USDA Natural Resources Conservation Service

Ecological site F043CY503OR
Mountain Riparian Forest (PIEN/ALIN)

Last updated: 9/08/2023
Accessed: 05/19/2024

General information

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.

MLRA notes

Major Land Resource Area (MLRA): 043C–Blue and Seven Devils Mountains

This MLRA covers the Blue and Seven Devils Mountains of Oregon, Washington and Idaho. The area is characterized by thrust and block-faulted mountains and deep canyons composed of sedimentary, metasedimentary, and volcanic rocks. Elevations range from 1,300 to 9,800 feet (395 to 2,990 meters). The climate is characterized by cold, wet winters and cool, dry summers. Annual precipitation, mostly in the form of snow, averages 12 to 43 inches (305 to 1,090 millimeters) yet ranges as high as 82 inches (2,085 millimeters) at upper elevations. Soil temperature regimes are predominately Frigid to Cryic and soil moisture regimes are predominately Xeric to Udic. Mollisols and Andisols are the dominant soil orders. Ecologically, forests dominate but shrub and grass communities may occur on south aspects and lower elevations as well as in alpine meadow environments. Forest composition follows moisture, temperature and elevational gradients and typically ranges from ponderosa pine and Douglas-fir plant associations at lower elevations, grand fir at middle elevations and subalpine fir and Engelman spruce at upper elevations. Historical fire regimes associated with these forest types range from frequent surface fires in ponderosa pine - Douglas Fir forest types to mixed and stand replacing fire regimes in grand fir and subalpine fir types. A large percentage of the MLRA is federally owned and managed by the U.S. Forest Service for multiple uses.

Classification relationships

Mid-Montane Wetland Plant Associations of the Malheur, Umatilla and Wallowa-Whitman National Forests (1997):
Engelmann spruce/arrowleaf groundsel - CEF335 (Modal)
Engelmann spruce/Columbia brome - CEM125
Engelmann spruce/redosier dogwood - CES511
Lodgepole pine/bluejoint reedgrass - CLM117
Mountain alder-currants/mesic forb - SW2217
Subalpine fir/arrowleaf groundsel - CEF333

Plant Assoc. of Wallowa-Snake Province (R6 E 255-86)
Engelmann spruce/common horsetail-twistedstalk - CEM221

Riparian and Wetland Vegetation of Central and Eastern Oregon (2004):
Engelmann spruce/Common horsetail Association - CEGL000363
Engelmann spruce/Mountain alder-Red-osier dogwood Association - CEGL000892
Engelmann spruce/Columbia brome Association – New type
Mountain alder-prickly currant-stinking swamp currant Association - CEGL001151
USDA Forest Service Ecological Sub-region
M332 “Blue Mountains”
U.S. National Vegetation Classification (NVC) Standard
Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest & Woodland - Group-219
Rocky Mountain Mesic-Wet Subalpine Fir-Engelmann Spruce Forest - Alliance-3614

LANDFIRE Biophysical Setting Model:
0710560 - Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest and Woodland

Ecological site concept

This ecological site represents a broad group of plant communities existing in riparian forest environments of the Blue and Wallowa mountains of Oregon and Washington. These communities are typically dominated by Engelmann spruce (Picea englemanni) and a diverse understory of facultative and obligate wetland plant species that often includes gray alder (*Alnus incana*). This site is typically found adjacent to moderate gradient streams in mountain valleys at moderate to high elevations. Deep, mineral soils with subsurfaces often containing a high composition of coarse fragments, typify the soils. Due to the nearby stream courses, high water tables favor plant species that can tolerate saturated soils for at least part of the year. Historically, climatic cycles acting on watershed hydrology would have controlled ecological dynamics and geomorphic processes.

This is a provisional ecological site that groups characteristics at a broad scale with little to no field verification and is subject to extensive review and revision before final approval. All data herein was developed using existing information and literature and should be considered provisional and contingent upon field validation prior to use in conservation planning.

