Final Draft 22 Nov 1999

LTRMP Scope of Work for FY2000

1. INTRODUCTION

This is the contractual scope of work for Interagency Agreement No. IA-00- between the U.S. Army Corps of Engineers and the U.S. Geological Survey for Fiscal Year 2000 (FY2000) conduct of the Long Term Resource Monitoring Program for the Upper Mississippi River System. This scope of work specifies work to be performed, products to be delivered, milestones, and allocation of funding. The primary areas of LTRMP activity for FY2000 will include:

- Monitoring and Analysis
- Applied Research
- Landscape and habitat analyses
- Integrated analyses
- Information transfer
- Program management

This scope of work covers the base funded areas of LTRMP activity for FY2000. The USGS UMESC study plan proposals for the work elements are referred by title number and in the list of references.

2. MONITORING AND ANALYSIS

Monitoring of selected components of the UMRS ecosystem will be conducted to maintain continuity of LTRMP monitoring records and sampling capabilities. Monitoring will include sampling, data collection, quality checking of data, calculation of summary statistics, archiving of data, statistical analysis of spatial and temporal trends, interpretation of monitoring results, reports on monitoring results, and transfer of data and reports to others. A brief summary report of FY1999 monitoring results will be prepared and distributed.

2.1 Aquatic Vegetation (Study Plan Title 10)

One annual increment of stratified random sampling (SRS) of submersed aquatic vegetation (SAV) an sampling of SAV and all aquatic vegetation along selected transects will be conducted following the LTRMP study plan and standard protocols (USGS 1999a, Yin et al. 1999).

2.1.1 Objectives

1) Monitor one annual increment of aquatic vegetation in LTRMP study areas (UMR Pools 4, 8, 13, 26, and LaGrange Pool on the Illinois River).
2) Determine if there are differences in relative abundance and community composition of SAV between strata, and within and between study areas.
3) Determine if there have been changes in relative abundance and community composition of SAV from previous years of monitoring.
4) Measure the relative abundance and community composition of aquatic vegetation along selected transects within UMR Pools 4, 8, 13, 26, and LaGrange Pool on the Illinois River.
5) Determine if there are differences in relative abundance and community composition along transects, between transects, within each study area, and between study areas.
6) Determine if there have been changes in relative abundance and community composition of aquatic vegetation along the sampled transects from previous years of monitoring.

2.1.2 Methods

In FY2000 vegetation will be sampled using both transect and stratified random sampling protocols in Pools 4, 8, 13, 26, and La Grange. FY 2000 sampling efforts will be at reduced levels compared with FY 1999 sampling efforts (USGS 1999a, Tables 1 and 2), based on field staff time available for SAV sampling.

SAV will be sampled from randomly located sites within five aquatic areas strata (SRS sampling) within each LTRMP study area except Open River: 1) main channel border, 2) secondary channels, 3) contiguous backwaters, 4) impounded areas, and 5) isolated backwaters. All sampling sites will be located in <2.5 ft of water depth below project pool elevation. The total number of SAV sampling sites will vary between LTRMP study areas: Pool 4 - 550, Pool 8 - 600, Pool 13 - 550, Pool 26 - 400, LaGrange -500. Six sub-sampling areas will be visually inspected at each site, and vegetation will be collected with a rake. Data on species relative abundance/frequency of occurrence (0 - 6 scale), water depth, and sediment type will be recorded. SAV sampling will be conducted twice, once during the early part of the growing season in June, and again in the later part of the growing season in August.

Transect sampling of aquatic vegetation (both SAV and emergent aquatic vegetation) will also be conducted at selected transects in Pools 4, 8, 13, 26 and LaGrange (USGS 1999a), following standard LTRMP sampling protocols.

2.1.3 Products

- Year 1999 SAV data will be quality checked and entered into the LTRMP monitoring database
- Summary statistics of year 1999 SAV sampling data will be calculated and quality checked.
- Statistical analysis of year 1999 SAV data to detect differences between strata, pools, and previous monitoring years.
- A Project Status Report summarizing and interpreting the results of year 1999 SAV monitoring.
- The 1999 SAV Annual Report

2.1.4 Milestones

December 29, 1999 - Complete year 1999 aquatic vegetation data quality checking and entry into the LTRMP database.
March 30, 2000 - Complete statistical analyses of 1999 aquatic vegetation data.
April 31, 2000 - Complete 1999 aquatic vegetation monitoring project status report.
May 15, 2000 - Complete 1999 aquatic vegetation monitoring Annual Report.
June 15, 2000 - Complete Window I transect sampling.
July 31, 2000 - Complete SAV stratified random sampling.
August 31, 2000 - Complete Window II transect sampling.

Scheduled for FY2001:
December 29, 2000 - Complete data quality checking and entry of year 2000 aquatic vegetation data into the LTRMP database.
April 31, 2001 - Complete annual project report for year 2000.

2.1.5 Funding

Total: $729.9

2.1.6 Personnel

Dr. Yao Yin will be the principal investigator in charge of LTRMP aquatic vegetation monitoring.

