USDA Natural Resources Conservation Service

Ecological site R022BI215CA
Frigid Gravelly Flood Plains

Accessed: 04/18/2024

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.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 022B–Southern Cascade Mountains

Site Concept –
Riparian Complex: Hydrologically connected by a C-D type stream channel system.
Slopes: 2 to 6
Landform: Flood plains and stream terraces.
Soils: Very deep, somewhat poorly to poorly drained soils that formed in recent alluvium from volcanic rocks.
Temp regime: Frigid.
MAAT: 42 degrees F (6 degrees C).
MAP: 49 to 53 inches (1,244 to 1,346 mm).
Soil texture: Loamy very fine sand
Surface fragments: 0 to 80 percent gravels, 0 to 32 percent larger rock fragments.
Vegetation: Several riparian plant communities are present with willow, mountain alder, black cottonwood, and forbs and grasses.

Note: This is a high velocity stream channel compared to other riparian steam channel ecological sites in Lassen Volcanic National Park.

Associated sites

F022BI110CA	**Frigid Humic Loamy Gentle Slopes** This is a white fir forest found on the older terraces and nearby hillslopes.

Similar sites

R022BI213CA	**Frigid Sandy Flood Plains** This site is associated with smaller B type channels.
R022BI210CA	**Frigid Loamy Flood Plains** This site is associated with smaller C type channels, which do not display a D type channel succession.

Table 1. Dominant plant species

Tree	(1) *Populus balsamifera ssp. trichocarpa*
Shrub	(1) *Alnus incana ssp. tenuifolia* (2) *Salix lucida*
Herbaceous	(1) *Calamagrostis canadensis* (2) *Artemisia douglasiana*

Physiographic features

This site is associated with moderate sized C and D type stream channels, and includes the valley bottom from the stream channel across the floodplains and lower terraces. This site is presently mapped between 5,280and 5,520 feet in elevation, but may exist outside the park in a broader elevation zone. Slopes range from 2 to 6 percent.

This site has a seasonal water table that fluctuates from 13 to 80 inches from March to June. The water table may be below 80 inches, in drier areas of this site, late in the year.

Table 2. Representative physiographic features

Landforms	(1) Flood plain (2) Stream terrace
Flooding duration	Brief (2 to 7 days) to long (7 to 30 days)
Flooding frequency	Rare to occasional
Ponding frequency	None
Elevation	5,280–5,520 ft
Slope	0–6%
Water table depth	13–80 in
Aspect	E, S, W

Climatic features

This ecological site receives most of its annual precipitation during winter months in the form of snow. The mean annual precipitation ranges from 49 to 53 inches (1,244 to 1,346 mm) and the mean annual temperature is 42 degrees F (6 degrees C). The frost free (>32F) season is 70 to 90 days. The freeze free (>28F) season is 85 to 200 days.

There are no representative climate stations for this site.

Table 3. Representative climatic features

Frost-free period (average)	90 days
Freeze-free period (average)	200 days
Precipitation total (average)	53 in

Influencing water features

This site is associated with a perennial stream, which transitions between Rosgen C and D channel types.

Soil features

The Aeric Endoaquents soil component is associated with this site and consists of very deep, somewhat poorly drained soils that formed in recent alluvium from volcanic rocks. There is about 3 inches of fresh organic material over several C horizons. The surface texture is loamy very fine sand with gravelly or cobbly sandy subsurface textures. The size of rock fragments tends to increase with depth. This site has very low AWC in the upper 60 inches of soil.

To a minor extent the Aquandic Humaquepts- flood plains soil component is associated with this site. It consists of very deep, poorly drained soils that formed in alluvium from volcanic rocks. The A horizons have a stony mucky ashy loam texture with medium subsurface textures and a high percentage of rock fragments. Redoximorphic features including masses of oxidized iron and gleyed soil colors are present 7 inches below the surface.

Although not directly correlated to this ecological site, the Humic Haploxerands, stream terrace soil component is found on the adjacent stream terraces and is associated with the white fir forest ecological site F022BI110CA, which is similar to PCC4 in State 3. The Humic Haploxerands, stream terrace component consists of very deep, moderately well and well drained soils that formed in ash influenced alluvium from volcanic rocks. The surface texture is gravelly medial sandy loam. Subsurface textures with increasing depth are medial fine sandy loam, gravelly medial fine sandy loam, extremely stony medial loamy coarse sand, and ashy stones.

