

Assessing Stream Health



Using BLM's Proper Functioning Condition Survey Method

**U.S. Department of the Interior
Bureau of Land Management**

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Why is Stream Health Important?

Streams are part of riparian and many wetland ecosystems, which are some of the most productive environments in the Western United States. Healthy riparian-wetland ecosystems provide a number of benefits, including a diversity of plant species; food, water, shade, and cover for fish, wildlife, and livestock; and recreational opportunities. In addition, in healthy systems, the streambanks can absorb water during higher flows and release it during lower flows, thereby prolonging flows into the dry season.

A stream's relationship to its environment is quite complex. Changes within the environment can impact the health of the stream, and in turn, changes in the health of the stream can impact the overall health of the riparian-wetland ecosystem. Therefore, in order to maintain the health of a riparian-wetland ecosystem and the benefits it provides, it is important that the stream be in balance with its environment.

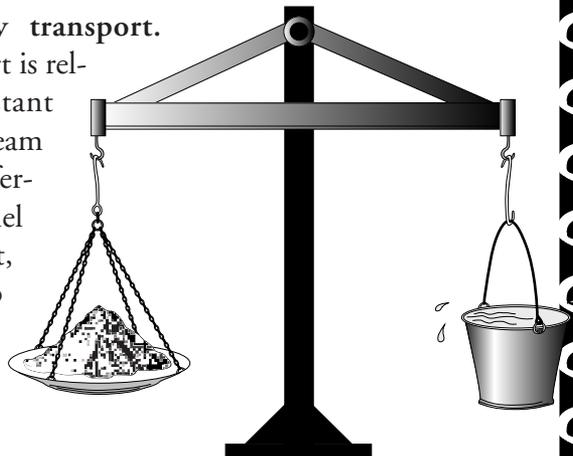
What is Meant by Balance?

A stream is constantly influenced by both natural and human-induced changes in its environment. These changes may occur instantaneously, over geologic time, or somewhere in between. A change to any point on a stream may have an effect on its entire length. As a result, the stream will continually adjust to these changes in order to maintain its natural balance.

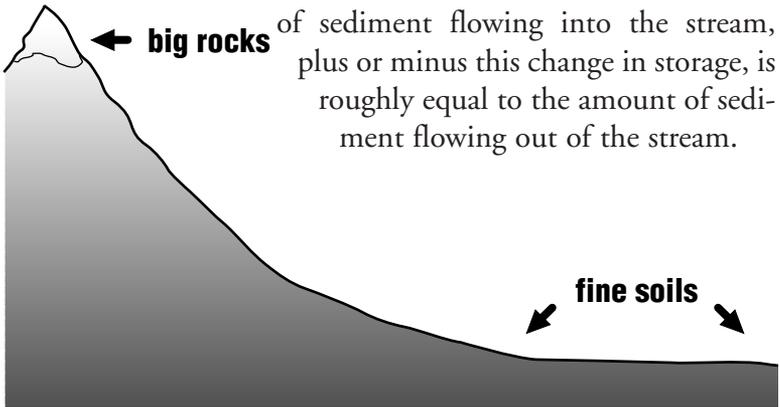
- **Streams are balanced in form.** A stream takes on different forms in response to the slope and content of the land it runs through. For example, in the mountains, where there are steep slopes and large rocks, streams generally flow in straighter channels and have banks and beds made up of larger bits of rock and sand. Valleys and plains are flatter and are usually covered with smaller rocks and sand. Valley streams tend to be meandering channels with banks and beds made up of finer sands and silts.

- **Streams are balanced in the amount of material they transport.**

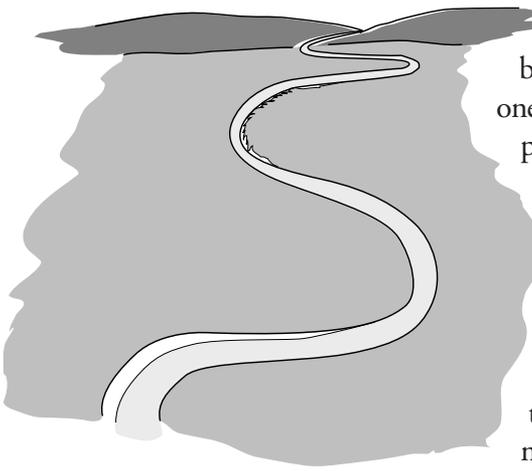
Sediment transport is relatively constant throughout a stream system. The different forms a channel takes are, in part, an adaptation to maintain this flow of sediment. Sediment flow is



not always constant, however. Some of the sediment is stored in floodplains that form along the flatter channels, and alluvial fans that form at the base of steeper channels. This stored material can be reintroduced into a stream through changes in stream shape or other processes that accelerate erosion. So, over time, the amount of sediment flowing into the stream, plus or minus this change in storage, is roughly equal to the amount of sediment flowing out of the stream.



