

## Evaluating Water Quality Best Management Practices for Reservoirs in North Central Texas

Texas Water Resources Institute  
FY 03 Federal Appropriated Funds  
Project # X7-9764801-0

Quarter no. 5 From 10/8/04 Through 1/7/05

### **Progress in Meeting Project Milestones and Output Commitments**

#### Task, Deliverables and Schedules

The Texas Water Resources Institute (TWRI) along with the Texas A&M University Spatial Sciences Laboratory (SSL), Alan Plummer Associates, Inc. (APAI) and Espey Consultants, Inc. (EC) have been diligently working to complete project deliverables. Project efforts during the fifth quarter focused on modeling activities. The SSL and EC have collaborated on efforts to interact SWAT and QUAL2E models to predict loadings within Cedar Creek Reservoir. SWAT and QUAL2E have successfully been integrated. Work continues on linking these two models with WASP in order to have a model that predicts entire watershed loadings. APAI has completed collecting data from wastewater treatment plants within Cedar Creek and Eagle Mountain Reservoirs and has input this data into an Access database. TWRI continues to update its Web site containing water quality information, specifically related to project efforts, for scientists and the general public, has produced a watershed management bulletin and is in the process of finalizing a stormwater publication.

In looking forward to the next quarter, SWAT, QUAL2E and WASP modeling activities should be completed, giving us a clear understanding of sediment and nutrient loadings within Cedar Creek Reservoir and Watershed. Work has begun to identify BMP's that will be effective in reducing loadings into stream segments and Cedar Creek Reservoir. Identifying BMP's and running them through the newly developed SWAT/QUAL2E/WASP model and computing the economic cost associated with these BMP's will be the focus of the sixth quarter.

The status of tasks, milestones and deliverables will be defined using the following terms:

Pending	Work has not started on the deliverable
Initiated	Work has started
Completed	Objectives were achieved and deliverables are finished
Deferred	Work has started, but further action is delayed pending other information, the completion of another objective, staff restraints, etc.
Ongoing	Work will continue throughout the term of the contract

**Task 1 SWAT Modeling**

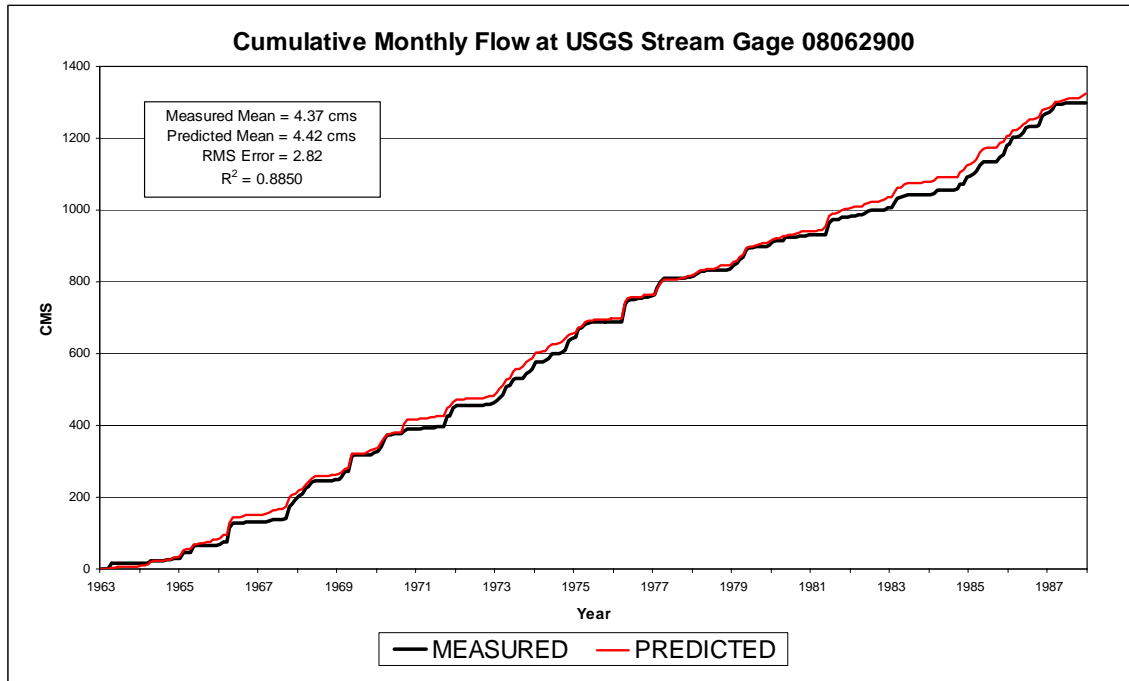
Due Date	Status	Deliverables
1/1/04	Completed	1. Complete model calibration and validation for Cedar Creek
4/1/04	Initiated	2. Development of Watershed databases
10/1/04	Initiated	3. Development and Evaluation of Different BMP strategies for Cedar Creek Watershed
1/1/05	Pending	4. Model calibration and validation for Eagle Mountain Watershed
9/1/05	Pending	5. Development and evaluation of different BMP strategies for Eagle Mountain Watershed
9/1/05	Pending	6. Development of ArcGIS/ArcHydro interface for SWAT and WASP
9/1/05	Pending	7. Development of interface for using NEXRAD weather information for SWAT

