Ecological site group 054XY000ND
Lotic Riparian Complex

Last updated: 04/24/2024
Accessed: 04/24/2024

Key Characteristics

None specified

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

Climate

MLRA 54 is considered to have a continental climate - cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are characteristic. The climate is the result of this MLRA's location in the geographic center of North America. There are few natural barriers on the northern Great Plains. The air masses move unobstructed across the plains and account for rapid changes in temperature. \nAnnual precipitation ranges from 14 to 18 inches per year. The normal average annual temperature is about 42 degrees F. January is the coldest month with average temperatures ranging from about 13 degrees F (Beach, ND) to about 72 degrees F (Timber lake, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 57 degrees F. This large annual range attests to the continental nature of this MLRA's climate. Hourly winds are estimated to average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.\nGrowth of native cool-season plants begins in late March and continues to early to mid-July. Native warm-season plants begin growth in mid-May and continue to the end of August. Green up of cool-season plants can occur in September and October when adequate soil moisture is present.\nThis site occurs within the Knife River Watershed, located in the Missouri Plateau portion of the Northwestern Great Plains Region of North Dakota (Severson and Sieg 2006). The landscape of the Unglaciated Plains is classified as a semiarid rolling plain of shale and sandstone with areas of buttes and badlands. The Missouri Plateau, which is located to the west of the Missouri River, this region was not impacted by glaciation and as a result retained its original soils and hydrologic patterns. The valleys of the streams in MLRA 54 were developed by down-cutting of the prehistoric Missouri River system through the soft sandstone and shale that make up the Fort Union Formation that is comprised of a group of Paleocene Epoch formations including: Sentinel Butte, Bullion Creek, Slope, Cannonball, and Ludlow (Bluemle and Biek 2007). The surrounding landscape is comprised of highly erodible sediments overlaid by a protective layer of sandstone and/or limestone. Erosion of sedimentary material over time has resulted in the entrenchment of streams and the formations of multiple terraces. The floodplain is composed primarily of sands with silts and clays present in the banks.\nThe soils that have developed on the floodplains of Spring Creek and Knife River are derived from material of a similar geological formation. Both of the streams cut through the Sentinel Butte Formation, with minor amounts of sediment coming from higher elevations that contain White River Group, Golden Valley Formation, and glaciated materials.\nThe two sites are different in how the soils have developed. The developmental differences of these soils indicates the amount and how the sediments are eroded or deposited depending on where you are at in the watershed. At the beginning of the watershed in the case of the Spring creek site, the sediment load isn't as great and does not bury the existing soil surface beyond the bankflow area. This allows for a more stable landform and increased vegetation which is needed in the development of the Mollisols soil order. The Knife River has a greater sediment load and will deposit more sediments as the water flow slows. The sediments that are deposited will bury the existing soil surface. When this occurs, there is not enough time for the soil to develop and lack of vegetation to improve the soil, so the Entisols soil order occurs; which is the first soil order in the soil development process.\nThe soils on the floodplain landform (bankflow) are Aquents. The Spring creek site is a Typic Psammaquent and the Knife River site is a Typic Fluvaquent. The soils have developed from different particle-sizes, but otherwise the soils are similar in how water is influencing the soil. These two soils will occur on this landform anywhere along the two

stream systems. After the first landform, the soils of the two sites are different. The soils at the Spring creek site have developed into Mollisols. The soils are as follows: floodplain step classified as a Fluventic Endoaquoll; the low terrace also classified as a Fluventic Endoaquoll, but if the upland water flow had not occured at this site that caused an elevated water table, it wold have classified as a Fluventic Haplustoll; the high terrace classified as a Fluventic Haplustoll. The soils at the Knife River site are as follows: the soil on the floodplain step classified as an Aeric Fluvaquent; the low terrace was not investigated, but form observation and tacit knowledge of the soils that occur at these positions, the soil would classify similar to an Oxyaquic Ustifluvent; the high terrace classified as a Fluventic Haplustoll, which is similar to the Spring Creek site, except the soil textures were different.\nThe salinity that is recorded was from field observations at the sites. There was very little salinity observed in the soils at both sites, so the values recorded are from none to slight salinity. At the Spring Creek site, there are areas that were downstream that appeared to have moderate salinity and at the Knife River site, slight salinity was noticed along the stream edge.

