

# **PROSPECTUS OF THE SUBCOMMITTEE ON SEDIMENTATION FOR THE YEARS 2002 – 2006**

(approved by the SOS December 13, 2003, with acknowledgement that some updates are needed)

## **I. INTRODUCTION**

### **A. Purpose**

The purpose of the prospectus is to help define the issues confronting the Federal sector that relate to sedimentation and the ways and means by which the Subcommittee on Sedimentation may effectively coordinate the combined effort of the participating agencies in addressing these issues.

### **B. Background**

Sediment-discharge measurements in the United States began in 1838 when Captain Talcott sampled flows in the Mississippi River. In the late nineteenth century, sediment sampling activities increased rapidly as Federal agencies organized civil-works programs. For the most part, engineers in charge of these programs developed their own sampling equipment and data collection methods. By the 1930's, agencies had started to develop equipment and metrologies for use by their agency, but there was no consistency between agencies. As sampling progressed, managers realized the accuracy and usability of sediment data was affected by lack of standardization in equipment and techniques. In 1939, the U.S. Department of Agriculture, the Bureau of Reclamation, the Office of Indian Affairs, the U.S. Geological Survey, the U.S. Army Corps of Engineers, and the Tennessee Valley Authority formed the "Inter-Departmental Committee." This committee was formed to oversee a project that would investigate sediment sampling equipment and techniques with the purpose of developing standardized ways of measuring and analyzing sediment loads.

From the time of its conception until the present day, Sedimentation Committee has functioned under several different parent organizations. These include the Federal Interagency River Basin Committee, the Interagency Committee on Water Resources, and the Water Resources Council. Since 1978, the committee has functioned as the Subcommittee on Sedimentation of the Interagency Advisory Committee on Water Data, an advisory committee to the Secretary of the Interior and administratively organized by the USGS Office of Water Data Coordination. The formation of the Advisory Committee on Water Information (ACWI) in 1996 has virtually replaced the IACWD but to date the SOS has not agreed to seek inclusion under ACWI.

In 1993, during one of its regularly scheduled meetings, the Subcommittee charged itself with the task of trying to:

1. Determine the major sediment related problems that will be facing the United States in the 21st century, and
2. Prepare a plan for the coordination and pooling of the resources of the participating agencies in order to effectively address these problems. The Prospectus of the Subcommittee on Sedimentation for the Year 2000 was a result of that review and summarizes the collective thinking of the participating agencies.

## **II. SEDIMENT ISSUES CONFRONTING THE FEDERAL SECTOR**

### **A. Reservoir Sedimentation**

Most of the dams and reservoirs in this country were built in the early decades of the last century and the storage space is being steadily depleted. With fewer opportunities to replace this storage, it is obvious that the existing storage and new storage be carefully managed. Therefore it is important that:

1. The sediment inflow can be accurately and continuously monitored.
2. The rate of consolidation of the inflowing sediment can be predicted and monitored.
3. The effect of shoreline erosion on storage change and shoreline development can be predicted and controlled.
4. Decommissioning of obsolete facilities is studied and guidelines produced.

### **B. Channel Operation and Maintenance**

Many natural and manmade channels are used for the conveyance of water, providing flood control, navigation routes, and providing recreational opportunities. Several of the participating Federal agencies are charged with operating and maintaining these water courses and their appurtenant structures. Budgetary restrictions and increased use pressures makes it critical that the soundest scientific and most economical methods be used for operating and maintaining these channels. Consequently it is important that:

1. Aggradation and degradation can be predicted and measured.
2. Bank erosion rates can be predicted and monitored and that appropriate means of bank stabilization can be designed and economically constructed.
3. Bedload rates can be measured in difficult hydraulic and sediment transport situations.
4. Dredging and disposal of spoil material be done at least cost and in an environmentally sensitive manner.

