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Riparian Complex Ecological Sites of North Dakota

A Pictorial Guide of Riparian Complex Ecological Sites Common in North Dakota

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The following is a pictorial guide of the valleys, streams and plant communities common in riparian complex ecological sites in North Dakota. Valley and stream types are represented by figures diagramming the shape of these features and photos. The vegetation communities will be represented by photos. This guide is intended to aid in the interpretation of riparian ecological site descriptions and assist in identification of riparian complex ecological sites when developing management plans for riparian ecosystems.

Contents

Riparian Complex Ecological Site

A riparian complex is the ecosystem associated with a stream and consists of multiple surfaces, each of which supports a unique plant community (Figure 1). A riparian complex ecological site is a unit of land with a unique set of biotic and abiotic factors that is capable of producing a distinct riparian complex and plant communities.

The surfaces and plant communities found within a riparian complex are a result of geomorphology and hydrologic processes. The primary factors that influence the riparian complex include: 1) valley type, 2) stream type, 3) stream gradient, 4) channel substrates, 5) fluvial surfaces and 6) vegetation patterns.

These factors vary across North Dakota due to differences in geology, soils, water, climate and topography. Areas that have similar geology, soils, water, climate and topography have been categorized by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) as major land resource areas (MLRA).

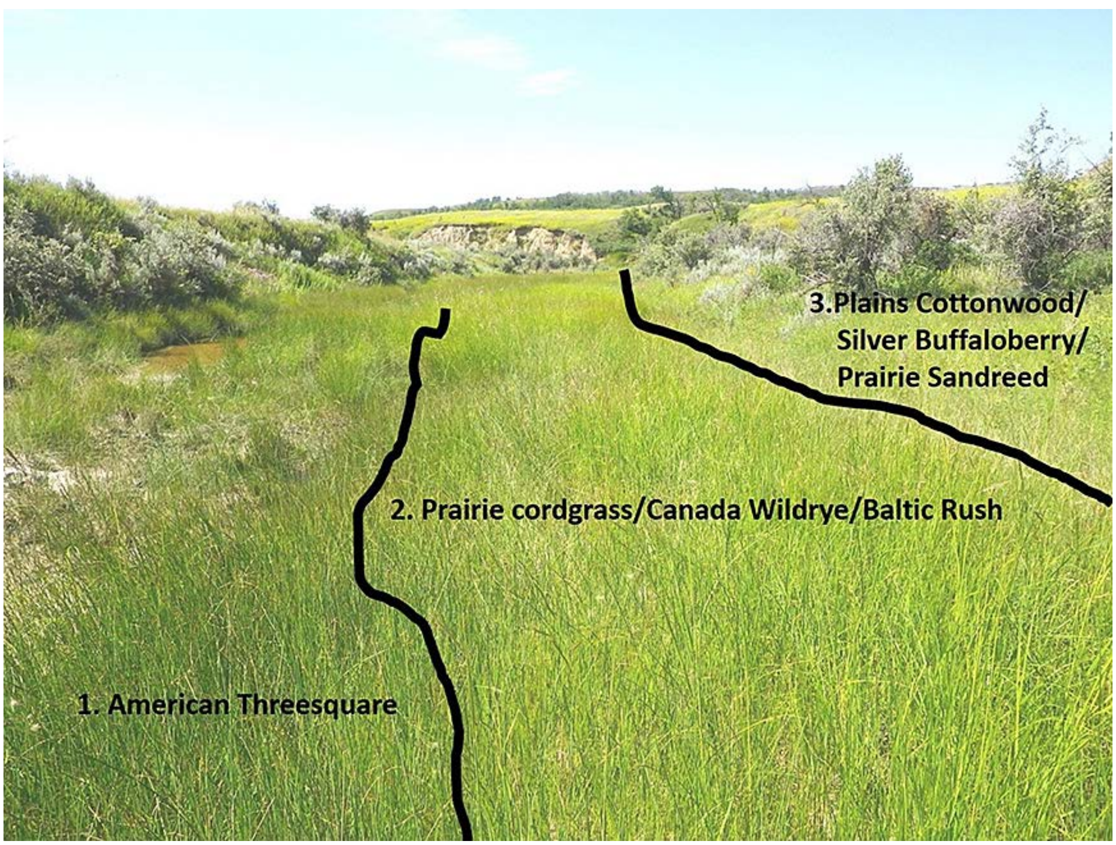


Figure 1. An example of a riparian complex showing multiple surfaces and plant communities. (Jeff Printz, NRCS)

Major Land Resource Areas

Major land resource areas (MLRA) are geographically associated land resource units. Identification of these large areas is important in statewide agricultural planning and has value in interstate, regional and national planning.

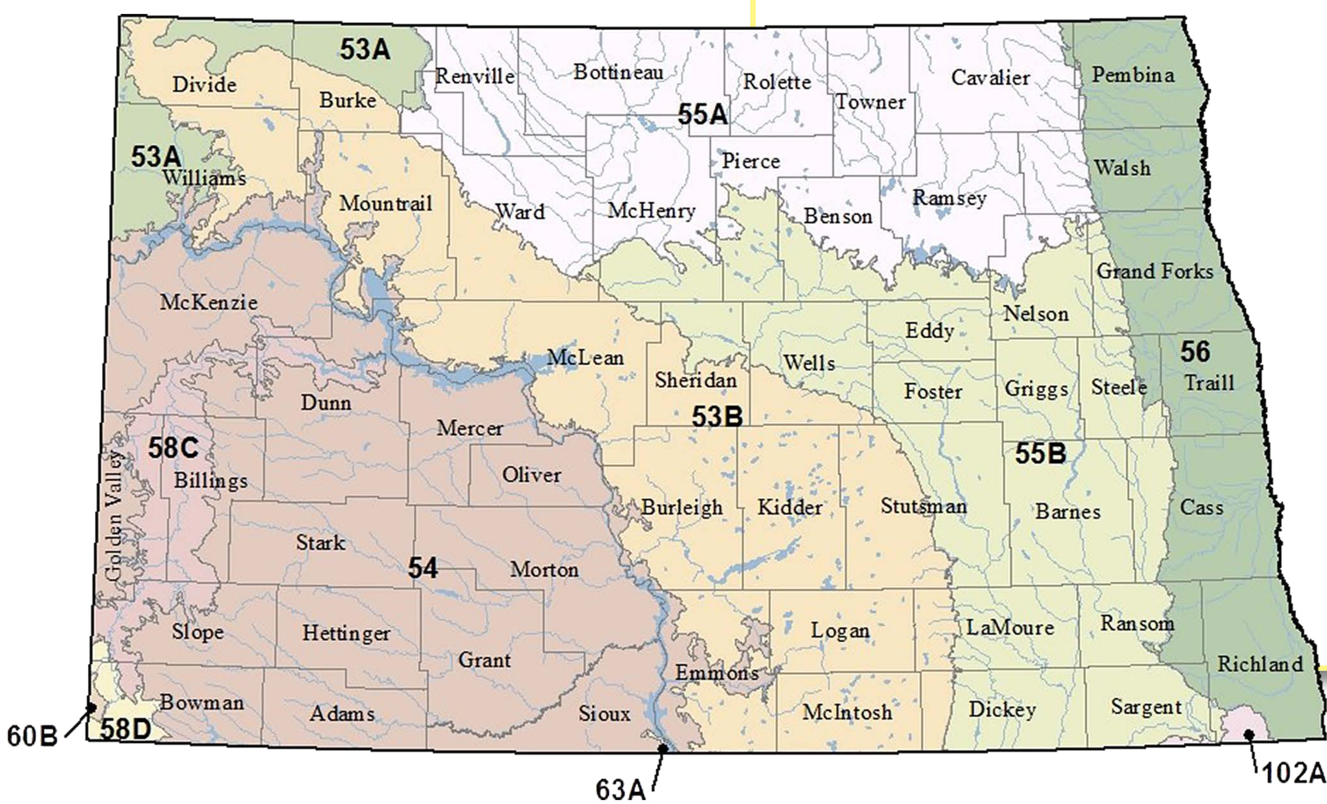
The NRCS has recognized 278 MLRAs that are designated and identified by a descriptive geographic name. An MLRA is a broad geographic area that is characterized by a particular pattern of geology, soils, climate, water resources, vegetation and land use.

