Appendix F: Vegetation Classifications and Development of Vegetation Plan Components

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Introduction

This appendix describes in detail the vegetation classifications and plant communities upon which many plan components are built, forming the basis for many forest plan components related to vegetation and wildlife habitat. This appendix also describes the process by which the natural range of variation was developed and/or modeled for vegetation attributes, and used to inform desired conditions.

Vegetation Classifications

Lands across the Custer Gallatin NF have been grouped into broad potential vegetation types, based on climatic and site conditions. Potential vegetation types serve as a basis for description of ecological conditions across the Forest. These groups are useful in understanding the various ecosystems, their potential productivity, natural biodiversity, and processes. Potential vegetation types are essentially assemblages of habitat types, which are aggregations of ecological sites of like biophysical environments (such as climate, aspect, and soil characteristics) that produce plant communities of similar composition, structure and function (Pfister et al 1977, Mueggler and Stewart 1980, Hansen and Hoffman 1988). The vegetation communities that would develop over time given no major disturbances (the climax plant community) would be similar within a habitat type or potential vegetation type. However, existing vegetation condition may vary widely on a potential vegetation type, reflecting each site's unique history, forest character, pattern of disturbances, and point in time along the successional pathways. Therefore, plan components also use classifications of cover types, which are assemblages of existing vegetation that occur at any one point in time. Cover types change through time whereas potential vegetation types generally remain constant.

A consistent hierarchy of broad potential vegetation type and cover type was developed for CGNF plan revision (Reid et al. 2016). This system is based on the Region 1 Existing and Potential Vegetation Groupings used for Broad-level Analysis and Monitoring (Milburn et al. 2015). Potential vegetation types and cover types are classified for plot data and map products. Estimates are made using plot data that is summarized with Region 1 analysis tools (Bush 2014). Attributes are also approximated on maps to understand the distribution and connectivity on the landscape. Mapping of potential vegetation types was completed across the Northern Region using data sources that included field plots, remote sensing, and modeling. Mapping of cover types is derived from dominance types classified in the Region 1 Vegetation Map (Brown 2016). The Region 1 Vegetation Map is a spatially explicit, polygon-based vegetation map derived from remotely sensed data that contains information about the extent, composition, and structure of vegetation across NFS lands in Region 1. The Custer Gallatin NFs vegetation map used for analysis is a compilation of the Region 1 Vegetation Map and the Region 1 Broad Potential Vegetation Map.

Table F-1 and Table F-2 show the classification for Region 1 broad potential vegetation types for forested and nonforested vegetation, based on Reid et al 2016.

Table F-1. Potential vegetation type classification for forested habitat types found on the Custer Gallatin NF

Region 1 Broad Potential Vegetation Type	Region 1 Habitat Type Groups	Region 1 Potential Vegetation Types[1]	ADP Habitat Type Code[2]
Warm Dry	Hot Dry	limber pine	091[3], 092[3], 093[3], 095[3]
Warm Dry	Warm Dry	ponderosa pine Douglas fir 1 Douglas fir 2	100, 110, 130, 140, 141, 142, 160,161, 162 200, 210, 220 311, 380

Region 1 Broad Potential Vegetation Type	Region 1 Habitat Type Groups	Region 1 Potential Vegetation Types[1]	ADP Habitat Type Code[2]
		Douglas fir 3 ponderosa pine	321 180, 181, 182
Warm Dry	Mod Warm Dry	ponderosa pine spruce Douglas fir 2 Douglas fir 3	170, 171, 172 430 260, 261, 262, 280,281, 292, 310, 312, 313 320, 321, 323, 330, 340, 360, 370
Warm Dry	Mod Warm Mod Dry	Douglas fir 2	290
Cool Moist	Cool Moist	subalpine fir 2 spruce	600, 660, 661, 663,670, 740 400, 460, 461, 470
Cool Moist	Cool Wet	subalpine fir 1 spruce	630, 650, 651, 653 410, 440, 480
Cool Moist	Cool Mod Dry to Moist	subalpine fir 2 subalpine fir 3 spruce lodgepole pine	661, 663, 740 691, 720, 750, 770, 780, 790, 791, 792 450 900, 910, 930, 950
Cold	Cold	subalpine fir 3 subalpine fir 4 lodgepole pine	731, 732, 733 730,740, 800, 810, 820 940
Cold	Timberline	whitebark pine	850, 870

1 R1 PVT's based on "Jones" metadata logic and labels.
2 Automatic Data Processing Code (habitat type publications) - includes all codes from valid references in Region 1 for use with NRM FSVeg. Unless otherwise specified, codes are from 101 (Forest Habitat Types of Montana, Pfister and others 1977)
3 Reference 199 = FSH 2409.21h R-1 Timber Management Data Handbook. Used in R1 until 2001.

