Quality Assurance Project Plan

Baseline Water Quality Monitoring Study for the Upper White River Basin Project, Missouri and Arkansas 2005-2006

Prepared by
Missouri State University
for the Upper White River Basin Foundation

Points of Contact:

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Project Management

A1 Approval Sheet

Prepared by: ______________________________ ______________
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Reviewed by: ______________________________ ______________
Steve Stewart, Executive Director Date
Upper White River Basin Foundation (UWRBF)

Reviewed by: ______________________________ ______________
Dr. Robert Pavlowsky (PI), Geography Date
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Missouri State University

Reviewed by: ______________________________ ______________
Jacquelyn Ferguson, Project Manager, Date
Region VII USEPA

Reviewed by: ______________________________ ______________
Dianne Harris, Regional Quality Assurance Manager Date
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Reviewed by: ______________________________ ______________
James C. Richburg, Project Supervisor, OWERI Date
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A3 Distribution List

Dr. Robert Pavlowsky, (PI), Geography, Missouri State University,

Dr. Richard Biagioni (co-PI), Chemistry, Missouri State University

Gopala Borchelt, Project Manager, Missouri State University

James C. Richburg, Project Supervisor, Missouri State University

Steve Stewart, Executive Director, Upper White River Basin Foundation

Jaci Ferguson, Project Manager, Region VII USEPA

Dianne Harris, Quality Assurance Officer, Region VII USEPA

A4 Project/Task Organization

Dr. Richard Biagioni, Professor of Chemistry, Chemistry Lab Manager, Missouri State University.
Will assist and train Project Assistant in laboratory analysis procedures. Will oversee the analysis of samples and check for quality control and accuracy of analyses and interpretation. Ensures proper laboratory procedures are followed.

Gopala Borchelt, Project Assistant, Missouri State University.
Will be the primary researcher for the Upper White River Basin water quality project. Responsible for sample collection and preservation as well as transfer of samples to the chemistry laboratory. Will collect water quality samples, take field notes, conduct laboratory analysis, create and manage GIS data and perform quality control measures. Will also be responsible for maintaining the official, approved QAPP until completion of the project. Is responsible for data storage, sampling schedule and the overall smooth running of the project.

Steve Stewart, Executive director, Upper White River Basin Foundation.
Will be principal data user.

Jeff Pavlik, Laboratory Analyst, Graduate Assistant in chemistry, Missouri State University through May 2005.
Will conduct laboratory analyses and train the Project Assistant in laboratory techniques. Will ensure that quality control measures are established within the laboratory analysis procedures.

Dr. Robert Pavlowsky, Project Director, Missouri State University.
Will oversee the data collection and analysis for the project. Ensure that proper water sampling techniques are being followed. Direct quality control in field sampling as well as Horiba U22 auto sampling techniques.

A5 Problem Definition and Background

Ozark watersheds are becoming increasingly vulnerable to water quality degradation because of increasing population in the region. The Upper White River Basin (UWRB) encompasses 21 counties in the Ozarks region of northwest Arkansas and southwest Missouri with a drainage area of over 8,300 square miles (Figure 1). The growing cities of Springfield, MO, Branson, MO, Ozark, MO, and Fayetteville, AR lie within this basin, which is one of the most rapidly growing areas in either state. Increases in population are causing stress on the environment by producing more septic system discharge, waste water discharge, road and parking lot run-off, and construction site erosion. All of these sources cause water quality degradation due to nutrient enrichment. The impacts of agricultural land use within the UWRB also increases nutrient loadings into streams. Increasing agricultural operations such as poultry houses, confined cattle and hog operations and manure fertilization are commonly associated with excess phosphorus and nitrogen in the soils and streams of the region. The karst geology of the Ozarks can further increase the discharge of nutrients to water supplies. Sink holes and complex subterranean fracture and cave systems circumvent natural filtration such as during soil percolation, vegetation uptake, and sedimentation and thus provide a direct connection between polluted surface runoff and the contamination of streams, lakes, and aquifers.