Associated sites

F043CY601OR	**Cold Wet Conifer Mountains and Plateaus (ABLA/VASC-VAME)** Adjacent cryic forested landforms out of the hydrologic influence of stream channels
R043CY501OR	**Cold Wet Mountain Meadow (CAREX)** Adjacent wet meadow areas with low slopes
F043CY503OR	**Mountain Riparian Forest (PIEN/ALIN)** Adjacent moist meadow areas with low slopes
F043CY605OR	**Cool Moist Conifer Mountains and Plateaus (PSME-PIPO/CARU)** Occupying forested areas nearby but out of the hydrologic influence of stream channels
F043CY603OR	**Cool Wet Conifer Mountains and Plateaus (ABGR/VAME/LIBO)** Occupying forested areas, at times on upper terrace positions nearby

Similar sites

R043CY501OR	**Cold Wet Mountain Meadow (CAREX)** Very low to low valley gradient, low energy soils

Table 1. Dominant plant species

Tree	(1) *Picea engelmannii*
Shrub	(1) *Alnus incana*
Herbaceous	Not specified

Physiographic features

This riparian site occurs on terraces, gravel bars, drainageways and floodplains adjacent to stream courses in narrow to broad mountain valleys. Occasionally, plant communities associated with this site may be found in wetlands. This site is subject to very rare to occasional flooding (1 to 50 times in 100 years), typically lasting from a few hours to two days. In reference condition, the floodplain is well connected to the primary channel. A water table is present and typically remains within 30 cm of the soil surface through the year but may fluctuate between 10 and 110 cm throughout the year. Valley gradients are typically moderate but range from low to moderately high. Elevations typically range from 4,200 to 4,800 feet (1,275 to 1,450 m) but may range from 3,100 to 6,600 ft (950 to 2,000 m).

Table 2. Representative physiographic features

Landforms	(1) Mountains > Flood plain (2) Mountains > Drainageway (3) Mountains > Terrace (4) Mountains > Bar
Flooding duration	Extremely brief (0.1 to 4 hours) to very brief (4 to 48 hours)
Flooding frequency	Very rare to occasional
Ponding frequency	None
Elevation	1,280–1,463 m
Slope	2–7%
Ponding depth	0 cm
Water table depth	10–30 cm
Aspect	Aspect is not a significant factor

Table 3. Representative physiographic features (actual ranges)

Flooding duration	Not specified
Flooding frequency	Not specified
Ponding frequency	Not specified
Elevation	945–2,012 m
Slope	0–10%
Ponding depth	Not specified
Water table depth	0–89 cm

Climatic features

The annual precipitation averages 25-40 inches (640 – 1010 mm), most of which occurs in the form of snow during the months of November through March. The soil moisture regime is typically Udic (with an Aquic or Oxyaquic subclass) but may also be Aquic (with a Typic or Aeric subclass). The soil temperature regime is Cryic (but may also be Frigid) with a mean air temperature between 37 to 43 degrees F (3 to 6 degrees C). The frost-free period ranges from less than 35 to more than 75 days. Where this site occurs toward its lower elevations, cold air pooling and cold subsurface flows often decrease air and soil temperatures relative to nearby sites. Climate graphs are populated from the closest available weather stations and are included to represent general trends rather than representative values.

Table 4. Representative climatic features

Frost-free period (characteristic range)	35-75 days
Freeze-free period (characteristic range)	
Precipitation total (characteristic range)	635-1,016 mm
Frost-free period (average)	65 days
Freeze-free period (average)	
Precipitation total (average)	762 mm