Comments:

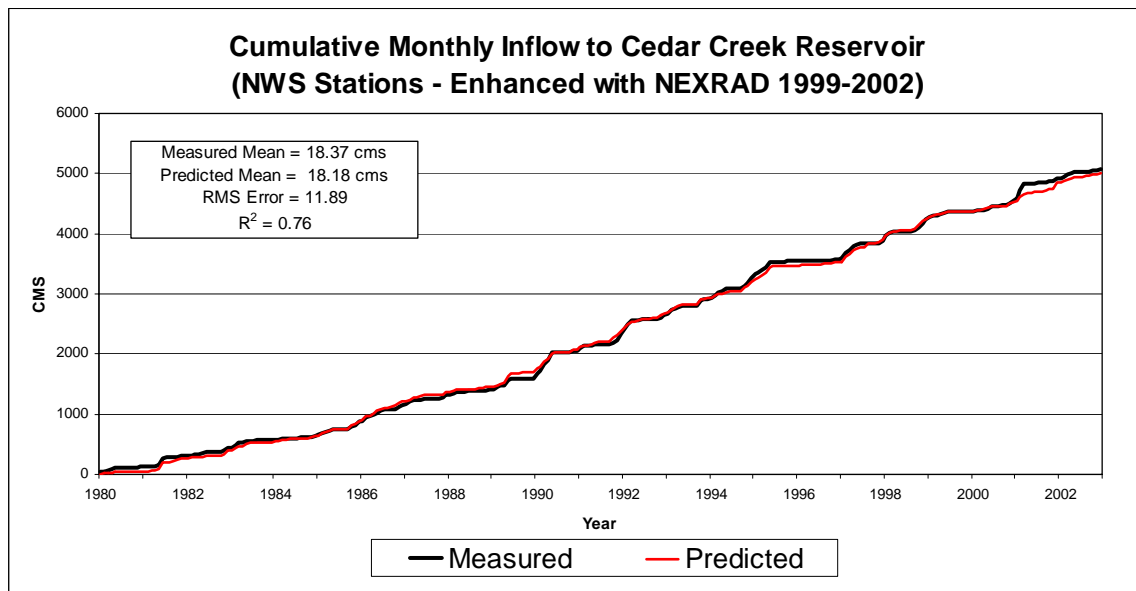
- The Spatial Sciences Lab (SSL), in cooperation with Blackland Agricultural Research and Extension Center, has completed the validation and calibration of the SWAT model for Cedar Creek Watershed. This deliverable is 100 percent complete.
- SSL has been in contact with state and federal agencies (TCEQ, TRWD, NRCS and USGS) to obtain GIS data for the watershed database. The Access database, once complete, will contain information on land use, soils, elevation, weather and watershed delineation data. TWRI is working to obtain soil sample data of Cedar Creek Watershed from Texas A&M University's Soil, Water and Forage Testing Laboratory for the time period of 1990-2000. Once this information is added to the database, it will be complete. This deliverable is currently 85 percent complete.
- The research team has begun to identify specific BMPs which will be beneficial in reducing loadings in stream segments and Cedar Creek Reservoir. SWAT runs have been made to get preliminary estimates as to the type of reservoir loadings (point or non point sources) and sources of contamination (stream segments, tributary flow or resuspension of reservoir sediments). These preliminary runs have helped focus BMP selection.

