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Restoring a Healthy Watershed

Godwin Brown

Abstract: ***A "watershed" is the term describing an area of land united by the flow of water, nutrients, pollutants and sediments, moving down slope to the lowest point, through a network of drainage pathways that may be underground or on the surface. A healthy watershed has clean air, water and soil and sustains various forms of life. Selecting the appropriate process for restoring a healthy watershed depends on the restoration objectives. Processes that restore watershed were outlined with an eye on their objective categories- connectivity, riparian, bank stabilization and sediments and hydrology.***

Keywords: Riparian, Restoration, Connectivity, Environment

1. Introduction

Water is an essential element for sustaining life. Rivers, streams and lakes are the "lifeblood" of our environment. When our waterways are polluted, we know the system is in need of repair. When waterways are healthy, we know the environment can support a diversity of plant and animal species. Adequate water supply and the biological diversity that the watersheds' waters support is the key to socially healthy and ecologically balanced futures. If water is the "lifeblood" of environment, the land that surrounds that water is the "muscles and bones" of the environment. Together, land and water make a watershed, a whole system.

A watershed is all of the land that drains to a particular stream, river, or bay. All land, from the wildest preserve to the most densely developed urban neighbourhood, is part of a watershed. Generally, these pathways converge into a stream or river system that becomes progressively larger as the water moves downstream. Watersheds can be large or small. Every stream, tributary, or river has an associated watershed, and small watersheds aggregate together to become larger watersheds.

A healthy watershed is a well-balanced system capable of sustaining a variety of environments and many forms of life. In a healthy watershed, water, soil and air are clean. People as well as fish and wildlife have the water, food, shelter, and other resources they need to survive. When watersheds are healthy and functioning well, they provide food and fibre, clean water, and habitat for native plants and animals. Healthy watersheds cycle nutrients and convert them into forms that living organisms can use. They even affect air quality by absorbing pollutants and greenhouse gases. Well-functioning watersheds are more resilient to natural and human-induced disturbances than highly-impacted watersheds

A healthy watershed may fail/deteriorate from excess fine materials (sediments or silt), loss of riparian areas, sewage spill, channelization or straightening, blockage of fish passage, loss of water quality or quantity, and other human activities or cumulative effects. It is critical to ascertain and understand the physical and ecological processes at work in the watershed and to work with these processes in designing and implementing restoration measures

Restoring a Healthy Watershed

Restoration means returning a site to a target condition. The target condition may not be the same as the pre- disturbance condition, but it is usually based on a desired level of function.

Some characteristics of a healthy watershed;

- Water quality is high enough to support native aquatic species.
- The streams and their flood path are able to accommodate flood flows without regular destructive flooding and erosion.
- Stream flows are close to pre deterioration conditions
- Streams have sufficient complex habitat features
- Native, keystone plant and animal species are able to sustain stable populations.
- The riparian corridor has a dense, healthy native plant community that regenerates naturally.
- Upland forests and grasslands are managed to promote rain infiltration, provide diverse habitat for native wildlife, reduce soil erosion, and deliver clean water into streams.
- Tidal areas are connected to their wetlands.

When a watershed deteriorates, it needs to be restored. A watershed or sub-unit may be selected for restoration because of specific interests in the watershed and concerns over known impacts. Landscape-level assessments can also be done to select watershed units for restoration based on criteria for watershed disturbance and relative environmental concern. Risk analysis is also recommended as part of restoration plan.

Selecting the appropriate restoration technique requires having clear restoration goals with specific objectives, an understanding of the disrupted processes and desired habitat conditions, and an understanding of which restoration techniques can achieve these objectives. Selection of restoration techniques logically follows a watershed assessment including identification of problems, disturbances that have occurred, current watershed trends and specific objectives for areas or reaches in need of restoration. While the processes and habitats are restored, the response time and longevity of the restoration are the all- important considerations when selecting a restoration technique. Having considered all relevant factors, the restoration process includes;

- Keep water clean. Prevent soil erosion, use non-toxic household and garden products, keep oil and animal waste out of streams and storm drains

- Repair erosion wherever possible with biotechnical techniques that incorporate native plants. These methods allow for natural watershed functions to continue
- Dam removal or breaching
- Culvert replacement
- Fish passage
- Levee setback or removal
- Reconnection of sloughs and lakes
- Road removal or abandonment
- Forest road improvements (e.g. resurfacing, stabilization, addition or removal of culverts, addition of cross - drains)
- Urban road improvement (e.g. reduction of impervious surface, natural drainage systems)
- Change agriculture practices
- Increase in-stream flows and/or flood flows
- Reconnect sediment sources
- Planting of trees and vegetation
- Thinning or removal of understory or invasive species
- Fencing and grazing reduction
- Complete removal of grazing
- Riparian buffers and protection
- Bank Stabilization

Based on the restoration objectives, these restoration processes are categorised into; connectivity, sediment and hydrology, riparian, and bank stabilization.