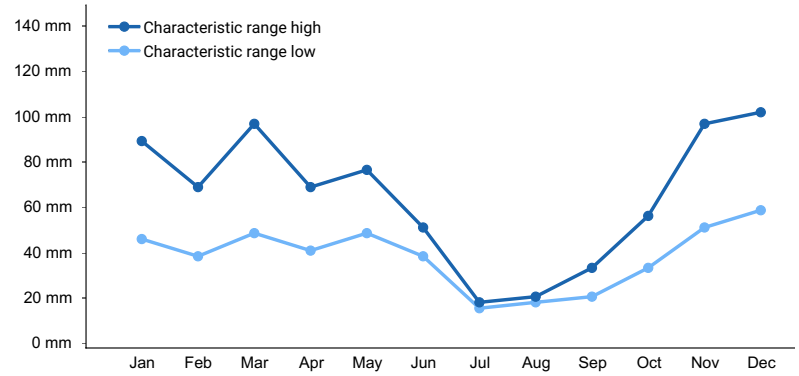


Figure 1. Monthly precipitation range

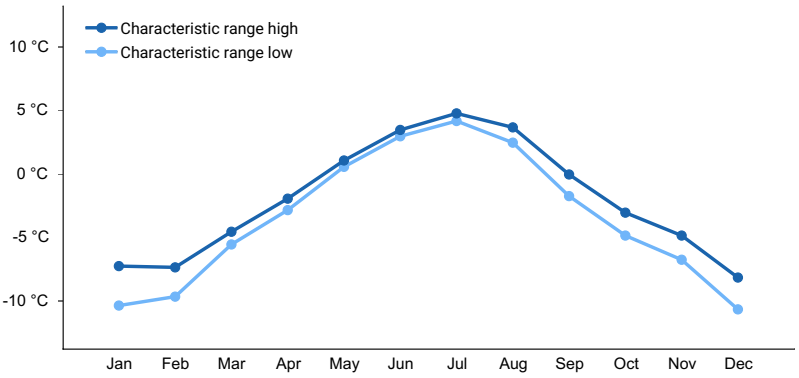


Figure 2. Monthly minimum temperature range

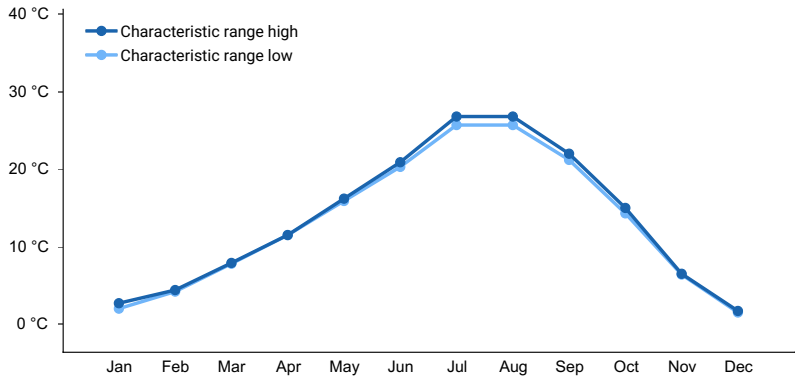


Figure 3. Monthly maximum temperature range

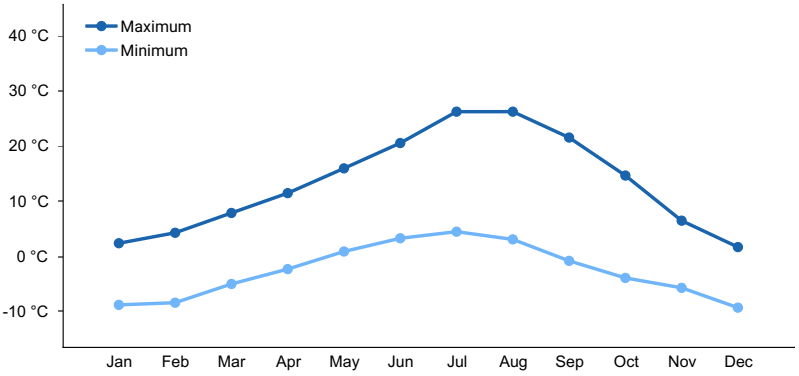


Figure 4. Monthly average minimum and maximum temperature

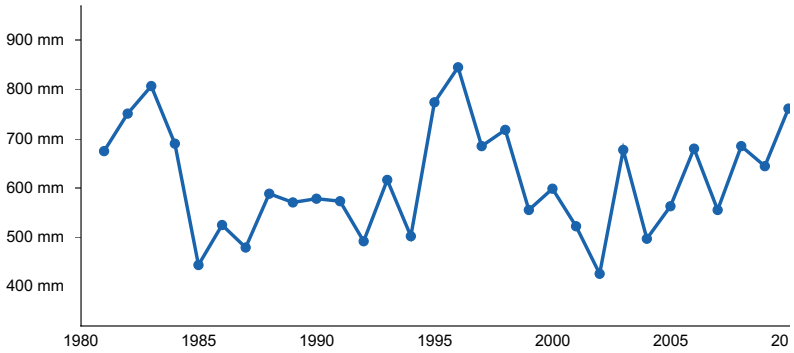


Figure 5. Annual precipitation pattern

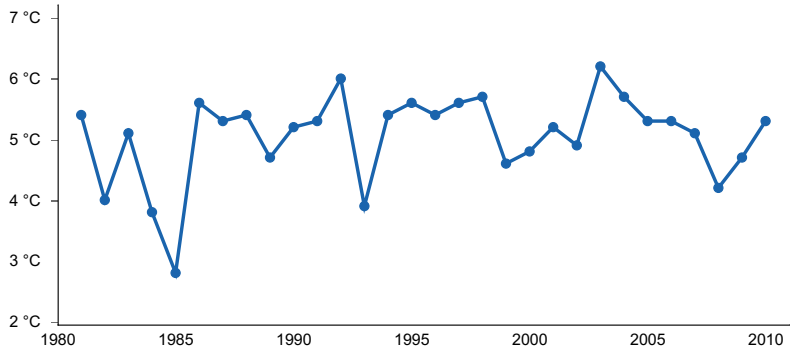


Figure 6. Annual average temperature pattern

Climate stations used

- (1) MEACHAM [USW00024152], Pendleton, OR
- (2) SENECA [USC00357675], Seneca, OR

Influencing water features

Frequent surface flows and long duration seasonal sub-surface flows from adjacent perennial and seasonal streams and associated uplands augment the precipitation. Duration and volume of flows during spring and summer will be dependent on snowpack within contributing watersheds, as well as vegetation type and cover, geology and watershed geomorphology. These processes will in part be controlled by the interactions of spring and summer air temperature and spring precipitation on melting and runoff.

Soil features