### **C. Environmental Concerns**

Water resource development and compliance with clean water standards (for TMDL criteria) require an increased awareness of sediment transported contaminants and the sensitivity required in collecting and analyzing these data. The capture and repose of these contaminants in deposited sediment is of particular importance. Specific problems identified:

1. The measurement of transport of contaminants attached to sediment particles including those at low concentrations.
2. Salinity changes related to sediment transport and dissolution.
3. Sediment related problems associated with Superfund Cleanup sites and their remediation.
4. Nonpoint source sediment.
5. "Clean" sediment TMDL targets and development.
6. River Corridor Restoration guidelines and agency coordination.

## **D. Geomorphic Responses**

When the flow regime and related sediment transport rates are altered in natural streams, it triggers a geomorphic response in the stream that may manifest itself in several ways. Aggradation, degradation, bank erosion, and altered channel substrate are all potential responses. Being able to predict and compensate for these changes can minimize environmental impacts and dictate appropriate preventive or mitigative measures. Of most importance are:

1. Being able to predict and counter changes in riparian and aquatic habitat.
2. Assessing the impact on conjunctive wetlands, estuaries and coastal waters.
3. Predicting long-term changes in river regime.

## **E. Sediment Production Response to Land Use Change**

All of the water development and resource management agencies are concerned with the ability to adequately predict the change in sediment production associated with changes in watershed land use.

## **F. Database Management**

With the ever increasing volume of data and the speed with which it can be communicated, data base management becomes an increasingly important problem. Consistency in managing data bases for interchange with others is probably as important a problem today as was standardization of sampling equipment in the past. Each agency should endeavor to provide web links for their sediment data.

## **G. Sediment Data Quality Assurance**

Sediment data quality assurance remains an issue that the subcommittee must address. Of most importance are:

1. Calibration of samplers (suspended, bed load)
2. Sediment lab quality assurance (see <http://sedserv.cr.usgs.gov/>)
3. Standardization of collection protocols, particularly for bed material and bed load

## **H. Sediment Related Hazards**

Under certain extreme conditions, sediment is transported in modes and rates that can have severely damaging results. Because of the rarity and extreme conditions under which they occur, it is particularly difficult to sample and monitor these phenomena. Specifically identified are:

1. Debris flows
2. Landslides
3. Bridge (or other structure) scour

## **I. Interstitial Hydraulics and Sediment Movement**

Of particular importance to the maintenance of spawning gravels and biologic habitat is the hydraulics of water movement and, hence, sediment movement between the substrate particles. The requirements for flushing and maintenance flows are dependent on these parameters.

### **III. SUBCOMMITTEE STRUCTURE AND ACTIVITIES TO ADDRESS ISSUES**

All Federal agencies with interests in sedimentation are welcome to participate in the Subcommittee on Sedimentation. Agency representatives on the subcommittee generally are managers, supervisors, or technical specialists with sufficient background to convey overall views of their agency's sediment related activities and issues and authority to commit agency resources or financial support to proposed collaborative efforts. The subcommittee members jointly provide vision, leadership, and general guidance on sediment issues of interest to participating agencies. The Sedimentation Subcommittee provides a vehicle for Federal agencies to share information on technical issues that are being addressed individually by the participating agencies. In addition, a number of the technical issues facing Federal agencies in the area of sediment are being addressed through jointly conducted projects, or by workgroups convened to coordinate the development and standardization of technical procedures and data bases. The sharing of information and the jointly conducted investigations contribute to avoiding duplication of efforts by the agencies. The major technical and coordination activities include:

#### **A. Technical Activities**

Federal agencies have been striving, for several decades, to develop and use standard equipment in the collection of sediment samples. The need for improved samplers, and other equipment related to measurement of morphologic parameters, still exists. In addition, concerns about accessibility and use of available data, the adoption of standardized procedures as well as standardized equipment in the collection of data, and the need for sampling environmental parameters related to sediment transport or sediment deposition are also goals of the Subcommittee. There is also a need to develop and test innovative samplers, procedures, and sampling strategies in natural stream systems to meet current and future needs.

