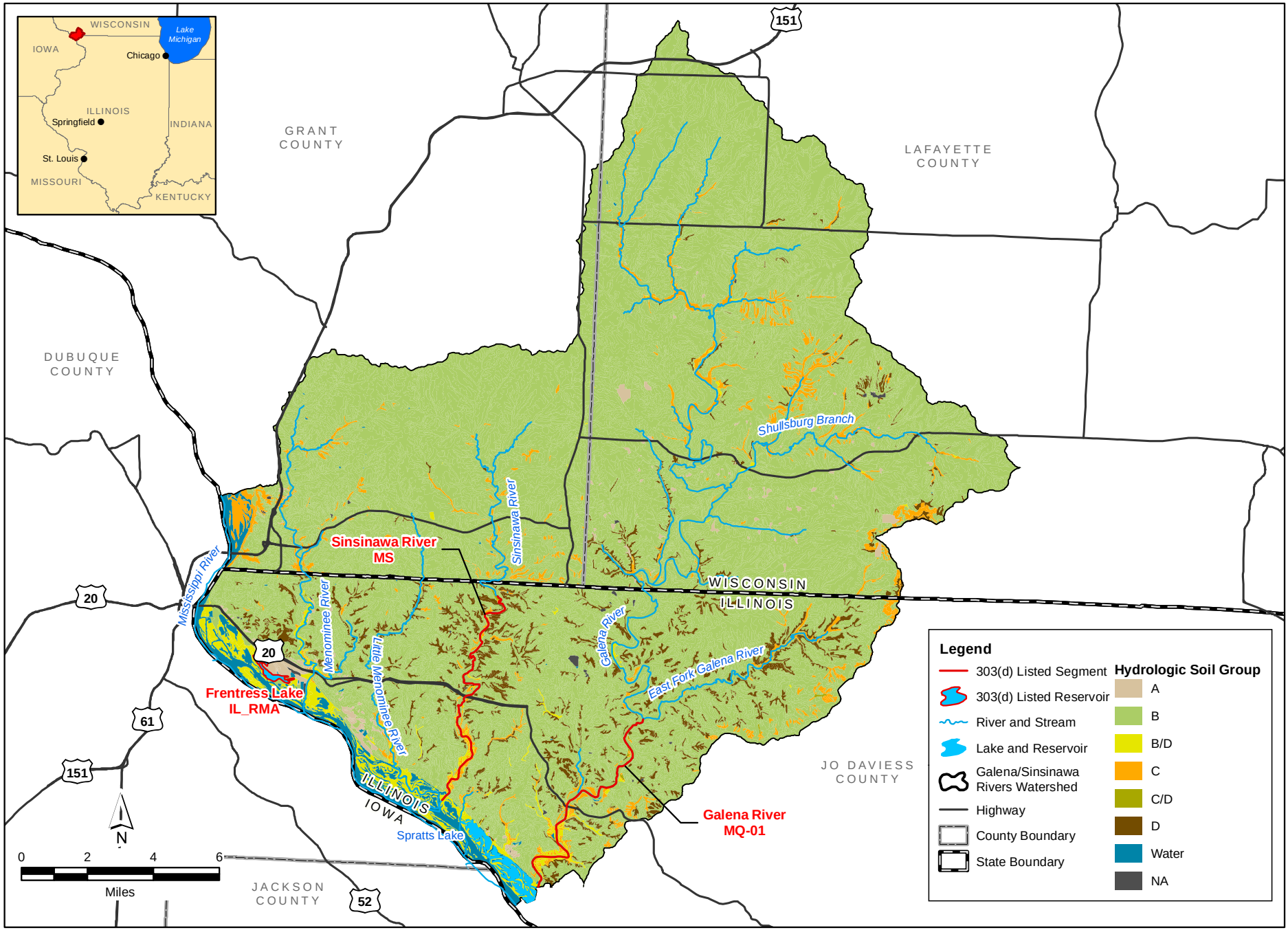

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CDM Smith

Galena/Sinsinawa Rivers Watershed Soils

FIGURE 2-3

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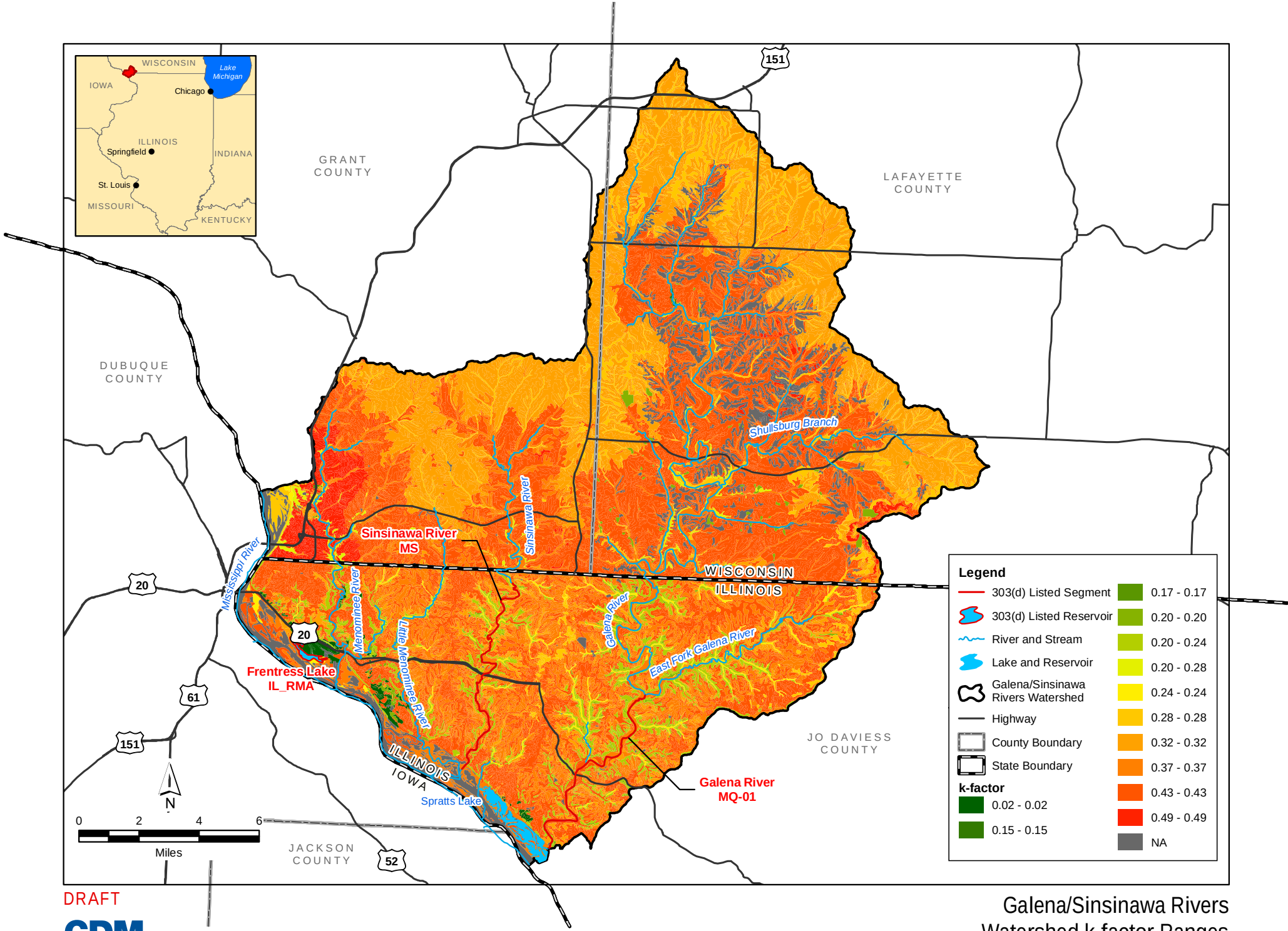

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Galena/Sinsinawa Rivers Watershed k-factor Ranges

FIGURE 2-4

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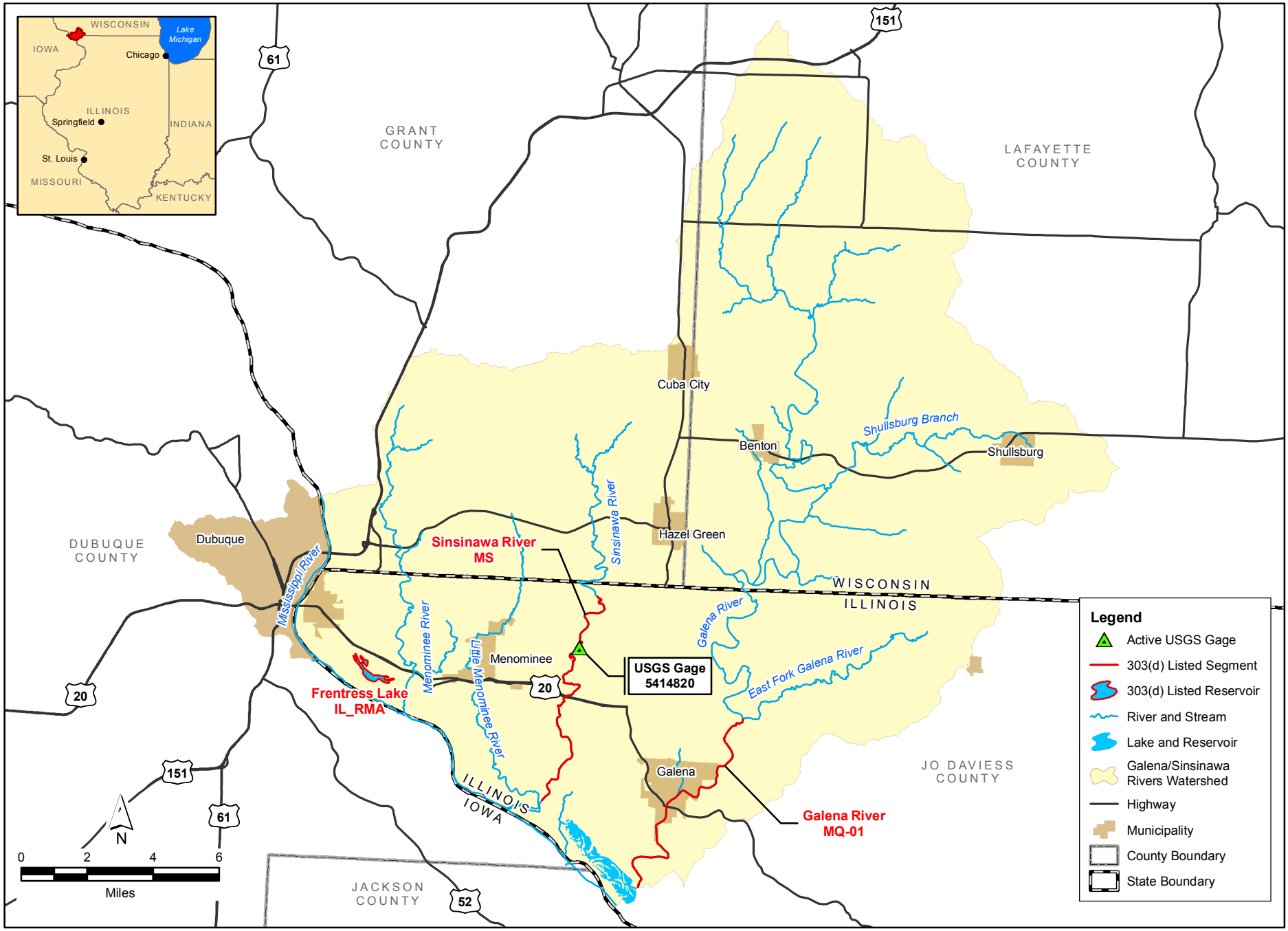