This ecological site has been correlated with the following map units and components within the CA789 Soil Survey Area:

DMU Component percent
160 Aeric Endoaquents 45
160 Aquandic humaquepts floodplains 5

Table 4. Representative soil features

Surface texture	(1) Loamy very fine sand
Family particle size	(1) Sandy
Drainage class	Poorly drained to somewhat poorly drained
Permeability class	Moderate to moderately rapid
Soil depth	60 in
Surface fragment cover <=3"	0–80%
Surface fragment cover >3"	0–32%
Available water capacity (0-40in)	0.35–3.92 in
Soil reaction (1:1 water) (0-40in)	4.5–6.5
Subsurface fragment volume <=3" (Depth not specified)	0–85%
Subsurface fragment volume >3" (Depth not specified)	0–40%

Ecological dynamics

This site is associated with alluvial deposits from Holocene age stream processes, and a Rosgen “C” type channel. These channels are in lower gradient, glacially carved U shaped valleys, where deposition occurs to form flood plains. The alluvial deposits and channel migration are restricted to the valley floors. As the channels migrate in the confined corridors, former channels are buried with overbank deposits from subsequent channel courses and typically form soil profiles with coarser channel deposits under finer overbank deposits. As down cutting occurred (likely due to uplift) the streams cut down into the original flood plain surfaces and transformed them into stream terraces and formed new flood plains at the lower channel level (NRCS, 2010).

Undisturbed, this site supports a "C" type channel according to the Rosgen classification scheme. A "C" type channel is a slightly entrenched single thread meandering channel with a well defined floodplain. The channel has moderate to high sinuosity and a low gradient with less than 2% slope, but can have gradients up to 3.9 (b modifier). These channel types generally have a width to depth ratio greater than 12, which means they are wide and shallow. They are often found in broad valleys with well developed alluvial floodplain terraces and such channels typically flood over bank two years out of three. In an undegraded state, a 50 year flood event should overflow onto the floodplain.

C type channels are constantly in the process or transporting and storing sediments from upstream sources or bank erosion. As the particle size of the channel bottom material decreases, the sediment supply generally increases and so does the erosion potential. The channel on this site supports cobble- bottom (C3), gravel-bottom (C4), reaches which have moderate to very high erosion potentials, respectively. The sensitivity to disturbance is very high for both C4 types, and moderate for C3. Vegetation exerts a very high controlling influence on stream dynamics in all three types (Rosgen, 1994).

A “D” type stream channel has multiple channels which can change location annually. It has a very high width/depth ratio and low sinuosity. Its slope is typically in the range of 0.1 to 2 percent, but it can range from 2 to 3.9 percent (b modifier). This site has a gravel-bottom or cobble bottom stream. The D type channel develops in this site when sediment accumulation is greater than the streams sediment transport capacity. This often occurs in areas where there is a reduction in the stream gradient. Large flood events or landslides deposit sediments in these zones. After these events, the channel will braid through the new material until it reestablishes a single thread channel.

The plant communities along the channel occur in distinct zones related to variable water table depth and disturbance events. There is a broad floodplain on this site with several topographic levels. A Sierra lodgepole pine-black cottonwood forest is present on the upper level floodplain. Terraces have developed as the channel incises through sediments. A white fir forest is present on these terraces. A shrub community comprised of thinleaf alder or a mix of thinleaf alder and Lemmon’s willow dominates the site in an undisturbed state. The riparian shrub community requires seasonal flooding and a water table that normally remains within 3 feet of the surface. Both thinleaf alder and Lemmon’s willow are flood and shade tolerant and act as an important stabilizing component of the streambank. Streambanks anchored by these shrubs are stable and can withstand relatively severe spring runoff and flooding. As alder and willow thickets develop after floods finer fluvial deposits are trapped within the extensive root networks, facilitating sediment accumulation. Thus the coarse channel deposits of cobble, gravel or sand, where thinleaf alder and willow typically establish, eventually develop a loam or sandy loam surface soil texture from overbank deposits overlaying the coarser channel deposits. In addition, thinleaf alder improves soil fertility through the addition of nitrogen to the soil from nitrogen-fixing root nodules and a nitrogen-rich leaf litter. The finer sediment (overbank deposits) and increased fertility enables establishment and retention of a native herbaceous community that provides valuable forage and habitat for wildlife.

