# 2019-2020 Final Greater Sage-Grouse Annual Report Pinedale Anticline Project Area

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# Contents

## OVERVIEW

The 2008 Final Supplemental Environmental Impact Statement Record of Decision (ROD) for the Pinedale Anticline Oil and Gas Exploration and Development Project (BLM 2008) includes a Wildlife Monitoring and Mitigation Matrix (WMMM) that identifies key wildlife species to be monitored and specific changes that require mitigation (Appendix A, Table 1). For Greater Sage-Grouse, the WMMM is designed to quantitatively identify changes in sage-grouse populations within the Pinedale Anticline Project Area (PAPA). Six lek complexes are monitored annually for changes specified in the WMMM (Appendix A, Figure 1). Lek attendance by male sage-grouse, number of active leks, winter concentration area use, and noise are all monitored. In 2020, monitoring results for attendance by male sage-grouse and number of active leks indicated matrix thresholds for sage-grouse were not surpassed.

## MATRIX THRESHOLD CRITERIA

There are several measurements used to evaluate the matrix thresholds (or triggers) for Greater Sage-Grouse.

### Active Leks Threshold

The matrix threshold of a 30% decline in total number of active leks within the development area has two comparisons that can be made with this component:

1. The total number of active leks in the three combined development area complexes is compared to the 2007 baseline for the combined development area complexes.
2. The number of active leks in a single development area complex is compared to the 2007 baseline data for that lek complex.

According to footnote 1 on page B-3 of the ROD (BLM 2008), for both of these comparisons, if the number of leks decline but the bird numbers on lek complexes do not, the mitigation threshold would not be surpassed. Therefore, the matrix threshold for a decline in the number of active leks can only be surpassed if there is a concurrent decrease in the peak number of males as explained below.

### Number of Peak Males Threshold

The matrix threshold of a 30% decline in peak male numbers has two comparisons for this component:

1. A 30% decline in peak male numbers within the entire development area is compared to the entire combined reference area total. The change is derived by comparing the current year total to the prior 2-year average in annual peak male numbers within the entire combined development area. The percent change from the development area is then compared to the percent change within the entire combined reference area.
2. A 30% decline in peak male numbers within an individual development area complex compared to the entire combined reference area. The change is derived by comparing the current year total to the prior 2-year average in annual peak male numbers within each

single development area complex.  The percent change from a single development area complex is then compared to the percent change within the entire combined reference area.

## Winter Habitat Use Threshold
The matrix threshold for a decline in habitat area use may be met when measurements detect an average 15% per year decline in the amount of winter concentration habitat area used over 2-years as compared to the entire combined reference areas and when combined with a concurrent average of 30% decline in peak number of males over 2-years compared to the entire combined reference areas.

## Noise Threshold
Noise is measured by evaluating decibel levels at development area leks.  A trigger is met when noise exceeding 10 dBA above background (39 dBA, BLM 2000) when measured from the edge of the lek, is combined with a concurrent average of 30% decline in peak number of male birds over 2-years compared to the entire combined reference area numbers.

# SURVEY METHODS
All monitoring follows the Wyoming Game and Fish Department (WGFD) protocols from the Handbook of Biological Techniques (Emmerich et al. 2007).

Guidelines for conducting noise monitoring (Blickley and Patricelli, 2012) were prepared for the PAPO as recommended by the Wyoming Cooperative Fish and Wildlife Research Unit (Connelly et al. 2010). Noise monitoring results are available in a separate noise monitoring report available on the PAPO website.

# RESULTS
Sage-grouse monitoring included identifying the number of active leks and peak numbers of males attending leks (Appendix A, Table 2).

## Total Number of Active Leks in Development Complexes Combined
In 2007, development area leks in 3 lek complexes (Mesa, Duke's Triangle and Yellowpoint) totaled 16 active leks. There were 12 total active leks within the development area in 2020, which equates to a 25% decline compared to the baseline year 2007 (Appendix B, Table 1).

One lek in the Mesa complex that had not been active since 2011 (Lovatt West), had three males in attendance in 2018, was inactive in 2019 and again active in 2020 with two males.  The Sand Draw Reservoir lek, in the Yellow Point complex, went inactive in 2018 and remained inactive 2020. This lek has declined steadily since 2006, when it had 64 males in attendance.  The Oil Road Fork Lek in the Mesa Complex has declined to 22 males from a high of 184 males in 2007.

There were two new leks found within the reference area complexes in 2019 in Speedway and Ryegrass respectively.  No new leks were found in 2020.

## Total Number of Active Leks in a Single Development Complex

In 2007 the Mesa complex began with 6 active leks. In 2020, 6 active leks were reported for the Mesa complex resulting in no change in the number of leks compared to 2007. There were 2 active leks in the 2007 baseline year for the Duke's Triangle complex with 1 active lek in 2020, representing a 50% decline. The Yellowpoint complex had 8 active leks in the 2007 baseline year with 5 active leks in 2020 representing a 38% decline (Appendix B, Table 2).

## Peak Number of Males Attending Lek Complexes

The WMMM outlines monitoring a 2-year change in the number of males attending 3 development complexes and 3 adjacent reference area lek complexes (Appendix A, Figure 1).  A decline of 30% in one of the development area complexes, when compared to the entire combined reference area, triggers mitigation. Data and calculations for these analyses can be found in Appendix B (Tables 3 thru 8).

