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Surprise Complex
Wild Horse and Burro Gather Plan

Month 2021

Preparing Office

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1.0 Purpose and Need

1.1 Introduction

The Bureau of Land Management Applegate Field Office (BLM) is proposing to gather and remove excess wild horses and burros from within and outside the Massacre Lakes, Bitner, Nut Mountain, Wall Canyon, High Rock, and Fox Hog Herd Management Areas (HMA; hereafter referred to as the Surprise Complex or the Complex) in order to bring the population to the established appropriate management level (AML) and implement a range of fertility controls to maintain the population to within AML over a period of up to 10 years from the date of the initial gather operation to allow for recovery of deteriorated rangeland resources. Aerial surveys would be conducted just prior to gathers to verify numbers and locations of the animals. The specific number of animals gathered and removed to achieve and/or maintain AML would depend on when the actions occur and how many wild horses and burros are inhabiting the Complex. All female horses returned to the Complex would be treated with an approved fertility control in accordance with current BLM policy and guidance.

In compliance with the National Environmental Policy Act (NEPA), this Environmental Assessment (EA) is a site-specific analysis of potential impacts that could result from implementation of the proposed action or alternatives. If the BLM determines significant impacts could occur, an Environmental Impact Statement (EIS) would be prepared for the project. If no significant impacts are expected, an EIS would not be prepared and a decision would be issued along with a Finding of No Significant Impact (FONSI) documenting the reasons why implementation of the selected alternative would not result in significant environmental impact.

1.2 Background

The Surprise Complex contains six HMAs administered by the BLM Applegate Field Office: Massacre Lakes, Bitner, Nut Mountain, Wall Canyon, High Rock, and Fox Hog which are managed as a complex. The Massacre Lakes HMA is included in this Complex because it is adjacent to the Bitner HMA and wild horses have been observed moving between the two HMAs. The total acreage of the Complex is 396,674 acres of public and private lands and consists of a vast, diverse, and remote landscape. The Surprise Complex lies in northwestern Nevada mostly in Washoe County, Nevada with a small portion in Humboldt County, Nevada. The Surprise Complex is approximately 45 miles long from north to south and 25 miles wide east to west. Portions of the Complex are within the Black Rock High Rock National Conservation Area, which is also administered by the BLM. The Complex is bordered to the northeast by the Sheldon National Wildlife Refuge. It is along Washoe County Route 8A and Washoe County Route 34. On lands adjacent to the east are several HMAs administered by the BLM Nevada Black Rock Field Office; the Calico Mountains, Granite Range, and Warm Springs Canyon HMAs are all part of the Calico Complex, which is managed under a different land use plan.

Therere are 377,063 acres of BLM-administered lands within the Surprise Complex (Table 1-1). The Complex contains many unique and important biological, geological, scenic, and cultural resources. Besides providing forage and habitat for wild horses, the Complex is an important habitat for several wildlife species, including the greater sage-grouse, pronghorn, and mule deer. The other predominant land uses within the HMA are livestock grazing, wilderness recreation, and general recreation, including hunting.

Table 1-1: Acreages Federal and Non-Federal lands for the HMAs in the Surprise Complex

HMA	BLM Acres	Non-BLM acres	Total acres
Massacre Lakes	36,084	3,842	39,926
Bitner	47,766	5,966	53,732
Nut Mountain	38,396	1,840	40,236
Wall Canyon	39,119	2,033	41,152
High Rock	94,612	77	94,689
Fox Hog	121,086	5,853	126,939
Total	377,063	19,611	396,674

The aggregate AML range within the Complex is 283-496 wild horses and zero burros, although burros have been observed in the Complex. The AML upper limit is the sum total of the maximum number of wild horses that the Complex can support while maintaining a thriving natural ecological balance and multiple use relationship on the BLM-administered lands in each of the HMAs in the area. Establishing AML as a population range allows for the periodic removal of excess animals (to the low range) and subsequent population growth (to the high range) between removals. The AML for each HMA was established independently, even though the Complex is managed as a metapopulation based on the sum of the AMLs of all the HMAs combined. The AML for each HMA in the Surprise Complex was determined based on in-depth analyses of habitat suitability, resource monitoring, and population inventory data with public involvement. The background history on AML establishment and subsequent decisions can be found in the 2011 High Rock Complex Wild Horse Population Management Plan (DOI-BLM-CA-N070-2011-04-EA, Section 1.5) and is incorporated into this assessment by reference. Monitoring data informing AML continue to be collected for each individual HMA, and these data do not indicate a need or basis for further adjustments.

The BLM designated the Massacre Lakes, Bitner, High Rock, Nut Mountain, and Wall Canyon Herd Areas as suitable for the long-term management of wild horses in the approved Cowhead-Massacre Management Framework Plan (MFP) in 1981. The Cowhead-Massacre MFP/Record of Decision (1982) established the multiple use balance between livestock, wild horses, and wildlife based on the analyses of alternative allocations between these uses, and set initial forage allocations for wild horses. In similar fashion, the BLM designated the Fox Hog Herd Area in the Tuledad/Homecamp MFP/Record of Decision in 1979. AML was established for the Massacre Lakes HMA in DOI-BLM-CAN070-2013-0021-EA in 2013.

Massacre Lakes HMA Appropriate Management Levels
The AML for Massacre Lakes HMA was estimated at 25-35 horses in the 2008 Surprise Field Office Resource Management Plan and Record of Decision (DOI-BLM-CA-N020-2008-0002-RMP-EIS).

Additional analysis and monitoring data supported establishment of the AML range of 25-45 horses in the 2013 Livestock Grazing Authorization and Wild Horse Appropriate Management Level Establishment Massacre Lakes Allotment and Herd Management Area EA (DOI-BLM-CAN070-2013-0021-EA). No other adjustments have been made to this AML and monitoring data do not indicate a need or basis for further adjustments.

Bitner HMA Appropriate Management Levels

The AML was re-established for the Bitner HMA as a population range of 15-25 in 1993, based on resource condition inventory and monitoring. The 1993 AML was established because the 1992 analysis supported the management levels established in the Management Framework Plan and confirmed that there was not extra forage to allocate on this HMA. The 1993 Decision stated that the population level of 40 wild horses in the HMA in 1992 was excessive, and that a range of 15-25 wild horses would result in a thriving natural ecological balance in combination with the other uses of the area. The 2008 Surprise RMP re-affirmed this AML range.

Fox Hog HMA Appropriate Management Levels

The AML for the Fox Hog HMA was increased from a range of 50-75 wild horses to a population range of 120-226 wild horses in April 1999. The AML increase was supported by livestock utilization data, actual use information, wild horse population inventory data, precipitation, and utilization monitoring data collected from 1987 to 1997. The 2008 Surprise RMP re-affirmed this AML range.

High Rock HMA Appropriate Management Levels

The combined AML for the High Rock HMA has been established as a population range of 78-120 horses. The High Rock HMA is subdivided into two home ranges: the East of Canyon Home Range and the Little High Rock Home Range. The AML was established for the East of Canyon Home Range as a population range of 30-40 in 1993. The 1993 Decision stated that wild horses were using the bottom of High Rock and Pole Canyons during the growing season, which was preventing the plant communities from achieving or being maintained at site potential. When wild horse numbers were between 30-40 head, they did not use the canyon bottoms during the summer, and this allowed the vegetation to progress towards meeting vegetation condition goals, and also helped to protect cultural resource sites.

The AML was established for the Little High Rock Home Range as a population range of 48-80 in June 2001. The AML was based on analysis of monitoring data and field inspections. The two primary limiting factors affecting wild horses and their habitat in the Little High Rock Home Range were: 1) the condition of riparian habitat and 2) water availability. The 2008 Surprise RMP re-affirmed this AML range.

Nut Mountain HMA Appropriate Management Levels

The AML was reaffirmed for the Nut Mountain HMA as a population range of 30-55 in 1993. This AML was established in order to address the riparian condition problems noted during the 1992 analysis, and to develop a thriving natural ecological balance in combination with the other herbivores on the range. The 2008 Surprise RMP re-affirmed this AML range.

Wall Canyon HMA Appropriate Management Levels

The AML was reaffirmed for the Wall Canyon HMA as a population range of 15-25 in 1993. This AML was based on riparian condition and impacts from wild horses, and developing a thriving natural ecological balance in combination with the domestic livestock and native wildlife on the range. The 2008 Surprise RMP re-affirmed this AML range.

Adjacent Lands Outside of HMAs

Management of wild horses and burros on the Calico Complex, to the east, falls within the jurisdiction of the BLM Nevada Black Rock Field Office, and is outside the scope of this EA. For the purposes of aerial survey, lands in the Surprise Complex and Calico Complex are surveyed at the same time as nearby lands on the Sheldon National Wildlife Refuge (NWR), Carter Researvoir HMA, Hart Mountain NWR, Beatys Butte HMA, in what is known as the 'tri-state complex' of survey flights (i.e., Lubow 2020). Administratively, though, all of those areas do not comprise a single complex. It is worth noting that animals regularly move across the administrative boundary separating the Surprise Complex and Calico Complex, as the fencing condition may be poor in in places. As a result, it is possible that some free-roaming wild horses and burros affected by BLM Nevada management decisions may move onto Surprise Complex lands. Conversely, some animals affected by BLM California Surprise Field Office decisions may move onto Calico Complex lands.

The public land portions of the High Rock Complex adjacent and to the west of six HMAs in the Surprise Complex are areas that did not have wild horses at the time of passage of the Wild Free-Roaming Horses and Burros Act of 1971 (as amended), or that have been determined through the BLM Land Use Planning process to not be suitable for wild horse use. As such, these areas are not managed for wild horses and applicable laws, policies, regulations, and land use plans direct that any wild horses found on these lands should be promptly removed. See Appendix B for a map of animal group locations both on- and off-HMAs.

Past Actions

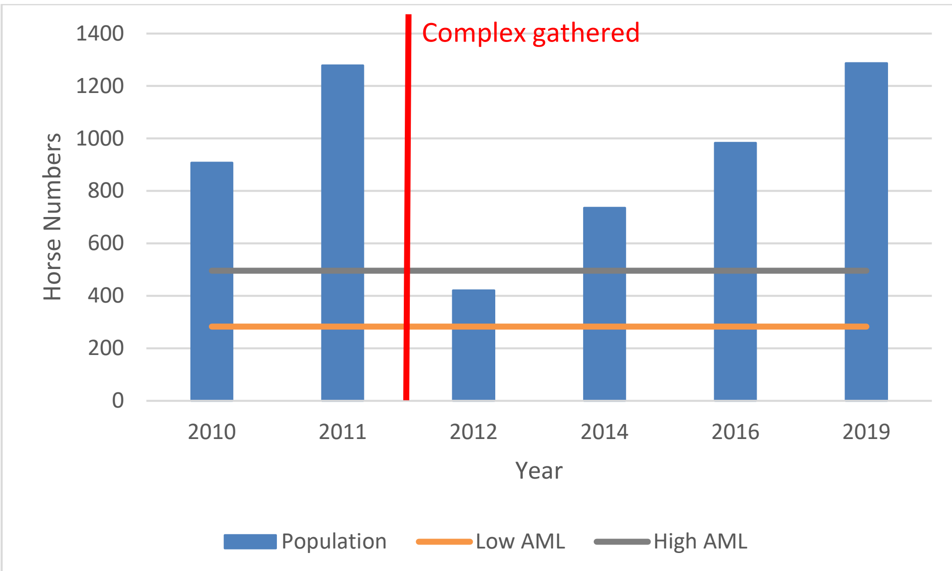
The 2011 High Rock Complex (Bitner, Fox Hog, High Rock, Nut Mountain and Wall Canyon Herd Management Areas) Wild Horse Population Management Plan EA (DOI-BLM-CA-N070-2011-04-EA) is available on the National NEPA Register at: https://eplanning.blm.gov/epl-front-office/eplanning/nepa/nepa_register.do. To locate the EA, select "text search," "California," "Surprise," and fiscal year "2011."

In 2011, 1,334 wild horses were gathered, 1,148 wild horses were removed, and 186 wild horses were released back to the High Rock Complex. Of these, 38 mares were treated with fertility control vaccine (Porcine Zona Pellucida, PZP-22) and freezemarked for future identification. Post-gather in 2011, an estimated 309 wild horses remained in the Complex based on an aerial survey.

Current Population Estimate

The most recent aerial survey within and outside the Surprise Complex in June 2019 included a estimated population of 1,301 wild horses and 11 burros. These numbers are based on an aerial survey observations made using the simultaneous double-observer method. Statistical analysis of data to account for animals present, but not seen, led to an estimated total of 1,301 wild horse in the Complex at the time of the survey – implying that observers saw approximately 97% of horses present. Burro observations were not analyzed, due to small sample size. It is also likely that the 2019 population estimates are lower than the actual number of animals present within and outside of the Complex because of known tendency for the double-observer analysis to lead to underestimating true herd sizes (Lubow 2020). Additionally, the census was completed prior to the end of the 2019 foaling season, so there were likely additional foals born after the completion of the 2019 census (Lubow 2020). The number of animals directly counted in the 2019 population counts is more than 400 percent over the lower AML for wild horses (see Figure 1-1).

Figure 1-1: Wild horse population estimates in the Surprise Complex based on aerial censuses from 2010 – 2019. Figure populated by data from Lubow (2010, 2011, 2013, 2015, 2016, 2020).



Proximity to Other HMAs
The Surprise Complex and the Calico Mountain Complex are adjacent to each other, and are separated by an administrative boundary fence that is known to be in disrepair in some areas. It is likely that any gather operations would occur either just prior to, or in conjunction with gathers for the Calico Mountains Complex and the McGee Mountain HMA that the BLM Nevada Winnemucca District Office is proposing preparing. If it would be possible, a collaborative effort to simultaneously gather these areas across BLM administrative units could increase gather efficiency, and could aid in successfully removing wild horse and burro populations from the range to achieve the low AML.

Based on all information available at this time, the BLM has determined that excess wild horses and burros exist within the Complex and need to be removed. BLM will continue to monitor resources and the wild horses and conduct assessments to help inform management decisions. The following factors for determining excess include, but are not limited to the following:

1. In June 2019, the BLM conducted an aerial survey of the Surprise Complex and counted 1,301 wild horses and 11 wild burros. There are at least 805 horses and 11 burros in excess of the AML upper limit (and 1,018 horses and 11 burros in excess of the AML lower limit).

2. Wild horses and burros are using more than 2.5 times their allocated forage based on AUMs allocated by the upper limit AML (see Table 1-2).

3. Riparian functional assessments completed between 2011 and 2020 document severe utilization of forage within riparian and wetland habitats and extensive trampling and trailing damage by wild horses and burros.

4. Cultural resource inventories completed between 2011 and 2020 indicate that wild horse and burro overpopulation is and has contributed to heavy trampling damage of archaeological sites, features, and artifacts resulting in adverse effects to historic properties.

5. Land health evaluations and determinations completed between 2000 and 2018 indicate that the wild horse and burro overpopulation is contributing to the following standard(s) not being met: Riparian/Wetland.

Table 1-2: Appropriate Management Levels for the HMAs in the Surprise Complex

HMA	2019 Population Counts[4/]		BLM Document(s)/Date	Appropriate Management Level (Numbers)		Forage Allocation (AUMs) [1/]	
	Horses	Burros		Horses	Burros	Horses [2/]	Burros [3/]
Massacre Lakes	129	0	Surprise RMP/ROD, April 2008; Livestock Grazing Authorization and Wild Horse Appropriate Management Level Establishment Massacre Lakes Allotment and Herd Management Area, August 2013.	25 – 45	0	300 – 540	0
Bitner	104	0	Surprise RMP/ROD, April 2008; Environmental Assessment # CA-028-93-03. Wild Horse Gathering and Removal: Bitner, High Rock, Nut Mountain, and Wall Canyon Herd Management Areas, June 1993.	15 – 25[5/]	0	180 – 300	0
Nut Mountain	95	0	Surprise RMP/ROD, April 2008; Environmental Assessment # CA-028-93-03. Wild Horse Gathering and Removal: Bitner, High Rock, Nut Mountain, and Wall Canyon Herd Management Areas, June 1993.	30 – 55	0	360 – 660	0
Wall Canyon	84	3	Surprise RMP/ROD, April 2008; Environmental Assessment # CA-028-93-03. Wild Horse Gathering and	15 – 25	0	180 – 300	0

			Removal: Bitner, High Rock, Nut Mountain, and Wall Canyon Herd Management Areas, June 1993.				
High Rock	214	8	Surprise RMP/ROD, April 2008; Environmental Assessment # CA-370-01-07. Gathering of Wild Horses in the High Rock HMA, Decision and Little High Rock Home Range AML Establishment/Capture Plan, June 2001. Environmental Assessment # CA-028-93-03. Wild Horse Gathering and Removal: Bitner, East of the Canyon Home Range (High Rock), Nut Mountain, and Wall Canyon Herd Management Areas, June 1993.	78 – 120	0	936 – 1,440	0
Fox Hog	351	0	Surprise RMP/ROD, April 2008; Environmental Assessment # CA-370-99-08. Bare Allotment and Fox Hog Wild Horse HMA: Livestock Carrying Capacity and Grazing Strategy, Wild Horse Appropriate Management Level , April 1999	120 – 226[6/]	0	1,440 – 2,712	0
Outside HMA	324	0		0	0	0	0
Total	1,301	11		283 – 496	0	3,396 – 5,952	0

[1/] Animal Unit Month (AUM) is defined as the amount of forage necessary for the sustenance of one cow or its equivalent for a period of 1 month.

[2/] Horse AUMS are calculated using one mature horse (with foal) as 1 animal unit equivalent, for a 12 month grazing period.

[3/] Burro AUMS are calculated using one mature burro (with foal) as 0.5 animal unit equivalent, for a 12 month grazing period.

[4/]Estimated population from 2019 aerial census which likely under counted the actual number of animals (Lubow 2020).

[5/]The Surprise RMP/ROD, April 2008 incorrectly lists the AML for Bitner HMA as 15-20 horses. This was a typographical error, and has been corrected through an RMP errata sheet.

[6/]The Surprise RMP/ROD, April 2008 incorrectly lists the AML for the Fox Hog HMA as 120-220 horses. This was a typographical error, and has been corrected through an RMP errata sheet.

The total forage allocation for wild horses in the Surprise Complex ranges between 3,396 AUMs at the low AML to 5,952 AUMs at the high AML (Table 1-2).

1.3 Purpose and Need for Action

The purpose of the proposed action and other action alternatives is to achieve and maintain wild horse populations to be within the established AMLs for the Surprise Complex over a period of 10 years. These actions would allow the BLM to achieve management goals and objectives of attaining and maintaining wild horse and burro populations within AML range, slow the current population growth rate through use of population growth suppression methods, and restore and maintain a thriving natural ecological balance within the Surprise Complex.

These actions are needed to protect rangeland resources from undue or unnecessary degradation, allow for recovery of degraded range resources, and restore a thriving natural ecological balance and within a multiple-use relationship on BLM-administered lands in the area consistent with the provisions of Section 3(b)(2) of the Wild Free-Roaming Horses and Burros Act of 1971, as amended (Wild Horse and Burro Act).[1]

1.4 Land Use Plan Conformance

The proposed action and action alternatives are in conformance with the Surprise Field Office Resource Management Plan and Record of Decision (April 2008), Section 2.24.4, and the Nevada and Northeastern California Greater Sage-Grouse Approved Resource Management Plan Amendment (USDOI BLM 2015; ARMPA) and Record of Decision (2015), Section 2.2.5. These documents are available on the National NEPA Register at: https://eplanning.blm.gov/epl-front-office/eplanning/nepa/nepa_register.do.

1.5 Relationship to Laws, Regulations, and Other Plans

The action alternatives are in conformance with the Wild Free-Roaming Horses and Burros Act of 1971 (as amended), applicable regulations at 43 CFR § 4700, and BLM policies (see Appendix B).

1.6 Conformance with Rangeland Health Standards and Guidelines

Between 2000 and 2020, the BLM completed land health assessments within the Surprise Complex. The BLM has determined that causal factors contributing to sites not meeting standards in the allotments include, but are not limited to, wildfire, activities on adjacent private lands, historic (pre-1970s) livestock grazing and high utilization from wild horses. A causal factor is defined as the predominant current factor that is contributing to the degradation of resource conditions, or past management activities that have impacted the land. More information regarding the Upland Soil and Biodiversity Standards for land health assessments conducted in the High Rock Complex (which includes all of the Surprise Complex HMAs except Massacre Lakes) between 2000 and 2010 can be found in the 2011 High Rock Complex Wild Horse Population Management Plan (DOI-BLM-CA-N070-2011-04-EA, Section 3.11). Allotments continue to be evaluated for achievement of the rangeland health standards. The Standards for Rangeland Health are located in the *Rangeland Health Standards and Guidelines for California and Northwestern Nevada Final EIS* (USDI 1998).

The BLM completed 67 individual riparian functional assessments within the Surprise Complex between 2010 and 2020 and determined that high amounts of grazing and trampling, resulting from the excess numbers of wild horses in the Complex, are contributing factors for sites not achieving the Riparian/Wetland Standard for Rangeland Health. See Section 3.3.4 for a complete description of upland and riparian/wetland health assessments and results.

1.7 Decision to be Made

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[1] The Interior Board of Land Appeals (IBLA) defined the goal for managing wild horse (or burro) populations in a thriving natural ecological balance as follows: "As the court stated in Dahl vs. Clark, supra at 594, the 'benchmark test' for determining the suitable number of wild horses on the public range is 'thriving natural ecological balance.' In the words of the conference committee which adopted this standard: 'The goal of WH&B management should be to maintain a thriving ecological balance (TNEB) between WH&B populations, wildlife, livestock and vegetation, and to protect the range from the deterioration associated with overpopulation of wild horses and burros.'"

The authorized officer would determine whether to implement the proposed actions to achieve and maintain wild horse and burro populations within the established AML range and implement population growth control measures. The decision would not set or adjust AML nor would it adjust livestock use, as these were set through previous land use planning decisions.

1.8 Scoping and Identification of Issues

The BLM interdisciplinary team identified wild horse and burro issues in the Surprise Complex through internal scoping. For this assessment, the BLM also considered issues from previous scoping with the public during the 2011 High Rock Complex Wild Horse Population Management Plan EA (DOI-BLM-CA-N070-2011-04-EA, see Section 1.9). For the 2011 wild horse gather for the High Rock Complex, the BLM sent a scoping letter to approximately 200 public interests and received over 1,600 scoping letters or emails from individuals or groups. The public will have opportunities to provide comments in response to this preliminary EA. The issues analyzed in this assessment are the following:

1. Impacts to individual wild horses and burros and the herd including:
   - Projected population size and annual growth rate [WinEquus population modeling (the modeling does not apply to burros)]
   - Effectiveness of proposed fertility control application (as modeled in WinEquus)
   - Projected effects to measures of genetic diversity
   - Impacts to animal health and condition

2. Impacts to vegetation/soils, riparian/wetland, and cultural resources including:
   - Forage utilization and alteration
   - Impacts to vegetation/soils and riparian/wetland resources assessed by measures of Proper Functioning Condition (PFC)

3. Impacts to wildlife, migratory birds, and threatened, endangered, and special status species and their habitat including:
   - Displacement, trampling, disturbance, or population decline
   - Competition for forage and water

See Chapter 6 Consultation and Coordination for information regarding Tribal Consultation. During regularly scheduled consultation meetings between the BLM Applegate Field Office and federally recognized tribes whose ancestral territories and/or areas of interest overlap with field office boundaries, Tribes expressed broad support for gathers generally and expressed concern that wild horse and burro overpopulation was actively resulting in cultural resource degradation.

2.0 Description of the Alternatives

2.1 Introduction

This section describes the proposed action and alternatives, including any that were considered but eliminated from detailed analysis. In this EA, four alternatives are analyzed in detail.

2.2 Description of Alternatives Considered in Detail

The action alternatives were developed in response to the identified resource issues and the purpose and need, as described in Section 1.3. The no action alternative would not achieve the identified purpose and need. However, it is analyzed in this EA to provide a basis for comparison with the other action alternatives and to assess the effects of not conducting any gathers, removals, or fertility control. The no action alternative is in violation of the Wild Horse and Burro Act which requires the BLM to immediately remove excess wild horses and burros when a determination is made that excess animals are present and that action is necessary to remove excess animals.

2.2.1 Management Actions Common to Alternatives 1, 2, and 3

- Gathers would be scheduled by the BLM National Wild Horse and Burro (WHB) Program Office. Summer or early fall gathers are preferred to avoid seasonal greater sage-grouse restrictions, peak foaling season, and hunting season. Several factors such as animal condition, herd health, weather conditions, or other considerations could result in adjustments in the schedule.
- The duration, frequency, and magnitude of the gathers would depend on the number of animals approved for removal following coordination with the National WHB Program. Aerial surveys would be used to estimate population size. Distribution flights should occur prior to gathering to determine herd locations but are dependent on BLM National WHB Program Office priorities and funding.
- Gather operations would be conducted in accordance with the Comprehensive Animal Welfare Program (see Appendix D). The primary gather (capture) methods would be the helicopter drive trapping method with occasional helicopter assisted roping (from horseback). Bait and water trapping may also be used to capture animals for removal or for fertility control treatment. Gather methods would be determined on a case-by-case basis.
- Trap sites and temporary holding facilities would be located in previously used sites or other disturbed areas whenever possible (Appendix E). Undisturbed areas identified as potential trap sites or holding facilities would be inventoried for cultural, botanical, and wildlife resources prior to initiation of gathers. If any special natural or cultural resources are encountered, these locations would not be used unless they could be modified to avoid impacts to cultural resources, as determined by the field office archaeologist.
- A U.S. Department of Agriculture – Animal and Plant Inspection Service or other veterinarian may be on-site during the gather, as needed, to examine animals and make recommendations to the BLM for care and treatment of wild horses and burros.
- Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy (Instruction Memorandum [IM] 2015-70; https://www.blm.gov/policy/im-2015-070).
- Data including sex and age distribution of gathered animals, condition class information (using the Henneke rating system), color, size, and other information may also be recorded, along with the disposition of that animal (removed or released).
- Wild horse genetic diversity would be monitored in keeping with BLM IM 2009-062. If observed heterzygosity leves are unacceptably low, 3-5 fertile wild horses from outside HMAs would be introduced every 8-10 years, to augment genetic diversity and reduce the risk of inbreeding depression.
- Excess animals that are removed would be transported to BLM off-range corrals where they would be prepared (e.g., freezemarked, mircrochipped, vaccinated, de-wormed, and gelded) for adoption, sale (with limitations), or off-range pastures, in accordance with current policy.
- There is no burro AML for any of the HMAs within the Complex, therefore any burros gathered from within or outside the Complex would be removed.
- No trap sites would be set up within a four mile buffer of active and/or pending greater sage-grouse leks during the lekking and nesting seasons in areas of documented use determined by telemetry locations. Areas within a four mile buffer of active and/or pending leks would be considered avoidance areas and protect approximately 85 percent of nesting greater sage-grouse.
- No trap sites would be set up in proximity to known populations of other sensitive wildlife species.

- All animals gathered from outside of established HMA boundaries would be removed. No horses or burros would be returned to areas outside the HMAs.
- One trap site (with one alternative) would be set up within the Massacre Rim Wilderness Study Area (WSA), and one trap site would be set up in designated Wilderness.

2.2.2 Management Actions Common to Alternatives 1 and 2

- All mares released back to the Complex would be treated with fertility control methods such as Porcine Zona Pellucida (PZP), GonaCon, or a similar approved immunocontraceptive vaccine and/ or an intrauterine device (IUD). Fertility control treatment would be conducted in accordance with approved standard operating and post-treatment monitoring procedures (SOPs, Appendix F). Mares returned to the range would be selected to maintain a diverse age structure, herd characteristics, and conformation.
- Post-gather, every effort would be made to return released horses to the same general area within individual HMAs from which they were gathered.

2.2.3 Alternative 1 (Proposed Action): Phased-in Gather and Removal of Excess Wild Horses to Low-AML, Population Growth Suppression, and Sex Ratio Adjustment

The proposed action has three separate goals to be accomplished in stages in the following order:

1. Gather and remove excess animals to reach low AML as expeditiously as feasible through one or more gathers .
2. Treat any mares returned to the Complex with fertility control method.
3. Sex ratio adjustment to 60 percent males and 40 percent females.
4. Once low AML is reached, if fertility controls do not keep population within AML and the wild horse population exceeds AML, conduct maintenance gather(s) to keep the population within AML during the 10-year period so that degraded range resources have sufficient opportunity to recover.

Gather and Remove

The proposed action would gather and remove as many excess wild horses and burros as feasible (based on gather efficiencies and holding capacity) from within and outside the Surprise Complex over a period of 10 years from the initial gather until low AML is reached and to maintain the wild horse population within the AML range. It is expected that gather efficiencies, funding, and holding space would not allow for attainment of low AML during the initial gather. Therefore, multiple gathers would occur to achieve low AML and management objectives during the 10-year period. After each gather, an aerial survey would be completed to count the remaining population as funding allows.

Fertility Control

The BLM has identified fertility control as a method that could be used to protect rangeland ecosystem health and to help maintain the population within AML and reduce the frequency of wild horse and burro gathers and removals. Expanding the use of population growth suppression to slow population growth rates and reduce the number of animals removed from the range and sent to off-range pastures is a BLM priority. Contraception has been shown to be a cost-effective and humane treatment to slow increases in wild horse populations or, when used with other techniques, to reduce horse population size (Bartholow 2004, de Seve and Boyles-Griffin 2013, Fonner and Bohara 2017). No finding of excess animals is required for the BLM to pursue contraception in wild horses or burros.

Under this alternative, the BLM would attempt to gather a sufficient number of wild horses to allow for the application of fertility control vaccines (PZP ZonaStat-H, PZP-22, GonaCon, or other approved formulation) and/ or IUDs to all mares that are released. It is not expected that BLM would ever gather all horses present in the Complex, so even with fertility control applications it is expected that a relatively large fraction of mares (e.g., 50% or more) would likely be fertile at any given time period. That fraction would be approximated via monitoring activities including aerial surveys and ground-based observations conducted during the course of management. Fertility control implementation would follow current program policy and guidelines. Over the 10 year period, all mares trapped and selected for release would be treated or boostered with fertility control treatments such as GonaCon and/ PZP-22, ZonaStat-H (native PZP), or most current approved vaccine formulations to prevent pregnancy in the following year(s). All animals treated with any type of fertility control would be freezemarked/microchipped and identified according to current policy. Some females would be treated once at the temporary holding facility and released back into the HMA while other females could be removed to the off-range corrals for treatment prior to release back to the Complex. For some vaccines (i.e., ZonaStat-H), annual retreatments are necessary to maintain fertility control efficacy. Decisions about fertility control treatments for mares would be made based on availability of treatments, space at off-range corrals, and the presence of a foal. Fertility control vaccine treatments and re-treatments could be administered as part of gather and release operations, in off-range corrals, or by remote delivery (e.g., darting). IUD treatments require an animal to be handled.

Liquid emulsion vaccines can be injected by hand or remotely administered in the field using a pneumatic dart (Roelle and Ransom 2009, Rutberg et al. 2017, McCann et al. 2017) in cases where mares are relatively approachable. Use of remotely delivered (dart-delivered) vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached within 50 meters (BLM 2010, Rutberg et al. 2017). Darting can be implemented opportunistically by applicators near water sources or along main trails out on the range. Blinds may be used to camouflage applicators to allow efficient treatment of as many mares as possible. ZonaStat-H, GonaCon-Equine (or other effective vaccine formulations) would be administered by applicators field darting the mares. Although PZP-22 pellets have been delivered via darting in trial studies (Rutberg et al 2017, Carey et al. 2019), BLM does not plan to use darting for PZP-22 delivery until there is more demonstration that PZP-22 can be reliably delivered via dart. Prior to actually darting, an inventory of the wild horses would be conducted. This could include a list of marked horses and / or a photo catalog with descriptions of the animals to assist in identifying which animals have been treated and which need to be treated.

Intrauterine Devices (IUDs)

Based on promising results from studies in domestic mares, BLM has begun to use IUDs to control fertility as a wild horse and burro fertility control method on the range. The initial management use was in mares from the Swasey HMA, in Utah. The BLM has supported and continues to support research into the development and testing of effective and safe IUDs for use in wild horse mares (Baldrighi et al. 2017, Holyoak et al. unpublished data). However, existing literature on the use of IUDs in horses allows for inferences about expected effects of any management alternatives that might include use of IUDs, and support the apparent safety and efficacy of some types of IUDs for use in horses. Overall, as with other methods of population growth suppression, use of IUDs and other fertility control measures are expected to help reduce population growth rates, extend the time interval between gathers, and reduce the total number of excess animals that will need to be removed from the range.

The 2013 National Academies of Sciences (NAS) report considered IUDs, and suggested that research should test whether IUDs cause uterine inflammation, and should also test how well IUDs stay in mares that live and breed with fertile stallions. Since that report, a recent study by Holyoak et al. (unpublished data) indicate that a flexible, inert, y-shaped, medical-grade silicone IUD design prevented pregnancies in all the domestic mares that retained the device, even when exposed to fertile stallions. Domestic mares in that study lived in large pastures, mating with fertile stallions. Biweekly ultrasound examinations showed that IUDs stayed in 75% of treated mares over the course of two breeding seasons. The IUDs were then removed so the researchers could monitor the mares' return to fertility. Uterine health, as measured in terms of inflammation, was not seriously affected by the IUDs, and most mares became pregnant within months after IUD removal. The overall results are consistent with results from an earlier study (Daels and Hughes 1995), which used O-shaped silicone IUDs.

IUDs are considered a temporary fertility control method that does not generally cause future sterility (Daels and Hughes 1995). Use of IUDs is an effective fertility control method in women, and IUDs have historically been used in livestock management, including in domestic horses. Insertion of an IUD can be a very rapid procedure, but it does require the mare to be temporarily restrained, such as in a squeeze chute. IUDs in mares may cause physiological effects including discomfort, infection, perforation of the uterus if the IUD is hard and angular, endometritis, uterine edema (Killian et al. 2008), and pyometra (Klabnik-Bradford et al. 2013). In women, deaths attributable to IUD use may be as low as 1.06 per million (Daels and Hughes 1995).

The exact mechanism by which IUDs prevent pregnancy is uncertain (Daels and Hughes 1995), but the presence of an IUD in the uterus may, like a pregnancy, prevent the mare from coming back into estrus (Turner et al. 2015). However, some domestic mares did exhibit repeated estrus cycles during the time when they had IUDs (Killian et al. 2008, Gradil et al. 2019). The main cause for an IUD to not be effective at contraception is its failure to stay in the uterus (Daels and Hughes 1995). As a result, one of the major challenges to using IUDs to control fertility in mares on the range is preventing the IUD from being dislodged or otherwise ejected over the course of daily activities, which could include, at times, frequent breeding.

At this time, it is thought that any IUD inserted into a pregnant mare may cause the pregnancy to terminate, which may also cause the IUD to be expelled. For that reason, it is expected that IUDs would only be inserted in non-pregnant (open) mares. Wild mares receiving IUDs would be checked for pregnancy prior to insertion of an IUD. This can be accomplished by transrectal palpation and/or ultrasound performed by a veterinarian. Pregnant mares would not receive an IUD. The IUD is inserted into the uterus using a thin, tubular applicator similar to a shielded culture tube, and would be inserted in a manner similar to that routinely used to obtain uterine cultures in domestic mares. If a mare has a zygote or very small, early phase embryo, it is possible that it will fail to be detected in screening, and may develop further, but without causing the expulsion of the IUD. Wild mares with IUDs would be individually marked and identified, so that they can be monitored occasionally and examined, if necessary, in the future, consistent with other BLM management activities.

Using metallic or glass marbles as IUDs may prevent pregnancy in horses (Nie et al. 2003), but can pose health risks to domestic mares (Turner et al. 2015, Freeman and Lyle 2015). Marbles may break into shards (Turner et al. 2015), and uterine irritation that results from marble IUDs may cause chronic, intermittent colic (Freeman and Lyle 2015). Metallic IUDs may cause severe infection (Klabnik-Bradford et al. 2013).

In domestic ponies, Killian et al. (2008) explored the use of three different IUD configurations, including a silastic polymer O-ring with copper clamps, and the "380 Copper T" and "GyneFix" IUDs designed for women. The longest retention time for the three IUD models was seen in the "T" device, which stayed in the uterus of several mares for 3-5 years. Reported contraception rates for IUD-treated mares were 80%, 29%, 14%, and 0% in years 1-4, respectively. They surmised that pregnancy resulted after IUD fell out of the uterus. Killian et al. (2008) reported high levels of progesterone in non-pregnant, IUD-treated ponies.

Soft IUDs may cause relatively less discomfort than hard IUDs (Daels and Hughes 1995). Daels and Hughes (1995) tested the use of a flexible O-ring IUD, made of silastic, surgical-grade polymer, measuring 40 mm in diameter; in five of six breeding domestic mares tested, the IUD was reported to have stayed in the mare for at least 10 months. In mares with IUDs, Daels and Hughes (1995) reported some level of uterine irritation, but surmised that the level of irritation was not enough to interfere with a return to fertility after IUD removal.

More recently, several types of IUDs have been tested for use in breeding mares. When researchers attempted to replicate the O-ring study (Daels and Hughes 1995) in an USGS / Oklahoma State University (OSU) study with breeding domestic mares, using various configurations of silicone O-ring IUDs, the IUDs fell out at unacceptably high rates over time scales of less than 2 months (Baldrighi et al. 2017). Subsequently, the USGS / OSU researchers tested a Y-shaped IUD to determine retention rates and assess effects on uterine health; retention rates were greater than 75% for an 18-month period, and mares returned to good uterine health and reproductive capacity after removal of the IUDs (Holyoak et al., unpublished results). These Y-shaped silicone IUDs are considered a pesticide device by the EPA, in that they work by physical means (EPA 2020). The University of Massachusetts has developed a magnetic IUD that has been effective at preventing estrus in non-breeding domestic mares (Gradil et al. 2019). After insertion in the uterus, the three subunits of the device are held together by magnetic forces as a flexible triangle. A metal detector can be used to determine whether the device is still present in the mare. In an early trial, two sizes of those magnetic IUDs fell out of breeding domestic mares at high rates (Holyoak et al., unpublished results). In 2019, the magnetic IUD was used in two trials where mares were exposed to stallions, and in one where mares were artificially inseminated; in all cases, the IUDs were reported to stay in the mares without any pregnancy (Gradil 2019).

Sex Ratio Manipulation

Sex ratio manipulation, leading to a reduced fraction of mares in the herd, can be considered a form of contraceptive management, insofar as it can reduce the realized growth rate in a herd. By reducing the proportion of breeding females in a population (as a fraction of the total number of animals present), the technique leads to fewer foals being born, relative to the total herd size (see Appendix O). Sex ratio is typically adjusted in such a way that 60 percent of the horses are male. In the absence of other fertility control treatments, this 60:40 sex ratio can temporarily reduce population growth rates from approximately 20% to approximately 15% (Bartholow 2004). While such a decrease in growth rate may not appear to be large or long-lasting, the net result can be that fewer foals are born, at least for a few years – which can extend the time between gathers, and reduce impacts on-range, and costs off-range.

Gathers and Associated Activities

The BLM has been conducting wild horse and burro gathers since the mid-1970s. During this time, methods and procedures have been identified and refined to minimize stress and impacts to wild horses and burros during gather implementation. Published reviews of agency practice during gathers and subsequent holding operations confirm that BLM follows guidelines to minimize those impacts and ensure humane animal care and high standards of welfare (GAO 2008, AAEP 2011, Greene et al. 2013, Scasta 2019). The Comprehensive Animal Welfare Program (CAWP) in Appendix C would be implemented to ensure a safe and humane gather occurs and would minimize potential stress and injury to wild horses and burros.

Transport, Off-Range Corral (ORC) Holding, and Adoption (or Sale) Preparation
Animals would be transported from the capture/temporary holding corrals to the designated BLM off-range corrals ORC(s). From there, they would be made available for adoption or sale to qualified individuals or sent to off-range pastures (ORP).

Wild horses or burros selected for removal from the range would be transported to the receiving ORC in a straight deck semi-trailers or goose-neck stock trailers. Vehicles would be inspected by the BLM Contracting Officer's Representative (COR) and Project Inspectors (PIs) prior to use to ensure wild horses and burros can be safely transported and that the interior of the vehicle is in sanitary condition. Wild horses and burros would be segregated by age and sex and loaded into separate compartments. A small number of mares or jennies may be shipped with foals. Travel time for recently captured wild horses or burros is limited to a maximum of 10 hours.

Upon arrival at the ORC, recently captured wild horses and burros would be off-loaded by compartment, placed in holding pens, and fed good quality hay and water. Most wild horses and burros will begin to eat and drink immediately and adjust rapidly to their new situation. At the ORC, a veterinarian will examine each load of horses and provide recommendations to the BLM regarding care, treatment, and if necessary, euthanasia. Any animals with a chronic or incurable disease, injury, lameness or serious physical defect (such as severe tooth loss or wear, club feet, and other severe congenital abnormalities) would be humanely euthanized using methods acceptable to the American Veterinary Medical Association (AVMA). Wild horses and burros in very thin condition or animals with injuries would be sorted and placed in hospital pens, fed separately and/or treated for their injuries as indicated. Recently captured animals in very thin condition may have difficulty transitioning to feed. Some of these animals may be in such poor condition that it is unlikely they would have survived if left on the range. Similarly, some females may lose their pregnancies. Every effort would be taken to help females make a quiet, low stress transition to captivity and domestic feed to minimize the risk of miscarriage or death.

After recently captured wild horses and burros have transitioned to their new environment, they would be prepared for adoption or sale. Preparation involves freezemarking the animals with a unique identification number, microchipping, drawing a blood sample to test for equine infectious anemia, vaccination against common diseases, castration, and de-worming.

At ORCs, a minimum of 700 square feet is provided per animal. Mortality at ORCs averages approximately five percent per year (GAO 2008), and includes animals euthanized due to pre-existing conditions; animals in extremely poor condition; animals that are injured and would not recover; animals which are unable to transition to feed; and animals which are seriously injured or accidentally die during sorting, handling, or preparation.

Adoption or Sale with Limitations and Off-Range Pastures (ORP)
Adoption applicants are required to have at least a 400 square foot corral with panels that are at least six feet tall for horses over 18 months of age. Applicants are required to provide adequate shelter, feed, and water. The BLM retains title to the horse for one year and the horse and the facilities are inspected to assure the adopter is complying with the BLM's requirements. After one year, the adopter may take title to the horse, at which point the horse becomes the property of the adopter. Adoptions are conducted in accordance with 43 CFR 4750.

Potential buyers must fill out an application and be pre-approved before they may buy a wild horse. A sale-eligible wild horse is any animal that is more than 10 years old or has been offered unsuccessfully for adoption three times. The application also specifies that buyers cannot re-sell the animal to slaughter buyers or anyone who would sell the animal to a commercial processing plant. Sales of wild horses are conducted in accordance with BLM policy.

ORPs are designed to provide excess wild horses with humane, life-long care in a natural setting off the public rangelands. Wild horses are maintained in grassland pastures large enough to allow free-roaming behavior and with the forage, water, and shelter necessary to sustain them in good condition. About 37,000 wild horses that are in excess of the existing adoption or sale demand (because of age or other factors) are currently located on private land pastures in Iowa, Kansas, Oklahoma, Missouri, Montana, Nebraska, Wyoming, Utah, and South Dakota. Located mainly in mid or tall grass prairie regions of the United States, these ORP are typically highly productive grasslands as compared to more arid western rangelands. These pastures comprise about approximately 400,000 acres. The majority of these animals are older in age.

Euthanasia and Sale without Limitation
Under the Wild Horse and Burro Act, healthy excess wild horses or burros should be humanely euthanized or sold without limitation if there is no adoption demand for the animals. However, while euthanasia and sale without limitation are allowed under the statute, for several decades Congress has prohibited the use of appropriated funds for this purpose. If Congress were to lift the current appropriations restrictions, then it is possible that excess horses removed from the Complex over the next 10 years could potentially be euthanized or sold without limitation consistent with the provisions of the Wild Horse and Burro Act.

Any old, sick or lame horses unable to maintain an acceptable body condition (greater than or equal to a Henneke BCS of 3) or with serious physical defects would be humanely euthanized either before gather activities begin or during the gather operations as well as at off-range holding facilities.

2.2.4 Alternative 2: Phased-in Gather and Removal of Excess Wild Horses to Low AML and Population Growth Suppression

Alternative 2 is similar to Alternative 1 but would not include a sex ratio adjustment. As with Alternative 1, horses would be gathered to low AML. Alternative 2 would include the removal of excess wild horses to low AML, removing all burros, population growth control using fertility control vaccine treatments for mares (PZP, PZP-22, GonaCon, or most current approved formula) and/ or IUDs, and maintaining the population at AML during the 10-year period. Under Alternative 2, the BLM would gather and remove excess wild horses and burros within the project area to return the population levels to low AML range. All excess wild horses and burros residing in areas outside of the Complex would be gathered and removed. Under this alternative, the BLM would attempt to gather a sufficient number of wild horses to allow for the application of fertility control (PZP, PZP-22, GonaCon, or other approved formulation) and/ or IUDs to all mares that are released. The procedures to be followed for implementation of fertility control are detailed in Appendix F. Once low AML is achieved, if the wild horse population should exceed AML, BLM would use a maintenance gather(s) to keep the population at AML.

See Alternative 1 (Section 2.2.3) for descriptions on fertility control vaccines that also pertain to Alternative 2.

See Alternative 1 (Section 2.2.3) for descriptions regarding gathers, transport, off-range corral (ORC) holding, and adoption (or sale) preparation, adoption or sale with limitations and off-range pastures (ORP), euthanasia and (prohibited) sale without limitation, all of which pertain to Alternative 2.

2.2.5 Alternative 3: Phased-in Gather and Removal Only

Alternative 3 would limit management activities to gathering and removing excess wild horses and burros from within and outside the Surprise Complex over a 10-year period as the sole method used to achieve low AML. The actual number of animals removed in a given gather would depend on availability of national holding space and funding, and gather efficiencies. Under this alternative, fertility control methods would not be applied and no changes to the herd's existing sex ratio would be made.

See Alternative 1 (Section 2.2.3) for descriptions regarding gathers, transport, off-range corral (ORC) holding, and adoption (or sale) preparation, adoption or sale with limitations and off-range pastures (ORP), euthanasia and (prohibited) sale without limitation all of which pertain to Alternative 3.

2.2.6 Alternative 4: No Action

Under Alternative 4, no gather, removal, and no population management to control the size of the wild horse and burro population within the Surprise Complex would occur.

2.2.7 Monitoring and Mitigation

The BLM COR and PIs assigned to the gather would be responsible for ensuring contract personnel abide by the contract specifications and the SOPs (Appendix C). Ongoing monitoring of forage condition and utilization, water availability, aerial population surveys, and animal health would continue.

Fertility control monitoring would be conducted in accordance with the SOPs (BLM Instruction Memorandum 2009-090: https://www.blm.gov/policy/im-2009-090). Genetic diversity monitoring would take place, consistent with BLM Instruction Memorandum 2009-062. Monitoring the herd's social behavior would be incorporated into routine monitoring. The objective of this additional monitoring would be to determine if additional studs form bachelor bands or are more aggressive with breeding bands for the forage and water present.

Required Design Features (RDF)

The following RDFs would be applied to be consistent with the ARMPA:

1. RDF Gen 12: Control the spread and effects of nonnative, invasive plant species (e.g. by washing vehicles and equipment, minimize unnecessary surface disturbance). All projects would be required to have a noxious weed management plan in place prior to construction and operations.
2. RDF Gen 13: Implement project site-cleaning practices to preclude the accumulation of debris, solid waste, putrescible wastes, and other potential anthropogenic subsidies for predators of greater sage-grouse.
3. RDF Gen 17: Restore disturbed areas at final reclamation to the pre-disturbance landforms and desired plant community.
4. RDF Gen 19: Instruct all construction employees to avoid harassment and disturbance of wildlife, especially during the greater sage-grouse breeding (e.g. courtship and nesting) season. In addition, pets shall not be permitted on site during construction.
5. RDF Gen 22: Load and unload all equipment on existing roads, pull outs, or disturbed areas to minimize disturbance to vegetation and soil.

2.3 Alternatives Considered but Dismissed from Detailed Analysis

1. Exclusive Use of Bait and/or Water Trapping

This alternative involves the use of bait (feed) and/or water to lure horses and burros into trap sites as the primary gather method. It would not be timely, cost-effective, or practical to use bait and/or water trapping as the only gather method because the number of water sources on both private and public lands within and outside the Complex would make it almost impossible to restrict wild horse and burro access to the selected water trap sites. Bait and/or water trapping may be used in strategic locations to assist in removals and fertility control treatments. As a result, this alternative was dismissed from detailed analysis.