The soils of this site are typically recent, very deep and somewhat poorly drained to poorly drained. These soils are formed in alluvium from mixed sources. The family particle size is typically loamy-skeletal but may vary. Surface textures are often silt loams, ashy silt loams, gravelly silt loams or loams. Subsurface horizons often exhibit substantial rock content with very to extremely cobbly and very to extremely stony coarse fragment modifiers common. See Broadycreek and Geebarc for soil series often associated with this site concept.

Table 5. Representative soil features

Parent material	(1) Alluvium–volcanic and metamorphic rock
Surface texture	(1) Silt loam (2) Loam (3) Ashy silt loam (4) Gravelly silt loam
Family particle size	(1) Loamy-skeletal (2) Coarse-loamy (3) Fine-loamy

Drainage class	Somewhat poorly drained to poorly drained
Permeability class	Moderately slow to moderate
Depth to restrictive layer	152–203 cm
Soil depth	152–203 cm
Surface fragment cover <=3"	0–45%
Surface fragment cover >3"	0–45%
Available water capacity (0-101.6cm)	5.08–14.22 cm
Soil reaction (1:1 water) (0-101.6cm)	6.1–7.5
Subsurface fragment volume <=3" (10.2-152.4cm)	10–35%
Subsurface fragment volume >3" (10.2-152.4cm)	15–45%

