Illinois River Riparian Targeting

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QUALITY ASSURANCE PROJECT PLAN

Submitted by:

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A1- TITLE AND APPROVAL PAGE

Oklahoma State University
Department of Biosystems and Agricultural Engineering
Illinois River Riparian Targeting

Quality Assurance Project Plan

Approving Officers:

Daniel E. Storm – Professor, Oklahoma State University, Biosystems & Agricultural Engineering

Signature: ________________________________ Date: _____________

Greg Kloxin – Senior Technical Writer/Quality Assurance Officer, Oklahoma Conservation Commission, Water Quality Division

Signature: ________________________________ Date: _____________

Jennifer Wasinger – Environmental Programs Manager, Oklahoma Office of the Secretary of the Environment

Signature: ________________________________ Date: _____________

Timothy Herfel – Project Officer, Region VI United States Environmental Protection Agency

Signature: ________________________________ Date: _____________

EPA Approving Official –Region VI United States Environmental Protection Agency

Signature: ________________________________ Date: _____________

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A3 - DISTRIBUTION LIST

Finalized, signed, and U.S. EPA Region VI approved copies of the Quality Assurance Project Plan (QAPP) will be distributed to the following persons:

Project Personnel at Oklahoma State University

Daniel Storm	Professor, Project PI, Oklahoma State University
Garey Fox	Assistant Professor, Project Co-PI, Oklahoma State University
Michael White	Research Engineer, Oklahoma State University
Philip Busteed	Research Engineer, Oklahoma State University

Oklahoma Conservation Commission

Greg Kloxin	Senior Technical Writer/Quality Assurance Officer, Water Quality Division, OCC

Oklahoma Office of the Secretary of the Environment

Jennifer Wasinger	Environmental Programs Manager, Oklahoma Office of the Secretary of the Environment

U.S. EPA Region VI

Timothy Herfel	Project Officer

A4 - PROJECT/TASK ORGANIZATION

The following organizations and personnel are responsible for project oversight, management, model validation, and data collection and analysis:

Oklahoma Conservation Commission (OCC)

Mike Thralls, Executive Director, OCC

Responsible for all operations of OCC including Water Quality Division operations.

Dan Butler, Program Director, Water Quality Division, OCC

Responsible for all operations of OCC in the Water Quality Division.

Judith Wilkins, Environmental Projects Coordinator, OCC Water Quality Division

Responsible for the administration and management of WQ projects. Monitors, reviews and coordinates: grant outputs, agreements, and WQ cost-share implementation and demonstration projects. Coordinates and authorizes the purchasing of all water quality monitoring equipment and supplies under the supervision of the WQ Asst. Director and Commission Comptroller. Coordinates with WQ staff on the creation and administration of contracts and agreements with other Agencies, Universities, and Non-governmental organizations.

Greg Kloxin, Senior Technical Writer/Quality Assurance Officer, OCC Water Quality Division

Lead technical writer, data analyst, and field investigator. He is responsible for the drafting and review of the technical reports and other information from the Division. He is also responsible for all Quality Assurance efforts implemented by the OCC.

Oklahoma State University, Department of Biosystems and Agricultural Engineering

Daniel E. Storm, Professor, PI

Dr. Storm is responsible for coordinating all activities. Dr. Storm is responsible for development of the QAPP. Dr. Storm will maintain records, address QA problems, and reporting problems to the OCC QA Officer.

Garey Fox, Assistant Professor, *Co-PI*

Dr. Fox will provide technical support in refining the riparian targeting methodology.

Michael J. White, Research Engineer

Mr. White is responsible for developing the methodology and conducting the analysis of riparian quality. Mr. White generate the targeting maps and collect field data to validate the targeting methodology.

Phil Busteed, Research Engineer

Mr Busteed will assist the collection of field data during the validation phase of the project.