## Comparison of Entire Development Area with Combined Reference Area

In 2020, the number of peak males attending leks within the entire development area complexes declined 28% from the previous year (Appendix B, Table 5).  Peak males attending leks within the combined reference area declined 36% (Appendix B, Table 8).

## Comparison of Individual Development Area Complexes with Combined Reference Area

Individual complexes within the development area were compared to the combined reference area.  A decline of 30% in an individual development area complex when compared to the combined reference areas triggers mitigation. Data and calculations for these analyses can be found in Appendix B (Tables 3 thru 8).

### Mesa Complex

In 2020, the Mesa complex decreased 33% (Appendix B, Table 5) while the combined reference area decreased by 36% from the previous year (Appendix B, Table 8).

### Duke's Triangle

In 2020, the Duke's Triangle complex decreased 20% (Appendix B, Table 5) while the combined reference area decreased by 36% from the previous year (Appendix B, Table 8).

### Yellowpoint

In 2020, the Yellowpoint complex decreased 21% (Appendix B, Table 5) while the combined reference area decreased by 36% from the previous year (Appendix B, Table 8).

## LEK SEARCHES

In 2020, ground searches were conducted in all complexes in the development area (Mesa, Duke's Triangle, and Yellowpoint) and all reference area complexes (Speedway, Ryegrass and East Fork).

## WINTER CONCENTRATION AREAS

Wyoming Executive Order 2015-04 requires that identification of winter concentration areas be based on habitat features and repeated observations of winter use by a biologically significant number of Greater Sage-Grouse using a validated resource selection function (RSF) modeling approach. The Sage Grouse Implementation Team (SGIT) is currently working on standardizing the methodology and a RSF model for delineating winter concentration areas in the state of Wyoming. This RSF model could be used to better refine winter concentration areas located within the development and reference area complexes (Appendix C, Figure 1). The PAPO will continue to work on winter concentration delineation and developing monitoring protocols to assess wintering sage-grouse use.

## NOISE MONITORING

The results of the 2020 noise monitoring can be found in a separate report.

## LITERATURE CITED

Blickley, J. L, and G. L. Patricelli. 2013. Noise monitoring recommendations for Greater Sage Grouse habitat in Wyoming. Prepared for the PAPO, Pinedale, WY.

Bureau of Land Management [BLM]. 2000. Record of Decision: Final Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project. Pinedale Field Office, Wyoming.

Bureau of Land Management [BLM]. 2008. Record of Decision: Final Supplemental Environmental Impact Statement for the Pinedale Anticline Oil and Gas Exploration and Development Project. Pinedale Field Office, Wyoming.

Connelly, J.W., T.A. Messmer, E.O. Garton. 2010. Review of sage-grouse monitoring for the Pinedale Anticline Project Area. Wyoming Cooperative Fish and Wildlife Research Unit. Laramie, WY.

Emmerich. J., R. Guenzel, L. Jahnke, B. Kroger, J. Nemick, B. Rudd, and T. Woolley. 2007. Handbook of Biological Techniques: third edition. Wyoming Game and Fish Department.

# Appendix A

**Table 1. Wildlife Matrix (sage-grouse) from Appendix B PAPA ROD (BLM 2008), as modified in 2011.**

| Criteria | Method | Changes that will be monitored | Specific Changes Requiring Mitigation | Mitigation Responses |
|---|---|---|---|---|
| Number of active leks in identified lek complexes | Lek counts according to protocol | Active use on 70% of total current leks; Active use on 70% of leks in each complex (the development area complexes include the Mesa, Duke's Triangle, and Yellow Point complexes) compared to 2007 data. | 30% decline in total number of active leks, or 30% decline in the number of leks in a single complex. | Select mitigation response sequentially as listed below, implement most useful and feasible and monitor results over sufficiently adequate time for the level of impact described by current monitoring. |
| Peak numbers of males attending lek complexes | Lek counts according to protocol | Total average 2-year change in numbers of males attending development area lek complexes (the Mesa, Duke's Triangle, or Yellow Point lek complex), compared to the East Fork, Speedway, or Ryegrass reference lek complexes. | Average of 30% decline in numbers over 2 years compared to reference area. | Select mitigation response sequentially as listed below, implement most useful and feasible and monitor results over sufficiently adequate time for the level of impact described by current monitoring. |
| Winter concentration area use | Monitoring according to protocol | Change in winter concentration area use compared to reference area (once initial data is available), and a concurrent change in the total average 2 year numbers of males attending development area lek complexes (the Mesa, Duke's Triangle or Yellow Point lek complex), compared to the East Fork, Speedway, or Ryegrass reference lek complexes. | Average of 15% per year decline in amount of winter habitat used over 2 years compared to reference areas, and a concurrent average of 30% decline in numbers over 2 years compared to reference area. | Select mitigation response sequentially as listed below, implement most useful and feasible and monitor results over sufficiently adequate time for the level of impact described by current monitoring. |
| Noise levels | Decibel monitoring from March 1-May 15 at lek sites | Noise levels demonstrated to impact peak lek use by male sage-grouse and a concurrent change in the total average 2-year numbers of males attending development area lek complexes (the Mesa, Duke's Triangle, or Yellow Point lek complex), compared to the East Fork, Speedway, or Ryegrass reference lek complexes. | Decibel levels at the lek more than 10 dBA above background measured from the edge of the lek (2000 ROD, p.27), and a concurrent average of 30% decline in peak numbers of male birds over 2 years vs. reference area. | Select mitigation response sequentially as listed below, implement most useful and feasible and monitor results over sufficiently adequate time for the level of impact described by current monitoring. |