The charts below graphically represent actual measured data versus predicted data generated with the SWAT model.

### Flow Calibration 1963-1987



### Flow Validation 1980-2002



## **Task 2 In-Stream and Reservoir Modeling**

Due Date	Status	Deliverables
4/1/04	Completed	1. Development of In-stream modeling (QUAL2E) for Cedar Creek Watershed
10/1/04	Completed	2. Development of Reservoir Modeling (WASP) for Cedar Creek Reservoir
10/1/04	Initiated	3. Development and Evaluation of Different BMP strategies for Cedar Creek Reservoir
1/1/05	Pending	4. Data Collection for Reservoir Modeling (WASP) for Eagle Mountain
7/1/05	Pending	5. Development of Reservoir Modeling (WASP) for Eagle Mountain Watershed
9/1/05	Pending	6. Development and Evaluation of Different BMP strategies for Eagle Mountain Watershed

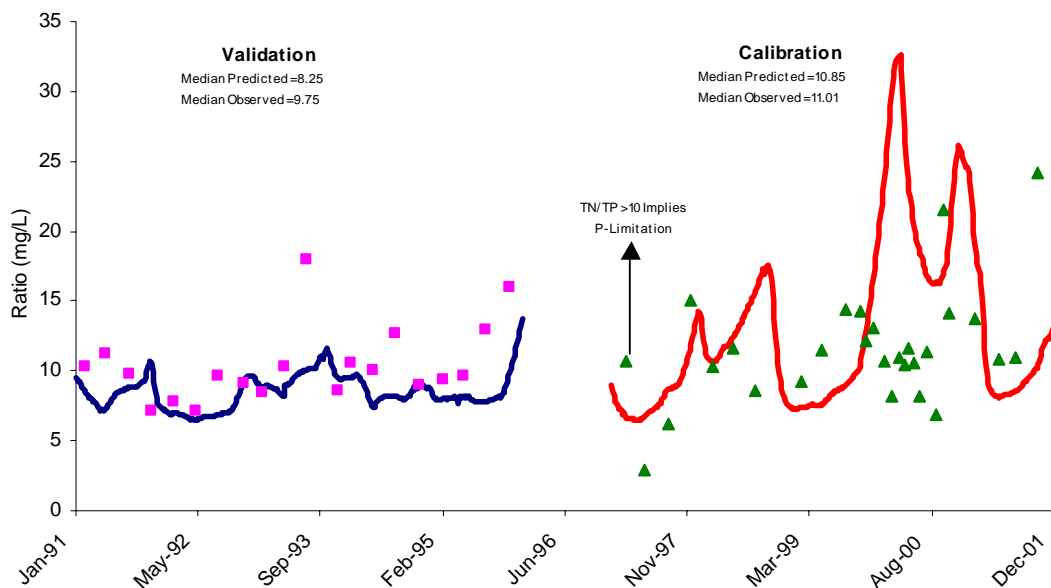
### Comments:

- QUAL2E modeling has been completed and coefficients have been submitted to the SWAT modeling team. This deliverable is 100 percent complete.
- APAI completed its work on the WASP postprocessor and input data related to nutrient kinetics and sediment sources of nutrients were finalized. The WASP model had been validated and calibrated. This deliverable is 100 percent complete.
- The research team has begun to identify specific BMPs which will be beneficial in reducing loadings in stream segments and Cedar Creek Reservoir. A technical memo with regard to BMP suggestions is in the process of being completed. Preliminary results show a necessary reduction of nutrients entering the reservoir to be within the 30-40 percent range.