2.2 Fish (Study Plan Title 7)

One annual increment of stratified random sampling of fish will be conducted, following the LTRMP study plan and standard protocols (USGS 1999b, Gutreuter et al. 1995). Fish monitoring will be reduced from previous years due to the reduced budget and in response to analyses of LTRMP fish monitoring data obtained in previous years.

2.2.1 Objectives

1) Measure fish relative abundance, community composition, and population structure within 6 LTRMP study areas in the UMRS (UMR Pools 4, 8, 13, 26, Open River reach, LaGrange Pool on the Illinois River).
2) Determine If there are differences in fish relative abundance, community composition, and population structure by taxa between strata within study areas, and between study areas.
3) Determine if there have been changes in fish relative abundance, community composition, and population structure from previous years of monitoring.

2.2.2 Methods

Fish will be sampled from randomly chosen locations from within aquatic areas strata present within each LTRMP study area:

- Backwater, contiguous, offshore (BWCO)
- Backwater, contiguous, shoreline (BWCS)
- Main channel border, wing dam (MCBW)
- Main channel border, unstructured (MCBU)
- Impounded, offshore (IMPO)
- Impounded, shoreline (IMPS)
- Secondary channel border (SCB)
- Tributary mouth (TRI)
- Tailwater (TWZ)

Fish will be sampled using day and night electrofishing, tyke nets, seines, small tyke nets, hoop nets, and small trawls, following standard LTRMP protocols (Gutreuter et al. 1995). Fish sampling will be conducted during three time periods between June 15 and October 15 in each LTRMP study area. Sample allocations will be based on the schedule listed in USGS (1999b Appendix A). The FY2000 sampling schedule includes changes made to meet the reduced budget and in consideration of analyses of LTRMP fish monitoring data from previous years. Sampling allocations were reduced by 26% to 38% among study areas except for the Open River reach (no change from FY99).

2.2.3 Products

- Fish data will be quality checked and entered into the LTRMP monitoring database.
- Summary statistics of fish sampling will be calculated and quality checked.
- Statistical analysis to detect differences between strata, pools, and previous monitoring years will be conducted.
- A project status report summarizing and interpreting the results of year 1999 fish monitoring.
- A 1999 fish monitoring Annual Report.

22.4 Milestones

October 30, 1999 - Complete the third FY 1999 fish sampling effort (Sept. 16-Oct. 31, 1999)
December 29, 1999 - Complete 1999 fish data quality checking and entry to LTRMP database.
March 31, 2000 - Complete summary statistics and statistical analyses of 1999 fish data.
March 31, 2000 - Complete a year 1999 project status report.
April 30, 2000 - Complete year 1999 fish monitoring annual report.
July 31, 2000 - Complete the first increment year 2000 fish sampling effort.
September 15, 2000 - Complete the second increment year 2000 fish sampling effort.

2.2.5 Funding

Total: $1304.0

2.2.6 Personnel

Dr. Todd Koel will be the principal investigator in charge of LTRMP fish monitoring.

2.3 Macroinvertebrates (Study Plan Title 8)

One annual increment of macroinvertebrate sampling will be conducted, following the LTRMP study plan and standard protocols (USGS 1999c, Thiel and Sauer 1999).

2.3.1 Objectives

1) Measure the density and community composition of soft-substrate macroinvertebrates within 6 LTRMP study areas in the UMRS (UMR Pools 4, 8,13, 26, and Open River reach, and LaGrange Pool on the Illinois River).
2) Determine if there are differences in macroinvertebrate density and community composition between strata within study areas, and between study areas.
3) Determine if there have been changes in macroinvertebrate density and community composition from previous years of monitoring.

2.3.2 Methods

Benthic macroinvertebrates will be sampled by Ponar dredge and screened in the field. Samples will be preserved and retained for laboratory identification and enumeration. Mayflies (Ephemeroptera), fingernail clams (Sphaeriidae), *Corbicula fluminea* (Asiatic clam), midges (Chironomidae) and *Dreissena polymorpha* (Zebra mussel) willbe collected, identified, and enumerated. The presence or absence of macroinvertebrates in the classes Odonata, Plecoptera, Trichoptera, Diptera, Bivalvia, Oligochaeta, Decapoda, Amphipoda, and Gastropoda will be observed and reported. Approximately 125 macroinvertebrate samples will be collected per study area. Sample allocation will be based on a stratified random design, where strata are aquatic areas:

- contiguous backwaters (BWC)
- main channel borders (MCB)
- impounded areas (IMP)
- secondary channels (SC)
- tributary delta lake (TDL)

All sites will be sampled in spring to characterize the benthic community before mayfly emergence. Pool-wide macroinvertebrate densities will be estimated by pooling data over all strata. Analyses will be conducted to assess the statistical power of detecting change in density and community composition by strata, study area, taxa, and between years.

