Quality Assurance Project Plan (QAPP)

QAPP Level 3

Asher Creek Watershed 319 Project

G12-NPS-02

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Prepared for:
Missouri Department of Natural Resources
Water Protection Program
Watershed Protection Section

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1.0 Project Management

1.1 Distribution List

Table 1. QAPP Distribution List

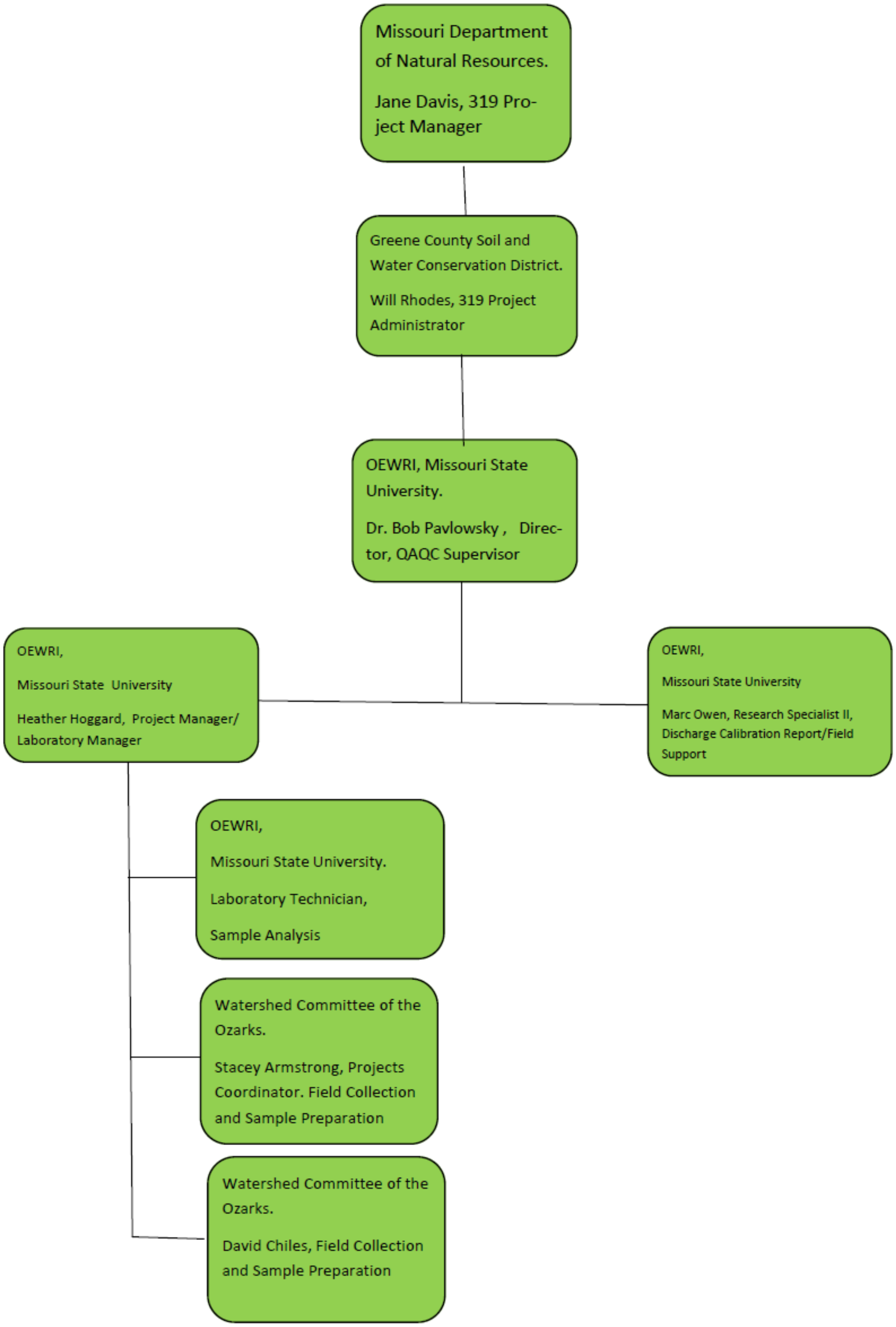
Name	Organization	Address	e-mail
Will Rhodes Greene County SWCD, Project Manager	Greene County Soil and Water Conservation District	688 S. State Hwy. B suite 200 Springfield, MO 65802	will.rhodes@swcd.mo.gov
Heather Hoggard OEWRI Laboratory Manager	Missouri State University, Ozarks Environmental and Water Resources Institute	901 S. National Ave., Temple Hall Springfield, MO 65897	HHoggard@MissouriState.edu
Shanda Feemster Greene County SWCD, Board Chairman	Greene County Soil and Water Conservation District	688 S. State Hwy. B suite 200 Springfield, MO 65802	
Jane Davis MoDNR NPS Project Manager	Missouri Department of Natural Resources	1101 Riverside Drive, Jefferson City, MO 65101	Jane.davis@dnr.mo.gov
Trish Rielly, MoDNR NPS QAPP Manager	Missouri Department of Natural Resources	1101 Riverside Drive, Jefferson City, MO 65101	trish.rielly@dnr.mo.gov
Dr. Robert Pavlowsky OEWRI Director, Principle Investigator	Missouri State University, Ozarks Environmental and Water Resources Institute	901 S. National Ave., Temple Hall Springfield, MO 65897	RobertPavlowsky@MissouriState.edu
Marc R. Owen OEWRI Research Specialist II	Missouri State University, Ozarks Environmental and Water Resources Institute	901 S. National Ave., Temple Hall Springfield, MO 65897	MOwen@MissouriState.edu

1.2 Project/Task Organization

Table 2 describes personnel responsibilities, contact information, and QAPP copy control numbers for this project. Figure 1 contains an organizational chart showing lines of authority and reporting responsibilities. If personnel changes during this project all parties will be notified of the replacement including contact information and project responsibilities.

Table 2 Personnel Responsibilities

Name and Title	Organization	Responsibilities	Contact Information	QAPP Receipt Control #
Dr. Robert T. Pavlowsky Director, Principal Investigator	Missouri State University, OEWRI	Overall supervision and QA of entire project. Review data. Assign tasks.	417-836-8473 BobPavlowsky@MissouriState.edu	1
Heather Hoggard OEWRI Laboratory Manager/ OEWRI Project Mang.	Missouri State University, OEWRI	Coordination of field monitoring and sample analysis. QA/QC, analytical and event reporting, final monitoring report writing.	417-836-3198 hhoggard@MissouriState.edu	2
Marc Owen Research Specialist II	Missouri State University, OEWRI	Discharge and calibration report. Sampling design and field support.	417-836-3197 mowen@MissouriState.edu	3
Stacey Armstrong Grant Administrator	Watershed Committee of the Ozarks	Field data collection oversight	417-866-1127 stacey@watersehdcommittee.org	4
Will Rhodes Project Manager	Greene County SWCD	Project administration, accounting, invoicing, MDNR reporting, QAPP writing.	417-831-5246 will.rhodes@swcd.mo.gov	5
Jane Davis Grant Project Manager	Missouri Department of Natural Resources Water Protection Program	MDNR grant oversight.	(573) 526-1386 jane.davis@dnr.mo.gov	6


Missouri Department of Natural Resources.
Jane Davis, 319 Project Manager
Greene County Soil and Water Conservation District.
Will Rhodes, 319 Project Administrator
OEWRI, Missouri State University.
Dr. Bob Pavlowsky , Director, QAQC Supervisor
OEWRI,
Missouri State University
Heather Hoggard, Project Manager/ Laboratory Manager
OEWRI,
Missouri State University
Marc Owen, Research Specialist II, Discharge Calibration Report/Field Support
OEWRI,
Missouri State University.
Laboratory Technician,
Sample Analysis
Watershed Committee of the Ozarks.
Stacey Armstrong, Projects Coordinator. Field Collection and Sample Preparation
Watershed Committee of the Ozarks.
David Chiles, Field Collection and Sample Preparation

1.3 Problem Definition/Background

The Asher Creek watershed is a 25,387 acre, 12 digit hydrologic unit in Greene and Polk Counties that is a sub-basin of the 390 square mile Little Sac Watershed. The Little Sac River Watershed including Fellows Lake, McDaniel Lake, and Stockton Lake make up the majority of the City of Springfield's public drinking water supply (see map 2, Appendix 1). In 1998, the Little Sac River was placed on the 303d list for bacterial contamination, for which a TMDL for Fecal Coliform was approved in 2006. The Watershed Committee of the Ozarks (WCO) conducted water quality field work in the Asher Creek Watershed sampling primarily for bacteria, from 2003 until 2007. In 2006, City Utilities of Springfield conducted sampling for total Phosphorus, total Nitrogen, Bacteria and other constituents in an effort to further define the problem. In 2009, in a joint effort between the WCO and the Greene County Soil and Water Conservation District (GCSWCD), a nine element watershed management plan entitled The Upper Little Sac Watershed Management plan was developed. The Upper Little Sac River plan covered the upper half of the Little Sac Basin, including the Asher Creek sub-basin and was accepted by Missouri Department of Natural Resources on July 8, 2010. In the Upper Little Sac Watershed Plan data from several previous studies, including the Little Sac River TMDL and the Little Sac River Data Gap Analysis were used to identify several priority sub-watersheds. Sampling data from four locations on Asher Creek indicated high levels of impairment in this relatively small sub-basin. In this dataset Site 3(19) and 4(20) (see map 1 in Appendix 1) displayed higher than 125cfu/100mL geomean of *E*.coli bacteria. Because of the elevated *E*. coli. levels, higher than many other sites in the entire watershed, the Asher Creek Basin was identified as a priority area for BMP implementation and restoration in the Upper Little Sac Watershed Plan.