Vegetation dynamics

MLRA 54 is considered to have a continental climate - cold winters and hot summers, low humidity, light rainfall, and much sunshine. Extremes in temperature are characteristic. The climate is the result of this MLRA's location in the geographic center of North America. There are few natural barriers on the northern Great Plains. The air masses move unobstructed across the plains and account for rapid changes in temperature. \nAnnual precipitation ranges from 14 to 18 inches per year. The normal average annual temperature is about 42 degrees F. January is the coldest month with average temperatures ranging from about 13 degrees F (Beach, ND) to about 72 degrees F (Timber lake, SD). The range of normal average monthly temperatures between the coldest and warmest months is about 57 degrees F. This large annual range attests to the continental nature of this MLRA's climate. Hourly winds are estimated to average about 11 miles per hour annually, ranging from about 13 miles per hour during the spring to about 10 miles per hour during the summer. Daytime winds are generally stronger than nighttime and occasional strong storms may bring brief periods of high winds with gusts to more than 50 miles per hour.\nGrowth of native cool-season plants begins in late March and continues to early to mid-July. Native warm-season plants begin growth in mid-May and continue to the end of August. Green up of cool-season plants can occur in September and October when adequate soil moisture is present.\nThis site occurs within the Knife River Watershed, located in the Missouri Plateau portion of the Northwestern Great Plains Region of North Dakota (Severson and Sieg 2006). The landscape of the Unglaciated Plains is classified as a semiarid rolling plain of shale and sandstone with areas of buttes and badlands. The Missouri Plateau, which is located to the west of the Missouri River, this region was not impacted by glaciation and as a result retained its original soils and hydrologic patterns. The valleys of the streams in MLRA 54 were developed by down-cutting of the prehistoric Missouri River system through the soft sandstone and shale that make up the Fort Union Formation that is comprised of a group of Paleocene Epoch formations including: Sentinel Butte, Bullion Creek, Slope, Cannonball, and Ludlow (Bluemle and Biek 2007). The surrounding landscape is comprised of highly erodible sediments overlaid by a protective layer of sandstone and/or limestone. Erosion of sedimentary material over time has resulted in the entrenchment of streams and the formations of multiple terraces. The floodplain is composed primarily of sands with silts and clays present in the banks.\nThe soils that have developed on the floodplains of Spring Creek and Knife River are derived from material of a similar geological formation. Both of the streams cut through the Sentinel Butte Formation, with minor amounts of sediment coming from higher elevations that contain White River Group, Golden Valley Formation, and glaciated materials.\nThe two sites are different in how the soils have developed. The developmental differences of these soils indicates the amount and how the sediments are eroded or deposited depending on where you are at in the watershed. At the beginning of the watershed in the case of the Spring creek site, the sediment load isn't as great and does not bury the existing soil surface beyond the bankflow area. This allows for a more stable landform and increased vegetation which is needed in the development of the Mollisols soil order. The Knife River has a greater sediment load and will deposit more sediments as the water flow slows. The sediments that are deposited will bury the existing soil surface. When this occurs, there is not enough time for the soil to develop and lack of vegetation to improve the soil, so the Entisols soil order occurs; which is the first soil order in the soil development process.\nThe soils on the floodplain landform (bankflow) are Aquents. The Spring creek site is a Typic Psammaquent and the Knife River site is a Typic Fluvaquent. The soils have developed from different particle-sizes, but otherwise the soils are similar in how water is influencing the soil. These two soils will occur on this landform anywhere along the two stream systems. After the first landform, the soils of the two sites are different. The soils at the Spring creek site have developed into Mollisols. The soils are as follows: floodplain step classified as a Fluventic Endoaquoll; the low terrace also classified as a Fluventic Endoaquoll, but if the upland water flow had not occured at this site that caused an elevated water table, it wold have classified as a Fluventic Haplustoll; the high terrace classified as a Fluventic Haplustoll. The soils at the Knife River site are as follows: the soil on the floodplain step classified as an

Aeric Fluvaquent; the low terrace was not investigated, but form observation and tacit knowledge of the soils that occur at these positions, the soil would classify similar to an Oxyaquic Ustifluvent; the high terrace classified as a Fluventic Haplustoll, which is similar to the Spring Creek site, except the soil textures were different.\nThe salinity that is recorded was from field observations at the sites. There was very little salinity observed in the soils at both sites, so the values recorded are from none to slight salinity. At the Spring Creek site, there are areas that were downstream that appeared to have moderate salinity and at the Knife River site, slight salinity was noticed along the stream edge.