Footnote 1. If the number of leks decline but the bird numbers on lek complexes do not, the mitigation threshold would not be surpassed. If the number of leks does not decline but the bird numbers on lek complexes does decline, the mitigation threshold would be surpassed. If both numbers of leks and birds decline, the mitigation threshold would obviously be surpassed

**Figure 1. Greater Sage-grouse Monitoring Project Area**

**Pinedale Anticline Project Area**
**Greater Sage-grouse Monitoring Area Complexes**
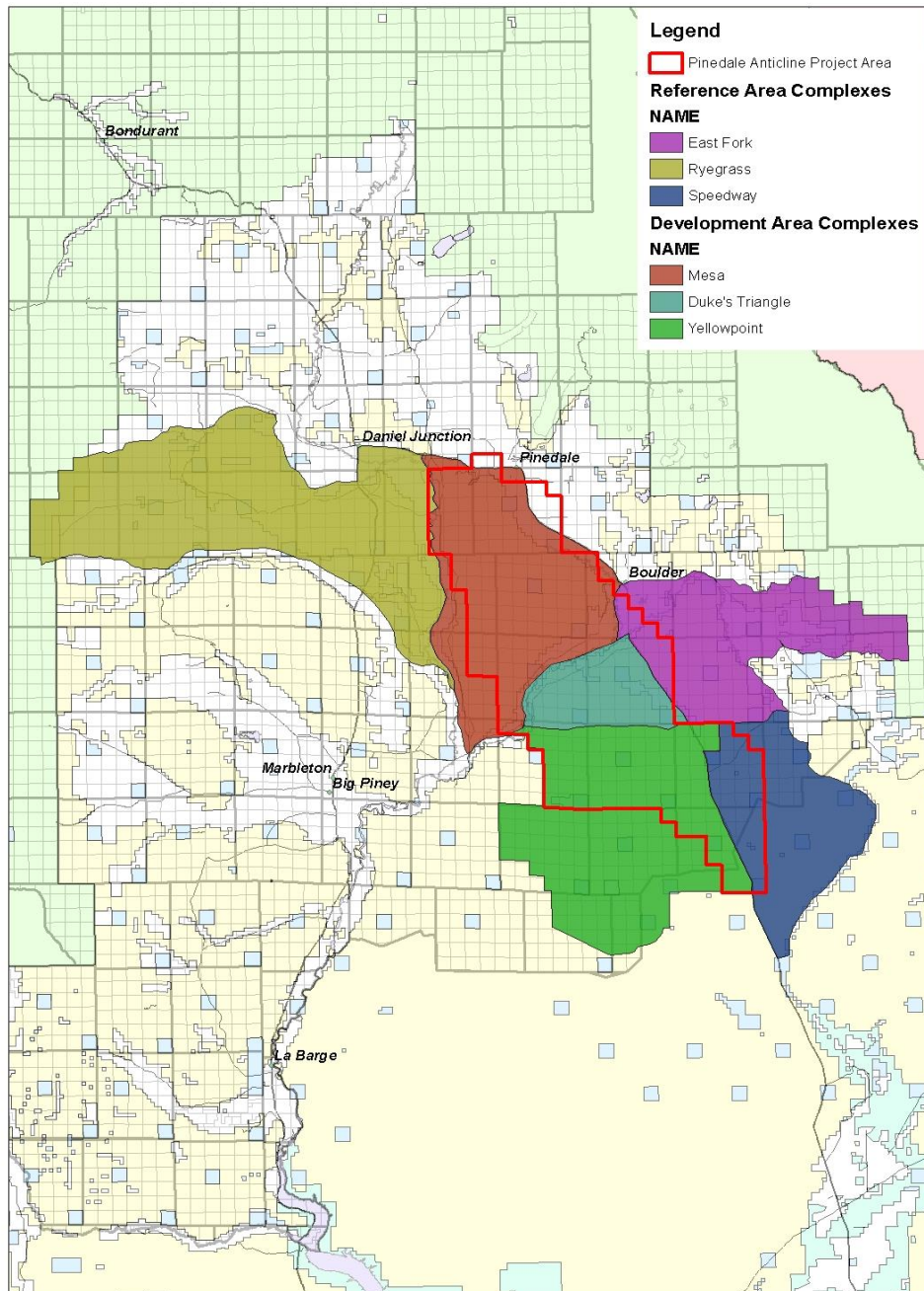
**Wyoming Sage-Grouse Lek Definitions:**

(Revised November 2012)

The following definitions have been adopted for the purposes of collecting and reporting sage-grouse lek data. See the sage-grouse chapter of the Wyoming Game and Fish Department's Handbook of Biological Techniques for additional technical details and methods.

**Lek** - A traditional courtship display area attended by male sage-grouse in or adjacent to sagebrush dominated habitat. A lek is designated based on observations of two or more male sage-grouse engaged in courtship displays. Before a suspected lek is added to the database, it must be confirmed by a survey conducted during the appropriate time of day, during the strutting season. Sign of strutting activity (tracks, droppings, feathers) can also be used to confirm a suspected lek. Sub-dominant males may display on itinerant (temporary) strutting areas during years when populations peak. Such areas usually fail to become established leks. Therefore, a site with small numbers of strutting males (<5) should be confirmed active for two years before the site is added to the lek database.