The Upper White River Basin Foundation received a Watershed Initiative Grant from the USEPA in 2004. The goals of this grant were to improve the capacity to develop a watershed-based water quality management plan and to implement load reduction practices for nutrients in the Upper White River Basin. In order to do this, improvements in the geospatial data quality, analysis, and sharing and water quality monitoring were needed. In addition, these improvements need to occur in coordination over all areas in the basin, including across the Missouri and Arkansas state line. The Ozarks Environmental and Water Resources Institute at Missouri State University was contracted by the Foundation to: (1) develop geospatial data bases and on-line access for geology, land use, and water quality information for the region, (2) complete a baseline water quality study for the basin, and (3) cooperate with the University of Arkansas to develop compatible geospatial and water quality data collection and analytical protocols that cross the state borders of the basin. This Quality Assurance Project Plan is for the baseline water quality component of the project (objective #2 above).

A6 Project/Task Description

Missouri State University (MSU) personnel will sample 19 sites located at existing USGS continuous flow-gage stations along the main stem and major tributaries of the Upper White River (see map on Figure 1). All sites will be sampled on each two-day sampling run. Sampling runs will occur 12 times throughout the year with a frequency of one run every month. Samples will be collected in March of 2005 through February 2006. This sampling program will produce a data set composed of at least 12 samples at each of 19 sites for a total of 228 water samples, not including duplicate sampling for quality assurance purposes.

Water quality samples will be collected during dry-weather or baseflow conditions as defined by at least a two week antecedent period of no significant precipitation or runoff. Baseflow sampling yields information on the most frequent water quality conditions occurring in the water column, but cannot be used to calculate the total transport rates of pollutants since wet-weather or storm samples typically transport most of the annual load in Ozark watersheds. However, given the time limitations of this study (1 year), the large area to be sampled (19 sites across 21,000 square kilometers), and high variability of water quality indicators in wet-weather flows (2 to 3 orders of magnitude) this sampling design gives the best chance of scientifically comparing water quality among the sites and identifying seasonal influences on water quality linked to land use characteristics of the USGS gage-defined watersheds.

Samples will be collected at each site in 500mL containers. They will be preserved and cooled in the field and returned to the MSU laboratory for the analysis. The target nutrient indicators selected for measurement in the baseline study are total phosphorus (TP) and total nitrogen (TN). These indicators are typically used to evaluate the degree of nutrient enrichment in water bodies in the USA and there is a history of their collection by other monitoring agencies and groups within the basin (James River Partnership, Missouri Department of Natural Resources and U.S. Geological Survey). In addition to nutrients, a multi-probe water quality meter (Horiba U22 auto sampler) will be used to collect information on ambient water chemistry in the field at the time of sampling. This instrument will measure temperature, pH, dissolved oxygen, specific conductance, and turbidity. Duplicate field measurements and duplicate samples for lab analysis will be taken at 10% of the sites sampled. Laboratory analysis will be completed within 5 days of sample collection.

Instantaneous discharge measurements at the time of sampling can be retrieved from the USGS "real-time" program through on-line data access. Personnel will also note precipitation, time of sample collection, predominant substrate type at the sampling location, any unusual water or substrate color, odor, precipitates, and any other observations that may relate to water quality at the site and record these in a field note book.

Maps created for this project will be based on GIS data obtained from the Missouri Spatial Data Information Service (MSDIS) website and from the Arkansas Center for

Advanced Spatial Technologies (CAST). The GPS coordinates used to plot sampling sites for this project will be obtained from the USGS real-time water monitoring stations website and verified by through field observations.

The final report for this project will be written within 3 months after the final field sampling.

A7 Quality Objectives and Criteria for Measurement Data

Quality control for the water sampling parameters collected using the *Horiba U-22* Water Quality Monitoring System will be conducted by re-calibrating the instrument sensors before each sampling in the field. This procedure is outlined in SOP WP-1.
Water sampling techniques will follow quality control procedures by taking duplicate samples at a minimum of 2 sites per sampling period. Blank samples will also be taken in the field using deionized water to ensure that no contamination is being introduced through human error. The duplicate and blank samples will be analyzed in the laboratory along with water quality samples.

Laboratory performance and quality assurance will be checked through quality control standard solutions (accuracy and bias) and laboratory duplicates (precision). Analyses of field blanks and laboratory blanks will be used to demonstrate freedom from contamination. The laboratory used for this project must maintain performance records that define the quality of the data that are generated.