Ecological dynamics

In its reference state, this site is dominated by an overstory of Engelmann spruce (Picea englemanni) and a diverse understory of facultative and obligate wetland plant species. Shrub species often include gray alder (*Alnus incana*), prickly currant (*Ribes lacustre*), stinking swamp currant (*Ribes hudsonianum*), and red-osier dogwood (*Cornus sericea* spp. sericea). Forbs often include arrowleaf groundsel (*Senecio triangularis*), sweet-scented bedstraw (*Galium triflorum*), brook saxifrage (*Saxifraga odontoloma*), american speedwell (*Veronica americana*), heart-leaved miner's lettuce (*Claytonia cordifolia*), sidebells pyrola (*Orthilia secunda*) and the fern ally common horsetail (*Equisetum arvense*). Graminoids may include tall mannagrass (*Glyceria striata*), drooping woodreed (*Cinna latifolia*), columbia brome (*Bromus vulgaris*), and soft-leaved sedge (*Carex disperma*). Understory trees such as grand fir (*Abies grandis*) and subalpine fir (*Abies lasiocarpa*) may be present, yet are less tolerant of saturated soils than Engelman spruce so will likely be found on raised hummocks or upper terrace positions. However, at the upper elevation limits of his site, subalpine fir may be a dominant overstory tree, especially on moist bench positions. This site also encompasses forested overstories of lodgepole pine (*Pinus contorta*) which are likely early seral communities that will be replaced by Engelman spruce overtime. Communities dominated by gray alder with subdominance of conifers may also occur within this site as early seral community types that will eventually succeed to conifer stands. Gray alder is an important species in these ecosystems, helping to enrich soils with nitrogen by hosting nitrogen-fixing actinomycetes in their roots.

Historically, the ecological dynamics of the site would have been influenced largely by climate cycles affecting seasonal snowpack, runoff, droughts, and flood. These processes would have been partly controlled by the type and cover of upslope forest vegetation throughout the watershed which would have modified water capture, storage and sediment supply. These upland dynamics would have been influenced by historical fire regimes and subsequently vegetation succession, erosion and runoff. In favorable habitats with lower channel gradients, beaver populations may have had impacts on water table depth and seasonality, frequency and duration of ponding and flooding, and stream channel structure. Natural transitions from alluvial bars to floodplains will decrease gray alder and favor the development of Engelmann spruce stands overtime. This occurs with the aggradation of fine-textured soil surface layers over coarse-textured materials thereby promoting the establishment of forested floodplains (Crowe et al. 2004).

These forests historically experienced infrequent fire (100+ year fire return interval, Landfire 2007) and when it did occur it was typically high severity and stand replacing. Fire frequency is influenced by the cold, wet climate and intensity is influenced by the low fire resistance of the dominant tree species. Engelman spruce has very low resistance to fire with high mortality occurring even with low intensity fires. This is the result of shallow rooting, thin bark and low hanging branches. Following fire, lodgepole pine may dominate young tree regeneration if a seed source is present due to its prolific seed production and establishment on newly burned sites. The superior shade tolerance of Engelmann spruce (as well as subalpine fir) will help to allow this species to outcompete lodgepole overtime in the absence of fire. Large increases in down woody debris would have likely occurred in the years following fire. Shrub species, especially gray alder, will dominate these communities following fire. Water tables may

also rise following fire yet site transitions following this process are likely ephemeral (Kovalchik 1987).

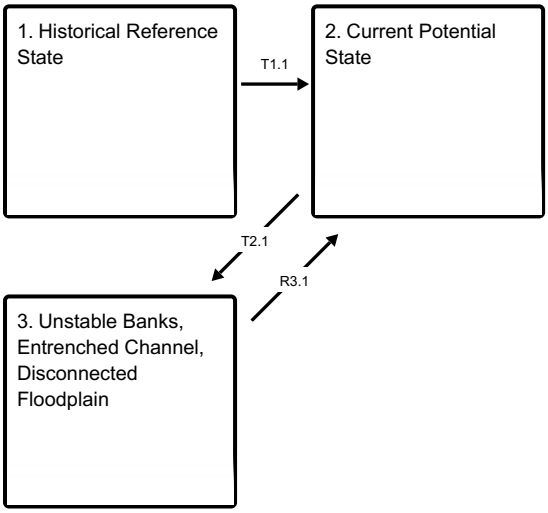
In addition to fire disturbance, this ecologic site is also impacted by periodic windthrow, and by insect and disease disturbances that affect major tree species. Of particular interest are spruce beetles which can kill both mature subalpine fir and Engelman spruce trees, and mountain pine beetle which targets lodgepole pine, especially mature trees.