2.3.4 Products

- 1999 macroinvertebrate density and community composition data quality checked and entered into the LTRMP database.
- Summary statistics of macroinvertebrate density and community composition data.
- Statistical analysis of year 1999 macroinvertebrate monitoring data.
- A Project Status Report summarizing and interpreting the results of year 1999 macroinvertebrate monitoring.
- A year 1999 Annual Report

2.3.5 Milestones

December 31, 1999 - Complete year 1999 macroinvertebrate data quality checking, calculate summary statistics, enter data into LTRMP database
March 31, 2000 - Complete statistical analyses of 1999 macroinvertebrate data.
March 31, 2000 - Complete and distribute macroinvertebrate monitoring Project Status Report.
March 31, 2000 - Complete year 1999 Annual Report.
July 31, 2000 - Complete macroinvertebrate sampling efforts in each LTRMP study area.

2.3.5 Funding

Total: $202.6

2.3.6 Personnel

Ms. Jennie Sauer will be the principal UMESC investigator in charge of LTRMP macroinvertebrate monitoring.

2.4 Water Quality (Study Plan Title 9)

One annual increment of LTRMP water quality monitoring will be conducted, following standard LTRMP protocols (USGS 1999d).

2.4.1 Objectives

1) Measure selected limnological variables within 5 LTRMP study areas in the UMRS (UMR Pools 4, 8, 13, 26, LaGrange Pool on the Illinois River) and at other selected locations.
2) Determine if there are differences in water quality between strata within study areas, and between study areas.
3) Determine if there are differences in water quality between sampling episodes.
4) Determine if there have been changes in water quality from previous years of monitoring.
5) Complete the LTRMP procedures manual for water quality monitoring.

2.4.2 Methods

A subset of limnological variables (physical-chemical characteristics, suspended sediment, major plant nutrients) will be monitored at stratified-random sites and at fixed locations within each LTRMP study area and at a number of other selected sites (need list of locations, sampling schedule in USGS 1999d). A combination of in-situ measurements and grab samples retained for laboratory analysis will be collected. Allocation of sampling effort will be based on four seasonal episodes each year for the stratified-random sampling, and periodic (biweekly or monthly) sampling at fixed sites, according to the schedule in USGS (1999d). The sampling allocation reflects the reduced

FY2000 budget and results of analyses of previous LTRMP monitoring data. Water quality sampling and laboratory analyses will be performed following standard LTRMP protocols (procedures manual in preparation).

2.4.3 Products

- Water quality data quality checked and entered into the LTRMP monitoring database from 4 water quality sampling episodes in year 1999.
- Summary statistics of year 1999 water quality data.
- Statistical analysis of year 1999 water quality monitoring data.
- A Project Status Report summarizing and interpreting the results of year 1999 water quality monitoring.
- A Procedures Manual for LTRMP water quality monitoring.
- A year 1999 Annual Water Quality Report.

2.4.4 Milestones

October 22, 1999 - Complete fall stratified random sampling episode at each of the six LTRMP field stations.
November 30, 1999 - Publish 1993-1996 summary reports for each of the six LTRMP field stations.
December 31, 1999 - Complete year of 1999 water quality sampling at two-week intervals. Implement new sampling design with 4-week sampling interval for fixed sites.
February 15, 1999 - Complete winter stratified random sampling episode at each of the six LTRMP field stations.
March 31, 2000 - Complete error checking of 1999 water quality laboratory analyses.
April 30, 2000 - Complete year 1999 water quality field data checking and entry to LTRMP database for fixed site sampling and SRS.
May 15, 1999 - Complete spring stratified random sampling episode at each of the six LTRMP field stations.
May 30, 1999 - Complete transfer of previous years analytical data from laboratory database to LTRMP database.
June 15, 2000 - Complete 1999 Water Quality Project Status Report.
June 30, 2000 - Complete 1999 water quality Annual Report including water quality summary statistics, analyses of spatial and temporal trends, of long-term patterns, and sampling performance statistics.
August 15, 2000 - Complete summer stratified random sampling episode at each of the LTRMP field stations.
September 1, 2000 - Complete water quality sampling plan for FY 2001.
September 29, 2000 - Complete the LTRMP water quality Procedures Manual.

2.4.5 Funding

Total: $1507.1

2.4.6 Personnel
Dr. David Soballe will be the principal investigator in charge of LTRMP water quality monitoring.

2.5 Hydrology
The USGS UMESC will maintain Internet home page links to sites serving hydrologic data collected by the USGS Water Resources Division and the U.S. Army Corps of Engineers. A brief summary of the annual hydrograph and discussion of hydrologic events will be included in the 1999 LTRMP Monitoring Summary Report.

3.0 APPLIED RESEARCH: LANDSCAPE AND HABITAT ANALYSES
A variety of LTRMP applied research efforts will be conducted, designed to assess habitat conditions and habitat forming processes in the UMRS, document historic changes in the UMRS landscape, and to develop predictive tools to aid in planning for river management.

3.1 Characterization of the UMR Hydrologic Regime (Study Plan Title 15)
An analysis of historical changes of the UMR hydrologic regime will be conducted using data from long-term UMR gaging stations (USGS 1999e).

