

APPENDIX E

BENEFITS EVALUATION PROCEDURES

E-1. It is expected that the majority of rehabilitation studies analyzed under this guidance will be for navigation and hydropower projects. The following steps outline basic procedures that can be used to evaluate rehabilitation for these project purposes. Deviation from these steps is encouraged when other techniques are more appropriate.

E-2. Hydropower Analysis. The conceptual basis for evaluating the benefits from energy produced by hydroelectric power plants is society's willingness to pay for these outputs.

Step 1. Determine the Energy and Capacity Values for the Project.

The energy and capacity values are based on the cost of the next best alternative. The energy value is the measure of the systems energy production cost. When there exists a demand for electric energy, adding a hydropower facility to a system instead of a thermal power source typically results in reduced system production cost. The capacity value of a hydroelectric facility reflects the greater reliability and operating flexibility of the hydropower system. The energy and capacity values are estimated using systems analysis. This analysis should only be attempted by those trained in hydroelectric benefit evaluation. Complete consideration of this technique is found in ER 1105-2-100. For small facilities, previously calculated energy and capacity values may be used. In the report *Power Benefits Forgone Due to Water Supply Withdrawals White River Basin Projects*, by North Pacific Division, dated 22 June 1990, for Area 25 the capacity value was estimated at \$117,000 per megawatt of capacity annually and the energy value was estimated at \$35.40 per megawatt hour. For the Missouri River System, in the Institute for Water Resources' report *Economic Value Functions for Missouri River System Analysis Model*, the capacity value was estimated at \$154,000 per megawatt annually and the energy value at \$18 per megawatt hour. The value used for major rehabilitation analysis should reflect conditions in the project area.

One particular issue in economic evaluation is the industry response to temporary versus permanent interruptions due to the unsatisfactory performance on individual hydropower units. The question to be answered is whether temporary losses in generating capacity will result in the electric generating industry building permanent replacement capacity. If so, there is a "capacity loss" without major rehabilitation; if not, there is no capacity restoration as a source of benefit from rehabilitation. The issue arises since the system contains some percentage of excess capacity to compensate for unplanned outages. This issue is currently the subject of research. Until procedures are established for calculating capacity losses due to unreliable performance, care should be taken in including a capacity loss avoidance as a benefit from major rehabilitation.

Step 2. For the period of analysis determine the annual capacity and annual energy outputs.

For each alternative, estimate the annual firm capacity and annual energy generation. This should reflect planned outages, plant reliability, modernization and power loss during rehabilitation or repair.

Step 3. Calculate the value of Hydropower.

This is the simple multiplication of step 1 and step 2. For each alternative, multiply the capacity value times the estimated firm capacity and the energy value times the annual energy produced.

Step 4. Calculate the average annual equivalent value (benefits).

Discount to the base year the future hydropower values using the Federal discount rate. Sum the discounted values for energy and capacity. Amortize this sum over the period of analysis using the Federal discount rate. Total annual benefits should also include benefits during construction.

Step 5. Calculate the annual cost of each alternative.

Show a schedule of cost over the period of analysis for each alternative. Discount the expenditures to the base year and amortize the present worth of the estimated cost over the period of analysis using the Federal discount rate. For each alternative these costs should include operation and maintenance, emergency repairs, interest during construction and scheduled rehabilitation.

Step 6. Compare the benefits and cost and rank the alternatives.

Provide a table showing the annual benefits, cost, benefit-to-cost ratio and the net benefits for each alternative.

Note: The treatment of capacity values and benefits when considering hydropower rehabilitation for reliability is unsettled. In general, you must be able to demonstrate that the power grid does not have sufficient flexibility to adapt to the reduced reliability of the project and that the continuation of the base condition would result in the capital investment of a thermal facility to replace the capacity lost due to unreliability. A small project will have a more difficult time satisfying this criteria than a large project.

E-3. Navigation Analysis. The basic economic benefit of a navigation project is the reduction in the value of resources (cost) required to transport commodities.

Step 1. Identify the commodities currently flowing through the waterway and those expected to flow through the waterway over the period of analysis. This should be done for each commodity, by origin and destination for all alternatives.

Step 2. Forecast the quantity of each commodity expected to pass through the waterway by year for the planning period.

Step 3. Identify the current fleet using the waterway and forecast the future fleet. Identify current and future fleet operating cost.

Step 4. Using the forecasted commodity flows and the future fleet analysis, estimate the average annual cost of transporting the forecasted flow of commodities passing through the waterway for each alternative.

Step 5. Estimate the average annual cost of transporting the forecasted flow of commodities by the least cost alternative route.

Step 6. Compute benefits. The benefits of the waterway will be equal to the transportation savings over the next best alternative.

Provide a table showing the annual benefits, cost, benefit-to-cost ratio and the net benefits for each alternative.