**Satellite Lek** – A relatively small lek (usually less than 15 males) within about 500 meters of a large lek often documented during years of relatively high grouse numbers. Locations of satellite leks should be encompassed within lek perimeter boundaries. Birds counted on satellite leks should be added to those counted on the primary lek for reporting purposes.

**Lek Perimeter** – The outer perimeter of a lek and associated satellite leks (if present). Perimeters of all leks should be mapped by experienced observers using accepted protocols (Section 1.b.v below); larger leks should receive higher priority. Perimeters may vary over time as population levels or habitat and weather conditions fluctuate. However, mapped perimeters should not be adjusted unless grouse use consistently (2+ years) demonstrates the existing perimeter is inaccurate. The lek location must be identified and recorded as a specific point within the lek perimeter. This point may be the geographic center of the perimeter polygon calculated though a GIS exercise, or a GPS waypoint recorded in the field, which represents the center of breeding activity typically observed on the lek.

**Lek Complex** - A cluster of leks within 2.5 km (1.5 mi) of each other, between which male sage-grouse may interchange from day to day.

**Lek Count** - A census technique that documents the number of male sage-grouse observed attending a particular lek, lek complex, or leks along a lek route based on repeated observation.
- Conduct lek counts at 7-10 day intervals over a 3-4 week period after the peak of mating activity. Although mating typically peaks in early April in Wyoming, the number of males counted on a lek is usually greatest in late April or early May when attendance by yearling males increases.
- Conduct lek counts only from the ground. Aerial counts are not accurate and are not comparable to ground counts.
- Conduct counts from ½ hour before sunrise to 1 hour after.
- Count attendance at each lek a minimum of three times annually during the breeding season.
- Conduct counts only when wind speeds are less than 15 kph (~10 mph) and no precipitation is falling.
- All leks within a complex should be counted on the same morning.

**Lek Count Route** – A lek route is a group of leks in relatively close proximity that represent part or all of a discrete breeding population/sub-population. Leks should be counted on routes to facilitate replication by other observers, increase the likelihood of recording satellite leks, and account for shifts in distribution of breeding birds. Lek routes should be set up so an observer following criteria described under "Lek Count" can count all leks within 1.5 hours.

**Lek Survey** - A monitoring technique designed primarily to determine whether leks are active or inactive. Obtaining accurate counts of males attending is secondary. Ideally, all sage-grouse leks would be counted annually. However, some breeding habitat is inaccessible during spring because of mud and snow, or the location of a lek is so remote it cannot be routinely counted. In other situations, topography or vegetation may prevent an accurate count from any vantage point. In addition, time and budget constraints often limit the number of leks that can be visited. Where lek counts are not feasible for any of these reasons, surveys are the only reliable means to monitor population trends. Lek surveys are designed principally to determine whether leks are active or inactive, requiring as few as one visit to a lek. Obtaining accurate counts of the numbers of males attending is not essential. Lek surveys involve substantially less effort and time than lek counts. They can also be done from a fixed-wing aircraft or helicopter. Lek surveys can be conducted from the initiation of strutting in early March until early-mid May, depending on the site and spring weather. When large numbers of leks are surveyed (50+) the resulting trends of lek attendance over time mirror that of lek counts.

**Annual status** – Lek status is assessed annually based on the following definitions:

**active** – Any lek that has been attended by male sage-grouse during the strutting season. Acceptable documentation of grouse presence includes observation of birds using the site or signs of strutting activity.

**inactive** – Any lek where sufficient data indicates no strutting activity took place throughout a strutting season. Absence of strutting grouse during a single visit is not sufficient documentation to establish a lek is inactive. This designation requires documentation no birds were present on the lek during at least 2 ground surveys separated by at least 7 days. The surveys must be conducted under ideal conditions (site visits between April 1 and May 7, no precipitation, light or no wind, ½ hour before to 1 hour after sunrise) or a ground check of the exact lek location late in the strutting season (after 4/15) during which sign (droppings/feathers) of strutting
activity is not found. Data collected by aerial surveys cannot be used to designate inactive status.

**unknown** – Leks for which active/inactive status has not been documented during the course of a strutting season. Excepting leks not scheduled to be checked in a particular year, the "unknown" status designation should be applied only in rare instances. Each lek should be checked enough times to determine whether it is active or not. It is preferable to conduct two good field checks every other year and confirm the lek is "inactive" rather than check it once every year and have it remain in "unknown" status.

**Management status** - Based on its annual status, a lek is assigned to one of the following categories for management purposes:

**occupied lek** – A lek that has been active during at least one strutting season within the prior ten years. Occupied leks are protected through prescribed management actions during surface disturbing activities.

**unoccupied lek** – Two classifications of unoccupied leks are "destroyed" and "abandoned" (defined below). Unoccupied leks are not protected during surface disturbing activities.

**destroyed lek** – A formerly active lek site and surrounding sagebrush habitat that has been destroyed and is no longer suitable for sage grouse breeding. A lek site that has been strip-mined, paved, converted to cropland or undergone other long-term habitat type conversion is considered destroyed. Destroyed leks are not monitored unless the site has been reclaimed to suitable sage-grouse habitat.