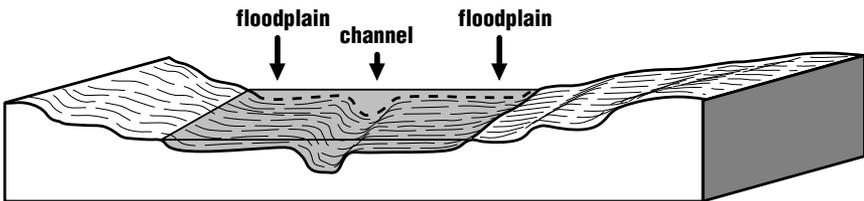
- **Streams are balanced in energy.** The faster water flows, the more energy it has, and the more energy it has, the greater the amount and size of material it can transport. A mountain channel tends to be steeper, which allows it to transport larger rocks. The bits and pieces that break off the rocks as they tumble are transported downstream until the water slows to the point that it can no longer carry them. At that point they settle out. Since less energy is required to move smaller rocks than larger rocks, less energy is required to change the shape of the banks along a gently sloped valley stream than a steep mountain stream. This means that in order to maintain a balance in sediment flow, valley channels need to have less energetic flows than mountain channels, which is one reason streams tend to meander in gently sloped valleys.



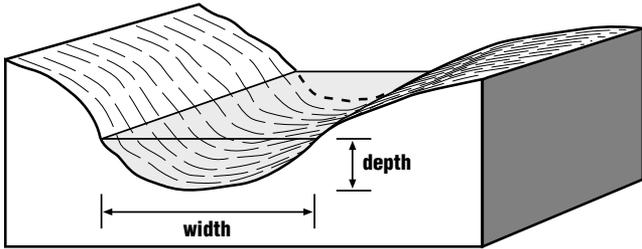
Meanders, like switch-back roads and ramps, are one way that streams dissipate energy. Meanders spread energy out over a longer distance. The length of a meandering stream is longer than the straight line distance along its valley; thus, the slope of a meandering channel is

less than the slope of the valley. The greater the meander, the more gentle the slope in the stream channel and the less energetic the flow.

The flow of a stream is not constant. Storms and spring runoff can increase the amount and energy of flow within a stream. Sections of channels that contain large, hard-to-move rocks can often handle higher energy flows. Channels that are made up of fine, easily moved sediments may not be able to handle higher flows and will constantly adjust to disperse excess water and energy. This often results in the formation of a floodplain. An active floodplain spreads the flow and energy of water over a much larger area than the channel itself, thereby reducing the amount of water and energy within the channel.



- **Streams are balanced in shape.** A stream will naturally tend towards the most efficient shape for transporting water and sediment under given conditions. However, a stream's width and depth are influenced by many factors, including flow volume and timing, bed and bank material, sediment loads, slope, and vegetation. If the shape changes, and the stream is no longer in balance with its environment, erosion and other forces will work to bring the channel back into balance.



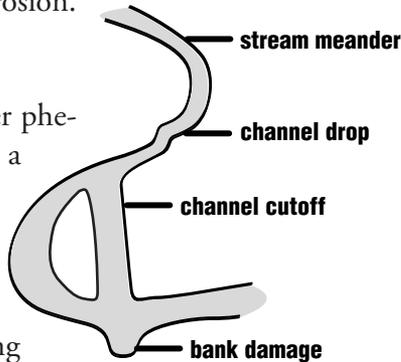
What Can Affect the Balance of a Stream?

Anything that can affect the timing and volume of flow and sediment can affect a stream and its channel, including erosion and vegetation.

