Big Lost River 208 Assessment Procedures and Techniques

1. Conceptual Approach

Non-point source water quality problems and conflicts are identified by determining where conditions exceed the chemical, biological, and physical threshholds required to maintain the beneficial uses of water. A "no problem" situation exists when conditions are acceptable to the beneficial uses or when there are no beneficial uses to protect.

The non-point source assessment procedure uses the sum total of available scientific and human social information and data to classify the non-point source water quality problems according to the following categories:

A. The problem is occurring in the location(s), severity and cause(s) are known and reasonable control measure(s) (BMPs) can be identified.

B. The problem is occurring in the water body, but more information is needed to define the location(s), severity, cause(s), and solution(s).

C. It is not known whether the problem is occurring in the water body and more information is needed to define the location(s), severity, cause(s), and solution(s).

D. The problem is not occurring in the water body.

Each composite categorization carries its own implications. In "A", the nature, severity, location(s), and cause(s) has been identified and a corrective strategy with alternatives can be developed, evaluated, and implemented. In "B", there is reason to suspect that a problem exists, but additional inventory data is required to define the nature, severity, location(s), cause(s), and solution(s). In "C", there is insufficient evidence or information regarding the status of the problem and, as in "B", additional information is required to reach a valid conclusion. In both cases "B" and "C", inventory data requirements should be immediately defined and prioritized to assure the timely completion of the overall assessment. In "D", there is no non-point source problem and the land use and conservation practices are consistent with good water quality and, hence, nothing needs to be done.

Public involvement with the assessment procedure occurs when the riparian landowners jointly arrive at conclusions concerning the problems, conflicts, and corrective strategies with the government project personnel. Interviews are conducted in the field and in the office with each and every riparian landowners in the project area.

The assessment is completed when each non-point source water quality problem, for each management unit of water, is classified in either:

CATEGORY 1	or	CATEGORY 4
Problem Identified		No problem
Corrective Strategy Defined		

2. Development of Prioritizing System
The final step in the assessment procedure is to identify, evaluate, and prioritize non-point source water quality management activities, practices, and control programs. In every case,this can only be done by comprehensively considering the type of water resources affected, the location and number of people and types of land affected, the land uses, beneficial uses, public concerns, outside interests, political and economic pressures, etc.

In areas where non-point source water quality problems have been identified and threaten or impair present and/or future beneficial uses, corrective strategies will tend to be rehabilitative in nature. The chosen action may be structural or non-structural depending on the nature, location, severity, and cause of the problem.

In areas where potential problems will need to be carefully managed, preventative corrective strategies should be applied to all future management actions to prevent an increase in the severity of non-point source problems. This will primarily involve a detailed consideration of the location, design, construction or operation and maintenance of the proposed management action and alternatives.

In areas where no significant problems are known or likely to occur, monitoring should be conducted at time intervals which ensure that non-point source conditions do not change. These areas should be clearly identified, acknowledged, and protected because of their "natural" character. They can be incredibly useful for "baseline" type comparison studies to other more severely impacted areas.

In areas where existing information is insufficient to assess non-point source problems, inventory and monitoring plans and programs should be developed and implemented. Funding requirements can be defined using the objectives of the assessment to guide the water resource scientist in the development of reasonably detailed and comprehensive study proposals.

Finally, in areas where site specific non-point source control programs have been developed and implemented, a review and reevaluation should be conducted to determine the effectiveness of the actions and need for improvements or modifications. This can have a very significant beneficial effect on the success of non-point source control programs implemented on known problem sites.

The results of the entire assessment procedure can then be combined, generalized and presented on a "3-Step Matrix" which describes the nature, condition, and collective knowledge of all non-point source water quality problems, conflicts and corrective strategies.

The "3-Step Matrix" is used to select problem sites and strategies for a workable implementation plan and schedule for water quality improvement activities.

2. Techniques

A. Reconnaissance Survey of Channel Stability

Erosional non-point source water quality problems, namely excessive riverbank erosion, sedimentation, and excessive large organic debris, were first evaluated using a modified version of the "Stream Reach Inventory and Channel Stability Evaluation". A carefully trained interdisciplinary, interagency team of specialists from the Bureau of Land Management and Idaho Health and Welfare, Division of Environment walked and "rated" the entire 29 miles of the Big Lost River 208 study area in October 1979. The procedure was originally developed to "systematize measurements and evaluations of the resistive capacity of mountain stream channels to the detachment of bed and bank materials and to provide information about the capacity of streams to adjust and recover from potential changes in flow and/or sediment production" (USDA Forest Service, 1975).