Additional work to assess the influences of impoundment and changes in channel geometry and levees on the UMRS hydrologic regime, making use of a synthetic hydrographic record simulating unregulated river conditions and pre-impoundment and pre-levee channel dimensions, will be conducted if funding becomes available (see Additional Work scope 3.1).

3.1.1 Objectives
1) This study will quantify long-term trends in water levels and discharges on the Upper Mississippi River. The null hypothesis is that the relation between these two factors has not changed.

3.1.2 Methods
Water level and discharge data will be analyzed with the Indicators of Hydrologic Alternation program, specific-gage analysis (Biedenharn and Watson 1997), and other methods as appropriate. Stations with more than a 50-year record of daily (mostly complete) data will be the main focus of the analysis. We will relate changes in the relation among variables to possible causes, including, but not limited to, channel geometry, watershed management practices, and floodplain management practices.

3.1.3 Products
- Historic databases of water levels, discharges, widths, maximum depths, cross sectional areas, and water velocities.
- Two journal articles.
- One or more presentations at scientific conferences.
- Project status report.
- One technical report.

3.1.4 Milestones
December 31, 1999 - Submit first journal article for publication.
March 30, 2000 - Complete draft project status report.
June 30, 2000 - Submit second journal article for publication.
September 30, 2000 - Submit draft technical report for review.

3.1.5 Funding
Total: $66.8

3.1.6 Personnel
Dr. Joe Wlosinski will be the UMESC principal investigator in charge of the research on alteration of the UMRS hydrologic regime.

3.2 Systemic Floodplain Landscape Analysis (Study Plan Title 16)
The pattern and spatial configuration of land cover types on the UMRS reflects the combined effects of natural habitat forming processes and human activities. Quantitative assessment of historic landscape structure and forecast of future conditions is needed for understanding riverine ecological processes and in planning for river management (USGS 1999w).

3.2.1 Objectives
1) Quantity and describe long-term changes in the landscape structure (the composition of land cover types and their spatial configuration) of landscapes of the UMRS from presettlement to the present.
2) Quantify and describe the existing UMRS landscape structure.
3) Forecast future UMRS landscape structure.

3.2.2 Methods
Historic changes in the UMRS landscape will be quantified using GIS data for presettlement, 1890's, and 1989 time periods. A pre-settlement land cover GIS has been developed for 8 UMR navigation pools from General Land Office surveyors records. An 1890's

land cover GIS has been developed from the Mississippi River Commission maps for nearly the entire UMR. The 1989 land use/land cover GIS for UMRS, based on aerial photography, is nearly complete.

Land cover type areas and the spatial structure of the landscape will be quantitatively analyzed using the three time period GIS coverages for UMR Pools 4, 8, 13, 26, and Open River. Longitudinal changes in landscape structure will be quantitatively assessed using a simple 7-type land cover classification and by dividing the river into lateral segments one mile in length. FRAGSTATS (McGarigal and Marks 1994), a spatially-based, statistical program will be used to calculate measures of landscape structure for each river segment. Similarities and differences in land cover between UMR navigation pools will be examined using cluster analyses. Floodplain connectivity will be quantified using the 1989 land cover and levees GIS coverages.

3.2.3 Products

- Technical report - Landscape patterns along the Upper Mississippi River.
- Technical report - Comparisons of 1890s and contemporary landscapes of the Upper Mississippi River.
- Chapter for the Coordination Act Report - Land cover change associated with side channel filling in the open reaches of the Upper Mississippi River.
- Manuscript - The natural history of Navigation Pool 4 of the Upper Mississippi River.
- Summaries of changes in land cover/land use for the Upper Mississippi River (1 890s, 1929, 1939, 1973/75, and 1989).

3.2.4 Milestones

January 31, 2000 - Chapter for Coordination Act Report, "Land cover change associated with side channel filling in the open river reach of the Upper Mississippi River." Complete and submit for publication.

February 15, 2000 - Complete summaries of changes in land cover/land use for the Upper Mississippi River (1890s, 1929, 1939, 1973/75, 1989).

March 30, 2000 - Manuscript, "The natural history of Navigation Pool 4", submitted for publication.

June 30, 2000 - Draft LTRMP Technical Report "Comparisons of 1890s and contemporary landscapes of the Upper Mississippi River." In review.

September 15, 2000 - Draft LTRMP Technical Report "Landscape patterns along the Upper Mississippi River." In review.

3.2.5 Funding

Total: $95,900

3.2.6 Personnel

Ms. Mary R. Craig will be the UMESC principal investigator in charge of the landscape ecology research.

3.3 Complete the 1989 land use/land cover GIS database for the UMRS (Study Plan Title 20)

To date, Pools 4-26, the Open River reach from Grand Tower to Cairo, Illinois, and the La Grange and Peoria Pools of the Illinois River, over 1.5 million acres total, have been classified and made available as digital files from the UMESC Internet home page. To complete this GIS database, the following reaches will be classified: Pools 1-3, the lower Saint Croix, Minnesota, and Kaskaskia Rivers, the Open River reach from Lock and Dam 26 to Grand Tower, Illinois, and the Alton, Starved Rock, Marseilles, Dresden, Brandon, and Lockport Pools of the Illinois River (USGS 1999g).