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Galena/Sinsinawa Rivers
Active USGS Gages

FIGURE 2-5

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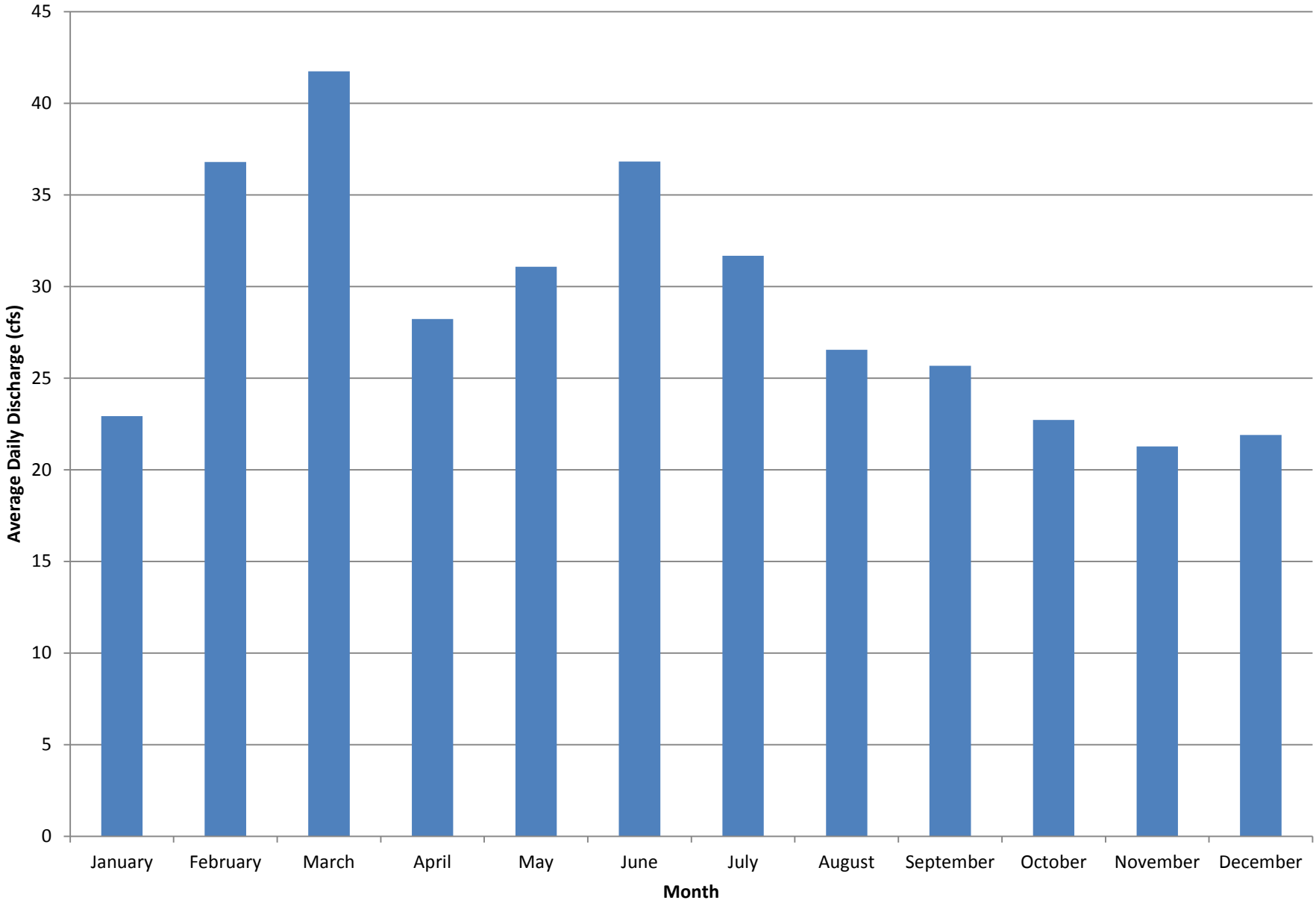

Figure 2-6: Average Daily Streamflow by Month
USGS Gage 05414820
Sinsinawa River near Menominee

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Section 3

Galena/Sinsinawa Rivers Watershed Public Participation

3.1 Galena/Sinsinawa Rivers Watershed Public Participation and Involvement

Public knowledge, acceptance, and follow-through are necessary to implement a plan to meet recommended TMDLs. It is important to involve the public as early in the process as possible to achieve maximum cooperation and counter concerns as to the purpose of the process and the regulatory authority to implement any recommendations.

The Stage 1 public meetings were held in Galena, Illinois on June 10-11, 2014. Comments received at the meeting, or following the meeting during the 30-day comment period, have been incorporated into this document.

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Section 4

Galena/Sinsinawa Rivers Water Quality Standards and Guidelines

4.1 Illinois Water Quality Standards

Water quality standards are developed and enforced by the state to protect the "designated uses" of the state's waterways. In the state of Illinois, setting the water quality standards is the responsibility of the Illinois Pollution Control Board (IPCB). Illinois is required to update water quality standards every 3 years in accordance with the CWA. The standards requiring modifications are identified and prioritized by Illinois EPA, in conjunction with USEPA. New standards are then developed or revised during the 3-year period.

Illinois EPA is also responsible for developing scientifically based water quality criteria and proposing them to the IPCB for adoption into state rules and regulations. The Illinois water quality standards are established in the Illinois Administrative Rules Title 35, Environmental Protection; Subtitle C, Water Pollution; Chapter I, Pollution Control Board; Part 302, Water Quality Standards.

4.2 Designated Uses

The waters of Illinois are classified by designated uses, which include: General Use, Public and Food Processing Water Supplies, Lake Michigan, and Secondary Contact and Indigenous Aquatic Life Use (Illinois EPA 2013). The designated use applicable to the Galena/Sinsinawa Rivers watershed is General Use.

4.2.1 General Use

The General Use classification is defined by IPCB as standards that "will protect the state's water for aquatic life, wildlife, agricultural use, secondary contact use and most industrial uses, and ensure the aesthetic quality of the state's aquatic environment." Primary contact uses are protected for all General Use waters whose physical configuration permits such use.

4.3 Illinois Water Quality Standards

According to the Illinois EPA Integrated Report, aquatic life use assessments in streams are typically based on the interpretation of biological information, physicochemical water data, and physical-habitat. The primary biological measures used are the fish Index of Biotic Integrity (fIBI), the macroinvertebrate Index of Biotic Integrity (mIBI) and the Macroinvertebrate Biotic Index (MBI). Physical-habitat information used in assessments includes quantitative or qualitative measures of stream-bottom composition and qualitative descriptors of channel and riparian conditions. Physicochemical water data used include measures of “conventional” parameters (e.g., dissolved oxygen [DO], pH, and temperature), priority pollutants, non-priority pollutants, and other pollutants.

For public and food processing water supply waters, Illinois EPA compares available data with water quality standards to make impairment determinations. **Tables 4-1 and 4-2** present the numeric water quality standards of the potential causes of impairment for both lakes and streams in the Galena/Sinsinawa Rivers watershed. Only constituents with numeric water quality standards will have TMDLs developed at this time.

Table 4-1 Summary of Numeric Water Quality Standards for Potential Causes of Lake Impairments in Galena/Sinsinawa Rivers Watershed

Parameter	Units	General Use Water Quality Standard	Regulatory Reference
Dissolved Oxygen	mg/L	*March through July* ≥5.0 minimum & ≥6.0 7-day daily mean averaged over 7 days *August through February* ≥3.5 minimum, ≥4.0 7-day minimum averaged over 7 days & ≥5.5 30-day daily mean[1]	302.206(b)
Total Phosphorus	mg/L	0.05[2]	302.205

mg/L = milligrams per liter
NA = Not Applicable
(1) Standard applies above the thermocline in stratified lakes and throughout the water column in unstratified lakes.
(2) Standard applies in particular to inland lakes and reservoirs (greater than 20 acres) and in any stream at the point where it enters any such lake or reservoir.

Table 4-2 Summary of Numeric Water Quality Standards for Potential Causes of Stream Impairments in Galena/Sinsinawa Rivers Watershed

Parameter	Units	General Use Water Quality Standard	Regulatory Reference
Zinc	µg/L	*Dissolved:* Acute = $e^{A+B\ln(H)}$ X 0.978* where A = 0.9035 and B = 0.8473 Chronic = $e^{A+B\ln(H)}$ X 0.986* where A = -0.4456 and B = 0.8473	302.208(e)
Total Fecal Coliform	Count/ 100 mL	*May through October* 200[1], 400[2]	302.209

µg/L = micrograms per liter
NA = Not Applicable
H = hardness
* = Conversion factor multiplier for dissolved metals
(1) Geometric mean based on a minimum of five samples taken over not more than a 30-day period.
(2) Standard shall not be exceeded by more than 10 percent of the samples collected during any 30-day period.

4.4 Water Quality Guidelines

In addition to the water quality standards provided above, the Illinois EPA has also established water quality guidelines for a number of parameters. Water quality guidelines are target values used by Illinois EPA during assessments for parameters that do not have numerical water quality criteria. LRSs will be developed using these established targets as water quality goals. The guideline for listing total suspended solids (TSS) for aquatic life in lakes is a non-volatile fraction of suspended solids or NVSS [TSS-volatile suspended solids (VSS)] greater than 12 mg/L. Aesthetic quality in lakes is considered impaired when NVSS is greater than 3 mg/L. Aquatic life in streams is considered to be impaired by siltation and sedimentation when TSS exceeds 116 mg/L. Additionally, streams have been listed for impairment caused by sedimentation/siltation when over 34% siltation was observed (prior to 2006), or over 75% siltation was observed (2008 and 2010).

4.5 Potential Pollutant Sources

In order to properly address the conditions within the Galena/Sinsinawa Rivers watershed, potential pollutant sources must be investigated for the pollutants where TMDLs will be developed. The following is a summary of the potential sources associated with the listed potential causes for the 303(d) listed segments in this watershed.