**abandoned lek** – A lek in otherwise suitable habitat that has not been active during a period of 10 consecutive years. To be designated abandoned, a lek must be "inactive" (see above criteria) in at least four non-consecutive strutting seasons spanning the ten years. The site of an "abandoned" lek should be surveyed at least once every ten years to determine whether it has been re-occupied by sage-grouse.

**undetermined lek** – Any lek that has not been documented as active in the last ten years, but survey information is insufficient to designate the lek as unoccupied. Undetermined lek sites are not protected through prescribed management actions during surface disturbing activities until sufficient documentation is obtained to confirm the lek is occupied. This status should be applied only in rare instances (also see "unknown" above).

## Table 2. Development and Reference Area Lek Male Attendance.

| Development Area | Lek Name | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MESA** | Bloom Reservoir | **123** | 107 | 97 | 68 | 81 | 75 | 67 | 61 | 68 | 75 | 75 | 72 | 55 | 40 |
| | Cat | **24** | 19 | 2 | 9 | 3 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Lovatt Draw Reservoir | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Lovatt West | **9** | 25 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 2 |
| | Luman Allotment Reservoir | | | | | | | | | | 46 | 48 | 44 | 33 | 29 |
| | Mesa Road 3 | **100** | 97 | 76 | 40 | 38 | 32 | 42 | 38 | 66 | 79 | 59 | 47 | 30 | 20 |
| | Mesa Spring | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Oil Road Fork | **184** | 154 | 156 | 105 | 93 | 72 | 53 | 43 | 53 | 67 | 63 | 49 | 31 | 22 |
| | Pole Creek | **0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Two Buttes | **99** | 88 | 86 | 82 | 87 | 79 | 64 | 77 | 88 | 94 | 59 | 34 | 18 | 31 |
| | Tyler Draw North | | | 21 | 25 | 35 | 36 | 40 | 33 | 46 | 55 | 60 | 37 | 23 | 15 |
| **DUKE'S TRIANGLE** | Big Fred | **0** | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Little Fred | **24** | 22 | 0 | 30 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Little Fred Satellite | **0** | 0 | 0 | NC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Lower Sand Springs Draw | **10** | 14 | 13 | 18 | 18 | 20 | 20 | 21 | 37 | 67 | 51 | 35 | 30 | 26 |
| **YELLOW POINT** | Alkali Draw | **67** | 37 | 23 | 29 | 29 | 19 | 26 | 23 | 40 | 51 | 55 | 52 | 31 | 27 |
| | Prairie Dog | **39** | 41 | 38 | 23 | 13 | 29 | 23 | 18 | 33 | 53 | 45 | 42 | 33 | 26 |
| | Sand Draw 3 | **5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Sand Draw Reservoir | **38** | 24 | 19 | 19 | 12 | 13 | 12 | 6 | 3 | 3 | 1 | 0 | 0 | 0 |
| | Shelter Cabin Reservoir | **74** | 51 | 44 | 27 | 22 | 40 | 41 | 34 | 28 | 36 | 42 | 27 | 18 | 22 |
| | South Rocks | **33** | 41 | 40 | 25 | 22 | 28 | 26 | 11 | 21 | 26 | 19 | 17 | 4 | 6 |
| | Stud Horse Butte E. | **4** | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | The Rocks | **26** | 24 | 9 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Little Saddle | | | | 33 | 21 | 21 | 23 | 22 | 45 | 68 | 45 | 45 | 28 | 37 |
| Reference Area | Lek Name | | | | | | | | | | | | | | |
| **RYEGRASS** | Brodie Burn | **2** | 0 | 0 | 6 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |

| | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Brodie Draw 1 | 30 | 18 | 19 | 8 | 14 | 10 | 20 | 17 | 21 | 18 | 22 | 18 | 16 | 11 |
| | Brodie Draw 2 | 18 | 32 | 18 | 12 | 7 | 20 | 43 | 22 | 19 | 43 | 21 | 30 | 24 | 9 |
| | Brodie Draw 3 | 0 | 2 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cut Across | 0 | 19 | 7 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fear Ditch | 41 | 42 | 21 | 18 | 37 | 23 | 43 | 30 | 38 | 47 | 36 | 37 | 10 | 0 |
| | Fear Ditch Reservoir | 30 | 4 | 20 | 19 | 24 | 11 | 10 | 11 | 18 | 25 | 33 | 22 | 16 | 15 |
| | Grindstone Butte North | | | | | 9 | 6 | 9 | 10 | 24 | 30 | 14 | 13 | 15 | 9 |
| | Grindstone Draw | 33 | 32 | 38 | 33 | 35 | 26 | 22 | 24 | 59 | 50 | 50 | 52 | 29 | 24 |
| | Jewett Red Flat Reservoir | 82 | 33 | 50 | 31 | 28 | NC | 24 | 49 | 55 | 43 | 50 | 33 | 14 | 0 |
| | Lloyd | | | | | | 24 | 27 | 19 | 35 | 37 | 40 | 51 | 42 | 29 |
| | North Luman Ridge | 28 | 27 | 7 | 2 | 4 | 0 | 0 | 0 | 0 | 0 | NC | 0 | 0 | 0 |
| | North Soapholes Creek | 16 | 15 | 26 | 15 | 31 | 1 | 12 | 12 | 0 | 11 | NC | 10 | 0 | 4 |
| | Old Reservoir | 8 | 19 | 60 | 2 | 6 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Onion Spring | 11 | 2 | 0 | 0 | 2 | 7 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| | Onion Spring 2 | | | 38 | 38 | 21 | 54 | 50 | 124 | 86 | 26 | 68 | 21 | 9 | 12 |
| | Rooster's Delight | | | | | | | 23 | 16 | 11 | 23 | 20 | 11 | 7 | 0 |
| | Ryegrass Draw | 81 | 88 | 147 | 106 | 125 | 59 | 78 | 75 | 96 | 103 | 69 | 47 | 39 | 38 |
| | Ryegrass Draw South | NC | 69 | 49 | 35 | 38 | 41 | 49 | 62 | 51 | 87 | 55 | 52 | 29 | 24 |
| | Ryegrass Reservoir | 7 | 14 | 10 | 2 | 15 | NC | 0 | 4 | 0 | 2 | 0 | 0 | 0 | 0 |
| **RYEGRASS** | Ryegrass Road Fork | 42 | 30 | 33 | 25 | 14 | 40 | 29 | 29 | 45 | 35 | 39 | 25 | 21 | 24 |
| | Sommers | 37 | 27 | 15 | 0 | 19 | 16 | 24 | 10 | 10 | 27 | NC | 7 | 19 | 0 |
| | South Luman Ridge | 44 | 42 | 40 | 25 | 15 | 20 | 21 | 14 | 50 | 32 | NC | 12 | 3 | 0 |
| | South Soapholes Creek | 13 | 21 | 6 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | NC | 0 | 0 | 0 |
| | Upper Onion Creek | 164 | 62 | 121 | 164 | 98 | 71 | 68 | 84 | 130 | 111 | 108 | 73 | 87 | 81 |
| | Big John | 117 | 96 | 80 | 73 | 63 | 56 | 65 | 53 | 185 | 187 | 166 | 142 | 118 | 71 |
| **SPEEDWAY** | Darby | 104 | 94 | 75 | 56 | 32 | 41 | 31 | 20 | 34 | 64 | 62 | 48 | 41 | 24 |
| | Desert Reservoir | 226 | 234 | 150 | 153 | 61 | 72 | 84 | 92 | 111 | 130 | 109 | 128 | 89 | 85 |
| | Hole 2 | 0 | 0 | 0 | 18 | 17 | 25 | 18 | 12 | 21 | 43 | 42 | 59 | 39 | 21 |

| | | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mud Hole State | 235 | 200 | 142 | 82 | 64 | 62 | 41 | 42 | 119 | 211 | 194 | 199 | 133 | 98 |
| | Speedway | 132 | 103 | 94 | 54 | 84 | 52 | 41 | 24 | 37 | 80 | 62 | 66 | 64 | 40 |
| | Waterhole Draw | 120 | 92 | 70 | 31 | 29 | 41 | 18 | 6 | 8 | 16 | 24 | 21 | 38 | 52 |
| | Blown Out Reservoir | 216 | 208 | 171 | 109 | NC | 87 | 84 | 89 | 138 | 119 | 116 | 116 | 81 | 64 |
| EAST FORK | Chalk Butte | | | | | | | | | | 25 | 16 | 5 | 6 | 0 |
| | Fremont Butte Well 2A | 31 | 14 | 16 | 12 | NC | 34 | 24 | 46 | 26 | 18 | 9 | 10 | 9 | 0 |
| | Fremont Butte Well 2B | 27 | 29 | 26 | 21 | NC | 21 | 26 | 30 | 49 | 54 | 41 | 57 | 49 | 35 |
| | Sand Springs Well 2 | | | | | | | | | | 54 | 23 | 20 | 11 | 13 |
| | | | | | | | | | | | | | | | |

# Appendix B

**Data and Calculations** (data is rounded to nearest whole number)

# DEVELOPMENT AREA

**Table 1. Number of active leks in combined development area.**

| Year | Combined Development Area Complexes Number of Active Leks* | Matrix Threshold: Percent change in active Leks compared to 2007 |
|------|------|------|
| **2007** | 16 | |
| **2008** | 16 | 0% |
| **2009** | 13 | -19% |
| **2010** | 15 | -6% |
| **2011** | 15 | -6% |
| **2012** | 13 | -19% |
| **2013** | 13 | -19% |
| **2014** | 12 | -25% |
| **2015** | 12 | -25% |
| **2016** | 13 | -19% |
| **2017** | 13 | -19% |
| **2018** | 13 | -19% |
| **2019** | 12 | -25% |
| **2020** | 12 | -25% |

**\*Lek data provided by WGFD.**

The percent change in active leks compared to the 2007 baseline year is calculated by taking the current year's number of active leks minus the number of active leks in 2007; divide this number by the number of active leks in 2007 and multiply by 100.