This ecological site is a complex of riparian plant communities that are interrelated by hydrology. This is a relatively new concept for ecological sites. The state and transition diagram below illustrates the change in plant community component composition as a result of disturbance, rather than focusing on the succession of one plant community. Although there is considerable qualitative experience supporting the pathways and transitions within the State and Transition Model (STM), there is no quantitative information to specifically identify threshold parameters that distinguish between natural equilibrium and altered states in this ecological site. For information on STMs, see the following citations: Bestelmeyer el al. 2003, Bestelmeyer et al. 2009, and Stringham and Shaver 2003.

State and transition model

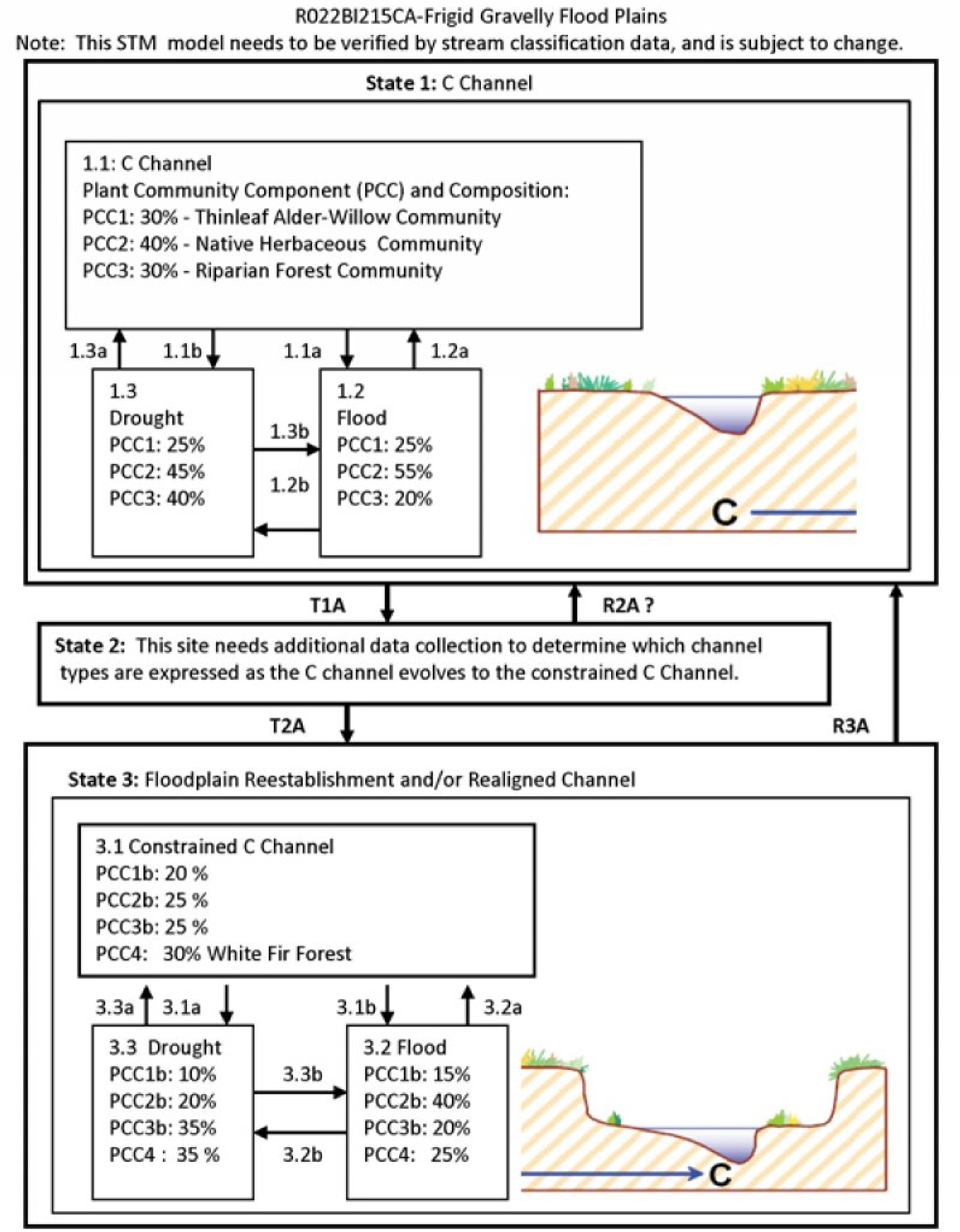

Figure 2. Frigid Gravelly Flood Plains Model

State 1

C Channel

This state is a single thread C type channel set in a broad valley bottom with gentle slopes associated with Holocene alluvial deposits. C channels are considered slightly entrenched and have a moderate to high width to depth ratio. Sinuosity is moderate to high, resulting in a well-defined meandering channel. The slope is low gradient and point bar formation and riffle/pool morphology are common features. C channels tend to be wide and shallow with a well-defined floodplain and may have alluvial terraces of abandoned floodplains. This state was not observed. Most of this stream channel exhibits State 2 or State 3 channel characteristics.

