

U.S. ARMY CORPS OF ENGINEERS WATER MANAGEMENT FOR ENVIRONMENTAL SUSTAINABILITY

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Abstract

As one of the nation's largest water resource agencies, the U.S. Army Corps of Engineers (Corps) manages over 600 dams located throughout the United States. These dams are operated for multiple purposes such as water supply, flood control, hydropower, navigation, recreation, and others. Throughout its history, the Corps has focused on being good stewards of the environment. To reaffirm its commitment to the environment, the Corps issued a new set of Environmental Operating Principles in 2002 to guide its emphasis on improving environmental sustainability.

The Environmental Operating Principles focus on improving environmental sustainability. The Corps also operates water resource projects in accordance with numerous other laws, regulations, and other guidelines focused on the environment. These include the Endangered Species Act (ESA), the Clean Water Act (CWA), and many others. In achieving environmental sustainability, a wide variety of different approaches are used. This paper will describe a broad range of examples of these efforts to manage water resource projects across the nation in an environmentally sustainable manner.

The focus of the paper is to provide a sampling of efforts the Corps has recently been making to enhance the environment through various types of water management activities across the country. These efforts range from changing the project operations, to replacing equipment with new equipment that is more environmentally friendly. They include actions such as: (1) reallocating reservoir storage to maintain flows for fish and wildlife; (2) changing project operating criteria to improve conditions for fish and wildlife; (3) incorporating new equipment designed to improve water quality and fish survival; and other similar actions. The paper will also describe the effects of these efforts in terms of environmental restoration, hydropower generation, economic effects, and others.

INTRODUCTION

Many water resource projects across the Corps incorporate various types of operations and equipment to enhance the environment. These include minimum and maximum flow requirements, rates of change criteria, and other similar measures. In many cases, these actions have evolved over time in response to changing conditions. However, the operation of many of these projects and the environmental measures were not initially planned and implemented based on a systems, or watershed approach.

As the demands placed on these water resource projects have increased over time, it has led to the use of a more integrated approach to planning and operation. Enactment of environmental

legislation such as the Endangered Species Act, Clean Water Act, and various other Federal, State, and local requirements has contributed to this requirement to use a more integrated approach to incorporate the needs of the all users of these water resources. The intent of the Environmental Operating Principles is to provide a signpost of awareness and commitment to the nation's environmental laws.

ENVIRONMENTAL OPERATING PRINCIPLES

The Environmental Operating Principles provide a roadmap for all Corps functional areas to follow in ensuring that the effects of their activities upon the environment are included in the decision process at the earliest possible time. They recognize that our survival depends upon sustained and balanced ecosystems. They also illuminate ways in which our missions integrate with environmental laws, values, and sound environmental practices. The seven Environmental Operating Principles are:

1. Strive to achieve Environmental Sustainability
2. Recognize the interdependence of life and the physical environment.
3. Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.
4. Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.
5. Seek ways and means to assess and mitigate cumulative impacts to the environment: bring systems approaches to the full life cycle of our process and work.
6. Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work.
7. Respect the views of individuals and groups interested in Corps activities; listen to them actively and learn from their perspective in the search to find innovative win-win solutions to the Nation's problems that also protect and enhance the environment.

EXAMPLES OF WATER MANAGEMENT ACTIVITIES IN SUPPORT OF ENVIRONMENTAL OPERATING PRINCIPLES

There are numerous examples of water management activities across the Corps that support the Environmental Operating Principles. This paper will provide a number of examples that illustrate some of the efforts the Corps has been making to enhance the environment. These activities span a broad range, including planning and assessment of proposed changes, implementation of operational changes, incorporation of equipment changes, and enhanced monitoring, analysis, and dissemination of environmental conditions. In many cases, the overall intent of these actions is to return rivers to more natural conditions.

Because of the multi-purpose aspects of most Corps reservoirs, the actions taken for environmental purposes have to be balanced with the operations for other project purposes. As described in Environmental Operating Principle #3, the goal is to seek balance and synergy among human development activities and natural systems by designing economic and

environmental solutions that support and reinforce one another. Given the differences in operational requirements for the many project purposes such as navigation, flood control, hydroelectric power generation, recreation, water supply, and others, seeking this balance and synergy can be a very challenging proposition.

In describing the examples of water management activities across the country that support the Environmental Operating Principles, the activities have been organized into four broad categories. These are: (1) planning and assessments of proposed changes; (2) implementation of operational changes; (3) incorporation of equipment changes; and (4) enhanced monitoring, analysis, and dissemination of environmental data.