Table 4-3 Impaired Water Bodies

Segment ID	Segment Name	Potential Causes of Impairment	Designated Use	Potential Sources (as identified by the 2012 303(d) list)
MS	Sinsinawa River	*Sedimentation/Siltation*	Aquatic Life	Agriculture
RMA	Frentress Lake	*Turbidity*	Aesthetic Quality	Littoral/shore Area Modifications (Non-riverine), Sediment Resuspension (Clean Sediment)
		Total Phosphorus	Aquatic Life, Aesthetic Quality	Agriculture, Urban Runoff/Storm Sewers
		Dissolved Oxygen	Aquatic Life	Agriculture, Urban Runoff/Storm Sewers
		Total Suspended Solids	Aquatic Life, Aesthetic Quality	Agriculture, Urban Runoff/Storm Sewers
MQ-01	Galena River	**Zinc**	Aquatic Life	Impacts from Abandoned Mine Lands (inactive), Urban Runoff/Storm Sewers
		Sedimentation/Siltation	Aquatic Life	Livestock (Grazing and Feeding Operations)
		Total Suspended Solids	Aquatic Life	Livestock (Grazing and Feeding Operations), Urban Runoff/Storm Sewers
		Fecal Coliform	Primary Contact Recreation	Source Unknown

Bold Causes of Impairment have numeric water quality standards and TMDLs will be developed. Italicized Causes of Impairment do not have numeric water quality standards and an LRS will be developed where appropriate. Some italicized causes of impairment will not have an LRS developed as it is likely that implementing strategies to reduce the loading of other parameters of concern (e.g. reducing phosphorus loading to lakes) will result in reduced loading of additional parameters of concern (e.g. TSS and turbidity in lakes).

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Section 5

Galena/Sinsinawa Rivers Watershed Characterization

In order to further characterize the Galena/Sinsinawa Rivers watershed, a wide range of pertinent data were collected and reviewed. Water quality data for streams and lakes, as well as information on potential point and nonpoint sources within the watershed, were compiled from a variety of data sources. This information is presented and discussed in further detail in the remainder of this section.

5.1 Water Quality Data

Data from a total of five historical water quality stations within the Galena/Sinsinawa Rivers watershed were located and reviewed for this report (**Figure 5-1**). These water quality data were primarily provided by the Illinois EPA. Station MQ-01 on Galena River (at Route 20) is part of the Illinois EPA Ambient Water Program and was sampled approximately nine times a year through 2007. Sampling was discontinued in 2007 due to staff reduction. The station is currently being monitored through a contract with the USGS that began in 2009. Station MS-01 on the Sinsinawa River (at Chetlain Lane) is part of Illinois EPA's Intensive Basin Survey Program in which stations are monitored every 5 years (2000, 2005, and 2010). Frentress Lake (three lake stations) was sampled by the Illinois EPA Lake Program in 2001 and 2010.

The impaired water body segments in the Galena/Sinsinawa Rivers watershed were presented in Section 1. Refer to Table 1-1 for impairment information specific to each segment. In general, data from 2009 to 2011 were used for the 2014 Integrated Report. The exception is bacteria, in which the last 5 years of data were used for assessment. Recent and historical data are included in this section for historical trends and observations. The following section addresses both stream and lake impairments. Data are summarized by impairment and discussed in relation to the relevant Illinois numeric water quality standard. Data summaries provided in this section include all available date ranges of collected data. The following sections will first discuss data for the impaired stream segments in the Galena/Sinsinawa Rivers watershed followed by data for the impaired lake in the watershed, Frentress Lake.

5.1.1 Stream Water Quality Data

Two impaired stream segments exist within the Galena/Sinsinawa Rivers watershed (Galena River segment MQ-01 and Sinsinawa River segment MS-01). The impaired segment of the Galena River is listed for impairment of the aquatic life use by zinc, sedimentation and siltation, and TSS. The impaired segment of the Sinsinawa River is listed for impairment of the aquatic life use by sedimentation and siltation. As discussed in Section 4.3, aquatic life use assessments are based on a combination of biological information, physicochemical water data, and physical-habitat data. Data from 2010 indicated that segment MQ-01 of the Galena River had a mIBI score of 11.3 while segment MS-01 of the Sinsinawa River had a mIBI score of 10.4. According to Table C-1 in Illinois EPA's Integrated Report, these scores indicate severe impairment of the aquatic life use. Segment MQ-01 of the Galena River is also listed for impairment of the primary contact recreation use by fecal coliform.

Data presented below relate to the constituents of concern that currently have numeric criteria as well as those with water quality guideline targets. As presented in Section 4.3, both zinc and fecal coliform have numeric criteria and impairment determinations can be confirmed through comparison of available historical data. Although sedimentation/siltation and TSS do not have numeric criteria, both parameters have target values that were presented in Section 4.4. These values will be used to confirm impairment listings in the following sections.

There is one active water quality monitoring location on Galena River segment MQ-01 used for the following data discussion (Figure 5-1). All historical water quality data for the impaired segments of the Galena/Sinsinawa Rivers watershed are available in Appendix C.

Additional water quality data are available from several sampling locations upstream of the impaired Illinois stream segments in the Wisconsin portion of the watershed. These data along with additional data scheduled to be collected during Stage 2 of the TMDL program by Illinois EPA from sampling stations in the Illinois portion of the watershed for zinc, TSS, and fecal coliform bacteria, will be included as appropriate in Stage 3 of the TMDL development process for the Galena/Sinsinawa Rivers watershed. Only currently available (as of October 2014) water quality data collected within the impaired stream segments are included in the summaries provided in the following sections of this report.

5.1.1.1 Zinc

Galena River segment MQ-01 is listed for impairment of the aquatic life use by elevated dissolved zinc concentrations. **Table 5-1** summarizes available historical zinc data for this segment. The current general use water quality standards include both an acute and a chronic limit for dissolved zinc concentrations. Both the acute and chronic standards are hardness-dependent standards and are calculated for each sampling event based on current water hardness conditions. The summary of data presented in Table 5-1 reflects all available dissolved zinc data for segment MQ-01. The available data set for segment MQ-01 consists of 97 records collected between 1999 and 2011. A total of 22 samples collected during this time period exceeded the currently applicable standard for chronic exceedances (**Figure 5-2**).

Table 5-1 Existing Zinc Data for Galena River

Sample Location and Parameter	Period of Record and Number of Data Points	Mean	Maximum	Minimum	Number of Acute Exceedances	Number of Chronic Exceedances
Galena River Segment MQ-01						
Zinc (µg/L)	1999 - 2011; 97	85	200	ND	0	22

Note: Acute and chronic standards for dissolved zinc in streams are hardness-dependent.
ND = Non-detect

5.1.1.2 Fecal Coliform

Galena River segment MQ-01 is listed for impairment of the primary contact recreation use by fecal coliform. **Table 5-2** summarizes available historical fecal coliform data on this segment. The general use water quality standard for fecal coliform states that the standard of 200 colony forming units (cfu) per 100 milliliters (mL) shall not be exceeded by the geometric mean of at least five samples, nor can 10 percent of the samples collected exceed 400 cfu per 100 mL in protected waters, except as provided in 35 Ill. Adm. Code 302.209(b). Samples must be collected over a 30-day period or less during the months of May through October. Although the minimum sampling frequency requirements

for assessing the 200 cfu/100 mL standard are not regularly achieved, single samples have been compared to the standards (200 cfu/100 mL and of the 400 cfu/100 mL) for purposes of this report. The summary of data presented in Table 5-2 reflects single samples compared to the standards during the appropriate months. **Figure 5-3** shows the total fecal coliform samples collected over time at segment MQ-01.

Table 5-2 Existing Fecal Coliform Data for Galena River Impaired Stream Segments

Sample Location and Parameter	Period of Record and Number of Data Points	Geometric Mean of all samples	Maximum	Minimum	Number of samples > 200(1)	Number of samples > 400(1)
Galena River Segment MQ-01						
Total Fecal Coliform (cfu/100 mL)	2000 – 2011; 36	475	4700	1	29	19

(1) Samples collected during the months of May through October

5.1.1.3 Total Suspended Solids

Galena River segment MQ-01 is listed for impairment of the aquatic life use by TSS. **Table 5-3** summarizes available historical suspended sediment data for this segment. The water quality guideline for TSS in streams is a maximum value of 116 mg/L. **Figure 5-4** shows the TSS data collected over time at sampling location MQ-01. Within the available dataset, there have been three violations of the target value. Two violations occurred in 1999 and one violation was recorded in 2001. There were no violations of the TSS standard in the water column during the last assessment period. TSS has decreased at this sampling location over time; maximum values were recorded in 1999 and violations have not occurred since 2001. Recent TSS levels have fluctuated between 80 mg/L and non-detect. It should be noted that TSS was added to the list of impairments due to the siltation/sedimentation impairment (see discussion in Section 5.1.1.4 below). Sediment issues in this segment will likely be addressed in the Stage 3 report.

Table 5-3 TSS Data for Galena River

Sample Location and Parameter	Period of Record and Number of Data Points	Mean	Maximum	Minimum	Number of Exceedances
Galena River Segment MQ-01					
TSS (mg/L)	1999-2011; 85	37	440	ND	3

5.1.1.4 Siltation/Sedimentation

Galena River segment MQ-01 and Sinsinawa segment MS are both listed for impairment of the aquatic life use by sedimentation and siltation. These listings were based on field observations of Illinois EPA staff. A sediment thickness of 24 inches above the stream bed (>34 percent of stream depth) was recorded in 2006 on segment MQ-01 of the Galena River. A sediment thickness between 18 and 24 inches above the streambed (>75 percent of stream depth) was recorded in 2008 on segment MS of the Sinsinawa River. The most recent habitat data are from 2010 for both MQ-01 and MS-01. Estimated amounts of silt during habitat assessment were 75 percent at MS-01 and 90 percent at MQ-01.

5.1.2 Frentress Lake Water Quality Data

Frentress Lake is listed for impairment of the aesthetic quality use by total phosphorus and the aquatic life use by low DO. In addition, high turbidity has been linked to impaired aesthetic quality and TSS and turbidity are associated with impaired aquatic life use in the reservoir. Data are available from three separate water quality monitoring locations within Frentress Lake (Figure 5-1). An inventory of all available data associated with the impairments in Frentress Lake is presented in **Table 5-4**. Additional water quality data are available from station M-13 located on the Mississippi River approximately 10 miles upstream of Frentress Lake. The Mississippi River is directly connected to Frentress Lake and available and relevant water quality data from the river will be included as needed in TMDL development and modeling processes scheduled for Stage 3 of the process. However, water quality data presented below are limited to data collected within the impaired waterbody, Frentress Lake.

Table 5-4 Data Inventory for Impairment at Frentress Lake

Frentress Lake Segment RMA; Sample locations RMA-1, RMA-2, RMA-3		
RMA-1	**Period of Record**	**Number of Samples**
Phosphorus, Total	2001 - 2010	5
Phosphorus, Dissolved	2001 - 2010	5
Phosphorus in Bottom Deposits	2001 - 2010	1
Dissolved Oxygen	2001	5
NVSS	2010	5
RMA-2		
Phosphorus, Total	2001 - 2010	9
Phosphorus, Dissolved	2001 - 2010	9
Phosphorus in Bottom Deposits	2001 - 2010	0
Dissolved Oxygen	2001	5
NVSS	2010	5
RMA3		
Phosphorus, Total	2001 - 2010	10
Phosphorus, Dissolved	2001 - 2010	10
Phosphorus in Bottom Deposits	2001 - 2010	2
Dissolved Oxygen	2001	5
NVSS	2010	5

Table 5-5 contains information on data availability for other parameters that may be useful in data needs analysis and future modeling efforts for phosphorus impairment assessment at Frentress Lake. The inventory presented in Table 5-5 represents data collected at all depths.