Community 1.1
C Channel

The plant communities associated with this site occur in distinct zones related to variable water table depth and disturbance events. Approximately 30% of the total vegetation is a Thinleaf Alder-Willow community that forms a continuous stringer immediately adjacent to the stream where the water table stays relatively high year round. Thinleaf alder, Lemmon’s willow, and shining willow are flood and shade tolerant and act as an important stabilizing component of the streambank. These shrubs produce copius amounts of seeds in the fall and winter and seeds germinate immediately after dispersal when conditions are favorable. Germination and seedling establishment is optimal on exposed mineral substrate. Thinleaf alder may also reproduce vegetatively through spreading underground rhizomes or suckers, but the willows do not have this capacity. These shrub species can re-sprout vigorous following a top cut or fire. Streambanks anchored by these shrubs are stable and can withstand relatively severe spring runoff and flooding. As alder and willow thickets develop after floods finer fluvial deposits are trapped within the extensive root networks, facilitating soil development. Thinleaf alder improves soil fertility through the addition of nitrogen to the soil from nitrogen-fixing root nodules and a nitrogen-rich leaf litter. Drought and flood are the primary forces that drive transitions between alternate community phases. A lower water table from prolonged drought facilitates encroachment of the upland community on the floodplain and an associated reduction in the thinleaf alder/Lemmon’s willow community. Conversely, a flood destroys sections of the thinleaf alder community within the active channel and favors establishment of the pioneering native herb community that colonizes recently exposed substrate and provides valuable forage and habitat for wildlife. Data was not collected for this state, but species composition within the communities components may be similar to the plant community components described in State 2, Community Phase 2.1. Prior to channel incision, this area would have had a higher water table across the valley floor. There may have been areas with more sedges and willows. PCC1: 30 % - Thinleaf Alder-Willow Community This community is found along the stream channel on the banks and relatively stable point bars. Thinleaf alder (*Alnus incana* ssp. tenuifolia) dominates this community with Lemmon's willow (*Salix lemmonii*), and shining willow (*Salix lucida*) present in smaller amounts. Within the patches of shrubs the canopy cover is dense with little understory. However, along the channel or in canopy openings fringed willowherb (*Epilobium ciliatum*), seep monkeyflower (*Mimulus guttatus*), purple monkeyflower (*Mimulus lewisii*), bugle hedgenettle (*Stachys ajugoides*), American vetch (*Vicia americana*), bluejoint (*Calamagrostis canadensis*), fowl mannagrass (*Glyceria striata*), and common rush (Juncus effuses) may be present as well as other species listed in PCC2. PCC2: 40% - Native Herbaceous Community This community is found on gravel bars and other recently disturbed areas. It is a mix of early successional species. There is a high cover of exposed gravels and rock. Canopy cover is very low after disturbance, but can gradually increase to about 50 percent cover. Common plants are common yarrow (*Achillea millefolium*), western pearly everlasting (*Anaphalis margaritacea*), Douglas' sagewort (*Artemisia douglasiana*), Indian paintbrushes (Castilleja spp.), Douglas' thistle (*Cirsium douglasii*), fringed willowherb (*Epilobium ciliatum*), groundsmokes (Gayophytum spp.), streambank bird's-foot trefoil (*Lotus oblongifolius*), bentgrass (Agrostis sp.), smallwing sedge (*Carex microptera*), sedge (Carex sp.), tufted hairgrass (*Deschampsia cespitosa*), blue wildrye (*Elymus glaucus*), swordleaf rush (*Juncus ensifolius*) rush (Juncus sp.), and bluegrass (Poa sp.). PCC3: 30% - Riparian Forest Community This plant community is found on rarely flooded floodplains. The overstory is a mix of Sierra lodgepole pine (*Pinus contorta* var. murrayana) and black cottonwood (*Populus balsamifera* ssp. trichocarpa), and quaking aspen (*Populus tremuloides*). The understory is dominated by grasses such as western needlegrass (*Achnatherum occidentale*), California brome (*Bromus carinatus*), blue wildrye (*Elymus glaucus*), and squirrel tail (*Elymus elymoides*). Other species from PCC2 may be present as well.