Major Land Resource Area

MLRA 054X
Rolling Soft Shale Plain

Stage

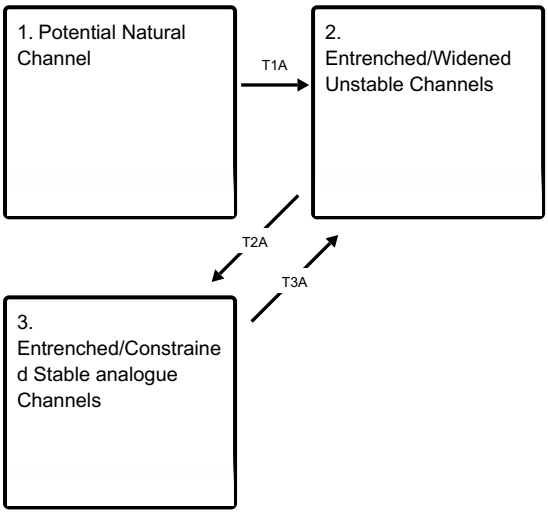
Provisional

Contributors

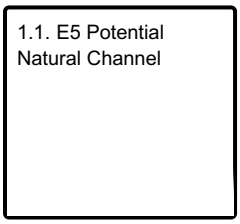
Curtis Talbot

State and transition model

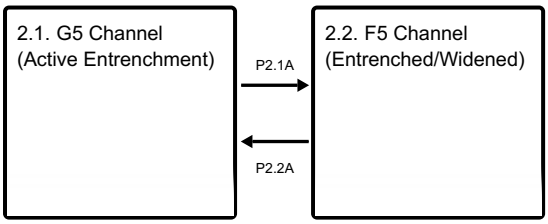
Ecosystem states



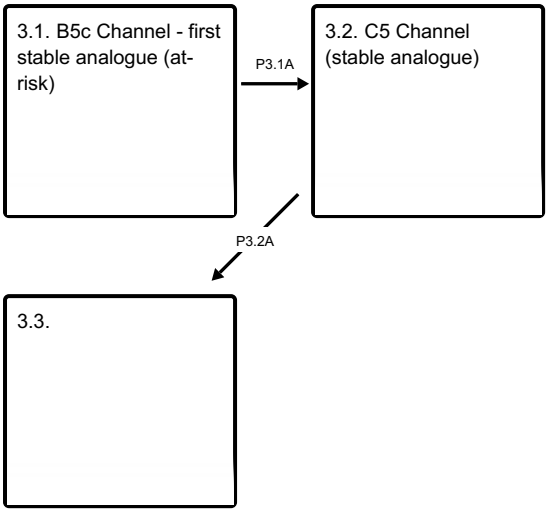
State 1 submodel, plant communities



State 2 submodel, plant communities



State 3 submodel, plant communities



State 1
Potential Natural Channel

This state includes the phase and plant community components believed to be the potential natural channel and incorporates the natural channel for the gradient and valley fill materials (E5) and fluvial surfaces that re freshened intermittently in order to produce the characteristic types of vegetation. This stream type is suited to handle the energy, water, and sediments supplied by the watershed and promote the plant community components that provide stability to the system. If undisturbed, this phase can supply the highest benefits and services from the riparian complex including, but not limited to: diverse, resilient plant community components that can withstand high flow events; significant fish and wildlife habitat; resistance to invasive species invasions; highest potential water quality and quantity; and ground water recharge and release. The natural disturbance regime within this state would have included beaver dam complexes which slowed stream flow rates, elevated water tables and reduced sediment loads; infrequent fires usually associated with periods of prolonged drought which, due to the fire tolerant nature of the plant species occupying these sites. Fire frequency would have been less on these sites as compared to the adjoining upland ecological sites due to increased fuel moisture associated with the greener vegetation; grazing by native herbivores which would have been attracted to these areas by the greener vegetation and reliable water supply, especially during periods of below normal precipitation or late summer months when upland vegetation is less palatable.

Management interpretations

Critical values	Interpretations

Community 1.1
E5 Potential Natural Channel

This channel and its associated fluvial surfaces and plant community components represent the highest expression of functioning and ecological services of the site. Streambanks have high percentages of stabilizing vegetation and channels are narrow and relatively deep with continuous flow connecting to downstream sites. habitat for amphibians and fish is very good. Beaver are active in constructing low statured dams that raise the local water table and positively influence riparian vegetation. An elevated water table permits an expansion of plant community component PCC2 (big bluestem/switchgrass/wheatgrass) with lesser amounts of PCC1 (prairie cordgrass/obligate sedge) forming a narrow strip adjacent to the water. The uplands adjacent to the riparian complex are dominated by big bluestem and needlegrasses.

State 2
Entrenched/Widened Unstable Channels

This state represents a set of degraded channels (G5c - F5) that have crossed a threshold by becoming vertically and laterally unstable resulting in moderately deep entrenchment and loss of floodplain and floodplain step

connectivity and vegetation. They are difficult, if not impossible to restore without changing profile, pattern, and dimension of the stream. These channels have little value for wildlife, fish, and water quality unless residual pools are deep enough to remain inundated between recharge or storm events that restore stream flows and reconnect isolated pools.

Community 2.1
G5 Channel (Active Entrenchment)

This channel phase is the result of loss of floodplain connectivity and vegetation (PCC1 and possibly PCC2) resulting in rapid vertical instability and deep entrenchment. The forces which cause the entrenchment continue to shape the channel into the next phase (F5) through bank sloughing and accelerated lateral movement.

