

# Sage-Grouse Conservation Forecasting for Additional Conservation Actions in Support of the Bank Enabling Agreement

Report to Nevada Gold Mines,  
The Bureau of Land Management, and  
the U.S. Fish and Wildlife Service



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# Executive Summary

The Nature Conservancy (TNC) completed simulations for the purposes of identifying additional conservation actions that could be implemented as part of the Bank Enabling Agreement and estimating their habitat value in terms of functional acres for greater sage-grouse. These simulations were completed consistent with the Methodology of the Bank Enabling Agreement and build upon previous work TNC has completed in service of this agreement, including the detailed methods described in Provencher et al (2017) and Provencher et al (2020). It is noted that the extent of the additional conservation actions simulated here are not fully contained within the current extent of Bank Enabling Agreement at the time of publishing.

Critically, this analysis should provide managers the information they need not only to plan restoration for the benefit of greater sage-grouse, but to account for the effects of those actions administratively. The Bank Enabling Agreement established Project Plans as the implementation agreement for the mitigation bank and in 2017, Barrick (now Nevada Gold Mines), the Fish and Wildlife Service, and the Bureau of Land Management agreed to a suite of conservation actions based on TNC’s science, along with required performance standards and durability measures in two Project Plans – one for public land and one for private land. These Project Plans were amended in 2023 based on TNC’s methodological revisions to reflect scenario PM\_v2.1.2 (Provencher et al. 2020). Scenario PM\_v2.1.2 was therefore used as a benchmark for establishing actions that have been agreed-to in the 2017 Project Plans (as amended in 2023) for this analysis. New simulations reported here include scenarios PM\_v3.1.0 and PM\_v3.2.0. Scenario PM\_v3.1.0 models what is substantially the same conservation action set as scenario

PM\_v2.1.2, but with a new “base” map that relies on 2019 imagery and includes some known fires. This establishes a new “baseline” from which we can understand the value of additional conservation actions for greater sage-grouse. Scenario PM\_v3.2.0 builds on this new baseline and includes additional conservation actions across the landscape. These scenarios taken together can be used to form the scientific basis of new project plans that can achieve uplift for greater sage-grouse over and above what is already agreed to.

## Landscape Modeled

The Full Landscape modeled for this simulation is 905,914 acres and is shown in Figure ES1. This landscape centers on the Cortez Range in central Nevada and includes portions of the

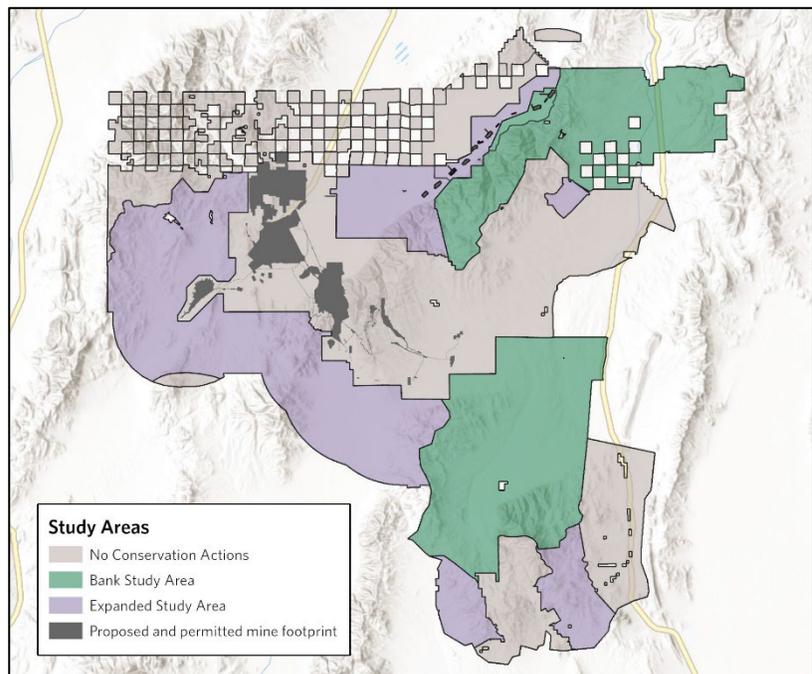


Figure ES1. Full Landscape included in scenarios PM\_v3.1.0 and PM\_v3.2.0. For scenario PM\_v3.1.0, conservation actions were only modeled in the Bank Study Area (green). For scenario PM\_v3.2.0, conservation actions were modeled in the Expanded Study Area (purple) as well as the Bank Study Area. Proposed and permitted mine footprint are included for reference.

Shoshone Range in the west and Roberts Mountains in the southeast. Actions currently enrolled in the Bank Enabling Agreement through Project Plans were modeled to occur in the Bank Study Area (235,267 acres) in scenario PM\_v2.1.2 as well as in the new baseline, scenario PM\_v3.1.0. The scenario that explored additional conservation actions, PM\_v3.2.0, includes all previously modeled actions along with additional actions in the Bank Study Area and new actions in the Expanded Study Area (253,126 acres). No conservation actions were modeled in the area labeled “No Conservation Actions” in any scenario, primarily to avoid conflicts with other land uses.

### Tabular Conservation action Information

In scenarios PM\_v2.1.2 and PM\_v3.1.0, the bulk of conservation actions were implemented between 2016 and 2025. In scenario PM\_v3.2.0, all previous conservation actions are retained, and new ones occur through 2034. The total conservation actions are reported in Table ES1, disaggregated by the two major conservation action areas (Bank Study Area and Expanded Study Area), public vs. private landownership, and conservation action. The difference between scenario PM\_v3.1.0 and scenario PM\_v3.2.0 can be used to form the basis of new credit-generating actions in the Bank Enabling Agreement at several scales.

Table ES1. Total conservation actions in acres summed across entire implementation period for scenarios PM\_v2.1.2, PM\_v3.1.0, and PM\_v3.2.0. The difference between scenarios PM\_v3.1.0 and PM\_v3.2.0 can be used to form the basis of new credit-generating actions in the Bank Enabling Agreement. In a few cases, the difference is negative due to the inherent variability in the model.

<b>Scenario</b>	<b>PM_v2.1.2 (acres)</b>	<b>PM_v3.1.0 (acres)</b>	<b>PM_v3.2.0 (acres)</b>	<b><i>Difference between PM_v3.1.0 and PM_v3.2.0 (acres)</i></b>
Bank Study Area				
BLM				
AerialSeed+Masticate+Plateau	9,709	<b>10,267</b>	<b>10,861</b>	593
Chainsaw-Thinning	2,716	<b>2,617</b>	<b>3,012</b>	395
Exotic-Control	203	<b>161</b>	<b>115</b>	-45
Fence&Water-Delivery	80	<b>82</b>	<b>244</b>	162
Herbicide-Plateau+Seed	1,228	<b>1,392</b>	<b>1,404</b>	11
Herbicide-Shrubs+Mow	44	<b>46</b>	<b>171</b>	125
Herbicide-Plateau+Seed+Shrub-Planting	13,869	<b>14,124</b>	<b>19,696</b>	5,572
Indaziflam	0	<b>0</b>	<b>12,634</b>	12,634
Small-Tree-Lopping	3,063	<b>2,666</b>	<b>3,497</b>	831
Weed-Inventory+Spot-Treat	2,674	<b>2,697</b>	<b>2,837</b>	141
Private				
AerialSeed+Masticate+Plateau	205	<b>150</b>	<b>150</b>	0
Chainsaw-Thinning	107	<b>84</b>	<b>81</b>	-2
Exotic-Control	187	<b>146</b>	<b>112</b>	-33
Fence&Water-Delivery	436	<b>457</b>	<b>467</b>	10
Herbicide-Plateau+Seed	1,138	<b>1,258</b>	<b>1,300</b>	42
Herbicide-Shrubs+Mow	20	<b>20</b>	<b>148</b>	128
Herbicide-Plateau+Seed+Shrub-Planting	5,165	<b>5,307</b>	<b>5,461</b>	154

Indaziflam	0	0	3,103	3,103
Irrigation	555	68	68	0
Small-Tree-Lopping	83	62	71	9
Weed-Inventory+Spot-Treat	746	717	821	104
Expanded Study Areas				
BLM				
AerialSeed+Masticate+Plateau	0	0	1,505	1,505
Chainsaw-Thinning	0	0	696	696
Exotic-Control	0	0	126	126
Fence&Water-Delivery	0	0	76	76
Herbicide-Plateau+Seed	0	0	792	792
Herbicide-Shrubs+Mow	0	0	27	27
Herbicide-Plateau+Seed+Shrub-Planting	0	0	12,240	12,240
Indaziflam	0	0	8,319	8,319
Small-Tree-Lopping	0	0	577	577
Water-Table-Uplift	0	0	13	13
Weed-Inventory+Spot-Treat	0	853	1,168	315
Private				
AerialSeed+Masticate+Plateau	0	0	103	103
Chainsaw-Thinning	0	0	175	175
Exotic-Control	0	0	89	89
Fence&Water-Delivery	0	0	124	124
Herbicide-Plateau+Seed	0	0	2,002	2,002
Herbicide-Shrubs+Mow	0	0	68	68
Herbicide-Plateau+Seed+Shrub-Planting	0	0	262	262
Indaziflam	0	0	0	0
Small-Tree-Lopping	0	0	2	2
Water-Table-Uplift	0	0	59	59
Weed-Inventory+Spot-Treat	0	448	691	242
Total Across Landscapes	42,228	43,621	95,368	

### Functional Acres

Across the landscape, an increase in functional acres was observed after 2019 between scenarios PM\_v3.1.0 and PM\_v3.2.0, with a peak functional acre uplift of 2,369 in 2044 as a result of potential additional conservation actions (Table ES2). Statistical analysis shows that the difference in functional acres between the two scenarios in 2044 is significant. Spatially, changes in habitat suitability are subtle but visible within the conservation action areas (Figure ES2). Many of the additional functional acres gained were found adjacent to areas of moderate to high quality habitat.

Table ES2. Functional acres estimated for scenarios PM v3.2.0 and PM v3.1.0 and the total functional acre (FA) gain in five year reporting increments.

Scenario	2014	2019	2024	2029	2034	2039	2044	2049
PM v3.2.0	248,482	248,647	248,331	247,351	246,084	244,844	243,335	242,101

PM v3.1.0	248,482	248,667	247,871	245,881	244,673	242,872	240,967	239,969
Total FA Gain	0	-20	460	1,470	1,412	1,972	2,369	2,132

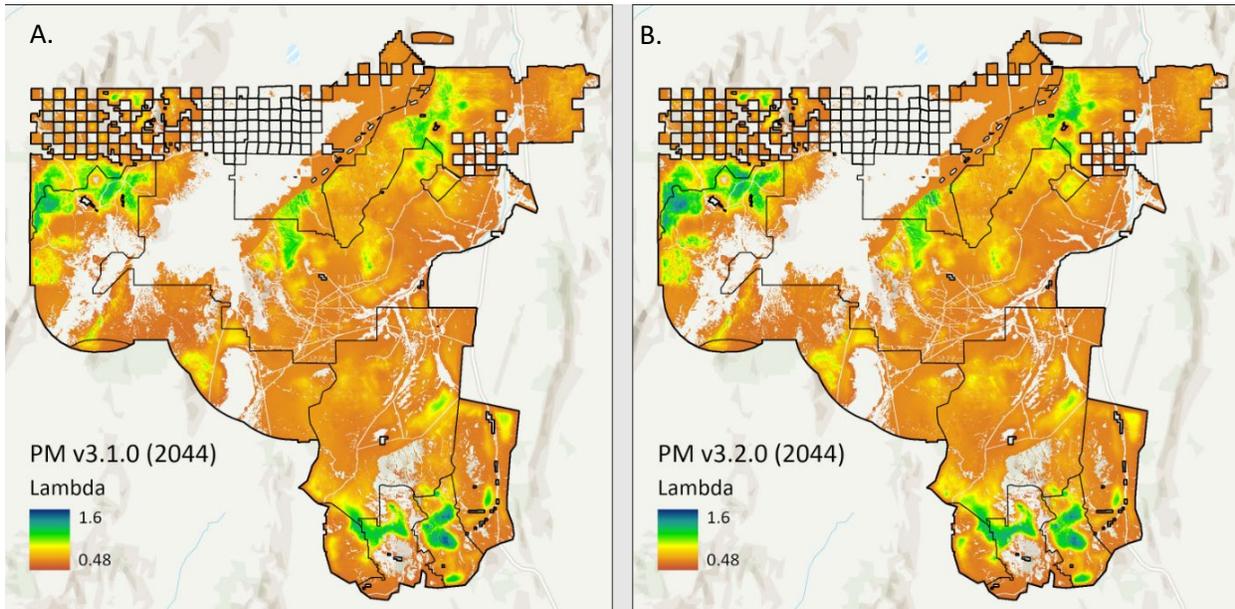


Figure ES2. Spatial distribution of lambda for greater sage-grouse habitat suitability for scenarios PM v3.1.0 (“A”) and PM v3.2.0 (“B”) for year 2044, which corresponded with the greatest functional acre gain. Overlain are the analysis zones.

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# Introduction

## Project Background

The sagebrush biome in the Great Basin supports a diverse range of plant and animal species and important resources for human communities. Conserving sagebrush habitat in Nevada for the benefit of wildlife and people is a priority for The Nature Conservancy (TNC) in Nevada. As such, TNC has long recognized the importance of businesses and sustainable economic development as critical to successful conservation. Based on these foundational principles, TNC in North America has pursued mitigation as a key strategy for achieving gains for conservation. The Nevada Chapter of TNC is uniquely suited to support mitigation through the application of the well-developed, Landscape Conservation Forecasting™ (LCF) tool (Low et al. 2010, Provencher et al. 2013). This quantitative tool, when paired with the University of Nevada, Reno's (UNR), greater sage-grouse (*Centrocercus urophasianus*, hereafter greater sage-grouse) habitat suitability model (Kane et al. 2017), has become the scientific underpinnings of the Bank Enabling Agreement (BEA), a mitigation mechanism that seeks to achieve a net conservation gain for greater sage-grouse, while providing increased regulatory certainty for future mining growth for Nevada Gold Mines. This report details modeling results that can be used by the U.S. Department of Interior (DOI) and Nevada Gold Mines (NGM) to help achieve the objectives of the BEA.

A hundred years ago there were an estimated as many as 16 million greater sage-grouse living across most western states (Federal Register 75 FR 13910). Current estimates suggest only 200,000 to 500,000 remain (Federal Register 75 FR 13910). Greater sage-grouse depend on several types of habitat and vegetation for food, nesting, and shelter from predators (Connelly et al. 2011). The decline of greater sage-grouse is related to the loss of these habitats (Schroeder et al. 2004). In Nevada, habitat is being continuously lost, primarily due to historically large rangeland wildfires, invasive weeds, and conifer encroachment (U.S. Fish and Wildlife Service 2013). Incremental loss of habitat for a species, and especially for threatened and endangered species, can have a dramatic impact on a species' viability.

Land management agencies and others have identified the mitigation hierarchy as a primary strategy for tackling this challenge not just in the United States, but around the world. Appropriate application of the mitigation hierarchy involves, first and foremost, avoiding and minimizing impacts as much as possible. For those impacts that are unavoidable, compensatory mitigation can be used to offset habitat degradation. To meet the goal of no net loss of habitat function from compensatory mitigation, decision-makers need robust quantitative tools to evaluate gains and losses due to conservation and development. In Nevada, TNC is uniquely positioned to provide scientific rigor to federal and private decision-makers through the application of the Sage-Grouse Conservation Forecasting Tool.

Sage-Grouse Conservation Forecasting (SGCF) is a special case of LCF created by TNC to help land managers design cost-effective strategies to restore ecological systems in large landscapes to increase greater sage-grouse habitat. As with LCF, SGCF can be summarized by the "3 Ms": maps, models, and metrics. Traditionally, LCF's metrics measured the departure between the distribution of current vegetation classes in a single ecological system and the expected distribution under reference conditions. The nature of metrics of success have been expanded to include wildlife habitat suitability indices (e.g., desert tortoise in the Mojave Desert, Provencher et al. 2011, and Utah prairie dog and greater sage-grouse in Utah's west desert, Provencher et al. 2015, 2021a). The focus on greater sage-grouse metrics for this project merited changing the name to emphasize the management objectives.

In 2010, greater sage-grouse were determined to be warranted for protection but precluded by other higher priorities under the Endangered Species Act (ESA, FWSFWS 2010). This decision lent focus and momentum to a west-wide effort to conserve and enhance habitat for the greater sage-grouse. Across the species' range, Federal, State, Local, and private entities sought ways to provide assurance that greater sage-grouse habitat would support viable populations for the long term. The agencies with jurisdiction over federally managed habitat sought ways to minimize or cap disturbances while allowing for multiple uses on the landscape. In June of 2015, SGCF became the scientific underpinnings of the BEA signed between the Fish and Wildlife Service, the Bureau of Land Management, and Barrick. The BEA created an approved, scientifically robust, and novel landscape-scale mitigation process:

“This Bank Enabling Agreement sets forth the mechanism for: (1) establishment, use, operation, and maintenance of the Bank to compensate for impacts to the greater sage-grouse and sagebrush ecosystems with actions that produce a Net Conservation Gain; and (2) the establishment of the conservation Credit and Debit metrics using the Sage-Grouse Conservation Forecasting Methodology developed by The Nature Conservancy (“TNC”) for calculating the Credits associated with Conservation Actions and the Debits associated with proposed mining or other associated activities (“TNC Methodology”). The Bank will provide for the preservation, restoration, and/or enhancement of sagebrush ecosystems by implementation of Projects to be agreed upon among the Parties; management and maintenance of those ecosystems in accordance with this Bank Enabling Agreement and Project Plans (“Bank Plans”); and a methodology for accounting for Credits associated with implementation of the Projects, or portions thereof.”

In the simplest sense, the BEA established an administrative and scientific methodology to dynamically (over decades) measure greater sage-grouse mitigation debits from proposed mining (loss of habitat suitability) and mitigation credits (gain of habitat suitability) created from restoration and protection of habitat, and financial commitment to implement actions that will achieve net conservation gains for greater sage-grouse in designated landscapes. In September of 2015, the FWS determined greater sage-grouse was not warranted for listing in part due to these planned conservation actions, such as the BEA.

SGCF uses UNR's statistical demographic habitat suitability model as the metric to design restoration strategies to increase greater sage-grouse habitat suitability compared to maintaining status quo management. The use of spatially explicit habitat suitability models allow for a unit of measurement, functional area, and, in the case of this project, Functional Acre. Functional Acres can be totaled across the landscape or totaled at smaller areas and compared over time and between alternative scenarios. By comparing alternate future scenarios, TNC can quantify the improvements to greater sage-grouse habitat from potential restoration actions as well as the impacts from increased infrastructure or habitat loss into the future.

The Nature Conservancy has used this methodology to complete seven reports since 2017 that provide the scientific basis for administration of the mitigation bank:

- Provencher L, Badik K, Anderson T, Munn L, Cameron M. 2017. Sage-Grouse conservation forecasting for Barrick's Bank Study Area and Deep South Expansion Projects Plan of Operations Study Area.
- Badik K, Provencher L, Byer S, Munn L. 2020a. Sage-Grouse Conservation Forecasting for Nevada Gold Mine's Proposed Plan of Operations for the Goldrush Mine.
- Badik K, Provencher L, Byer S, Munn L. 2020b. Effects of the Updates to The Nature Conservancy's Science and Modeling Methods on Functional Acres and Proposed Management

for Conservation in support of the Bank Enabling Agreement.

- Provencher L, Badik K, Byer S, Munn L. 2020a. Updates to The Nature Conservancy's Science and Modeling Methods in support of the Bank Enabling Agreement.
- Provencher L, Badik K, Byer S, Munn L. 2020b. Effects of the Updates to The Nature Conservancy's Science and Modeling Methods on Vegetation in support of the Bank Enabling Agreement.
- Provencher L, Byer S, Munn L, Badik K. 2021. Major Themes in Change Detection for the 2014-2019 Period.
- Badik K, Provencher L, Byer S, Munn L. 2023. Sage-Grouse Conservation Forecasting for Nevada Gold Mine's Revised Proposed Plan of Operations for the Goldrush Mine.

These reports establish the detailed methods (Provencher et al 2017, 2020a) and results (Provencher et al 2017, 2020b, 2023; Badik et al 2020a, 2020b, 2023) from modeling simulations and the effects of mining on forecasted vegetation (and consequently, greater sage-grouse habitat suitability). Notable among these is Provencher et al. (2021) which reports on new remote sensing for the entire landscape, both establishing a new underlying vegetation map as well as analyzing change on the landscape since the initial remote sensing was performed.

Critically, this analysis should provide managers the information they need not only to plan restoration for the benefit of greater sage-grouse, but to account for the effects of those actions administratively. The Bank Enabling Agreement established Project Plans as the implementation agreement for the mitigation bank and in 2017, Barrick (now Nevada Gold Mines), the Fish and Wildlife Service, and the Bureau of Land Management agreed to a suite of conservation actions based on TNC's science, along with required performance standards and durability measures. These Project Plans were amended in 2023 to incorporate updates to the science reported in Provencher et al 2020a, 2020b, and Badik et al 2020b. To account for this, TNC used scenario PM\_v2.1.2 from Provencher et al. 2020b and Badik et al 2020b as a benchmark for this report.

## Spatial Scope

The Full Landscape modeled for this simulation is 905,914 acres and is shown in Figure 1. This landscape centers on the Cortez Range in central Nevada and includes portions of the Shoshone Range in the west and Roberts Mountains in the southeast and is part of the homeland of the Western Shoshone people. Actions currently enrolled in the Bank Enabling Agreement through Project Plans were modeled to occur in the Bank Study Area (235,267 acres) in scenario PM\_v2.1.2 as well as in the new baseline, scenario PM\_v3.1.0. The scenario that explores additional conservation actions, PM\_v3.2.0, includes all previously modeled actions along with additional actions in the Bank Study Area and new actions in the Expanded Study Area (253,126 acres). No conservation actions were modeled in the area labeled "No Conservation Actions" in any scenario, primarily to avoid conflicts with other land uses.

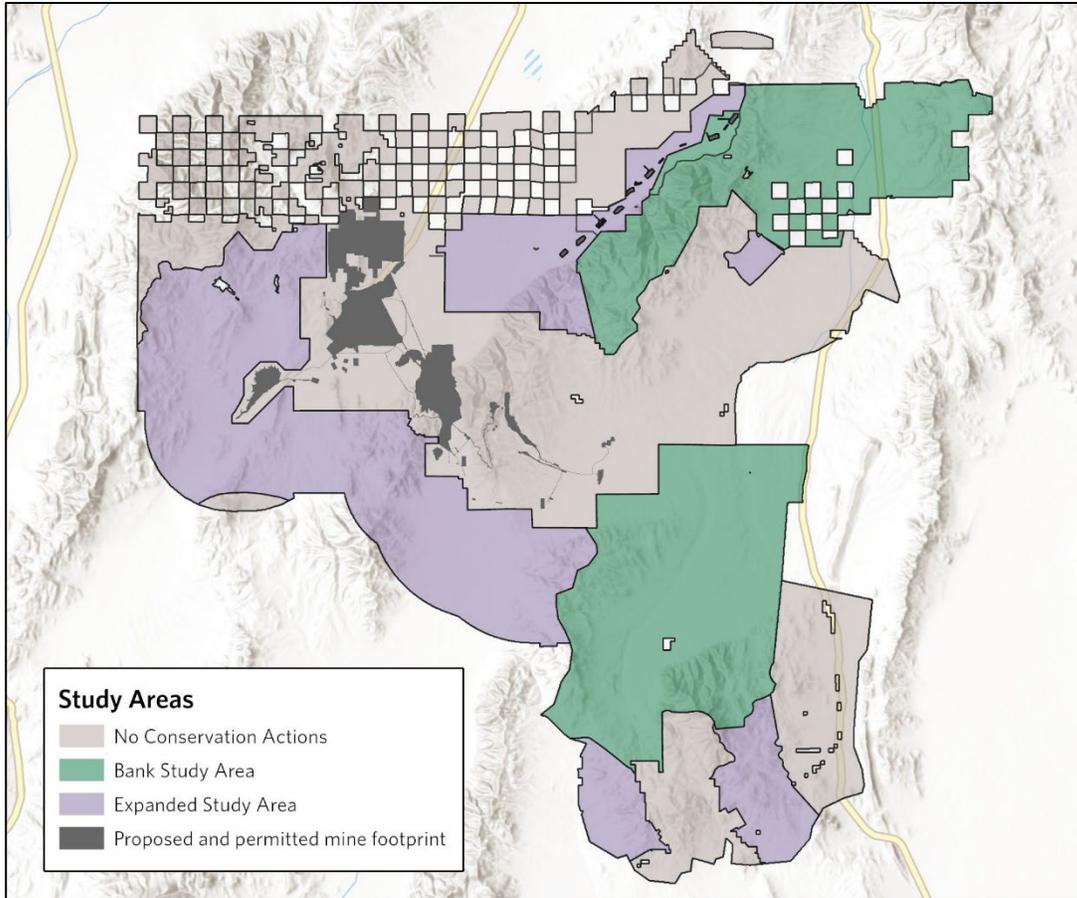


Figure 1. Full landscape included in the analysis.

## Management Objectives

In consultation with local and regional experts, the following objectives were established and reported in Provencher et al. (2017):

Table 1. SGCF Management Objectives for the Banking Area.

Objectives	Conceptual Strategies
Manage to protect important sage-grouse habitat from wildfire and other disturbances <sup>1</sup>	<ul style="list-style-type: none"> <li>• Implement and maintain appropriate fuel breaks to protect critical areas.</li> <li>• Treat annual grasslands to achieve longer fire-return intervals.</li> <li>• Prevent expansion of non-native forbs and tree encroachment</li> </ul>

<sup>1</sup> Provencher et al. 2017 used the phrase “manage to preserve critical sage-grouse habitat from wildfire and other disturbances.” This has been updated to reflect a more precise objective with respect to regulatory language.

Optimize the increase in habitat suitability for greater sage-grouse	<ul style="list-style-type: none"> <li>• Maintain or restore vegetation classes that contribute to chick survival (especially near current/potential nesting) (i.e., late-brood rearing habitat, focusing on wet meadows)</li> <li>• “Do no harm” to higher-value nesting areas; no net loss of intact sagebrush (e.g., close to late-brood habitat).</li> <li>• Treat vegetation classes that increase potential nesting areas (near leks and current/potential late-brood habitat) (E.g., treating encroached PJ and annual grasslands)</li> </ul>
Maintain and/or improve overall ecological health of select systems according to collective priorities	<ul style="list-style-type: none"> <li>• Survey for and treat invasions of exotic forbs to prevent further spread.</li> </ul>

In addition to these objectives, for this set of simulations, an additional objective emerged:

- Build on and complement other conservation actions happening in the area, including those committed to by Nevada Gold Mines as part of the 2017 Project Plans (as amended in 2023) and those planned by other actors. For example, another company had committed to treat Pinyon and Juniper stands in the Roberts Mountains (outside of the Bank area), and we explored whether there were actions that could compliment these.

Importantly, concern over the populations of other species in the sagebrush sea, specifically the Pinyon Jay, has grown since this project was initiated (FWS 2023). While the conservation actions analyzed in this report were designed to benefit only greater sage-grouse starting in 2015, the information provided in this report, including the detailed results by ecological system, should give managers many of the tools they need to evaluate the trade-offs of managing for these two species if and where the trade-offs may exist.

Similarly, this technical effort does not include explicit cultural objectives based on consultation with Western Shoshone tribal members or other current and historic human stewards. In addition to completing cultural surveys prior to ground disturbing activities, the technical details of this report can be used in concert with other ways of knowing to design refined conservation actions for implementation that meet multiple objectives.

## Methods

As mentioned above, SGCF (and LCF) can be summarized by the “3 Ms”: maps, models, and metrics. The methods that define each of these steps were originally described in Provencher et al 2017 and clarified or modified in subsequent reports by TNC. Here, we focus exclusively on new developments to the methods not previously described in TNC reports and explain both the context and rationale for the change as well as the scientific steps.

### Maps

The base vegetation maps used for this analysis were developed during the 2019 Change Detection process as described in Provencher et al. 2021b. These mapping products were used as they represented the most up-to-date classifications of the current ecological systems and classes across the landscape. In addition, the 2019 maps included corrections to post-processing errors as documented in Provencher et al. 2021b. They also represented the largest extent of mapped landscape to-date as over 75,000 acres were newly mapped in 2019. Importantly, few detectable conservation actions had been implemented prior to 2019 change detection relative to the overall recommended acreages from Provencher et al. 2020. Of the 29,684 acres of reported “change,” only 1,795 of those acres were within reported analysis zones, over half of which were in the JD Meadows where known irrigation and seeding projects were the major sources of change (Provencher et al. 2021b). Thus, the value of using the most up-to-date map, which included nearly 28,000 acres of other changes that improved the map quality, outweighed the value of the potential inconsistencies with the recommended conservation action program.

However, the choice to use the 2019 data presented a series of modeling challenges, namely 1) how to incorporate new vegetation into the state-and-transition models, 2) how to develop an approach to modeling that remained consistent for administrative purposes but still used the newest vegetation layers, 3) how to populate areas that were recently burned and therefore mapped as “CHAR,” and 4) how to accommodate other known fires in the region that occurred between the remote sensing capture and the simulations. The modeling methods used to address each one of these challenges are described below.

### Models

As described in previous reports, STSMs, like those used in this analysis, are stochastic models of landscape change. The landscape in an STSM consists of a discrete set of simulation cells classified into a discrete set of states. Those discrete sets of states were obtained from the remote-sensed ecological systems and vegetation classes and the nested descriptions of vegetation (Appendix A). Simulation cells change over discrete timesteps according to a discrete set of possible transitions that are caused by either natural (e.g., wildfire) or anthropogenic (e.g., seeding) processes operating within temporal or spatial constraints (Daniel et al. 2016; Provencher et al. 2016). The models used to complete this analysis followed the more specific methods described in previous reports, but also included the following updates from previous versions:

- New state and transition pathways were developed for the new ecological systems found in the 2019 change detection and refined understanding of the ecological processes occurring on this landscape.
- New methods were developed to incorporate actual fires that occurred on the landscape.

- New methods were developed to approximate grazing on the landscape and spatial constraint layers for grazing were updated to reflect the larger extent.
- New scenarios were developed to meet new management objectives.

These four updates are described in detail below. All simulations were conducted using the ST-Sim package in SyncroSim (currently Version 2.3.14; Daniel et al. 2016; [www.apexrms.com](http://www.apexrms.com)). A full reporting of the transition pathways for the model is included in Appendix C.

### Transition Pathways for New Ecological Systems and Classes

As described in Provencher et al. 2021, compared to the original mapping conducted in 2014-2018, two new classifications were identified reflecting improved understanding of the ecological landscape. For this analysis, transition pathways were developed to support these new classifications. See Appendix C for a full description of the pathways to and from these classifications.

### Incorporating Actual Fires

Fire was the most important disturbance in the Full Landscape and abundantly covered in previous reports. An interesting aspect of fire was that the latest mapping in 2019 captured several fires that had burned in 2017, 2018, and 2019, all since the initial mapping for this project. This included the Horse Fire that was literally still smoldering or charred when visited for remote sensing field verification. The 2017, 2018, and 2019 fires were either charred or had not experienced enough regrowth during a prolonged drought for easy classification. In addition, actual fires occurred after the 2019 change detection in 2020. Modeling using the 2019 maps thus required that we develop a technique to populate areas that were “charred” with probable vegetation classes that would emerge in future years, as well as to “force” fires to occur in known perimeters.

Even though the analysis was run using the updated map, the simulations were developed with initial year of 2014 (e.g., timestep zero of initial conditions = 2014). This is described in more detail in the “simulation” section below. Given this, we developed a method for approximating vegetation dynamics by starting simulations in 2014 with the updated vegetation map. For the burn perimeters where fires were observed, we approximated fire outcomes by forcing them to burn within downloaded MTBS fire perimeters. To repopulate the areas within these known burn scars, the model followed the probabilistic pathways associated with the previously mapped ecological system and vegetation classes of each pixel. We suppressed all other fire in 2015, 2016, 2021 and 2022, when no fires occurred on this landscape. Normal simulated fires resumed in 2023.

### Grazing

For the grazing model, grazing may be caused by cattle, wild horses in federal Herd Management Areas, and stray horses found from Pine Valley over the Cortez Range to Frenchie Flat. Spatially, this grazing is governed by layers that represent federal grazing permits and known private area use for cattle, and Herd Management Areas and areas of known stray presence for horses (Figs. 2 and 3). Within all simulations, cattle grazing was the most ubiquitous disturbance often occurring annually. The method to model grazing was updated for this analysis to increase the efficiency of iterative modeling while maintaining the spatial and temporal probabilities of the effects of grazing from previous reports.

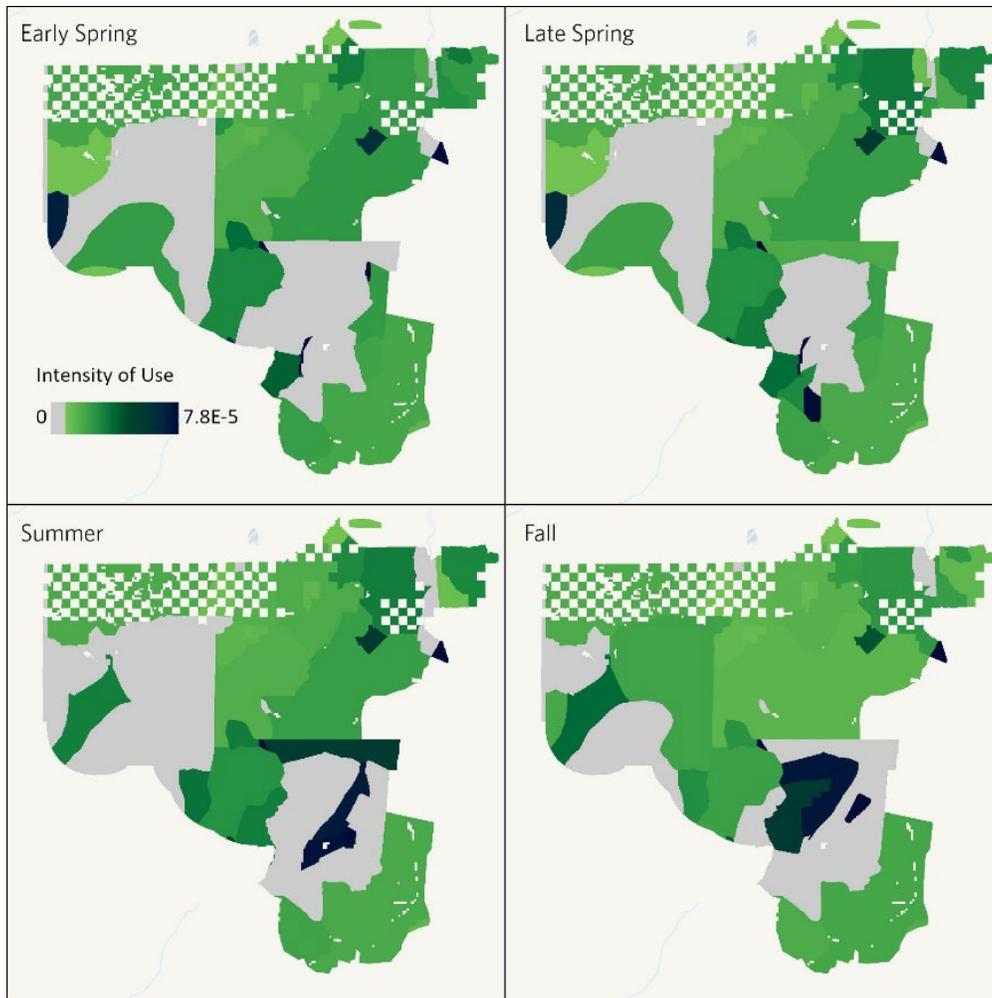


Figure 3. Cattle grazing intensity by season, including early spring (top left), late spring (top right), summer (bottom left), and fall (bottom right).

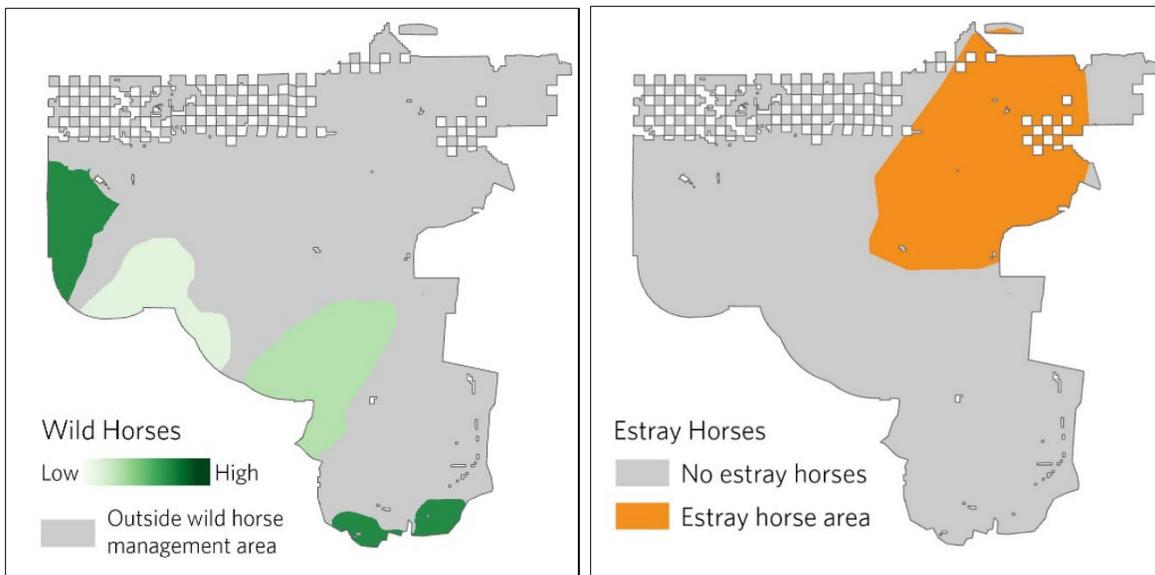


Figure 2. Wild horse and estray horse grazing areas.

In previous analyses, per pixel cattle grazing for each of four seasons of use were tallied across all allotments and pastures and iteratively adjusted to approximate the seasonal AUM target. Targets were based on an audit of grazing permits and use of private pastures. Relative intensity of use for each pasture within allotments was weighted by heads of cattle, proportion of days per year in a pasture, and area of pasture. In past analyses this analysis, four seasonal targets were summed into one AUM target (44,578 AUMs) from which all seasons of use were iteratively controlled (Provencher et al. 2017). To improve model speed, the iterative process of controlling AUMs was replaced by specifying the area grazed per raster of season of use (but not AUMs), thus regaining the realism of season of use, and was modeled as four non-iterative conservation action targets (i.e., as any other vegetation conservation action) applied to the relative pasture use. The annual areas grazed for the early- spring, late spring, summer, and fall, respectively, were 625,290 acres (253,046 ha), 640,364 acres (259,146 ha), 588,096 acres (237,994 ha), and 691,650 acres (279,901 ha).

The modeling of wild and estray horse populations in PM\_v3.1.0 and PM\_v3.2.0 mirrored the levels in PM\_v2.1.2, which assumed lower levels of horse grazing. Therefore, those sources of grazing were unchanged from 2020 (Provencher et al 2020a), the only updates for this analysis were the spatial constraint layers, which needed to be expanded given the larger study area (Figure 3).

### Scenarios

The scenarios provide the suite of conservation actions that may be applied to the landscape. Critically, the scenarios included in this analysis must provide managers the information they need,— not only to plan restoration for the benefit of greater sage-grouse, but to account for the effects of those actions within the established mitigation bank. The Bank Enabling Agreement established Project Plans as the implementation agreement for the mitigation bank. In 2017, NGM, the FWSUSFWS, and the BLMBLM agreed to a suite of conservation actions based on TNC’s science. These actions occurred in the “Bank Study Area” (Figure 4). The Project Plans were amended in 2023 to reflect the results of the Methods update and resulting scenario PM\_v2.1.2 (Provencher et al. 2020a, 2020b, Badik et al. 2020a).

For the current analysis, PM\_v3.1.0 is a new simulation completed and to replicate PM\_v2.1.2 both in the number of acres treated by conservation action and ecological system, and in the timing of conservation actions. Preserving the timing and number of conservation actions from the previous analyses as much as possible ensures that the calculation of the value of additional conservation actions is as straight-forward as possible. Thus, our simulations needed to have an initial “year” (timestep zero) of 2014. PM\_v3.1.0 effectively establishes a new “baseline” from which we can understand the value of “additional conservation actions,” (i.e., those that are above and beyond the actions planned based on PM\_v2.1.2 and discussed below). The types of conservation actions that occurred in PM\_v3.1.0 were the same as those in PM\_v2.1.2. Generally, these actions were limited to the following ecological systems: big sagebrush shrubland-upland with trees, montane sagebrush steppe on upland soils, low sagebrush, black sagebrush, and wet meadow-montane. Special seeding and irrigation actions targeted existing pastures of greasewood and basin wildrye bottomland soils to create brood rearing habitat were in previous analyses and remained unmodified in PM\_v3.1.0. Exotic noxious forb and tree species control actions were used in non-greater sage-grouse systems such as basin wildrye-montane and saline meadow to prevent invasion in adjacent greater sage-grouse habitat found in wet meadow and sagebrush systems in PM\_v2.1.2 and again, remained unmodified in PM\_v3.1.0.

In order to understand how increased levels of investment, new conservation action types, and new areas of conservation actions may contribute to greater sage-grouse habitat, we designed scenario

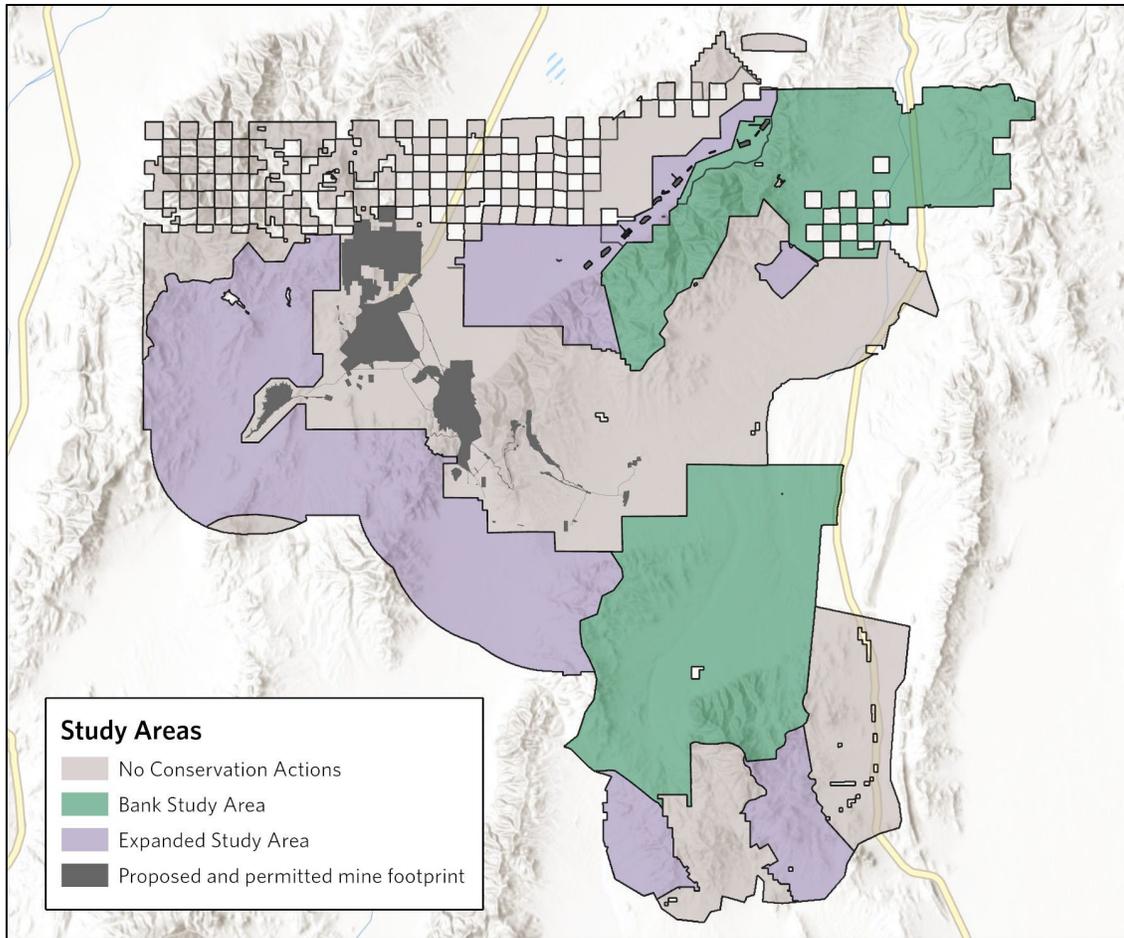


Figure 4. Full landscape included in PM\_v3.1.0 and PM\_v3.2.0. For PM\_v3.1.0, conservation actions were only modeled in the Bank Study Area (green). For PM\_v3.2.0, conservation actions were modeled in the Expanded Study Area (purple) as well as the Bank Study Area. Proposed and permitted mine footprint are included for reference.

PM\_v3.2.0. All actions that occurred in PM\_v3.1.0 were carried over to PM\_v3.2.0. For scenario PM\_v3.2.0, additional conservation actions were implemented after 2024 and ended in 2035 (Figure 5). These additional actions were either an increase in implementation above what was modeled in PM\_v3.1.0, or the addition of totally new actions. Spatially, the additional conservation actions occurred in both the Bank Study Area and the Expanded Study Area (Figure 4).

The two new actions added for PM\_v3.2.0 were “Spraying-Indaziflam” and “Water-Table-Uplift.” Spraying-Indaziflam was used to prevent annual species germination occurred only in seedlings and big sagebrush shrublands with perennial grasses invaded by non-native annual species. Water-Table-Uplift was used to deploy low-tech, process-based restoration in qualifying wet meadow systems. A description of the conservation actions with their per unit costs and the specific transition pathways that result from these actions is included in Appendix D (see Provencher et al 2017 for a description of the conservation actions in PM\_v2.1.2). For this analysis, the costs per unit acre of each conservation action were updated for both model runs PM\_v3.1.0 and PM\_v3.2.0.

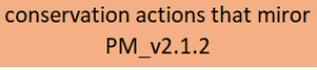
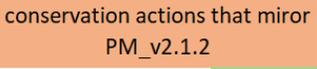
Total Model Time Period (35 years)	2014  2039
PM_v3.1.0	 conservation actions that mirror PM_v2.1.2
PM_v3.2.0	 conservation actions that mirror PM_v2.1.2   new conservation actions

Figure 5. Conceptual representation of the relationship between the two scenarios, PM\_v3.1.0 and PM\_v3.2.0.

## Metrics

Metrics are used to help managers understand the value of conservation actions over time. The metric applied to understand the value of conservation actions is GRSG habitat suitability, as measured in functional acres. Functional acres reported here use the same methods as described in Provencher et al, 2020a, (see the full description of the method is included in Appendix C). However, one innovation in the reporting of functional acres was the introduction of “Analysis Zones” which allow for analysis of the effects of conservation actions in discrete, mutually exclusive polygons.

### Analysis Zones

An innovation for this report is the reporting of habitat suitability metrics in discrete “Analysis Zones.” Analysis Zones are used to report the habitat results in discrete units after the landscape scale modeling is complete. The parties to the BEA, in consultation with The Nature Conservancy, concluded that while it was appropriate to simulate the Full Landscape, even when conservation actions were on a subset of the landscape, the value of those conservation actions in functional acres between two scenarios was appropriate to calculate at somewhat smaller scales. This was codified in the 2023 amendment to the 2017 Project Plans; however, some of the specific parameters to these zones had not yet been established.

The “Analysis Zones” were designed to:

1. Respect previous administrative boundaries.
2. Capture the majority of the effects caused by conservation actions in terms of their benefit to greater-sage grouse.
3. Capture the interactive effects of spatially proximate conservation actions.
4. Ensure no double-counting occurred in the administration of the bank.

Once established, analysis zones can be implemented independently although the suite of modeled conservation actions<sup>2</sup> within the zone would need to be completed to realize estimated functional acre gains. For administrative purposes, because the functional acre value of these zones is mutually exclusive, they can be added together without causing issues of “double counting.” The final analysis zones are presented as part of the habitat suitability results section.

<sup>2</sup> Note that “modeled conservation actions” include variation of implementation across replicates.

# Results

## Initial Conditions

Provencher et al 2021 includes a detailed discussion of the area that was mapped for change detection. However, in 2019, over 75,000 acres were newly mapped in the northwest of the study area. Thus, we present here a summary of the initial conditions across the full study area, both in terms of ecological systems and greater sage-grouse habitat suitability.

## Ecological Systems

Twenty-seven ecological systems were mapped in the Full Landscape (Table 22 and Figure 6). Four of the top five most extensive systems were sagebrush shrublands used by greater sage-grouse. Since the 2014 remote sensed mapping of vegetation, one new system, dry wet meadow-montane, was added to the list of ecological system. Many dry wet meadows were the outer ring of wet meadows in 2014 but split from them during the last change detection mapping. See Provencher et al (2021) for a more detailed discussion of this change.

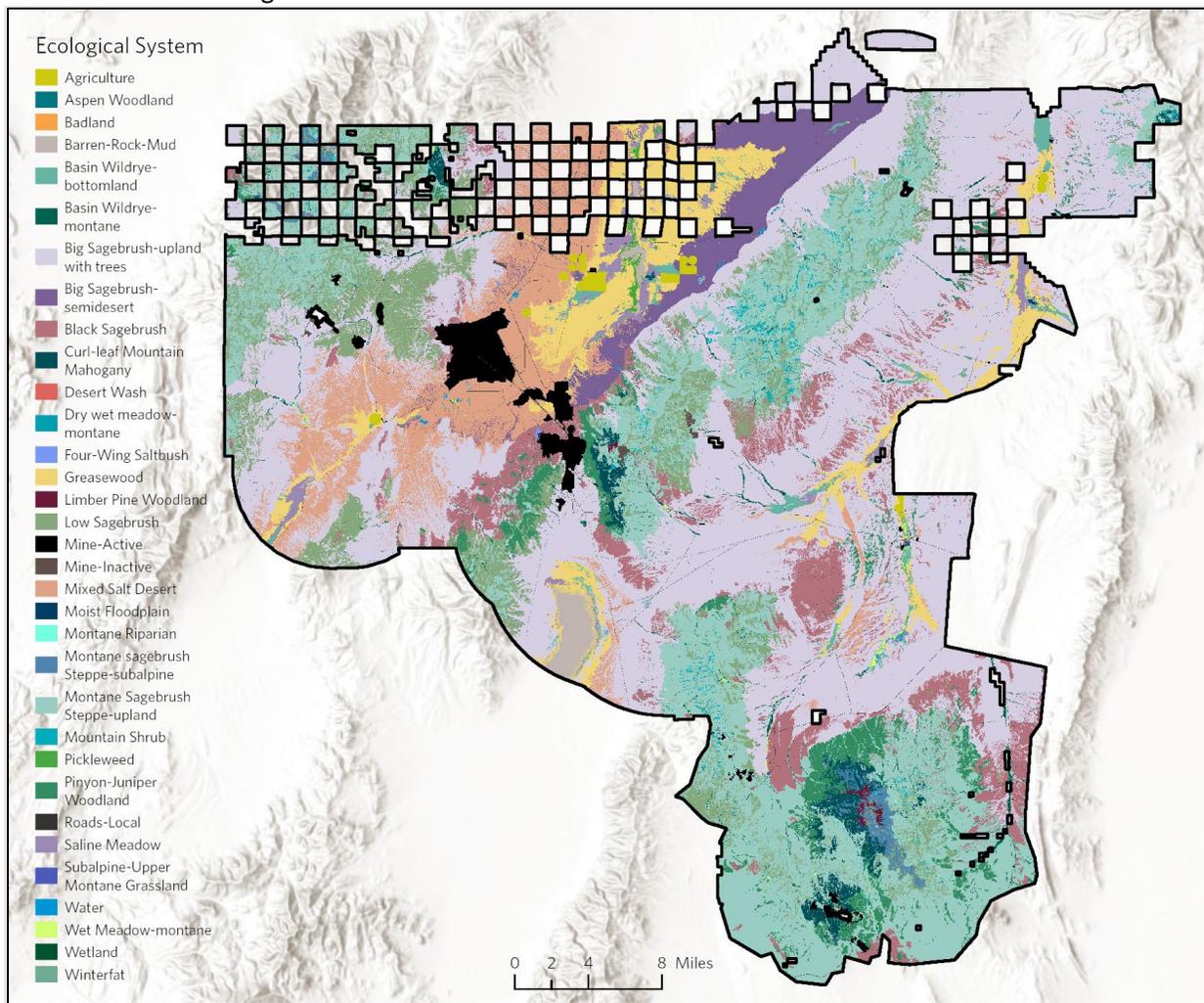


Figure 6. Ecological systems of the Full Landscape as captured with 1.5-m resolution Spot 6/7 satellite imageries in 2019. White squares are private lands not owned by NGMs, many in checkerboard lands.

In decreasing order of area across all ownerships, the largest systems were big sagebrush upland with trees (i.e., Wyoming big sagebrush; 340,372 acres or 137,802 ha), montane sagebrush steppe on upland soils (i.e., mountain big sagebrush; 171,360 acres or 69,377 ha), low sagebrush (74,676 acres or 30,233 ha), mixed salt desert (65,837 acres or 26,655 ha; not greater sage-grouse habitat), and black sagebrush (57,555 acres or 23,302 ha). Among smaller systems important to greater sage-grouse for brood-rearing habitat, wet meadow – montane accounted for 1,380 acres (559 ha) and dry wet meadows covered 234 acres (95 ha) (Table 4). Many dry wet meadows formed the concentric outer ring of wet meadows.

Table 2. Ecological systems and anthropogenic surface areas (ha) of the Area of Interest as captured with 1.5-m resolution Spot 6 satellite imageries from 2014 to 2016 and Spot 6/7 satellite imageries from 2017 to 2019.

<b>Ecological System</b>	<b>Area (acres)</b>	<b>Area (hectares)</b>
Big Sagebrush-upland with trees	340,372	137,802
Montane Sagebrush Steppe-upland	171,360	69,377
Low Sagebrush	74,676	30,233
Mixed Salt Desert	65,837	26,655
Black Sagebrush	57,555	23,302
Greasewood	47,805	19,354
Big Sagebrush-semidesert	29,283	11,855
Pinyon-Juniper Woodland	27,122	10,981
Mine-Active	13,939	5,643
Curl-leaf Mountain Mahogany	10,821	4,381
Barren-Rock-Mud	9,114	3,690
Saline Meadow	7,781	3,150
Basin Wildrye-bottomland	6,678	2,703
Basin Wildrye-montane	6,101	2,470
Mountain Shrub	5,458	2,210
Montane sagebrush Steppe-subalpine	4,815	1,949
Agriculture	3,457	1,399
Roads-Local	3,086	1,249
Wet Meadow-montane	1,380	559
Pickleweed	1,310	530
Montane Riparian	1,108	449
Limber Pine Woodland	775	314
Mine-Inactive	762	308
Aspen Woodland	759	307
Badland	548	222
Four-Wing Saltbush	369	149
Water	307	124
Dry wet meadow-montane	234	95
Winterfat	211	85
Subalpine-Upper Montane Grassland	191	77
Moist Floodplain	126	51
Desert wash	111	45
Wetland	16	7

### Greater Sage-Grouse Habitat Suitability

Based on the demographic models for the initial year, the highest quality habitat was found in the southern portion (in the Three Bars and Vinini zones), in the Cortez Mountains in the BSA North and South Cortez zones, and in the Shoshone zone (Figure 7). Several areas where lambda was at or above 1.0 (indicating a stable to increasing contribution to population growth) fell outside of areas of conservation action. Particularly of note are the areas between Three Bars and Vinini zones, south of the South Cortez zone, and near the south end of the BSA North.

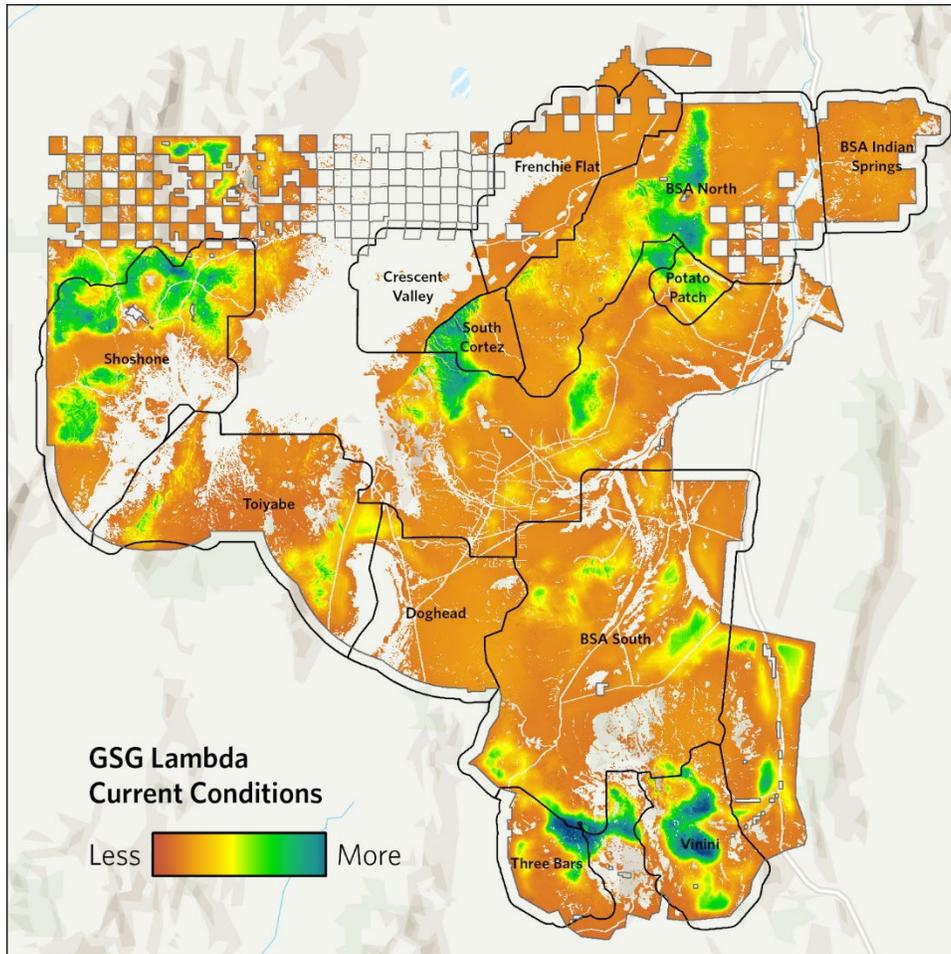


Figure 7. Initial  $\lambda$  (year 2014) across the Full Landscape. Areas within the Full Landscape boundary (grey boarder) but without color indicate that those pixels were categorized as "non-habitat." Note that many of the checkerboard areas are not included withing the Full Landscape as these are private, non-Nevada Gold Mines parcels.

## Ecological Systems and Vegetation Classes

Future results are presented by ecological system. A complete description of all ecological systems and classes is included as Appendix A. Only those systems that were targeted for new conservation actions in PM\_v3.2.0 are presented.

For each ecological system, we present the total number of acres of the system, then discuss the “problems or concerns.” These problems or concerns focus on issues specific to greater sage-grouse habitat suitability (see Appendix C for a full listing of the ecological systems and classes that are suitable for use by greater sage-grouse), although some general ecological health issues are discussed as well. We also provide a reference table of all the classes in the system, their percent occurrence in historic reference conditions, and their prevalence in current conditions both by area and percent occurrence. We then present a bulleted list of the specific conservation actions that were used to address the problems or concerns that relate to greater sage-grouse, followed by tabular results of the acres of conservation actions that were implemented in the model. Finally, we include a discussion of the future vegetation conditions as a result of the conservation actions and graphs of how specific classes targeted for conservation actions changed over time in the simulations.

Big Sagebrush Upland with Trees

Current System Acres at 60-m resolution: 340,372

Problems or Concerns

- For greater sage-grouse habitat suitability, the most problematic classes were those dominated by non-native annual species (41,921 acres of U-A:Annual Spp) or trees (6,612 acres of U-E:TEA). No more than 2% of the system should be occupied by trees in classes D and E; therefore, most trees in these classes and U-E:TEA are outside the reference condition (Table 3).
- Also problematic for greater sage-grouse were shrublands occupied by young trees (1,619 acres of D: Open and 3,173 acres of U-D:SAP) that would soon become dominated by older trees.
- A general problem was that nearly all (94%) of 2019 vegetation classes were not reference classes; therefore, this system was close to being completely departed from the reference condition (last column of Table 33).

Table 3. Vegetation classes of Big Sagebrush Upland with Trees in 2019.