Eight MLRAs represent the majority of North Dakota (Figure 2). Each MLRA may support multiple riparian complex ecological sites due to this broad pattern of soils, vegetation and water resources. A stream or river may have multiple ecological sites if it crosses more than one MLRA.

Key to Major Land Resource Areas of North Dakota

- 55B – Central Black Glaciated Plains
- 53B – Central Dark Brown Glaciated Plains
- 55A – Northern Black Glaciated Plains
- 53A – Northern Dark Brown Glaciated Plains
- 58D – Northern Rolling High Plains, Eastern Part
- 58C – Northern Rolling High Plains, Northeastern Part
- 63A – Northern Rolling Pierre Shale Plains
- 60B – Pierre Shale Plains, Northern Part
- 56 – Red River Valley of the North
- 54 – Rolling Soft Shale Plain
- 102A – Rolling Till Prairie

Figure 2. Major land resource areas of North Dakota.



Riparian Site Dynamics

Riparian ecosystems are highly dynamic and continuously changing due to the dynamic nature of streams. As a result of the fluvial activity in these ecological sites, the plant communities shift in response to the influences of erosion, deposition and water table on a fluvial surface.

Fluvial surfaces are the floodplains and terraces associated with a stream. The stability (geomorphology) of a stream changes in response to shifts in climatic patterns, and alterations in vegetation and management.

Historically (prior to European settlement), hydrology, climate, fire and grazing by free-roaming herbivores were the primary disturbances influencing the stream channel, fluvial surfaces and riparian vegetation communities. For example, prolonged periods of drought and/or heavy utilization by herbivores resulted in the loss of bank-stabilizing riparian vegetation.

When followed by a flood event, this often would result in a change in stream type. These events typically resulted in entrenchment of the stream channel, which reduces the size of the floodplain and lowers the position of the water table within the watershed.

Ecological site descriptions (ESD) attempt to describe the stream types, fluvial surfaces, plant communities and the site's responses to disturbances. The ecological dynamics of each site are represented through the use of a state-and-transition model (STM). Figure 3 depicts a riparian complex STM for a perennial stream in MLRA 54.

The STM depicts our current understanding of the ecological dynamics of the site in response to various disturbance regimes (for example, drought, overgrazing, fire and no grazing). The STM, along with the ecological dynamics narratives, identifies and describes the different stream states, phases, thresholds, transitional pathways and drivers that may occur on a site. The STM describes the fluvial surfaces and plant community components and their relationship to the stream type in each state and phase. Understanding these dynamics helps a manager predict how a riparian complex will respond to changes in management.

The reference state, State 1 in Figure 3, describes the stream channel and plant community components that would have occupied the site under the historic disturbance regime. This stream type is suited to transport the energy, water and sediments supplied by the watershed, and promote the plant community components that provide stability to the system. The "historic" stream types are referred to as the "Reference State" or the "Potential Natural Channel(s)."

The potential natural channels, fluvial features and plant community components of the reference state are described based upon data collected from sites determined to be representative of historic conditions. Additional information is gathered from historical documents and other reference sources that describe the stream, streamflow and plant community components prior to settlement, when the natural disturbance regime would have occurred.

Since settlement, these sites have been subjected to numerous disturbances that alter the stream and riparian plant communities. Changes in land use, unmanaged grazing, or the removal of grazing within watersheds and floodplains altered riparian plant communities, leaving streams vulnerable to entrenchment.

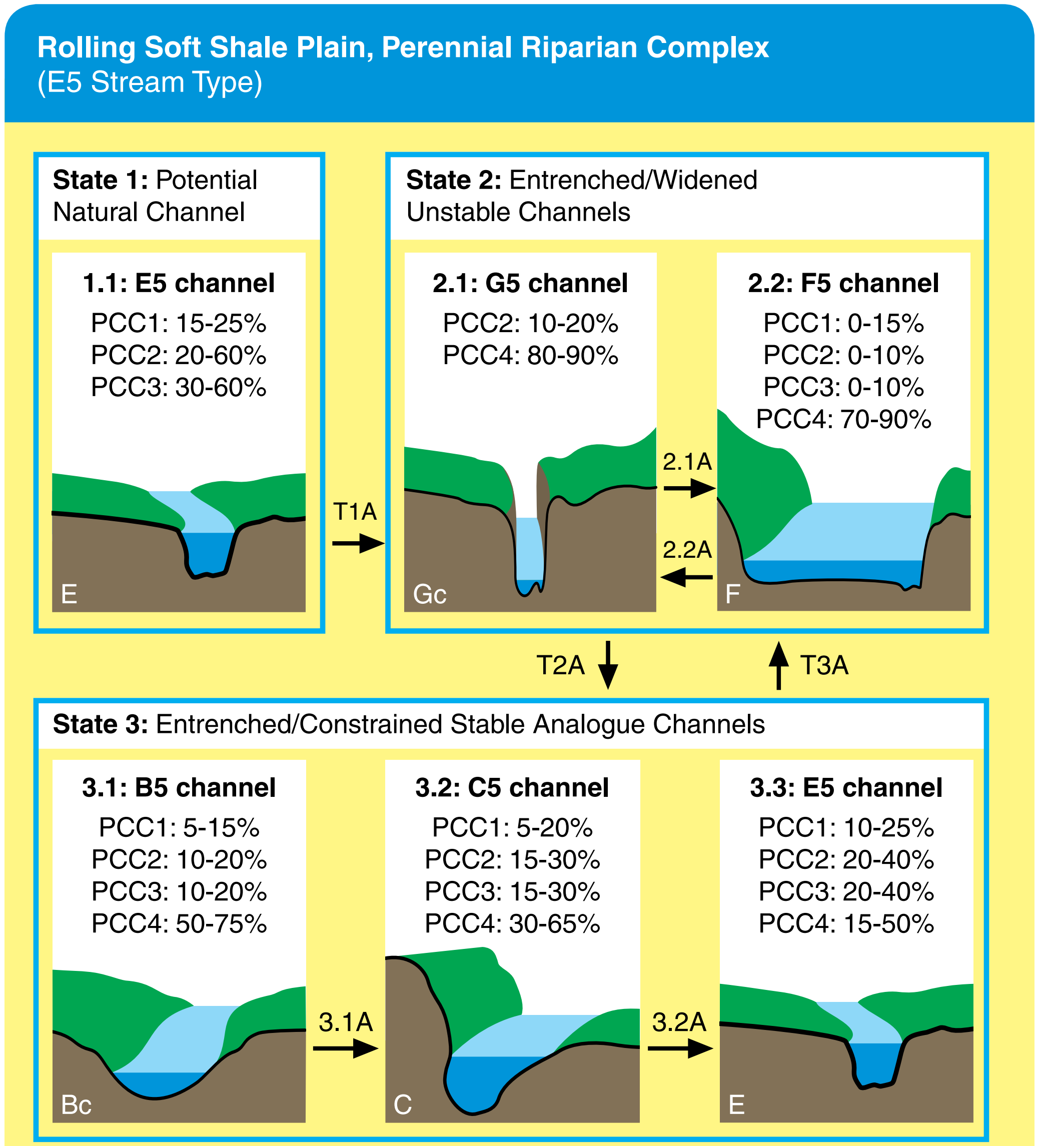
Additionally, non-native species such as Kentucky bluegrass, smooth bromegrass, reed canary grass, saltcedar and Russian olive have invaded the sites and negatively impacted stream stability. Many stream systems have been subjected to direct hydrologic alterations from the development of infrastructure, livestock grazing, crop and forage production, and energy development. Stream reaches have been modified by channel straightening, bridge design, concrete crossings and dam construction.