The analytical method used for this study to determine Total Phosphorus (TP) has a detection limit of 0.01 mg TP/L and an upper range of 0.5 mg TP/L (SOP TP-1). The upper range may be extended by sample dilution. From previous studies, the TP concentrations found in the study area are expected to range between 0.005 and 0.500 mg TP/L. The analytical method for determining Total Nitrogen (TN) has a detection limit of 0.1 mg TN/L and an upper range of 5 mg TN/L (SOP TN-1). The upper range may be extended by sample dilution. Expected concentrations for this study are between 0.6 and 5.8 mg TN/L.

The performance and precision of the analytical instrument (spectrophotometer) will be measured using the standard calibration before each laboratory analysis. The calibration will measure known concentrations of TP and TN to produce an accuracy assessment of the measurement instruments. A second order polynomial equation in an Excel spreadsheet will be used to calculate the fit of the measured standards as outlined in the Calculations section of SOPs TN-1 and TP-1. The concentrations of each analyte will be based on the fit of the standards to the polynomial equation.

Calibration results will be rejected if the measure of fit (r squared) value is less than 0.9 while fit values between 0.9 and 1 (perfect fit) will be acceptable and allow the data to be used. The decision to accept or reject results of the laboratory analysis will therefore be based on the accuracy of the calibration and will be confirmed by Dr. Richard Biagioni. Rejected analyses will be redone until they meet the accuracy requirements of this study.

The error or uncertainty associated with GIS mapping data will be obtained from the metadata provided with each dataset from MSDIS and CAST. This information will be documented along with any spatial information and calculations.

A8 Special Training Requirements/Certificates:

No special training or certificates are required for personnel in this project.

A9 Documents and Records

Documentation procedures are explained in the SOPs for this project. Standard data sheets are included with each SOP. The Project Assistant will be in charge of the field books, standard data sheets and analyses data which will be stored in a locked filing cabinet and digitally on the hard drive of a computer in the Geomorphology laboratory at MSU. All digital project files will be backed up on a second disk and all raw chemical analysis data as well as final reports will be retained by MSU for at least 24 months. All final data and reports obtain from and associated with this project will be stored on a designated sever in the MSU Geology, Geography and Planning Dept. which is specified for this purpose and will serve this information for downloading by the end user (UWRBF).

Data Generation and Acquisition

B1 Sampling Process Design (Experimental Design)

Samples will be taken at pre-established points throughout the watershed. All sites have been previously evaluated for accessibility. Evaluations have identified all sites as low risk for safety and contamination. Training for data acquisition and analysis will be provided by Robert Pavlowsky in the Geomorphology Laboratory and Richard Biagioni in the Chemistry Laboratory at Missouri State University.

Nineteen active USGS gage sites have been selected for water quality testing and sample collection. Water collected from these sites will be tested for total nitrogen (TN) and total phosphorus (TP) as well as ambient water chemistry including temperature, pH, dissolved oxygen, specific conductance, and turbidity. Water quality samples will be taken at base flow 12 times over a year at approximately 1 month intervals. Therefore each sample at a particular site will represent the base flow concentrations of various measured parameters for the month in which it was collected. The locations of these sites are listed in Table 1.

Sample locations will be plotted on a basin-wide map using GPS coordinates and ArcMap GIS software. The boundary of the UWRB will also be shown using DEM and flow direction information from MSDIS and CAST (see Figure 1).

B2 Sampling Methods

Water samples will be collected manually for laboratory analysis of nutrient content. Duplicate samples will be collected for all parameters (SOP W-1).

Water samples will be collected in 500mL containers which will be labeled with the project name, the sample ID number and the date of collection. Sample containers will be cleaned and decontaminated in the Missouri State Geomorphology Lab using a 5% hydrochloric acid solution and triple rinsed with deionized water. This will be done before each sample collection. To preserve the water samples for N and P analyses, concentrated H_2SO_4 will be added (4 drops for each 500 mL water sample). This will bring the water to pH of $\leq$ 2.0. The pH of the sample can be checked using narrow range pH paper. The samples will be cooled in the field immediately after collection using ice and stored in the Geomorphology Lab refrigerator until analysis is performed.

The *Horiba U-22* Water Quality Monitoring System used to collect the ambient water chemistry data will be operated at each site on the same date as water sample collection. This instrument is operated according to the directions of the manufacturer as outlined in SOP WP-1. A measurement of stage (water height) will be taken using a metric stadia rod at each site and at a location that will not change with shifting stream-bed, such as a bridge support.