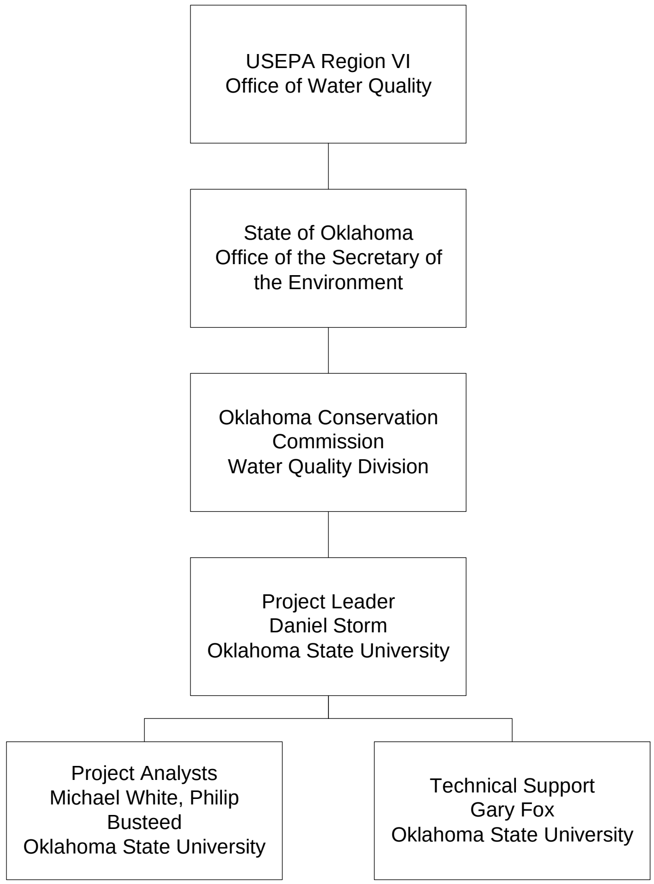

Figure A-1. Quality Assurance Project Plan organizational chart.

Table A-1. Key Positions and Areas of Responsibilities.

Title	**Description of Duties/Responsibilities**
USEPA Region VI, Office of Water Quality	Approves the requirements for the project and reviews project deliverables to ensure standards have been met.
Oklahoma Office of the Secretary of the Environment	Recipient and administrator of Federal Clean Water Act funds, e.g. Section 319(h) funds.
Oklahoma Conservation Commission	Oversees work performed by the subcontractor for the project to meet EPA requirements.
Project Leader	Supervise project personnel and coordinate activities related to the project including but not limited to QAPP development and implementation, reporting, budgets, providing guidance and technical advise, assuring accurate and appropriate input data and output interpretation, validation, and ensure that project goals are met.
Project Analysts	Perform all aspects of the analysis and data collection necessary to meet project objectives.
Technical Support	Support in the development of targeting methodologies

A5 - PROBLEM DEFINITION/BACKGROUND

Figure A-2. Illinois River Basin.

The Illinois River Basin covers approximately 1,600 square miles and is divided nearly equally by the Oklahoma/Arkansas border (Figure A-2). The basin is located in the Ozark Highlands and the Central Irregular Plains Ecoregion. The land cover is primarily pasture and forest. Forests are mostly deciduous, but pine trees are common. Pastures are used for hay and grazing cattle. Poultry production is abundant in the basin, and thus poultry litter is often applied to these pastures to increase their productivity. The topography is Karst, with exposed limestone in some areas. Soils are mainly of the ultisol order, and are typically thin and highly permeable. Average annual precipitation is approximately 45 inches.

The Illinois River is arguable Oklahoma's most valued scenic river. Degraded water quality in the Illinois River and it's receiving waters, Lake Tenkiller, have been linked to excessive phosphorus, which contributes to excessive primary production. Point source dischargers and the application of poultry litter have been blamed as the chief sources of phosphorus in the Illinois River. Significant reductions in point source phosphorus discharges are underway, but nonpoint sources remain a significant contributor.