Disturbances to the potential natural channel can result in stream entrenchment and floodplain abandonment. When this occurs, a threshold has been crossed to State 2, which consists of the unstable channels. These unstable channels are highly erosive and have no floodplain.

Once entrenchment has occurred, recovering the potential natural channel is nearly impossible without a major investment of time and money for restoration. The stream will stabilize within the new valley formed by entrenchment, forming a smaller, restricted floodplain.

As the stream stabilizes, it crosses a threshold into State 3, which consists of stable channels with restricted floodplains and extent of plant community components due to past entrenchment. If these streams are not managed properly, they will transition back to State 2, where they become further entrenched.

Figure 3. State-and-transition model for a riparian complex ecological site.



Notes (not all possible states and phases of all reaches are shown. Refer to narratives for descriptions):

- Phase 1.1 is rarely encountered due to past entrenchment of the entire system.
- Phase 2.1 is occasionally observed: 2.2 begins to form immediately due to instability of bed and bank materials.
- Reaches in States 2 and 3 can have invasions of Reed canarygrass in PCC1 and smooth brome, Kentucky bluegrass, and quack grass in PCC2 and PCC3.

I.D.	Plant Community Component (PCC)	Fluvial Surface/Landform
1	Prairie cordgrass/Obligate sedge sp.	Floodplain
2	Big bluestem/Switchgrass/Wheatgrass	Floodplain Step
3	Big bluestem/Needlegrass/Forb/Shrub	Low Terrace
4	Western wheatgrass/Needlegrass	High Terrace

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Using the Riparian Complex Ecological Site Guide

The information in the riparian complex ecological site descriptions (RCESDs) can be utilized to direct management and restoration efforts, and monitor whether these efforts are achieving the desired outcomes. The intention of this guide is to help land mangers interpret the information in the RCESDs and identify the current state of riparian complexes.

To set management objectives, knowing the current state of the resources being managed is important. If the stream type were determined to be stable, you likely would continue current management; however, if the stream type is determined to be unstable or at risk of becoming unstable, then changes in management may be required.

In addition to guiding management, the information in RCESD can be utilized in riparian restoration efforts in determining stream and floodplain dimension and/or selecting the appropriate species for riparian plantings.

Monitoring stream morphology and riparian plant communities is critical to determine if changes in management are needed or if management objectives are being achieved. Changes in the stream's width and depth are early indicators of potential changes in stream type. Shifts in the size and number of plant communities within a riparian complex are often indicative of changes in stream type.

The greenline plant community is critical for bank stabilization. Monitoring changes in species composition and ground cover within this community is important. When this community has elevated levels of upland plant species and bare ground, it is at risk for increased erosion and transitioning to an unstable stream type.

The extent of riparian complex ecological sites is dictated by streamflow and valley type; thus, the ability to distinguish the different streamflow and valley type classifications is required to ensure you are utilizing the correct RCESD. RCESDs for North Dakota are available in Section II of the "NRCS Field Office Technical Guide" (FOTG), which can be accessed at https://efotg.sc.egov.usda.gov/.

Streamflow

Knowing the type of streamflow for the stream reach you are managing is critical when utilizing this guide. The concepts in this guide are best suited for intermittent and perennial streams with defined channels that are capable of transferring water, sediment and nutrients, and support the development of riparian plant communities.

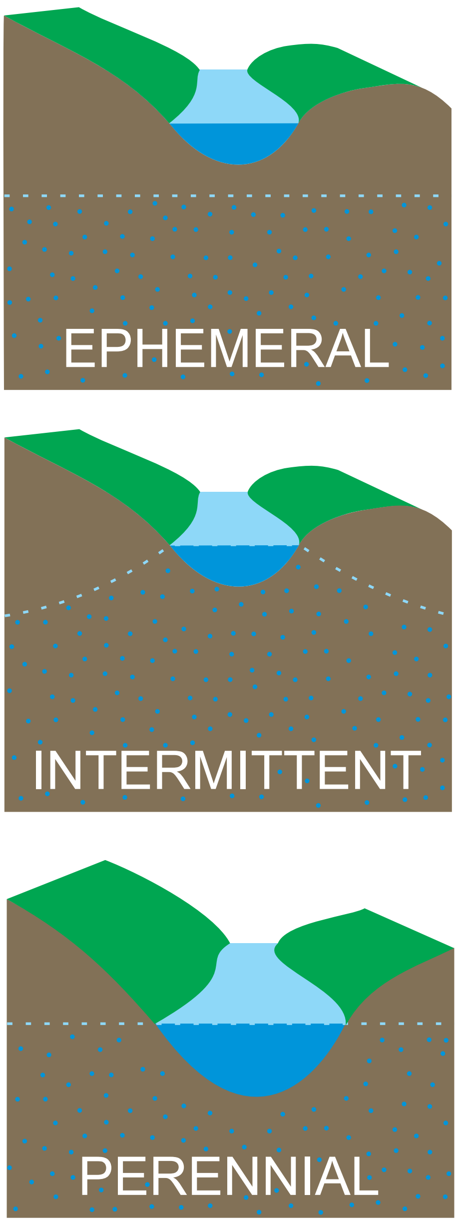
There are three types of streamflow: 1) ephemeral, 2) intermittent and 3) perennial. Streamflow is dictated by the channels position in relationship to the water table (Figure 4).

Ephemeral streams flow only in direct response to precipitation, with water only being transported during and immediately after precipitation events. An ephemeral stream generally does not have a well-defined channel or support riparian vegetation. The bed of an ephemeral stream always is above the water table. Ephemeral streams tend to function more like upland sites than riparian sites.

Intermittent streams have a channel that only contains water for a portion of the year, typically in the spring when runoff from snowmelt and precipitation provides sustained flow. The channel associated with an intermittent stream may or may not be well-defined. The position of the stream channel in relation to the water table fluctuates throughout the year. Intermittent streams often have decreased or no active stream flow in the late summer and fall.

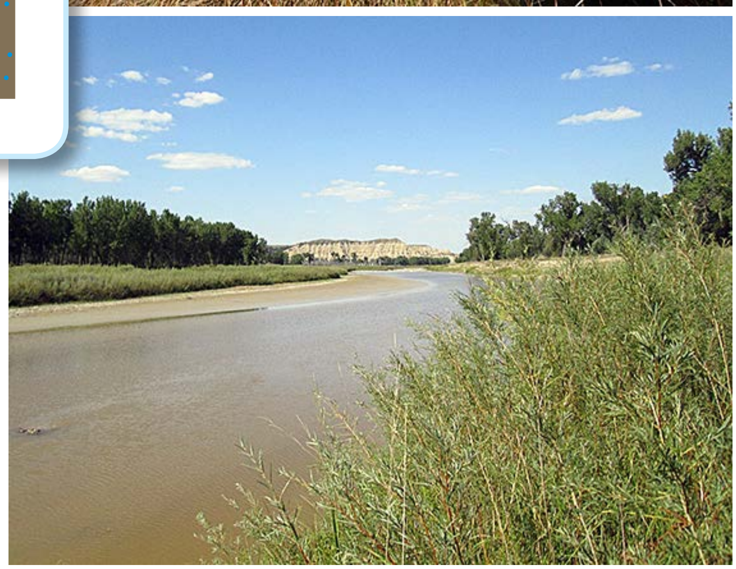
Perennial streams have defined channels that contain water throughout the year, given normal precipitation. The bed of the stream channel is below the water table, with groundwater providing the base flow level of the stream.