Class	Area (acres)	Area (ha)	% of Total	Reference Condition (%)
CHAR	1,102	446	0.3	ephemeral
A:All	612	248	0.2	17
B:Open	4,454	1,802	1.3	24
C:Closed	14,013	5,671	4.1	57
C:Dense	0	0	0.0	0
D:Dense	0	0	0.0	0
D:Open	1,619	655	0.5	1
E:Closed	93	38	0.0	1
U-A:Annual Spp	41,921	16,965	12.3	n/a
U-A:Bare Ground	1,278	517	0.4	n/a
U-A:Early Shrub	166	67	0.0	n/a
U-A:Exotic Forb	2,608	1,055	0.8	n/a
U-A:Pasture	19	8	0.0	n/a
U-A:SAP	23,919	9,680	7.0	n/a
U-A:SI	11,022	4,461	3.2	n/a
U-A:SI+AS	15,137	6,126	4.4	n/a
U-A:Unpalat. Forb	70	28	0.0	n/a
U-B:Depleted	39,148	15,843	11.5	n/a
U-B:Early Shrub	193	78	0.1	n/a
U-B:Exotic Forb	774	313	0.2	n/a
U-B:SA	31,367	12,694	9.2	n/a
U-B:SAP	41,312	16,718	12.1	n/a
U-B:SI	5,023	2,033	1.5	n/a
U-B:SI+AS	1,565	633	0.5	n/a
U-C:DP-Dense	1,006	407	0.3	n/a
U-C:Depleted	37,934	15,351	11.1	n/a
U-C:Early Shrub	1,082	438	0.3	n/a
U-C:Exotic Forb	56	23	0.0	n/a
U-C:SA	9,720	3,934	2.9	n/a
U-C:SA-Dense	173	70	0.1	n/a
U-C:SAP	39,276	15,894	11.5	n/a
U-C:SAP-Dense	939	380	0.3	n/a

U-C:SI	1,466	593	0.4	n/a
U-C:SI+AS	12	5	0.0	n/a
U-C:Unpalat. Forb	9	4	0.0	n/a
U-D:Depleted	244	99	0.1	n/a
U-D:SA	977	395	0.3	n/a
U-D:SAP	3,173	1,284	0.9	n/a
U-E:TEA	6,612	2,676	1.9	n/a

### Management Actions

Using the proposed conservation actions:

- Convert shrublands dominated by non-native annual species (U-A:Annual Spp) to a functional shrubland with at least a mid-successional cover range of Wyoming big sagebrush and perennial grasses (U-B:SI, U-B:SI+AS, U-C:SI, U-C:SI+AS) that could be used for nesting and even chick rearing.
- Convert areas uncharacteristically dominated by trees to a functional shrubland with at least a mid-successional cover range of Wyoming big sagebrush and perennial grasses (U-B:SI, U-B:SI+AS, U-C:SI, U-C:SI+AS) that could be used for nesting and even chick rearing.
- Lop young trees in classes where they are present without transforming the nesting or brood rearing potential of those classes but slowing down woody succession that would render vegetation unusable by greater sage-grouse.
- Control fine fuels in the form of non-native annual species in classes using aerial herbicide where additional herbaceous seeding was not required: the seeded classes U-A:SI+AS (in simulation U-A:SNI+AS), U-B:SI+AS, U-C:SI+AS, and nesting classes U-C:SAP and U-B:SAP. This action could help release native perennial species from competition with annual species as well as help prevent the loss of greater sage-grouse habitat classes from fire. This objective was only possible because of the recent approved use of indaziflam.
- Protect higher elevation sagebrush shrubland in important greater sage-grouse habitat, specifically in the Cortez Range, by converting lower elevation and upwind classes of this system completely dominated by non-native annual species, specifically in Frenchie Flat, to less flammable perennial and introduced grass species.

Table 4.. Acres of modeled conservation actions in Big Sagebrush Upland with Trees. Differences in conservation action rates prior to 2025 are due to inherent model variability.

Private	Period of Implementation			
	2015 to 2020	2021 to 2024	2025 to 2030	2031 to 2049
<b>PM_v3.1.0</b>	<b>Sum of 25% - 75% percentile</b>			
Herbicide-Plateau+Seed+Shrub-Planting	4,536 - 4,650	203 - 299	144 - 288	70 - 135
AerialSeed+Masticate+Plateau	126 - 129	0	0	0
Small-Tree-Lopping	50 - 50	0	0	0
Indaziflam	0	0	0	0
Herbicide-Plateau+Seed	1,232 - 1,278	0	0	0
<b>PM_v3.2.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	4,594 - 4,730	257 - 363	188 - 350	58 - 124
AerialSeed+Masticate+Plateau	126 - 129	0	29 - 30	0

Small-Tree-Lopping	50 – 50	0 - 3	0	0
Indaziflam	0	0	179 – 2,159	313 – 1,916
Herbicide-Plateau+Seed	1,228 – 1,279	1,961 – 2,046	32 - 45	1 - 4
<b>BLM</b>	<b>2015 to 2020</b>	<b>2021 to 2024</b>	<b>2025 to 2030</b>	<b>2031 to 2049</b>
<b>PM_v3.1.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	7,108 - 7,237	1,858 - 2,148	270 -557	4,489 – 6,288
AerialSeed+Masticate+Plateau	2,026 – 2,108	340 - 383	88 - 100	0
Small-Tree-Lopping	57 - 500	642 - 761	190 - 190	0
Indaziflam	0	0	0	0
Herbicide-Plateau+Seed	1,285 - 1,327	0	68 - 109	0
<b>PM_v3.2.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	7,664 – 7,847	1,258 - 1,928	7,033 – 9,447	
AerialSeed+Masticate+Plateau	1,434 - 1,480	930 - 990	704 - 750	0
Small-Tree-Lopping	476 - 500	725 - 1,399	286 - 983	0
Indaziflam	0	0	6,480 - 9,268	3,867 – 9,150
Herbicide-Plateau+Seed	1,320 - 1,384	0	832 - 856	0

## Future Condition at 60-m resolution

### Vegetation Classes (ST-Sim Results)

- Spraying herbicide to control non-native annual species, seeding perennial grasses and shrubs and planting sagebrush (Herbicide-Plateau+Seed+Shrub-Planting) reduced the class dominated by non-native annual species (U-A:Annual Spp) in PM\_\_v3.2.0 compared PM\_v3.1.0 over all ownerships. Similarly, in the Frenchie Flat zone, Herbicide-Plateau+Seed in the U-A:Annual Spp class to prevent future fires that could climb into greater sage-grouse habitat of the Cortez Range also reduced the area of the U-A:Annual Spp class. The effects of both conservation actions on the annual species class are confounded in Figure 8 and their overall reduction of the U-A:Annual Spp class was about 10,000 acres. Despite conservation actions, the non-native annual species class progressively increased in both PM\_v3.1.0 and PM\_v3.2.0 thus indicating that future fires were causing non-native species dominance that were not feasibly accessible to conservation actions or whose amount exceeded future conservation action levels.
- Reduction of the tree-encroached class (U-E:TEA) with aerial seeding of perennial species followed by tree mastication, sagebrush planting, and optional herbicide spraying for annual species to prevent their germination (AerialSeed+Masticate+Plateau) was about 1,000 acres after 2025 in PM\_v3.2.0 compared to PM\_v3.1.0 (Figure 8). While the difference between the two simulations persisted until 2049, the area of the U-E:TEA class perceptibly increased with time in both PM\_v3 scenarios by a few hundred acres due to encroachment occurring outside of treated areas.
- Cutting of small conifers with either loppers or chainsaws (Small-Tree-Lopping) in the initial process of shrubland encroachment (U-D:SAP and U-D:Depleted) resulted in at most a 500-acre reduction of the class's area in the PM\_v3.2.0 compared to the PM\_v3.1.0 scenarios. The U-D:SAP class (much less abundant U-D:Depleted class not shown) rapidly declined and then plateaued in both scenarios until the end of simulations (Figure 8).
- The action of spraying indaziflam (a preemergent herbicide) had the greatest role in the un-treed, late-successional class with perennial and annual species (U-C:SAP) where the area of this class was reduced by about 1010,000 acres in the PM\_v3.2.0 compared to PM\_v3.1.0 scenarios (Figure 9). Application of the herbicide to this class caused a transition to the reference late-successional class (C:Closed; Figure 9), used by greater sage-grouse for nesting. Less evident, the early-successional

class seeded with native and introduced species and invaded with non-native species (U-A:SNI+AS) was also the recipient of indaziflam spraying, which resulted in the trajectories of both PM\_v3.1.0 and PM\_v3.2.0 scenarios to converge towards the end of simulations despite high levels of U-A:SNI+AS class creation as a by-product of annual species invasion in the U--A:SNI class (Figure 9). When this class stopped being sprayed with indaziflam in 2035 and the U-A:SNI+AS class matured into the mid-successional class (U-B:SISI+AS), the PM\_v3.2.0 scenario clearly showed more area of U-B:SISI+AS than in the PM\_v3.1.0 scenario (Figure 8).

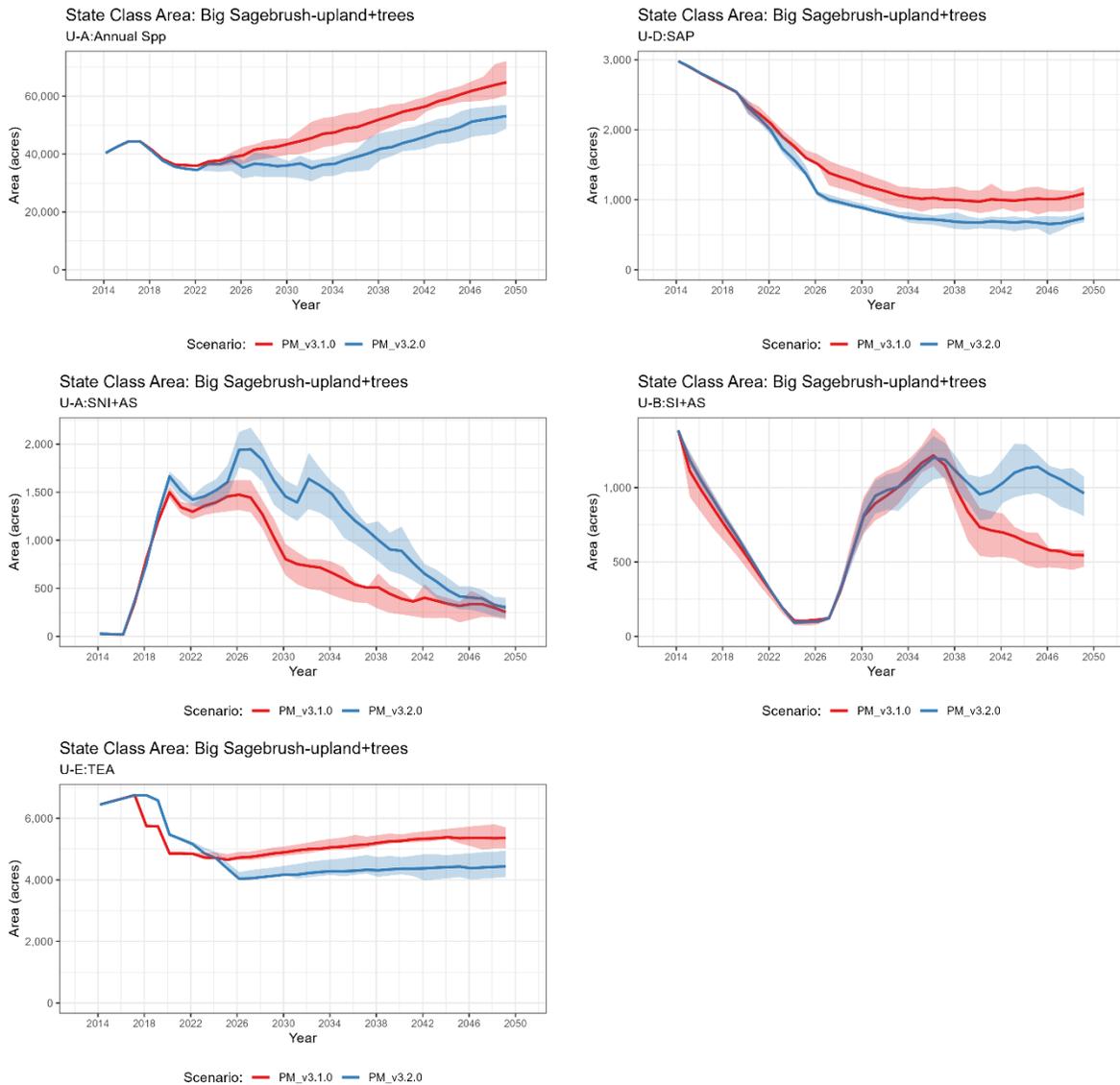


Figure 8. Simulated vegetation class areas (acres) of big sagebrush with trees on upland soils that were the focus of control by management actions on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

- All conservation actions creating new seedlings that included native species (Herbicide-Plateau+Seed+Shrub-Planting and AerialSeed+Mastication+Plateau) increased the area of the U-A:SNI class by 8,000 acres at most from 2033-2035 (Figure 9). With time, this class matured into the U-B:SI class represented by 2,500 acres more in the PM\_v3.2.0 than PM\_v3.1.0 scenarios by 2039 (Figure 9). The process of succession from U-B:SI to U-C:SI continued with at most 2,000 acres more in the PM\_v3.2.0 than PM\_v3.1.0 scenarios by 2039 (Figure 8).
- The reference late-successional class without trees (C:Closed) was the recipient of small-tree lopping and indaziflam spraying (directly and in two transitions). The area of the C:Closed class increased by about 10,000 acres in PM\_v3.2.0 over PM\_v3.1.0 scenarios after 2034 (Figure 9).

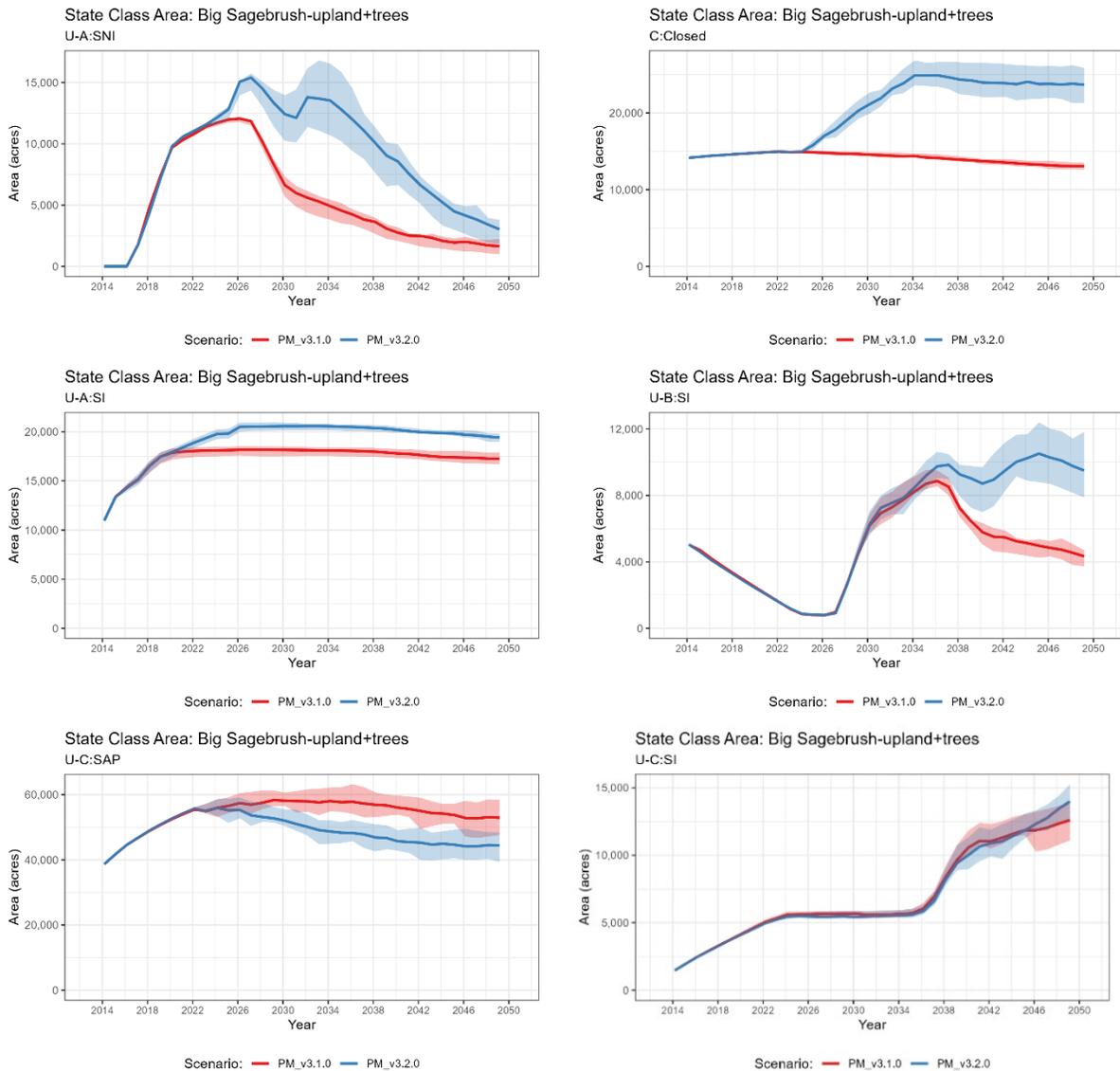


Figure 9. Simulated vegetation class areas (acres) of big sagebrush with trees on upland soils that were the focus of recruitment by management actions on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

- Seeding of only introduced species and herbicide application (Herbicide-Plateau+Seed) in Frenchie Flat resulted in 2,500 acres more seeding (U-A:SI) in the PM\_v3.2.0 than PM\_v3.1.0 scenarios after 2025 (Figure 9).

### Cost by Ecological System

The cost of conservation actions varied dramatically among periods of implementation. Cost was shy of \$3M per year during the 2015 to 2020 period where there were no planned and statistically realized differences between the two scenarios (Figure 10). Starting in 2021, the cost was higher in the PM\_v3.2.0 than PM\_v3.1.0 scenarios, especially in 2026 where the cost in the PM\_v3.2.0 scenario reached \$2.6M. The largest differences between scenarios were from 2026 to 2033. Cost was minimal after 2035 in both scenarios.

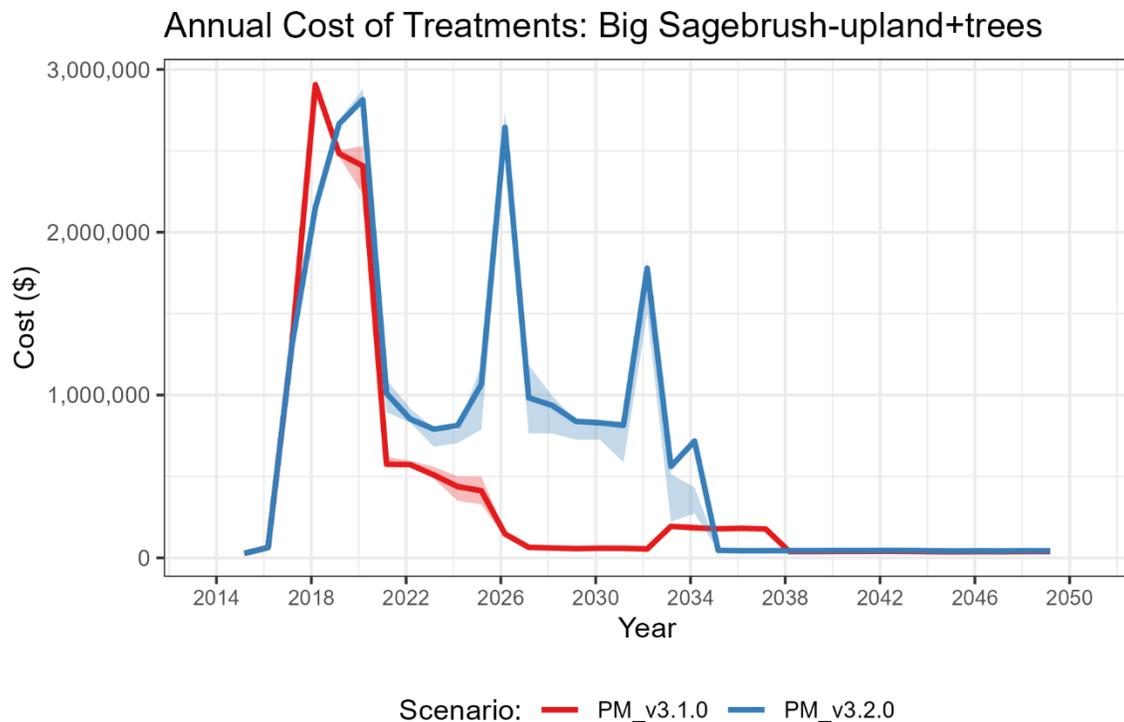


Figure 10. Simulated cost (\$) of conservation actions in big sagebrush with trees on upland soils in private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

## Montane Sagebrush Steppe Upland

**Current System Acres at 60-m resolution: 171,360**

### Problems or Concerns

- One large problem at 14.4% of the system's area was the late-successional tree-encroached class likely invaded by non-native annual species (U-E:TEA). This class deprives greater sage-grouse of nesting or brood rearing vegetation (Table 55).
- The second problem, especially for greater sage-grouse nesting, was that 7.1% of the system was dominated by non-native annual species (U-A:Annual Spp; Table 55).
- In general, the areas of all first three reference successional classes (A:All, B:Open, and C:Closed) were very unrepresented compared to the reference condition as many acres were in uncharacteristic vegetation classes (Table 55).
- Large areas of treeless classes with sagebrush and perennial grasses were also invaded by non-native annual species (A:SAP, B:SAP, and C:SAP). Cumulatively, these classes amount to about 42% of the system's area (Table 55). While greater sage-grouse can use the classes with non-native annual species, these represent a higher fire risk and would eventually convert to vegetation dominated by non-native annual species (U-A:Annual Spp).

Table 5. Vegetation classes of montane sagebrush steppe-upland soils in 2019.

Class	Area (acres)	Area (ha)	% of Total	Reference Condition (%)
A:All	2,143	867	1.3	22
B:Open	8,418	3,406	4.9	25
C:Closed	24,142	9,770	14.1	48
C:Dense	1,387	561	0.8	0
D:Dense	0	0	0.0	0
D:Open	4,210	1,704	2.5	3
E:Closed	317	128	0.2	2
U-A:Annual Spp	12,226	4,948	7.1	n/a
U-A:Bare Ground	59	24	0.0	n/a
U-A:Early Shrub	52	21	0.0	n/a
U-A:Exotic Forb	81	33	0.0	n/a
U-A:SAP	23,066	9,334	13.5	n/a
U-A:SI	170	69	0.1	n/a
U-A:SI+AS	1,502	608	0.9	n/a
U-A:Unpalat. Forb	1,043	422	0.6	n/a
U-B:Depleted	153	62	0.1	n/a
U-B:Early Shrub	10	4	0.0	n/a
U-B:Exotic Forb	0	0	0.0	n/a
U-B:SA	3,004	1,216	1.8	n/a
U-B:SAP	22,471	9,094	13.1	n/a
U-B:SI	21	8	0.0	n/a
U-B:Unpalat. Forb	1,663	673	1.0	n/a
U-C:DP-Dense	22	9	0.0	n/a
U-C:Depleted	4,789	1,938	2.8	n/a
U-C:Early Shrub	45	18	0.0	n/a
U-C:SA	558	226	0.3	n/a
U-C:SAP	26,518	10,732	15.5	n/a
U-C:SAP-Dense	656	265	0.4	n/a
U-C:Unpalat. Forb	138	56	0.1	n/a

U-D:Depleted	1,966	795	1.1	n/a
U-D:SA	4,655	1,884	2.7	n/a
U-D:SAP	0	0	0.0	n/a
U-D:Unpalat. Forb	1,239	501	0.7	n/a
U-E:TEA	24,668	9,983	14.4	n/a
U-E:Unpalat. Forb	39	16	0.0	n/a

### Management Actions

Using the proposed conservation actions:

- Further reduce the area of the tree-encroach class (U-E:TEA) with aerial seeding followed by mastication of conifers (Table 66). Planting seedlings of sagebrush and follow-up of herbicide spraying if needed to prevent germination of non-native annual species were the other components of this conservation action.
- Convert the area of the non-native annual species class (U-A:Annual Spp) to seedings of native and introduced species to both create future foraging and nesting habitat and reduce fire risk. In addition to seeding, herbicide to control non-native annual species germination might have been required.
- Use indaziflam to transition, respectively, classes U-A:SAP, U-B:SAP, and U-C:SAP, and seedings invaded by non-native annual species, to reference classes A:All, B:open, and C:Closed, and to seeded classes without non-native annual species. This would reduce fire risk and, therefore, the area burned that could become dominated by non-native annual species.
- Use Small-Tree-Lopping to remove the future young conifers in the U-D:SAP and U-D:SI classes (“Christmas Tree” phase).

Table 6. Conservation action rates Implemented in montane sagebrush steppe-upland soil.

Private	Period of Implementation			
	2015 to 2020	2021 to 2024	2025 to 2030	2031 to 2049
<b>PM_v3.1.0</b>	<b>Sum of 25% - 75% percentile</b>			
Herbicide-Plateau+Seed+Shrub-Planting	1,859 - 1,918	560 - 617	149 - 159	286 - 313
AerialSeed+Masticate+Plateau	0	21 - 23	0	0
Small-Tree-Lopping	12 - 12	0	0	0
Indaziflam				
<b>PM_v3.2.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	2,042 - 2,101	961 - 1,547	2,411 - 3,163	239 - 563
AerialSeed+Masticate+Plateau	0	32 - 37	22 - 22	0
Small-Tree-Lopping	12 - 12	0	0	0
Indaziflam	0	0	34 - 392	75 - 300
<b>BLM</b>	<b>2015 to 2020</b>	<b>2021 to 2024</b>	<b>2025 to 2030</b>	<b>2031 to 2049</b>
<b>PM_v3.1.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	1,859 - 1,918	560 - 617	149 - 159	286 - 313
AerialSeed+Masticate+Plateau	2,795 - 2,882	3,310 - 5,486	13 - 19	0
Small-Tree-Lopping	0	0	1,555 - 1,784	0 - 19
Indaziflam				
<b>PM_v3.2.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	2,042 - 2,101	961 - 1,547	2,411 - 3,163	239 - 563
AerialSeed+Masticate+Plateau	2,797 - 2,869	3,301 - 5,485	357 - 395	0
Small-Tree-Lopping	0	0	245 - 2,707	0
Indaziflam	0	0	1,980 - 4,256	1,269 - 4,157

## Future Condition at 60-m resolution

### Vegetation Classes (ST-Sim Results)

- Aerial seed followed by mastication reduced the area of U-E:TEA only reduced the area of the class by another couple of 100 of acres in the PM\_v3.2.0 scenario when compared to the PM\_v3.1.0 scenario (Figure 11).
- The Herbicide-Plateau+Seed+Shrub-Planting conservation action effectively decreased the area of the vegetation dominated by non-native annual species (U-A:Annual Spp) by about 4,000 acres in the PM\_v3.2.0 compared to the PM\_v3.1.0 by year 2049 (Figure 11). As seen in the Wyoming big sagebrush on upland soil system above, the trend was a continuous increase of this class in both scenarios, therefore suggesting recruitment of this class from fires.
- While barely visible on the Y-scale of the chart, indaziflam reduced the area of U-C:SAP by about 1,000 acres after 2031 in the PM\_v3.2.0 compared to the PM\_v3.1.0 by year 2049 (Figure 11).
- After 2040, small-tree lopping only reduced the area of the U-D:SAP class by about 100 acres, although the rate of increase of the area of this class was exponential and never exceeded 900 acres.

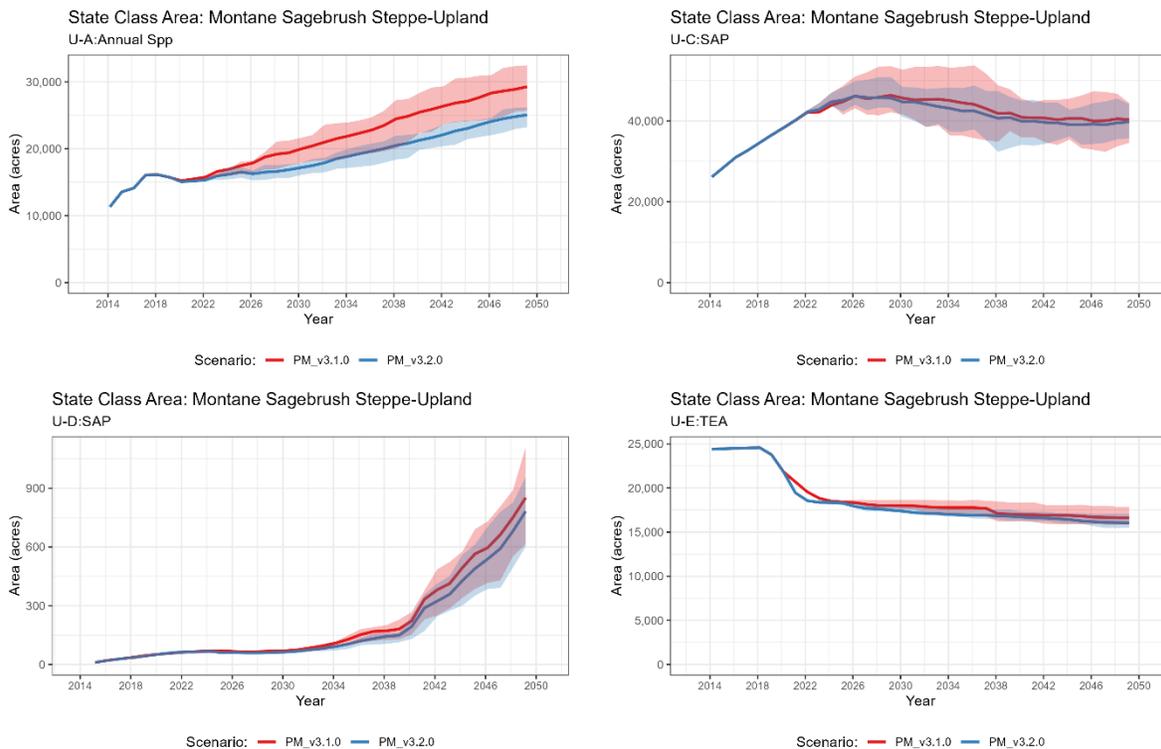


Figure 11. Simulated vegetation class areas (acres) of montane sagebrush steppe on upland soils that were the focus of recruitment by management actions on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

- Conservation actions involving seeding caused the area of the seeded class to be consistently greater in the PM\_v3.2.0 scenario than the PM\_v3.1.0 scenario by about 500 to 1,000 acres from 2021 to 2033. The two periods of greatest differences were in 2021 and 2030, which indicated

continuous influx into this class. With ongoing woody succession, the area of the mid- (U-B:SI) and late-successional classes (U-C:SI) increased each in their time (Figure 12).

- Indaziflam caused the reference mid-successional class (B:Open), which was recruited from the U-C:SAP class, to be by about 500-700 acres higher in the PM\_v3.2.0 than PM\_v3.1.0 scenarios after 2030 (Figure 12). After cessation of indaziflam spraying combined with woody succession starting in 2046, the area of the B:Open class in the PM\_v3.2.0 scenario was lower than in the PM\_v3.1.0 scenario.

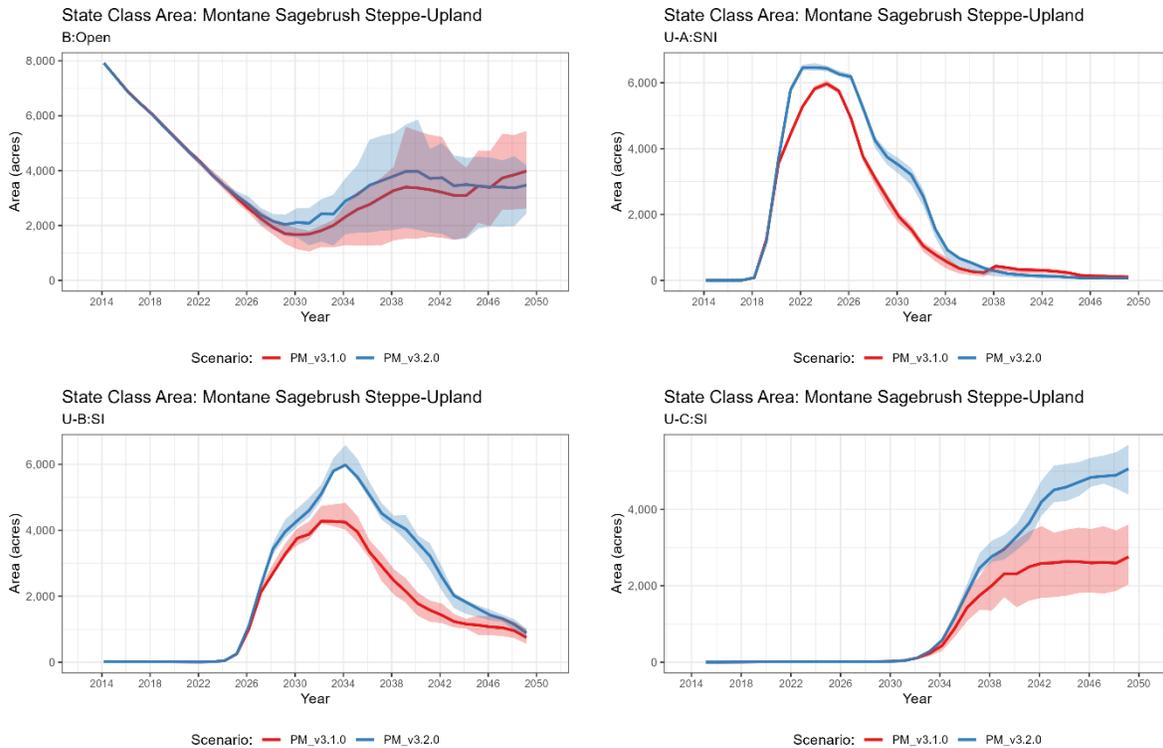


Figure 12. Simulated vegetation class areas (acres) of montane sagebrush steppe on upland soil that were the focus of recruitment by management actions on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

### Cost by Ecological System

Two peaks of cost of conservation actions were observed (Figure 13). The first peak around 2020 reached between \$2.3M and \$2.5M. It was notable that cost peaked during years 2020 and 2021 in the PM\_v3.2.0 scenario, whereas it was about \$1M lower in the PM\_v3.1.0 scenario in 2021. The second peak centered on 2026 was smaller and differences in cost within years ranged between \$700,000 in 2025 and \$250,000 in 2026 with values being higher in the PM\_v3.2.0 scenario. Because these differences occurred over 7 years, the cumulative difference was enormous. Especially interesting was the very low variability in the cost for both scenarios.

### Annual Cost of Treatments: Montane Sagebrush Steppe-Upland

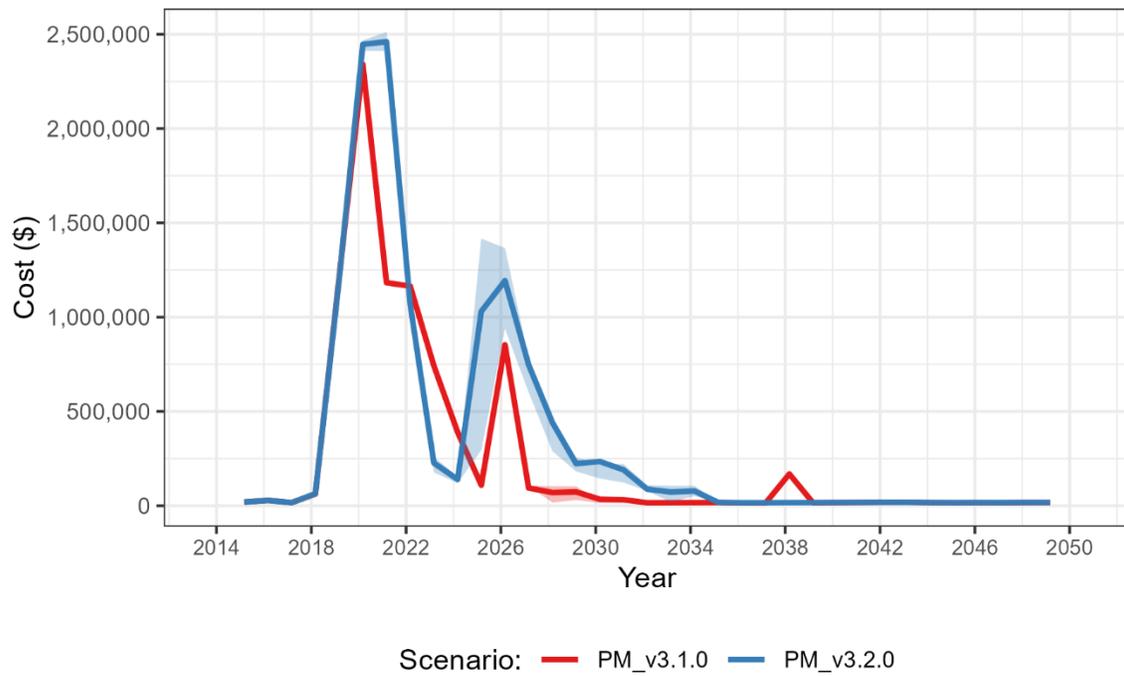


Figure 13. Simulated cost (\$) of conservation actions in montane sagebrush steppe on upland soils from private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

## Low Sagebrush

### Current System Acres at 60-m resolution 74,676

#### Problems or Concerns

- The primary problem for greater sage-grouse in low sagebrush was that 4.4% of the system's area was encroached with trees (U-D:TEA) (Table 77). Two types of treed classes were found. A certain percentage of the treed late-successional class (D:Open) was expected up to 10% of the reference condition of the system's area but we mapped 2.7%; therefore, tree dominance from this class might not be a high-priority problem although removing trees would increase greater sage-grouse habitat availability.
- A smaller problem for greater sage-grouse was that about 903 acres were dominated by non-native annual species.

Table 7. Vegetation classes of low sagebrush in 2019.

Class	Area (acres)	Area (ha)	% of Total	Reference Condition (%)
A:All	261	106	0.3	10
B:Open	12,352	4,999	16.5	36
C:Closed	39,941	16,164	53.5	44
D:Open	1,994	807	2.7	10
U-A:Annual Spp	903	365	1.2	n/a
U-A:Bare Ground	59	24	0.1	n/a
U-A:Early Shrub	5	2	0.0	n/a
U-A:SAP	3,263	1,321	4.4	n/a
U-A:SI	9	4	0.0	n/a
U-A:SI+AS	750	303	1.0	n/a
U-A:Unpalat. Forb	20	8	0.0	n/a
U-B:Depleted	941	381	1.3	n/a
U-B:SA	375	152	0.5	n/a
U-B:SAP	4,174	1,689	5.6	n/a
U-B:Unpalat. Forb	12	5	0.0	n/a
U-C:Depleted	472	191	0.6	n/a
U-C:Early Shrub	1	0	0.0	n/a
U-C:SA	99	40	0.1	n/a
U-C:SAP	5,758	2,330	7.7	n/a
U-C:Unpalat. Forb	5	2	0.0	n/a
U-D:TEA	3,314	1,341	4.4	n/a

#### Management Actions

Using the proposed conservation actions:

- Reduce the area of the tree-encroached class (U-D:TEA).
- Convert the non-native annual species class to perennial seedlings.
- Occasional chainsaw operations to reduce the area of the reference treed late-successional class (D:Open).
- Convert seedlings invaded by non-native annual species to seedlings with no or low levels of such species using the herbicide indaziflam.

Table 8. Conservation action rates Implemented in low sagebrush.

Private	Period of Implementation			
	2015 to 2020	2021 to 2024	2025 to 2030	2031 to 2049
<b>PM_v3.1.0</b>	Sum of 25% - 75% percentile			
Herbicide-Plateau+Seed+Shrub-Planting	40 - 45	2 - 7	0-1	0
AerialSeed+Masticate+Plateau	0	0	0	0
Small-Tree-Lopping	0	16 - 48	0 - 4	0
Indaziflam	0	0	0	0
<b>PM_v3.2.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	42 - 44	2 - 8	0 - 2	0
AerialSeed+Masticate+Plateau	0	0	0	0
Small-Tree-Lopping	0	9 - 68	0	0
Indaziflam	0	0	1 - 89	2 -46
<b>BLM</b>	<b>2015 to 2020</b>	<b>2021 to 2024</b>	<b>2025 to 2030</b>	<b>2031 to 2049</b>
<b>PM_v3.1.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	146 - 173	0	0	0
AerialSeed+Masticate+Plateau	414 - 463	0	0	0
Small-Tree-Lopping	456 - 809	0	0	0
Indaziflam	0	0	0	0
<b>PM_v3.2.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	152 - 176	0	177 - 253	0
AerialSeed+Masticate+Plateau	507 - 562	0	501 - 519	0
Small-Tree-Lopping	126 - 1473	0	162 - 666	0
Indaziflam	0	0	378 - 737	142 - 374

### Future Condition at 60-m resolution

#### Vegetation Classes (ST-Sim Results)

- Aerial seeding and mastication of trees clearly reduced the area of tree-encroached class (U-DD:TEA) by about 700 acres in the PM\_v3.2.0 scenario compared to PM\_v3.1.0 scenario (Figure 14). The primary difference between scenarios was observed in the third period of implementation after 2025 as the PM\_v3.1.0 had no implementation during this period.
- The effect of the Herbicide-Plateau+Seed+Shrub-Planting conservation action caused only a small consistent difference between scenarios despite a differential implementation rate of 200 acres per year in the PM\_v3.2.0 scenario (Figure 14). This suggested that many areas were on steep slopes or that other factors, such as wild or stray horse grazing and new fires, caused failure of seedings or continuous recruitment into the U-A:Annual Spp class. The role of fires was likely because the area of this class consistently increased during in the simulations.
- Cumulatively, the above two conservation actions caused a >350 acres difference of the area of the seeded class (U-A:SNI) between scenarios (PM\_v3.2.0 being higher) starting in 2025 (Figure 14).
- Chainsaw thinning in the reference late-successional treed class (D:Open) achieved the goal of reducing the area of this class by 100-200 acres after year 2025 in the PM\_v3.2.0 compared to the PM\_v3.1.0 scenarios (Figure 14). The reference mid-successional class (B:Open) was the recipient class of this action that caused at least 500 acres more in the PM-V3.2.0 than PM\_v.3.1.0 scenarios (Figure 14).

- The effect of indaziflam on seedlings invaded by non-native annual species was present but only indirectly detected. In theory based on proportional occurrences, the early seeded class (U-A:SNI) and the same class but invaded by non-native annual species (U-A:SNI+AS) should have the same temporal profiles (but different areas), but did not because the area of the U-A:SNI+AS class in the PM\_v3.2.0 scenario nearly rejoined the PM\_v3.1.0 scenario towards the end of simulations (Figure 14). Because this was not observed in the U-A:SNI class, the narrowing of the difference between the scenario was caused by indaziflam making U-A:SNI+AS transition to U-A:SNI, as intended.

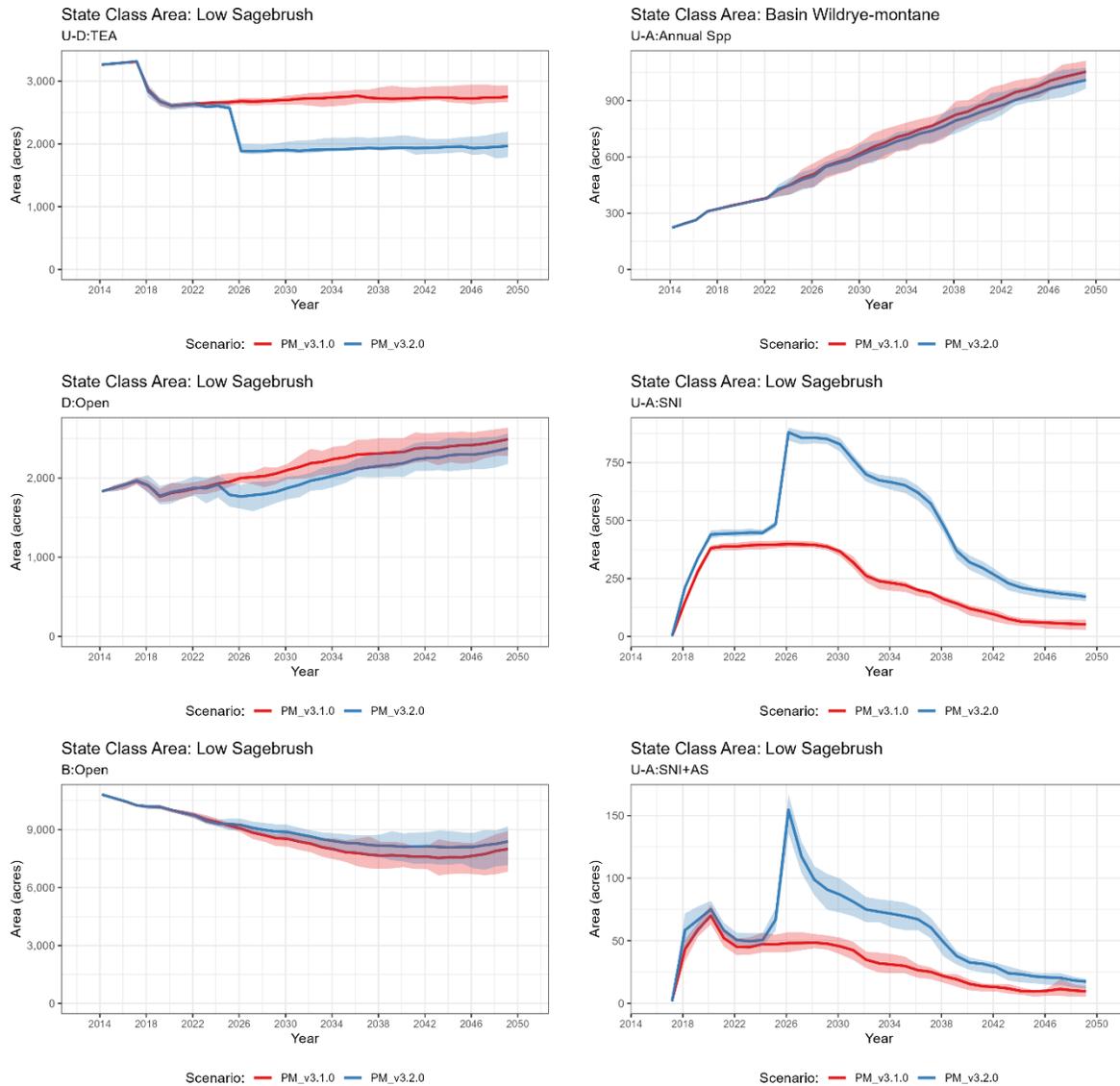


Figure 14. Simulated vegetation class areas (acres) of black sagebrush that were the focus of recruitment by management actions on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

### Cost by Ecological System

There were two distinct peaks of expenditures in low sagebrush; the first of \$500,000 in both scenarios from 2015 to 2020 and the second of about \$700,000 from 2025 to 2027 only in the PM\_v3.2.0 scenario (Figure 15). The dominant source of the cost was the aerial seeding followed by mastication of conifers conservation action. The second peak of expenditure was surprisingly high and could be reduced by applying a lower implementation rate over a period of 2 to 3 more years.

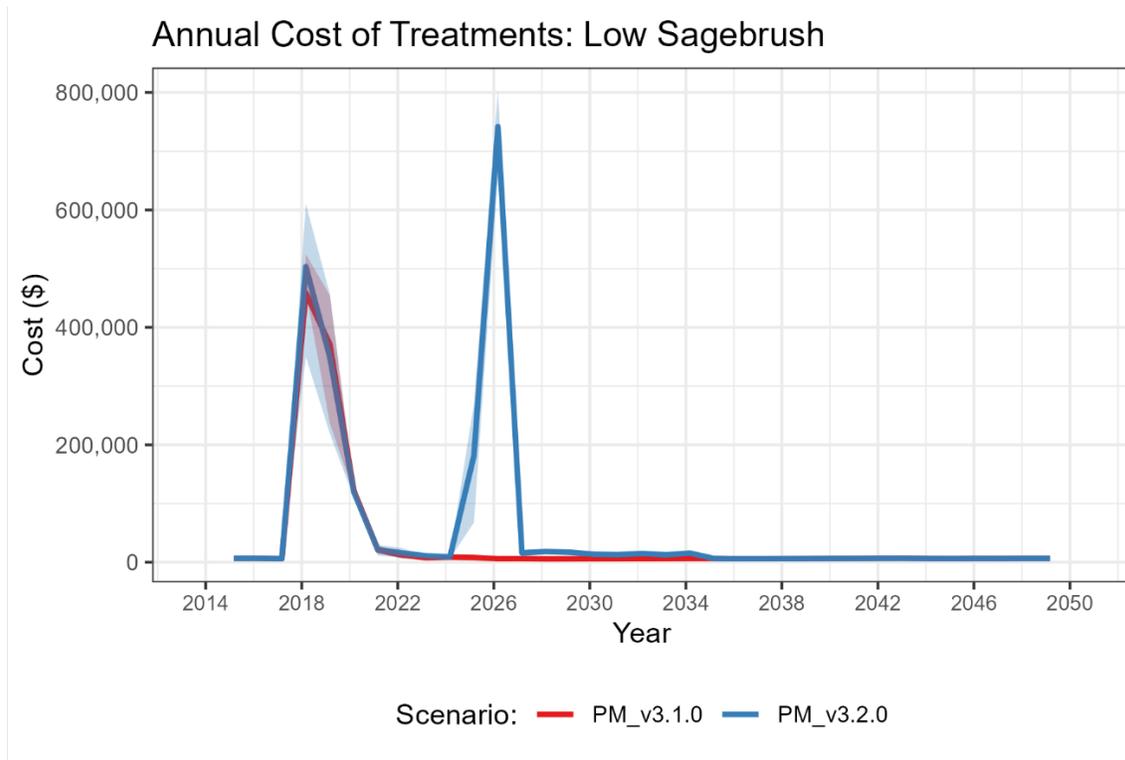


Figure 15. Simulated cost (\$) of conservation actions in low sagebrush on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

## Black Sagebrush

**Current System Acres at 60-m resolution: 57,555**

### Problems or Concerns

- The main problem for greater sage-grouse in the black sagebrush system was the dominance of trees. Two types of treed classes were found. A certain percentage of the treed late-successional class (D:Open) is expected up to 16% of the reference condition of the system's area but we mapped 8.1%; therefore, tree dominance from this class might not be a high-priority problem although removing trees would increase greater sage-grouse habitat suitability (Table 99). A higher priority problem was the tree-encroached class potentially invaded by non-native annual species (U-D:TEA) that occupied 18.4% of the black sagebrush's area.
- A smaller problem was that about 527 acres were dominated by non-native annual species, and it is likely that 337 acres of CHAR area will become dominated non-native annual species (Table 99).
- The presence of 26.7% of the system's area occupied by depleted sagebrush (U-B:Depleted and U-C:Depleted) was a landscape health problem but was not treated as current practices would mean the removal of intact sagebrush cover.

Table 9. Vegetation classes for Black Sagebrush in 2019.

Class	Area (acres)	Area (ha)	% of Total	Reference Condition (%)
CHAR	337	136	0.6	ephemeral
A:All	264	107	0.5	17
B:Open	2,372	960	4.1	46
C:Closed	15,879	6,426	27.6	21
D:Open	4,654	1,883	8.1	16
U-A:Annual Spp	527	213	0.9	n/a
U-A:Bare Ground	43	17	0.1	n/a
U-A:Early Shrub	2	1	0.0	n/a
U-A:Exotic Forb	18	7	0.0	n/a
U-A:SAP	2,326	941	4.0	n/a
U-A:SI	937	379	1.6	n/a
U-A:SI+AS	847	343	1.5	n/a
U-B:Depleted	9,735	3,940	16.9	n/a
U-B:Exotic Forb	0	0	0.0	n/a
U-B:SA	26	10	0.0	n/a
U-B:SAP	1,439	582	2.5	n/a
U-B:SI	0	0	0.0	n/a
U-B:SI+AS	1	0	0.0	n/a
U-C:Depleted	5,651	2,287	9.8	n/a
U-C:Early Shrub	17	7	0.0	n/a
U-C:Exotic Forb	0	0	0.0	n/a
U-C:SA	7	3	0.0	n/a
U-C:SAP	1,924	779	3.3	n/a
U-D:TEA	10,573	4,279	18.4	n/a

## Management Actions

Using the proposed conservation actions:

- Reduce the area of the tree-encroached class (U-D:TEA).
- Convert the non-native annual species class to perennial seedlings.
- Occasional chainsaw operations to reduce the area of the reference treed late-successional class (D:Open).
- Convert seedlings invaded by non-native annual species to seedlings with no or low levels of such species using the herbicide indaziflam.

Table 10. Conservation action rates Implemented in black sagebrush.

Private	Period of Implementation			
	2015 to 2020	2021 to 2024	2025 to 2030	2031 to 2049
<b>PM_v3.1.0</b>	<b>Sum of 25% - 75% percentile</b>			
Herbicide-Plateau+Seed+Shrub-Planting	0 – 1	0 - 1	0 - 1	0
AerialSeed+Masticate+Plateau	0	0	0	0
Chainsaw-Thinning	47 – 51	0	0	0
Indaziflam	0	0	0	0
<b>PM_v3.2.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	0 - 2	0 - 4	0 - 1	0
AerialSeed+Masticate+Plateau	0	29 - 53	0	0
Chainsaw-Thinning	47 - 52	23 - 253	0	0
Indaziflam	0	0	179 - 2,159	313 - 1,916
<b>BLM</b>	<b>2015 to 2020</b>	<b>2021 to 2024</b>	<b>2025 to 2030</b>	<b>2031 to 2049</b>
<b>PM_v3.1.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	1,037 - 1,116	0	0	0
AerialSeed+Masticate+Plateau	2,026 – 2,108	340 - 383	88 - 100	0
Chainsaw-Thinning	1,054 - 1,509	539 - 701	175 - 175	0
Indaziflam	0	0	0	0
<b>PM_v3.2.0</b>				
Herbicide-Plateau+Seed+Shrub-Planting	1,026 – 1,107	0	461 - 550	0
AerialSeed+Masticate+Plateau	1,434 - 1,480	930 - 990	704 - 750	0
Chainsaw-Thinning	1,731 - 1,811	196 - 1,241	458 - 630	0
Indaziflam	0	0	98 - 282	66 – 389

## Future Condition at 60-m resolution

### Vegetation Classes (ST-Sim Results)

- Chainsaw operations of larger trees reduced by about 1,000 acres the area of the reference late-succession treed class (D:Open) in the PM\_v3.2.0 compared to PM\_v3.1.0 scenarios that was more evident after 2025 (Figure 16). Over time, the area of this class progressively increased by about 1,000 acres in both scenarios.
- Aerial seeding and mastication of larger trees in the tree-encroached class likely invaded by non-native annual species (U-D:TEA) caused a 1,500-acre decrease of the area of the U-D:TEA class starting in 2025 (Figure 16). The trajectories of this class's areas were constant in both scenarios.
- Conservation action of the non-native annual species class (U-A:Annual Spp), while clearly greater in PM\_v3.2.0 compared to PM\_v3.1.0 (Table 1616), caused no difference in the area of this class as percentiles completely overlapped – in fact, there was slightly more area of this class in the

PM\_v3.2.0 scenario (Figure 16). This lack of difference simply reflected the net balance between the conservation action to control U-A:Annual Spp and more of this class being created by simulated failed seedings in the Herbicide-Plateau+Seed+Shrub-Planting and Aerial Seed + Masticate + Plateau conservation actions.

- Spraying of Indaziflam reduced by a few 100 acres the U-C:SAP class in the PM\_v3.2.0 compared to PM\_v3.1.0 scenarios (Figure 16).
- Chainsaw thinning in the reference late-successional treed class (D:Open) recruited into the reference mid-successional class (B:Open; trees having already thinned the sagebrush cover), which was 2,000 acres higher in the PM\_v3.2.0 than PM\_v3.1.0 scenarios (Figure 16).
- Conservation actions with native and introduced species seeding (Herbicide-Plateau+Seed+Shrub-Planting and Aerial Seed + Masticate + Herbicide) increased the area of seeding (U-A:SNI) by about 600 acres in the PM\_v3.2.0 compared to the PM\_v3.1.0 scenarios after 2026. Moreover, areas of the U-A:SNI class in both scenarios consistently decreased until 2049.
- With succession, the U-A:SNI class matured into the U-B:SI class where a higher area of the class in the PM\_v3.2.0 than PM\_v3.1.0 scenarios was evident after 2038.

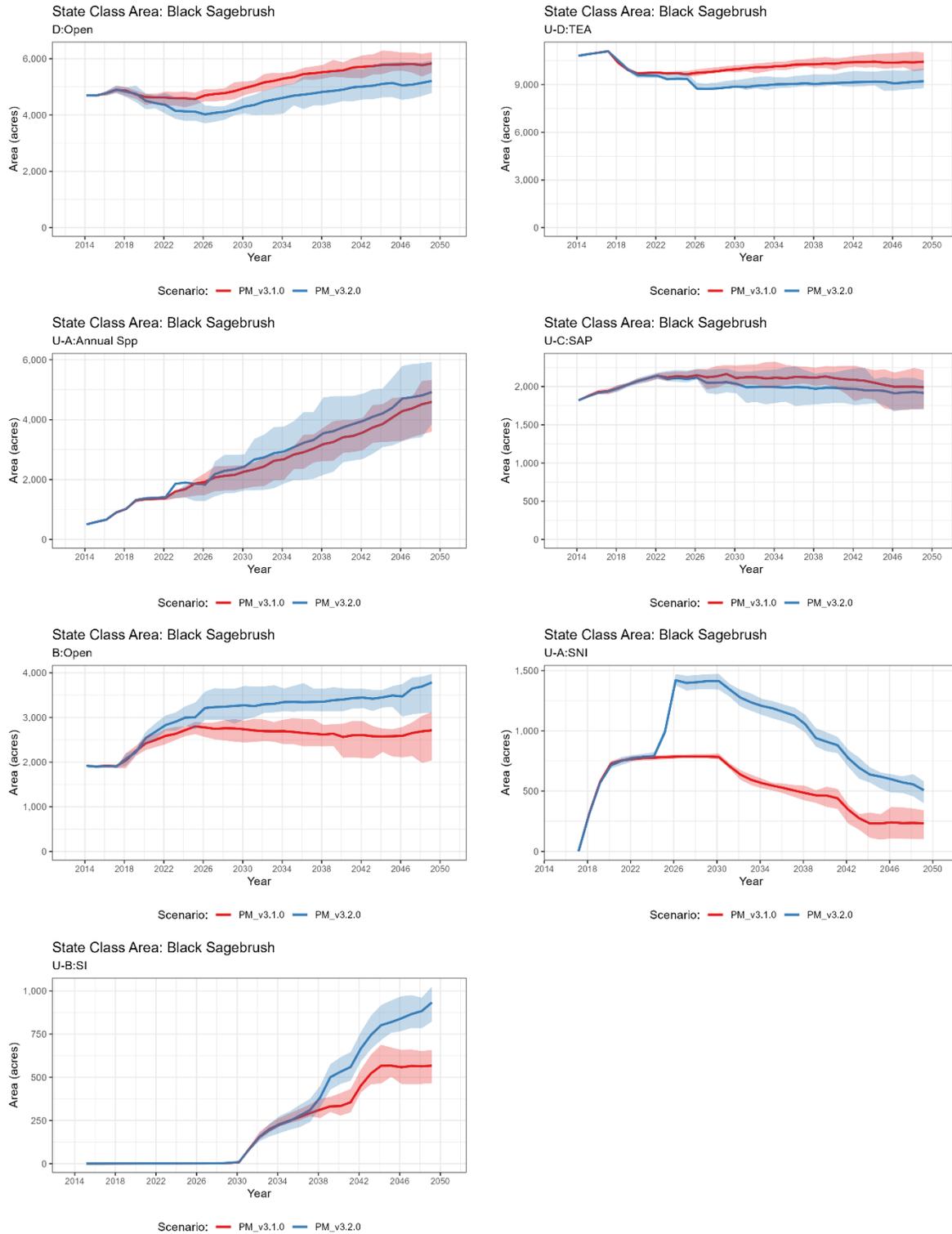


Figure 16. Simulated vegetation class areas (acres) of black sagebrush that were the focus of control by management actions on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

### Cost by Ecological System

The cost of conservation actions did not differ among scenarios until 2025, but about \$750,000 was spent in the PM\_v3.2.0 scenario compared to \$0 in 2026 (Figure 17). Cost was zero in both scenarios after 2026.

Annual Cost of Treatments: Black Sagebrush

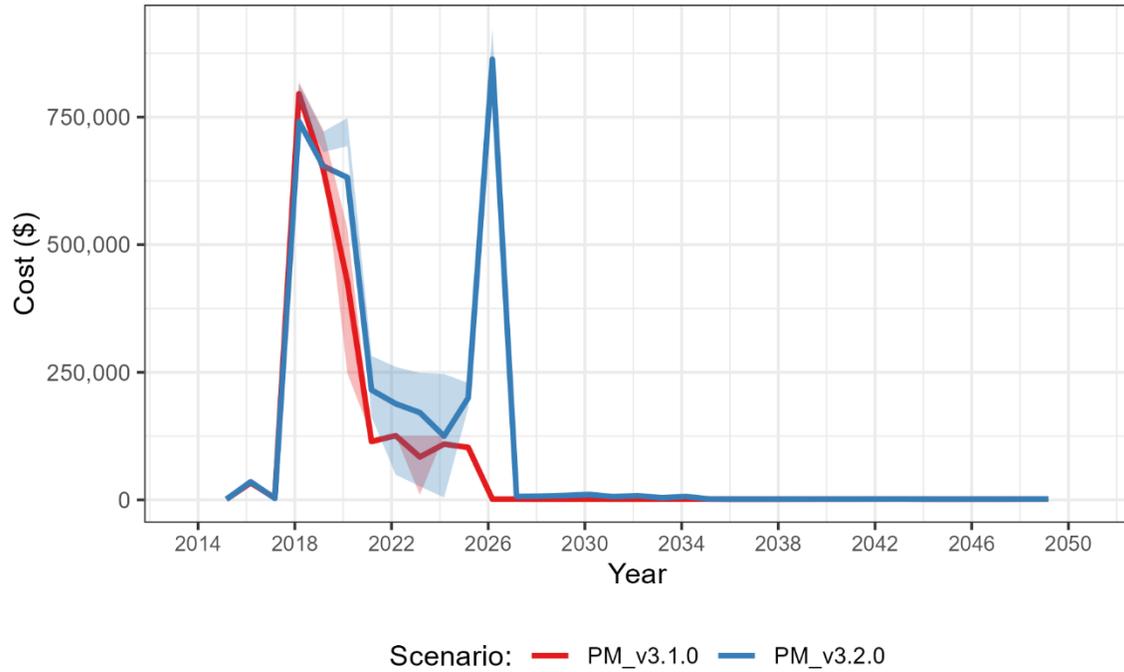


Figure 17. Simulated cost (\$) of conservation actions in black sagebrush on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

## Saline Meadow

**Current System Acres at 60-m resolution: 7,781**

### Problems or Concerns

- Saline meadow was not greater sage-grouse habitat, but often it was adjacent to lower elevation wet meadows. The presence of exotic noxious forbs (U-A, -B, -C:Exotic-Forb-Tree) was a problem (cumulative 1.5% of area) and the source of exotic propagules to wet meadows, a critical brood rearing greater sage-grouse habitat (Table 1111).

