Otter River Partnership and Project

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Abstract

In 1999, an unusual partnership approach to river rehabilitation was instituted on Michigan's Otter River. Three organizations: the Michigan Civilian Conservation Corps, the Michigan Department of Natural Resources and Michigan Technological University came together to work jointly on improving the Otter River's fish habitat and reducing sediment loads to the stream. Many of the rehabilitation sites were inaccessible to vehicles and required hand labor solutions. All of the Project Managers on the project were graduate students in Civil and Environmental Engineering Department. This paper describes the partnership and the project. It was found that the partnerships worked well in this type of work because the expertise, work force and technical knowledge needed were all available through the different groups.

Introduction

A river rehabilitation project integrating several organizations was begun on the Otter River, Michigan, in 1999. Three major groups were involved in the project: the Michigan Civilian Conservation Corps (MCCC), the Michigan Department of Natural Resources (MDNR), and Michigan Technological University (Michigan Tech). Specific project duties were assumed by each of the organizations. The MCCC provided the labor force, the MDNR provided the initial surveys, project monitoring and permitting expertise, as well as the heavy equipment and operators, and Michigan Tech identified necessary rehabilitation work while acting as overall project manager. Coordination between the organizations was significant. The project goal was to rehabilitate the river while providing an educational aspect for the MCCC members.

The main situation requiring remediation on the Otter River was an overburden of sediment load on the riverbed. The excess sediment was adversely affecting fish survival by covering the gravel necessary for spawning and invertebrate habitat. MDNR monitoring revealed an alarming decrease in fish populations despite an aggressive stocking program. Fish monitoring studies showed that a stable trout population was not being maintained in the river, and it became apparent that river rehabilitation was necessary.

In 1999, the partnership between Michigan Tech, MCCC and MDNR was begun on bases of a 2-year research project that was awarded to Michigan Tech's Civil & Environmental Engineering department by the MDNR. The goal of the project was to enhance the river habitat while educating MCCC members and the public about river enhancement/rehabilitation procedures. Michigan Tech's duties in the rehabilitation were to identify unhealthy areas, develop rehabilitation work plans, implement a series of educational programs for MCCC participants, and manage the project work The MCCC was responsibility to provide an adequate workforce to the project. In addition to funding the project the MDNR through the Fisheries Division provided technical data about the watershed. The general public provided additional input and support. The organization of the project is shown in Figure 1. The project was begun in the summer of 1999 and continued through the summer of 2000, at which time the project was extended for two additional years. Without this partnership the project would not have been implemented because of lack of funding and staff.

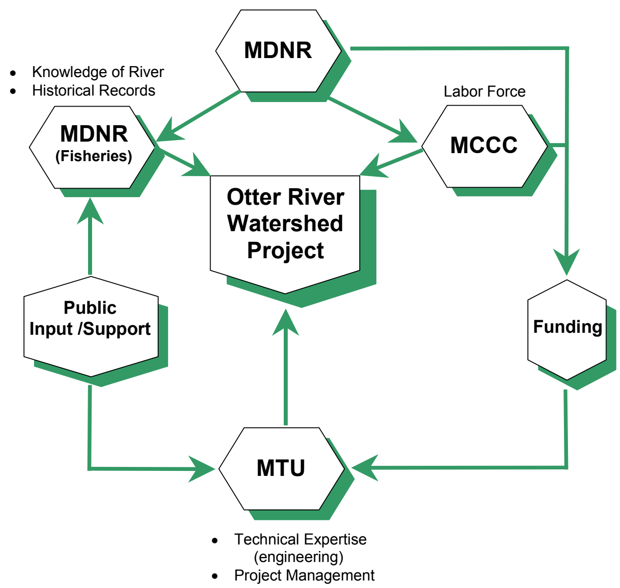

Figure 1. Organization of the Otter River Watershed Project.