. The primary goal of the Asher Creek water quality weekly monitoring effort is to quantify the load level of the measured impairments in the watershed (pre-implementation). Up until this point no extended, weekly water quality monitoring effort has been conducted in this watershed.

A secondary goal of the monitoring effort is to measure the effectiveness of the project's proposed best management practices (BMP's. BMP implementation will necessarily be limited due to time and funding constraints. It is hoped however that reducing the size of the watershed in order to more narrowly focus the restoration efforts will be proven beneficial by the monitoring program.

1.4 Project/Task Description

Monitoring efforts will be used to gain a better understanding of the health of this watershed. No data collection has been completed in the area since 2007. However, as shown in the Little Sac River Data Gap analysis and noted above, sampling data from four locations on Asher Creek indicated high levels of impairment in this relatively small sub-basin. In this dataset, Site 3(19) and 4(20) displayed higher than 125cfu/100mL geomean of E.coli bacteria. Therefore, some amount of collection is necessary to evaluate the current condition of the stream. Collected water quality data can then be used to monitor the ongoing health of the stream as the BMPs are installed. The BMP's for this project consist of Rotational Grazing Systems, Riparian Buffer Exclusion and Soil pH Correction. BMP locations are not known at this time. However, when sites are located, GPS data will be recorded as well as drainage areas and the distance to sampling locations. After installation the data can then be used as an indicator as to whether or not the BMPs have had the desired effect. The data will also be useful in determining if more BMPs are needed or if different BMPs are required all together.

It could be that the data collected will show that the impairments in the watershed are from sources that this project is not able to address and that other funding sources would be better suited to complete the watershed restoration.

Field monitoring conducted by WCO will be used to gather the required data. Data will be collected for stream flow conditions, bacteria, Total Phosphorus, Total Nitrogen and Optical Brightener concentrations. Flow conditions will be recorded at the time of sampling. Water quality samples will be collected as grab samples at six different locations along Asher Creek. Samples will be taken to the Ozarks Environmental Water Resources Institute (OEWRI) laboratory at Missouri State University and analyzed for bacteria, including *E*. coli., Total Phosphorus, Total Nitrogen and Optical Brighteners. See table 3 below.

Table 3. Project Study Schedule

Activity	Anticipated Date of Initiation	Anticipated Date of Completion
Collect weekly samples - grab	4-1-12	10-31-12
Collect monthly samples – grab	11-01-12	03-31-12
Collect -weekly samples - grab	04-01-13	10-31-13
Collect monthly samples – grab	11-01-13	12-31-13
Continuous	4-1-12	12-31-13

1.5 Data Quality Objectives and Criteria for Measurement Data

This section references the project data quality indicators (DQI) and is provided in table 4 below.

Table 4. Data Quality Indicators (DQI's)

DQI	Definition	Determination Methodologies
Precision	The measurement among repeated measurements of the same property under identical or substantially similar conditions; calculated as either the range or as the standard deviation. May also be expressed as a percentage of the mean of the measurements, such as relative range or relative standard deviation (coefficient of variation).	For this project, samples will be collected in duplicate (field duplicates) and single samples will be analyzed in duplicate in the laboratory (laboratory duplicates).
Bias	The systematic or persistent distortion of a measurement process that causes errors in one direction.	Bias will be measured by analyzing reference materials and spiked matrix samples
Accuracy	A measurement of the overall agreement of a measurement to a known value; includes a	Accuracy will be measured by analyzing a reference material and spiked matrix

DQI	Definition	Determination Methodologies
	combination of random error (bias) components of both sampling and analytical operations.	samples
Representativeness	A qualitative term that expresses “the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition”.	For the goals of this study, these samples will be considered representative of the conditions found at the collection sites and within the Asher Creek Watershed.
Comparability	A qualitative term that expresses the measure of confidence that one data set can be compared to another and can be combined for the decision(s) to be made.	Water samples are collected and analyzed according to the standard operating procedures used at Missouri State University and OEWRI for all water quality projects.
Completeness	A measure of the amount of valid data needed to be obtained from a measurement system.	It is expected that all samples will be collected and analyzed. However, it is known that lost samples and missed analyses can occur.
Sensitivity	The capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest.	This is also known as the detection limit. For this project the method detection limit (MDL) is determined.

Table 5. Data Quality Objectives

Parameter	Precision	Accuracy	Completeness
Total Nitrogen	*± 20% RPD*	*± 20%*	*100%*
Total Phosphorus	*± 20% RPD*	*± 20%*	*100%*
Bacteria (E. coli)	*± 20% RPD*	*± 20%*	*100%*
Optical Brighteners	*± 20% RPD*	*± 20%*	*95%*
Leveloggers	*± 0.05%*	*± 0.05%*	*100%*
Stream discharge	*± 2%*	*± 2% + zero stability*	*100%*

1.6 Special Training Requirements/Certification

All WCO personnel who collect and analyze water samples for this project will receive appropriate training from the OEWRI project manager for all methods needed to complete the study following the necessary standard operating procedures (SOPs) and standard methods. Records of this training will be kept with other documents related to this project. The final storage location for these records will be the OEWRI office (currently room 328 Temple Hall).

Upon completion of the project, all relevant hardcopy files will be transferred to the GCSWCD for long term storage.

Table 6. Educational Background and Training

Name and Title	Organization	Education and Background
Dr. Robert T. Pavlowsky Director, Principal Investigator	Missouri State University, OEWRI	B.S. in Natural Resource Management and M.S. in Geography from Rutgers University Ph.D. in Geography at the University of Wisconsin-Madison in the areas of fluvial geomorphology, environmental geochemistry, and water quality. At Missouri State since 1997, has mentored over 25 completed Master theses on water environmental problems in the Ozarks. Director of the Ozarks Environmental and Water Resources Institute within the College of Natural and Applied Sciences since 2005. Recent projects focus on stream restoration, channel stability, water quality trends, human impacts on watersheds, and sedimentation patterns in Ozark streams and lakes.
Heather Hoggard OEWRI Laboratory Manager/QAQC Mang.\OEWRI Project Supervisor	Missouri State University, OEWRI	B.S. Environmental and Natural Resources Missouri State University, Springfield, Missouri 1998 M.S. Resource Planning Missouri State University, Springfield, Missouri 2000. Previously employed as a Geographic Information Systems Specialist at VillaGIS Environmental Scientist, Midwest Environmental Consultants Manager or the James River TMDL Project and the Geomorphology Laboratory, Missouri State University before her position at OEWRI. Projects include Bull Shoals Sample Analysis, Bennett Springs Project, PCR Project and WQ Monitoring Projects.
Marc Owen Research Specialist II	Missouri State University, OEWRI	B.S. in Geography with a minor in Biology in 2000 from Missouri State University. M.S. in Resource Planning at Missouri State in 2003. Spent 3 years working as an Environmental Investigator for Greene County. Joined OEWRI as a project supervisor in 2005. Specializes in field investigations in fluvial geomorphology, soils/sedimentation, and water quality along with the application of geospatial technology to watershed science.
Stacey Armstrong Grant Administrator	Watershed Committee of the Ozarks	BS in Geography from Southwest Missouri State University in 2004. Joined the Watershed Committee in 2007. She is currently working on a M. S. in Geospatial Sciences from MSU. Background includes environmental work related to GIS, geomorphology, water quality, cartography and planning.
Will Rhodes Project Manager	Greene County SWCD	B.S. in Wildlife Management with a minor in Agronomy in 1999 from Missouri State University. Grant Project Manager/Administrator with the Greene County SWCD since 2000. Projects include the Upper Little Sac River SALT Project, Middle Little Sac River SALT Project, Fellows-McDaniel-Fulbright Spring 319 Project, Pearson Creek SALT Project and the Asher Creek 319 Project.
David Chiles Field Technician	Watershed Committee of the Ozarks	B.S. in Environmental Science and Public Policy, Harvard College, Cambridge MA, 2008. Study emphasized the emerging field of scientific policy dynamics between scientists and policymakers. Courses included biology, chemistry, economics, government and mathematics.

Analytical Staff at OEWRI Laboratory

Name	Position	Analyses Trained For	Years Experience	Degrees	Current Major
Andrea Mayus	Graduate Assistant/Laboratory Technician	TSS, Cl, Gamma Spec, Laser Particle Sizer, CNS, XRF	1	BS Environmental Geosciences	MS Geospatial Science
Nicole Daugherty	Graduate Assistant/Laboratory Technician	TN/TP, TSS, Cl, Laser Particle Sizer	2	BS Environmental Science	MS Geospatial Science
Terry Phillips	Laboratory Technician	TSS, Cl, Gamma Spec, Laser Particle Sizer, CNS, XRF, IC, OM, TN/TP, TIC/TOC	2	BS Chemistry/ Bioschemistry	MS Chemistry

1.7 Documentation and Record

The documents and records produced for this project will be stored in the OEWRI office in a file entitled: "Asher Creek 319 (2012-2014)". The documents listed below will be included in this file. Electronic copies of all reports, plans and procedures will be issued to all individuals on the distribution list, unless otherwise requested. A paper copy of each document will be kept on file in the OEWRI office.