Table 5-5 Frentress Lake Data Needs Analysis and Future Modeling Efforts

Frentress Lake; Sample Locations RMA-1, RMA-2, RMA-3		
RMA-1	**Period of Record**	**Number of Samples**
Chlorophyll a, corrected	2001 - 2010	9
Depth, bottom	2001 - 2010	4
Temperature, sample	2001 - 2010	11
RMA-2		
Chlorophyll a, corrected	2001 - 2010	10
Depth, bottom	2001 - 2010	5
Temperature, sample	2001 - 2010	5
RMA-3		
Chlorophyll a, corrected	2001 - 2010	9
Depth, bottom	2001 - 2010	8
Temperature, sample	2001 - 2010	6

5.1.2.1 Total Phosphorus in Frentress Lake

The applicable water quality standard for total phosphorus in Frentress Lake is 0.05 mg/L. Compliance with the total phosphorus standard is assessed using samples collected at a 1-foot depth from the lake surface. The number of samples, a count of exceedances, and the average total phosphorus concentrations at a 1-foot depth for each year of available data at each monitoring segment in Frentress Lake are presented in **Table 5-6** and shown on **Figure 5-5**. Based on the limited available dataset, total phosphorus concentrations in Frentress Lake are consistently high. All samples collected at 1-foot depth in the lake exceed the 0.05 mg/L standard and the average concentrations at each site are greater than 0.15 mg/L or three times the applicable water quality standard. No seasonal or annual trends in total phosphorus concentrations were observed based on the currently available dataset.

Table 5-6 Sample Counts, Exceedances of WQ Standard (0.05 mg/L), and Average Total Phosphorus Concentrations (mg/L) at One-Foot Depth in Frentress Lake

Station	RMA-1		RMA-2		RMA-3	
Year	Data Count; Number of Exceedances	Average	Data Count; Number of Exceedances	Average	Data Count; Number of Exceedances	Average
2001	0; NA	NA	4; 4	0.16	5; 5	0.18
2010	5; 5	0.16	5; 5	0.21	5; 5	0.20

5.1.2.2 Dissolved Oxygen in Frentress Lake

The water quality standard for DO in Frentress Lake is a seasonally variable standard based on a minimum instantaneous DO value of 5.0 mg/L from March through July and 3.5 mg/L from August to February. Compliance with the minimum DO standard is assessed using measurements recorded at depths above the thermocline of a thermally stratified water body or throughout the water column in an un-stratified water body. The thermocline is defined as the depth within the water column at which water temperatures decline sharply and indicates the boundary between the warmer upper layer of the lake (epilimnion) and the cooler lower layer of the lake (hypolimnion). The depth of the thermocline can vary from location to location and at different times of year; however, in the case of the Frentress Lake dataset, the thermocline appears to consistently begin less than approximately 10 feet below the water surface.

The number of sample events, a count of exceedances, and the average DO concentrations at all depths above the thermocline for each year of available data at each monitoring segment in Frentress Lake are presented in **Table 5-7**. The minimum DO concentrations recorded above the thermocline at each site during each sampling event are shown in **Figure 5-6**. DO concentrations fell below the minimum allowable standard once in 2001 and twice in 2010.

Table 5-7 Average Dissolved Oxygen Concentrations above the Lake Thermocline and Monitoring Events with Reported Exceedances of the Minimum DO Standard (5.0 mg/L from March-July and 3.5 mg/L August-February) in Frentress Lake

	RMA-1		RMA-2		RMA-3		Lake-Wide	
Year	Monitoring Events; Events with Exceedances	Average DO above Thermocline (mg/L)	Monitoring Events; Events with Exceedances	Average DO above Thermocline (mg/L)	Monitoring Events; Events with Exceedances	Average DO above Thermocline (mg/L)	Monitoring Events; Events with Exceedances	Average DO above Thermocline (mg/L)
2001	5; 1	7.6	5; 0	7.7	5; 1	6.9	5; 2	7.3
2010	5; 2	7.3	5; 2	7.4	5; 3	6.3	5; 8	7.0

5.1.2.3 Total Suspended Solids in Frentress Lake

The guideline for listing TSS for aquatic life in lakes is a NVSS [TSS- VSS] greater than 12 mg/L. Aesthetic quality in lakes is considered impaired when NVSS is greater than 3 mg/L. **Table 5-8** summarized NVSS values calculated for Frentress Lake in 2010. All calculated values are above 3 mg/L and all but three calculated values are above 12 mg/L. Data indicate that NVSS values are lowest during July and August.

Table 5-8 Calculated NVSS value (mg/L) in Frentress Lake

Date	RMA-1	RMA-2	RMA-3	Lake Average
11-May-10	25	26	19	23
08-Jun-10	21	94	36	50
13-Jul-10	4	9	16	10
10-Aug-10	13	16	10	13
14-Oct-10	21	22	16	20

5.2 Lake Characteristics

5.2.1 Frentress Lake

Frentress Lake is located within Jo Daviess County, approximately 10 miles northwest of the city of Galena, Illinois. The lake is a backwater lake located adjacent to the Mississippi River. Two permanent channels hydrologically connect Frentress Lake to the Mississippi River; however, the degree of influence of the Mississippi River on the water within the lake is unknown. Frentress Lake has a surface area of 158 acres and a reported maximum depth of 46 feet. This lake is currently used for recreational activities and as an access point for boaters to the Mississippi River via the Frentress Lake Marine Center boat launch and marina.

Frentress Lake Marina

The overland watershed draining into Frentress Lake is relatively small at approximately 1,100 acres. Approximately half of the lake's watershed is located in the Mississippi River floodplain and consists primarily of agricultural land use. Further east, the remainder of the watershed is mostly upland forest with considerable residential development. No significant or named tributaries flow into the lake from the east, further suggesting that water levels in the lake are maintained and heavily influenced by inflow from the Mississippi River.

Frentress Lake wildlife

5.3 Point Sources

There are 13 active point sources in both Wisconsin and Illinois that are located within the Galena/Sinsinawa Rivers watershed. **Table 5-9** contains permit information for all point sources in the watershed while **Figure 5-7** shows the locations of outfalls for each facility. National Pollutant Discharge Elimination System (NPDES) facilities with permit limits are required to submit discharge monitoring reports (DMRs) to Illinois EPA. Stage 3 will include a summary of relevant DMR data. Stormwater permits require the development of a stormwater management program comprised of BMPs and measurable goals. An annual report is submitted that includes status of compliance, data collected, stormwater activities planned, and any changes in goals. Under the Concentrated Animal Feeding Operation (CAFO) permit, requirements include: a nutrient management plan, a spill control and prevention plan, a stormwater management plan, and annual reporting.

Table 5-9 Permitted Facilities Discharging to or Upstream of Impaired Segments in the Galena/Sinsinawa Rivers Watershed

Facility ID	Facility Name	Design Average/ Maximum Flow	Permit Program/ Facility Type	Effluent Limits	Receiving Water	Notes
ILG840160	AGGREGATE MATERIALS CO	0.06	NPDES/ Coal Mine, Quarry (Water)	TSS, Flow, pH	Menominee	DMR Records- No discharge 2008-2013
ILA000023	CAR-MER DAIRY FARM[1]	Intermittent (Stormwater Excludes Livestock Areas)	NPDES CAFO/ Agriculture (Water)		Sinsinawa River*	
ILA010078	CAR-MER DAIRY FARM[1]				Sinsinawa River*	
IL0075191	GALENA SOUTH STP	1.171/ 4.241	NPDES/ Municipal (Water)	Flow, CBOD, TSS, pH, Fecal Coliform, Ammonia-N, TP (Monitor), TN (Monitor)	Galena River	DMR Records Available
ILR006236	GALENA SOUTH STP	Intermittent	NPDES Stormwater		Galena River*	
ILG010002	HELLER BROTHERS[1]	Intermittent (Stormwater Excludes Livestock Areas)	NPDES CAFO/ Agriculture (Water)		Galena River*	Permit Expired 1998
IL0003077	INSPIRATION DEVELOPMENT CO		NPDES/ Coal Mine, Quarry (Water)- Tailing Runoff	Flow, TSS, Zinc, Lead, Manganese, pH, Sulfate, TDS	Millbrig Hollow, trib to Galena River	DMR Records show No Discharge 2000-2001. Permit Expired 1999, Terminated 2011
ILR001290	LEMFCO INC	Intermittent	Stormwater		Galena River*	
IL0078204	RH STEWART PROPERTIES	0.03	NPDES/ Industry (Water)/Non-Contact Cooling Water	Flow, Temperature	Frentress Lake	No records since 2008/ Terminated 2010

Table 5-9 Permitted Facilities Discharging to or Upstream of Impaired Segments in the Galena/Sinsinawa Rivers Watershed

Facility ID	Facility Name	Design Average/ Maximum Flow	Permit Program/ Facility Type	Effluent Limits	Receiving Water	Notes
ILR10H343	STEWART INDUSTRIAL PARK – EAST	Intermittent	NPDES Stormwater		Frentress Lake	
WI0022217	CUBA CITY WASTEWATER TREATMENT FACILITY		WI DNR		Galena River	
WI0059439	DARLINGTON RIDGE FARMS LLC		WI DNR		Galena River	
WI0064734	DC KAMPS		WI DNR		Galena River	
WI0020672	BENTON WASTEWATER TREATMENT FACILITY		WI DNR		Galena River	

[1] CAFO facilities assigned a zero discharge NPDES permit

5.4 Nonpoint Sources

There are many potential nonpoint sources of pollutant loading to the impaired segments in the Galena/Sinsinawa Rivers watershed. This section will discuss site-specific cropping practices, animal operations, and area septic systems. Data were collected when available through communications with the local NRCS, Illinois Soil and Water Conservation Districts, and Wisconsin County Land and Water Conservation Departments and public health departments.

5.4.1 Crop Information

Approximately 76.1 percent of the land within the Galena/Sinsinawa Rivers watershed is devoted to agriculture. Tillage practices for crops such as corn, soybeans, and grains can be categorized as conventional till, reduced till, mulch till, and no till. The percentage of each tillage practice for corn, soybeans, and small grains by county are generated from County Transect Surveys by the Illinois Department of Agriculture (IDA) and the Wisconsin County Land and Water Conservation Departments. Data from the 2011 and 2013 surveys are presented in **Tables 5-10 and 5-11** for Jo Daviess County, Illinois and for 2011 in Grant County, Wisconsin, respectively. Data from Lafayette County, Wisconsin were unavailable at the time of this report but all additional information will be added if the data becomes available in the future.