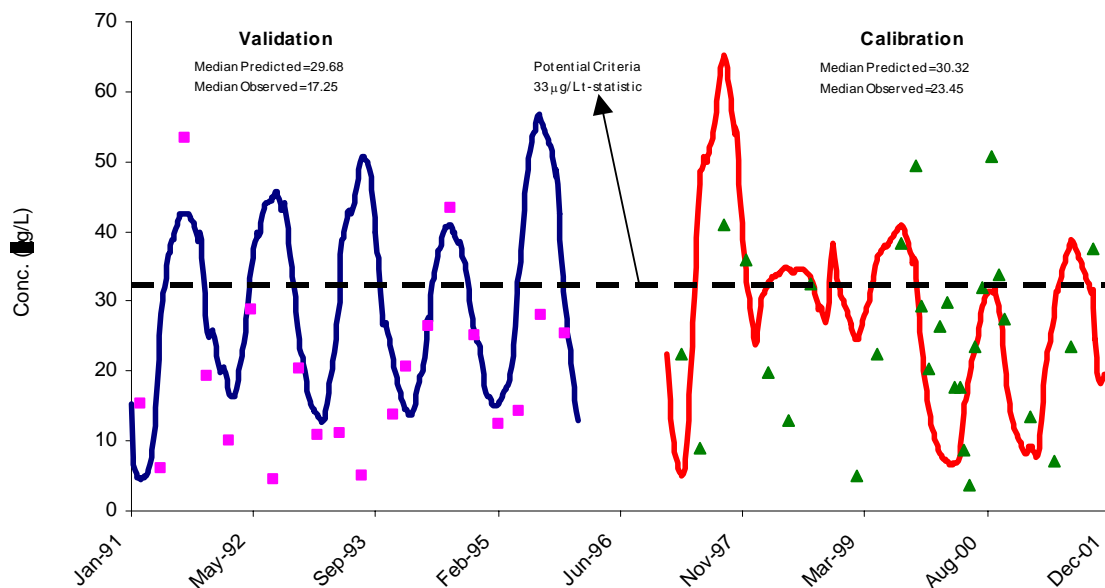
The Cedar Creek WASP model was calibrated based on a 5-year time period starting January 1, 1997 and ending December 31, 2001. The Cedar Creek WASP validation model was simulated for a five-year time period starting January 1, 1991 and ending December 31, 1995. The charts below graphically represent actual measured data versus predicted data generated with the WASP model.

Cedar Creek Reservoir, segment four is the location receiving loadings from the watershed.

### Total N/Total P in Segment 4 of Cedar Creek Reservoir (solid lines = predicted; points = observed data)



### Chlorophyll A in Segment 4 of Cedar Creek Reservoir (solid lines = predicted; points = observed data)



### **Task 3 Study of Wastewater Treatment Plants**

Due Date	Status	Deliverables
7/1/04	Completed	1. Development of a Database for Wastewater Treatment Plants in Cedar Creek and Eagle Mountain Watersheds
10/1/04	Completed	2. Assessment of Impact of Wastewater Treatment Plants (point source discharges) for Cedar Creek and Eagle Mountain Reservoirs
4/1/05	Initiated	3. Development of a Database for Wastewater Treatment Plants in the Richland-Chambers Watershed
7/1/05	Pending	4. Assessment of Impact of Wastewater Treatment Plants (point source discharge) for Richland-Chambers Reservoir

#### Comments:

- The wastewater treatment database is complete with information from both Cedar Creek and Eagle Mountain Reservoirs. This deliverable is 100 percent complete.
- APAI has developed a database containing all wastewater treatment plants in the Cedar Creek and Eagle Mountain Watersheds. Data contained in these databases include process diagrams of plants current capacity as well as diagrams of future upgrades that could be made to make the plant more efficient and to meet operating demands. Also included in the database is information regarding operating capacity, permit information, quality of discharged effluent, fate of released effluent and proximity to water bodies. Cost estimates for all process recommendations are included.
- APAI has developed a flow balance program that provides modeling capability within the WASP model that is more compatible with current modeling employed using SWAT model. APAI incorporated the previously developed internal flow balance program into an Access application capable of managing extensive historical flow data and SWAT model output, structure the visual basic program to accommodate user-defined time periods, as small as one day (previously set up on a monthly time period), and develop input data for Eagle Mountain Reservoir. This deliverable is 100 percent complete.
- APAI is working with TRWD to identify all wastewater treatment plants permitted to discharge waste into Richland Chambers Watershed. APAI will collect general data on all wastewater treatment plants for the database but will only do further analysis on those whose discharge flows into Richland Chambers Reservoir.