Riparian buffers are a commonly recommended Best Management Practice (BMP) to reduce nonpoint source pollution. Their use is promoted by federal programs such as the Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Environmental Quality Incentives Program (EQIP), and various cost-share programs funded by USEPA 319(h) and state funds. Buffers are among the primary BMPs recommended by environmental agencies to reduce nonpoint sources pollution (Fields, 1992). Effectiveness of buffers in the removal of sediment and nutrients at a field scale has been extensively explored (Barling and Moose, 1994; Hill, 1996; Fennessy and Cronk, 1997; Lowrance et al., 2002).

The effect of riparian buffers placement within a watershed has not been well studied. Placement is, nevertheless, likely to have a significant effect on the effectiveness of the BMP. Optimizing overall BMP performance through proper placement is a critical issue (Tomer et al., 2003; Marcelo and Conrad, 2003). Establishment of buffers is expensive and funding is limited; only a small fraction of streams within a watershed generally receive the BMP. By evaluating the effectiveness of riparian buffers at all potential sites within a watershed we can optimally place the buffers in targeted areas to generate the most environmental benefit per dollar spent.

A6 - PROJECT/TASK DESCRIPTION

The establishment of riparian corridors has a significant impact on water quality. In order to make the best possible use of available funding, the best possible location for riparian buffers within the Oklahoma portion of the Illinois River will be identified. The objective of this work is to apply and validate a methodology to best utilize existing data to predict the optimal placement of riparian buffers within a basin. The methodology was developed by Storm et al. (2006) in the neighboring Spavinaw Creek Basin. The methodology uses multiple indicators of riparian BMP suitability and effectiveness obtainable from various GIS data and weights them into a single indicator. This master indicator is used to rank all possible riparian BMP sites from most to least effective. GIS derived indicators are:

1) Landcover within the riparian zone
2) RUSLE gridcell predicted erosion
3) Extrapolated SWAT runoff volume and soluble phosphorus yield
4) Flow accumulation from adjacent areas
5) Stream curvature
6) Stream order and gradient

The methodology will be applied to the Oklahoma portion of the Illinois River Basin. Riparian targeting maps for both degraded riparian areas and well vegetated riparian areas for preservation will be produced. In addition, ground-truthing and field data will be collected and used to validate the methodology. If adjustments are warranted, the riparian targeting maps will be updated.

A7 - QUALITY OBJECTIVES AND CRITERIA

A7.1 - Problem Statement

The objective of this project is to identify the best places to establish riparian buffers within the Oklahoma portion of the Illinois River Basin to reduce nonpoint source phosphorus contributions. Riparian buffers filter water from adjacent pastures and reduce sediment and nutrient contribution to the stream. In addition riparian buffers exclude cattle from the stream and its banks, eliminating nutrients directly deposited in the stream in manures.

The establishment of riparian buffers is expensive, and limited funding is available. The effectiveness of riparian buffers and other BMPs is in part a function of their placement within the landscape. A riparian buffer receiving polluted runoff from an adjacent source like a heavily grazed pasture, will have a greater impact on overall water quality than a buffer that receives relatively clean runoff from adjacent forest. The establishment of riparian buffers in the best possible location will generate the largest improvement in water quality per dollar spent.

A7.2 - Targeting Model

The final targeting maps will be a compilation of many factors. Each of the following factors is an indicator of riparian effectiveness or characteristics:

1. Landcover within riparian zone (Boolean) (LC)
2. Erosion predicted in riparian zone (ER)

3. Erosion accumulation from adjacent areas (EA)
4. Runoff accumulation from adjacent areas (RA)
5. Soluble phosphorus accumulation from adjacent areas (PA)
6. Stream curvature (SC)
7. Stream order (categorical)
8. Drainage area (DA)
9. Stream gradient (SG)
10. Buffer slope (BS)

The final targeting index is calculated as:

TI= LC (WER*ER+WEA*EA+WRA*RA+WPA*PA+WSC*SC+WDA*DA+WSG*SG+WBS*BS)

where TI is the targeting index, WX is the respective weighting factor for factor X, and factor abbreviations are defined in the list above.

The final targeting index is not a quantifiable measure of nutrient or sediment load. It is an index which will be used to rank each the importance of each river segment with respect to buffer effectiveness. This use of this model in a relative mode makes it less sensitive to input data uncertainties.