Watershed description

The Otter River watershed is a remote, rural watershed in Michigan's Upper Peninsula with a watershed area of 464 km^2 (179 mi^2). The majority of the watershed (95.5%) is contained in Houghton county, with 2.7% in Baraga county, and 1.8% in Ontonagon county. The river consists of three major branches: the North Branch, the West Branch and the Main Branch. The North and West Branches meet, and flow together as the Main Branch before entering Otter Lake.

In contrast to much of the United States, population within Houghton county reached a peak of 88,098 in 1910, and has since decreased to 35,446.[1] Population during the 1990 census in the watershed area was approximately 6265 persons based on population density by area.[1] In actuality, population in the watershed is probably lower since there are no towns within the watershed, and the population density assumes an even population distribution based on total county area. Land use in the watershed is 87% forested, 9% agriculture, and the remaining 4% is a mixture of lakes and wetlands.

The Otter River was historically a first-class fishing river, supporting large populations of resident grayling and trout, as well as huge spawning runs of steelhead, salmon, burbot and walleye. It is known for its cool, consistent flows and ability to sustain large trout. The North Branch of the Otter River was once the site of a fish hatchery and also was the last river in Michigan to hold native grayling.

Physical Characteristics

Sediments in the river have been a constant problem. MDNR Fisheries reports dating to 1954 document bank erosion, sand bedload, and sediment runoff.[2] From the earliest records, concerned residents have been contacting the MDNR Fisheries office about decreasing fish populations and an increasing layer of sediment on the riverbed that has been covering gravel beds and filling in the pools. Topics of concern were lowered fish populations, reduced spawning runs and sediment accumulations in Otter Lake. A 1954 Watershed Reconnaissance Survey by the MDNR predecessor, the Michigan Department of Conservation (MDC) attributed the excess sediment load to a combination of logging practices, improperly designed road crossings, and natural erosional processes, with meander bank erosion contributing the greatest sediment volume.[2] The 1954 survey also noted that the lower Main Branch had sediment filling its pools, causing a uniformly distributed flow rather than pool-riffle sequences.

In 1996, the MDNR conducted a physical survey of the river by traversing each of the main branches and many of the tributaries. The comprehensive river survey took several hundred person-hours, and revealed the presence of 243 large, eroding, meander banks throughout the river system, and an estimated 417,655 cubic meters (546,272 cubic yards) of bed sediment in the 11 river kilometers (7 river miles) upstream from the weir.[3]

Unique Characteristics of the Otter River Project

Many of the Otter River watershed lands are publicly owned as State and Federal forests; these areas are mainly on the West Branch, while the North Branch is mostly under private ownership. The MCCC, as part of their public service commitment, are only permitted to work on public lands. For this reason, the majority of the rehabilitation work was done on the West Branch.

The West Branch of the Otter River is a remote watershed, with few road crossings and minimal vehicle access along much of the river. To work on many of the eroding banks, it was necessary to pack equipment and materials in by hand or boat. Because of the remoteness of the river, the majority of the rehabilitation work was done by hand labor, using chainsaws, hand winches and prybars. The hand labor and remote location made several common rehabilitation techniques infeasible. Carrying in stabilizing rock was too labor-intensive, as was digging down to the armoring layer at every location. In areas where imported materials such as geotextiles and skyhook deflectors were needed, these materials were transported up or downstream by jonboat.

Strategies and Solutions

The decision was made to stabilize the slope bases with rock rip-rap and tree-drop deflectors, and use geotextiles in combination with vegetative material on the upper slopes. Eroding slopes were stabilized with three steps: 1) the toe was stabilized with riprap or tree-drop deflectors, 2) geotextile was placed on the bare hillside above the toe, and 3) the hillside was seeded with grasses and planted with conifers

Tree-drop deflectors, consist of 2-meter to 4-meter long logs that are wired together against the unstable bank and anchored to the streambed with cables. Brush bundles are then fastened behind the tree-drop deflectors; these bundles help to reconstruct the bank by catching sediments when the deflector is overtopped by water. [4] An advantage of the deflectors is that the underwater logs are large woody debris (LWD) and offer advantages in habitat structure for aquatic invertebrates[5] as well as for fish[6]. The bank structures used had three purposes: to protect the banks from river scouring at mean flow, to constrict the river channel at mean flow and to provide cover for the fish. The purpose of protecting the banks was to remove a ready sediment source from the river. By constricting the flow, the river’s hydraulic energy was increased, and a greater point sediment carrying capacity realized, exposing gravel in impacted spawning sites. Cover was provided by the design of the structures. Only dead trees (both standing and recent windfalls) were used for the deflectors, and these were taken from within 30 meters (100 ft) of the river’s edge.