**Task 4 Administration**

Due Date	Status	Deliverables
1/5/04	Completed	1. Write QAPP
1/7/04	Completed	2. Quarterly Progress Reports
4/7/04	Completed	
7/7/04	Completed	
10/7/04	Completed	
1/7/05	Completed	
4/7/05	Ongoing	
7/7/05	Ongoing	
10/7/05	Ongoing	3. Final Report

Comments:

- TWRI continually updates the Web site created specifically for the North Central Texas Water Quality Project. The Web site can be accessed at the following address: <http://nctx-water.tamu.edu>.
- On January 5, 2005, project participants met at the Blackland Agricultural Research and Extension Center in Temple, TX to present the status of deliverables and discuss objectives for the upcoming quarter.
- TWRI is working with the department of Biological and Agricultural Engineering to create and publish a bulletin on stormwater management. The bulletin describes the effects of stormwater on water quality and identifies best management practices that can be employed to help solve water quality issues.

## **Problems or Obstacles Encountered and Remedial Actions Taken**

The research team has had difficulty in adapting all the parameters for the SWAT/QUAL2E/WASP model. While all three models have been successfully linked, there were challenges. The challenge has been in establishing compatible parameters and coefficients for the three distinct models.

WASP was calibrated and the validation model for 1991-1995 has been generated. However, right before BMP simulations were to take place, TRWD, sent the NPS file and the model to Tim Wool at EPA in order for Mr. Wool to create a scaling system for the BMP simulations with the NPS file. During this effort led by Mr. Wool, he determined that WASP was multiplying the model time step (0.01 in this case) to each individual daily load in the NPS file and hence, the daily loads that enter the system were being significantly reduced. Tim Wool subsequently sent out a new EUTRO subroutine to WASP to all users to correct the problem. This problem has been resolved and we have a completed WASP model.

Great strides have been made by the modeling team to configure an accurate up-to-date model, which patterns both the watershed and the reservoir simultaneously for nutrient and sediment loading. SWAT/QUAL2E/WASP model integration is complete and BMP scenario runs should begin by the first of February 2005.

## **Work Planned for Next Quarter**

### Task 1: SWAT Modeling

Finalize inputting data for the watershed database. Begin running the SWAT/QUAL2E/WASP model using select BMP scenarios and looking at total load reductions within the reservoir. Finalize which BMP strategies are most effective and least costly at reducing nutrient, sediment and pollutant loadings into Cedar Creek Reservoir.

### Task 2: In-Stream and Reservoir Modeling

Finalize development and integration of WASP reservoir model for Cedar Creek Reservoir. Incorporate SWAT flow balances using updated NEXRAD information for the time period 1999-2002. Begin making model runs.

### Task 3: Study of Wastewater Treatment Plants

Begin evaluating impacts that wastewater treatment plants and their discharges have on water quality of Richland Chambers Reservoir.



Task 4: Administration

Continue working with TRWD, SSL, EC and APAI in moving forward with project deliverables and reporting progress on a quarterly basis. Efforts will be made to publicize the project and raise awareness of water quality issues within the study area. Furthermore, TWRI will work to secure additional funding for this project above the additional federally appropriated funds received in FY 05. TWRI will begin working with EPA to develop a comprehensive plan of work and budget for these year three funds.

Additional funds currently used to support project activities include federally appropriated monies from USDA-NRCS to conduct economic analysis of BMPs scenarios at reducing loadings in North Central Texas Watersheds and to develop educational program materials on watershed management.