Community 2.2
F5 Channel (Entrenched/Widened)

This channel continues the lateral expansion of Phase 2.1 resulting in an F5 channel. These channels are highly unstable and further disturbances can force these to quickly transform back into vertically unstable G5 channels. These channels are generally disconnected from the floodplain except for during extreme flooding events. As a result, PCC1 is non-existent and water tables in terraces are further lowered. Fish and wildlife habitat and water quality values are significantly lowered or absent. If carefully managed, these channels can begin to build new floodplains; allowing for increased sinuosity and the re-establishment of floodplain vegetative communities, both of which help dissipate energy.

Pathway P2.1A
Community 2.1 to 2.2

Lateral movement with significant bank erosion, increased sediment load and increase in width/depth ratio.

Pathway P2.2A
Community 2.2 to 2.1

Increased vertical instability and entrenchment from further loss of vegetation (similar to T1A). This may be caused by disturbances that remove stabilizing vegetation, natural flooding, ice or beaver dam failure. Significant increase in bank erosion although some stabilizing vegetation may increase.

State 3
Entrenched/Constrained Stable analogue Channels

This state includes channels that, after experiencing vertical and lateral instability and entrenchment, develop new floodplains within the entrenchment. Floodplain plant community components return to the incipient floodplains and streams develop new connectivity. Channel forming processes at bankfull are better able to handle the energy, flow, and sediments. Channels begin as B5c channels and with careful management, are able to develop E5 morphology with associated (although truncated) floodplains and terraces. Water tables are elevated and expand laterally. There is increased connectivity of upstream and downstream habitats resulting in improved fish and wildlife habitat and enhanced water quality. Some streams that have had the riparian vegetation removed and/or significantly changed may not develop the native plant community components. Where Kentucky bluegrass (*Poa pratensis*) or other shallow rooted grasses have taken over as dominant on the floodplain marginal bank stabilization will occur.

Community 3.1
B5c Channel - first stable analogue (at-risk)

This phase represents the channel evolution from F5 to B5c resulting from a reduction in the near vertical, unstable banks associated with the F5 channel to somewhat more stable, parabolic shaped B5c channel. The lack of an established floodplain and associated stabilizing vegetation makes this phase unstable "At-Risk" phase which can quickly transtion to the F5 channel via transitional pathway T3A. Further rehabilitation of this phase may be limited by intense farming activities (to the stream's edge), inappropriate livestock grazing, invasive species, or other

disturbances (drought, large floods). If the native vegetation is not present or sources are not locally available, the phase is considered to be at-risk of crossing a threshold (T3A) to state 2.

Community 3.2
C5 Channel (stable analogue)

This phase represents the channel change from B5 to C5 post-entrenchment that develops a new floodplain, moves laterally creating cut banks, and depositional areas on the insides of channel bends. Riparian vegetation is able to return to the newly cut/deposited floodpalin. Incipient vegetation which does not have superior bank holding attributes can make this an "At-Risk" channel. Disturbances that remove vegetation and affect bank stability (i.e. excessive trampling, farming practices, and prolonged flood) can result in a transition to one of the phases in State 2. Careful management allowing natural forces to shape the channel and adequate seed sources for more desirable, deep rooted riparian bank vegetation can move this phase towards the stable analogue, phase 3.3. If the native vegetation is not present or sources are not locally available, the phase is considered to be at-risk of crossing a threshold (T3A) to state 2.

Community 3.3

Pathway P3.1A
Community 3.1 to 3.2

The B5/6c channel will eventually (with proper management that increases bank stabilizing vegetation and normal flow variability) develop a small floodplain within the entrenched area, forming point bars and slight cut banks. This pathway may require particularly long time periods to complete due to the stability of phase 3.1.

Pathway P3.2A
Community 3.2 to 3.3

Increase of desirable greenline vegetation, sediment trapping, expansion of water table, and widening of floodplain (increased sinuosity, energy, and sediment transport balance). Stream narrows and deepens. Increased connectivity to floodplain. Bank height ratio decreases (3.3).

Transition T1A
State 1 to 2

Entrenchment of reference E channel due to loss of vegetation (obligate and facultative wet plant functional groups), increased bank erosion, and down cutting. this transition may be initiated by overgrazing and changes in upland management likely following European settlement.

Restoration pathway T2A
State 2 to 3

Rehabilitation of entrenchment with stabilizing herbaceous vegetation (increased connectivity and/or formation of new floodplain and return to better energy and sediment balance). Multiple plant community components present on fluvial surfaces. May be significant decreases in bank height ratios.

Transition T3A
State 3 to 2

Disturbance results in entrenchment of stable analogue channels (Bc, C, or E) due to loss of vegetation (obligate and facultative wet plant functional groups), increased bank erosion, and down cutting.

Citations