3.3.1 Objectives

1) Complete the 1989 land use/land cover and aquatic areas GIS database for the entire UMRS.

3.3.2 Methods

The land use/land cover and aquatic areas classification will be produced using the 1989 1:15,000 scale (1 inch=1250 feet) color infrared aerial photography. A new low-resolution land use/land cover classification (USGS 1999g) has been developed that will allow larger areas to be classified in ecologically useful categories but is still general enough for efficient LCU data set production. All work produced under this scope of work will be performed either by or under the supervision of competent and trained professional staff using documented standard operated procedures and will be subject to rigorous quality control and quality assurance practices (NBS, 1995).

3.3.3 Products

- 1989 land use/land cover and aquatic areas GIS datasets for:
    - Pools 1-3
    - The lower Minnesota River
    - The lower St. Croix River
    - The lower Kaskaskia River
    - Open River Reach from Lock and Dam 26 to Grand Tower, Illinois
    - The Alton, Starved Rock, Marseilles, Dresden, Brandon, and Lockport Pools of the Illinois River

- The land use/land cover and GIS datasets will be made available to others via the UMESC Internet home page.

3.3.4 Milestones

January 30, 1999 - Complete Pools 1-3, lower St. Croix River
July 31, 2000 - Complete Open River Reach from Lock and Dam 26 to Grand Tower, Illinois and lower Kaskaskia River
September 29, 2000 - Complete Alton, Starved Rock, Marseilles, Dresden, Brandon, and Lockport Pools of the Illinois River

3.3.5 Funding

Total: $196.8

3.3.6 Personnel

Mr. Larry Robinson will be the UMESC principal investigator in charge of completing the 1989 land use/land cover and aquatic areas databases for the UMRS.

3.4 Suspended Sediment Budgets for Pools 8. 13, and 26 and the La Grange Pool (Study Plan Title 13)

The proposed work is a continuation of sediment budget studies that began in 1994. Data were collected for the 1995, 1996, and 1997 water years in Pool 13 of the Mississippi River and the La Grange Pool on the Illinois River. In 1998, what was to be a three-year study in Pools 8 and 26 was initiated. This study was terminated after one year of data collection because of a shortfall in funding. This project will complete analyses of sediment-budget data that have been collected for Pools 8, 13, and 26 of the Upper Mississippi River and the La Grange Pool of the Illinois River.

3.4.1 Objectives

1) Complete analysis of suspended sediment budgets of Upper Mississippi River Pool 8, 13, 26, and La Grange Pool on the Illinois River.
2) Develop pool-scale (input/output) suspended sediment budgets for studied reaches, based on existing data.

3.4.2 Methods

Data analyses will document temporal patterns (annual and shorter intervals), quantify loadings from the mainstem river and major tributaries, and estimate budgets (inputs-output) for the studied reaches.

3.4.3 Products

- UMESC three-year database on suspended sediment concentrations, suspended sediment loads for Pools 13 and LaGrange.
- UMESC one-year database on suspended sediment concentrations, suspended sediment loads for Pools 8 and 26.
- Technical Report on suspended sediment budgets for Pool 8, 13, 26, and LaGrange.

3.4.4 Milestones

September 29, 2000 - Complete and distribute Technical Report on suspended sediment budgets for Pools 8, 13, 26 and LaGrange.

3.4.5 Funding

Total: $134.7

3.4.6 Personnel

Dr. Robert Gaugush will be the UMESC principal investigator in charge of determining pool-scale suspended sediment budgets.

3.5 Assessment and Evaluation of an In-situ Sediment Penetrometer for the Classification of Sediment Type and Its Distribution (Study Plan Title 14)

Sediment penetrometers were used to rapidly survey soft sediment type distribution in Lake Onalaska as part of the HREP Biological Response Study of the Effects of Islands. Additional spatial surveys with penetrometers were conducted in Pools 4, 8, and 13. The penetrometers effectively sampled sediment in the field, allowing estimation of bulk density, percent water content, and percent organic matter. A report evaluating the effectiveness of sediment penetrometer for spatial surveys of soft sediment type distribution will be prepared.

3.5.1 Objectives

1) Evaluate the effectiveness of sediment penetrometers for surveying soft sediment type distributions in the UMRS.

3.5.2 Methods

Penetrometer data from Lake Onalaska in Pool 7, and from Pools 4, 8, and 13 will be compared to available laboratory analyses of sediment and visual characterizations of sediment samples. Use of sediment penetrometers for rapid surveying and characterization of sediment type distribution in the UMRS will be evaluated with respect to accuracy of penetrometer-derived estimates of bulk density, water content and organic content. Comparisons of penetrometer-derived data with visual characterizations of sediment type will be made, and logistical considerations of application of penetrometers for spatial surveys of sediment type distribution will be described.