Planning and Assessments of Proposed Changes to Water Management Activities

There are numerous examples of planning and assessment activities for proposed changes to water management activities to improve environmental conditions across the Corps. Examples include the Sustainable Rivers Initiative established with the Nature Conservancy in 2002, many comprehensive river basin studies, environmental restoration studies, and other similar activities. While these activities can fall under several of the Environmental Operating Principles, they are most closely aligned with Environmental Operating Principle #5 (Seeking ways and means to assess and mitigate cumulative impacts to the environment; bring systems approaches to the full life cycle of our process and work.).

Examples of comprehensive river basin studies with an environmental emphasis include: (1) the Columbia River System Operation Review; (2) the studies related to the development of the new Missouri River Water Control Master Manual; (3) the Comprehensive Everglades Restoration Plan; (4) the Lower Snake River Juvenile Salmon Migration Feasibility Study; and many others. As evidenced by the large budgets and multi-year schedules associated with these studies, planning and assessing these types of changes is a major undertaking. Because they involve multi-purpose projects, these studies and assessments usually involve an evaluation of many different alternatives and their effects on different project purposes.

A major component of these comprehensive studies is the extensive coordination and communication done to ensure that stakeholders are involved in these processes. For example, in the Lower Snake River Juvenile Salmon Migration Feasibility Study, a total of over 230,000 comments were received and 225 public meetings were held during the study process (Conway, 2002). This is a good example of Environmental Operating Principle #7 (Respect the views of individuals and groups interested in Corps activities; listen to them actively and learn from their perspective in the search to find innovative win-win solutions to the Nation's problems that also protect and enhance the environment.) In many cases, the process of communicating with others in these studies and assessments has resulted in new alternatives for water management that are more aligned with environmental requirements, while at the same time meeting other objectives.

Another very good example in this category is the partnership the Corps recently entered into with The Nature Conservancy to explore mutually agreeable solutions to environmental issues. As a part of this partnership, the Sustainable Rivers Initiative was established in 2002 (Peavey, 2002). Under this initiative, the two organizations have agreed to work together to improve dam operations, helping to restore and protect the health of rivers and surrounding natural areas, while

continuing to meet human needs for services such as flood control, power generation, and others. The specific rivers and dams are shown below:

- White/Black/Little Red Rivers, Beaver/Table Rock/Bull Shoals/Norfolk/Greers Ferry/Clearwater Dams, Corps Little Rock District
- Green River, Green River Dam, Corps Louisville District
- Bill Williams River, Alamo Dam, Corps Los Angeles District
- Ashuelot River, Surry Mountain Dam, Corps New England District
- French Creek River, Union City/Woodcock Dams, Corps Pittsburgh District
- Roanoke River, John H. Kerr Dam, Corps Wilmington District
- Skagit River, Gorge/Diablo/Ross Dams, Corps Seattle District
- Willamette River, Numerous Dams, Corps Portland District

The Sustainable Rivers Initiative is just one example of many collaborative efforts taking place across the country where the views of key stakeholders are being incorporated in the process of planning and implementing changes to water management activities. Although the Sustainable Rivers Initiative is a relatively recent program, there have already been a number of success stories associated with it. For example, at the Green River Dam in the Louisville District, modifications to the dam operation are being evaluated on a trial basis to identify potential environmental benefits, as well as potential impacts. On the White River system in the Little Rock District, evaluations have been made on reallocating reservoir storage to provide water to meet minimum flow objectives.

Implementation of Operational Changes at Corps Water Resource Projects

Another example of an environmental initiative that has involved Corps water management activities is various types of operational changes being made at projects across the country. These changes are aligned with Environmental Operating Principle #4 (Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems), and are being made in response to a number of environmental requirements. These include the Endangered Species Act, the Clean Water Act, and other Federal, State, and local legislation.