In comparison to lower elevation stream courses more commonly altered for agricultural purposes, the ecological dynamics of stream courses associated with this site have likely been less impacted since European settlement. However, removal of large woody debris sources and road construction may directly alter channel morphology. Additionally, contemporary changes in adjacent forest fire regimes may alter sediment loads and watershed hydrology, thereby impacting this site. Timber harvest is uncommon on these sites due to proximity to stream channels and wet soils. Where timber harvest does occur, removal of large diameter trees will have lasting impacts on stream channel morphology and valley water storage by limiting large woody debris inputs. Livestock grazing is sometimes present on this site. Care should be taken to avoid livestock grazing when soils are wet and subject to compaction. Additionally, deferment during late season periods when shrub species are more favored will help avoid loss of woody riparian vegetation overtime. Improperly managed grazing may promote the invasion of non-native facultative wetland grasses such as Kentucky bluegrass (*Poa pratensis*) as well as other invasive plant species.

This site may be vulnerable to alterations in surface water hydrology as a result of climate change. Snowpack is expected to decline across the mountains of Oregon with a warming climate (Mote et al. 2005) and shifts from snow to rain is expected to be most pronounced at middle elevations of the Cascade and Blue Mountains. Research suggests that expected shifts in precipitation timing and type will have far reaching effects on blue mountain riparian ecosystems (Dwire et al 2018). The state and transition model below does not take into account the potential impacts of a changing climate and instead represents an approximation of ecological dynamics resulting from a simplified model of this riparian system. Further work is needed to better understand community response to climate shifts as well as the existence of alternative states and plant communities that may exist within these states.

State and transition model

Ecosystem states

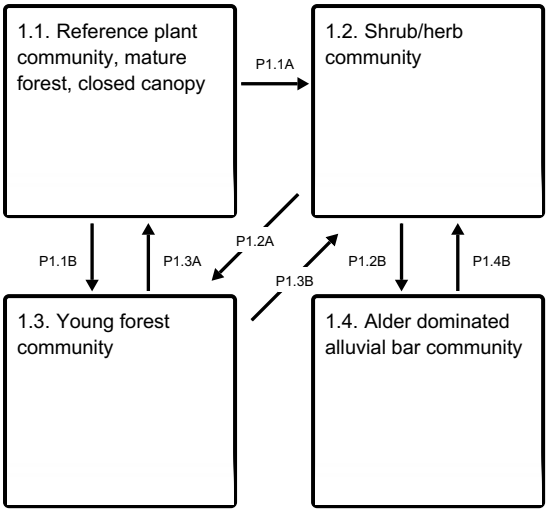


T1.1 - Exotic plant invasion

T2.1 - Hydrologic alteration

R3.1 - Restoration of hydrologic/biotic processes

State 1 submodel, plant communities



P1.1A - Severe fire, disease, windthrow or insects

P1.1B - Insects, disease or windthrow

P1.2A - Time without major disturbance

P1.2B - Catastrophic flood

P1.3A - Time without major disturbance

P1.3B - Severe fire, disease, windthrow or insects

P1.4B - Extended time elapses

State 1
Historical Reference State

This represents the historical reference state in pristine conditions. Variability in depth to water table and seasonal fluctuations support native obligate wetland vegetation and vegetated communities include all historical functional and structural groups. The historical disturbance regime is intact and driven primarily by climate which influences drought and flood cycles. The resilience and resistance of the site is bolstered by negative feedbacks between vegetation establishment and hydrologic processes that maintains a dynamic equilibrium with geomorphological processes.

