Table A.3.1--Descriptions of montane riparian and meadow ecosystems in the Great Basin.

Montane Riparian Ecosystems

Subalpine-Montane Conifer. This system occurs on stream terraces or trough-shaped floodplains. Common tree species at higher elevations with colder soils include *Pinus flexilis*, *Abies concolor*, *Abies lasiocarpa*, *Picea engelmannii*, and *Pseudotsuga menziesii*. *Pinus ponderosa* and *Juniperus scopulorum* can occur at more moderate elevations with warmer soils. *Pinus flexilis* occurs in the central part of the Great Basin, but most of these types are more common in in the eastern portion of the Great Basin. Common shrubs are *Cornus sericea*, *Rosa woodsia*, *Prunus virginiana*, and *Salix* spp. A wide variety of herbaceous species occur on these sites, with graminoids being more common on sites with finer textured soils and shallower depths to field capacity, and forbs occurring more often on site with a higher proportion of cobbles and greater depths to field capacity.

Subalpine-Montane *Populus tremuloides*. This type commonly occurs on trough floodplains but is also found on stream terraces and toe slopes. Soils are relatively cold. On sites with relatively shallow depth to field capacity (27 $\pm$ 27 cm in the eastern Sierra Nevada), graminoids occur in understory and willows and alder may be present. On sites where depth to field capacity is greater (53 $\pm$ 53 cm in the eastern Sierra Nevada) shrub species include *Salix* spp., *Alnus incana*, *Ribes* spp., and *Symphoricarpos* spp. Understory species can include *Osmorhiza* spp., *Thalictrum* spp., *Mertensia* spp., *Geranium* spp., *Ligusticum grayi*, *Aquilegia formosa*, *Aconitum columbianum*, *Poa wheeleri*, *Bromus marginatus*, and *Elymus* spp.

Subalpine-Montane Cold Willow. This ecological type typically occurs on trough floodplains or trough stream terraces but also occurs on gravelbars. These sites occur at higher elevation in areas with steeper valley slopes (2.5 to 8%). Soils are sandy and depth to field capacity is close

to the soil surface (about 10 to 50 cm). The dominant willow species are *Salix boothii*, *Salix lutea* x *Salix boothii*, *Salix lucida* ssp. *lasiandra,* and *Salix geyeriana*. Sites with fewer cobbles where field capacity is close to the soil surface tend to have understories dominated by graminoids. Sites with a higher percentage of cobbles in the soil layers and greater depths to field capacity tend to have understories dominated by forbs.

Montane *Betula occidentalis*. This type typically occurs on stream terraces or trough-shaped floodplains that tend to be found in canyon constrictions. Average soil temperatures tend to be warmer but exhibit a broad range. Soils typically have a high proportion of coarse fragments (gravels, cobbles, and boulders). Sites usually have a dense overstory *of Betula occidentalis*.

Lower Montane Warm Willow. This ecological type typically occurs on gravelbars but is also found on trough-shaped floodplains, stream terraces, and incised landforms (Riverine HGM Class). These sites have a tendency to be found at lower elevations with gentler valley slopes (1-5%). Sites are associated with gravel-bed streams, and depth to field capacity is relatively close to the surface (approximately 80 cm). Warm willow species dominate (*Salix exigua*, *S. lutea*, *S. lemmoni*, or *S. lasiolepis*). On very warm sites, exotic shrub species may include *Tamarix* spp. and *Elaeagnus angustifolia.* Sites with finer textured soils where field capacity is close to the soil surface tend to have understories dominated by graminoids; those with coarser textured soils and a high percentage of cobbles in the soil layers tend to have understories dominated by forbs. This system may occur on slopes, lakeshores, or around ponds where the vegetation is associated with groundwater discharge or a subsurface connection to lake or pond water and may experience overland flow but no channel formation (Slope, Lacustrine, or Depressional HGM Classes). It is also typically found in backwater channels and other perennially wet but less scoured sites, such as floodplain swales and irrigation ditches.

Lower Montane Cottonwood. This type is most commonly found on stream terraces but also occurs on trough-shaped floodplains. Soils are relatively warm. Usually no more than 15% cobbles are found in any one soil horizon. Cottonwoods, either *Populus fremontii*, *Populus balsamifera* ssp. *trichocarpa*, or *Populus angustifolia* are overstory species. Understory shrubs may include *Salix* spp., *Prunus* spp., *Rhus trilobata*, *Cornus* spp., or *Artemisia* spp. Understory grasses and forbs may include *Achnatherum* spp., *Elymus* spp., *Leymus* spp., *Bromus carinatus, Bromus marginatus, Poa fendleriana, Lupinus* spp., *Geranium* spp., *Osmorhiza* spp., *Maianthemum* spp., *Aquilegia formosa, Thalictrum* spp., and *Aconitum columbianum.* This system can also occur on lakeshores or around ponds where the vegetation is associated with groundwater discharge or a subsurface connection to lake or pond water, and may experience overland flow but no channel formation (Slope, Lacustrine, or Depressional HGM Classes)