Table F-2. Potential vegetation type classification for nonforested habitat types found on the Custer Gallatin NF

Region 1 Broad Potential Vegetation Type	Region 1 Habitat Type Groups	Region 1 Potential Vegetation Types	Habitat Types
Grassland	Bluebunch Wheatgrass	Dry Grass	needle and thread grass; needle and thread grass/ blue grama; needle and thread grass/ blue grama – western wheatgrass; bluebunch wheatgrass; bluebunch wheatgrass/ blue grama; bluebunch wheatgrass/ blue grama – liatris; bluebunch wheatgrass/ Sandberg bluegrass; bluebunch wheatgrass/ Sandberg bluegrass – needle and thread grass; bluebunch wheatgrass/ balsamroot; bluebunch wheatgrass/ threadleaf sedge
Grassland	Western Wheatgrass	Western Wheatgrass	western wheatgrass; bluebunch wheatgrass / western wheatgrass, bluebunch wheatgrass / western wheatgrass –green needlegrass, western wheatgrass / threadleaf sedge
Grassland	Fescue	Idaho Fescue	Idaho fescue; Idaho fescue / slender wheatgrass, Idaho fescue / slender wheatgrass –sticky geranium, Idaho fescue /western wheatgrass, Idaho fescue / bluebunch wheatgrass, Idaho fescue / bluebunch wheatgrass-western needlegrass, Idaho fescue / threadleaf sedge, Idaho fescue / tufted hairgrass, Idaho fescue / Richardson's needlegrass, Idaho fescue / slender wheatgrass, Idaho fescue / slender wheatgrass –sticky geranium, Idaho fescue / threadleaf sedge

Region 1 Broad Potential Vegetation Type	Region 1 Habitat Type Groups	Region 1 Potential Vegetation Types	Habitat Types
Shrubland/ Woodland	Mesic Shrubland	Shrubby Cinquefoil	shrubby cinquefoil; shrubby cinquefoil /Idaho fescue
Shrubland/ Woodland	Mesic Shrubland	Skunkbrush	skunkbrush; skunkbrush /bluebunch wheatgrass, skunkbrush/Idaho fescue, Wood's rose, chokecherry, serviceberry
Shrubland/ Woodland	Mesic Shrubland	Mesic Shrub	ceanothus/ bluebunch wheatgrass, mallow ninebark/mountain dandelion, mallow ninebark / serviceberry, mallow ninebark /OSOC, smooth sumac, smooth sumac/ bluebunch wheatgrass, snowberry, snowberry /bluebunch wheatgrass, snowberry /balsamroot, snowberry/Idaho fescue, snowberry/ gallium
Shrubland/ Woodland	Low Shrubland	Low/Black Sagebrush	low sagebrush/ bluebunch wheatgrass, low sagebrush / bluebunch wheatgrass –needle and thread grass; low sagebrush / Idaho fescue; black sagebrush
Shrubland/ Woodland	Mountain Shrubland	Wyoming Sagebrush	Wyoming sagebrush
Shrubland/ Woodland	Mountain Shrubland	Mountain Sagebrush	mountain sagebrush/ Idaho fescue
Shrubland/ Woodland	Mountain Shrubland	Sliver Sage	silver sage
Shrubland/ Woodland	Xeric Shrubland	Mountain Sagebrush - Dry	mountain sagebrush/ bluebunch wheatgrass
Shrubland/ Woodland	Mountain Mahogany Woodland	Dry Shrub	curl-leaf mountain mahogany/ bluebunch wheatgrass, bitterbrush/ bluebunch wheatgrass, bitterbrush/Idaho fescue, Skunkbrush/Idaho fescue;, rabbitbrush; rabbitbrush/ bluebunch wheatgrass; horizontal juniper/little bluestem, bitterbrush/ bluebunch wheatgrass
Shrubland/ Woodland	Juniper Woodland	Juniper	Rocky Mountain Juniper/ bluebunch wheatgrass; Utah juniper
Shrubland/ Woodland	Green Ash Woodland	Riparian / Deciduous	green ash/ chokecherry (Non-riparian - green ash woodland)
Riparian/ Wetland	Riparian - Green Ash Woodland	Riparian / Deciduous	green ash/ chokecherry (riparian - green ash woodland)
	Aspen Woodland	Riparian / Deciduous	aspen; aspen/ red osier dogwood
	Riparian Shrub	Mesic Shrub	alder; willow; bog birch; red osier dogwood; black hawthorne - wide valleys; black hawthorne -narrow valleys; black hawthorne with shrub herbaceous mosaic pattern
	Wetland Graminoid	Riparian Grass/ Grasslike	tufted hairgrass, sedge; tufted hairgrass/sedge; beaked sedge, Nebraska sedge; water sedge; bluejoint
	Riparian Deciduous Tree	Cottonwood	plains, black, and narrow-leaf cottonwood
Alpine	Alpine Herbaceous Alpine Shrub	Alpine	alpine shrublands; alpine turf; alpine grassland; cushion plant communities; alpine slope communities; snowbed communities; alpine wetlands
Sparse	Sparse	Sparsely Vegetated	sparse vegetation typically in alpine/montane scree/rock; exposed sites; or prairie badlands on the Custer Gallatin NF