Dominant plant species

- Engelmann spruce (*Picea engelmannii*), tree
- gray alder (*Alnus incana*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- currant (*Ribes*), shrub

Community 1.1
Reference plant community, mature forest, closed canopy

In its reference state, this site is dominated by an overstory of mature Engelmann spruce (*Picea engelmannii*) and a diverse understory of facultative and obligate wetland plant species. Shrub species often include gray alder (*Alnus incana*), prickly currant (*Ribes lacustre*), stinking swamp currant (*Ribes hudsonianum*), and red-osier dogwood (*Cornus sericea* spp. sericea). Forbs often include arrowleaf groundsel (*Senecio triangularis*), sweet-scented bedstraw (*Galium triflorum*), brook saxifrage (*Saxifraga odontoloma*), american speedwell (*Veronica americana*), heart-leaved miner's lettuce (*Claytonia cordifolia*), sidebells pyrola (*Orthilia secunda*) and the fern ally common horsetail (*Equisetum arvense*). Graminoids may include tall mannagrass (*Glyceria striata*), drooping woodreed (*Cinna latifolia*), Columbia brome (*Bromus vulgaris*), and soft-leaved sedge (*Carex disperma*). Understory trees such as grand fir (*Abies grandis*) and subalpine fir (*Abies lasiocarpa*) may be present, yet are less tolerant of saturated soils than Engelman spruce and will likely be found on raised hummocks or upper terrace positions.

Community 1.2

Shrub/herb community

These communities are dominated by shrubs such as gray alder and currant species (Ribes spp.), and a rich community of forbs in the herbaceous layer. Community composition will likely differ substantially following fire, insects or disease yet high composition of gray alder will be very likely. Gray alder is an important species in these early seral ecosystems, helping to enrich soils with nitrogen by hosting nitrogen-fixing actinomycetes in their roots. Water tables may increase following loss of conifers yet this process will likely be ephemeral (Kovalchik 1987).

Community 1.3
Young forest community

Young forest community dominated by sapling to pole sized trees. Lodgepole pine may dominate young tree regeneration if a seed source is present due to its prolific seed production and establishment on newly burned sites. Shrub communities will decrease and herbaceous species will transition toward more shade tolerant species. Overtime the shade tolerant Engelmann spruce (and subalpine fir on favorable sites) will begin to establish and eventually outcompete lodgepole overtime in the absence of fire.

Community 1.4
Alder dominated alluvial bar community

This community follows degradation of floodplains and fine sediments into alluvial bars by natural processes (Crowe et al. 2004). Plant community composition is similar to community 1.2 with yet gray alder and red osier dogwood more common. However, this community will have a greater composition of wetland obligate species such as sedges, as soils have been diminished. Gray alder is an important species in these early seral ecosystems, helping to enrich soils with nitrogen by hosting nitrogen-fixing actinomycetes in their roots.

Pathway P1.1A
Community 1.1 to 1.2

Severe fire, disease, windthrow or insects remove conifers.

Pathway P1.1B
Community 1.1 to 1.3

Insects, disease or windthrow removes only the mature tree canopy leaving most younger trees unharmed.

Pathway P1.2A
Community 1.2 to 1.3

Given sufficient time without large scale disturbance, conifers begin to recolonize the site and will come to dominate the canopy.

Pathway P1.2B
Community 1.2 to 1.4

Catastrophic flood leads to floodplain degradation and erosion of fine textured soils from floodplains, transitioning these into alluvial bars.

Pathway P1.3A
Community 1.3 to 1.1

Time without major disturbance will allow Engelman spruce to outcompete early seral tree species and mature into a dominant canopy.

Pathway P1.3B
Community 1.3 to 1.2

Severe fire, disease, windthrow or insects remove conifers.

Pathway P1.4B
Community 1.4 to 1.2

Extended time in the presence of sufficient sediment loads upstream, large woody debris and channel and vegetation structure that permits aggradation and floodplain development.