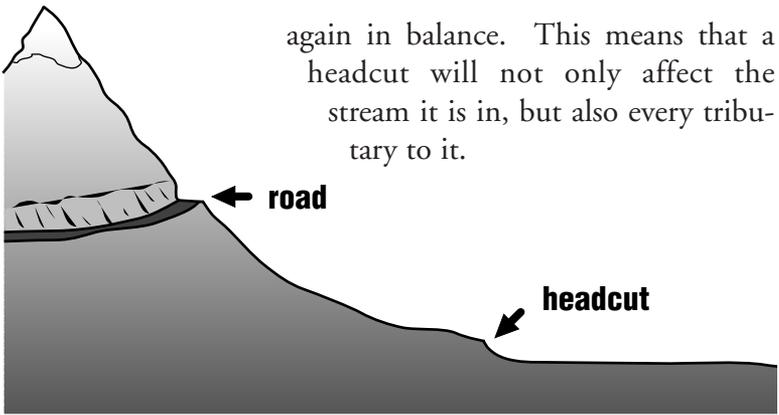
Erosion is a natural process. However, the fact that we have soil indicates that *natural* erosion occurs at a rate equal to or less than the rate of soil formation. If soil erodes faster than it forms, a valuable resource is lost. Streams are the most obvious place to look for accelerated soil erosion. Fires, earthquakes, weather, floods, wildlife, livestock grazing, and human activities can all cause change within a stream channel and change the rate of erosion.

For example:

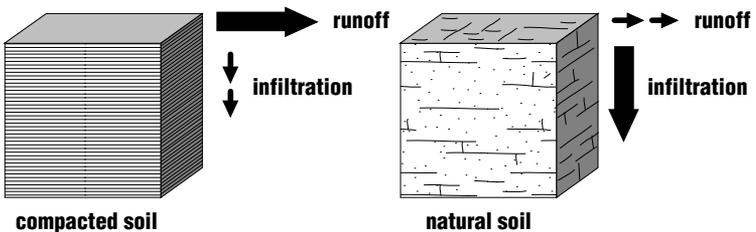
- An earthquake or other phenomenon can cause a change in the landscape which cuts off a meander and steepens a portion of the channel. The faster flowing water will have more energy to pick up and carry more soil from the channel banks and bed. Erosion will then adjust the size, slope, and shape of the stream channel until it is able to handle the increased energy of the flows. This change in channel slope, sometimes referred to as a head-cut, will travel up the stream profile until the stream profile has readjusted to the slope where the forces are once



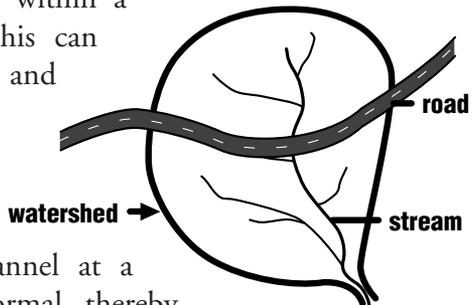
again in balance. This means that a headcut will not only affect the stream it is in, but also every tributary to it.



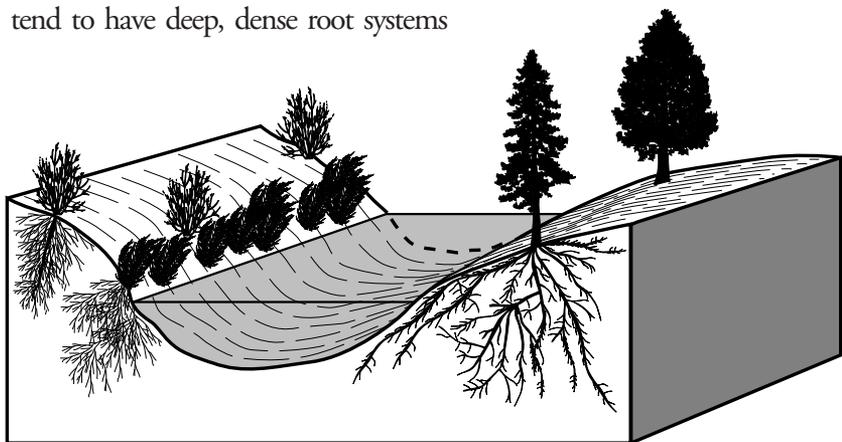
- Wildlife or livestock can compact the streambank soil, which reduces the amount and rate of infiltration of water into the channel bank. This can increase the amount of immediate runoff from storms and cause higher short-term flows, which in turn can increase the potential for erosion.