Skyhook deflectors were used in heavy equipment-accessible locations. The skyhook deflector is a bank structure that serves the dual purpose of providing cover while deflecting the current. Named by Hunt in 1993, the skyhook structure is designed to improve trout habitat in wide, shallow streams with little natural cover. [7] The design is basically a “T” shape, with one limb anchored into the bank, and the other extending over the water and forming the cover. The entire structure is then covered with riprap and soil, and seeded. Several skyhook deflectors can be placed end-to-end to form a continuous structure.

Natural vegetation and geotextiles were used for further stabilization on the slopes above the stabilized toe. There are two reasons for doing this: the tree-drop deflectors are not permanent, and will degrade over time, and vegetated slopes release less sediment as washload during rainstorms. In order to maintain a barrier at the bases of the slopes, grasses and conifers were planted in accordance with the USDA Streambank Protection guidelines.[8] These were placed in and among the tree-drop deflectors, as well as along the slope. The goal was to have naturally vegetated stream barriers growing at the slope bases and on the slopes by the end of the five-year project.

Educational component

A strong educational component was present in the rehabilitation effort. Several seminars on hydrology, project management, and rehabilitation procedures were given to MCCC workers by Michigan Tech professors and graduate students, and much of the river work required knowledge of surveying, monitoring and data recording. Field courses on surveying and GPS navigation were given to the workers, and crewmembers were involved in fish monitoring studies. In addition, the MCCC contract guarantees an educational scholarship to workers after completion of a specified amount of work-hours. Several of the former MCCC river workers have enrolled in college, many in natural resources and forestry curriculums.

Graduate Student Experience

Three Masters students from the Department of Civil and Environmental Engineering worked on the project over a span of four years. The graduate students working as project manager were able to realize several important opportunities. While functioning as project manager, the Michigan Tech graduate students were placed in a position of authority and responsibility not typically found at this experience level. Once employed as an engineer, it is usually several years before this type of responsibility is placed upon an entry-level engineer. It was also a chance for the graduate students to work outside all summer and enjoy the beauty of the Otter River watershed.

Public Involvement

An important component of this project was public outreach and public awareness. The Otter River project held significant interest for local conservation groups. Presentations were prepared to address questions and concerns raised by the work. In line with this, twelve informational meetings and four public tours of the ongoing rehabilitation activities were offered. Buses were chartered to view the accessible areas, and presentations detailing the project were given. Presentations were given to the local Trout Unlimited chapter, watershed council, and public interest groups. Rehabilitation techniques were discussed in detail with the various groups.

Conclusions

The partnering approach to river rehabilitation was an effective and valuable experiment. By this approach, vast amounts of experience and technical expertise were available throughout the various rehabilitation stages, and costs were more distributed, leading to a lower economic burden on any one group. Project tensions were also minimized, as each group had input to the ongoing work, and could coordinate an agreeable solution without the need for a halt in work. An atmosphere of checks and balances was created as well, since each partner brought a different area of expertise to the project. Rehabilitation techniques were examined for ecological, biological, structural and hydraulic viability before implementation. In order to effectively use these areas of expertise, communication was critical.

The Otter River project was unique in the remoteness of its sites and the hand labor rehabilitation approach used. Rehabilitation work was done using accepted and procedural techniques from various governmental agencies and rehabilitation handbooks, which were then modified as required in the field. The hand labor required on the Otter River resulted in the majority of the bank stabilization structures being field adaptations of tree-drop deflectors. Integrating the MCCC workers into the project created dual benefits by providing an educational aspect for crewmembers while improving the river's ecosystem.

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