The inventory was used to tentatively describe where the problems on the river existed and how they needed to be evaluated in more detail so as to manage and protect the beneficial uses from being threatened or impaired by ongoing land use activities and practices.

The method is based on a visual rating of 15 physical factors that yield a qualitative ranking of stream stability. The evaluation partitions a stream corridor into cross-sectional divisions of upper banks, lower banks and streambed which in turn are broken down into the significant factors affecting channel stability.

The inventory procedure consists of walking the "reach" (designated in this survey to be 1 mile in length) to be rated and filling out the standard form for each parameter. If the actual conditions observed fall between two of the categories presented on the form, an intermediate value is selected.

B. Statistical Evaluation of Water Quality Conditions in the Upper Watershed

Stream survey data and information supplied by the Challis National Forest provided the basis for identifying the nature, severity, and location of erosional non-point source problems in the upper watershed of the Big Lost River, upstream of the designated 208 study area. The surveys were conducted by Forest Service "stream teams" during the summer field seasons of 1978 and 1979. Each survey represented 1 mi. of stream including qualitative ratings for:

- the vegetative bank cover
- the bank rock content
- the bed and bottom deposition
- the amount of ungulate use

The analysis of stream survey data was accomplished using graphic statistical techniques to develop histograms of frequency distributions for each stream survey factor. Each "stream reach" was coded with an alphanumeric symbol to aid in identifying the locations of stream segments during subsequent interpretations. Frequency distributions prepared in this manner were developed and portrayed the number, severity, and locations of stream survey stations describing:

- bank cutting
- sediment deposition
- bank damage due to ungulate use
- bank vegetative cover and protection

Eighty-nine stream survey transects on eighteen watersheds in the upper Big Lost River basin were thus evaluated to determine the nature, extent, and severity of erosional non-point source water quality problems contributing to the observed conditions in the 208 project study area.

C. Reservoir Sedimentation

Reservoir sedimentation due to erosion of the river and streambanks of the Big Lost River is perhaps the most important concern to be addressed by the 208 project because of the reservoir's role in supplying irrigation water to the farmers of the Big Lost River Valley.

Reservoir sedimentation was determined by comparing the actual measured volume of water in the reservoir with the capacity of water inferred from the original 1919 capacity tables. The difference between these two values was assumed to be due to sedimentation over the 64 year life of the reservoir.

The capacity of Mackay Reservoir was measured on August 5, 1980 by an interagency team consisting of personnel from the Bureau of Land Management and the Idaho Department of Health and Welfare, Division of Environment. Reservoir capacity was measured by computing the sum of the volumes of water columns at regularly spaced depth stations along the seventeen linear transects of the reservoir. Each transect's beginning and end point was carefully located on EPA flown, large scale (1:4000), high quality, natural color aerial photos. A jet boat (29.5 ft. long Valeo Model RR Utility Boat with an Evinrude 140 HP motor) started at the shoreline of a transect and accelerated rapidly to a constant velocity. Depth soundings were taken 25 ft. from the shore and then at 10 second intervals across each transect.

The lengths of a transect and width of each station were measured photogrammetrically from the aerial photo imagery of the reservoir. Volume computations were performed on a Texas Instruments model TI desk-top calculator with printer. Depth readings were recorded to the nearest foot using a Hummingbird Tournament Model Depth Sounder manufactured by Techsonic Industries. The unit weight of sediment for the sedimentation rate computations was measured from a sample of sediment taken from the reservoir.

The long-term sedimentation rate was determined by computing the equivalent weight of sediment from the displaced volume of water over the 64 year life of the reservoir. The rate at which reservoir capacity was diminishing was derived by evaluating the change in reservoir capacity due to displacement by sediment over a period of time. The results of these analyses where presented in the report "Sedimentation in the Mackay Reservoir".

D. Aerial Photo Interpretation of Erosional and Depositional Features

Large scale, high quality, natural color, river-centered imagery of the Big Lost River was taken by the US EPA specifically for the Big Lost River 208 Water Quality Improvement Project. The aerial photo mission was conducted by Lockheed Aircraft on October 5, 1979 at a scale of 1:8000. The resulting imagery is in the form of 9" x 9" color Cibachrome prints providing stereoscopic coverage of the 208 study area. Selected photos were enlarged two times to a scale of 1:4000 for photo interpretative mapping purposes. The imagery is presently on file at the BLM Salmon District Office, Salmon, Idaho; the Soil Conservation Service District Office, Arco, Idaho; and the US Environmental Protection Agency Surveillance Division Office, Las Vegas, Nevada.