Table 11. Vegetation classes of saline meadow in 2019.

Class	Area (acres)	Area (ha)	% of Total	Reference Condition (%)
A:All	1,371	555	17.6	2
B:Closed	3,826	1,548	49.2	84
C:Open	1,288	521	16.5	14
U-A:Annual Spp	28	11	0.4	n/a
U-A:Exotic-Forb-Tree	114	46	1.5	n/a
U-A:Hummocked	7	3	0.1	n/a
U-A:Stock Tank	0	0	0.0	n/a
U-B:Exotic-Forb-Tree	1	0	0.0	n/a
U-C:Depleted	1,149	465	14.8	n/a
U-C:Exotic-Forb-Tree	0	0	0.0	n/a

### Management Actions

Using the conservation actions proposed as part of Conservation Plan 2:

- Prevent invasion of uninvaded classes by new infestations of weeds (Table 12).

Table 12. Conservation action rates Implemented in saline meadow. Acres are presented as a range where the lower number is the sum of the 25th percentile and the higher number is a sum of the 75th percentile within a given period of implementation.

Private	Period of Implementation			
	2015 to 2020	2021 to 2024	2025 to 2030	2031 to 2049
<b>PM_v3.1.0</b>	<b>Sum of 25% -75% percentile</b>			
Weed-Inventory+Spot-Treat	57 - 82	43 - 58	62 - 85	210 - 287
<b>PM_V3.2.0</b>				
Weed-Inventory+Spot-Treat	59 - 79	44 - 59	65 - 96	209 - 292
<b>BLM</b>	<b>2015 to 2020</b>	<b>2021 to 2024</b>	<b>2025 to 2030</b>	<b>2031 to 2049</b>
<b>PM_v3.1.0</b>				
Weed-Inventory+Spot-Treat	119 - 150	90 - 111	133 - 111	417 - 524
<b>PM_V3.2.0</b>				
Weed-Inventory+Spot-Treat	114 - 145	85 - 109	130 - 168	405 - 512

## Future Condition at 60-m resolution

### Vegetation Classes (ST-Sim Results)

- Weed inventory and spot spraying had no to little visible effects on the area of exotic species as this conservation action did not directly target already invaded class in saline meadow (Figure 18). The conservation action prevents new invasions and increase of the exotic species classes.
- Moreover, there were no changes to the reference classes as this conservation action was designed to keep the status quo (Figure 18).
- As this conservation action does not target already invaded classes (U-A:Exotic Forbs, U-B:Exotic Forbs), these invaded classes increase somewhat over the course of the simulation. (Figure 18).

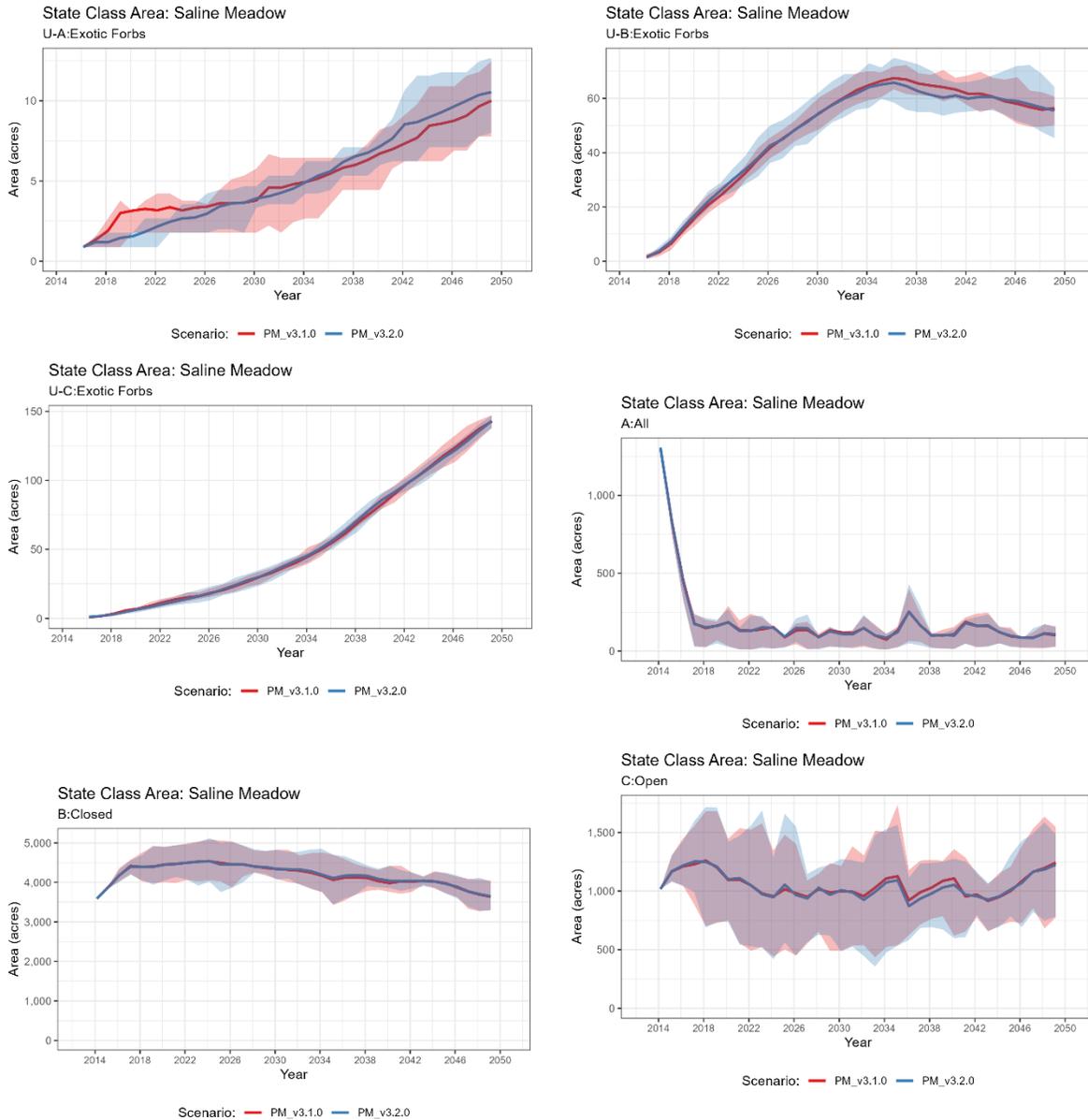


Figure 18. Simulated vegetation class areas (acres) of saline meadow that were the focus of recruitment by management actions on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

### Cost by Ecological System

The cost of the single conservation action hovered around \$6,500 per year with no difference between scenarios (Figure 19). The lack of cost differences was due to the equal application of the action to all non-invaded classes in both scenarios. If the action only applied to invaded classes, then cost would be noticeably higher in the PM\_v3.2.0 scenario.

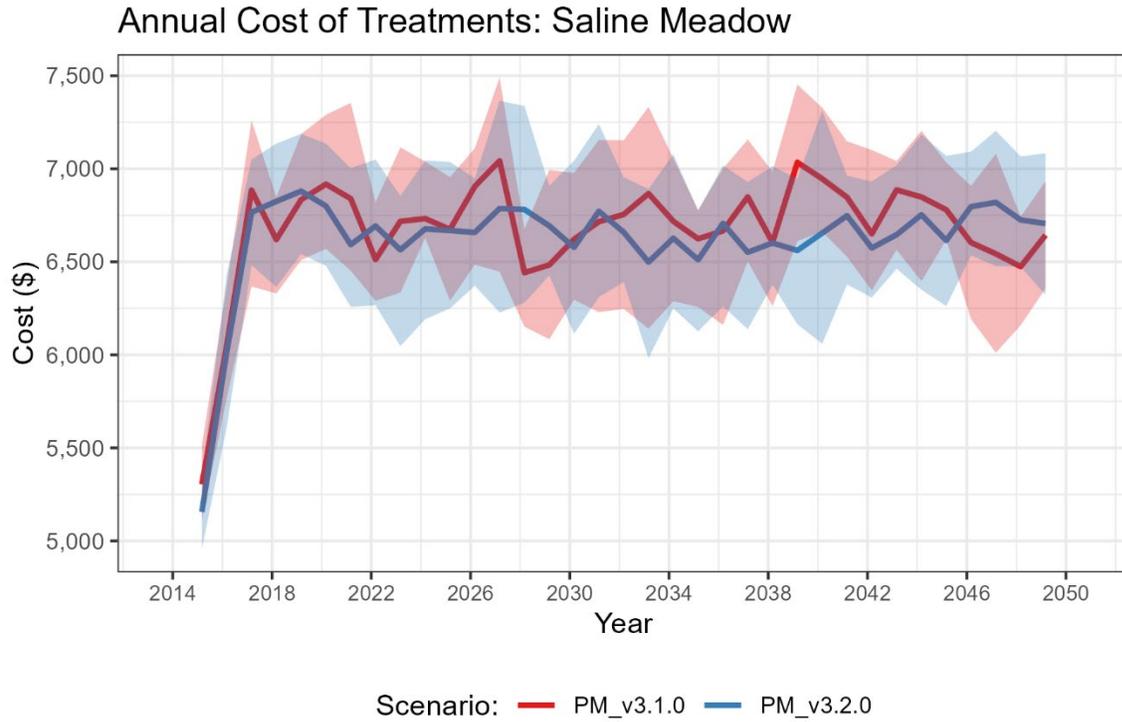


Figure 19. Simulated cost (\$) of conservation actions in saline meadow on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

Basin Wildrye Montane

**Current System Acres at 60-m resolution: 6,101**

**Problems or Concerns**

- Basin wildrye-montane was not greater sage-grouse habitat, but it was imbedded within the sagebrush and wet meadow ecosystems. The presence of exotic noxious forbs (U-A, -B, -C:Exotic Forb) was a frequent problem (cumulative 1.8% of area) and the source of exotic propagules to adjacent systems that were greater sage-grouse habitat (Table 13).

Table 13. Vegetation classes of basin wildrye montane in 2019.

Class	Area (acres)	Area (ha)	% of Total	Reference Condition (%)
CHAR	40	16	0.6	Ephemeral
A:All	20	8	0.3	20
B:Closed	32	13	0.5	61
C:Open	79	32	1.3	19
U-A:Annual Spp	389	157	6.4	n/a
U-A:Bare Ground	31	13	0.5	n/a
U-A:Early Shrub	6	2	0.1	n/a
U-A:Exotic Forbs	89	36	1.5	n/a
U-A:Pasture	86	35	1.4	n/a
U-A:SAP	723	293	11.8	n/a
U-A:SI	19	7	0.3	n/a
U-A:SI+AS	128	52	2.1	n/a
U-B:Early Shrub	11	5	0.2	n/a
U-B:Exotic Forbs	6	2	0.1	n/a
U-B:SA	3	1	0.0	n/a
U-B:SAP	98	40	1.6	n/a
U-B:SI	1	0	0.0	n/a
U-B:SI+AS	25	10	0.4	n/a
U-C:Depleted	512	207	8.4	n/a
U-C:Early Shrub	1,177	476	19.3	n/a
U-C:Exotic Forb	14	5	0.2	n/a
U-C:SA	346	140	5.7	n/a
U-C:SAP	2,178	881	35.7	n/a
U-C:SI	5	2	0.1	n/a
U-C:SI+AS	4	2	0.1	n/a
U-C:TEA	84	34	1.4	n/a

## Management Actions

Using the proposed conservation actions:

- Control exotic noxious forbs with periodic weed inventories that included spot spraying of herbicide on discovered exotics and to spray weed patches found within the buffer of roads that traverse basin-wildrye-montane (Table 1414).

Table 14. Conservation action rates implemented in basin wildrye- montane.

	Period of Implementation			
<b>Private</b>	<b>2015 to 2020</b>	<b>2021 to 2024</b>	<b>2025 to 2030</b>	<b>2031 to 2049</b>
<b>PM_v3.1.0</b>	<b>Sum of 25% -75% percentile</b>			
Weed-Inventory+Spot-Treat	27 - 41	0	18 - 32	69 - 118
<b>PM_v3.2.0</b>				
Weed-Inventory+Spot-Treat	48 - 70	33 - 50	46 - 72	33 - 47
<b>BLM</b>	<b>2015 to 2020</b>	<b>2021 to 2024</b>	<b>2025 to 2030</b>	<b>2031 to 2049</b>
<b>PM_v3.1.0</b>				
Weed-Inventory+Spot-Treat	101 - 136	74 - 92	107 - 138	334 - 434
<b>PM_v3.2.0</b>				
Weed-Inventory+Spot-Treat	50 -69	34 -47	51 - 70	32 -47

## Future Condition at 60-m resolution

### Vegetation Classes (ST-Sim Results)

- Exotic forb control reduced the area of exotic forbs by about 10-20 acres from 2025 to 2049 (Figure 20). This level of reduction matched the conservation action levels in Table 14.
- Control of exotic forbs was reflected in the increase of the area of all three reference classes, especially the mid-successional (B:Closed) and late-successional class (C:Open; Figure 19). One key assumption of the transition from the exotic forb class to reference classes was the presence of remnant basin wildrye plants among the exotic forb plants.

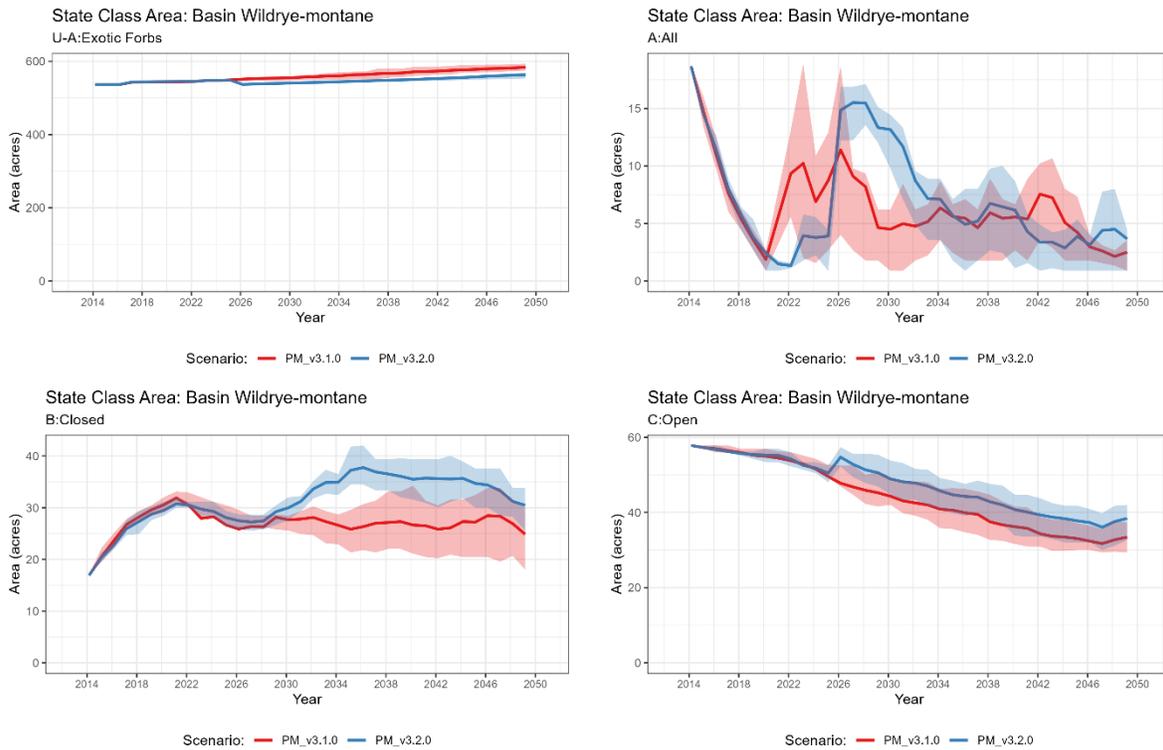


Figure 20. Simulated vegetation class areas (acres) of basin wildrye-montane that were the focus of recruitment by management actions on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

### Cost by Ecological System

The cost of exotic forb control was similar in both scenarios until 2034; however, the cost of control dropped from about \$5,000 in the PM\_v3.1.0 scenario to about \$2,500 in the PM\_v3.2.0 scenario (Figure 21). This was the opposite of expected (i.e., greater expenditure in the PM\_v3.2.0 scenario) but a test simulation showed that lowering the implementation rate did not appreciably change the level of exotic control in late years and saved money.

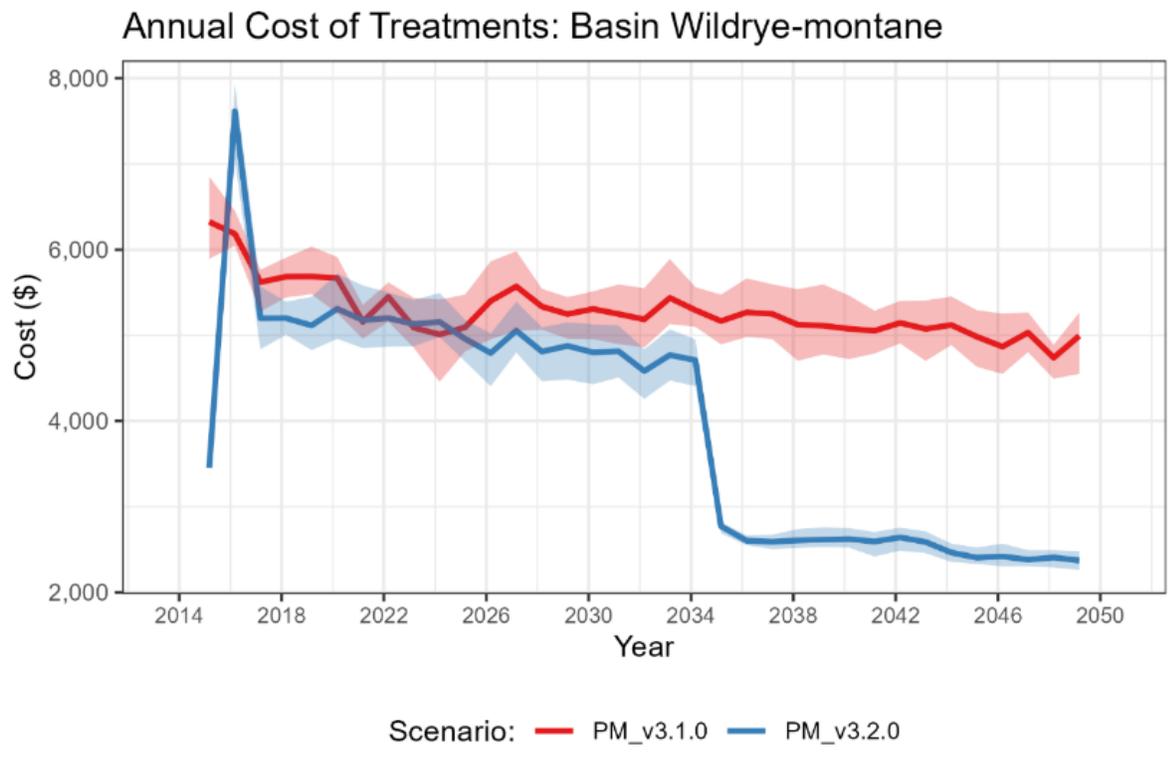


Figure 21. Simulated cost (\$) of conservation actions in basin wildrye-montane on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

## Wet Meadow Montane

**Current System Acres at 60-m resolution: 1,380**

### Problems or Concerns

- The three reference classes were under-represented compared to the reference condition because 21% of wet meadows were hummocked (U-A:Hummocked) (Table 16)) which negatively impacts the value of this important late-brood rearing habitat for greater sage-grouse.
- Cumulatively among classes 12% of wet meadows were encroached with shrub and forbs (U-A: Shrb-Frb Encr, U-B: Shrb-Frb Encr, and U-C: Shrb-Frb Encr; Table 15) which also negatively impacts the value of this important late-brood rearing habitat for greater sage-grouse.
- While only 2.8% of the wet meadow area was invaded by exotic noxious forbs, this was a threat to ecological condition and usability by greater sage-grouse and projected to increase over time.
- A few wet meadows were incised (U-C:Desertified; 0.1% of the area). Moreover, incision was an outcome of continued ungulate hoof action in already hummocked meadows, thus suggesting a potential for the area of incised meadows to increase over time, further degrading this late brood-rearing habitat for sage grouse.

Table 15. Vegetation classes of wet meadow-montane in 2019.

Class	Area (acres)	Area (ha)	% of Total	Reference Condition (%)
A:All	10	4	0.7	13
B:Closed	671	272	48.6	81
C:Open	13	5	0.9	6
U-A:Annual Spp	1	0	0.1	n/a
U-A:Desertified	10	4	0.7	n/a
U-A:Exotic Forb	10	4	0.7	n/a
U-A:Hummocked	286	116	20.7	n/a
U-A:Pasture	141	57	10.2	n/a
U-A:SAP	12	5	0.9	n/a
U-A:Shrb-Frb Encr	1	0	0.1	n/a
U-B:Exotic Forb	39	16	2.8	n/a
U-B:SAP	3	1	0.2	n/a
U-B:SI	7	3	0.5	n/a
U-B:Shrb-Frb Encr	84	34	6.1	n/a
U-C:Desertified	1	1	0.1	n/a
U-C:Early Shrub	0	0	0.0	n/a
U-C:Exotic Forb	3	1	0.3	n/a
U-C:Shrb-Frb Encr	88	36	6.4	n/a

### Management Actions

Using the conservation actions proposed as part of Conservation Plan 2:

- Transition the hummocked wet meadows (U-A:Hummocked) to the early- and mid-successional classes reference classes (A:All and B:Closed) as these were the greatest contributors to greater sage-grouse brood-rearing habitat. The objective used meadow fencing supplemented with a water delivery that was followed in later years with fence maintenance (Table 1616). While levels of meadow fencing supplemented with a water delivery were high in the BSA, especially

given the high cost of this action in Provencher et al. (2017), still higher levels could be used in the BSA (and new implementation in the ACA) on private and BLM lands under the PM\_v3.2.0 scenario. We noticed during past simulations many wet meadows in the BSA were not treated within the constraints of the budget of the 2017 final report.

- Reduce the area of shrub and forb encroachment (U-A,-B, -C: Shrb-Frb Encr) with mowing and herbicide spraying, therefore causing an increase in the area of reference classes (A:All and B:Closed).
- Control of exotic forbs with herbicides (Exotic Control) and weed inventories with occasional spot spraying of herbicides (Weed Inventory & Spot Conservation action) were periodically repeated actions although low-level ones.
- Take action to restore hydrologic function (Water-Table-Uplift) in incised wet meadow that desiccated over time. These were low-cost and low-technology methods to slow flow in meadow creeks that could also trap sediment and debris over time, thus acting as porous dams.

Table 16. Conservation action rates implemented in wet meadow-montane.

	Period of Implementation			
<b>Private</b>	<b>2015 to 2020</b>	<b>2021 to 2024</b>	<b>2025 to 2030</b>	<b>2031 to 2049</b>
<b>PM_v3.1.0</b>	<b>Sum of 25% -75% percentile</b>			
Exotic-Control	38 - 53	1 – 8	1 - 5	4 - 36
Fence&Water-Delivery	441 - 459	0	4 - 6	0
Fence-Inspect &Maintain	0	0	467 - 473	1,419 - 1,420
Herbicide-Shrubs+Mow	14 - 26	0	0	0
Water-Table-Uplift	0	0	0	0
Weed-Inventory+Spot-Treat	66 - 89	33 – 48	38 - 57	113 - 169
<b>PM_v3.2.0</b>				
Exotic-Control	45 - 79	5 – 50	3 - 21	3 - 15
Fence&Water-Delivery	454 - 471	123 – 126	2 - 6	0
Fence-Inspect &Maintain	374 - 398	0	801 - 818	598 -598
Herbicide-Shrubs+Mow	41 - 61	0	155 - 173	0
Water-Table-Uplift	0	34 – 76	1 - 7	0
Weed-Inventory+Spot-Treat	94 - 128	118 – 143	125 - 155	127 - 159
<b>BLM</b>	<b>2015 to 2020</b>	<b>2021 to 2024</b>	<b>2025 to 2030</b>	<b>2031 to 2049</b>
<b>PM_v3.1.0</b>				
Exotic-Control	49 - 63	15 – 7	2 - 9	12 - 46
Fence&Water-Delivery	38 - 47	25 – 40	6 - 10	0
Fence-Inspect &Maintain	0	0	28 - 33	101 - 123
Herbicide-Shrubs+Mow	28 - 34	5 – 15	2 - 4	0
Water-Table-Uplift	0	0	0	0
Weed-Inventory+Spot-Treat	103 - 131	67 – 89	85 - 115	247 -318
<b>PM_v3.2.0</b>				
Exotic-Control	55 - 68	1 – 14	55 - 126	6 - 29
Fence&Water-Delivery	31 - 44	90 – 109	175 - 193	0
Fence-Inspect &Maintain	0	0	18 - 44	1,005 - 1,023
Herbicide-Shrubs+Mow	22 - 29	53 – 66	105 - 118	0
Water-Table-Uplift	0	0	12 - 16	0
Weed-Inventory+Spot-Treat	102 - 139	68 – 91	177 - 217	284 - 325

**Future Condition at 60-m resolution**

## Vegetation Classes (ST-Sim Results)

- The additional level of fencing supplemented with a water delivery system resulted in at most 50 acres of difference of the area of the U-A:Hummocked class between the PM\_v.3.2 and PM\_v3.1.0 distributed over two periods on implementation (Figure 22). This modest decrease of the area of U-A:Hummocked was commensurate a few 100s of acres of additional conservation action (Table 17). It was noteworthy that >1,500 acres of U-A:Hummocked remained, most likely in meadows not used by greater sage-grouse, outside of NGM's control, or inaccessible.
- The mowing and herbicide conservation action reduced the area of mid- and late-successional shrub and forb encroached classes (U-B:Shrb-Frb Encr and U-C:Shrb-Frb Encr), respectively, by about 100 and 50 acres in the PM\_v3.2.0 compared to PM\_v3.1.0 scenarios starting in 2025 (Figure 22). The conservation action was effective because the failure rate and cost were low. The trend of these classes was downward, indicating general improvement of wet meadows.
- The area of the exotic forb class (U-A:Exotic Forb) decreased by about 50 acres after 2030 due to the area implemented level of the two exotic fob control actions in the PM\_v3.2.0 scenario compared to PM\_v3.1.0 scenario (Figure 22). Unfortunately, the trends for the class's area were increasing in both scenarios; however, the increase was due to the invasion rate specified in the wet meadow model.
- The reference classes that were recipient of all additional levels of conservation actions increased by about 25 acres in the A:All class, a short duration class, and 500 acres in the B:Open class, the most desirable for greater sage-grouse brood feeding (Figure 22).

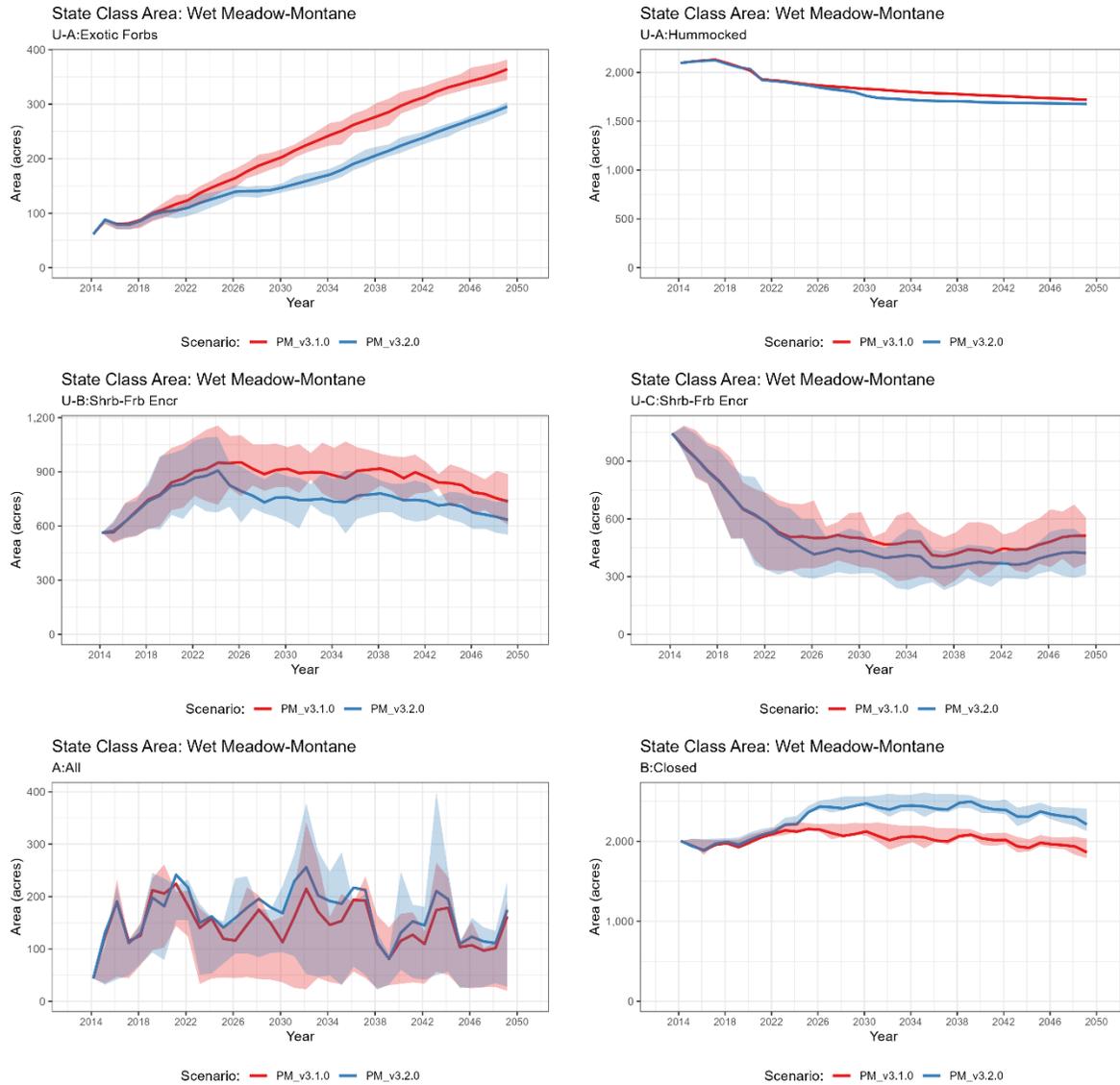


Figure 22. Simulated vegetation class areas (acres) of wet meadow-montane that were the focus of recruitment by management actions on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

### Cost by Ecological System

Three peaks of expenditures way beyond the levels in PM\_v3.1.0 were estimated: 2016, 2019, and 2025-2027 (Figure 23). The first peak of about \$700,000 in 2016 was an oddity and corrected the omission of the fence and water delivery maintenance conservation action in PM\_v3.1.0 (Provencher et al. 2017). This higher cost can be ignored, especially since it was fully (i.e., all at once) implemented in all meadows with potential fencing if no maintenance had been conducted for a certain number of years (always true in 2016). The other peaks of \$300,000 and \$250,000 were nearly entirely caused by additional expenditures in Table 13 for PM\_v3.2.0.

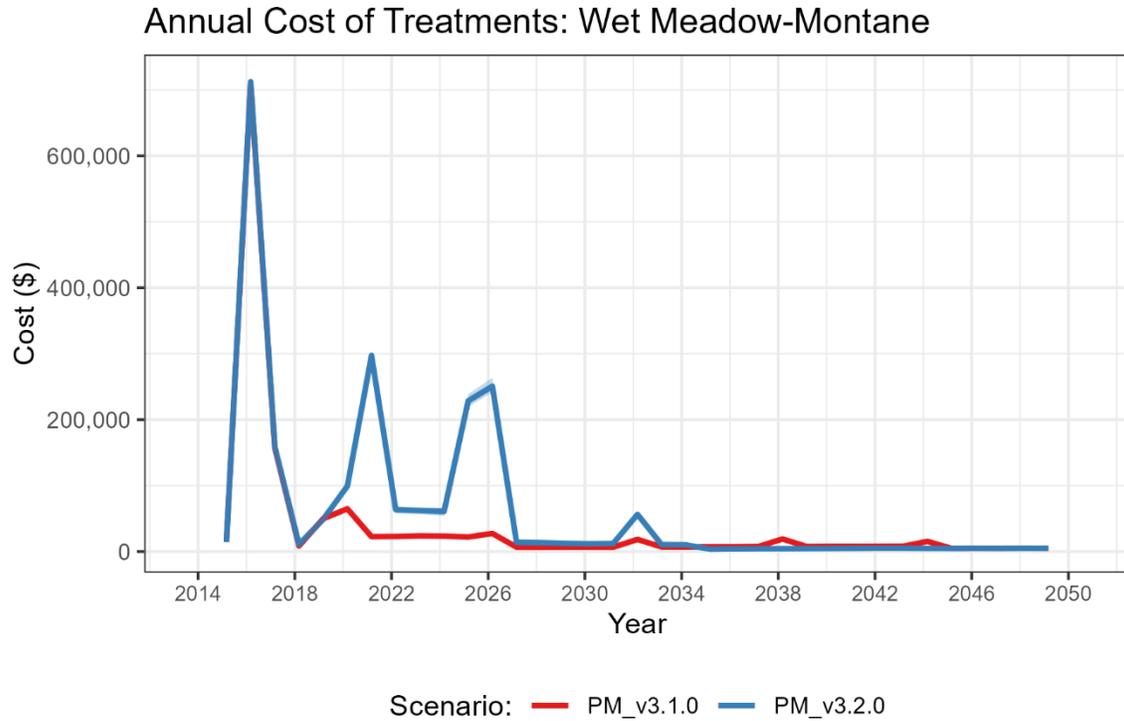


Figure 23. Simulated cost (\$) of conservation actions in wet meadow-montane on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

## Montane Riparian

**Current System Acres at 60-m resolution: 1,108**

### Problems or Concerns

- The montane riparian system was not considered greater sage-grouse habitat; however, it was a potential source of noxious exotic species propagules to wet meadows and all sagebrush systems. About 1.5% of the system was invaded by exotic species in classes U-A,B,C:Exotic-Forb-Tree, U-B:Incised-EFT, U-A,B:Inset-EFT, mostly by thistles and knapweed (Table 1717).

Table 17. Vegetation classes of montane riparian in 2019.

Class	Area (acres)	Area (ha)	% of Total	Reference Condition (%)
A-Cottonwood:Closed	0	0	0.0	38
A-Willow:Closed	84	34	7.6	8
B-Cottonwood:Closed	8	3	0.7	4
B-Willow:Closed	680	275	61.3	26
C-Cottonwood:Closed	28	11	2.5	0
C-Willow:Closed	5	2	0.5	24
U-A:Desertified	2	1	0.1	n/a
U-A:Exotic-Forb-Tree	1	1	0.1	n/a
U-A:Hummocked	11	5	1.0	n/a
U-A:Inset	43	17	3.9	n/a
U-A:Inset-EFT	0	0	0.0	n/a
U-A:Inset-HU	6	2	0.5	n/a
U-A:Inset-SFE	0	0	0.0	n/a
U-A:Shrb-Frb Encr	9	4	0.8	n/a
U-B:Desertified	16	6	1.4	n/a
U-B:Exotic-Forb-Tree	6	2	0.5	n/a
U-B:Incised-EFT	1	0	0.1	n/a
U-B:Inset	115	46	10.3	n/a
U-B:Inset-EFT	7	3	0.7	n/a
U-B:Inset-SFE	24	10	2.2	n/a
U-B:SAP	3	1	0.3	n/a
U-B:Shrb-Frb Encr	57	23	5.2	n/a
U-C:Exotic-Forb-Tree	1	1	0.1	n/a
U-C:SAP	1	0	0.1	n/a
U-C:Shrb-Frb Encr	1	0	0.1	n/a

## Management Actions

Using the proposed conservation actions:

- reduce the area of all classes with exotic forbs or trees. As done with basin wildrye-montane, exotic control of larger patches of exotic species with spraying and periodic weed surveys that included spot conservation actions for small patches (including single individuals) were the only management actions (Table 1818).

Table 18. Conservation action rates Implemented in montane riparian.

Private	Period of Implementation			
	2015 to 2020	2021 to 2024	2025 to 2030	2031 to 2049
<b>PM_v3.1.0</b>	<b>Sum of 25% -75% percentile</b>			
Exotic-Control	24 - 32	2 - 6	0 - 9	7 -33
Weed-Inventory+Spot-Treat	40 - 60	19 - 30	32 - 53	100 - 161
<b>PM_v3.2.0</b>				
Exotic-Control	27 - 46	2 - 7	9 - 38	1 - 8
Weed-Inventory+Spot-Treat	80 - 110	49 - 69	92 - 124	59 - 78
<b>BLM</b>	<b>2015 to 2020</b>	<b>2021 to 2024</b>	<b>2025 to 2030</b>	<b>2031 to 2049</b>
<b>PM_v3.1.0</b>				
Exotic-Control	7 - 13	1 - 8	3 - 15	12 -42
Weed-Inventory+Spot-Treat	216 -265	143 - 173	227 - 261	697 - 833
<b>PM_v3.2.0</b>				
Exotic-Control	6 - 14	0	23 - 52	3 - 14
Weed-Inventory+Spot-Treat	218 - 262	0	258 - 304	1705 - 1774

**Future Condition at 60-m resolution**  
**Vegetation Classes (ST-Sim Results)**

- Exotic species control reduced the area of all classes with exotic species (Figure 24). Conservation actions at most reduced, respectively, the area of class U-A:Exotic-Forb-Tree, U-B:Exotic-Forb-Tree, and U-C:Exotic-Forb-Tree by about 1-2 acres, 23 acres, and 25 acres compared to the PM\_v3.1.0 scenario.
- The transitions from exotic species classes to reference late-successional class resulted, respectively, in about 100 acres and 10 acres more of C-Willow:Closed by 2049 and C-Cottonwood:Closed around 2030 in the PM\_v3.2.0 than PM\_v3.1.0 scenarios (Figure 24).

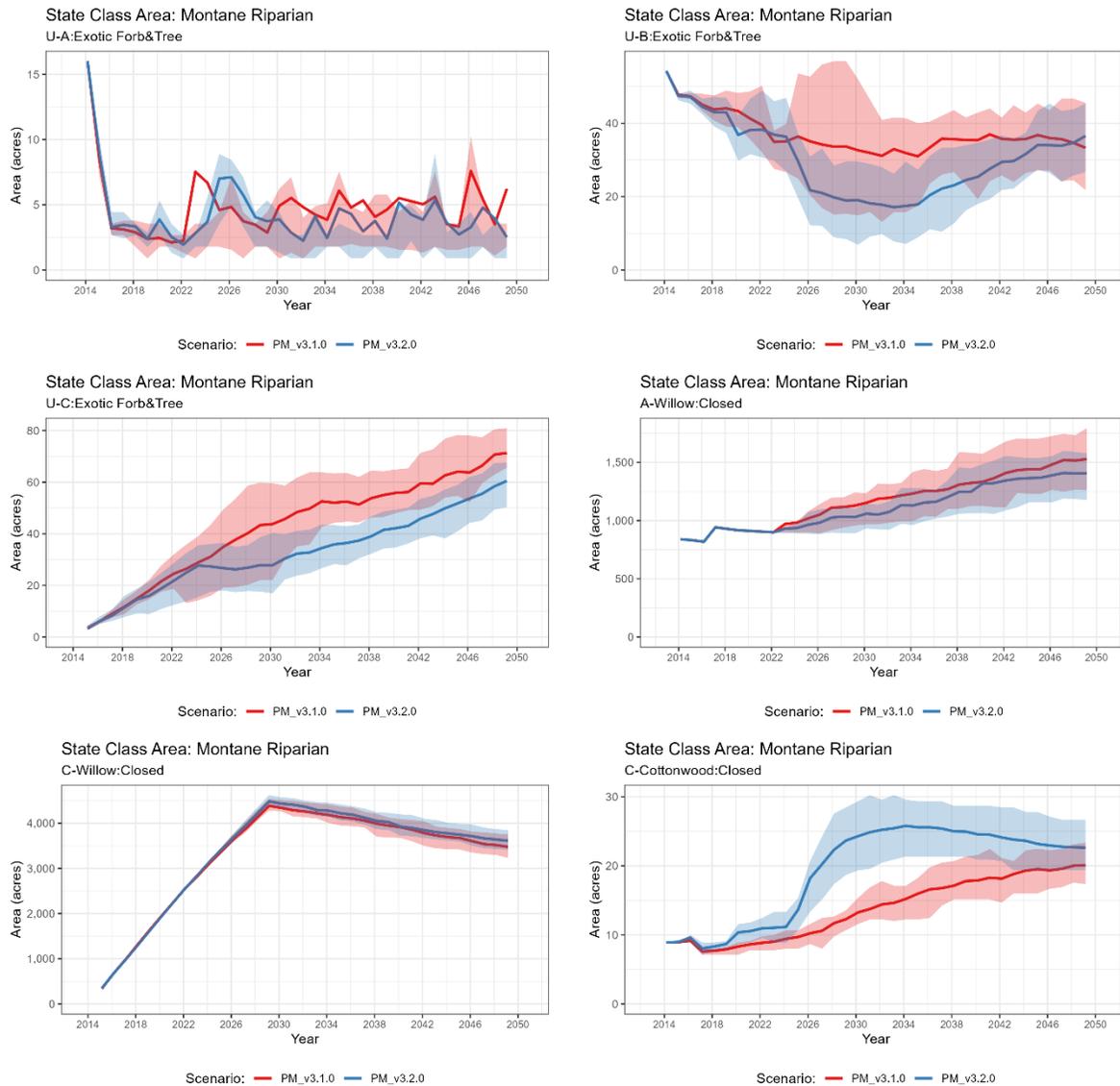


Figure 24. Simulated vegetation class areas (acres) of montane riparian that were the focus of recruitment by management actions on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

### Cost by Ecological System

The cost of exotic species control ranged below \$25,000 per year in both scenarios, except in 2033 and 2034 when cost peaked to about \$85,000 only in the PM\_v3.2.0 scenario (Figure 25). The peak was entirely caused by the significantly higher implementation rate of the weed inventory and spot spraying action during the same period (Table 18).

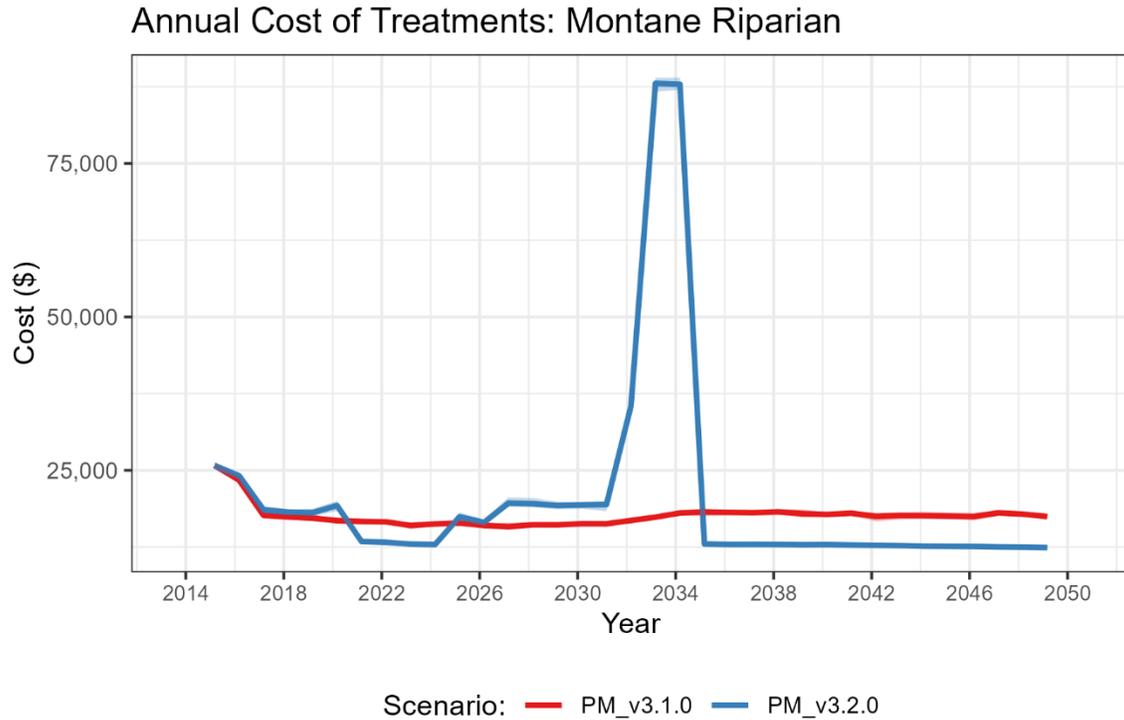


Figure 25. Simulated cost (\$) of conservation actions in montane riparian on private lands owned by NGM and land managed by BLM. Duration of simulations was 35 years. N = 20 replicates. Error bars are the 25% and 75% percentiles.

## Fire

The spatial distribution of wildfire frequency was comparable between the PM\_v3.1.0 and PM\_v3.2.0 scenarios (Figure 26). The higher and lowest concentrations of frequencies occupied the same general locations between scenarios and these areas generally were where past fires had caused the dominance of non-native annual species. The area with the highest wildfire frequencies in both scenarios were in Frenchie Flat just north of the area that was seeded to prevent fires from spreading east up the Cortez range, which was apparently successful and a good idea.

Five patterns were noticeably different between management scenarios (Figure 26):

- Wildfire frequency activity and its spread increased in the old Fraser fire on the northeastern slope of the Roberts Mountains and south in the PM\_v3.2.0 compared to PM\_v3.1.0 scenarios, which was not expected.
- Wildfire frequency decreased in the corridor extending from the western Roberts Mountains into the Simpson Park Range where extensive tree removal, seeding, and Indaziflam spraying were more heavily used in the PM\_v3.2.0 compared to PM\_v3.1.0 scenarios.
- Wildfire frequency decreased in the corridor extending from the Grass Valley playa into Pine Valley (within the Goldrush area) in the PM\_v3.2.0 compared to PM\_v3.1.0 scenarios, although no conservation actions were implemented there.
- Wildfire activity was slightly less intense in the Cottonwood Canyon Road over the Cortez Range in the PM\_v3.2.0 compared to PM\_v3.1.0 scenarios. This was important because of the proximity to the critically important greater sage-grouse habitat in the Pole Creek watershed to the north-east on the Cortez Range.
- Wildfire activity was slightly less intense in the Shoshone Range below and within the checkerboard area in the PM\_v3.2.0 compared to PM\_v3.1.0 scenarios. That was another important area for greater sage-grouse.
- Wildfire activity was substantially reduced in PM\_v3.2.0 in the extended area of seeding implementation in Frenchie Flat as desired.

in nearly all cases, the occurrence of fire was reduced in the ecological systems in which conservation actions occur in PM\_v3.2.0 as compared to PM\_v3.1.0 (Table 19).

Table 19. Average acres burned in ecological systems where conservation action occur.

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Basin Wildrye-montane	1,241	1,094	-147
Big Sagebrush-upland+trees	85,690	74,523	-11,167
Black Sagebrush	6,382	6,949	567
Greasewood	663	418	-245
Low Sagebrush	10,027	8,505	-1,522
Montane Riparian	789	733	-55
Montane Sagebrush Steppe-Upland	66,679	52,980	-13,698
Mountain Shrub	2,601	2,306	-295
Saline Meadow	34	29	-4
Wet Meadow-Montane	1,004	850	-154

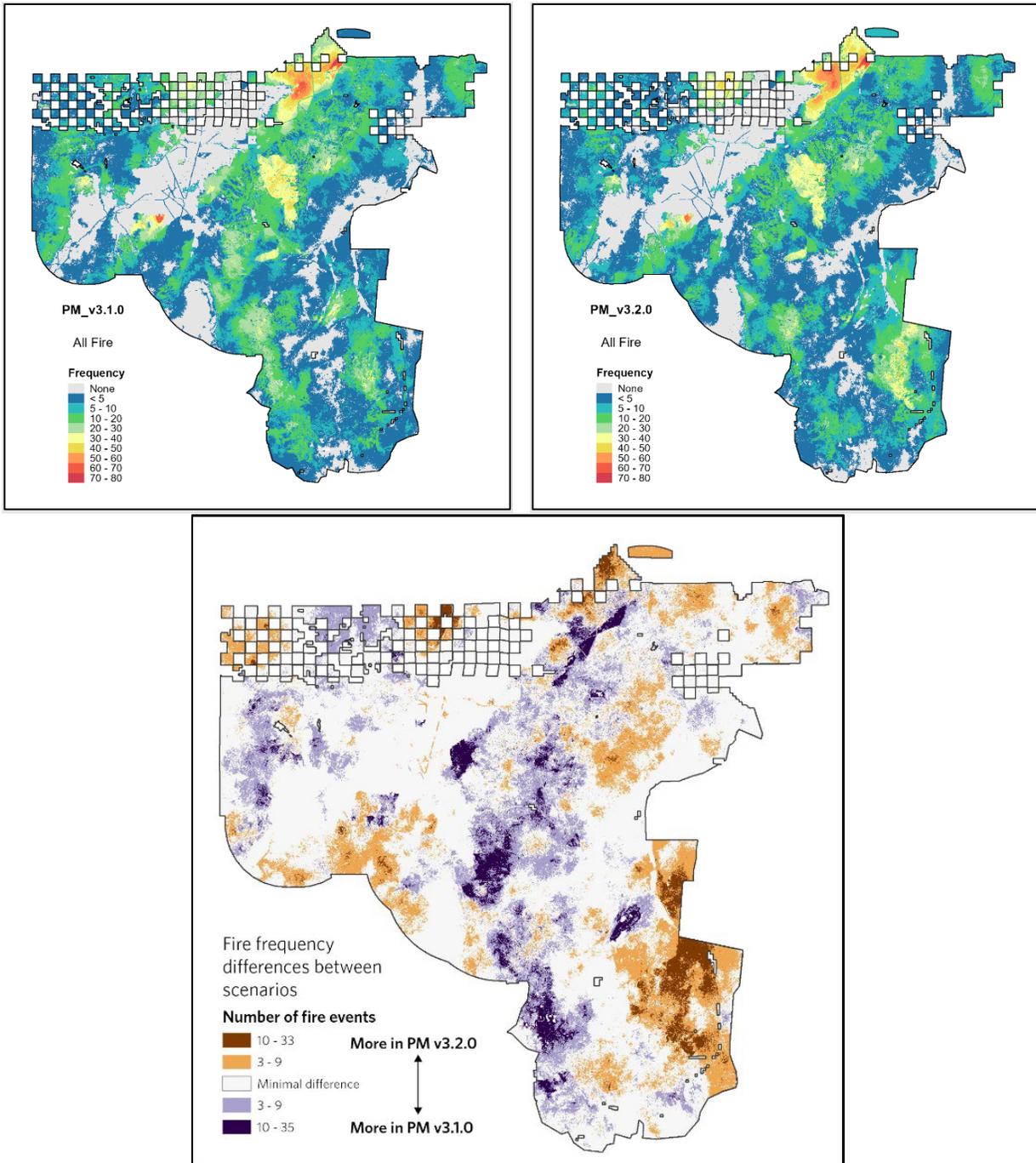


Figure 26. Top panels: mapped frequency (number of events) of wildfire per map pixel in the PM\_v3.1.0 (left panel) and PM\_v3.2.0 (right panel) scenarios across the Full Landscape. Bottom panel: differences in modeled fire occurrence where dark purple are areas of higher fire occurrence in PM\_3.1.0 and dark brown are areas of higher fire occurrence in PM\_v3.2.0. For all panels, the maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

## Conservation Actions

The simulated results above were by focal system and non-spatial. In this part of the report, results were for the entire study area and in map format. A very useful result presented here were frequency rasters that show the number of times each single simulated map pixel was selected to receive the same disturbance over the 35-year simulation and across all 20 replicates. The theoretical maximum number of events per pixel would be 35 years  $\times$  20 replicates = 700 events, which never happens.

In the figures below, we converted the probability of those events in terms of number of events (probability  $\times$  700), which is more easily understood. Here, we presented the wildfire frequency, because fire is very consequential to vegetation dynamics, and then all the management conservation actions.

### AerialSeed+Masticate+Plateau

The AerialSeed+Masticate+Plateau conservation action was the primary combined conifer removal and seeding action in sagebrush systems but used primarily in montane sagebrush steppe on upland soil, less in big sagebrush on upland soils (Wyoming big sagebrush), and in small amounts in black and low sagebrush systems (Table 20). The action accounted for a large part of the simulated NGM budget.

The action was mostly limited to the Roberts Mountains and Simpson Park Range in the PM\_v3.1.0 scenario (Fig 27). The greatest concentration of trees was in the southern BSA. The PM\_v3.2.0 extended implementation of the action in the northern Toiyabe Range and on the western slope of the Simpson Park Range, and in a few other small patches (Figure 27). Also notable was intensification and spread of the action in the original BSA footprint allowed by the greater implementation rates specified in the simulation.

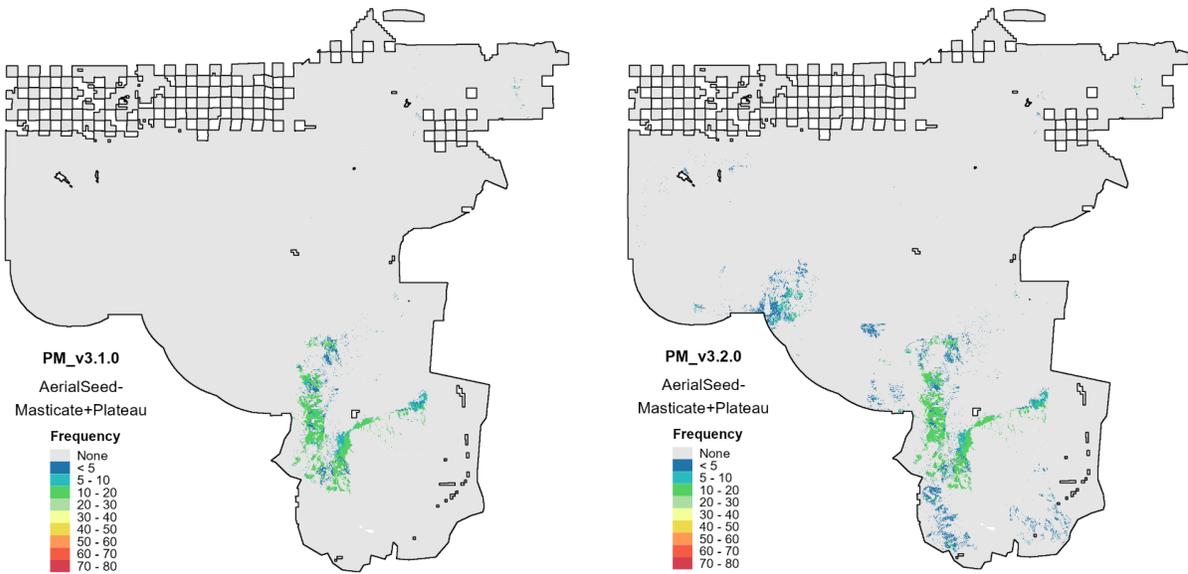


Figure 27. Mapped frequency (number of events) of the AerialSeed+Masticate+Plateau conservation action per map pixel in the PM\_v3.1.0 (left panel) and PM\_v3.2.0 (right panel) scenarios across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

Table 20. Average total acres of the AerialSeed+Masticate+Plateau conservation action by ecological system.

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Big Sagebrush-upland+trees	2,648	3,298	650
Black Sagebrush	1,070	1,615	544
Low Sagebrush	433	1,039	605
Montane Sagebrush Steppe-Upland	6,266	6,668	402

## Chainsaw-Thinning

Chainsaw thinning was an inexpensive tool to cut older trees in reference late-successional treed classes in only black and low sagebrush systems (Table 21). Because these were reference classes, no seeding was required.

In both scenarios, the locations of chainsaw thinning implementation were similar to those of the AerialSeed+Masticate+Plateau conservation action, except often at the adjacent lower elevation contour (Figures 27-28). One exception to this pattern was the scattered use of chainsaw thinning in low sagebrush in the northern Cortez Range. The four noticeable effects of the PM\_v3.2.0 scenario compared to the PM\_v3.1.0 scenarios were (Figure 28):

- Intensification of implementation in already targeted zones on the lower northern slope of the Roberts Mountains where black sagebrush was widespread.
- New implementation of chainsaw thinning in the northern Toiyabe Range where low sagebrush was widespread.
- New implementation in the southeastern Roberts Mountains.
- New implementation in the southwestern edge of the Roberts Mountains.

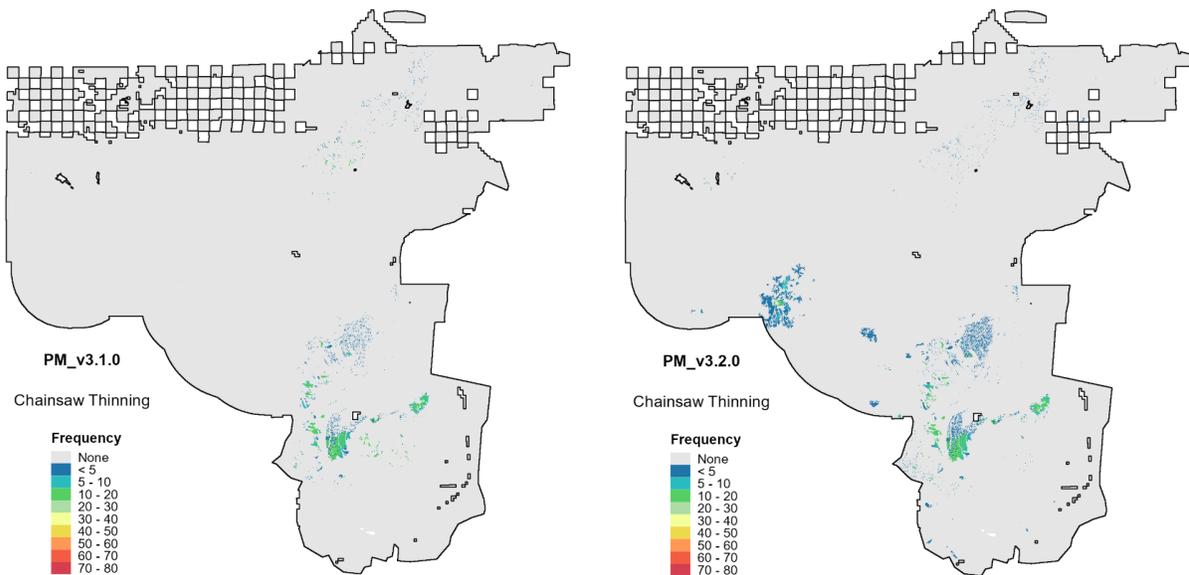


Figure 28. Mapped frequency (number of events) of the chainsaw thinning conservation action per map pixel in the PM\_v3.1.0 (left panel) and PM\_v3.2.0 (right panel) scenarios across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

Table 21. Average total acres of the Chainsaw-Thinning conservation action by ecological system

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Black Sagebrush	2,051	2,960	909
Low Sagebrush	650	1,003	353

## Exotic-Control

Exotic-Control was a widely scattered and sustained conservation action of herbicide spraying to control larger exotic noxious forb and tree patches in all wet (wet meadow-montane, and montane riparian) and productive systems (basin wildrye-montane; Table 22). In wet meadows, the conservation action was used to improve greater sage-grouse habitat suitability.

The main areas of implementation were in the Cortez Range, Simpson Park Range, and Roberts Mountains for both scenarios (Figure 29). In the PM\_v3.2.0 scenario, the Shoshone Range, western slope of the Simpson Park Range, and northern Toiyabe Range were also selected by simulations (Figure 29).