If a water sample is dropped, spilled or contaminated accidentally, that sample container will not be included in the analysis and will be noted in the laboratory data sheet and field book. When a duplicate of the contaminated or spilled sample is available, it may be used in place of the sample.

All sample sites have been determined as accessible and are located near bridges and on public property. Thus, there is very little chance of these sites becoming inaccessible and disrupting the sampling routine for this project.

B3 Sample Handling and Custody

Persons responsible for sample custody will be Gopala Borchelt and Robert Pavlowsky. Sample container descriptions, preservation and holding times can be found in SOP W-1. Labeling, collecting and handling of water samples are also conducted according to SOP W-1. Overall quality control with environmental sampling is outlined in SOP QA/QCE-1. Water samples collected in the field are stored in the MSU Geomorphology Laboratory and analyzed in the MSU Chemistry Laboratory. Sample transport from the field to the laboratory includes coolers and ice for refrigeration. Containers are sealed in the field after collection. Violated seals observed during chain of-custody transfer are disregarded for analysis. Although holding times are 28 days for preserved samples, analyses will be completed within 5 days of collection.

B4 Analytical Methods

All samples will be analyzed in the MSU Chemistry Laboratory in accordance with the appropriate Standard Operating Procedures based on variations of the EPA methods 353.3, 4500-N_{org} D, 2540 D and on EPA publication 600/4-87/026 and 600/4-87/026. These variations are described in detail in the SOPs TN-1 and TP-1. Ambient water chemistry is determined in the field using a *Horiba U-22* Water Quality Monitoring System as described in SOP WP-1.

B5 Quality Control

Quality control is the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer. This system of activities and checks is used to ensure that the measurement systems are maintained within prescribed limits, provide protection against unforeseen conditions and ensure the results are of acceptable quality.

Duplicate samples will be collected at a frequency of approximately 10% of the total number of samples collected for chemical analysis. This is done by collecting field duplicates at a minimum of two sites for each sampling period. Field duplicates will be taken at different sites for each sampling period and thus rotated throughout the study area. Specific quality control elements can be found in SOPs TP-1, TN-1, W-1 and QA/QCE-1. Field instruments or equipment used for this project will be maintained and calibrated according to instructions provided by the manufacturer.

Laboratory analytical results will be checked using quality control standard solutions and laboratory duplicates. Analyses of field blanks and laboratory blanks will be used to demonstrate freedom from contamination. The laboratory used for this project must maintain performance records (e. g. quality control charts) that define the quality of the data that are generated.

Detection limits, and necessary duplicates, laboratory blanks, field blanks, and standard solutions are described in detail in the SOPs TP-1, TN-1, W-1 and QA/QCE-1. MSU project personnel are responsible for ensuring all analytical data produced or provided meet the quality requirements specified in this QAPP.

B6. Instrument/Equipment Testing, Inspection, and Maintenance

Field sample containers and lids will be stored in the MSU Geomorphology Laboratory and cleaned between each sample collection to prevent contamination. Labels, field books, chest waders and ice coolers will also be stored in the Geomorphology Laboratory along with spare parts, instruction booklets, and calibration equipment for the Horiba U-22 Water Quality Monitoring System. This instrument requires periodic calibration for the pH, DO, Turbidity, Conductivity and TDS sensors. Calibration will be performed in the Geomorphology Laboratory by the Project Assistant according to instructions from the manufacturer.

Routine maintenance and calibration of the Spectrophotometers (*Hitachi UV-2001* for TN and *Spectronic Genesys 20* for TP) described in SOPs TN-1 and TP-1 will be performed by Dr. Richard Biagioni. These instruments are located in the MSU Chemistry Laboratory.

Glass test tubes used in the TN and TP laboratory analysis, as well as beakers, pipettes and glassware will be cleaned before each procedure using a 5% hydrochloric acid solution followed by triple rinsing with deionized water.

The autoclave used for the digestion process must be checked before each digestion procedure is performed. The Project Assistant will ensure proper handling of this instrument and that the correct time is set for digestion of samples as outlined in the TN and TP SOPs (TN-1 and TP-1 respectively).

B7. Instrument/Equipment Calibration and Frequency

The Horiba U-22 Water Quality Monitoring System will be calibrated before each field sampling period. If one or more instrument sensors are out of calibration it will be corrected using the appropriate standard calibration solution provided by the manufacturer. Sensors may be rebuilt or replaced when necessary to ensure proper reading.