2. Remove or Reduce Livestock within the Complex

This alternative would involve no removal of wild horses and burros in the Complex and would instead remove or reduce authorized livestock grazing. This alternative was not considered in detail because it is contrary to previous decisions which allocated forage for livestock use and would not be in conformance with the existing land use plan nor does it achieve the purpose and need for this EA. Livestock grazing can only be reduced or eliminated through provisions identified within regulations (43 CFR 4100) and must be consistent with multiple use allocation set forth in the RMP. This alternative would exchange use by livestock for use by wild horses, and eliminating or reducing grazing in order to shift forage use to wild horses would not be in conformance with the Surprise RMP and is contrary to the BLM's multiple-use mission as outlined in the 1976 Federal Land Policy and Management Act. The BLM is required to manage wild horses and burros in a manner designed to achieve a thriving natural ecological balance between wild horse and burro populations, wildlife, livestock, and other uses. Wild horses have been identified as a causal factor in not meeting rangeland health standards. Thus reducing livestock AUMs to increase AMLs would not achieve a thriving natural ecological balance. Horses are present year-round and their impacts to rangeland resources differ from livestock, as livestock can be controlled through an established grazing system (confinement to specific pastures and limited period or season of use to minimize impacts to vegetation and riparian). This alternative would also be inconsistent with the Wild Horse and Burro Act, which directs the immediate removal of excess wild horses and burros and requires management for a thriving natural ecological balance.

3. Gather the Complex to the AML Upper Limit

Under this alternative, a gather would be conducted to remove enough wild horses to achieve the upper range of the AML. This alternative was dismissed from detailed study because AML would be exceeded by the next foaling season following a gather resulting in the need to conduct another gather within one year. This would result in increased stress to individual wild horses and the herd. Resource damage due to wild horse overpopulation would continue in the interim, as the upper level of the AML established for the Surprise Complex represents the maximum population for which thriving natural ecological balance would be maintained. This alternative is not consistent with the Wild Horse and Burro Act, which requires the immediate removal of excess wild horses and burros if BLM determines their removal is necessary.

4. Fertility Control Treatment Only (No Removal)

Under this alternative, no excess wild horses and burros would be removed. Population modeling (which does not apply to burros) analyzed the potential impacts associated with conducting gathers about every 2 to 3 years over the next 20 year period to treat captured mares with fertility control. Due to the vast size of this Complex, wide distribution of animals, and inaccessibility to the animals, remote darting opportunities are extremely limited because of the annual retreatment requirements to maintain vaccination efficiency. While there would be an average reduction of 15.9 percent to 24.7 percent, compared to the current annual population growth rate (as modeled in WinEquus), AML would still not be achieved through fertility control alone and damage to the range associated with wild horse and burro overpopulation would continue. Moreover, this alternative would not meet the Purpose and Need for the Action and would be contrary to the Wild Horse and Burro Act.

5. Designate the Complex to be Managed Principally for Wild Horse or Burro Herds

This alternative would address the issue of excess wild horses in the Complex through the complete removal of authorized livestock grazing, instead of by gathering and/or removing excess wild horses and burros from the HMA. This alternative would be contrary to the Surprise RMP by allowing the wild horse and burro population to remain above AML. Therefore, this alternative does not meet the purpose and need to achieve and maintain the established AMLs.

This alternative is also inconsistent with the Wild Horse and Burro Act, which directs the Secretary to immediately remove excess wild horses and burros. The current apportionment of multiple use grazing between livestock and wild horses and burros was established through a five-year public review process between 2004 and 2008, which developed and approved the Surprise RMP. The available monitoring data does not indicate a need to change the level of livestock grazing. Nor does the available monitoring data indicate that changes to AML are warranted at this time, since there is no evidence of changes in habitat conditions (such as greater availability of water) that would allow for increases in the wild horse AML.

The current population of wild horses and burros above AML is resulting in adverse impacts to water sources, riparian/wetland sites, and vegetation. Even in areas where there has been little to no livestock grazing, monitoring data indicates that wild horse and burro impacts are affecting the BLM's ability to manage for rangeland health.

The current level of authorized livestock grazing has been established through inventory and monitoring data over the past 50 years. Forage allocations for livestock have been made in accordance with forage and habitat needs for wildlife and wild horses and burros. The BLM has not received any new information that would indicate a need to change the level of livestock grazing at this time. Furthermore, the BLM establishes grazing systems to manage livestock grazing through specific terms and conditions that confine grazing to specific pastures, limit periods of use, and set utilization standards. These terms and conditions minimize livestock grazing impacts to vegetation during the growing season and to riparian zones during the summer months.

Wild horses, however, are present year-round, and their impacts to rangeland resources cannot be controlled through establishment of a grazing system, such as for livestock. Thus, impacts from wild horses can only be addressed by limiting their numbers to a level that does not adversely impact rangeland resources and other multiple uses.

While the BLM is authorized to remove livestock from HMAs "if necessary to provide habitat for wild horses or burros, to implement herd management actions, or to protect wild horses or burros from disease, harassment or injury" (43 CFR § 4710.5), this authority is usually applied in cases of specific emergency conditions and not for the general management of wild horses or burros under the Wild Horse and Burro Act, as wild horse and burro management is based on the land-use planning process, multiple use decisions, and establishment of AML. For these reasons, this alternative was eliminated from further consideration.

6. Raising the Appropriate Management Level for Wild Horses and Burros

The BLM has established current AML ranges based on many years of data collection, resource monitoring, and multi-agency planning efforts. The current AMLs are based on established biological resource monitoring protocols and land health assessments and were approved in the 2008 Surprise RMP and 2013 Livestock Grazing Authorization and Wild Horse Appropriate Management Level Establishment Massacre Lakes Allotment and Herd Management Area EA. Delay of a gather until the AML can be reevaluated is not consistent with the Wild Horse and Burro Act, Public Rangelands Improvement Act, FLPMA, or the 2008 Surprise RMP. Monitoring data collected within the Complex does not indicate that an increase in AML is warranted at this time. On the contrary, such monitoring data confirms the need to remove excess wild horses and burros to reverse downward resource trends and promote improvement of rangeland and riparian health. Severe resource degradation would occur in the meantime and large numbers of excess animals would ultimately need to be removed from the Complex in order to achieve AML or to prevent the death of individual animals under emergency conditions. This alternative was eliminated from further consideration because it is contrary to the Wild Horse and Burro Act which requires the BLM to manage the rangelands to prevent resources from deterioration associated with an overpopulation of wild horses and burros. In addition, raising the AML where there are known resource degradation issues associated with an overpopulation of wild horses and burros does not meet the purpose and need of this EA to restore and maintain a thriving ecological balance. If future data suggest that adjustments in the AML are needed (either upward or downward), then changes would be based on an analysis of monitoring data, including a review of wild horse habitat suitability, such as the condition of water sources in the Complex. For the reasons stated above, this alternative was eliminated from further consideration.

7. Wild Horse and Burro Numbers Controlled by Natural Means

This alternative was eliminated from further consideration because it is contrary to the Wild Horse and Burro Act which requires the BLM to prevent range deterioration associated with an overpopulation of wild horses and burros. The alternative of using natural controls to achieve a desirable AML has not been shown to be feasible in the past. Wild horse and burro populations in the Surprise Complex have not been shown to be controlled by predators or other natural factors. In addition, wild horses are a long-lived species with documented foal survival rates exceeding 95 percent and they do not self-regulate their population growth rate.

This alternative would result in a steady increase in the wild horse and burro populations which would continue to exceed the carrying capacity of the range resulting in a catastrophic mortality of wild horses in the Surprise Complex. As the vegetative and water resources are degraded to the point of no recovery as a result of the wild horse and burros overpopulation, wild horses would start showing signs of malnutrition and starvation. The weaker animals, generally the older animals, and the mares and foals, would be the first to be impacted. It is likely that a majority of these animals would die from starvation and dehydration which could lead to a catastrophic die off. Allowing horses to die of dehydration and starvation would be inhumane treatment and would be contrary to the Wild Horse and Burro Act, which mandates removal of excess wild horses and humane treatment of the animals.

This alternative would also lead to irreparable damage to rangeland resources from excess wild horses and burros, which is contrary to the Wild Horse and Burro Act, which mandates the BLM to *"protect the range from the deterioration associated with overpopulation", "remove excess animals from the range so as to achieve appropriate management levels",* and *"to preserve and maintain a thriving natural ecological balance and multiple-use relationship in that area."* Habitat conditions would deteriorate as wild horse numbers above AML reduce herbaceous vegetative cover, damage springs and increase erosion, and could result in irreversible damage to the rangelands. For these reasons, this alternative was eliminated from further consideration. This alternative would not meet the purpose and need for this EA which is to remove excess wild horses from within and outside the Surprise Complex and to reduce the wild horse population growth rates to manage wild horses within established AML ranges.

3.0 Affected Environment

This section of the EA briefly discusses the relevant components of the human environment which may be affected by the action alternatives or no action (see Table 3-1).

3.1 General Description of the Affected Environment

The Surprise Complex encompasses 396,674 acres of public, private, and state lands within Humboldt and Washoe Counties in Nevada (see Appendix A for map). Topography varies from gently rolling hills to deeply dissected canyons. Elevation varies from 4,800 feet to 8,200 feet. Annual precipitation averages 8 inches at lower elevations to 12 inches at the highest elevations. Temperatures also vary from -10 degrees Fahrenheit in the winter and 100 degrees Fahrenheit in the summer.

The wild horses of the Surprise Complex are descendants of local ranch horses, and cavalry remounts (Amesbury 1967). During World War I, the local ranchers were involved in gathering wild horses from the Surprise Complex for U.S. Army remounts. The first aerial inventories of the Surprise Complex were undertaken by the BLM in 1973, 1974, and 1975, which noted 615 horses. Based on 2007 and 2011 capture data, horses in the Surprise Complex predominantly exhibit bay, black, sorrel, and brown coat colors; however many horses have varied colors, including palomino, gray, dun, grulla, buckskin, chestnut, pinto, and red roan. Horses within the Complex are commonly 15 hands tall, of slight to moderate build, and average 800 to 1100 pounds in weight.

Vegetation is typical of sagebrush steppe with co-dominance of shrubs and native perennial grasses. Some wildfires have also occurred in the Complex, resulting in conversions of sagebrush steppe to invasive, annual grass monocultures. Invasive grass monocultures are generally stable ecological states, in which recovery to native perennial grasses is not expected. In addition to a decline in biodiversity, wildfires have also exposed vulnerable soils to trampling resulting in increased wind and water erosion. Water is available through a variety of undeveloped streams, springs, and seeps, as well as developed water sources such as stock tanks, pits, troughs, and reservoirs on public and private lands. These are scattered throughout the Complex. Many of the undeveloped springs and seeps are ephemeral and produce water for only a few months in normal precipitation years. Many of them produce no water during below average precipitation years.

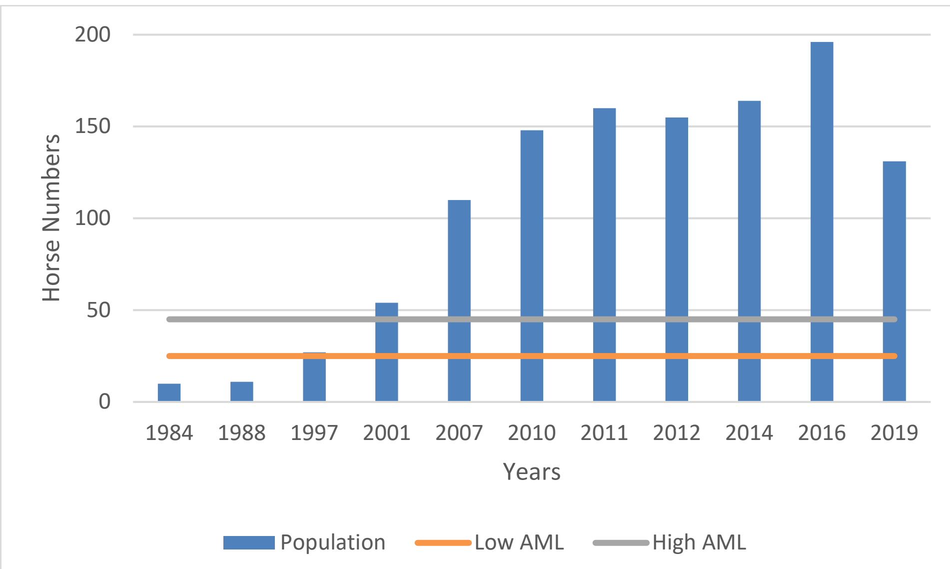
A more detailed description of the Surprise Complex, history, and elements of the affected environment can be found in the 2011 High Rock Complex Wild Horse Population Management Plan (Chapter 3, pages 41 to 111) and is incorporated into this assessment by reference.

<u>Massacre Lakes</u>

Massacre Lakes HMA was not included in the 2011 High Rock Complex, and is described here. The topography, climate and vegetation do not differ significantly from the rest of the complex (as described above). Water availability in the Massacre Lakes HMA is provided by natural and man-made water sources. Several of the natural water sources have been developed and some of these developed waters have been fenced.

Horses in the Massacre Lakes HMA have likely descended from local ranching stock, and generally come in solid colors. The last removal of excess wild horses from the Massacre Lakes HMA was completed in 1988 when 25 horses were gathered and 14 were removed. Following the gather, 8 mares and 3 stallions or a total of 11 animals were released. None of the release mares were given a fertility control vaccine (PZP, or Porcine Zona Pellucida, PZP-22) prior to their release. Following the 1988 gather and removals, the population growth rate was below the normal until approximately 2016 (**Figure 3-1**). Explanations for this increase up to 2016 are wild horse egression outside the Massacre Lakes HMA and/or predation. The current estimated population of 131 wild horses is based on the 2019 Tri-State aerial survey. Although the graph depicts a drop in population from 2016 to 2019, it may be explained by the large increase in population in the adjacent HMA, Bitner. In 2016, the population in Bitner was 62 and in 2019, the population was 107 as known interchanges occur between these two HMAs regularly.

Figure 3-1. Historic population of the Massacre Lakes HMA. The HMA population was below AML unil 2001 and has continued to increase since that time.



3.2 Description of Affected Resources/Issues

Table 3-1 lists the elements of the human environment subject to requirements in statute, regulation, or executive order which were considered for detailed analysis. The BLM has discussed all the resources mentioned below, and has either incorporated and analyzed them within this EA, or provided an explanation of why they were not analyzed in detail. Resources that may be affected by the proposed action and alternatives were identified to be analyzed in detail. Resources that are not present or not affected by the proposed action and alternatives were considered but eliminated from detailed analysis.

Table 3-1: Supplemental Authorities (Critical Elements of the Human Environment)

Supplemental Authorities	Present	May Affect	Rationale

Area of Critical Environmental Concern (ACEC)	**YES**	**NO**	The Surprise Complex contains three ACECs: Massacre Rim, Bitner, and High Rock Canyon ACECs. The proposed action would positively affect ACECs by reducing damage to cultural resources, upland vegetation, and riparian areas and improve the biological integrity of the ACEC's from reducing year-round grazing pressure by wild horses.
Air Quality	**YES**	**NO**	The planning area is outside a non-attainment area. The proposed action would result in small and temporary areas of disturbance.
Cultural Resources	**YES**	**YES**	To prevent any impacts to cultural resources, trap sites and temporary holding facilities would be located in previously surveyed areas. Cultural resource inventories and would be required prior to using trap sites or holding facilities outside existing areas of disturbance. Cultural resources would primarily be impacted under the no action alternative. Discussed below in Sections 3.2.1 and 4.4.1.
Environmental Justice	**NO**	**NO**	The proposed action would have no disproportionately high or adverse human health or environmental effects on minority or low-income populations.
Greater Sage-Grouse	**YES**	**YES**	Discussed below in Section 3.2.6 and 4.4.6.
Farmlands, Prime or Unique	**NO**	**NO**	No Prime or Unique Farmlands (as defined by 7 CFR 657.5) are present in the Complex.
Fish Habitat	**YES**	**NO**	Fish habitat would benefit from the removal of excess wild horses and burros by reducing year-round trampling and sediment loading.
Floodplains	**NO**	**NO**	Not present.
Forest / Woodlands	**YES**	**NO**	Juniper woodlands occurring in the Complex would not be affected.
Fuels/ Fire	**YES**	**NO**	Fuel projects within the Complex would not be affected.
Health and Safety	**YES**	**NO**	The health and safety of the public during gather operations would follow Observation Day Protocol and Ground Rules that have been used in recent gathers to ensure that the public remains at a safe distance and does not impede gather operations. Appropriate BLM staff would be present to ensure compliance with visitation protocols. These measures minimize the risks to the health and safety of the public, BLM staff and contractors,

			and to the wild horses and burros during the gather operations. The BLM also follows current policy and guidelines pertaining to Observation Days [BLM IM No. 2013-058].
Lands/ Access	**NO**	**NO**	No new rights-of-way or other land authorizations are required to implement the proposed action or alternatives.
Livestock Grazing	**YES**	**YES**	Discussed below in Section 3.2.2 and 4.4.2.
Migratory Birds	**YES**	**YES**	Discussed below in Section 3.2.6 and 4.4.6.
Native American Concerns	**YES**	**NO**	Native American consultation is ongoing, no concerns have been expressed to date..
Noxious Weeds	**YES**	**NO**	To prevent the risk for spread of noxious weeds, any noxious weeds or non-native invasive weeds would be avoided when establishing and accessing trap sites and holding facilities. Project Design Features (PDFs) and Standard Resource Protection Measures (SRPMs) to reduce the spread of noxious weeds by vehicles are discussed in the Programattic Applegate Integrated Invasive Plant Management EA (DOI-BLM-CA-N020-2017-0017-EA). These PDFs and SRPMs would be followed under this EA. All trap sites, holding facilities, and camp sites would be surveyed prior to selection. A reduction of wild horse populations would reduce the occurrence of noxious weed sites across the landscape.
Recreation	**YES**	**NO**	Recreation infrastructure would not be impacted. Recreation use has occurred mainly in the form of wilderness recreation, hiking, camping, and hunting. Activities that have occurred with very low frequency are wildlife observation, nature study, and archaeological sightseeing.
Riparian-Wetland Zones	**YES**	**YES**	Discussed below in Section 3.2.4 and 4.4.4.
Socioeconomics	**YES**	**NO**	The proposed action or alternatives would not affect the socioeconomic status of the counties or nearby towns.
Soil Resources	**YES**	**YES**	Impacts to soils would affect less than 1% of the Complex and would be temporary under Alternatives 1, 2 and 3. Alternative 4 would have an impact to soils in areas where horses and burro congregate, which would generally be around riparian areas. Discussed below in Section 3.2.5 and 4.4.5.

Threatened and Endangered (T&E) Plant Species	**NO**	**NO**	There are no known populations of designated T&E plant species occurring within the Applegate Field Office Boundary.
T&E Wildlife Species	**NO**	**NO**	Not present.
Upland Vegetation	**YES**	**YES**	Discussed below in Section 3.2.3 and 4.4.3.
Visual Resources	**YES**	**NO**	Gather operations are temporary and would not impact visual resources within the Complex.
Water Quality	**YES**	**NO**	Trap sites and temporary holding facilities would be located away from any water sources to avoid impacts to water quality. Any impacts to water sources used while horses are in route to trap sites would be temporary and would not significantly affect water quality.
Waste (Hazardous or Solid)	**NO**	**NO**	Not present.
Wild Horse and Burros	**YES**	**YES**	Discussed below in Sections 3.2.7 and 4.4.7
Wild and Scenic Rivers	**NO**	**NO**	Not present.
Wilderness	**YES**	**YES**	Discussed below in Sections 3.2.8 and 4.4.8
Wildneress Study Area	**YES**	**YES**	Discussed below in Sections 3.2.9 and 4.4.9
Wildlife	**YES**	**YES**	Discussed below in Section 3.2.6 and 4.4.6.

Critical elements of the human environment identified as present and potentially affected by the action alternatives (alternatives 1, 2, and 3) and/or the no action alternative include: cultural resources, livestock grazing, upland vegetation, riparian and wetland resources, soil resources, wildlife (migratory birds, threatened and endangered wildlife species, greater sage-grouse), and wild horses and burros. The affected environment relative to these resources is described below.

3.2.1 Cultural Resources

The entirety of the Surprise Complex lies within the ethnographic or traditional territory of the Northern Paiute; of the 22 bands that comprise the Northern Paiute, five are represented in the area encompassed by the Surprise Complex. The northern portion of the Complex falls within the area identified as being used by the *Agaipaninadokado* ("Fish Lake Eaters") and *Moadokado* ("Wild Onion Eaters") of Summit Lake, and the *Gidutidad* or *Kidütökadö* ("Groundhog Eaters") of Surprise Valley. The southern portion lies primarily within the area traditionally used by the *Kamodokado* ("Jack Rabbit Eaters") of Gerlach, Nevada and the the *Sawadokado* ("Sagebrush Mountain Dwellers) of Winnemucca. Northern Paiute from other band areas likely passed through the Surprise Complex as part of seasonal subsistence rounds as well. Many members of the *Kidütökadö* continue to reside at the Fort Bidwell Reservation. Additional information on the Northern Paiute can be found in Fowler and Liljeblad (1986), Kelly (1932), King et al. (2004), and Stewart (1939); these references are incorporated here by reference.

Previous cultural resource inventories completed within the Surprise Complex footprint indicate that the area was used prehistorically for a wide array of resource procurement activities, and that both seasonal upland habitation and more permanent, year-round habitation on valley floors occurred throughout the region. In addition, seasonal, temporary campsites were established for purposes of resource procurement, including stone-tool materials, game, and plant resources. Other prehistoric resources common to the region include stacked rock features (cairns, placements, blinds, alignments) and rock art (petroglyph) sites. Initial prehistoric use of the area may have occurred as early as 12,000 years before present, with historic Euro-American settlement occurring during the mid-1800s. Historically, use of the Surprise Complex area was predominately associated with sheep and cattle grazing, and historic resources identified in the area are related to early homesteading, ranching, emigrant and military trails, mining, and railroads. The Surprise Complex area also includes portions of the historic (1846) Applegate Emigrant Trail, particularly in the High Rock and Nut Mountain HMAs. King et al. (2004) and the Surprise Resource Management Plan (RMP; 2007) contain further information on the archaeological resources present within the Surprise Complex and surrounding vicinity.

Various Class II and III cultural resource inventories have been completed throughout the Surprise Complex by BLM, academic, and cultural resource management (CRM) personnel since the early 1970s. To date, these undertakings have resulted in the identification of 1,652 archaeological sites, including predominately prehistoric resources but also historic and/or multicomponent resources as well. In addition to the sites that have been identified and documented as a result of previous inventory work, the Surprise Complex also includes parts of three Areas of Critical Environmental Concern (ACEC) and the Black Rock Desert-High Rock Canyon Emigrant Trails National Conservation Area (NCA) which were designated as a result of high densities of significant cultural resource values along with other related significant natural resource values. ACECs encompassed by the Surprise Complex are Massacre Rim, Bitner, and High Rock Canyon; the former two ACECs are located within the Applegate Field Office administrative area while the High Rock Canyon ACEC is located in the Black Rock Field Office but whose cultural resources are administered by Applegate Field Office. The Surprise RMP (2007) also contains additional information on the ACECs described above.

The most sensitive areas for cultural resources, both in terms of impacts and where those resource types are most prevalent, are those which have natural water sources such as springs and streams. Heavy historical livestock grazing (pre-1970s) prior to the implementation of current grazing standards severely impacted and damaged many cultural sites. Lithic scatters (reduction areas), habitation localities, and quarry sites are especially vulnerable because trampling and hoof action can displace, physically break, and/or otherwise alter and destroy artifacts and surface archaeological features. Sites damaged by livestock or wild horse grazing begin to erode as a result of soil displacement and compaction and vegetation loss as well, increasing loss of integrity over time until they are eventually completely destroyed. Grazing damage to cultural sites has historically been associated with cattle grazing, but since the implementation of changes in cattle grazing management practices in recent years, including closing of the High Rock Canyon and adjacent areas to livestock grazing, the observed damage has been caused by wild horse grazing.

Increasing populations of wild horses competing for limited access to water and food resources has resulted in significant impacts to cultural resources at riparian areas. In an effort to access water, horses have caused substantial ground disturbance from trampling and pawing the ground around spring sources and seeps. As a result, both prehistoric and historic artifacts and features at or nearby these water sources have been displaced and/or destroyed. In addition to the loss of some artifacts and features, these sites have suffered a loss of integrity and data potential that cannot be recovered.

3.2.2 Livestock

The affected environment for livestock grazing provides information on how ecosystems within the Surprise Complex are being affected by multiple uses of the land, including livestock grazing permits.

Adjustments to livestock grazing permits is outside of the scope of this assessment. Information about livestock grazing permits within the Surprise Complex is provided below in Table 3-2.

All livestock permits within the Surprise Complex have undergone multiple changes to permit terms and conditions over the past 30 years. Livestock active AUMs were reduced in several allotments in the 1960s. In recent years, the BLM has monitored livestock grazing utilization, conducted riparian functional assessments and used other monitoring methods to determine if the active numbers are meeting allotment resource objectives. The BLM issues grazing permit renewals on a 10-year basis and makes adjustments as necessary to active numbers, AUMs, and season of use to meet land health standards.

The BLM has reduced active livestock use on the Surprise Complex by 41 percent over the last 50 years (see Appendix I). Further information regarding reduced use is incorporated into this assessment by reference from the 2011 High Rock Complex Wild Horse Population Management Plan EA (Section 3.6, pages 60 to 66). The decision to reduce the amount of livestock grazing in the allotment was to promote healthy sustainable rangeland ecosystems. The allotments within the HMA are mapped in Appendix H. There are a total of seven livestock operators who are currently authorized to graze livestock in these allotments annually. The cattle operators are authorized to use a total of 30,587 AUMs of forage each year. An AUM is the amount of forage needed to sustain one cow, five sheep, or five goats for a month. The allotments consist of various pastures grazed in a rest- and deferred-rotation.

Each allotment has specific terms and conditions defining turnout locations and seasons of use depending on the prior year's available water, climatic conditions, and actual use numbers. Annual meetings (Annual Operating Plans) are held prior to livestock turnout to plan deferment and livestock rotations. During drought years, livestock use may be limited or decrease due to lack of water availability. The BLM Rangeland Management Specialists work closely with operators on livestock distribution and movement during such years to limit excessive use on riparian areas. The season of use may vary by one to two weeks annually based upon forage availability, drought conditions, and other management criteria.

The BLM allocated forage for livestock use, and the management of cattle in the Surprise Complex involves careful adherence to permit stipulations, particularly regarding livestock numbers and season-of-use restrictions. Decisions pertaining to the six grazing allotments are contained in the following documents:

1. BLM Environmental Assessment, DOI-BLM-CA-N070-2013-0007-EA, *Massacre Lakes Permit Renewal* (2013)
2. BLM Revised Environmental Assessment, DOI-BLM-CAN070-2009-006-EA, *Livestock Grazing Authorization for the Nut Mountain Allotment* (2009)
3. BLM Environmental Impact Statement, DOI-BLM-CA-N020-2008-0002-RMP-EIS, *Surprise Resource Management Plan and Record of Decision* (2008)
4. BLM Environmental Impact Statement, DOI-BLM-NV-W030-2018-0022-RMP-EIS, *Black Rock-High Rock NCA Resource Management Plan of 2004* (2004)
5. BLM Environmental Assessment, CA-370-2001-03, *Environmental Assessment for Livestock, Grazing Authorization and Grazing Plan Revision: Wall Canyon East Allotment Actions to Meet Rangeland Health Standards* (2000)
6. BLM Environmental Assessment, CA-370-99-08, *Bare Allotment and Fox Hog Wild Horse Herd Management Area Livestock Carrying Capacity and Grazing Strategy Wild Horse Appropriate Management Level* (1999)

7. BLM Environmental Assessment, CA-370-98-05, *Bitner Allotment Management Plan Revision* (1998)
8. BLM Environmental Assessment, BLM-CA-028-96-02, *Cowhead/Massacre Management Framework Plan Amendment: Massacre Mountain Allotment Class of Livestock* (1996)

Livestock grazing use is controlled by fencing, herding, and strategic placement of water and salt. Rest-rotation and/or deferred rotational grazing strategies are also employed. Under the rest rotation grazing strategy, a pasture is grazed for one season then rested for one or two growing seasons to allow sufficient recovery time for plant growth and vigor prior to being grazed again. Deferred grazing is the postponement of grazing on a pasture until a specified time. For example, when plants mature and seeds set, they are not as vulnerable to damage from grazing as they would be during spring growth, therefore grazing may be deferred until seed set. Other grazing strategies include early-on and early-off grazing, turnout location rotation, delayed turnout, or a modified annual season-of-use. Annual adjustments to livestock grazing are made by the BLM according to forage availability and in response to below- or above-average precipitation.

Table 3-2 below includes the number of animals and AUMs that are permitted in each grazing allotment for cattle, the permitted season of use, and the type of grazing system used. See Appendix H for a more complete description of grazing management actions that are permitted within each of the six grazing allotments within the Surprise Complex. See Appendix J for summary of livestock actual use information for the allotments in the HMA since the 2011 gather in the Surprise Complex.

Table 3-2: Cattle Grazing Summary in the Surprise Complex

Livestock Grazing Allotment Name	No. of Cattle Permits	No. of Cattle[1/]	Active Cattle AUMs	Season of Use (Dates)	Grazing System
Bitner	1	283 183 100	1,702	04/16-8/30 9/16-10/15 9/16-10/15	5 pasture deferred use with reduced livestock numbers from 9/16-10/15.
Bare	1	1870 1340 670	13,260	3/1 - 6/30 7/1 - 10/31 11/1 - 11/30	8 Pasture Rest Rotation and Deferred Use
Massacre Mountain	2	968[2/]	5,824	4/1 - 9/30	Riparian Restrictions/Closure Areas
Massacre Lakes	1	150 450	1,693	5/15-5/29 5/30-9/17	4 pastures with 2-year cycle of rest/ rotation and deferred use.
Nut Mountain	1	813	4,893	4/16-10/15	7 pastures with 2-year cycle of rest/ rotation and deferred use.
Wall Canyon East	1	656	3,215	5/1-9/30	4 Use Areas – Deferred Rest Rotation
Total		**7,483**	**30,587**		

[1/]Livestock numbers are for the entire grazing allotment, and do not reflect the AUMs that would be allocated within each HMA, as only a portion of the grazing allotments fall within the HMAs.

2/ Approximately 90% of cattle use on Massacre Mountain Allotment occurs outside the High Rock HMA due to a lack of water sources and fences to manage cattle grazing. Approximately 43% of the HMA is closed to all livestock grazing.

Livestock use has varied since the 2011 wild horse and burro gather. In 2012, the Lost Fire burned over 30,615 acres of BLM and private lands within the Surprise Complex. The fire altered entire plant communities within the burned area. Subsequent grazing management was altered as well. Appendix J shows the decreased livestock use in the two years following the fire. Livestock use fluctuated between 2012 and 2015 as BLM worked with permittees to rest burned areas from livestock grazing. Additionally, many permittees do not use their full grazing preference most years because they are balancing their use with conditions on the ground (e.g., available water, pastures rested previous year, soil moisture conditions). On average since 2011, permittees only use about 52% of full grazing preference (see Appendix J). This allows for rest from livestock grazing. However, wild horses and burros have free access to all areas year-round, thus livestock rest does not allow for complete rest for vegetative communities, especially in riparian areas which continue to be degraded by wild horses and burros.

3.2.3 Upland Vegetation

Maintaining a balance of grazing animals and controlling the timing and amount of forage that is consumed each year by wildlife, livestock, and wild horses is crucial to maintaining healthy upland plant communities within the Surprise Complex. Heavy grazing on the upland vegetation from excess wild horses does not allow upland sites to recover from past disturbances and those areas are in danger of trending downward in ecological health. The 2011 High Rock Complex Wild Horse Population Management Plan EA (Section 3.11, pages 89 to 94) has a more complete description of the upland vegetation. The Massacre Lakes HMA was not included in the 2011 analysis and an excerpt from a Land Health Evaluation in the Massacre Lakes Allotment/ HMAvcompleted in 2013 is presented below.

In March 2010, a Rangeland Health Determination was completed for the Massacre Lakes Allotment/ HMA. Data from rangeland health assessments, riparian functional assessments and trend studies indicated that land health standards for Upland Soils, Riparian Wetland Areas and Biodiversity were not met. The standards for Streams and Water Quality were not applicable, therefore not assessed.

The standard for upland soils was not met and not progressing towards due to pedestalling, lack of litter, lack of organic matter and the slight loss of soil due to water erosion. Continued heavy grazing pressure by wild horses and cattle and below average precipitation were determined to be the causal factors for the non-achievement of this standard.

The standard for riparian wetland areas was not met, but progressing towards meeting the standard. While fenced riparian areas were functional, half of the assessed unfenced sites were either FAR or nonfunctional. In the northern most portions of the HMA, negative impacts to Sage Hen Spring and smaller un-named springs in the vicinity were reducing the water holding capacity for riparian habitats. The poor conditions of riparian areas in the northeast portion of HMA were generally due to year-round use by wild horses rather than seasonal use by livestock.

The standard for biodiversity was not met and not progressing towards. Data and observations indicated a lack of deep rooted perennial grasses (and in some cases forbs) in shrub interspaces with low species diversity. Continued heavy grazing by wild horses and cattle were determined to be the causal factors for the non-achievement of this standard.

Plant communities and sagebrush ecosystems that have been impacted in the past by wildfires and historic livestock grazing are vulnerable to losing more of their native perennial grass component when grazed at higher than moderate utilization levels (less than 60 percent) (USFS 2017). Sites that are close to crossing an ecological successional threshold to annual species and sites that are adjacent to water sources are the most vulnerable. Increased amounts of grazing on the uplands from an excess number of wild horses and burros does not allow some upland sites to obtain the amount of rest needed to recover from past disturbances.

3.2.4 Riparian-Wetland Sites

Past uses include, but are not limited to, historical grazing by domestic livestock and wild horses and burros, multiple large wildfires, numerous multi-year droughts that resulted in the loss of riparian vegetation and erosion of riparian soils. To mitigate effects to riparian areas, over the last 50 years, livestock AUMs have been reduced and grazing management actions such as deferred rest rotation have been implemented.

Riparian and wetland sites within the Surprise Complex are generally small (less than 1 acre) and are capable of providing water for a limited number of wildlife, livestock, and wild horses. A more complete description of riparian areas and wetland sites within the Complex can be found in the 2011 High Rock Complex Wild Horse Population Management Plan (Section 3.8, pages 67-86). A few larger springs with associated wet meadows exist within the Complex, and these sites are typically heavily used by livestock and wild horses and burros. Green riparian vegetation available during the hot summer months is an attractant to grazing animals when adjacent upland vegetation becomes mature, dry, and loses nutritional value.

Figure 3-2: This wet meadow complex in the Fox Hog HMA shows heavy use and multiple braided trails as animals congregate in green, riparian areas during hot weather. This photo was taken in July when upland vegetation such as that in the foreground, has become dry and mature. Large, connected bare ground patches are evident as is the drying of the lower meadow which is a direct result of chronic, severe overuse by primarily wild horses. This spring was rated as Nonfunctional by an interdisciplinary team in 2020.

During drought years, and in seasons with less than average precipitation, many riparian areas are unable to store water past spring or early summer. Therefore, many riparian/wetland areas are not capable of providing water for any species during drought years. As a result of water sources drying up during a drought season, larger, perennial riparian systems receive a disproportionate amount of use, as shown in photos of Sage Hen Spring in the Massacre Lakes HMA (Figure 3-1) and Cherry Spring in the High Rock HMA (Figure 3-2). This often leads to riparian systems becoming degraded from heavy use and soil loss occurs from a concentrated number of animals using limited perennial water sources.

Figure 3-3: Large, connected patches of bare ground are evident at Sage Hen Spring in the Massacre Lakes HMA, a severely degraded riparian system. These large, connected patches of bare ground lead to soil loss, erosion, and invasion by non-native species. Cattle rarely use this part of the allotment and historic game camera photos show nearly exclusive use by wild horses which have damaged this spring.

Figure 3-4: Cherry Spring, in the High Rock HMA, has been denuded of vegetation due to severe, chronic overuse by wild horses and burros and has lost significant topsoil due to erosion by wind and water.

Grazing by wildlife, livestock, and wild horses can impact riparian/wetland areas through trampling and/or grazing of riparian vegetation. When forage plants are overgrazed and trampled, desirable native species can be replaced by less desirable species that produce little or no forage value. Since wild horses graze year-round (unlike livestock where areas can be rested or deferred from grazing), wild horses can damage riparian areas and spring sites in late summer and fall when little green forage is available in the uplands. A decline in soil condition, plant cover, and plant species composition from trampling and overgrazing can result in bare soil and/or encourage the invasion and growth of noxious weeds or other invasive plants in riparian sites. Early spring grazing can also adversely affect vegetation resources as a result of trampling of wet soils, uprooting of seedlings, and damaging mature plants. These damaging effects are all occurring as a result of the overpopulation of wild horses in the Complex.

Sensitive riparian and wetland areas are often the first to show impacts of degradation in arid environments such as the Surprise Complex. Of the 67 individual riparian functional assessments conducted since the last gather in 2011, 42% percent (n = 28) rate as "Functional - At Risk. (FAR)" Of the 4 percent (n = 3) rated as "Proper Functioning Condition (PFC)" one of the three are fenced to exclude wild horses and livestock. The remaining 54 percent (n = 36) were rated as "Non Functional (NF)" which means that biological, geomorphological, and hydrologic processes have been so severely disrupted that the spring is no longer providing ecosystem goods and services (Chambers et al. 2014). Locations of riparian functional assessments and more detailed report are located in a map in Appendix J.

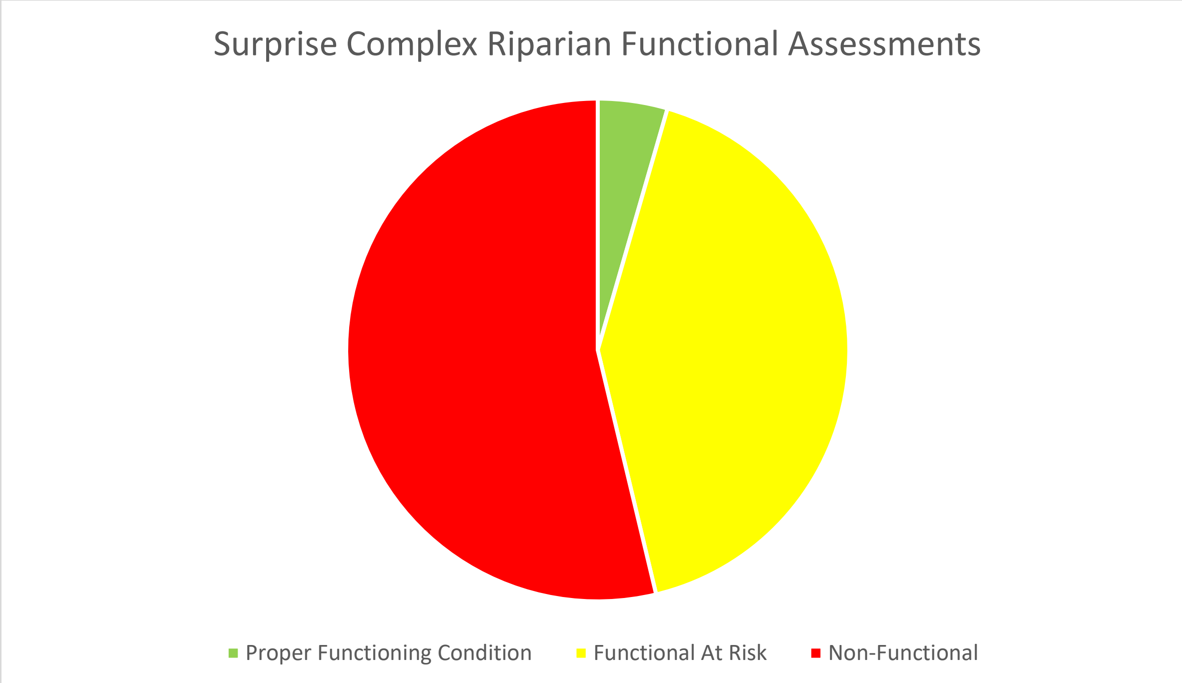


Figure 3-5: Riparian function assessments were completed for 67 springs in the Surprise Complex. The majority were rated as "Nonfunctional," and most of the rest were rated as "Functional - At Risk." Only three springs were rated as "Proper Functioning Condition."

Additionally, of the 27 springs that had repeated visits, one improved from a previous rating, nine were static, meaning the rating had not changed, and 17 declined in rating due to continued overuse by wild horses and burros.

Table 3-4: Repeat Assessment Ratings for Surprise Complex Selected Springs.

HMA	Spring	Rating from 2011 EA	Rating from 2020 EA	Trend
Massacre Lakes	Sage Hen Spring	NF	NF	Static
	Alkali Meadows	FAR	FAR	Static
Nut Mountain	Miller & Lux Spring	NF	NF	Static
	Rock Spring	FAR	FAR	Static
Wall Canyon	Cherry Spring	FAR	FAR	Static
	Big John Spring	FAR	FAR	Static
	Fountain Spring	NF	NF	Static
High Rock	Powers Spring	FAR	NF	Down
	Pappy's Corral Spring	FAR	FAR	Static
	Yellow Rock Spring	FAR	PFC	Up
Fox Hog	Rabbitsfoot Spring	PFC	NF	Down
	Lower Look Spring	FAR	NF	Down
	Texas Creek Spring	FAR	NF	Down
	Cottonwood Creek Canyon	PFC	FAR	Down

	Cow Spring	FAR	NF	Down
	Buttercup Spring	FAR	NF	Down
	Maianthemum Spring	FAR	NF	Down
	Cloud Spring	FAR	NF	Down
	Headcut Spring	FAR	NF	Down
	Sunny Day Spring	FAR	NF	Down
	Dy Spring	FAR	NF	Down
	Valley View Spring	FAR	NF	Down
	Valley View Spring	FAR	NF	Down
	Anomaly Spring	FAR	FAR	Static
	Talus Spring	NF	NF	Static
	Hog Mountain Spring	FAR	NF	Down

PFC = Proper Functioning Condition, FAR = Functional - At Risk, and NF= Non Functional

In general, springs are in fair to poor condition, with most at risk for losing further ecological structure and function. Loss of these springs would have dire consequences on the landscape, not only for wild horses, but also all livestock and wildlife species which depend on them for water and habitat.

3.2.5 Soil Resources

Landforms that make up the Complex vary from mountains to valley bottoms. Soils types within the Complex are quite variable from loams to clays. The vertisol soils (montmorillonitic) in the Complex are of particular concern, as they are easily destroyed if trampled when wet. Vertisols are clayey soils with very little organic matter and montmorillionitic soils are a subset of vertisols that have a unique physical and chemical structure that allows them to absorb more than twice their weight in water. When these soils are undisturbed, they are deep enough to support substantial plant production. When these soils are disturbed, the fragile clays become compacted and do not allow water to absorb into deeper horizons and reduce plant growth and survival. Seasonally controlled grazing can limit disturbance to these fragile soils when wet, but continuous, season-long grazing does not provide any protection against damage to soils. Once these soils are damaged, they can become unproductive and are vulnerable to invasion from annual grasses (e.g. medusahead). Loss of herbaceous cover and change in plant community composition negatively impacts soils. Soils within riparian areas and wetlands are extremely vulnerable to trampling by livestock and wild horses. A detailed description of the soils within the HMA can be found in the Soil Survey of Washoe County, Nevada, North Part, part 1 (NRCS 1999), Soil Survey of Washoe County, Nevada, Central Part (NRCS 1997) and the Surprise Valley-Home Camp Area California and Nevada Soil Survey (NRCS 2006).

The soil surface community includes cyanobacteria, green algae, lichens, mosses, microfungi and other bacteria. Soils with these organisms are often referred to as cryptogamic soils and form biological crusts. The cyanobacteria and microfungal filaments aid in holding loose soil particles together, forming a biological crust (e.g., bryophytes) which stabilizes and protects soil surfaces (Belknap et al. 2001). Biological crusts benefit soils by increasing moisture retention, nitrogen fixation, and inhibiting annual plant growth. Most biological crust organisms grow during cool, moist conditions when soils are most vulnerable to trampling. Soils in the Surprise Complex are at risk for degradation by trampling due to the overpopulation of wild horses.

3.2.6 Wildlife

Threatened and Endangered Species

The HMA has no known occurrences of federally-listed threatened or endangered species, and no federally-designated critical habitat occurs within the HMA. Therefore, these species will not be discussed further in this EA.

BLM Special Status Species

BLM Policy (USDOI BLM, 2001) under BLM Manual 6840 (Management of Special Status Species) requires that state-listed species receive the same level of protection afforded to ESA candidate species or the level of protection provided by state law – whichever would most effectively conserve the species. BLM Special Status Species that may utilize the HMA for foraging and/or nesting habitat include greater sage-grouse (*Centrocercus urophasianus*) and golden eagle (*Aquila chrysaetos*).

Greater sage-grouse

As the name implies, this species is heavily dependent on sagebrush habitats, and is considered a sagebrush-obligate species. Greater sage-grouse are a landscape-scale species that are seasonally mobile and annually have a large home range (Stiver *et al*., 2006). Historical and active breeding strutting grounds (known as leks) on BLM-administered lands are located primarily in open, low sagebrush habitats. Sage-grouse use sagebrush stands as both winter and nesting habitat, with leks often located in open areas surrounding sagebrush (Connelly *et al*., 2000). Sage-grouse most often nest under sagebrush shrubs, and successful nesting habitat contains tall grass cover (Gregg *et al*., 1994) in association with this sagebrush. Although many nests have been found in lower quality habitats (e.g. rabbitbrush-dominated habitats or habitats that lack perennial grasses and nesting cover), these are typically unsuccessful due to nest abandonment and predation. Early brood-rearing consists of upland sagebrush sites relatively close to nest sites, typically characterized by high species richness, with an abundance of forbs and insects. Sage-grouse raise their broods in wet meadow and riparian habitats, where the young can forage on the abundant insects that are a critical component to their diet during their first few weeks of life (Schroeder *et al*., 1999). Hens typically move their chicks to more mesic conditions, such as higher elevation sagebrush communities, wet meadow complexes, or agricultural fields. Chick recruitment is diminished in areas lacking an abundance of succulent vegetation or available clean water. Specific factors that have been known to limit population expansion of greater sage-grouse include loss of vegetation cover, degradation of riparian areas, and degradation of wet meadows. Degradation of riparian and wetland habitats from continuous use by excess wild horses and burros is one reason these birds are at risk. The presence of wild horses is associated with a reduced degree of greater sage-grouse lekking behavior (Muñoz et al. 2020). Moreover, increasing densities of wild horses, measured as a percentage above AML, are associated with decreasing greaer sage-grouse population sizes, measured by lek counts (Coates 2020).

The gather complex area falls almost entirely within the boundary of the Buffalo-Skedaddle greater sage-grouse Population Management Unit. This area includes lands classified as priority habitat management areas (PHMA), general habitat management areas (GHMA), other habitat management areas (OHMA), and unclassified (typically non-habitat). PHMAs are defined as BLM-administered lands identified as the highest value to maintaining sustainable greater sage-grouse populations. GHMAs are BLM-administered lands where special management will apply to sustain greater sage-grouse populations in adjacent areas. OHMAs are BLM-administered lands identified as unmapped habitat within the planning area and contain seasonal or connectivity habitat areas (USDOI BLM, 2015).

In the ARMPA, Special Status Species (SSS) Management Decision (MD) 2 D states that seasonal restrictions will be applied during the period specified below to manage discretionary surface-disturbing activities and uses on public lands (i.e. anthropogenic disturbances) that are disruptive to greater sage-grouse, to prevent disturbances to greater sage-grouse during seasonal life-cycle periods. The following seasonal restrictions (SSS MD 2-D; ARMPA) will be applied to avoid disturbance to greater sage-grouse:

1. In breeding habitat within four miles of active and pending greater sage-grouse leks from March 1 through June 30
    a. Lek - March 1 to May 15
    b. Lek hourly restrictions - 6 p.m. to 9 a.m.
    c. Nesting - April 1 to June 30

2. Brood-rearing habitat from May 15 to September 15
    a. Early - May 15 to June 15
    b. Late - June 15 to September 15

3. Winter habitat from November 1 to February 28

Golden eagle

Golden eagles are a species of high public interest and are given consideration when planning resource activities. The golden eagle is designated a BLM sensitive species and is protected under the Migratory Bird Treaty Act of 1918 and the Bald and Golden Eagle Protection Act of 1940.

