INTRODUCTION

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Charlie, a tall, thin, gray-haired gentleman of 75 years, recalls playing among the downed trees and fishing the Neuse for its bountiful shrimp, crab, and many species of fish during his boyhood days. In another corner of the country, Native Americans still recall their ancestors' stories of how bountiful fishing was in the Columbia and Snake Rivers that flow through the States of Washington, Oregon, and Idaho. They said that salmon runs were so plentiful that you could walk from shore to shore and never see

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water. Created by retreating glaciers, once bountiful riparian ecosystems and aquatic habitats provided the Native Americans who inhabited these areas with their food, shelter, and clothing from around 8000 B.C. until the arrival of the early pioneers and settlers.

The settlers' actions caused big changes in the ecology of the landscape. They were the first to harvest prodigious amounts of timber. As a result of their deforestation practices, huge amounts of sediment were released into lakes and streams. The advent of mechanized equipment in the late 1800's, agriculture—especially the production of tobacco, cotton, and grain—created a thirst for more land, and more trees fell. Deforestation was rapid.

In the continental Eastern United States, forests blanketed 454 million of 552 million total acres. Except for western Missouri, Iowa, and the prairie peninsula of central and northern Illinois, at least 95 percent of every State was forested with centuries-old trees. By the end of the 19th century, of the 454 million acres, 99 percent had been logged. All riparian ecosystems were cut down. (Forty-nine percent of these acres regenerated second growth forests; however, half of the riparian ecosystems remain in agriculture.) (Verry 2000) The trees, shrubs, and other plants that slowed erosion and filtered runoff before it reached streams, rivers, and other water bodies were gone. Upland, riparian, and aquatic ecosystems no longer had the resilience to withstand the interventions of man.

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Timber harvest activities.

This change in land use patterns set the stage for post-World War II pollution and environmental degradation resulting from increased use of fertilizers, runoff from feed lots, mining, grazing, timber harvesting, recreational activities, road construction and maintenance practices, housing subdivisions, and numerous other demands caused by rapid urbanization.

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Today, decreased fish populations and the altered ecology of riparian ecosystems reflect the changes all across the country. In 1991, the American Fisheries Society issued a report documenting the decline of 214 discrete populations of west coast salmon and steelhead trout. Several of these populations, including runs of chinook and sockeye in the Columbia and Snake Rivers, are now listed as threatened and endangered. Many more species may qualify for protection under the Endangered Species Act. Scientists have learned that habitat loss, hydropower development, overfishing, and interaction with hatchery-raised fish have, in many ways, harmed anadromous fish populations. Many forests are faced with the possibility of having to close recreation facilities adjacent to lakes and streams if shorelines, streambanks, and associated plant communities are not protected from damaging impacts. It is this situation that has prompted the preparation of this guide.

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We also discovered that the cause-and-effect relationships between overgrazing are similar to the effects of dispersed recreation activities. Many of the problems caused by grazing are the same as for those caused by recreational activities.

Historically, engineered solutions to streambank failures relied primarily on straightening and channeling streams and stabilizing banks with solid concrete, riprap, gabions, steel, and other hardscape materials. These solutions have not always been successful and have proved to be expensive to build and maintain.

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In recent years, however, more creative and environmentally sensitive solutions have been applied and have been proven to be highly successful. Widely known as soil bioengineering, these techniques combine the natural elements of the site, such as rock, soil, trees, and other native vegetation, to create a complex mix of material to fortify the banks. Once the vegetation has established itself, and the need for maintenance is dramatically reduced or completely eliminated, then lakeshores and streambanks are stabilized.

Objectives

This guide provides information on how to successfully plan and implement a soil bioengineering project, including the application of soil bioengineering techniques.

This guide is designed for recreation staff personnel and forestry technicians who are engaged in the day-to-day construction and maintenance of water-related recreation facilities, including dispersed areas, forest roads, and trails, as well as for those who are interested in learning more about soil bioengineering stabilization techniques and how to apply them. Basic principles and background information needed before attempting a restoration project are presented.

Many forests are already using these techniques with great success. It must be noted at the outset that this guide does not address the complex issue of stream and river alteration and restoration. This is a very difficult task and is better left to professionals who are acquainted with the many complexities of dynamic geomorphic systems. The term “stream” is also used in this guide to mean a river or other flowing body of water.

Chapters 1, 2, and 3 seek to impart an understanding of the nature of streams and the symbiotic relationships between the upland, and riparian and aquatic ecosystems as they perform their functions in the watershed. Chapter 4 provides a planning approach. Chapter 5 illustrates and describes the applications of numerous soil bioengineering techniques for streambanks and lakeshore stabilization.

Purpose

Although the soil bioengineering techniques are often simple and easy to construct, planning for them and applying them effectively is often more difficult. Chapter 1, "Making the Connection," emphasizes the importance of understanding the interaction between the ecology and human impacts in an entire watershed before deciding how to treat problems along a specific reach of stream. Engaging in this process presents an opportunity to understand why streambanks degrade and riparian vegetation is altered. In doing so, our ability to understand current conditions and interpret clues to identify watershed health is enhanced and our vision of the desired future condition made possible. Our ability to employ stabilization and restoration strategies is also improved.

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Chapter 2 is about the riparian ecosystem, its composition, its structure, its function, and the relationships between each of these elements. It discusses how riparian ecosystems are connected to the upland forests and to streams and streambanks and the significance of these connections.

Chapter 3 discusses, in general, river and stream dynamics. Rivers and streams are the workhorses of the watershed, places of constant motion and change. Like tenacious and productive ant colonies, rivers and streams are constantly at work balancing water and sediment loads and moving them to the ocean.

Chapter 4 is full of tips on planning a stabilization project, harvesting and storing plant materials, and listings of tools that may be needed. It emphasizes the importance of an interdisciplinary team approach that relies heavily on the ability of project managers, planners, and designers to ensure the best possible opportunity for each of the planning components to succeed. Team members need to use good judgement while integrating ecological principles, construction expertise, engineering practices, and practices from botany, biology, ecology, soils, hydrology, scenery management, and others.

Chapter 5 illustrates and explains numerous soil bioengineering techniques, to be used alone or in combination. In most cases, the application of the techniques requires basic construction skills and can be done by Forest Service maintenance crews, volunteers, and general contractors (provided they receive good direction and supervision). A Stabilization Techniques and Applications Chart that lists all the techniques and their applications is also found in this chapter.