Table 5-10 Tillage Practices in Jo Daviess County, Illinois- 2011 and 2013

Tillage System	Corn		Soybean		Small Grain	
	2011	2013	2011	2013	2011	2013
Conventional	13%	61%	3%	36%	0%	26%
Reduced - Till	28%	11%	10%	32%	28%	16%
Mulch - Till	45%	4%	46%	8%	72%	0%
No - Till	13%	25%	41%	24%	0%	58%

Table 5-11 Tillage Practices in Grant County, Wisconsin- 2011 and 2013

Tillage System	Corn	Soybean	Small Grain
Conventional	2%	0%	0%
Reduced - Till	64%	22%	100%
Mulch - Till	12%	19%	0%
No - Till	23%	59%	0%

Tillage practices from the 2004 County Transect Survey for Jo Daviess County were also reviewed to provide further information on changes in tillage practices over time (**Table 5-12**). The data available from Jo Daviess County indicate that while the percentage of farmland utilizing conventional tillage has varied somewhat over time, a trend towards increased use of no-till practices is noted for small grains. Increased use of reduced-till practices for soybean production is also evident in the 2004, 2011, and 2013 data for Jo Daviess County.

Table 5-12 Historical Tillage Practices in Jo Daviess County, Illinois - 2004

Tillage System	Corn	Soybean	Small Grain
Conventional	13%	2%	0%
Reduced - Till	30%	12%	56%
Mulch - Till	29%	28%	44%
No - Till	28%	58%	0%

Local NRCS offices reported that they currently do not keep records on which farms use tile drainage. The NRCS office in Jo Daviess County said the use of drain tile is common but they did not have exact numbers. NRCS officials in Lafayette County, Wisconsin also stated that they have no records but that tiling is very common throughout the county. NRCS officials from Grant County, Wisconsin also did not have records on tiling, although they did state that drain tile is not especially common there.

Fields near W Valley Road

5.4.2 Animal Operations

Information on commercial animal operations is available from the NASS. Although watershed-specific data is not available, county-wide data for Jo Daviess County, Illinois, and Grant and Lafayette Counties in Wisconsin are presented in the following tables (**Tables 5-13 through 5-13**). Data from 2002 and 2012 have been published on the USDA website.

Table 5-13 Jo Daviess County Animal Population (2002 and 2012 Census of Agriculture)

Livestock Type	2002	2012	Percent Change
Cattle and Calves	57,276	53,057	-8%
Beef	18,471	15,473	-19%
Dairy	7,771	8,311	6%
Hogs and Pigs	18,983	14,146	-34%
Poultry	510	897[1]	43%
Sheep and Lambs	1,198	1,312	9%
Horses and Ponies	838	926	10%

Table 5-14 Grant County Animal Population (2002 and 2012 Census of Agriculture)

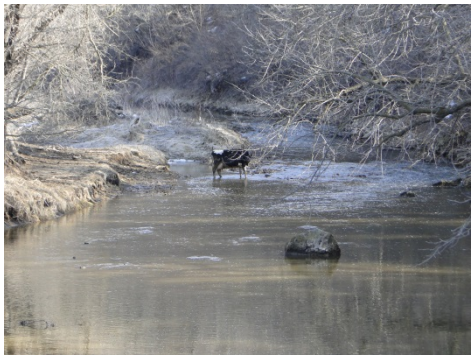
Livestock Type	2002	2012	Percent Change
Cattle and Calves	163,392	173,249	6%
Beef	21,828	22,171	2%
Dairy	46,564	46,466	0%
Hogs and Pigs	75,332	54,798	-37%
Poultry	11,126	87,038	87%
Sheep and Lambs	2,303	4,659	51%
Horses and Ponies	3,011	2,977	-1%

Table 5-15 Lafayette County Animal Population (2002 and 2012 Census of Agriculture)

Livestock Type	2002	2012	Percent Change
Cattle and Calves	89,894	108,943	17%
Beef	9,370	10,967	15%
Dairy	30,090	30,831	2%
Hogs and Pigs	25,617	14,267	-80%
Poultry	6,173	12,860	52%
Sheep and Lambs	1,725	1,628	-6%
Horses and Ponies	1,544	1,751	12%

Specific information on animal operations was not available. An Illinois EPA site visit in March 2013 noted livestock near both impaired stream segments.

Goats in watershed



Cattle in watershed

5.4.3 Septic Systems

Many households in rural areas of Wisconsin and Illinois that are not connected to municipal sewers make use of onsite sewage disposal systems, or septic systems. There are many types of septic systems, but the most common septic system is composed of a septic tank draining to a septic field, where nutrient removal occurs. However, the degree of nutrient removal is limited by soils and system upkeep and maintenance.

Across the U.S., septic systems have been found to be a significant source of phosphorus pollution. Failing or leaking septic systems contribute to fecal coliform pollution, although animal waste, urban runoff, and permitted point sources can also contribute.

Information on the extent of sewered and non-sewered municipalities in the Galena/Sinsinawa Rivers watershed was obtained from the county health departments. Health department officials in Grant County, Wisconsin, stated that the towns of Hazel Green and Cuba City are served by sewer systems, but most county residents within the watershed rely on private septic systems. In Lafayette County, Wisconsin, town residents are generally on municipal sewer systems, but county health department officials stated that roughly half of county residents use private septic systems.

Jo Daviess County public health department officials indicated that the town of Galena is served by a municipal sewer system, although older homes still have private systems. However, any homes outside of the municipal boundary are generally served by septic systems.

5.5 Watershed Studies and Other Watershed Information

An "Assessment of Water Quality in the Galena River Watershed" was performed in 2007-2008 by the Wisconsin Department of Natural Resources. Information from this report will be reviewed and incorporated where applicable during Stage 3 of TMDL development. **Table 5-16** contains information on the projects known to have been implemented throughout the watershed. Additional information is available through the Resource Management Mapping Service at: http://www.rmms.illinois.edu/RMMSMigrated/(S(qbogdt552pfsuj55nharo055))/Home.aspx.

In addition, stakeholders in the watershed have indicated that there are a substantial number of Conservation Reserve Program (CRP) practices in the watershed that are beneficial but are not available for mapping purposes.

Table 5-16 Watershed Projects

Program	Project Name	Description	Recipient/Grantee	Year	Receiving Water
IDNR Conservation 2000	Horseshoe Mound Restoration	Restoration of native oak savanna on 28 acres	Natural Land Institute	Ongoing	Galena River
IDA Conservation Practices Program	Cover and Green Manure Crops	160 acres	Jo Daviess SWCD	2012	Galena River
Conservation Easement (NCED)	Gateway Easement	100 acres permanently put in conservation easement	Jo Daviess Conservation Foundation	2011	Galena River
IDA Streambank and Shoreline Restoration Practice (SSRP)	Streambank and Shoreline Protection	1305 feet of stabilized shoreline	Jo Daviess SWCD	2010	Galena River
IDA Streambank and Shoreline Restoration Practice (SSRP)	Streambank and Shoreline Protection	525 feet of stabilized shoreline	Jo Daviess SWCD	2007	Galena River
IEPA Nonpoint Source Program (319)	Sealing of Abandoned water wells and mine holes	180 water wells/min holes were sealed and demonstrations were made (5 sealed in watershed	Jo Daviess SWCD	2007	Galena River
IDA Streambank and Shoreline Restoration Practice (SSRP)	Streambank and Shoreline Protection	310 feet of stabilized shoreline	Jo Daviess SWCD	2005	Galena River

Table 5-16 Watershed Projects

Program	Project Name	Description	Recipient/Grantee	Year	Receiving Water
IEPA Nonpoint Source Program (319)	Northwest Illinois Livestock Project	Waste storage structures (2 in Sinsinawa watershed and 1 in Galena watershed)	Blackhawk Hills RC & D	2004	Sinsinawa and Galena Rivers
IDA Streambank and Shoreline Restoration Practice (SSRP)	Streambank and Shoreline Protection	180 feet of stabilized shoreline	Jo Daviess SWCD	2003	Galena River
IDA Streambank and Shoreline Restoration Practice (SSRP)	Streambank and Shoreline Protection	365 feet of stabilized shoreline	Jo Daviess SWCD	2003	Galena River
IDNR Conservation 2000	Galena River Ecological Study	Inventoried specific natural resources of the Galena River watershed	The Prairie Enthusiast	2001	Galena River
IDNR Conservation 2000	Certified and Prescribed Burn Training	Provided burning training for restoration areas	Jo Daviess SWCD	1999	Galena River
IDOT Mitigation Banks and Sites	Galena River Bridge Wetland Site	Wetland mitigation at Stagecoach Trail site/ wetland and upland buffer created on 7.75 acres	IDOT/INHS	1998	Galena River

The Illinois Department of Transportation (IDOT) is currently conducting study and planning operations related to future development and expansion of US 20, a major highway that crosses and has the potential to impact the water quality of the impaired portions of the Galena and Sinsinawa Rivers. US 20 also passes through the Frentress Lake overland catchment area and future expansion projects have the potential to influence water quality in this waterbody as well. Funding, engineering, and environmental impact studies have been ongoing related to this project since 2005. More information can be found at the IDOT project description webpage at: http://www.idot.illinois.gov/projects/us20-freeport.

A volunteer water quality monitoring program also exists for streams within the watershed that is managed by the National Great Rivers Research & Education Center. This River Watch program's data was collected by volunteers and although it will not be directly used by Illinois EPA for the purposes of the TMDL program, data available from this program may be beneficial for watershed planning and best management practices (BMP) implementation purposes.

County-wide information regarding hazard mitigation and specifically flood control planning for Jo Daviess County can be found in county's Multi-Jurisdictional All Hazards Mitigation Plan published in March 2013. This plan is available from the Illinois Emergency Management Agency's website: http://www.iema.illinois.gov/iema/planning/Documents/Plan_JodaviessCounty.pdf. Further information regarding county-wide growth and development planning for Jo Daviess County can be found in the *Jo Daviess County, Illinois Comprehensive Plan- 2012 Update*, available at http://www.jodaviess.org.

In addition, there is an ongoing 319 Nonpoint Source Program project being performed for the Apple Canyon Lake watershed, a nearby watershed within Jo Daviess County, Illinois. The Apple Canyon Lake Property Owner's Association is working on this project to improve water quality by controlling nonpoint source pollution in the watershed. Along with an education component, there is in-lake and tributary monitoring. The end result will be a watershed based plan and recommendations for future implementation which may include items relevant and applicable to the Galena/Sinsinawa Rivers watershed.