Connectivity

Connectivity processes reconnect migration corridors, allow natural transport of sediment and nutrients, reconnect lateral habitats, allows natural migration of channel. It includes; Dam removal or breaching, Culvert replacement, Fish passage, Levee setback or removal, Reconnection of sloughs and lakes.

The connectivity of watersheds and their habitats is critical for maintaining the flux of water, sediment, organic matter, nutrients, and the migration and movement of fish and other biota (Vannote et al. 1980; Fullerton et al. 2010)

Dam removal and the restoration of the hydrologic regime to more natural conditions are employed primarily to restore longitudinal connectivity of stream and floodplain habitats; improve fish access and migration; allow for natural transport of water, sediment, organic material, and nutrients; and maintain or restore natural riverine processes that create and maintain aquatic habitat (Pess et al. 2005).

In many cases, dam or weir removal, culvert replacement, or other forms of reconnecting isolated habitats or stream reaches are not possible. In these cases, a variety of fish passage structures can be used to effectively restore migration corridors and longitudinal connectivity for fishes. These include various types of fish ladders, fish locks, addition of baffles or weirs, and bypass channels

Sediment and Hydrology

Sediment and hydrology processes reduce or restore sediment supply, restore runoff and hydrology, improve water quality, provide adequate flows for aquatic biota and habitat reduce sediment and runoff from farms. This category includes; Road removal or abandonment, Forest road improvements (e.g. resurfacing, stabilization, addition or removal of culverts, addition of cross - drains), Urban road improvement (e.g. reduction of impervious surface, natural drainage systems), Change agriculture and waste disposal practices, Increase in-stream flows and/or flood flows and Reconnect sediment sources because so many human activities impact basic sediment and hydrologic processes, a suite of different approaches has been developed to restore more natural levels and timing of sediment and runoff. Many of these techniques are designed to address both sediment delivery and hydrology and to address a specific type of human infrastructure or land use.

In many cases, road removal, decommissioning or closure are not feasible and restoration efforts must focus on minimizing the impacts of roads on sediment, hydrology, and water quality by stabilizing the road and roadside ditch network, minimizing exposed soil, disconnecting road drainage from the stream, and improving stream crossings to minimize erosion

Riparian

Riparian processes restore riparian zone, vegetation and processes, improve bank stability and in-stream conditions, increase or decrease shade. It includes; planting of trees and vegetation, Thinning or removal of understory or invasive species, fencing and grazing reduction, complete removal of grazing, Riparian buffers and protection.

Planting native plants that fit your specific location and conditions from grasses for erosion control and wildflowers for bees and butterflies, to shrubs and trees for birds and healthy stream. Thinning increases the growth rate of remaining trees. Cut trees can be left on site to provide organic material to forest floor. Controlling the number and distribution of livestock, duration and/or season of grazing, or control of forage use, removal of grazing or Elimination of livestock from riparian area or entire watershed minimize impacts to allow natural recovery of riparian area and stream channel, water quality and biota while still allowing for livestock use.

Bank stabilization

Bank stabilization stabilizes banks to reduce erosion and improve riparian or in-stream habitat.

2. Conclusion

The success of restoration projects depends on setting clear goals for the project and specific objectives for individual remedial measures. It is critical to understand the physical and ecological processes at work in the watershed and to work with these processes in designing and implementing restoration measures.

As with many fields of developing science, there are divergent views on restoration approaches and treatment methodologies. For this reason, it is essential to set specific objectives and select the approach most likely to achieve those objectives and the overarching restoration goal. The type of treatment

selected may also depend on other factors, such as legislated requirements for site remediation or reforestation and the expected time frames for different approaches to achieve the desired results.

Techniques that focus on restoring connectivity, sediment and hydrology, and to a lesser extent riparian conditions, are often used to restore watershed - scale and reach - scale processes, while habitat improvement techniques are often used to improve more localized conditions and processes. In-stream habitat improvement and restoration of connectivity usually results in rapid improvements, while techniques such as road removal or riparian planting may take many years to detect benefits. These long-term and short-term strategies can be implemented simultaneously to provide initial benefits while setting the system on a path to long - term recovery.

The processes employed here have a low to medium maintenance and longevity. Most techniques are effective if designed properly and other watershed processes are addressed or incorporated into the design. Many restoration actions require periodic maintenance, particularly during the first 5 to 10 years after completion and occasionally throughout the life of the project, to ensure that they are leading to the desired benefits.

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