Numerous golden eagle nest sites occur in the Applegate Field Office and the species is present within all watersheds. Currently, it is unknown how many of the known golden eagle nests are occupied; additional occupied nests could likely be found with additional survey effort. Management for this species is restricted to applying limited operating periods during the nesting season around known active nests. Although the golden eagle population trend in the Applegate Field Office is unknown, there is no evidence of decline.

Migratory birds

Migratory bird means any bird listed in 50 CFR 10.13. All native birds commonly found in the United States, with the exception of native resident game birds, are protected under the Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 U.S.C. 703 *et seq*.). The MBTA prohibits taking of migratory birds, their parts, nests, eggs and nestlings without a permit. Executive Order 13186 directs federal agencies to protect migratory birds by integrating bird conservation principles, measures and practices.

Numerous species of migratory birds use habitat within the HMA for food, cover, and nesting. Most of these species require diverse plant structure and herbaceous understory. Some species (e.g. western scrub jay, juniper titmouse, Oregon junco) primarily use trees, some other species (e.g. western meadowlark, Brewer's sparrow, sage thrasher, sage sparrow) use sagebrush and other shrub species, and some nest on the ground. Woodland plants, such as western juniper, provide nesting and foraging habitat for many species. Riparian areas, such as those found within the HMA, serve as important transition habitats for a variety of species between seasons and are often heavily used during summer months. Additionally, riparian areas with woody species are important habitats for some migratory bird species as they provide important foraging and nesting habitats and are at risk for degradation due to yearlong continued use by wild horses and burros.

Sections 3.23 and 4.22 of the Surprise RMP (USDOI BLM, 2008) provides additional information on wildlife resources within the Applegate Field Office resource area. These sections are incorporated by reference and describe Affected Environment and Environmental Consequences for wildlife within the Applegate Field Office resource area.

3.3.7 Wild Horses and Burros

The BLM designated the Massacre Lakes, Bitner, High Rock, Nut Mountain, and Wall Canyon Herd Areas as suitable for the long-term maintenance of wild horses in the approved Cowhead-Massacre Management Framework Plan (MFP) in 1981. The Cowhead-Massacre MFP/Record of Decision (1982) established the multiple use balance between livestock, wild horses, and wildlife based on the analyses of alternative allocations between these uses, and set initial forage allocations for wild horses. In similar fashion, the BLM designated the Fox Hog Herd Area in the Tuledad/Homecamp MFP/Record of Decision in 1979. AML was established for Massacre Lakes HMA in the 2013 Livestock Grazing Authorization and Wild Horse Appropriate Management Level Establishment Massacre Lakes Allotment and Herd Management Area EA (DOI-BLM-CAN070-2013-0021-EA). The AML for the Complex is 283 to 496 wild horses. The last removal of excess wild horses from the Complex was completed in September 2011, except for Massacre Lakes HMA which was last gathered in 1988. At that time, 1,334 wild horses were gathered, of which 186 wild horses were released back to the range. All mares released were administered a fertility control vaccine (PZP, or Porcine Zona Pellucida, PZP-22) prior to their release. Appendix L provides details on number of animals removed by year.

The Surprise Complex herds are in overall good health. Few animals rate lower than a 3 Henneke body condition score. As the population increases, however, competition for resources, especially water in drought years, would likely lead to more animals in poorer body conditions. The population of wild horses and burros in the Surprise Complex was counted during an aerial population survey using the simultaneous double observer method in June 2019. Previous aerial surveys were completed in 2016, 2014, 2012, and 2011 (pre-gather).

Because of history, context, and periodic introductions, wild horses that live in the Surprise Complex herd are not a truly isolated population. The National Academies of Sciences report to the BLM (2013) recommended that single HMAs or complexes should not be considered isolated genetic populations. Rather, managed herds of wild horses should be considered as components of interacting metapopulations, connected by interchange of individuals and genes due to both natural and human-facilitated movements. These animals are part of part of a larger metapopulation (NAS 2013) that has demographic and genetic connections with other BLM-managed herds in California, Nevada, Oregon, and beyond. Origins of this herd, documentation of past ecological conditions (up to 2010), and evolution of AML and the HMA can be found in the 2011 High Rock Complex Wild Horse Population Management Plan EA (DOI-BLM-CA-N070-2011-04-EA). Herds in the larger metapopulation have a background of shared domestic breed heritage (Appendix M), and natural and intentional movements of animals between herds. This background is very similar to that of many other herds managed by the BLM. Genetic diversity data were collected at the last gather in 2011 and results are provided in Appendix M. Hair samples would be periodically collected on at least 25 to 100 animals per HMA/trap location to assess the genetic diversity of the herd. Samples would also be collected during future gathers as needed to determine whether management is maintaining acceptable genetic diversity (avoiding inbreeding depression). Based on samples analyzed in 2011, genetic variability of the herds in all HMAs was generally high or above average (Appendix M). Genetic similarity among all sampled HMAs suggested herds with mixed ancestry primarily of North American origin (Appendix M).

Under all action alternatives, wild horse introductions from other HMAs could be used if needed, to augment observed heterozygosity, which is a measure of genetic diversity, the result of which would be to reduce the risk of inbreeding-related health effects. Introducing a small number of fertile animals every generation (about every 8-10 years) is a standard management technique that can alleviate potential inbreeding concerns (BLM 2010).

The 2013 National Academies of Sciences report included other evidence that shows that the Surprise Complex is not genetically unusual, with respect to other wild horse herds. Specifically, Appendix F of the 2013 NAS report is a table showing the estimated 'fixation index' (Fst) values between 183 pairs of samples from wild horse herds. Fst is a measure of genetic differentiation, in this case as estimated by the pattern of microsatellite allelic diversity analyzed by Dr. Cothran's laboratory. Low values of Fst indicate that a given pair of sampled herds has a shared genetic background. The lower the Fst value, the more genetically similar are the two sampled herds. Values of Fst under approximately 0.05 indicate virtually no differentiation. Values of 0.10 indicate very little differentiation. Only if values are above about 0.15 are any two sampled subpopulations considered to have evidence of elevated differentiation (Frankham et al 2010). Fst values for HMAs in the Surprise Complex had pairwise Fst values that were less than 0.05 with a large number of other sampled herds. These results support the interpretation that Surprise Complex horses are components in a highly connected metapopulation that includes horse herds in many other HMAs.

Diet and Overlap

Numerous studies identify dietary overlap of preferred forage species and habitat preference between horses, cattle, and wildlife species in the Great Basin ecosystems for all seasons (Ganskopp 1983, Ganskopp and Vavra 1986, 1987, McInnis 1984, McInnis and Vavra 1987, Smith et al. 1982, Vavra and Sneva 1978). A strong potential exists for exploitative competition between horses and cattle under conditions of limited forage (water and space) availability (McInnis and Vavra 1987).

Although horses and cattle are often compared as grazers, horses can be more destructive to the range than cattle due to their differing digestive systems and grazing habits. The dietary overlap between wild horses and cattle is much higher than between wild horses and wildlife, and averages between 60 and 80% (Hubbard and Hansen 1976, Hansen,et al. 1977, Hanley 1982, Krysl et al. 1984, McInnis and Vavra 1987). Horses are cecal digesters while most other ungulates including cattle, pronghorn, and others are ruminants (Hanley and Hanley 1982, Beever 2003). Cecal digesters do not ruminate, or have to regurgitate and repeat the cycle of chewing until edible particles of plant fiber are small enough for their digestive system. Ruminants, especially cattle, must graze selectively, searching out digestible tissue (Olsen and Hansen 1977). Horses, however, are one of the least selective grazers in the West because they can consume high fiber foods and digest larger food fragments (Hanley and Hanley 1982, Beever 2003, Bauer et al. 2017).

Wild horses can exploit the high cellulose of graminoids, or grasses, which have been observed to make up over 88% of their diet (McInnis and Vavra 1987, Hanley 1982). However, this lower quality diet requires that horses consume 20-65% more forage than a cow of equal body mass (Hanley 1982, Menard et al. 2002). With more flexible lips and upper front incisors, both features that cattle do not have, wild horses trim vegetation more closely to the ground (Symanski 1994, Menard and others 2002, Beever 2003). As a result, areas grazed by horses may retain fewer plant species and may be subject to higher utilization levels than areas grazed by cattle or other ungulates. A potential benefit of a horse's digestive system may come from seeds passing through system without being digested but the benefit is likely minimal when compared to the overall impact wild horse grazing has on vegetation in general. Wild horses can spread nonnative plant species, including cheatgrass, and may limit the effectiveness of habitat restoration projects (Beever et al. 2003, Couvreur et al. 2004, Jessop and Anderson 2007, Loydi and Zalba 2009, King et al. 2019).

Intraspecific Competition
Wild horses also compete with wildlife species for various habitat components, especially when populations exceed AML and/or habitat resources become limited (i.e. reduced water flows, low forage production, dry conditions, etc.). Smith (1986a, b) determined that elk and bighorn sheep were the most likely to negatively interact with wild horses. Hanley and Hanley (1982) compared the diets of wild horses, domestic cattle and sheep, pronghorn antelope, and mule deer and found that horse and cattle diets consisted mostly of grasses, pronghorn and mule deer diets consisted mostly of shrubs (>90%) and sheep diets were intermediate. Due to different food preferences, diet overlap between wild horses, deer, and pronghorn rarely exceeds 20% (Hubbard and Hansen 1976, Hanse et al. 1977, Meeker 1979, Hanley and Hanley 1982). Impacts to riparian vegetation per individual wild horse can exceed impacts per individual domestic cow (Kaweck et al. 2018).

There is growing concern about limited water and forage available to wild horses, livestock, and wildlife in the desert climate of the Great Basin (Gooch et al. 2017, Hall et al. 2016). Heavy use of forage near available water and competition between wild horses, livestock, and wildlife for limited forage and water has increased (Ostermann-Kelm et al. 2008; USFWS 2008; Perry et al. 2015; Hall et al. 2016; Gooch et al. 2017; Hall et al. 2018). A Nevada Department of Wildlife (NDOW) wildlife biologist observed, "The aggressive nature of wild horses kept elk from drinking, in some cases, and in other cases temporarily delayed their apparent need for water for approximately one hour. The aggressive acts documented included bluff charges and in one case a horse biting the rump of an adult elk" (McAdoo 2010).

Livestock permittees often haul water, transport water in water pipelines, or pump wells to provide water for their livestock. Because there are limited sources of water in the HMA, the wild horses and burros tend to stay closer to, and concentrate around, those sources of water. Forage around the water sources is heavily impacted because of the high concentration of wild horses in that area. Wild horses and burros have to travel greater distances to meet both their forage and water needs. Increasing competition at the water source, can cause increased stress to the animals and can lead to emergency conditions where a failure to take action may result in the suffering or death of individual wild horses.

Given the dry conditions that occur annually in the summer time, and the expanding wild horse numbers along with the limited perennial water sources in the Surprise Complex, there is a real concern that wild horses and burros could suffer from dehydration and possible death. If their known or common (habitual) water sources become dry or unavailable wild horses will linger sometimes until death, instead of searching out new or unknown water sources.

Results of WinEquus Population Modeling
The Alternatives (1, 2, 3, and 4) were modeled using Version 1.40 of the WinEquus population model (Jenkins 2000). Alternatives 1 and 2 were modeled together because WinEquus lacks a feature to adjust sex ratios on animals returned to the Complex. The purpose of the modeling was to analyze and compare the effects of the action alternatives on population size, average population growth rate, and average removal number. Alternatives 1, 2 and 3 all reduce the population. Alternative 4 results in a large population increase that could result in up to between 3,302 and 5,375 wild horses within 10 years (average numbers from WinEquus modeling, see Appendix N).

3.2.8 Wilderness

The proposed project area includes approximately 122,820 acres of Wilderness within the East Fork High Rock Canyon, High Rock Canyon, and Little High Rock Canyon Wilderness areas. These wilderness areas were designated by the Black Rock Desert-High Rock Canyon-Emigrant Trails National Conservation Area Act of 2000 (NCA Act). The NCA Act recognizes special features of the wilderness areas: wagon ruts, historic inscriptions, prehistoric and historic Native American sites, large natural potholes, threatened fish and sensitive plants, and a largely untouched emigrant trail view shed. The NCA Act additionally identifies the unique segments of the Northern Great Basin and its broad representation of landforms, plant, and animal species, including "free roaming horses and burros."

The Wilderness Act of 1964 established a "National Wilderness Preservation System to be composed of federally owned areas designated by Congress as "wilderness areas", these shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness." The Wilderness Act of 1964 mandates that Wilderness areas are managed in a manner that maintains or enhances the areas Wilderness Characteristics. Wilderness Characteristics include: untrammeled, natural, undeveloped, and outstanding opportunities for solitude or a primitive and unconfined type of recreation.

The action alternatives include helicopter overflights under 300 feet to herd WHB in areas that overlap with wilderness. The majority of the temporary trap sites are located outside of the wilderness boundaries. However, one temporary trap site (Bernard's Corral) occurs within the East Fork High Rock Canyon Wilderness. Bernard's Corral has been used as a trap site, dating as far back as 1981 prior to the establishment of the East Fork High Rock Wilderness. The Bernard's Corral trap site would include the use of temporary installations (e.g., corral), a temporary road, and motorized vehicles (semitruck, stock truck, trailers) to transport trapsite materials (e.g., metal panels, steel posts) and to haul captured wild horses and burros to offsite holding corrals. The temporary road would follow previous existing disturbance as the area has been used as a trapsite on past WH&B gathers (1981 - 2011).

3.2.9 Wilderness Study Areas

The proposed project area includes approximately 147,595 acres of Wilderness Study Areas (WSA). The Massacre Rim WSA (CA-020-1013) has 101,290 acres, and Wall Canyon (CA-020-805) has 46,305 acres within the WSA. The Federal Land Policy And Management Act of 1976 (FLPMA), Section 603-wilderness study and Section 202-Land Use Planning, directed BLM to inventory all public lands for wilderness potential, and identify lands that met the wildereness criteria as wilderness study areas.

WSAs are managed to ensure they are unimpaired for preservation as wilderness until Congress has determined to designate them as wilderness or release them from WSA status. FLPMA recognizes special features of the public lands suitable for designation of a WSA: Roadless Areas over 5,000 acres, Naturalness"…appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable….", Outstanding Opportunities"...has outstanding opportunities for solitude or a primitive and unconfined type of recreation, Other Features"…may also contain ecological, geological, scientific, educational, scenic, or historical value."

All BLM lands, including those in the project area, were inventoried for wilderness characteristics in 1979 as required under the Federal Land Policy and Management Act of 1976 (FLPMA). Under section 603 of FLPMA, lands found to have wilderness characteristics in the original 1979 inventory were designated as Wilderness Study Areas (WSAs). WSAs that met the criteria and are within the project area include; Wall Canyon and Massacre Rim. Sec. 603. [43 U.S.C. 1782] (a)

There are no existing trap sites or temporary holding areas located within the Massacre Rim WSA. Two new trapsites have been identified in the Massacre Rim WSA. The preferred site (Trap site #1) is located on a two-track road midway between Post spring and Massacre Lakes. The alternative site (Trap site #2) is located on a dead end two track road, approximately 2 miles from North Massacre Lake at the edge of a small canyon complex. Existing trap sites located in the Wall Canyon WSA will be used, no new trap sites are anticipated.

No off road driving is anticipated-although areas will be needed to back truck and trailers around, parking areas, and holding corrals-these areas could encompass 1-2 acres of landscape. Helicopters will be used for horse gathers, but no landings in WSAs are permissible, except in emergency situations.

4.0 Environmental Consequences

4.1 Introduction

This section of the EA analyzes the potential environmental impacts which would be expected with implementation of Alternatives 1, 2, 3, or 4. These include the direct impacts (those that result from the management actions), indirect impacts (those that exist once the management action has occurred), and cumulative impacts for the resources that were identified as issues to analyze—cultural resources, livestock, upland vegetation, riparian/wetland zones, soils, wildlife, and wild horses and burros.

The NEPA regulations define cumulative impacts as impacts on the environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions (40 CFR 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The cumulative impacts study area for the purposes of evaluating cumulative impacts is Surprise Complex and adjacent areas where horses have strayed outside the Complex boundaries.

For the purposes of analyzing cumulative impacts on all affected resources, Sections 4.2 and 4.3 describe the past, present, and reasonably foreseeable relevant actions within the Surprise Complex.

4.2 Past and Present Actions

Livestock

Allotments within the Surprise Complex have been grazed by livestock for more than 100 years. Excessive livestock grazing from the late 1800's to the 1930's altered plant composition and productivity on substantial portions of the lands currently managed by the Surprise Field Office. Over the past 40 years, the BLM has reduced the amount of livestock grazing in the HMA by approximately 41 percent. Livestock grazing management has been modified to reduce or eliminate impacts to vegetation and cultural sites through previous grazing decisions, which also resulted in adjustments to livestock numbers and seasons of use and for implementation of grazing systems and the associated range improvements to promote rangeland health.

Recreation

Recreation use has occurred mainly in the form of wilderness recreation, hiking, camping, and hunting. Activities that have occurred with very low frequency are wildlife observation, nature study, and archaeological sightseeing. Some areas of the Complex have been impacted by off-highway vehicle use that occurred off established trails. The Surprise RMP limits all off-highway vehicle use to designated trails.

Vegetation and Riparian

While the current livestock grazing system and efforts to manage the wild horse population within the AML has reduced the potential of past historic impacts to occur, the current overpopulation of wild horses is continuing to contribute to areas of heavy vegetation use, trailing and trampling damage and is preventing the BLM from managing for rangeland health and a thriving natural ecological balance and multiple use relationship on BLM-administered lands in the area. Wild horses can have substantial impacts on rangeland resources, including vegetation (Crist et al. 2019). This overpopulation has degraded vegetation and riparian areas and the growing overpopulation continues to degrade vegetation resources and sensitive riparian areas. The BLM has repaired or newly constructed (fenced) approximately five riparian areas in the Surprise Complex since 2011.

Vegetation, Wildfire, and Noxious Weeds

Numerous wildfires have occurred within the Surprise Complex. These wildfires have influenced native vegetation and potentially affected cultural resources. There have been numerous seedings within the Complex in response to wildland fires and past degradation. Past seedings include the use of both native and non-native plant species. Noxious weeds may also spread and increase post-wildfire. The BLM has conducted integrated weed management for over 25 years to monitor and treat infestations of noxious weeds and invasive species within the Complex. Monitoring and treatments would continue into future years as outlined in the 2018 Applegate Integrated Weed Management Plan Programmatic Environmental Assessment (DOI-BLM-CA-N020-2017-0017-EA).

Wildlife

Hunting for various wildlife species within and outside of the HMA occurs consistent with state wildlife laws and is managed by California Department of Fish and Wildlife (CDFW) and Nevada Department of Wildlife (NDOW). Forage allocations for livestock, wild horses, and wildlife have been established in the past by the BLM. Additionally, annual livestock numbers, seasons of use, and other factors in livestock grazing management have been implemented to improve rangeland and ecosystem health benefiting wildlife.

The ARMPA contains program area goals, objectives, and management decisions to strive to protect and preserve the greater sage-grouse and its habitat on BLM-administered lands that include the Complex and its vicinity (see Table 2-2 of the ARMPA). Vegetation, livestock grazing, and wild horses are examples of these program areas. The BLM, along with NDOW and other partners, have also installed water catchments that benefit wildlife and may also be used at times by wild horses and livestock. Overpopulation of wild horses is increasing the habitat degradation of both vegetation and water resources within and outside of the Complex, and decreasing habitat quantity and quality for numerous wildlife species.

Sections 3.23 and 4.22 of the 2008 Surprise RMP provide additional information on wildlife resources within the Applegate Field Office resource area. These sections are incorporated by reference and describe Affected Environment and Environmental Consequences for wildlife within the Applegate Field Office resource area.

Wild Horses and Burros

Historically, wild horses have used the HMAs in the Surprise Complex. In years that the populations of wild horses have exceeded the established AML range, disturbance to vegetation and to cultural resource sites has occurred in some areas. Since 1976, the BLM has conducted approximately 35 gathers of wild horses in different parts of the Complex in order to remove excess animals to manage the population size within the established AML ranges. Gathering any wild animals into pens has the potential to cause impacts to individual animals. There is also the potential for impacts to individual horses and burros during transportation, short-term holding, or long-term holding that take place after a gather. However, BLM follows guidelines to minimize those impacts and ensure humane animal care and high standards of welfare. The following literature review summarizes the limited number of scientific papers and government reports that have examined the effects of gathers and holding on wild horses and burros.

Two early papers, by Hansen and Mosley (2000) and Ashley and Holcomb (2001) examined limited effects of gathers, including behavioral effects and effects on foaling rates. Hansen and Mosley (2000) observed BLM gathers in Idaho and Wyoming. They monitored wild horse behaviors before and after a gather event, and compared the behavioral and reproductive outcomes for animals that were gathered by helicopter against those outcomes for animals that were not. This comparison led to the conclusion that gather activities used at that time had no effect on observed wild horse foraging or social behaviors, in terms of time spent resting, feeding, vigilant, traveling, or engaged in agonistic encounters (Hansen and Mosley 2000). Similarly, the authors did not find any statistically significant difference in foaling rates in the year after the gather in comparisons between horses that were captured, those that were chased by a helicopter but evaded capture, or those that were not chased by a helicopter. The authors concluded that the gathers had no deleterious effects on behavior or reproduction. Ashley and Holcomb (2001) conducted observations of reproductive rates at Garfield Flat HMA in Nevada, where horses were gathered in 1993 and 1997, and compared those observations at Granite Range HMA in Nevada, where there was no gather. The authors found that the two gathers had a short-term effect on foaling rates; pregnant mares that were gathered had lower foaling rates than pregnant mares that were not gathered. The authors suggested that BLM make changes to the gather methods used at that time, to minimize the length of time that pregnant mares are held prior to their release back to the range. Since the publications by Hansen and Mosley (2000) and by Ashley and Holcomb (2001), BLM did make changes to reduce the stress that gathered animals, including pregnant females, may experience as a result of gather and removal activities; these measures have been formalized as policy in the comprehensive animal welfare program (BLM IM 2015-151).

A thorough review of gather practices and their effects on wild horses and burros can be found in a 2008 report from the Government Accounting Office. The report found that the BLM had controls in place to help ensure the humane treatment of wild horses and burros (GAO 2008). The controls included SOPs for gather operations, inspections, and data collection to monitor animal welfare. These procedures led to humane treatment during gathers, and in short-term and long-term holding facilities. The report found that cumulative effects associated with the capture and removal of excess wild horses include gather-related mortality averaged only about 0.5% and approximately 0.7% of the captured animals, on average, are humanely euthanized due to pre-existing conditions (such as lameness or club feet) in accordance with BLM policy. Scasta (2019) found the same overall mortality rate (1.2%) for BLM WH&B gathers in 2010-2019, with a mortality rate of 0.25% caused directly by the gather, and a mortality rate of 0.94% attributable to euthanasia of animals with pre-existing conditions such as blindness or club-footedness. Scasta (2019) summarized mortality rates from 70 BLM WH&B gathers across nine states, from 2010-2019. Records for 28,821 horses and 2,005 burros came from helicopter and bait/water trapping. For wild burro bait / water trapping, mortality rates were 0.05% due to acute injury caused by the gather process, and death for burros with pre-existing conditions was 0.2% (Scasta 2019). For wild horse bait / water trapping, mortality rates were 0.3% due to acute injury, and the mortality rate due to pre-existing conditions was 1.4% (Scasta 2019). For wild horses gathered with the help of helicopters, mortality rates were only slightly lower than for bait / water trapping, with 0.3% due to acute causes, and 0.8% due to pre-existing conditions(Scasta 2019). Scasta (2019) noted that for other wildlife species capture operations, mortality rates above 2% are considered unacceptable and that, by that measure, BLM WH&B "…welfare is being optimized to a level acceptable across other animal handling disciplines."

The GAO report (2008) noted the precautions that BLM takes before gather operations, including screening potential gather sites for environmental and safety concerns, approving facility plans to ensure that there are no hazards to the animals there, and limiting the speeds that animals travel to trap sites.

In 2010, the American Association of Equine Practitioners (AAEP 2011) was invited by the BLM to visit the BLM operations and facilities, spend time on WH&B gathers and evaluate the management of the wild equids. The AAEP Task Force evaluated horses in the BLM Wild Horse and Burro Program through several visits to wild horse gathers, and short- and long-term holding facilities. The task force was specifically asked to "review animal care and handling within the Wild Horse and Burro Program, and make whatever recommendations, if any, the Association feels may be indicated, and if possible, issue a public statement regarding the care and welfare of animals under BLM management." In their report (AAEP 2011), the task force concluded "that the care, handling and management practices utilized by the agency are appropriate for this population of horses and generally support the safety, health status and welfare of the animals."

In June 2010 BLM invited independent observers organized by American Horse Protection Association (AHPA) to observe BLM gathers and document their findings. AHPA engaged four independent credentialed professionals who are academia-based equine veterinarians or equine specialists. Each observer served on a team of two, and was tasked specifically to observe the care and handling of the animals for a 3-4-day period during the gather process, and submit their findings to AHPA. An Evaluation Checklist was provided to each of the observers that included four sections: Gather Activities; Horse Handling During Gather; Horse Description; and Temporary Holding Facility. The independent group visited 3 separate gather operations and found that "BLM and contractors are responsible and concerned about the welfare of the horses before, during and after the gather process" and that "gentle and knowledgeable, used acceptable methods for moving horses… demonstrated the ability to review, assess and adapt procedures to ensure the care and well-being of the animals" (Greene et al. 2013).

BLM commissioned the Natural Resources Council of the National Academies of Sciences (NAS) to conduct an independent, technical evaluation of the science, methodology, and technical decision making approaches of the BLM Wild Horse and Burro Management Program. Among the conclusions of their 2013 report, NAS (2013) concluded that wild horse populations grow at 15-20 percent a year, and that predation will not typically control population growth rates of free-ranging horses. The report (NAS 2013) also noted that, because there are human-created barriers to dispersal and movement (such as fences and highways) and no substantial predator pressure, maintaining a herd within an AML requires removing animals in roundups, also known as gathers, and may require management actions that limit population growth rates. The report (NAS 2013) examined a number of population growth suppression techniques, including the use of sterilization, fertility control vaccines, and sex ratio manipulation.

The effects of gathers as part of feral horse management have also been documented on National Park Service Lands. Since the 1980s, managers at Theodore Roosevelt National Park have used periodic gathers, removals, and auctions to maintain the feral horse herd size at a carrying capacity level of 50 to 90 horses (Amberg et al. 2014). In practical terms, this carrying capacity is equivalent to an AML. Horse herd sizes at those levels were determined to allow for maintenance of certain sensitive forage plant species. Gathers every 3-5 years did not prevent the herd from self-sustaining. That herd continues to grow, to the point that the NPS now uses gathers and removals along with temporary fertility control methods in its feral horse management (Amberg et al. 2014).

The excess animals removed have been transported to off-range corral (ORC) facilities where they were prepared for adoption, sale (with limitations), off-range pastures (ORP), or other statutorily authorized disposition. The GAO report (2008) noted that BLM used SOPs for short-term holding facilities (e.g., corrals) that included procedures to minimize excitement of the animals to prevent injury, separating horses by age, sex, and size, regular observation of the animals, and recording information about the animals in a BLM database. The GAO reported that BLM had regular inspections of short-term holding facilities and animals there, ensuring that the corral equipment is up to code and that animals are treated with appropriate veterinary care (including that hooves are trimmed adequately to prevent injury). Mortality was found to be about 5% per year associated with transportation, short term holding, and adoption or sale with limitations. The GAO noted that BLM also had controls in place to ensure humane care at long-term holding facilities (i.e., pastures). BLM staff monitor the number of animals, the pasture conditions, winter feeding, and animal health. Veterinarians from the USDA Animal and Plant Health Inspection Service inspect long-term facilities annually, including a full count of animals, with written reports. Contract veterinarians provide animal care at long-term facilities, when needed. Weekly counts provide an incentive for contractors that operate long-term holding facilities to maintain animal health (GAO 2008). Mortality at long-term holding was found to be about eight percent per year, on average (GAO 2008). The mortality rates at short-term and long-term holding facilities are in the range of natural annual mortality rates on the range, which varies by year and location but may average about 13-16 percent per year for foals (animals under age 1), about 5-10 percent per year for horses ages 1-10 years, and about 10-25 percent for animals aged 10-20 years (Garrott and Taylor 1990, Ransom et al. 2016).

The last gather for the Surprise Complex (except Massacre Lakes HMA) was conducted in 2011 (1988 for Massacre Lakes HMA). In 2011, 1,334 wild horses were gathered, 1,148 wild horses were removed, and 186 wild horses were released back to the High Rock Complex. Of these, 38 mares were treated with fertility control vaccine (Porcine Zona Pellucida, PZP-22) and freezemarked for future identification. Post-gather in 2011, an estimated 309 wild horses were in the Complex based on an aerial survey.

The current population within and outside the Surprise Complex for 2019 is 1,272 wild horses and 11 burros. The actions which have influenced today’s wild horse and burro population are primarily wild horse gathers, which have resulted in the capture of wild horses, removal of excess wild horses, and release of wild horses back into the Complex (see Appendix L for the historical gather and release record for the Surprise Complex). Potential effects of fertility control methods are considered in Appendix O.

Wilderness

Wildfires, livestock grazing, wild horse HMAs, and recreation are actions that have occurred within the wilderness areas. Wildfires impact wilderness landscapes, vegetation composition, and potential vegetation screening for solitude. Livestock grazing and wild horse HMAs have the potential to impact vegetation composition and forage availability for wildlife that are considered special values. Recreation has the potential to impact the undeveloped, and opportunities for unconfined recreation/solitude for other wilderness visitors. By law, no buffer zones are created to protect wilderness from the influence of activities on land outside of wilderness boundaries.

Wilderness Study Areas

Wildfires, livestock grazing, livestock water facilities, wildhorse and burros, off road driving, and recreation are actions that have occurred within the wilderness study areas. Wildfires impact wilderness study area landscapes and vegetation composition. Livestock grazing and wild horses and burros have the potential to impact vegetation composition and forage availability for wildlife and watchable wildlife values. Livestock water projects can affect the natural character of the area. Recreation also has the potential to impact the undeveloped areas that contribute to the WSA.

4.3 Reasonably Foreseeable Future Actions

Wild Horses and Burros

Continued wild horse grazing would likely occur. Over the next 10 to 20 year period, reasonably foreseeable future actions include gathers with a frequency of up to two years to remove excess wild horses and/or implement fertility controls in order to manage population size within the established AML range could occur. The excess animals removed would be transported to ORCs where they would be prepared for adoption, sale (with limitations), or long-term holding. A program with annual remotely-delivered fertility control, or one in which remotely-delivered fertility control is administered in conjunction with future gathers could also reduce population growth. There is the potential that some animals treated by fertility control methods approved by separate BLM administrative units (e.g., from the Calico Complex) could move onto Surprise Complex lands; such animals may marginally reduce average fertility rates on the Surprise Complex, but such effects are expected to be minimal. Any future wild horse management, aside from the proposed management actions specified in this EA, would be analyzed in appropriate environmental analysis/documentation following site-specific planning with public involvement.

Vegetation, Wildfire, and Noxious Weeds

It is predicted that additional wildfires will occur in the future, and the lands affected may have emergency stabilization or rehabilitation efforts implemented on them. Future actions would likely be related to the effects from wildfires. Ongoing restoration and rehabilitation efforts include planting native shrubs and beneficial herbaceous species to increase cover, biodiversity and function. This type of action also increases soil health and productivity. Planting vegetation would be the primary action to reduce wind and water soil erosion. Other actions could include juniper thinning and removing Phase I stands that are encroaching on sagebrush dominated rangelands. No new roads are expected to be built. Livestock grazing is expected to continue at similar stocking rates and utilization of the available vegetation (forage) would also be expected to continue at similar levels. The BLM will continue to monitor and treat infestations of noxious weeds and invasive species in the Surprise Complex using Integrated Weed Management.

Wildlife

Wildlife habitat needs and hunting of game species would continue to occur in the Complex. The ARMPA and its program area goals, objectives, and management decisions will continue to be implemented for the benefit of greater sage-grouse and other wildlife species. The BLM, NDOW and other partners will maintain and replace the water catchments that benefit wildlife and continue to implement projects to improve rangeland health and wildlife habitat. Reasonably foreseeable future actions also include greater sage-grouse lek counts, which will continue within the Complex to assist in contributing to population data and to monitor habitat conditions.

Livestock

Livestock grazing is expected to continue at similar stocking rates as those currently authorized. The BLM will continue to authorize permits that require livestock to be grazed under specific terms and conditions that are designed to achieve or make significant progress towards achieving Rangeland Health

Standards.

Riparian
Ongoing restoration and rehabilitation efforts include restoring riparian and wet meadows through spring head development, off-site watering, and spring protection exclosures to increase cover, biodiversity, and function. Maintaining a balance of grazing animals and controlling the timing, intensity, and duration of grazing and amount of forage consumed each year by livestock and wild horses is crucial to maintaining healthy riparian plant communities for the future. One riparian area is planned for repair/restoration in the Surprise Complex by the BLM.

Wilderness
Wildfires, livestock grazing, wild horse management, and recreation are reasonably foreseeable future actions that are expected to occur within the wilderness areas. Wildfires have the potential to impact wilderness landscapes, vegetation composition, and potential vegetation screening for solitude. Livestock grazing and wild horse HMAs have the potential to impact vegetation composition and forage availability for wildlife that are considered special values. Recreation has the potential to impact the undeveloped areas, and opportunities for unconfined recreation/solitude for other wilderness visitors. By law, no buffer zones are created to protect wilderness from the influence of activities on land outside of wilderness boundaries.

Wilderness Study Areas
Wildfires, livestock grazing, wild horse and burro management, and recreation are reasonably foreseeable future actions that are expected to occur within the wilderness study areas. Wildfires have the potential to impact wilderness study area landscapes, vegetation composition, and visual resources. Livestock grazing and wild horses and burros have the potential to impact and alter vegetation composition and forage availability for high or special value wildlife. This in turn can affect the natural character of the area. Recreation activities, hunters, and special recreation permits have the potential to impact wilderness study area visitors. Trap sites alter the landscape on a temporary short term basis for the WSA recreation experience.

4.4 Predicted Effects of Alternatives
The direct, indirect, and cumulative impacts to these resources which would be expected to result with implementation of the Action Alternatives or No Action Alternative are discussed in detail below.

4.4.1 Cultural Resources
Impacts Common to Action Alternatives (1, 2, and 3)
The gather and removal of excess wild horses is an action common to alternatives 1, 2, and 3.Alternatives 1, 2, and 3 would result in minimal effects to cultural resources within the Surprise Complex due to inventory and avoidance of proposed gather, trap, and holding sites. The gather and removal of excess wild horses would reduce future soil compaction, artifact breakage, feature disturbance, and bare ground subject to erosion. Grazing by wild horses has likely affected a larger number of sites than is documented. By removing excess wild horses as described in Alternatives 1, 2, and 3, vegetation health and cover would improve, trampling, rolling and wallowing by horses would be reduced, and protection to cultural resources would be improved.

Impacts of Alternative 4 (No Action)
The no-action alternative (4) could be expected to result in continued or increased detrimental effects to cultural resources, particularly those around water sources where horses congregate. Increasing numbers of wild horses could intensify damage to archaeological sites, especially in areas adjacent to water. This

damage could be expected through loss of archaeological soil deposits near the surface, soil compaction, artifact breakage, feature damage, and increased bare ground, exposing sites to looting and higher erosion potential. Wild horse overgrazing of upland areas where cultural resources are located could result in complete destruction of sites as the vegetation cover is reduced and removed.

Cumulative Effects

Any ground disturbing activities can damage site function and integrity, thus the excessive overgrazing of uplands and riparian/wetland sites that would occur with Alternative 4, combined with past actions of wildfire and historic heavy livestock grazing, would likely cause some plant communities to become degraded to the point of crossing an ecological threshold. The resulting limited amount of plant litter and cover would afford little to no protection to cultural sites, resulting in potential loss and destruction of cultural resources. Riparian sites or wetlands which are still recovering from the damage caused by past heavy grazing use would likely become so damaged as to lose the entire structure, function, and integrity of the water source. Smaller sites would likely become nonfunctional and dry up, with a high amount of damage to cultural resources through breakage, displacement, and loss of site integrity. The gather and removal of excess wild horses as described in Alternatives 1, 2, and 3, would improve vegetation health, reduce tramping, and provide greater protection for cultural resources.

4.4.2 Livestock

Impacts Common to Action Alternatives (1, 2, and 3)

Wild horses directly compete with livestock for available forage and water. Alternatives 1, 2, and 3 would have less impact on social and economic values associated with livestock grazing operations than the no action alternative (4). Grazing systems for individual allotments are designed to function in a thriving natural ecological balance with wild horse populations within the established AML range. Within the established AML range, livestock operations and grazing systems would function properly and forage plants would be less heavily utilized by excessive season-long wild horse grazing. Furthermore, livestock operators could improve pasture rotation by allowing for proper rest and defer spring rest in areas where year-round wild horse use has negatively impacted deep rooted perennial grasses and riparian areas.

Impacts of Alternative 1 and 2

With Alternatives 1 and 2, a thriving natural ecological balance would be achieved and maintained longer than with Alternative 3. A thriving natural ecological balance would not be achieved with Alternative 4. Alternatives 1 and 2 would allow for a longer recovery period for degraded range resources and less overall use of forage species and would result in healthier livestock and forage.

Impacts of Alternative 3

With Alternative 3, wild horse populations would exceed high AML again in four to five years after achieving low AML, and the benefits to livestock would be shorter-term than benefits resulting from Alternative 1 or Alternative 2. Additionally, livestock operators would be more likely to receive reductions in permits due to poor range condition from continual, yearlong grazing by wild horses under Alternative 3.

Impacts of Alternative 4 (No Action)

Utilization by authorized livestock has been directly impacted due to the overpopulation of wild horses, both within and outside the Complex. Livestock operators have been asked by the BLM to take voluntary non-use or reduce use in some areas due to the impacts of the wild horse population on range vegetation/forage conditions. Wild horses are currently using nearly three times more than their forage allocation resulting in heavy to severe utilization of vegetation. The indirect impacts of Alternative 4 include increased damage to the rangelands, continued competition between livestock, wild horses and wildlife for the available forage and water, reduced quantity and quality of forage and water, and undue hardship on the livestock operators who would continue to be unable to make use of the forage they are authorized to use. Additionally, further damage to range improvements such as water troughs and riparian protection fencing would also occur as a result of large numbers of horses concentrating in one location competing for water. This amount of use and destruction increases maintenance and labor costs to repair and inspect each development.

Allotment and pasture division fences become damaged by excess wild horses attempting to move out of areas where their numbers and resource competition has become so severe they have to move somewhere else to find food and/or water. When this occurs, livestock may be able to get through these areas of fence lines that were damaged by excess wild horses, therefore livestock may end up on an adjacent allotment in which they are not authorized to graze.

Cumulative Effects

Through the land-use planning process and grazing permit renewal decisions, livestock grazing permits have been set at a level that balances forage resources between livestock and wild horses. The terms and conditions of livestock grazing permits are designed to allow forage resources to rest from grazing at various times of each year and to ensure that plants have adequate time for regrowth after grazing. When horse numbers become higher than the established AML, overall impacts to forage resources are higher, as more forage is consumed in the same time periods. This does not allow the livestock grazing systems to function as they have been designed, as no rest occurs on forage plants after livestock are removed from the allotment since they are continuously grazed by higher numbers of horses than the range can sustain.

By removing excess wild horses as described in Alternatives 1, 2, and 3, livestock operations and grazing systems would function properly, and forage plants would receive rest from grazing during scheduled rest periods. The health and condition of vegetation would be maintained, and plant communities that have been impacted by wildfires or past heavy livestock grazing would continue to improve in condition. Forage quality and production for livestock grazing would be expected to be maintained.

Implementation of Alternative 4 would result in substantial increases in wild horse numbers, and competition for forage and water would become more prevalent between livestock and horses. Plant communities that are still recovering from the effects of wildfires or past heavy livestock grazing would be the most vulnerable to further degradation. As wild horse and burro numbers increase, plant communities would experience a serious decline in condition, forage quality, and production. Forage resources for livestock would be highly degraded, and changes to grazing permits would most likely need to be made because of declining rangeland health.

4.4.3 Upland Vegetation

Impacts of Action Alternatives (1, 2, and 3)

Under Alternatives 1, 2, and 3, numbers of wild horses would be reduced, and maintained at AML, which would result in decreased impacts to vegetation throughout the Complex. While removal of excess wild horses may not be able to restore plant communities that have crossed ecological thresholds to annual grass dominated communities, having the number of horses in the Complex within AML would help prevent areas dominated by annual grass species from spreading. The removal of grazing pressure from excessive numbers of wild horses would lessen the impacts to perennial grasses, thus allowing them to better recover from natural disturbances such as fire, and to compete with non-native annual grasses such as cheatgrass and medusahead.

There would be some short-term direct effects to the vegetation within the gather sites and temporary holding facilities. Each of the gather sites is expected to be used for only a short duration (1 to 10 days) and at a level of use where effects would be short-term. Holding sites would be used for 1 to 30 days. In all trap and holding sites, vegetation is expected to be trampled by the animals with some plants likely becoming uprooted. Annual vegetation would have already senesced for the season, so the effects would be greater to the perennial species, such as bunchgrasses and shrubs. This short-term effect is outweighed, however, by reducing the long-term impacts to vegetation over the much larger area of the entire Complex from heavy grazing by high numbers of horses (above AML) on the upland vegetation.

Impacts of Alternative 4

Implementation of alternative 4 would result in a continued increase in the number of wild horses above AML, which would have compounding impacts upon upland vegetation. Impacts would be seen first in sites that are already close to crossing an ecological successional threshold, or on sites that are near water sources. The increased grazing pressure from horse numbers in excess of the high AML range would result in a decrease in native perennial species, and an increase in non-native annual species (e.g., cheatgrass) or shrubs tolerant of disturbance (e.g., rabbitbrush) that have lower forage value and provide fewer ecosystem goods and services (Chambers et al. 2014). These changes would decrease the stability, biodiversity, vigor, and production of native plant communities within the Complex.

Cumulative Effects

The Surprise Complex contains several areas where upland vegetation has been impacted by wildfires, historic livestock grazing, and other disturbances, which has damaged those plant communities. Sites that have low biodiversity have lost a high percentage of their native plant component, are comprised of a higher percentage of shrubs, or have been invaded by annual grasses. Maintaining a balance of grazing animals and controlling the timing and amount of forage that is consumed each year by livestock and wild horses is crucial to maintaining healthy upland plant communities. By removing excess wild horses as described in Alternatives 1, 2, and 3, cumulative impacts are expected to be positive for vegetation resources.

Alternative 4 would result in the increase in wild horse numbers and increased disturbance to native vegetation and soils, which could lead to increased damage to upland vegetation. Plant communities that have been impacted in the past by wildfires and historic livestock grazing would be vulnerable to losing native perennial grasses, due to the high amount of surface disturbance and trampling from excessive wild horses.

As perennial plant cover decreases within the Complex, annual plant cover from invasive species would increase, as these species are adapted to filling in gaps (areas devoid of vegetation). This change in functional/structural groups would have an impact on the vegetation, forage resources, and soil resources in the Complex. Soils would become less resistant to trampling impacts and would become more susceptible to wind or water erosion. Many sites that have been previously disturbed would transition from native perennial plant communities to invasive annuals plant (e.g., cheatgrass) communities.

4.4.4 Riparian-Wetland Zones

Impacts of Alternatives 1, 2, and 3

Implementation of Alternatives 1, 2, and 3 would improve and protect springs, streams, and associated riparian and wetland communities by managing wild horses within established AML ranges. This would reduce direct impacts to many riparian and wetland sites from high use, continuous grazing, and ground disturbance from wild horses. Most of the riparian and wetland sites are currently rated as "Functioning At Risk" or "Non Functioning," mostly due to yearlong grazing pressure from excessive wild horses. Decreased grazing pressure from excessive wild horse use would allow these areas to recover and return to a healthier, better functioning condition.

Impacts of Alternative 1 & 2

Under Alternatives 1 & 2, recovery of riparian areas would likely be prolonged due to wild horse population management, as the population would be reduced to low AML and would be maintained within the AML range during the 10-year period. This would allow more opportunity for recovery of degraded riparian areas and for thriving natural ecological balance to be met and maintained.

Impacts of Alternative 3

Under Alternative 3, wild horse populations could grow to above upper AML within four years and riparian recovery would cease. Thriving natural ecological balance would fail to be met when wild horse populations rise above high AML.

Impacts of Alternative 4 (No Action)

Implementation of Alternative 4 would allow for increased numbers of wild horses above the established AML range to continue degrading riparian areas. Without a decrease in the wild horse populations, it is likely that the functional ratings of riparian areas would further decrease. It is estimated that with the projected increase in the wild horse population under this alternative over the next five years (based on the WinEquus population model), approximately 16 riparian/wetland sites within the Complex could become severely degraded and/or dewatered transitioning from "Functional - At Risk" to "Nonfunctional."

Cumulative Effects

The number of wild horses and burros in the Complex has been above the established AML range for at least six years. Data from 2012 through 2020 demonstrates that riparian/wetland sites, especially lentic sources, are being adversely impacted as a result of year-long wild horse use. By removing excess wild horses as described in Alternatives 1, 2, and 3, sites rated as "Functioning at Risk" would have the opportunity to recover and improve in condition, and no cumulative impacts are expected. Sites currently rated as "Proper Functioning Condition" would be able to maintain that condition.

Implementation of Alternative 4 would allow continued overpopulation of wild horses above the established AML range. Without a decrease in wild horse populations, it is likely the functional ratings of riparian areas would decrease, in some cases crossing irreparable ecological thresholds. Riparian areas that are recovering from past overgrazing could become de-watered (reversing improvements that have been made over time), as the vegetation converts from riparian dominated vegetation to upland species. If these changes occur, water sources would stay wetter for a shorter period of time and stand the chance of converting from surface flow (which serves as a water source for horses, livestock and wildlife) to sub-surface flow that is unavailable for drinking water. This would increase impacts on remaining spring sources, as animals would concentrate in ever higher numbers on the remaining available drinking water sites.

4.4.5 Soils

Impacts of Alternatives 1, 2, and 3
Alternatives 1, 2, and 3 would result in the removal of excess horses to return the population to within AML. All three alternatives would result in short-term impacts to soils at gather site locations and temporary holding facilities. Some soils within these sites could become devoid of vegetation and be susceptible to soil erosion, however these areas are of limited size (typically less than 50 acres) and are expected to recover within a short period of time. The short-term effects to soils within these sites is outweighed by the long term beneficial impacts to soil resources that would occur as a result of removing excess horses to within the established AML ranges.

Impacts of Alternative 4 (No Action)
Alternative 4 would result in the increase of wild horse numbers, which would increase the level of disturbance to vegetation and soils. Greater than 60 percent vegetation utilization levels as a result of livestock grazing or wild horse use in areas with sensitive soil types can degrade soils in both the short- and long-term through soil compaction, erosion, sedimentation, and degradation of stream channel conditions (George et al. 2011). Within the Complex, soil compaction and erosion occur in areas where livestock, horses, concentrate (e.g., watering areas, salt locations, fence lines, and corrals) and vegetation has been reduced or removed. As wild horse populations continue to increase, the number of sites that would not meet the upland soils standard of the Standards for Rangeland Health would increase across the Complex.

Cumulative Effects
Cumulative effects to soils under Alternatives 1, 2, and 3 would be minimal and temporary. Some areas such as trap sites and holding facilities would experience some trampling, however these areas are generally small and make up less than one (1) percent of the project area. Once animals are removed from these sites, soils are expected to recover. Reducing the population of wild horses to within the established AML range under Alternatives 1, 2, and 3 would significantly reduce the long-term damage to soils resulting from trampling and overgrazing of vegetation.

Under Alternative 4, wild horse populations would continue to increase and upland sites would become overgrazed by horses resulting in the loss of vegetative cover and litter to protect the soil surface. There would also be a decrease in biological soil crusts and an increase in soil erosion and compaction. Sites currently dominated by annual and invasive grass species would become more degraded and eventually cross ecological thresholds. These degraded sites typically produce lower amounts of plant biomass and cover, are dominated by plants with shallow root systems, and provide little soil stability.