The spectrophotometer used for TN and TP analysis will be calibrated using de-ionized water to achieve a baseline value before each analysis procedure.

B8. Inspection/Acceptance for Supplies and Consumables

The Project Assistant will be responsible for ordering water collection supplies including sample containers, labels and Horiba U-22 replacement parts. The MSU Chemistry Department with Dr. Biagioni will be responsible for providing all chemicals, standard solutions and laboratory glassware, as well as maintaining analytical instruments.

B9. Non-Direct Measurements:

A non-direct measurement used for this project will be the stream discharge measurements acquired from the USGS real-time gage website. These measurements will be used to assess the general condition of the stream on the dates that water samples were collected for this project. The discharge measurements will therefore not need to be verified. However, through comparison to the stream height measurement taken by this project on the same date as the samples, the general accuracy of the USGS station measurements can be assessed.

Another data set considered non-direct is the GIS data acquired form the MSDIS and CAST websites. This data will be used for mapping the locations of the sample sites and showing the general shape and location of the UWRB study area.

B10. Data Management

The Project Assistant will manage all field data and Laboratory analysis results. The data collected both in the field and Laboratory will be entered into an Excel database and stored electronically as well as printed as a hard copy. This data will be maintained on the computer hard drive in the MSU Geomorphology Laboratory and retrieved periodically for comparison and updating with additional data input by the Project Assistant. Chemical standard data sheets are included with SOPs TP-1, and TN-1. Documentation and reporting will be in accordance to SOP QA/QCE-1. If difficulties are encountered during sample collection, handling, or analyses, a brief description of the problem will be provided by the Project Assistant in field books or standard data sheets.

The Project Assistant will be responsible for converting all raw values produced in the laboratory into reportable values. All data reduction calculations will be recorded in standard data sheets. All charts or illustrations will be labeled, dated, and initialed by the Project Assistant. The Project Assistant will also be responsible for converting all raw values collected in the field into reportable values. All data reduction calculations will be recorded in field books and standard data sheets. Digital formats of the data will be filed as well.

Assessment and Oversight

C1 Assessments and Response Actions

Upon receipt of data the Project Assistant will perform a data quality assessment by looking for anomalous data, missing data or any confusing or questionable statements or data displays. If any of these kinds of problems are identified, the Project Assistant will contact Dr. Robert Pavlowsky and Dr. Richard Biagioni for further input, clarification and assessment of possible solutions. Corrective action will be taken by the Project Assistant as soon as possible to prevent future occurrences of that error.

C2 Reports to Management

The Project Assistant, Gopala Borchelt, will report to the project management, Dr. Robert Pavlowsky, and to Dr. Richard Biagioni, in the month following each sampling period or as soon as possible. Information regarding data, sampling problems, laboratory and analytical issues will be included. Possible solutions to any problems will also be addressed.

Data Validation and Usability

D1 Data Review, Verification and Validation

Data will be verified by the Project Assistant, Gopala Borchelt, and reviewed by Dr. Robert Pavlowsky.

Once the analytical results are compiled in Excel worksheets, the Project Assistant will review all data to determine if they fall within the acceptance limits as defined in this QAPP. As stated in section A7, the expected range for TP and TN concentrations in the study area is 0.005 to 0.500 mg TP/L and 0.6 to 5.8 mg TN/L. Method detection limits for this study range from 0.01 to 0.5 mg/L for TP and 0.1 to 5 mg/L for TN. These ranges can be extended upward by dilution of the water samples.

Sample readings for TP that fall below 0.01 mg/L will not be considered significant in this study and will be noted as uncertain. Similarly, sample readings for TN that fall below 0.1 mg/L will be discounted. High sample readings that have been extended through dilution will be noted and accepted as anomalously high values.

The Project Assistant will also verify that blanks, check standards, and duplicates are within acceptable limits. As stated in section A7, analytical results will be rejected if the measure of fit (r squared) value is less than 0.9 while fit values between 0.9 and 1 (perfect fit) will be acceptable for data in this study. The decision to accept or reject results of the laboratory analysis will therefore be based on the accuracy of the standard calibration and will be confirmed by Dr. Richard Biagioni. Rejected analyses will be redone until they meet the accuracy requirements of this study.