Upon completion of the project, all relevant hardcopy files will be transferred to the GCSWCD. Documents and records will be retained for a minimum of five years. After that time the documents will be reviewed and a decision to retain the records for a longer period will be made. Electronic records are retained on the server at Missouri State University (MSU) and GCSWCD. There is a system in place to automatically backup all data files.

<u>Quality Assurance Project Plan (QAPP):</u> This document will be updated as needed by the GCSWCD project administrator. The MDNR project manager, and the OEWRI QA/QC coordinator through the project administrator, must then approve any updates prior to those changes being distributed. Updates may require that the document be reprinted and distributed to those listed in Table 1. If the changes do not alter the plan the project administrator may use e-mail to notify the personnel on the distribution list of the changes.

<u>Standard Operating Procedures (SOPs):</u> Analytical, field collection, and other procedures are documented in individual SOPs. These documents are prepared, edited, and updated by the OEWRI QA/QC coordinator. Project personnel are required to review all SOPs that pertain to their functions and responsibilities. Outdated SOPs are archived in the OEWRI office in both a paper and electronic versions. SOPs used for this project are listed referenced throughout the document and also listed in Appendix A with associated web links.

<u>Chain of Custody forms/Sample Log forms:</u> Chain of custody / sample log forms are completed for each sample collection run. Copies of these forms are stored with the project data in the OEWRI office. Example of the field sheet and custody form is provided in the following SOP: OEWRI 1030R01 Chain of Custody.

<u>Field Notebooks:</u> Field notebooks will be completed for this project. Any data related to this project will be recorded within the book. The field personnel will keep appropriate records of field events and include such items as sites visited, time of arrival, samples collected, weather conditions, etc. Personnel should sign or initial for each date that the notebook is used. These notebooks will be archived with the project records in the OEWRI office. Additional information is provided in the following SOPs: OEWRI 1030R01 Chain of Custody, and OEWRI 1040R03 Water Sampling.

<u>Laboratory Bench sheets:</u> These forms are generated with each analysis. They may include forms, computer printouts, or other records of analytical procedures. Sample and quality control data will be included on these forms. These are stored with the project data. Example Laboratory Sheets from OEWRI provided as Appendix 2.

<u>Quality Assurance documents:</u> Any document that describes QA processes in the field or laboratory and related to this project will be stored in the OEWRI office with other

records for this project. Some records are continuous, for example, instrument maintenance data, and remain with the instrument in log books that are attached to that instrument.

Analytical and Final Monitoring reports: A copy of all analytical reports and the final monitoring report will be kept in the OEWRI office. These reports may also include presentations given to the community as requested by the grant administrator; copies or the original will be stored in the OEWRI office.

2.0 Measurement/Data Acquisition

2.1 Sampling Process Designs

The Asher Creek watershed is a 25,387 acre, 12 digit hydrologic unit in Greene and Polk Counties that is a sub-basin of the 390 square mile Little Sac Watershed. Again, the primary goal of the Asher Creek water quality weekly monitoring effort is to quantify the load level of the measured impairments in the watershed (pre-implementation). Up until this point no extended, weekly water quality monitoring effort has been conducted in this watershed.

A secondary goal of the monitoring effort is to measure the effectiveness of the project's proposed best management practices (BMP's. BMP implementation will necessarily be limited due to time and funding constraints. It is hoped however that reducing the size of the watershed in order to more narrowly focus the restoration efforts will be proven beneficial by the monitoring program.

Leveloggers will be secured within protective PVC piping and deployed at sites AC03 and AC06 along with a barologger. The level logger will be set to collect data at 15 minute intervals to start, but may adjust based upon information received during the project period to determine if the data collection interval can be scaled back (e.g. 30 minute intervals). Data will be downloaded during each site visit based upon the schedule provided in table 3. Levelogger data will be downloaded by WCO field personnel onto a laptop.

Surface water samples will be collected from bridge crossings, therefore, the concern with inaccessibility is not of concern due to high flow events. However, if the site should become inaccessible, then resampling will occur if can be conducted within a reasonable timeframe and prior to the next sampling event. The major concern within the upper reaches of Asher Creek relates to the lack of water or flow. If sample collection cannot be conducted, the condition will be noted in the field notebook. Resampling will not be conducted. If sample volume is limited, then sample collection efforts will be prioritized in the following order 1) bacteria, 2) optical brightener, 3) nutrients.

Surface water grab samples will be gathered weekly from the Asher Creek watershed between the dates of April 1st until October 31st. Monthly samples will be taken the rest of the year. For the 2012 sampling year there will be 32 sampling days. The total number of samples for the six sites during the 2012 calendar year for bacteria will be 208 samples. For Total Nitrogen and Total Phosphorus at sites 3 and 6 only, including duplicates and blanks for QA/QC, the total will be 103 samples. For optical brighteners at all six sites, including duplicates and blanks for QA/QC, the total will be 208 samples.

For the 2013 sampling year there will be 35 sampling days. The total number of samples for the six sites during the year for bacteria will be 227 samples. For Total Nitrogen and Total Phosphorus at sites 3 and 6, including duplicates and blanks for QA/QC, the total will be 112 samples. For optical brighteners at all six sites, including duplicates and blanks for

QA/QC, the total will be 227 samples. Over the two year period the project will collect and analyze a total of 1085 water samples from the watershed.

Table 7: 2012 Sampling schedules

Analyte	# of sites	In season	Out of season	Field Blanks	Field Duplicates	Total
Bacteria *(E. coli)*	6	30	2	0	16**	208
TN/TP	2	30	2	32	7*	103
OB	6	30	2	0	16**	208
Level Logger	2	Continuous	Continuous	N/A	N/A	35,000+/year
Flow Meter	6	30	2	N/A	N/A	192
*monthly **every other week/event TN/TP = total nitrogen/total phosphorus						

Table 8: 2013 Sampling schedules

Analyte	# of sites	In season	Out of season	Field Blanks	Field Duplicates	Total
Bacteria	6	30	5	0	17**	227
TN/TP	2	30	5	35	7*	112
OB	6	30	5	0	17**	227
Level Logger	2	Continuous	Continuous	N/A	N/A	35,000+/yr
Flow Meter	6	30	5	N/A	N/A	210
*monthly **every other week/event TN/TP = total nitrogen/total phosphorus						

In-stream surface water quality monitoring will occur at six different bridges across Asher Creek and its tributary (map 3, Appendix 1). These locations are spaced throughout the watershed in an effort to gather data from above and below future potential BMP sites. Because livestock and forage production related BMPs are the primary focus of the restoration efforts in this watershed, an attempt was made to not locate the sampling points near large areas of timber to reduce variability and increase sample representiveness to meet the water quality monitoring goals and objectives of the project. See table 9 for site locations.

Other sources of data variability in this sampling plan is the possibility that large sections of Asher Creek have the potential to have no or little flow during dry times of the year. Asher Creek is considered a losing stream and in dry summers it does not contain any water. If weather conditions similar to the summer of 2011 occur again in 2012 or 2013 then those sites that are dry will be noted in the field notebook accordingly.

A second consideration is that by collecting one third of the samples during storm events, the bacteria levels will be extremely elevated. In addition, optical brightener levels will be extremely diluted, almost to the point of being below the detection limit.

Table 9: Site Locations

Site ID	Location	Latitude	Longitude
AC01	Asher Creek at Z Highway	37.327342	-93.432211
AC02	Asher Creek west of Farm Road 52	37.35114882916	-93.46462352072
AC03	Asher Creek N Farm Road 81	37.38269999909	-93.47021667000
AC04	Asher Creek State Highway BB	37.40776291454	-93.46254126055
WG05	Tributary from Walnut Grove on Farm Road 4	37.420228	-93.478136
AC06	Asher Creek / Little Sac River confluence	37.43719999909	-93.46505000000

2.2 Sampling Methods Requirements

The WCO will be performing all field data collection according to established OEWRI SOP's. Upon collection, the WCO field staff will deliver the samples to the OEWRI laboratory at MSU for analysis within in the stated holding times (Table 10). Data will be collected for stream flow conditions, bacteria (*E. coli*), Total Phosphorus and Total Nitrogen, and Optical Brightener concentration. Field monitoring will be used to gather the required data. Flow conditions will also be recorded at the time of sampling with a Marsh McBirney Flow-Mate 2000 portable flow-meter as well as two Leveloggers located at sites AC03 and AC06 (reference product web site for additional information: **http://www.hachflow.com/portable/Flo-Mate.cfm and http://www.solinst.com/Prod/Data/3001.pdf**).

Leveloggers will be deployed to collect data at (maximum) 15 minute intervals. The level loggers will be locked and secured in PVC piping a deployed with a barologger hanging within the same PVC housing. The entire PVC assembly will be secured to a bridge wingwall or tree. The PVC will extend into the channel. As water rises in the pipe the information is recorded by the level logger. The barologger will used to compensate for pressure. Raw data will be downloaded from the level loggers onto a PDA laptop then transferred to local PC where proprietary software will be used to develop summary of conditions (additional information can be found in the Installation, Operation, and Maintenance of the Solinst Levelogger Gold and Baralogger Gold (Model 3001) – under review).