- A road can change the slope of the land, and can act as an additional channel within a drainage area. This can change the timing and volume of runoff from storms by allowing more water to flow to the stream channel at a faster rate than normal, thereby increasing the amount of energy in the flow and the potential for erosion.



Vegetation can affect a channel's shape and its ability to dissipate energy. Plant roots physically bind the soil in a channel. Plants that have evolved next to streams (sedges, rushes, willows, etc.) tend to have deep, dense root systems



that, when healthy, help hold the soil in place and protect the streambank. Upland plants, such as bluegrass, do not have extensive root systems and do not hold the soil as well, leaving it vulnerable to erosion. Plant roots also help regulate the amount of water in the soil. Living roots draw water from the soil and dead roots provide channels for water to percolate to the lower regions of the soil. This helps streambanks to absorb more water during higher flows.

The above-ground portions of plants can affect soil as well. During higher flows, sedge and grass leaves will lay down over the top of the soil and protect the soil surface. Willows and other woody stemmed plants dissipate the flow of water.

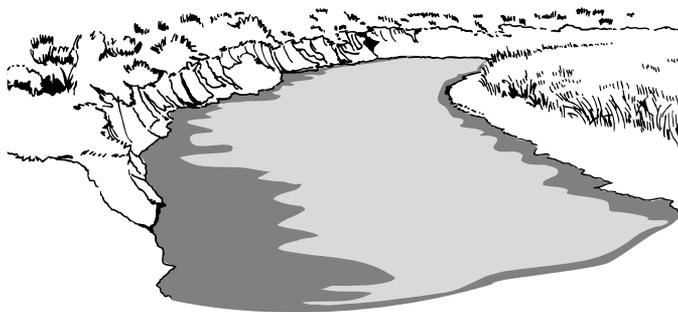
water flows around tree



bent over sedge



A change in amount and/or type of vegetation will often precede a change in sediment transport or channel shape. An increase in vegetation of any sort, especially riparian-wetland vegetation, can slow the flow of water and allow it to drop its sediment load. This helps build streambanks and shape the channel. The inverse is also true. A channel can more easily erode if the vegetation is removed to a point that it can no longer protect the soil surface.



How Fast Can a Stream Recover?

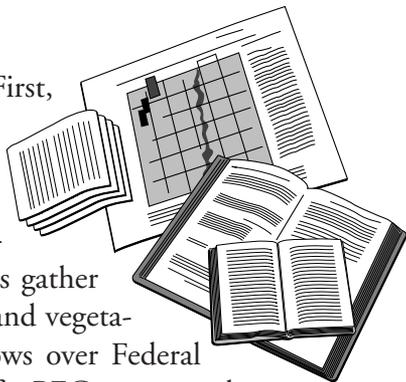
Many things can affect the rate a stream changes. As a general rule, the streams that degrade the quickest are the quickest to recover, but this is not always the case. Many factors, such as aspect, soils, previous use, and vegetation type, play a significant role in stream recovery. The streams that can withstand greater pressure without changing take longer to recover once they are disturbed. Smaller streams tend to react faster than larger streams. Perennial streams (those that flow year-round) recover faster than intermittent or ephemeral streams (those that flow for only part of the year or only in response to storms and snowmelt).



How is the Condition of a Stream Assessed?

Determining the physical condition of a stream requires a comprehensive survey of the components of the riparian-wetland ecosystem. The Bureau of Land Management (BLM) uses the Proper Functioning Condition (PFC) survey method.¹

A PFC survey has two stages. First, all available data (maps, photos, surveys, etc.) are assembled prior to going to the field. Second, an interdisciplinary team of resource specialists gather data about the hydrology, soil, and vegetation of the stream where it flows over Federal land. The hydrology portion of a PFC survey evaluates the physical form of a stream and compares it to the form the stream would take if it were in balance with its environment. At this point, the stream is assigned a rating (Proper Functioning Condition, Functional—At Risk, or Nonfunctional). The rating is based upon the relationship of its hydrologic, soil, and vegetation status to its capability and potential, and reflects the overall stability of the system. A stream's potential is determined based on relic areas, past surveys, professional judgment, and channel typing methods, such as the Rosgen system.²



¹ Bureau of Land Management. A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas. Technical Reference 1737-15.1998. 132 pp.