Community 1.2
Flood

This community phase develops after a major flood event. The plant community components remain the same, as described in Community phase 1.1, but the proportion of each community type shifts after flooding scours sections of the active channel, exposing mineral substrate in some locations and depositing large quantities of sediment in other areas. The destruction of sections of the thinleaf alder community in the channel is accompanied by a dramatic increase in the herbaceous pioneer community. After the flood the early seral grasses like squirreltail and herbs quickly colonize the recently exposed substrate and within a season the herbaceous community may comprise over half (55%) of the total riparian vegetation. Estimate of plant community component composition in this phase: PCC1: 25% PCC2: 55% PCC3: 20%

Community 1.3
Drought

This community phase results from prolonged drought. Drought reduces the water flow in the stream and lowers the seasonal water table. A lower water table facilitates encroachment of the upland Sierra lodgepole pine- black cottonwood forest on the floodplain, and an associated reduction in the thinleaf alder/ willow community. Estimate of plant community component composition in this phase: PCC1: 25% PCC2: 45% PCC3: 40%

Pathway 1.1a
Community 1.1 to 1.2

This pathway is created when a flood scours the channel of existing vegetation and deposits a layer of sediment, initiating regeneration.

Pathway 1.1b
Community 1.1 to 1.3

This pathway is created by natural processes that cause the site to become drier, usually several years of drought.

Pathway 1.3a
Community 1.3 to 1.1

This pathway is created when the site becomes wetter for natural reasons, such as the end of a drought cycle.

Pathway 1.3b
Community 1.3 to 1.2

This pathway is created when a flood scours the channel of existing vegetation and deposits a layer of sediment, initiating regeneration.

State 2
Stream Evolution

Additional stream classification data is required to determine which channel types are expressed as the C channel evolves in response to disturbance. In a possible succession scenario, the “C” type channel in State 1 fills with sediment, and the flows disperses into multiple braided channels typical of a “D” type channel. As flow concentrates into one main channel, it will down-cut into an entrenched low gradient “Gc” type channel. The unstable “Gc” type channel naturally begins to widen over time into an entrenched “F” type channel. The plant community components associated with these possible successional channel types is not known. The “D” type channel has a broad area that is frequently flooded, with high cover of exposed gravels and cobbles and patches pioneer plants. Deeply incised “Gc” and “F” channels generally lose the wetland obligate species and become dominated by upland grass, shrub and/or forest plant communities. As the water table lowers at the site, the adjacent white fir forest community can encroach and the thinleaf alder and mixed willow community declines. Upland grass species like blue wildrye and western neeedlegrass would begin to dominate the native herbaceous community.

Community 2.1
Stream Evolution

Figure 3. Rosgen Stream Succession Scenario 3

The Rosgen Stream Succession Scenario #3 above displays a possible channel evolution pathway for this site. Sections of this site are presently braided exhibiting a “D” type channel. However, stream classification data is needed to determine the actual stream evolution process occurring on this site. Braided “D” channels are unstable systems, with poor lateral bank stability. They tend to carry large amounts of bedload gravels and cobbles. The constantly moving channels make it difficult to design stream crossings or implement restoration. When flow begins to concentrate into a main channel a “D” channel may evolve into a “Gc” type channel. A “Gc” type channel is an unstable, gully-like, entrenched channel which will naturally begin to widen over time into an entrenched “F” type channel. The broadly entrenched “F” type channel allows for sediment deposition, which builds point bars and floodplains with a meandering channel. As riparian vegetation begins to reestablish on the new floodplains, channel stability increases, and an entrenched “C” type channel with a developed floodplain and a meandering channel will eventually develop within the entrenched “F” type channel. This new entrenched “C” type channel may resemble the original “C” type channel with wetland plant communities, but it will be constrained by terraces to the lower floodplain area. The old floodplain becomes a terrace, disconnected from flood events. The terrace has a lower seasonal water table which supports a greater proportion of upland plant communities.

State 3
Constrained C Channel

This C Channel has re-established a floodplain and natural sinuosity. It is constrained by the old flood plain, which is now a hydrologically disconnected terrace.