At numerous locations across the country, the Corps is changing project operations, replacing and/or modifying equipment, and undertaking other activities to improve conditions for threatened or endangered species. Some of the more extensive examples of this are located in the Pacific Northwest where activities are being undertaken for many species of threatened or endangered salmon, steelhead, bull trout, and others. Examples of water management operational changes being taken in response to these situations include:

- Spilling water over spillways of dams on projects on the mainstem of the Columbia and Snake River during juvenile salmon and steelhead migration periods to enhance fish passage success.
- Reservoir drawdowns during spring and summer months to provide flow augmentation and improved conditions for endangered and threatened species.
- Adjustment of reservoir releases throughout the year to provide better flow conditions

Recent fish passage data indicate that these actions may be having a positive effect on the populations of many of these species. For example, in 2002, returning numbers of adult fish were far greater than observed in the past ten years averaged together (DeHart, 2002). At the same time, these types of actions have other effects such as reduced power generation, reduced recreation on lakes, and other similar effects.

Another example is the actions being taken on several river systems to improve conditions for the endangered Interior Least Tern and other species. These river systems include the Missouri, Arkansas, Red, and Mississippi Rivers. Islands, sandbars, and other habitat formed in these river systems provide critical bird nesting areas. Specific releases are made from upstream reservoirs in an attempt to maintain conditions required for these species. In order to take a more integrated and consistent approach across all of these river systems, a Regional Management Strategy for the Interior Least Tern was recently developed between the Corps Mississippi Valley Division, Northwestern Division, South Pacific Division, and Southwestern Division. In taking an inter-regional approach, the goal is to meet the recovery goals for this species, while at the same time potentially achieving more operational flexibility across these river systems.

Many other examples of these types of actions can be found across the country. In an effort to improve overall conditions for fish and wildlife in rivers downstream of many Corps lakes, various types of rules are set on minimum releases, maximum releases, and rates of change in releases. In many lakes across the Corps, thermal stratification can result in very low dissolved oxygen levels during the summer and fall in lower levels of the lakes where water is withdrawn for hydropower and other releases. In response to these situations, releases are often restricted to minimize the impact to the environment in rivers downstream of these lakes. Operational changes are also made to meet various types of water temperature and flow objectives.

As a final example, in the Columbia River Basin, a Technical Management Team was formed several years ago to make collaborative decisions on water management operations. This team consists of numerous stakeholders such as the National Marine Fisheries Service, U.S. Fish and Wildlife Service, Environmental Protection Agency, environmental agencies from Oregon and Washington, and many others. This team meets weekly to assess river, environmental, power, and other conditions, and makes operational decisions based on this information. There are many other similar examples across the Corps. This is a good example of Environmental Operating Principle #7 (Respect the views of individuals and groups interested in Corps activities; listen to them actively and learn from their perspective in the search to find innovative win-win solutions to the Nation's problems that also protect and enhance the environment) being implemented in water management.

Incorporation of Equipment Changes at Corps Water Resource Projects

A wide range of equipment changes associated with water management activities have been made at Corps projects to help improve environmental conditions. These changes can help meet environmental objectives such as improved water quality, better fish passage, increased ability to meet flow objectives, and others. In addition to these equipment changes, some new projects are being built specifically to restore the environment.

Many equipment changes are being incorporated as part of the upgrading program for other equipment at projects. For example, as turbines are replaced in hydroelectric plants, new technology turbines are being installed to improve water quality and conditions for fish passage. In the Columbia River System, new technology "fish friendly" turbine designs are being installed and tested at projects such as Bonneville Dam and others as older equipment is being replaced. These are designed to provide very efficient power production, while at the same time improving passage conditions for juvenile salmon and steelhead migrating downstream. In addition, Removable Spillway Weirs and other devices are being installed.

In projects at many river systems in the Southwest and South Central U.S., new "auto-venting" and aerating turbines are being installed as equipment is replaced to improve dissolved oxygen levels in powerhouse releases. For example, at the J. Strom Thurmond project in the Savannah District, new technology aerating turbines are currently being installed. These turbines will aerate water used in power generation to improve the ability to meet dissolved oxygen objectives (Vann, 2002). Existing turbines are also being modified with improved venting capabilities to improve oxygen levels in project releases.

Other equipment to enhance environmental conditions is being added independent of other activities. Examples include multi-level water intakes for better temperature control, oxygen injection systems and downstream weirs for better control of dissolved oxygen levels, fish bypass facilities, and many others. For example, at the Cougar, Blue River, and Lost Creek projects in the Pacific Northwest, new multi-level intakes have been, or are being installed to allow better control of water temperatures for fish species in downstream reaches (Helwig, 2003). At many projects in the Southwest and South Central U.S., various forms of oxygen injection systems, downstream weirs, and other equipment are being used for better control of dissolved oxygen levels.