² Rosgen, David L. A classification of natural rivers. *Cantena* Vol. 22, No. 3. June 1994. pp 169-199.



What Do the PFC Ratings Mean?

BLM has specific definitions for the terms used in the PFC rating system. These definitions are included in *italic* below, and are further explained to provide a clear understanding of the rating system.

Potential Natural Community (PNC): *Represents the seral stage the botanical community would achieve if all successional sequences were completed without human interference under the present environmental conditions.*

In other words, this is the state the vegetation along a stream would reach if it was not disturbed for a long time and allowed to go through a natural progression of changes. This is generally the most stable state a stream can be in.

Desired Plant Community (DPC): *Of the several plant communities that may occupy an ecological site, the plant community identified through a land use or management plan that best meets the objectives for the site. A real, documented plant community that embodies the necessary resource attributes for the present or potential use(s) of an area. The desired plant community is consistent with the site's capability to produce the required resource attributes through natural succession, management intervention, or both.*

BLM's land use or management plans identify specific management objectives for a site, such as providing for channel stability, wildlife habitat, or grazing. DPC is the state that land managers believe the vegetation should be in to best sup-

support the specific uses identified in these plans. DPC may be equal to or less advanced than the PNC.

Proper Functioning Condition (PFC): *Riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality, filter sediment, capture bedload, and aid floodplain development; improve flood-water retention and ground-water recharge; develop root masses that stabilize streambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity. The functioning condition of riparian-wetland areas is a result of interaction among geology, soil, water, and vegetation.*

Adequate vegetation, landform, or large woody debris is present to:

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- Dissipate stream energy
 - Filter sediment
 - Aid ground-water recharge
 - Aid in floodplain development
 - Stabilize streambanks
 - Maintain channel characteristics
 - Channel stability
 - Less erosion
 - Good water quality
 - Good water availability
 - Forage
 - Fish & wildlife habitat



PFC is a state in which a stream is in balance with its environment. The plant community or channel may not be in the desired condition (DPC), but there is sufficient stability in the stream and its surroundings to maintain the balance of the system. PFC is the minimum condition that a stream should be in.

Functional—At Risk (FAR): *Riparian-wetland areas that are in functional condition, but an existing soil, water, or vegetation attribute makes them susceptible to degradation.*

For example, a riparian-wetland area may have some attributes of a stable stream system; however, a condition in the hydrology or vegetation may be causing excessive erosion or instability along the stream channel. A rating of Functional—At Risk also includes an estimation of trend (up, down, or not apparent). An apparent upward trend indicates that while the stream is still not as stable as it should be, there is an aspect that indicates that the stream is becoming more stable with the present management. An apparent downward trend indicates that the channel is continuing to degrade. When a trend is not apparent, it indicates that there are several different actions along the stream, some which are stabilizing the stream and others which are degrading it, and the overall trend could not be determined at the time of observation.

Nonfunctional (NF): *Riparian-wetland areas that clearly are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows, and thus are not reducing erosion, improving water quality, etc. The absence of certain physical attributes, such as a floodplain where one should be, are indicators of nonfunctioning conditions.*

This means that there is nothing to indicate stability in the stream channel. Nonfunctional streams are usually characterized by a lack of meanders where they would normally be present; little or no vegetation; and steep, raw banks.

How is the Information from a PFC Survey Used?

PFC surveys are tools which provide information that land managers use to determine the physical condition of the stream and its channel. But a PFC survey is only the beginning. If a PFC survey indicates a need to modify land management practices to bring a stream back into balance or to control the rate of change, these modifications are made through other BLM procedures, including Allotment Management Plans (AMPs), Resource Management Plans (RMPs), and other land use plans.

How Can I Get More Information?

BLM has published a technical reference, entitled *Process for Assessing Proper Functioning Condition*, which explains PFC surveys in greater detail. In addition, anyone who has an interest in learning more about PFC surveys or in providing information for them is welcome to join the interdisciplinary team when they make their field observations. If you would like to obtain the technical reference (TR 1737-15), or if you have any questions about the PFC survey method or any other BLM procedure, please contact your local BLM office for further information.



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