The aerial photographs were used to map the erosional and depositional features of the 208 project area because the extraordinarily high resolution of the imagery (about 6") permitted making distinctions between the various landforms and features. Ground truth field checks showed that image quality was more than adequate to assure a high level of confidence in feature identification.

The photo-interpreted features mapped from the imagery included:

Erosional Features:

- eroding cutbanks
- large bank failures
- rock and talus
- landslides

Depositional Features:

- streambank and bed deposits
- large organic debris accumulations and jams

Cultural Disturbance Features:

- road disturbances and structures
- excavations
- irrigation headings and ditches
- riprap and channel alterations
- forest fire sites

The photo interpretation and mapping procedure consisted of:

1. preparation of tentative list of features to be identified;
2. acquisition of imagery;
3. detailed photo-interpretation and mapping of features to be identified;
4. verification (ground truth of preliminary photo-interpretive mapping);
5. revision and modification of preliminary maps of features;
6. preparation of final photo-interpretive map.

Features are generally mapped to indicate the length or area affected and are classified according to the dominant process and feature which is observed on the imagery at a given site. In general, the smallest feature mapped is about 10 ft. long. Several sites contained more than one feature which were too closely spaced to be mapped and classified individually at the chosen scale of mapping.

Detailed ground investigations were used to carefully define the problem type and extent. At several sites the dominant process or feature identified from the imagery was found to actually be a complex of processes and/or features. Sometimes, more than one erosional process was found to be active and features would be forming on top of features. In the "reach" below the Sinks, cutbanks were forming in old deposits.

Most of the features mapped are semi-permanent, that is, they are not transitional and will remain where they are found for a period of several years. The erosional features, namely the cutbanks and failure, will probably remain in whatever location and state of activity they were observed in until they are naturally or artificially stabilized. The gravel deposits and large organic debris accumulations were readily transported, at least temporarily, by the periodic high flows of the river. The locations of these features pertain only to the study period of 1980-1981.

Cultural disturbance features are relatively permanent structures if they are adequately designed and constructed. The 208 project revealed, however, that ditches, irrigation headings, roads, bridges, riprap, and channel alterations were easily within reach of flows of the river and, when subjected to the tremendous erosive forces of the river, may be significantly modified.

Mapping of erosional and depositional features was conducted by an interagency team of specialists from the Bureau of Land Management, the Soil Conservation Service, and the Idaho Department of Health and Welfare, Division of Environment. Ranchers and other riparian landowners in the 208 project area participated directly in the ground truth verification of the photo-interpreted features mapped by the 208 project team.

E. River Sedimentation and Channel Changes

The 208 project showed that erosion, deposition, and all the concomitant impacts associated with these natural processes are significant on the Big Lost River. In order to truly develop quantitative understanding of the fluvial processes and the mechanics involving sediment erosion and deposition, the US Geological Survey studied the effects of stream discharge, sedimentation and hydraulic geometry on erosion, deposition, and sediment transport rates (USGS 1980).

Specifically, the elements of the work included the collection of:

1. streambank data;
2. suspended sediment;

3. bedload sediment;
4. particle size distribution of suspended and bedload samples;
5. particle size distribution of bed and bank materials;
6. channel cross-section data before and after the peak flow period;
7. reservoir sedimentation core samples for Cesium 137 radiometric data analysis for sedimentation rate determination.

Streamflow data was used to describe flow durations and flood return periods. Channel cross-sections were surveyed at some 50 locations to describe the hydraulic geometry relationships. A step-backwater analysis was used to compare the changes in the river regime over a 50 year period. Discharge, suspended sediment and bedload sediment were measured at the following five locations: North Fork Big Lost River; Big Lost River at Bartlett Point Bridge; Big Lost River at Chilly Bridge; Big Lost River at Tower Steel Bridge; Big Lost River at Goddard Bridge.

Suspended bedload transport rates and the volume of material transported was computed and related to the observed channel morphology and measured hydraulic geometry. Finally, measured bedload sedimentation rates were compared to bedload values computed by the Meyer-Peter-Muller equation using the hydraulic geometry (slope, velocity, depth, and width). The entire analysis was presented in a Water Resources Investigations/Open File Report or Water Supply Paper. Personnel on the project included a USGS hydrologist, a BLM hydrologist, and a technician from the Soil Conservation Service.