3.5.3 Products

- UMESC sediment penetrometer and sediment analyses data archives.
- Technical Report on application of sediment penetrometers.

3.5.4 Milestones

September 1, 2000 - Complete UMESC sediment penetrometer and sediment analyses data archives.
September 29, 2000 - Complete and distribute Technical Report evaluating use of sediment penetrometers.

3.5.5 Funding

Total: $42.5

3.5.6 Personnel

Dr. Robert Gaugush will be the UMESC principal investigator for the evaluation of sediment penetrometers.

4. APPLIED RESEARCH: INTEGRATED ANALYSES

A variety of research activities will be conducted to examine and predict relationships between physical processes and biological responses in the UMRS, making extensive use of LTRMP monitoring and river survey data.

4.1 Predict the Density Distribution of Selected Macroinvertebrates (Study Plan Title 1)

An existing empirical model, combining water depth and current velocity predicted from 2-D numerical hydraulic modeling (FASTABS) was developed and applied using data from Lake Onalaska in Pool 7 and from Pool 8. The model will be further tested and applied to predict the densities of selected macroinvertebrates inhabiting sand and finer substrates in the UMRS (USGS 1999l).

4.1.1 Objectives

1) Further develop and apply an existing empirical model that predicts fingernail clam *(Musculium* spp., *Psidium* spp., and *Sphaerium spp.),* mayfly *(Hexagenia spp.)* and midge larva (Chironomidae) densities using water depth and current velocity.

4.1.2 Methods

Macroinvertebrates; will be sampled from soft substrates using a Ponar dredge and screened in the field, following LTRMP standard sampling protocols (Thiel and Sauer 1999). Samples will be obtained in September from randomly located sites within strata that are defined by water depth and mean water column current velocity:

Strata	Velocity (cm/s)	Water Depth (m)
1	<4	<1
2	4-6	<1
3	>6	<1
4	<4	1-3
5	4-6	1 -3
6	6-12	1-3

Mean water column current velocity will be estimated using 2-D numerical hydraulic (TABS) models for the level of river discharge at the time of sampling, or a time-weighted velocity estimate will be derived for each sampling area. Samples will be obtained from Lake Onalaska, Pool 8, and Pool 13 of the UMR. Effectiveness of the empirical model in predicting density distribution of macroinvertebrates will be statistically tested. The model will be modified to best estimate density of macroinvertebrates using water depth and current velocity as independent variables.

4.1.3 Products

No products are expected in FY2000. A Technical Report on this research will be prepared in FY2001.

4.1.4 Milestones

September 29, 2000 - Macroinvertebrate sampling for model calibration and testing completed in Pools 7, 8, and 13.
June 30, 2001 - Draft report completed, distributed for review.
September 29, 2001 - Final report complete, in publication.

4.1.5 Funding

Total: $56.3

4.1.6 Personnel

Mr. Randy Burkhardt will be the UMESC principal investigator in charge of further development of the model for predicting density distribution of macroinvertebrates.

4.2 Aquatic Vegetation Responses to River Dynamics (Study Plan Title 3)

Exploratory analyses of existing LTRMP and other data on SAV, hydrology, meteorology, and water quality will be conducted to infer responses of SAV to changing river conditions, and to infer causal relations influencing spatial and temporal changes in SAV within UMR Pools 4, 8, and 13 (USGS 1999f). Existing plant growth models (Best and Boyd 1999a - d) will be applied to assess the influence of hydrologic, water quality, and meteorological conditions on SAV. The USGS and Corps' Waterways Experiment Station will conduct this work jointly over the course of FY2000 and FY2001.

4.2.1 Objectives

1) Identify areas where SAV has occurred.
2) Identify areas that have consistently supported SAV.
3) Assess spatial patterns of SAV community composition within pools, between aquatic area types.
4) Assess spatial patterns of SAV community composition between pools.
5) Assess spatial patterns of SAV community composition between years.
6) Assess annual changes in SAV within pools, between aquatic area types.
7) Assess annual changes in SAV between pools.
8) Assess the influence of hydrologic conditions on SAV response.
9) Assess the influence of water quality conditions on SAV response.
10) Assess the influence of hydraulic conditions on SAV response (current velocity, residence time).
11) Assess the influence of meteorological conditions on SAV response.
12) Assess the interannual response of SAV to dynamic river conditions.

4.2.2 Methods

The analyses will be performed using SAV, water quality, meteorological, bathymetry, sediment type, hydrologic data, and results of 2-D (TABS) hydraulic modeling. Multivariate statistical techniques will be applied to infer relationships between habitat factors and SAV response. Existing plant growth models (Best and Boyd 1999) will be applied to assess the influence of hydrologic, water quality, and meteorological conditions on SAV in Pools 4, 8, and 13.

4.2.3 Products

- Project status report on FY2000 progress.
- A technical report will be developed in FY2001 describing spatial and temporal patterns of submersed aquatic vegetation (SAV) in Pools 4, 8, and 13, correlations between SAV and habitat variables, and analysis of the influence of habitat variables on SAV growth and reproduction based on modeling. The report will include recommendations on future LTRMP SAV monitoring design.