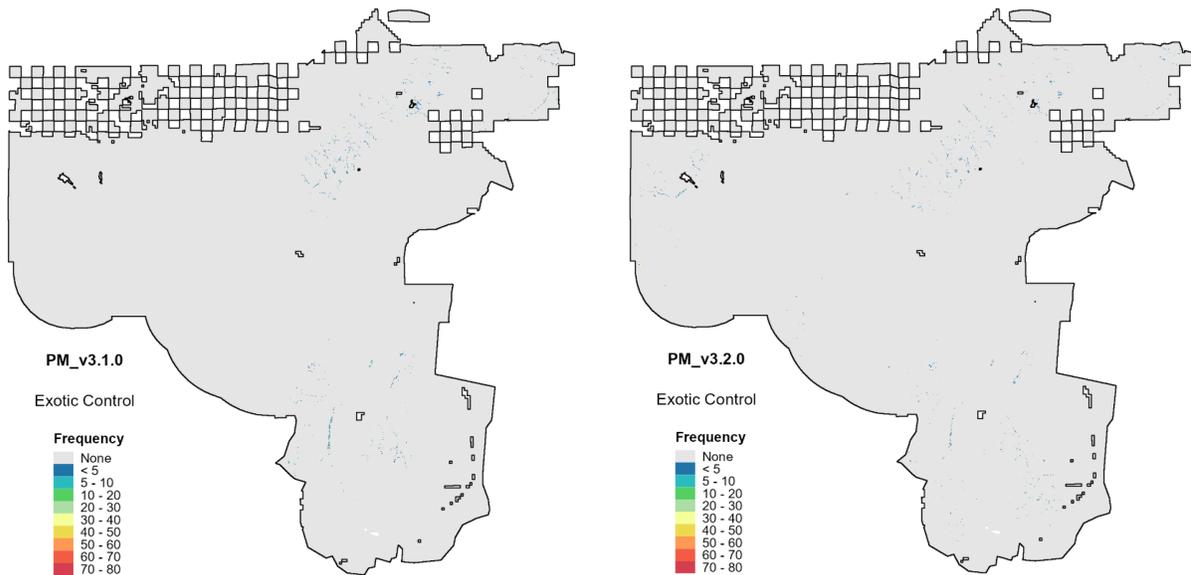


Figure 29. Mapped frequency (number of events) of the exotic control conservation action per map pixel in the PM\_v3.1.0 (left panel) and PM\_v3.2.0 (right panel) scenarios across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

Table 22. Average total acres of the Exotic-Control conservation action by ecological system.

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Montane Riparian	118	132	14
Wet Meadow-Montane	187	310	123

### Fence&Water-Delivery

The fencing of hummocked wet meadows (Table 23) with the building of an alternative water delivery system with water piped from meadows to cattle troughs was the most expensive action per acre. It was also one of the most important for improvement of greater sage-grouse brood-rearing habitat. This conservation action was coupled with periodic maintenance of fences and water delivery systems recommended by NGM livestock operators.

Table 23. Average total acres of the Fence&Water-Delivery conservation action by ecological system.

<b>Ecological System</b>	<b>PM_v3.1.0 (Acres)</b>	<b>PM_v3.2.0 (Acres)</b>	<b>Difference (Acres)</b>
Wet Meadow-Montane	539	912	373

The two conservation actions had had nearly identical rasters because maintenance of fences and water delivery always and only occurred where fences and water delivery systems were first implemented (Figure 30). The primary areas of implementation were the Simpson Park Range, the wet meadows between the Simpson Park Range and the Robert Mountains, and meadows on the eastern slopes of the northern Cortez Range for the PM\_v3.1.0 and PM\_v3.2.0 scenarios. The added areas of implementation in the PM\_v3.2.0 scenario were in the Toiyabe and Shoshone Ranges (Figure 30).

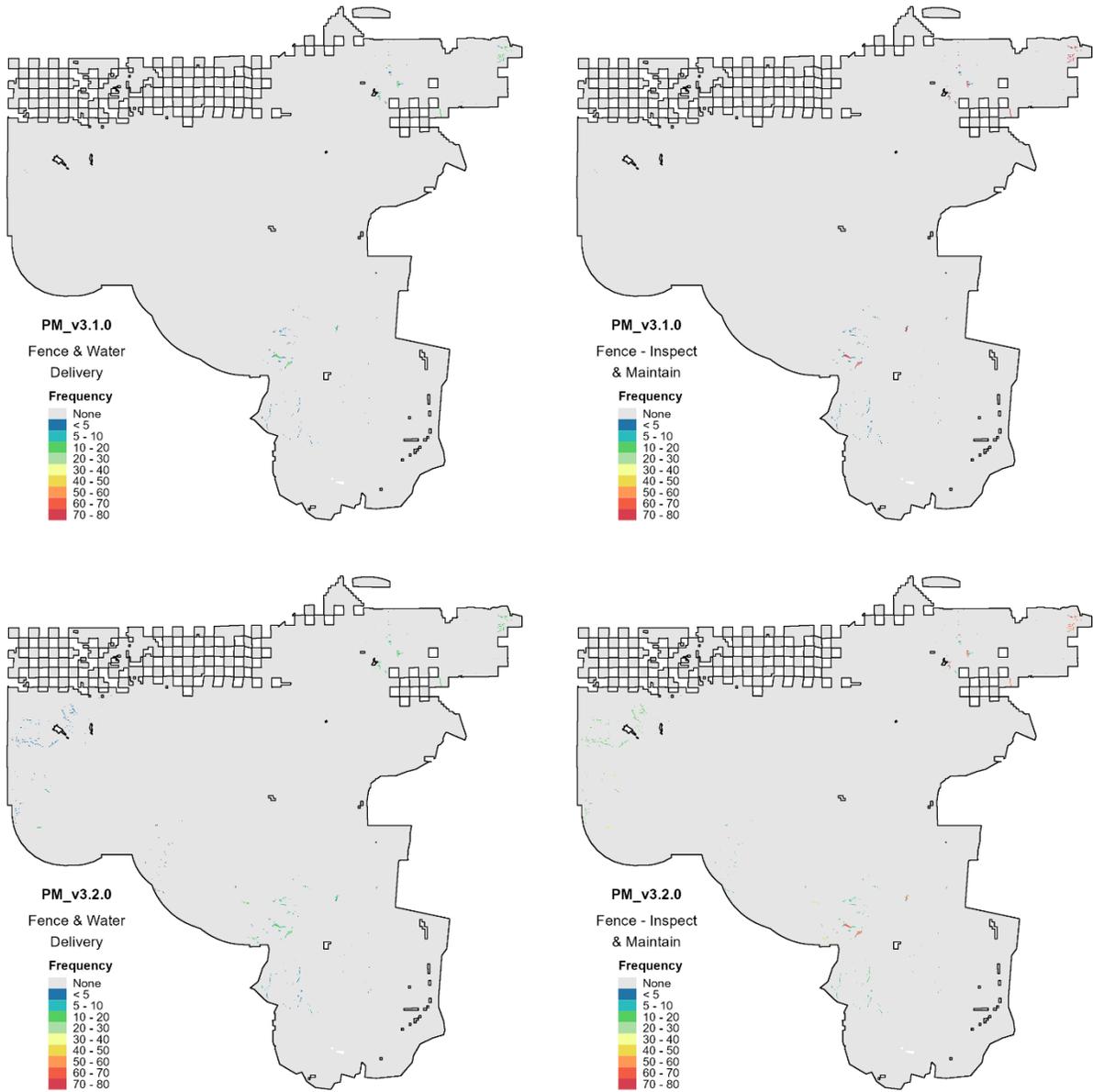


Figure 30. Mapped frequency (number of events) of the fencing-water delivery conservation action (graphs on left) and Fence&Water-Delivery system maintenance conservation action (graphs on right) per map pixel in the PM\_v3.1.0 (top panels) and PM\_v3.2.0 (bottom panels) scenarios across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

### Herbicide-Plateau+Seed (HPS)

The Herbicide-Plateau+Seed conservation action was only used in Frenchie Flat to convert sagebrush areas completely dominated by non-native species to seedings of introduced species that would reduce fire activity and act as large fuel breaks preventing fires from spreading uphill into the northern Cortez Range.

In PM\_v2.1.2, this conservation action was planned for a narrow strip of the Bank Study Area in Frenchie Flat, which was replicated in PM\_v3.1.0 as relatively small, thin shape stretched from the southwest to northeast (Figure 31). With the inclusion of the Expanded Study Area and the prospect of additional resources, this area for this conservation action was expanded west and elongated in PM\_v3.2.0 to increase the likelihood that the area would stop a fire coming from Crescent Valley.

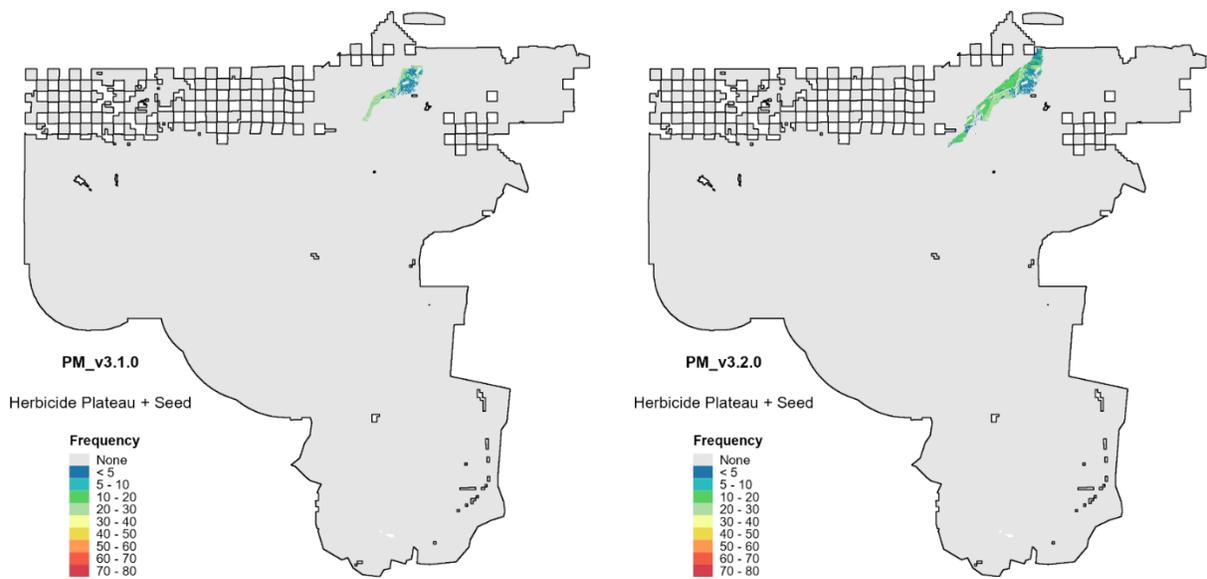


Figure 31. Mapped frequency (number of events) of the herbicide Plateau and seeding conservation action per map pixel in the PM\_v3.1.0 (left panel) and PM\_v3.2.0 (right panel) scenarios across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

Table 24. Average total acres of the Herbicide-Plateau+Seed conservation action by ecological system.

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Big Sagebrush-upland+trees	2,650	5,498	2,848

### Herbicide-Plateau+Seed+Shrub-Planting

The Herbicide-Plateau+Seed+Shrub-Planting conservation action was the most widespread and consequential conservation action for greater sage-grouse habitat improvement affecting the nest selection and nesting success demographic rates. The shrub planting component increased substantially the cost per unit area.

In the PM\_v3.1.0 scenario, the conservation action was implemented in three areas (Figure 32):

- The northeastern portion east of the northern Cortez Range (Boohoo fire) extending east into the Pinion Range.
- The large area north and northwest of the Roberts Mountains extending to the limit of BSA where conservation actions were allowed in the JD Ranch.
- The central Cortez Range near and northeast of the Buckhorn Mine.

With additional resources and area, the conservation action was widely implemented from the northern Toiyabe Range into the Shoshone Range in the PM\_v3.2.0 scenario (Figure 32). Moreover, the frequency of implementation increased in all areas of the BSA in the PM\_v3.2.0 scenario.

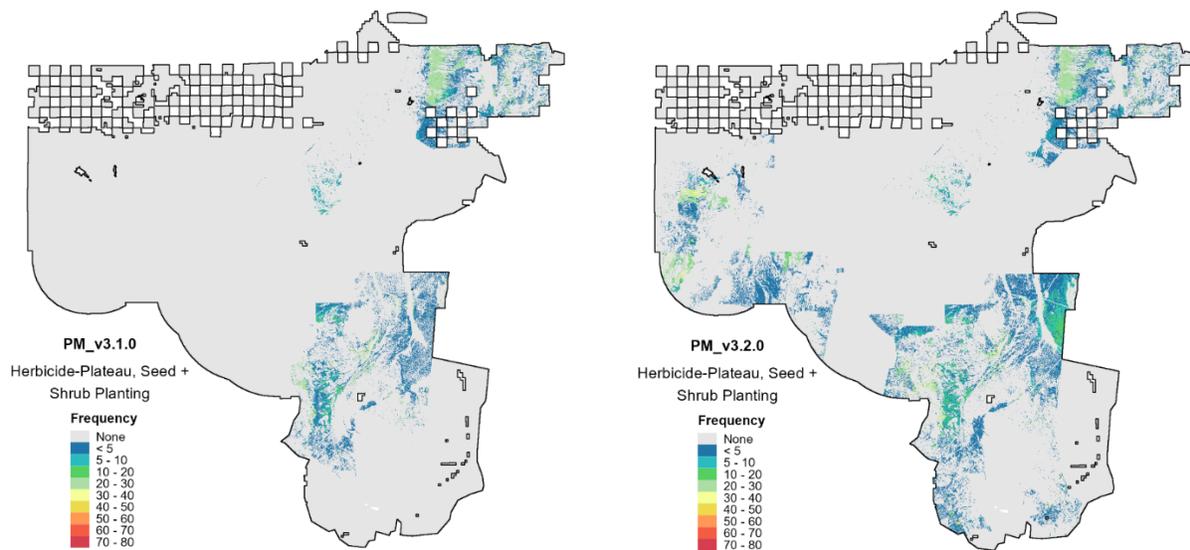


Figure 32. Mapped frequency (number of events) of the Herbicide-Plateau+Seed+Shrub-Planting conservation action per map pixel in the PM\_v3.1.0 (left panel) and PM\_v3.2.0 (right panel) scenarios across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

Table 25. Average total acres of the Herbicide-Plateau+Seed+Shrub-Planting conservation action by ecological system.

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Big Sagebrush-upland+trees	16,223	29,837	13,614
Black Sagebrush	2	459	457
Low Sagebrush	207	428	221
Montane Sagebrush Steppe-Upland	2,999	6,934	3,935

### Herbicide-Shrubs+Mow

The herbicide and shrub mowing conservation action was only used in montane wet meadows dominated by native woody vegetation where the goal was to restore the native herbaceous dominance. The conservation action improved greater sage-grouse brood rearing habitat.

In the PM\_v3.1.0 scenario with actions limited to the BSA, the main area of implementation was on the eastern slope of the Simpson Park Range, although other small occurrences were detected in the northern Cortez Range (Figure 33). Under the PM\_v3.2.0 scenario, the frequency of implementation increased in the Simpson Park Range and several new implementation areas were observed in the Shoshone Range (Figure 33, Table 27). A few scattered occurrences were also found in the northern Toiyabe Range.

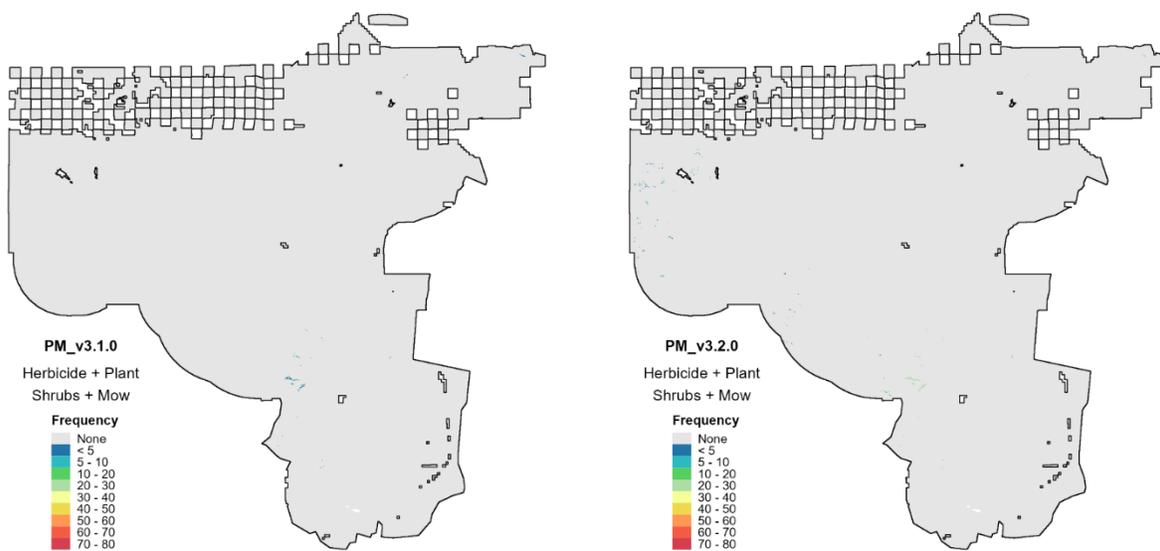


Figure 33. Mapped frequency (number of events) of the Herbicide-Shrubs+Mow conservation action per map pixel in the PM\_v3.1.0 (left panel) and PM\_v3.2.0 (right panel) scenarios across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

Table 26. Average total acres of the Herbicide-Shrubs+Mow conservation action by ecological system.

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Wet Meadow-Montane	66	414	348

Indaziflam

Indaziflam was sprayed in many areas at middle elevations that matched the seeding footprint of other widespread conservation actions (Figure 34). Of greater interest was the large implementation zone in the Fraser Fire (Figure 34), which counter-intuitively corresponded to greater fire activity in the PM\_v3.2.0 scenario. We cannot explain the fire frequency result, except if fire occurred before indaziflam spraying from 2025-2035.

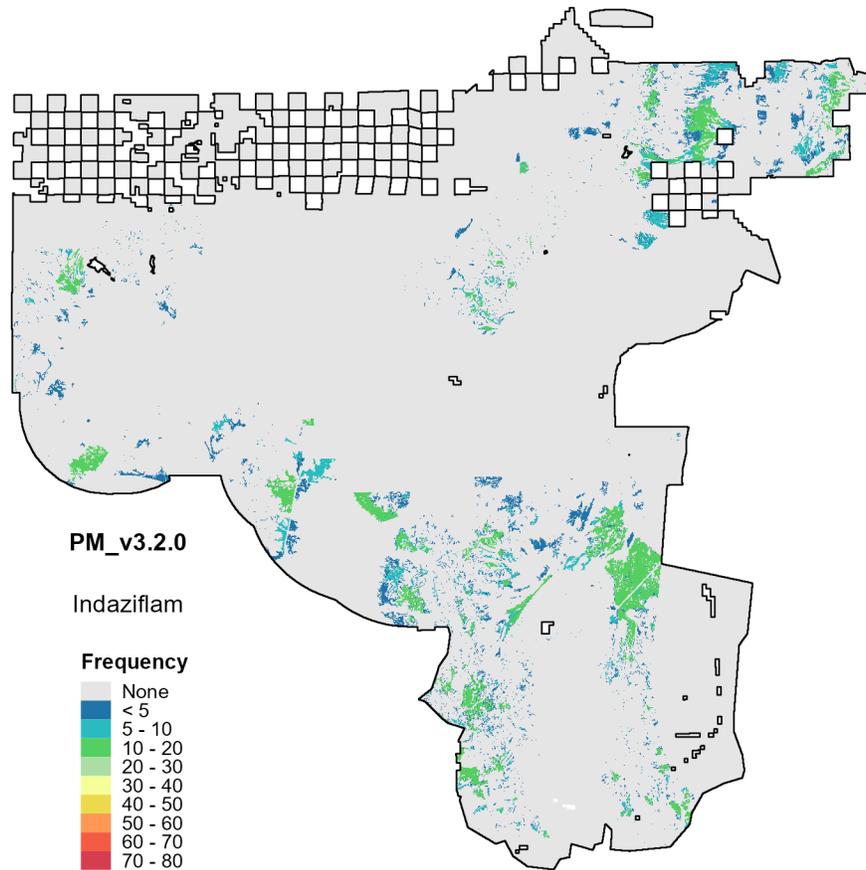


Figure 34. Mapped frequency (number of events) of the Indaziflam conservation action per map pixel in the PM\_v3.2.0 scenario across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

Table 27. Average total acres of the Indaziflam conservation action by ecological system.

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Big Sagebrush-upland+trees	0	16,406	16,406
Black Sagebrush	0	537	537
Low Sagebrush	0	960	960
Montane Sagebrush Steppe-Upland	0	6,154	6,154

### Small-Tree-Lopping

Small-Tree-Lopping was only used in montane sagebrush steppe to cut young trees during the “Christmas Tree” phase of different classes before trees grow and eliminate usable greater sage-grouse vegetation. The conservation action was inexpensive and could be used on steep slopes that no other equipment could reach.

In the PM\_v3.1.0 scenario, small tree lopping was mainly implemented in the corridor spanning from the Simpson Park Range to the northeastern corner of the Robert Mountains (Figure 36). While the same areas were reproduced with the PM\_v3.2.0 scenario, new areas on the western slope of the Simpson Park Range and the northeast Toiyabe Range were added where montane sagebrush and young conifers overlapped (Figure 36).

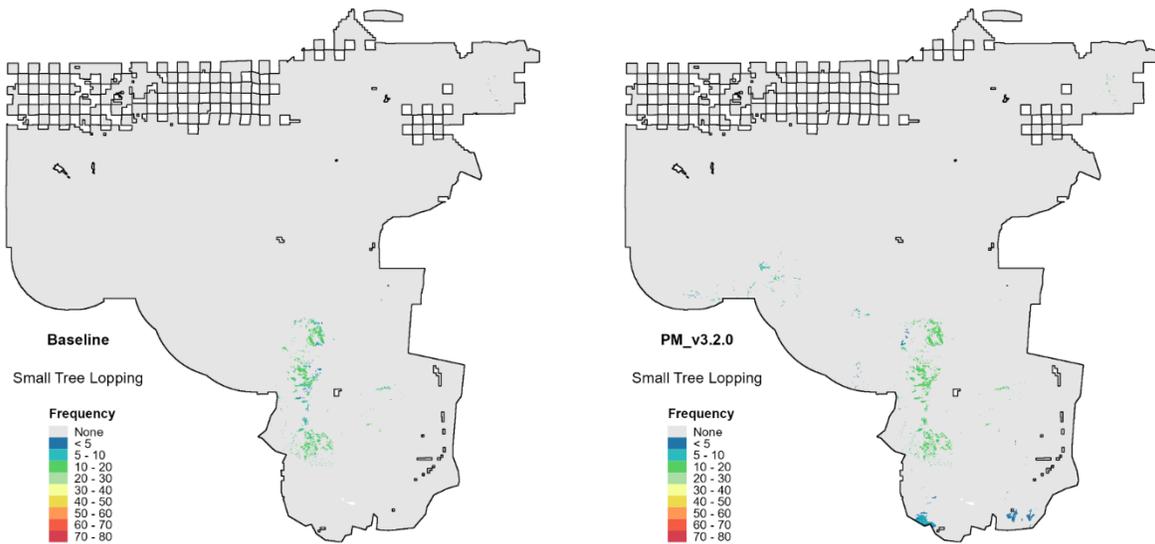


Figure 35. Mapped frequency (number of events) of the Small-Tree-Lopping conservation action per map pixel in the PM\_v3.1.0 (left panel) and PM\_v3.2.0 (right panel) scenarios across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$ .

Table 28. Average total acres of the Small-Tree-Lopping conservation action by ecological system.

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Big Sagebrush-upland+trees	1,191	2,112	920
Montane Sagebrush Steppe-Upland	1,536	2,035	498

### Small-Tree-Lopping in Gold Bar Mitigation Area

As part of the workshopping process, TNC learned of conservation actions being undertaken by another entity in the South Roberts Mountains under a different mitigation agreement. To account for this, and test the value of complementing complementary actions, TNC created a special case of the small tree lopping conservation action in sagebrush systems of the Gold Bar mitigation area that was in both the PM\_v3.1.0 and PM\_v3.2.0 (Table 31). The general area of conservation action was close, but not overlapping, with independent greater sage-grouse habitat mitigation conducted by the Gold Bar mine. This operation was low cost and limited in extent.

The area of implementation was in the southwest corner at the foothills of the Robert Mountain near the edge of the Full Landscape (Figure 37). Lopping was primarily conducted in montane sagebrush steppe in two small patches.

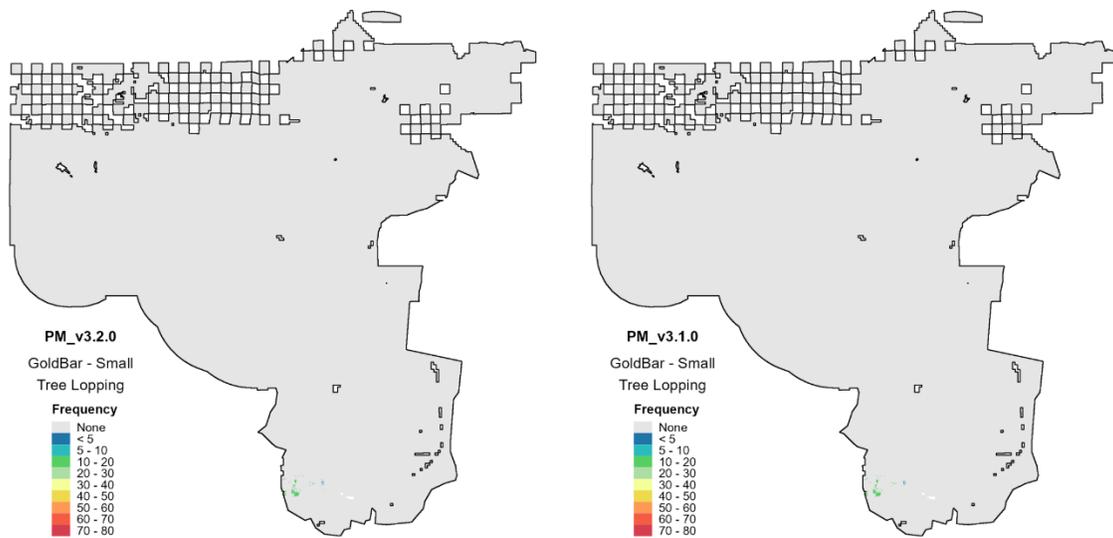


Figure 36. Mapped frequency (number of events) of the Small-Tree-Lopping conservation action conducted only in the Goldbar mitigation area per map pixel in the PM\_v3.1.0 (left) and PM\_v3.2.0 (right) scenarios across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

Table 29. Average total acres of the Goldbar Small Tree Lopping conservation action by ecological system.

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Montane Sagebrush Steppe-Upland	272	270	-2

### Water-Table-Uplift

The Water-Table-Uplift was a conservation action to elevate the water table in incised wet meadows using low cost and low technology methods. It was only used in the PM\_v3.2.0 scenario. The implementation rate of the conservation action was low, and each occurrence was small; therefore, implementation areas were barely visible (Figure 38). The conservation action was more commonly used on the eastern slopes of the Cortez Range and the Shoshone Range (Figure 38). While 73 acres of this conservation action was completed on average across the range (Table 32), it is important to note that the estimate of conservation action acres that occur on small systems are assumed to be over-estimates due to priority reclassification process from 1.5m pixels to 60m pixels. TNC recommends cross-referencing with the 1.5m data for implementation purposes.

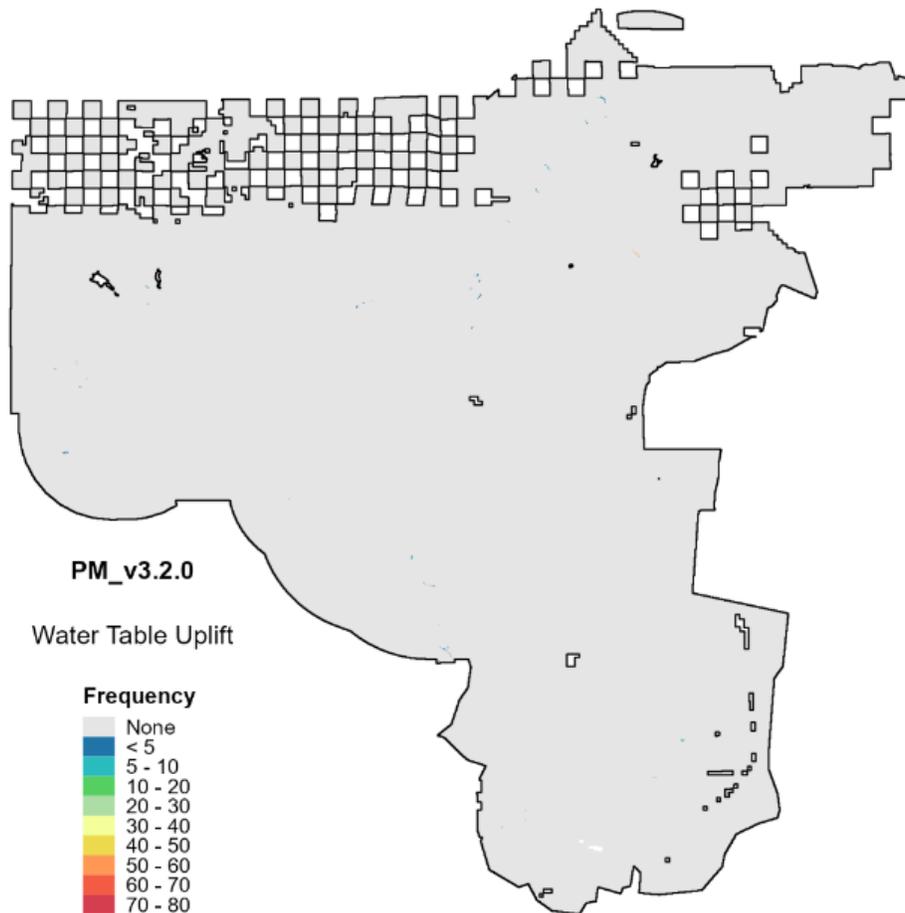


Figure 37. Mapped frequency (number of events) of the Water-Table-Uplift conservation action per map pixel in the PM\_v3.2.0 scenarios across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

Table 30. Average total acres of the Water-Table-Uplift conservation action by ecological system.

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Wet Meadow-Montane	0	73	73

### Weed-Inventory+Spot-Treat

The Weed-Inventory+Spot-Treat conservation action was applied to classes not or only slightly invaded by exotic noxious forbs and trees in all wet systems and basin wildrye-montane. Spot treatment was applied to locations with low levels of infestation; however, there was no way to distinguish between simple inventory and spot treatment of a few individual plants. Unfortunately, the same spatial constraints were applied to both scenarios and the only exclusion for conservation action use was for Grass Valley where the herbicide Plateau and seed conservation action was applied (Figure 39). The error in the simulation was that the conservation action should only be implemented in the BSA for the PM\_v3.1.0 scenario, which was not the case. This would also explain why there were no differences between the two scenarios in the charts above. As discussed, this conservation action does not directly lead to habitat uplift for greater sage-grouse but prevents some loss of habitat that can occur when late brood rearing habitat becomes unusable due to complete conversion to weeds as no weed inventory increases the likelihood of full invasion. As such, this error is not expected to substantially influence the outcome of the functional acre calculations at the landscape scale.

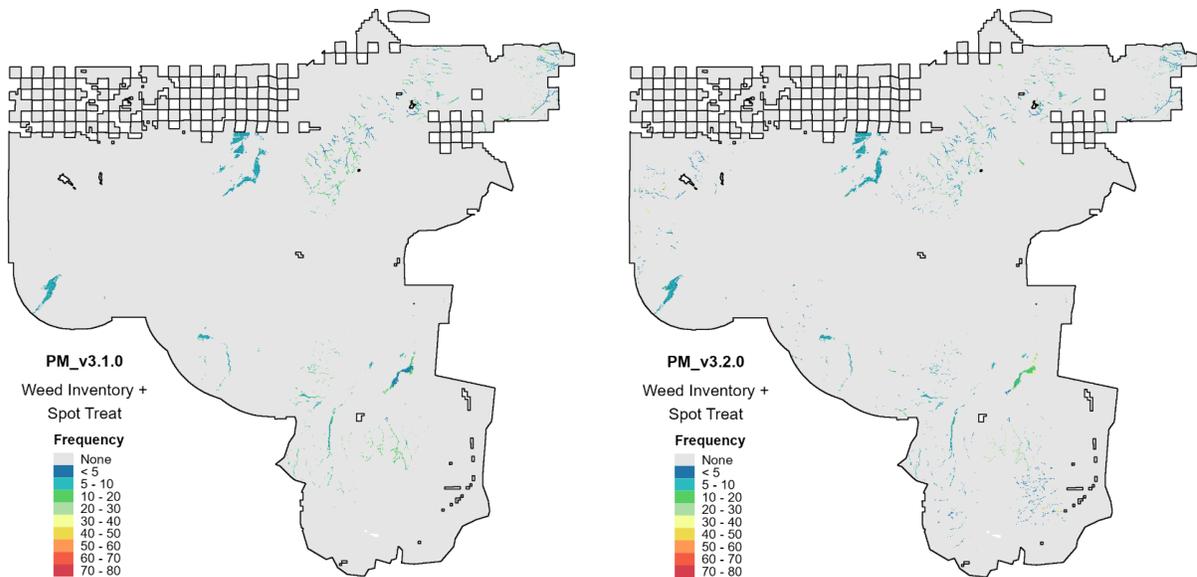


Figure 38. Mapped frequency (number of events) of the Weed-Inventory+Spot-Treat spraying conservation action per map pixel in the PM\_v3.1.0 (left panel) and PM\_v3.2.0 (right panel) scenarios across the Full Landscape. The maximum possible frequency across 35 years and 20 replicates was  $35 \times 20 = 700$  events.

Table 31. Average total acres of the Weed-Inventory+Spot-Treat conservation action by ecological system.

Ecological System	PM_v3.1.0 (Acres)	PM_v3.2.0 (Acres)	Difference (Acres)
Basin Wildrye-montane	864	401	-462
Montane Riparian	1,657	2,596	939
Saline Meadow	1,301	1,288	-13
Wet Meadow-Montane	893	1,231	339

This conservation action was implemented in all wet systems on the slopes of mountain ranges such as the Robert Mountains, Simpson Park Range, Cortez Range, Toiyabe Range, and the Shoshone Range (Figure 39). The higher implementation rates in the PM\_v3.2.0 scenario did result in more systems being treated, especially in the Shoshone Range.

### Combined Conservation Actions

Taken at the landscape-level, a total of 43,621 acres of conservation actions are included in PM\_v3.1.0 and a total of 95,368 acres of conservation actions are included in PM\_v3.2.0. The difference between scenarios PM\_v3.1.0 and PM\_v3.2.0 can be used to form the basis of new credit-generating actions in the Bank Enabling Agreement either at the landscape scale, or at smaller scales. In almost all cases, the total amount of a given conservation action in PM\_v3.2.0 exceeds the total amount of that conservation action in PM\_v3.1.0, including when considered by planning area (Bank Study Area vs. Expanded Study Area). In a few cases (Exotic-Control, Chainsaw-Thinning) the total amount of conservation action acreage is higher in PM\_v3.1.0, but it is considered within a reasonable range given the stochasticity of the model. These can therefore be assumed to essentially have no additional acreage for the purposes of implementation.

Table 32. Total conservation actions in acres summed across entire implementation period for scenarios PM\_v2.1.2, PM\_v3.1.0, and PM\_v3.2.0. The difference between scenarios PM\_v3.1.0 and PM\_v3.2.0 can be used to form the basis of new credit-generating actions in the Bank Enabling Agreement. However, in a few cases, the difference is negative due to the inherent variability in the model. The total difference between scenarios PM\_v3.1.0 and PM\_v3.2.0 is not presented because of the negative values in some cells.

Scenario	PM_v2.1.2 (acres)	PM_v3.1.0 (acres)	PM_v3.2.0 (acres)	<i>Difference between PM_v3.1.0 and PM_v3.2.0 (acres)</i>
Bank Study Area				
BLM				
AerialSeed+Masticate+Plateau	9,709	<b>10,267</b>	<b>10,861</b>	593
Chainsaw-Thinning	2,716	<b>2,617</b>	<b>3,012</b>	395
Exotic-Control	203	<b>161</b>	<b>115</b>	-45
Fence&Water-Delivery	80	<b>82</b>	<b>244</b>	162
Herbicide-Plateau+Seed	1,228	<b>1,392</b>	<b>1,404</b>	11
Herbicide-Shrubs+Mow	44	<b>46</b>	<b>171</b>	125
Herbicide-Plateau+Seed+Shrub-Planting	13,869	<b>14,124</b>	<b>19,696</b>	5,572
Indaziflam	0	<b>0</b>	<b>12,634</b>	12,634
Small-Tree-Lopping	3,063	<b>2,666</b>	<b>3,497</b>	831
Weed-Inventory+Spot-Treat	2,674	<b>2,697</b>	<b>2,837</b>	141
Private				
AerialSeed+Masticate+Plateau	205	<b>150</b>	<b>150</b>	0
Chainsaw-Thinning	107	<b>84</b>	<b>81</b>	-2
Exotic-Control	187	<b>146</b>	<b>112</b>	-33
Fence&Water-Delivery	436	<b>457</b>	<b>467</b>	10
Herbicide-Plateau+Seed	1,138	<b>1,258</b>	<b>1,300</b>	42
Herbicide-Shrubs+Mow	20	<b>20</b>	<b>148</b>	128
Herbicide-Plateau+Seed+Shrub-Planting	5,165	<b>5,307</b>	<b>5,461</b>	154
Indaziflam	0	<b>0</b>	<b>3,103</b>	3,103
Irrigation	555	<b>68</b>	<b>68</b>	0
Small-Tree-Lopping	83	<b>62</b>	<b>71</b>	9
Weed-Inventory+Spot-Treat	746	<b>717</b>	<b>821</b>	104

Expanded Study Area				
BLM				
AerialSeed+Masticate+Plateau	0	0	1,505	1,505
Chainsaw-Thinning	0	0	696	696
Exotic-Control	0	0	126	126
Fence&Water-Delivery	0	0	76	76
Herbicide-Plateau+Seed	0	0	792	792
Herbicide-Shrubs+Mow	0	0	27	27
Herbicide-Plateau+Seed+Shrub-Planting	0	0	12,240	12,240
Indaziflam	0	0	8,319	8,319
Small-Tree-Lopping	0	0	577	577
Water-Table-Uplift	0	0	13	13
Weed-Inventory+Spot-Treat	0	853	1,168	315
Private				
AerialSeed+Masticate+Plateau	0	0	103	103
Chainsaw-Thinning	0	0	175	175
Exotic-Control	0	0	89	89
Fence&Water-Delivery	0	0	124	124
Herbicide-Plateau+Seed	0	0	2,002	2,002
Herbicide-Shrubs+Mow	0	0	68	68
Herbicide-Plateau+Seed+Shrub-Planting	0	0	262	262
Indaziflam	0	0	0	0
Small-Tree-Lopping	0	0	2	2
Water-Table-Uplift	0	0	59	59
Weed-Inventory+Spot-Treat	0	448	691	242
Total Across Landscapes	42,228	43,621	95,368	

### Analysis Zone Identification

When taken together, the spatial frequency of all conservation actions offers insights into areas where a high concentration of conservation actions may or may not align with a high level of habitat uplift and can provide boundaries for implementing suites of conservation actions that are related to each other either administratively or from a habitat uplift perspective. TNC used the following criteria to define discrete Analysis Zones (Figure 40):

1. All zones must be mutually exclusive.
2. Analysis zones are for areas where Conservation Actions were allowed in the model (i.e., the Bank Study Area and the Expanded Study Area).
3. Analysis zones are contained either within the Bank Study Area or the Expanded Study Area and preserve previously agreed-to administrative boundaries.
4. Where possible, create zones where topographic or other features are likely to drive the real-world outcomes.
5. Where possible, include a 1000m buffer around the zone to capture functional acre changes that exceed the footprint of the conservation actions.

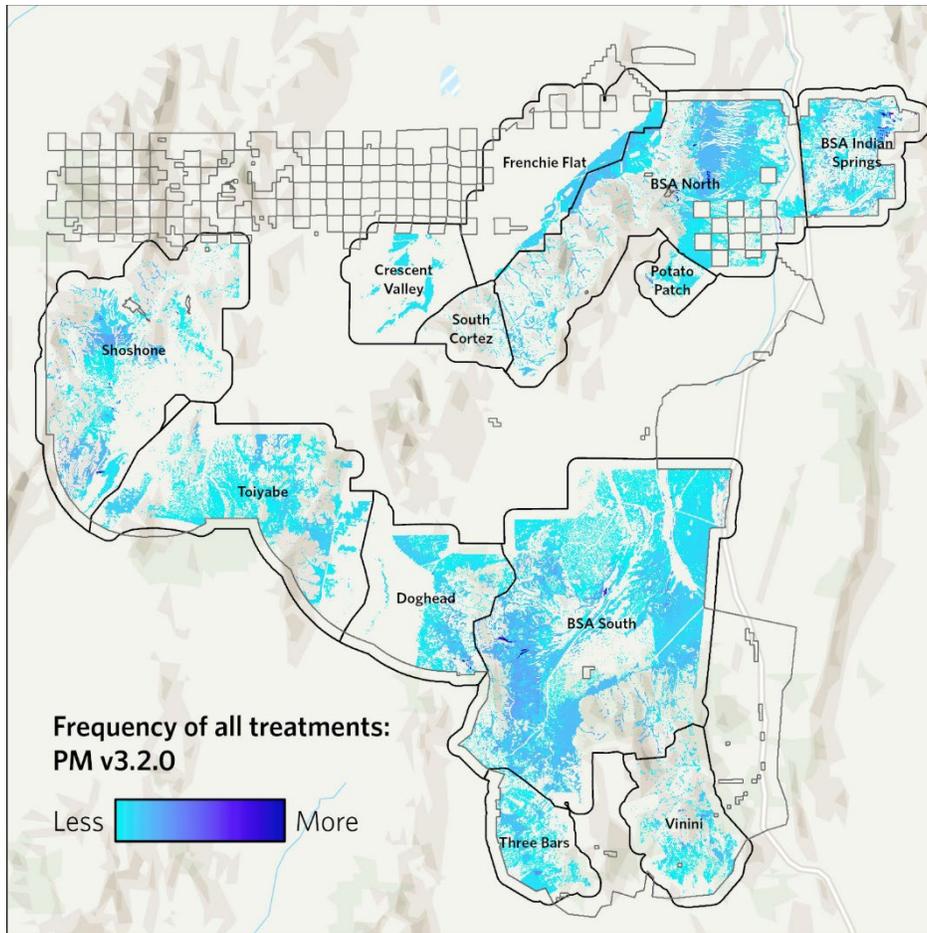


Figure 39. Mapped frequency (number of events) of all conservation actions per map pixel in the PM\_v3.2.0 and proposed Analysis Zones.

Table 33. Analysis zone conservation action rationale.

Zone	Rationale
Shoshone	Captures all conservation actions in the Shoshone Range down to the Carico Lake Valley bottom. Conservation actions closest to the boundary with Toiyabe are weed conservation actions which have a low likelihood to have effects that extend beyond their footprint.
Toiyabe	Captures all conservation actions in the Toiyabe between Carrico Lake Valley and Grass Valley. Conservation actions closest to the east and west boundaries are weed conservation actions which have a low likelihood to have effects that extend beyond their footprint. During workshops, there was some discussion about splitting this area into eastern and western portions, but further discussion is needed with local experts to design a split that makes ecological sense.
Doghead	Captures all conservation actions on the west slope of the Simpson Park Range. Conservation actions near the boundary between the BSA South and the Doghead may have some interactive effects, but the boundary was preserved for administrative reasons.
BSA South Main	Existing administrative boundary of the Bank Enabling Agreement. Captures conservation actions in an area that was previously modeled and conservation actions were enrolled in the mitigation banking system.

Three Bars	Captures conservation actions on the southwest side of the Roberts Mountains. Conservation actions near the boundary between the BSA South and Three Bars may have some interactive effects, but the boundary was preserved for administrative reasons.
Vinini	Captures conservation actions on the southeast side of the Roberts Mountains in the Vinini Creek watershed. Conservation actions near the boundary between the BSA South and Vinini may have some interactive effects, but the boundary was preserved for administrative reasons.
Crescent Valley	Captures a patch of weed conservation actions that is isolated in Crescent Valley.
Frenchie Flat	Captures conservation actions exclusively designed to reduce the risk of fire spreading from Crescent Valley to the Cortez Range. Therefore, the value of conservation action in Frenchie Flat may be most realized in BSA North, Similar conservation actions occur on the east side of the boundary with BSA North and may also have interactive effects
BSA North	Predominantly designed to follow existing administrative boundary of the Bank Enabling Agreement. Captures conservation actions in an area that was previously modeled and conservation actions were enrolled in the mitigation banking system. Bifurcated along Hwy 278 which runs down Pine Valley to assist in implementation and where effects of conservation actions have limited interactive effects.
South Cortez	Captures new conservation actions in the south end of the Cortez range. Conservation actions near the boundary between BSA North and South Cortez may have some interactive effects, but the boundary was preserved for administrative reasons.
BSA Indian Springs	Predominantly designed to follow existing administrative boundary of the Bank Enabling Agreement. Captures conservation actions in an area that was previously modeled and conservation actions were enrolled in the mitigation banking system. Bifurcated along Hwy 278 which runs down Pine Valley to assist in implementation and where effects of conservation actions have limited interactive effects.
Potato Patch	Captures new conservation actions at mid-elevations in Pine Valley. Conservation actions near the boundary between BSA North and Potato may have some interactive effects, but the boundary was preserved for administrative reasons and no double counting occurs.

## Future Habitat Suitability

Across the landscape, an increase in functional acres was observed after 2019, with a peak functional acre uplift of 2,369 in 2044 (Table 35), although a functional acre gain was observed by 2024. Across all iterations and years, PM v3.2.0 ranged from 237,113 to 252,260 FA while PM v3.1.0 ranged from 232,870 to 250,245 FA (data not shown). Mixed model ANOVA indicate highly significant differences in the 2044 between the two scenarios, with iteration as a random factor, using the ‘lme4’ (Bates et al. 2015) and ‘car’ (Fox and Weisberg 2019) packages in R (R Core Team 2023).

Table 34. Functional acres estimated for scenarios PM v3.2.0 and PM v3.1.0 and the total functional acre (FA) gain across the Full Landscape.

Scenario	2014	2019	2024	2029	2034	2039	2044	2049
PM v3.2.0	248,482	248,647	248,331	247,351	246,084	244,844	243,335	242,101
PM v3.1.0	248,482	248,667	247,871	245,881	244,673	242,872	240,967	239,969
Total FA Gain	0	-20	460	1,470	1,412	1,972	2,369	2,132

Within the Bank Study Area, the most notable areas were along the western foothills of the Cortez (especially in the BooHoo fire), along the southern portion of the Bank Study Area, as well as the northern end of the Simpson Park range (Fig 40). Increased fire activity in the historic Fraser Fire, on the northeast side of the Roberts, appear to cause reduced habitat suitability where  $\lambda$  decreased in the PM\_v3.2.0 compared to the PM\_v3.1.0 scenarios in the same area where fire frequency increased in the PM\_v3.2.0 scenario compared to the PM\_v3.1.0 scenario despite spraying of Indaziflam (Figs. 41, 34, 35). As seen in prior modeling efforts, this is rugged terrain where concentrated seeding conservation action is not feasible.

In new areas, the most significant habitat improvements were observed in the Shoshone range. This area benefitted from the improvements to late brood habitat and nesting habitat. Also, the 3 Bars area saw increased habitat uplift through the PJ expansion removal and HPSS efforts to improve nesting habitat. Smaller increases were observed in the central portion of the Potato Patch allotment, although fires originating outside of the allotment in the South Buckhorn appear to moderate the increase in that area. Similarly, in the Vinini area, conservation actions were offset by increased fire activity in regions where conservation actions are not logistically possible.

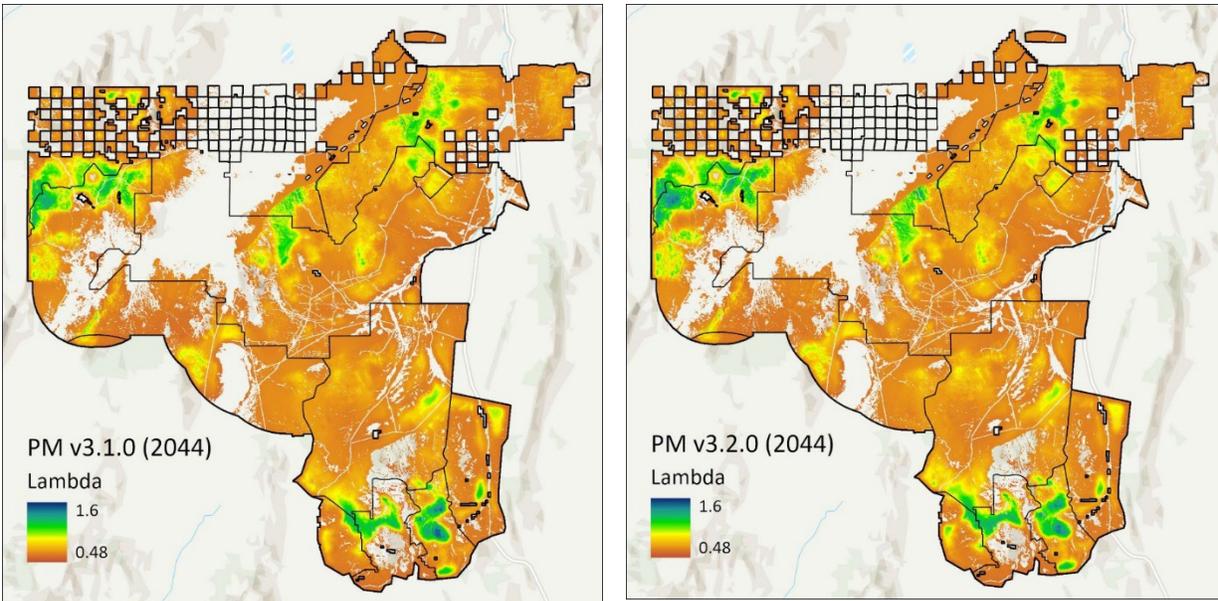


Figure 40. Average  $\lambda$  per map pixel in the PM\_v3.1.0 (left panel) and PM\_v3.2.0 (right panel) scenarios across the Full Landscape. N = 20 replicates.

Table 35. Comparison of mean functional acre (FA) change among the original Bank Study Area, Expanded Study Area, and the No Conservation Action area. FA gain is the mean difference calculated between the PM\_v3.2.0 and PM\_v3.1.0 scenarios. Positive numbers indicate a gain of functional acres in PM\_v3.2.0 when compared to PM\_v3.1.0. Negative numbers indicate a loss in functional acres in PM\_v3.2.0 when compared to PM\_v3.2.0.

Area	2014	2019	2024	2029	2034	2039	2044	2049
Bank Study Area	0	-33	170	388	230	403	579	537
Expanded Study Area	0	17	130	918	1,015	1,515	1,784	1,477
No Conservation Action Area	0	-3	159	164	167	54	6	118
Total FA Gain	0	-20	460	1,470	1,412	1,972	2,369	2,132

When broken down by the analysis zones, we see that almost all the functional acre gains between PM\_v3.2.0 and PM\_v3.1.0 are attributed to changes in the treated areas (Table 36). Between the original BSA and the Expanded Study Area, the majority of the functional acres gain was from the ACA; however, the BSA still shows sizeable functional gain opportunities (Table 3636). Among the 12 analysis zones, Shoshone presents the most opportunity for functional acre gains, as improvements to nesting and late brood-rearing habitats were modeled (Table 37). Relative to its size, the Three Bars zone produced 200+ functional acres by year 2039. Concentrated increases in habitat suitability were seen in the central portion of that zone. Interestingly, the Vinini zone showed more variability in habitat improvement compared to Three Bars zone (Table 37), which was roughly similar in size and vegetation. The difference is likely due to the topographic limits of Vinini and is reflected in the lower level of overall conservation action that occurred there (Figure 40). It should be noted that in the Frenchie Flat and Crescent Valley zones conservation actions were designed to limit exotic species spread and/or changing wildfire behavior and, therefore, have little direct impact on GSG habitat.

Table 36. Comparison of mean functional acre gains (FA) among the 12 analysis zones. FA gain is the mean difference calculated from the PM\_v3.2.0 and PM\_v3.1.0 scenarios. “BSA” indicates “Bank Study Area”. All other zones are part of the Expanded Study Area. Positive numbers indicate a gain of functional acres in PM\_v3.2.0 when compared to PM\_v3.1.0. Negative numbers indicate a loss in functional acres in PM\_v3.2.0 when compared to PM\_v3.1.0.

Zone Name	2014	2019	2024	2029	2034	2039	2044	2049
BSA North	0	20	151	213	77	40	175	173
BSA South	0	-61	12	142	125	382	421	374
Frenchie Flat	0	0	-3	-4	-8	-4	5	-2
Doghead	0	-1	17	81	87	77	71	52
Potato Patch	0	-3	29	37	63	33	-16	10
Toiyabe	0	23	-16	39	151	107	173	140
Shoshone	0	11	70	418	554	974	1,222	962
South Cortez	0	-12	16	-3	13	-24	129	162
Crescent Valley	0	0	-1	-1	-2	-1	-3	-4
Three Bars	0	-1	38	115	67	222	204	181
Vinini	0	0	-20	236	90	131	0	-24
BSA Indian Springs	0	8	7	34	28	-19	-17	-10

## Conclusions

The primary goal of this project was to explore the value of additional conservation actions to benefit greater sage-grouse within the entire mapped project area. The conservation actions were modeled to be implemented as soon as practicably possible in order to achieve habitat uplift as quickly as possible, although in many cases, the full value of the conservation action in terms of sage-grouse functional acre gains are not expected to be realized until 10-20 years in the future.

Evaluation of the results both in time and space can help managers decide on when, where, and how to implement conservation actions and assist in the administration of the mitigation banking mechanism, the BEA. For example, the BEA requires that lands on which conservation actions will be completed be enrolled in the bank, as well as the calculation of credits and debits, and the results can be used to evaluate if additional lands should be enrolled and the value of the implementing the modeled conservation actions in terms of greater sage-grouse functional acres.

## Essential Vegetation Dynamics

The increased conservation action rates and their extent in the PM\_v3.2.0 scenario accomplished many improvements to greater sage-grouse habitat compared to the PM\_v3.1.0 scenario. A few conservation actions appear to have disproportionately contributed to increased greater sage-grouse habitat suitability between the two scenarios. As noted above, the largest increase in  $\lambda$  was in the Shoshone Range (Figure 6) where mostly Herbicide-Plateau+Seed+Shrub-Planting in sagebrush (Figure 32) and fence and water delivery in wet meadows (Figure 30) were used. In addition, the largest increase within the Shoshone Range using Herbicide-Plateau+Seed+Shrub-Planting appeared to overlap with montane sagebrush steppe, although some increases of  $\lambda$  overlapped with big sagebrush on upland soils (Figs. 6, 32). Importantly, the effects of the restoration of upland systems and the improvement of wet meadow systems are dependent on each other in order to gain the full value for greater sage-grouse.

In all other areas of  $\lambda$  increases, the conservation actions AerialSeed+Masticate+Plateau (but not in the BooHoo Fire), Herbicide-Plateau+Seed+Shrub-Planting, and fence and water delivery were heavily used in the same areas; therefore, conservation action-specific contributions to habitat suitability could not be mathematically partitioned. Other conservation actions appear to have contributed somewhat (e.g., chainsaw thinning in black and low sagebrush, shrub mow + herbicide, small tree lopping in montane sagebrush steppe) but not as much as the first three.

## Greater Sage-grouse Functional Area Credits and Debits

Our modeling indicates that adding new conservation action acres in the Bank Study Area and new areas can provide a significant increase in habitat for greater sage-grouse. In previously modeled areas, increasing efforts in the BooHoo Fire as well as in several places in the JD allotment show significant functional acre uplift. Among the new conservation action areas, the Shoshone range showed the largest potential where opportunities for late brood and nesting habitat improvement are found.