Table F-3 provides the proportion of each Region 1 broad potential vegetation type that occurs within the geographic areas on the Custer Gallatin NF. There is variation in the proportion of each GA in the

Region 1 broad potential vegetation type groups, which provides insight into the unique pattern of environmental, site, and vegetation conditions within each GA, and how they differ from one another.

Table F-3. Percent of broad potential vegetation types on NFS lands on the Custer Gallatin NF and by geographic area, in % of area1

Region 1 Broad Potential Vegetation Type	Total Custer Gallatin NF	Ashland	Sioux	Pryor Mountains	Bridger/Bangtail and Crazy Mountains	Absaroka Beartooth Mountains	Madison, Gallatin and Henrys Lake Mountains
Warm Dry Forest	23%	50%	41%	43%	29%	15%	13%
Cool Moist Forest	29%	0%	0%	17%	39%	26%	54%
Cold Forest	13%	0%	0%	0%	4%	21%	13%
Nonforest Potential Vegetation Types	35%	50%	59%	40%	28%	37%	20%

[1] Data is from Region 1 Vegetation Map (Brown 2016).

Table F-4 below shows the classification for cover types, based on Reid et al 2016.

Table F-4. Vegetation cover type classification for Region 1 dominance types

R1 Cover Type	Species included	DomMid40[1]	Dom Group 6040[1]
Ponderosa Pine	Ponderosa pine with components Douglas-fir, limber pine, juniper.	MX-PIFL2, MX-PIPO, or MX-JUNIP[2]	PIFL2, PIFL2-Imix, , PIFL2-Tmix, PIFL2-Hmix, PIPO, PIPO-Imix, PIPO-Tmix, PIPO-Hmix, JUNIP-Hmix, JUNIP-Tmix, or JUNIP- Imix[2]
Dry Douglas-fir[3]	Dry Douglas-fir (potential components of ponderosa pine, limber, and juniper).	(IMIX or MX-PSME) ***AND (Jones PVT = pifl, pipo, psme1, or psme) or (R1 Habitat type Group = Hot Dry or Warm Dry)***	(PSME, PSME-Imix, PSME-Hmixor IMIX) ***AND (PVT = pifl, pipo, psme1, or psme3) or (R1 Habitat type Group = Hot Dry or Warm Dry)***
Mixed Mesic Conifer[3]	Moist Douglas-fir, cedar, white pine, grand fir, western hemlock (potential components of lodgepole pine, spruce, subalpine fir).	MX-ABGR, MX-PIMO3, MX-THPL, MX-TSHE, MX- TSME, TMIX or [(MX- PSME or IMIX ***AND (PVT NOT pifl, pipo, psme1, or psme3) or (R1 Habitat Type Group is NOT Hot Dry or Warm Dry)***	ABGR, ABGR-Imix, ABGR-Tmix, ABGR-Hmix, PIMO3, PIMO3-Imix, PIMO3-Tmix, PIMO3-Hmix, PSME- Tmix, THPL, THPL-Imix, THPL-Tmix, THPL-Hmix, TSHE, TSHE-Imix, TSHE-Tmix, TSHE-Hmix, TSME, TSME-Imix, TSME-Tmix, TSME-Hmix, Tmix, or [(PSME, PSME-Imix, PSME-Hmix, or IMIX) ***(PVT NOT pifl, pipo, psme1, or psme3) or (R1 Habitat Type Group NOT Hot Dry or Warm Dry)***