A7.3 - Input Data Quality

The riparian targeting will be derived from numerous existing GIS data. These data will be derived from existing sources, and will include both published sources with associated quality assurance and data from unpublished sources with little or no quality assurance. The level of quality will differ among the sources, the determination of which data will be included will be made on a case by case basis based on professional judgement. Some of these data that will be used are given below:

Table A-2. Existing Data Sources.

Data Name	Data Type	Data Source
30 m DEM	Elevation	US Geological Survey
SSURGO	Soils	Oklahoma Natural Resource Conservation Commission
Landsat imagery	Multi-spectral	Satellite Imaging
2001 National Land Cover Dataset	Land use land cover	US Geological Survey
Phosphorus loads		Oklahoma State University
Ground truth		Collected in field by Oklahoma State University Personnel
National Hydrographic Dataset	Streams and Rivers	US Geological Survey
National Agriculture Imagery Program	Aerial Photo	US Department of Agriculture
Soil test phosphorous	Soil Test Phosphorus	Oklahoma State University Soil, Water & Forage Analytical

A7.4 - Field Data Quality

Field data will be collected to validate the riparian targeting. Most of these data, as described in Section B-2, have subjective components too them. Therefore, specific data quality criteria are not specified.

A7.5 - Output Performance Criteria

Data will be collected in the Oklahoma portion of the Illinois River Basin which will be used to validate the riparian targeting. There are no observational data which can be collected from a water craft to directly evaluate the suitability of a particular stream segment for riparian buffers. For this reason there is no direct way to determine if the model successfully predicts the best locations for riparian buffers. Several indicators of riparian quality can be assessed via field observations and compared with indicators derived from GIS sources. These observed field data will be plotted in a GIS and specific elements will be compared to the predicted riparian targeting or indicators of riparian quality. Observed stream alinement, and bank slope will be compared to the stream curvature GIS index. The flow accumulation index will be compared to occurrence of bank gullies as an indicator of concentrated flow. Because these field data are generally qualitative, and the GIS data are quantitative, quantitative performance indicators such as the coefficient of determination and Nash-Sutcliff Efficiency do not apply. For this reason, numeric performance criteria cannot be determined for these comparisons. These comparisons will be based on professional judgment.

Other observed data can be used quantitatively. Floodplain land use will be directly compared with landcover from the GIS to estimate an error rate. Allowable error rates will depend upon the number of samples, as floodplain land use may not be collected at all sites. These data will be aggregated to forest, grass, urban, and bare/crop prior to comparison. With a minimum of 25 samples, an error rate of 35% is allowable.

A8 - SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

All personnel will be supervised by Dr. Storm. No special certification is required.

A9 - DOCUMENTATION AND RECORDS

A9.1- Purpose/Background

This element describes the following:

- Information and records to be included in the report package.
- Other records and reports that will be produced.
- Requirements for final disposition of records and documents.

A9.2 - Information in Validation Report Package

The report will consist of summary tables and maps of the riparian targeting and other supporting data, as well as summaries for the procedures and data analysis. The report will also include summaries model input and outputs.

A9.3 - Documentation Control and Management

A majority of internal documentation and record transfer within the project team while the project is ongoing will be done electronically. Hard copy reports will be made to USEPA Region VI and the Oklahoma Conservation Commission. The Project Leader will be responsible for final electronic and hard copy documentation version control, updates, storage, tracking, and distribution. Because existing software will be used for all phases of this project, there is no need to develop any new file types or protocols. While the project is ongoing, project analysts will backup all electronic documentation and data on local hard drives with weekly full backups. The backup data will be archived using two separate hard drives, one of which is stored off-site.

A9.4 - Disposition of Records and Documents

At the end of the project, all documentation, data (GIS, photographs, etc.), and model files will be archived on DVDs. These DVDs will be archived and stored by Dr. Storm, and if requested will be provided to the USEPA Region VI and/or the Oklahoma Conservation Commission.