Those persons on the distribution list and project organization chart will also review sampling design, laboratory results and calculations.

D2 Verification and Validation Methods

The Project Assistant, Gopala Borchelt, will review all field and laboratory data collected on the standard data sheets, compare with field notes and laboratory notes and verify proper entry of this information into the computer software program Excel.
The Project Director, Dr. Robert Pavlowsky, and Dr. Richard Biagioni will have access to all analytical results and field data and will verify that this data is within expected analysis ranges. Any discrepancies found in data entry or results will be discussed with the Project Assistant and a decision will be made to omit or correct that portion of the data. The Project Assistant will be responsible for documenting any changes or revisions in the data along with descriptions of the reasoning for these changes.

D3 Reconciliation with User Requirements and Data Objectives

All of the data gathered in this project will be compiled in a final report which will be presented to the Upper White River Basin Foundation. All maps, raw data, and analyses results will be compiled into a database stored on a server in the Geography, Geology and Planning Dept. of MSU. This database will be served through the internet, providing online access to water quality and mapping data created by this project.

The limitations associated with usage of this data, such as accuracy of maps and stream flow data, will be noted in the final report and also provided through the internet to allow users to assess this project's compatibility with their own objectives.

References

James River Total Maximum Daily Load (TMDL) Webster, Greene, Christian and Stone Counties Missouri Department of Natural Resources Water Pollution Control Program 2004 http://www.dnr.mo.gov/env/wpp/tmdl/james-r-update-12-04.pdf

JRBP James River Basin Partnership 2004 http://www.jrbp.missouristate.edu/about.html

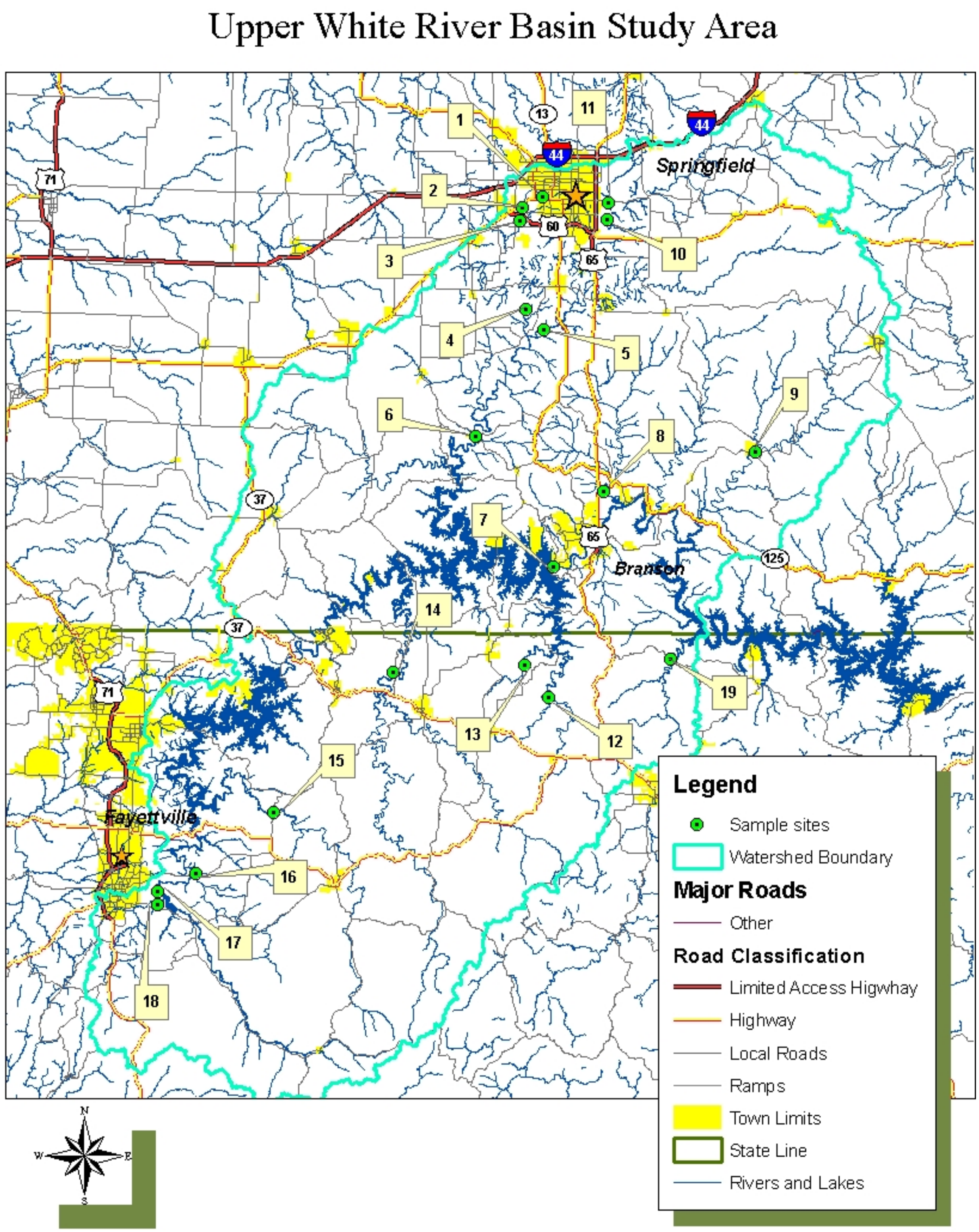
Peterson, James C., Adamski, James C., Bell, Richard W., Davis, Jerri V., Femmer, Suzane R., Freiwald, David A., and Joseph, Robert L. 1998 U. S. Geological Survey *Water Quality in the Ozark Plateaus; Arkansas, Kansas, Missouri and Oklahoma, 1992-95.*