State 2
Current Potential State

This state is similar to the reference state yet plant communities include a component of non-native species such as Kentucky bluegrass (*Poa pratensis*). Community phases and pathways will mirror those of the reference state, yet succession of herbaceous species may be somewhat altered. Ecological process and function have not been altered fundamentally by this low level of invasion, yet resistance and resilience to further disturbance are decreased. Erosion processes are still within a historical range of variation, yet with continued vegetation loss the site risks a transition to an alternative state. Variability in depth to water table and seasonal fluctuations support native vegetation and vegetated communities include all historical functional and structural groups, yet composition and richness may be reduced. The resilience and resistance of the site is bolstered by negative feedbacks between vegetation establishment and hydrologic processes that maintains a dynamic equilibrium with geomorphological processes. This state is common due to widespread invasion of non-native species in the Western US. This state may also include scenarios where an entrenched, confined floodplain has developed following restoration of an incised reach.

Dominant plant species

- Engelmann spruce (*Picea engelmannii*), tree
- gray alder (*Alnus incana*), shrub
- redosier dogwood (*Cornus sericea*), shrub
- currant (*Ribes*), shrub
- Kentucky bluegrass (*Poa pratensis*), grass

State 3
Unstable Banks, Entrenched Channel, Disconnected Floodplain

Since this site is hydrologically dependent on a stream network, sustained disturbance may lead to unstable stream banks and entrenched channels. Removal of woody debris may destabilize banks, decrease hyporheic flow and increase energy during peak discharge and flood events. Road construction may confine floodplains, or concentrate flows, increasing erosion, gradient and discharge, and accelerate downcutting processes. Primary floodplains will become disconnected from the channel and evolve into terraces with significantly lowered water tables. This will often lead to the replacement of obligate wetland plants with facultative wetland plants. Dominant conifer species may shift toward a higher composition of grand fir as water tables are lowered and conditions favor its growth. Herb and shrub plant communities within this state will vary and may depend on water table levels, past disturbance history, drought and current management.

Dominant plant species

- grand fir (*Abies grandis*), tree
- Kentucky bluegrass (*Poa pratensis*), grass

Transition T1.1
State 1 to 2

Invasion of Kentucky bluegrass and/or other non-native plant species into the site.

Transition T2.1
State 2 to 3

This transition may be the result of several disturbances that lower water tables beyond depths that support obligate wetland vegetation, alter sediment supply and transport leading to scouring and channel incision, or directly increase flow velocities or flashiness. These may include: removal of large woody debris or large woody debris sources, from channels or adjacent forests; road construction across or parallel to stream courses; and significant alterations of upland watershed vegetation altering peak discharge or sediment loads.

Restoration pathway R3.1
State 3 to 2

Restoration of hydrologic and biotic process and function through rehabilitation of channel and vegetation structure may be possible but will require considerable inputs, time and cost. This may require replanting of native vegetation in addition to more intensive action such as the placement of large woody debris; removal of impoundments; road removal or relocation; and mechanical manipulation of stream channel courses among other intensive interventions. Restoration options will be highly site specific and may not be possible/practical in many circumstances. Given time, if channel disturbances are removed and natural channel evolution processes are allowed to take place, the stream will form an entrenched floodplain at a lower depth than the original. The original floodplain will remain a low terrace, perched above the newly forming floodplain and supporting a lowered water table and facultative wetland plant species. The resulting riparian area will be more confined and of significantly less extent than originally. The capacity of the basin to capture and regulate water will be reduced considerably.

Additional community tables

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Contributors

Andrew Neary - Original concept for 2020 PES initiative

Approval

Kirt Walstad, 9/08/2023

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	

Contact for lead author	
Date	05/19/2024
Approved by	Kirt Walstad
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:**

2. **Presence of water flow patterns:**

3. **Number and height of erosional pedestals or terracettes:**

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):**

5. **Number of gullies and erosion associated with gullies:**

6. **Extent of wind scoured, blowouts and/or depositional areas:**

7. **Amount of litter movement (describe size and distance expected to travel):**

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):**

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):**

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:**

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):**

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

Dominant:

Sub-dominant:

Other:

Additional:

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13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):**

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14. **Average percent litter cover (%) and depth (in):**

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15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):**

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16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:**

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17. **Perennial plant reproductive capability:**