B - MEASUREMENT AND DATA ACQUISITION

B1 - SAMPLING PROCESS DESIGN (EXPERIMENTAL DESIGN)

Field data will be collected from navigable portions of the Illinois River only and from public roads. There will be no randomized sampling.

B2 - SAMPLING METHODS

Field data will be collected to validate the riparian targeting. The actual field parameters which will be collected are given in Figure B-1. These observation data will be collected at 25 to 50 locations on portions of the Illinois River and its tributaries which are navigable via small powered water craft. The data collection will be performed during the "leaf-off" season to allow greater visibility of the flood plain area. The actual number and distribution of observations will depend upon the navigability of the river at the time of sampling. Two teams will spend approximately two days collecting data. The majority of parameters listed in Figure B-1 can be assessed from the water, other parameters may require physical access to the flood plain. Detailed flood plain data will not be collected at sites due to the lack of physical access and landowner permission. The vast majority of the land adjacent to the Illinois River is privately owned. In addition to data in Figure B-1, multiple geo-referenced pictures will be collected at all sites. Each team will contain two to three persons.

A data collection trial run with one three-person team will be performed prior to the main data collection. The purpose of this trial is to determine the navigability of the Illinois and its tributaries in the selected water craft and to determine if changes to the data collection protocol are necessary. Because many of the parameters in the data collection protocol have subjective elements, members of the trial team may develop more specific criteria based on what is observable from the water craft. During the main data collection each of the two teams will contain at least one member of the trial team to increase the consistency of the subjective elements in the observed field data. The quality of these data will be sufficient for the purposes of validating riparian buffer targeting.

B3 - SAMPLE HANDLING AND CUSTODY

No physical or chemical samples will be taken. All sample data are digital in nature.

B4 - ANALYTICAL METHODS

No physical or chemical samples will be taken. All sample data are digital in nature.

B5 - QUALITY CONTROL

Field observations will be made in the presence of at least one other person and will use the data sheet given in Figure B-1.

B6 - INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE

Instrumentation is digital in nature and does not require testing or maintenance.

B7 - MODEL CALIBRATION

The model will not be calibrated unless it contradicts significantly from observed field data. Weighting factors may be adjusted based on field data. Any recalibration will be based on professional judgement since most of these validation data contain subjective components.

B8 - INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

Instrumentation is digital in nature and does not require supplies or consumables.

B9 - NON- DIRECT MEASUREMENTS

A variety of data will be used in the model, existing data sources are given in Table A-2.

B10 - DATA MANAGEMENT

Summaries of these data will be included with all archived data.

B10.1 Data Storage

Data including documents and files of all types will be archived in multiple locations. These data will be maintained in multiple locations on Compact Disc (CD) or Digital Video Disc (DVD), removable hard disks, and fixed hard disk connected to working computer systems at Oklahoma State University in the Offices of the Project Leader and Project Analysts.

B10.1 Document Control

Documents files will dated and indexed, and appropriable dated draft versions will be included in the project archive. All files will contain both the date of creation and last modification. Files superseded with newer versions will be deleted if they are deemed to have no future value by the Project Leader or Project Analysts to keep the final archives reasonably sized and preserve their future utility.

Riparian Buffer Assessment Protocol

Site Identifier________________ Collection Team_____________________________

Date ______________ Time___________ Latitude___________ Longitude_____________

Position
Latitude__________ Longitude___________

Stream Metrics
Length of Bank Segment (ft.) ___________
Bank Height (ft.) _______
Water Width (ft.) _______
Bank Width (ft.) _______
Bankfull Width (ft.) _______

Stream Type
___Perennial ___Intermittent

Bank (Facing Upstream)
___Left ___Right

Stream Gradient
___Slight (few to no riffles)
___Moderate (balance of pools and riffles)
___High (primarily riffles)

Stream Alignment
___Straight
___Moderately Curved
___Sharply Curved

Floodplain Metrics
Width (ft.) _______
Height above Water (ft) _______

Floodplain Land Use
___Trees ___Grass ___Shrubs
___Crop ___Pasture ___Urban
___Other________________________