4.4.6 Wildlife
Impacts Common to Action Alternatives 1, 2, and 3
Direct short-term impacts from gather activities include disturbance to wildlife from the presence of people, vehicles, helicopters and wild horses and burros at the trap locations and temporary holding facilities during gather operations. Ground-nesting species such as the greater sage-grouse and northern harrier, and ground-dwelling species including badger, burrowing owl, and ground squirrel, could experience loss of nests, damage to burrows, injury or mortality to individuals or their young. Impacts to greater sage-grouse would be minimized, as no trap sites would be set up within a four mile buffer of active and/or pending greater sage-grouse leks during the lekking and nesting seasons in areas of documented use determined by telemetry locations. Areas within a four mile buffer of active and/or pending leks would be considered avoidance areas and protect approximately 85 percent of nesting greater sage-grouse. Additionally, no trap sites would be set up in proximity to known populations of other sensitive species. Short and long term indirect impacts include reduced competition between wild

horses and wildlife for forage and water due to an increase in the quality and quantity of available forage and water. Alternative 1, 2 and 3 would allow wildlife habitats to recover and improve the quality of habitats for most wildlife species in the long term.

Implementation of Alternatives 1, 2 and 3 would provide the greatest benefit to wildlife. The habitat would be able to recover and improve, and there would be less competition for resources between wild horse and wildlife populations. Specifically, shrub, native grass, total plant cover and species richness would increase and invasive species would decrease (Beever et al. 2003; 2008). Riparian areas and meadow function would also improve as well as their associated perennial grasses and forbs – all of which would increase nest and brood survival of greater sage-grouse (Doherty et al. 2014) and other species, increase hiding cover, and result in the overall improvement of habitat quality for wildlife species. Reducing wild horse density to AML is associated with increasing greater sage-grouse population trends (Coates 2020). Alternatives 1, 2, and 3 would also make progress towards meeting or making progress towards greater sage-grouse habitat objectives as outlined in Table 2-2 of the ARMPA. See Chapter 5 for design features that would be applied to be consistent with the ARMPA.

Impacts of Alternative 4 (No Action)
The direct impacts of this alternative would eliminate the short-term impacts from gather activities including disturbance to wildlife from the presence of people, vehicles, helicopters and wild horses and burros at the trap locations and temporary holding facilities during gather operations. Ground-nesting species such as the greater sage-grouse and northern harrier, and ground-dwelling species including badger, burrowing owl, and ground squirrel, would not experience loss of nests, damage to burrows or habitat, and injury or mortality to individuals or their young would not occur.

Indirect impacts from this alternative would be the continued degradation to wildlife habitats including reduced quantity and quality of vegetation and degradation of riparian, meadows and water resources necessary for wildlife. In the long term, this alternative would result in fewer plant species, lower the occurrence of native grasses, increase the presence of invasive species, and decrease vegetative cover (Beever & Aldridge 2011); all of which would result in a decrease in nesting and brood survival of greater sage-grouse (Doherty et al. 2014) and other species. This alternative would also increase predation of wildlife species by reducing hiding cover. Alternative 4 would not conform to the ARMPA by not managing greater sage-grouse habitat within established AML ranges to achieve and maintain greater sage-grouse habitat objectives outline in Table 2-2 (Management Decision WHB 2).

Cumulative Effects
Maintaining a balance of grazing animals and controlling the timing and amount of forage that is consumed each year by livestock and wild horses is crucial to maintaining healthy upland plant communities that provide important wildlife forage and cover. By removing excess wild horses as described in Alternatives 1, 2, and 3, cumulative impacts to wildlife habitat are expected to be beneficial. Habitat enhancement projects, including the fencing of riparian and spring sites from livestock and wild horses, further improve habitat quality for greater sage-grouse and other wildlife.

Implementation of Alternative 4 would result in the further degradation of riparian/wetland sites. It is estimated that with the projected increase in the wild horse population under this alternative, over the next five years approximately 16 riparian/wetland sites within the Complex could become severely degraded and/or dewatered (based on the average population growth rate). These impacts would cause a rapid decline in the amount and quality of riparian habitat for many wildlife species. Riparian and wetland sites that are currently rated as "Proper Functioning Condition" would also be at risk of degradation. Over time, drinking water for wildlife would become nonexistent in some areas, or be of very low quality due to the high amount of sediment in the water from horse trampling. Greater sage-grouse habitat would become degraded, especially in riparian and wetland communities. Nesting success would be impacted as sites become devoid of native perennial species, and have reduced amounts of plant cover and litter.

4.4.7 Wild Horses and Burros

Impacts of Alternative 1 (Proposed Action)

Under Alternative 1, band size would be expected to decrease, competition for mares would be expected to increase, recruitment age for reproduction among mares would be expected to decline, and size and number of bachelor bands would be expected to increase. These effects would be slight, as the proposed sex ratio (60% male) is not an extreme departure from normal sex ratio ranges. Modification of sex ratios for a post-gather population favoring studs would further reduce growth rates in combination with fertility control. This alternative would adjust the sex ratio of the herd that is returned to the range which would affect population dynamics and herd structure. Sex ratio adjustment would also decrease the number of mares which would need to be handled for fertility control, thus reducing stress to individual animals.

Impacts Common to Alternatives (1 and 2)

Contraception

All fertility control methods in wild animals are associated with potential risks and benefits, including effects of handling, frequency of handling, physiological effects, behavioral effects, and reduced population growth rates (Hampton et al. 2015). Contraception by itself does not remove excess horses from an HMA's population. If a wild horse population is in excess of AML, then contraception alone would result in some continuing environmental effects of overpopulation. Successful contraception reduces future reproduction.

Successful contraception would be expected to reduce the frequency of gather activities, as well as wild horse management costs to taxpayers. Bartholow (2007) concluded that the application of 2 or 3-year contraceptives to wild mares could reduce operational costs in a project area by 12 to 20 percent, or up to 30 percent in carefully planned population management programs. He also concluded that contraceptive treatment would likely reduce the number of horses that must be removed in total, with associated cost reductions in the number of private placements and total holding costs. Population suppression becomes less expensive if fertility control is long-lasting (Hobbs et al. 2000). BLM acknowledges that mares treated repeatedly with fertility control vaccines may become sterile (Nunez 2018). Although contraceptive vaccines and IUDs may be associated with a number of potential physiological, behavioral, demographic, and genetic effects, detailed in Appendix O, those concerns do not generally outweigh the potential benefits of using contraceptive treatments in situations where it is a management goal to reduce population growth rates (Garrott and Oli 2013).

Fertility Control Vaccines

Fertility control vaccines (also known as immunocontraceptives) meet the BLM requirements for safety to mares and the environment (EPA 2009a, 2012). Because they work by causing an immune response in treated animals, there is no risk of hormones or toxins being taken into the food chain when a treated mare dies. The BLM and other land managers have mainly used three fertility control vaccine formulations for fertility control of wild horses and burros on the range: ZonaStat-H, PZP-22, and GonaCon-Equine. As other formulations become available they may be applied in the future.

In any vaccine, the antigen is the stimulant to which the body responds by making antigen-specific antibodies. Those antibodies then signal to the body that a foreign molecule is present, initiating an immune response that removes the molecule or cell. Adjuvants are additional substances that are included in vaccines to elevate the level of immune response. Adjuvants help to incite recruitment of lymphocytes and other immune cells which foster a long-lasting immune response that is specific to the antigen.

Booster doses can be safely administered by hand or by dart. Even with repeated booster treatments of the vaccines, it is expected that most mares would eventually return to fertility, though some individual mares treated repeatedly may remain infertile. Once the herd size in a project area is at AML and population growth seems to be stabilized, the BLM can make adaptive determinations as to the required frequency of new and booster treatments.

The BLM will follow standard operating and post-treatment monitoring procedures for fertility control vaccine application (BLM Instruction Memorandum 2009-090: https://www.blm.gov/policy/im-2009-090). Herds selected for fertility control vaccine use should have annual growth rates over 5 percent and a herd size over 50 animals. The Complex is managed as a metapopulation with an AML between 283 – 490. The procedure requires that treated mares be identifiable via a visible freeze brand or individual color markings, so that their vaccination history can be known. The procedure calls for follow-up population surveys to determine the realized annual growth rate in herds treated with fertility control vaccines.

Porcine Zona Pellucida (PZP) Vaccine
The PZP may be applied to mares prior to their release back into the Complex during gather actions. The PZP vaccines ZonaStat-H and PZP-22 meet most of the criteria that the National Research Council (2013) used to identify promising fertility control methods, in terms of delivery method, availability, efficacy, and side effects (see Appendix O). ZonaStat-H is relatively inexpensive, meets BLM requirements for safety to mares and the environment, and is an EPA-registered commercial product (EPA 2012, SCC 2015). PZP-22 is a formulation of PZP vaccine which includes polymer pellets that may lead to a longer immune response (Turner et al. 2002, Rutberg et al. 2017, Carey 2019).

For the PZP-22 vaccine pellet formulation administered during gathers, each released female would receive a single dose of the PZP contraceptive vaccine pellets at the same time as a dose of the liquid PZP vaccine with modified Freund’s Complete adjuvant. Most females recover from the stress of capture and handling quickly once released back into the HMA and none are expected to suffer serious long term effects from the injections, other than the direct consequence of becoming temporarily infertile. Injection site reactions associated with fertility control treatments are possible in treated animals (Roelle and Ransom 2009, Bechert et al. 2013, French et al. 2017), but swelling or local reactions at the injection site are expected to be minor in nature. In subsequent years, Native PZP (or currently most effective formulation) could be administered as a booster dose using the one year liquid PZP vaccine by field or remote darting. The dart-delivered formulation produced injection-site reactions of varying intensity, though none of the observed reactions appeared debilitating to the animals (Roelle and Ransom 2009). Joonè et al. (2017a) found that injection site reactions had healed in most mares within 3 months after the booster dose, and that they did not affect movement or cause fever. Application of fertility control treatment would be conducted in accordance with the approved standard operating and post-treatment monitoring procedures (SOPs, Appendix F).

The historically accepted hypothesis explaining PZP vaccine effectiveness posits that when injected as an antigen in vaccines, PZP causes the mare’s immune system to produce antibodies that are specific to zona pellucida proteins on the surface of that mare’s eggs. The antibodies bind to the mare’s eggs surface proteins (Liu et al. 1989), and effectively block sperm binding and fertilization (Zoo Montana, 2000).

Because treated mares do not become pregnant but other ovarian functions remain generally unchanged, PZP can cause a mare to continue having regular estrus cycles throughout the breeding season. Other research has shown, though, that there may be changes in ovarian structure and function due to PZP vaccine treatments (e.g., Joonè et al. 2017b, 2017c). Research has demonstrated that contraceptive efficacy of an injected liquid PZP vaccine, such as ZonaStat-H, is approximately 90 percent or more for mares treated twice in one year (Turner and Kirkpatrick 2002, Turner et al. 2008). The highest success for fertility control has been reported when the vaccine has been applied November through February. High contraceptive rates of 90 percent or more can be maintained in horses that are boostered annually with liquid PZP (Kirkpatrick et al. 1992). Approximately 60 percent to 85 percent of mares are successfully contracepted for one year when treated simultaneously with a liquid primer and PZP-22 pellets (Rutberg et al. 2017). The application of PZP for fertility control would reduce fertility in a large percentage of mares for at least one year (Ransom et al. 2011).

Detailed effects of PZP vaccines are located in Appendix O.

Gonadotropin Releasing Hormone (GnRH) Vaccine (GonaCon)
GonaCon may be applied to animals prior to their release back into the Complex. Taking into consideration available literature on the subject, the National Research Council concluded in their 2013 report that GonaCon-B (which is produced under the trade name GonaCon-Equine for use in feral horses) was one of the most preferable available methods for contraception in wild horses (NRC 2013), in terms of delivery method, availability, efficacy, and side effects (see Appendix O). The BLM may apply GonaCon-Equine to captured mares, and would return to the Complex as needed to re-apply GonaCon-Equine, including by recapture and/or remote darting. GonaCon-Equine can safely be reapplied (Baker et al. 2018) as necessary to control the population growth rate. GonaCon-Equine is approved for use by authorized federal, state, tribal, public and private personnel, for application to wild and feral equids in the United States (EPA 2013, 2015). GonaCon will only be used in California if approved by the California EPA.

GonaCon is an immunocontraceptive vaccine which has been shown to provide multiple years of infertility in several wild ungulate species, including horses (Killian et al., 2008; Gray et al., 2010). GonaCon uses the gonadotropin-releasing hormone (GnRH), a small neuropeptide that performs an obligatory role in mammalian reproduction, as the vaccine antigen. When combined with an adjuvant, the GnRH vaccine stimulates a persistent immune response resulting in prolonged antibody production against GnRH, the carrier protein, and the adjuvant (Miller et al., 2008). The most direct result of successful GnRH vaccination is that it has the effect of decreasing the level of GnRH signaling in the body, as evidenced by a drop in luteinizing hormone levels, and a cessation of ovulation. The lack of estrus cycling that results from successful GonaCon vaccination has been compared to typical winter period of anoestrus in open mares. As anti-GnRH antibodies decline over time, concentrations of available endogenous GnRH increase and treated animals usually regain fertility (Power et al., 2011).

Changes in hormones associated with anti-GnRH vaccination lead to measurable changes in ovarian structure and function. The volume of ovaries reduced in response to treatment (Garza et al. 1986, Dalin et al. 2002, Imboden et al. 2006, Elhay et al. 2007, Botha et al. 2008, Gionfriddo 2011a, Dalmau et al. 2015). Treatment with an anti-GnRH vaccine changes follicle development (Garza et al. 1986, Stout et al. 2003, Imboden et al. 2006, Elhay et al. 2007, Donovan et al. 2013, Powers et al. 2011, Balet et al. 2014), with the result that ovulation does not occur.

Even with one booster treatment of GonaCon-Equine, it is expected that most, if not all, mares would return to fertility at some point, although the average duration of effect after booster doses has not yet been quantified. Although it is unknown what would be the expected rate for the return to fertility rate in mares boosted more than once with GonaCon-Equine, a prolonged return to fertility would be consistent with the desired effect of using GonaCon (e.g., effective contraception).

Injection site reactions associated with immunocontraceptive treatments are possible in treated mares (Roelle and Ransom 2009). Whether injection is by hand or via darting, GonaCon-Equine is associated with some degree of inflammation, swelling, and the potential for abscesses at the injection site (Baker et al. 2018). Swelling or local reactions at the injection site are generally expected to be minor in nature, but some may develop into draining abscesses.

Detailed effects of GonaCon are located in Appendix O.

Intrauterine Devices (IUDs)
Existing literature on the use of IUDs in horses allows for inferences about expected effects of any management alternatives that might include use of IUDs, and support the apparent safety and efficacy of some types of IUDs for use in horses. IUDs are considered a temporary fertility control method that does not generally cause future sterility (Daels and Hughes 1995). The genetic effects of use of IUDs are expected to be comparable to those expected from fertility control vaccine use, insofar as reversible fertility control treatments can temporarily reduce the fraction of fertile mares in a herd.

The 2013 National Academies of Sciences (NAS) report considered IUDs, and suggested that research should test whether IUDs cause uterine inflammation, and should also test how well IUDs stay in mares that live and breed with fertile stallions. A more recent study tested a Y-shaped IUD to determine retention rates and assess effects on uterine health; retention rates were greater than 75% for an 18-month period, and mares returned to good uterine health and reproductive capacity after removal of the IUDs (Holyoak et al., unpublished results). Available evidence indicates that flexible IUDs should be considered a reversible fertility control method for most mares. Soft or flexible IUDs (e.g., Gradil et al. 2019, HOlyoak et al. unpublished results) may cause relatively less discomfort than hard IUDs (Daels and Hughes 1995).

Insertion of an IUD can be a very rapid procedure, but it does require the mare to be temporarily restrained, such as in a squeeze chute. Wild mares receiving IUDs would be checked for pregnancy by a veterinarian, prior to insertion of an IUD. Pregnant mares would not receive an IUD. The IUD is inserted into the uterus using a thin, tubular applicator similar to a shielded culture tube, and would be inserted in a manner similar to that routinely used to obtain uterine cultures in domestic mares. The presence of an IUD in the uterus may, like a pregnancy, prevent the mare from coming back into estrus (Turner et al. 2015). However, some domestic mares did exhibit repeated estrus cycles during the time when they had IUDs (Killian et al. 2008, Gradil et al. 2019). Because IUDs may prolong the time between estrus, but still allow for some degree of estrus behavior, it could be surmised that treated mares would continue to engage in behaviors consistent with estrus, though perhaps at somewhat reduced frequency.

Detailed effects of IUDs are located in Appendix O.

<u>*Fertility Control Indirect Effects*</u>
One expected long-term, indirect effect on wild horses treated with fertility control, such as PZP vaccines, GonaCon, or IUDs would be an improvement in their overall health (Turner and Kirkpatrick 2002).

Many treated mares would not experience the biological stress of reproduction, foaling and lactation as frequently as untreated mares. The observable measure of improved health is higher body condition scores (Nuñez et al. 2010). After a treated mare returns to fertility, her future foals would be expected to be healthier overall, and would benefit from improved nutritional quality in the mare's milk. This is particularly to be expected if there is an improvement in rangeland forage quality at the same time, due to reduced wild horse population size. Past application of fertility control has shown that the animal's overall health and body condition remains improved even after fertility resumes. Fertility control vaccine treatment may increase mare survival rates, leading to longer potential lifespan (Turner and Kirkpatrick 2002, Ransom et al. 2014a). Changes in lifespan and decreased foaling rates could combine to cause changes in overall age structure in a treated herd (Turner and Kirkpatrick 2002, Roelle et al. 2010), with a greater prevalence of older mares in the herd (Gross 2000). Observations of mares treated in past gathers showed that many of the treated mares were larger than, maintained higher body condition than, and had larger healthy foals than untreated mares.

Impacts of Alternative 3

In the short term, implementation of Alternative 3 would result in capturing fewer wild horses than would be captured in Alternative 1. Removals would follow current WHB policy and guidelines. Alternative 3 would not involve fertility control; mares would not undergo the marginal additional stress of receiving fertility control injections or freezemarking and would foal at normal rates until the next gather is conducted. The post-gather sex ratio would be about 50:50 mares to studs, or would slightly favor mares. This would be expected to result in fewer and smaller bachelor bands, increased reproduction on a proportional basis within the herd, larger band sizes, and individual mares would likely begin actively producing at a slightly older age. In the long term, because annual growth rates would remain higher than under either alternative with fertility control application, a larger number of wild horses may need to be captured and removed from the range than under either Alternatives 1 or 2.

Impacts Common to Alternatives 1, 2, and 3

For over 40 years, various impacts to wild horses as a result of gather activities have been observed. Under Alternatives 1, 2, and 3 impacts to wild horses would be both direct and indirect, occurring to both individual horses and burros and the population as a whole.

In any given gather, gather-related mortality averages only about 0.5 percent, which is very low when handling wild animals. Approximately, another 0.6 percent of the captured animals could be humanely euthanized due to pre-existing conditions and in accordance with BLM policy (GAO 2008). These data affirm that the use of helicopters and motorized vehicles has proven to be a safe, humane, effective, and practical means for the gather and removal of excess wild horses and burros from the public lands. The BLM also avoids gathering wild horses and burros by helicopter during the 6 weeks prior to and following the peak foaling season (i.e., March 1 through June 30).

Impacts to Individual Horses and Burros

Individual, direct impacts to wild horses include the handling stress associated with the roundup, capture, sorting, handling, and transportation of the animals. The intensity of these impacts varies by individual and is indicated by behaviors ranging from nervous agitation to physical distress. When being herded to trap site corrals by the helicopter, injuries sustained by wild horses may include bruises, scrapes, or cuts to feet, legs, face, or body from rocks, brush or tree limbs. Rarely, wild horses will encounter barbed wire fences and may receive wire cuts. These injuries are very rarely fatal and are treated on-site until a veterinarian can examine the animal and determine if additional treatment is indicated.

Other injuries may occur after a horse has been captured and is either within the trap site corral, the temporary holding corral, during transport between facilities, or during sorting and handling. Occasionally, horses may sustain spinal injuries or fractured limbs but based on prior gather statistics, serious injuries requiring humane euthanasia occur in less than one horse per every 100 captured. Similar injuries could be sustained if wild horses were captured through bait and/or water trapping, as the animals still need to be sorted, aged, transported, and otherwise handled following their capture. These injuries result from kicks and bites, or from collisions with corral panels or gates.

To minimize the potential for injuries from fighting, the animals are transported from the trap site to the temporary holding facility where they are sorted as quickly and safely as possible, then moved into large holding pens where they are provided with hay and water. On many gathers, no wild horses are injured or die. On some gathers, due to the temperament of the horses, they are not as calm and injuries are more frequent. Overall, direct gather-related mortality averages less than one percent.

Indirect individual impacts are those which occur to individual wild horses after the initial event. These may include miscarriages in mares, increased social displacement, and conflict between males. These impacts, like direct individual impacts, are known to occur intermittently during wild horse gather operations. An example of an indirect individual impact would be the brief 1 to 2 minute skirmish between older studs which ends when one stud retreats. Injuries typically involve a bite or kick with bruises which do not break the skin. Like direct individual impacts, the frequency of these impacts varies with the population and the individual. Observations following capture indicate the rate of miscarriage varies, but can occur in about one to five percent of the captured mares, particularly if the mares are in very thin body condition or in poor health.

A few foals may be orphaned during a gather such as if the mare rejects the foal, the foal becomes separated from its mother and cannot be matched up following sorting, the mare dies or must be humanely euthanized during the gather, the foal is ill or weak and needs immediate care that requires removal from the mother, or the mother does not produce enough milk to support the foal. On occasion, foals are gathered that were previously orphaned on the range (prior to the gather) because the mother rejected it or died. These foals may be in poor, unthrifty condition. Every effort is made to provide appropriate care to orphan foals. Veterinarians may administer electrolyte solutions or orphan foals may be fed milk replacer as needed to support their nutritional needs. Orphan foals may be placed in a foster home in order to receive additional care. Despite these efforts, some orphan foals may die or be humanely euthanized if the prognosis for survival is very poor.

In some areas, gathering wild horses during the winter may avoid the heat stress that could be associated with a summer gather. By fall and winter, foals are of larger body size and sufficient age to be weaned. Winter gathers are often preferred when terrain and higher elevations make it difficult to gather wild horses during the summer months. Under winter conditions, horses and burros are often located in lower elevations due to snow cover at higher elevations. This typically makes the horses closer to the potential trap sites and reduces the potential for fatigue and stress. While deep snow can tire horses as they are moved to the trap, helicopter pilots allow the horses and burros to travel slowly at their own pace. Trails in the snow are often followed to make it easier for horses to travel to the trap site. On occasion, trails can be plowed in the snow to facilitate the safe and humane movement of horses and burros to a trap. Wild horses may be able to travel farther and over terrain that is more difficult during the winter, even if snow does not cover the ground. Water requirements are lower during the winter months, making distress from heat exhaustion extremely rare. By comparison, during summer gathers, wild horses may travel long distances between water and forage and become more easily dehydrated.

Through the capture and sorting process, wild horses are examined for health, injury and other defects. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy. The BLM Euthanasia Policy IM-2015-070 is used as a guide to determine if animals meet the criteria and should be euthanized. Animals that are euthanized for non-gather related reasons include those with old injuries (broken or deformed limbs) that cause lameness or prevent the animal from being able to maintain an acceptable body condition (greater than or equal to BCS 3); old animals that have serious dental abnormalities or severely worn teeth and are not expected to maintain an acceptable body condition, and wild horses that have serious physical defects such as club feet, severe limb deformities, or sway back. Some of these conditions have a causal genetic component and the animals should not be returned to the range to prevent suffering, as well as to avoid amplifying the incidence of the problem in the population.

Wild horses not captured may be temporarily disturbed and moved into another area during the gather operation. With the exception of changes to herd demographics from removals, direct population impacts have proven to be temporary in nature with most, if not all, impacts disappearing within hours to several days of release. No observable effects associated with these impacts would be expected within one month of release, except for a heightened awareness of human presence.

It is not expected that genetic health would be impacted by the action alternatives. The AML range of 283 – 496 horses in the Complex should provide for acceptable genetic diversity and if need be will be monitored with further genetic testing (see Appendix M). Genetic diversity will be monitored with respect to observed heterozygosity (Ho; BLM 2010). Genetic monitoring will inform the BLM as to whether or not genetic diversity, as measured by observed heterozygosity (Ho), is acceptable, or whether any mitigating actions will need to be taken (BLM 2010). If monitoring of observed heterozygosity levels, as measured from genetic monitoring samples, gives indication that measure of genetic diversity should be increased, the BLM may consider introducing animals to the herd to increase local genetic diversity.

By returning wild horse population to AML, there would be a lower density of wild horses across the Complex, reducing competition for resources and allowing wild horses to utilize their preferred habitat. Maintaining population size within the established AML would be expected to improve forage quantity and quality and promote healthy, self-sustaining populations of wild horses in a thriving natural ecological balance and multiple use relationship on the public lands in the area. Deterioration of the range associated with wild horse overpopulation would be avoided. Managing wild horse populations in balance with the available habitat and other multiple uses would lessen the potential for individual animals or the herd to be affected by drought, and would avoid or minimize the need for emergency gathers, which would reduce stress to the animals and increase the success of these herds over the long-term.

Transport, Off-Range Corral (ORC) Holding, and Adoption (or Sale) Preparation

During transport, potential impacts to individual horses can include stress, as well as slipping, falling, kicking, biting, or being stepped on by another animal. Unless wild horses are in extremely poor condition, it is rare for an animal to be seriously injured or die during transport. During the preparation process for sale or adoption (e.g. freezemarking, blood samples, vaccination), potential impacts to wild horses are similar to those that can occur during handling and transportation. Serious injuries and deaths from injuries during the preparation process are rare, but can occur.

At ORCs, a minimum of 700 square feet is provided per animal. Mortality at ORCs averages approximately five percent per year (GAO 2008), and includes animals euthanized due to a pre-existing condition; animals in extremely poor condition; animals that are injured and would not recover; animals which are unable to transition to feed; and animals which are seriously injured or accidentally die during sorting, handling, or preparation.

Adoption or Sale with Limitations and Off-Range Pastures (ORP)
Potential impacts to wild horses from transport to adoption, sale, or ORP are similar to those previously described. One difference is that when shipping wild horses for adoption, sale or ORP, animals may be transported for a maximum of 24 hours. Immediately prior to transportation, and after every 18 to 24 hours of transportation, animals are offloaded and provided a minimum of 8 hours on-the-ground rest. During the rest period, each animal is provided access to unlimited amounts of clean water and 25 pounds of good quality hay per horse with adequate bunk space to allow all animals to eat at one time. Most animals are not shipped more than 18 hours before they are rested. The rest period may be waived in situations where the travel time exceeds the 24-hour limit by just a few hours and the stress of offloading and reloading is likely to be greater than the stress involved in the additional period of uninterrupted travel.

ORPs are designed to provide excess wild horses with humane, life-long care in a natural setting off the public rangelands. Animals are segregated into separate pastures by sex except one facility where geldings and mares coexist. Although the animals are placed in ORP, they remain available for adoption or sale to qualified individuals. No reproduction occurs in the ORP, but foals born to pregnant mares are gathered and weaned when they reach about 8 to10 months of age and are then shipped to ORCs where they are made available adoption. Handling by humans is minimized to the extent possible although regular on-the-ground observation and weekly counts of the wild horses to ascertain their numbers, well-being, and safety are conducted. A very small percentage of the animals may be humanely euthanized if they are in very thin condition and are not expected to improve to a BCS of three or greater due to age or other factors. Natural mortality of wild horses in ORP pastures averages approximately eight percent per year, but can be higher or lower depending on the average age of the horses pastured there (GAO 2008).

Euthanasia
Decisions to humanely euthanize animals would be made in conformance with BLM policy (IM 2015-070 or most current edition). Conditions requiring humane euthanasia occur infrequently and are described in more detail in IM 2015-070: https://www.blm.gov/policy/im-2015-070.

Impacts of Alternative 4 (No Action)
Under Alternative 4, there would be no active management to control the population size within the established AML at this time. In the absence of a gather, wild horse populations would continue to grow. Without gather and removal now, the wild horse population could reach between 3,302 and 5,375 wild horses within 10 years.

Use by wild horses would continue to exceed the amount of forage allocated for their use. Competition between wildlife, livestock and wild horses for limited forage and water resources would continue. Damage to rangeland resources would continue or increase. Over time, the potential risks to the health of individual horses would increase, and the need for emergency removals to prevent their death from starvation or thirst would also increase. Over the long-term, the health and sustainability of the wild horse population is dependent upon achieving a thriving natural ecological balance and sustaining healthy rangelands. Allowing wild horses to die of dehydration or starvation would be inhumane and would be contrary to the Wild Horse and Burro Act which requires that excess wild horses be immediately removed when necessary to achieve a thriving natural ecological balance. Allowing rangeland damage to continue to result from wild horse overpopulation would also be contrary to the Wild Horse and Burro Act which requires the BLM to "protect the range from the deterioration associated with overpopulation", "remove excess animals from the range so as to achieve appropriate management levels", and "to preserve and maintain a thriving natural ecological balance and multiple-use relationship in that area."

Cumulative Effects
Impacts Common to Action Alternatives (1, 2, and 3)
The cumulative effects associated with the capture and removal of excess wild horses includes gather-related mortality of less than one (1) percent of the captured animals, about five (5) percent per year associated with transportation, off-range corrals, adoption or sale with limitations and about eight (8) percent per year associated with off-range pastures. This compares with natural mortality on the range, which varies by year and location but may average about 13-16 percent per year for foals (animals under age 1), about 5-10 percent per year for horses ages 1 to 10, about 10-25 percent for animals aged 10-20 years, and about 25-50 percent for animals aged 20-25 years (Jenkins 1996, Garrott and Taylor 1990, Ransom et al. 2016). In situations where forage and/or water are limited, mortality rates increase, with the greatest impact to young foals, nursing mares and older horses. Animals can experience lameness associated with trailing to/from water and forage, foals may be orphaned (left behind) if they cannot keep up with their mare, or animals may become too weak to travel. After suffering, often for an extended period, the animals may die. Before these conditions arise, the BLM generally removes the excess animals to prevent their suffering from dehydration or starvation.

While humane euthanasia and sale without limitation of healthy horses for which there is no adoption demand is authorized under the Wild Horse and Burro Act, Congress prohibited the use of appropriated funds between 1987 and 2004 and again since 2010 for this purpose.

The other cumulative effects which would be expected when incrementally adding either of the Action Alternatives would include continued improvement of upland vegetation conditions, which would in turn benefit permitted livestock, native wildlife, and wild horse and burro population as forage (habitat) quality and quantity is improved over the current level. Benefits from a reduced wild horse population would include fewer animals competing for limited forage and water resources. Cumulatively, there should be more stable wild horse populations, healthier rangelands, healthier wild horses, and fewer multiple use conflicts in the area over the short and long-term. Over the next 15 to 20 years, continuing to manage wild horses within the established AML range would achieve a thriving natural ecological balance and multiple use relationship on public lands in the area.

Cumulative Impacts of Alternative 1 (Proposed Action)
Application of fertility control and adjustment in sex ratios to favor males should slow population growth and result in fewer gathers and less frequent disturbance to individual wild horses and the herd's social structure. However, return of wild horses back into the Complex could lead to decreased ability to effectively gather horses in the future as released horses learn to evade the helicopter.

Cumulative Impacts of Alternative 2
Application of fertility control will slow population growth and result in fewer gathers and less frequent disturbance to individual wild horses and the herd's social structure. However, return of wild horses back into the Complex could lead to decreased ability to effectively gather horses in the future as released horses learn to evade the helicopter.

Cumulative Impacts of Alternative 4 (No Action)

Under the No Action Alternative, the wild horse population could reach or exceed 5,375 wild horses in four years based on WinEquus modeling (Appendix N). Movement outside the Complex and onto private lands would be expected as greater numbers of horses search for food and water for survival, thus impacting larger areas of public lands. Heavy to excessive utilization of the available forage would be expected and the water available for use could become increasingly limited. Eventually, ecological plant communities would be damaged to the extent that they are no longer sustainable or recoverable and the wild horse population would be expected to crash.

Emergency removals could be expected in order to prevent individual animals from suffering or death as a result of insufficient forage and water. These emergency removals could occur as early as the next drought and perennial water sources become dry early in the season. During emergency conditions, competition for the available forage and water increases. This competition generally impacts the oldest and youngest horses as well as lactating mares first. These groups would experience substantial weight loss and diminished health, which could lead to their prolonged suffering and eventual death. If emergency actions are not taken, the overall population could be affected by severely skewed sex ratios towards stallions as they are generally the strongest and healthiest portion of the population. An altered age structure would also be expected.

Cumulative impacts would result in foregoing the opportunity to improve rangeland health and to properly manage wild horses in balance with the available forage and water and other multiple uses. Attainment of site-specific vegetation management objectives and Standards for Rangeland Health would not be achieved. AML would not be achieved and the opportunity to collect the scientific data necessary to re-evaluate AML levels, in relationship to rangeland health standards, would be foregone.

4.4.8 Wilderness

Impacts Common to Action Alternatives 1, 2, and 3

The action alternatives include the use helicopter overflights to herd WHB, motorized vehicles to transport heavy materials & WHB, a temporary road, and installations (temporary corral) within wilderness at one trap site. Motorized vehicles, temporary roads, and installations are uses prohibited by Section 4(c) of the Wilderness Act. However, the use of helicopter overflights, motorized vehicles, a temporary road, and installations (such as traps, temporary corrals, and fences) are permissible for the management of WHB if they are determined to be the minimum required to manage WH&B (BLM Manual 6340) . The Minimum Requirements Decision Guide (MRDG – Appendix P) identifies the use of helicopter overflights, motorized vehicles, a temporary road, and temporary installations for the trap site within wilderness as the minimum tools required to conduct the action alternatives.

The Wilderness Act defines untrammeled as a place where ecological systems are unhindered and free from intentional actions of modern human control or manipulation. In this case, the presence of WHB is the natural condition, as legislated by the Wild Free-Roaming Horses and Burros Act of 1971 (P.L. 92-195). The action alternatives would negatively impact the untrammeled quality of wilderness character because herding WHB within wilderness for capture is a trammeling activity, as it is a human manipulation of the natural processes or conditions that exist within the wilderness boundary.

Undeveloped in relation to wilderness is defined by being without structures or installations, the use of motorized vehicles, motorized equipment, or mechanical transport. The undeveloped quality of wilderness character would be negatively impacted from the use of motorized vehicles and trailers along a temporary road and the installation and use of a temporary trapsite within wilderness. For motorized transport to occur by aircraft within wilderness, a landing would have to occur. A landing is defined by 43 CFR 6302.20(e) as "dropping or picking up any material, supplies, or person by means of aircraft; it does not include overflights" (BLM Manual 6340). Because no helicopter landings would occur within the wilderness boundary, there would be no impacts to the undeveloped quality of wilderness character from the use of helicopters.

Opportunities for solitude or primitive and unconfined recreation would be impacted during the gather operation from the presence and use of helicopter, semitruck, stock trailer, temporary road, and the installation of a trap site within wilderness. Visitors to the wilderness that witness WH&B gather activities may be affected by the presence and noise of the aircraft in low overflight and their related exposure to the sights and sounds of motorized vehicles and temporary installations. The entirety of the wilderness areas would not be negatively impacted as the action is ephemeral by nature, though this quality of wilderness character would be impacted for the duration of gather and monitoring operations where the presence of helicopters, motorized transport, and temporary installations are prevalent.

The natural quality of wilderness character is negatively impacted by the excess population of WHB above AML due to WHB populations competing with native wildlife for forage utilization, trampling native vegetation, and trampling watersheds and riparian areas impacting the natural hydrology. The goals of the action alternatives are to manage the WHB population at the AML. The AMLs are mandated for management to "ensure that the herd population does not exceed the productive capacity of the habitat, as determined by the best available science and monitoring activities, in order to maintain a thriving natural ecological balance and prevent degradation of wilderness character, watershed function, and ecological processes" (BLM manual 6340). By removing the excess WHB the natural quality of wilderness character may be preserved and enhanced by reducing the degradation due to excess animals within the wilderness. Removing the excess WHB may reduce or eliminate the impact of excess animals competing with native wildlife for forage utilization, excess trampling of native vegetation and reduce trampling watersheds and other riparian areas within the wilderness areas.

Impacts of Alternative 4 (No Action)
Under the No Action Alternative, no excess WHB would be removed from the wilderness areas. The excess population of WHB above AML would negatively impact the natural quality of wilderness character by WHB competing with native wildlife for forage utilization, trampling native vegetation, and trampling watersheds and riparian areas impacting the natural hydrology. The natural quality of wilderness character would not be preserved or enhanced from the No Action Alternative. The opportunity for solitude and primitive recreation, undeveloped, and untrammeled qualities of wilderness character would not be affected under the No Action Alternative.

Cumulative Effects
By removing excess wild horses as described in Alternatives 1, 2, and 3, cumulative impacts to wilderness are expected to benefit the natural character and would not have long term negative impact on the other wilderness character nor would it combine with any other reasonably foreseeable future actions to negatively impact long term wilderness character.

Implementation of Alternative 4 would result in the further degradation of riparian/wetland sites and the natural character of wilderness. Cumulative impacts to wilderness under Alternative 4 are expected to have a long term negative impact on the natural character of wilderness but not have a long term negative impact on the other wilderness characters.

4.2.9 Wilderness Study Areas

BLM Manual 6330—Management of BLM Wilderness Study Areas Guidlelines for Wildhorse and Burro management

Protect or enhance wilderness characteristics or values, as described in section 1.6.A.2 of BLM manual 6330, and Section 2(c) of the Wilderness Act of 1964 outlines the characteristics required of every wilderness. Actions that clearly benefit a WSA by protecting or enhancing these characteristics are allowable even if they are impairing, though they must still be carried out in the manner that is least disturbing to the site.

Wildhorses and burros are managed to remain in balance with the productive capacity of the habitat; this includes managing herds so as not to impair wilderness characteristics. Wildhorse and burro populations must be managed at appropriate management levels so as to not exceed the productive capacity of the habitat (as determined by available science and monitoring activities), to ensure a thriving natural ecological balance, and to prevent impairment of wilderness characteristics, watershed function, and ecological processes.

Temporary traps may be located within WSAs for the effective removal of animals in excess of the appropriate management level. Traps must be situated to minimize impacts to vegetation and soils. Vehicles necessary for set-up and take-down of traps and for transporting excess wildhorses and burros away from the area may be driven off of existing primitive routes or boundary roads on a route specified through the NEPA analysis. At the completion of the gather, all facilities must be removed, the route used for trap access closed to motor vehicles until it is restored to the original condition, and any new access route and trap area rehabilitated so that the route is no longer visible to subsequent motor vehicle operators.

Impacts Common to Action Alternatives 1, 2, and 3

The proposed action and alternatives would on a temporary short term basis negatively impact WSA values during gather activities, and throughout the indefinite duration of this proposal. The alternatives would impact visitors to the WSA as a result of the presence and noise of the helicopter, diesel trucks, other vehicles, staff personel, and spectators for the duration of the gather. The alternatives are aimed at the removal of excess WHBs to reduce their population to the low level AML in the Massacre Rim WSA(CA-020-1013), and to remove all horses in the Wall Canyon WSA(CA-020-805), as this area does not have an HMA. Managing the WHB population to appropriate AML will be a positive long term benefit to the natural character of the wilderness study areas; as it is expected to result in a healthy herd level and reduce negative impacts to the landscape from high numbers of WHBs. Excess WHBs compete with native populations of wildlife, overgraze riparian areas, and trample and denude native vegetation near springs and other water sources. Watchable wildlife values in the WSAs would be enhanced with fewer WHBs, although WHB enthusists would have a minor negative impact for WHB watching with fewer animals in the HMAs. Motorized vehicles would use the trails, roads, and ways within the WSAs, which would result in higher use than normal, which in turn could cause some erosion and impacts from excess dust. There would be moderate impacts to the WSAs at trap sites, from surface disturbing activities which would be limited to trampled vegetation and soils where diesel trucks/horse trailers would turn around. Trampled vegetation and soils would also occur at the wings and trap site from the horses and burros. There would be no landing of aircraft within the WSA, except for emergency situations, therefore no impacts from aircraft except for noise and presence. There would be temporary impacts to visual resources and the WSA recreation experience at the trap sites and surrounding area, due to the metal fence posts and jute fenceing, which would be removed once the AML is reached. The undeveloped character of the wilderness study areas would have temporary impacts, but no long term negative impacts once the gather activities are complete.

New trap sites in the Massacre Rim WSA

Both the Preferred trap site (Trap site #1) and the Alternative (Trap site #2) are located on the east slope of the Massacre Rim WSA on two track roads. The same impacts common to Alternatives 1,2,&3 would also occur on the new trap sites. Although, the new Trap sites would have additional impacts from the construction of the new temporary facilities, widening of the roads, turn arounds, and equipment parking areas. Each Trap site would occupy approximately 10 total acres of landscape. The wings would be linear features constructed of metal fence posts and jute netting. The wings would extend out further than the trap site itself and have the least temporary impact to the recreation WSA experience due to the low profile and jute netting, as well as the lack of people and equipment. The temporary facilities, widening of the roads, turn arounds, and equipment parking areas would occupy approximately1-2 acres and would result in moderate direct, short-term negative impacts to the WSA experience within the Massacre WSA for the duration of the gathering activities.

Overall the removal of excess wild horses from the WSAs would result in long term benefits to the natural type character of the landscape, by reducing the damage to native plant communities and water sources from overgrazing and excessive trampling. Watchable wildlife and hunting activities would have moderate benefits long term. The WSA guidelines in Manual 6330 allows for new disturbance if that action would provide long term benefits to the WSA.

Impacts of Alternative 4 (No Action)
The No Action Alternative would have no direct impacts from gather operations. However, the WSA experience would contintue to deteriorate from excess wildhorses and burros and have greater negative impacts overtime with higher numbers of WHBs. There would be no new impacts from construction of new facilitities or surface disturbance from the new proposed Preferred and Alternative Trap sites in the Massacre Rim WSA.

Cumulative Effects
Past recreation activities have had minor short term effects from unauthorized roads, campsites, and off-road driving. Wild horse and burro gathers have had short term impacts from vehicles, equipment, and trap locations. This area has not had a wildhorse and burro gather for 30 years, which has allowed the natural character of the landscape to be negitavely compromised and continue to decline over the years from excess WHB numbers on the landscape. The highest level of deterioration is around springs, other water sources and upland vegetation. By removing excess wildhorses and burros as described in Alternatives 1, 2, and 3, cumulative impacts to wilderness study areas are expected to benefit all values long-term, but would have short term temporary impacts to the WSA experience during the gather phase from vehicles, helicopers, noise and temporary facilities. With the removal of excess wild horses and burros, long term positive benefits would occur to the natural character of the landscape. This would not combine with any other reasonably foreseeable future actions to negatively impact long term wilderness characters that contribute to WSA status. There would be temporary and short term direct impacts from construction of new facilitities and surface disturbance from the new proposed Preferred and Alternative Trap sites in the Massacre Rim WSA. There would be an additional 20 acres of new disturbance within the Massacre Rim WSA, although these two small areas (20 acres total) would re-vegetate between gather

activities, and are insignificant within the 101,290 acres of the WSA. One of the trap sites is on a two track road, and the other is at the end of a two track road which would help to reduce the overall footprint of disturbance.

Alternative 4 would result in the further degradation of riparian/wetland sites and the natural character of the wilderness study areas. Cumulative impacts to the WSAs under Alternative 4 are expected to have long term continuing negative impacts on the natural character of the landscape. This would affect hunting and watchable wildlife values due to the continuing decline of the vegetation and water sources from the excessive use by WHBs.

5.0 Consultation and Coordination

The BLM began tribal consultation efforts related to the Surprise Complex Gather in early 2020 with numerous in-person, regularly scheduled consultation meetings. Additional scoping and ePlanning efforts are anticipated as the EA will be made available to the public. On September 14, 2020, the following tribes were invited to consult on the Surprise Complex Gather via formal letter: Alturas Rancheria, Cedarville Indian Rancheria, Klamath Tribes, Fort Bidwell Tribe, Modoc Nation, Pit River Tribe, Reno-Sparks Indian Colony, Summit Lake Tribe, and Susanville Indian Rancheria. Each Tribe was invited to respond within 30 days of receiving the letter if they wished to consult on the undertaking further; to date, no replies related to the consultation letter request have been received. Specific consultation efforts with specific Tribes have occurred either in-person, via email, and/or via Zoom call as requested on the following dates:

- Susanville Indian Rancheria: 01/28/2020 (in-person meeting) and 07/29/2020 (conference call); Comments made during meetings indicate that SIR supports horse gathers, such as the Surprise Complex Gather and the Tribe feels that because the horses are non-native and damage cultural resources and riparian areas the horses should be gathered. No other more gather-specific comments were received.

- The Pit River Tribe: 02/06/2020 (in-person meeting) and 07/28/2020 (Zoom call); The Tribe wants to be informed and involved in all gathers, and is supportive of BLM gathers and reducing the number of wild horse and burro currently on public lands in a broad sense. No other gather-specific comments were received.