Figure 4. Streamflow as related to the water table.



Stream with ephemeral flow. This site functions as an upland site and supports an upland plant community. (Miranda Meehan, NDSU)

Stream with intermittent flow. (Miranda Meehan, NDSU)



Stream in western North Dakota with perennial flow. (Miranda Meehan, NDSU)

Stream with ephemeral flow.
(Miranda Meehan, NDSU)

Stream with intermittent flow with no active flow due to lowered water table.
(Miranda Meehan, NDSU)

Stream in eastern North Dakota with perennial flow. (Miranda Meehan, NDSU)

Valley Type

Each valley type has unique landforms that are a product of historical fluvial processes, such as deposition and erosion, and geologic material. The type of valley that the stream is within influences the stream channels and their response to disturbances; only certain stream types are supported by each valley type.

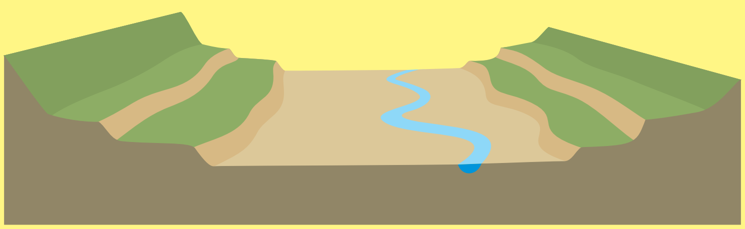
The stream is constrained by the valley's width, slope, parent material and vegetation. The two most common valley types documented in North Dakota are alluvial and lacustrine.

Alluvial Valley Type

The alluvial valley is described as a broad valley with gentle down-valley relief that has a well-developed floodplain, and numerous glacial and alluvial terraces. Active alluvial terraces support riparian vegetation, whereas abandoned terrace no longer are connected to the stream or water table and are inhabited by upland plants.

This is the most prevalent valley type across North Dakota due to past glaciation and the erodibility of our soils. The alluvial valley type is able to support stream types B, C, D, E, F and G (see Page 12).

Alluvial Valley

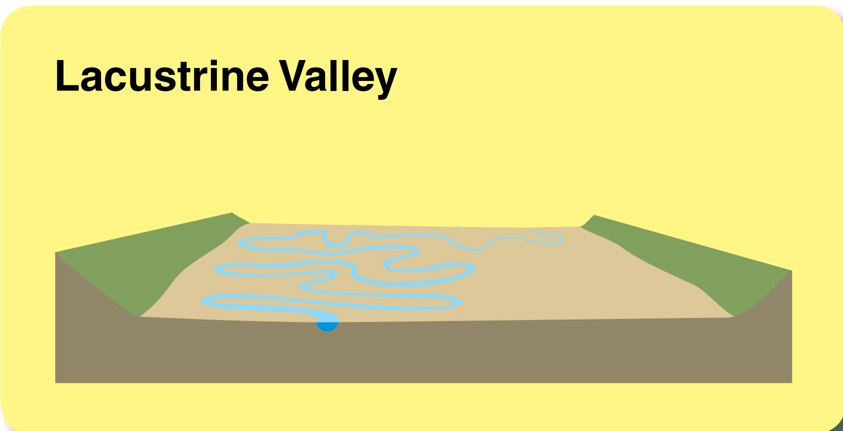


Stream in an alluvial valley type with multiple terraces. (Miranda Meehan, NDSU)

Lacustrine Valley Type

The lacustrine valley forms in old lake beds and is described as a very wide valley with gentle slopes. The lacustrine or lake bed material that this valley forms in can be from recent lakes or glacial lakes, such as Lake Agassiz.

The streams in this valley type tend to have expansive floodplains that frequently are flooded and have many wetlands and oxbows. This valley type is associated with many streams in the Red River Valley of eastern North Dakota. The lacustrine valley type is able to support stream types B, C, D, E, F and G (See Page 12).



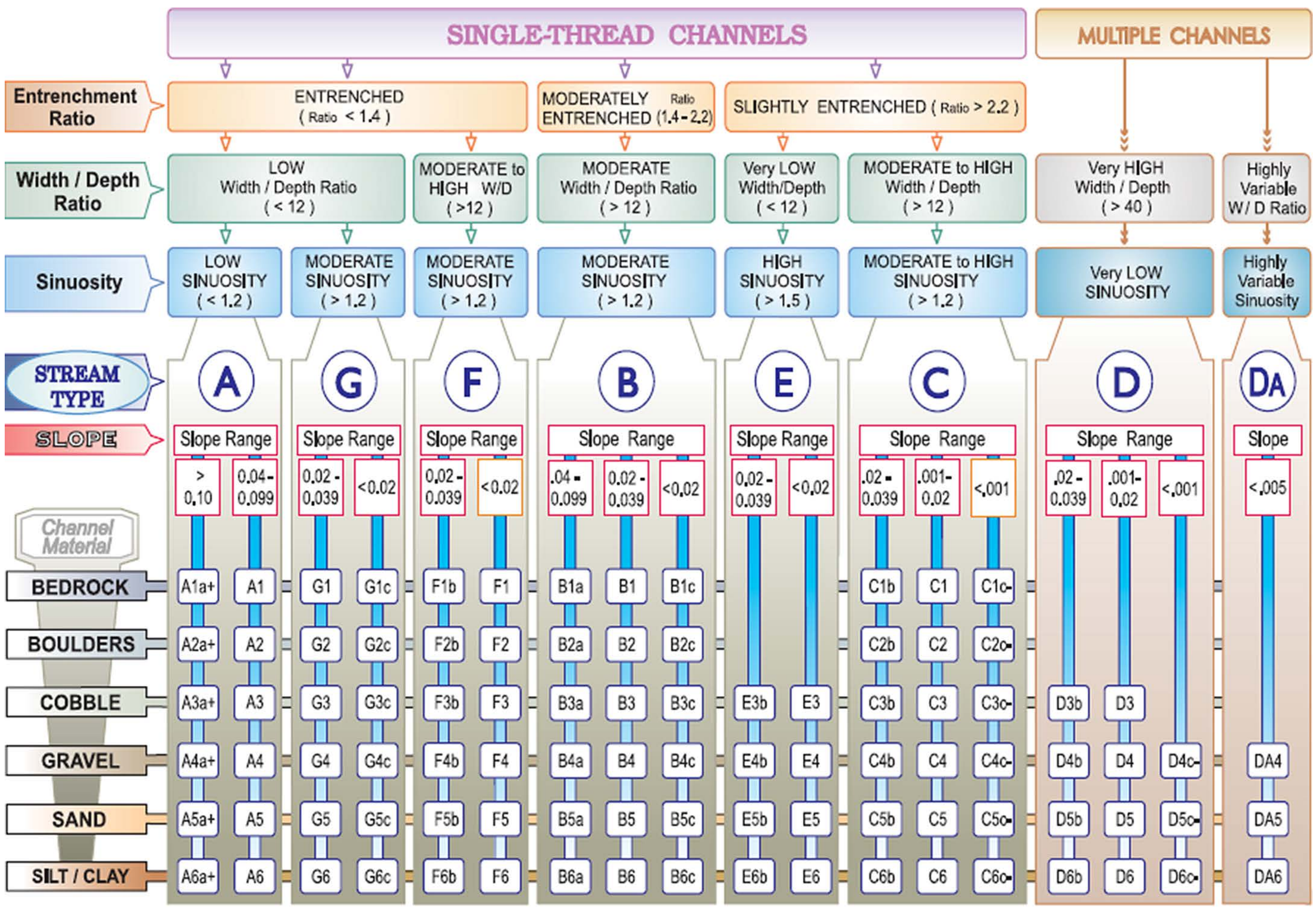
Stream within lacustrine valley with broad floodplain and oxbow wetlands.
(Vern Whitten, Vern Whitten Photography)

Stream Type

Stream type is based primarily on the shape of the channel and sinuosity. Stream types can be defined further based on the slope of the channel and channel material/substrate.