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## Appendix A

### Working descriptions of Ecological Systems (Biophysical Settings) and their Vegetation Classes on Barrick Project Areas

**Revision Date:** October 20, 2023

<b>Agriculture (10070)</b>	<b>10070 – potentially GSG habitat</b>
U-A:Pasture 10070119	<b>Pasture:</b> Either irrigated, leveled, or otherwise maintained pasture. Pasture can be active or fallow. Usually native vegetation has been removed, reseeded, or “improved.”
U-A:Agriculture 10070122	<b>Agriculture:</b> Generally alfalfa, although other crops can be present. Includes fallow agricultural lands. Active or abandoned center pivots nearly always present.
<b>Aspen-Mixed Conifer (ASM) (10610)</b>	<b>10610 – not GSG habitat</b>
	Overview: The Aspen-Mixed Conifer BpS is commonly called “seral aspen.” <i>Populus tremuloides</i> is the dominant tree species, except in late succession where prolonged fire exclusion and ungulate herbivory allow dominance by mixed conifers, such as white fir and limber pine. The presence of even a single aspen tree in a stand provides strong evidence that the area historically supported aspen clones. This BpS typically occurs on flat to steep terrain (<80%) on all aspects. Elevation generally ranges from 1,700 m to 2,800 m (5,600’ to 9,200’). Soils are highly variable, but generally cool. This type occurs above the juniper and/or sagebrush zones. Aspen stands that are difficult to “see through” are considered healthy. Shrub, forb, and grass species typical of mesic sites are very diverse and plant cover is very high.
A 10610010 <sup>3</sup>	<b>Early-all:</b> 10-100% cover aspen <4.9m; mountain snowberry and <i>Ribes</i> common; 0-9 yrs
B 10610021	<b>Mid1-closed:</b> 40-99% cover aspen 5-9.9m; mountain snowberry and <i>Ribes</i> common; 10-39 yrs
C 10610030	<b>Mid2-closed:</b> 40-99% cover aspen 10-24m; conifer saplings visible in mid-story; mountain snowberry and <i>Ribes</i> common; 40-79 yrs
D 10610042	<b>Late1-open:</b> 10-39% cover aspen 10-25 m; 10-25% mixed conifer cover 5-10 m; mountain snowberry and <i>Ribes</i> common; >80 yrs
E 10610050	<b>Late1-closed:</b> 40-80% cover of mixed conifer 10-50m; <40% cover of aspen 10-25m; mountain snowberry and <i>Ribes</i> present; >100 yrs
U-ASM->MC (aka: No-ASP) 10610109	<b>Loss of clone:</b> permanent conversion to Mixed Conifer – 1052; >50% white fir and/or limber pine cover; aspen absent or in trace amount; dead aspen boles may be present

<sup>3</sup> Remote Sensing code (geotiff code)

<b>Aspen Woodland (ASP)(10110)</b>	<b>10110 – not GSG habitat</b>
	<p>Overview: The Aspen Woodland BpS is dominated by <i>Populus tremuloides</i> and is commonly called “stable aspen.” Aspen woodland is a debated BpS as it is assumed, but not proven, that soils prevent encroachment of conifers even with fire exclusion, therefore maintaining the <u>relative</u> cover of conifers to &lt;25%. Where the BpS is adjacent to conifers, an occasional conifer seedling may occur, but conifers do not drive the fire regime. Elevations generally range from 1,981 m to 2,743 m (6,500’- 9,000’), but occurrences can be found at lower elevations, and average annual precipitation ranges from 36 cm to &gt;51 cm (14” to &gt;20”). Distribution of this ecological system is limited primarily by adequate soil moisture required to meet its high evapotranspiration demand, and secondarily by the length of the growing season or low temperatures. This BpS occurs commonly as multi-storied stands. Stands are usually closed. Aspen suckers 1.5 m to 4.6 m (5-15’) tall will be present in all classes (min. 500 stems/acre). The BpS also includes aspen thickets that occur on concave shoulders of mountains and plateaus on northerly aspects or on the lee-side of snow-blown plateau and mountain summits. Snow accumulation prevents full development of aspen as tall trees. The Aspen Woodland BpS typically occurs above juniper and adjacent to mountain big sagebrush. At elevations below 6,500 feet this group grades into black and narrowleaf cottonwood types along riparian corridors. Understory consists of abundant herbaceous and shrub components. Often species of tall forbs, perennial grasses and shrubs are found in the understory. The herbaceous layer may be lush and diverse.</p>
A 10110010	<b>Early-all:</b> 10-100% cover of aspen <5m; 0-9 yrs
B 10110021	<b>Mid1-closed:</b> 40-99% cover of aspen 5-9.9m (this class also includes aspen thickets caused by heavy snow bank deposition); 10-39 yrs
C 10110030	<b>Late1-closed:</b> 40-99% cover of aspen 10-25m; few conifers in mid-story; 39 -99 yrs
D 10110042	<b>Late1-open:</b> 10-39% cover of aspen 10-25 m; conifers may be present but less than 25% relative cover; >99 yrs
U-B:Depleted (aka: DP) 10110203	<b>Depleted-Mid1-open:</b> 10-39% cover of pole size aspen <5-9.9m; no or little aspen regeneration; mountain big sagebrush common in understory; high visibility through the midstory; at most few conifers in mid-story; 10-39 yrs
U-C:Depleted (aka: DP) 10110303	<b>Depleted-Late1-open:</b> 10-39% cover of aspen 10-25m; no or little aspen regeneration; mountain big sagebrush common in understory; high visibility through the midstory; at most few conifers in mid-story; 39 -99 yrs
U-D:Depleted (aka: DP) 10110403	<b>Depleted-Late2-open:</b> 10-39% cover of older aspen 10-25m; no or little aspen regeneration; mountain big sagebrush common in understory; high visibility through the midstory; at most few conifers in mid-story
U:ASP->MSS (aka: No-ASP) 10110109	<b>Loss of clone:</b> permanent conversion to montane sagebrush steppe - 1126; dead clone of aspen; very few aspen stems present; dead boles may be visible on the ground; 5-50% cover of mountain big sagebrush/mountain shrub; <50% herbaceous cover
<b>Badland(10002)</b>	<b>10002 – not GSG habitat</b>

A:Bare Ground 10002001	<b>Bare Ground:</b> Barren localized geologic features with no or barely any observable vegetation. Often associated with paleo-lacustrine erosional features or eroded un-welded tuff. Soil or surface material often white or very reflective.
A: Sparse 10002002	<b>Sparse:</b> Sparsely vegetated (<5% total vegetation cover) localized geologic features. Often associated with paleo-lacustrine erosional features or eroded un-welded tuff. Soil or surface material often white or very reflective.
<b>Barren-Playa(10001)</b>	<b>10001 – not GSG habitat</b>
A (aka: Playa) 10001001	<b>Playa:</b> Dry lake made of evaporated salts. Sometimes inundated.
<b>Barren-Rock-Mud(10000)</b>	<b>10000 – not GSG habitat</b>
	Overview: This feature can be present as natural barren areas of soil, rock, or mud, or human-caused barren areas.
A 10000001	<b>Bare Ground:</b> natural barren areas of soil, rock, or mud
U-A:Bare ground 10000101	<b>Bare Ground:</b> Human-caused barren area
<b>Basin Wildrye- bottomland (BWb)(10803)</b>	<b>1080bwb or 10803<sup>4</sup> – not GSG habitat</b>
	Overview: The Basin Wildrye-bottomland BpS is a grassland dominated by basin wildrye ( <i>Elymus cinereus</i> ). Many locations occur at the bottom of broad valleys and on alluvial flats at elevations of 1,219 m to 1,829 m (4,000' to 6,000') with slopes between 0-4%, although more typically <2%. Soils have water tables that may attain depths of 150 to 75 cm (60" to 30"). The BpS occurs on two sites in the landscape: (i) Dry floodplains (NRCS site name) at the outer margins of axial-stream floodplains, fan skirts and along intermittent drainages and (ii) saline bottoms (NRCS site name) on lake-plain terraces, stream terraces and on the margin of axial-stream floodplains. On lower precipitation sites, these locations may be positioned at the base of slopes such that water may run onto these sites. Typically soils are deep to very deep with loamy to coarse loamy textures. Soils are well drained with water tables below the rooting zone of the dominant shrubs. Salts, if present, can increase with depth. Annual precipitation ranges from 20 to 25 cm (6" to 10"). Not much is written specifically about the dynamics of this BpS but research is being conducted to determine if dry floodplains are really incised moist floodplains underlain by wetland soils with artificially lowered water tables. This is a grassland-shrubland mixture dominated by basin wildrye, a deep-rooted cool-season bunchgrass, where the dominant shrub species varies with salt content later in succession. On saline bottoms, black greasewood ( <i>Sarcobatus vermiculatus</i> ) is the dominant shrub with basin big sagebrush ( <i>Artemisia tridentata</i> spp. <i>tridentata</i> ) sub-dominant. Basin big

<sup>4</sup> If two codes are listed for the BpS, the first is the field code and the second is the Geotiff code.

	sagebrush is the dominant shrub on less saline and more productive soils. Other shrubs generally represent less than 10 % of the overall cover and include various species and subspecies of rubber, green, and gray rabbitbrush. Other grasses are generally cool season bunchgrasses, with the exception of some rhizomatous grasses on the dry meadows with deep soils and high precipitation. Forbs represent less than 10 % of the herbaceous cover.
A 10803010	<b>Early-all:</b> 5-20% cover of basin wildrye; 0-10 yrs
B 10803021	<b>Mid-closed:</b> 21-80% cover of basin wildrye; <11% shrub (basin big sagebrush and/or black greasewood – generally at lower elevations) cover; 11-75 yrs
C 10803032	<b>Late-open:</b> 11-20% cover of basin big sagebrush and/or black greasewood, and rabbitbrush; <75% cover of basin wildrye; >75 yrs
U-A:Annual Spp (aka: AS) 10803100	<b>Annual-Species:</b> >10% cover of non-native annual species; shrubs largely absent
U-A:Bare Ground (aka: BAGR) 10803101	<b>Bare-Ground:</b> Mostly bare ground caused by anthropogenic disturbances
U-C:Depleted (aka: DP) 10803303	<b>Depleted:</b> >20% cover of basin big sagebrush, and/or black greasewood, and rabbitbrush; <5% basin wildrye; >20% mineral soil and litter cover
U-A:Exotic Forb (aka: EF) 10803108	<b>Exotic-Forbs-early:</b> 5-100% exotic forbs (knapweed, tall whitetop, thistles, halogeton, purple loosestrife); <20% cover of basin wildrye
U-B:Exotic Forb (aka: EF) 10803208	<b>Exotic-Forbs-mid:</b> 5-80% exotic forbs (knapweed, tall whitetop, thistles, halogeton, purple loosestrife); 21-80% cover of basin wildrye; 1-11% cover of big sagebrush or greasewood
U-C:Exotic Forb (aka: EF) 10803308	<b>Exotic-Forbs-late:</b> 5-90% exotic forbs (knapweed, tall whitetop, thistles, halogeton, purple loosestrife); 11-20% cover of basin big sagebrush and/or black greasewood (generally at lower elevations), and rabbitbrush; <75% cover of basin wildrye but generally absent
U-A:FoxtailBarley (aka: NGPG) 10803107	<b>Foxtail-Barley-early:</b> 5-100% <i>Hordeum jubatum</i> ; basin big sagebrush and/or greasewood absent; 0-20% cover of basin wildrye
U-B:FoxtailBarley (aka: NGPG) 10803207	<b>Foxtail-Barley-mid:</b> 5-80% <i>Hordeum jubatum</i> ; 1-10% cover of big sagebrush and/or greasewood; >20% cover of basin wildrye
U-C:FoxtailBarley (aka: NGPG) 10803307	<b>Foxtail-Barley-late:</b> 5-90% <i>Hordeum jubatum</i> ; >10% cover of basin big sagebrush and/or black greasewood; <75% cover of basin wildrye but generally absent
U-A:Early Shrub (aka: ES) 10803105	<b>Early-Shrub-early:</b> >20% cover of rabbitbrush or snakeweed species; big sagebrush or greasewood uncommon; native grasses present; <5% cover of non-native annual species
U-B:Early Shrub (aka: ES) 10803205	<b>Early-Shrub-mid:</b> >20% cover of rabbitbrush or snakeweed species; 1-10% cover of big sagebrush or greasewood; native grasses present; <5% cover of non-native annual species

U-C:Early Shrub (aka: ES) 10803305	<b>Early-Shrub-late:</b> >20% cover of rabbitbrush or snakeweed species; >10% cover of big sagebrush or greasewood; native grasses may be present; <5% cover of non-native annual species
U-A:Pasture (aka: PAS) 10803119	<b>Pasture:</b> Agricultural pasture irrigated or fallow
U-B:SA 10803221	<b>Shrub-Annual-Species-mid:</b> ≥5% cover of non-native annual species; ≤10% cover of native shrubs; ≤5% basin wildrye
U-C:SA 10803321	<b>Shrub-Annual-Species-late:</b> ≥5% cover of non-native annual species; >10% cover of native shrubs; ≤5% basin wildrye
U-A:SAP (aka: ASPG) 10803124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> ≥5% cover of non-native annual species; 5-20% basin wildrye and other native grasses; shrubs largely absent
U-B:SAP 10803224	<b>Shrub-Annual-Species-Perennial-Grass-mid:</b> ≥5% cover of non-native annual species; 21-80% basin wildrye; ≤10% cover of native shrubs
U-C:SAP 10803324	<b>Shrub-Annual-Species-Perennial-Grass-late:</b> ≥5% cover of non-native annual species; >10% cover of native shrubs; <75% basin wildrye
U-A:Seeded Native (aka:SD) 10803135	<b>Seeded-native-early:</b> 5-20% seeded basin wildrye, other native grasses, forbs; shrubs generally absent; <5% non-native annual species (if ≥5 non-native annual species, then U-A:SAP or even U-A:Annual Species)
U-B:Seeded Native (aka:SD) 10803235	<b>Seeded-native-mid:</b> >20% seeded basin wildrye, other native grasses, forbs; 1-10% cover of big sagebrush and/or greasewood; <5% non-native annual species (if ≥5 non-native annual species, then U-B:SAP or even U-B:SA)
U-A:SI (aka: SDI-A) 10803129	<b>Seeded-Introduced-early:</b> >10% seeded introduced grasses, with native grasses and forbs possible; <5% of non-native annual species
U-B:SI (aka: SDI-B) 10803229	<b>Seeded-Introduced-mid:</b> >10% seeded introduced grasses, with native grasses and forbs possible; 1-10% cover of big sagebrush and/or greasewood; <5% of non-native annual species
U-C:SI (aka: SDI-C) 10803329	<b>Seeded-Introduced-late:</b> >10% seeded introduced grasses, with native grasses and forbs possible; >10% cover of basin big sagebrush and/or greasewood; <5% of non-native annual species
U-A:SI+AS 10803138	<b>Seeded-Introduced+Annual-Species-early:</b> >10% seeded introduced grasses, with native grasses and forbs possible; shrubs generally absent; ≥5% cover of non-native annual species
U-B:SI+AS (aka: SI-B+AS) 10803238	<b>Seeded-Introduced+Annual-Species-mid:</b> >10% seeded introduced grasses, with native grasses and forbs possible; 1-10% cover of basin big sagebrush and/or greasewood; ≥5% cover of non-native annual species
U-C:SI+AS (aka: SDI-B+AS) 10803338	<b>Seeded-Introduced+Annual-Species-late:</b> >10% seeded introduced grasses, with native grasses and forbs possible; >10% cover of basin big sagebrush and/or greasewood; ≥5% cover of non-native annual species
<b>Basin Wildrye-montane (BWm)(10801)</b>	<b>1080bwm or 10801 – GSG habitat</b>
	Overview: The Basin Wildrye-montane BpS is a grassland dominated by basin wildrye ( <i>Elymus cinereus</i> ). The BpS is found at elevations from about 1,372 m to 2,134 m (4,500' to over 7,000'). Typically soils are deep to very deep with loamy to coarse loamy textures (NRCS's loamy bottom). Soils are well drained with water tables

	below the rooting zone of the dominant shrubs. Salts, if present, can increase with depth. Soils were formed through alluvial processes and typically form valley bottoms with slopes generally less than 8%, and typically between 0 and 4%. Annual precipitation ranges from 20 to 41 cm (8" to 16"). Many locations occur along valley bottoms outside of the wet meadow areas, but within zones where water tables may attain depths of 150 to 75 cm (60" to 30"). On lower precipitation sites (20 to 25 cm or 8 to 10") these locations may be positioned on dry floodplains at the base of slopes such that water may run onto these sites. Not much is written specifically about the dynamics of this BpS. This is a grassland-shrubland mixture dominated by basin wildrye, a deep-rooted cool-season bunchgrass, with basin big sagebrush or mountain big sagebrush, respectively, subdominant (<15% cover) later in succession below or above 36 cm (14") of precipitation (about 2,134 m or 7,000' of elevation). Other shrubs generally represent less than 10% of the overall cover and include various species and subspecies of rabbitbrush. Other grasses are generally cool season bunchgrasses, with the exception of some rhizomatous grasses on the dry meadows with deep soils and high precipitation. Forbs represent less than 10% of the herbaceous cover.
A 10801010	<b>Early-all:</b> 5-20% cover of basin wildrye; 0-10 yrs <sup>5</sup>
B 10801021	<b>Mid-closed:</b> 21-80% cover of basin wildrye; <11% basin big sagebrush and rabbitbrush cover; 11-75 yrs
C 10801032	<b>Late-open:</b> 11-20% cover of basin big sagebrush and rabbitbrush; <75% cover of basin wildrye; >75 yrs
U-A:Annual Spp (aka: AS) 10801100	<b>Annual-Species:</b> >10% cover of non-native annual species; shrubs largely absent
U-A:Bare Ground (aka: BAGR) 10801101	<b>Bare-Ground:</b> Mostly bare ground
U-C:Depleted (aka: DP) 10801303	<b>Depleted:</b> >20% cover of basin big sagebrush and rabbitbrush; <5% basin wildrye; >20% mineral soil and litter cover
U-A:Exotic Forb (aka: EF) 10801108	<b>Exotic-Forbs-early:</b> 5-100% exotic forbs (thistles, knapweed, tall whitetop, halogeton, purple loosestrife); 0-20% cover of basin wildrye
U-B:Exotic Forb 10801208	<b>Exotic-Forbs-mid:</b> 5-80% exotic forbs (thistles, knapweed, tall whitetop, halogeton, purple loosestrife); 21-80% cover of basin wildrye; 1-10% cover of big sagebrush
U-C:Exotic Forb 10801308	<b>Exotic-Forbs-late:</b> 5-90% exotic forbs (thistles, knapweed, tall whitetop, halogeton, purple loosestrife); >10% cover of basin big sagebrush and rabbitbrush; <75% cover of basin wildrye but generally absent
U-A:Early Shrub (aka: ES) 10801105	<b>Early-Shrub-early:</b> >20% cover of rabbitbrush or snakeweed species; big sagebrush uncommon; native grasses may be present; <5% cover of non-native annual species
U-B:Early Shrub 10801205	<b>Early-Shrub-mid:</b> >20% cover of rabbitbrush or snakeweed species; 1-10% cover of big sagebrush; native grasses may be present; <5% cover of non-native annual species

<sup>5</sup> = Brood-rearing vegetation class; = Nesting vegetation class

U-C:Early Shrub 10801305	<b>Early-Shrub-late:</b> >20% cover of rabbitbrush or snakeweed species; >10% cover of big sagebrush; native grasses may be present; <5% cover of non-native annual species
U-A:Pasture (aka: PAS) 10801119	<b>Pasture:</b> Agricultural pasture irrigated or fallow
U-B:SA 10801221	<b>Shrub-Annual-Species-mid:</b> ≥5% cover of non-native annual species; 1-10% cover of native shrubs; ≤5% basin wildrye
U-C:SA 10801321	<b>Shrub-Annual-Species-late:</b> ≥5% cover of non-native annual species;>10% cover of native shrubs; ≤5% basin wildrye
U-A:SAP (aka: ASPG) 10801124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> ≥5% cover of non-native annual species; 5-20% basin wildrye and other native grasses; shrubs largely absent
U-B:SAP 10801224	<b>Shrub-Annual-Species-Perennial-Grass-mid:</b> ≥5% cover of non-native annual species; 21-80% basin wildrye; 1-10% cover of native shrubs
U-C:SAP 10801324	<b>Shrub-Annual-Species-Perennial-Grass-late:</b> ≥5% cover of non-native annual species; >10% cover of native shrubs; <75% basin wildrye
U-A:Seeded Native (aka:SD) 10801135	<b>Seeded-native-early:</b> 5-20% seeded basin wildrye, other native grasses, forbs; shrubs generally absent; <5% non-native annual species (if ≥5 non-native annual species, then U-A:SAP or even U-A:Annual Species)
U-B:Seeded Native 10801235	<b>Seeded-native-mid:</b> ≥20% seeded basin wildrye, other native grasses, forbs; 1-10% cover of big sagebrush; <5% non-native annual species (if ≥5 non-native annual species, then U-B:SAP or even U-B:SA)
U-A:SI 10801129	<b>Seeded-Introduced-early:</b> >10% seeded introduced grasses, with native grasses and forbs possible; <5% of non-native annual species
U-B:SI 10801229	<b>Seeded-Introduced-mid:</b> >10% seeded introduced grasses, with native grasses and forbs possible; 1-10% cover of big sagebrush; <5% of non-native annual species
U-C:SI 10801329	<b>Seeded-Introduced-late:</b> >10% seeded introduced grasses, with native grasses and forbs possible; >10% cover of basin big sagebrush; <5% of non-native annual species
U-A:SI+AS 10801138	<b>Seeded-Introduced+Annual-Species-early:</b> >10% seeded introduced grasses, with native grasses and forbs possible; shrubs generally absent; ≥5% cover of non-native annual species
U-B:SI+AS 10801238	<b>Seeded-Introduced+Annual-Species-mid:</b> >10% seeded introduced grasses, with native grasses and forbs possible; 1-10% cover of basin big sagebrush; ≥5% cover of non-native annual species
U-C:SI+AS 10801338	<b>Seeded-Introduced+Annual-Species-late:</b> >10% seeded introduced grasses, with native grasses and forbs possible; >10% cover of basin big sagebrush; ≥5% cover of non-native annual species
U-C:TEA 10801344	<b>Tree-Encroached or Tree with Annual Species:</b> ≥10% cover of conifers; ≥0% (i.e., absent to common) cover non-native annual species
<b>Big Sagebrush-semidesert (BSsd)(10802)</b>	<b>1080sd or 10802 – GSG habitat</b>
	<i>Overview:</i> The Big Sagebrush semidesert BpS occurs on well-drained and/or shallow loamy soils on foothills, terraces, slopes and plateaus. Wyoming and basin big sagebrush characterize the BpS, with basin big sagebrush established on hills with deep soils. Elevation ranges from 1,280 m to 1,981 m (4,200' – 6,500'), which corresponds to annual precipitation zones from 20 cm to 30 cm (8 to 12"). The BpS is

	found on soil depths as shallow as 25 cm (10") and as deep as 152 cm (60+"). When Wyoming and basin big sagebrush are found on deeper soil, annual precipitation is <25 cm (<10"). The BpS is found just above the low elevation salt desert shrub typically unfavorable to tree establishment. Thus, other site characteristics (e.g. aspect, drainage) should be considered in identifying this BpS. At the precipitation extremes, this BpS generally occurs as small patches and stringers. Shrub canopy cover generally ranges from 5 to 25%, but can exceed 30% at the upper elevations, deeper soils, and precipitation zones. Wyoming big sagebrush sites have fewer understory species relative to other big sagebrush types. Rubber rabbitbrush and spiny hopsage may be co-dominant and basin big sagebrush might occur on concave sites with finer soils. Perennial forb cover is usually <10% and perennial grass cover reaches 40-60% on more productive sites. Thurber's needlegrass may be a dominant species following replacement fires and as a co-dominant after 20 years. Bottlebrush squirreltail, Indian ricegrass, and Sandberg bluegrass are common on more xeric sites. Percent cover and species richness of understory are determined by site limitations.
A 10802010	<b>Early-all:</b> ≥10% herbaceous cover; <10% cover of rabbitbrush species; <10% cover of big sagebrush; 0-20 yrs
B 10802022	<b>Mid-open:</b> 10-19% cover of big sagebrush and other shrubs; ≥10% herbaceous cover; 20-39 yrs
C 10802030	<b>Late1-closed:</b> 20%-39% cover of big sagebrush and other shrubs; 10-20% native herbaceous cover; 40-79 yrs
C-Dense (aka: D) 10802031	<b>Late1-dense:</b> ≥40% cover of big sagebrush and other shrubs; ≥5% native herbaceous cover; ≥80 yrs
U-A:Annual Spp (aka: AS) 10802100	<b>Annual-Species:</b> >10% cover of non-native annual grass and forb species; <10% cover of shrubs
U-A:Bare Ground (aka: BAGR) 10082101	<b>Bare Ground:</b> primarily bare ground due primarily to anthropogenic disturbances
U-B:Depleted (aka: DP) 10802203	<b>Depleted-mid:</b> 10-19% cover of big sagebrush, and rabbitbrush; <5% native grass cover dominated by bottlebrush squirreltail and Sandberg bluegrass; <5% non-native annual species; >20% mineral soil and litter cover
U-C:Depleted (aka: DP) 10802303	<b>Depleted-late:</b> 20-39% cover of big sagebrush, and rabbitbrush; <5% native grass cover dominated by bottlebrush squirreltail and Sandberg bluegrass; <5% non-native annual species; >20% mineral soil and litter cover
U-C:DP-Dense (aka: D-DP) 10802302	<b>Depleted-Dense-late:</b> >39% cover of big sagebrush, and rabbitbrush; <5% native grass cover dominated by bottlebrush squirreltail and Sandberg bluegrass; <5% non-native annual species; >20% mineral soil and litter cover
U-A:Exotic Forb (aka: EF) 10802108	<b>Exotic-Forb-early:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); <10% cover of rabbitbrush species; <10% cover of big sagebrush; native grass and forbs may be present
U-B:Exotic Forb (aka: EF) 10802208	<b>Exotic-Forb-mid:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); 10-19% cover of big sagebrush and other shrubs; native grass and forbs may be present
U-C:Exotic Forb (aka: EF) 10802308	<b>Exotic-Forb-late:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); >19% cover of big sagebrush and other shrubs; native grass and forbs may be present

U-A:Early Shrub (aka: ES) 10802105	<b>Early-Shrub-early:</b> >10% cover rabbitbrush species; <5% non-native annual species; native grass may be present
U-B:Early Shrub (aka: ES) 10802205	<b>Early-Shrub-mid:</b> >10% cover rabbitbrush species; 10-19% cover of big sagebrush and other shrubs; <5% non-native annual species; native grass and forbs may be present
U-C:Early Shrub (aka: ES) 10802305	<b>Early-Shrub-late:</b> >10% cover rabbitbrush species; >19% cover of big sagebrush and other shrubs; <5% non-native annual species; native grass may be present
U-B:SA (aka: SA-1) 10802221	<b>Shrub-Annual-Species-open:</b> ≥5% cover non-native annual species; 10%-19% cover of big sagebrush and other shrubs; native grasses rare
U-C:SA (aka: SA-1) 10802321	<b>Shrub-Annual-Species-closed:</b> ≥5% cover non-native annual species; 20%-39% cover of big sagebrush and other shrubs; native grasses rare
U-C:SA-Dense (aka: SA-2) 10802323	<b>Shrub-Annual-Species-dense:</b> ≥5% cover non-native annual species ; ≥40% cover of big sagebrush and other shrubs; native grasses rare
U-A:SAP (aka: ASPG) 10802124	<b>Shrub-Annual-Species-Perennial-Grass:</b> ≥5% cover of non-native annual species; ≥5% native grasses; <10% cover of shrubs
U-B:SAP 10802224	<b>Shrub-Annual-Species-Perennial-Grass-open:</b> ≥5% cover non-native annual species; 10%-19% cover of big sagebrush and other shrubs <0.5m; ≥5% cover native grasses
U-C:SAP (aka: SAP-1) 10802324	<b>Shrub-Annual-Species-Perennial-Grass-closed:</b> ≥5% cover non-native annual species; 20%-39% cover of big sagebrush and other shrubs; ≥5% cover native grasses
U-C:SAP-Dense (aka: SAP-2) 10802326	<b>Shrub-Annual-Species-Perennial-Grass-dense:</b> ≥5% cover non-native annual species; ≥40% cover of big sagebrush and other shrubs <0.5m; ≥5% cover native grasses
U-A:Seeded Native (aka: SD) 10802135	<b>Seeded Native:</b> >10% seeded native grasses, forbs, and shrubs; <5% non-native annual species cover (if ≥5 non-native annual species cover, then see U-A:Seeded Native or U-A:Annual Species); <10% shrub cover
U-B:Seeded Native (aka: SD) 10802235	<b>Seeded Native:</b> >10% seeded native grasses, forbs, and shrubs; <5% non-native annual species cover (if ≥5 non-native annual species cover, then see U-B:SAP or U-B:SA); ≥10% shrub cover
U-A:SI (aka: SDI-A) 10802129	<b>Seeded-Introduced-early:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of rabbitbrush species; <10% cover of big sagebrush; native grass may be present to common; <5% cover of non-native annual species
U-B:SI (aka: SDI-B) 10802229	<b>Seeded-Introduced-mid-open:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-19% cover of big sagebrush; native grass may be present to common; <5% cover of non-native annual species
U-C:SI (aka: SDI-C) 10802329	<b>Seeded-Introduced-late-closed:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 20-39% cover of big sagebrush; native grass may be present to common; <5% cover of non-native annual species

U-C:SI-Dense (aka: SDI-D) 10802331	<b>Seeded-Introduced-late-dense:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); ≥40% cover of big sagebrush; native grass may be present to common; <5% cover of non-native annual species
U-A:SI+AS (aka: SI-A+AS) 10802138	<b>Seeded-Introduced +Annual-Species-early:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of rabbitbrush species; <10% cover of big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species
U-B:SI+AS (aka: SI-B+AS) 10802238	<b>Seeded-Introduced +Annual-Species-mid-open:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-19% cover of big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species
U-C:SI+AS (aka: SI-C+AS) 10802338	<b>Seeded-Introduced +Annual-Species-late-closed:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 20-39% cover of big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species
U-C:SI+AS-Dense (aka: SI-D+AS) 10802339	<b>Seeded-Introduced +Annual-Species-late-dense:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); ≥40% cover of big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species
<b>Big Sagebrush Shrubland-upland with trees (WSup)(10804)</b>	<b>1080up or 10804 – GSG habitat</b>
	Overview: The Big Sagebrush Shrubland BpS occurs on well-drained soils on foothills, terraces, slopes and plateaus. It ranges from 1,524 m to 2,134 m (5,000' – 7,000') in elevation. It is found on soil depths greater than 45 cm (18") and up to 152 cm (60+"). The BpS occurs from 25 cm to 36 cm (10" to 14") of annual precipitation on drier, shallower soils, and from 20 cm to 30 cm (8 to 12") of annual precipitation on deeper, more productive soils. Thus, site characteristics (e.g. aspect, drainage) should be considered in identifying this BpS. Shrub canopy cover generally ranges from 5 to 25%, but can exceed 30% at the upper elevation and precipitation zones. Big sagebrush includes basin big sagebrush and/or Wyoming big sagebrush sites. Rubber rabbitbrush may be co-dominant and antelope bitterbrush should be common. Perennial forb cover is usually <10% and perennial grass cover reaches 20 - 25% on more productive sites. Thurber's needlegrass and bluebunch wheatgrass may be dominant species following replacement fires and a co-dominant after 20 years, but only in precipitation zones above 25 cm (10"). Bottlebrush squirreltail, Indian ricegrass, and Sandberg bluegrass are common on more xeric sites. Percent cover and species richness of understory are determined by site limitations. Utah juniper ( <i>Juniperus osteosperma</i> ) and single-leaf pinyon ( <i>Pinus monophylla</i> ) can be present, occasionally reaching 50% canopy cover in areas of more productive soils that have escaped fire.
A 10804010	<b>Early-all:</b> ≥10% herbaceous cover; <10% cover of rabbitbrush species; <10% cover of big sagebrush; 0-20 yrs
B 10804022	<b>Mid-open:</b> 10-19% cover of big sagebrush and other shrubs; ≥10% herbaceous cover; 20-39 yrs

C 10804030	<b>Late1-closed:</b> 20%-39% cover of big sagebrush and other shrubs; 10-20% native herbaceous cover; 40-79 yrs
C-Dense (aka: D) 10804031	<b>Late1-dense:</b> ≥40% cover of big sagebrush and other shrubs; ≥5% native herbaceous cover; ≥80 yrs
D (aka: E) 10804041	<b>Late2-open:</b> 5-15% juniper sapling <5m tall; 10-25% cover of big sagebrush; >5% native herbaceous cover; 75-149 yrs
D-Dense 10804042	<b>Late2-open-dense:</b> 5-15% juniper sapling <5m tall; >25% cover of big sagebrush; >5% native herbaceous cover; 75-149 yrs
E (aka: F) 10804050	<b>Late3-closed:</b> >20% juniper cover <10m tall; <10% cover of big sagebrush; >5% native herbaceous cover; ≥150 yrs
U-A:Annual Spp (aka: AS) 10804100	<b>Annual-Species:</b> >10% cover of non-native annual grass and forb species; <10% cover of shrubs
U-A:Bare Ground (aka: BAGR) 10804101	<b>Bare Ground:</b> primarily bare ground primarily due to anthropogenic disturbances
U-B:Depleted (aka: DP) 10804203	<b>Depleted-mid:</b> 10-19% cover of big sagebrush and rabbitbrush; <5% native grass cover dominated by bottlebrush squirreltail and Sandberg bluegrass; <5% non-native annual species; >20% mineral soil and litter cover
U-C:Depleted (aka: DP) 10804303	<b>Depleted-late:</b> 20-39% cover of big sagebrush and rabbitbrush; <5% native grass cover dominated by bottlebrush squirreltail and Sandberg bluegrass; <5% non-native annual species; >20% mineral soil and litter cover
U-C:DP-Dense (aka: D-DP) 10804302	<b>Depleted-Dense-late:</b> >39% cover of big sagebrush and rabbitbrush; <5% native grass cover dominated by bottlebrush squirreltail and Sandberg bluegrass; <5% non-native annual species; >20% mineral soil and litter cover
U-D:Depleted (aka: DP) 10804403	<b>Depleted-late:</b> 5-15% juniper sapling; 20-39% cover of big sagebrush and rabbitbrush; <5% native grass cover dominated by bottlebrush squirreltail and Sandberg bluegrass; <5% non-native annual species; >20% mineral soil and litter cover
U-D:DP-Dense 10804402	<b>Depleted-Dense-late:</b> 5-15% juniper sapling; >39% cover of big sagebrush and rabbitbrush; <5% native grass cover dominated by bottlebrush squirreltail and Sandberg bluegrass; <5% non-native annual species; >20% mineral soil and litter cover
U-A:Exotic Forb (aka: EF) 10804108	<b>Exotic-Forb-early:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); <10% cover of rabbitbrush species; <10% cover of big sagebrush; native grass and forbs may be present
U-B:Exotic Forb (aka: EF) 10804208	<b>Exotic-Forb-mid:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); 10-19% cover of big sagebrush and other shrubs; native grass and forbs may be present
U-C:Exotic Forb (aka: EF) 10804308	<b>Exotic-Forb-late:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); >19% cover of big sagebrush and other shrubs; native grass and forbs may be present
U-A:Early Shrub (aka: ES) 10804105	<b>Early-Shrub-early:</b> >10% cover rabbitbrush species; <5% non-native annual species; native grass may be present

U-B:Early Shrub (aka: ES) 10804205	<b>Early-Shrub-mid:</b> >10% cover rabbitbrush species; 10-19% cover of big sagebrush and other shrubs; <5% non-native annual species; native grass and forbs may be present
U-C:Early Shrub (aka: ES) 10804305	<b>Early-Shrub-late:</b> >10% cover rabbitbrush species; >19% cover of big sagebrush and other shrubs; <5% non-native annual species; native grass may be present
U-B:SA 10804221	<b>Shrub-Annual-Species-open:</b> ≥5% cover non-native annual species; 10%-19% cover of big sagebrush and other shrubs; native grasses rare
U-C:SA (aka: SA-1) 10804321	<b>Shrub-Annual-Species-closed:</b> ≥5% cover non-native annual species; 20%-39% cover of big sagebrush and other shrubs; native grasses rare
U-C:SA-Dense (aka: SA-2) 10804323	<b>Shrub-Annual-Species-dense:</b> ≥5% cover non-native annual species; ≥40% cover of big sagebrush and other shrubs; native grasses rare
U-D:SA (aka: SA-1) 108040421	<b>Shrub-Annual-Species-late1-closed:</b> 5-15% cover of young mixed conifers <3m; ≥5% cover non-native annual species; 10-25% cover of big sagebrush and other shrubs; native grasses rare
U-D:SA-Dense (aka: SA-2) 108040423	<b>Shrub-Annual-Species-late1-dense:</b> 5-15% cover of young mixed conifers <3m; ≥5% cover non-native annual species; ≥25% cover of big sagebrush and other shrubs; native grasses rare
U-A:SAP (aka: ASPG) 10804124	<b>Shrub-Annual-Species-Perennial-Grass:</b> ≥5% cover of non-native annual species; ≥5% native grasses; <10% cover of shrubs
U-B:SAP (aka: SAP-1) 10804224	<b>Shrub-Annual-Species-Perennial-Grass-open:</b> ≥5% cover non-native annual species; 10%-19% cover of big sagebrush and other shrubs <0.5m; ≥5% cover native grasses
U-C:SAP (aka: SAP-1) 10804324	<b>Shrub-Annual-Species-Perennial-Grass-closed:</b> ≥5% cover non-native annual species; 20%-39% cover of big sagebrush and other shrubs; ≥5% cover native grasses
U-C:SAP-Dense (aka: SAP-2) 10804326	<b>Shrub-Annual-Species-Perennial-Grass-dense:</b> ≥5% cover non-native annual species; ≥40% cover of big sagebrush and other shrubs <0.5m; ≥5% cover native grasses
U-D:SAP (aka: SAP-1) 10804424	<b>Shrub-Annual-Species-late1-closed:</b> 5-15% cover of young mixed conifers <3m; ≥5% cover non-native annual species; 10-25% cover of big sagebrush and other shrubs; >5% native grasses cover
U-D:SAP-Dense (aka: SAP-2) 10804426	<b>Shrub-Annual-Species-late1-dense:</b> 5-15% cover of young mixed conifers <3m; ≥5% cover non-native annual species; ≥25% cover of big sagebrush and other shrubs; >5% native grasses cover
U-A:Seeded Native (aka: SD) 10804135	<b>Seeded Native:</b> >10% seeded native grasses, forbs, and shrubs; <5% non-native annual species cover (if ≥5 non-native annual species cover, then see U-A:Seeded Native or U-A:Annual Species); <10% shrub cover
U-B:Seeded Native (aka: SD) 10804235	<b>Seeded Native:</b> >10% seeded native grasses, forbs, and shrubs; <5% non-native annual species cover (if ≥5 non-native annual species cover, then see U-B:SAP or U-B:SA); ≥10% shrub cover
U-A:SI (aka: SDI-A) 10804129	<b>Seeded-Introduced-early:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of rabbitbrush species; <10% cover of big sagebrush; native grass may be present to common; <5% cover of non-native annual species

U-B:SI (aka: SDI-B) 10804229	<b>Seeded-Introduced-mid-open:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-19% cover of big sagebrush; native grass may be present to common; <5% cover of non-native annual species
U-C:SI (aka: SDI-C) 10804329	<b>Seeded-Introduced-late1-closed:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 20-39% cover of big sagebrush; native grass may be present to common; <5% cover of non-native annual species
U-C:SI-Dense (aka: SDI-D) 10804331	<b>Seeded-Introduced-late1-dense:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); ≥40% cover of big sagebrush; native grass may be present to common; <5% cover of non-native annual species
U-D:SI (aka: SDI-E) 10804429	<b>Seeded-Introduced-late2-open:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 5-15% juniper sapling <5m tall; 10-25% cover of big sagebrush; native grass may be present to common; <5% cover of non-native annual species
U-D:SI-Dense 10804431	<b>Seeded-Introduced-late2-open-dense:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 5-15% juniper sapling <5m tall; ≥25% cover of big sagebrush; native grass may be present to common; <5% cover of non-native annual species
U-A:SI+AS (aka: SI-A+AS) 10804138	<b>Seeded-Introduced +Annual-Species-early:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of rabbitbrush species; <10% cover of big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species
U-B:SI+AS (aka: SI-B+AS) 10804238	<b>Seeded-Introduced +Annual-Species-mid-open:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-19% cover of big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species
U-C:SI+AS (aka: SI-C+AS) 10804338	<b>Seeded-Introduced +Annual-Species-late-closed:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 20-39% cover of big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species
U-C:SI+AS-Dense (aka: SI-D+AS) 10804339	<b>Seeded-Introduced +Annual-Species-late-dense:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); ≥40% cover of big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species
U-D:SI+AS (aka: SI-E+AS) 10804438	<b>Seeded-Introduced-late2-open:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 5-15% juniper sapling <5m tall; 10-25% cover of big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species
U-D:SI+AS-Dense 10804439	<b>Seeded-Introduced-late2-open-dense:</b> ≥10% cover of introduced forage species (e.g., crested wheatgrass, intermediate wheatgrass, or forage kochia); 5-15% juniper sapling <5m tall; ≥25% cover of big sagebrush; native grass may be present to common; ≥5% cover of non-native annual species
U-E:TEA 10804544	<b>Tree-Encroached or Tree with Annual Species:</b> : >20% mixed conifers cover; if <5% annual grass cover then <5% shrub cover; <5% herbaceous cover; <b>OR</b> if ≥5% cover of annual grass then >0% shrub cover; >5% herbaceous cover

U-A:Unpalat. Forb (aka: UF) 10804146	<b>Unpalatable-Forb-early:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; <10% big sagebrush cover; native grass may be present
U-B:Unpalat. Forb (aka: UF) 10804246	<b>Unpalatable-Forb-mid:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; 10-19% big sagebrush cover; native grass may be present
U-C:Unpalat. Forb (aka: UF) 10804346	<b>Unpalatable-Forb-late1:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; >20% big sagebrush cover; native grass may be present
U-D:Unpalat. Forb (aka: UF) 10804446	<b>Unpalatable-Forb-late2-open:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; 5-15% small pinyon or juniper <5m tall; >20% big sagebrush cover; native grass may be present
U-E: Unpalat. Forb (aka: UF) 10804546	<b>Unpalatable-Forb-late2-closed:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; >15% pinyon or juniper <5m tall; >20% big sagebrush cover; native grass may be present
<b>Black Sagebrush (BS)(10791)</b>	<b>1079an or 10791 – GSG habitat</b>
	<p>Overview: The Black Sagebrush BpS is found on shallow calcareous or shallow clay loamy/sandy soils. Soil differences and widely ranging elevations create a variety of communities. <i>Artemisia nova</i> is the dominant shrub species. Black sagebrush tends to grow where there is a calcite-based root-limiting layer in the soil profile; however, a shallow clay-based root-restricting layer also supports black sagebrush sometimes mixed with low sagebrush in northern-central Nevada. Wyoming big sagebrush and basin big sagebrush generally occur with black sagebrush on moderately deep to deep soils that are well-drained. Older pinyon and juniper occupy older vegetation classes if tree seed sources are present. Elevations range from 1,524 m to 2,896 m (5,000' to 9,500'). Average annual precipitation varies between 20 cm to over 41 cm (8" to over 16"). The BpS mostly occurs on alluvial fans, piedmonts, bajadas, rolling hills and moderate to steep mountain slopes, and warmer slopes of basalt slopes. The BpS can also be found on flats and plains. Soils typically contain high volumes of gravel and rock fragments. Black sagebrush generally has relatively low fuel loads with low-growing and cushion forbs and scattered bunchgrasses. The lower elevation black sagebrush community shares many species with mixed salt desert communities, such as Sandberg's bluegrass (<i>Poa secunda</i>), Indian ricegrass (<i>Achnatherum hymenoides</i>), bottlebrush squirreltail (<i>Elymus elymoides</i>), bud sagebrush (<i>Picrothamnus desertorum</i>), winterfat (<i>Krascheninnikovia lanata</i>), spiny hopsage (<i>Grayia spinosa</i>), and shadscale (<i>Atriplex confertifolia</i>). With increasing elevation, Thurber needlegrass (<i>Achnatherum thurberianum</i>), Sandberg's bluegrass, Indian ricegrass, bluebunch wheatgrass (<i>Pseudoroegneria spicata</i>), and Idaho fescue (<i>Festuca idahoensis</i>) become dominant. Antelope bitterbrush (<i>Purshia tridentata</i>) also increases with elevation. At even higher elevations &gt;36 cm (&gt;14") precipitation on shallow calcareous soils, Utah serviceberry (<i>Amelanchier utahensis</i>), mountain snowberry (<i>Symphoricarpos oreophilus</i>), and antelope bitterbrush become sub-dominant to black sagebrush. Forbs often include buckwheats (<i>Eriogonum</i> spp.), fleabanes (<i>Erigeron</i> spp.), phloxes (<i>Phlox</i> spp.), paintbrushes (<i>Castilleja</i> spp.), globemallows (<i>Sphaeralcea</i> spp.), and lupines (<i>Lupinus</i> spp.). Because the mean fire</p>

	return interval is long and soils harsh, old scattered Utah juniper and single-leaf pinyon can be present to common.
A 10791010	<b>Early-all:</b> <10% cover rabbitbrush; ≥10% cover of native grass; <50% cover mineral soil; 0-25 yrs
B 10791022	<b>Mid-open:</b> 10-19% cover of black sagebrush and rabbitbrush; ≥10% native grass cover; <40% cover of mineral soil; 25-119 yrs
C 10791030	<b>Late-closed:</b> ≥20% cover of black sagebrush and rabbitbrush; 10-30% cover of native grasses; <10% pinyon-juniper sapling cover; 120-194 yrs
D 10791042	<b>Late-open:</b> 10-40% cover of pinyon or juniper 3-8m tall; <10% black sagebrush cover; <10% grass cover; >195 yrs
U-A:Annual Spp (aka: AS) 10791100	<b>Annual-Species:</b> >10% cover of non-native annual species; <10% cover of shrubs
U-A:Bare Ground (aka: BAGR) 10791101	<b>Bare Ground:</b> Disturbed area of mostly exposed mineral soil; crushed vegetation may be present
U-B:Depleted (aka: DP) 10791203	<b>Depleted-mid:</b> 10-19% cover of black sagebrush; <5% native herbaceous cover; 0% pinyon or juniper sapling cover
U-C:Depleted (aka: DP) 10791303	<b>Depleted-late:</b> >20% cover of black sagebrush; <5% native herbaceous cover; <10% pinyon or juniper sapling cover
U-A:Exotic Forb (aka: EF) 10791108	<b>Exotic-Forbs-early:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); <10% cover rabbitbrush; native grasses may be present
U-B: Exotic Forb (aka: EF) 10791208	<b>Exotic-Forbs-mid:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); 10-19% cover of black sagebrush and rabbitbrush; native grasses may be present
U-C: Exotic Forb (aka: EF) 10791308	<b>Exotic-Forbs-late:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); >19% cover of black sagebrush and rabbitbrush; native grasses may be present
U-A:Early Shrub (aka: ES) 10791105	<b>Early-Shrub-early:</b> ≥10% cover rabbitbrush species; <10% cover of black sagebrush; ≤5% non-native annual species cover; native grasses may be present
U-B:Early Shrub (aka: ES) 10791205	<b>Early-Shrub-mid:</b> >10% cover rabbitbrush species; 10-19% cover of black sagebrush and other shrubs; <5% non-native annual species; native grass and forbs may be present
U-C:Early Shrub (aka: ES) 10791305	<b>Early-Shrub-late:</b> >10% cover rabbitbrush species; >19% cover of black sagebrush and other shrubs; <5% non-native annual species; native grass may be present
U-B:SA 10791221	<b>Shrub-Annual-Species-mid:</b> ≥5% non-native annual species cover; 10-19% cover of black sagebrush; <5% cover of native grass
U-C:SA 10791321	<b>Shrub-Annual-Species-late:</b> ≥5% non-native annual species cover; ≥20% cover of black sagebrush; <5% cover of native grass; <10% pinyon or juniper sapling cover
U-A:SAP (aka: ASPG) 10791124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> ≥5% cover of non-native annual species; ≥5% native grasses; <10% cover of shrubs
U-B:SAP 10791224	<b>Shrub-Annual-Species-Perennial-Grass-mid:</b> ≥5% non-native annual species cover; 10-19% cover of black sagebrush; >5% cover of native grass

U-C:SAP 10791324	<b>Shrub-Annual-Species-Perennial-Grass-late:</b> ≥5% non-native annual species cover; ≥20% cover of black sagebrush; >5% cover of native grass; <10% pinyon or juniper sapling cover
U-A:Seeded Native (aka: SD) 10791135	<b>Seeded-Native-early:</b> >10% seeded native grasses, other shrubs, and forbs, <10% cover of black sagebrush
U-B:Seeded Native (aka: SD) 10791235	<b>Seeded-Native-mid:</b> >10% seeded native grasses, other shrubs, and forbs; ≥10% black sagebrush cover
U-A:SI (aka: SDI-A) 10791129	<b>Seeded-Introduced-Early:</b> >10% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of shrubs; native grasses and forbs may be present to abundant; <5% non-native annual species cover
U-B:SI (aka: SDI-B) 10791229	<b>Seeded-Introduced-Mid:</b> >10% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-19% cover of black sagebrush and rabbitbrush; native grasses and forbs may be present to abundant; <5% non-native annual species cover
U-C:SI (aka: SDI-C) 10791329	<b>Seeded-Introduced-Late:</b> >5% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); >20% cover of black sagebrush; native grasses and forbs may be present to abundant; <5% non-native annual species cover; <10% pinyon-juniper sapling cover
U-D:SI (aka: SDI-D) 10791429	<b>Seeded-Introduced-Late:</b> >5% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-40% cover of pinyon or juniper 3-8m tall; <10% black sagebrush cover; native grasses and forbs may be present to abundant; <5% non-native annual species cover
U-A:SI+AS (aka: SI-A+AS) 10791138	<b>Seeded-Introduced-Early+Annual-Species:</b> >10% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of shrubs; native grasses and forbs may be present to abundant; ≥5% non-native annual species cover
U-B:SI+AS (aka: SI-B+AS) 10791238	<b>Seeded-Introduced-Mid+Annual-Species:</b> >10% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-19% cover of black sagebrush and rabbitbrush; native grasses and forbs may be present to abundant; ≥5% non-native annual species cover
U-C:SI+AS (aka: SI-C+AS) 10791338	<b>Seeded-Introduced-Late+Annual-Species:</b> >5% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); ≥20% cover of black sagebrush; native grasses and forbs may be present to abundant; ≥5% non-native annual species cover; <10% pinyon-juniper sapling cover
U-D:SI+AS (aka: SI-D+AS) 10791438	<b>Seeded-Introduced-Late+Annual-Species:</b> >5% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-40% cover of pinyon or juniper 3-8m tall; <10% black sagebrush cover; native grasses and forbs may be present to abundant; ≥5% non-native annual species cover
U-D:TEA 10791444	<b>Tree-Encroached-Annual-Grass:</b> >10% mature pinyon or juniper cover 3-8m tall; <5% shrub cover; <b>either</b> <5% native herbaceous cover <b>and</b> <5% cheatgrass; <b>OR</b> ≥5% cheatgrass <b>and</b> >0% native herbaceous cover
U-A:Unpalat. Forb (aka: UF) 10791146	<b>Unpalatable-Forb-early:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; <10% black sagebrush cover; native grass may be present

U-B:Unpalat. Forb (aka: UF) 10791246	<b>Unpalatable-Forb-mid:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; 10-19% black sagebrush cover; native grass may be present
U-C:Unpalat. Forb (aka: UF) 10791346	<b>Unpalatable-Forb-late-closed:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; >20% black sagebrush cover; <10% pinyon-juniper sapling cover; native grass may be present
U-D:Unpalat. Forb (aka: UF) 10791446	<b>Unpalatable-For-late-open:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; 10-40% cover of pinyon or juniper 3-8m tall; <10% black sagebrush cover; native grass may be present
<b>Bluebunch Wheatgrass Grassland (BWG)(11230)</b>	<b>11230 – GSG habitat</b>
	Overview: These grasslands are similar floristically to big sagebrush steppe typically found in large areas of southern Idaho, but central Nevada sites are narrow and located in shallow depressions or drainage ways between ridges of pinyon, juniper, or curl-leaf mountain mahogany. Bluebunch wheatgrass is dominant, grasses dominate the aspect, and shrub cover is absent to low, unless the site is degraded. Depending on geology and soil depth, NRCS ecological sites could be either Calcareous Loam 10-14 P.Z. (precipitation zone; 028BY094NV) or Stony Bottom (025BXY050NV). Soils are variable, non-saline, ranging from deep, fine-textured often with coarse fragments of carbonate rock (limestone or dolomite), and often with a microphytic crust, to stony volcanic-derived clays with shallow rooting depth. Soil moisture is supplemented by snow runoff and subsurface flow originating from higher elevations. This grassland is dominated by perennial bunch grasses and forbs (>25% cover) sometimes with a sparse (<10% cover) shrub layer. Associated bunch grasses include Thurber's needlegrass (only found on non-calcareous soils), Indian ricegrass (found mostly on calcareous soils), Great Basin wildrye, Sandberg's bluegrass, needle-and-thread, and bottlebrush squirreltail. Rabbitbrush, snakeweed, horsebrush, or big sagebrush may be present in disturbed stands. Common forbs are phloxes, penstemons, milk-vetches, and arrowleaf balsamroot. Unlike Idaho grasslands that burn frequently over large areas, these isolated strands of grassland squeezed between wooded areas appear to depend on high variation in soil moisture drowning shrub and trees roots during the spring, but not on fire.
A 11230010	<b>Early-all:</b> <5% shrub cover (rabbitbrush and snakeweed); 10-25% cover of bunch grasses (bluebunch wheatgrass and others); <5% cheatgrass cover; soil cover may be high; 0-4 yrs
B 11230021	<b>Mid-closed:</b> <5% shrub cover (rabbitbrush and snakeweed); >25% cover of bunch grasses (bluebunch wheatgrass and others); <5% cheatgrass cover; 5-20yrs
C 11230032	<b>Late-open:</b> 5-15% cover of big sagebrush, snakeweed, or rabbitbrush; ≥15% cover of bunchgrass; <5% pinyon-juniper sapling cover; >20 yrs
U-A:Annual Spp (aka: AS) 11230100	<b>Annual-Species:</b> ≥10% non-native annual species cover; <5% shrub (mostly rabbitbrush, sagebrush) cover; <10% native grass cover; <1% cover of pinyon or juniper saplings
U-C:Depleted (aka: DP) 11230303	<b>Depleted Early-late:</b> <5% cover of annual grasses; <10% native grass cover; <5% shrub (mostly rabbitbrush, snakeweed, and sagebrush) cover

U-A:Early Shrub (aka: ES) 11230105	<b>Early-Shrub-early:</b> >10% cover of rabbitbrush or snakeweed; 10-30% bare ground cover; <10% native grass cover
U-C:SA 11230321	<b>Shrub-Annual-Grass-late:</b> ≥5% shrub (mostly rabbitbrush, sagebrush) cover; ≥5% cover of annual grasses; <10% native grass cover; <5% cover of pinyon or juniper saplings
U-A SAP (aka: ASPG) 11230124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> ≥5% cover of annual grasses; ≥10% native grass cover; <5% shrub (mostly rabbitbrush, snakeweed, and sagebrush) cover
U-B:SAP 11230224	<b>Shrub-Annual-Perennial-Grass-mid:</b> <5% shrub (mostly rabbitbrush, sagebrush) cover; ≥5% cover of annual grasses; >25% native grass cover
U-C:SAP 11230324	<b>Shrub-Annual-Perennial-Grass-late:</b> ≥5% shrub (mostly rabbitbrush, sagebrush) cover; ≥5% cover of annual grasses; ≥15% native grass cover;<5% cover of pinyon or juniper saplings
U-C:TEA 11230344	<b>Tree-Encroached-Annual-Grass:</b> >5% mature pinyon-juniper cover; <5% cover of shrubs; <b>either</b> <5% cover native grasses <b>AND</b> <5% cover of cheatgrass <b>OR</b> ≥5% cover of cheatgrass <b>AND</b> native grasses may be present; litter or bare ground may be abundant under the canopy of trees
U-A:Unpalat. Forb (aka: UF) 11230146	<b>Unpalatable-Forb-early:</b> >25% Increaser forb cover, such as mules'ears wyethia or arrowleaf balsamroot; 0% shrub cover (rabbitbrush and snakeweed); <25% cover of bunch grasses (bluebunch wheatgrass and others)
U-B:Unpalat. Forb (aka: UF) 11230246	<b>Unpalatable-Forb-mid:</b> >25% Increaser forb cover, such as mules'ears wyethia or arrowleaf balsamroot; <5% cover of big sagebrush, snakeweed, or rabbitbrush; >25% of bunch grasses (bluebunch wheatgrass and others)
U-C:Unpalat. Forb (aka: UF) 11230346	<b>Unpalatable-Forb-late:</b> >25% Increaser forb cover, such as mules'ears wyethia or arrowleaf balsamroot; >5% cover of big sagebrush, snakeweed, or rabbitbrush; bunch grasses (bluebunch wheatgrass and others) may be present
<b>Curl-leaf Mountain Mahogany (CMM)(10620)</b>	<b>10620 – not GSG habitat</b>
	Overview: The Curl-leaf Mountain Mahogany ( <i>Cercocarpus ledifolius</i> var. <i>intermontanus</i> ) BpS is usually found on upper slopes and ridges between 2,133 m to 3,200 m (7,000' to 10,500') elevation. Most stands occur on rocky shallow soils and outcrops. Stands are assumed to reach old age, >1,000 years, without fire. The BpS is present in two distinct forms due to soil differences: 1) savannas of old and well-dispersed trees form open and often grassy woodlands (with mature stand cover between 10-55%) with a diverse understory on soils with a large proportion of boulders above and below ground; and 2) dense thickets of old shrubs (56% to 100% cover) with thick litter and little understory cover form on soils without bouldering. Curl-leaf mountain mahogany is both a primary early successional colonizer rapidly occupying bare mineral soils after disturbance and the dominant long-lived species. Seedlings require mineral soil without plant competition to reestablish after fire. Reproduction often appears dependent upon geographic variables (slope, aspect, and elevation) more than biotic factors. Where curl-leaf mountain mahogany has reestablished quickly after fire, rabbitbrush ( <i>Chrysothamnus nauseosus</i> ) may co-dominate. Litter and shading by woody plants inhibits establishment of curl-leaf mountain mahogany. Mountain big sagebrush ( <i>Artemisia tridentata</i> spp. <i>vaseyana</i> ) and mountain snowberry ( <i>Symphoricarpos oreophilus</i> ) are the most common shrubs,

	with Utah serviceberry ( <i>Amelanchier utahensis</i> ) and creeping barberry ( <i>Mahonia repens</i> ) also common. Utah juniper ( <i>Juniperus osteosperma</i> ) and other conifers may be present, with less than 10% total cover. In old, closed canopy stands, understory may consist largely of prickly phlox ( <i>Leptodactylon pungens</i> ). In savannas, the herbaceous understory can be diverse and abundant.
A 10620010	<b>Early-all:</b> <70% cover of mountain mahogany; other shrubs (snowberry, rabbitbrush) and grasses may be present; 0-20 yrs
B 10620022	<b>Mid-open:</b> 10-30% cover mountain mahogany and other shrubs; 20-60 yrs
C 10620030	<b>Late1-closed:</b> 30-70% cover of mountain mahogany, other shrubs (snowberry, rabbitbrush, big sagebrush, bitterbrush, black sagebrush) abundant; 60-150 yrs
D (aka: savanna) 10620042	<b>Late2-open:</b> 10-30% cover of mountain mahogany; big sagebrush, black sagebrush, bitterbrush; grasses abundant; occasional mixed conifer possible; 150+ yrs
E (aka: thicket) 10620040	<b>Late2-closed:</b> >30% cover of mountain mahogany; 5-10% cover of Utah juniper; snowberry may be common; occasional mixed conifer possible ; 150+ yrs
U-A:Annual Spp (aka: AS) 10620100	<b>Annual-Species:</b> ≥10% non-native annual species cover; mountain mahogany largely absent; ≤80% cover of mineral soil, bedrock, and rock
U-C:TEA 10620344	<b>Tree-Encroached or Annual-Species-late1:</b> >5% cheatgrass cover; 30-70% cover of young mountain mahogany; 40% cover of mineral soil, bedrock, and rock
U-D:TEA 10620444	<b>Tree-Encroached or Annual-Species-late2:</b> >5% cheatgrass cover; >10-30% cover of older mountain mahogany; 40% cover of mineral soil, bedrock, and rock
U-D:Unpalat. Forb (aka: UF) 10620446	<b>Unpalatable-Forb:</b> >75% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot
<b>Desert Wash (DW)(11544)</b>	<b>1154dw or 11544 – not GSG habitat</b>
	Overview: The Desert Wash BpS comprises intermittent to dry desert drainages with mostly subsurface flow whose banks are deeply incised. Flash-flooding is the major disturbance in this BpS. Gravels and desert shrub species dominate the system with shrub cover increasing with time since last flood. Common species include burrobrush, big sagebrush, snakeweed, rabbitbrush, Indian ricegrass, and squirreltail.
A 11544010	<b>Early-all:</b> 20-50% cover may be gravel, sands, and/or flood debris; 10-19% cover of burrobrush, rabbitbrush, desert willows present; 5-15% cover of grasses (Indian ricegrass, squirreltail); forbs present to abundant; 0-5 yrs
B 11544021	<b>Mid-closed:</b> <20% of gravel and rocks; >20% cover of burrobrush, big sagebrush, rabbitbrush, desert willows; 5-10% cover of grasses (Indian ricegrass, squirreltail); forbs present to abundant; 5-19 yrs
U-A:Bare Ground (aka: BAGR) 11544101	<b>Bare-Ground:</b> mineral soil exposed by human-caused disturbances
U-A:Early Shrub (aka: ES) 11544105	<b>Early-Shrub-early:</b> 20-50% cover of snakeweed or rabbitbrush species; 10-19% cover of burrobrush, rabbitbrush, desert willows present
U-B:Early Shrub (aka: ES) 11544205	<b>Early-Shrub-late:</b> 20-50% cover of snakeweed or rabbitbrush species; >20% cover of burrobrush, big sagebrush, rabbitbrush, desert willows

U-A:Exotic-Forb-Tree (aka: EFT) 11544106	<b>Exotic-Forb-Tree-early:</b> >5% cover of salt cedar or exotic forbs (knapweed, tall whitetop); 10-19% cover of bursage, burrobrush, big sagebrush, Anderson's wolfberry, rabbitbrush, desert almond.
U-B:Exotic-Forb-Tree (aka: EFT) 11544206	<b>Exotic-Forb-Tree-late:</b> >5% cover of salt cedar or exotic forbs (knapweed, tall whitetop); >20% cover of bursage, burrobrush, big sagebrush, Anderson's wolfberry, rabbitbrush.
U-A:SA 11544121	<b>Shrub-Annual-Grass-early:</b> 5-14% exotic species ( <i>Bromus tectorum</i> ) cover; 10-19% small trees and shrubs; <5% cover of native grasses; mineral soil may be common
U-B:SA 11544221	<b>Shrub-Annual-Grass-late:</b> 5-14% exotic species ( <i>Bromus tectorum</i> ) cover; >20% small trees and shrubs; <5% cover of native grasses; mineral soil may be common
U-A:SAP 11544124	<b>Shrub-Annual-Grass-Perennial-Grass-early:</b> 5-14% exotic species ( <i>Bromus tectorum</i> ) cover; 10-19% small trees and shrubs, ≥5% cover of grasses (Indian ricegrass, squirreltail); mineral soil may be common
U-B:SAP 11544224	<b>Shrub-Annual-Grass-Perennial-Grass-late:</b> 5-14% exotic species ( <i>Bromus tectorum</i> ) cover; >20% small trees and shrubs, ≥5% cover of grasses (Indian ricegrass, squirreltail); mineral soil may be common
<b>Developed-Town(10011)</b>	<b>10011 – not GSG habitat</b>
U-A:Building 10011102	<b>Buildings</b>
<b>Developed-Power Plant(10012)</b>	<b>10012 – not GSG habitat</b>
U-A:Building 10012102	<b>Buildings</b>
<b>Dry Wet Meadow (DWM) (11453)</b>	<b>1145dwm or 11453 – GSG habitat</b>
	<i>Overview:</i> The Dry Wet Meadow BpS is a drier version of wet meadows that usually do not have an obvious spring or proximate waterway. Dry wet meadows are usually sub-irrigated and dry out by mid-July as graminoids become senescent. Maybe found on gentle slope. Some dry wet meadow can be found in the outer concentric ring of wet meadows. Because soils are not heavily saturated with water or channels are not present, channel incision or hummocking are not found. Saturated soils during the spring and early summer favor graminoid dominance, but the dominant graminoids differ from those of wetter meadows. The presence of shrubs (Wood's rose, sagebrush, rabbitbrush) at the meadow's edge increases during consecutive drought years and decreases during consecutive high water years. With grazing pressure, early shrub species, such as rabbitbrush, increase in abundance.
A:All 11453010	<b>Early-all:</b> 10-60% herbaceous cover – mostly graminoids; 0-2 yrs
B:Closed 11453021	<b>Mid-closed:</b> 61-100% herbaceous cover – mostly graminoids; 3-22 yrs
C:Open 11453032	<b>Late-open:</b> 5-10% shrub (Wood's rose, sagebrush, rabbitbrush) cover; 60-80% herbaceous cover – mostly graminoids; >22 yrs
U-A:Annual Spp (aka: AG) 11453100	<b>Annual-Species:</b> >5% cover of non-native annual species; < 10% shrub cover