##### **1. Equipment/Technical Procedures**

###### **a. Technical Committee/FISP**

The Federal Interagency Sedimentation Project (FISP) has been in existence for over 50 years. It is important that the FISP be an independent project responsible to and responsive to the participating Federal agencies. Consequently, the activities of the FISP have been directed by a Technical Committee, a working group of the Federal Interagency Subcommittee on Sedimentation. Membership on the Technical Committee has been restricted to those Federal agencies that make fiscal contributions to the project activities. Technical Committee membership consists mainly of technical specialists from the contributing agencies working under the general advice and guidance of the Subcommittee on Sedimentation. The Technical Committee meets semi-annually to review progress on the research and development activities and to set priorities for future activities.

The FISP was originally created to standardize sediment sampling equipment and procedures to insure the accuracy of data collected and reported by the various Federal agencies active in the water resources arena. The FISP has been most successful in meeting that intended purpose and in providing equipment and repairs to the participating agencies at a reasonable cost. The current emphasis of FISP remains much the same with the addition of marketing their products. Changes in the mission of participating agencies, shifts in public perceptions, and budget constraints alter priorities resulting in a continual need to reevaluate the FISP program and reorientate activities to be more responsive to the needs of all Federal agencies. In 1993 the Technical Committee

proposed the following changes in the structure of the FISP and alternative methods of prioritizing and accomplishing project work. These recommendations are remain viable considerations.

Because of the wide range of types of equipment needs, it is unlikely that the Project staff will have the breadth of experience needed to effectively conduct the development of all future equipment. Contracting with individual agencies or private organizations will probably be more common in the future than in the past requiring Project staff to emphasize the role of coordinating and reviewing the results of equipment and methods development projects. Likewise, the varying priorities of the different agencies must be accommodated more effectively than in the past. Member agencies should cooperatively fund and conduct those projects for which they have the greatest need and/or expertise.

The future FISP level of function and staffing will be dependent upon the level of funding available from the participating agencies and whether or not some of the research and development activities are done by contract. Ideally the Project would be able to:

- Provide research and development for standardized equipment and methods
- Investigate new technologies for potential application
- Provide calibration for equipment
- Procure equipment from vendors and manufacturers
- Market equipment
- Develop computer software

Current FISP staff capabilities and funding is not adequate to support both innovative research and development of sediment-related software.

In 1994, the FISP was relocated to the Corps of Engineers Waterways Experiment Station (WES). This relocation resulted in a significant cost savings to the Project due to reduced space costs and access to the wide range of laboratory and shop facilities at WES. The administrative costs were also reduced due to the use of existing WES staff on a less than full time basis for some functions. The WES location met all the requirements for research and development work as well as calibration and repair. Relocation of FISP to the USGS Hydraulic Instrumentation Facility in Bay St-Louis, Mississippi is now being proposed to the Subcommittee.

A Memorandum of Understanding has been established which commits the participating agencies to some base level of support. Activities beyond the calibration, procurement, marketing, and a minimal R&D program are selected and prioritized based upon proposals to address special needs submitted by participating agencies. The initiating agency is required to submit a project plan to the Technical Committee by circulating the plan prior to the meeting. Each plan should include:

- Purpose of activity
- Deliverable(s)
- Schedule
- Estimated cost
- Cost sharing, if appropriate
- Staff time commitment

At the meeting action is taken by the Committee as to approving the proposal, setting a priority, and establishing a schedule. A proposed action would require a financing plan that would inherently effect the prioritization process. The Technical Committee envisions that the FISP budget would be established as a combination of base funding and additional financial support from

approved action plans. The Technical Committee may ask general guidance and financial support from the Subcommittee before the plan of action is finalized.

Based upon the issues identified earlier, several equipment and/or standardized procedures are needed to adequately address those issues:

- Continued development of equipment and methods for measuring suspended sediment concentrations including temporally and spatially integrating the measurements for flows with both high and low concentrations.
- Equipment and methods for determining in-situ particle size analyses of suspended sediment.
- Equipment and methods for making in-situ measurements including density variation with depth, shear strength, gradation, and chemical composition of deposited sediment.
- Improved equipment and methods for core recovery from sediment deposits.
- Laboratory equipment and methods for measuring sediment shear strength.
- Improved techniques for measurement of bedload movement of large sandbed streams.
- Improved sampler for collecting bedload samples in coarse bed streams.
- Automatic continuous bedload sampler for coarse bed streams.
- Improved bed material sampler for coarse material particularly in deep water.
- Development of samplers (suspended, bed material, bedload) which will not contaminate samples when looking for metals, organics, and volatiles.
- Equipment and methods for in-situ measurements of adsorbed salt and other contaminants.
- Develop standardized sediment databases with quality control.
- Develop standardized software for processing sediment data.
- Develop a reliable, simple, inexpensive scour meter to determine the depth of scour at piers and abutments during floods.
- Investigate hybrid modeling/sampling techniques to extend limited data sets.