R1 Cover Type	Species included	DomMid40[1]	Dom Group 6040[1]
Lodgepole Pine	Lodgepole pine (other minor components)	MX-PICO	PICO, PICO-Imix, PICO-Tmix, PICO-Hmix
Spruce/fir	Subalpine fir, Engelmann spruce (minor lodgepole component)	MX-ABLA,MX-PIEN, or MX-TABR2	ABLA, ABLA-Imix, ABLA-Tmix, ABLA-Hmix, PIEN, PIEN-Imix, PIEN- Tmix, PIEN-Hmix, TABR2, TABR2-Imix, TABR2-Tmix, TABR2-Hmix
Whitebark pine	Whitebark pine	MX-LALY or MX-PIAL	LALY, LALY-Imix, LALY-Tmix, LALY- Hmix, PIAL, PIAL-Imix, PIAL-Tmix, PIAL-Hmix
Aspen/Hardwood[4]	Aspen, cottonwood, birch (other minor conifer components)	MX-BEPA, HMIX, MX-FRPE, MX-POPUL, or MX- POTR5	BEPA, BEPA-Imix, BEPA-Tmix, BEPA-Hmix, Hmix, FRPE, FRPE-Imix, FRPE-Tmix, FRPE-Hmix, POPUL, POPUL-Imix, POPUl-Tmix, POPUL- Hmix, POTR5, POTR5-Imix, POTR5-Tmix,
Riparian Grass/Shrub	Willow, alder, deciduous shrub mix; mountain brome; smooth brome; dry sedge; Wet sedge/spikerush/ juncus; annual brome	Grass-Wet	Grass-Wet
Mesic Shrub	chokecherry, plum; rose; snowberry; huckleberry; mallow ninebark; white spirea; buffaloberry; evergreen shrub	Shrub-Mesic	Shrub-Mesic
Dry Shrub	sagebrush; antelope bitterbrush; skunkbush sumac; curl-leaf mountain mahogany; greasewood; rabbitbrush; Saltbush, spineless horsebrush; soapweed yucca	Shrub-Xeric; MX-CELE3	CELE3, CELE3-Imix, CELE3-Tmix, CELE3-Hmix
Dry Shrub	Juniper shrub	MX-JUNIP, JUNIP	JUNIP
Grass	Forb mixes; Idaho fescue; western wheatgrass; Bluebunch wheatgrass, needle-and- thread grass; tufted hairgrass; little bluestem; prairie sandreed; green needlegrass; Timothy; crested wheatgrass; blue grama; Kentucky bluegrass; cool season short grass mix; cool season mid grass mix; warm season mid grass mix; warm season short grass mix; mixed grass	Grass-Dry; Grass-Bunch; Grass-Singlestem	Grass-Dry; Grass-Bunch; Grass- Singlestem
Sparsely Vegetated	Sparsely vegetated	Sparse	Sparse

[1]See Barber et al. (2011) for a description of DomMid40 and DomGroup6040 classifications

[2]The JUNIP dominance 6040 type is included in the dry shrub cover type given its common association with grass/shrub. However, juniper dominance types that include a mix of other tree species (JUNIP-Imix, JUNIP-Hmix, JUNIP-Tmix) include components of ponderosa pine, limber pine, and/or Douglas-fir, and are therefore included in the Ponderosa Pine cover type.

[3]PVT information must be used to split the PSME dominance groups to distinguish between the dry Douglas-fir and the Mixed Mesic Conifer cover types.

[4]Aspen is also depicted in potential vegetation associated with riparian types. It is included as a forested cover type to account for upland aspen that occurs outside of riparian areas.

Natural Range of Variation

The intent of desired conditions for vegetation is to generally manage each component within our best understanding of the natural range of variation. This includes appropriate adjustments made to incorporate additional considerations including expected future climates, long-term resilience to disturbances, sustainability of important wildlife habitats, and social and economic factors. The locations, amounts, and distributions of vegetation characteristics should shift over time as influenced by succession, climate, and disturbances.

The natural range of variation represents the distribution of conditions under which ecosystems developed. The natural range of variation approach gives context for evaluating the integrity of current conditions, and identifying important compositional, structural, and functional elements that may warrant restoration.

The factors and rationale applied in the development of natural range of variation for nonforested vegetation was derived through a review and synthesis of available information relevant to the plan area and selected key ecosystem characteristics including composition, ground cover, and effects of stressors and how they are likely to have affected ecosystem integrity. Information used included scientific journal articles, historical records and photographs, and descriptions of reference areas.