Lower Montane *Artemisia tridentata* ssp. *tridentata*. This type occurs along trough-shaped drainage ways and floodplains, stream terraces and toe slopes. This type may also occur in associations with incised or avulsed landforms. Soil temperatures are relatively warm. In systems that are not incised, field capacity is typically within a meter of the surface, but in incised systems field capacity is often greater than 1 m. Coarse fragments (gravels, cobbles, and boulders) are typically less than 60% by volume for unincised systems but can be greater than 60% for incised systems. The graminoids *Achnatherum* spp., *Leymus cinereus*, *Leymus triticoides*, or *Poa secunda* ssp. *juncifolia* are the most common grasses on unincised sites. Following incision, *Poa secunda* ssp. *secunda*, *Elymus elymoides*, and *Bromus tectorum* can be the most common grasses. This type may also occur at relatively high elevations in association with *Artemisia tridentata* ssp. *vaseyana.*

Meadow Complexes

Herbaceous wetlands associated with a relatively high water table (ranges from 0 cm to about 300 cm depth to water table) that typically lack prolonged standing water These herbaceous wetlands occur in association with seeps or springs and/or montane streams, and are located in geomorphic positions that allow the accumulation of fine-textured sediments. Sites may be dominated by *natural* groundwater inputs with fairly stable hydrology. Sites may exhibit ground water sapping, lowered water tables, and changes in vegetation composition when located adjacent to incising (downcutting) streams. Sites may also be controlled by *artificial* overland flow (surface or subsurface irrigation runoff or return flow) or artificial groundwater seepage (including from leaky irrigation ditches). Sites may be small or very large. These sites may be intentionally managed for hay production or may be the result of unintentional return flows, runoff, or seepage. Vegetation is dominated by native or non-native herbaceous species; graminoids (grasses, sedges, rushes) typically have the highest canopy cover. Species composition may be dominated by non-native hay grasses. Patches of emergent marsh vegetation and standing water are less than 0.1 ha in size and not the predominant vegetation.

Montane Meadow - Herbaceous wetlands associated with a high water table or overland flow. Sites are typically associated with snowmelt or elevated groundwater. Sites associated with the Flats or Slope HGM class are rarely subjected to high disturbance events such as flooding. Those associated with a stream channel are more tightly connected to overbank flooding from the stream channel (Riverine HGM Class) and may be affected by avulsion and/or incision. Sites vary in size; montane meadow vegetation may occur on stream terraces with elevated water tables. Vegetation is dominated by herbaceous species; graminoids typically have the highest canopy cover. Different plant community types are associated with different groundwater levels

and are indicated by species with different physiological tolerances for depth to water table (Castelli et al. 2000; Chambers et al. 2004; Lord et al. 2011).

- ***Meadows with perennial standing water —*** Depth to water table is +10 to 0 cm. Characteristic species include *Carex aquatilis*, *Carex utriculata*, *Scirpus microcarpus*, and *Senecio hydrophilus.*
- ***Wet meadow —*** Depth to water table is 5 to 30 cm. Characteristic species include *Carex nebrascensis*, *Deschampsia elongata,* and *Deschampsia cespitosa*.
- ***Mesic meadow —*** Depth to water table – 30 to 90 cm. Characteristic species include *Carex microptera*, Carex praegracilis, *Poa secunda juncifolia*, *Juncus arcticus* ssp. *littoralis*, and *Deschampsia cespitosa*. *Poa pratensis* is common; it is an indicator of historical heavy grazing and may not reflect the current grazing regime.
- ***Dry meadow —*** Depth to water table – 90 to 170 cm. Characteristic species include *Leymus triticoides*, *Elymus trachycaulus*, *Poa secunda juncifolia*, and *Muhlenbergia richardsonis*. *Poa pratensis* is common; it is an indicator of historical heavy grazing and may not reflect the current grazing regime.
- ***Dry shrub meadow —*** Depth to water table is 125 to 275 cm. Characteristic species include *Artemisia tridentata* ssp., *Carex douglassi,* and *Leymus cinereus*.

Irrigated Wet Meadow - Large herbaceous wetlands associated with a high water table that is controlled by artificial overland flow (irrigation). Sites typically lack prolonged standing water, but may have standing water early in the season if water levels are very high. Vegetation is dominated by native or nonnative herbaceous species; graminoids have the highest canopy cover. Species composition may be dominated by non-native hay grasses such as *Poa* spp.*, Alopecurus* spp.*, Phleum pratense*, and *Bromus inermis* spp. *inermis*. There

can be patches of emergent marsh vegetation and standing water less than 0.1 ha; these are not the predominant vegetation.

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