Community 3.1
Constrained C Channel

Figure 4. Gravelly Flood Plains, Kings Creek

Figure 5. Gravelly Flood Plains

The composition of the plant communities has shifted primarily, because the stream channel incised through deposits creating a terrace with an upland plant community (PCC4). The riparian communities are confined to a smaller area within the new floodplain. In some areas, the sedges associated with the Lemmon’s willow- thinleaf alder community (PCC2) have been replaced by grasses because of lower water tables. Non-native species may be present. PCC1b: 20 % Thinleaf Alder- Willow Community This community is found along the stream channel on the banks and relatively stable point bars. Thinleaf alder (*Alnus incana* ssp. tenuifolia) dominates this community with Lemmon's willow (*Salix lemmonii*), and shining willow (*Salix lucida*) present in smaller amounts. Within the patches of shrubs the canopy cover is dense with little understory. However, along the channel or in canopy openings fringed willowherb (*Epilobium ciliatum*), seep monkeyflower (*Mimulus guttatus*), purple monkeyflower (*Mimulus lewisii*), bugle hedgenettle (*Stachys ajugoides*), American vetch (*Vicia americana*), bluejoint (*Calamagrostis canadensis*), fowl mannagrass (*Glyceria striata*), and common rush (Juncus effuses) may be present as well as other species listed in PCC2b. PCC2b: 25 % Herbaceous Community This community is found on gravel bars and other recently disturbed areas. It is a mix of early successional species. There is a high cover of exposed gravels and rock. Canopy cover is very low after disturbance, but can gradually increase to about 50 percent cover. Common plants are common yarrow (*Achillea millefolium*), western pearly everlasting (*Anaphalis margaritacea*), Douglas' sagewort (*Artemisia douglasiana*), Indian paintbrushes (Castilleja spp.), Douglas' thistle (*Cirsium douglasii*), fringed willowherb (*Epilobium ciliatum*), groundsmokes (Gayophytum spp.), streambank bird's-foot trefoil (*Lotus oblongifolius*), bentgrass (Agrostis sp.), smallwing sedge (*Carex microptera*), sedge (Carex sp.), tufted hairgrass (*Deschampsia cespitosa*), blue wildrye (*Elymus glaucus*), swordleaf rush (*Juncus ensifolius*), rush (Juncus sp.), and bluegrass (Poa sp.). PCC3b: 25 % Riparian Forest Community This plant community is found on rarely flooded floodplains and low terraces. The overstory is a mix of Sierra lodgepole pine (*Pinus contorta* var. murrayana) and black cottonwood (*Populus balsamifera* ssp. trichocarpa), with some white fir (*Abies concolor*) and quaking aspen (*Populus tremuloides*). The understory is dominated by grasses such as western needlegrass (*Achnatherum occidentale*), California brome (*Bromus carinatus*), blue wildrye (*Elymus glaucus*), and squirrel tail (*Elymus elymoides*). Other species from PCC2b and PCC4 may be present as well. PCC4: 30% White fir forest This forest is present on the upper terraces. These terraces are high above the stream channel so there is a lower water table, and the area is no longer utilized as a floodplain. However, large flood events or log jams may cause portions of terraces to calve into the stream channel. White fir (*Abies concolor*) is able to establish forests in the drier more stable landform. Sierra lodgepole pine (*Pinus contorta* var. murrayana) and incense cedar (*Calocedrus decurrens*) may be present in small amounts. Ecological succession is less influenced by riparian processes at this point and it is more influenced by forest dynamics such as fire and pest infestations. Please refer to the white fire ecological site F022BI110CA for more information on forest dynamics. The understory is relatively sparse, having an average of 10 percent cover. Grasses generally dominate with a few forbs and shrubs. Common plants include: needlegrass (Achnatherum spp.), California brome (*Bromus carinatus*), Orcutt's brome (*Bromus orcuttianus*), Brainerd's sedge (*Carex brainerdii*), Ross' sedge (*Carex rossii*), whitethorn ceanothus (*Ceanothus cordulatus*), squirreltail (*Elymus elymoides*), naked buckwheat (*Eriogonum nudum*), spreading groundsmoke (*Gayophytum diffusum*) and Sierra gooseberry (*Ribes roezlii*). The species composition in the tables below is a compilation of PCC1b, PCC2b, and PCC3b. Please refer to the plant community description above for composition by plant community component. Production data is based on ocular estimates, actual weights were not collected.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Shrub/Vine	900	1800	2820
Forb	16	50	105
Grass/Grasslike	11	45	99
Tree	0	12	57
Total	**927**	**1907**	**3081**