None of the tribes identified any Traditional Cultural Properties (TCPs), sacred sites, cultural, archaeological, or other associated issues or concerns related to proposed trap sites or other associated gather

6.0 List of Preparers

The following list identifies the interdisciplinary team member's area of responsibility:

Name	Title
Amanda Gearhart	Wild Horse and Burro Specialist
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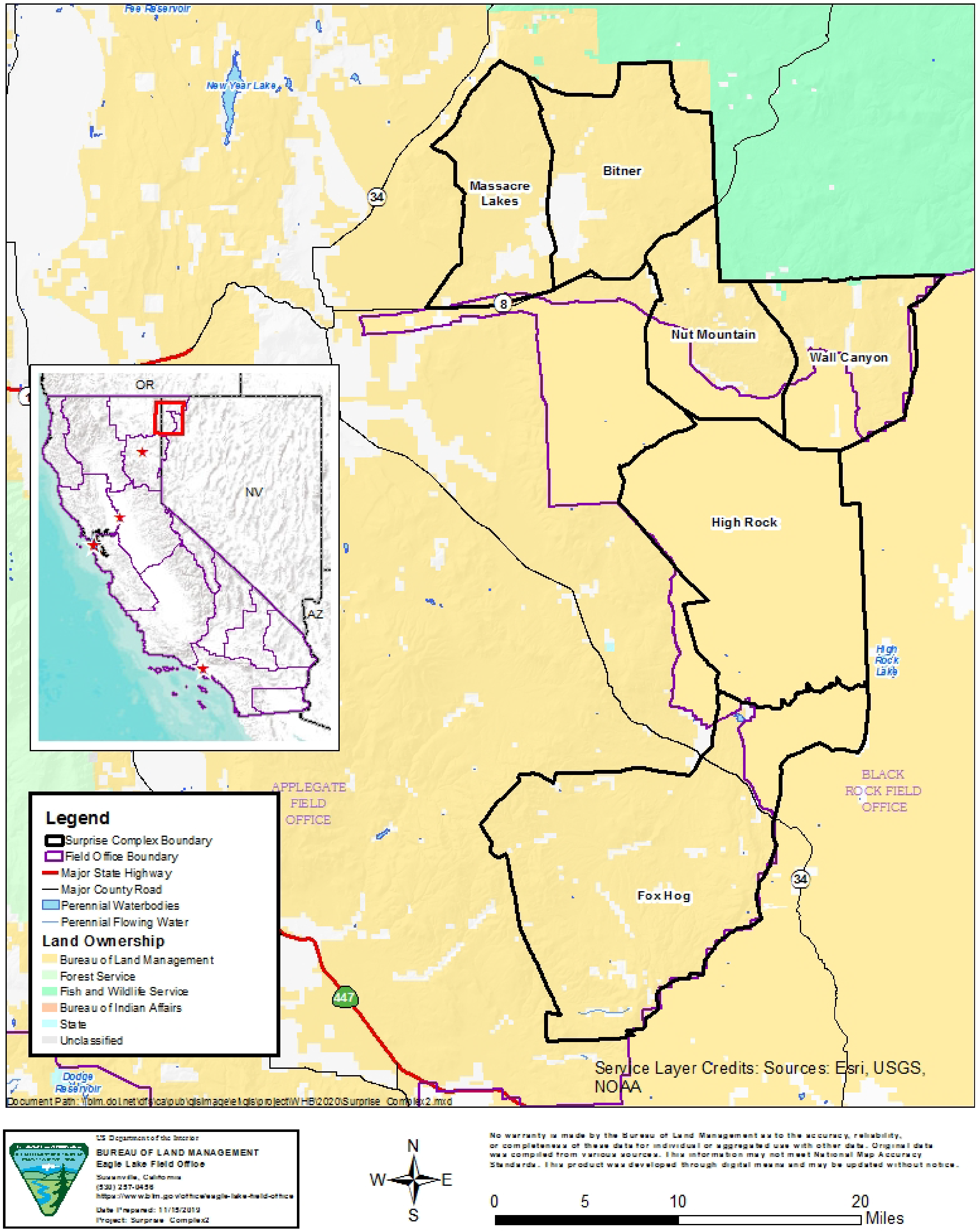
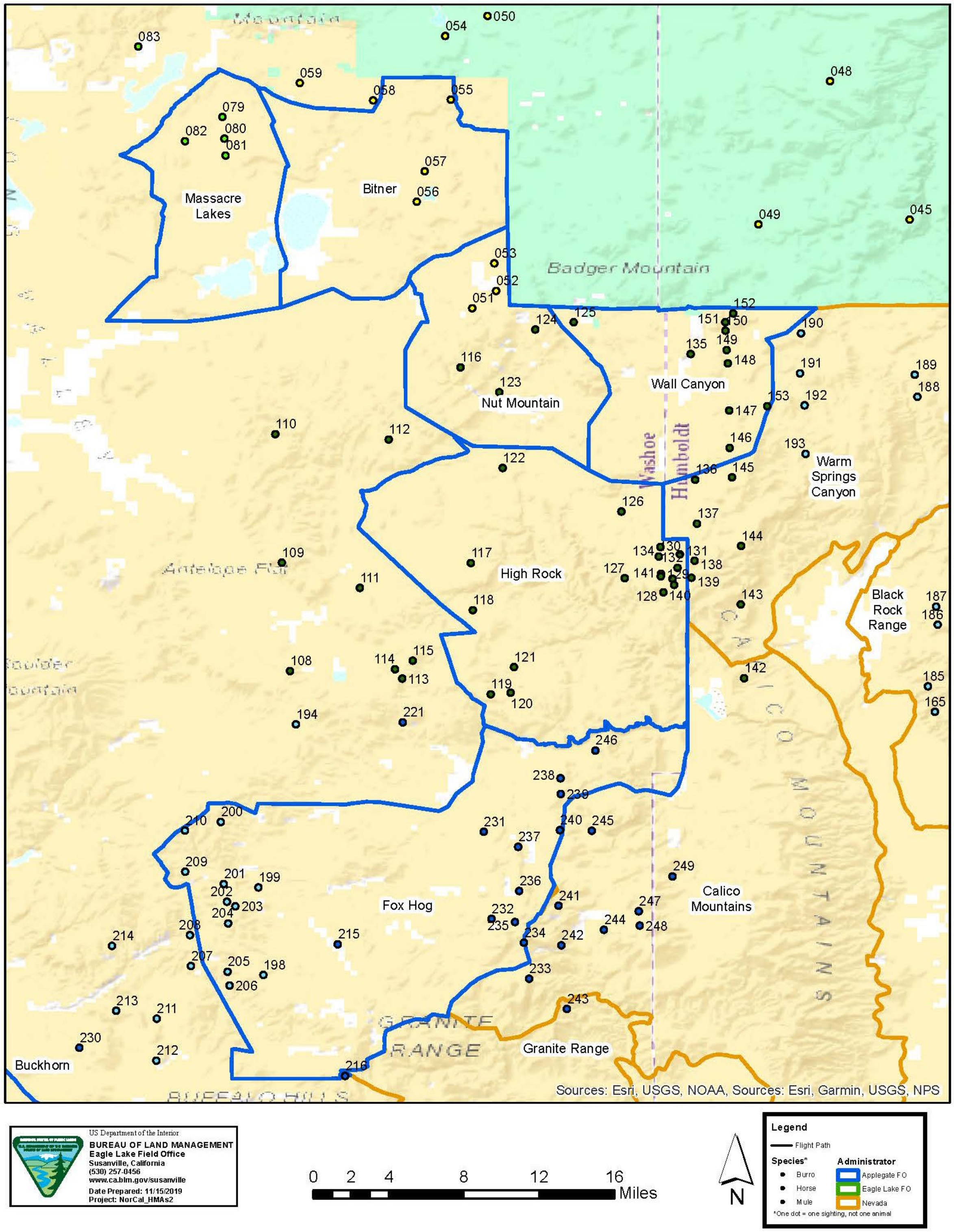
Appendix A. Map of Surprise Complex: Massacre Lakes, Bitner, Nut Mountain, Wall Canyon, High Rock, and Fox Hog Herd Management Areas



Appendix B. Map of Animal Group Sightings On-HMA and Off-HMA from 2019 Aerial Survey



Appendix C. 43 CFR § 4700 Applicable Regulations

The Proposed Action is in conformance with the *Wild Free-Roaming Horses and Burros Act of 1971* (as amended), applicable regulations at 43 CFR § 4700, and BLM policies. Included are:

43 CFR § 4710.4 Constraints on Management: Management of wild horses and burros shall be undertaken with the objective of limiting the animals' distribution to herd areas. Management shall be at the minimum feasible level necessary to attain the objectives identified in approved land use plans and herd management area plans.

43 CFR § 4720.1 Removal of excess animals from public lands: Upon examination of current information and a determination by the authorized officer that an excess of wild horses or burros exists, the authorized officer shall remove the excess animals immediately.

43 CFR § 4740.1 Use of motor vehicles or aircraft:

a) Motor vehicles and aircraft may be used by the authorized officer in all phases of the administration of the Act, except that no motor vehicle or aircraft, other than helicopters, shall be used for the purpose of herding or chasing wild horses or burros for capture or destruction. All such use shall be conducted in a humane manner.

b) Before using helicopters or motor vehicles in the management of wild horses or burros, the authorized officer shall conduct a public hearing in the area where such use is to be made.

The Proposed Action is also in conformance with the *Interim Management Policy for Lands under Wilderness Review*, BLM H-8550-1, (July 1995b), Chapter IIIE, Wild Horse and Burro Management, and with other BLM decisions for management of multiple use resources on public lands within this area.

Environmental Assessments, other BLM Documents

The following documents contain information from prior NEPA analyses to which this EA is tiered, and BLM decisions related to land health assessments, livestock grazing, wild horses, and other resources within the Surprise Complex:

1. BLM Environmental Assessment, DOI-BLM-CA-N070-2013-0007-EA, *Massacre Lakes Permit Renewal* (2013)
2. BLM Revised Environmental Assessment # DOI-BLM-CAN070-2009-06. *Notice of Field Manager's Final Decision, Grazing Permit Issuance for the Nut Mountain Allotment*, 2009.
3. BLM Environmental Impact Statement, DOI-BLM-CA-N020-0002-RMP-EIS, *Surprise Resource Management Plan and Record of Decision,* 2008.
4. BLM Environmental Assessment # CA-370-06-16. *The Gather and Removal of Wild Horses from the High Rock Herd Management Area*, August, 2006.
5. BLM Environmental Assessment # CA370-06-02. *Proposal to Construct Wildlife Water Developments in the East Fork High Rock Canyon Wilderness Area within the*

Black Rock-High Rock Emigrant Trails NCA, June, 2006.

6. BLM Environmental Assessment # CA-370-05-28. *Capture Plan for the Wall Canyon, Nut Mountain and Bitner Wild Horse Herd Management Areas*, September 2005.
7. BLM Environmental Assessment # CA-370-03-26. *Fox-Hog Wild Horse Herd Management Area Capture Plan*, May 2004.
8. BLM Environmental Impact Statement, DOI-BLM-NV-W030-2018-0022-RMP-EIS, *Black Rock-High Rock NCA Resource Management Plan of 2004*, 2004.
9. BLM Environmental Assessment # CA-370-01-07. *Gathering of Wild Horses in the High Rock HMA, Decision and Little High Rock AML Establishment/Capture Plan*, June 2001.
10. BLM Environmental Assessment # CA-370-00-1. *Helicopter Capture Plan for Wild Horses in the High Rock, Nut Mountain and Wall Canyon Herd Management Areas*, July 2000.
11. BLM Environmental Assessment, CA-370-2001-03, *Environmental Assessment for Livestock, Grazing Authorization and Grazing Plan Revision: Wall Canyon East Allotment Actions to Meet Rangeland Health Standards*, 2000.
12. BLM Environmental Assessment # CA-370-99-08. *Bare Allotment and Fox Hog Wild Horse HMA: Livestock Carrying Capacity and Grazing Strategy, Wild Horse Appropriate Management Level*, April 1999.
13. BLM Environmental Assessment # CA-370-98-05. *Bitner Management Plan Revision*, 1998.
14. BLM Environmental Assessment, BLM-CA-028-96-02, *Cowhead/Massacre Management Framework Plan Amendment: Massacre Mountain Allotment Class of Livestock*, 1996.
15. BLM Environmental Assessment # CA-028-93-03. *Wild Horse Gathering and Removal: Bitner, High Rock, Nut Mountain, and Wall Canyon Herd Management Areas*, June 1993.
16. BLM High Rock Herd Management Area Plan, CA-264, 1989.
17. BLM Wall Canyon Herd Management Area Plan, CA-265, 1989.
18. BLM Fox Hog Herd Management Area Plan, CA-263, 1989.
19. BLM Nut Mountain Herd Management Area Plan, CA-266, 1989.
20. BLM Bitner Herd Management Area Plan, CA-267, 1989.
21. BLM Land Use Plan, Cowhead-Massacre Management Framework Plan, July 1983.
22. BLM Land Use Plan, Tuledad/Homecamp Management Framework Plan, July 1977.

Appendix D. Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers SOPs

In 2015 (IM2015-151), BLM initiated a comprehensive animal welfare program (CAWP) which updated WH&B gather SOPs to formalize the standards, training and monitoring for conducting safe, efficient and successful WH&B gather operations while ensuring humane care and handling of animals gathered. These standards include requirements for trap and temporary holding facility design; capture and handling; transportation; and appropriate care after capture. The standards have been incorporated into helicopter gather contracts as specifications for performance. It includes a requirement that all Incident Commanders (IC), Lead Contracting Officer Representatives (LCOR), Contracting Officer Representatives (COR), Project Inspectors (PI), and contractors must complete a mandatory training course covering all aspects of the CAWP prior to gathers. The goal is to ensure that the responsibility for humane care and treatment of WH&Bs remains a high priority for the BLM and its contractors at all times. The BLM's objective is to use the best available science, husbandry and handling practices applicable for WH&Bs and to make improvements whenever possible, while also meeting our overall gather goals and objectives in accordance with current BLM policy, SOPs and contract requirements.

Gathers would be conducted by utilizing contractors from the Wild Horse Gathers-Western States Contract, or BLM personnel. The following procedures for gathering and handling wild horses would apply whether a contractor or BLM personnel conduct a gather. For helicopter gathers conducted by BLM personnel, gather operations will be conducted in conformance with the *Wild Horse Aviation Management Handbook* (January 2009).

Prior to any gathering operation, the BLM will provide a pre-gather evaluation of existing conditions in the gather area(s). The evaluation will include animal conditions, prevailing temperatures, drought conditions, soil conditions, road conditions, and a topographic map with wilderness boundaries, the location of fences, other physical barriers, and acceptable trap locations in relation to animal distribution. The evaluation will determine whether the proposed activities will necessitate the presence of a veterinarian during operations. If it is determined that a large number of animals may need to be euthanized or gather operations could be facilitated by a veterinarian, these services would be arranged before the gather would proceed. The contractor will be apprised of all conditions and will be given instructions regarding the gather and handling of animals to ensure their health and welfare is protected.

Trap sites and temporary holding sites will be located to reduce the likelihood of injury and stress to the animals, and to minimize potential damage to the natural resources of the area. These sites would be located on or near existing roads whenever possible.

The primary gather methods used in the performance of gather operations include:
1. Helicopter Drive Trapping. This gather method involves utilizing a helicopter to herd wild horses into a temporary trap.

2. Helicopter Assisted Roping. This gather method involves utilizing a helicopter to herd wild horses or burros to ropers.

3. Bait Trapping. This gather method involves utilizing bait (e.g., water or feed) to lure wild horses into a temporary trap.

The following procedures and stipulations will be followed to ensure the welfare, safety and humane treatment of wild horses in accordance with the provisions of 43 CFR 4700.

Helicopter Gather Methods used in the Performance of Gather Contract Operations

The primary concern of the contractor is the safe and humane handling of all animals gathered.

All gather attempts shall incorporate the following:

1. All trap and holding facilities locations must be approved by the Contracting Officer's Representative (COR) and/or the Project Inspector (PI) prior to construction. All trap and holding facilities locations must be approved by the LCOR/COR/PI prior to construction. The Contractor may also be required to change or move trap locations as determined by the LCOR/COR/PI. LCOR/COR/PI will determine when capture objectives are met. All traps and holding facilities not located on public land must have prior written approval of the landowner that will be provided to the LCOR prior to use. Selection of all traps and holding sites will include consideration for public and media observation.

2. The rate of movement and distance the animals travel must not exceed limitations set by the LCOR/COR/PI who will consider terrain, physical barriers, access limitations, weather, condition of the animals, urgency of the operation (animals facing drought, starvation, fire, etc.) and other factors. The trap site shall be moved close to WH&B locations whenever possible to minimize the distance the animals need to travel.

3. All traps, wings, and holding facilities shall be constructed, maintained and operated to handle the animals in a safe and humane manner and be in accordance with the following:

a. When moving the animals from one pasture/allotment to another pasture/allotment, the fencing wire needs to be let down for a distance that is approved by the LCOR on either side of the gate or crossing.

b. If jute is hung on the fence posts of an existing wire fence in the trap wing, the wire should either be rolled up or let down for the entire length of the jute in such a way that minimizes the possibility of entanglement by WH&Bs unless otherwise approved by the LCOR/COR/PI. No modification of existing fences will be made without authorization from the LCOR/COR/PI. The Contractor shall be responsible for restoration of any fence modification which they have made.

c. Building a trail using domestic horses through the fence line, crossing or gate may be necessary to avoid animals hitting the fence.

d. The trap site and temporary holding facility must be constructed of stout materials and must be maintained in proper working condition. Traps and holding facilities shall be constructed of portable panels, the top of which shall not be less than 72 inches high for horses and 60 inches for burros, and the bottom rail of which shall not be more than 12 inches from ground level. All traps and holding facilities shall be oval or round in design with rounded corners.

e. All portable loading chute sides shall be a minimum of 6 feet high and shall be fully covered on the sides with plywood, or metal without holes.

f. All alleyways that lead to the fly chute or sorting area shall be a minimum of 30 feet long and a minimum of 6 feet high for horses, and 5 feet high for burros and the bottom rail must not be more than 12 inches from ground level. All gates and panels in the animal holding and handling pens and alleys of the trap site must be covered with plywood, burlap, plastic snow fence or like material approximately 48” in height to provide a visual barrier for the animals. All materials shall be secured in place. These guidelines apply:

i. For exterior fences, material covering panels and gates must extend from the top of the panel or gate toward the ground.
ii. For alleys and small internal handling pens, material covering panels and gates shall extend from no more than 12 inches below the top of the panel or gate toward the ground to facilitate visibility of animals and the use of flags and paddles during sorting.
iii. The initial capture pen may be left uncovered as necessary to encourage animals to enter the first pen of the trap.
iv. Padding must be installed on the overhead bars of all gates used in single file ally.
v. An appropriate chute designed for restraining WH&B's must be available for necessary procedures at the temporary holding facility. The government furnished portable fly chute to restrain, age, or provide additional care for the animals shall be placed in the alleyway in a manner as instructed by or in concurrence with the LCOR/COR/PI.
vi. There must be no holes, gaps or openings, protruding surfaces, or sharp edges present in fence panels, latches, or other structures that may cause escape or possible injury.
vii. Hinged, self-latching gates must be used in all pens and alleys except for entry gates into the trap, which may be secured with tie ropes or chains.
viii. When dust conditions occur within or adjacent to the trap or holding facility, the Contractor shall be required to wet down the ground with water.

All animals gathered shall be sorted into holding pens as to age, size, temperament, sex, condition, and whether animals are identified for removal as excess or retained in the HMA. These holding pens shall be of sufficient size to minimize, to the extent possible, injury due to fighting and trampling as well as to allow animals to move easily and have adequate access to water and feed. All pens will be capable of expansion on request of the LCOR/COR/PI. Alternate pens, within the holding facility shall be furnished by the Contractor to separate mares or Jennies with small foals, sick and injured animals, and private animals from the other animals. Under normal conditions, the BLM will require that animals be restrained to determine an animal's age, sex, and ownership. In other situations restraint may be required to conduct other procedures such as veterinary treatments, restraint for fertility control vaccinations, castration, spaying, branding, blood draw, collection of hair samples for genetic testing, testing for equine diseases, application of GPS collars and radio tags. In these instances, a portable restraining chute may be necessary and will be provided by the government. Alternate pens shall be furnished by the Contractor to hold animals if the specific gathering requires that animals be released back into the capture area(s) following selective removal and/or population suppression treatments. In areas requiring one or more satellite traps, and where a centralized holding facility is utilized, the contractor may be required to provide additional holding pens to segregate animals transported from remote locations so they may be returned to their traditional ranges. Either segregation or temporary marking and later segregation will be at the discretion of the LCOR/COR/PI. The LCOR will determine if the corral size needs to be expanded due to horses staying longer, large.

FEEDING AND WATERING

a. Adult WH&Bs held in traps or temporary holding pens for longer than 12 hours must be fed every morning and evening and provided with drinking water at all times other than when animals are being sorted or worked.

b. Dependent foals must be reunited with their mares/jennies at the temporary holding facility within four hours of capture unless the LCOR/COR/PI authorizes a longer time or foals are old enough to be weaned. If a nursing foal is held in temporary holding pens for longer than 4 hours without their dams, it must be provided with water and good quality weed seed free hay.

c. Water must be provided at a minimum rate of 10 gallons per 1,000 pound animal per day, adjusted accordingly for larger or smaller horses, burros and foals, and environmental conditions, with each trough placed in a separate location of the pen (i.e. troughs at opposite ends of the pen) with a minimum of one trough per 30 horses. Water must be refilled at least every morning and evening when necessary.

d. Good quality weed seed free hay must be fed at a minimum rate of 20 pounds per 1,000 pound adult animal per day, adjusted accordingly for larger or smaller horses, burros and foals.

1. Hay must not contain poisonous weeds or toxic substances.
2. Hay placement must allow all WH&B's to eat simultaneously.

e. When water or feed deprivation conditions exist on the range prior to the gather, the LCOR/COR/PI shall adjust the watering and feeding arrangements in consultation with the onsite veterinarian as necessary to provide for the needs of the animals to avoid any toxicity concerns.

TRAP SITE

A dependent foal or weak/debilitated animal must be separated from other WH&Bs at the trap site to avoid injuries during transportation to the temporary holding facility. Separation of dependent foals from mares must not exceed four hours unless the LCOR/COR/PI authorizes a longer time or the decision is made to wean the foals.

TEMPORARY HOLDING FACILITY

a. All WH&B's in confinement must be observed at least twice daily during feeding time to identify sick or injured WH&Bs and ensure adequate food and water.

b. Non-ambulatory WH&B's must be located in a pen separate from the general population and must be examined by the LCOR/COR/PI and/or on-call or on-site veterinarian no more than 4 hours after recumbency (lying down) is observed. Unless otherwise directed by a veterinarian, hay and water must be accessible to an animal within six hours after recumbency.

c. Alternate pens must be made available for the following:

1. WH&Bs that are weak or debilitated
2. Mares/jennies with dependent foals
3. Aggressive WH&B's that could cause serious injury to other animals.

d. WH&B's in pens at the temporary holding facility shall be maintained at a proper stocking density such that when at rest all WH&B's occupy no more than half the pen area.

e. It is the responsibility of the Contractor to provide security to prevent loss, injury or death of captured animals until delivery to final destination.

f. It is the responsibility of the Contractor to provide for the safety of the animals and personnel working at the trap locations and temporary holding corrals in consultation with the LCOR/COR/PI. This responsibility will not be used to exclude or limit public and media observation as long as current BLM policies are followed.

g. The contractor will ensure that non-essential personnel and equipment are located as to minimize disturbance of WH&Bs. Trash, debris, and reflective or noisy objects shall be eliminated from the trap site and temporary holding facility.

h. The Contractor shall restrain sick or injured animals if treatment is necessary in consultation with the LCOR/COR/PI and/or onsite veterinarian. The LCOR/COR/PI and/or onsite veterinarian will determine if injured animals must be euthanized and provide for the euthanasia of such animals. The Contractor may be required to humanely euthanize animals in the field and to dispose of the carcasses as directed by the LCOR/COR/PI, at no additional cost to the Government.

i. Once the animal has been determined by the LCOR/COR/PI to be removed from the HMA/HA, animals shall be transported to final destination from temporary holding facilities within 48 hours after capture unless prior approval is granted by the LCOR/COR/PI. Animals to be released back into the HMA following gather operations will be held for a specified length of time as stated in the Task Order/SOW. The Contractor shall schedule shipments of animals to arrive at final destination between 7:00 a.m. and 4:00 p.m. unless prior approval has been obtained by the LCOR. No shipments shall be scheduled to arrive at final destination on Sunday and Federal holidays, unless prior approval has been obtained by the LCOR. Animals shall not be allowed to remain standing on gooseneck or semi-trailers while not in transport for a combined period of greater than three (3) hours. Total planned transportation time from the temporary holding to the BLM facility will not exceed 10 hours. Animals that are to be released back into the capture area may need to be transported back to the original trap site per direction of the LCOR.

CAPTURE METHODS THAT MAY BE USED IN THE PERFORMANCE OF A GATHER

Helicopter Drive Trapping

a. The helicopter must be operated using pressure and release methods to herd the animals in a desired direction and shall not repeatedly evoke erratic behavior in the WH&B's causing injury or exhaustion. Animals must not be pursued to a point of exhaustion; the on-site veterinarian must examine WH&B's for signs of exhaustion.

b. The rate of movement and distance the animals travel must not exceed limitations set by the LCOR/COR/PI who will consider terrain, physical barriers, access limitations, weather, condition of the animals, urgency of the operation (animals facing drought, starvation, fire, etc.) and other factors.

i. WH&B's that are weak or debilitated must be identified by BLM staff or the contractors. Appropriate gather and handling methods shall be used according to the direction of the LCOR/COR/PI as defined in this contract.

ii. The appropriate herding distance and rate of movement must be determined the LCOR/COR/PI on a case-by-case basis considering the weakest or smallest animal in the group (e.g., foals, pregnant mares, or horses that are weakened by body condition, age, or poor health) and the range and environmental conditions present.

iii. Rate of movement and distance travelled must not result in exhaustion at the trap site, unless the exhausted animals were already in a severely compromised condition prior to the gather. Where compromised animals cannot be left on the range or where doing so would only serve to prolong their suffering, the LCOR/COR/PI will determine if euthanasia will be performed in accordance with BLM policy.

c. WH&B's must not be pursued repeatedly by the helicopter such that the rate of movement and distance travelled exceeds the limitation set by the LCOR/COR/PI. Abandoning the pursuit or alternative capture methods may be considered by the LCOR/COR/PI in these cases.

d. The helicopter is prohibited from coming into physical contact with any WH&B regardless of whether the contact is accidental or deliberate.

e. WH&B's may escape or evade the gather site while being moved by the helicopter. If there are mare/dependent foal pairs in a group being brought to a trap and half of an identified pair is thought to have evaded capture, multiple attempts by helicopter may be used to bring the missing half of the pair to the trap or to facilitate capture by roping. In these instances, animal condition and fatigue will be evaluated by the LCOR/COR/PI or on-site veterinarian on a case-by-case basis to determine the number of attempts that can be made to capture an animal.

f. Horse captures must not be conducted when ambient temperature at the trap site is below 10ºF or above 95ºF without approval of the LCOR/COR/PI. Burro captures must not be conducted when ambient temperature is below 10ºF or above 100ºF without approval of the LCOR/COR/PI. The LCOR/COR/PI will not approve captures when the ambient temperature exceeds 105 ºF.

g. The contractor shall assure that dependent foals shall not be left behind. Any animals identified as such will be recovered as a priority in completing the gather.

h. Any adult horse or burro that cannot make it to the trap due to physical limitations shall be identified to the LCOR/COR/PI by the pilot or contractor immediately. An inspection of the animal will be made to determine the problem and the LCOR/COR/PI and/or veterinarian will decide if that animal needs to be humanely euthanized.

ROPING

a. The roping of any WH&B must be approved by the LCOR/COR/PI prior to the action.

b. The roping of any WH&B will be documented by the LCOR/COR/PI along with the circumstances. WH&Bs may be roped under circumstances which include but are not limited to the following: reunite a mare or jenny and her dependent foal; capture nuisance, injured or sick WH&Bs or those that require euthanasia; environmental reasons such as deep snow or traps that cannot be set up due to location or environmental sensitivity; and public and animal safety or legal mandates for removal.

c. Ropers should dally the rope to their saddle horn such that animals can gradually be brought to a stop and must not tie the rope hard and fast to the saddle, which can cause the animals to be jerked off their feet.

d. WH&Bs that are roped and tied down in recumbency must be continuously observed and monitored by an attendant at a maximum of 100 feet from the animal.

e. WH&Bs that are roped and tied down in recumbency must be untied within 30 minutes.

f. If the animal is tied down within the wings of the trap, helicopter drive trapping within the wings will cease until the tied-down animal is removed.

g. Sleds, slide boards, or slip sheets must be placed underneath the animal's body to move and/or load recumbent WH&Bs.

h. Halters and ropes tied to a WH&B may be used to roll, turn, and position or load a recumbent animal, but a WH&B must not be dragged across the ground by a halter or rope attached to its body while in a recumbent position.

i. All animals captured by roping must be marked at the trap site by the contractor for evaluation by the on-site/on-call veterinarian within four hours after capture, and re-evaluation periodically as deemed necessary by the on-site/on-call veterinarian.

HANDLING

Willful Acts of Abuse
The following are prohibited:
a. Hitting, kicking, striking, or beating any WH&B in an abusive manner.

b. Dragging a recumbent WH&B across the ground without a sled, slide board or slip sheet. Ropes used for moving the recumbent animal must be attached to the sled, slide board or slip sheet unless being loaded as specified in Section C 9.2.h

c. Deliberate driving of WH&Bs into other animals, closed gates, panels, or other equipment.

d. Deliberate slamming of gates and doors on WH&Bs.

e. Excessive noise (e.g., constant yelling) or sudden activity causing WH&Bs to become unnecessarily flighty, disturbed or agitated.

General Handling
a. All sorting, loading or unloading of WH&Bs during gathers must be performed during daylight hours except when unforeseen circumstances develop and the LCOR/COR/PI approves the use of supplemental light.

b. WH&Bs should be handled to enter runways or chutes in a forward direction.

c. WH&Bs should not remain in single-file alleyways, runways, or chutes longer than 30 minutes.

d. With the exception of helicopters, equipment should be operated in a manner to minimize flighty behavior and injury to WH&Bs.

Handling Aids
a. Handling aids such as flags and shaker paddles are the primary tools for driving and moving WH&Bs during handling and transport procedures. Contact of the flag or paddle end with a WH&B is allowed.

Ropes looped around the hindquarters may be used from horseback or on foot to assist in moving an animal forward or during loading.

b. Routine use of electric prods as a driving aid or handling tool is prohibited. Electric prods may be used in limited circumstances only if the following guidelines are followed:

1. Electric prods must only be a commercially available make and model that uses DC battery power and batteries should be fully charged at all times.
2. The electric prod device must never be disguised or concealed.
3. Electric prods must only be used after three attempts using other handling aids (flag, shaker paddle, voice or body position) have been tried unsuccessfully to move the WH&Bs.
4. Electric prods must only be picked up when intended to deliver a stimulus; these devices must not be constantly carried by the handlers.
5. Space in front of an animal must be available to move the WH&B forward prior to application of the electric prod. 000230 Antelope and Triple B Complexes Gather Plan EA
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6. Electric prods must never be applied to the face, genitals, anus, or underside of the tail of a WH&B.
7. Electric prods must not be applied to any one WH&B more than three times during a procedure (e.g., sorting, loading) except in extreme cases with approval of the LCOR/COR/PI. Each exception must be approved at the time by the LCOR/COR/PI.
8. Any electric prod use that may be necessary must be documented daily by the LCOR/COR/PI including time of day, circumstances, handler, location (trap site or temporary holding facility), and any injuries (to WH&B or human)

MOTORIZED EQUIPMENT

Loading and Unloading Areas

a. Facilities in areas for loading and unloading WH&B's at the trap site or temporary holding facility must be maintained in a safe and proper working condition, including gates that swing freely and latch or tie easily.

b. The side panels of the loading chute must be a minimum of 6 feet high and fully covered with materials such as plywood or metal without holes that may cause injury.

c. There must be no holes, gaps or openings, protruding surfaces, or sharp edges present in fence panels or other structures that may cause escape or possible injury.

d. All gates and doors must open and close properly and latch securely.

e. Loading and unloading ramps must have a non-slip surface and be maintained in a safe and proper working condition to prevent slips and falls**.** Examples of non-slip flooring would include, but not be limited to, rubber mats, sand, shavings, and steel reinforcement rods built into ramp. There must be no holes in the flooring or items that can cause an animal to trip.

f. Trailers must be properly aligned with loading and unloading chutes and panels such that no gaps exist between the chute/panel and floor or sides of the trailer creating a situation where a WH&B could injure itself.

g. Stock trailers shall be positioned for loading or unloading such that there is no more than 12" clearance between the ground and floor of the trailer for burros and 18" for horses. . If animals refuse to load, it may be necessary to dig a tire track hole where the trailer level is closer to ground level.

TRANSPORTATION

A. General
1. All sorting, loading, or unloading of WH&Bs during gathers must be performed during daylight hours except when unforeseen circumstances develop and the LCOR/COR/PI approves the use of supplemental light.

2. WH&Bs identified for removal should be shipped from the temporary holding facility to a BLM facility within 48 hours.

3. Shipping delays for animals that are being held for release to range or potential on-site adoption must be approved by the LCOR/COR/PI.

4. Shipping should occur in the following order of priority; 1) debilitated animals, 2) pairs, 3) weanlings, 4) dry mares and 5) studs.

5. Total planned transport time to the BLM preparation facility from the trap site or temporary holding facility must not exceed 10 hours.

6. WH&Bs should not wait in stock trailers and/or semi-trailers at a standstill for more than a combined period of three hours during the entire journey.

B. Vehicles
1. All motorized equipment employed in the transportation of captured animals shall be in compliance with appropriate State and Federal laws and regulations applicable to the humane transportation of animals. The Contractor shall provide the CO annually, with a current safety inspection (less than one year old) for all motorized equipment and tractor-trailers used to transport animals to final destination.

2. Only tractor-trailers or stock trailers with a covered top or overhead bars shall be allowed for transporting animals from trap site(s) to temporary holding facilities, and from temporary holding facilities to final destination(s). Sides or stock racks of all trailers used for transporting animals shall be a minimum height of 6 feet 6 inches from the floor. Single deck tractor-trailers 40 feet or longer shall have two (2) partition gates providing three (3) compartments within the trailer to separate animals. Tractor-trailers less than 40 feet shall have at least one partition gate providing two (2) compartments within the trailer to separate the animals. Compartments in all tractor-trailers shall be of equal size plus or minus 10 percent. Each partition shall be a minimum of 6 feet high and shall have a minimum 5 foot wide swinging gate. The use of double deck tractor-trailers is prohibited. Only straight deck trailers and stock trailers are to be used for transporting WH&B's.

3. WH&B's must have adequate headroom during loading and unloading and must be able to maintain a normal posture with all four feet on the floor during transport without contacting the roof or overhead bars.

4. The width and height of all gates and doors must allow WH&B's to move through freely.

5. All gates and doors must open and close easily and be able to be secured in a closed position.

6. The rear door(s) of stock trailers must be capable of opening the full width of the trailer.

7. Loading and unloading ramps must have a non-slip surface and be maintained in proper working condition to prevent slips and falls.

8. All partitions and panels inside of trailers must be free of sharp edges or holes that could cause injury to WH&B's.

9. The inner lining of all trailers must be strong enough to withstand failure by kicking that would lead to injuries.

10. Partition gates in transport vehicles shall be used to distribute the load into compartments during travel.

11. Surfaces and floors of trailers must be cleaned of dirt, manure and other organic matter prior to the beginning of a gather.

12. Surfaces and floors of trailers shall have non-slip surface, use of shavings, dirt, and floor mates.

C. Care of WH&B's during Transport Procedures

1. WH&B's that are loaded and transported from the temporary holding facility to the BLM preparation facility must be fit to endure travel per direction of LCOR/COR/PI following consultation with on-site/on-call veterinarian.

2. WH&B's that are non-ambulatory, blind in both eyes, or severely injured must not be loaded and shipped unless it is to receive immediate veterinary care or euthanasia.

3. WH&B's that are weak or debilitated must not be transported without approval of the LCOR/COR/PI in consultation with the on-site veterinarian. Appropriate actions for their care during transport must be taken according to direction of the LCOR/COR/PI.

4. WH&B's shall be sorted prior to transport to ensure compatibility and minimize aggressive behavior that may cause injury.

5. Trailers must be loaded using the minimum space allowance in all compartments as follows:

a. For a 6.8 foot wide; 24 foot long stock trailer 12 to 14 adult horses
b. For a 6.8 foot wide; 24 foot long stock trailer 18 to 21 adult burros
c. For a 6.8 foot wide; 20 foot long stock trailer 10 to 12 adult horses can be loaded
d. For a 6.8 foot wide; 20 foot long stock trailer 15 to 18 adult burros

For a semi-trailer:
a. 12 square feet per adult horse.
bi. 6.0 square feet per dependent horse foal.

c. 8.0 square feet per adult burro.
d. 4.0 square feet per dependent burro foal

6. Considering the condition of the animals, prevailing weather, travel distance and other factors or if animals are going down on trailers or arriving at their destination down or with injuries or a condition suggesting they may have been down, additional space or footing provisions may be necessary and will be required if directed by the LCOR/COR.

7. The LCOR/COR/PI, in consultation with the receiving Facility Manager, must document any WH&B that is recumbent or dead upon arrival at the destination. Non-ambulatory or recumbent WH&B's must be evaluated on the trailer and either euthanized or removed from the trailers using a sled, slide board or slip sheet.

8. Saddle horses must not be transported in the same compartment with WH&B's.

EUTHANASIA or DEATH

Euthanasia Procedure during Gather Operations
1. An authorized, properly trained, and experienced person as well as a firearm appropriate for the circumstances must be available at all times during gather operations. When the travel time between the trap site and temporary holding facility exceeds one hour or if radio or cellular communication is not reliable, provisions for euthanasia must be in place at both the trap site and temporary holding facility during the gather operation.

2. Euthanasia must be performed according to American Veterinary Medical Association euthanasia guidelines (2013) using methods of gunshot or injection of an approved euthanasia agent.

3. The decision to euthanize and method of euthanasia must be directed by the LCOR/COR/PI who must be on site and may consult with the on-site/on-call veterinarian. In event and rare circumstance that the LCOR/COR/PI is not available, the contractor if properly trained may euthanize an animal as an act of mercy.

4. All carcasses will be disposed of in accordance with state and local laws and as directed by the LCORCOR/PI.

5. Carcasses left on the range should not be placed in washes or riparian areas where future runoff may carry debris into ponds or waterways. Trenches or holes for buried animals should be dug so the bottom of the hole is at least 6 feet above the water table and 4-6 feet of level earth covers the top of the carcass with additional dirt mounded on top where possible.

COMMUNICATIONS
a. The Contractor shall have the means to communicate with the LCOR/COR/PI and all contractor personnel engaged in the capture of wild horses and burros utilizing a VHF/FM Transceiver or VHF/FM portable Two-Way radio.

b. The Contractor shall obtain the necessary FCC licenses for the radio system.

SAFETY AND SECURITY

a. All accidents involving animals or people that occur during the performance of any task order shall be immediately reported to the LCOR/COR/PI.

b. It is the responsibility of the Contractor to provide security to prevent unauthorized release, injury or death of captured animals until delivery to final destination.

c. The contractor must comply with all applicable federal, state and local regulations.

d. Fueling operations shall not take place within 1,000 feet of animals or personnel and equipment other than the refueling truck and equipment.

e. Children under the age of 12 shall not be allowed within the gather's working areas which include near the chute when working animals at the temporary holding facility, or near the pens at the trap site when working and loading of animals. Children under the age of 12 in the non-working area must be accompanied by an adult at either location at all times.

BIOSECURITY

A. Health records for all saddle and pilot horses used on WH&B gathers must be provided to the LCOR during the BLM/Contractor pre-work meeting, including:

1. Certificate of Veterinary Inspection (Health Certificate, within 30 days).
2. Proof of:
    a. A negative test for equine infectious anemia (Coggins or EIA ELISA test) within 12 months.
    b. Vaccination for tetanus, eastern and western equine encephalomyelitis, West Nile virus, equine herpes virus, influenza, *Streptococcus equi*, and rabies within 12 months.

B. Saddle horses and pilot horses must not be removed from the gather operation (such as for an equestrian event) and allowed to return unless they have been observed to be free from signs of infectious disease for a period of at least three weeks and a new Certificate of Veterinary Inspection is obtained after three weeks and prior to returning to the gather.

C. WH&B's, saddle horses, and pilot horses showing signs of infectious disease must be examined by the on-site/on-call veterinarian.

1. Any saddle or pilot horses showing signs of infectious disease (fever, nasal discharge or illness) must be removed from service and isolated from other animals on the gather until such time as the horse is free from signs of infectious disease and approved by the on-site/on-call veterinarian to return to the gather.
2. WH&B's showing signs of infectious disease will normally not be mixed with groups of healthy WH&B's at the temporary holding facility, or during transport..

PUBLIC AND MEDIA INTERACTION

a. Due to heightened public interest in wild horse and burro gathers, the BLM expects an increasing number of requests from the public and media to view the operation. All requests received by the Contractor to view gather operation shall be forwarded to the BLM, who will provide a person with the expertise necessary to escort the public and media. The safety of the WHB's, BLM employees, Contractor crew, Contractor's private animals, and the media and public will be the first priority in determining whether a viewing opportunity will be provided, and if so, the time, location, and conditions associated with the viewing opportunity.

b. Assuming the BLM determines that providing a viewing opportunity for the media and the public is appropriate, the Contractor will establish the viewing area in accordance with instructions from the LCOR/COR/PI and current wild horse and burro program policy and guidance. BLM's observation policy will be discussed with the contractor during the pre-work meeting.

c. Member(s) of the viewing public or media whose conduct interferes with the gather operation in a way that threatens the safety of the WH&B's, BLM employees, contractor crew (including animals), the media, or the public will be warned once to terminate the conduct. If the conduct persists, the offending individual(s) will be asked to leave the viewing area and the gather operation. The LCOR/COR/PI may direct the Contractor to temporarily shut down the gather operation until the situation is resolved.

d. Under no circumstances will the public or any media or media equipment be allowed in or on the gather helicopter or on the trap or holding equipment. The public, media, and media equipment must be at least 500 feet away from the trap during the trapping operation.

e. The public and media may be escorted closer than 500 feet to the trap site if approved by the LCOR/COR and in consultation with the Contractor during the time between gather runs or before or after the gather operation.

f. The Contractor shall not release any information to the news media or the public regarding the activities being conducted under this contract. All communications regarding BLM WH&B management, including but not limited to media, public and local stakeholders, are to come from the BLM unless it expressly authorizes the Contractor to give interviews, etc.

CONTRACTOR-FURNISHED PROPERTY

a. As specified herein, it is the contractor's responsibility to provide all necessary support equipment and vehicles including weed seed free hay and water for the captured animals and any other items, personnel, vehicles (which shall include good condition trucks and stock trailers to haul horses and burros from the trap site to the holding facility and two tractor trailers in good condition to haul horses from the holding facility to the preparation facility), saddle horses, etc. to support the humane and compassionate capture, care, feeding, transportation, treatment, and as appropriate, release of WHB's. Other equipment includes but is not limited to, a minimum 2,500 linear feet of 72-inch high (minimum height) panels for horses or 60-inch high (minimum height) for burros for traps and holding facilities. Separate water troughs shall be provided at each pen where animals are being held meeting the standards in section C.6. Water troughs shall be constructed of such material (e.g., rubber, galvanized metal with rolled edges, rubber over metal) so as to avoid injury to the animals.

b. The Contractor shall provide a radio transceiver to insure communications are maintained with the BLM project PI when driving or transporting the wild horses/burros. The contractor needs to insure communications can be made with the BLM and be capable of operating in the 150 MHz to 174 MHz frequency band, frequency synthesized, CTCSS 32 sub-audible tone capable, operator programmable, 5kHz channel increment, minimum 5 watts carrier power.

c. The Contractor shall provide water and weed seed free hay.

d. The proper operation, service and maintenance of all contractor furnished property is the responsibility of the Contractor.

BLM ROLES AND RESPONSIBILITIES

a. Veterinarian
1. On-site veterinary support must be provided for all helicopter gathers.

2. Veterinary support will be under the direction of the LCOR/COR/PI. Upon request, the on-site/on-call veterinarian will consult with the LCOR/COR/PI on matters related to WH&B health, handling, welfare and euthanasia. All final decisions regarding medical treatment or euthanasia will be made by the on-site LCOR/COR/PI based on recommendations from the on-site veterinarian.

b. Transportation
1. The LCOR/COR/PI shall consider the condition and size of the animals, weather conditions, distance to be transported to the final destination or release, recommendations from the contractor and on-site veterinarian and other factors when planning for the movement of captured animals. The LCOR/COR/PI shall provide for any brand inspection services required for the movement of captured animals to BLM prep facilities. If animals are to be transported over state lines the LCOR will be responsible for obtaining a waiver from the receiving State Veterinarian.

2. If the LCOR/COR/PI determines that conditions are such that the animals could be endangered during transportation, the Contractor will be instructed to adjust speed or delay transportation until conditions improve.

GOVERNMENT FURNISHED EQUIPMENT/SUPPLIES/MATERIALS
a. The government will provide:

1. A portable restraining chute for each contractor to be used for the purpose of restraining animals to determine the age of specific individuals or other similar procedures. The contractor will be responsible for the maintenance of the portable restraining chute during the gather season.
2. All inoculate syringes, freezemarking equipment, and all related equipment for fertility control treatments.
3. A boat to transport burros as appropriate.
4. Sleds, slide boards, or slip sheets for loading of recumbent animals.

b. The Contractor shall be responsible for the security of all Government Furnished Property.

SITE CLEARANCES
a. Prior to setting up a trap or temporary holding facility, BLM will conduct all necessary legal reviews and clearances (NEPA, ARPA, NHPA, etc.). All proposed site(s) must be inspected by a government archaeologist. Once archaeological clearance has been obtained, the trap or temporary holding facility may be set up. Said clearance shall be coordinated and arranged for by the COR/ PI, or other BLM employees.

Water and Bait Trapping Standard Operating Procedures
The work consists of the capture, handling, care, feeding, daily rate and transportation of wild horses and/or burros from the States of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico,

Oregon, Utah and Wyoming. The method of capture will be with the use of bait and/or water traps in accordance with the standards identified in the Comprehensive Animal Welfare Program (CAWP) for Wild horse and Burro Gathers, Bureau of Land Management (BLM) Instruction Memorandum 2015-151 (Attachment 1). Items listed in the sections of the Statement of Work (SOW) either are not covered or deviate from the CAWP, the SOW takes precedence over the CAWP when there is conflicting information. Extended care, handling and animal restraint for purposes of population growth suppression treatments may be required for some trapping operations. The contractor shall furnish all labor, supplies, transportation and equipment necessary to accomplish the individual task order requirements with the exception of a Government provided restraint fly chute, as needed for population growth suppression. The work shall be accomplished in a safe and humane manner and be in accordance with the provisions of 43 CFR Part 4700, the CAWP, the specifications and provisions included in this SOW, and any subsequent SOW documents issued with individual task orders. The primary concern of the contractor shall be the safety of all personnel involved and the humane capture and handling of all wild horses and burros. It is the responsibility of the contractor to provide appropriate safety and security measures to prevent loss, injury or death of captured wild horses and burros.

Any reference to hay in this SOW or subsequent SOW documents issued with individual task orders will be implied as certified weed-free hay (grass or alfalfa). The contractor will be responsible for providing certifications upon request from the Government. The COR/PI's will observe a minimum of at least 25 percent of the trapping activity. BLM reserves the right to place game cameras or other cameras in the capture area to document animal activity and response, capture techniques and procedures, and humane care during trapping. No private/non-BLM camera will be placed within the capture areas.

Trapping activities would be on the HA/HMA/WHBT or outside areas specified in the task order. However, trapping could be required on adjacent land, federal, state, tribal, military, or private property. If trapping operations include work on military and/or other restricted areas, the BLM will coordinate all necessary clearances, such as background checks, to conduct operations for equipment and personnel.

The permissions to use private/state/tribal lands during task order performance will be coordinated by the BLM, contractor, and landowner. The need for these permissions will be identified in the Task Order SOW and will be obtained in writing.

Prior to any gathering operation, the BLM will provide for a pre-capture evaluation of existing conditions in the gather area(s). The evaluation will include animal conditions, prevailing temperatures, drought conditions, soil conditions, road conditions, and preparation of a topographic map with wilderness boundaries, the location of fences, other physical barriers, and acceptable gather site locations in relation to animal distribution. The evaluation will determine whether the proposed activities will necessitate the presence of a veterinarian during operations. If it is determined that capture operations necessitate the services of a veterinarian, one would be obtained before the capture would proceed. The contractor will be apprised of all conditions and will be given instructions regarding the capture and handling of animals to ensure their health and welfare is protected.

Gather sites and temporary holding sites will be located to reduce the likelihood of undue injury and stress to the animals, and to minimize potential damage to the natural and cultural resources of the area. Temporary holding sites would be located on or near existing roads.

Bait Trapping - Facility Design (Temporary Holding Facility Area and Traps)
All trap and temporary holding facility areas locations must be approved by the COR and/or the

Project Inspector (PI) prior to construction and/or operation. The contractor may also be required to change or move trap locations as determined by the COR/PI. All traps and temporary holding facilities not located on public land must have prior written approval of the landowner or other management agency.

Facility design to include traps, wings, alleys, handling pens, finger gates, and temporary holding facilities, etc. shall be constructed, maintained and operated to handle the wild horses and burros in a safe and humane manner in accordance with the standards identified in the Comprehensive Animal Welfare Program (CAWP) for Wild Horse and Burro Gathers, Bureau of Land Management (BLM) Instruction Memorandum 2015-151 (Attachment 1).

Some gather operations will require the construction of an off-site temporary holding facility as identified in specific individual task orders for extended care and handling for purposes of slow trapping conditions or management activities such as research, population growth suppression treatments, etc.

No modification of existing fences will be made without authorization from the COR/PI. The contractor shall be responsible for restoring any fences that are modified back to the original condition.

Temporary holding and sorting pens shall be of sufficient size to prevent injury due to fighting and trampling. These pens shall also allow for captured horses and burros to move freely and have adequate access to water and feed.

All pens will be capable of expansion when requested by the COR/PI.

Separate water troughs shall be provided for each pen where wild horses and burros are being held. Water troughs shall be constructed of such material (e.g., rubber, plastic, fiberglass, galvanized metal with rolled edges, and rubber over metal) so as to avoid injury to the wild horses and burros.

Any changes or substitutions to trigger and/or trip devices previously approved for use by the Government must be approved by the COR prior to use.

Bait Trapping, Animal Care, and Handling

If water is to be used as the bait agent and the Government determines that cutting off other water sources is the best action to take under the individual task order, elimination of other water sources shall not last longer than a period of time approved by the COR/PI.

Hazing/Driving of wild horses and burros for the purpose of trapping the animals will not be allowed for the purposes of fulfilling individual task orders. Roping will be utilized only as directed by the COR.

Darting of wild horses and burros for trapping purposes will not be allowed.

No barbed wire material shall be used in the construction of any traps or used in new construction to exclude horses or burros from water sources.

Captured wild horses and burros shall be sorted into separate pens (i.e. by age, gender, animal health/condition, population growth suppression, etc.).

A temporary holding facility area will be required away from the trap site for any wild horses and burros that are being held for more than 24 hours.

The contractor shall assure that captured mares/jennies and their dependent foals shall not be separated for more than 4 hours, unless the COR/PI determines it necessary.

The contractor shall provide a saddle horse on site that is available to assist with the pairing up of mares/jennies with their dependent foals and other tasks as needed.