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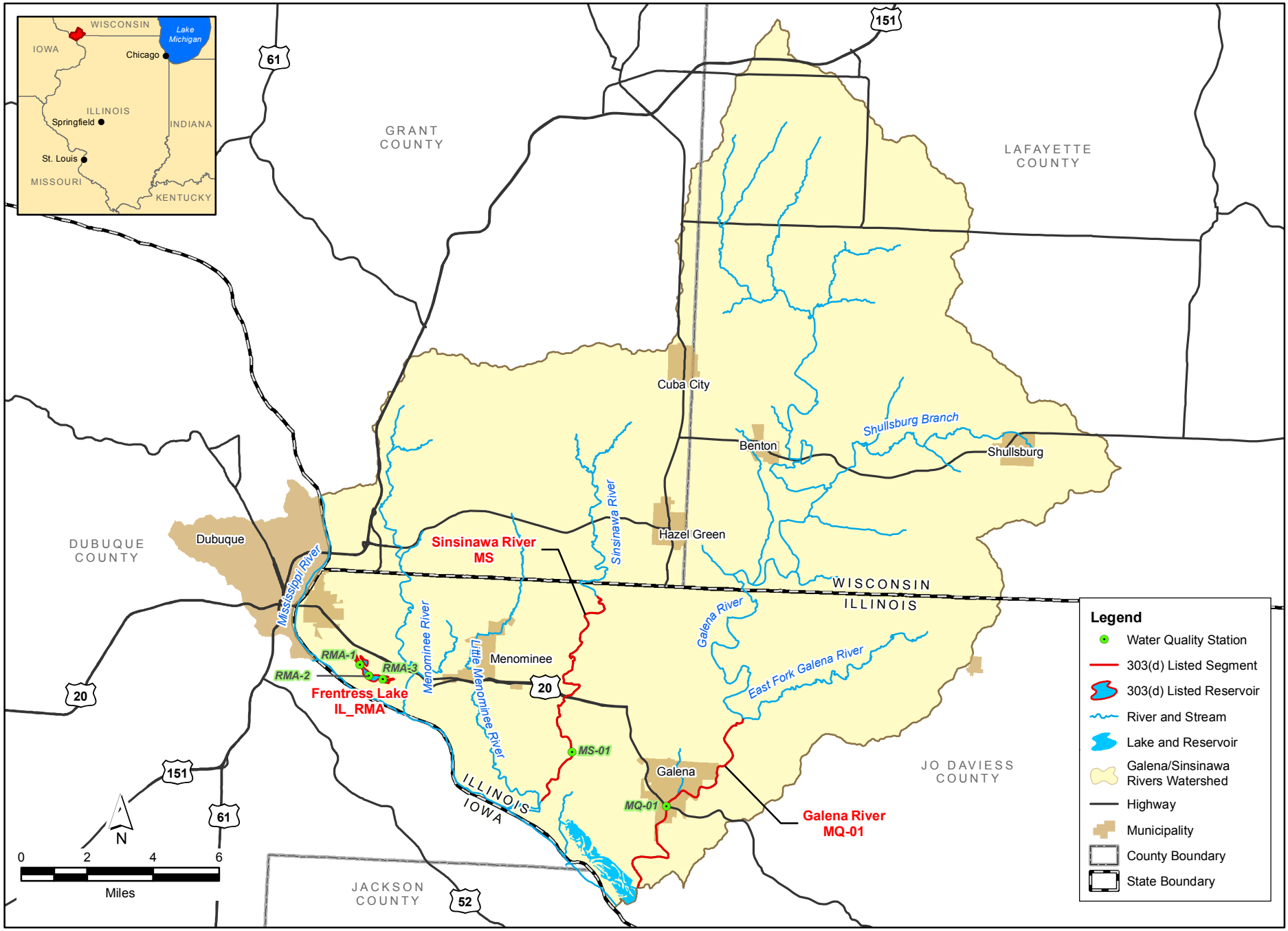

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Galena/Sinsinawa Rivers Water Quality Stations

FIGURE 5-1

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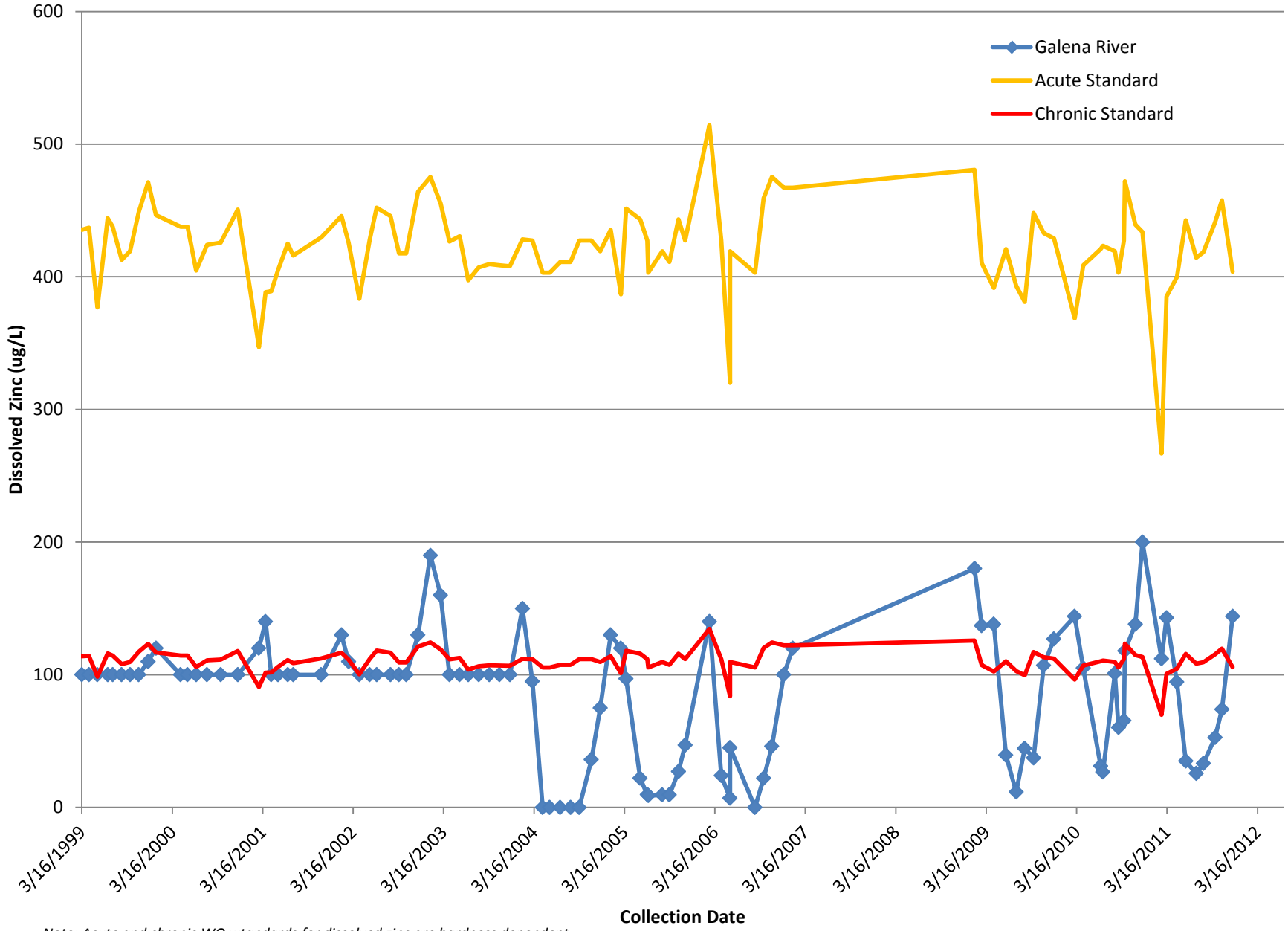

Note: Acute and chronic WQ wtandards for dissolved zinc are hardness dependent

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Figure 5-2
Dissolved Zinc
Galena River MQ-01

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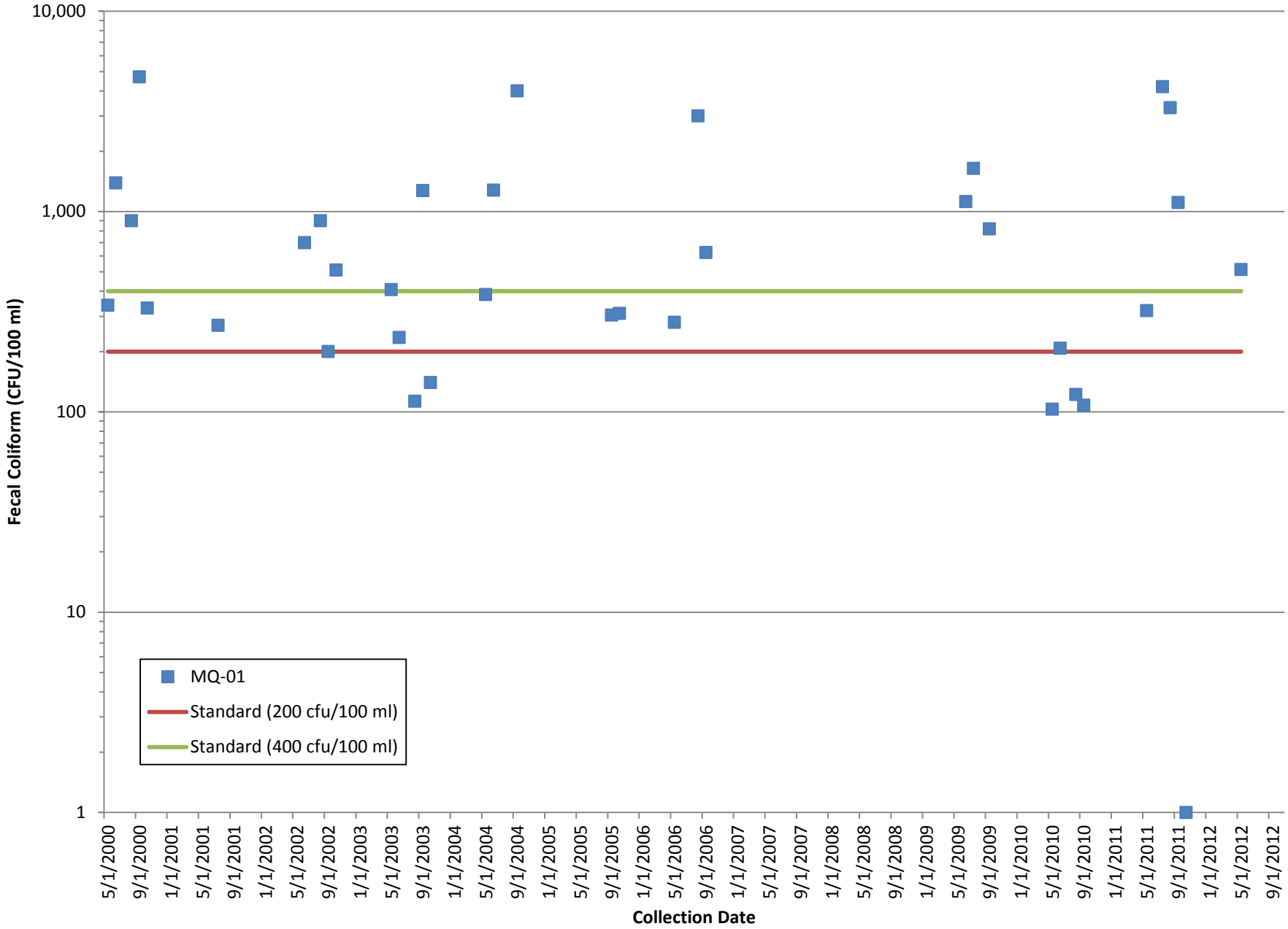