Community 3.2
Flood

This community phase develops after flooding scours sections of the active channel, exposing mineral substrate in some locations and depositing large quantities of sediment in other areas. The plant community components remain the same, as described in Community phase 2.1, but the proportion of each community components shifts. The destruction of sections of the thinleaf alder community in the channel is accompanied by a dramatic increase in the herbaceous pioneer community. However since the channel is constrained, the old flood plain is now a hydrologically disconnected terrace. With a lowered water table, the upland community gradually replaces the thinleaf alder /willow and may eventually occupy 25% of the formerly riparian vegetation. Estimate of plant community component composition in this phase: PCC1b: 15% PCC2b: 40% PCC3b: 20% PCC4: 25%

Community 3.3
Drought

This community phase results from prolonged drought. Drought reduces the water flow in the stream and lowers the seasonal water table. A lower water table facilitates encroachment of the upland white fir forest on the terrace, and nearly eliminates the thinleaf alder/willow community. Estimate of plant community component composition in this phase: PCC1b: 10% PCC2b: 20% PCC3b: 35% PCC4 : 35%

Pathway 3.1b
Community 3.1 to 3.2

This pathway is created when a flood creates erosion and deposition, leaving barren soil for early successional species to establish.

Pathway 3.1a
Community 3.1 to 3.3

This pathway is caused by natural processes that cause the site to become drier, such as several years of drought.

Pathway 3.2a
Community 3.2 to 3.1

This pathway is created with time and allows for the recovery of the plant communities after a flood event.

Pathway 3.2b
Community 3.2 to 3.3

This pathway is created when the site becomes drier due to drought or other causes.

Pathway 3.3a
Community 3.3 to 3.1

This pathway is created when the site becomes wetter for natural reasons, such as the end of a drought cycle.

Pathway 3.3b
Community 3.3 to 3.2

This pathway is created when a flood leaves barren soil from erosion or deposition, allowing the pioneer plant community to increase in area.

Transition T1A
State 1 to 2

This transition can occur naturally as the “C” type channel in State 1 down-cuts through the valley bottom. The channel on this site supports cobble-bottom (C3) and gravel-bottom (C4) reaches which have moderate to very high erosion potentials, respectively. Bank erosion is a natural river adjustment process and can as the result of mass wasting, liquification, freeze-thaw, fluvial entrainment, and ice scour. The glacial outwash and alluvial deposits in the U-shaped valley bottom are gradually eroded through these processes. This transition can also be initiated by a disturbance that alters the hydrology of the site or impacts the vegetation along the stream bank. Alterations that can affect the hydrology of this site include channel realignment and/or confinement, culvert installations, and road construction. Such alterations straightened the channel, eliminating its ability to meander. This increases the shear stress along the stream bank, which accelerates stream bank erosion, thereby increasing sediment supply and decreasing sediment transport capacity. As the channel straightens it has a shorter course down the valley, creating a steeper gradient. The stream may adjust by headcutting into the base level of the channel until it establishes a new gradient. As the stream bed is lowered, so is the water table. The new larger and steeper channel can contain more flow, reducing the frequency of flooding and the extent of the floodplain, creating terraces. Cattle grazing and/or the seeding of non-native grass for forage can cause a similar entrenchment of the channel but through a different mechanism. When cattle reduce vegetation and trample the exposed stream banks, the resulting erosion also leads to eventual straightening and headcutting of the channel. Likewise, when non-native grasses displace the native riparian sedges and rushes, the stabilizing root mats that help prevent erosion are also removed.

Restoration pathway R2A
State 2 to 1

Additional stream classification data is required to determine which channel types are expressed in State 2 as the C channel evolves in response to disturbance. Without this data it is not possible to identify the restoration pathway for the intermediate phase of the stream succession scenario.

Transition T2A
State 2 to 3

This transition occurs when continued sediment deposition in the broadly entrenched “F” type channel allows the riparian vegetation to reestablish on the new floodplain. The vegetation increases channel stability and eventually channel sinuosity returns and a new meandering channel will develop that is constrained by the old floodplain.

Restoration pathway R3A
State 3 to 1

The processes that have altered this stream system may be natural or human-influenced. If the primary reason for channel adjustment is a result of natural erosion through alluvial deposits as a result of uplift, the channel should be fairly well readjusted and left alone. However, if human caused disturbance has caused the erosion, then restoration procedures should be considered. The goal of restoration is to return the channel to its full potential, which is defined as the best channel condition, based on quantifiable morphological characteristics of that stream type. For a constrained C channel the goal is to raise the water table, increase the channel sinuosity, and re-establish riparian vegetation on the stream banks to reduce bank erosion. Each segment of the stream channel should be surveyed to determine the evolutionary stages of channel adjustment and evaluate the potential for natural recovery. If natural recovery does not seem likely, a thorough stream departure analysis can determine the feasibility of restoration, anticipate response to future changes in management, and develop appropriate restoration designs.