Contractor will report any injuries/deaths that resulted from trapping operations as well as preexisting conditions to the COR/PI within 12 hours of capture and will be included in daily gather activity report to the COR.

The COR/PI may utilize contractor constructed facilities when necessary in the performance of individual task orders for such management actions as population growth suppression, and/or selecting animals to return to the range.

In performance of individual task orders, the contractor may be directed by the COR to transport and release wild horses or burros back to the range.

At the discretion of the COR/PI the contractor may be required to delay shipment of horses until the COR/PI inspects the wild horses and burros at the trap site and/or the temporary holding facility prior to transporting them to the designated facility.

Wild Horse and Burro Care and Biosecurity
The contractor shall restrain sick or injured wild horses and burros if treatment is necessary in consultation with the COR/PI and/or veterinarian.

Any saddle or pilot horses used by the contractor will be vaccinated within 12 months of use (EWT, West Nile, Flu/rhino, strangles).

Transportation and Animal Care
The contractor, following coordination with the COR, shall schedule shipments of wild horses and burros to arrive during the normal operating hours of the designated facility unless prior approval has been obtained from the designated facility manager by the COR. Shipments scheduled to arrive at designated facilities on a Sunday or a Federal holiday requires prior facility personnel approval.

All motorized equipment employed in the transportation of captured wild horses and burros shall be incompliance with appropriate State and Federal laws and regulations.

Sides or dividers of all trailers used for transporting wild horses and burros shall be a minimum height of 6 feet 6 inches from the floor. A minimum of one full height partition is required in each stock trailer. All trailers shall be covered with solid material or bars to prevent horses from jumping out.

The contractor shall consider the condition and size of the wild horses and burros, weather conditions, distance to be transported, or other factors when planning for the movement of captured wild horses and burros.

The Government shall provide for any brand and/or veterinary inspection services required for captured wild horses and burros. Prior to shipping across state lines the Government will be responsible for coordinating with the receiving state veterinarian to transport the animals without a health certificate or coggins test. If the receiving state does not agree to grant entry to animals without a current health certificate or coggins test, the Government will obtain them prior to shipment.

When transporting wild horses and burros, drivers shall inspect for downed animals a minimum of every two hours when travelling on gravel roads or when leaving gravel roads onto paved roads and a minimum of every four hours when travelling on paved roads. a)

Euthanasia or Death
The COR/PI will determine if a wild horse or burro must be euthanized and will/may direct the contractor to destroy the animal in accordance with the BLM Animal Health, Maintenance,
Evaluation, and Response Instruction Memorandum, 2015-070 (Attachment 2). Any contractor personnel performing this task shall be trained as described in this Memorandum.

Pursuant to the IM 2015-070 the contractor may be directed by the Authorized Officer and/or COR to humanely euthanize wild horses and burros in the field and to dispose of the carcasses in accordance with state and local laws.

Safety and Communication
The nature of work performed under this contract may involve inherently hazardous situations. The primary concern of the contractor shall be the safety of all personnel involved and the humane handling of all wild horses and burros. It is the responsibility of the contractor to provide appropriate safety and security measures to prevent loss, injury or death of captured wild horses and burros until delivery to the final destination.

The BLM reserves the right to remove from service immediately any contractor personnel or contractor furnished equipment which, in the opinion of the COR and/or CO violate contract rules, are unsafe or otherwise unsatisfactory. In this event, BLM will notify the contractor to furnish replacement personnel or equipment within 24 hours of notification. All such replacements must be approved in advance by the COR and/or CO.

Contractor personnel who utilize firearms for purposes of euthanasia will be required to possess proof of completing a State or National Rifle Association firearm safety certification or equivalent (conceal carry, hunter safety, etc.).

All accidents involving wild horses and burros or people that occur during the performance of any task order shall be immediately reported to the COR/PI.

The contractor shall have the means to communicate with the COR/PI and all contractor personnel engaged in the capture of wild horses and burros utilizing a cell/satellite phone or radio at all times during the trapping operations. The Contractor will be responsible for furnishing all communication equipment for contractor use. BLM will provide the frequency for radio communications.

The contractor will provide daily gather activity reports to the COR/PI if they are not present.

Public and Media

Due to increased public interest in the Wild Horse and Burro Gathers, any media or visitation requests received by the contractor shall be forwarded to the COR immediately. Only the COR or CO can approve these requests.

The Contractor shall not post any information or images to social media networks or release any information to the news media or the public regarding the activities conducted under this contract.

If the public or media interfere in any way with the trapping operation, such that the health and well-being of the crew, or horses and burros are threatened, the contractor will immediately report the incident to the COR and trapping operations will be suspended until the situation is resolved as directed by the COR.

1. All motorized equipment employed in the transportation of captured animals shall be in compliance with appropriate State and Federal laws and regulations applicable to the humane transportation of animals. The Contractor shall provide the COR/PI with a current safety inspection (less than one year old) for all motorized equipment and tractor-trailers used to transport animals to final destination.

2. All motorized equipment, tractor-trailers, and stock trailers shall be in good repair, of adequate rated capacity, and operated so as to ensure that captured animals are transported without undue risk or injury.

3. Only tractor-trailers or stock trailers with a covered top shall be allowed for transporting animals from gather site(s) to temporary holding facilities and from temporary holding facilities to final destination(s). Sides or stock racks of all trailers used for transporting animals shall be a minimum height of 6 feet 6 inches from the floor. Single deck tractor-trailers 40 feet or longer shall have two (2) partition gates providing three (3) compartments within the trailer to separate animals. Tractor-trailers less than 40 feet shall have at least one partition gate providing two (2) compartments within the trailer to separate the animals. Compartments in all tractor-trailers shall be of equal size plus or minus 10 percent. Each partition shall be a minimum of 6 feet high and shall have a minimum 5 foot wide swinging gate. The use of double deck tractor-trailers is unacceptable and shall not be allowed.

4. All tractor-trailers used to transport animals to final destination(s) shall be equipped with at least one (1) door at the rear end of the trailer which is capable of sliding either horizontally or vertically. The rear door(s) of tractor- trailers and stock trailers must be capable of opening the full width of the trailer. Panels facing the inside of all trailers must be free of sharp edges or holes that could cause injury to the animals. The material facing the inside of all trailers must be strong enough so that the animals cannot push their hooves through the side. Final approval of tractor-trailers and stock trailers used to transport animals shall be held by the COR/PI.

5. Floors of tractor-trailers, stock trailers and loading chutes shall be covered and maintained with wood shavings to prevent the animals from slipping.

6. Animals to be loaded and transported in any trailer shall be as directed by the COR/PI and may include limitations on numbers according to age, size, sex, temperament and animal condition. The following minimum square feet per animal shall be allowed in all trailers:

a. 11 square feet per adult horse (1.4 linear foot in an 8 foot wide trailer);
b. 8 square feet per adult burro (1.0 linear foot in an 8 foot wide trailer);
c. 6 square feet per horse foal (.75 linear foot in an 8 foot wide trailer);
d. 4 square feet per burro foal (.50 linear feet in an 8 foot wide trailer).

7. The COR/PI shall consider the condition and size of the animals, weather conditions, distance to be transported, or other factors when planning for the movement of captured animals. The COR/PI shall provide for anybrand and/or inspection services required for the captured animals.
8. If the COR/PI determines that dust conditions are such that the animals could be endangered during transportation, the Contractor will be instructed to adjust speed.

Safety and Communications
1. The Contractor shall have the means to communicate with the COR/PI and all contractor personnel engaged in the capture of wild horses and burros utilizing a VHF/FM Transceiver or VHF/FM portable Two-Way radio. If communications are ineffective the government will take steps necessary to protect the welfare of the animals.

a. The proper operation, service and maintenance of all contractor furnished property are the responsibility of the Contractor. The BLM reserves the right to remove from service any contractor personnel or contractor furnished equipment which, in the opinion of the contracting officer or COR/PI violate contract rules, are unsafe or otherwise unsatisfactory. In this event, the Contractor will be notified in writing to furnish replacement personnel or equipment within 48 hours of notification. All such replacements must be approved in advance of operation by the Contracting Officer or his/her representative.
b. The Contractor shall obtain the necessary FCC licenses for the radio system
c. All accidents occurring during the performance of any task order shall be immediately reported to the COR/PI.

Public and Media
Due to heightened public interest in wild horse and burro gathers, the BLM/Contractor may expect an increasing number of requests from the public and media to view the operation.

1. Due to this type of operation (luring wild horses and burros to bait) spectators and viewers will be prohibited as it will have impacts on the ability to capture wild horses and burros. Only essential personnel (COR/PI, veterinarian, contractor, contractor employees, etc.) will be allowed at the trap site during operations.

2. Public viewing of the wild horses and burros trapped may be provided at the staging area and/or the BLM preparation facility by appointment.

3. The Contractor agrees that there shall be no release of information to the news media regarding the removal or remedial activities conducted under this contract.

4. All information will be released to the news media by the assigned government public affairs officer.

5. If the public or media interfere in any way with the trapping operation, such that the health and wellbeing of the crew, horses and burros is threatened, the trapping operation will be suspended until the situation is resolved.

COR/PI Responsibilities
a. In emergency situations, the COR/PI will implement procedures to protect animals as rehab is initiated, i.e. rationed feeding and watering at trap and or staging area.

b. The COR/PI will authorize the contractor to euthanize any wild horse or burros as an act of mercy.

c. The COR/PI will ensure wild horses or burros with pre-existing conditions are euthanized in the field according to BLM policy.

d. Prior to setting up a trap or staging area on public land, the BLM and/or Forest Service will conduct all necessary clearances (archaeological, T&E, etc.). All proposed sites must be inspected by a government archaeologist or equivalent. Once archaeological clearance has been obtained, the trap or staging area may be set up. Said clearances shall be arranged for by the COR/PI.

e. The COR/PI will provide the contractor with all pertinent information on the areas and wild horses and burros to be trapped.

f. The COR/PI will be responsible to establish the frequency of communicating with the contractor.

g. The COR/PI shall inspect trap operation prior to Contractor initiating trapping.

h. The Contractor shall make all efforts to allow the COR/PI to observe a minimum of at least 25 percent of the trapping activity.

i. The COR/PI is responsible to arrange for a brand inspector and/or veterinarian to inspect all wild horses and burros prior to transporting to a BLM preparation facility when legally required.

j. The COR/PI will be responsible for the establishing a holding area for administering PZP, gelding of stallions, holding animals in poor condition until they are ready of shipment, holding for EIA testing, etc.

k. The COR/PI will ensure the trailers are cleaned and disinfected before WH&B's are transported. This will help prevent transmission of disease into our populations at a BLM Preparation Facility.

Responsibility and Lines of Communication
The Wild Horse Specialist (COR) or delegate has direct responsibility to ensure human and animal safety. The Field Manager will take an active role to ensure that appropriate lines of communication are established between the field, field office, state office, national program office, and BLM holding facility offices.

All employees involved in the gathering operations will keep the best interests of the animals at the forefront at all times.

All publicity and public contact and inquiries will be handled through the Office of Communications. These individuals will be the primary contact and will coordinate with the COR on any inquiries.

The BLM delegate will coordinate with the off range corrals to ensure animals are being transported from the capture site in a safe and humane manner and are arriving in good condition.

The BLM require humane treatment and care of the animals during removal operations. These specifications are designed to minimize the risk of injury and death during and after capture of the animals. The specifications will be vigorously enforced.

Resource Protection
Gather sites and holding facilities would be located in previously disturbed areas whenever possible to minimize potential damage to the natural and cultural resources.

Gather sites and temporary holding facilities would not be constructed on wetlands or riparian zones.

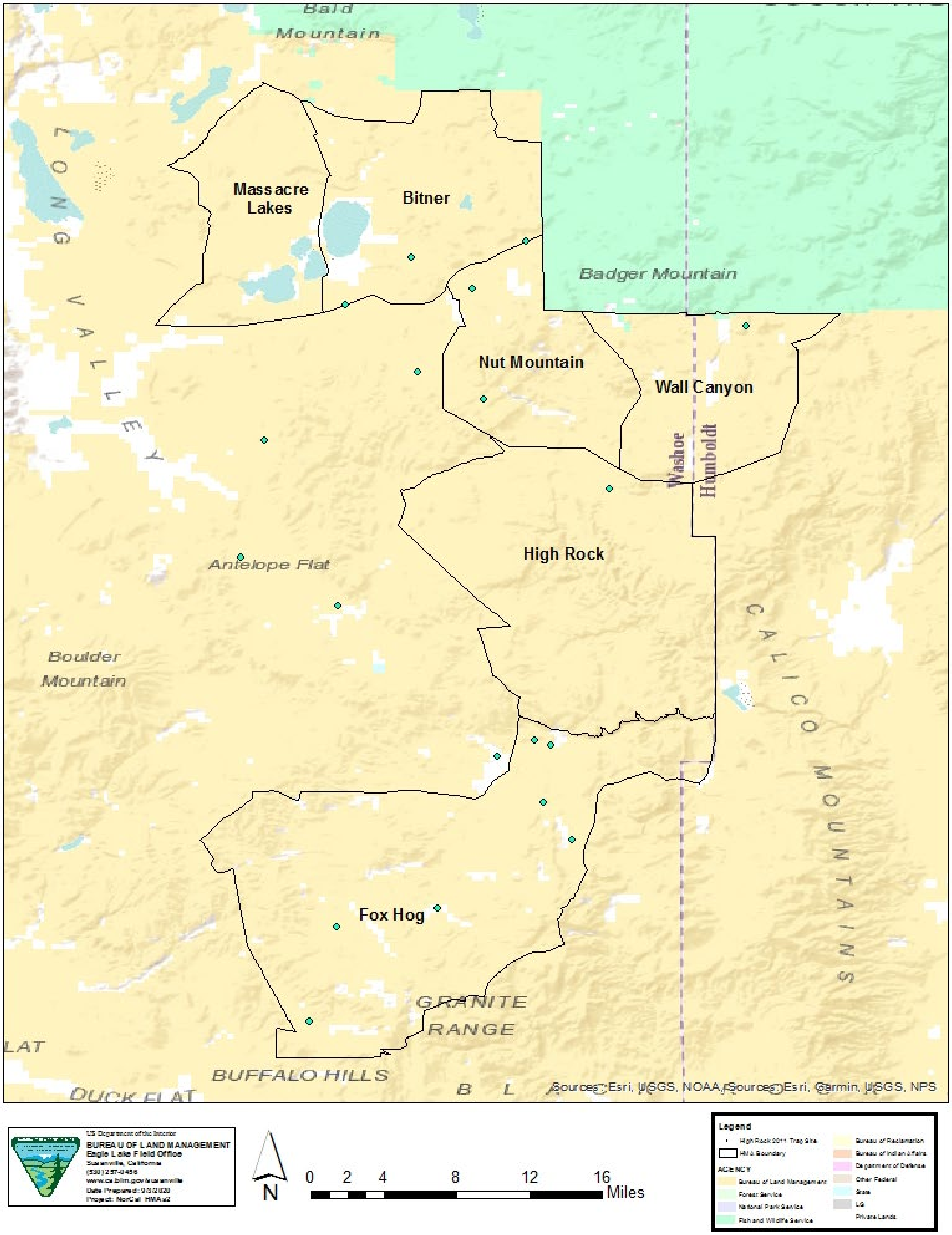
Prior to implementation of gather operations, gather sites and temporary holding facilities would be evaluated to determine their potential for containing cultural resources. All gather facilities (including gather sites, gather run- ways, blinds, holding facilities, camp locations, parking areas, staging areas, etc.) that would be located partially or totally in new locations (i.e. not at previously used gather locations) or in previously undisturbed areas would be inventoried by a BLM archaeologist or Field Office archaeological technician before initiation of the gather. A buffer of at least 30 meters would be maintained between gather facilities and any identified cultural resources.

Gather sites and holding facilities would not be placed in known areas of Native American concern.

The contractor would not disturb, alter, injure or destroy any scientifically important paleontological remains; any historical or archaeological site, structure, building, grave, object or artifact; or any location having Native American traditional or spiritual significance within the project area or surrounding lands. The contractor would be responsible for ensuring that its employees, subcontractors or any others associated with the project do not collect artifacts and fossils, or damage or vandalize archaeological, historical or paleontological sites or the artifacts within them.

Should damage to cultural or paleontological resources occur during the period of gather due to the unauthorized, inadvertent or negligent actions of the contractor or any other project personnel, the contractor would be responsible for costs of rehabilitation or mitigation. Individuals involved in illegal activities may be subject to penalties under the Archaeological Resources Protection

Appendix E. Map of Previous Trap Site Locations



Appendix F. Fertility Control Treatment Standard Operating Procedures (SOPs)

SOPs common to all vaccine types:

Animal Identification
Animals intended for treatment must be clearly, individually identifiable to allow for positive identification during subsequent management activities. For captured animals, marking for identification may be accomplished by marking each individual with a freeze mark on the hip or neck and a microchip in the nuchal ligament. In some cases, identification may be accomplished based by cataloguing markings that make animals uniquely identifiable. Such animals may be photographed using a telephoto lens and high quality digital camera as a record of treated individuals.

Safety
Safety for both humans and animals is the primary consideration in all elements of fertility control vaccine use. Administration of any vaccine must follow all safety guidance and label guidelines on applicable EPA labeling.

Injection Site
For hand-injection, delivery of the vaccine should be by intramuscular injection, while the animal is standing still, into the left or right side, above the imaginary line that connects the point of the hip (hook bone) and the point of the buttocks (pin bone): this is the hip / upper gluteal area. For dart-based injection, delivery of the vaccine should be by intramuscular injection, while the animal is standing still, into the left or right thigh areas (lower gluteal / biceps femoralis).

Monitoring and Tracking of Treatments
1. Estimation of population size and growth rates (in most cases, using aerial surveys) should be conducted periodically after treatments.
2. Population growth rates of some herds selected for intensive monitoring may be estimated every year post-treatment using aerial surveys. If, during routine HMA field monitoring (on-the-ground), data describing adult to foal ratios can be collected, these data should also be shared with HQ-261.
3. Field applicators should record all pertinent data relating to identification of treated animals (including photographs if animals are not freeze-marked) and date of treatment, lot number(s) of the vaccine, quantity of vaccine issued, the quantity used, the date of vaccination, disposition of any unused vaccine, the date disposed, the number of treated mares by HMA, field office, and State along with the microchip numbers and freeze-mark(s) applied by HMA and date. A summary narrative and data sheets will be forwarded to HQ-261 annually (Reno, Nevada). A copy of the form and data sheets and any photos taken should be maintained at the field office.
4. HQ-261 will maintain records sent from field offices, on the quantity of PZP issued, the quantity used, disposition of any unused PZP, the number of treated mares by HMA, field office, and State along with the freeze-mark(s) applied by HMA and date.

SOPs for one-year liquid PZP vaccine (ZonaStat-H)

ZonaStat-H vaccine (Science and Conservation Center, Billings, MT) would be administered through hand-injection or darting by trained BLM personnel or collaborating partners only. At present, the only PZP vaccine for dart-based delivery in BLM-managed wild horses or burros is ZonaStat-H. For any darting operation, the designated personnel must have successfully completed a nationally recognized wildlife darting course and who have documented and successful experience darting wildlife under field conditions.

Until the day of its use, ZonaStat-H must be kept frozen.

Animals that have never been treated with a PZP vaccine would receive 0.5 cc of PZP vaccine emulsified with 0.5 cc of Freund's Modified Adjuvant (FMA). Animals identified for re-treatment receive 0.5 cc of the PZP vaccine emulsified with 0.5 cc of Freund's Incomplete Adjuvant (FIA).
Hand-injection of liquid PZP vaccine would be by intramuscular injection into the gluteal muscles while the animal is restrained in a working chute. The vaccine would be injected into the left hind quarters of the animal, above the imaginary line that connects the point of the hip (hook bone) and the point of the buttocks (pin bone).

For Hand-injection, delivery of the vaccine would be by intramuscular injection into the left or right buttocks and thigh muscles (gluteals, biceps femoris) while the animal is standing still.

Application of ZonaStat-H via Darting
Only designated darters would prepare the emulsion. Vaccine-adjuvant emulsion would be loaded into darts at the darting site and delivered by means of a projector gun.

No attempt to dart should be taken when other persons are within a 100-m radius of the target animal. The Dan Inject gun should not be used at ranges in excess of 30 m while the Pneu-Dart gun should not be used over 50 m.

No attempts would be taken in high wind (greater than 15 mph) or when the animal is standing at an angle where the dart could miss the target area and hit the flank or rib cage. The ideal is when the dart would strike the skin of the animal at a 90° angle.

If a loaded dart is not used within two hours of the time of loading, the contents would be transferred to a new dart before attempting another animal. If the dart is not used before the end of the day, it would be stored under refrigeration and the contents transferred to another dart the next day, for a maximum of one transfer (discard contents if not used on the second day). Refrigerated darts would not be used in the field.

A darting team should include two people. The second person is responsible for locating fired darts. The second person should also be responsible for identifying the animal and keeping onlookers at a safe distance.

To the extent possible, all darting would be carried out in a discrete manner. However, if darting is to be done within view of non-participants or members of the public, an explanation of the nature of the project would be carried out either immediately before or after the darting.

Attempts will be made to recover all darts. To the extent possible, all darts which are discharged and drop from the target animal at the darting site would be recovered before another darting occurs. In exceptional situations, the site of a lost dart may be noted and marked, and recovery efforts made at a later time. All discharged darts would be examined after recovery in order to determine if the charge fired and the plunger fully expelled the vaccine. Personnel conducting darting operations should be equipped with a two-way radio or cell phone to provide a communications link with a project veterinarian for advice and/or assistance. In the event of a veterinary emergency, darting personnel would immediately contact the project veterinarian, providing all available information concerning the nature and location of the incident.

In the event that a dart strikes a bone or imbeds in soft tissue and does not dislodge, the darter would follow the affected animal until the dart falls out or the animal can no longer be found. The darter would be responsible for daily observation of the animal until the situation is resolved.

SOPs for application of PZP-22 pelleted vaccine:
PZP-22 pelleted vaccine treatment would be administered only by trained BLM personnel or designated partners.
A treatment of PZP-22 is comprised of two separate injections: (1) a liquid dose of PZP vaccine (equivalent to one dose of ZonaStat-H) is administered using an 18-gauge needle primarily by hand injection; (2) the pellets are preloaded into a 14-gauge needle. For animals constrained in a working chute, these are delivered using a modified syringe and jabstick to inject the pellets into the gluteal muscles of the animals being returned to the range. The pellets are intended to release PZP over time. Until the day of its use, the liquid portion of PZP-22 must be kept frozen.

At this time, delivery of PZP-22 treatment would only be by intramuscular injection into the gluteal muscles while the animal is restrained in a working chute. The primer would consist of 0.5 cc of liquid PZP emulsified with 0.5 cc of adjuvant. Animals that have never been treated with a PZP vaccine would receive 0.5 cc of PZP vaccine emulsified with 0.5 cc of Freund's Modified Adjuvant (FMA). Animals identified for re-treatment receive 0.5 cc of the PZP vaccine emulsified with 0.5 cc of Freund's Incomplete Adjuvant (FIA). The syringe with PZP vaccine pellets would be loaded into the jabstick for the second injection. With each injection, the liquid or pellets would be injected into the left hind quarters of the animal, above the imaginary line that connects the point of the hip (hook bone) and the point of the buttocks (pin bone).
In the future, the PZP-22 treatment may be administered remotely using an approved long range darting protocol and delivery system if and when BLM has determined that the technology has been proven safe and effective for use.

SOPs for GonaCon-Equine Vaccine Treatments
GonaCon-Equine vaccine (USDA Pocatello Storage Depot, Pocatello, ID; Spay First!, Inc., Oklahoma City, OK) is distributed as preloaded doses (2 mL) in labeled syringes. Upon receipt, the vaccine should be kept refrigerated (4° C) until use. Do not freeze GonaCon-Equine. The vaccine has a 6-month shelf-life from the time of production and the expiration date will be noted on each syringe that is provided.

For initial and booster treatments, mares would ideally receive 2.0 ml of GonaCon-Equine.

Administering GonaCon Vaccine by Hand-Injection
Experience has demonstrated that only 1.8 ml of vaccine can typically be loaded into 2 cc darts, and this dose has proven successful. Calculations below reflect a 1.8 ml dose.

For hand-injection, delivery of the vaccine should be by intramuscular injection, while the animal is standing still, into the left or right side, above the imaginary line that connects the point of the hip (hook bone) and the point of the buttocks (pin bone): this is the hip / upper gluteal area.

A booster vaccine may be administered after the first injection to improve efficacy of the product over subsequent years.

Application of GonaCon-Equine via Darting

General practice guidelines for darting operations, as noted above for dart-delivery of ZonaStat-H, should be followed for dart-delivery of GonaCon-Equine.

Wearing latex gloves, the applicator numbers darts, and loads numbered darts with vaccine by attaching a loading needle (7.62 cm; provided by dart manufacturer) to the syringe containing vaccine and placing the needle into the cannula of the dart to the fullest depth possible. Slowly depress the syringe plunger and begin filling the dart. Periodically, tap the dart on a hard surface to dislodge air bubbles trapped within the vaccine. Due to the viscous nature of the fluid, air entrapment typically results in a maximum of approximately 1.8 ml of vaccine being loaded in the dart. The dart is filled to max once a small amount of the vaccine can be seen at the tri-ports.

Important! Do not load and refrigerate darts the night before application. When exposed to moisture and condensation, the edges of gel barbs soften, begin to dissolve, and will not hold the dart in the muscle tissue long enough for full injection of the vaccine. The dart needs to remain in the muscle tissue for a minimum of 1 minute to achieve dependable full injection. Sharp gel barbs are critical.

Darts should be weighed to the nearest hundredth gram by electronic scale when empty, when loaded with vaccine, and after discharge, to ensure that 90% (1.62 ml) of the vaccine has been injected. GonaCon weighs 0.95 grams/mL, so animals should receive 1.54 grams of vaccine to be considered treated. Animals receiving <50% should be darted with another full dose; those receiving >50% but <90% should receive a half dose (1 ml). All darts should be weighed to verify a combination of ≥1.62 ml has been administered. Therefore, every effort should be made to recover darts after they have fallen from animals.

Although infrequent, dart injections can result in partial injections of the vaccine, and shots are missed. As a precaution, it is recommended that extra doses of the vaccine be ordered to accommodate failed delivery (which may be as high as ~15 %). To determine the amount of vaccine delivered, the dart must be weighed before loading, and before and after delivery in the field. The scale should be sensitive to 0.01 grams or less, and accurate to 0.05 g or less.

For best results, darts with a gel barb should be used. (i.e. 2 cc Pneu-Dart brand darts configured with Slow-inject technology, 3.81 cm long 14 ga.tri-port needles, and gel collars positioned 1.27 cm ahead of the ferrule). One can expect updates in optimal dart configuration, pending results of research and field applications.

Darts (configured specifically as described above) can be loaded in the field and stored in a cooler prior to application. Darts loaded, but not used can be maintained in dry conditions at about 4° C and used the next day, but do not store in any refrigerator or container likely to cause condensation, which can compromise the gel barbs.

SOPs for Insertion of Y-shaped Silicone Intrauterine Devices for Feral Horses

<u>Background</u>: Mares must be open. A veterinarian must determine pregnancy status via palpation or ultrasound. Ultrasound should be used as necessary to confirm open status of mares down to at least 14

days for those that have recently been with stallions. For mares segregated from stallions, this determination may be made at an earlier time when mares are identified as candidates for treatment, or immediately prior to IUD insertion. Pregnant mares should not receive an IUD.

Preparation: IUDs must be clean and sterile. Sterilize IUDs with a low-temperature sterilization system, such as Sterrad.

The Introducer is two PVC pipes. The exterior pipe is a 29” length of ½” diameter pipe, sanded smooth at one end, then heat-treated to smooth its curvature further (Fig. 1). The IUD will be placed into this smoothed end of the exterior pipe. The interior pipe is a 29 ½” long, ¼” riser tube (of the kind used to connect water lines to sinks), with one end slightly flared out to fit more snugly inside the exterior pipe (Fig. 1), and a plastic stopper attached to the other end (Fig. 2).

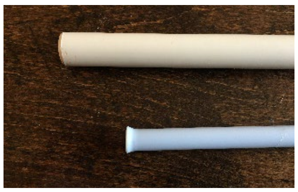


Figure 1. Interior and exterior pipes (unassembled), showing the ends that go into the mare

Figure 2. Interior pipe shown within exterior pipe. After the introducer is 4” beyond the os, the stopper is pushed forward (outside the mare), causing the IUD to be pushed out from the exterior pipe.

Introducers should be sterilized in Benz-all cold steriliant, or similar. Do not use iodine-based sterilant solution. A suitable container for sterilant can be a large diameter (i.e., 2”) PVC pipe with one end sealed and one end removable.

Prepare the IUD: Lubricate with sterile veterinary lube, and insert into the introducer. The central stem of the IUD goes in first (Fig. 3).

Figure 3. Insert the stem end of the IUD into the exterior pipe.

Fold the two 'legs' of the IUD, and push the IUD further into the introducer, until just the bulbous ends are showing (Fig. 4).

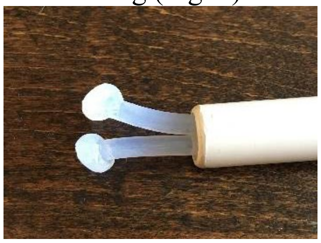


Figure 4. Insert the IUD until just the tips of the 'legs' are showing.

Restraint and Medication: The mare should be restrained in a padded squeeze chute to provide access to the rear end of the animal, but with a solid lower back door, or thick wood panel, for veterinarian safety.

Some practitioners may choose to provide sedation. If so, when the mare's head starts to droop, it may be advisable to tie the tail up to prevent risk of the animal sitting down on the veterinarian's arm (i.e., double half hitch, then tie tail to the bar above the animal).
Some practitioners may choose to provide a dose of long-acting progesterone to aid in IUD retention. Example dosage: 5mL of BioRelease LA Progesterone 300 mg/mL (BET labs, Lexington KY), *or* long-acting Altrenogest). No other intrauterine treatments of any kind should be administered at the time of IUD insertion.

Insertion Procedure:
➔ Prep clean the perineal area.
➔ Lubricate the veterinarian's sleeved arm and the Introducer+IUD.
➔ Carry the introducer (IUD-end-first) into the vagina.
➔ Dilate the cervix and gently move the tip of the introducer past the cervix.
➔ Advance the end of the 1/2" PVC pipe about 4 inches past the internal os of the cervix.
➔ Hold the exterior pipe in place, but push the stopper of the interior pipe forward, causing the IUD to be pushed out of the exterior pipe, into the uterus.
➔ Placing a finger into the cervical lumen just as the introducer tube is removed from the external os allows the veterinarian to know that the IUD is left in the uterus, and not dragged back into or past the cervix.
➔ Remove the introducer from the animal, untie the tail.

Mares that have received an IUD should be observed closely for signs of discharge or discomfort for 24 hours following insertion after which they may be released back to the range.

Label for Y-Shaped Silicone IUD for Feral Horses

Y-Shaped Silicone IUD for Feral Horses

The *Y-Shaped Silicone IUD for Feral Horses* is an intrauterine device (IUD) comprised solely of medical-grade, inert, silicone that is suitable for use in female feral horses (free-roaming or "wild" *Equus caballus*). Intended users include government agencies with feral horses in their management purview, Native American tribes that have management authority over feral horses, and authorized feral horse care or rescue sanctuaries that manage feral horses in a free ranging environment.

The *Y-Shaped Silicone IUD for Feral Horses* can mitigate or reduce feral horse population growth rates because these IUDs can provide potentially reversible fertility control for female feral horses. This IUD prevents pregnancy by its physical presence in the mare's uterus as long as the IUD stays in place. In trials, approximately 75% of mares living and breeding with fertile stallions retained the *Y-Shaped Silicone IUD for Feral Horses* over two breeding seasons. None of the mares that kept their IUDs became pregnant during an experimental trial. After IUD removal, the majority of mares returned to fertility.

Directions for Use:

The *Y-Shaped Silicone IUD for Feral Horses* is to be placed in the uterus of feral horse mares by a veterinarian. The *Y-Shaped Silicone IUD for Feral Horses* is intended for use in feral mares that are at least approximately 1 year old, where age is determined based on available evidence, such as tooth eruption pattern.

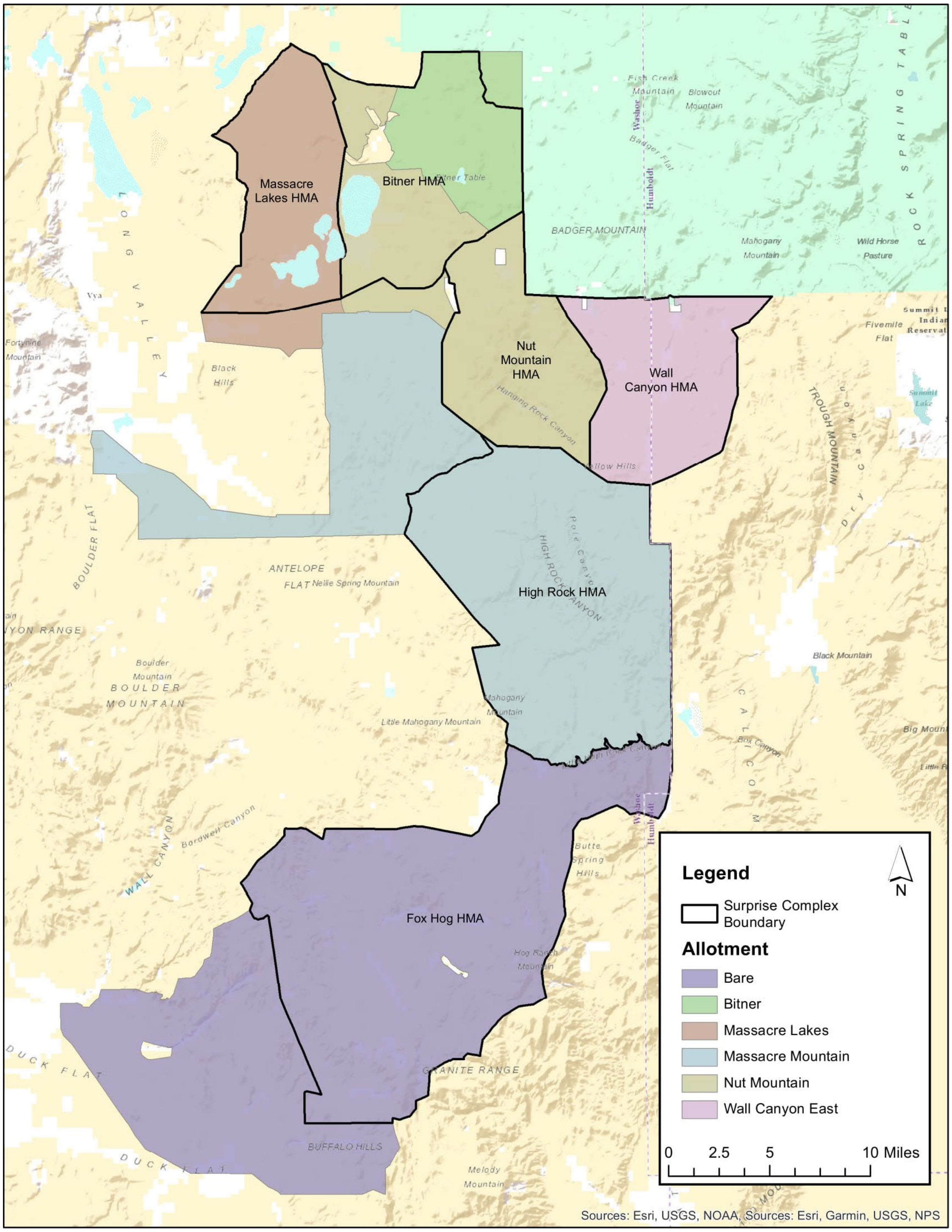
IUDs must be sterilized before use. The IUD is inserted into the uterus using a thin, tubular applicator, similar to a shielded culture tube commonly used in equine reproductive veterinary medicine, in a manner similar to methods used for uterine culture of domestic mares. Feral mares with IUDs should be individually marked and identified (i.e., with an RFID microchip, or via visible freeze-brand on the hip or neck).

Caution:

These IUDs are only to be used in mares that are confirmed to be not pregnant. Checking pregnancy status can be accomplished by methods such as a transrectal palpation and/or ultrasound performed by a veterinarian. If a *Y-Shaped Silicone IUD for Feral Horses* is inserted in the uterus of a pregnant mare, it may cause the pregnancy to terminate, and the IUD to be expelled.

Manufactured for:
U.S. Bureau of Land Management (97949)
1340 Financial Blvd., Reno, NV 89052
EPA Est.: 97628-MI-1

Appendix G. Map of Grazing Allotments within the Surprise Complex



Appendix H. Grazing Management Actions between 1982 and 2020

Livestock Grazing Allotment Name	Reduction in Livestock AUMs	Increase of Livestock AUMs	Change in Season of Use/ Livestock Class	Change in Grazing Strategy	Riparian Area Restrictions/ Other Restrictions
Bitner	None	None	Current:4/16-10/15	Current: Bitner Uplands rotation system: North: Even years South: Odd years	North Badger and Evans Camp, and the Headcut Field and Wrangler Field are excluded from livestock grazing. 40 % max. utilization on all other riparian areas.
Bare	2 pastures rested in 2013 and 2014 due to Lost Fire.	0	Reduced cattle by a third from 7/1 – 11/30	Current: Deferred Rotation System Past: 3-Pasture Rest Rotation	14 spring and riparian areas excluded from livestock by fencing
Massacre Lakes	As per 2014 grazing decision: Temp suspension of 1522 AUM's.	None	Current: 5/15-5/29 (150 Cattle) 530-9/17 (450 Cattle)	Two year early season rest rotation and mid/ late season deferred use	Riparian Restrictions on public portions of Alkaline Meadows.
Massacre Mountain	Cattle – reduced by 4714 AUMs since 1982. Temporary reduction of 1623 AUMs in 2013 and 2014 due to Lost Fire	0	Current: Cattle Past: Cattle and Sheep	NA	Riparian Restrictions; Exclosures
Nut Mountain	None	None	Current: 4/16 to 10/15	Two year early season rest rotation and mid/ late season deferred use	Planned fencing for 3 riparian areas to exclude livestock and horses.

Livestock Grazing Allotment Name	Reduction in Livestock AUMs	Increase of Livestock AUMs	Change in Season of Use/ Livestock Class	Change in Grazing Strategy	Riparian Area Restrictions/ Other Restrictions
Wall Canyon East	Allotment voluntarily rested from 2006 to 2011 due to drought and to improve range conditions.	0	Current: 5/1 – 9/30 (125 days) Past: 5/1 – 7/15 (76 days)	Current: Deferred Rest Rotation System; 1 use area rested each year Past: Early use of all use areas	Riparian restrictions on 2 systems

Appendix I. Livestock and Wild Horse and Burro Actual Use Tables 2011-2019

Surprise Complex Grazing Allotments					Varies within Dates		Annual Actual Use by Allotment								
Allotment Number	Allotment Name	Livestock Number	AUMs	Livestock Species	Period Begin Date	Period End Date	2011	2012	2013	2014	2015	2016	2017	2018	2019
00900	Bare	3880	13,260	Cattle	3/1	11/30	11,447	4,426	7,692	7,074	6,392	7,830	7,041	5,468	9,272
01006	Bitner	566	1,702	Cattle	4/16	10/15	1,642	1,512	2,013	652	929	1,669	1,692	1,454	1,671
01007	Massacre Lakes	600	1,693	Cattle	5/15	9/17	2,053	2,027	2,007	1,683	0	919	1,066	586	1,077
01008	Massacre Mountain	968	5,824	Cattle	4/16	10/15	2,435	2,227	2,118	1,798	1,530	1,845	2,483	3,178	2,686
01010	Nut Mountain	813	4,893	Cattle	4/16	10/15				2,849	2,013	3,008	3,956	3,813	3,517
01014	Wall Canyon East	656	3,215	Cattle	5/1	9/30	0	568	2,407	1,478	1,388	1,243	1,376	1,097	1,571
Total Livestock Use			30,587				17,577	10,760	16,237	15,334	12,252	16,504	17,620	15,596	19,794
WHB Avg Annual Use															

Appendix J. 2020 Surprise Complex Riparian Report

Introduction

In semi-arid landscapes such as the sagebrush steppe, often the first areas to show signs of ecological distress are riparian areas. Riparian areas are the parts of the landscape that are immediately adjacent to water and influenced by the presence of the water and are the transition between aquatic and upland areas. They are complex, dynamic ecosystems defined by specific geomorphological, hydrological, and vegetative attributes (e.g., hydric soils, wetland obligate vegetation species). Riparian areas serve as critical habitat for many wildlife species and the associated surface water as important drinking water sources for most species of the sagebrush steppe. Properly functioning riparian systems have a high degree of resistance and resilience to disturbances, including grazing. They are able to dissipate energies associated with overland flow, develop root masses that protect soil surfaces from erosion, improve floodwater retention and ground-water recharge, resist water percolation, maintain geomorphic and soil characteristics, and direct physical alteration from human and animal activities (Gonzales and Smith 2020).

Methods

During the spring of 2020, a water source survey was completed for the Surprise Complex using the PFC database and Google Earth Pro® imagery. Imagery sources incorporated Landsat, Copernicus, U.S.D.A. Farm Service Agency, U.S. Geological Survey, and other sensors. The National Wetland Inventory was consulted, but after a comparison, it was determined that it was not complete enough to use as a sole source. A careful study was made of imagery and all water sources in each HMA were identified and categorized. Riparian functional assessments are only conducted on systems that are relatively natural and generally have the capability to support riparian vegetation. Stock tanks, ephemeral playas, dugouts, pit reservoirs, and wells are not assessed using the Proper Functioning Condition assessment. The Proper Functioning Condition (PFC) assessment has been around approximately 30 years and is used for both lentic and lotic systems. The abbreviation PFC describes both the assessment process and an on-the-ground condition of a system.

After all water sources were identified, systems without PFC potential were eliminated from further consideration. Each HMA was considered independent from other HMAs. Springs, seeps, and streams for each HMA were evaluated for PFC potential. Springs, seeps, and streams were chosen for assessment based on land ownership (federally managed water sources were preferred), accessibility, use (a range of uses was selected), and spatial balance across each HMA. Because each HMA is unique, the proportion of selected water sources was different for each HMA.

In the PFC assessment process, an interdisciplinary team travels to each chosen location to perform an assessment. Team members work together to complete the assessment. Sites are assessed on several ecological attributes under the subcategories hydrology, geomorphology and soils, and vegetation. The team works together to identify any ecological attributes that are not functioning as expected. After ecological attributes that are not functioning have been identified, the team assigns the area one of the following ratings: 1) Proper Functioning Condition (PFC), Functional - At Risk (FAR), or Nonfunctional (NF). For PFC and FAR, additional qualifiers of 1) high, 2) mid, or 3) low are added using a thermometer diagram (Figure 1). Additionally, the team may elect to further quantify Functional - At Risk trend. How the team decides on the ratings is based on the amount, severity, and weight of indicators that are not functioning. Most of the lentic areas have a natural potential and were assessed as such. Some, however, have been modified historically and have an altered potential (e.g., spring with dugout reservoir) but are still able to be assessed using PFC.

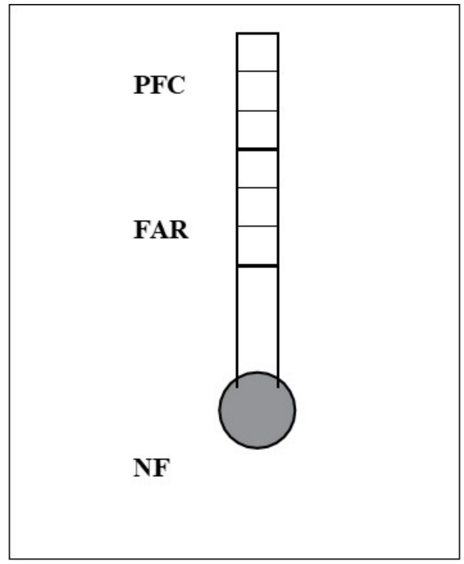


Figure 1 Thermometer diagram to help ID teams visualize where a particular system may rate.

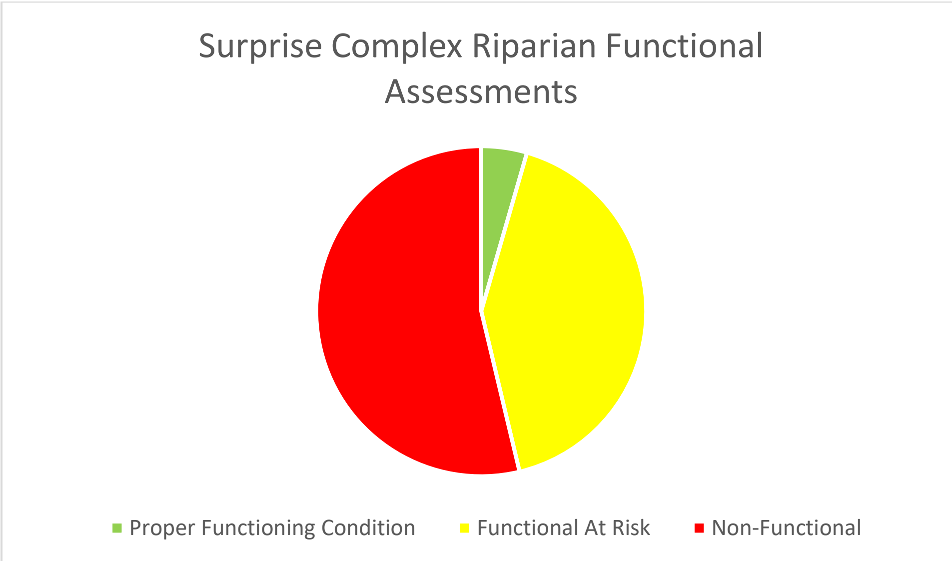
Results

In the Complex, 67 riparian areas were selected to be assessed (map of assessment locations follows report conclusion).

HMA	Total Number of Water Sources	Number of Assessable Water Sources*	Water Sources Assessed	HMA Acres
Massacre Lakes	45	18	6	39,926
Bitner	36	15	4	53,732
Nut Mountain	38	19	3	40,236
Wall Canyon	35	20	5	41,152
High Rock	58	50	12	94,689
Fox Hog	124	89	37	126,939
Surprise Complex	***336***	***211***	***67***	***396,674***

*More than half of potential assessable water sources are have gone dry, no longer produce surface water and do not support riparian vegetation or riparian function, which is a requirement of the PFC assessment.

Some of the same riparian areas were assessed as part of data gathering efforts and informing the 2010 High Rock Complex Horse Gather EA. In general, there are fewer riparian areas with a PFC rating and more with FAR and NF ratings as landscapes continue to be degraded by excessive wild horses. Additionally, natural desiccation has been exacerbated by continued, excessive, overuse by wild horses. Out of the 67 riparian areas in the Complex were assessed; 4 percent (n = 3) were rated as Proper Functioning Condition (PFC), 42 percent (n = 28) were rated as Functional - At Risk (FAR), and 54 percent (n = 36) were rated as Nonfunctional. Most of these riparian areas are small (<5 acres) but are critical areas in arid landscapes.