Figure 5-3
Fecal Coliform
Galena River MQ-01

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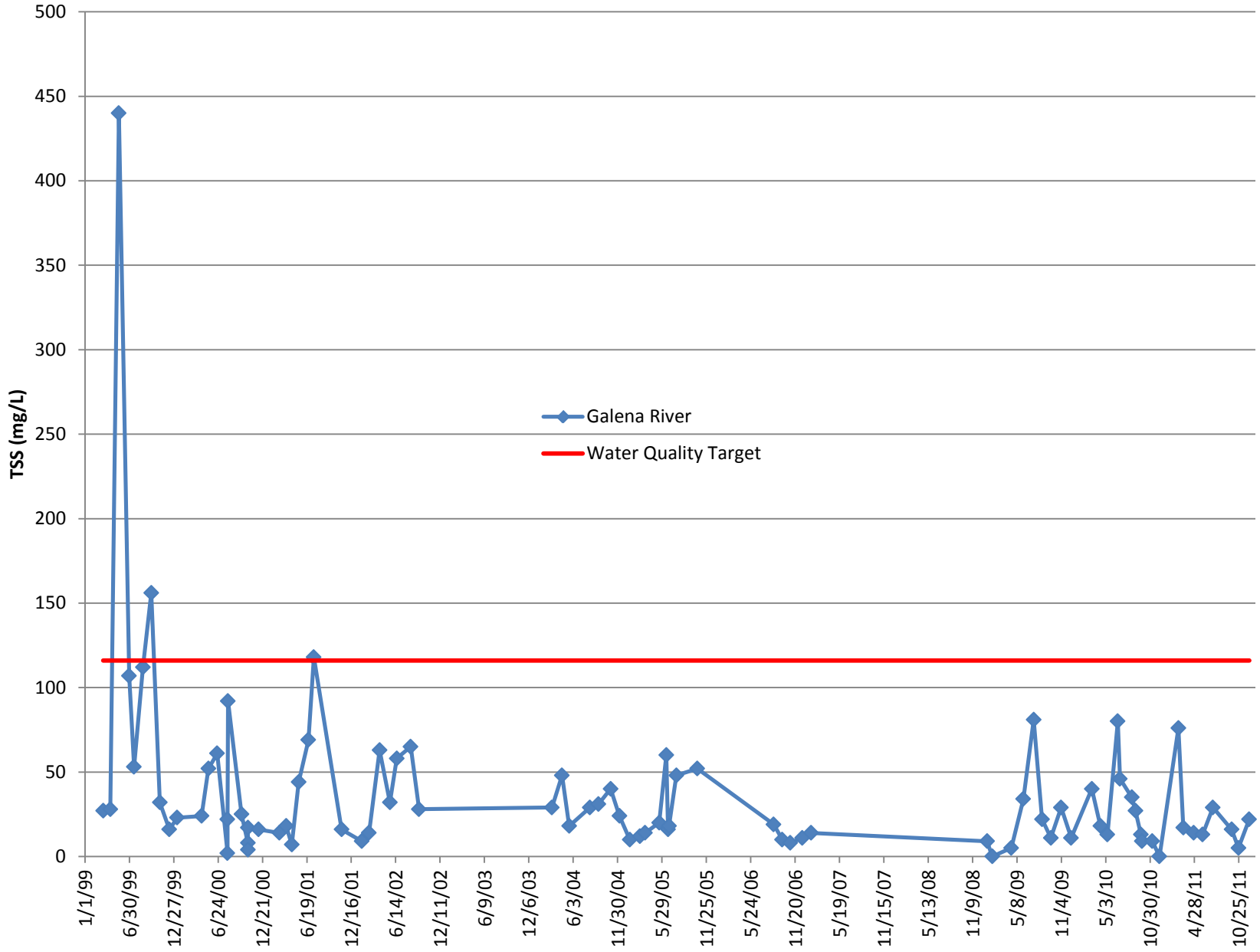

Figure 5-4
Total Suspended Solids
Galena River MQ-01

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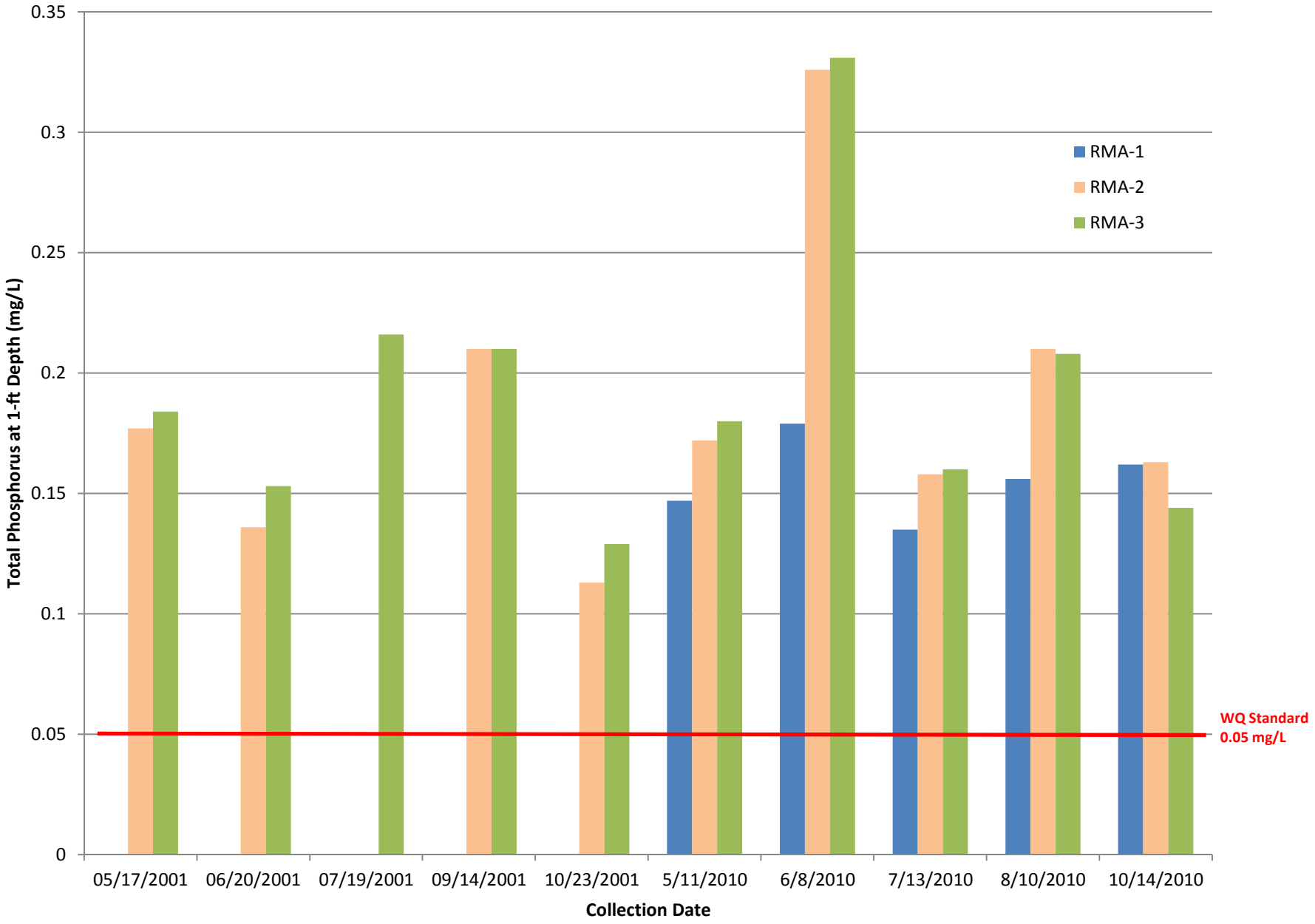

Figure 5-5
Total Phosphorus
Frentress Lake

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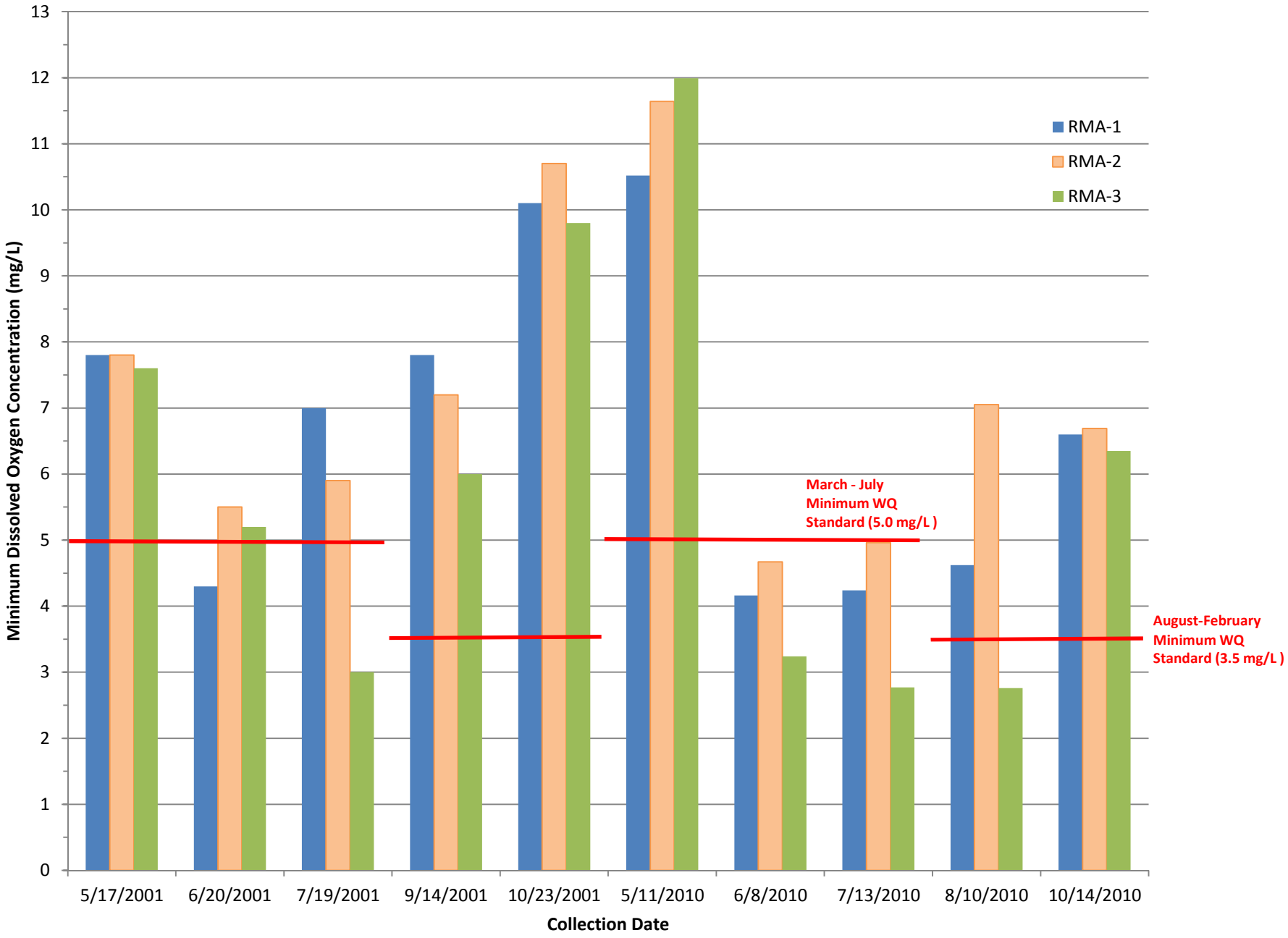