Example: to calculate the percent change in active leks in 2020 compared to 2007

$$(12 - 16) / 16 \times 100 = -25\%$$

Table 2. Number of active leks per single complex in development area.

| Year | Mesa Complex Number of active Leks | Matrix Threshold: Percent change in active Leks compared to 2007 |
|------|------|------|
| **2007** | 6 | |
| **2008** | 6 | 0% |
| **2009** | 6 | 0% |
| **2010** | 6 | 0% |
| **2011** | 7 | 17% |
| **2012** | 6 | 0% |
| **2013** | 6 | 0% |
| **2014** | 5 | -17% |
| **2015** | 5 | -17% |

| Year | Mesa Complex Number of active Leks | Matrix Threshold: Percent change in active Leks compared to 2007 |
|---|---|---|
| 2016 | 6 | 0% |
| 2017 | 6 | 0% |
| 2018 | 7 | 17% |
| 2019 | 6 | 0% |
| 2020 | 6 | 0% |
| Year | Duke's Triangle Complex Number of active Leks | Matrix Threshold: Percent change in active Leks compared to 2007 (bold indicates threshold has been met) |
| 2007 | 2 | |
| 2008 | 3 | 50% |
| 2009 | 1 | -50% |
| 2010 | 2 | 0% |
| 2011 | 2 | 0% |
| 2012 | 1 | -50% |
| 2013 | 1 | -50% |
| 2014 | 1 | -50% |
| 2015 | 1 | -50% |
| 2016 | 1 | -50% |
| 2017 | 1 | -50% |
| 2018 | 1 | -50% |
| 2019 | 1 | -50% |
| 2020 | 1 | -50% |
| Year | Yellowpoint Complex Number of active Leks | Matrix Threshold: Percent change in active Leks compared to 2007 |
| 2007 | 8 | |
| 2008 | 7 | -13% |
| 2009 | 6 | -25% |
| 2010 | 7 | -13% |
| 2011 | 6 | -25% |
| 2012 | 6 | -25% |
| 2013 | 6 | -25% |
| 2014 | 6 | -25% |
| 2015 | 6 | -25% |
| 2016 | 6 | -25% |
| 2017 | 6 | -25% |
| 2018 | 5 | -38% |
| 2019 | 5 | -38% |
| 2020 | 5 | -38% |
| | | |

The percent change in active leks compared to the 2007 baseline year is calculated by taking the current year's number of active leks minus the number of active leks in 2007; divide this number by the number of active leks in 2007 and multiply by 100.

Example: to calculate the percent change in active leks in the Duke's Triangle Complex in 2020 compared to 2007: $(1 - 2) / 2 \times 100 = -50\%$

**Table 3. Peak Number of Males Attending Development Area Lek Complexes.**

| Year | Mesa Complex | Duke's Triangle Complex | Yellowpoint Complex | Combined Development Area |
|------|------|------|------|------|
| 2007 | 539 | 34 | 286 | 859 |
| 2008 | 490 | 38 | 220 | 748 |
| 2009 | 438 | 13 | 173 | 624 |
| 2010 | 329 | 48 | 167 | 544 |
| 2011 | 339 | 27 | 119 | 485 |
| 2012 | 296 | 20 | 150 | 466 |
| 2013 | 269 | 20 | 151 | 440 |
| 2014 | 252 | 21 | 114 | 387 |
| 2015 | 321 | 37 | 170 | 528 |
| 2016 | 416 | 67 | 237 | 720 |
| 2017 | 364 | 51 | 207 | 622 |
| 2018 | 286 | 35 | 183 | 504 |
| 2019 | 190 | 30 | 114 | 334 |
| 2020 | 159 | 26 | 118 | 303 |

*Lek data provided by WGFD.

**Table 4. Two-year Average Number of Males Attending Development Area Lek Complexes.**

| Years | Mesa Complex | Duke's Triangle Complex | Yellowpoint Complex | Combined Development Area |
|------|------|------|------|------|
| 2006-2007 | 558 | 31 | 261 | 850 |
| 2007-2008 | 515 | 36 | 253 | 804 |
| 2008-2009 | 464 | 26 | 197 | 686 |
| 2009-2010 | 384 | 31 | 170 | 584 |
| 2010-2011 | 334 | 38 | 143 | 515 |
| 2011-2012 | 318 | 24 | 135 | 476 |
| 2012-2013 | 283 | 20 | 151 | 453 |
| 2013-2014 | 252 | 21 | 133 | 414 |
| 2014-2015 | 321 | 29 | 142 | 458 |
| 2015-2016 | 416 | 52 | 204 | 624 |
| 2016-2017 | 364 | 59 | 222 | 671 |
| 2017-2018 | 286 | 43 | 195 | 563 |
| 2018-2019 | 238 | 33 | 149 | 419 |
| 2019-2020 | 175 | 28 | 116 | 319 |

The two-year average is calculated by adding two consecutive years of the peak number of males attending the lek complex (Table 3) and dividing by 2.

Example: 2019-2020 average for Mesa Complex  (190+ 159) / 2 = 175

Table 5. Percent Change in Number of Males Attending Development Area Lek Complexes.

| Year | Mesa Complex | Duke's Triangle Complex | Yellowpoint Complex | Combined Development Area |
|------|------|------|------|------|
| 2007 | 11% | 0% | 50% | 21% |
| 2008 | -12% | 23% | -16% | -12% |
| 2009 | -15% | -64% | -32% | -22% |
| 2010 | -29% | 85% | -15% | -21% |
| 2011 | -12% | -13% | -30% | -17% |
| 2012 | -11% | -47% | 5% | -10% |
| 2013 | -15% | -17% | 12% | -8% |
| 2014 | -11% | 5% | -25% | -15% |
| 2015 | 23% | 76% | 28% | 28% |
| 2016 | 45% | 131% | 67% | 57% |
| 2017 | -1% | -2% | 2% | 0% |
| 2018 | -27% | -41% | -18% | -25% |
| 2019 | -42% | -30% | -42% | -42% |
| 2020 | -33% | -20% | -21% | -28% |

The percent change in number of males attending development area lek complexes is calculated using the following calculation:

The current year annual peak male attendance for a complex (Table 3) minus the previous two-year running average for that complex (Table 4); divide this number by the previous two-year running average for that complex (Table 4) and multiply by 100.