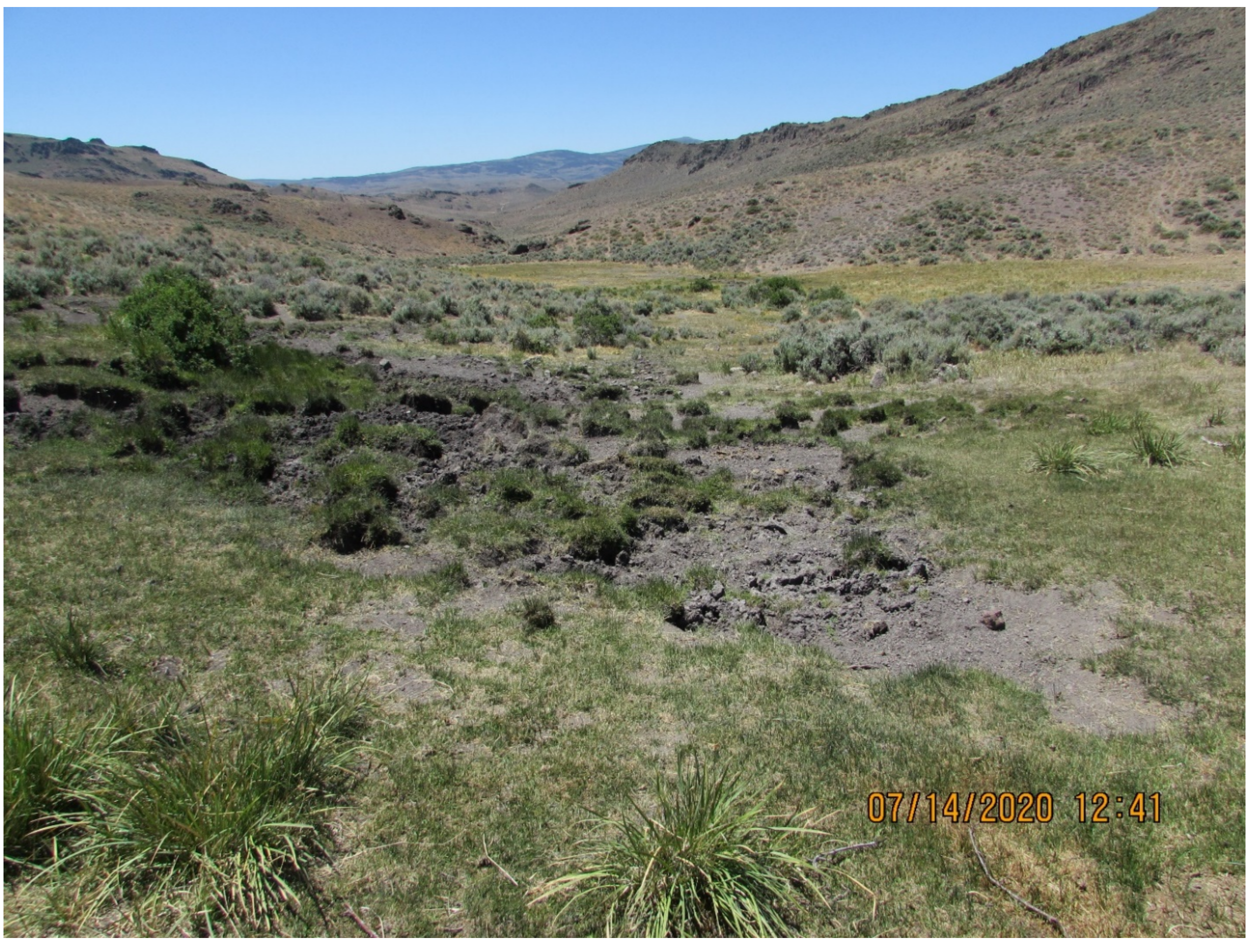
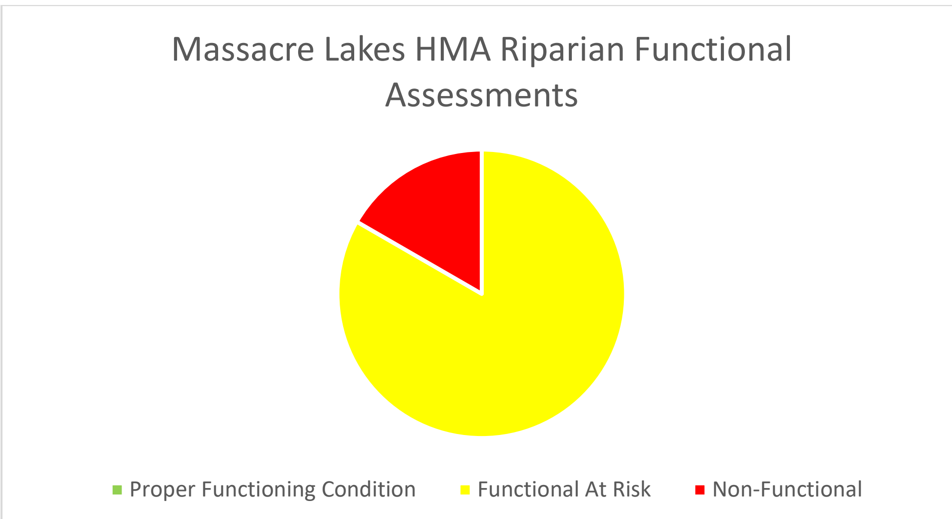


Figure 2 Example of a large, wet meadow complex site that was rated as NF due to loss of hydric soils, erosion, headcuts, lack of riparian vegetation, and large, connected patches of bare ground.

Massacre Lakes HMA

Spring	Date Completed	Rating	Qualifier	Trend	Protected
Sage Hen Spring	28 Sept 2017	NF			No
Alkali Meadows	25 June 2020	FAR	High	Not Apparent	No
Biebe Spring	25 June 2020	FAR	High	Not Apparent	Yes
Indian Spring	25 June 2020	FAR	High	Not Apparent	Yes
Tuffy Spring	25 June 2020	FAR	Mid	Downward	Yes (not maintained)
Post Spring	25 June 2020	FAR	Mid	Upward	Yes



Springs in Massacre Lakes HMA were generally in fair condition, although most of the riparian areas are excluded with off-site water provided. Historically, these riparian areas were severely degraded and are now in various stages of recovery. Some areas are static due to a lack of light disturbance. It should be noted that these areas would benefit from a short, light disturbance, but would quickly return to a degraded state with prolonged and/or heavy disturbance, such as year-round grazing. A few of the riparian areas have a natural non-vegetated potential (e.g., Figure 3). Juniper encroachment into riparian areas of springs and seeps is a concern in this HMA, particularly on the northern end. Juniper contribute to dewatering and lowering of water tables as taproots extend into riparian areas.

Figure 3 Rocky riparian area with a non-vegetated potential.

Proper Functioning Condition

No riparian areas in the Massacre Lakes HMA were rated as PFC.

Functional - At Risk

Biebe Spring is part of a large exclosure that was constructed to protect cultural resources and is not used by wild horses or domestic livestock. Juniper encroachment has led to a shrinking of the riparian area due to dewatering. This spring retains high vegetative diversity and water quantity is adequate to support riparian vegetation. Despite being located on a steep gradient, this spring supports sheet flow (not channelized) and a convex appearance indicating the riparian "sponge" is intact and functioning. Alkali Meadows is a lentic seep located in the former lakebed of Massacre Lakes from an upwelling of groundwater. There are several springs in the area, but most are privately owned. Outwardly, the seep appears to be supporting a diversity of robust vegetation. However, evidence of heavy use during wet seasons is plentiful. Large pugs, hoof shear, and trailing were all observed. Additionally, because of the salinity of the soil, abnormal frost heaving is now occurring on many pugs.

Tuffy Spring has an exclosure around it, but the exclosure is broken and not functioning. It is clearly being used by both wild horses and domestic livestock. This spring has been severely degraded in the past and is continuing to evolve. Historic extents of hydric soils persist 50 m on either side of the exclosure. Additionally, the flow channels are still changing. Hoof sheaf, pugging and trailing are all present and actively contributing to riparian impairment. This spring is missing the wetland obligate and stabilizer functional structural groups and has much more bare ground than expected for the site. Bare ground patches are of moderate size and becoming interconnected. Dewatering issues are being exacerbated by juniper encroachment.

Indian Spring has been excluded from grazing for more than 30 years but shows evidence of being severely degraded historically. Channels are revegetated and becoming more convex. Water is plentiful and supporting riparian vegetation through sheet flow. Much of the area is dominated by mountain rush (*Juncus arcticus*) and lacks wetland obligate and other stabilizer functional groups. This site would very likely benefit from a short, light disturbance and seems to be static in this plant community. Hydrologic function and geomorphology attributes continue to heal. Juniper encroachment may also be contributing to dewatering.

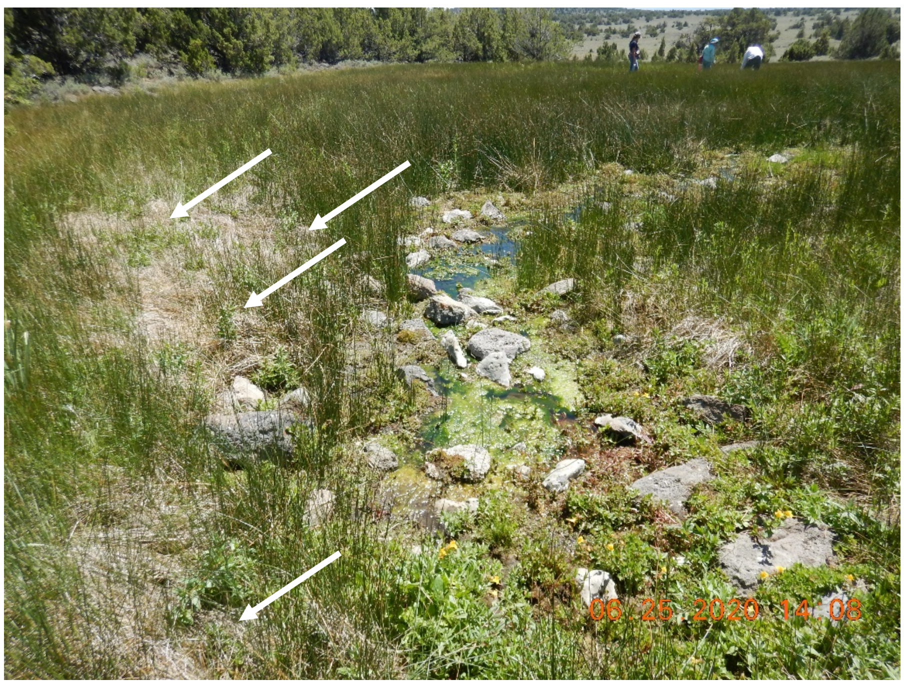


Figure 4 Indian Spring was historically severely degraded, but has been excluded from grazing for more than 30 years. The system is still healing, although the plant community development appears to be static due to lack of short, light disturbance. [Note the accumuluation of thick mats of thatch (white arrows) that suppress plant growth.] Indian Spring was rated as Functional - At Risk – High.

Post Spring is similar to Indian Spring and has been excluded from grazing for at least 30 years. The hydrologic function and geomorphology are still recovering and have not recovered as much of the sponge as Indian Spring. Channels are still visible and not yet supporting a functioning sponge. This site is also lacking wetland obligate and stabilizer functional groups.

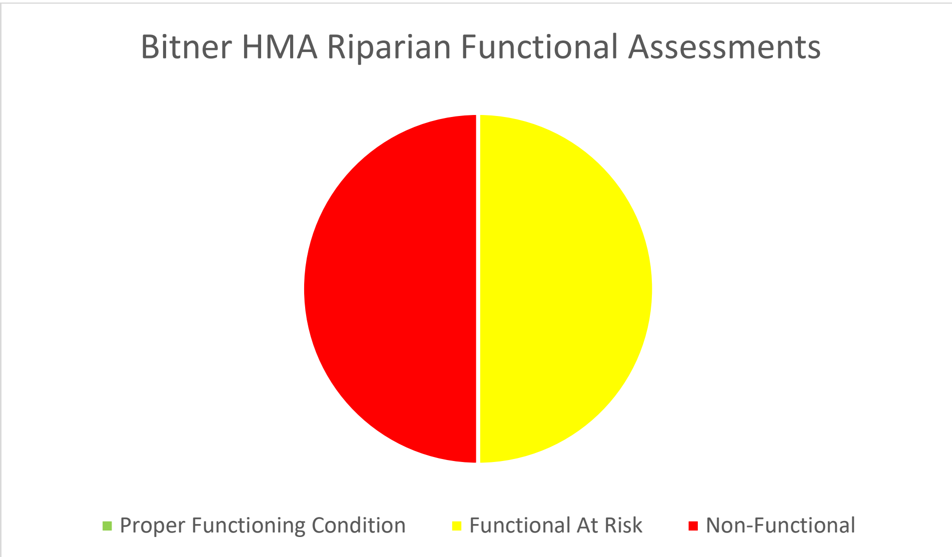
Nonfunctional

Sage Hen Spring is the primary water source in the northern end of the HMA. It was formerly a large spring and mesic wet meadow. Excessive, chronic overuse by almost exclusively wild horses has resulted in degradation and lack of critical functioning ecological attributes leading to a nonfunctional rating. Excessive pugging, trailing, hoof shear, and trampling have disrupted all hydrologic functions. There is very little vegetation left and several functional groups are missing altogether. This large spring complex has been reduced to a mud puddle and the meadow is now xeric.

Figure 5 Sage Hen Spring has been so extremely overused that although it is still producing a small amount of water, all critical hydrologic, geomorphologic, and biologic functions have been severely damaged. Sage Hen Spring was rated as Nonfunctional.

Bitner HMA

Spring	Date Completed	Rating	Qualifier	Trend	Protected
Badger Creek	24 June 2020	FAR	Mid	Downward	No
Evans Creek	24 June 2020	FAR	High	Upward	No
Scabland Seep	05 June 2020	NF			No
Buck Spring	09 June 2020	NF			No



Most water in the Bitner HMA is provided by stock ponds, pit reservoirs, and wells which are not assessed using the Proper Functioning Condition assessment. Badger Creek and Evans Creek are both interrupted lotic systems with sections of surface and subsurface water and were assessed using the lotic PFC manual whereas Scabland Seep and Buck Spring are both lentic systems and assessed using he lentic manual.

Proper Functioning Condition
No riparian areas in the Bitner HMA were rated as PFC.

Functional - At Risk

Figure 6 Badger Creek, an interrupted lotic system, was rated as Functional - At Risk due to lack of woody species (which were found in the adjacent reach which is excluded from grazing) and cutbanks which indicate lateral instability of the system. Badger Creek was rated as Functional - At Risk – Mid.

Badger Creek is an interrupted lotic system. Water surfaces at bedrock outcrops and becomes subterranean with less consolidated materials that lead to more percolation. Plant communities still support wetland obligate species throughout the channel, so water is not far from the surface. Channel evolution still occurring but lacks enough water for continued development. Woody species are absent in reach assessed, but very likely part of potential community (as seen in adjacent exclosure). Some herbaceous recruitment is occurring, but hampered by continual trailing within channel. Plants still present, but cutbanks are common and actively eroding. Trailing is contributing to vertical incision of the channel except in bedrock outcrops. Evans Creek is also an interrupted lotic system in which water surfaces at bedrock outcrops similar to Badger Creek. Evans Creek is generally in good condition and appears to be continuing to improve. Likely has some woody potential with willows. The stream is caught in a historically eroded channel that has not had time to develop adequate sinuosity. It is forming a new floodplain and is now vertically stable. Vegetation communities have all functional groups present. System lacks enough water for continual channel development, but it appears to be happening slowly.

Nonfunctional

Buck Spring was historically a large lentic complex and associated wet meadow. Due to natural desiccation, development, and historic overgrazing, this spring no longer produces surface water. Much topsoil has been lost from this site through excessive erosion and loss of the hydric plant community.

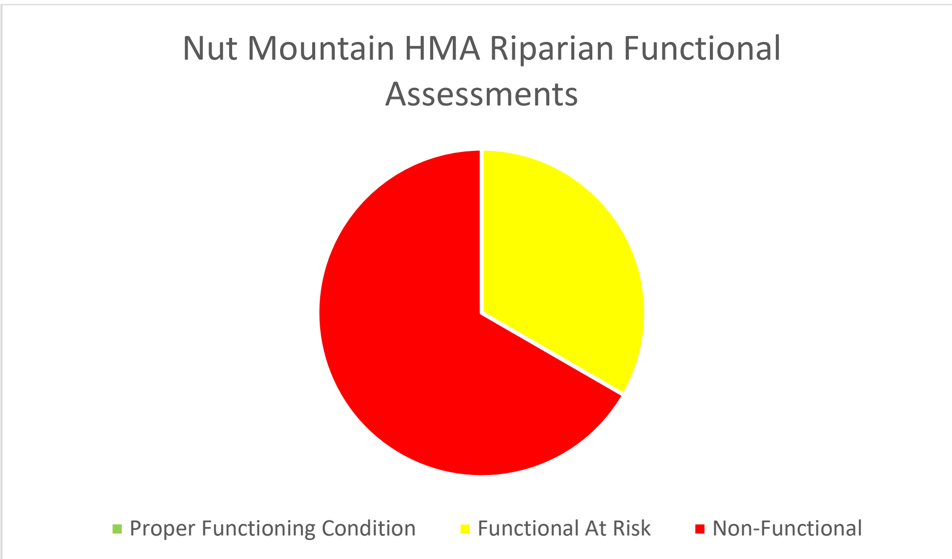
Figure 7 Buck Spring was historically a wet meadow complex, but no longer produces surface water due to lack of ground water recharge and loss of hydric vegetation communities and soils. Buck Spring was rated as Nonfunctional.

Some facultative wetland plants are scattered throughout the site, but upland species such as cheatgrass and sagebrush have encroached due to lack of surface water.

Scabland Seep is on the fenceline between Massacre Lakes and Bitner HMAs. This spring produced water historically as evidenced by historic hydric soils and remnant facultative wetland plant community. The former hydric soils likely retain moisture in the wet season, but excessive hoof action has created a drying effect in this seep. Bare ground patches are still common and healing bare patches have been filled with weedy upland species such as cheatgrass.

Nut Mountain HMA

Spring	Date Completed	Rating	Qualifier	Trend	Protected
Miller & Lux	21 Sept 2017	NF			No
Rock Spring	24 June 2020	FAR	Low	Not Apparent	Yes
Sagebrush Spring	24 June 2020	NF			No



Much like Bitner HMA, most of the water in the Nut Mountain HMA is also provided by stock ponds, pit reservoirs, and wells. There are few natural springs in this HMA.

Proper Functioning Condition
No riparian areas in the Nut Mountain HMA were rated as PFC.

Functional At Risk
Rock Spring was historically degraded and has an altered potential due to a large dug out reservoir. An exclosure was constructed in 2015 to protect the water source. Most of the water is captured in the reservoir but an overflow pipe has created a new channel with some riparian vegetation. The new channel was likely part of the historic lentic area, although historically it was likely sheet flow as opposed to the channelized flow that is now occurring. Historic hydric soils are now dry and populated with weedy facultative upland species such as tumble mustards (e.g., *Sisymbrium altissimum*, *Descurainia pinnata*).

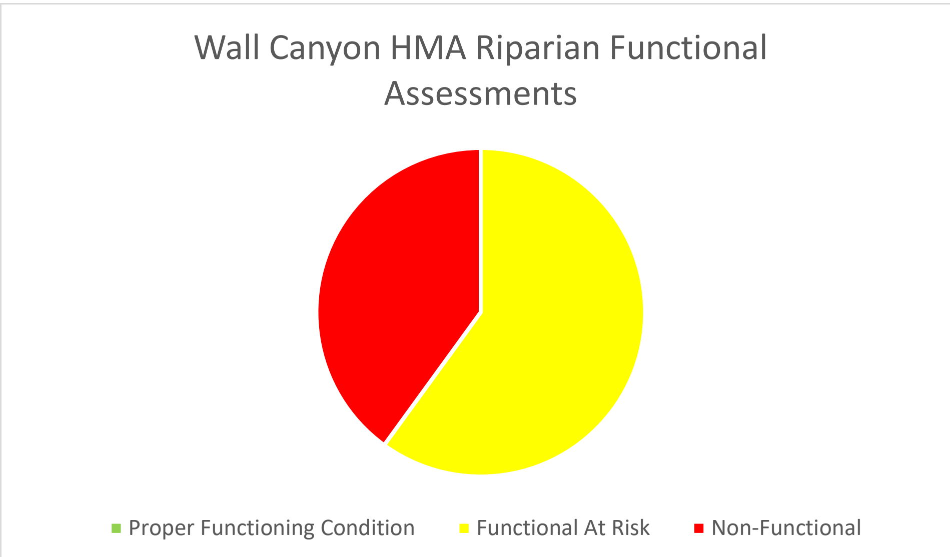
Nonfunctional

Figure 8 Miller and Lux Spring has been so degraded that vegetation is no longer present except in isolated patches. Hydric soils have been exposed and lost due to excessive erosion. Miller and Lux was rated as Nonfunctional.

Miller and Lux is the main natural water source for this HMA. Although the photo from 2017 shows some vegetation subsequent revisits have shown it is devoid of vegetation for approximately 50 meters from the water. Hydrologic and geomorphologic functions are disrupted and not working to capture, store, or safely release water. The spring is still producing some water, but it is muddy and of low quality for drinking. Sagebrush Spring, northwest of Hanging Rock Reservoir, was historically a large lentic wet meadow complex. Evidence of hydric soils persists even though the area is not producing water any longer.

Wall Canyon HMA

Spring	Date Completed	Rating	Qualifier	Trend	Protected
Ramshead Spring	17 June 2020	NF			No
Big John Spring	23 June 2020	FAR	Low	Not Apparent	No
Fountain Spring	23 June 2020	NF			No
Cherry Spring	23 June 2020	FAR	Mid	Downward	No (private)
Cottonwood Creek	23 June 2020	FAR	Mid	Not Apparent	Yes (not maintained)



Wall Canyon HMA has a variety of water sources; pit reservoirs, stock ponds, wells, and both lentic and lotic systems.

Proper Functioning Condition
No riparian areas in the Wall Canyon HMA were rated as PFC.

Functional - At Risk
Many lentic areas in this HMA are at risk because of a combination of natural desiccation and continued, excessive, overuse. Big John Spring is a natural seep that likely still holds some water early in the season and supports facultative wetland species, but has lost wetland obligate plants due to dewatering from both

Figure 9 The headwaters of Cherry Spring seen in this photo are private property, but are an important water source in the Wall Canyon HMA. Interconnected bare ground patches, hoof action, and pugging, and lack of stabilizing vegetation communities make this spring at high risk for further degradation. Cherry Spring was rated as Functional - At Risk – Mid.

natural desiccation and season-long grazing by WHB. Cherry Spring is a large, private spring, but is not fenced from the adjacent public land and is an important water source for the northeast corner of the HMA. Edges of this system are drying and facultative upland species are encroaching. The spring is on a relatively steep gradient which has exacerbated erosion in the thalweg due to trailing, hoof action, and pugging. Some pugs are now abnormally heaving (more than expected for the site). Although all functional groups of vegetation are present, they lack the strong communities to protect the system from overland flow and physical alteration from hoof action of large unglulates. Bare ground is present and patches are becoming interconnected, particularly in the thalweg which puts this system at substantial risk. The reach of Cottonwood Creek that was assessed was a large wet meadow complex south of Sheldon National Wildlife Refuge. Though this system is generally lotic, the potential for this particular reach is lentic. This reach is protected by an exclosure fence, but it is currently not functioning. Edges of the lentic reach are drying and being encroached by facultative upland species. Area has historically been overused and degraded and is still recovering. The system is still somewhat channelized even though the gradient is relatively flat. The channel is beginning to aggrade and push water back out into the meadow which is allowing plant communities to recover. The exclosure needs to be repaired so this system can continue to heal.

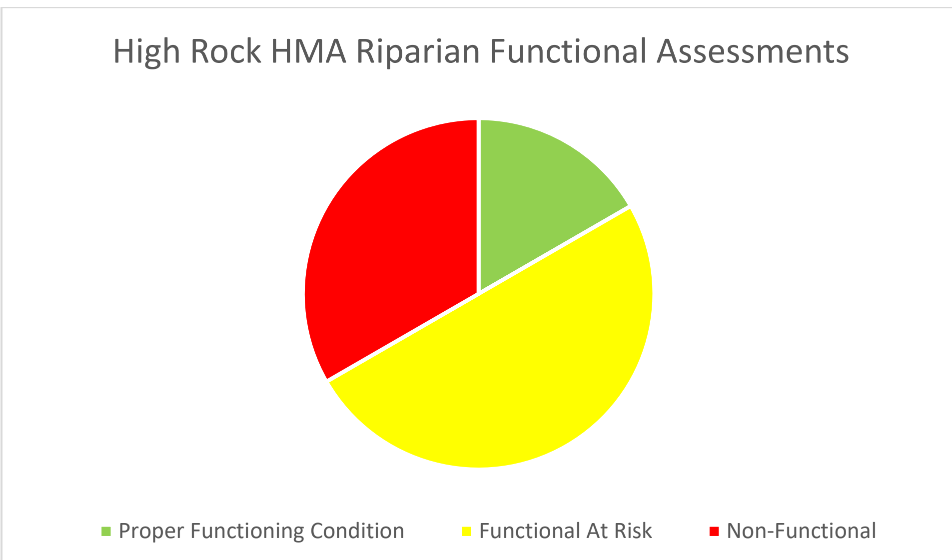
Figure 10 Ramshead Spring has been excessively overused, primarily by wild horses, and has lost most of the critical ecological functions in the hydrology, geomorphology, and biology subcategories. All woody shrubs are excessively browsed and are not reproducing. Ramshead Spring was rated as Nonfunctional.

Nonfunctional

Fountain Spring historically produced quite a bit of water, based on the extent of former hydric soils. It is also a very disturbed system and has a historic impoundment and channelization. It appears that the historic disturbance has punctured the non-permeable layer as this system no long holds any water. Some of the sources are still producing water, but it is immediately absorbed into the soil. The historic impoundment was lined with bentonite and holds a small amount of very muddy water. Even though this spring is severely degraded, it continues to be overused primarily by wild horses. Ramshead Spring is excessively overused and severely degraded. Although there is a potential for woody shrubs, all have been severely hedged and browsed, primarily by wild horses. Loss of hydric soils due to excessive erosion and overuse and loss of most vegetation have all contributed to the lack of function at this spring.

High Rock HMA

Spring	Date Completed	Rating	Qualifier	Trend	Protected
Laxague Spring	26 September 2017	FAR	Mid	Not Apparent	No
Powers Spring	26 September 2017	NF			No
Pappy's Corral Spring	26 September 2017	FAR	Mid	Not Apparent	No
Yellow Rock Spring	26 September 2017	PFC			No
Pole Creek Canyon	28 July 2020	PFC	Mid		No
Nettle Spring	28 July 2020	FAR	Low	Not Apparent	No
Chukar Spring	28 July 2020	NF			No
Conlon Spring	28 July 2020	FAR	High	Not Apparent	No
Cherry Spring	29 July 2020	NF			No
Pronghorn Spring	29 July 2020	FAR	Low	Downward	No
Blind Spring	29 July 2020	FAR	Mid	Not Apparent	No
Done Spring	29 July 2020	NF			No



High Rock HMA is part of the Black Rock Desert – High Rock Canyon NCA and only a small part of this wilderness area still has permitted livestock grazing (western side of the HMA is part of the Massacre Mountain grazing allotment). Wild horses and wild burros that have strayed from other HMAs (High Rock HMA has no burro AML) have access to the entire area.

Proper Functioning Condition
A large wet meadow complex at the delta where Pole Creek Canyon and High Rock Canyon meet was assessed as PFC. The meadow had a good diversity of species and was continuing to recover from

historically severe grazing in which there are still several gullies, but all are vegetated and aggrading. Hydrologic processes are beginning to be restored. Yellow Rock Spring was also assessed as PFC.

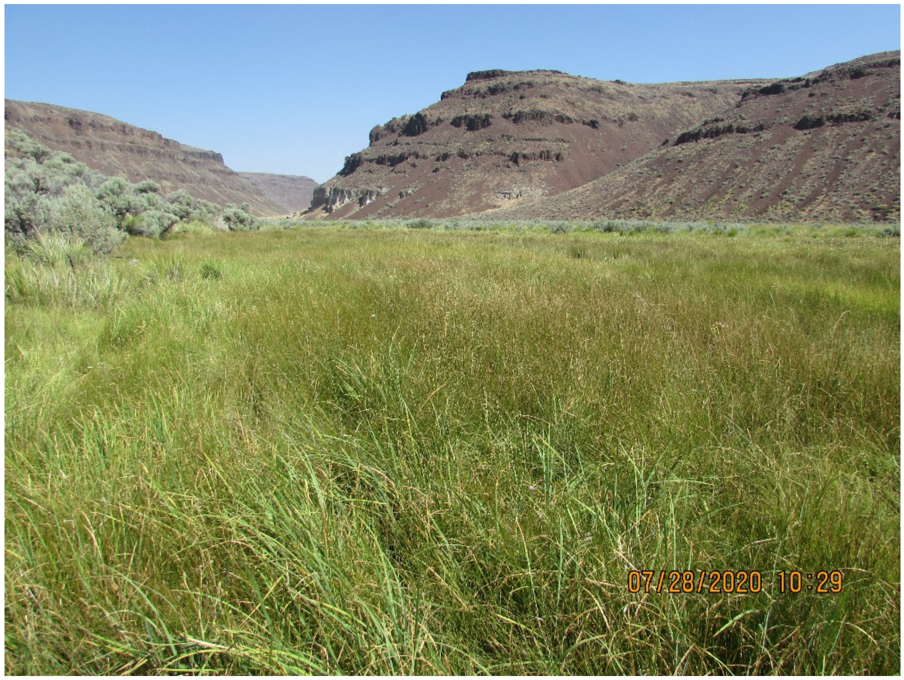


Figure 11 All vegetation functional structural groups present in communities, historically damaged hydrologic processes healing. System is resistant to disturbances and resilient to disturbances that do occur. Pole Creek Canyon was rated as Proper Functioning Condition.

Functional - At Risk

Conlon Spring is a large wet-meadow complex on the southern end of High Rock Canyon and is fed by both Conlon Spring and Mahogany Creek. It has been severely degraded in the past as evidenced by the channelization of what was historically sheet flow over the meadow. Although wetland obligate species are still present, they are only present in the thalweg. Because it is actively still being degraded, the hydrologic processes have not yet recovered.

Nettle Spring is a very small seep on the side of a very steep slope within High Rock Canyon. It has historically been severely overused however because of the steep slope, the soil was relatively thin and it is well armored. It is currently producing a small amount of water however the vegetation is primarily composed of weedy species, such as Canada thistle (*Cirsium arvense*) and stinging nettle (*Urtica dioica*) indicating historical high levels fo soil disturbance.

Both Pronghorn and Blind Spring are still currently receiving heavy use exclusively by wild horses. Blind Spring is naturally more armored than Pronghorn Spring and received a higher rating. Both lack complete functional groups of vegetation and have a large amount of bare ground due to pugging and hoof shear.

Laxague Spring was rated as FAR due to chronic, severe overuse disrupting the hydrology and loss of vegetation within the site. Pappy's Corral Spring has seen and continues to see chronic, severe disturbance from grazing, primarily from wild horses. Large, bare ground patches are well connected, and erosion has been and continues to be excessive. A large headcut and incised channel have dramatically altered this former wet meadow complex. With continued disturbance, this system will likely become nonfunctional.

Nonfunctional

Powers Spring, Cherry Spring, Chukar Spring, and Done Spring were rated as nonfunctional. Chukar Spring is dry likely due to natural desiccation combined with overuse which lowered the water table. It appears to produce water early in the season as evidenced by dry pugs and hoof shears. Powers Spring is still producing a small amount of water but is heavily utilized by wild horses in the fall and early winter. The seep is now eroded into a channelized gully which shunts water off site quickly and does not allow for safe capture, storage or release that would demarcate a healthy riparian area. Cherry Spring is still also producing water but has lost at least 6 feet of topsoil due to the excessive, chronic overuse by wild horses. The source is armored, but the lentic area has lost all vegetation and it is at least 35 meters to the nearest vegetation (tumble mustards and cheatgrass). There is no riparian vegetation left. The small trickle of water is channelized and evaporating (not soaking into the soil). All ecological processes are severely disrupted and recovery for this spring may never be possible. Done Spring is a former lentic seep that is now dry due to a combination of natural desiccation and historic excessive, chronic overuse.

Figure 12 Cherry Spring has had all ecological processes disrupted due to severe, chronic overuse. No plants are present within 35 m of the water source, except shrubs that are protected by rocks. No wetland obligate plant could be located. Cherry Spring was rated as Nonfunctional.

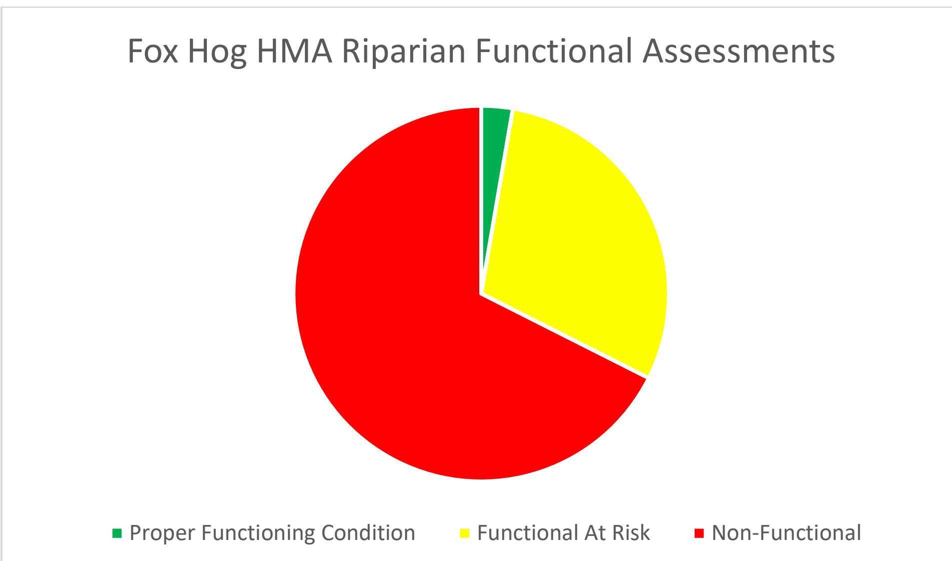
Fox Hog HMA

Fox Hog HMA is the southern-most HMA in the Complex. Most water in lower elevations is available from dugouts and pit reservoirs. As elevation increases, natural springs become more abundant. In general, this HMA has plentiful and well-distributed water sources, although a significant number are privately owned.

Nearly 70% of the areas assessed are in non-functioning condition meaning that they have lost critical functional abilities. When riparian areas have lost critical functions, often they become compromised. Many times this leads to a dewatering of the system and loss of riparian habitat, possibly even the complete loss of a water source. Riparian areas on the western side of the HMA are being excessively used and degraded primarily by wild horses. Moving east, excessive use becomes more evenly split between wild horses and domestic livestock, with a few exceptions, such as Valley View and Metamorphic Springs which are primarily degraded due to chronic, excessive use by wild horses.

Spring	Date Completed	Rating	Qualifier	Trend	Protected
View Spring	13 July 2020	NF			No
Cool Day Spring	13 July 2020	NF			No
Shingle Spring	13 July 2020	NF			No
East Clover Meadow	13 July 2020	FAR	High	Not Apparent	Yes
Dry Spring	13 July 2020	NF			No
Holey Rock Spring	13 July 2020	NF			No
Sunny Day Spring	13 July 2020	NF			No
Lower Meadow	13 July 2020	FAR	Low	Downward	Yes
Pup Spring	13 July 2020	FAR	Low	Downward	No
Bottleneck Spring	14 July 2020	FAR	High	Upward	Yes (not maintained)
Cloud Spring	14 July 2020	NF			No
Maianthemum Spring	14 July 2020	NF			No
Headcut Spring	14 July 2020	NF			No
Hog John Spring	14 July 2020	NF			Yes (small and not maintained)
Iris Spring Complex	14 July 2020	NF			No
Hog Mountain Spring	14 July 2020	NF			No
Cow Spring	14 July 2020	NF			No
Lower Look Spring	15 July 2020	NF			No
Look Spring	15 July 2020	NF			No
Texas Creek Spring	15 July 2020	FAR	Low	Downward	No
Stone Cabin Spring	15 July 2020	FAR	Mid	Upward	No
Corner Spring	15 July 2020	NF			No
Cottonwood Creek Canyon, 75 Dollar Pipeline Reach	15 July 2020	FAR	High	Not Apparent	No
Scarlet Spring	16 July 2020	NF			No
Summit Spring	16 July 2020	NF			No
Anomaly Spring	16 July 2020	FAR	High	Upward	No

Cottonwood Creek, Bitteroot Reach	16 July 2020	FAR	High	Upward	No
Little Antelope Spring	16 July 2020	NF			Yes (small and not maintained)
Big Antelope Spring	16 July 2020	NF			No (private)
Talus Spring	16 July 2020	NF			No
Lost Dog Spring	16 July 2020	PFC	Mid		Yes
Rabbitsfoot Spring	27 July 2020	NF			No
Buttercup Spring	27 July 2020	NF			Yes (not maintained)
Metamorphic Spring	27 July 2020	NF			No
UPValley View Spring	27 July 2020	NF			No
U00213	27 October 2017	FAR	Low	Downward	No
U00215	27 October 2017	FAR	Low	Downward	No



Proper Functioning Condition

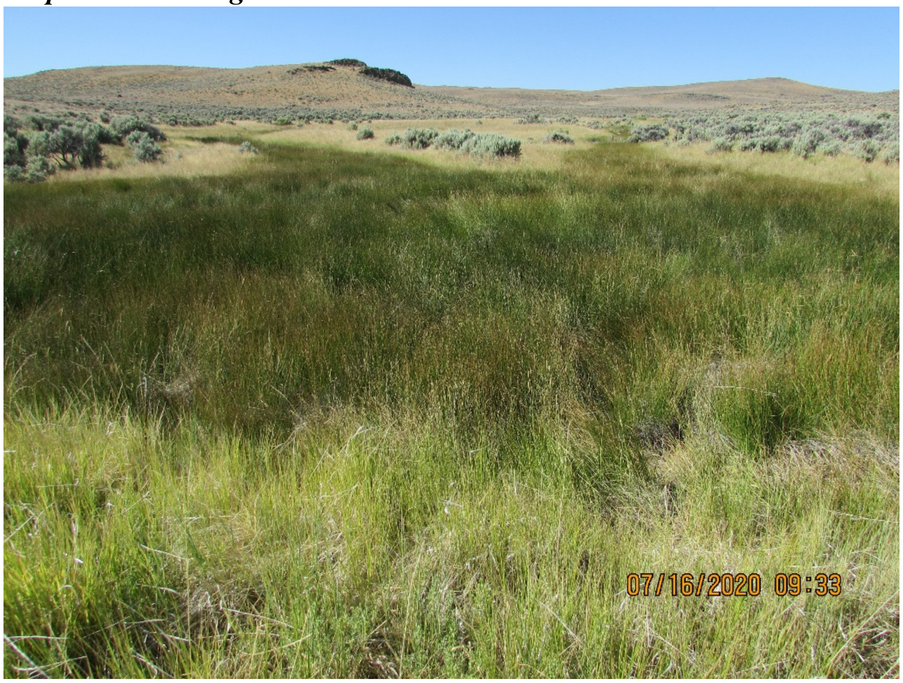


Figure 13 Lost Dog Meadow is still recovering from severe historical degradation. Channels have re-vegetated and are aggrading. Lost Dog Meadow was rated as Proper Functioning Condition.

Lost Dog Meadow was the only spring in the Fox Hog HMA was rated as PFC. Lost Dog Spring has an exclosure that prevents grazing by large ungulates and has allowed recovery of this historically severely degraded system. Although there is still historical channelization, rock gabions have increased channel aggradation.

Functional - At Risk

Twelve springs were rated as FAR in the Fox Hog HMA. FAR ratings mean that one or more indicators are lacking but it is not the same indicator for all systems. These systems are at risk for further loss of function if degradation continues.

FAR-*High*

Six riparian areas were rated as FAR-High. East Clover Meadow, a large mesic meadow, was historically very degraded and is recovering due to an exclosure fence. It is still enlarging back to historical proportions and slowly re-wetting dried "islands" of facultative upland vegetation. It is missing the entire stabilizing wetland obligate structural functional group which kept it out of the PFC rating. Bottleneck Spring also has an exclosure fence which needs repair. This spring has historically been very degraded and the degradation has been exacerbated by a steep gradient. A lack stabilizing wetland obligates also kept this spring out of the PFC rating.

Figure 14 The only indicator keeping Cottonwood Creek Canyon out of the PFC rating was the undercut banks leading to some slumping and sloughing. Cottonwood Creek Canyon was rated as Functional - At Risk – High.

Cottonwood Creek Canyon (75 Dollar pipeline reach) is one of the few lotic systems in this HMA. Most of the functions of this system are intact, but it still has a few undercut banks that are have minor active slumping and sloughing and these attributes are keeping this system out of PFC. Cottonwood Creek (Bitterroot reach) is an intermittent lotic system after it loses the gradient from Fox Mountain. This system also is laterally instable and is entrenched within the banks, so there is little room for channel evolution. Lack of perennial water is also contributing to a loss of channel evolution, though this appears to be a combination of bedrock control and natural desiccation. Anomaly Spring was also rated as FAR-High since this spring is very obviously not stable and continues to change shape. It may be expanding, although it is probably dependent on annual groundwater recharge. This artesian spring is in a curious location as the geology does not suggest water discharge.

FAR-Mid

Only one spring was rate in FAR-Mid, Stone Cabin Spring. This alkaline seep has very clearly seen a high amount of historical disturbance and may have even been deliberately dug into a ditch by settlers. It is slowly recovering and has all classes of vegetation present. Lack of deep rooted stabilizing vegetation, wetland obligates, elongation due to channelization and gradient of source, historic pugging, trailing, and alterations all contributed to this FAR-Mid rating.

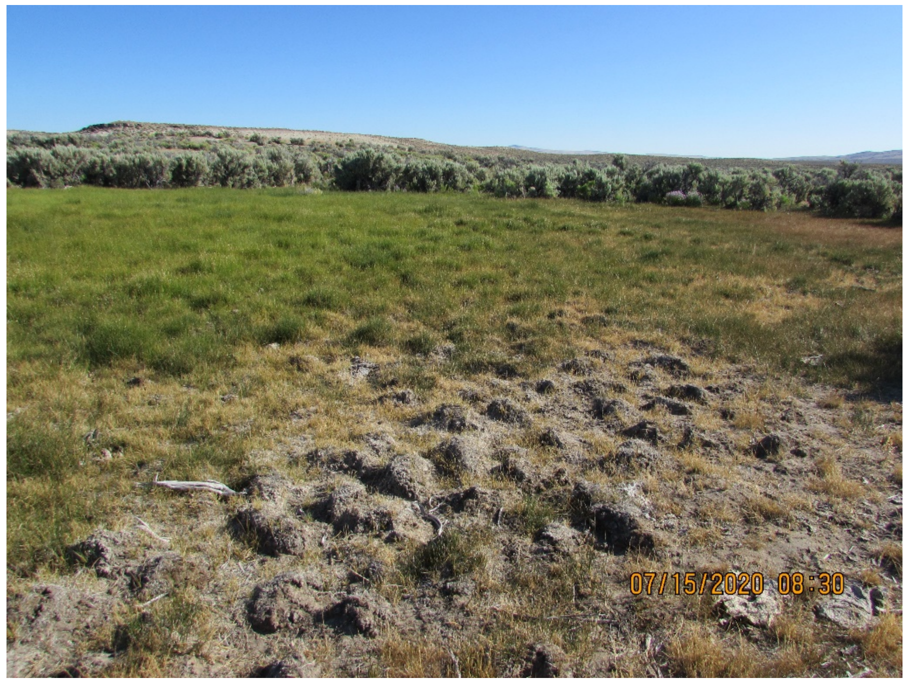


Figure 15 The deep pugging combined with the natural alkalinity of this spring has contributed abnormal hydrologic heaving as evidenced by the lack of vegetation and steep angle of repose on the heaves. Stone Cabin Spring was rated as Functional - At Risk – Mid.

FAR-Low

Lower Spring Meadow, a mesic meadow protected by an exclosure was rated as FAR-Low because the exclosure is not placed appropriately and is not protecting the spring source. Excessive trailing has created a new terrace disconnecting the water from the original lentic meadow. With continued overuse of the source, and no

Figure 16 The source for Lower Meadow Spring is outside this exclosure fence. Excessive trailing and trampling has created a diversion and now water is flowing down the trail instead of the riparian area. This spring is at serious risk for loss of ecological function. Lower Meadow Spring was rated as Functional - At Risk – Low.

resolution to the misplacement of the exclosure fence, this system will continue to lose ecological function and is in danger of becoming nonfunctional. Pup Spring is an alkaline seep that is shrinking due to excessive overuse, dewatering due to alterations, pugging, and trailing. The edges are drying and riparian vegetation is being replaced by upland species. RFA U000213 and RFA U000215 are both at risk of complete functionality due to dewatering and desiccation. Natural desiccation is occurring and being exacerbated by excessive use.

Nonfunctional

The majority of springs in the Fox Hog HMA were rated as NF. Across all the springs, they are rated as NF due to major disruptions of critical ecological processes. Many springs have been naturally desiccated as climates warms and precipitation changes from snow to rain. Groundwater is not recharging as it was historically, so many of the springs are now dry. However, natural desiccation has assuredly been exacerbated in most cases by chronic, excessive overuse. Lowering of the water table, dewatering of systems, loss of vegetative functional, structural groups, loss of hydric soils, large, connected patches of bare ground, headcuts, gullies, severe pugging, and excessive erosion are all common to these nonfunctional systems.

Figure 17 Excessive trampling and pugging has lowered the water table and is exacerbated by a trail in the bottom of this drainage that has become a six foot gully. Cool Day Spring was rated as Nonfunctional.

Figure 18 Complete loss of vegetation due to excessive overuse and trampling has led extreme erosion of the hydric soils, complete loss of hydric vegetation, and total disruption of ecosystem goods and services. Valley View Spring was rated as Nonfunctional.

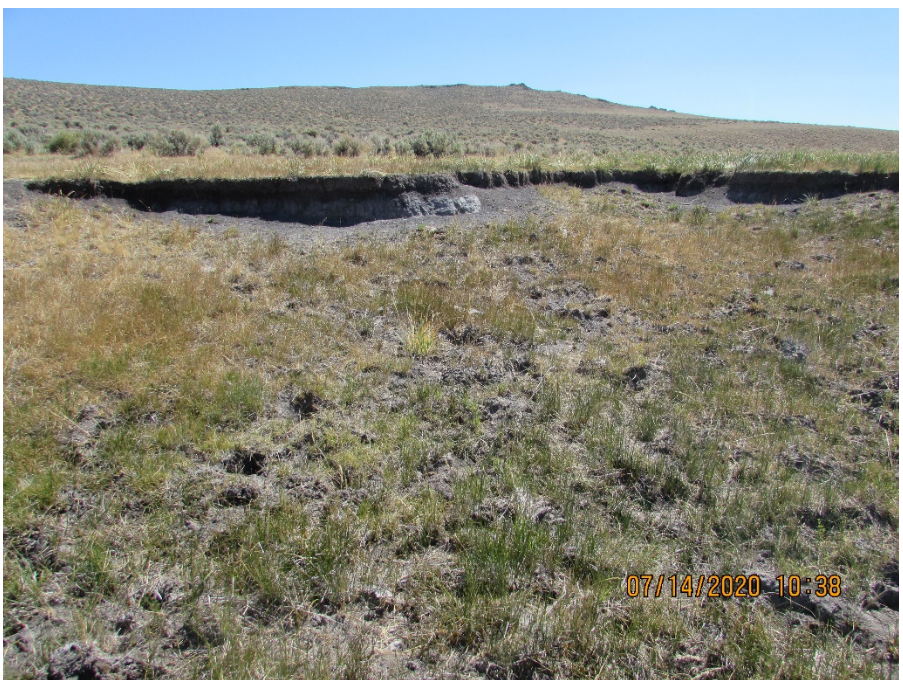


Figure 19 Lowering of the ground water coupled with decreased ground water recharge and exacerbated by severe, chronic overuse has completed desiccated this spring. The headcut show in this photo is approximately 24 inches high, and one of several in this spring. Iris Spring Complex was rated as Nonfunctional.

Repeat RFAs

Of the 67 site visits included in this report, 27 of them were repeats from previous years. Four percent (n = 1) were up in rating from a previous rating, 33 (n = 9) percent were static, meaning the rating had not changed, and 63 percent (n = 17) were down in rating from the previous rating.