Water quality samples will be collected as grab samples from approximately three to six inches below the surface at six different locations along Asher Creek. Samples will be collected from flowing water where possible or as according to guidance in the attached Water Sample Collection SOP (SOP: 1040R03 Water Sample Collection). Samples will be delivered to OEWRI laboratory at MSU and analyzed by approved methods for bacteria, including *E*. coli, Total Phosphorus, Total Nitrogen and Optical Brighteners. Nutrient samples will be collected in 500 ml plastic bottles. Bacteria samples will be collected in sterile 100 ml Thio-Test bags. Optical Brightener samples will be collected in brown 500ml plastic bottles. See table 10.

Duplicate samples will be collected during each sampling event at the subwatershed sites. All sampling bottles will be cleaned by OEWRI using procedures included in the Preparation of Sample Bottles For non-Metals Analyses (SOP: 0150R01 Bottle Prep non-Metals) prior to sampling events. Parameter-specific bottles will be cleaned by OEWRI using procedures included in the Preparation of Sample Bottles For non-Metals Analyses (see attached SOP: 0150R01 Bottle Prep non-Metals) prior to sampling events.

Water samples will be collected for Total Phosphorus, Total Nitrogen, *E*. coli. and Optical Brighteners. Samples will be collected in bottles specific to each parameter, transported on ice, transferred to the laboratory with a chain of custody form, acidified based on the Analyte of interest, and analyzed prior to appropriate hold times. The data from all analyses will be processed by the OEWRI QA/QC coordinator, recorded in a spreadsheet, and stored in the OEWRI office.

All water quality data derived for this project will be reviewed by the analyst, the OEWRI QA/QC coordinator, and by the OEWRI QA officer/Principle Investigator. All data will be stored in Excel and Word files dedicated to this project. These electronic files are stored on the computer server with controlled access (that is, access to these files will be limited to MSU personnel associated with this project). The OEWRI QA/QC coordinator will forward project information to additional parties.

Laboratory measured analytes:

1. Total Phosphorus (SOP: 3010R01 Total P): Nutrients promote aquatic plant growth such as algae in waterways which can increase turbidity and deplete dissolved oxygen which can be detrimental to a healthy aquatic biological community. All forms of phosphorus, including organic phosphorus, are converted to orthophosphate by an acid persulfate digestion. Digested samples are compared to colorimetric assay absorbance readings from a spectrophotometer and those absorbance's are used to determine Total Phosphorus concentrations.

2. Total Nitrogen (SOP: 3020R01 Total N): Nutrients promote aquatic plant growth such as algae in waterways which can increase turbidity and deplete dissolved oxygen which can be detrimental to a healthy aquatic biological community. Total Nitrogen is a measure of organic nitrogen, ammonia, nitrite, and nitrate nitrogen. Digested samples are compared to colorimetric assay absorbance readings from a spectrophotometer and those absorbances are used to determine Total Nitrogen concentrations.

3. Bacteria (SOP: 4010R01 *E*.coli IDEXX.doc): Human and animal wastes carried to stream systems are sources of pathogenic or disease-causing, bacteria and viruses. The disease causing organisms are accompanied by other common types of nonpathogenic bacteria found in animal intestines, such as fecal coliform bacteria, enterococci bacteria, and Escherichia coli (*E*. coli) bacteria.

Fecal coliform, enterococci, and *E*. coli bacteria are not usually disease-causing agents themselves. However, high concentrations suggest the presence of disease-causing organisms. Fecal coliform, enterococci, and *E*. coli bacteria are used as indicator organisms; they indicated the probability of finding pathogenic organisms in a stream.

Due to the requirement that 1/3 of the samples be collected during storm events, Bacteria data may be extremely high in many of the samples. Samples taken during storm events will be noted in the Asher Creek 319 (2012-2014) field notebook.

4. Optical brighteners (SOP: Optical Brighteners Water R01.doc): Optical brighteners (also known as OBs or OBAs), or fluorescent whitening agents (FWAs in the detergent industry), are compounds that are excited (activated) by wavelengths of light in the near-ultraviolet (UV) range (360 to 365 nm) and then emit light in the blue range (400 to 440 nm). Electrons in fluorescent molecules are excited into a higher energy state by absorption of light and then emit a small amount of heat plus fluorescence as the electrons return to their ground state. Usually, the fluorescence from the second excited state is measured as this can be accomplished with a variety of different pieces of equipment called fluorometers.

Optical brighteners are primarily added to laundry soaps, detergents, and cleaning agents for the purpose of brightening fabrics and/or surfaces. Optical brighteners are dyes that are added to essentially all laundry detergents. These brighteners are adsorbed by fabric and brighten clothing.

Laundry wastewater is the largest contributor of optical brighteners to wastewater systems because it retains a large portion of dissolved optical brighteners. Laundry effluent is predominantly associated with sanitary wastewater. Toilet papers contain fluorescent whitening agents. As toilet paper breaks down, fluorescent whitening agents are released into water. Since optical brighteners decompose relatively slowly except through photo-decay, they serve as ideal indicators (surrogates) of illicit discharges in storm drains, leaking pipes from community wastewater treatment systems, and/or failing septic tanks.

Due to the requirement that 1/3 of the samples be collected during storm events, OB data may be diluted in many of the samples. Samples taken during storm events will be noted in the Asher Creek 319 (2012-2014) field notebook.

Calculated Data:

Discharge will be calculated with the data obtained by Leveloggers installed at sites AC03 and AC06. Discharge indicates basin characteristics such as land use, soil type, slope, and size and illustrates the basins response to precipitation events. Generally as discharge increases the river's capacity to carry sediments increases and pollutants can be suspended by certain flows. A rating curve will be established for to predict discharge based on stage data continuously recorded by stage recorders installed that those sites (SOP: Levelogger). Standard engineering equations for estimating discharge will be used and discharge will be verified through field measurements using a propeller style flowmeter (Marsh McBirney Flow-Mate 2000).

Table 10. Summary of Sampling Procedures/ Collection Conditions

Parameter	Sample Matrix	Frequency	Sampling Method	Sample Container	Sample Volume	Hold Time	Pre-servative	SOP
Bacteria (*E. coli*)	Water	weekly	Grab	Sterile Thio-test bag	100 ml	6-hours	Ice	4010R02 E.coli IDEXX
Total Phosphorus	Water	weekly	Grab	Plastic bottles	500 ml	28 days	H2SO4 to pH ≤ 2 Ice	3010R01 Total P
Total Nitrogen as N	Water	weekly	Grab	Plastic bottles	500 ml	28 days	H2SO4 to pH ≤ 2 Ice	3020R01 Total N
Optical Brightener	Water	weekly	Grab	Brown bottles	500ml	6-hours	Ice Dark	Optical Brighteners Water R01

P= plastic, G=glass

2.3 Sample Handling and Custody Requirements

Again, WCO will collect all of the field data and samples. WCO will enter flow data into the field notebooks, collect samples, download stage recorder data, and fill out chain of custody documentation. Field conditions such as changes to the channel will also be recorded in the Asher Creek 319 (2012-2014) field notebook, see attached example.

The project will be assigned a unique project ID, while each sample will be identified by a unique ID number (reference Appendix 2 for example of sample ID). WCO will collect all of the water samples in the appropriate bottles for each parameter. A label will be affixed to or written on each container and will contain the following information: date and time (in 24hour time) of collection, site code, project, list of analytes, and sample collector's initials (SOP: 1040R03 Water Sampling.doc). . After collection, the bottles are placed into a cooler containing ice, the samples are transported to the laboratory, and the proper preservative is added to the bottle when applicable once received by the laboratory.

The chain of custody will be completed as the samples are transferred at the laboratory following the instructions outlined in the SOP (1030R01Chain of Custody). Each sample will be tracked by this chain of custody record that serves to efficiently document the individuals who were responsible for the sample during each successive transfer of that sample to the OEWRI laboratory.

Sample bottles that are not used for immediate analysis will be stored in the laboratory refrigerator. Upon completion of the analyses, including review of data, the sample may be discarded. Re-analysis can occur if sample remains in the bottle and the hold time has not been exceeded. At no time will a re-analysis take place on samples when the hold time has expired. See table 10.

2.4 Analytical Methods Requirements

See Table 11 for a list of analytes, SOPs or standard methods, and method performance criteria. Analyses are completed as soon as possible after collection and within the allowable holding times. Samples are not disposed of until after the analyses are complete and data has been reviewed. Samples will be analyzed and batch reports submitted to the GCSWCD within 35 days following analysis. Appendix 2 provides a summary analytical data provided in a batch report.

When problems arise with the analytical method, for example, blanks exceeding the detection limit, the procedures will be reviewed by the analyst and the QA/QC coordinator and/or the project management. Corrections will be made and samples reanalyzed if possible. The problem will be documented in the parameter QA/QC files.