## 2. Standards

A major objective of the Sedimentation Subcommittee is to promote standardization of equipment and technical procedures related to sediment data collection and interpretation. Development of standardized sampling and related equipment is the principal objective of the FISP. Other areas of standardization promoted by the Subcommittee concern procedures for sampling and monitoring of suspended sediment and bedload, measurement of deposition in water bodies, quality assurance, and numerical modeling of sediment and related characteristics.

### a. Monitoring

#### (1) Parameters To Be Sampled:

- Sediment inflow
- Other sources (bank erosion, etc.)
- Sediment deposition and trap efficiency (distribution, and rate of accumulation, etc.)
- Sediment outflow

## (2) Methods

- Pre-survey preparations
  - Site selection
  - Number, characteristics, and distribution of sample points
  - Interval and network of survey
- Alternative survey methods and quality assurance for sampling the parameters required by Item (1)
- Post-survey analysis
  - Data processing and treatment
  - Data analysis
  - Data storage and data bases
  - Data reporting, presentation, and availability

## b. Major Reservoir Sedimentation Related Issues

### (1) Major Investigations

- Determination of the loss of storage capacity
- Estimation of the physical, chemical, and biological impacts of reservoir sedimentation on project operation
- Prediction of the effects of soil conservation, mitigation, and storage preservation measures
- Prediction of the effects of storage recovery measures and decommissioning
- Research needs

### (2) Numerical Modeling

- Selection of models
- Calibration
- Verification
- Interpretation

### (3) Physical Models

### (4) Uncertainties, limitations, and future directions

## 3. Data Base/Software

### a. Workgroup

A work group will be formed to coordinate data exchange, the development of standardized data bases, the application of quality control procedures, and the development of standardized software for processing sediment data.

In the past the Subcommittee has coordinated input for the long-term monitoring of sedimentation in reservoirs. This has included the development of standard data forms and coordination of their submission to one agency for compilation. In addition to the compilation of the forms, there has been a series of resulting "Five Year Summary of Reservoir Sedimentation". The Natural Resources Conservation Service had a professional at the Texas Agricultural Experiment Station update the associated data base. Currently a US Geological Survey researcher is expanding the data base and working toward establishing and maintaining the data base on a web site.

One function of the work group will be to coordinate the development and access to data bases similar to the reservoir sedimentation one. With time, it is anticipated that there will be less need for exchange of printed data, but an increasing need for electronic transfer of data in a form that can be used by Geographic Information Systems (GIS). The data will include not only numerical results, but also graphic data which can be in vector and raster formats. Large maps can be scanned into a raster format, which can be called up on a computer screen and used alone or as a base layer for superimposed other data. The work group can assist in the coordination of the data exchange.

#### 4. Environmental

Historically the sedimentation subcommittee has been mainly concerned with the physical problems associated with sediment transport, i.e., reservoir sedimentation, loss of fertility, or damage to structures or systems caused by erosion or deposition. As water resources become more developed, as society asks for existing water resource projects to be operated for purposes not considered when they were designed (recreation, pollution dilution, aesthetics, maintenance of fisheries or other habitat) and as the demand for cleaner water resources increases the emphasis in data collection is shifting from physical quantities (sediment yield, erosion/ sedimentation rates) to chemical and biological quantities (TMDL's, fluxes of chemicals attached to sediments, reservoirs contamination, distribution of sediment as it relates to habitat, aesthetic qualities of the water and riparian area). This change in emphasis requires new equipment for measurement and methods of analysis.