Rosgen (1985; 1994) developed a stream classification system based on these major variables that has been adapted by the Natural Resources Conservation Service and the U.S. Forest Service for the assessment of riparian complex ecological sites. Rosgen's stream classification system allows natural resource managers to predict a stream's behavior and compare data from one reach with that from similar reaches by grouping similar streams.

Key to the Rosgen Classification of Natural Rivers



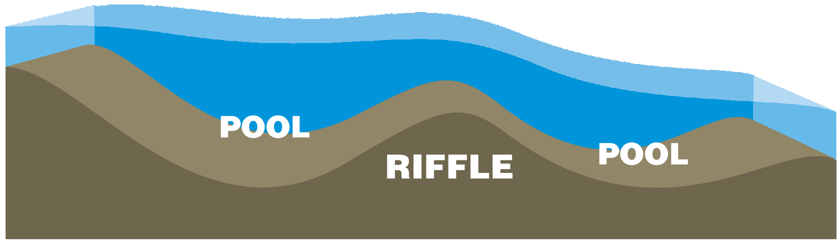
KEY to the ROSGEN CLASSIFICATION of NATURAL RIVERS. As a function of the "*continuum of physical variables*" within stream reaches, values of ***Entrenchment*** and ***Sinuosity*** ratios can vary by +/- 0.2 units; while values for ***Width / Depth*** ratios can vary by +/- 2.0 units.

The specific measurements/calculation required to determine stream type are entrenchment ratio, width/depth ratio and sinuosity. These measurements must be taken at a riffle within the reach being assessed. Riffles are located at the tail of a pool and are the shallowest portions of the stream.

To ensure measurements are accurate, identifying the bankfull elevation or bankfull flow of the stream correctly is important. Bankfull elevation is the point where the stream leaves the channel and enters its floodplain.

Common indicators used to identify the bankfull elevation are the floodplain surface, vegetation line and top of bars. Bars are features formed when the stream deposits material. The bankfull flow is the channel-forming flow and occurs, on average, every 1.5 years.

Stream Profile



Bankfull elevation can be identified as the top of the floodplain, as depicted in this figure. The yellow lines highlight the extent of the bankfull elevation. Often, a change in plant community occurs at the bankfull elevation. (Miranda Meehan, NDSU)

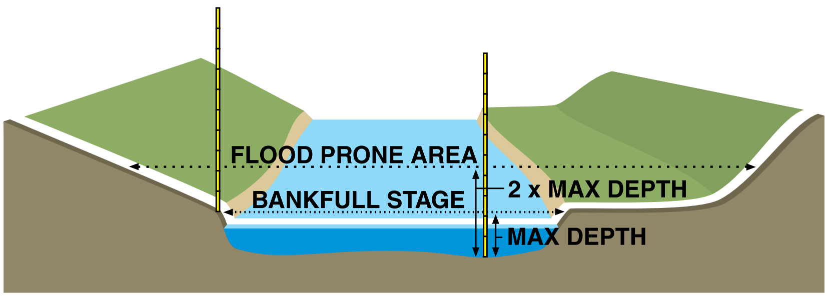
Bankfull elevation can be identified by the top of bars and depositional features. The yellow lines highlight the extent of the bankfull elevation. (Jeff Printz, NRCS)

Entrenchment Ratio

The entrenchment ratio is a measure of the stream's ability to access its floodplain. A low entrenchment ratio indicates the stream no longer is connected to the floodplain, whereas a high entrenchment ratio indicates the stream has a well-developed floodplain that the stream is able to access on a regular basis (during bankfull events, which occur every 1.5 years in North Dakota).

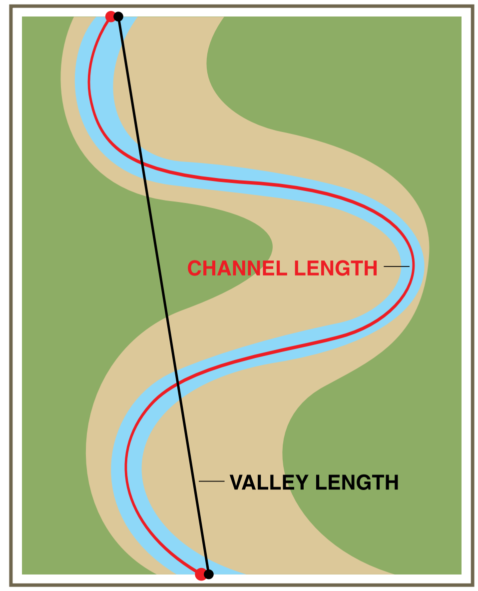
Entrenchment ratio = flood prone width ÷ bankfull width. Where flood prone width is the width at the elevation at twice the maximum depth.

Width to depth ratio = bankfull width ÷ average bankfull depth



Sinuosity

Sinuosity measures how much the stream is able to move within the floodplain or simply how much the stream curves. Under natural conditions, North Dakota streams typically have high sinuosity of 1.5 or greater.



Sinuosity = channel length ÷ valley length

In North Dakota, the channel material of most streams is silts/clays (denoted by a 6) or sands (denoted by a 5) following the stream type. For example, an E channel with silt/clay as the channel material is an E6 stream.

Example

Bankfull width = 11.3 feet

Flood prone width = 38.42 feet

Mean depth = 2.8 feet

Channel length = 4,775 feet

Valley length = 2,999 feet

Entrenchment ratio = 38.42 ÷ 11.3

Entrenchment ratio = 3.4

Width to depth ratio = 11.3 ÷ 2.8

Width to depth ratio = 4.03

Sinuosity = 4,775 ÷ 2,999

Sinuosity = 1.6

(Miranda Meehan, NDSU)

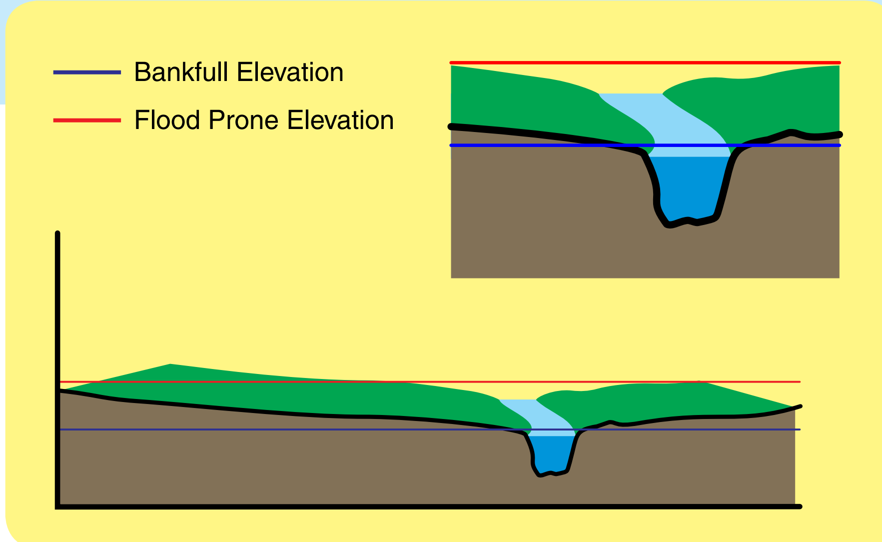
E Stream

The E stream type is the most stable stream type and is the potential natural channel for many streams in North Dakota. E channels are slightly entrenched (entrenchment ratio > 2.2), have a narrow and deep channel (width/depth ratio <12), and moderate to high sinuosity (> 1.5).