Table 11: Summary of Analytical Procedures

Parameter	Analytical Method	Performance Range or Detection Limit	Reporting Units
E. coli	IDEXX – Quanti tray 2000 System with Colilert Reagent method	1 MPN/ 100 ml.	Colonies/100 mL
Total phosphorus	EPA Method # 365.2 with size of sample reduced	0.01 mg TP/L - 0.5 mg TP/L	mg/L
Total Nitrogen	Crumpton, Isenhart, and Mitchel (1992)	0.1 mg TN/L – 5.0 mg TN/L	mg/L
Optical Brighteners	Gillieson (1996)	200 mg/L - 1,000 mg L	mg/L
Leveloggers	Solinst (pressure	F30/M10, F100/M30	Ft/m

	transducer)		
Flow Meter	Marsh-McBirney, Inc. (electromagnetic sensor)	-0.5 to +19.99	ft/sec

2.5 Quality Control Requirements

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 stated requirements. Quality control activities ensure that measurement systems are maintained within prescribed limits and that results are of acceptable quality.

The quality control checks used in this project are listed in Table 12. Laboratory blanks and duplicates will be used as a check for precision. Matrix spikes, check standards, and calibration standards are used to measure bias and accuracy. Sensitivity is determined by analyzing equipment blanks and reagent blanks. One field blank will be collected during each sampling event. One field duplicate will be collected for every sampling event. Laboratory duplicates will be analyzed at a frequency of one per 10 samples analyzed. One laboratory spiked sample will be analyzed for every batch of samples analyzed. The laboratory blank and check standards will be analyzed after every 10 samples analyzed.

Individual SOPs or standard methods specifically present all equations used to determine quality control measures for each parameter associated with this project. Relative percent difference (RPD) will be calculated for pairs of duplicate analyses to determine precision. The coefficient of variation (CV%) will be used to determine precision if triplicates are required for specific parameters. Accuracy will be determined by calculating RPD between multiple analyses of manufacturer- or laboratory-certified standards throughout each batch of samples. The effectiveness of digestion procedures will be determined by calculating percent recovery of matrix spike solutions. The Method Detection Limit (MDL) for each type of chemical analysis is calculated by multiplying 3.14 and the standard deviation of multiple analyses of the blank associated with the analysis. The “3.14” value is derived from the table of a one-sided t distribution when a 99% confidence level is desired.

Quality control data outside the acceptance limits or exhibiting a trend are evidence of unacceptable error in the analytical process. Corrective action will be taken as soon as possible to determine and eliminate the source of the error. The analyst is responsible for understanding when the analytical process is out of control. See Table 13 for error types and corrective action measures. All corrective actions taken will be recorded in the instrument log book to be used as a reference to avoid repeating the same error.

If a sample batch is reanalyzed because a QC sample was out of control, the second set of results will be reported if all QC are within established limits for the project. However, a comment will be written on the data sheet that the data is a reanalysis and the reason for the reanalysis will be recorded. The initial analysis data sheet will be retained for the QC file associated with the project. All QC data, in and out of control, will be recorded on the control charts.

Table 12: Summary of Quality Control Procedures

Quality Control Procedure	Field Procedure (Yes/No)	Laboratory Procedure (Yes/No)	Frequency
Duplicates	Y	Y	Table 8 parameter specific Lab: Every 10th sample
Replicates	N	Y	Every 10th sample
Spiked Matrix	N	Y	Every sample batch
Field blank	Y	N	Table 8 parameter specific
Reagent blank	N	Y	Every 10th sample

Table 13 below details the Quality control action plan being used for this project.

Table 13: Quality Control Corrective Action Plan. (Standard Methods, 2005)

QC Type and Error	Corrective Action	Comment*
Laboratory Reagent Blank > MDL	1. Analyze another blank; if 2nd LRB is acceptable, then data is acceptable. 2. If 2nd LRB fails, then re-prepare and reanalyze affected samples	These data are associated with an LRB result that is > the MDL for this analyte.
Spiked samples (LS) fails	1. If Reference sample (LS) is acceptable, then qualify the data 2. If LS and LB fail, then re-prepare and reanalyze the affected samples.	These data are associated with a LS recovery result that is > UCL (or < LCL).
Laboratory Blank (LB) fails	1. Analyze another LB. 2. If 2nd LB fails then check another source for the reference material. 3. If the 2nd source is acceptable, then re-prepare and reanalyze affected samples.	These data are associated with a LB recovery result that is > UCL (or < LCL).
Calculations	1. Check calculations for error, correct if found.	No comment needed for corrected calculations.
Calibration Standards fail	1. Check calibration standards against the reference sample. 2. If calibration standards fail then reprepare and reanalyze the calibration standards and affected samples.	No comment needed for reanalyzed calibration standards.
*If the QC sample fails and the samples cannot be reanalyzed, then record the comment on the data sheet.		
UCL = Upper Control Limit, LCL = Lower Control Limit		

2.6 Instrument/Equipment Testing Inspection and Maintenance Requirements

Once deployed, WCO will maintain leveloggers by checking and cleaning the sensors as needed during scheduled site visits, while the portable flow meters will be maintained and cleaned following or prior to field use. The laboratory equipment and instruments will be maintained by OEWRI personnel to prevent down time and missed sample data. See Table 14 for a list of instrumentation and equipment and the approximate schedule for preventive maintenance. Preventive maintenance procedures are also listed in the SOPs. Preventive maintenance activities will be recorded in the log book associated with the instrument. After a corrective activity has been completed, the instrument will be tested to ensure that it functions appropriately for the analysis in question.

For routine maintenance procedures an adequate supply of spare parts will be kept on hand. New parts will be purchased before they are needed. When parts are no longer functioning, they will be replaced. If there is a major instrument break down the manufacturer may be contacted to perform a service call for repairs.

Table 14: Maintenance, Testing, and Inspection of Sampling Equipment and Analytical Instrumentation.

Equipment / Instrument	Maintenance, Testing, or Inspection Activity	Frequency	SOP/Method Reference
Spectrophotometer	Create calibration curve	Before each use	3010R01 Total P
Spectrophotometer	Create calibration curve	Before each use	3020R01 Total N
Spectrophotometer	Create calibration curve	Before each use	Optical Brighteners Water
Flow Meter (portable)	Performance Check (e.g. sensor cleaning, zero check/adjustment)	Before each use	Marsh McBirney Flow Mate 2000
Level Loggers	Clean casing, circulation holes, and the optical infrared “eyes”	Each Visit	Levelogger

2.7 Instrument Calibration and Frequency

Laboratory analytical instrumentation require calibration to ensure quality data. Calibration procedures follow the instrument manufacturers recommendations and OEWRI SOPs. Field instruments (portable flow meter and levelogger) are factory calibrated and do not require field calibration. Laboratory personnel calibrate instrumentation according to Tables 14 and 15 and specific OEWRI SOPs. The QA/QC coordinator reviews all data.

Initial calibrations of field and laboratory instruments will be performed before deployment, prior to each field sampling event or each batch of laboratory samples. If linear regression is used to fit the calibration curve, then the minimum correlation coefficient value should be 0.995. To determine if calibration points are acceptable, compare each point to the curve and recalculate. An acceptable point will result in a calculated value of the expected value ±10% (Standard Methods, 2005). Initial calibrations are recorded by the technician and included within the data set that is reviewed by the QA/QC coordinator.

Calibration verification will be done by analyzing a calibration standard periodically to ensure that the instrument performance has not changed. Analysis of the verification (check) standard will be after every 10 samples during the analytical run. A verification (check) standard will be acceptable if its value is within ±10% of the expected value. Instrument performance checks are recorded by the technician and included within the data set that is reviewed by the QA/QC coordinator.

See Table 15 for a list of instruments that require calibration. The type of calibration is listed in the table and a detailed description of the calibration procedure is included in the respective SOPs for the analyte of interest.

Table 15: Laboratory Instrumentation Requiring Calibration.

Instrument	Analyte	Calibration Type	SOP/Method Reference
Spectrophotometer	Total Phosphorus and Total Nitrogen	Calibration Curve	3010R01 Total P and 3020R01 Total N
Spectrophotometer	Optical Brighteners	Calibration Curve	Optical Brighteners Water

2.8 Inspection/Acceptance Requirements for Supplies and Consumables

Adequate quantities of supplies and consumables are inventoried for this project. When the number of items needed begins to run low, replacements are ordered from the vendor. Chemicals are ordered as needed for laboratory analyses by the laboratory manager. Reference standards for calibrating instruments are received with “certificates of analysis” documents from the supplier. “Critical” supplies and consumables are listed specifically for each analyte of interest within the respective SOP for that analyte. Specific supply sources and acceptance criteria are also listed in specific SOPs for each analyte. The QA/QC coordinator will receive and inspect supplies and consumables upon delivery and return them if they do not met specifications.

Bottles used to collect samples will be reused throughout the sampling period. Nutrient sample bottles will be emptied, rinsed with tap water, washed with a 2% solution of Citranox, rinsed with deionized water (DI), soaked in 10% hydrochloric acid or nitric acid (depending on the parameter to be collected in the bottle) overnight and rinsed with DI water again. The bottles are allowed to drain dry and then are stored in sealed plastic containers until use. Sample blanks will routinely be analyzed for all of the parameters of interest. The hydrochloric and nitric acid solutions will be tested by the cleanliness of the bottles as indicated by the results of the blank for each batch. If the bottles show no residual for the parameters of interest, then the acid solutions will be considered “clean” enough for this procedure. The solution will not be re-used beyond three months after its preparation.