Additional community tables

Table 6. Community 3.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Tree					
1	**Trees**			0–57	
	black cottonwood	POBAT	*Populus balsamifera ssp. trichocarpa*	0–30	0–10
	Sierra lodgepole pine	PICOM	*Pinus contorta var. murrayana*	0–24	0–12
	quaking aspen	POTR5	*Populus tremuloides*	0–10	0–2
	white fir	ABCO	*Abies concolor*	0–3	0–1
Shrub/Vine					
1	**Shrubs**			900–2820	
	thinleaf alder	ALINT	*Alnus incana ssp. tenuifolia*	900–2000	10–20
	shining willow	SALU	*Salix lucida*	0–700	0–10
	Lemmon's willow	SALE	*Salix lemmonii*	0–120	0–2
Grass/Grasslike					
1	**Grass/grasslike**			11–99	
	bentgrass	AGROS2	*Agrostis*	2–25	1–10
	bluejoint	CACA4	*Calamagrostis canadensis*	3–25	1–7
	sedge	CAREX	*Carex*	3–25	1–7
	blue wildrye	ELGL	*Elymus glaucus*	3–8	1–2
	California brome	BRCA5	*Bromus carinatus*	0–8	0–2
	smallwing sedge	CAMI7	*Carex microptera*	0–6	0–2
	fowl mannagrass	GLST	*Glyceria striata*	0–4	0–1
	tufted hairgrass	DECE	*Deschampsia cespitosa*	0–3	0–1
	common rush	JUEF	*Juncus effusus*	0–1	0–3
	swordleaf rush	JUEN	*Juncus ensifolius*	0–1	0–3
	rush	JUNCU	*Juncus*	0–1	0–3
	bluegrass	POA	*Poa*	0–1	0–3
Forb					
1	**Native forbs**			16–105	
	Douglas' sagewort	ARDO3	*Artemisia douglasiana*	10–40	3–8
	western pearly everlasting	ANMA	*Anaphalis margaritacea*	3–13	1–4
	seep monkeyflower	MIGU	*Mimulus guttatus*	0–10	0–4
	common yarrow	ACMI2	*Achillea millefolium*	3–10	1–3
	bugle hedgenettle	STAJ	*Stachys ajugoides*	0–8	0–2
	Douglas' thistle	CIDO2	*Cirsium douglasii*	0–6	0–2
	fringed willowherb	EPCI	*Epilobium ciliatum*	0–6	0–2
	Indian paintbrush	CASTI2	*Castilleja*	0–3	0–1
	purple monkeyflower	MILE2	*Mimulus lewisii*	0–3	0–1
	American vetch	VIAM	*Vicia americana*	0–2	0–1
	groundsmoke	GAYOP	*Gayophytum*	0–2	0–1
	streambank bird's-foot trefoil	LOOB2	*Lotus oblongifolius*	0–2	0–1

Animal community

This site provides valuable wildlife resources such as water and cover. Thinleaf alder and willow communities often serve as travel corridors for big game animals such as deer and many bird species utilize these riparian corridors for nesting and brood rearing. Overhanging alder and willow branches provide shade and cover for salmonids. In addition, wildlife and livestock depend on the leaves, stems, of various grasses and sedges as forage.

Hydrological functions

The hydrological function of the flood plain is to provide a catchment for water, sediments, and nutrients. Floodplains may also provide water storage, which is slowly released down the drainage throughout the year.

Recreational uses

These streams provide scenic hiking corridors with wildlife viewing, fishing and photographic opportunities.

Inventory data references

The following NRCS vegetation plots were used to describe this ecological site:

CA789245- Type location
CA789 Kings Creek

Type locality

Location 1: Plumas County, CA	
Township/Range/Section	T30 N R6 E S19
UTM zone	N
UTM northing	4477748
UTM easting	639353
General legal description	The type location is about 0.38 miles north of Kelly Camp, just inside the Lassen Volcanic National Park boundary.

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Contributors

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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	
Approved by	
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:

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

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

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

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:**

17. **Perennial plant reproductive capability:**