These streams typically have a large floodplain unless floodplain development is restricted by the valley. This happens when an E stream develops in a former F stream type. An E stream is able to access the floodplain easily during bankfull flood events.

The water table associated with this stream type is elevated, supporting the expansion of highly productive riparian plant communities. A healthy riparian plant community is required to maintain a stable E stream.

Disturbances that alter streambank vegetation resulting in the replacement of deep-rooted riparian plant species by shallow rooted upland species can destabilize streambanks and increase sediment loads. These changes make the stream at risk of transitioning to a less stable or unstable stream type.



E streams are narrow and deep like this perennial reach. (Jeff Printz, NRCS)

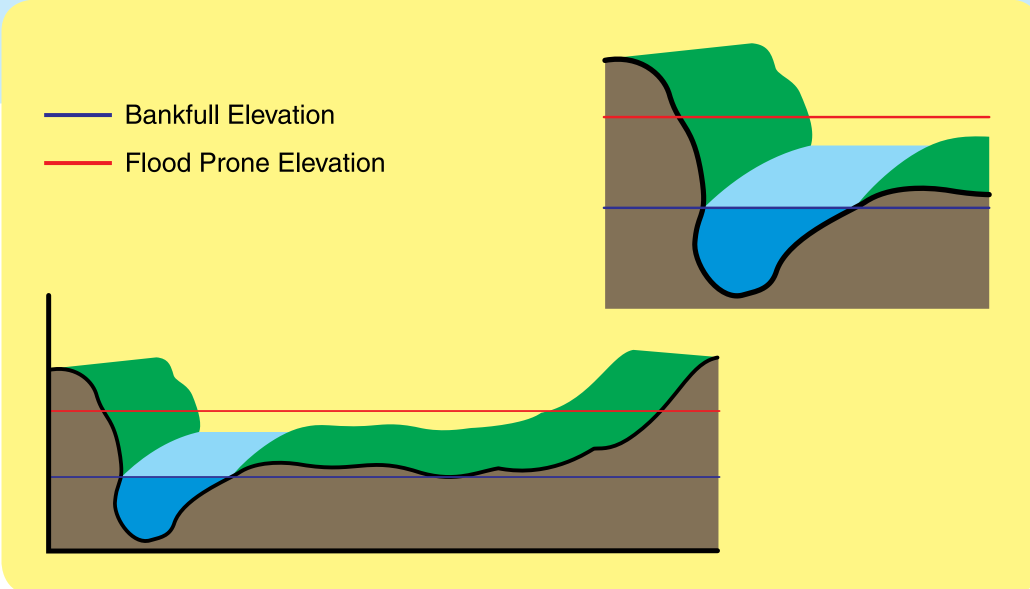
E streams have well-developed floodplains such as the one associated with this intermittent reach. (Jeff Printz, NRCS)

C Stream

The C stream type is characterized by active lateral movement, with material being removed from outer bends (cut banks) and deposited on inner bends (point bars). C channels are slightly entrenched (entrenchment ratio > 2.2), have a moderate to high width-to-depth ratio (>12) and moderate to high sinuosity (> 1.2).

The C channel is the potential natural channel for some streams in North Dakota that have sands as the dominant channel material. Due to the active lateral movement of C streams, they have a high sediment supply unless streambanks are well-vegetated. These streams typically have a well-defined floodplain with numerous fluvial features (terraces) as a result of deposition during flood events. Each of these features supports a different plant community, the composition of which is dictated by the depth to the water table.

A healthy riparian plant community is required to maintain a stable C stream or facilitate the transition to a more stable E channel (if that is the potential natural channel for the site). A healthy greenline plant community traps sediments, aiding in floodplain development. Disturbances that alter streambank vegetation can result in the replacement of deep-rooted riparian plant species by shallow-rooted upland species can destabilize streambanks and alter sediment loads. These changes make the stream at risk of transitioning to a less stable or unstable stream type.



C channels are characterized by point bar formation as a result of deposition on the inner bends. Note the point bar formation on the perennial stream in western North Dakota. (Miranda Meehan, NDSU)

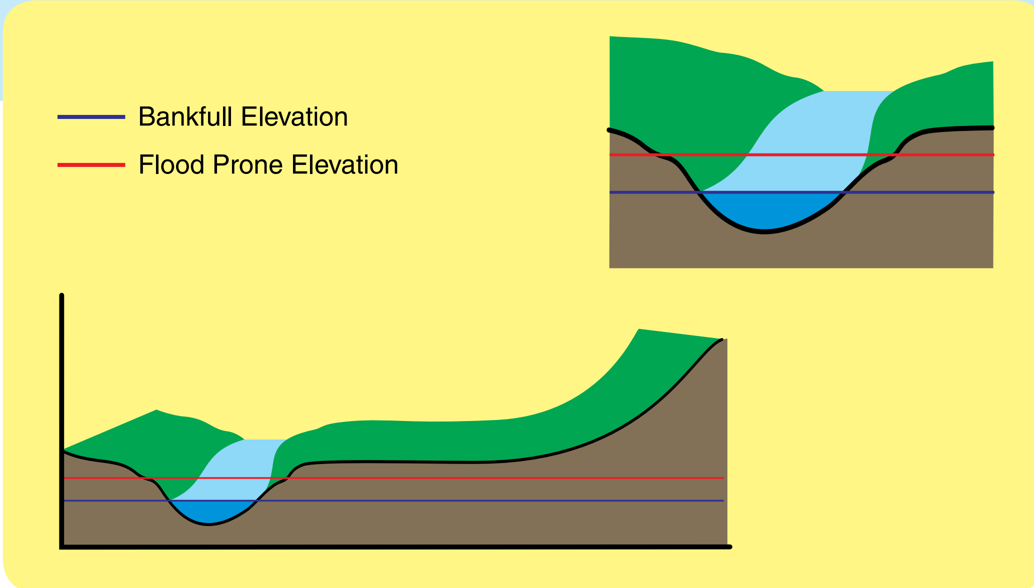
As the floodplain develops, point bars are stabilized by riparian vegetation, as seen along this reach of a perennial stream in eastern North Dakota. (Miranda Meehan, NDSU)

C stream type along a reach of an intermittent stream in western North Dakota. (Jeff Printz, NRCS)

B Stream

The B stream type is characterized as having a parabolic shape and is the most widely documented channel in North Dakota to date. This shape makes this a very stable stream with stable streambanks. B channels are moderately entrenched (entrenchment ratio of 1.4-to-2.2), with a moderate width-to-depth ratio (> 12) and moderate to high sinuosity (> 1.2).

In North Dakota, the channel material of this streams is silts/clays (denoted by a 6) or sands (denoted by a 5). This stream is indicative of past disturbance because it is a stabilizing channel that is associated with the early stages of floodplain development. These streams typically have a very narrow floodplain consisting of early successional riparian species.