Figure 5-6
Dissolved Oxygen
Frentress Lake

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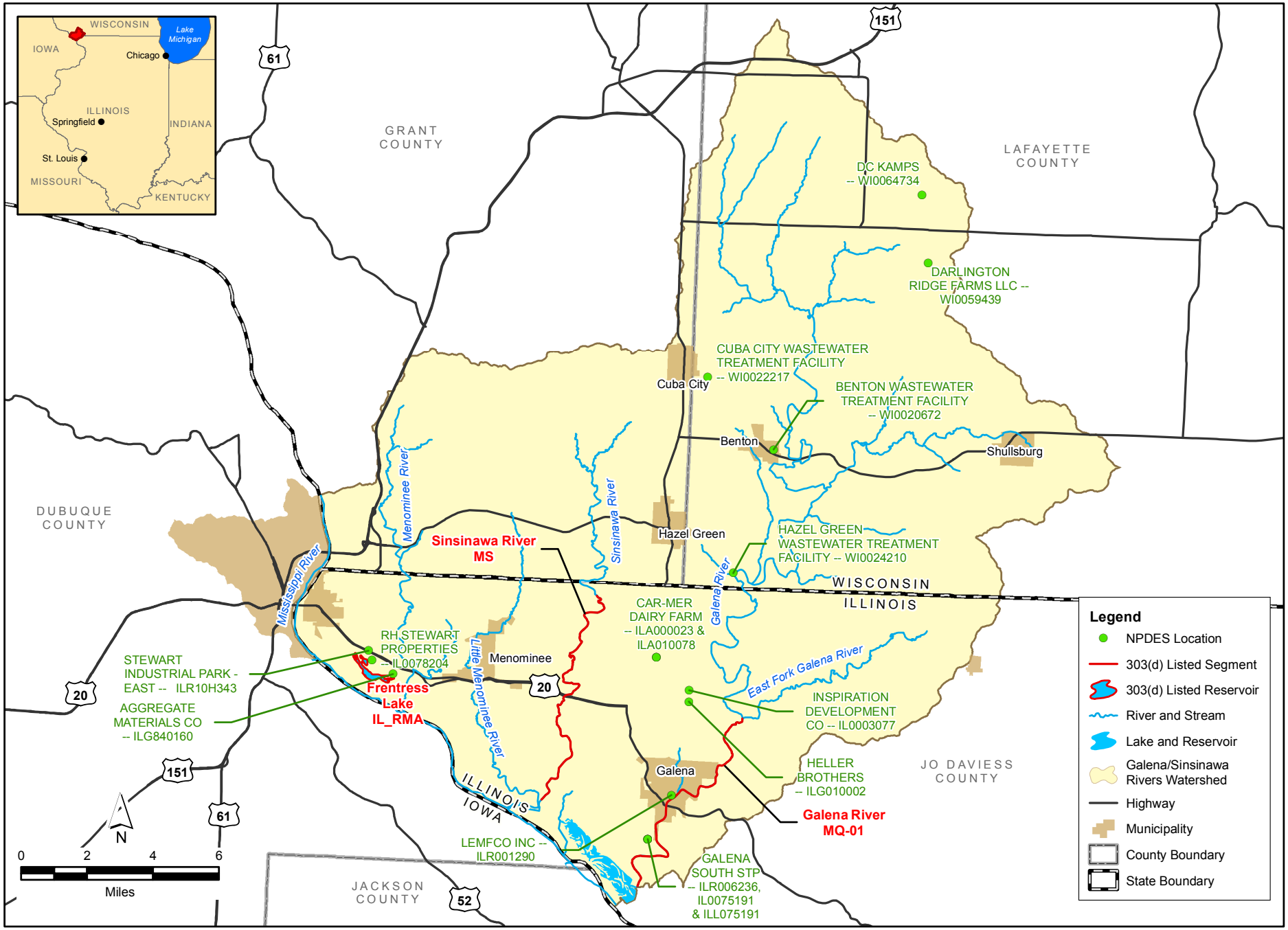

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Galena/Sinsinawa Rivers NPDES Locations

FIGURE 5-7

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Section 6

Approach to Developing TMDL and Identification of Data Needs

Illinois EPA is currently developing TMDLs for pollutants that have numeric water quality standards. Of the pollutants causing impairment in the Galena/Sinsinawa Rivers watershed, total phosphorus, zinc, fecal coliform, and DO are the only parameters for which numeric water quality standards currently exist. In addition, an LRS will be developed for TSS in the Galena River. Additional analyses may be completed for sediment/siltation in impaired stream segments and TSS and turbidity in Frentress Lake. It is likely that by addressing the parameters with numeric standards and water quality targets, an overall improvement in water quality will be observed due to the interrelated nature of the other listed pollutants. Recommended technical approaches for developing TMDLs for streams and lakes are presented in this section. Additional data needs are also discussed.

6.1 Simple and Detailed Approaches for Developing TMDLs

The range of analyses used for developing TMDLs varies from simple to complex. Examples of a simple approach include mass-balance, load-duration, and simple watershed and receiving water models. Detailed approaches incorporate the use of complex watershed and receiving water models. Simplistic approaches typically require less data than detailed approaches and therefore these are the analyses recommended for the Galena/Sinsinawa Rivers watershed. Establishing a link between pollutant loads and resulting water quality is one of the most important steps in developing a TMDL. As discussed above, this link can be established through a variety of techniques. The objective of the remainder of this section is to recommend approaches for establishing these links for the constituents of concern in the Galena/Sinsinawa Rivers watershed.

6.2 Approaches for Developing TMDLs and LRSs for Stream Segments in Galena/Sinsinawa Rivers Watershed

6.2.1 Recommended Approach for Zinc, Fecal Coliform, and Total Suspended Solids in the Galena River

Table 6-1 contains summary information regarding data availability for the metals, fecal coliform, and suspended solids impairments on the Galena River.

Table 6-1 Stream Impairment Data Availability for Zinc, Fecal Coliform, and TSS in the Galena River

Waterbody Name	Segment ID	Impairment	Data Count	Period of Record
Galena River	MQ-01	Zinc, Dissolved	38	2006-2011
		Fecal Coliform	12	2009-2011
		TSS	51	1999-2005

The recommended approach for developing TMDLs/LRSs for this segment and parameters is the load-duration curve method. The load-duration methodology uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the allowable loads for a waterbody. Due to the relatively limited data set available for fecal coliform, further data collection may be beneficial for model calibration and validation. The dataset for dissolved zinc is more robust and appears to have sufficient quantities of recently collected data for a reasonably accurate application of the load duration curve approach. The dataset for TSS shows that an exceedance of the target has not occurred since 2001 and additional data collection could help to confirm impairment still exists or to support delisting this segment.

Based on additional data collection recommendations previously discussed with Illinois EPA, Illinois EPA is planning to collect additional water quality data during Stage 2 of the Galena/Sinsinawa Rivers watershed TMDL process. Additional sample collection for zinc, TSS, and fecal coliform bacteria are scheduled for the impaired portions of the Galena River. Additional sample collection for TSS is also scheduled for the impaired portions of the Sinsinawa River. All newly available data will be incorporated in model and TMDL development for each waterbody that will occur during Stage 3 of the Galena/Sinsinawa Rivers watershed TMDL process.

6.2.2 Recommended Approach for Siltation/Sedimentation Evaluation

Illinois EPA is currently working with in-house habitat specialists to determine a reduction goal for siltation/sedimentation in the Galena and Sinsinawa Rivers. These reduction goals will be included in the Stage 3 TMDL/LRS report. Potential sources of siltation/sedimentation have been identified as agriculture in the Sinsinawa River watershed and agriculture, livestock, and urban runoff in the Galena River watershed. The implementation plan that is developed during Stage 3 of TMDL/LRS development will include BMPs to address these sources.

6.3 Approaches for Developing TMDLs for Frentress Lake

6.3.1 Recommended Approach for Total Phosphorus and DO TMDLs

Frentress Lake is listed for impairment caused by total phosphorus, DO, turbidity, and TSS. The BATHTUB model is typically recommended for TMDL development for lake and reservoir impairments such as those in Frentress Lake. The BATHTUB model performs steady-state water and nutrient balance calculations in a spatially segmented hydraulic network that account for advective and diffusive transport, and nutrient sedimentation. The model relies on empirical relationships to predict lake trophic conditions and subsequent DO conditions as functions of total phosphorus and nitrogen loads, residence time, and mean depth (USEPA 1997). Oxygen conditions in the model are simulated as meta- and hypolimnetic depletion rates, rather than explicit concentrations. Watershed loadings to the lakes will be estimated using event mean concentration data, precipitation data, and estimated flows within the watershed.

Frentress Lake is a backwater of the Mississippi River that is permanently connected to the river by several channels along the western edge of the lake. The hydrologic connection between the lake and the river appears to be significant and water quality and water quantity in the lake are likely heavily influenced by conditions in the Mississippi River. Frentress Lake is not fed by any other significant tributaries and has a small connected land drainage area of approximately 1,100 acres, suggesting that a bulk of factors influencing water quality within Frentress Lake are a product of interactions with the

Mississippi River. Illinois EPA has provided water quality data for the Mississippi River. These data will be reviewed during model development and included as appropriate.

A simple approach to TMDL development for total phosphorus is recommended for Frentress Lake that would include using a BATHTUB model to assess the lake and any inflow from the lake's overland watershed. Addressing the total phosphorus loading to the lake will also improve DO. Calculation of existing and allowable phosphorus loads to the reservoir based on inflow calculations conducted during BATHTUB modeling can be used to assess the loading of phosphorus into the lake from overland runoff within the 1,100 acre watershed. The necessary reductions would be the difference between the existing and allowable loads. Implementation strategies to meet these reduction goals within the direct watershed of Frentress Lake will include BMPs to reduce TSS from surrounding agriculture and urban areas as well as strategies to reduce erosion. Nutrient loading is closely linked to the loading of solids and implementation planning for the watershed will include strategies to improve both. While this approach would serve as a relatively simple method to assess phosphorus loads originating from point and non-point sources within the lake's watershed, it is anticipated that the interaction of the lake with the Mississippi River will limit the efficacy of any load reduction strategies developed for the Frentress Lake watershed. However, improved watershed management strategies that are currently being, and have recently been, implemented throughout the Upper Mississippi River watershed will likely contribute to reduced nutrient loads within the river and as a result, may lead to improved water quality within Frentress Lake as well.

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Appendix A

Land Use Categories

Appendices are available by request.
Contact Mr. Abel Haile at (217) 782-3362.

Appendix B

Soil Characteristics

Appendices are available by request.
Contact Mr. Abel Haile at (217) 782-3362.

Appendix C

Historical Water Quality Data

Appendices are available by request.
Contact Mr. Abel Haile at (217) 782-3362.

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