Tables and Figures

F1 Sampling Locations at 19 USGS “Real-time” Flow Gage Stations

Site ID	Location	USGS Gage number	Drainage Area (square mi)	HUC number	County	Latitude	Longitude
1	Wilson Creek at Springfield	7052000	17.8	11010002	Greene, MO	37.11.12	93.19.52
2	Wilson Creek South Springfield	7052100	31.4	11010002	Greene, MO	37.10.06	93.22.14
3	Wilson Creek near Battlefield	7052160	58.3	11010002	Greene, MO	37.07.04	93.24.14
4	James River, Boaz	7052250	462	11010002	Christian, MO	37.00.25	93.21.41
5	Finley Creek, Riverdale	7052345	261	11010002	Christian, MO	36.58.30	93.19.39
6	James River, Galena	7052500	987	11010002	Stone, MO	36.48.19	93.27.41
7	Below Table Rock Dam, Branson	7053400	4,020	11010001	Taney, MO	36.35.46	93.18.35
8	Bull Creek, Walnut Shade	7053810	191	11010003	Taney, MO	36.43.05	93.12.24
9	Beaver Creek, Bradleyville	7054080	298	11010003	Taney, MO	36.46.47	92.54.25
10	James River, Springfield	7050700	246	11010002	Greene, MO	37.09.00	93.12.12
11	Pearson Creek, Springfield	7050690	21	11010002	Greene, MO	37.10.41	93.11.53
12	Long Creek, Denver	7053207	104	11010001	Carroll, AR	36.23.23	93.19.01
13	Yocum Creek, Oak Grove	7053250	52.8	11010001	Carroll, AR	36.27.14	93.21.23
14	Kings River, Berryville	7050500	527	11010001	Carroll, AR	36.25.36	93.37.15
15	War Eagle Creek, Hindsville	7049000	263	11010001	Madison, AR	36.12.00	93.15.18
16	Richland Creek, Goshen	7048800	138	11010001	Washington, AR	36.06.15	94.00.28
17	White River, Fayetteville	7048600	400	11010001	Washington, AR	36.04.23	94.04.52
18	West Fork White River, Fayetteville	7648550	123	11010001	Washington, AR	36.03.00	94.04.42
19	Bear Creek, Omaha	7054410	133	11010003	Boone, AR	36.26.58	93.21.23

F2 Upper White River Basin sampling locations



Appendices

Standard Operating Procedures (SOPs) used in the UWRB project

Title	Ref SOP	Source
Standard Operating Procedures for Total Nitrogen (TN)	TN-1	From EPA Method 4500-Norg D
Standard Operating Procedures for Total Phosphorus (TP)	TP-1	EPA publication 600/4-87/026
Standard Operating Procedures for Water Sampling	W-1	User instructions
Standard Operating Procedures For Collecting Water Quality Parameters	WP-1	Manufacturer's manual