4.2.4 Milestones

September 29, 2000 - Project status report completed, distributed.
June 30, 2001 - Draft report completed, distributed for review.
September 29, 2001 - Final report complete, in publication.

4.2.5 Funding

Total: $126.5

4.2.6 Personnel

Dr. Kenneth Lubinski will be the UMESC principal investigator in charge of research on the response of SAV to changing river conditions.

4. 3 Habitat models for SAV (Study Plan Title 12)

The proposed study is to develop spatially explicit models to predict potential habitats of SAV in the UMR (USGS 1999i). Work conducted to assess SAV response to dynamic river conditions (scope of work 4.2 above) will contribute to this effort.

4.3.1 Objectives

1) Develop and calibrate a spatially explicit model for predicting potential habitat for SAV in the UMR.
2) Predict the potential habitat for SAV in the UMR.

4.3.2 Methods

LTRMP stratified-random SAV sample data was collected in 1998 and 1999 from 5650 randomly locations within UMRS aquatic areas strata in UIVIR Pools 4, 8, 13, and 26. Bathymetric GIS coverage will serve as the base map, on which distribution of SAV will be modeled statistically using raster (cells) as basic units. The potential habitat of SAV under given environmental conditions will be modeled in a geo-spatial and statistical approach, to be compared with growth simulation model (Best and Boyd 1999). In statistical analyses, the presence/absence of SAV on a raster will be modeled as a probabilistic event, with and without abundance as a weighting factor. Explanatory variables in the initial model will include flow velocity, suspended solids, underwater light, water depth (adjusted by hydrograph data), and sediment type. Flow velocity data will be generated by the TABS models of the Corps. Potential habitat will be projected in two different ways depending on the strength of each model, measured by the goodness of fit. A weak model will be used to generate presence/absence GIS coverage, while a strong model will be used to generate a presence/absence probability GIS coverage.

4.3.3 Products

- An initial model will be developed for Pool 8, including a GIS coverage to display the modeled habitat of SAV.
- A technical report on model development.

4.3.4 Milestones

May 30, 2000 - Complete literature search and data compilation.
July 30, 2000 - Complete draft technical report, distribute for review.
August 30, 2000 - Complete Project Status Report, distribute.
September 29, 2000 - Final Technical Report complete, in publication.

Schedule for FY 2001 and FY 2002:
September 29, 2001 - Field testing of model.
September 29, 2002 - Expand model to other pools when the required bathymetry, water quantity, and flow velocity is available.

4.3.5 Funding

Total: $58.6

4.3.6 Personnel

Dr. Yao Yin will be the UMESC principal investigator in charge of modeling the spatial occurrence of SAV.

Integrated Analysis of Fish Monitoring Data (Study Plan Title 20 – overtarget proposal #1)

Ten years of LTRMP fish monitoring data will be analyzed to assess changes in abundance and population structure of socially important fishes in the UMRS, differences between habitat areas and between LTRMP study areas, to assess the influences of environmental conditions on the fish community, and to examine the design of the LTRMP fish monitoring program (USGS 1999y).

4.4.1 Objectives

1) Compile and synthesize LTRMP fish data (1990 - 1999)
2) Analyze fish community dynamics (species richness, evenness, diversity) at the aquatic habitat, pool, reach, and UMRS scales.
3) Quantify spatial variability (among habitat types and trend analysis areas) and temporal variability (among seasonal sampling periods and years) of the fish community and of the status (relative abundance and population structure) of selected socially important fish species.
4) Assess and identify any LTRMP fish component monitoring inefficiencies, gear redundancies, or serious gaps in data collection.
5) Compare LTRMP fisheries data to that which is currently collected by Minnesota, Wisconsin, Iowa, Illinois, and Missouri natural resource agencies to determine if trends are similar among sampling programs and design.
6) Analyze the influence of environmental factors on the UMRS fish community.

4.4.2 Methods

Mean catch-per-unit-effort (CPUE) of economically important UMRS fish species will be used as an index of relative abundance. Statistically valid comparisons of CPUE will be made to examine spatial variability (among habitat types and trend analysis areas) and temporal variability (among seasonal sampling periods and years). Fish community dynamics will be described utilizing species richness, evenness, and diversity indices. Correlation of fish CPUE with environmental factors will be accomplished with multivariate statistics.

4.4.3 Products

- Project status report describing preliminary results and leading to a 10-year LTRMP systemic-level fish Technical Report in FY2001.

4.4.4 Milestones

August 15, 2000 - Complete statistical analysis of data
September 29, 2000 - Complete, distribute project status report
May 31, 2001 - Complete, distribute Technical Report.

4.4.5 **Funding**

Total: $30.2

4.4.6 Personnel

Dr. Todd Koel will be the principal investigator in charge of integrated analysis of LTRMP fish monitoring data.