Analysts will employ good laboratory practices and observe all processes or changes that may be caused by a new batch of supply items. If a process does appear to be affected by a supply item, a corrective action response will be initiated. This may require discontinuing the use of that item and ordering replacement items as well as reviewing protocol with the analyst.

2.9 Data Acquisition Requirements (non-direct Measurements)

There are no non-direct measurements planned for this project.

2.10 Data Management

Data are generated in many steps from field sample collection to laboratory analyses, calculations and observations. All data are recorded on laboratory bench sheets, field notebooks, in instrument data loggers or on instrument software. Field personnel will transfer all digital and hardcopy data to the QA/QC coordinator after each sampling event for review. Upon passing QA/QC review, field reports will be produced and signed, and transferred (digital and hardcopy versions) to the project manager. Laboratory personnel will transfer all digital and hardcopy data to the QA/QC coordinator after each analytical batch for review. Upon passing QA/QC review, laboratory reports will be produced and signed, and transferred (digital and hardcopy versions) to the project manager. The PI will review and sign all field and laboratory reports as they are generated. The following are the procedures that will be followed for managing data for each type of data collection.

<u>Field notebooks:</u> The field notebook will be similar to item number 8152-55 manufactured by Sokkia and will be titled "Asher Creek 319 (2012-2014)". This book has water resistant surfaced pages. Notes are written in indelible ink. WCO Personnel will record all field observations in this book at the time of their visit. The date, time, sites visited, samples taken, other personnel present, weather conditions, and other information deemed necessary and appropriate will be recorded. WCO Personnel should initial or sign each page. The notebook will be dedicated to this project. When the book is filled or the project completed, the notebook will be stored in the OEWRI office.

<u>Laboratory bench sheets:</u> Bench sheets will be completed for every analysis. Methods that require bench sheets have the sheets available as attachments within the SOP. The analyst should record all information on the forms using indelible ink. QC calculations, for example, spike percent recovery, will be recorded on the form in the "Comments" section of the bench sheet. Errors are crossed out with a single line, the correct entry is made and the analyst initials the correction. Completed data are transcribed into an Excel spreadsheet for further use. Completed bench sheets are stored with the project file in the OEWRI office.

<u>Field Instrumentation:</u> Data internally stored in the stage recorders will be downloaded on to a laptop in the field personnel (WCO). The stored laptop data will then be downloaded to the laboratory computer file titled "Asher Creek 319 (2011-2014)". Raw instrument data will be stored in the Asher Cr level logger data folder of the QC coordinator's computer as well. The raw data will be transferred to an Excel file for processing and review. A second copy of all processed data will be stored on the Asher Creek 319 removable drive. All data printouts will be stored in the project file to back up the digital data.

<u>Laboratory Instrumentation:</u> Data internally stored on a computer associated with a laboratory instrument will be saved to the file titled "Asher Creek 319 (2011-2014)". Raw instrument data will be stored in an Asher Creek 319 (2011-2014) folder of the QC coordinator's computer as well. The raw data will be transferred to an Excel file for processing and review. A second copy of all processed data will be stored on the Asher Creek 319 removable drive. All data printouts will be stored in the project file in the OEWRI office.

The OEWRI project manager will be responsible for data management throughout the monitoring and processing portions of the project. Data records will be stored by OEWRI for a minimum of five years after the completion of the project. After five years the data will be reviewed to determine if any part of the data may be discarded. The decision to retain archived data will be made by OEWRI and the Greene County SWCD.

3.0 Assessment/Oversight

3.1 Assessments and Response Action

The Project's activities will be assessed to identify and correct any potential or existing problems before the data is affected. A readiness review will be conducted prior to starting the project. Proficiency test samples will be procured for assessing analytical skill. A surveillance assessment will be conducted throughout the project. The QA/QC Coordinator will have the authority to stop work and request that corrective actions be taken at any time in the project as it is deemed necessary. Each of these assessments is discussed below. Handling of the results for these assessments is discussed in the next section.

<u>Readiness Review:</u> Prior to the initiation of sampling, the QC Coordinator will review with the project Graduate Assistants and WCO field collection staff all aspects of sampling and analyses. A review will be completed once per technician after each training session. Items that will be covered in this assessment are; location and preparation of sample bottles, use of chain of custody forms, analytical processes including necessary quality control analyses, sample site locations including site codes, the use of field instrumentation and sampling devices, and how to transfer data after it is generated.

<u>Proficiency Testing:</u> A sample with a known-concentration of analyte will be purchased from an appropriate vendor, such as, the USGS (http://bqs.usgs.gov/srs/) or Environmental Resource Associates (http://www.eraqc.com). The sample will be assigned to the analyst without informing the analyst of the sample's source. The sample will be treated the same as other samples. The results will be evaluated by the QA/QC coordinator. Testing will be done as the QA/QC coordinator feels it is necessary or once every two years.

<u>Surveillance Assessment:</u> Surveillance is the observation of ongoing work to document conformance with specified requirements and/or procedures, such as those given in the SOPs. These observations will be continuous throughout the project and will be conducted by the QA/QC coordinator and the co-principal investigators as dictated by the QA/QC. Any deficiencies or problems detected will be addressed as soon as possible. Surveillance and review will continue to ensure that corrections have been implemented for all future uses. Documentation may include hand written notes, copies of e-mail, or other forms that will be stored in the project file. These documents may be useful for future projects.

3.2 Reports to Management

Analytical reports for each parameter of interest from water samples will be prepared by the QA/QC coordinator. Event reports for each sampling event will be prepared by the OEWRI project manager and submitted to GCSWCD at minimum quarterly. A summary of field and analytical activities shall be submitted to the GCSWCD for incorporation to their MDNR quarterly reporting. These may be issued as e-mail messages or as a Word or Excel file in an e-mail attachment. Copies of all reports will be stored in the project file in the OEWRI office.

Both OEWRI and WCO project management will forward information to the SWCD grant administrator to provide to outside agencies including MDNR oversight personnel associated with this project. The GCSWCD will provide quarterly reports to the MDNR as listed in the general schedule and milestones section of the nonpoint source implementation grant application including any raw water quality data available. The monitoring report is due to GCSWCD on January 15th, 2014 and the final project report is due to the MDNR on January 31st, 2014. The final water monitoring report will include: data from site monitoring; empirical multi-variable regression models that predict pollutant loadings at sites as a function of land use, storm event characteristics, and hydrology; and frequency of exceedance of pollutant concentrations over TMDL limits.

4.0 Data Validation and Usability

4.1 Data Review, Validation, and Verification Requirements

These procedures are summarized as follows: data are reviewed for completeness and correct calculations, data are verified against quality control parameters, and data are validated against project goals and objectives.

<u>Data Review:</u> Sample collection forms, field instrument data printouts, laboratory bench sheets, and other sources of project data will be reviewed for transcription, calculation, reduction, and transformation errors. Data review is also a completeness check to determine if there are any deficiencies such as missing or lost data. Errors will be corrected when found. Missing data will be noted in the project narrative of the final report. The project analysts, OEWRI QC coordinator, and project management will review all data.

<u>Data Verification:</u> Data verification is the evaluation of the data collected for the project compared to the requirements outlined in this QAPP, the original project agreement, and SOPs. Analytical data are compared to required levels of precision and accuracy as outline in the analyte's SOP. If the levels are not met, then a cause for the discrepancy will be determined. The result of this determination will be whether the data may be used with qualifications or not used. After the verification process it may be possible to recollect or reanalyze. The analyst, QC coordinator, project management, and principal investigators are all responsible for data verification during the project.

<u>Data Validation:</u> One goal of data validation is to evaluate whether the data quality goals established during the planning phase have been achieved. Using the reviewed and verified data, the validation process compares the results with the objectives of the project stated in the Problem Definition and Background section.

4.2 Validation and Verification Methods

The verification method includes checking all bench sheets, data forms, and records for complete and accurate transcription of data, correct calculations, and appropriate comparison of quality control data to established limits. The reviewer will indicate on any form verified that this process has occurred. Any deviations from expected values will be noted on the report forms. Corrections can be made by crossing out the incorrect value with a single line, writing in the correct value, and initialing the correction. The QA/QC coordinator is responsible for verification of field and laboratory data and verification will occur per batch immediately after receipt.

The validation method involves reviewing the data and reports and comparing that information to what was expected as outlined in this document. The project manager and PI are responsible for validation of the data and validation will occur on a per event basis immediately after all data is compiled for each event. Deviations from what is required will be noted and a comment will be added to the final report indicating whether, or how, the deficiency will affect the final interpretations.

4.3 Reconciliation with Data Quality Objectives

The goal of this project is to fulfill the water monitoring portion of the Greene County SWCD's grant obligations. This goal will be met by processing data generated by following the procedures outlined in this QAPP and specifically stated in associated SOPs or standard methods. Uncertainty values associated with each analytical batch of data will be reported on each individual event report. These individual event reports will be saved by the project manager as well as transferred to the SWCD project administrator for quarterly reporting. Specific procedures used to derive uncertainty data exists in each individual SOP. See attached analytical report from OEWRI.

Trip reports will be similar. WCO will be submitting copies of those to the GCSWD project administrator to be forwarded on to the DNR project Manager on a quarterly basis. They will include the number of sites sampled, number of samples taken, and flow conditions.

OEWRI will assemble the data at the end of the project and develop the final report. The final water monitoring report will include: data from site monitoring; empirical multi-variable regression models that predict pollutant loadings at sites as a function of land use, storm event characteristics, and hydrology; and frequency of exceedance of pollutant concentrations over TMDL limits.