B streams have a parabolic or U-shape, as seen on the intermittent stream. (Miranda Meehan, NDSU)

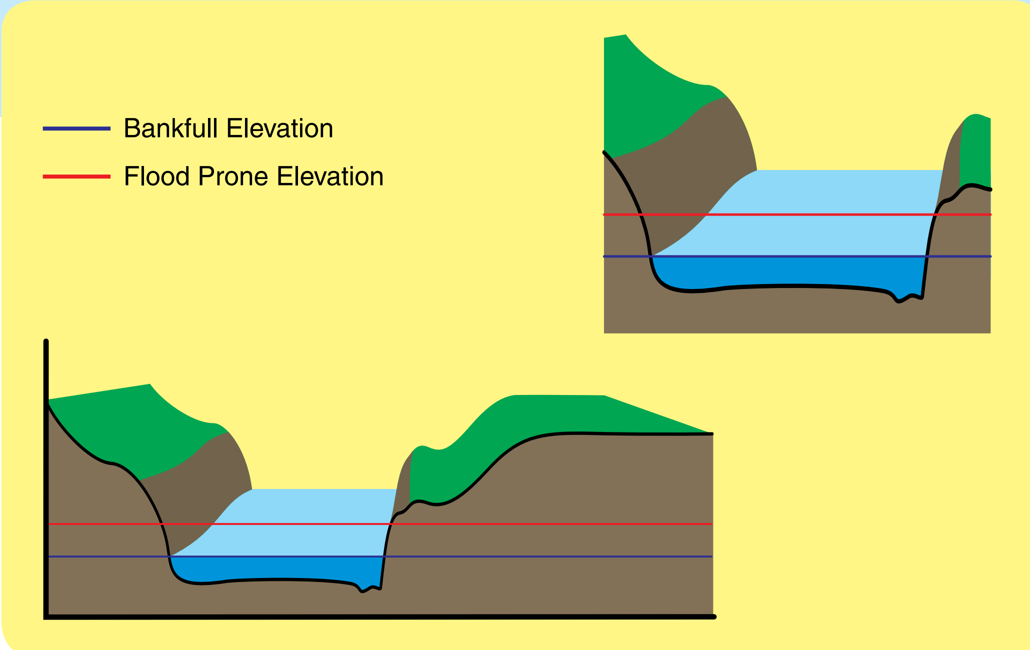
The floodplains of B streams are narrow, like those associated with this reach of a perennial stream in eastern North Dakota. (Miranda Meehan, NDSU)

Floodplain plant communities associated with B streams often are inhabited by early successional plants, as seen along this reach of a perennial stream in eastern North Dakota. (Miranda Meehan, NDSU)

F Stream

The F stream type is an unstable channel that is shaped like a trough, with a wide, flat bottom and vertical sides. F channels are entrenched (entrenchment ratio <1.4) and do not have an active floodplain. These streams are wide and shallow (width-to-depth ratio > 12) and relatively straight (sinuosity is >1.2), when compared with the potential natural channels.

In North Dakota, the channel material of this stream is silts/clays (denoted by a 6) or sands (denoted by a 5). Because the stream is unable to access the floodplain, it places increased force on streambanks during flood events, resulting in increased erosion, sediment loads and channel widening. However, this process is required to facilitate floodplain development and the transition to a stable B, C or E channel.



F streams are trough-shaped and wide, with a flat bottom and nearly vertical sides, as seen in this intermittent stream in western North Dakota. (Jeff Printz, NRCS)

F streams are shallow as a result of the high width-to-depth ratio, with perennial reaches having little to no flow during dry periods. (Miranda Meehan, NDSU)

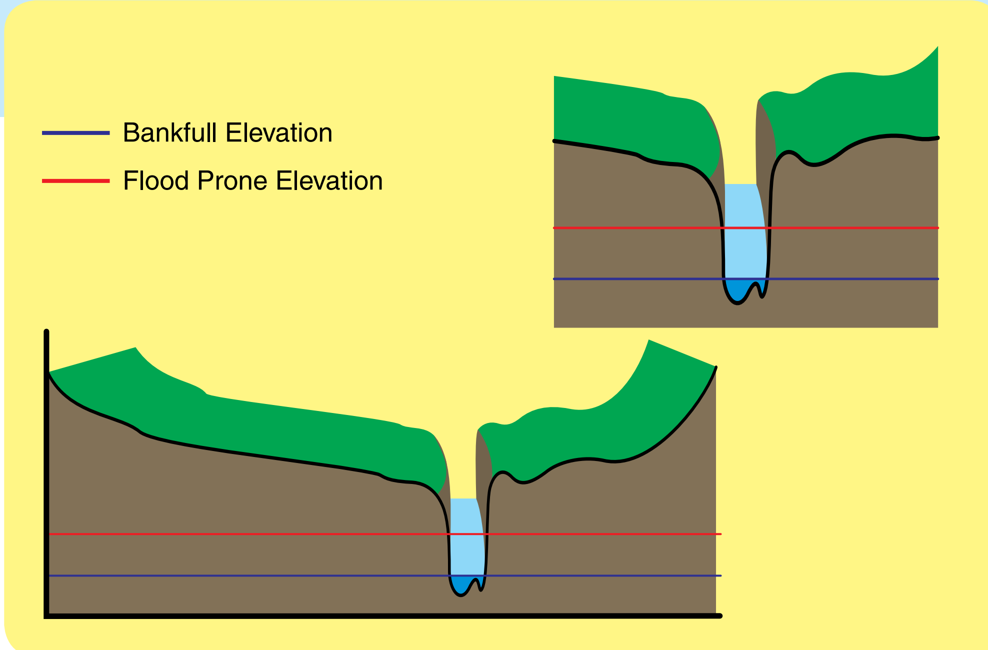
F channels do not leave the channel during flood events and have no floodplain. (Miranda Meehan, NDSU)

G Stream

The G stream type is highly unstable with a gullylike channel that is narrow and very deep (width-to-depth ratio <12). G channels are entrenched (entrenchment ratio <1.4), having lost connection to the floodplain due to down-cutting. Down-cutting is often a response to changes in grade and increased sediment loads.

These streams are relatively straight (sinuosity is >1.2), when compared with the potential natural channels, decreasing sinuosity, and increasing the speed and force of floodwaters.

Because the stream is unable to access the floodplain, the increased force leads to increased erosion of the streambank, sediment loads, and channel down-cutting and widening. The high instability of this channel in North Dakota is increased by the erodibility of silts/clays and sands channel material. As a result, these streams often quickly transition to F streams.



G streams are gully- or trench-shaped, being narrow and deep with no floodplain. (Miranda Meehan, NDSU)

Riparian Plant Community Components

Riparian complex ecological sites consist of numerous plant communities called plant community components (PCC), with each associated with a different fluvial surface. PCCs are assigned a number based on their respective location to the stream, with PCC1 being nearest to the stream.

The composition of each of these components depends on flooding frequency, depth to the water table and channel material. The species within each PCC vary depending on MLRA, valley type, and the dominant channel material.

Riparian complex sites across North Dakota exhibit between two and five PCCs. The PCCs associated with a site and the percentage of each are a function of the stream type. PCCs dominated by riparian species are associated with stream types B, C and E, and are often absent at sites with stream type G or F (see STM in Figure 3).

While changes in stream type influence PCCs, similarly changes within PCCs can lead to changes in stream type. This is especially true of changes within the PCC1, the greenline plant community, which occurs at the water's edge. The greenline community generally occurs within the bankfull elevation (or slightly higher), and is maintained by seasonal flows and a local water table.

Considerable scouring occurs in this portion of the floodplain on an annual basis, so the plants in this community are adapted to this frequent disturbance and function to protect and stabilize banks. Riparian plants have many growing points, enabling them to produce many stems and deep roots that help stabilize stream banks.

Stream with a well-defined greenline plant community consisting of deep-rooted riparian species. (Jeff Printz, NRCS)

The greenline plant community (PCC1) is subject to damage by natural forces that include extreme flooding and drought, and anthropogenic actions including channel modification (bridges, crossings, straightening), improper grazing management and crop production. Overgrazing tends to facilitate the invasion of Kentucky bluegrass, a shallow-rooted upland species; however, the absence of grazing within the northern Great Plains makes sites susceptible to invasion by smooth brome, another shallow-rooted upland species.