Example: to calculate the 2020 percent change in the Mesa Complex:

$$(238 – 175) \ / \ 238 \ X \ 100 = -33\%$$

## REFERENCE AREA

**Table 6. Peak Number of Males Attending All Reference Area Lek Complexes.**

| Year | Ryegrass Complex | East Fork Complex | Speedway Complex | Combined Reference Area |
|------|------|------|------|------|
| 2007 | 687 | 274 | 934 | 1895 |
| 2008 | 598 | 251 | 819 | 1668 |
| 2009 | 726 | 213 | 611 | 1550 |
| 2010 | 545 | 142 | 467 | 1154 |
| 2011 | 555 | NA* | 350 | NA |

| Year | Ryegrass Complex | East Fork Complex | Speedway Complex | Combined Reference Area |
|---|---|---|---|---|
| 2012 | 430 | 142 | 349 | 921 |
| 2013 | 552 | 134 | 298 | 984 |
| 2014 | 633 | 165 | 249 | 1047 |
| 2015 | 748 | 213 | 515 | 1476 |
| 2016 | 752 | 270 | 731 | 1753 |
| 2017 | 625 | 205 | 659 | 1489 |
| 2018 | 514 | 208 | 663 | 1385 |
| 2019 | 380 | 156 | 522 | 1058 |
| 2020 | 280 | 112 | 391 | 783 |

*Lek data provided by WGFD

**Table 7. Two Year Average Number of Males Attending Reference Area Lek Complexes.**

| Year | Ryegrass Complex | East Fork Complex | Speedway Complex | Combined Reference Area |
|---|---|---|---|---|
| 2006-2007 | 572 | 250 | 908 | 1730 |
| 2007-2008 | 643 | 263 | 877 | 1782 |
| 2008-2009 | 662 | 232 | 715 | 1609 |
| 2009-2010 | 636 | 178 | 539 | 1352 |
| 2010-2011 | 550 | NA | 409 | NA |
| 2011-2012 | 493 | NA | 350 | NA |
| 2012-2013 | 491 | 138 | 324 | 953 |
| 2013-2014 | 593 | 150 | 274 | 1016 |
| 2014-2015 | 691 | 189 | 382 | 1262 |
| 2015-2016 | 750 | 242 | 623 | 1615 |
| 2016-2017 | 689 | 238 | 695 | 1621 |
| 2017-2018 | 570 | 207 | 661 | 1437 |
| 2018-2019 | 447 | 182 | 593 | 1222 |
| 2019-2020 | 330 | 134 | 457 | 921 |

*Note: the East Fork complex was not included in the 2010-2012 calculations because data was not collected in 2011. Although the running two-year average could be calculated, it would not be possible to calculate the percent change since there is not a running two-year value for the years 2011-2012.

The two-year average is calculated by adding two consecutive years of the peak number of males attending the lek complex (Table 6) and dividing by 2.

Example: 2019-2020 average for Ryegrass Complex: (380 + 280) / 2 = 330

**Table 8. Percent Change in Number of Males Attending Reference Area Lek Complexes.**

| Year | Ryegrass Complex | East Fork Complex | Speedway Complex | Combined Reference Area |
|---|---|---|---|---|
| **2007** | 66% | 34% | 19% | 35% |
| **2008** | 5% | 0% | -10% | -4% |
| **2009** | 13% | -19% | -30% | -13% |
| **2010** | -18% | -39% | -35% | -28% |
| **2011** | -13% | NA | -35% | -23* |
| **2012** | -22% | NA | -15% | -19* |
| **2013** | 12% | NA | -15% | 1%* |
| **2014** | 29% | 20% | -23% | 10% |
| **2015** | 26% | 42% | 88% | 45% |
| **2016** | 9% | 43% | 91% | 39% |
| **2017** | -17% | -15% | 6% | -8% |
| **2018** | -25% | -13% | -5% | -15% |
| **2019** | -33% | -25% | -21% | -26% |
| **2020** | -37% | -38% | -34% | -36% |

*Note: The East Fork complex was not included in the 2010-2013 calculations because data was not collected in 2011 due to heavy snow conditions. Although the running two-year average could be calculated, it would not be possible to calculate the percent change since there is not a running two-year value for the years 2011-2013.

The percent change in number of males attending reference area lek complexes is calculated using the following calculation:

> The current year annual peak male attendance for a complex (Table 6) minus the previous two-year running average for that complex (Table 7); divide this number by the previous two-year running average for that complex (Table 7) and multiply by 100.

> Example: to calculate the 2020 percent change in the Ryegrass Complex:

$$(280 - 447) / 447 \times 100 = -37\%$$

# Appendix C

**Figure 1. Sage-grouse winter concentration areas.**



## Pinedale Anticline Project Area
## Greater Sage-grouse Winter Concentration Areas