The SIMulating Patterns and Processes at Landscape scaLEs (SIMPPLLE) model was used to generate the natural range of variation analysis for forested vegetation. This model was developed in Region 1 to answer landscape level management questions. It is a spatially-explicit, dynamic landscape model used for projecting temporal changes in the spatial distribution of vegetation in response to insects, disease, wildland fire, and other disturbances (Chew et al. 2012). The model is designed to provide a balance between incorporating enough complexity to provide an acceptable level of realism while making enough simplifications to be a useful management tool in planning processes. The model and its results are a simplified portrayal of complex ecosystem dynamics. As such, the results should not be considered an exact representation of a historical landscape, but are a good attempt at approximating vegetation change over time in response to various disturbances and stressors, including historic climate and fire and insect regimes. The model provides useful insight into the complicated dynamics of our ecosystem over time and space, and strengthens our scientific understanding. It provides insight and a frame of reference for the evaluation of ecological integrity and conditions that have sustained the current complement of wildlife and plan species on the Custer Gallatin NF.

The natural range of variation does not provide insight into conditions that may vary in the future based on drivers such as climate change, or other considerations relative to the capability and social demands placed on the ecosystem. Further, the natural range of variation analysis includes inherent uncertainty and it is appropriate to utilize additional resources, including literature, to ensure the “envelope” of vegetation conditions described by the desired conditions is appropriate to meet the future ecological and social needs of the Custer Gallatin NFs. Therefore, the desired condition is not always equal to the natural range of variation. However, all factors in the development of desired future conditions are governed by the prevailing concept to maintain ecosystem and forest resilience as informed by evaluation of the natural range of variation.

The SIMPPLLE model uses existing data and grows it “backwards” through time with parameters that reflect historic climates and disturbances. Thirty simulation runs were done for 1000 years into the past to provide a range of possible outcomes. Any single simulation can present a possible scenario of what

could happen, but it cannot be taken as a precise prediction. SIMPPLLE provides for interaction between disturbance processes and vegetative patterns (Chew et al. 2012).

The best available data for forested vegetation on the Custer Gallatin NF are Forest Inventory and Analysis and Forest and Inventory and Analysis intensified grid plots (USDA 2015). SIMPPLLE also requires a spatial depiction of conditions across the landscape. The best available spatial vegetation data is the Region 1 Vegetation Map version 2014 (USDA 2015). The plot data is used to inform the population of all of the attributes required by SIMPPLLE into the Region 1 Vegetation Map, resulting in a complete spatial dataset across all lands in the planning area. The starting SIMPPLLE spatial dataset was built to reflect the condition measured with Forest Inventory and Analysis data as closely as possible, but minor differences are inherent due to the process of associating grid data to mapped polygons. All existing condition classifications used are consistent with the Region 1 Classification System (Barber et al 2011) and Region 1 Existing and Potential Vegetation Groupings Used for Broad-level Analysis and Monitoring (Milburn et al 2015). As needed, SIMPPLLE classifications and labels are cross-walked to be as consistent as possible with these concepts.

Additional pathways and processes in the model were calibrated to accurately reflect forested conditions on the Custer Gallatin NF, including:

- Successional Pathways: Successional pathways are state and transitional models for each vegetation type that provide the foundation for the model. The existing data was reviewed, and pathways for both forested and non-forested vegetation types were added and/or modified based on expert judgment and successional theory literature to ensure the model depicted the conditions found on the Custer Gallatin NF.
- Wildfire Processes: Wildfire processes, including the probability of ignition, fire sizes, fire
- Regimes (severities), weather ending events, and effects to successional pathways are key drivers in the model. Wildfire processes were calibrated using local fire history data, applicable fire history studies and publications, previous modeling efforts, and expert judgment.
- Insect and Disease Processes: The probability and effects of key insect and disease processes (bark beetles, defoliators, and root diseases) were also calibrated using the latest science regarding insect hazard and mortality trends, local data, and expert judgment.

The factors and rationale applied in the development of natural range of variation for forested vegetation and associated wildlife habitat in the Custer Gallatin NF Revised Forest Plan addressed:

- Forest Composition: vegetation cover type, tree species presence
- Forest Structure: forest size class, forest density class, forest vertical structure class, large live trees
- Landscape Pattern: patch size and configuration
- Disturbance: extent, severity and frequency

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