OEWRI will present findings upon request and will make recommendations for future studies based on pollutant concentrations and trends as necessary.

One final note of caution is included in order to remind the reader of the limitations of this project when viewing the final report and any associated load calculations. BMP implementation is extremely limited due to severe time and funding constraints. An effort has been made to overcome this by reducing the size of the watershed in order to more narrowly focus the restoration efforts. However, Asher Creek is considered a losing stream and in dry years there is no flow in many sections of the upper reaches. 2011 was an abnormally dry year in Greene County and if 2012 is a repeat of the weather conditions seen in 2011, it may prove difficult to gather any data let alone flow data from the upper half of the watershed. Conversely, bacteria will be extremely high in a large percentage of the samples due to the requirements that the program obtain 1/3 of the samples from storm events. These storm events may also limit the quality of the optical brightener samples as well by diluting them to below the detection level. Taken together, the limited time span of this project and varying weather conditions may be the deciding factor in determining accurate load calculations for this watershed.

List of References

Literature cited

10 CSR 20-7.031. Code of State Regulations. Department of Natural Resources. Water Quality Standards. November 30, 2005. www.sos.mo.gov/adrules/csr/current/10csr/10c20-7.pdf

Midwest Environmental Consultants and Ozark Environmental and Water Resources Institute. The Southwest Missouri Water Quality Improvement Project - Data Gap Analysis. 2007. http://www.oewri.missouristate.edu/45039.htm

Missouri Department of Natural Resources. Little Sac River Watershed, Fecal Coliform Total Maximum Daily Load FAPRI-UMC Report #11-06 June 2006 http://dnr.mo.gov/env/wpp/tmdl/1381-l-sac-r-tmdl.pdf

Missouri Department of Natural Resources, Environmental Services Program, Water Quality Parameters. http://dnr.mo.gov/env/esp/waterquality-parameters.htm

USEPA. 1983. Methods for chemical analysis of water and wastes. 2nd ed. Method 365.2. U.S. Environmental Protection Agency, Washington, DC. http://water.epa.gov/type/rsl/monitoring/vms56.cfm

Watershed Committee of the Ozarks and the Greene County Soil and Water Conservation District. The Upper Little Sac River Management Plan. 2010 http://www.dnr.mo.gov/env/wpp/nps/319applicationresourcetools.htm

SOP’s from OEWRI

http://oewri.missouristate.edu/assets/OEWRI/4010R02_Ecoli_IDEXX.pdf

http://oewri.missouristate.edu/assets/OEWRI/Total_N_Genesys_R04.pdf

http://oewri.missouristate.edu/assets/OEWRI/Total_P_Absorbance_Genesys_R01.pdf

http://oewri.missouristate.edu/assets/OEWRI/1030R01_Chain_of_Custody.pdf

http://oewri.missouristate.edu/assets/OEWRI/0150R01_Bottle_Prep_non-Metals.pdf

http://oewri.missouristate.edu/assets/OEWRI/SOP_1040R03_Water_Sampling.pdf

http://www.hachflow.com/portable/Flo-Mate.cfm

http://www.solinst.com/Prod/3001/3001.html

Appendices

Appendix 1

Map 1: Existing *E*. coli data in Sac River Basin

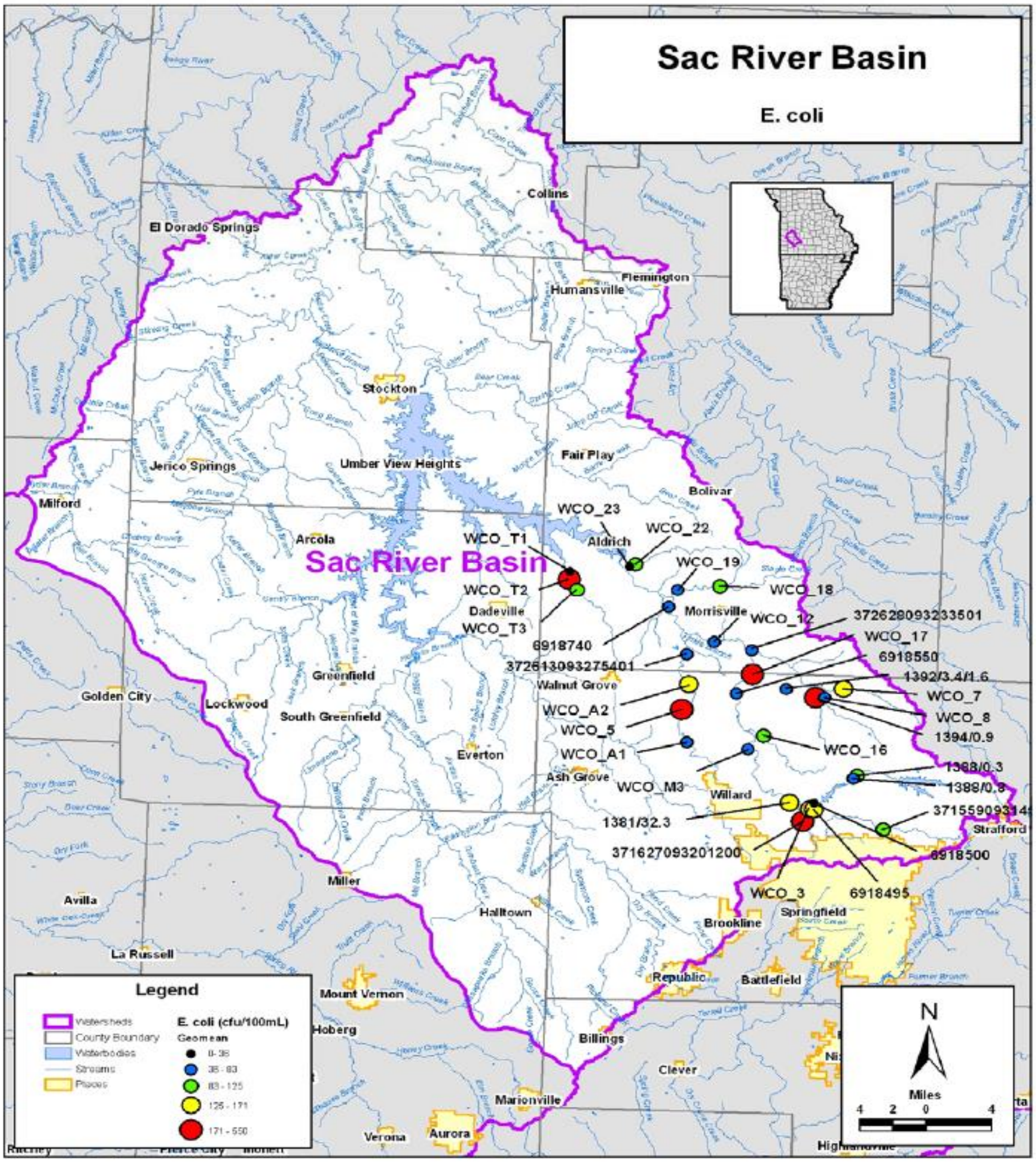
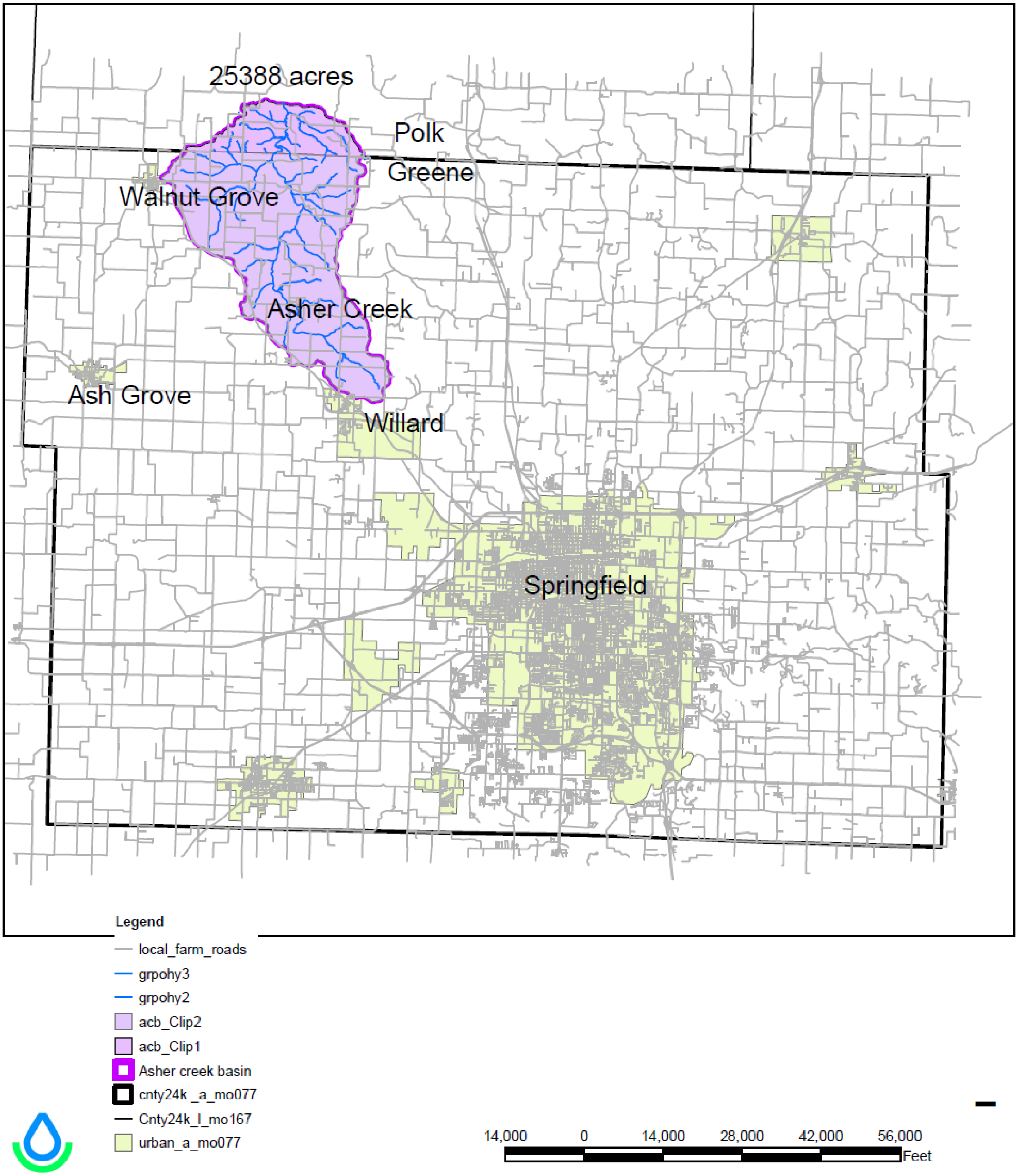
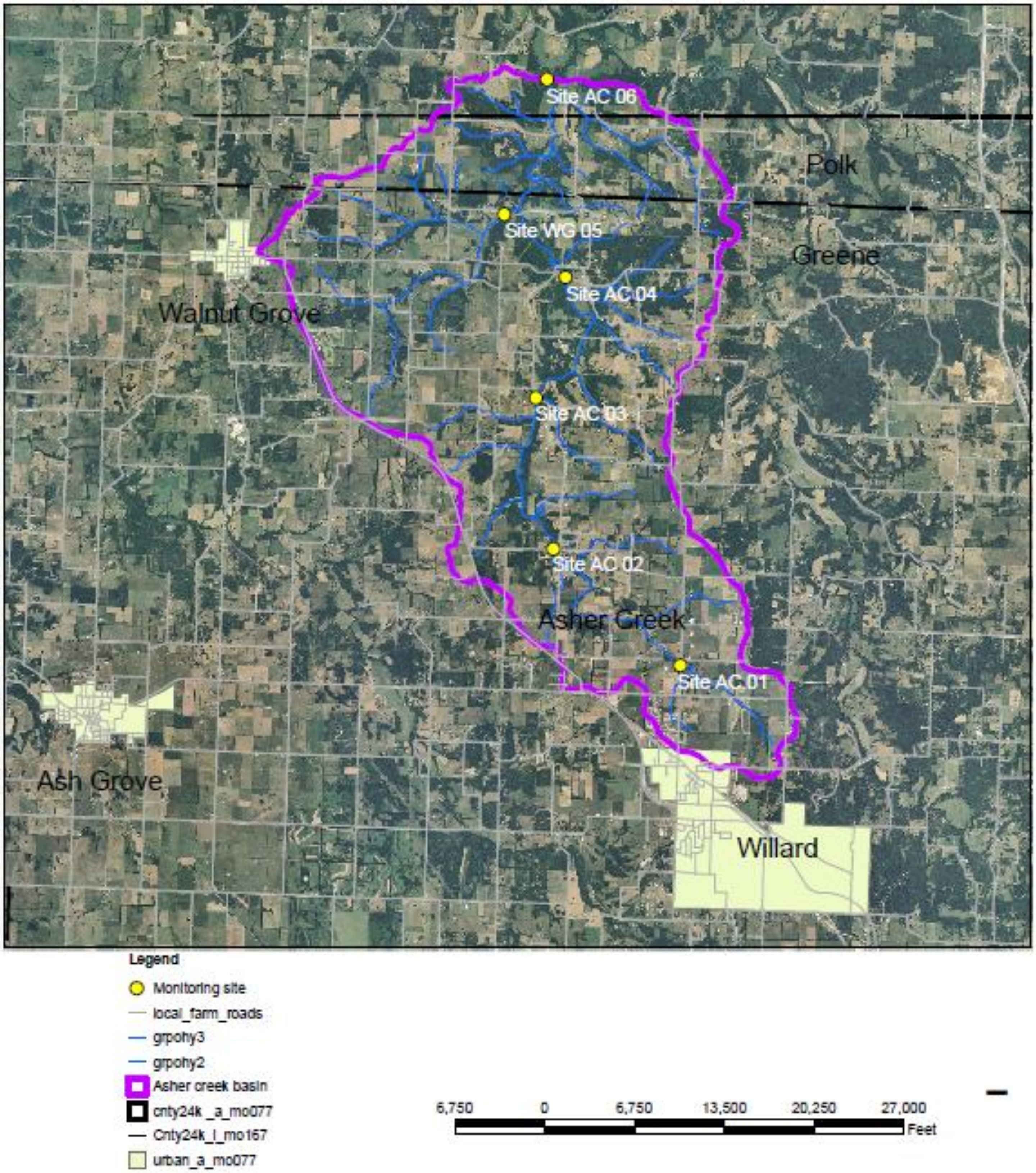