In some of the most extensive forms of equipment changes for the environment, evaluations have been made on the potential removal of several large dams. For example, in 2002, the Corps concluded a seven-year, \$29 million study of the removal of the four lower Snake River Dams. The purpose of the proposed dam removal was to improve conditions for the passage of endangered salmon and steelhead species in the Snake River. The study concluded that the preferred alternative to dam removal was another alternate consisting of major system improvements including changes in equipment and operations.

Not only are equipment changes being made to restore the environment, but several entirely new projects are being built as well. As an example, the Davis Pond Freshwater Diversion Project on the Mississippi River in the New Orleans District was dedicated in 2002 (Hall, 2002). This \$119.6 million project is the world's largest freshwater diversion project, and will reintroduce fresh water, nutrients, and sediment to the salt-threatened Barataria estuary, which stretches south to the Gulf of Mexico. The project will divert up to 10,650 cfs through a two-mile channel to preserve 33,000 acres of marsh and benefit up to 777,000 acres of marshes and bays. The Caernarvon Project, opened in 1991, is a similar project that is downstream from this project, and can divert up to 8,000 cfs into another marsh area.

Enhanced Monitoring, Analysis, and Dissemination of Environmental Data

Another water management activity that is aligned with Environmental Operating Principle #6 (Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and impacts of our work) and others, is enhanced monitoring, analysis, and dissemination of key environmental information. Because of increased environmental requirements such as the Clean Water Act, Endangered Species Act, and others, there has been an extensive expansion of the number and locations of water quality and environmental monitoring equipment in many regions of the country. There has also been much more extensive analysis and utilization of the data collected in these monitoring programs. Various forms of regional databases and computer models are increasingly used to store and analyze all of this data. Finally, there has been a significant increase in the dissemination of this data and information through websites, newsletters, and various other forms of distribution.

In many regions, additional water quality and environmental monitoring equipment has been installed to more closely monitor various types of parameters. For example, at projects on the White River system in Arkansas and Missouri, dissolved oxygen monitoring stations have been added in lakes as well as downstream locations to better track dissolved oxygen levels. This information is widely disseminated to others using websites, and other methods. The White River is a Blue Ribbon trout fishery, and the recreational fishing industry is a major component of the regional economy. Similar examples can be found in many other river systems throughout the Corps.

Another example is the Columbia River system in the Pacific Northwest. Increased spill for enhancing juvenile salmon and steelhead migration can result in high dissolved gas levels. As a result, an extensive network of water quality monitoring stations has been installed throughout the system to provide additional information for water management decision makers.

CONCLUSIONS

As described in this paper, the Corps is taking many water management actions across the country in support of environmental sustainability. Water managers have always had to balance the needs of many competing interests for scarce water resources. As the demands for these resources have increased, the challenge becomes even greater. There are many different approaches that can be taken to meeting these challenges. This paper has provided examples of some of these, including planning and assessment studies, operational and equipment changes, and enhanced monitoring, analysis, and assessment of environmental data.

The Environmental Operating Principles provide a very good framework to build around in planning and implementing more environmentally sustainable water management actions across the country. Collaborative efforts and partnerships with groups such as The Nature Conservancy and others provide opportunities to utilize the expertise of others and work together to help restore and protect the health of rivers while continuing to meet other project purposes.

REFERENCES

- Conway, N. (2002). "Corps completes lower Snake River study on improving fish passage." U.S. Army Corps of Engineers, Walla Walla District News Release, http://www.nww.usace.army.mil/html/offices/pa/NR/NR02_files/02-42.pdf.
- DeHart, M. (2002). *Fish Passage Center 2002 Annual Report*, Fish Passage Center, Portland, OR, xvii.
- Hall, J. (2002). "Water Flows Through Davis Pond." U.S. Army Corps of Engineers News Release, <http://www.hq.usace.army.mil/cepa/davispondrelease.html>.
- Helwig, H. (2003). "Resource stewardship helps Corps protect Nation's waters, environment." *The Corps Environment*, Vol. 4, No. 1, 1.
- Peavey, J. (2002). "The Nature Conservancy and U.S. Army Corps of Engineers Announce Partnership to Improve Management of U.S. Rivers." The Nature Conservancy News Release, <http://nature.org/pressroom/press/press705.html>.
- Vann, B. (2002). "Corps first aerated turbine installed at Thurmond Power Plant." *Thurmond Lake Times Winter 2002 Edition*, Savannah, GA,