U-A:Bare Ground (aka: BAGR) 11453101	<b>Bare-Ground:</b> Mostly mineral soil due to anthropogenic disturbances
U-A:Early-Shrub (aka: ES) 11453105	Early-Shrub: >20% cover of mostly rabbitbrush species
U-A:Exotic Forb (aka: EF) 11453108	<b>Exotic-Forb:</b> >5% exotic forbs (knapweed, purple loosestrife, thistles)
U-A:SAP (aka: ASPG) 11453124	<b>Shrub-Annual-Perennial-Grass-Early:</b> 5-14% cover of non-native annual species; native graminoids dominant; no shrubs; soil cover may be high
U-A:SI (aka: SDI) 11453129	<b>Seeded-Introduced:</b> ≥10% cover of introduced forage species (e.g., smooth brome, intermediate wheatgrass); native graminoids present to common
U-A:SI+AS (aka: SDI) 11453138	<b>Seeded-Introduced-Early+Annual-Species:</b> >10% seeded introduced species e.g., smooth brome, intermediate wheatgrass); ≥5% non-native annual species cover
U-B:SAP 11453224	<b>Shrub-Annual-Perennial-Grass-Mid:</b> ≥5% cover of non-native annual species; 61-100% herbaceous cover – mostly graminoids
U-C:SA 11453121	<b>Shrub-Annual-Species:</b> >10% cover of native shrubs; <5% native graminoid cover; ≥5% cover of non-native annual species
U-C:SAP 11453324	<b>Shrub-Annual-Perennial-Grass-Mid:</b> ≥5% cover of non-native annual species; 61-80% herbaceous cover – mostly graminoids; 5-10% shrub (Wood’s rose, sagebrush, rabbitbrush) cover
U-C:Shrb-Frb Encr 11453337	<b>Shrub-Forb-Encroached:</b> >10% cover of less palatable grasses and forbs (e.g., Iris missouriensis) <b>OR</b> >10% shrub cover (willow, Wood’s rose, sagebrush, aspen); 10-30% cover of bare ground
U-C:TEA 11453344	<b>Tree-Encroached-Annual-Species (on incised meadow):</b> >20% conifer cover 10-25m; <5% shrub cover; <5% native herbaceous cover; ≥0% cover of non-native annual species
<b>Four-Wing Saltbush (FWS)(10811)</b>	<b>1081fws or 10811 – not GSG habitat</b>
	The Four-Wing Saltbush BpS occurs from 1,524 – 1,585 m (5,000’ – 5,200’). It is part of the Mixed Salt Desert community, but the high stature and high density of four-wing saltbush ( <i>Atriplex canescens</i> ) makes it stand apart. Soils are alkaline, made of loamy fine sand, highly permeable, and very deep (>152 cm or >60”). Many soils are derived from eolian deposits and often associated with dunes. Average annual precipitation ranges from 0-25.4 cm (0 to 10”). This system generally occurs as small patches and stringers. Summers are hot and dry with many days reaching 30 degrees C (100 degrees F). Spring is the only dependable growing season with moisture both from winter and spring precipitation. Cool springs can delay the onset of plant growth and drought can curtail the length of active spring growth. Four-wing saltbush are tall shrubs found at high density (3-5 plants per sq. m) interspersed with low to mid-height bunch grasses. Other shrubs include basin big sagebrush ( <i>Artemisia tridentata</i> ssp. <i>tridentata</i> ) and rubber rabbitbrush ( <i>Ericameria nauseosa</i> ). Common bunch grass species are Indian ricegrass ( <i>Achnatherum hymenoides</i> ),

	needle-and-thread ( <i>Hesperostipa comata</i> ), and, where monsoonal influences are present, rhizomatous/sod forming grasses such as galleta grass ( <i>Pleuraphis jamesii</i> ) and sand dropseed ( <i>Sporobolus cryptandrus</i> ). The biophysical setting has not evolved with fire and fire is absent from the reference condition.
A 10811010	<b>Early-all:</b> ≥10% Indian ricegrass, galleta grass, needle-and-thread, or bottlebrush cover; <5% young four-wing saltbush or rubber rabbitbrush cover; mineral soil common to abundant; 0-5 yrs
B 10811022	<b>Mid-open:</b> 5-20% four-wing saltbush, basin big sagebrush, or rabbitbrush cover; >10% Indian ricegrass, galleta grass, needle-and-thread, or bottlebrush cover; mineral soil common to abundant; 6-19 yrs
C 10811030	<b>Late-closed:</b> >20% four-wing saltbush and basin big sagebrush cover >1m tall; >10% Indian ricegrass, needle-and-thread, or bottlebrush cover; ≥20 years
U-A:Annual Spp (aka: AS) 10811100	<b>Annual-Species:</b> ≥10% non-native annual species cover; <5% shrub cover; native grass may be present to common
U-A:Bare Ground (aka: BAGR) 10811101	<b>Bare-ground:</b> Mostly mineral soil due to anthropogenic disturbances
U-A:Depleted (aka: DP) 10811103	<b>Depleted-early:</b> <5% cover of young four-wing saltbush, basin big sagebrush, or rabbitbrush; 5-10% native grass cover; <5% non-native annual species cover
U-B:Depleted (aka: DP) 10811203	<b>Depleted-mid:</b> 5-20% cover of four-wing saltbush, basin big sagebrush, or rabbitbrush; <5% native grass; <5% non-native annual species cover
U-C:Depleted (aka: DP) 10811303	<b>Depleted-late:</b> >20% cover of four-wing saltbush, basin big sagebrush, or rabbitbrush; <5% native grass; <5% non-native annual species cover
U-A:Exotic Forb (aka: EF) 10811108	<b>Exotic-Forbs-early :</b> 5-100% exotic forbs (knapweed, thistles, halogeton); <5% young four-wing saltbush or rubber rabbitbrush cover; native grass may be present to common; non-native annual species may be present
U-B:Exotic Forb (aka: EF) 10811208	<b>Exotic-Forbs-mid :</b> 5-100% exotic forbs (knapweed, thistles, halogeton); 10-20% of four-wing saltbush or rubber rabbitbrush cover; native grass may be present to common; non-native annual species may be present
U-C:Exotic Forb (aka: EF) 10811308	<b>Exotic-Forbs-late :</b> 5-100% exotic forbs (knapweed, thistles, halogeton); >20% of four-wing saltbush or rubber rabbitbrush cover; native grass may be present to common; non-native annual species may be present
U-A:Pasture (aka: PAS) 10811119	<b>Pasture:</b> Irrigated or fallow pasture
U-A:SAP (aka: ASPG) 10811124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> ≥5% cover of non-native annual species; ≥5% native grasses; <5% shrub cover
U-B:SAP 10811224	<b>Shrub-Annual-Species-Perennial-Grass-mid:</b> ≥5% non-native annual species cover; 5-20% four-wing saltbush, basin big sagebrush, or rabbitbrush cover; >10% Indian ricegrass, galleta grass, needle-and-thread, or bottlebrush cover
U-C:SAP 10811324	<b>Shrub-Annual-Species-Perennial-Grass-late:</b> ≥5% non-native annual species cover; >20% cover of four-wing saltbush, basin big sagebrush, or rabbitbrush; >5% cover of native grass

U-A:Seeded Native (aka: SD) 10811135	<b>Seeded-Native-early:</b> >5% native grass seed mix cover; 1-5% cover of four-wing saltbush; <5% non-native annual species cover
U-B:Seeded Native (aka: SD) 10811235	<b>Seeded-Native-mid:</b> 10-20% cover of four-wing saltbush >5% native grass seed mix cover; <5% non-native annual species cover
<b>Greasewood (GW)(11530)</b>	<b>11530 – not GSG habitat</b>
	Overview: The Greasewood BpS occurs on alluvial flats or lake plains usually adjacent to playas. Sites typically have saline to sodic soils, shallow water table, and flood intermittently, but remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations. Slope gradients of less than 2 percent are most typical. Elevations range from 1,067 to 1,768 m (3,500' to 5,800'). Average annual precipitation is 13 to 25 cm (5" to 10"); and average growing season is 100 to 120 days. The surface layer normally crusts over, inhibiting water infiltration and seedling emergence. This BpS sometimes occurs as a mosaic of multiple communities, with open to moderately-dense shrublands dominated or co-dominated by <i>Sarcobatus vermiculatus</i> (greasewood). <i>Artimesia tridentata</i> spp. <i>tridentata</i> (Basin big sagebrush), <i>Atriplex confertifolia</i> (shadscale) may be present or co-dominant. An herbaceous layer, if present, is usually dominated by salt-tolerant graminoids. There may be inclusions of <i>Sporobolus airoides</i> (alkali sacaton), <i>Distichilis spicata</i> (saltgrass), and <i>Elymus cinereus</i> (basin wildrye). Vegetation on this site is normally restricted to coppice mound areas that are surrounded by playa-like depressions or nearly level, usually barren, inner spaces. As ecological condition declines, herbaceous understory is reduced or eliminated and the site becomes a community of halophytic shrubs dominated by greasewood.
A 11530010	<b>Early-all:</b> >5% herbaceous cover of inland salt grass, alkali sacaton, or basin wildrye; ≤5% young or resprouting greasewood; >25% mineral soil; flood debris may be abundant; 0-4 years
B 11530021	<b>Late-closed:</b> >5% cover of mature greasewood with other shrubs possible (basin big sagebrush); >0% herbaceous cover of inland salt grass, alkali sacaton, or basin wildrye; mineral soil may be common; >4 years
U-A:Annual Spp (aka: AS) 11530100	<b>Annual-Species:</b> >10% cover of non-native annual species; <5% cover of mature greasewood and other shrubs
U-A:Exotic Forb (aka: EF) 11530108	<b>Exotic-Forbs-early:</b> 5-100% exotic forbs (knapweed, tall whitetop, thistles, halogeton, purple loosestrife); ≤5% young or resprouting greasewood; native grasses may be absent to common
U-B:Exotic Forb (aka: EF) 11530208	<b>Exotic-Forbs-late:</b> 5-95% exotic forbs (knapweed, tall whitetop, thistles, halogeton, purple loosestrife); >5% mature greasewood; native grasses may be absent to common
U-B:SAP (aka: SA) 11530224	<b>Shrub-Annual-Species-late:</b> ≥5% non-native annual species cover; >5% cover of mature greasewood or basin big sagebrush; native grasses may be absent to common; >4 years
U-A:SI (aka: SDI) 11530129	<b>Seeded-Introduced-early:</b> >10% seeded introduced grasses (usually Russian wheatgrass), forbs, and shrubs; ≤5% young or resprouting greasewood and other shrubs; <5% non-native annual species cover

U-B:SI (aka: SDI) 11530229	<b>Seeded-Introduced-late:</b> >10% seeded introduced grasses (usually Russian wheatgrass), forbs, and shrubs; >5% greasewood and other shrubs; <5% non-native annual species cover
U-A:SI+AS (aka: SDI+AS) 11530138	<b>Seeded-Introduced+Annual-Species-early:</b> ≥5% non-native annual species cover; ≤5% greasewood and other shrubs; >10% seeded introduced grasses (usually Russian wheatgrass), forbs, and shrubs
U-B:SI+AS (aka: SDI+AS) 11530238	<b>Seeded-Introduced+Annual-Species -late:</b> ≥5% non-native annual species cover; >5% greasewood and other shrubs; >10% seeded introduced grasses (usually Russian wheatgrass), forbs, and shrubs
<b>Lek</b>	<b>10020 – GSG habitat</b>
A 10020010	<b>Early-All:</b> lek area assumed semi-barren or low-statured vegetation
<b>Limber Pine Woodland (LB)(10200)</b>	<b>10200 – not GSG habitat</b>
	Overview: The Limber BpS is often the highest subalpine forest type. Elevation ranges from 2,438 m to 3,505 m (8,000' to 11,500') on mid to upper slopes on smooth to concave mountain slopes. The BpS is found on northerly aspects at lower elevations and on all aspects at higher elevations. Slopes range from 8% to over 75%. The areas are typically in rain shadows, and are the dry and cold extent of tree cover. Stands occur on thin, stony soils, high windswept ridges and open slopes with minimal ground cover. <i>Pinus flexilis</i> can exist separately or as mixed stands with white fir.
A 10200010	<b>Early-all:</b> ≤10% limber cover 0-5m tall; abundant mineral soil or talus cover; sparse ground cover; 0-99 yrs
B 10200022	<b>Mid1-open:</b> 11-30% limber pine cover 5-10m tall; abundant mineral soil or talus cover; sparse ground cover; 100-249 yrs
C 10200032	<b>Late1-open:</b> very old trees; 11-35% limber pine cover 5-25m tall; abundant mineral soil or talus cover; sparse ground cover; >250 yrs
<b>Low Sagebrush (LS)(10790)</b>	<b>1079aa or 10790 – GSG habitat</b>
	Overview: The Low Sagebrush BpS is found on clay soils. Low sagebrush ( <i>Artemisia arbuscula</i> ) is the dominant species. Low sagebrush tends to grow where there is a clay-based root-limiting layer in the soil profile that causes a perched spring water table and poor aeration after wetting. Big sagebrush species generally occur on deeper loamy soils. Elevations range from 1,371 m to 2,438 m (5,500' to 8,000') in MLRA 25 and from 1,981 m to 2,591 m (6,500' to 8,500') in MLRA 24. In central Nevada, low sagebrush intermixed with sub-dominant black sagebrush are sometimes found as high as 2,895 m (9,500') on mountain ridges and summits where soils are very shallow and wind swept. Low sagebrush communities found above the 36 cm (14") of precipitation on mountain valleys and basins are a different BpS: Low Sagebrush Steppe. The BpS mostly occurs on alluvial fans, piedmonts, bajadas, rolling hills and mountain slopes. The BpS can also be found on flats, plains, scablands. Low sagebrush generally has relatively low fuel loads with low-growing and cushion forbs

	and scattered bunchgrasses such as Thurber needlegrass ( <i>Achnatherum thurberianum</i> ), Sandberg's bluegrass ( <i>Poa secunda</i> ), Indian ricegrass ( <i>Achnatherum hymenoides</i> ), and, at higher elevations, Idaho fescue ( <i>Festuca idahoensis</i> ), and bluebunch wheatgrass ( <i>Pseudoroegneria spicata</i> ). Forbs often include buckwheats ( <i>Eriogonum</i> spp.), fleabanes ( <i>Erigeron</i> spp.), phloxes ( <i>Phlox</i> spp.), paintbrushes ( <i>Castilleja</i> spp.), globemallows ( <i>Sphaeralcea</i> spp.), and lupines ( <i>Lupinus</i> spp.).
A 10790010	<b>Early-all:</b> <10% cover rabbitbrush and other shrubs; >10% cover of native grass; <50% cover mineral soil; 0-24 yrs
B 10790022	<b>Mid-open:</b> 10-19% cover of low sagebrush and rabbitbrush; >10% native grass cover; <40% cover of mineral soil; 25-119 yrs
C 10790030	<b>Late-closed:</b> ≥20% cover of low sagebrush; >5% cover of native grasses; ≤5% juniper (maybe pinyon) sapling cover; 120-194 yrs
D 10790042	<b>Late-open:</b> >5% cover of pinyon or juniper 3-8m tall; <10% low sagebrush cover; <10% grass cover; ≥195 yrs
U-A:Annual Spp (aka: AS) 10790100	<b>Annual-Species:</b> >10% cover of non-native annual species; <10% cover of shrubs (primarily rabbitbrush and snakeweed)
U-A:Exotic Forb (aka: EF) 10790108	<b>Exotic-Forbs-early:</b> 5-100% exotic forbs (knapweed, thistles, halogeton); <10% cover of shrubs; native grasses may be present to common
U-B:Exotic Forb (aka: EF) 10790208	<b>Exotic-Forbs-mid:</b> 5-100% exotic forbs (knapweed, thistles, halogeton); 10-19% cover of low sagebrush; native grasses may be present to common; <5% cover of non-native annual species
U-C:Exotic Forb (aka: EF) 10790308	<b>Exotic-Forbs-late:</b> 5-100% exotic forbs (knapweed, thistles, halogeton); ≥20% cover of low sagebrush; native grasses may be present to common; <5% cover of non-native annual species; ≤5% juniper (maybe pinyon) sapling cover
U-A:Early Shrub (aka: ES) 10790105	<b>Early-Shrub-early:</b> >10% cover rabbitbrush species; <10% cover of low sagebrush or other shrubs; <5% cover of non-native annual species; native grasses may be present
U-B:Early Shrub (aka: ES) 10790205	<b>Early-Shrub-mid:</b> >10% cover rabbitbrush species; 10-19% cover of low sagebrush; <5% cover of non-native annual species; native grasses may be present
U-C:Early Shrub (aka: ES) 10790305	<b>Early-Shrub-late:</b> >10% cover rabbitbrush species; ≥20% cover of low sagebrush; <5% cover of non-native annual species; native grasses may be present
U-B:Depleted (aka: DP) 10790203	<b>Depleted-mid:</b> 10-19% cover of low sagebrush; <5% native herbaceous cover; <5% cover of non-native annual species; ≤5% juniper (maybe pinyon) sapling cover
U-C:Depleted (aka: DP) 10790303	<b>Depleted-late:</b> ≥20% cover of low sagebrush; <5% native herbaceous cover; <5% cover of non-native annual species; ≤5% juniper (maybe pinyon) sapling cover
U-B:SA 10790221	<b>Shrub-Annual-Species-mid:</b> ≥5% non-native annual species cover; 10-19% cover of low sagebrush; <5% cover of native grass; ≤5% juniper (maybe pinyon) sapling cover
U-C:SA 10790321	<b>Shrub-Annual-Species-late:</b> ≥5% non-native annual species cover; ≥20% cover of low sagebrush; <5% cover of native grass; ≤5% juniper (maybe pinyon) sapling cover
U-A:SAP (aka: ASPG) 10790124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> ≥5% cover of non-native annual species; ≥5% native grasses; <10% cover of shrubs

U-B:SAP 10790224	<b>Shrub-Annual-Species-Perennial-Grass-mid:</b> ≥5% non-native annual species cover; 10-19% cover of low sagebrush; >5% cover of native grass
U-C:SAP 10790324	<b>Shrub-Annual-Species-Perennial-Grass-late:</b> ≥5% non-native annual species cover; >20% cover of low sagebrush; >5% cover of native grass; ≤5% juniper (maybe pinyon) sapling cover
U-A:Seeded Native (aka: SD) 10790135	<b>Seeded-Native-early:</b> >5% seeded native grass and forb species; <10% cover of shrubs; <5% non-native annual species cover (if ≥5 non-native annual species cover, then see U-A:Annual Spp)
U-B:Seeded Native (aka: SD) 10790235	<b>Seeded-Native-mid:</b> >5% seeded native grass and forb species; 10-19% cover of shrubs; <5% non-native annual species cover (if ≥5 non-native annual species cover, then see U-B:SAP)
U-A:SI (aka: SDI-A) 10790129	<b>Seeded-Introduced-Early:</b> >10% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of shrubs; native grasses and forbs may be present to abundant; <5% non-native annual species cover
U-B:SI (aka: SDI-B) 10790229	<b>Seeded-Introduced-Mid:</b> >10% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-19% cover of low sagebrush and rabbitbrush; native grasses and forbs may be present to abundant; <5% non-native annual species cover
U-C:SI (aka: SDI-C) 10790329	<b>Seeded-Introduced-Late:</b> >5% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); >20% cover of low sagebrush; native grasses and forbs may be present to abundant; <5% non-native annual species cover; ≤5% juniper (maybe pinyon) sapling cover
U-D:SI (aka: SDI-D) 10790429	<b>Seeded-Introduced-Late:</b> >5% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); >5% cover of pinyon or juniper 3-8m tall; <10% cover of low sagebrush; native grasses and forbs may be present to abundant; <5% non-native annual species cover
U-A:SI+AS (aka: SI-A+AS) 10790138	<b>Seeded-Introduced+Annual-Species-Early:</b> >10% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); <10% cover of shrubs; native grasses and forbs may be present to abundant; ≥5% non-native annual species cover
U-B:SI-AS (aka: SI-B+AS) 10790238	<b>Seeded-Introduced+Annual-Species-mid:</b> >10% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); 10-19% cover of low sagebrush and rabbitbrush; native grasses and forbs may be present to abundant; ≥5% non-native annual species cover
U-C:SI-AS (aka: SI-C+AS) 10790338	<b>Seeded-Introduced +Annual-Species-Late:</b> >5% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); >20% cover of low sagebrush; native grasses and forbs may be present to abundant; ≥5% non-native annual species cover; ≤5% juniper (maybe pinyon) sapling cover
U-D:SI+AS (aka: SI-D+AS) 10790438	<b>Seeded-Introduced+Annual-Species-Late:</b> >5% seeded introduced species (crested wheatgrass, intermediate wheatgrass, or forage kochia); >5% cover of pinyon or juniper 3-8m tall; <10% cover of low sagebrush; native grasses and forbs may be present to abundant; <5% non-native annual species cover
U-D:TEA (aka: TA, TE) 10790444	<b>Tree-Encroached-or-Annual-Grass:</b> ≥3% mature pinyon or juniper cover; <10% low sagebrush and other shrub cover; { <5% native herbaceous cover; <5% cheatgrass; <b>OR</b> ≥5% native herbaceous cover; ≥5% cheatgrass}

U-A:Unpalat. Forb (aka: UF) 10790146	<b>Unpalatable-Forb-early:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; <10% cover of low sagebrush or other shrubs; <5% cover of non-native annual species; native grasses may be present
U-B:Unpalat. Forb (aka: UF) 10790246	<b>Unpalatable-Forb-mid:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; 10-19% cover of low sagebrush or other shrubs; <5% cover of non-native annual species; native grasses may be present
U-C:Unpalat. Forb (aka: UF) 10790346	<b>Unpalatable-Forb-late-closed:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; ≥20% cover of low sagebrush or other shrubs; <5% cover of non-native annual species; <5% cover of pinyon-juniper sapling cover; native grasses may be present
U-D:Unpalat. Forb (aka: UF) 10790446	<b>Unpalatable-Forb-late-open:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; >5% cover of pinyon or juniper 3-8m tall; <10% low sagebrush cover; <10% grass cover
<b>Low Sagebrush Steppe (LSS)(11240)</b>	<b>11240 – GSG habitat</b>
	Overview: The Low Sagebrush Steppe BpS is found on upper-montane to subalpine clay soils. Low sagebrush ( <i>Artemisia arbuscula</i> ) and Idaho fescue ( <i>Festuca idahoensis</i> ) are the dominant species. Low sagebrush tends to grow where there is a clay-based root-limiting layer in the soil profile that causes a perched spring water table and poor aeration after wetting. Big sagebrush species generally occur on deeper loamy soils. The BpS occurs on mountain slopes and basins. Elevation is above 2,438 m (8,000'), although the BpS is sometimes higher, where precipitation is greater than 41 cm (16"). Low sagebrush steppe has higher fuel loads than the low sagebrush BpS and, therefore, the steppe's mean fire return interval will be shorter. The dominant grass species is Idaho fescue with Cusick's bluegrass ( <i>Poa cussikii</i> ) subdominant. Forbs often include balsamroots ( <i>Balsamorhiza sagittata</i> ), buckwheats ( <i>Eriogonum</i> spp.), fleabanes ( <i>Erigeron</i> spp.), phloxes ( <i>Phlox</i> spp.), paintbrushes ( <i>Castilleja</i> spp.), globemallows ( <i>Sphaeralcea</i> spp.), and lupines ( <i>Lupinus</i> spp.). Utah serviceberry ( <i>Amelanchier utahensis</i> ) and antelope bitterbrush ( <i>Purshia tridentata</i> ) will be subdominant shrubs. Subalpine conifers may occasionally establish in low sagebrush steppe's harsh soils; however, low sagebrush does not generally support trees.
A 11240010	<b>Early-all:</b> >15% cover of grass; <10% cover rabbitbrush and other shrubs; <50% cover mineral soil; 0-24 yrs
B 11240022	<b>Mid-open:</b> 10-19% cover of low sagebrush, Utah serviceberry, snowberry, and rabbitbrush; >15% grass cover; <40% cover of mineral soil; 25-119 yrs
C 11240030	<b>Late-closed:</b> >20% cover of low sagebrush low sagebrush, Utah serviceberry, and snowberry; <3% mature conifer cover; ≤5% conifer sapling cover; 10-15% cover of grasses; >120 yrs
U-B:Depleted (aka: DP) 11240203	<b>Depleted-mid:</b> 10-19% cover of low sagebrush, Utah serviceberry, and snowberry; <5% herbaceous cover
U-C:Depleted (aka: DP) 11240303	<b>Depleted-late:</b> >20% cover of low sagebrush, Utah serviceberry, and snowberry; <5% herbaceous cover; <3% mature conifer cover; ≤5% conifer sapling cover
U-A:Early Shrub (aka: ES) 11240105	<b>Early-Shrub-early:</b> >10% cover rabbitbrush species; <10% cover of low sagebrushh and other shrubs

U-B:Early Shrub (aka: ES) 11240205	<b>Early-Shrub-mid:</b> >10% cover rabbitbrush species; 10-19% cover of low sagebrush and other shrubs
U-C:Early Shrub (aka: ES) 11240305	<b>Early-Shrub-late:</b> >10% cover rabbitbrush species; >20% cover of low sagebrush and other shrubs
U-D:TEA (aka: TE) 11240444	<b>Tree-Encroached-or-Annual-Grass :</b> ≥3% mature conifer cover; <10% low sagebrush and other shrub cover; {<5% native herbaceous cover; <5% cheatgrass; <b>OR</b> ≥5% native herbaceous cover; ≥5% cheatgrass}
U-A:Unpalat. Forb (aka: UF) 11240146	<b>Unpalatable-Forb-early:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; <10% cover rabbitbrush and other shrubs
U-B:Unpalat. Forb (aka: UF) 11240246	<b>Unpalatable-Forb-mid:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; 10-19% cover low sagebrush and other shrubs
U-C:Unpalat. Forb (aka: UF) 11240346	<b>Unpalatable-Forb-late:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; 10-19% cover low sagebrush and other shrubs; <3% mature conifer cover
<b>Mine-Active(10060)</b>	<b>10060 – not GSG habitat</b>
U-A:Bare Ground 10060101	Exposed rock and soil caused by mining activity
U-A:Buildings 10060102	Buildings associated with active mine
<b>Mine-Inactive(10061)</b>	<b>10061 – not GSG habitat</b>
U-A:Bare Ground 10061101	Exposed rock and soil caused by former mining activity
U-A:Buildings 10061102	Buildings associated with inactive mine
<b>Mixed Salt Desert (MSD)(10810)</b>	<b>10810 – not GSG habitat</b>
	Overview: The Mixed Salt Desert occurs from lower slopes to valley bottoms ranging in elevation from 1,067 – 1981 m (3,500' - 6,500'). Soils are often alkaline or calcareous. Soil permeability ranges from high to low, with more impermeable soils occurring in valley bottoms. Water ponds on alkaline bottoms. Texture is variable becoming finer toward valley bottoms. Many soils are derived from alluvium. Average annual precipitation ranges from 7.5-25.4 cm (3" to 10"); however, this system is in 12.7 - 30.3 cm (5"-8") of effective moisture within this broader range. Thus, other site characteristics (e.g. aspect, drainage, soil type) should be considered in identifying this biophysical setting. At the precipitation extremes, this system generally occurs as small patches and stringers. Summers are hot and dry with many days reaching 30 degrees C (100 degrees F). Spring is the only dependable growing season with moisture both from winter and spring precipitation. Cool springs can delay the onset of plant growth and drought can curtail the length of active spring growth. Freezing temperatures are common from November through April. Mixed

	<p>Salt Desert generally lies above playas, lakes, and greasewood communities. Up slope the BpS is bordered by low elevation big sagebrush groups, commonly Wyoming big sagebrush, low sagebrush, and black sagebrush communities. Mixed Salt Desert includes low (&lt;0.91 m or 3') and medium-sized shrubs found widely scattered (often 6.1 - 9.1 m [20'-30'] apart) to high density (3-5 plants per sq. m) shrubs interspersed with low to mid-height bunch grasses. Common shrubs are shadscale, greasewood, winterfat, budsage, Nevada ephedra, horsebrush, low rabbitbrush, broom snakeweed, and spiny hopsage. Shrub dominance is highly dependent on the site. Some of these shrubs will be present. Common bunch grass species are Indian ricegrass, needle-and-thread, purple three-awn, and bottlebrush squirreltail. Globemallows are the most common and widespread forbs. The understory grasses and forbs are salt-tolerant, not particularly drought tolerant, and are variably abundant. The relative abundance of species may vary in a patchwork pattern across the landscape in relation to subtle differences in soils (e.g., sand sheets or other surface textural differences) and reflect variation in disturbance history. Total cover rarely exceeds 25% and annual precipitation is closely linked to prior 12 months precipitation. Stand-replacing disturbances (insects, extended wet periods and drought) shift dominance between shrub and grass species. Following drought coupled with insect infestations, the system will tend more toward bud sagebrush dominance. The biophysical setting has not evolved with fire and fire is absent from the reference condition.</p>
A 10810010	<b>Early-all:</b> 0-5% cover of young Atriplex spp. or other shrubs; Indian ricegrass and squirreltail common; 0-5 yrs
B 10810022	<b>Late1-open:</b> >5% cover Atriplex spp. or other shrubs; Indian ricegrass and squirreltail present to common; ≥6 yrs
C 10810032	<b>Late2-open:</b> >5% cover budsage <0.25m; Indian ricegrass and squirreltail present to common; ≥6 years
U-A:Annual Spp (aka: AS) 10810100	<b>Annual-Species:</b> ≥10% non-native annual species cover; <5% shrub cover
U-A:Bare Ground (aka: BAGR) 10810101	<b>Bare-ground:</b> Mostly mineral soil due to anthropogenic disturbances
U-A:Exotic Forb (aka: EF) 10810108	<b>Exotic-Forbs-early:</b> 5-100% exotic forbs (knapweed, thistles, halogeton); <5% shrub cover
U-B:Exotic Forb (aka: EF) 10810208	<b>Exotic-Forbs-late:</b> 5-100% exotic forbs (knapweed, thistles, halogeton); ≥5% shrub cover
U-B:SA 10810221	<b>Shrub-Annual-Species-late:</b> ≥5% non-native annual species cover; ≥5% cover of Atriplex spp. or other shrubs; native grasses may be present
U-A:SAP (aka: ASPG) 10810124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> ≥5% non-native annual species cover; ≥5% native grass species cover; ≤5% shrub cover
U-B:SAP 10810224	<b>Shrub-Annual-Species-Perennial-Grass-late:</b> ≥5% non-native annual species cover; >5% shrub cover; ≥5% native grass species cover

U-A:Seeded Native (aka: SD) 10810135	<b>Seeded-Native-early:</b> ≤5% salt desert shrub cover; >5% native seed mix cover; <5% non-native annual species cover (if ≥5% non-native annual species cover, then see U-A:SAP or Annual Spp)
U-B:Seeded Native (aka: SD) 10810235	<b>Seeded-Native-late:</b> >5% salt desert shrub cover; >5% native herbaceous seed mix cover; <5% non-native annual species cover (if ≥5% non-native annual species cover, then see U-B:SAP or U-B:SA)
U-A:SI (aka: SDI) 10810129	<b>Seeded-Introduced-early:</b> >5% seeded introduced grasses, forbs; ≤5% seeded salt desert shrub cover; <5% non-native annual species cover;
U-B:SI (aka: SDI) 10810229	<b>Seeded-Introduced-late:</b> >5% seeded introduced grasses, forbs; >5% seeded salt desert shrub cover; <5% non-native annual species cover
U-A:SI+AS (aka: SDI+AS) 10810138	<b>Seeded-Introduced+Annual-Species-early:</b> >5% seeded introduced grasses and shrubs; ≤5% seeded salt desert shrub cover; ≥5% non-native annual species cover
U-B:SI+AS (aka: SDI+AS) 10810238	<b>Seeded-Introduced+Annual-Species-late:</b> >5% seeded introduced grasses and shrubs; >5% seeded salt desert shrub cover; ≥5% non-native annual species cover
<b>Moist Floodplain (MF)(11541)</b>	<b>1154mf or 11541 – GSG habitat</b>
	Overview: The Moist Floodplain BpS is found in lower gradient valleys often as axial valley waterways or rivers in broad valleys sometimes cutting through mountains ranges. The Humboldt River and some of its low gradient tributaries fall into this group. The BpS is the primary riparian community adjacent to larger rivers. Species require flooding and silt and gravel for growth and reestablishment. Sites are subject to temporary flooding during spring runoff, although summer flash floods can have dramatic effects on succession. Severe flood events can alter the potential of the local floodplain to support the Moist Floodplain BpS, thus causing a shift in BpS. Underlying gravels may keep the water table just below the ground surface, and are favored substrates for willow, and if applicable, cottonwood germination. Surface water is generally high for variable periods. Soils are typically alluvial deposits of sand, clays, silts and cobbles that are highly stratified with depth due to flood scour and deposition. Vegetation is predominantly herbaceous with species composition varying with salt tolerance and alluvial deposits. Riparian shrubs are found at the river's edge as willows or distributed in clumps farther away from the channel in wetter areas. Co-dominant and diagnostic species include creeping wildrye and basin wildrye. Other common species are tufted hairgrass, Nevada bluegrass, sedges, alkali sacaton, inland saltgrass, willow, black greasewood, basin big sagebrush, and silver buffaloberry. Cottonwood is occasional.
Point Bar (aka: PTB) 11541004	<b>Point-Bar:</b> >80% cover of silt, gravel, rock, and boulders as a part of the waterway's meanders; <20% very recently germinated seedlings; 0-5 yrs
Aw 11541014	<b>Early-Willow:</b> 30%-50% cover of creeping wildrye and basin wildrye codominant with other graminoids subdominant (Nevada bluegrass, and/or sedges); <5% cover of willow seedlings and sapling in clumps or at the river's edge <1.5m high; <1% cottonwood cover; 50-70% cover of gravel, rock, and boulders, although this may be highly variable by reach; 0-5 yrs

Bw 11541024	<b>Mid-Willow:</b> 50-90% cover of creeping wildrye and basin wildrye codominant with other graminoids subdominant (Nevada bluegrass, and/or sedges); 5-10% cover of large but not arborescent willow ( $\leq 6''$ diameter and $< 3m$ high) and other shrubs in clumps or at the river's edge; $< 1\%$ cottonwood cover; $< 50\%$ gravel, rock, and boulders; 5-74 yrs
Cw 11541034	<b>Late-Willow:</b> 10-15% cover of large diameter ( $> 6''$ and $\geq 3m$ high) arborescent willow and other tall shrubs in clumps or at the river's edge; 50-80% cover of creeping wildrye and basin wildrye codominant with other graminoids subdominant (Nevada bluegrass, and/or sedges); $< 1\%$ cottonwood cover; $< 10\%$ gravel, rock, and boulders; $> 75$ yrs
Ac 11541012	<b>Early-Cottonwood:</b> 0-40% cover of cottonwood seedlings and saplings $< 1.5m$ height; creeping wildrye and/or basin wildrye may co-dominate; $< 50\%$ cover gravel, rock, and boulders, although this may be highly variable by reach; 0-5 yrs
Bc 11541023	<b>Mid-Cottonwood:</b> 31-100% cover of small pole-sized cottonwood trees ( $\geq 1.5m$ and $< 10m$ height) and other tall shrubs (willows, buffaloberry); creeping wildrye and basin wildrye dominate the understory $< 20\%$ gravel, rock, and boulders; 5-19yrs
Cc 11541033	<b>Late-Cottonwood:</b> 31-100% cover of cottonwood trees 10-24m high; creeping wildrye and basin wildrye dominate herbaceous layer; willow and other shrubs in mid-story; $< 20\%$ gravel, rock, and boulders; $> 20$ yrs
U-A:Annual Spp (aka: AS) 11541100	<b>Annual-Species:</b> dry incised banks with $> 10\%$ cover of non-native annual species; $< 10\%$ shrub cover
U-A:Desertified (aka: DE) 11541104	<b>Desertified-early:</b> Incised river/creek with 5-20% native grass cover, especially basin wildrye; 0% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry)
U-B:Desertified (aka: DE) 11541204	<b>Desertified-mid:</b> Incised river/creek with $\leq 10\%$ cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); 21-80% native grass cover, especially basin wildrye
U-C:Desertified (aka: DE) 11541304	<b>Desertified-late:</b> Incised river/creek with $> 10\%$ cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); $< 75\%$ native grass cover, especially basin wildrye
U-A:Early Shrub (aka: ES) 11541105	<b>Early-Shrub-early:</b> $> 20\%$ cover of rabbitbrush or snakeweed species; big sagebrush uncommon; native grasses present; $< 5\%$ cover of non-native annual species
U-B:Early Shrub (aka: ES) 11541205	<b>Early-Shrub-mid:</b> $> 20\%$ cover of rabbitbrush or snakeweed species; 1-11% cover of big sagebrush; native grasses present; $< 5\%$ cover of non-native annual species
U-C:Early Shrub (aka: ES) 11541305	<b>Early-Shrub-late:</b> $> 20\%$ cover of rabbitbrush or snakeweed species; $\geq 11\%$ cover of big sagebrush; native grasses may be present; $< 5\%$ cover of non-native annual species
U-A:Exotic-Forb-Tree (aka: EFT) 11541106	<b>Exotic-Forb-Tree-early:</b> $> 5\%$ cover of exotic forb species or tree species on un-incised waterways (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); $< 5\%$ cover of willow seedlings and sapling in clumps or at the river's edge $< 1.5m$ high; $< 50\%$ cover of creeping wildrye and basin wildrye co-dominant with other graminoids subdominant (Nevada bluegrass, and/or sedges)
U-B:Exotic-Forb-Tree (aka: EFT) 11541206	<b>Exotic-Forb-Tree-mid,-late:</b> $> 5\%$ cover of exotic forb species or tree species on un-incised waterways (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 5-10% cover of large ( $\leq 6''$ diameter and $< 3m$ high) or arborescent

	willow and other shrubs in clumps or at the river's edge; <80% cover of creeping wildrye and basin wildrye codominant with other graminoids subdominant (Nevada bluegrass, and/or sedges)
U-C:Exotic-Forb-Tree (aka: EFT) 11541306	<b>Exotic-Forb-Tree-late:</b> >5% cover of exotic forb species or tree species on un-incised waterways (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 31-100% cover of cottonwood trees 10-24m high; creeping wildrye and basin wildrye dominate herbaceous layer; willow and other shrubs in mid-story; <20% gravel, rock, and boulders
U-A:FoxtailBarley (aka: NGPG) 10803107	<b>Foxtail-Barley-early:</b> >10% foxtail barley ( <i>Hordeum jubatum</i> ); <5% cover of willow seedlings and sapling in clumps or at the river's edge <1.5m high; <50% cover of creeping wildrye and basin wildrye codominant with other graminoids subdominant (Nevada bluegrass, and/or sedges)
U-B:FoxtailBarley (aka: NGPG) 10803207	<b>Foxtail-Barley-mid:</b> >10% foxtail barley ( <i>Hordeum jubatum</i> ); 5-10% cover of large (≤6" diameter and <3m high) or arborescent willow and other shrubs in clumps or at the river's edge; <80% cover of creeping wildrye and basin wildrye codominant with other graminoids subdominant (Nevada bluegrass, and/or sedges)
U-C:FoxtailBarley (aka: NGPG) 10803307	<b>Foxtail-Barley-late:</b> >10% foxtail barley ( <i>Hordeum jubatum</i> ); 31-100% cover of cottonwood trees 10-24m high; creeping wildrye and basin wildrye dominate herbaceous layer; willow and other shrubs in mid-story
U-A:Incised-EFT 11541111	<b>Incised-Exotic-Forb-Tree-early:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 5-20% native grass cover, especially basin wildrye; 0% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry)
U-B: Incised-EFT 11541211	<b>Incised-Exotic-Forb-Tree-mid,-late:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); ≤10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); non-native annual species cover may be present; 21-80% native grass cover, especially basin wildrye
U-C: Incised-EFT 11541311	<b>Incised-Exotic-Forb-Tree-late:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); >10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); non-native annual species cover may be present; <75% native grass cover, especially basin wildrye; large cottonwood might be present
U-B:SAP 11541224	<b>Shrub-Annual-Species-Perennial-Grass-mid:</b> Incised river/creek with ≤10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); >5% non-native annual species cover; <80% native grass cover, especially basin wildrye, although native grass might be absent
U-C:SAP 11541324	<b>Shrub-Annual-Species-Perennial-Grass-late:</b> Incised river/creek with >10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); >5% non-native annual species cover; <75% native grass cover, especially basin wildrye, although native grass might be absent; large cottonwood might be present
U-A:Shrb-Frb Encr (aka: SFE) 11541137	<b>Shrub-Forb-Encroached-early:</b> 10-50% cover of irises, Wood's rose, rabbitbrush, or other unpalatable forbs or shrubs in open areas or under tree canopy; <5% cover of willow seedlings and sapling in clumps or at the river's edge <1.5m high; <50% cover of creeping wildrye and basin wildrye codominant with other graminoids subdominant (Nevada bluegrass, and/or sedges)

U-B:Shrb-Frb Encr (aka: SFE) 11541237	<b>Shrub-Forb-Encroached-mid,-late:</b> 10-50% cover of irises, Wood's rose, rabbitbrush, or other unpalatable forbs or shrubs in open areas or under tree canopy; 5-10% cover of large ( $\leq 6''$ diameter and $< 3m$ high) or arborescent willow and other shrubs in clumps or at the river's edge; $< 80\%$ cover of creeping wildrye and basin wildrye codominant with other graminoids subdominant (Nevada bluegrass, and/or sedges)
U-C:Shrb-Frb Encr (aka: SFE) 11541337	<b>Shrub-Forb-Encroached-mid,-late:</b> 10-50% cover of irises, Wood's rose, rabbitbrush, or other unpalatable forbs or shrubs in open areas or under tree canopy; 31-100% cover of cottonwood trees 10-24m high; creeping wildrye and basin wildrye dominate herbaceous layer; willow and other shrubs in mid-story; $< 20\%$ gravel, rock, and boulders
U-A:Pasture (aka: PAS) 11541119	<b>Pasture:</b> Irrigated, sub-irrigated, or fallow pasture or alfalfa field
<b>Montane Riparian (MR)(11540)</b>	<b>11540 – GSG habitat</b>
	Overview: The Montane Riparian BpS is found within a broad elevation range above 1,220 m (4,000'). Riparian communities require flooding and gravel for reestablishment. The BpS is found in low- to mid-elevation canyons and draws, on montane floodplains, in steep-sided canyons, or narrow V-shaped valleys with rocky substrates. Sites are subject to temporary flooding during spring runoff, although summer flash floods can have dramatic effects on succession. Underlying gravels may keep the water table just below ground surface, and are favored substrates for cottonwood and willow. In steep-sided canyons, streams typically have perennial flow on mid to high gradients. Surface water is generally high for variable periods. Soils are typically alluvial deposits of sand, clays, silts and cobbles that are highly stratified with depth due to flood scour and deposition. Codominant and diagnostic species include willow, cottonwood, chokecherry, sumac, Wood's rose, currant, occasional aspen, and conifers. Vegetation is very heterogeneous and diverse along river reaches. Some reaches will be dominated by cottonwood, whereas others are completely occupied by willow, and even cinquefoil and sagebrush on natural stream terraces (not due to incision). Lower slopes $< 6\%$ favor cottonwood, whereas willow are more typically found on steeper slopes.
Point Bar (aka: PTB) 11540004	<b>Point-Bar:</b> $> 80\%$ cover of silt, gravel, rock, and boulders as a part of the waterway's meanders; $< 20\%$ very recently germinated seedlings; 0-5 yrs
Aw 11540014	<b>Early-Willow:</b> 1-40% cover of willow, but cottonwood absent; grass may co-dominate; $< 50\%$ cover gravel, rock, and boulders, although this may be highly variable by reach; 0-5 yrs
Bw 11540024	<b>Mid-Willow:</b> 41-100% cover of willow and other small shrubs and cottonwood absent; $< 20\%$ gravel, rock, and boulders; 5-19yrs
Cw 11540034	<b>Late-Willow:</b> 41-100% cover of large willow, other tall shrubs (chokecherry), deciduous trees, conifers, and cottonwood absent; $< 20\%$ gravel, rock, and boulders $\geq 20$ yrs
Ac 11540012	<b>Early-Cottonwood:</b> 1-40% cover of cottonwood seedlings and saplings; grass may co-dominate; $< 50\%$ cover gravel, rock, and boulders, although this may be highly variable by reach; 0-5 yrs

Bc 11540023	<b>Mid-Cottonwood:</b> 31-100% cover of small cottonwood trees and other tall shrubs (willows, chokecherry) and; <20% gravel, rock, and boulders; 5-19 yrs
Cc 11540033	<b>Late-Cottonwood:</b> 31-100% cover of cottonwood, willow, conifers and other trees 10-24m; <20% gravel, rock, and boulders; >20 yrs
U-A:Annual Spp (aka: AS) 11540100	<b>Annual-Species:</b> Dry incised banks with >10% cover of non-native annual species; <10% shrub (generally rabbitbrush or snakeweed) cover
U-A:Desertified (aka: DE) 11540104	<b>Desertified-early:</b> Incised river/creek with 5-20% native grass cover, especially basin wildrye; 0% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); <5% of non-native annual species
U-B:Desertified (aka: DE) 11540204	<b>Desertified-mid:</b> Incised river/creek with ≤10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); 21-80% native grass cover, especially basin wildrye; <5% of non-native annual species
U-C:Desertified (aka: DE) 11540304	<b>Desertified-late:</b> Incised river/creek with >10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); <75% native grass cover, especially basin wildrye; <5% of non-native annual species
U-A:Early Shrub (aka: ES) 11540105	<b>Early-Shrub-early:</b> >20% cover of rabbitbrush or snakeweed species; big sagebrush uncommon; native grasses may be present; <5% cover of non-native annual species
U-B:Early Shrub (aka: ES) 11540205	<b>Early-Shrub-mid:</b> >20% cover of rabbitbrush or snakeweed species; 1-11% cover of big sagebrush; native grasses present; <5% cover of non-native annual species
U-C:Early Shrub (aka: ES) 11540305	<b>Early-Shrub-late:</b> >20% cover of rabbitbrush or snakeweed species; ≥11% cover of big sagebrush; native grasses may be present; <5% cover of non-native annual species
U-A:Exotic-Forb-Tree (aka: EFT) 11540106	<b>Exotic-Forb-Tree-early:</b> >5% cover of exotic forb species or tree species on un-incised waterways (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 1-40% cover of willow or of cottonwood seedlings and saplings; grass may co-dominate; <50% cover gravel, rock, and boulders, although this may be highly variable by reach
U-B:Exotic-Forb-Tree (aka: EFT) 11540206	<b>Exotic-Forb-Tree-mid,-late:</b> >5% cover of exotic forb species or tree species on un-incised waterways (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 41-100% cover of willow and other small shrubs or 31-100% cover of small cottonwood trees and other tall shrubs (willows, chokecherry); <20% gravel, rock, and boulders
U-C:Exotic-Forb-Tree (aka: EFT) 11540306	<b>Exotic-Forb-Tree-late:</b> >5% cover of exotic forb species or tree species on un-incised waterways (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 41-100% cover of large willow <u>or</u> 31-100% cover of cottonwood other tall shrubs (chokecherry), deciduous trees, conifers and other trees 10-24m; <20% gravel, rock, and boulders
U-A:Hummocked (aka: HU) 11540110	<b>Hummocked:</b> Trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs
U-A:Incised-EFT 11540111	<b>Incised-Exotic-Forb-Tree-early:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 5-20% native grass cover, especially basin wildrye; 0% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry)

U-B:Incised-EFT 11540211	<b>Incised-Exotic-Forb-Tree-mid,-late:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); ≤10% cover of upland shrubs (e.g., big sagebrush snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); non-native annual species cover may be present; <80% native grass cover, especially basin wildrye
U-C:Incised-EFT 11540311	<b>Incised-Exotic-Forb-Tree-late:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); >10% cover of upland shrubs (e.g., big sagebrush snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); non-native annual species cover may be present; <75% native grass cover, especially basin wildrye; large cottonwood might be present
U-A:Inset 11540113	<b>Inset-Floodplain-early:</b> Reformed riparian floodplain at bottom of incised creeks; 1-40% cover of willow, young cottonwood may be present; grass may co-dominate or dominate; although this may be highly variable by reach; 0-5 yrs
U-B:Inset 11540213	<b>Inset-Floodplain-late:</b> Reformed riparian floodplain at bottom of incised creeks; 31-100% cover of willow and other tall shrubs (chokecherry), pole-sized cottonwood might be present; >5 yrs
U-A:Inset-HU 11540117	<b>Inset-Floodplain-Hummocked:</b> Reformed riparian floodplain at bottom of incised creeks; Trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs
U-A:Inset-EFT 11540116	<b>Inset-Floodplain-Exotic-Forb-Tree-early:</b> Reformed riparian floodplain at bottom of incised creeks; >1% cover of exotic forb or tree species (knapweed, tall whitetop, thistles, purple loosestrife, salt cedar, or Russian olive); 1-40% cover of willow, young cottonwood may be present; grass may co-dominate or dominate; although this may be highly variable by reach
U-B:Inset-EFT 11540216	<b>Inset-Floodplain-Exotic-Forb-Tree-late:</b> Reformed riparian floodplain at bottom of incised creeks; >1% cover of exotic forb or tree species (knapweed, tall whitetop, thistles, purple loosestrife, salt cedar, or Russian olive); 31-100% cover of willow and other tall shrubs (chokecherry), pole-sized cottonwood might be present
U-A:Inset-SFE 11540118	<b>Inset-Floodplain-Shrub-Forb-Encroached-early:</b> Reformed riparian floodplain at bottom of incised creeks; 10-50% cover of Wood's rose, and other unpalatable forbs and shrubs in open areas or under tree canopy; 1-40% cover of willow, young cottonwood may be present
U-B:Inset-SFE 11540218	<b>Inset-Floodplain-Shrub-Forb-Encroached-late:</b> Reformed riparian floodplain at bottom of incised creeks; 10-50% cover of Wood's rose, and other unpalatable forbs and shrubs in open areas or under tree canopy; 31-100% cover of willow and other tall shrubs (chokecherry), pole-sized cottonwood might be present
U-A:Pasture (aka: PAS) 11540119	<b>Pasture:</b> Irrigated, sub-irrigated, or fallow pasture or alfalfa field
U-B:SAP 11540224	<b>Shrub-Annual-Species-Perennial-Grass-mid:</b> Incised river/creek with ≤10% cover of upland shrubs (e.g., big sagebrush snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); >5% non-native annual species cover; <80% native grass cover, especially basin wildrye, although native grass might be absent
U-C:SAP 11540324	<b>Shrub-Annual-Species-Perennial-Grass-late:</b> Incised river/creek with >10% cover of upland shrubs (e.g., big sagebrush snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); >5% non-native annual species cover; <75% native grass cover, especially basin wildrye, although native grass might be absent; large cottonwood might be present

U-A:Shrb-Frb Encr (aka: SFE) 11540137	<b>Shrub-Forb-Encroached-early:</b> 10-50% cover of irises, Wood's rose, rabbitbrush, or other unpalatable forbs or shrubs in open areas or under tree canopy; <5% cover of willow seedlings and sapling in clumps or at the river's edge <1.5m high; <50% cover of creeping wildrye and basin wildrye codominant with other graminoids subdominant (Nevada bluegrass, and/or sedges)
U-B:Shrb-Frb Encr (aka: SFE) 11540237	<b>Shrub-Forb-Encroached-mid,-late:</b> 10-50% cover of irises, Wood's rose, rabbitbrush, or other unpalatable forbs or shrubs in open areas or under tree canopy; 5-10% cover of large (≤6" diameter and <3m high) or arborescent willow and other shrubs in clumps or at the river's edge; <80% cover of creeping wildrye and basin wildrye codominant with other graminoids subdominant (Nevada bluegrass, and/or sedges)
U-C:Shrb-Frb Encr (aka: SFE) 11540337	<b>Shrub-Forb-Encroached-mid,-late:</b> 10-50% cover of irises, Wood's rose, rabbitbrush, or other unpalatable forbs or shrubs in open areas or under tree canopy; 31-100% cover of cottonwood trees 10-24m high; creeping wildrye and basin wildrye dominate herbaceous layer; willow and other shrubs in mid-story; <20% gravel, rock, and boulders
U-A:SI (aka: SDI-A) 10803129	<b>Seeded-Introduced-early:</b> >10% seeded introduced grasses, with native grasses and forbs possible; <5% of non-native annual species
U-B:SI (aka: SDI-B) 10803229	<b>Seeded-Introduced-mid:</b> >10% seeded introduced grasses, with native grasses and forbs possible; 1-10% cover of big sagebrush and/or greasewood; <5% of non-native annual species
U-C:SI (aka: SDI-C) 10803329	<b>Seeded-Introduced-late:</b> >10% seeded introduced grasses, with native grasses and forbs possible; >10% cover of basin big sagebrush and/or greasewood; <5% of non-native annual species
U-A:SI+AS (aka: SI-A+AS) 10803128	<b>Seeded-Introduced+Annual-Species-early:</b> >10% seeded introduced grasses, with native grasses and forbs possible; shrubs generally absent; ≥5% cover of non-native annual species
U-B:SI+AS (aka: SI-B+AS) 10803228	<b>Seeded-Introduced+Annual-Species-mid:</b> >10% seeded introduced grasses, with native grasses and forbs possible; 1-10% cover of basin big sagebrush and/or greasewood; ≥5% cover of non-native annual species
U-C:SI+AS (aka: SI-C+AS) 10803328	<b>Seeded-Introduced+Annual-Species-late:</b> >10% seeded introduced grasses, with native grasses and forbs possible; >10% cover of basin big sagebrush and/or greasewood; ≥5% cover of non-native annual species
U-C:TEA 11540344	<b>Tree-Encroached or Tree-Annual-Species:</b> >20% conifer cover; if <5% annual grass cover then <5% shrub cover; <5% herbaceous cover; OR if ≥5% cover of annual grass then >0% shrub cover; >5% herbaceous cover
<b>Montane Sagebrush Steppe-subalpine (MSSs)(11261)</b>	<b>1126s or 11261 – GSG habitat</b>
	Overview: The Montane Sagebrush Steppe subalpine BpS (a.k.a., mountain big sagebrush) is found above and inter-grades with the upland soils of montane sagebrush steppe. Precipitation is above 41 cm (16"). Elevation varies with soil depth and aspect ranging above 1981 m (6,500') on deeper and colder aspects and generally above 2,591 m (8,500') on other shallower soils or warmer aspects. In general this system shows an affinity for mild to very steep topography, fine soils, and some source of subsurface moisture. Soils generally are moderately deep to deep, well-drained, and made of loam, sandy loam, clay loam, or gravelly loam

	<p>textural classes; soils often have a substantial volume of coarse fragments, and are derived from a variety of parent materials. This system primarily occurs on deep soiled to stony flats, ridges, nearly flat ridge tops, and mountain slopes. Vegetation types are usually dominated by <i>Artemisia tridentata</i> ssp. <i>vaseyana</i>. A variety of other shrubs can be found in some occurrences such as mountain snowberry, Utah serviceberry, antelope bitterbrush, but these are seldom dominant (if dominant, see Mountain Shrub BpS). Abundant forbs are an indicator of good range condition. Grasses are abundant, sometimes very abundant, and often diverse. As elevation or precipitation increase, spike-fescue, mountain brome, and Idaho fescue increase while bluebunch wheatgrass and Thurber's needlegrass decrease. Cheatgrass is nearly always absent from this BpS. White fir and limber pine may occupy this site in late-succession.</p>
A 11261010	<b>Early-all:</b> ≥10% grass and forb cover; 0-10% cover of mountain sage, mountain brush; 0-12 yrs
B 11261022	<b>Mid-open:</b> 11-19% cover of mountain sage, mountain shrub; >50% herbaceous cover; 13-29 yrs
C 11261030	<b>Late1-closed:</b> 20%-49% cover of mountain sagebrush (dominant) and mountain brush; ≥25% herbaceous cover; <10% young conifer cover; >30 yrs
C-Dense (aka: D) 11261031	<b>Late1-dense:</b> ≥50% cover of mountain sagebrush (dominant) and mountain brush; 25-50% herbaceous cover; <10% young conifer cover; >30 yrs
D (aka: E) 11261042	<b>Late2-open:</b> 10-30% cover of young mixed conifers <3m; 25-40% cover of mountain sagebrush (dominant) and mountain brush; >10% herbaceous cover; 75-149 yrs
D-Dense 11261041	<b>Late2-dense:</b> 10-30% cover of young mixed conifers <3m; >40% cover of mountain sagebrush (dominant) and mountain brush; >10% herbaceous cover; 75-149 yrs
E (aka: F) 11261050	<b>Late2-closed:</b> >30% mixed conifers cover ≥3m; 6-20% shrub cover; >10% herbaceous cover; ≥150 yrs
U-A:Annual Spp (aka: AS) 11261100	<b>Annual-Species:</b> >10% cover of non-native annual species; <10% native grasses; snakeweed or rabbitbrush may be present
U-A:Bare Ground (aka: BAGR) 11260101	<b>Bare-ground:</b> Mostly mineral soil due to anthropogenic disturbances
U-B:Depleted (aka: DP) 11261203	<b>Depleted-mid:</b> 11-19% cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; young conifer absent; litter and mineral soil common
U-C:Depleted (aka: DP) 11261303	<b>Depleted-late1:</b> 20-49% cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; <10% young conifer cover; litter and mineral soil common
U-C:DP-Dense (aka: DP-Dense) 11261302	<b>Depleted-late1-dense:</b> ≥50% cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; <10% young conifer cover; litter and mineral soil common
U-D:Depleted (aka: DP) 11261403	<b>Depleted-Late2-open:</b> 10-30% cover of young mixed conifers <3m; 25-40% cover of mountain sagebrush (dominant) and mountain brush; ≤10% herbaceous cover

U-D:DP-Dense (aka: DP-Dense) 11261402	<b>Depleted-Late2-dense:</b> 10-30% cover of young mixed conifers <3m; >40% cover of mountain sagebrush (dominant) and mountain brush; ≤10% herbaceous cover
U-A:Early-Shrub (aka: ES) 11261105	<b>Early-Shrub-early:</b> >20% cover of snakeweed or rabbitbrush species; <10% cover of mountain sage, mountain brush; <5% cover of non-native annual species; native grass and forb may be present
U-B:Early-Shrub (aka: ES) 11261205	<b>Early-Shrub-mid:</b> >20% cover of snakeweed or rabbitbrush species; 11-19% cover of mountain sage, mountain shrub; <5% cover of non-native annual species; native grass and forb may be present
U-C:Early-Shrub (aka: ES) 11261305	<b>Early-Shrub-late:</b> >20% cover of snakeweed or rabbitbrush species; ≥20% cover of mountain sage, mountain shrub; <5% cover of non-native annual species; native grass and forb may be present
U-A:SAP (aka: ASPG) 11261124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> ≥5% cover of non-native annual species; ≥10% native grasses; <10% shrub cover
U-B:SAP (aka: SAP-1) 11261224	<b>Shrub-Annual-Species-Perennial-Grass-mid-open:</b> >5% non-native annual species cover; 10-19% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass; <10% young conifer cover
U-C:SAP (aka: SAP-1) 11261324	<b>Shrub-Annual-Species-Perennial-Grass-late1-closed:</b> >5% non-native annual species cover; 20-49% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass; <10% young conifer cover
U-C:SAP-Dense (aka: SAP-2) 11261326	<b>Shrub-Annual-Species-Perennial-Grass-late1-dense:</b> >5% non-native annual species cover; ≥50% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass; <10% young conifer cover
U-D:SAP (aka: SAP-1) 11261424	<b>Shrub-Annual-Species-Perennial-Grass-late2-open:</b> 10-30% cover of young mixed conifers <3m; >5% non-native annual species cover; 20-49% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass
U-D:SAP-Dense (aka: SAP-2) 11261426	<b>Shrub-Annual-Species-Perennial-Grass-late2-dense:</b> 10-30% cover of young mixed conifers <3m; >5% non-native annual species cover; ≥50% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass
U-E:TEA 12611544	<b>Tree-Encroached or Tree–Annual-Grass:</b> >20% mixed conifers cover; if <5% annual grass cover then <5% shrub cover; <5% herbaceous cover; OR if ≥5% cover of annual grass then >0% shrub cover; >5% herbaceous cover
U-A:Unpalat. Forb (aka: UF) 11261146	<b>Unpalatable-Forb-early:</b> >75% Increaser forb cover, such as mules’ears wyethia or narrowleaf balsamroot; 0-10% cover of mountain sage, mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; young conifer absent;
U-B:Unpalat. Forb (aka: UF) 11261246	<b>Unpalatable-Forb-mid:</b> >65% Increaser forb cover, such as mules’ears wyethia or narrowleaf balsamroot; 11-19% cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; young conifer absent;
U-C:Unpalat. Forb (aka: UF) 11261346	<b>Unpalatable-Forb-late1:</b> >25% Increaser forb cover, such as mules’ears wyethia or narrowleaf balsamroot; 20-49% cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; <10% young conifer cover
U-D:Unpalat. Forb (aka: UF) 11261446	<b>Unpalatable-Forb-late2-open:</b> >25% Increaser forb cover, such as mules’ears wyethia or narrowleaf balsamroot; 10-30% cover of young mixed conifers <3m; ≥20%

	cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species
U-E:Unpalat. Forb (aka: UF) 11261546	<b>Unpalatable-Forb-late2-closed:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; >30% mixed conifers cover ≥3m; 6-20% shrub cover; <10% herbaceous cover; <5% cover of non-native annual species
<b>Montane Sagebrush Steppe-upland (MSSu)(11260)</b>	<b>1126up or 11260 – GSG habitat</b>
	Overview: The Montane Sagebrush Steppe BpS (a.k.a., mountain big sagebrush) is found on deep soil to stony flats, ridges, nearly flat ridge tops, and mountain slopes. Annual precipitation ranges from 30 cm to 41 cm (12" to 16"). Elevation is from 1,768 m (5,800') on cooler and more productive soils to 2,743 m (9,000') on steep southern slopes. In general this system shows an affinity for fine soils and some source of subsurface moisture. Soils generally are moderately deep to deep, well-drained, and made of loam, sandy loam, clay loam, or gravelly loam textural classes; soils often have a substantial volume of coarse fragments, and are derived from a variety of parent materials. Vegetation types are usually dominated by <i>Artemisia tridentata</i> ssp. <i>vaseyana</i> . A variety of other shrubs can be found in some occurrences, such as antelope bitterbrush, Utah serviceberry, and black chokecherry, but these are seldom dominant (if dominant, see Mountain Shrub BpS). Abundant forbs are an indicator of good range condition. Grasses are abundant, sometimes very abundant, and often diverse. Common grass species are Thurber's needlegrass, bluebunch wheatgrass, and, at higher elevations, Idaho fescue, Cusick's blugrass, and basin wildrye.
A 11260010	<b>Early-all:</b> ≥10% grass and forb cover; 0-10% cover of mountain sage, mountain brush; 0-12 yrs
B 11260022	<b>Mid-open:</b> 11-19% cover of mountain sage, mountain shrub; >50% herbaceous cover; 13-29 yrs
C 11260030	<b>Late1-closed:</b> 20%-49% cover of mountain sagebrush (dominant) and mountain brush; ≥25% herbaceous cover; <10% young conifer cover; ≥30 yrs
C-Dense (aka: D) 11260031	<b>Late1-dense:</b> ≥50% cover of mountain sagebrush (dominant) and mountain brush; 25-50% herbaceous cover; <10% young conifer cover; ≥30 yrs
D (aka: E) 11260042	<b>Late2-open:</b> 10-30% cover of young mixed conifers <3m; 25-40% cover of mountain sagebrush (dominant) and mountain brush; >10% herbaceous cover; 75-149 yrs
D-Dense 11260041	<b>Late2-dense:</b> 10-30% cover of young mixed conifers <3m; >40% cover of mountain sagebrush (dominant) and mountain brush; >10% herbaceous cover; 75-149 yrs
E (aka: F) 11260050	<b>Late2-closed:</b> >30% mixed conifers cover ≥3m; 6-20% shrub cover; >10% herbaceous cover; ≥150 yrs
U-A:Annual Spp (aka: AS) 11260100	<b>Annual-Species:</b> >10% cover of non-native annual species; <10% native grasses; snakeweed or rabbitbrush may be present
U-A:Bare Ground (aka: BAGR) 11260101	<b>Bare-ground:</b> Mostly mineral soil due to anthropogenic disturbances