Floodplain Slope
____%

Floodplain Terraces
___Yes ___No ___ Unknown

Floodplain Water Features
___Unknown
___None
___Standing water
___Dry with evidence of recent standing water
___ Perennially dry except during flooding

Bank Gullies
___ None
Width (ft.) _______ Depth (ft.) _______

Bank Vegetation
___Trees ___Grass ___Shrubs
___Other____________________________

Bank Vegetation Coverage
__________%

Primary Bank Soil Texture
___ Clay ___ Silt ___ Sand ___ Rock or Stony

Bank Slope
___Slight (3:1 or less)
___Moderate (3:1 but < 1:1)
___High (1:1 to near vertical)
___Vertical

Bank Failure Mode
___No Failure ___Undercutting ___Slump
___Slide ___Unknown
___Other____________________________

Slope of Inside Depositional Bar
___Not Applicable
___Severe (Less than 3:1)
___Moderate (3:1 to 10:1)
___Slight (Greater than 10:1)

Figure B-1 Field data collection worksheet.

C - ASSESSMENT AND OVERSIGHT

C1 - ASSESSMENT AND RESPONSE ACTIONS

C1.1 - Purpose/Evaluation

The purpose of this element is to describe internal and external checks that ensure that:

- All elements of the QAPP are correctly implemented as prescribed.
- The quality of these data generated by implementation of the QAPP is adequate.
- Corrective actions, when needed, are implemented in a timely manner and their effectiveness is documented.

C1.2 - Assessment and Project Activities

No external audits will be conducted for the validation. Internal checking of model results will be performed by Dr. Storm and through reviews by the Oklahoma Conservation Commission and the US EPA Region VI. This internal checking will go on throughout the model application process, not just at the end. The purpose of this self-assessment will be to verify that appropriate input values are being used and proper calibration procedures are being followed. Dr. Storm will be responsible for the final product before it is submitted to the Oklahoma Conservation Commission and the US EPA Region VI.

C1.3 - Reporting and Resolution of Issues

Findings of practices and procedures that do not conform to this QAPP will be reported by Dr. Storm to the Oklahoma Conservation Commission Quality Assurance Officer . These findings as well as deficiencies discovered will be reported to Dr. Storm as soon as they are discovered. Appropriate corrective action, including that already in place, will be discussed. Corrective action will then be initiated or modified as needed. Corrective action will be documented through preparation and submittal of memoranda to Dr. Storm. The Quality Assurance Officer will be notified, as necessary, of any deficiency that might compromise the quality of the data or adversely affect the health of personnel resulting in a stop-work situation.

C2 - REPORTS TO MANAGEMENT

Riparian targeting results and associated documentation will be compiled by the Dr. Storm and submitted to the Oklahoma Conservation Commission and US EPA Region VI after internal checking. Results of QC checks will be presented to the Dr. Storm. After all QAQC activities and appropriate corrective actions have been identified, implemented, and evaluated, Dr. Storm will prepare a memorandum describing the results of QAQC activities, and corrective actions with appended documentation, as necessary.

D - DATA VALIDATION AND USABILITY

D1- DEPARTURES FROM VALIDATION CRITERIA

The purpose of this element is to state the criteria for deciding the degree to which each data item has met its quality specifications as described in Group A. This decision will be based on the investigator's estimate of the effect that each deviation from the QAPP will have on the usability of the associated data item, its contribution to the quality of the reduced and analyzed data, and its effect on the decision. Quantitative criteria for acceptance of the validation were listed in Section A7.4. The validation results will be evaluated against these criteria by Dr. Storm.

D2 - VALIDATION METHODS

Validation criteria and methods are described in Section B-2.

D3 - RECONCILIATION WITH USER REQUIREMENTS

The goal of the QAPP for this project is to provide a reasonable riparian targeting for the Illinois River Basin. If performance criteria do not meet the project's requirements the model will be reexamined.

E - REFERENCES

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