FIGURE 32. *E. coli* Geometric Means at Select Stations in the Sac River Basin

Map 2: Asher Creek Watershed in Greene County Missouri



Map 3: Sampling Site Locations in the Upper Asher Creek Watershed



Appendix 2

Example Laboratory Sheets from OEWRI

MISSOURI STATE UNIVERSITY
OEWRI
Ozarks Environmental and Water Resources Institute

Heather Hoggard - Laboratory Manager
phone: 836-3198
email: hhoggard@missouristate.edu

To: Heather Hoggard
OEWRI
Missouri State University
RE: James SS & DS

Laboratory Testing Results
Total Nitrogen (mg/l)

Sample ID	Collection	Received	Analysis	Analyst	TN conc	OEWRI SOP	QC Check	QA/QC Mng	Detection Limit (mg/l)	Laboratory Reagent Blank (mg/l)	Replicate (%)	Laboratory Spike (%)
(code)	(date)	(date)	(date)	(initials)	(mg/l)	(code)	(date)	(initials)	(≤ 0.1 mg/l)	(≤ 0.1 mg/l preferred)	(±20% required)	(100 ±20% required)
F	12/4/2008	12/4/2008	12/14/2008	JH	1.91	3020R02	12/15/2008	HH	0.001	-0.001	-3.5	106.5
F-FD	12/4/2008	12/4/2008	12/14/2008	JH	2.10	3020R02	12/15/2008	HH	0.001	-0.001	-3.5	106.5
JK1	12/4/2008	12/4/2008	12/14/2008	JH	1.00	3020R02	12/15/2008	HH	0.001	-0.001	-3.5	106.5
JK2	12/4/2008	12/4/2008	12/14/2008	JH	0.93	3020R02	12/15/2008	HH	0.001	-0.001	-3.5	106.5
JK3	12/4/2008	12/4/2008	12/14/2008	JH	0.89	3020R02	12/15/2008	HH	0.001	-0.001	-3.5	106.5
J-SR	12/4/2008	12/4/2008	12/14/2008	JH	4.37	3020R02	12/15/2008	HH	0.001	-0.001	-3.5	106.5
J-SR-FB	12/4/2008	12/4/2008	12/14/2008	JH	0.13	3020R02	12/15/2008	HH	0.001	-0.001	-3.5	106.5
P	12/4/2008	12/4/2008	12/14/2008	JH	2.05	3020R02	12/15/2008	HH	0.001	-0.001	-3.5	106.5
W	12/4/2008	12/4/2008	12/14/2008	JH	1.76	3020R02	12/15/2008	HH	0.001	-0.001	-3.5	106.5

Verification of Quality Control: EXAMPLE FOR SMYNFR 319 QAPP

Heather L Hoggard Signature Date

Final check and approved for release by:

Dr. Robert T. Pavlowsky Signature Date

Example of Chain of Custody Documentation

Missouri State University
Ozarks Environmental and Water Resources Institute
Springfield, Missouri
Sample Collection

Sampling Date: ________________ Project: ___________________________

Analyses Required: ____

Site ID	Sample Type[1]	Sample Matrix[2]	Container Type[3]	Preservative[4]	Time Collected	Sampler's Initials

1. Sample Type: Grab or Composite.
2. Sample Matrix: water, sediment, etc.
3. Container Type: e.g., 1 L plastic bottle, 250 mL glass bottle, 100 mL Whirl-Pak bag, etc.
4. Preservative: indicate the concentration and amount used if applicable (e.g., H_2SO_4 to pH < 2).

Chain of Custody

Samples Collected by: ____________________ ____________________

Released to lab by: ____________________ Date: __________ Time: __________

Received for lab by: ____________________ Date: __________ Time: __________

Laboratory storage location: ______________________________

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Appendix 3 Attach Standard Operating Procedures

See Enclosed SOP's.