Disturbance can result in the plant community being replaced by shallow-rooted upland species that are not capable of protecting and stabilizing banks. This results in the formation of tensile cracks, bank sloughing, and accelerated lateral and vertical channel movement (unstable state). In the unstable channel phases, the PCC1 is lost and the stream is subject to extreme bank and bed erosion.

Tensile cracks on streambank where riparian species have been replaced by Kentucky bluegrass. (Miranda Meehan, NDSU)

Bank sloughing along stream reach where riparian species have been replaced by smooth bromegrass, resulting in widening of stream channel. (Miranda Meehan, NDSU)

Glossary

Abandoned terrace: A terrace that is no longer connected to the stream or water table and is inhabited by upland plants.

Alluvial valley: A broad valley with gentle down-valley relief that has a well-developed floodplain and numerous glacial and alluvial terraces.

At-risk: A site that is in a stable state but could cross the threshold and become unstable because it is slowly becoming degraded. An example is a stream reach that has a high potential to transition to a less-stable or unstable stream type if management is not changed.

Bankfull elevation: The elevation where the stream leaves the channel and enters its floodplain.

Bankfull flow: The channel-forming flow, which occurs, on average, every 1.5 years.

Base flow: Stream flow where the water is provided by ground water seepage.

Bed: The bottom of the stream channel. The bed of an ephemeral stream is always above the water table, whereas the bed of a perennial stream is below the water table.

Channel: The portion of the stream that transports water and sediments flowing within the streambanks.

Channel substrate: The materials (sand, silt and clay) that make up the channel bed.

Climate: The prevailing environmental conditions in a region, such as precipitation, temperature and wind.

Deposition: The process of soil and other materials settling out of the water column and being left behind when the flow is no longer sufficient to transport them. A point bar would be an example of a depositional feature.

Disturbance: A change in conditions that causes a change in ecosystem processes, such as fire or heavy grazing.

Drought: A prolonged time without precipitation, or receiving below-average precipitation.

Ecological site description: A detailed description of a unit of land with a unique set of biotic and abiotic factors that is capable of producing a distinct riparian complex and plant communities.

Entrenchment: The process of a stream becoming vertically contained as it incises into the valley floor, lowering the water table.

Entrenchment ratio: Flood prone width (at the elevation twice the maximum depth) ÷ bankfull width. A measure of the stream's ability to access its floodplain. A low entrenchment ratio indicates the stream has incised, whereas a high entrenchment ratio indicates the stream has a well-developed floodplain.

Ephemeral stream: Streams that have flow for short periods of time in direct response to precipitation; water is transported only during and immediately after precipitation events. The bed of an ephemeral stream always is above the water table.

Erosion: The wearing away of land surfaces by the action of ice, water and wind.

Floodplain: A relatively flat area adjacent to a river channel constructed by the river overflowing during moderate-flow events. The floodplain helps dissipate energy during high-flow events.

Flood prone: The active floodplain and lower terraces, and is qualitatively defined as two times the maximum bankfull depth. This elevation often is associated with the 50-year floodplain.

Fluvial activity: Activity relating to the stream, such as flooding.

Fluvial surfaces: These are the floodplains and terraces associated with a stream.

Geology: The parent materials, structures and processes that create the landscape.

Geomorphology: The topography, or relief of an area (land form).

Grazing: The consumption of plant biomass by herbivores.

Greenline: Occurs within the bankfull elevation (or slightly higher) and is maintained by seasonal flows and a local water table. The greenline plant community is critical for bank stabilization.

Herbivore: An animal that consumes vegetation for food.

Hydrology: The way water moves and interacts with the landscape.

Hydrologic processes: Processes that influence hydrology and flow, such as relief, climate, precipitation, evaporation, infiltration and ground water.

Intermittent stream: Has a channel that only contains water for a portion of the year, typically in the spring, and then flow decreases and/or stops in late summer and fall. The position of the stream channel in the relation to water table fluctuates throughout the year.

Major land resource area: This is a broad geographic area that is characterized by a particular pattern of geology, soils, climate, water resources, vegetation and land use.

Management objective: A goal or objective that is desired to be achieved through management of rangeland resources.

Monitoring: The process of observing and recording data to find a trend.

Lacustrine valley: A valley that formed within an old lake bed. This valley type is described as a very wide valley with gentle slopes.

Lateral movement: The ability of streams, particularly C stream types, to erode at their banks and move laterally (meander) within their valley.

Parent material: The material (primary minerals) that the soil formed from through pedogenesis.

Perennial stream: A stream that has defined channels that contain water throughout the year, given normal precipitation. The bed of the stream channel is below the water table, with ground water providing the base flow level of the stream.

Plant community: An assemblage of plants that occur and interact with each other within a similar area, such as an ecological site or fluvial surface.

Plant community component: Plant communities that change have different species based on flooding frequency, depth to water table and channel materials.

Point bar: An alluvium depositional feature that is made on the inside of a stream bend of a meandering stream.

Potential natural channel: Describes the stream channel and plant community components that would have occupied the site historically.

Precipitation: The condensation of water vapors that fall to Earth's surface as rain, sleet, snow or hail.

Reference state: The state that is believed to have occupied the site historically, prior to European settlement.

Restoration: To return a site to a pristine and previous state.

Riffle: Shallowest portion of a stream located at the tail of a pool.

Riparian complex: The ecosystem associated with a stream and consisting of multiple surfaces, each of which supports a unique plant community.

Riparian complex ecological site: A unit of land with a unique set of biotic and abiotic factors that is capable of producing a distinct riparian complex and plant communities.

Riparian ecosystem: An ecosystem that is highly dynamic and continuously changing due to the dynamic nature of streams, and bordered by uplands.

Riparian vegetation: Vegetation that is hydrophilic, or water-loving, and aids in bank stabilization.

Sinuosity: A measurement of how much a stream curves (meanders); it's calculated as stream length ÷ valley length.

Soil: A combination of mineral and organic material that formed on the surface of the Earth through weathering. Soil serves as a medium for plant growth.

Stability: The resistance of a site to change states.

State: A site that is resistant to change; its possible pathways for change are described in the state-and-transition model.

State-and-transition model: A diagram that predicts how an ecological site will change in response to various disturbance regimes.

Stream gradient: A measurement of slope that is found by measuring the differences in elevation of points taken along a stream.

Stream morphology: Channel characteristics that define the stream type, such as the dimensions and pattern on which the stream has developed.

Stream reach: A portion of a stream that is uninterrupted, or under similar management and state.

Stream type: Streams are categorized into eight different stream types based on their morphological characteristics, which give insight to how they may behave.

Streamflow: Characteristic of a stream that describes how regularly water flows through the channel, based on the water table's relationship with the stream bed.

Terrace: A level strip of land that buffers a stream; has sloping sides that may lead to an older terrace on the opposite side of the stream.

Threshold: A critical point in space and time between two states that is driven by disturbance. When crossed, a site will transition into a different state, and substantial energy and time will be required to revert back to a stable state.

Transition: A change in the state of a site that is triggered by natural and/or anthropogenic disturbances.

Topography: The physical landscape we see created by natural and man-made features.

Unstable channels: Channels that are highly erosive and entrenched, and have no floodplain.

Uplands: Lands that are influenced minimally by hydrology because of their elevated relationship to the water table.

Upland plant species: Plants that are not found in wetlands and do better in areas of lower soil moisture. They oftentimes do not have extensive root systems to help maintain bank stability.

Utilization: Refers to use primarily by herbivores by consuming and trampling vegetation.

Valley: A drainage basin that has been shaped by erosional and depositional process.

Valley type: A classification of valleys based on their formation and landform that influences what suite of stream types can be found within them.

Water table: The level where the soil is completely saturated with water.

Watershed: The entire drainage basin that supplies water to a stream.

Width-to-depth ratio: The bankfull width ÷ average bankfull depth.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