U-B:Depleted (aka: DP) 11260203	<b>Depleted-mid:</b> 11-19% cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; young conifer absent; litter and mineral soil common
U-C:Depleted (aka: DP) 11260303	<b>Depleted-late1:</b> 20-49% cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; <10% young conifer cover; litter and mineral soil common
U-C:DP-Dense (aka: DP-Dense) 11260302	<b>Depleted-late1-dense:</b> ≥50% cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; <10% young conifer cover; litter and mineral soil common
U-D:Depleted (aka: DP) 11260403	<b>Depleted-Late2-open:</b> 10-30% cover of young mixed conifers <3m; 25-40% cover of mountain sagebrush (dominant) and mountain brush; ≤10% herbaceous cover
U-D:DP-Dense (aka: DP-Dense) 11260402	<b>Depleted-Late2-dense:</b> 10-30% cover of young mixed conifers <3m; >40% cover of mountain sagebrush (dominant) and mountain brush; ≤10% herbaceous cover
U-A:Early-Shrub (aka: ES) 11260105	<b>Early-Shrub-early:</b> >20% cover of snakeweed or rabbitbrush species; <10% cover of mountain sage, mountain brush; <5% cover of non-native annual species; native grass and forb may be present
U-B:Early-Shrub (aka: ES) 11260205	<b>Early-Shrub-mid:</b> >20% cover of snakeweed or rabbitbrush species; 11-19% cover of mountain sage, mountain shrub; <5% cover of non-native annual species; native grass and forb may be present
U-C:Early-Shrub (aka: ES) 11260305	<b>Early-Shrub-late:</b> >20% cover of snakeweed or rabbitbrush species; ≥20% cover of mountain sage, mountain shrub; <5% cover of non-native annual species; native grass and forb may be present
U-A:Exotic Forb (aka: EF) 11260108	<b>Exotic-Forb-early:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); <10% cover of rabbitbrush species; <10% cover of big sagebrush; native grass and forbs may be present
U-B:Exotic Forb (aka: EF) 11260208	<b>Exotic-Forb-mid:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); 10-19% cover of big sagebrush and other shrubs; native grass and forbs may be present
U-C:Exotic Forb (aka: EF) 11260308	<b>Exotic-Forb-late:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); >19% cover of big sagebrush and other shrubs; native grass and forbs may be present
U-B:SA 11260221	<b>Shrub-Annual-Species-open:</b> ≥5% cover non-native annual species; 10%-19% cover of big sagebrush and other shrubs; native grasses rare
U-C:SA (aka: SA-1) 11260321	<b>Shrub-Annual-Species-late1-closed:</b> ≥5% cover non-native annual species; 20%-49% cover of big sagebrush and other shrubs; native grasses rare; <10% young conifer cover
U-C:SA-Dense (aka: SA-2) 11260323	<b>Shrub-Annual-Species-late1-dense:</b> ≥5% cover non-native annual species ; ≥50% cover of big sagebrush and other shrubs; native grasses rare; <10% young conifer cover
U-D:SA (aka: SA-1) 11260421	<b>Shrub-Annual-Species-late1-closed:</b> 10-30% cover of young mixed conifers <3m; ≥5% cover non-native annual species; 20%-39% cover of big sagebrush and other shrubs; native grasses rare
U-D:SA-Dense (aka: SA-2) 11260423	<b>Shrub-Annual-Species-late1-dense:</b> 10-30% cover of young mixed conifers <3m; ≥5% cover non-native annual species; ≥40% cover of big sagebrush and other shrubs; native grasses rare

U-A:SAP (aka: ASPG) 11260124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> ≥5% cover of non-native annual species; ≥10% native grasses; <10% shrub cover
U-B:SAP (aka: SAP-1) 11260224	<b>Shrub-Annual-Species-Perennial-Grass-mid-open:</b> >5% non-native annual species cover; 10-19% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass; <10% young conifer cover
U-C:SAP (aka: SAP-1) 11260324	<b>Shrub-Annual-Species-Perennial-Grass-late1-closed:</b> >5% non-native annual species cover; 20-49% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass; <10% young conifer cover
U-C:SAP-Dense (aka: SAP-2) 11260326	<b>Shrub-Annual-Species-Perennial-Grass-late1-dense:</b> >5% non-native annual species cover; ≥50% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass; <10% young conifer cover
U-D:SAP (aka: SAP-1) 11260424	<b>Shrub-Annual-Species-Perennial-Grass-late2-open:</b> 10-30% cover of young mixed conifers <3m; >5% non-native annual species cover; 20-49% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass
U-D:SAP-Dense (aka: SAP-2) 11260426	<b>Shrub-Annual-Species-Perennial-Grass-late2-dense:</b> 10-30% cover of young mixed conifers <3m; >5% non-native annual species cover; ≥50% cover of mountain sagebrush (dominant) and mountain brush; >5% cover of native grass
U-A:Seeded Native (aka: SD) 11260135	<b>Seeded-Native-early:</b> >10% seeded native grasses, forbs, and shrubs; <10% big sagebrush cover; <5% non-native annual species cover (if ≥5% non-native annual species cover, then see U-A:SAP or Annual Spp)
U-B:Seeded Native (aka: SD) 11260235	<b>Seeded-Native-mid:</b> >10% seeded native grasses, forbs, and shrubs; ≥10% big sagebrush cover; <5% non-native annual species cover (if ≥5% non-native annual species cover, then see U-B:SAP)
U-A:SI (aka: SDI-A) 11260129	<b>Seeded-Introduced-Early:</b> >10% seeded introduced grasses and shrubs; <10% canopy of mountain sage, mountain brush; native grasses present to common; <5% cover of non-native annual species
U-B:SI (aka: SDI-B) 11260229	<b>Seeded-Introduced-Mid-open:</b> >10% seeded introduced grasses and shrubs; 10-19% cover of mountain sagebrush and mountain shrub; native grasses present to common; <5% cover of non-native annual species
U-C:SI (aka: SDI-C) 11260329	<b>Seeded-Introduced-Late-closed:</b> >5% seeded introduced grasses and shrubs; 20-49% cover of mountain sagebrush and mountain shrub; native grasses present to common; <5% cover of non-native annual species; <10% young conifer cover
U-C:SI-Dense (aka: SDI-D) 11260331	<b>Seeded-Introduced-Late-dense:</b> >5% seeded introduced grasses and shrubs; ≥50% cover of mountain sagebrush and mountain shrub; native grasses present to common; <5% cover of non-native annual species; <10% young conifer cover
U-A:SI+AS (aka: SI-A+AS) 11260138	<b>Seeded-Introduce +Annual-Species-Early:</b> >10% seeded introduced grasses and shrubs; <10% canopy of mountain sage, mountain brush; native grasses present to common; ≥5% cover of non-native annual species
U-B:SI+AS (aka: SI-B+AS) 11260238	<b>Seeded-Introduced+Annual-Species-Mid-Open :</b> >10% seeded introduced grasses and shrubs; 10-19% cover of mountain sage and mountain shrub; native grasses present to common; ≥5% cover of non-native annual species
U-C:SI+AS (aka: SI-C+AS) 11260338	<b>Seeded-Introduced+Annual-Species-Late-Closed:</b> >5% seeded introduced grasses and shrubs; 20-49% cover of mountain sage and mountain shrub; native grasses present to common; ≥5% cover of non-native annual species; <10% young conifer cover
U-C:SI+AS-Dense (aka: SI-D+AS)	<b>Seeded-Introduced+Annual-Species-Late-Dense:</b> >5% seeded introduced grasses and shrubs; ≥50% cover of mountain sage and mountain shrub; native grasses

11260339	present to common; ≥5% cover of non-native annual species; <10% young conifer cover
U-E:TEA 12611544	<b>Tree-Encroached or Tree–Annual-Grass:</b> >20% mixed conifers cover; if <5% annual grass cover then <5% shrub cover; <5% herbaceous cover; OR if ≥5% cover of annual grass then >0% shrub cover; >5% herbaceous cover
U-A:Unpalat. Forb (aka: UF) 11260146	<b>Unpalatable-Forb-early:</b> >25% Increaser forb cover, such as mules’ears wyethia or narrowleaf balsamroot; 0-10% cover of mountain sage, mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; young conifer absent
U-B:Unpalat. Forb (aka: UF) 11260246	<b>Unpalatable-Forb-mid:</b> >25% Increaser forb cover, such as mules’ears wyethia or narrowleaf balsamroot; 11-19% cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; young conifer absent;
U-C:Unpalat. Forb (aka: UF) 11260346	<b>Unpalatable-Forb-late1:</b> >25% Increaser forb cover, such as mules’ears wyethia or narrowleaf balsamroot; 20-49% cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species; <10% young conifer cover
U-D:Unpalat. Forb (aka: UF) 11260446	<b>Unpalatable-Forb-late2-open:</b> >25% Increaser forb cover, such as mules’ears wyethia or narrowleaf balsamroot; 10-30% cover of young mixed conifers <3m; ≥20% cover of mountain sagebrush (dominant) and mountain brush; <10% herbaceous cover; <5% cover of non-native annual species
U-E:Unpalat. Forb (aka: UF) 11260546	<b>Unpalatable-Forb-late2-closed:</b> >25% Increaser forb cover, such as mules’ears wyethia or narrowleaf balsamroot; >30% mixed conifers cover ≥3m; 6-20% shrub cover; <10% herbaceous cover; <5% cover of non-native annual species
<b>Mountain Shrub (MSh)(11060)</b>	<b>11060 – GSG habitat</b>
	Overview: The Mountain Shrub BpS includes several mountain shrub species that can each dominate: Utah serviceberry ( <i>Amelanchier utahensis</i> ), mountain snowberry ( <i>Symphoricarpos oreophilus</i> ), common chokecherry ( <i>Prunus virginiana</i> ), mountain oceanspray ( <i>Holodiscus dumosa</i> ) antelope bitterbrush ( <i>Purshia tridentata</i> ), and occasionally desert almond ( <i>Prunus fasciculata</i> ) at middle elevations at the mouth of mountain canyons. Mountain big sagebrush ( <i>Artemesia tridentata</i> spp. <i>vaseyana</i> ) is never more than 10% cover. These shrublands occur between 1,981 m and 2,581 m (6,500’ and 8,500’) of elevation and are usually associated on smooth to usually concave mountain side slopes on all aspects. The site is typically associated with talus and rubbleland lying below areas of rock outcrop and on fractured bedrock covered with shallow soil. Sites dominated by snowberry are often associated with landform features that cause deep snow accumulation on more gentle slopes where soils contain high rock volumes or rubble. Annual precipitation ranges from 35.5 cm and 46 cm (14” and 18”). Grasses are represented as species of bluebunch wheatgrass ( <i>Pseudoroegneria spicata</i> ), Thurber’s needlegrass ( <i>Achnatherum thurberianum</i> ), mountain brome ( <i>Bromus marginatus</i> ), slender wheatgrass ( <i>Elymus trachycaulus</i> ), and basin wildrye ( <i>Elymus cinereus</i> ).
A 11060010	<b>Early-all:</b> >10% cover of resprouting mountain shrubs; <10% cover of sagebrush; ≥10% grass and forb cover; 0-4 yrs
B 11060021	<b>Mid-closed:</b> >30% cover of fast and slow growing mountain shrubs (mountain snowberry, Utah serviceberry, chokecherry); <10% cover of sagebrush; ≥10% herbaceous cover; 5-19 yrs

C 11060032	<b>Late-open:</b> 5-10% cover of conifer sapling <2m tall; >30% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; <10% cover of sagebrush; ≥10% herbaceous cover; 20-79 yrs
D 11060042	<b>Late-Open:</b> 10-20% cover pinyon-juniper >2m tall; >25-40% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; <10% cover of sagebrush; ≥5% herbaceous cover; ≥80 yrs
U-A:Bare Ground (aka: BAGR) 11060101	<b>Bare-ground:</b> Mostly mineral soil due to anthropogenic disturbances
U-A:Exotic Forb (aka: EF) 11060108	<b>Exotic-Forb-early:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); >10% cover of resprouting mountain shrubs; <10% cover of sagebrush; native grass and forbs may be present
U-B:Exotic Forb (aka: EF) 11060208	<b>Exotic-Forb-mid:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); >30% cover of fast and slow growing mountain shrubs (mountain snowberry, Utah serviceberry, chokecherry); <10% cover of sagebrush; native grass and forbs may be present
U-C:Exotic Forb (aka: EF) 11060308	<b>Exotic-Forb-late:</b> 5-100% exotic forbs (thistles, halogeton, knapweed); 5-10% cover of conifer sapling <2m tall; >30% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; <10% cover of sagebrush; native grass and forbs may be present
U-A:Early Shrub (aka: ES) 11060105	<b>Early-Shrub-early:</b> >20% cover rabbitbrush species; >10% cover of resprouting mountain shrubs; <10% cover of sagebrush; <5% non-native annual species cover; native grasses and forbs may be present to common
U-B:Early Shrub (aka: ES) 11060205	<b>Early-Shrub-mid:</b> >20% cover rabbitbrush species; >30% cover of fast and slow growing mountain shrubs (mountain snowberry, Utah serviceberry, chokecherry); <10% cover of sagebrush; <5% non-native annual species cover; native grasses and forbs may be present to common
U-C:Early Shrub (aka: ES) 11060305	<b>Early-Shrub-late:</b> >20% cover rabbitbrush species; 5-10% cover of conifer sapling <2m tall; >30% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; <10% cover of sagebrush; <5% non-native annual species cover; native grasses and forbs may be present to common
U-B:Depleted (aka: DP) 11060203	<b>Depleted-mid:</b> >30% cover of less palatable shrubs and big sagebrush; <10% native grass cover; <5% non-native annual species cover; unpalatable native forbs often present to common
U-C:Depleted (aka: DP) 11060303	<b>Depleted-late:</b> <10% young conifer cover; >30% cover of less palatable shrubs and big sagebrush; <10% native grass cover; <5% non-native annual species cover; unpalatable native forbs often present to common
U-A:SAP 11060124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> ≥5% non-native annual species cover; >10% cover of resprouting mountain shrubs; <10% big sagebrush cover; >0% native herbaceous cover
U-B:SAP 11060224	<b>Shrub-Annual-Species-Perennial-Grass-mid:</b> ≥5% non-native annual species cover; >30% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; <10% big sagebrush cover; native herbaceous cover usually present
U-C:SAP 11060324	<b>Shrub-Annual-Species-Perennial-Grass-late:</b> <10% young conifer cover; ≥5% non-native annual species cover; >30% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; <10% cover of sagebrush; native herbaceous cover usually present

U-A:SI (aka: SDI-A) 11060129	<b>Seeded-Introduced-Early:</b> >10% seeded introduced grasses; >10% cover of resprouting mountain shrubs; native grasses present to common; <5% cover of non-native annual species
U-B:SI (aka: SDI-B) 11060229	<b>Seeded-Introduced-Mid-open:</b> >10% seeded introduced grasses; >30% cover of resprouting mountain shrubs; native grasses present to common; <5% cover of non-native annual species
U-C:SI (aka: SDI-C) 11060329	<b>Seeded-Introduced-Late-closed:</b> >5% seeded introduced grasses; 5-10% cover of conifer sapling <2m tall; >30% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; <5% cover of non-native annual species
U-D:SI (aka: SDI-D) 11060429	<b>Seeded-Introduced-Late-open:</b> >5% seeded introduced grasses; 10-20% cover pinyon-juniper >2m tall; >25-40% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; <10% cover of sagebrush; ≥5% herbaceous cover
U-A:SI+AS (aka: SI-A+AS) 11060138	<b>Seeded-Introduce +Annual-Species-early:</b> >10% seeded introduced grasses; >10% cover of resprouting mountain shrubs; native grasses present to common; ≥5% cover of non-native annual species
U-B:SI+AS (aka: SI-B+AS) 11060238	<b>Seeded-Introduced+Annual-Species-Mid-open :</b> >10% seeded introduced grasses; >30% cover of resprouting mountain shrubs; native grasses present to common; ≥5% cover of non-native annual species
U-C:SI+AS (aka: SI-C+AS) 11060338	<b>Seeded-Introduced+Annual-Species-Late1-closed:</b> >5% seeded introduced grasses; native grasses present to common; <10% young conifer cover; >30% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; ≥5% cover of non-native annual species
U-D:SI+AS (aka: SI-D+AS) 11060438	<b>Seeded-Introduced+Annual-Species-Late2-open:</b> >5% seeded introduced grasses; native grasses present to common; 10-20% cover pinyon-juniper >2m tall; >25-40% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; ≥5% cover of non-native annual species;
U-D:TEA 11060444	<b>Tree-encroached or Tree-annual-grass:</b> >20% pinyon or juniper cover; if <5% annual grass cover then <5% shrub cover; <5% herbaceous cover; <b>OR</b> if ≥5% cover of annual grass then >0% shrub cover; >5% herbaceous cover
U-A:Unpalat. Forb (aka: UF) 11060146	<b>Unpalatable-Forb-early:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; >10% cover of resprouting mountain shrubs; <10% big sagebrush cover; <10% native herbaceous cover
U-B:Unpalat. Forb (aka: UF) 11060246	<b>Unpalatable-Forb-mid:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; >30% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; <10% big sagebrush cover; native herbaceous cover usually present
U-C:Unpalat. Forb (aka: UF) 11060346	<b>Unpalatable-Forb-late1-open:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; <10% young conifer cover; >30% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; <10% cover of sagebrush; native herbaceous cover usually present
U-D:Unpalat. Forb (aka: UF) 11060446	<b>Unpalatable-Forb-late2-open:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; 10-20% cover pinyon-juniper >2m tall; >25-40% cover of serviceberry, antelope bitterbrush, mountain snowberry, or chokecherry; <10% cover of sagebrush; ≥5% herbaceous cover
<b>Pickleweed(PW)(11531)</b>	<b>11531- not GSG habitat</b>

A 11531010	<b>Early-all:</b> >5% herbaceous cover of inland salt grass, alkali sacaton, or basin wildrye; ≤5% young or resprouting pickleweed; >25% mineral soil; flood debris may be abundant; 0-4 years
<b>Pinyon-Juniper Woodland (PJ)(10190)</b>	<b>10190 – not GSG habitat</b>
	Overview: The Pinyon-Juniper Woodland BpS is typically found from 1,600-2,743 m (5,250'-9,000') above the 25 cm (10") precipitation zone. This BpS generally occurs on most soils and landforms, especially fire-safe sites of steep (8% to 75% slopes) and rocky slopes. Soils supporting this system are generally skeletal and vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay. Woodlands comprising this system are dominated by <i>Juniperus osteosperma</i> with <i>Pinus monophylla</i> increasing towards the south. Typical understory layers are variable and include big sagebrush, antelope bitterbrush, black sagebrush, and curl-leaf mountain mahogany. Grass and shrub species are often diverse and common, although not abundant.
A 10190010	<b>Early-all:</b> 5-20% herbaceous cover; charred stumps and trunks; <10% cover of big sagebrush or bitterbrush; 0-9 yrs
B 10190022	<b>Mid1-open:</b> 11-30% cover big sagebrush or bitterbrush <1.0m; 10-40% herbaceous cover; 10-29 yrs
C 10190032	<b>Mid2-open:</b> 11-20% cover of young (<100 yrs old and usually conical) juniper and/or pinyon <5m; 10-20% shrub cover; <20% herbaceous cover; 30-99 yrs
D 10190042	<b>Late-open:</b> 21-60% cover of old juniper and/or pinyon, generally with thick lateral branches 5m-9m high; 10-40% shrub cover; <20% herbaceous cover; ≥100 yrs
U-A:Annual Spp (aka: AS) 10190100	<b>Annual-Species:</b> >10% non-native annual grasses cover; dead juniper visible; <5% native grass cover; <5% sagebrush or mountain shrub cover
U-A:Exotic Forb (aka: EF) 10190108	<b>Exotic-Forbs-early:</b> 5-100% exotic forbs (knapweed, thistles, halogeton); <20% herbaceous cover; charred stumps and trunks; sagebrush and mountain shrub cover
U-B:Exotic Forb (aka: EF) 10190208	<b>Exotic-Forbs-mid1:</b> 5-90% exotic forbs (knapweed, thistles, halogeton); 11-30% cover big sagebrush or bitterbrush <1.0m; <40% herbaceous cover
U-C:Exotic Forb (aka: EF) 10190308	<b>Exotic-Forbs-mid2:</b> 5-80% exotic forbs (knapweed, thistles, halogeton); 11-20% cover of young (<100 yrs old) juniper and/or pinyon <5m; 10-20% shrub cover; <20% herbaceous cover
U-A:SAP 10190124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> >5% non-native annual species; >5% native herbaceous cover; <10% cover of big sagebrush or bitterbrush
U-B:SAP 10190224	<b>Shrub-Annual-Species-Perennial-Grass-mid1:</b> >5% non-native annual species; 11-30% cover big sagebrush or bitterbrush <1.0m; >5% herbaceous cover; tree sapling can be present in older patches of this class
U-C:TEA (aka: TA) 10190344	<b>Tree-Annual-Species-mid2:</b> >5% non-native annual species cover; 11-20% cover of young juniper and/or pinyon; 10-40% shrub cover; native herbaceous varies greatly with soil productivity; ≥100 yrs
U-D:TEA (aka: TA) 10190444	<b>Tree-Annual-Species-late:</b> >5% non-native annual species cover; 20-60% cover of older juniper and/or pinyon <5m-9m; <40% shrub cover; native herbaceous varies greatly with soil productivity; ≥100 yrs

U-A:Unpalat. Forb (aka: UF) 10190146	<b>Unpalatable-Forb-early:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; <10% cover of sagebrush, mountain brush; <10% herbaceous cover <5% cover of non-native annual species; conifer absent
U-B:Unpalat. Forb (aka: UF) 10190246	<b>Unpalatable-Forb-mid1:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; 11-29% cover of sagebrush (dominant) and mountain brush; <40% native herbaceous cover; <5% cover of non-native annual species; tree sapling can be present in older patches of this class
U-C:Unpalat. Forb (aka: UF) 10190346	<b>Unpalatable-Forb-mid2:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot;10-20% cover of young juniper and/or pinyon; 10-40% shrub cover; native herbaceous varies greatly with soil productivity
U-D:Unpalat. Forb (aka: UF) 10190446	<b>Unpalatable-Forb-late:</b> >25% Increaser forb cover, such as mules'ears wyethia or narrowleaf balsamroot; 20-60% cover of older juniper and/or pinyon <5m-9m; <40% shrub cover; native herbaceous varies greatly with soil productivity
U-A:SI (aka: SDI-A) 10190129	<b>Seeded-Introduced-Early:</b> >10% seeded introduced grasses and shrubs; <10% canopy of sagebrush, mountain brush; native grasses present to common; <5% cover of non-native annual species
U-B:SI (aka: SDI-B) 10190229	<b>Seeded-Introduced-Mid1:</b> >10% seeded introduced grasses; >10% cover of sagebrush and mountain shrubs; native grasses present to common; <5% cover of non-native annual species; tree sapling can be present in older patches of this class
U-A:SI+AS (aka: SI-A+AS) 10190138	<b>Seeded-Introduce+Annual-Species-Early:</b> >10% seeded introduced grasses and shrubs; ≥5% cover of non-native annual species <10% canopy of sagebrush, mountain brush; native grasses present to common;
U-B:SI+AS (aka: SI-B+AS) 10190238	<b>Seeded-Introduced+Annual-Species-Mid1:</b> >10% seeded introduced grasses; >10% cover of mountain sage and mountain shrub; ≥5% cover of non-native annual species; native grasses present to common; tree sapling can be present in older patches of this class
<b>Roads-Local(10032)</b>	<b>10032 – not GSG habitat</b>
U-A:Bare Ground 10032101	<b>Bare-Ground:</b> Local dirt road bigger than two-track roads
<b>Roads-Paved(10031)</b>	<b>10031 – not GSG habitat</b>
U-A:Paved 10031120	<b>Paved:</b> Paved road
<b>Saline Meadow (SM)(11451)</b>	<b>1145sm or 11451 – not GSG habitat</b>
	Overview: The Saline Meadow BpS is found at the bottom of broad valleys or axial valley, and on alluvial flats at elevations of 1,219 m to 1,829 m (4,000' to 6,000') with slopes between 0-4%, although more typically <2%, usually surrounded by salt tolerant plant communities. The BpS is wetted by an elevated water table at a depth of 102 cm (40") on saline soils and between 51-102 cm (20" to 40") on sodic floodplains that periodically rise to the surface during the spring or is spring-fed in broad valley bottoms. Saturated soils support graminoid dominance. Soils are deep saline and often calcareous or sodic and made of alluvium of mixed origins. Average annual precipitation ranges from 15 to 25 cm (6" to 10"). Alkali sacaton ( <i>Sporobolus airoides</i> ) and alkali muhly ( <i>Muhlenbergia asperifolia</i> ) dominate, although inland saltgrass ( <i>Distichlis spicata</i> ), and alkali cordgrass ( <i>Spartina gracilis</i> ) may co-dominate.

	Inland saltgrass dominates on sodic soils. Black greasewood ( <i>Sarcobatus vermiculatus</i> ), iodine bush ( <i>Allenrolfea occidentalis</i> ), silver buffaloberry ( <i>Shepherdia argentea</i> ), alkali rabbitbrush ( <i>Chrysothamnus albidus</i> ), and willow ( <i>Salix</i> spp.) may be present at low abundance. As the sodium concentration in the soil increases, vegetation cover decreases from <70% to <15%.
A 11451010	<b>Early-all:</b> 10-39% alkali sacaton and other salt-tolerant grasses cover; >60% mineral soil cover; 0-2 yrs
B 11451021	<b>Mid-closed:</b> ≥40% alkali sacaton and other salt-tolerant grasses cover; >30% mineral soil cover; <5% shrub cover; 3-22 yrs
C 11451032	<b>Late-open:</b> 5-10% shrub (greasewood and other shrubs) cover; ≥40% alkali sacaton and other salt-tolerant grasses cover; >50% mineral soil cover; >22 yrs
U-A:Annual Spp (aka: AS) 11451100	<b>Annual-Species:</b> ≥10% cover of non-native annual species; <10% inland saltgrass, Baltic rush cover, and other salt-tolerant grasses cover; <10% shrub cover; >30% mineral soil cover
U-A:Bare Ground (aka: BAGR) 11451101	<b>Bare-Ground: Bare-ground:</b> Mostly mineral soil due to anthropogenic disturbances
U-B:Depleted (aka: DP) 11451203	<b>Depleted:</b> <5% shrub cover (greasewood and other shrubs); <40% of inland saltgrass and Baltic rush cover; 10-30% cover of bare ground
U-C:Depleted (aka: DP) 11451303	<b>Depleted:</b> ≥5% shrub cover (greasewood and other shrubs); <40% of inland saltgrass and Baltic rush cover; 10-30% cover of bare ground
U-A:Exotic-Forb-Tree (aka: EFT) 11451106	<b>Exotic-Forb-Tree-early:</b> >5% cover of exotic forb species or tree species (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 10-39% alkali sacaton and other salt-tolerant grasses cover; native shrub absent; 10-30% cover of bare ground
U-B:Exotic-Forb-Tree (aka: EFT) 11451206	<b>Exotic-Forb-Tree-mid:</b> >5% cover of exotic forb species or tree species on un-incised waterways (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); <5% shrub cover (greasewood and other shrubs); ≥40% of inland saltgrass and Baltic rush cover; 10-30% cover of bare ground
U-C:Exotic-Forb-Tree (aka: EFT) 11451306	<b>Exotic-Forb-Tree-late:</b> >5% cover of exotic forb species or tree species on un-incised waterways (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); ≥5% shrub cover (greasewood and other shrubs); ≥40% of inland saltgrass and Baltic rush cover; 10-30% cover of bare ground
U-A:Hummocked (aka: HU) 11451110	<b>Hummocked:</b> Trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs
U-A:SAP (aka: ASPG) 11451124	<b>Shrub-Annual-Species-Perennial-Grass-early :</b> ≥5% cover of non-native annual species; 10-39% inland saltgrass, Baltic rush cover, and other salt-tolerant grasses cover; native shrubs absent; >20% mineral soil cover
U-B:SAP 11451224	<b>Shrub-Annual-Species-Perennial-Grass-mid:</b> ≥5% non-native annual species cover; <5% cover of native shrubs; ≥40% inland saltgrass and Baltic rush cover
U-C:SAP 11451324	<b>Shrub-Annual-Species-Perennial-Grass-late:</b> ≥5 non-native annual species cover; ≥5% cover of native shrubs; ≥10% inland saltgrass and Baltic rush cover
<b>Semi-Desert Grassland (SDG)(11350)</b>	<b>11350 – GSG habitat</b>

	<p>Overview: The Semi-Desert Grassland BpS occupies sandy soil and is found at approximately 1,450m to 2,320 m (4,750'-7,610') of elevation. Indian ricegrass (<i>Stipa hymenoides</i>) is often the diagnostic and dominant grass species. Needle-and-thread (<i>Stipa comata</i>) is also common with greater soil moisture. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesa tops, plateau parks, alluvial flats, and plains, but sites are typically xeric. Substrates are often well-drained sandy or loamy-textured soils derived from sedimentary parent materials but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. Where they occur near foothill grasslands, they will be at lower elevations. These grasslands occur on a variety of aspects and slopes. Sites may range from flat to moderately steep. Annual precipitation is usually from 20-40 cm (7.9"-15.7"). Grasslands within this system are typically characterized by a sparse to moderately dense herbaceous layer dominated by medium-tall and short bunch grasses, often in a sod-forming growth. The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant plants. In some sites, scattered and usually old pinyon and juniper can be present in late succession as a result of badlands dynamics.</p>
A 1135010	<p><b>Early-all:</b> &lt;5% shrub cover (rabbitbrush, snakeweed, big sagebrush, salt desert species); &gt;10% cover of grasses (Indian ricegrass, needle-and-thread, desert needlegrass); sandy soil cover may be high; 0-19 yrs</p>
B 11350021	<p><b>Late-closed:</b> ≥5% shrub cover (rabbitbrush, sagebrush, salt desert species); &gt;25% cover of grasses (Indian ricegrass, needle-and-thread, desert needlegrass); &lt;20% cover of pinyon or juniper saplings earlier during succession and older scattered individuals much later in succession; sandy soil cover may be high; ≥20 yrs</p>
U-A:Bare Ground (aka: BAGR) 11350101	<p><b>Bare-Ground:</b> Mostly mineral soil due to anthropogenic disturbances</p>
U-B:Depleted (aka: DP) 11350203	<p><b>Depleted:</b> ≥5% shrub (mostly rabbitbrush, sagebrush, salt desert species) cover; &lt;10% cover of grasses; 10-30% bare ground cover; &lt;20% cover of pinyon or juniper; sandy soil cover may be high</p>
U-A:Early Shrub (aka: ES) 11350105	<p><b>Early Shrub-early:</b> ≥10% cover of rabbitbrush; &lt;5% cover of big sagebrush and salt desert species; ≤10% native grass cover; 10-30% bare ground cover; sandy soil cover may be high</p>
U-B:Early Shrub (aka: ES) 11350205	<p><b>Early Shrub-late:</b> ≥10% cover of rabbitbrush; ≥5% cover of big sagebrush and salt desert species; ≤10% native grass cover; 10-30% bare ground cover; sandy soil cover may be high</p>
U-A:SAP (aka: ASPG) 11350124	<p><b>Shrub-Annual-Perennial-Grass-early:</b> ≥5% cover of annual grasses; &lt;5% shrub (mostly rabbitbrush, sagebrush, and salt desert species) cover; native grasses may be present to common; sandy soil cover may be high</p>
U-B:SAP 11350224	<p><b>Shrub-Annual-Perennial-Grass-late:</b> ≥5% cover of annual grasses; ≥5% shrub (mostly rabbitbrush, sagebrush, and salt desert species) cover; native grasses may be present to common; &lt;20% cover of pinyon or juniper; sandy soil cover may be high</p>
U-A:SI (aka: SDI) 11350129	<p><b>Seeded-Introduced-early:</b> &gt;10% cover of introduced seeded grass species; &lt;5% cover of cheatgrass; &lt;5% cover of sagebrush and other salt desert shrubs; native grasses may be present to common; sandy soil cover may be moderately high</p>
U-B:SI (aka: SDI) 11350229	<p><b>Seeded-Introduced-late:</b> &gt;10% cover of introduced seeded grass species; &lt;5% cover of cheatgrass; ≥5% cover of sagebrush and other salt desert shrubs; native grasses may be present to common; sandy soil cover may be moderately high</p>

U-A:SI+AS (aka: SDI+AS) 11350138	<b>Seeded-Introduced+Annual-Species-early:</b> >10% cover of introduced seeded grass species; ≥5% cover of annual grasses; <5% cover of sagebrush and other salt desert shrubs; native grasses may be present to common; sandy soil cover may be moderately high
U-B:SI+AS (aka: SDI+AS) 11350238	<b>Seeded-Introduced+Annual-Species-late:</b> >10% cover of introduced seeded grass species; ≥5% cover of annual grasses; ≥5% cover of sagebrush and other salt desert shrubs; native grasses may be present to common; sandy soil cover may be moderately high
<b>Subalpine-Upper Montane Grassland (SMG)(11400)</b>	<b>11400 – GSG habitat</b>
	Overview: The Subalpine-Upper Montane Grassland BpS ranges from elevations of 1,676 m to over 3,048 m (5,500' to over 10,000'). Average annual precipitation is >36 cm (>14"). The soils are moderately deep to very deep to bedrock and well drained. These soils are modified by high volumes of pebbles, gravel, rock fragments through their profile. Heavy snow accumulation on this site often persists into summer and significantly reduces the potential plant growth period. Snow melt adds to the soils moisture supply. Site is medium to rapid and potential for surface erosion is moderate to high depending on slope. Graminoids dominant and species composition changes with elevation. At lower elevations, meadow barley ( <i>Hordeum brachyantherum</i> ), bluegrasses ( <i>Poa</i> spp.), and sedges ( <i>Carex</i> spp.) dominate. As elevation increases, Idaho fescue ( <i>Festuca idahoensis</i> ), Cusick's bluegrass ( <i>Poa cusickii</i> ), and bluebunch wheatgrass ( <i>Pseudoroegneria spicata</i> ) become dominant, and mountain big sagebrush ( <i>Artemisia tridentata</i> spp. <i>vaseyana</i> ) is a minor shrub component. At subalpine elevation, slender wheatgrass ( <i>Elymus trachycaulus</i> ) and Letterman's needlegrass ( <i>Achnatherum lettermanii</i> ) are dominant, whereas wyethia ( <i>Wyethia</i> spp.) and lupines ( <i>Lupinus</i> spp.) are sub-dominant forb species. A few shrub species are normally incidental: rabbitbrush ( <i>Chrysothamnus</i> spp.), mountain snowberry ( <i>Symphoricarpos oreophilus</i> ), Wood's rose ( <i>Rosa woodsii</i> ), or low sagebrush ( <i>Artemisia arbuscula</i> ).
A 11400010	<b>Early-all:</b> 5-19% grass and sedge cover; ≤20% forb cover; abundant bare ground and rock cover; <5% shrub cover; 0-4 yrs
B 11400021	<b>Mid-closed:</b> ≥20% graminoid cover; ≤10% forb cover; abundant bare ground and rock cover; <5% shrub cover; 5-9 yrs
C 11400032	<b>Late-open:</b> 5-10% shrub cover; ≥20% graminoid cover; common bare ground and rock cover; <5% palatable forb cover; >10 yrs
U-A:Unpalat. Forb (aka: UF) 11260146	<b>Unpalatable-Forb-early:</b> >20% Increaser forb cover, such as lupine, mules'ears wyethia or narrowleaf balsamroot; <20% native grass cover; ≤20% palatable forb cover; <5% shrub cover
U-B:Unpalat. Forb (aka: UF) 11260246	<b>Unpalatable-Forb-mid:</b> >20% Increaser forb cover, such as lupine, mules'ears wyethia or narrowleaf balsamroot; ≥20% graminoid cover; ≤10% palatable forb cover; abundant bare ground and rock cover; <5% shrub cover
U-C:Unpalat. Forb (aka: UF) 11260346	<b>Unpalatable-Forb-late:</b> >20% Increaser forb cover, such as lupine, mules'ears wyethia or narrowleaf balsamroot; ≥5% shrub cover; native grass cover highly variable; <5% palatable forb cover

<b>Water(10040)</b>	<b>10040 – not GSG habitat</b>
A 10040011	<b>Water:</b> natural waterway
U-A:Water 10040148	<b>Anthropogenic Water:</b> water in reservoirs, impoundment, or irrigation ditch
<b>Wet Meadow - bottomland (Wmb)(11452)</b>	<b>1145wmb or 11452 – not GSG habitat</b>
	<i>Overview:</i> The Wet Meadow-bottomland BpS is found in bottomland floodplains or adjacent to valley axial streams. Slope is typically less than 2%. The BpS is wetted by an elevated water table about 51 cm (20”) from the surface during the growing season and adjacent to rivers, or is spring-fed. Saturated soils support graminoid dominance. Elevation is generally below 1,524 m (5,000’) and annual precipitation is between 15 cm and 25 cm (6” and 10”). Being in a floodplain away from the main channel, bottomland wet meadows can experience large flood events and fine sediment accumulation. Above 20 cm (8”) of annual precipitation, tufted hairgrass ( <i>Deschampia cespitosa</i> ) dominates and Nevada bluegrass ( <i>Poa nevadensis</i> ) codominates, whereas Alkali bluegrass ( <i>Poa juncifolia</i> ) dominates and alkali sacaton ( <i>Sporobolus airoides</i> ) codominates below 20 cm (8”) of annual precipitation. Baltic rush ( <i>Juncus balticus</i> ), inland saltgrass ( <i>Distichlis spicata</i> ), and alkali cordgrass ( <i>Spartina gracilis</i> ) are also common, especially as soil become more saline or sodic. The presence of shrubs (willow [ <i>Salix</i> spp.], Wood’s rose [ <i>Rosa woodsii</i> ], silver buffaloberry [ <i>Shepherdia argenta</i> ]) at the meadow’s edge increases during consecutive drought years and decreases during consecutive high water years.
A 11452010	<b>Early-all:</b> 10-60% herbaceous cover – mostly graminoids; 0-2 yrs
B 11452021	<b>Mid-closed:</b> 61-100% herbaceous cover – mostly graminoids; <5% woody species; 3-22 yrs
C 11452032	<b>Late-open:</b> 5-10% tree-shrub (willow, Wood’s rose, silver sagebrush, silver buffaloberry) cover; 60-80% herbaceous cover – mostly graminoids; >22 yrs
U-A:Annual Spp (aka: AS) 11450100	<b>Annual-Species (on incised meadow):</b> >10% cover of non-native annual species; <5% shrub cover; <5% cover of native grass species
U-A:Bare Ground (aka: BAGR) 11452101	<b>Bare-Ground: Bare-ground:</b> Mostly mineral soil due to anthropogenic disturbances
U-B:Depleted (aka: DP) 11452203	<b>Depleted (incised)-mid:</b> Incised meadow creek with 5-10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood’s Rose); <5% native graminoid cover; <5% non-native annual species cover
U-C:Depleted (aka: DP) 11452303	<b>Depleted (incised)-late:</b> Incised meadow creek with >10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood’s Rose); <5% native graminoid cover; <5% non-native annual species cover

U-A:Desertified (aka: DE) 11452104	<b>Desertified (incised)-early:</b> Incised meadow creek with 5-20% native graminoid cover; 0% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); <5% non-native annual species cover
U-B:Desertified (aka: DE) 11452204	<b>Desertified (incised)-mid:</b> Incised meadow creek with ≤10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose); 21-80% native graminoid cover; <5% non-native annual species cover
U-C:Desertified (aka: DE) 11452304	<b>Desertified (incised)-late:</b> Incised meadow creek with >10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose); <75% native graminoid cover; <5% non-native annual species cover
U-A:Exotic Forb (aka: EF) 11452108	<b>Exotic-Forbs-early:</b> >5% exotic forbs (knapweed, tall whitetop, purple loosestrife, thistles); 10-60% herbaceous cover – mostly graminoids
U-B:Exotic Forb (aka: EF) 11452208	<b>Exotic-Forbs-mid:</b> >5% exotic forbs (knapweed, tall whitetop, purple loosestrife, thistles); 61-100% herbaceous cover – mostly graminoids; <5% woody species
U-C:Exotic Forb (aka: EF) 11452308	<b>Exotic-Forbs-late:</b> >5% exotic forbs (knapweed, tall whitetop, purple loosestrife, thistles); >5% tree-shrub (willow, Wood's rose, silver sagebrush) cover; graminoid cover highly variable
U-A:Early Shrub (aka: ES) 11452105	<b>Early-Shrub-early:</b> on incised meadow >10% cover of rabbitbrush or snakeweed species; big sagebrush and rabbitbrush uncommon; native grasses may be present; <5% cover of non-native annual species
U-B:Early Shrub (aka: ES) 11452205	<b>Early-Shrub-mid:</b> on incised meadow >10% cover of rabbitbrush or snakeweed species; 1-11% cover of big sagebrush; native grasses may be present; <5% cover of non-native annual species
U-C:Early Shrub (aka: ES) 11452305	<b>Early-Shrub-late:</b> on incised meadow >10% cover of rabbitbrush or snakeweed species; ≥11% cover of big sagebrush; native grasses may be present; <5% cover of non-native annual species
U-A:Hummocked (aka: HU) 11452110	<b>Hummocked:</b> Trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs
U-A:Incised-EFT 11452111	<b>Incised-Exotic-Forb-Tree-early:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 5-20% native grass cover; 0% cover of upland shrubs
U-B:Incised-EFT 11452211	<b>Incised-Exotic-Forb-Tree-mid,-late:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); <10% cover of upland shrubs (e.g., big sagebrush snakeweed, rabbitbrush, Wood's Rose); non-native annual species cover may be present; <80% native grass cover
U-C:Incised-EFT 11452311	<b>Incised-Exotic-Forb-Tree-late:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); >10% cover of upland shrubs (e.g., big sagebrush snakeweed, rabbitbrush, Wood's Rose); non-native annual species cover may be present; <75% native grass cover
U-A:Pasture (aka: PAS) 11452119	<b>Pasture:</b> Agricultural pasture

U-A:SAP (aka: ASPG) 11452124	<b>Shrub-Annual-Species-Perennial-Grass (on incised meadow)-early:</b> >5% native grass may be present; ≥5% cover of non-native annual species; <10% cover of native shrubs
U-B:SAP 11452224	<b>Shrub-Annual-Species-Perennial-Grass (on incised meadow)-mid:</b> 10-19% cover of native shrubs; ≥5% cover of native grass; ≥5% cover of non-native annual species
U-C:SAP 11452324	<b>Shrub-Annual-Species-Perennial-Grass (on incised meadow)-late:</b> ≥20% cover of native shrubs; ≥5% cover of native grass; ≥5% cover of non-native annual species
U-A:Shrb-Frb Encr (aka: SFE) 11452137	<b>Shrub-Forb-Encroached-early:</b> >10% cover of less palatable grasses and forbs (e.g., <i>Iris missouriensis</i> ); 10-60% herbaceous cover – mostly graminoids; no woody cover; 10-30% cover of bare ground
U-B:Shrb-Frb Encr (aka: SFE) 11452237	<b>Shrub-Forb-Encroached-mid:</b> >10% cover of less palatable grasses and forbs (e.g., <i>Iris missouriensis</i> ); 61-80% herbaceous cover – mostly graminoids; <5% shrub cover (willow, Wood’s rose, silver sagebrush); 10-30% cover of bare ground
U-C:Shrb-Frb Encr (aka: SFE) 11452337	<b>Shrub-Forb-Encroached-late:</b> >10% shrub cover (willow, Wood’s rose, silver sagebrush); less palatable grasses and forbs (e.g., <i>Iris missouriensis</i> ) may be present to common; <80% herbaceous cover – mostly graminoids; 10-30% cover of bare ground
<b>Wet Meadow - montane (WM)(11450)</b>	<b>1145wm or 11450 – GSG habitat</b>
	Overview: The Wet Meadow BpS is wetted by an elevated water table about 51 cm (20”) from the surface during the growing season and adjacent to creeks or rivers, or is spring-fed. Three types are included here: true wet meadows close to mountain streams and around or below seeps and springs, clay seeps dominated by grasses and mules’ ears wyethia, and dry “wet” meadows that dry out during the hot season. Saturated soils support graminoid dominance. Elevation ranges from 1,524 m to 2,896 m (5,000’ to 9,500’) and annual precipitation is between 25 cm and 41 cm (10” and 16”). Tufted hairgrass ( <i>Deschampia cespitosa</i> ) dominates and Nevada bluegrass ( <i>Poa nevadensis</i> ) codominates in true wet meadows, whereas Nevada bluegrass dominates in dry meadows. Alpine timothy ( <i>Phleum alpinum</i> ) and sedges ( <i>Carex</i> spp.) are also common in both types of wet meadows. Clay seeps are dominated by Idaho fescue ( <i>Festuca idahoensis</i> ), mountain brome ( <i>Bromus marginatus</i> ), mules’ ears wyethia ( <i>Wyethia amplexicaulis</i> ), and whitehead wyethia ( <i>Wyethia helenioides</i> ). The presence of shrubs (willow [ <i>Salix</i> spp.], Wood’s rose [ <i>Rosa woodsii</i> ], silver sagebrush [ <i>Artemisia cana</i> ]) at the meadow’s edge increases during consecutive drought years and decreases during consecutive high water years.
A 11450010	<b>Early-all:</b> 10-60% herbaceous cover – mostly graminoids; 0-2 yrs
B 11450021	<b>Mid-closed:</b> 61-100% herbaceous cover – mostly graminoids; <5% woody species; 3-22 yrs
C 11450032	<b>Late-open:</b> 5-10% tree-shrub (willow, Wood’s rose, silver sagebrush) cover; 60-80% herbaceous cover – mostly graminoids; >22 yrs
U-A:Annual Spp (aka: AS) 11450100	<b>Annual-Species (on incised meadow):</b> >10% cover of non-native annual species; <10% shrub cover; <5% cover of native grass species
U-A:Bare Ground (aka: BAGR)	<b>Bare-Ground:</b> Mostly mineral soil due to anthropogenic disturbances

11450101	
U-B:Depleted (aka: DP) 11450203	<b>Depleted (incised)-mid:</b> Incised meadow creek with 5-10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose); <5% native graminoid cover; <5% non-native annual species cover
U-C:Depleted (aka: DP) 11450303	<b>Depleted (incised)-late:</b> Incised meadow creek with >10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose); <5% native graminoid cover; <5% non-native annual species cover
U-A:Desertified (aka: DE) 11450104	<b>Desertified (incised)-early:</b> Incised meadow creek with 5-20% native graminoid cover; 0% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose, silver buffaloberry); <5% non-native annual species cover
U-B:Desertified (aka: DE) 11450204	<b>Desertified (incised)-mid:</b> Incised meadow creek with ≤10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose); 21-80% native graminoid cover; <5% non-native annual species cover
U-C:Desertified (aka: DE) 11450304	<b>Desertified (incised)-late:</b> Incised meadow creek with >10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose); <75% native graminoid cover; <5% non-native annual species cover
U-A:Exotic Forb (aka: EF) 11450108	<b>Exotic-Forbs-early:</b> >5% exotic forbs (knapweed, tall whitetop, purple loosestrife, thistles); 10-60% herbaceous cover – mostly graminoids
U-B:Exotic Forb (aka: EF) 11450208	<b>Exotic-Forbs-mid:</b> >5% exotic forbs (knapweed, tall whitetop, purple loosestrife, thistles); 61-100% herbaceous cover – mostly graminoids; <5% woody species
U-C:Exotic Forb (aka: EF) 11450308	<b>Exotic-Forbs-late:</b> >5% exotic forbs (knapweed, tall whitetop, purple loosestrife, thistles); >5% tree-shrub (willow, Wood's rose, silver sagebrush) cover; graminoid cover highly variable
U-A:Early Shrub (aka: ES) 11450105	<b>Early-Shrub-early:</b> on incised meadow >10% cover of rabbitbrush or snakeweed species; big sagebrush and rabbitbrush uncommon; native grasses may be present; <5% cover of non-native annual species
U-B:Early Shrub (aka: ES) 114501205	<b>Early-Shrub-mid:</b> on incised meadow >10% cover of rabbitbrush or snakeweed species; 1-11% cover of big sagebrush; native grasses may be present; <5% cover of non-native annual species
U-C:Early Shrub (aka: ES) 11450305	<b>Early-Shrub-late:</b> on incised meadow >10% cover of rabbitbrush or snakeweed species; ≥11% cover of big sagebrush; native grasses may be present; <5% cover of non-native annual species
U-A:Hummocked (aka: HU) 11450110	<b>Hummocked:</b> Trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs
U-A:Incised-EFT 11450111	<b>Incised-Exotic-Forb-Tree-early:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); 5-20% native grass cover; 0% cover of upland shrubs
U-B:Incised-EFT 11450211	<b>Incised-Exotic-Forb-Tree-mid,-late:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); <10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush, Wood's Rose); non-native annual species cover may be present; <80% native grass cover
U-C:Incised-EFT 11450311	<b>Incised-Exotic-Forb-Tree-late:</b> >5% cover of exotic forb species or tree species on <u>incised</u> banks (knapweed, tall whitetop, thistles, purple loosestrife, saltcedar, Russian olive); >10% cover of upland shrubs (e.g., big sagebrush, snakeweed, rabbitbrush,

	Wood's Rose); non-native annual species cover may be present; <75% native grass cover
U-A:Pasture (aka: PAS) 11450119	<b>Pasture:</b> Agricultural pasture
U-A:SAP (aka: ASPG) 11450124	<b>Shrub-Annual-Species-Perennial-Grass (on incised meadow)-early:</b> >5% native grass may be present; ≥5% cover of non-native annual species; <10% cover of native shrubs
U-B:SAP 11450224	<b>Shrub-Annual-Species-Perennial-Grass (on incised meadow)-mid:</b> 10-19% cover of native shrubs; ≥5% cover of native grass; ≥5% cover of non-native annual species
U-C:SAP 11450324	<b>Shrub-Annual-Species-Perennial-Grass (on incised meadow)-late:</b> ≥20% cover of native shrubs; ≥5% cover of native grass; ≥5% cover of non-native annual species
U-A:Shrb-Frb Encr (aka: SFE) 11450137	<b>Shrub-Forb-Encroached-early:</b> >10% cover of less palatable grasses and forbs (e.g., <i>Iris missouriensis</i> ); 10-60% herbaceous cover – mostly graminoids; no woody cover; 10-30% cover of bare ground
U-B:Shrb-Frb Encr (aka: SFE) 11450237	<b>Shrub-Forb-Encroached-mid:</b> >10% cover of less palatable grasses and forbs (e.g., <i>Iris missouriensis</i> ); 61-80% herbaceous cover – mostly graminoids; <5% shrub cover (willow, Wood's rose, silver sagebrush, rabbitbrush); 10-30% cover of bare ground
U-C:Shrb-Frb Encr (aka: SFE) 11450337	<b>Shrub-Forb-Encroached-late:</b> >10% shrub cover (willow, Wood's rose, silver sagebrush); less palatable grasses and forbs (e.g., <i>Iris missouriensis</i> ) may be present to common; <80% herbaceous cover – mostly graminoids; 10-30% cover of bare ground
U-A:SI (aka: SDI-A) 10801129	<b>Seeded-Introduced-early:</b> >10% seeded introduced grasses, with native grasses and forbs possible; <5% of non-native annual species
U-B:SI (aka: SDI-B) 10801229	<b>Seeded-Introduced-mid:</b> >10% seeded introduced grasses, with native grasses and forbs possible; 1-10% cover of shrubs (big sagebrush, rabbitbrush); <5% of non-native annual species
U-C:SI (aka: SDI-C) 10801329	<b>Seeded-Introduced-late:</b> >10% seeded introduced grasses, with native grasses and forbs possible; >10% cover of shrubs (big sagebrush, rabbitbrush); <5% of non-native annual species
U-A:SI+AS (aka: SI-A+AS) 10801128	<b>Seeded-Introduced+Annual-Species-early:</b> >10% seeded introduced grasses, with native grasses and forbs possible; shrubs generally absent; ≥5% cover of non-native annual species
U-B:SI+AS (aka: SI-B+AS) 10801228	<b>Seeded-Introduced+Annual-Species-mid:</b> >10% seeded introduced grasses, with native grasses and forbs possible; 1-10% cover of shrubs (big sagebrush, rabbitbrush); ≥5% cover of non-native annual species
U-C:SI+AS (aka: SI-C+AS) 10801328	<b>Seeded-Introduced+Annual-Species-late:</b> >10% seeded introduced grasses, with native grasses and forbs possible; >10% cover of shrubs (big sagebrush, rabbitbrush); ≥5% cover of non-native annual species
U-A:Stock Tank 11450143	<b>Stock-Tank:</b> stock pond or stock tank in meadow
<b>Wetland (WL)(11543)</b>	<b>1001wl or 11543 – not GSG habitat</b>

	Overview: The Wetland BpS is found in bottomland floodplains or adjacent to valley axial streams. Wetlands are generally formed by flood events cutting river meanders and creating backwater wetlands or created by beaver activity.
Water (aka: W) 11543011	<b>Water:</b> Open water with <5% emergent vegetation cover
A 11543010	<b>Early-all:</b> 5%-24% emergent vegetation cover; remaining area is water
B 11543020	<b>Late-all:</b> ≥25% emergent vegetation cover; remaining area is water
U-A:Exotic Forb&Tree (aka: EFT) 11543106	<b>Exotic-Forb-Tree-early:</b> >1% noxious non-native forbs, tamarisk, or Russian olive; 5%-24% emergent vegetation cover; remaining area is water
U-B:Exotic Forb&Tree (aka: EFT) 115431206	<b>Exotic-Forb-Tree-late:</b> >1% noxious non-native forbs, tamarisk, or Russian olive; ≥25% emergent vegetation cover; remaining area is water
U-A:Hummocked (aka: HU) 11543110	<b>Hummocked:</b> Trampled by ungulates; graminoids present to common in and out of holes created by ungulate hoofs
<b>Winterfat (WF)(10812)</b>	<b>1081wf or 10812 – not GSG habitat</b>
	Overview: The winterfat BpS is generally considered part of the mixed salt desert scrub communities. Winterfat communities occupy saline silty or gravelly silty soils on shallow slopes between 1,219 – 1,829 m (4,000' - 6,000'). Such sites are often found in shallow washes with slopes typically <4%. Average annual precipitation ranges from 10 cm to 20 cm (4" to 8"). Winterfat ( <i>Krascheninnikovia lanata</i> ) is the dominant shrub, often monotypic. Shadscale ( <i>Atriplex confertifolia</i> ), budsage ( <i>Artemisia spinescens</i> ), snakeweed ( <i>Gutierrezia</i> spp.), rabbitbrush ( <i>Chrysothamnus</i> spp.) also can be common shrubs. Common grasses are Indian ricegrass, bottlebrush, squirreltail, and needle-and-thread.
A 10812010	<b>Early-all:</b> >10% Indian ricegrass, squirreltail, other native grasses; ≤5% cover of rabbitbrush, snakeweed, and other salt desert shrubs; <60% mineral soil <0.5m; 0-49 yrs
B 10812022	<b>Mid1-open:</b> 5-20% cover winterfat, budsage, rabbitbrush, and other desert shrubs <0.5m; >10% native grass cover; 50-149 yrs
C 10812030	<b>Late1-closed:</b> >20% cover winterfat, budsage, rabbitbrush, and other salt desert shrubs; >5% native grass cover; >150 yrs
U-A:Annual Spp (aka: AS) 10812100	<b>Annual-Species:</b> >10% non-native annual species cover; <5% cover of native shrubs; <5% native grass cover
U-A:Bare Ground (aka: BAGR) 11450101	<b>Bare-Ground:</b> Mostly mineral soil due to anthropogenic disturbances
U-B:Depleted (aka: DP) 10812203	<b>Depleted-mid:</b> 5-20% cover of winterfat; <5% herbaceous cover; <5% non-native annual species cover

U-C:Depleted (aka: DP) 10812303	<b>Depleted-late:</b> >20% cover of winterfat; <5% herbaceous cover; <5% non-native annual species cover
U-A:Exotic Forb (aka: EF) 10812108	<b>Exotic-Forbs-early:</b> >5% cover halogeton or exotic mustards; ≤5% cover of rabbitbrush, snakeweed, and other salt desert shrubs; <10% cover of non-native annual species; >50% mineral soil
U-B:Exotic Forb (aka: EF) 10812208	<b>Exotic-Forbs-mid:</b> >5% cover halogeton or exotic mustards; 5-20% cover winterfat, budsage, rabbitbrush, and other desert shrubs; <10% cover of non-native annual species; >50% mineral soil
U-C:Exotic Forb (aka: EF) 10812308	<b>Exotic-Forbs-late:</b> >5% cover halogeton or exotic mustards; >20% cover winterfat, budsage, rabbitbrush, and other salt desert shrubs; <10% cover of non-native annual species; >50% mineral soil
U-B:SA 10812221	<b>Shrub-Annual-Species-mid:</b> ≥5% non-native annual species cover; 5-20% cover of winterfat or other shrubs; <5% native grass cover
U-C:SA 10812321	<b>Shrub-Annual-Species-Grass-late:</b> ≥5% non-native annual species cover; >20% cover of winterfat or other shrubs; <5% native grass cover
U-A:SAP (aka: ASPG) 10812124	<b>Shrub-Annual-Species-Perennial-Grass-early:</b> ≥5% cover of non-native annual species; ≥5% native grass cover; <10% cover of rabbitbrush, snakeweed, and other salt desert species
U-B:SAP 10812224	<b>Shrub-Annual-Species-Perennial-Grass-mid:</b> ≥5% non-native annual species cover; 5-20% cover of winterfat or other shrubs; >5% native grass cover cover
U-C:SAP 10812324	<b>Shrub-Annual-Species-Perennial-Grass-late:</b> ≥5% non-native annual species cover; >20% cover of winterfat or other shrubs; >5% native grass cover cover
U-A:Seeded Native (aka: SD) 10812135	<b>Seeded-Native-early:</b> >5% native seed mix cover ≤5% cover of rabbitbrush, snakeweed, and other salt desert shrubs; <5% non-native annual species cover (if ≥5% non-native annual species cover, then see U-A:SAP or Annual Spp)
U-B:Seeded Native (aka: SD) 10812235	<b>Seeded-Native-mid:</b> 5-20% salt desert shrub cover; >5% native herbaceous seed mix cover; <5% non-native annual species cover (if ≥5% non-native annual species cover, then see U-B:SAP or U-B:SA)
U-A:SI (aka: SDI) 10812129	<b>Seeded-Introduced-early:</b> >5% seeded introduced grasses, forbs; ≤5% cover of rabbitbrush, snakeweed, and other salt desert shrubs; <5% non-native annual species cover;
U-B:SI (aka: SDI) 10812229	<b>Seeded-Introduced-late:</b> >5% seeded introduced grasses, forbs; 5-20% seeded salt desert shrub cover, including winterfat; <5% non-native annual species cover
U-A:SI+AS (aka: SDI+AS) 10812138	<b>Seeded-Introduced+Annual-Species-early:</b> >5% seeded introduced grasses and shrubs; ≤5% cover of rabbitbrush, snakeweed, and other salt desert shrubs; ≥5% non-native annual species cover
U-B:SI+AS (aka: SDI+AS) 10812238	<b>Seeded-Introduced+Annual-Species-late:</b> >5% seeded introduced grasses and shrubs; ; 5-20% seeded salt desert shrub cover, including winterfat; ≥5% non-native annual species cover



## Appendix B

### Greater Sage-grouse Habitat Suitability Model

We used covariates that were identified as important from the 2003-2012 Falcon-to-Gonder transmission powerline field study in Eureka County to build spatial models of four demographic parameters (i.e. life history stages; Atamian and others 2010; Blomberg and others 2013; Gibson and others 2016; Kane and others 2017): nest site selection (NSS), nest success (NS), and chick survival (CS), and female. These parameters were used to model the per capita population growth rate ( $\lambda$ ) as a function of the spatial variation in sage-grouse demographic parameters to predict contributions of specific habitat characteristics to regional population dynamics. This process, coupled with the ST-Sim results, allows for spatially explicit interpretation of how management actions impact sage-grouse demography on the current landscape and into the future.