The dominant percentage of work performed by the Federal Interagency Sediment Project (FISP) for the past few years has been associated with supplying sediment samplers. Some work remains to be done, completion of the large XD-99 sampler and possibly a 1-liter bag sampler should fill the need for water quality samplers. Essentially all sediment samplers developed since 1947 had to be re-designed so that they did not distort the chemical or biological properties of the sediment they sample. In addition, as the purpose of sediment investigations change from quantifying the amount of sediment delivered or rates of deposition/erosion to quantifying or characterizing the distribution and quality of sediment, both in storage and in transport, the methods of analysis must be modified. For example past investigations were generally more interested in sediments of the sand size class while future investigations are likely to concentrate on the silt/clay size classes or the gravel sizes. There needs to be strong coordination among agencies as each struggle to provide these new procedures and methods of analysis to insure a minimum duplication of effort and to share limited resources.

#### **B. Communication/Coordination Activities**

To help accomplish the Sedimentation Subcommittee's goal of disseminating and sharing information among the Federal agencies and with State, local, and private entities, the Subcommittee allocates time during each of its regular meetings to allow participating agencies to describe new programs, sponsors conferences and workshops, and publishes information on the general activities being conducted by the participating agencies. The communication and coordination activities include:

##### 1. Sedimentation Conference

The Subcommittee sponsors, on a 5-year basis, a Sedimentation conference (“Conference”) that draws attendees from around the world. The conference requires considerable planning and coordination of effort by the staffs of participating agencies as well as by Subcommittee members. Activities required to convene and conduct this conference include:

a. Initial Planning Committee (IPC). The IPC has the responsibilities of:

- Determining dates of the Conference
- Selecting sites--city and hotel

This committee will cease to function after it completes its assignments above.

b. General Committee. The responsibilities of the General Committee are:

- Overall planning and scheduling the Conference
- Coordinating the Technical and Operation Programs
- Developing and managing opening session
- Inviting keynote speaker(s)
- Approving conference budget

c. Technical Program Committee(TPC). The responsibilities of the TPC are:

- Determining central theme
- Developing preliminary issues and topics
- Preparing Call for Papers and other Conference announcements
- Reviewing abstracts
- Developing technical programs
- Reviewing Papers
- Preparing conference proceedings
- Scheduling and managing conference sessions and programs
- Planning and managing technical tours

d. Operational Committee. The responsibilities of the Operating Committee are:

- Developing Conference budget and accounting procedures
- Opening a special bank account
- Collecting all Conference fees
- Paying all Conference bills
- Maintaining all Conference financial records
- Developing registration procedures
- Managing registration
- Printing and distributing Call for Papers, announcements, and proceedings
- Developing and managing non-technical programs (receptions, spouse programs, etc.) and tours
- Planning and managing Conference exhibit program

## 2. Notes on Sedimentation Activities

The need for disseminating current information on activities in the field of sedimentation was proposed by the Chairman of the Federal Interagency River Basin Committee's Subcommittee on Sedimentation shortly after it was formed in May 1946. On September 17, 1946, the members approved this proposal and agreed to the issuance of a quarterly report as one means of effecting better coordination in the work of various Federal agencies in the field of sedimentation.

Quarterly reports were issued during the period of July 1, 1946 through June 30, 1947, when the reporting period was changed to a 6-month period, and semiannual reports were issued through 1953. Starting in 1954 and continuing through 1992, these reports have been made annually and cover the activities of the federal agencies in the field of sedimentation on a calendar-year basis. Notes on Sediment Activities is a digest of information furnished by Federal agencies conducting sedimentation investigations on work in progress or planned, important findings, new methods, new publications, laboratory and other research activities, and other pertinent information. The material is organized by drainage regions. There is also a section on research and other activities. The development of this report each year was a major undertaking for the participating agencies and documenting and publication of this information ceased in 1990. The Subcommittee should look into alternate ways, possibly via the computer and internet, to develop a better product that will reach more people and be more timely and useful to its users.