4.5 Sediment Type Distribution Modeling (Study Plan Title 2) An empirical model was developed using data from Lake Onalaska, Pool 7, to predict sediment type distribution. Water depth, wind fetch, and mean water column current velocity from a 2-D numerical hydraulic model (TABS) were used in the model. The model will be further calibrated and verified, and applied to Pools 4, 8, and 13 of the UMR to generate GIS coverages of sediment type distribution (USGS 1999v).

4.5.1 Objectives

1) Predict the spatial distribution of sediment types in the UMR, using river geometry and hydrodynamic data in an empirical model.
2) Generate modeled sediment type distribution GIS databases for Pools 4, 8, and 13.

4.5.2 Methods

Existing LTRMP data (bathymetry, a GIS-based wind fetch model, and limited sediment distribution data) and existing current velocity data (from U.S. Army Corps of Engineers TABS hydrodynamic models) will be used to verify or refine the existing empirical model. Predicted sediment type distribution will be compared to sediment type distribution determined by field sampling, visual characterization of sediment type, and laboratory analyses. The model will be used to generate GIS coverages illustrating sediment distribution in Pools 4, 8, and 13.

4.5.3 Product

- Technical report on modeling sediment type distribution
- GIS databases of modeled sediment type distribution in Pools 4, 8, and 13
- Project status report on modeling sediment type distribution

4.5.4 Milestones

September 29, 2000 - Draft technical report on modeling sediment type distribution, submitted for review.
September 29, 2000 - Project status report on modeling sediment type distribution completed, distributed.
September 29, 2000 - GIS databases on modeled sediment type distribution for Pools 4, 8, and 13 available via the UMESC Internet site.

4.5.5 Funding

Total: $59.0

4.5.6 Personnel

Dr. Robert Gaugush will be the UMESC principal investigator in charge of modeling sediment type distribution.

5. INFORMATION TRANSFER

5.1 Annual LTRMP Monitoring Summaries (Study Plan Title 17)

The first LTRMP Ecological Status and Trends report was published in 1999. An executive summary needs to be prepared for distribution to the public. Subsequent Ecological Status and Trends reports will be written at six-year intervals to become part of future EMP Reports to Congress or as necessary to describe river ecosystem disturbances or support major river management decisions. Annual summaries of LTRMP monitoring results will be prepared to supplement the Ecological Status and Trends reports.

5.1.1 Objectives

1) Complete and distribute an executive summary for the 1999 Ecological Status and Trends Report.
2) Complete and distribute an annual LTRMP monitoring summary.

5.1.2 Methods

Trends report by the LTRMP and others will be compiled and reviewed by an interdisciplinary team. Trends in ecological components monitored by the LTRMP and from other sources will be summarized. A 10 - 15 page color report will be prepared, providing narrative, tables, figures, and maps describing recent changes in the ecological conditions on the UMRS.

5.1.3 Products

- Status and Trends Report Executive Summary
- Annual monitoring summary report for the UMRS.

5.1.4 Milestones

Annual monitoring summary report for the UMRS:
December 15,1999 - Content and rough format established and writing assignments made.
March 15, 2000 - First draft and rough mock up of report available for review.
May 15, 2000 - Final draft report available for review.
June 1, 2000 - Final report complete, in publication.
July 1, 2000 - Report returned from printer and distributed by UMESC.

Status and Trends Report Executive Summary:
November 20, 1999 - Solicit comments on draft from Analysis Team and Team Leaders.
December 30, 1999 - Final executive summary complete, in publication.
February 15, 2000 - Report returned from printer and distributed by UMESC.

5.1.5 Funding
Total: $55.4

5.1.6 Personnel
Drs. Carl Korschgen and James Wiener will be the UMESC principal investigators responsible for the annual addendum and the annual monitoring summary report.

6. PROGRAM DEVELOPMENT

6.1 Analysis of Monitoring Designs (Study Plan Title 6)
A series of statistical analyses of LTRMP monitoring data were conducted in 1999 to identify the degree to which temporal and spatial differences in conditions can be detected. The analyses were performed to assess the adequacy of monitoring designs and to identify redundancies. Some of the results were presented to EMP partners. However, the analyses were not summarized or reported (USGS 1999h).

6.1.1 Objectives
1) Complete statistical analysis of LTRMP monitoring data collected from 1989 through 1998, and prepare a report with results and interpretation.

6.1.2 Methods
The statistical analyses completed in FY 1999 included all LTRMP monitoring components. The statistical results and narrative interpretations will address the degree to which the existing monitoring designs and sampling procedures allow detection of temporal changes and spatial differences. Redundancies among sampling gear types and monitoring variables will be identified. Recommendations for changes to the existing LTRMP monitoring designs that would improve the ability to detect spatial differences and temporal changes, and improve monitoring effectiveness will be made.

6.1.3 Products
- Program report on analysis of LTRMP monitoring designs.

6.1.4 Milestones
July 1, 2000 - Final Program Report on analysis of LTRMP monitoring designs.

6.1.5 Funding
Total: $66.7

6.1.6 Personnel
Dr. Kenneth Lubinski will be the UMESC principal investigator in charge of reporting on the statistical analysis of the LTRMP monitoring designs.

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