Impacts from infrastructure (e.g. power lines and roads) was modeled as a post-hoc analysis for two of the vital rates, NSS and NS (see below for details). Impacts from noise production from the proposed mine expansion was not considered in the habitat suitability for several reasons, although increased anthropogenic noise has been shown to negatively impact greater sage-grouse (Holloran 2005, Blickey et al. 2012). First, a report prepared by Environmental Resource Management for Barrick modeled production of noise due to proposed activities in the PoOSA. This analysis indicated that, due to topography and existing noise, proposed actions are unlikely to increase noise above 10 dBA currently ambient levels (10 dBA is the recommended as threshold for negative impact in Patricelli et al. 2013 for greater sage-grouse). Second, while negative impacts of noise on lekking behavior is well documented (Holloran 2005, Blickey et al. 2012), to our knowledge no data exist on the impact of noise to other aspects of sage-grouse life history.

Rasters for environmental variables were gathered and analyzed in the software R (R Core Team, 2014). All rasters were at a 60 x 60 m resolution. Rasters from ST-Sim/Syncrosim software that included both ecological systems and vegetation classes were imported in an R script. Elevation and slope were obtained from the USGS National Elevation Dataset Digital Elevation Model (i.e., DEM). Lek locations were made available by the Nevada Department of Wildlife (NDOW; see Kane and others 2017). All leks labeled as “Active” or “Pending” within 15 km of either the BSA or the PoOSA were considered.

All independent variables rasters in each 60-m map pixel were standardized with fixed Eureka County dataset means and standard deviations to give them equal footing in logistic regression equations. While the estimation of habitat suitability and  $\lambda$  is covered in Kane and others (2017), the dynamic aspect of forecasting in this project required further examination of future standardization. The mean and standard deviation of each independent variables in pixel  $p$  from the Eureka Co. of the landscape was used:

$$x_{Stan,p} = \frac{x_p - x_{Eureka\ avg}}{x_{Eureka\ sd}} \quad (\text{Eq. S2.1})$$

where  $x_{Stan,p}$  = the standardized value at pixel  $p$ ,  $x_p$  = value at a given pixel  $p$ ,  $x_{Eureka\ avg}$  = mean of the Eureka Co. dataset, and  $x_{Eureka\ sd}$  = standard deviation of the Eureka Co. dataset.

Using fixed means and fixed standard deviations from the Eureka County dataset was required to maintain valid comparisons across timesteps as some standardized variables, such as distance to lek and proportion of sagebrush within a 1,000 m radius, changed more than others across 5-year analysis periods. Using time-varying landscape averages of standardized variables would have rendered

detection of scenario effects impossible because future averages would have been increased by habitat improvements, thus artificially diminishing scenario differences. Additionally, adding a new area would not impact the calculation at a pixel that was far from the new area using fixed averages, whereas time-varying landscape averages were affected by distant areas completely removed from the greater sage-grouse sub-population added during the study.

For calculation of the four demographic parameters the following general form of logistic regression equation was used (Hosmer and Lemeshow 1989):

$$S = \frac{e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n)}}{1 + e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n)}} \quad (\text{Eq. S2-2})$$

where  $\beta_0$  is the model intercept,  $\beta_i$  are the logistic regression coefficients, and  $X_i$  are the measured covariates.

### 1. Nest Site Selection (NSS)

Nest locations were not available for either the BSA or PoOSA; therefore, every pixel in the study region was considered as a potential nest point. Since nesting locations and associated vegetation do not occur at roads, roads were excluded as nesting habitat. Distance to lek was previously found to have a negative influence on NSS (Gibson et al. 2015) and was calculated as the distance from every pixel in the study region to the nearest lek. greater sage-grouse are dependent on sagebrush and other native shrubs for nesting (Braun et al. 1977, Connelly et al. 2004); the amount of sagebrush present around a nest within a 1000m radius circle was calculated. This variable was the proportion of pixels within the moving window designated as nesting habitat. The ecological systems and vegetation class codes classified as nesting habitat are shown in Table S2.1 (See Supplemental 1 for the model names of ecological systems and vegetation classes). Additionally, elevation and slope were included in the NSS calculation. It has been previously shown that sage-grouse prefer to use habitats at moderate slopes and elevations (Gibson et al. 2015):

$$\text{NSS} = \frac{1 - (1 / (1 + e^{(\beta_{NSS0} + (\beta_{NSS1} \cdot \text{elev.}) + (\beta_{NSS2} \cdot \text{slope}) + (\beta_{NSS3} \cdot \text{dist. to lek}) + (\beta_{NSS4} \cdot \text{amount of sagebrush} + (\beta_{NSS5} \cdot \text{slope} \cdot \text{elev.}) + (\beta_{NSS6} \cdot \text{dist. to lek} \cdot \text{amount of sagebrush))))))}{1} \quad (\text{Eq. S2-3})$$

Beta coefficients  $\beta_{NSS}$  were listed in Table S2.2.

**Table B.1.** State and associated classes within those states that were categorized as nesting habitat. Italics indicate ecological systems and classes that were only considered available habitat above 2,100m.

Ecological System	Vegetation Class	Ecological System	Vegetation Class
Big Sagebrush-semidesert	2-Mid:Open	Black Sagebrush	Mid-open
	3-Late:Closed		Late-closed
	4-Late:Dense		U:Depleted
	U:Depleted		U:SA
	U:SA-Closed		U:SAP
	U:SA-Dense		U:SDI-B

	U:SAP-Closed		U:SDI-C
	U:SAP-Dense		U:SI-B+AS
	U:SDI-B		U:SI-C+AS
	U:SDI-C	Juniper Woodland	U:SAP
	U:SDI-D	Low Sagebrush	3-Late:Closed
	U:SI-B+AS		U:Depleted
	U:SI-C+AS		U:SA
	U:SI-D+AS		U:SAP
Big Sagebrush-upland no trees	2-Mid:Open		U:SDI-B
	3-Late:Closed		U:SDI-C
	4-Late:Dense		U:SI-B+AS
	U:Depleted		U:SI-C+AS
	U:SA-Closed	Low Sagebrush Steppe	3-Late:Closed
	U:SA-Dense		U:Depleted
	U:SAP-Closed	Moist Floodplain	U:Desertified
	U:SAP-Dense		U:SAP
	U:SDI-B	Montane Riparian	U:Desertified
	U:SDI-C		U:SAP
	U:SDI-D	Montane Sagebrush Steppe	2-Mid:Open
	U:SI-B+AS		3-Late:Closed
	U:SI-C+AS		4-Late:Dense
	U:SI-D+AS		U:Depleted
Big Sagebrush-upland+trees	2-Mid:Open		U:SA-Closed
	3-Late:Closed		U:SA-Dense
	4-Late:Dense		U:SAP-Closed
	5-Late:Open		U:SAP-Dense
	U:Depleted		U:SDI-B
	U:SA-Closed		U:SDI-C
	U:SA-Dense		U:SDI-D
	U:SAP-Closed		U:SI-B+AS
	U:SAP-Dense		U:SI-C+AS

	U:SDI-B		U:SI-D+AS
	U:SDI-C	Montane Sagebrush Steppe-Subalpine	2-Mid:Open
	U:SDI-D		3-Late:Closed
	U:SDI-E		4-Late:Dense
	U:SI-B+AS		U:Depleted
	U:SI-C+AS		U:SAP-Closed
	U:SI-D+AS		U:SAP-Dense
	U:SI-E+AS		
			<i>Mountain Shrub</i>
			<i>U:Depleted</i>
			<i>U:SAP</i>
		Owyhee River Riparian	U:SAP

**Table B.2.** Variables and beta coefficients used for Nest site selection used to estimate lambda.

Model	Variable	Beta coefficient Name	Beta coefficient
Nest Site Selection	Intercept	$\beta_{NSS0}$	-2.34506
	Elevation	$\beta_{NSS1}$	0.59617
	Slope	$\beta_{NSS2}$	0.50795
	Dist. to Lek	$\beta_{NSS3}$	-0.64372
	Amount of Sagebrush	$\beta_{NSS4}$	1.43117
	Slope*Elevation	$\beta_{NSS5}$	-0.33100
	Dist. to Lek*Amount of Sagebrush	$\beta_{NSS6}$	-0.62407

## 2. Nest success (NS)

Nest success is derived from daily nest survival and the exposure time of the nest to predation. To calculate the probability of daily nest survival, the proportion of grass-dominated vegetation or grasslands classes around each pixel within a 2000m radius was measured. Grass-dominated classes include those dominated by non-native annuals, non-native seeded species (e.g. crested wheatgrass (*Agropyron cristatum*)), and native grass species, excluding Basin Wildrye systems (*Leymus cinereus*). Fire was previously identified as having a negative association with NS as burned sites tend to convert to non-native annual grasslands (e.g. cheatgrass (*Bromus tectorum*)) following wildfire (Blomberg et al. 2012). Additionally, non-native species seedings, forage kochia (*Kochia prostrata*), and/or early seral native grasses appear to have negative impacts on NS (*J. Sedinger, personal communication, 2015*).

In the original demography studies from the Falcon-to-Gonder study, forbs were identified as important components of nest success (Nonne et al. 2011); however, scaling from the plot scale to landscape level proved difficult due to limitations using remotely sensed data from any source. Forb cover (<15%) could

not be directly estimated from remote-sensed vegetation data with TNC’s methodology. Forb cover was a covariate of Nest Success but forb cover that is incidental in sagebrush shrublands cannot be detected from space as a stand-alone greenness component. Kane et al. (2017) used the annual herbaceous cover layer available through the National Land Cover Database (NLCD, Xian and others, 2015) to approximate native annual forbs. However, because the NLCD layer does not distinguish between annual grasses, including non-native annual species, and annual forbs, Kane et al. (2017) method was modified to better fit with TNC’s remote sensing data.

Annual herbaceous and perennial herbaceous percent cover layers were obtained from the NLCD for the Full Landscape. At high elevation, the NLCD annual herbaceous (AH+) layer had no data because herbaceous cover tends to be dominated by perennial grass and perennial forbs. In these no-data areas, the perennial herbaceous cover value was used. This created a new layer, “AH+.” The AH+ layer was then overlaid onto TNC’s 60-m resolution vegetation map for Year 0 (i.e., classified 2014-2016 imagery). For each unique system-by-class vegetation combination in the TNC raster, the average AH+ cover was calculated. For classes of TNC vegetation where no data from the AH+ layer were present (either due to areas of no data or a TNC vegetation type not being present in Year 0), values were assigned based on the characteristics of similar vegetation types.

To remove non-native annual species and introduced perennial species, such as crested wheatgrass (*Agropyron cristatum*) and forage kochia (*Bassia prostrata*), AH+ values were adjusted. For example, pixels dominated by non-native annual species were given an AH+ value of 0, as it was assumed non-native annual species were likely to competitively exclude natives. It was assumed that introduced species seedlings also had reduced native forb cover as both crested wheatgrass and forage kochia are known to be strong competitors (McAdoo and others, 2017). This process was used to create a look-up table used to calculate the forb variable for Nest Success.

Daily nest survival was also influenced by the cover of non-sagebrush shrub species at a nest site. Greater shrub cover is associated with enhanced predation protection for pre-nesting females and supply a relatively high protein food for chicks immediately after hatching. Estimates of non-sagebrush shrub cover for the two areas were extrapolated from field data from Eureka Co. A statistical relationship was found between sagebrush cover and total non-sagebrush cover. To calculate the non-sagebrush shrub cover, the low range of sagebrush for nesting habitat was multiplied by a constant, approximately 0.1976. These variables, proportion of grasslands and non-sagebrush shrub cover, were used in a logistic regression to estimate daily nest survival. Nest success was then estimated by using the exposure period for sage- grouse (9 egg laying days + 28 incubation days = 37 days exposed) as an exponent of daily nest survival. Finally, NS is influenced by factors such as visitation and overall nest quality. Gibson et al. 2015 found that observer-related abandonment introduced a negative bias (0.068) into estimates of overall NS by reducing the average timing of nest fate and thereby lowering daily nest survival. This bias was added to daily nest survival model:

$$\text{Daily nest survival} = 1 - \left( \frac{1}{1 + e^{(\beta_0 + \beta_{NS1} \cdot \text{Forb Cover} + \beta_{NS2} \cdot \text{Shrub Cover} + \beta_{NS3} \cdot \text{Early Grass} + \beta_{NS4} \cdot \text{Forb Cover} \cdot \text{shrub cover})}} \right) \quad (\text{Eq. S2-4})$$

where Forb Cover = AH+ value calculated at the given pixel, Shrub Cover = non-sagebrush shrub cover, and Early Grass = proportion of early seral grass within a 2,000-m window, and  $\beta_{NS}$  beta coefficients were listed in Table S2.3. The variable AH+ and its derivation was explained in the main text.

**Table B.3.** Variables and beta coefficients used for Nest Success used to estimate lambda.

Model	Variable	Beta coefficient Name	Beta coefficient
Daily Nest Survival	Intercept	$\beta_{NS0}$	2.9816303
	Forb Cover	$\beta_{NS1}$	0.254
	Shrub Cover	$\beta_{NS2}$	0.2958471
	Early Grass	$\beta_{NS3}$	-0.1170051
	Forb Cover · Shrub Cover	$\beta_{NS4}$	0.315

$$NS_1 = \text{daily nest survival}^{37} + 0.068 \quad (\text{Eq. S2-4})$$

In many instances females whose nest fails (likely due to predation) will initial a second nest attempt. Data from the Eureka Co. dataset suggest the re-nesting probability was 85%. In order to account for re-nesting, the following equation is used to correct daily nest survival:

$$NS = NS_1 + (1 - NS_1) * (\text{re-nesting probability}) * NS_1 \quad (\text{Eq. S2-5})$$

### 3. Infrastructure Impacts (I)

To assess impacts from infrastructure (e.g., to busy roads, transmission lines, and buildings), we used empirical relationships that were derived from the Eureka Co. dataset. Research from the Sedingler lab found that the presence of the Falcon-to-Gondor Transmission Line impacted two reproductive demographic rates: NSS and NS, generally reflecting the impact of increased perch availability for corvids and raptors (Gibson et al. 2013). Additionally, they found that the impact differed between the two demographic parameters, with the effect being milder for NS (Figure S2.1).

The process of calculating the effect of infrastructure involved the calculation of the unweighted demographic rate raster, calculation of the distance from infrastructure weight, and the application of the weight to the raw raster. Once the unweighted NSS and NS were estimated, distance from each pixel to all infrastructure was measured and then standardized using the mean and standard deviation from the Eureka Co. dataset. Next, the distance weight was calculated using same general equation for both NSS and NS, though intercepts and beta coefficients varied (Table S2.3):

$$I = (1 - (1 / (1 + e^{(\beta_0 + (\beta_{11} * \text{dist. to infrastructure}) + (\beta_{12} * \text{dist. to infrastructure}^2))}))) \quad (\text{Eq. S2-6})$$

Once calculated, the infrastructure impact weight was added to respective vital rate. Finally, vital rates were rescaled so that NSS and NS values were between 0 and 1. In effect, pixels closer to infrastructure are less valuable than those further away.

**Table B.4.** Variables and beta coefficients used to calculate the infrastructure effect. The infrastructure buffer was added to the unadjusted Nest-Site Selection and Nest Success.

Model	Variable	Beta coefficient Name	Beta coefficient
Nest Site Selection	Intercept	$\beta_{10}$	-2.01765
	Dist. to infrastructure	$\beta_{11}$	0.3453
	Dist. to infrastructure <sup>2</sup>	$\beta_{12}$	-0.18176
Nest Success	Intercept	$\beta_0$	3.0928324
	Dist. to infrastructure	$\beta_{11}$	0.1405036
	Dist. to infrastructure <sup>2</sup>	$\beta_{12}$	-0.1195951

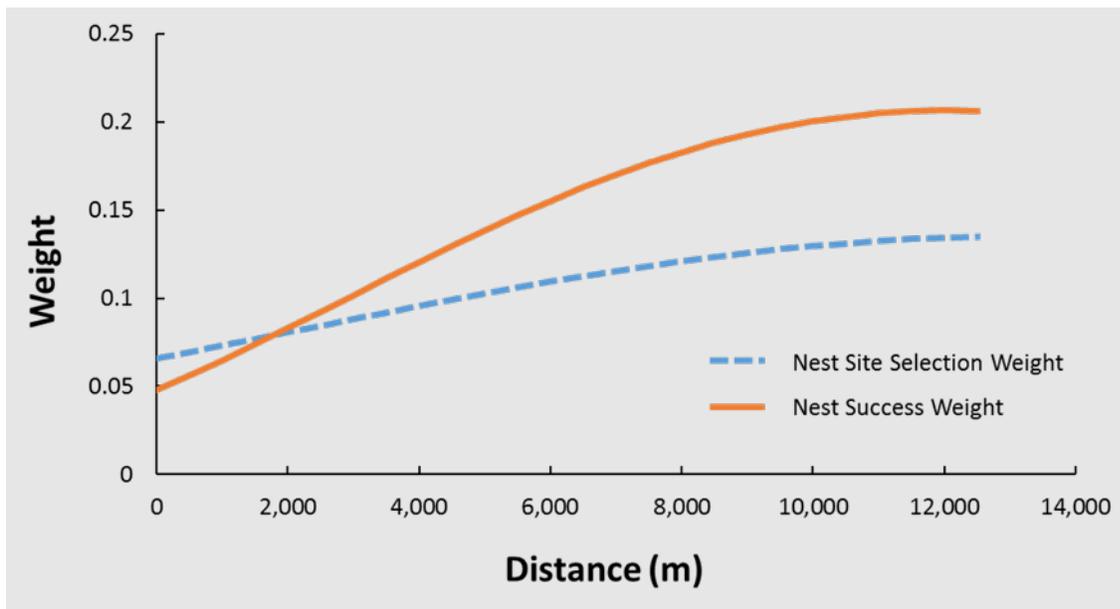


Figure B.1. The relationship between distance from infrastructure and estimated weight, which was applied to Nest Site Selection and Nest Success, respectively. Infrastructure included power lines, transmission lines, high use roads, and structures which may act as perches for corvids and/or raptors.

#### 4. Chick Survival (CS)

Daily chick survival was calculated as a function of daily distance moved between nests and late-brood habitat (LBH). All pixels were reclassified based on their availability as LBH (Table S2. 4). In wet meadows, the presence of exotic forb classes may impede the ability of sage-grouse to locate and use otherwise good LBH. A 180m moving window was applied to the wet meadows. If more than two of the surrounding pixels were an exotic forb or annual grass class, then the pixel was designated as non-LBH regardless of the pixel vegetation. The distance was measured between each pixel to the closest pixel of LBH. From the Eureka Co. data, it takes roughly 6 weeks (42 days) for chicks to travel from a nest to LBH. Chick survival varied among weeks, so the probabilities of chicks surviving was estimated for each week based on daily survival for that week and distance moved. This variable was then divided by 42 (representing 42 days of exposure). Finally, distance moved was standardized using the average and standard deviation of distance moved from the Eureka Co. data. The final chick survival was the sum of the weekly survival rates:

$$\text{Weekly survival (WS}_i\text{)} = (1 - (1 / (1 + e^{(\beta_{CS0} + \beta_{CS1} \cdot \text{daily dist.} + \beta_{CS2(i)} \cdot \text{Week}(i))}))) \quad (\text{Eq. S2-7})$$

where  $\beta_0$  is the intercept,  $\beta_{CS1}$  is the coefficient for average daily distances moved by a brood, and  $\beta_{CS2(i)}$  is the coefficient for each Week ( $i$ ) where  $\text{Week}(i) = 1$  (Table S2.5).

$$CS = WS_1 \cdot WS_2 \cdot WS_3 \cdot WS_4 \cdot WS_5 \cdot WS_6 \quad (\text{Eq. S2-8})$$

**Table B.5.** State and associated classes within those states that were categorized as late-brood habitat. Italics indicate ecological systems and classes that were only considered available habitat above 1,829m.

Ecological System	Vegetation Class	Ecological System	Vegetation Class
Basin Wildrye-bottomland	U:Pasture	Montane Sagebrush Steppe	1-Early:All
Basin Wildrye-montane	U:Pasture		2-Mid:Open
<i>Low Sagebrush</i>	<i>1-Early:All</i>		U:ASPG
	<i>2-Mid:Open</i>		U:SDI-A
	<i>3-Late:Closed</i>		U:SDI-B
	<i>U:ASPG</i>		U:Seeded Native
	<i>U:SDI-A</i>		U:SI-A+AS
	<i>U:SDI-B</i>		U:SI-B+AS
	<i>U:SDI-C</i>		
	<i>U:Seeded Native</i>		
	<i>U:SI-A+AS</i>		
	<i>U:SI-B+AS</i>		
		Montane Sagebrush Steppe-Subalpine	1-Early:All
			2-Mid:Open
			U:ASPG
		<i>Mountain Shrub</i>	<i>1-Early:All</i>
			<i>2-Mid:Open</i>
		Owyhee River Riparian	1-Early:Willow
			U:Early Shrub
			U:Pasture
			U:SDI
			U:SDI+AS
<i>Low Sagebrush Steppe</i>	<i>1-Early:All</i>		
	<i>2-Mid:Open</i>		
	<i>3-Late:Closed</i>		
Lower Montane-Valley Grassland	1-Early:All		
	2-Mid:Open		

	4-Late:Closed	Subalpine-Upper Montane Grassland	1-Early:All
	U:ASPG		2-Mid:Closed
	U:Increaser Grass		3-Late:Open
Moist Floodplain	1-Early:Cottonwood		U:Unpalat. Shrub
	1-Early:Willow	Wet Meadow-Montane	1-Early:Open
	2-Mid:Willow		2-Mid:Closed
	3-Late:Willow		3-Late:Open
	U:Pasture		U:Hummocke d
Montane Riparian	1-Early:Cottonwood		U:Pasture
	1-Early:Willow	Wallow	
	U:Pasture		
	U:SDI		
Montane Riparian	U:SDI+AS		

**Table B.6.** Variables and beta coefficients used for Chick Survival used to estimate lambda

Model	Variable	Beta coefficient Name	Beta coefficient
Chick Survival	Intercept	$\beta_0$	1.6472797
	Dist. moved	$\beta_{CS1}$	-1.3712585
	Week 1	$\beta_{CS2(1)}$	-1.3781732
	Week 2	$\beta_{CS2(2)}$	-0.6970342
	Week 3	$\beta_{CS2(3)}$	0.0549484
	Week 4	$\beta_{CS2(4)}$	-0.0973284
	Week 5	$\beta_{CS2(5)}$	0.1817422
	Week 6	$\beta_{CS2(6)}$	1.647279

In the current CS equation, only distance from a pixel to the nearest LBH pixel was measured. However, not all LBH contributed equally to CS. This was most apparent when comparing hummocked classes with reference classes in wet meadow systems. To account for the difference between hummocked and other LBH, two separate distances were measured: distance to the nearest hummocked class and distance to the nearest reference LBH classes. For pixels nearer to hummocked classes, CS was recalculated using the previously described methods. Then a weight was applied to the new CS, which

represents a 30% reduction of CS for pixels with the highest unweighted CS (Figure B.). The equation for the weight was:

$$CS_W = -3.3761 \cdot CS_{hum}^3 + 1.2479 \cdot CS_{hum}^2 + 0.887 \cdot CS_{hum} + 0.0011 \quad (\text{Eq. S2-9})$$

Where  $CS_W$  was weighted CS and  $CS_{hum}$  is the unweighted CS for areas closest to hummocked classes. Once the original CS raster and weighted CS raster were then merged so that weighted CS values were retained in areas closest to hummocked classes.

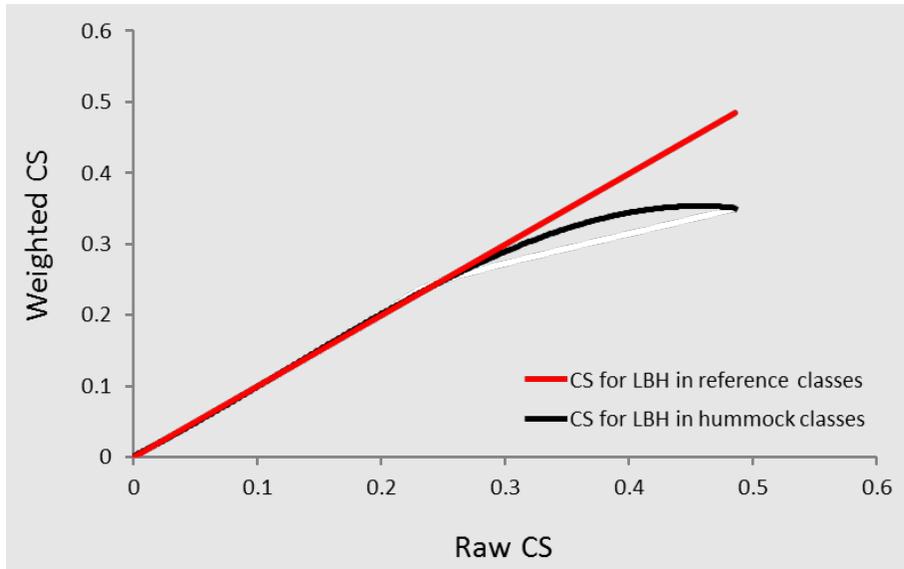


Figure B.2. The relationship between raw chick survival (CS) and weighted CS. Weighted CS was applied to pixels that were nearest hummocked classes compared to other late-brood habitat classes.

## 5. Female Survival (FS)

There was a trade-off between the reproductive success of an individual female and that female's survival (i.e. females who successfully raise a brood have a lower annual survival rate; Blomberg et al. 2013). To calculate female survival, first the probability that a female will successfully hatch a nest and that nest will survive was calculated (termed nest survival ( $N_s$ ) here).  $N_s$  was a function of nest site selection and nest success:

$$N_s = NS \cdot B + (1 - NS) \cdot R \cdot NS \quad (\text{Eq. S2.10})$$

where  $N_s$  = nest survival, NS = nest success, B = breeding probability (0.85), and R = reneating probability (0.385).

We then calculated the probability that at least one chick hatched and survived through late brood-rearing (BS). BS was a function of NS, CS, mean clutch size (females only) across all age classes (3.6), and mean hatchability of the clutch (0.92). Estimates of hatchability of clutch comes from Taylor et al. (2012). BS was calculated as:

$$BS = NS * (1 - (1 - CS)^{(\text{mean clutch size} * \text{mean hatchability of the clutch})}) \quad (\text{Eq. S2.11})$$

Both BS and NS were standardized along with spring, summer, and fall survival, and then used to calculate female survival:

$$FS = \text{Spring Survival} \cdot (1 - (1 / (1 + e^{3.009277 + \beta_{\text{Summer Survival}} + \beta_{\text{NS}} \cdot \text{NS}})))^2 \cdot (1 - (1 / (1 + e^{3.009277 + \beta_{\text{Fall Survival}} + \beta_{\text{BS}} \cdot \text{BS}})))^3 \cdot 0.99 \quad (\text{Eq. S2.12})$$

Spring survival represented monthly nesting survival rates in April and May (0.93), and winter survival represented monthly winter survival during November-March (0.99) (Blomberg et al. 2013b).  $\beta$  Summer Survival and  $\beta$  Fall Survival were season-specific effects for summer and fall, respectively.  $\beta_{\text{NS}}$  was the negative effect of successfully hatching a nest on summer survival, and  $\beta_{\text{BS}}$  was the negative effect of successfully raising a brood on fall survival.

## 6. Per-Capita Population Growth Rate ( $\lambda$ )

We used the life table response experiment (LTRE) (Caswell 1989, Cooch et al. 2001) as a tool to understand the contribution of specific seasonal habitats to regional population dynamics of the sage-grouse. LTRE was a retrospective analysis which expresses  $\lambda$  as a function of observed variation in the demographic parameters. We used this approach to understand how much of the change in population growth rate can be attributed to the changes in four demographic parameters. Additionally, this allowed us to estimate  $\lambda$  at each pixel so that spatial and temporal patterns of change could be identified.

First, fecundity was calculated for adults ( $F_1$ ) and juveniles ( $F_2$ ). Due to a lack of data, fecundity was assumed to be the same for adults and juveniles.  $F_1$  was the value of nest site selection, nest success, chick survival, and female survival at a given pixel multiplied by the half of the mean clutch size (3.6) and the mean post-fledging survival (0.528):

$$F_1 = \text{NSS} \cdot \text{NS} \cdot \text{CS} \cdot (\text{mean clutch size}/2) \cdot \text{post-fledging survival} \quad (\text{Eq. S2.13})$$

Once fecundity was calculated, a matrix was created with mean female survival,  $S_1$  and  $S_2$ , respectively (though as with fecundity a single survival rate was used for juveniles and adults). The most positive eigenvalue from these matrix products was the per-capita growth. This matrix was then used to calculate the  $\lambda$  at each pixel. Finally, the difference between lambda at current conditions and the average  $\lambda$  from the Eureka Co. data was added to the raw  $\lambda$  raster (for the Bank Study Area the value was 0.191 and for the Plan of Operation Study Area the value was 0.175). This was done to normalize the results to the Eureka Co. dataset.

## Appendix C

### Conservation action Probability Rates by System

<https://tnc.box.com/s/gs86zt7xmsv92k6gg7vrmem4ogm5ajb2>

## Appendix D

Summary of conservation actions used in modeling to increase habitat suitability for GSG including key assumptions important for managers to consider.

Objective(s)	Conservation actions	Specific Goal	Key Assumptions	PM_v3.1.0	PM_v3.2.0
Control Pinon-Juniper encroachment	AerialSeed+ Masticate+ Plateau  \$910·acre <sup>-1</sup> or \$2,248·ha <sup>-1</sup>	Remove trees from shrublands and create nesting habitat, and, to some extent, late-brood rearing habitat only at the higher elevations.	<ul style="list-style-type: none"> <li>Mixed introduced species (crested wheatgrass and or intermediate wheatgrass at higher elevations) and native grass and forb seed. Sagebrush and bitterbrush must be planted. Ratio of natives increases above Wyoming big sagebrush on upland soils.</li> <li>Seeding must precede mastication for better incorporation of seed in soil. Herbicide can be sprayed later.</li> <li>Masticator can be used on slopes up to 30%. Plateau will need to be spread aerially on steep slopes.</li> </ul>	X	X
	Chainsaw-Thinning  \$710·acre <sup>-1</sup> or \$1,754·ha <sup>-1</sup>	Remove trees from shrublands and create nesting habitat.	<ul style="list-style-type: none"> <li>Work Crews with Chainsaws</li> <li>Price based on felling, lopping, and scattering biomass</li> </ul>	X	X
	Small-Tree-Lopping  \$700·acre <sup>-1</sup> or \$1,729·ha <sup>-1</sup>	Maintain nesting habitat	<ul style="list-style-type: none"> <li>Chainsaw. Simply drop small trees without lopping off lateral branches to reduce cost.</li> </ul>	X	X

Treat annual grasslands to achieve greater resistance to fire and restoring nesting function.	Herbicide-Plateau+ Seed+Shrub- Planting  \$510·acre <sup>-1</sup> or \$1,260·ha <sup>-1</sup>	Seed recently burned areas or areas dominated by non-native annual species to create nesting habitat, and, to some extent, late-brood rearing habitat only at the higher elevations.	<ul style="list-style-type: none"> <li>• Spray Plateau before seeding to reduce competition during germination.</li> <li>• Mixed introduced species (crested wheatgrass and or intermediate wheatgrass at higher elevations) and native grass and forb seed. Sagebrush and bitterbrush must be planted. Ratio of natives increases above Wyoming big sagebrush on upland soils.</li> <li>• Rangeland drill can be used on slopes up to 15%. For the success assume, a Truax Roughrider rangeland drill was assumed (pers. comm., Mike Pellant)</li> </ul>	X	X
Restore vegetation classes that contribute to chick survival.	Fence&Water- Delivery  \$1,900·acre <sup>-1</sup> or \$4,693·ha <sup>-1</sup>	Control livestock and horse access to wet meadows	<ul style="list-style-type: none"> <li>• Fencing that will withstand horses as needed.</li> <li>• Piping and stock-tank for alternative water source outside fence perimeter</li> </ul>	X	X
	Water-Table-Uplift  \$50·acre <sup>-1</sup> or \$129·ha <sup>-1</sup>	Restore hydrologic function to small lentic and lotic systems	<ul style="list-style-type: none"> <li>• Use low-tech process-based restoration approaches appropriate to the site conditions.</li> </ul>		X
	Fence-Inspect &Maintain  \$21·acre <sup>-1</sup> or \$54·ha <sup>-1</sup>	Control livestock and horse access to wet meadows	<ul style="list-style-type: none"> <li>• Inspect before maintenance</li> </ul>	X	X
	Herbicide-Shrubs +Mow  \$300·acre <sup>-1</sup> or \$741·ha <sup>-1</sup>	Restore late-brood habitat in wet meadows	<ul style="list-style-type: none"> <li>• Spray herbicides specific to native shrub or forbs and mow standing biomass if needed.</li> </ul>	X	X

Maintain ecological health of select systems	Weed-Inventory +Spot-Treat  \$100·acre <sup>-1</sup> or \$247·ha <sup>-1</sup>		<ul style="list-style-type: none"> <li>• Locate small exotic forb or tree occurrences and spot spray</li> </ul>	X	X
	Exotic-Control  \$100·acre <sup>-1</sup> or \$247·ha <sup>-1</sup>	Kill exotic noxious plant species.	<ul style="list-style-type: none"> <li>• May involve wetland or riparian seed mix.</li> </ul>	X	X
	Spraying indaziflam  \$100·acre <sup>-1</sup> or \$247·ha <sup>-1</sup>	Suppress germination of non-native annual species in already invaded sagebrush shrubland	<ul style="list-style-type: none"> <li>• Only applies to the native shrubland classes and seedings of introduced species invaded by non-native annual species.</li> </ul>		X

## Conservation Action Outcomes

Vegetation Type	Class	To Class	Transition Type	Proportion/Probability
Big Sagebrush-upland+trees	U-E:TEA	U-A:Annual Spp	AerialSeed+Masticate+Plateau	0.1000
Big Sagebrush-upland+trees	U-E:TEA	U-A:SNI	AerialSeed+Masticate+Plateau	0.8000
Big Sagebrush-upland+trees	U-E:TEA	U-A:SNI+AS	AerialSeed+Masticate+Plateau	0.1000
Black Sagebrush	U-D:SI	U-A:Annual Spp	AerialSeed+Masticate+Plateau	0.2000
Black Sagebrush	U-D:SI	U-A:SNI	AerialSeed+Masticate+Plateau	0.6000
Black Sagebrush	U-D:SI	U-A:SNI+AS	AerialSeed+Masticate+Plateau	0.2000
Black Sagebrush	U-D:SI+AS	U-A:Annual Spp	AerialSeed+Masticate+Plateau	0.2000
Black Sagebrush	U-D:SI+AS	U-A:SNI	AerialSeed+Masticate+Plateau	0.6000
Black Sagebrush	U-D:SI+AS	U-A:SNI+AS	AerialSeed+Masticate+Plateau	0.2000
Black Sagebrush	U-D:TEA	U-A:Annual Spp	AerialSeed+Masticate+Plateau	0.2000
Black Sagebrush	U-D:TEA	U-A:SNI	AerialSeed+Masticate+Plateau	0.6000
Black Sagebrush	U-D:TEA	U-A:SNI+AS	AerialSeed+Masticate+Plateau	0.2000
Low Sagebrush	U-D:SI	U-A:Annual Spp	AerialSeed+Masticate+Plateau	0.1500
Low Sagebrush	U-D:SI	U-A:SNI	AerialSeed+Masticate+Plateau	0.7000
Low Sagebrush	U-D:SI	U-A:SNI+AS	AerialSeed+Masticate+Plateau	0.1500
Low Sagebrush	U-D:SI+AS	U-A:Annual Spp	AerialSeed+Masticate+Plateau	0.2000

Low Sagebrush	U-D:SI+AS	U-A:SNI	AerialSeed+Masticate+Plateau	0.6000
Low Sagebrush	U-D:SI+AS	U-A:SNI+AS	AerialSeed+Masticate+Plateau	0.2000
Low Sagebrush	U-D:TEA	U-A:Annual Spp	AerialSeed+Masticate+Plateau	0.2000
Low Sagebrush	U-D:TEA	U-A:SNI	AerialSeed+Masticate+Plateau	0.6000
Low Sagebrush	U-D:TEA	U-A:SNI+AS	AerialSeed+Masticate+Plateau	0.2000
Montane Sagebrush Steppe-Upland	U-E:TEA	U-A:Annual Spp	AerialSeed+Masticate+Plateau	0.1000
Montane Sagebrush Steppe-Upland	U-E:TEA	U-A:SNI	AerialSeed+Masticate+Plateau	0.8000
Montane Sagebrush Steppe-Upland	U-E:TEA	U-A:SNI+AS	AerialSeed+Masticate+Plateau	0.1000
Black Sagebrush	D:Open	A:All	Chainsaw-Thinning	0.1000
Black Sagebrush	D:Open	B:Open	Chainsaw-Thinning	0.9000
Black Sagebrush	U-D:TEA	U-A:Annual Spp	Chainsaw-Thinning	0.0500
Black Sagebrush	U-D:TEA	U-A:Early Shrub	Chainsaw-Thinning	0.0500
Black Sagebrush	U-D:TEA	U-B:Depleted	Chainsaw-Thinning	0.3000
Black Sagebrush	U-D:TEA	U-B:SA	Chainsaw-Thinning	0.4000
Black Sagebrush	U-D:TEA	U-B:SAP	Chainsaw-Thinning	0.3000
Low Sagebrush	D:Open	A:All	Chainsaw-Thinning	0.1000
Low Sagebrush	D:Open	B:Open	Chainsaw-Thinning	0.9000
Low Sagebrush	U-D:TEA	U-A:Annual Spp	Chainsaw-Thinning	0.0500
Low Sagebrush	U-D:TEA	U-A:Early Shrub	Chainsaw-Thinning	0.0500
Low Sagebrush	U-D:TEA	U-B:Depleted	Chainsaw-Thinning	0.3000
Low Sagebrush	U-D:TEA	U-B:SA	Chainsaw-Thinning	0.3000
Low Sagebrush	U-D:TEA	U-B:SAP	Chainsaw-Thinning	0.3000
Montane Riparian	U-A:Exotic Forb&Tree	A-Willow:Closed	Exotic-Control	0.6000
Montane Riparian	U-A:Exotic Forb&Tree	U-A:Exotic Forb&Tree	Exotic-Control	0.4000
Montane Riparian	U-A:Incised-EFT	U-A:Desertified	Exotic-Control	0.6000
Montane Riparian	U-A:Incised-EFT	U-A:Incised-EFT	Exotic-Control	0.4000
Montane Riparian	U-A:Inset-EFT	U-A:Inset	Exotic-Control	0.6000
Montane Riparian	U-A:Inset-EFT	U-A:Inset-EFT	Exotic-Control	0.4000
Montane Riparian	U-B:Exotic Forb&Tree	B-Willow:Closed	Exotic-Control	0.6000
Montane Riparian	U-B:Exotic Forb&Tree	U-A:Exotic Forb&Tree	Exotic-Control	0.4000
Montane Riparian	U-B:Incised-EFT	U-A:Incised-EFT	Exotic-Control	0.4000
Montane Riparian	U-B:Incised-EFT	U-B:Desertified	Exotic-Control	0.6000
Montane Riparian	U-B:Inset-EFT	U-A:Inset-EFT	Exotic-Control	0.4000

Montane Riparian	U-B:Inset-EFT	U-B:Inset	Exotic-Control	0.6000
Montane Riparian	U-C:Exotic Forb&Tree	C-Cottonwood:Closed	Exotic-Control	0.6000
Montane Riparian	U-C:Exotic Forb&Tree	U-C:Exotic Forb&Tree	Exotic-Control	0.4000
Montane Riparian	U-C:Incised-EFT	U-A:Incised-EFT	Exotic-Control	0.4000
Montane Riparian	U-C:Incised-EFT	U-C:Desertified	Exotic-Control	0.6000
Wet Meadow-Montane	U-A:Exotic Forbs	A:All	Exotic-Control	0.6000
Wet Meadow-Montane	U-A:Exotic Forbs	U-A:Exotic Forbs	Exotic-Control	0.4000
Wet Meadow-Montane	U-A:Incised-EFT	U-A:Desertified	Exotic-Control	0.6000
Wet Meadow-Montane	U-A:Incised-EFT	U-A:Incised-EFT	Exotic-Control	0.4000
Wet Meadow-Montane	U-B:Exotic Forbs	B:Closed	Exotic-Control	0.6000
Wet Meadow-Montane	U-B:Exotic Forbs	U-A:Exotic Forbs	Exotic-Control	0.4000
Wet Meadow-Montane	U-B:Incised-EFT	U-A:Incised-EFT	Exotic-Control	0.4000
Wet Meadow-Montane	U-B:Incised-EFT	U-B:Desertified	Exotic-Control	0.6000
Wet Meadow-Montane	U-C:Exotic Forbs	C:Open	Exotic-Control	0.6000
Wet Meadow-Montane	U-C:Exotic Forbs	U-A:Exotic Forbs	Exotic-Control	0.4000
Wet Meadow-Montane	U-C:Incised-EFT	U-A:Incised-EFT	Exotic-Control	0.4000
Wet Meadow-Montane	U-C:Incised-EFT	U-C:Desertified	Exotic-Control	0.6000
Wet Meadow-Montane	A:All	A:All	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	A:All	A:All	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	B:Closed	B:Closed	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	B:Closed	B:Closed	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	C:Open	C:Open	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	C:Open	C:Open	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:Annual Spp	U-A:Annual Spp	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-A:Annual Spp	U-A:Annual Spp	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:Desertified	U-A:Desertified	Fence&Water-Delivery	0.0100

Wet Meadow-Montane	U-A:Desertified	U-A:Desertified	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:Early Shrub	U-A:Early Shrub	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-A:Early Shrub	U-A:Early Shrub	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:Exotic Forbs	U-A:Exotic Forbs	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-A:Exotic Forbs	U-A:Exotic Forbs	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:Hummocked	U-A:Hummocked	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-A:Hummocked	U-A:Hummocked	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:Incised-EFT	U-A:Incised-EFT	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-A:Incised-EFT	U-A:Incised-EFT	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:SAP	U-A:SAP	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-A:SAP	U-A:SAP	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:SI	U-A:SI	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-A:SI	U-A:SI	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:SI+AS	U-A:SI+AS	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-A:SI+AS	U-A:SI+AS	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:SNI	U-A:SNI	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-A:SNI	U-A:SNI	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-A:SNI+AS	U-A:SNI+AS	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-A:SNI+AS	U-A:SNI+AS	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-B:Depleted	U-B:Depleted	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-B:Depleted	U-B:Depleted	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-B:Desertified	U-B:Desertified	Fence&Water-Delivery	0.0100

Wet Meadow-Montane	U-B:Desertified	U-B:Desertified	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-B:Early Shrub	U-B:Early Shrub	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-B:Early Shrub	U-B:Early Shrub	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-B:Exotic Forbs	U-B:Exotic Forbs	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-B:Exotic Forbs	U-B:Exotic Forbs	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-B:Incised-EFT	U-B:Incised-EFT	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-B:Incised-EFT	U-B:Incised-EFT	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-B:SAP	U-B:SAP	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-B:SAP	U-B:SAP	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-B:Shrb-Frb Encr	U-B:Shrb-Frb Encr	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-B:Shrb-Frb Encr	U-B:Shrb-Frb Encr	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-B:SI	U-B:SI	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-B:SI	U-B:SI	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-B:SI	U-B:SI	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-B:SI	U-B:SI	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-B:SI+AS	U-B:SI+AS	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-B:SI+AS	U-B:SI+AS	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-C:Depleted	U-C:Depleted	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-C:Depleted	U-C:Depleted	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-C:Desertified	U-C:Desertified	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-C:Desertified	U-C:Desertified	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-C:Early Shrub	U-C:Early Shrub	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-C:Early Shrub	U-C:Early Shrub	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-C:Exotic Forbs	U-C:Exotic Forbs	Fence&Water-Delivery	0.0100

Wet Meadow-Montane	U-C:Exotic Forbs	U-C:Exotic Forbs	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-C:Incised-EFT	U-C:Incised-EFT	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-C:Incised-EFT	U-C:Incised-EFT	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-C:SAP	U-C:SAP	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-C:SAP	U-C:SAP	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-C:Shrb-Frb Encr	U-C:Shrb-Frb Encr	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-C:Shrb-Frb Encr	U-C:Shrb-Frb Encr	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-C:SI	U-C:SI	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-C:SI	U-C:SI	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-C:SI	U-C:SI	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-C:SI	U-C:SI	Fence-Inspect&Maintain	0.0100
Wet Meadow-Montane	U-C:SI+AS	U-C:SI+AS	Fence&Water-Delivery	0.0100
Wet Meadow-Montane	U-C:SI+AS	U-C:SI+AS	Fence-Inspect&Maintain	0.0100
Big Sagebrush-upland+trees	U-A:Annual Spp	U-A:SI	Herbicide-Plateau+Seed	0.8000
Big Sagebrush-upland+trees	U-A:Annual Spp	U-A:SI+AS	Herbicide-Plateau+Seed	0.1000
Wet Meadow-Montane	U-A:Shrb-Frb Encr	A:All	Herbicide-Shrubs+Mow	0.8000
Wet Meadow-Montane	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Herbicide-Shrubs+Mow	0.2000
Wet Meadow-Montane	U-B:Shrb-Frb Encr	A:All	Herbicide-Shrubs+Mow	0.8000
Wet Meadow-Montane	U-B:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Herbicide-Shrubs+Mow	0.1000
Wet Meadow-Montane	U-B:Shrb-Frb Encr	U-B:Shrb-Frb Encr	Herbicide-Shrubs+Mow	0.1000
Wet Meadow-Montane	U-C:Shrb-Frb Encr	A:All	Herbicide-Shrubs+Mow	0.8000
Wet Meadow-Montane	U-C:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Herbicide-Shrubs+Mow	0.1000
Wet Meadow-Montane	U-C:Shrb-Frb Encr	U-C:Shrb-Frb Encr	Herbicide-Shrubs+Mow	0.1000
Big Sagebrush-upland+trees	U-A:Annual Spp	U-A:Annual Spp	Herbicide-Plateau+Seed+Shrub-Planting	0.1500

Big Sagebrush-upland+trees	U-A:Annual Spp	U-A:SNI	Herbicide-Plateau+Seed+Shrub-Planting	0.7000
Big Sagebrush-upland+trees	U-A:Annual Spp	U-A:SNI+AS	Herbicide-Plateau+Seed+Shrub-Planting	0.1500
Black Sagebrush	U-A:Annual Spp	U-A:Annual Spp	Herbicide-Plateau+Seed+Shrub-Planting	0.1500
Black Sagebrush	U-A:Annual Spp	U-A:SNI	Herbicide-Plateau+Seed+Shrub-Planting	0.7000
Black Sagebrush	U-A:Annual Spp	U-A:SNI+AS	Herbicide-Plateau+Seed+Shrub-Planting	0.1500
Low Sagebrush	U-A:Annual Spp	U-A:Annual Spp	Herbicide-Plateau+Seed+Shrub-Planting	0.1500
Low Sagebrush	U-A:Annual Spp	U-A:SNI	Herbicide-Plateau+Seed+Shrub-Planting	0.7000
Low Sagebrush	U-A:Annual Spp	U-A:SNI+AS	Herbicide-Plateau+Seed+Shrub-Planting	0.1500
Montane Sagebrush Steppe-Upland	U-A:Annual Spp	U-A:Annual Spp	Herbicide-Plateau+Seed+Shrub-Planting	0.1000
Montane Sagebrush Steppe-Upland	U-A:Annual Spp	U-A:SNI	Herbicide-Plateau+Seed+Shrub-Planting	0.8000
Montane Sagebrush Steppe-Upland	U-A:Annual Spp	U-A:SNI+AS	Herbicide-Plateau+Seed+Shrub-Planting	0.1000
Big Sagebrush-upland+trees	U-A:SAP	A:All	Indaziflam	1.0000
Big Sagebrush-upland+trees	U-A:SI+AS	U-A:SI	Indaziflam	1.0000
Big Sagebrush-upland+trees	U-A:SNI+AS	U-A:SNI	Indaziflam	1.0000
Big Sagebrush-upland+trees	U-B:SAP	B:Open	Indaziflam	1.0000
Big Sagebrush-upland+trees	U-B:SI+AS	U-B:SI	Indaziflam	1.0000
Big Sagebrush-upland+trees	U-C:SAP	C:Closed	Indaziflam	1.0000
Big Sagebrush-upland+trees	U-C:SI+AS	U-C:SI	Indaziflam	1.0000
Big Sagebrush-upland+trees	U-C:SI+AS-Dense	U-C:SI-Dense	Indaziflam	1.0000
Big Sagebrush-upland+trees	U-D:SAP	D:Open	Indaziflam	1.0000
Big Sagebrush-upland+trees	U-D:SAP-Dense	D:Dense	Indaziflam	1.0000
Big Sagebrush-upland+trees	U-D:SI+AS	U-D:SI	Indaziflam	1.0000
Black Sagebrush	U-A:SAP	A:All	Indaziflam	1.0000

Black Sagebrush	U-A:SI+AS	U-A:SI	Indaziflam	1.0000
Black Sagebrush	U-A:SNI+AS	U-A:SNI	Indaziflam	1.0000
Black Sagebrush	U-B:SAP	B:Open	Indaziflam	1.0000
Black Sagebrush	U-B:SI+AS	U-B:SI	Indaziflam	1.0000
Black Sagebrush	U-C:SAP	C:Closed	Indaziflam	1.0000
Black Sagebrush	U-C:SI+AS	U-C:SI	Indaziflam	1.0000
Black Sagebrush	U-D:SI+AS	U-D:SI	Indaziflam	1.0000
Low Sagebrush	U-A:SAP	A:All	Indaziflam	1.0000
Low Sagebrush	U-A:SI+AS	U-A:SI	Indaziflam	1.0000
Low Sagebrush	U-A:SNI+AS	U-A:SNI	Indaziflam	1.0000
Low Sagebrush	U-B:SAP	B:Open	Indaziflam	1.0000
Low Sagebrush	U-B:SI+AS	U-B:SI	Indaziflam	1.0000
Low Sagebrush	U-C:SAP	C:Closed	Indaziflam	1.0000
Low Sagebrush	U-C:SI+AS	U-C:SI	Indaziflam	1.0000
Low Sagebrush	U-D:SI+AS	U-D:SI	Indaziflam	1.0000
Montane Sagebrush Steppe-Upland	U-A:SAP	A:All	Indaziflam	1.0000
Montane Sagebrush Steppe-Upland	U-A:SI+AS	U-A:SI	Indaziflam	1.0000
Montane Sagebrush Steppe-Upland	U-A:SNI+AS	U-A:SNI	Indaziflam	1.0000
Montane Sagebrush Steppe-Upland	U-B:SAP	B:Open	Indaziflam	1.0000
Montane Sagebrush Steppe-Upland	U-B:SI+AS	U-B:SI	Indaziflam	1.0000
Montane Sagebrush Steppe-Upland	U-C:SAP	C:Closed	Indaziflam	1.0000
Montane Sagebrush Steppe-Upland	U-C:SI+AS	U-C:SI	Indaziflam	1.0000
Montane Sagebrush Steppe-Upland	U-C:SI+AS-Dense	U-C:SI-Dense	Indaziflam	1.0000
Montane Sagebrush Steppe-Upland	U-D:SAP	D:Open	Indaziflam	1.0000
Montane Sagebrush Steppe-Upland	U-D:SI+AS	D:Dense	Indaziflam	1.0000

Big Sagebrush-upland+trees	D:Dense	C:Dense	Small-Tree-Lopping	1.0000
Big Sagebrush-upland+trees	D:Open	C:Closed	Small-Tree-Lopping	1.0000
Big Sagebrush-upland+trees	U-D:SA	U-C:SA	Small-Tree-Lopping	1.0000
Big Sagebrush-upland+trees	U-D:SAP	U-C:SAP	Small-Tree-Lopping	1.0000
Big Sagebrush-upland+trees	U-D:SAP	U-C:SAP	Small-Tree-Lopping	1.0000
Big Sagebrush-upland+trees	U-D:SAP-Dense	U-C:SAP-Dense	Small-Tree-Lopping	1.0000
Big Sagebrush-upland+trees	U-D:SAP-Dense	U-C:SAP-Dense	Small-Tree-Lopping	1.0000
Montane Sagebrush Steppe-Subalpine	D:Dense	C:Dense	Small-Tree-Lopping	1.0000
Montane Sagebrush Steppe-Subalpine	D:Open	C:Closed	Small-Tree-Lopping	1.0000
Montane Sagebrush Steppe-Subalpine	U-D:SAP	U-C:SAP	Small-Tree-Lopping	1.0000
Montane Sagebrush Steppe-Subalpine	U-D:SAP-Dense	U-C:SAP-Dense	Small-Tree-Lopping	1.0000
Montane Sagebrush Steppe-Upland	D:Dense	C:Dense	Small-Tree-Lopping	1.0000
Montane Sagebrush Steppe-Upland	D:Open	C:Closed	Small-Tree-Lopping	1.0000
Montane Sagebrush Steppe-Upland	U-D:Depleted	U-C:Depleted	Small-Tree-Lopping	1.0000
Montane Sagebrush Steppe-Upland	U-D:SA	U-C:SA	Small-Tree-Lopping	1.0000
Montane Sagebrush Steppe-Upland	U-D:SA-Dense	U-C:SA-Dense	Small-Tree-Lopping	1.0000
Montane Sagebrush Steppe-Upland	U-D:SAP	U-C:SAP	Small-Tree-Lopping	1.0000
Montane Sagebrush Steppe-Upland	U-D:SAP-Dense	U-C:SAP-Dense	Small-Tree-Lopping	1.0000
Wet Meadow-Montane	U-A:Annual Spp	A:All	Water-Table-Uplift	0.2000

Wet Meadow-Montane	U-A:Annual Spp	U-A:Annual Spp	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-A:Desertified	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-A:Desertified	U-A:Desertified	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-A:Early Shrub	U-A:Early Shrub	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-A:Early Shrub	U-A:Shrb-Frb Encr	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-A:Incised-EFT	U-A:Exotic Forbs	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-A:Incised-EFT	U-A:Incised-EFT	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-A:SAP	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-A:SAP	U-A:SAP	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-A:SI	A:All	Water-Table-Uplift	0.1000
Wet Meadow-Montane	U-A:SI	U-A:SI	Water-Table-Uplift	0.9000
Wet Meadow-Montane	U-A:SI+AS	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-A:SI+AS	U-A:SI	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-A:SNI	A:All	Water-Table-Uplift	0.1000
Wet Meadow-Montane	U-A:SNI	U-A:SNI	Water-Table-Uplift	0.9000
Wet Meadow-Montane	U-A:SNI+AS	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-A:SNI+AS	U-A:SNI	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-B:Depleted	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-B:Depleted	U-B:Depleted	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-B:Desertified	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-B:Desertified	U-B:Desertified	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-B:Early Shrub	U-B:Early Shrub	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-B:Early Shrub	U-B:Shrb-Frb Encr	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-B:Incised-EFT	U-B:Exotic Forbs	Water-Table-Uplift	0.2000

Wet Meadow-Montane	U-B:Incised-EFT	U-B:Incised-EFT	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-B:SAP	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-B:SAP	U-B:SAP	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-B:SI	A:All	Water-Table-Uplift	0.1000
Wet Meadow-Montane	U-B:SI	U-B:SI	Water-Table-Uplift	0.9000
Wet Meadow-Montane	U-B:SI+AS	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-B:SI+AS	U-B:SI	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-C:Depleted	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-C:Depleted	U-C:Depleted	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-C:Desertified	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-C:Desertified	U-C:Desertified	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-C:Early Shrub	U-C:Early Shrub	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-C:Early Shrub	U-C:Shrb-Frb Encr	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-C:Incised-EFT	U-C:Exotic Forbs	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-C:Incised-EFT	U-C:Incised-EFT	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-C:SAP	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-C:SAP	U-C:SAP	Water-Table-Uplift	0.8000
Wet Meadow-Montane	U-C:SI	A:All	Water-Table-Uplift	0.1000
Wet Meadow-Montane	U-C:SI	U-C:SI	Water-Table-Uplift	0.9000
Wet Meadow-Montane	U-C:SI+AS	A:All	Water-Table-Uplift	0.2000
Wet Meadow-Montane	U-C:SI+AS	U-C:SI	Water-Table-Uplift	0.8000
Basin Wildrye-montane	A:All	A:All	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	B:Closed	B:Closed	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	C:Open	C:Open	Weed-Inventory+Spot-Treat	1.0000

Basin Wildrye-montane	U-A:Annual Spp	U-A:Annual Spp	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-A:Bare Ground	U-A:Bare Ground	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-A:Early Shrub	U-A:Early Shrub	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-A:SAP	U-A:SAP	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-A:Seeded Native	U-A:Seeded Native	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-A:SI	U-A:SNI	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-A:SI+AS	U-A:SNI+AS	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-B:Early Shrub	U-B:Early Shrub	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-B:SA	U-B:SA	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-B:SAP	U-B:SAP	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-B:Seeded Native	U-A:Seeded Native	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-B:SI	U-B:SI	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-B:SI+AS	U-B:SI+AS	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-C:Depleted	U-C:Depleted	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-C:Early Shrub	U-C:Early Shrub	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-C:SA	U-C:SA	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-C:SAP	U-C:SAP	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-C:SI	U-C:SI	Weed-Inventory+Spot-Treat	1.0000
Basin Wildrye-montane	U-C:SI+AS	U-C:SI+AS	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	A-Cottonwood:Closed	A-Cottonwood:Closed	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	A-Willow:Closed	A-Willow:Closed	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	B-Cottonwood:Closed	B-Cottonwood:Closed	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	B-Willow:Closed	B-Willow:Closed	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	C-Cottonwood:Closed	C-Cottonwood:Closed	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	C-Willow:Closed	C-Willow:Closed	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-A:Annual Spp	U-A:Annual Spp	Weed-Inventory+Spot-Treat	1.0000

Montane Riparian	U-A:Desertified	U-A:Desertified	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-A:Early Shrub	U-A:Early Shrub	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-A:Inset	U-A:Inset	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-A:Inset-SFE	U-A:Inset-SFE	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-A:SI	U-A:SI	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-A:SI+AS	U-A:SI+AS	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-A:SI+AS	U-A:SI+AS	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-A:SNI	U-A:SNI	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-A:SNI+AS	U-A:SNI+AS	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-B:Desertified	U-B:Desertified	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-B:Early Shrub	U-B:Early Shrub	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-B:Inset	U-B:Inset	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-B:Inset-SFE	U-B:Inset-SFE	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-B:Shrb-Frb Encr	U-B:Shrb-Frb Encr	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-B:SI	U-B:SI	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-B:SI+AS	U-B:SI+AS	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-C:Desertified	U-C:Desertified	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-C:Early Shrub	U-C:Early Shrub	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-C:SAP	U-C:SAP	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-C:Shrb-Frb Encr	U-C:Shrb-Frb Encr	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-C:SI	U-C:SI	Weed-Inventory+Spot-Treat	1.0000
Montane Riparian	U-C:SI+AS	U-C:SI+AS	Weed-Inventory+Spot-Treat	1.0000
Saline Meadow	A:All	A:All	Weed-Inventory+Spot-Treat	1.0000
Saline Meadow	B:Closed	B:Closed	Weed-Inventory+Spot-Treat	1.0000
Saline Meadow	C:Open	C:Open	Weed-Inventory+Spot-Treat	1.0000
Saline Meadow	U-A:Annual Spp	U-A:Annual Spp	Weed-Inventory+Spot-Treat	1.0000
Saline Meadow	U-A:Bare Ground	U-A:Bare Ground	Weed-Inventory+Spot-Treat	1.0000
Saline Meadow	U-A:Hummocked	U-A:Hummocked	Weed-Inventory+Spot-Treat	1.0000
Saline Meadow	U-A:SAP	U-A:SAP	Weed-Inventory+Spot-Treat	1.0000
Saline Meadow	U-B:Depleted	U-B:Depleted	Weed-Inventory+Spot-Treat	1.0000
Saline Meadow	U-B:SAP	U-B:SAP	Weed-Inventory+Spot-Treat	1.0000
Saline Meadow	U-C:Depleted	U-C:Depleted	Weed-Inventory+Spot-Treat	1.0000
Saline Meadow	U-C:SAP	U-C:SAP	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	A:All	A:All	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	B:Closed	B:Closed	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	C:Open	C:Open	Weed-Inventory+Spot-Treat	1.0000

Wet Meadow-Montane	U-A:Annual Spp	U-A:Annual Spp	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-A:Desertified	U-A:Desertified	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-A:Early Shrub	U-A:Early Shrub	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-A:Hummocked	U-A:Hummocked	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-A:SAP	U-A:SAP	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-A:Shrb-Frb Encr	U-A:Shrb-Frb Encr	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-A:SI	U-A:SI	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-A:SI+AS	U-A:SI+AS	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-A:SNI	U-A:SNI	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-A:SNI+AS	U-A:SNI+AS	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-B:Depleted	U-B:Depleted	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-B:Desertified	U-B:Desertified	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-B:Early Shrub	U-B:Early Shrub	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-B:SAP	U-B:SAP	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-B:Shrb-Frb Encr	U-B:Shrb-Frb Encr	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-B:SI	U-B:SI	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-B:SI+AS	U-B:SI+AS	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-C:Depleted	U-C:Depleted	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-C:Desertified	U-C:Desertified	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-C:Early Shrub	U-C:Early Shrub	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-C:SAP	U-C:SAP	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-C:Shrb-Frb Encr	U-C:Shrb-Frb Encr	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-C:SI	U-C:SI	Weed-Inventory+Spot-Treat	1.0000
Wet Meadow-Montane	U-C:SI+AS	U-C:SI+AS	Weed-Inventory+Spot-Treat	1.0000