## 3. Sediment Deposition in Reservoirs Information

### a. Introduction

Sedimentation is an increasingly serious problem worldwide. The World Bank recently estimated that worldwide reservoir storage capacity loss from siltation alone is approximately 40 million acre-feet--slightly less than the total area of six New England states combined, covered with one-foot of sediments.

Sedimentation often has negative effects on our valuable water resources development projects. However, advance comprehensive project planning and careful on-site operation and management can greatly reduce these effects.

In the United States, to determine the amount of sediment deposition in a reservoir two major approaches--direct field survey and indirect analytical methods--are in use today.

### b. Reservoir Sedimentation Survey

(1) Introduction. In 1934, the Soil Conservation Service (SCS) established standard procedures for measuring the accumulated volume of sediment in a reservoir, in connection with a nationwide study of reservoir sedimentation. Today, these procedures have been widely adopted by various other Federal and state agencies.

(2) Purposes. In general, the purpose of a reservoir sedimentation survey is to measure the accumulated volume of sediment in a reservoir during the period of storage record. This information is useful for:

- Incorporating the prevailing and future sedimentation impacts in engineering planning, analysis, and design, including the possibility of decommissioning.
- Periodically modifying the reservoir capacity curve to insure more efficient operation
- Preparing regional sediment production indexes
- Evaluating the cumulative impacts of erosion, resources developments, and soil conservation efforts in a watershed

### (3) Components of Reservoir Sedimentation Surveys

#### (a) Field measurements

- Initial surveys
- Soundings
- Resurveys

#### (b) Office work

- Laboratory analysis
- Data processing
- Data analysis
- Data storage
- Data presentation

#### (c) Alternative methods

(4) Data Summary. In order to promote a uniform assembly of the data, a set of data forms and instructions for compiling reservoir sedimentation data has been developed by the Subcommittee. The Forms consist of 50 items including information on characteristics of dam and reservoir, survey data, date of survey, agency conducting the survey, etc. It is anticipated that with the completion of the reservoir sedimentation data base, RESIS-II, that this form will be available on-line to facilitate incorporation into the data base.

## 4. Workshops

Ad-hoc work groups will be formed to coordinate the holding of various workshops and symposia on sediment-related subjects. These meetings are to be on more focused topics than the five year sedimentation conferences. Examples of activities of this type in recent years are the Bridge Scour Symposium, the Bilateral Workshop on Understanding Sedimentation Processes and Model Evaluation, and the Sediment Technology for the 21<sup>st</sup> Century workshop (<http://water.usgs.gov/osw/techniques/sedtech21/index.htm>).

These workshops usually will be hosted by a single agency in cooperation with the Sedimentation Subcommittee. The Subcommittee may be able to provide computer software for registration, help in publishing the proceedings, and distribution of brochures advertising the workshops.

The workshops primarily will be to foster technical information exchange among workers in subjects related to sedimentation or other missions of the parent Interagency Advisory Committee on Water Data. Registration fees will be kept to a minimum. Workshops at technical facilities with relatively access to sedimentation scientists and engineers from many agencies will be encouraged.

## 5. Meeting Program

One of the functions of the Subcommittee on Sedimentation is to foster the exchange of information among the participating agencies. It is proposed that all agencies participate by making presentations regarding program initiatives and special research that are of interest to the Subcommittee members. Such presentations would keep the Subcommittee abreast of current developments and provide a forum for feedback to the presenting agency. Each Subcommittee meeting would incorporate a single presentation of 45 minutes to 1 hour duration with an opportunity for discussion. The presenting agency will prepare a companion narrative with illustrations, if appropriate, which will be incorporated into the meeting minutes. The program will be administered by a standing work group responsible for soliciting a presentation for each meeting in which time is available.

The most beneficial interaction of the Subcommittee is to address current sediment issues in meeting discussions and develop a plan to resolve identified issues. The Subcommittee should prioritize tasks based on need, tractability, and cost. The Subcommittee should then strive to actively work, as a whole or select work groups, on the resolution of one or more of the top priority issues.

(posted on-line after minor format edits, correction of a URL, deletion of a an obsolete sentence referring to an action item to revise this plan since fall, 1999; jrgray@usgs.gov, Sept. 10, 2004)