HMA	Spring	Previous name (2011)	2011 EA	2020 EA	Trend
Massacre Lakes	Sage Hen Spring		NF	NF	Static
	Alkali Meadows		FAR	FAR	Static
Nut Mountain	Miller & Lux Spring		NF	NF	Static
	Rock Spring		FAR	FAR	Static
Wall Canyon	Cherry Spring		FAR	FAR	Static
	Big John Spring	Unnamed spring #1, U 00197	FAR	FAR	Static
	Fountain Spring		NF	NF	Static
High Rock	Powers Spring		FAR	NF	Down
	Pappy's Corral Spring		FAR	FAR	Static
	Yellow Rock Spring		FAR	PFC	Up
Fox Hog	Rabbitsfoot Spring	Mid No Savvy Creek	PFC	NF	Down
	Lower Look Spring	Look Spring	FAR	NF	Down
	Texas Creek Spring	Upper Texas Creek	FAR	NF	Down
	Cottonwood Creek Canyon	Upper Cottonwood Creek	PFC	FAR	Down
	Cow Spring	Unnamed undeveloped spring	FAR	NF	Down
	Buttercup Spring		FAR	NF	Down
	Maianthemum Spring	Riparian above Leadville spring	FAR	NF	Down
	Cloud Spring	Unnamed seep #1	FAR	NF	Down
	Headcut Spring	Seep Complex #3	FAR	NF	Down
	Sunny Day Spring	Unnamed dry meadows #2	FAR	NF	Down
	Dy Spring	Unnamed dry meadows #3	FAR	NF	Down
	Valley View Spring	Unnamed riparian drainage reach 1	FAR	NF	Down
	Valley View Spring	Unnamed riparian drainage reach 2	FAR	NF	Down
	Anomaly Spring	Unnamed/unidentified spring near Cottonwood Creek Rd	FAR	FAR	Static
	Talus Spring		NF	NF	Static
	Hog Mountain Spring	25-14	FAR	NF	Down

Conclusion

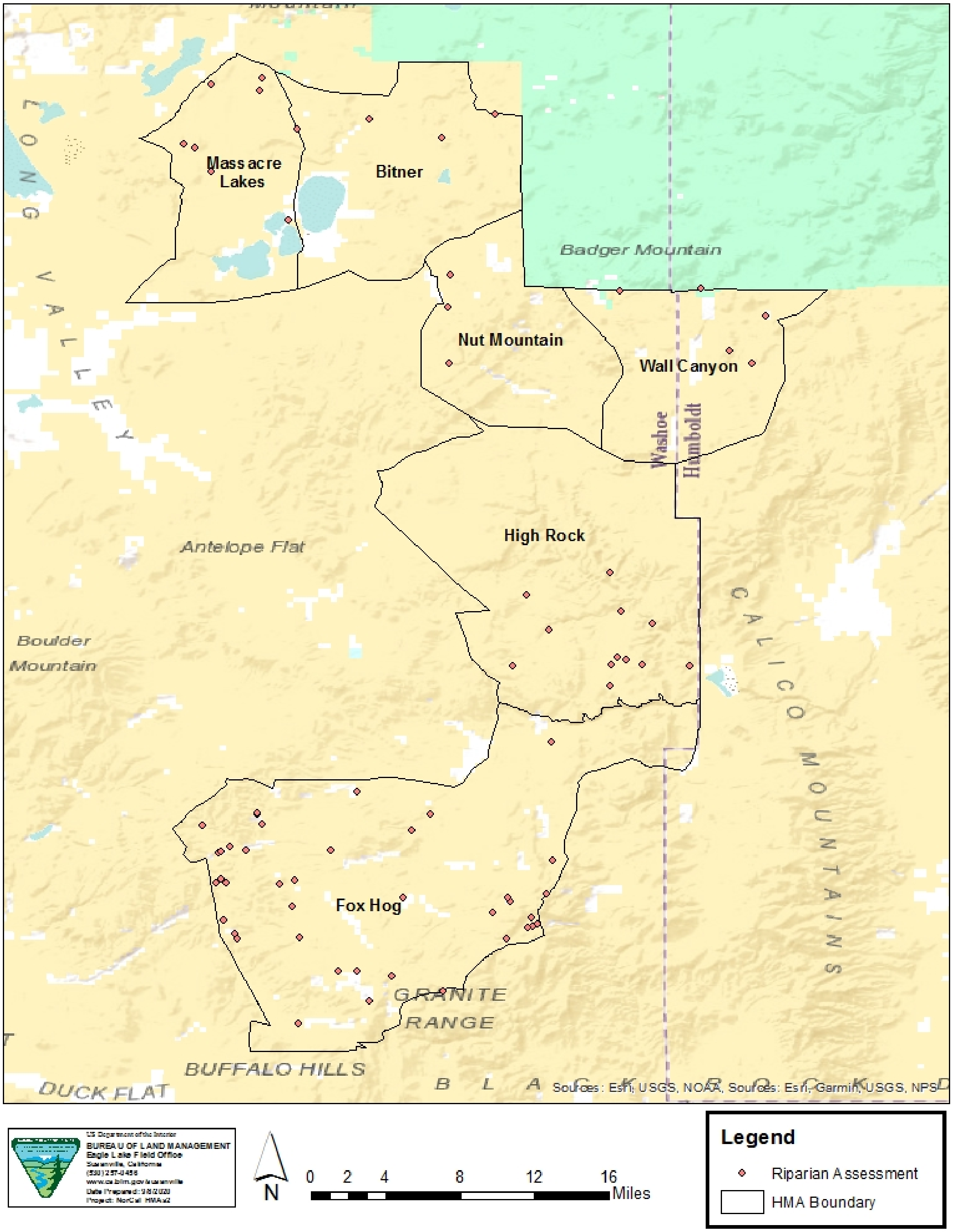
The lack of riparian areas rated as PFC is concerning. Of those rated as FAR-High, most have a grazing exclosure and provide off-site water outside the exclosure. That is not to say that grazing contradicts systems in PFC or FAR-High, there are examples of systems in both High Rock and Fox Hog HMAs that both have grazing and are in very good condition. In fact, complete lack of grazing leads to a stagnation of vegetation communities and healing of hydrologic processes, as evidenced by several systems in the Massacre Lakes HMA. Most of the riparian areas in this study are at risk for further impairment from chronic, excessive overuse. Many are completely lacking wetland obligate structural functional vegetation group. Without removal of the year round disturbance from wild horses, these systems may be irreversibly damaged or completely lost.

Interdisciplinary Team

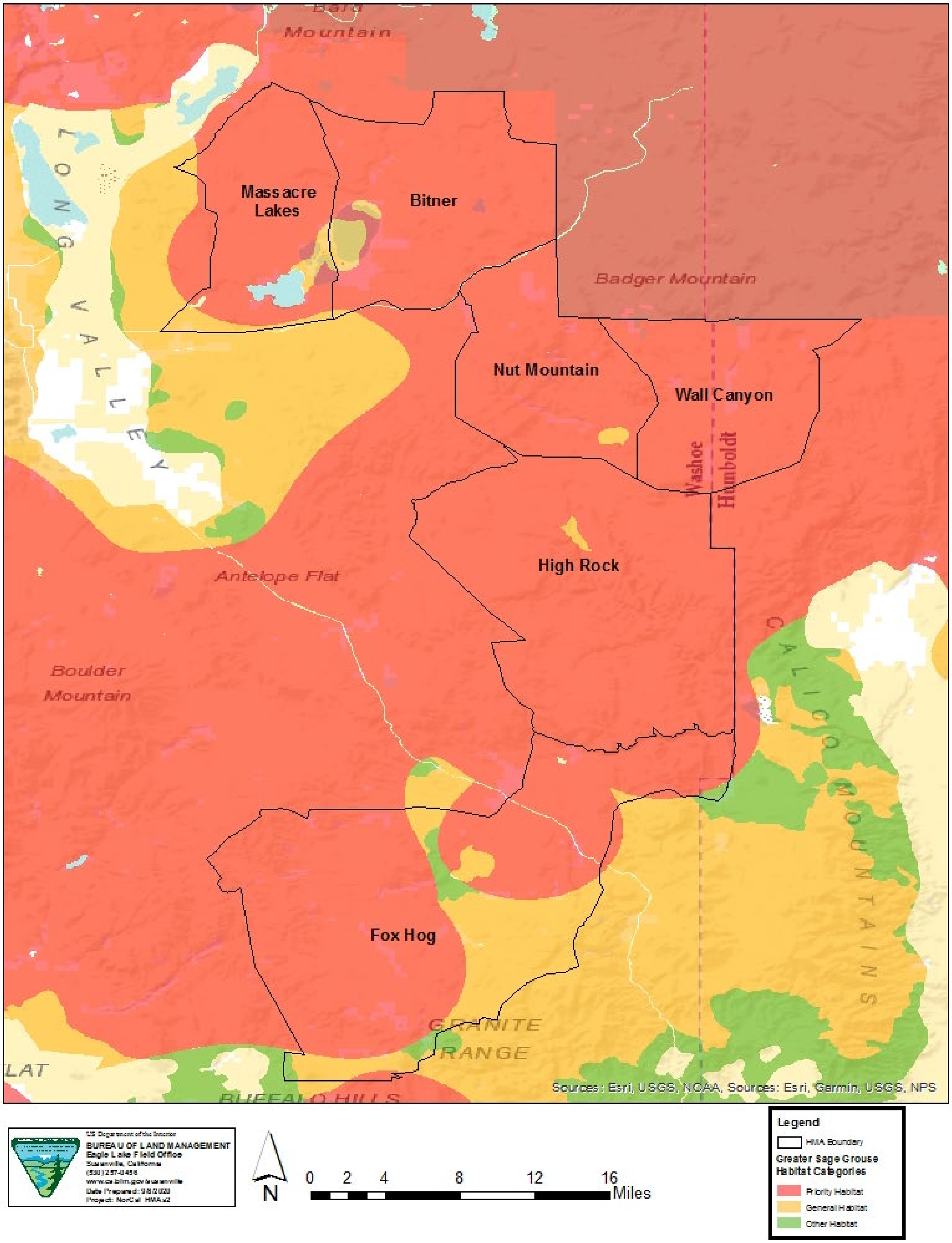
Interdisciplinary team members, position, and report contributions:

Name	Position	Responsibilities
Amanda Gearhart	Wild horse & burro specialist, IDT lead	Vegetation, geomorphology, hydrology
Mike Eytchison	Range Management Specialist	Vegetation
Jennifer Millar	Range Management Specialist	Vegetation
Steve Mathews	Supervisory Range Management Specialist	Vegetation
Craig Drake	Field Manager	Hydrology
Jennifer Mueller	Wildlife Technician	ID team member
John Morris	Wildlife Biologist	ID team member

Riparian Assessment Locations



Appendix K. Map of Greater Sage-Grouse Habitat within the Surprise Complex



Appendix L. Historical Gather and Release Record from Surprise Complex

The table below reflects the ongoing nature of the gather and removal cycle from the Surprise Complex from early 1980's. This table was created from queries into the Wild Horse and Burro Program System (WHBPS) database and internal BLM documents.

Date	Number Gathered	Estimated Number Not Gathered	Number Released	Number Removed
Fox Hog HMA: AML 120-226				
1981	27	0	0	27
1986	138	50	0	138
1989	100	50	0	100
1999	359	163	82	278
2001	86	N/A	0	86
2005	526	72	51	475
2011	375	16	110	265
High Rock HMA – Little High Rock Home Range				
1981	94	20	7	87
1986	92	30	0	92
1990	52	16	24	28
2001	389	41	12	374
2008	168	26	20	148
2011				
High Rock HMA – East of Canyon Home Range				
1981	25	30	0	0
1985	102	45	0	102
1988	53	4	33	20
1993	67	4	31	36
2000	210	0	62	148

2006	200	88	0	200
2011*	398	43	37	361
Wall Canyon HMA: AML 15-25				
1988	142	N/A	19	123
1993	82	9	15	67
2000	136	5	14	122
2007	113	8	10	103
2011	102	34	0	102
Massacre Lakes HMA: AML 25-45				
1984	138	10	0	138
1988	25	N/A	11	14
Bitner HMA: AML 15-25				
1980	145	48	0	145
1984	73	13	0	73
1988	33	N/A	13	20
1993	14	7	8	6
2007	67	19	3	64
2011	72	15	11	61
Nut Mountain HMA: AML				
1988	70	N/A	30	40
1993	36	4	26	10
2000	107	13	23	84
2007	149	32	10	139
2011	57	5	26	31

Appendix M. 2012 Surprise Complex Individual HMA Genetic Reports

Genetic reports were available for Bitner, Nut Mountain, Wall Canyon, High Rock, and Fox Hog HMAs. Genetic data has not been collected for Massacre Lakes HMA.

Genetic Analysis of the
Bitner HMA, CA0267

E. Gus Cothran

May 15, 2012

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The following is a report of the genetic analysis of the Bitner HMA, CA0267.

A few general comments about the genetic variability analysis based upon DNA microsatellites compared to blood typing. The DNA systems are more variable than blood typing systems, thus variation levels will be higher. Variation at microsatellite loci is strongly influenced by allelic diversity and changes in variation will be seen in allelic measures more quickly that at heterozygosity, which is why more allelic diversity measures are calculated. For mean values, there are a greater proportion of rare domestic breeds included in the estimates than for blood typing so relative values for the measures are lower compared to the feral horse values. As well, feral values are relatively higher because the majority of herds tested are of mixed ancestry which results in a relatively greater increase in heterozygosity values based upon the microsatellite data. There are no specific variants related to breed type so similarity is based upon the total data set.

METHODS

A total of 12 samples were received by Texas A&M University, Equine Genetics Lab on November 11, 2011 and 9 samples on January 5, 2012. DNA was extracted from the samples and tested for variation at 12 equine microsatellite (mSat) systems. These were *AHT*4, *AHT*5 *ASB*2, *ASB*17, *ASB*23*, HMS*3, *HMS*6, *HMS*7, *HTG*4, *HTG*10, *LEX*33, and *VHL*20. These systems were tested using an automated DNA sequencer to separate Polymerase Chain Reaction (PCR) products.

A variety of genetic variability measures were calculated from the gene marker data. The measures were observed heterozygosity *(Ho)* which is the actual number of loci heterozygous per individual; expected heterozygosity *(He),* which is the predicted number of heterozygous loci based upon gene frequencies; effective number of alleles *(Ae)* which is a measure of marker system diversity; total number of variants *(TNV)*; mean number of alleles per locus (*MNA*); the number of

rare alleles observed which are alleles that occur with a frequency of 0.05 or less (*RA*); the percent of rare alleles (*%RA*); and estimated inbreeding level *(Fis)* which is calculated as 1-*Ho/He*.

Genetic markers also can provide information about ancestry in some cases. Genetic resemblance to domestic horse breeds was calculated using Rogers' genetic similarity coefficient, *S.* This resemblance was summarized by use of a restricted maximum likelihood (RML) procedure.

RESULTS AND DISCUSSION

Variants present and allele frequencies are given in Table 1. No variants were observed which have not been seen in horse breeds. Table 2 gives the values for the genetic variability measures of the Bitner HMA herd. Also shown in Table 2 are values from a representative group of domestic horse breeds. The breeds were selected to cover the range of variability measures in domestic horse populations. Mean values for feral herds (based upon data from 126 herds) and mean values for domestic breeds (based upon 80 domestic horse populations) also are shown.

Mean genetic similarity of the Bitner HMA herd to domestic horse breed types are shown in Table 3. A dendrogram of relationship of the Bitner HMA herd to a standard set of domestic breeds is shown in Figure 1.

Genetic Variants: A total of 71 variants were seen in the Bitner HMA herd which is just below the mean for feral herds and well below the mean for domestic breeds. Of these, 18 had frequencies below 0.05 which is a high percentage of variants at risk of future loss. Allelic diversity as represented by *Ae* is slightly below the average for feral herds as is *MNA*. The low *TNV* may partly be explained by sample size but as all diversity values are on the low side this does not completely explain the values.

Genetic Variation: Observed heterozygosity in the Bitner HMA herd is above the feral mean while *He* is only slightly higher than average. *Ho* is higher than *He.* Differences such as this can indicate a recent reduction in population size, within the past few generations, and this is consistent with the other levels of diversity but this not possible to confirm by DNA data alone.

Genetic Similarity: Overall similarity of the Bitner HMA herd to domestic breeds was about average for feral herds. Highest mean genetic similarity of the Bitner HMA herd was with Light Racing and Riding breeds, followed by the North American Gaited breeds. As seen in Fig. 1 the Bitner HMA herd clusters within Light Racing and Riding breeds, closest to the Quarter Horse. These results indicate a herd with riding horse origins.

SUMMARY

Genetic variability of this herd is just above the feral mean for heterozygosity levels and slightly less than average for allelic diversity. There is a high percentage of variation that is at risk. There is a possibility that this herd has seen a recent loss of population size which would increase the risk to genetic diversity. DNA heterozygosity values are highly dependent on allelic diversity and the levels for this herd could decline rapidly if there is further loss of alleles. Genetic similarity results suggest a herd with riding horse or even Quarter Horse ancestry.

RECOMMENDATIONS

Current variability levels are just high enough that no immediate action is needed. However, the herd should be monitored closely due to the high proportion of rare alleles and because allelic diversity already is low. Herd size should be maintained at the highest numbers possible until the next gather.

Table 1. Allele frequencies of genetic variants observed in Bitner HMA feral horse herd.

VHL20															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**					
0.333	0.000	0.000	0.024	0.214	0.048	0.024	0.119	0.024	0.214	0.000					
HTG4															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.000	0.262	0.000	0.643	0.024	0.071	0.000	0.000	0.000						
AHT4															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**					
0.572	0.071	0.214	0.095	0.000	0.000	0.000	0.024	0.024	0.000	0.000					
HMS7															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.214	0.286	0.333	0.024	0.143	0.000	0.000	0.000	0.000						
AHT5															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.524	0.095	0.048	0.000	0.333	0.000	0.000	0.000	0.000						
HMS6															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.000	0.119	0.000	0.215	0.095	0.071	0.500	0.000	0.000						
ASB2															
B	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**					
0.000	0.048	0.000	0.263	0.000	0.190	0.190	0.214	0.000	0.000	0.095					
HTG10															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**			
0.000	0.285	0.000	0.048	0.024	0.071	0.095	0.310	0.000	0.000	0.143	0.024	0.000			
HMS3															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**				
0.000	0.262	0.000	0.000	0.000	0.071	0.071	0.358	0.167	0.000	0.071	0.000				
ASB17															
D	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**
0.000	0.000	0.024	0.024	0.000	0.000	0.000	0.000	0.286	0.119	0.095	0.000	0.000	0.404	0.048	0.000
ASB2															
G	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**
0.000	0.000	0.024	0.190	0.310	0.000	0.024	0.000	0.000	0.000	0.000	0.000	0.190	0.000	0.262	0.000
LEX33															
F	**G**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**				
0.000	0.119	0.143	0.310	0.000	0.000	0.071	0.000	0.167	0.190	0.000	0.000				

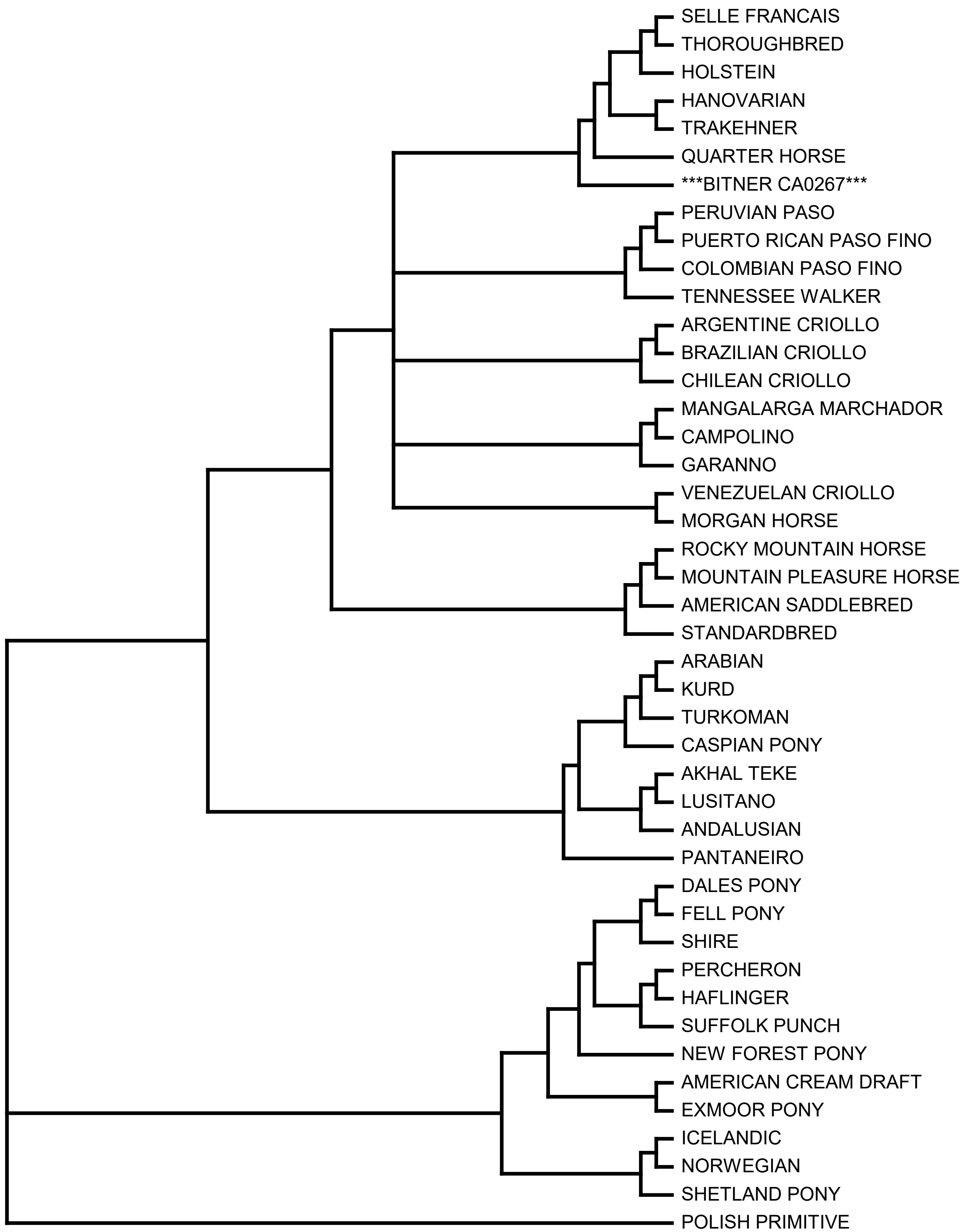
Table 2. Genetic variability measures.

	N	*Ho*	*He*	*Fis*	*Ae*	*TNV*	*MNA*	*Ra*	*%Ra*
BITNER CA	**21**	**0.734**	**0.713**	**-0.029**	**3.78**	**71**	**5.92**	**18**	**0.254**
Cleveland Bay	47	0.610	0.627	0.027	2.934	59	4.92	16	0.271
American Saddlebred	576	0.740	0.745	0.007	4.25	102	8.50	42	0.412
Andalusian	52	0.722	0.753	0.041	4.259	79	6.58	21	0.266
Arabian	47	0.660	0.727	0.092	3.814	86	7.17	30	0.349
Exmoor Pony	98	0.535	0.627	0.146	2.871	66	5.50	21	0.318
Friesian	304	0.545	0.539	-0.011	2.561	70	5.83	28	0.400
Irish Draught	135	0.802	0.799	-0.003	5.194	102	8.50	28	0.275
Morgan Horse	64	0.715	0.746	0.041	4.192	92	7.67	33	0.359
Suffolk Punch	57	0.683	0.711	0.038	3.878	71	5.92	13	0.183
Tennessee Walker	60	0.666	0.693	0.038	3.662	87	7.25	34	0.391
Thoroughbred	1195	0.734	0.726	-0.011	3.918	69	5.75	18	0.261
Feral Horse Mean	126	0.716	0.710	-0.012	3.866	72.68	6.06	16.96	0.222
Standard Deviation		0.056	0.059	0.071	0.657	13.02	1.09	7.98	0.088
Minimum		0.496	0.489	-0.284	2.148	37	3.08	0	0
Maximum		0.815	0.798	0.133	5.253	96	8.00	33	0.400
Domestic Horse Mean	80	0.710	0.720	0.012	4.012	80.88	6.74	23.79	0.283
Standard Deviation		0.078	0.071	0.086	0.735	16.79	1.40	10.11	0.082
Minimum		0.347	0.394	-0.312	1.779	26	2.17	0	0
Maximum		0.822	0.799	0.211	5.30	119	9.92	55	0.462

Table 3. Rogers' genetic similarity of the Bitner HMA feral horse herd to major groups of domestic horses.

	Mean *S*	Std	Minimum	Maximum
Light Racing and Riding Breeds	0.768	0.020	0.729	0.785
Oriental and Arabian Breeds	0.742	0.023	0.721	0.781
Old World Iberian Breeds	0.735	0.023	0.712	0.773
New World Iberian Breeds	0.730	0.022	0.687	0.749
North American Gaited Breeds	0.747	0.022	0.719	0.781
Heavy Draft Breeds	0.679	0.062	0.603	0.778
True Pony Breeds	0.684	0.028	0.636	0.707

Figure 1. Partial RML tree of genetic similarity to domestic horse breeds.


SELLE FRANCAIS
THOROUGHBRED
HOLSTEIN
HANOVARIAN
TRAKEHNER
QUARTER HORSE
BITNER CA0267
PERUVIAN PASO
PUERTO RICAN PASO FINO
COLOMBIAN PASO FINO
TENNESSEE WALKER
ARGENTINE CRIOLLO
BRAZILIAN CRIOLLO
CHILEAN CRIOLLO
MANGALARGA MARCHADOR
CAMPOLINO
GARANNO
VENEZUELAN CRIOLLO
MORGAN HORSE
ROCKY MOUNTAIN HORSE
MOUNTAIN PLEASURE HORSE
AMERICAN SADDLEBRED
STANDARDBRED
ARABIAN
KURD
TURKOMAN
CASPIAN PONY
AKHAL TEKE
LUSITANO
ANDALUSIAN
PANTANEIRO
DALES PONY
FELL PONY
SHIRE
PERCHERON
HAFLINGER
SUFFOLK PUNCH
NEW FOREST PONY
AMERICAN CREAM DRAFT
EXMOOR PONY
ICELANDIC
NORWEGIAN
SHETLAND PONY
POLISH PRIMITIVE

Appendix 1. DNA data for the Bitner HMA, CA herd.

AID	VHL20	HTG4	AHT4	HMS7	AHT5	HMS6	ASB2	HTG10	HMS3	ASB17	ASB23	LEX33	LEX3
56065	II	MM	JK	JL	JN	MP	MM	IO	IO	MO	JU	GL	NN
56066	MR	KM	HH	JL	JN	MP	KK	OR	II	MM	SU	GO	MM
56067	IM	MM	JK	KL	JN	KM	MO	IR	OP	OR	JK	GR	HH
56068	IM	KM	HI	KL	JJ	KN	KO	IN	IR	RR	JU	LR	MM
56069	IP	KM	HK	KL	JN	KP	KM	IO	OO	MR	SU	LR	HN
56070	IR	MM	HJ	JN	NN	MP	IR	OR	IO	MS	KU	KK	HK
56071	IN	KM	HJ	LL	JJ	PP	OR	II	IO	RR	SU	LR	HM
56072	IP	KM	HH	KL	JL	NP	KO	IO	IO	NR	SU	QR	HM
56073	MM	MM	HJ	KM	JN	KK	KN	IM	PR	NR	JJ	KL	HH
56074	IO	MO	JP	LL	JN	OO	IN	IM	NR	GR	KU	LQ	FF
56075	QR	MN	HH	NN	KN	PP	KN	KR	MP	NR	KK	KQ	FK
56076	IN	MM	HH	JL	JN	OP	NR	MR	OO	MS	KK	KO	KM
57719	IP	KM	HK	JK	JN	MP	MO	OO	IO	MR	JU	LQ	HN
57720	LR	KM	HI	NN	JN	MM	MM	OO	MN	HM	KK	LL	KL
57721	RR	MM	HH	JJ	KK	PP	NN	KO	IN	MM	MU	GO	HH
57722	IR	MM	HO	JN	KN	PP	KR	OR	MO	MR	IK	GQ	FH
57723	IM	KK	HH	KL	JN	MP	NO	IN	IO	NR	KS	LQ	HH
57724	MP	KO	HI	KK	JL	NP	KO	IN	IP	NR	JS	LR	HH
57725	MP	KO	HJ	KK	JJ	NP	KK	NO	OP	OR	JS	LR	HH
57726	RR	MM	HH	LL	JJ	PP	MN	LS	OP	MR	KS	KQ	MM
57727	IM	MM	JJ	JK	JJ	MP	OO	IO	OP	OR	KU	LR	MM

Genetic Analysis of the Nut Mountain HMA, CA0266

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The following is a report of the genetic analysis of the Nut Mountain HMA, CA0266.

A few general comments about the genetic variability analysis based upon DNA microsatellites compared to blood typing. The DNA systems are more variable than blood typing systems, thus variation levels will be higher. Variation at microsatellite loci is strongly influenced by allelic diversity and changes in variation will be seen in allelic measures more quickly that at heterozygosity, which is why more allelic diversity measures are calculated. For mean values, there are a greater proportion of rare domestic breeds included in the estimates than for blood typing so relative values for the measures are lower compared to the feral horse values. As well, feral values are relatively higher because the majority of herds tested are of mixed ancestry which results in a relatively greater increase in heterozygosity values based upon the microsatellite data. There are no specific variants related to breed type so similarity is based upon the total data set.

METHODS

A total of 47 samples were received by Texas A&M University, Equine Genetics Lab on November 1, 2011. DNA was extracted from the samples and tested for variation at 12 equine microsatellite (mSat) systems. These were *AHT*4, *AHT*5 *ASB*2, *ASB*17, *ASB*23*, HMS*3, *HMS*6, *HMS*7, *HTG*4, *HTG*10, *LEX*33, and *VHL*20. These systems were tested using an automated DNA sequencer to separate Polymerase Chain Reaction (PCR) products.

A variety of genetic variability measures were calculated from the gene marker data. The measures were observed heterozygosity *(Ho)* which is the actual number of loci heterozygous per individual; expected heterozygosity *(He),* which is the predicted number of heterozygous loci based upon gene frequencies; effective number of alleles *(Ae)* which is a measure of marker system diversity; total number of variants *(TNV)*; mean number of alleles per locus (*MNA*); the number of

rare alleles observed which are alleles that occur with a frequency of 0.05 or less (*RA*); the percent of rare alleles (*%RA*); and estimated inbreeding level *(Fis)* which is calculated as 1-*Ho/He*.

Genetic markers also can provide information about ancestry in some cases. Genetic resemblance to domestic horse breeds was calculated using Rogers' genetic similarity coefficient, *S.* This resemblance was summarized by use of a restricted maximum likelihood (RML) procedure.

RESULTS AND DISCUSSION

Variants present and allele frequencies are given in Table 1. No variants were observed which have not been seen in horse breeds. Table 2 gives the values for the genetic variability measures of the Nut Mountain HMA herd. Also shown in Table 2 are values from a representative group of domestic horse breeds. The breeds were selected to cover the range of variability measures in domestic horse populations. Mean values for feral herds (based upon data from 126 herds) and mean values for domestic breeds (based upon 80 domestic horse populations) also are shown.

Mean genetic similarity of the Nut Mountain HMA herd to domestic horse breed types are shown in Table 3. A dendrogram of relationship of the Nut Mountain HMA herd to a standard set of domestic breeds is shown in Figure 1.

Genetic Variants: A total of 88 variants were seen in the Nut Mountain HMA herd which is above the mean for feral herds and for domestic breeds. Of these, 26 had frequencies below 0.05 which is a high percentage of variants at risk of future loss. Allelic diversity as represented by *Ae* is above the average for feral herds while *MNA* is well greater than the mean.

Genetic Variation: Observed heterozygosity in the Nut Mountain HMA herd is well above the feral mean as is *He*. *Ho* is a good bit higher than *He.* Differences such as this can indicate a recent reduction in population size, within the past few generations, but this not possible to confirm by DNA data alone.

Genetic Similarity: Overall similarity of the Nut Mountain HMA herd to domestic breeds was about average for feral herds. Highest mean genetic similarity of the Nut Mountain HMA herd was with Light Racing and Riding breeds, followed by the North American Gaited breeds. As seen in Fig. 1, however, the Nut Mountain HMA herd clusters between the Oriental breeds with a couple of the Old World Iberian breeds and the South American breeds. These results indicate a herd with mixed origins with no clear indication of primary breed type although it is likely American riding or ranch stock. As with most trees involving feral herds, the tree is somewhat distorted.

SUMMARY

Genetic variability of this herd in general is high but there is a high percentage of variation that is at risk. There is a possibility that this herd has seen a recent loss of population size which would increase the risk to genetic diversity. This is the first time that DNA has been typed for this herd. Genetic similarity results suggest a herd with mixed ancestry.

RECOMMENDATIONS

Current variability levels are high enough that no action is needed at this point but the herd should be monitored closely due to the high proportion of rare alleles. This is especially true if it is known that the herd size has seen a recent decline.

Table 1. Allele frequencies of genetic variants observed in Nut Mountain HMA feral horse herd.

VHL20															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**					
0.106	0.043	0.000	0.170	0.223	0.181	0.053	0.043	0.000	0.181	0.000					
HTG4															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.000	0.266	0.074	0.340	0.043	0.064	0.181	0.032	0.000						
AHT4															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**					
0.192	0.074	0.181	0.106	0.000	0.000	0.021	0.234	0.192	0.000	0.000					
HMS7															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.011	0.074	0.628	0.032	0.170	0.085	0.000	0.000	0.000						
AHT5															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.510	0.021	0.064	0.064	0.181	0.117	0.000	0.043	0.000						
HMS6															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.000	0.117	0.043	0.138	0.021	0.117	0.564	0.000	0.000						
ASB2															
B	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**					
0.000	0.032	0.000	0.277	0.021	0.106	0.170	0.032	0.000	0.160	0.202					
HTG10															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**			
0.000	0.160	0.000	0.000	0.106	0.106	0.021	0.309	0.021	0.011	0.266	0.000	0.000			
HMS3															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**				
0.000	0.053	0.000	0.000	0.000	0.255	0.117	0.085	0.341	0.000	0.149	0.000				
ASB17															
D	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**
0.000	0.000	0.202	0.043	0.032	0.000	0.117	0.000	0.117	0.053	0.096	0.000	0.021	0.287	0.032	0.000
ASB2															
G	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**
0.000	0.000	0.170	0.032	0.340	0.043	0.011	0.000	0.000	0.000	0.000	0.000	0.085	0.032	0.287	0.000
LEX33															
F	**G**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**				
0.000	0.085	0.074	0.415	0.000	0.000	0.032	0.000	0.160	0.170	0.000	0.064				

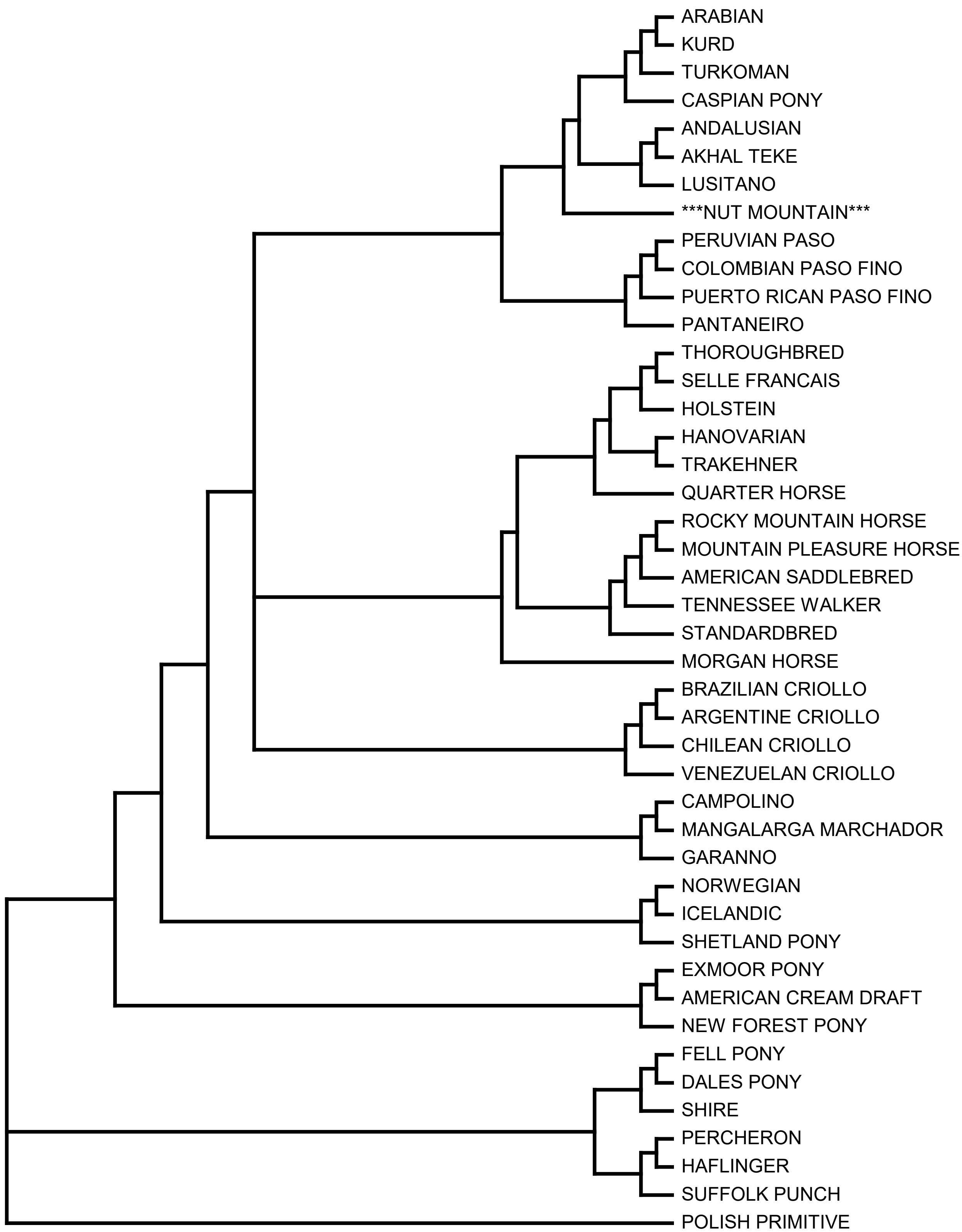
Table 2. Genetic variability measures.

	N	*Ho*	*He*	*Fis*	*Ae*	*TNV*	*MNA*	*Ra*	*%Ra*
NUT MOUNTAIN CA	**47**	**0.770**	**0.752**	**-0.023**	**4.42**	**88**	**7.33**	**26**	**0.295**
Cleveland Bay	47	0.610	0.627	0.027	2.934	59	4.92	16	0.271
American Saddlebred	576	0.740	0.745	0.007	4.25	102	8.50	42	0.412
Andalusian	52	0.722	0.753	0.041	4.259	79	6.58	21	0.266
Arabian	47	0.660	0.727	0.092	3.814	86	7.17	30	0.349
Exmoor Pony	98	0.535	0.627	0.146	2.871	66	5.50	21	0.318
Friesian	304	0.545	0.539	-0.011	2.561	70	5.83	28	0.400
Irish Draught	135	0.802	0.799	-0.003	5.194	102	8.50	28	0.275
Morgan Horse	64	0.715	0.746	0.041	4.192	92	7.67	33	0.359
Suffolk Punch	57	0.683	0.711	0.038	3.878	71	5.92	13	0.183
Tennessee Walker	60	0.666	0.693	0.038	3.662	87	7.25	34	0.391
Thoroughbred	1195	0.734	0.726	-0.011	3.918	69	5.75	18	0.261
Feral Horse Mean	126	0.716	0.710	-0.012	3.866	72.68	6.06	16.96	0.222
Standard Deviation		0.056	0.059	0.071	0.657	13.02	1.09	7.98	0.088
Minimum		0.496	0.489	-0.284	2.148	37	3.08	0	0
Maximum		0.815	0.798	0.133	5.253	96	8.00	33	0.400
Domestic Horse Mean	80	0.710	0.720	0.012	4.012	80.88	6.74	23.79	0.283
Standard Deviation		0.078	0.071	0.086	0.735	16.79	1.40	10.11	0.082
Minimum		0.347	0.394	-0.312	1.779	26	2.17	0	0
Maximum		0.822	0.799	0.211	5.30	119	9.92	55	0.462

Table 3. Rogers' genetic similarity of the Nut Mountain HMA feral horse herd to major groups of domestic horses.

	Mean *S*	Std	Minimum	Maximum
Light Racing and Riding Breeds	0.786	0.024	0.751	0.815
Oriental and Arabian Breeds	0.764	0.047	0.691	0.819
Old World Iberian Breeds	0.774	0.022	0.752	0.804
New World Iberian Breeds	0.757	0.019	0.724	0.777
North American Gaited Breeds	0.779	0.022	0.752	0.812
Heavy Draft Breeds	0.705	0.061	0.629	0.811
True Pony Breeds	0.712	0.041	0.656	0.757

Figure 1. Partial RML tree of genetic similarity to domestic horse breeds.


ARABIAN
KURD
TURKOMAN
CASPIAN PONY
ANDALUSIAN
AKHAL TEKE
LUSITANO
NUT MOUNTAIN
PERUVIAN PASO
COLOMBIAN PASO FINO
PUERTO RICAN PASO FINO
PANTANEIRO
THOROUGHBRED
SELLE FRANCAIS
HOLSTEIN
HANOVARIAN
TRAKEHNER
QUARTER HORSE
ROCKY MOUNTAIN HORSE
MOUNTAIN PLEASURE HORSE
AMERICAN SADDLEBRED
TENNESSEE WALKER
STANDARDBRED
MORGAN HORSE
BRAZILIAN CRIOLLO
ARGENTINE CRIOLLO
CHILEAN CRIOLLO
VENEZUELAN CRIOLLO
CAMPOLINO
MANGALARGA MARCHADOR
GARANNO
NORWEGIAN
ICELANDIC
SHETLAND PONY
EXMOOR PONY
AMERICAN CREAM DRAFT
NEW FOREST PONY
FELL PONY
DALES PONY
SHIRE
PERCHERON
HAFLINGER
SUFFOLK PUNCH
POLISH PRIMITIVE

Appendix 1. DNA data for the Nut Mountain HMA, CA herd.

AID	VHL20	HTG4	AHT4	HMS7	AHT5	HMS6	ASB2	HTG10	HMS3	ASB17	ASB23	LEX33	LEX3
56077	MR	KM	KO	LL	NQ	LP	KN	MM	MR	RR	KU	RR	PP
56078	LL	LM	HO	LN	JO	KP	KN	LO	NP	IR	IM	KL	FF
56079	LN	MQ	NO	LL	JJ	MP	KR	OR	PP	RR	LL	LQ	KK
56080	NN	KN	HO	LL	OO	PP	IM	IL	PP	HK	UU	LQ	HH
56081	MM	KK	JP	LL	JJ	PP	LR	RR	MM	GR	IL	GL	FF
56082	LM	MO	HI	NO	JN	KO	NR	NR	MR	GN	IU	LQ	HH
56083	LM	MM	IJ	KN	JJ	OP	KR	MR	NR	GM	KU	LQ	FF
56084	NR	LM	HJ	LN	JN	MP	MQ	IO	NP	MO	KK	KL	LL
56085	PP	KM	KP	LL	JL	MO	KK	OR	IO	GO	IS	LQ	FF
56086	MO	KK	JP	LO	JK	OO	RR	MR	MO	GR	IL	LT	FF
56087	LO	MP	IO	LL	JK	PP	KN	RR	MP	MR	KU	KL	FF
56088	IN	KP	HH	LL	OO	MP	IQ	IL	NP	KR	SU	LQ	HH
56089	MN	KM	IO	LL	JL	PP	NR	RR	MP	RR	IU	LR	NN
56090	IR	KM	KP	LL	JJ	OP	KQ	IO	MN	GH	SU	GL	FK
56091	IL	LM	HK	LN	JO	KP	KN	OO	MR	IR	IK	LQ	FP
56092	IM	MO	PP	KL	JN	KO	KN	II	RR	GM	KU	LL	FH
56093	JM	OP	HJ	LO	JN	OP	MR	OR	PR	GK	IK	QT	FH
56094	MO	KP	JP	LN	MM	NP	MR	RR	MM	GQ	KT	LR	MM
56095	LO	KM	JP	LM	JM	NO	OR	OR	MP	GM	KU	GL	FM
56096	IR	KM	PP	LM	JN	KL	KN	IN	PR	MS	IU	LL	HM
56097	JR	LP	JO	LN	JN	MP	MQ	OO	PP	KM	KK	KT	FL
56098	MR	MQ	HO	NO	JJ	MP	QR	IR	NP	RR	KK	GL	KL
56099	LM	PQ	OO	LO	JJ	MP	KR	OR	OP	GR	IK	LR	FL
56100	LR	MP	IK	LL	JJ	KP	KQ	II	MO	GR	IK	GL	HK
56101	IN	MN	NO	LL	JO	PP	KR	MP	PP	OO	UU	LO	LL
56102	IL	KM	IP	KL	JJ	KO	KN	II	MN	GG	IU	LL	FH
56103	LL	KO	OP	LO	NO	KP	OR	OR	IM	MS	UU	KL	FL
56104	LP	KK	KP	LO	LN	MP	KR	OR	II	GS	IU	LL	FF
56105	MO	KK	PP	LL	JM	KP	OR	RR	MM	GG	IK	GL	FM
56106	NR	MP	JJ	LN	JL	KP	MR	LR	OP	NR	TU	RR	FM
56107	NN	LP	HO	KL	JN	MP	MQ	LO	NP	KO	KK	LT	FL
56108	NR	MN	KO	LL	JN	PP	KN	MP	PR	OR	KU	OR	LL
56109	IM	KM	HK	LN	JQ	LP	KK	MO	MR	RR	KK	QR	PP
56110	MR	MP	JP	LN	JM	PP	KR	IL	OP	NR	IU	QR	FM
56111	NR	PP	HJ	LN	JO	MP	IM	LO	NP	KM	KS	LT	FH
56112	JN	KP	OO	KL	JJ	PP	QQ	LO	PP	KR	KK	LT	FI
56113	IM	MP	HH	JL	NN	PP	NN	OR	IP	NO	JJ	GQ	LN
56114	MN	MP	JJ	LN	LM	PP	KM	LR	MP	NQ	TU	QR	MM
56115	MR	KM	HO	LL	JN	PP	QQ	LO	PR	HK	KS	LL	NN
56116	PR	KM	OP	KL	JL	MP	KN	OO	MO	KO	IS	QR	HH
56117	IM	LM	KO	LN	JQ	PP	KK	MO	MR	IR	KK	LR	PP
56118	MN	MN	OO	LL	JQ	LP	KN	MM	PR	OR	UU	OR	LL
56119	LR	MO	JP	LO	JO	OP	LR	OQ	MM	GM	JU	KL	LL
56120	JN	LP	HJ	LL	NO	MP	MQ	IO	PP	KM	KU	KQ	FH
56121	LM	MO	IJ	MN	JJ	KP	KN	OR	NR	GR	KU	LQ	HH
56122	NR	KK	HO	KL	JN	PP	QQ	OO	MP	KR	KS	LR	II
56123	RR	MP	HK	LN	JN	MP	NQ	IO	NO	HR	KS	GR	KK

Genetic Analysis of the Wall Canyon HMA, CA0265

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May 23, 2012

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The following is a report of the genetic analysis of the Wall Canyon HMA, CA0265.

A few general comments about the genetic variability analysis based upon DNA microsatellites compared to blood typing. The DNA systems are more variable than blood typing systems, thus variation levels will be higher. Variation at microsatellite loci is strongly influenced by allelic diversity and changes in variation will be seen in allelic measures more quickly that at heterozygosity, which is why more allelic diversity measures are calculated. For mean values, there are a greater proportion of rare domestic breeds included in the estimates than for blood typing so relative values for the measures are lower compared to the feral horse values. As well, feral values are relatively higher because the majority of herds tested are of mixed ancestry which results in a relatively greater increase in heterozygosity values based upon the microsatellite data. There are no specific variants related to breed type so similarity is based upon the total data set.

METHODS

A total of 14 samples were received by Texas A&M University, Equine Genetics Lab on January 5, 2012. DNA was extracted from the samples and tested for variation at 12 equine microsatellite (mSat) systems. These were *AHT*4, *AHT*5 *ASB*2, *ASB*17, *ASB*23*, HMS*3, *HMS*6, *HMS*7, *HTG*4, *HTG*10, *LEX*33, and *VHL*20. These systems were tested using an automated DNA sequencer to separate Polymerase Chain Reaction (PCR) products.

A variety of genetic variability measures were calculated from the gene marker data. The measures were observed heterozygosity *(Ho)* which is the actual number of loci heterozygous per individual; expected heterozygosity *(He),* which is the predicted number of heterozygous loci based upon gene frequencies; effective number of alleles *(Ae)* which is a measure of marker system diversity; total number of variants *(TNV)*; mean number of alleles per locus (*MNA*); the number of

rare alleles observed which are alleles that occur with a frequency of 0.05 or less (*RA*); the percent of rare alleles (*%RA*); and estimated inbreeding level *(Fis)* which is calculated as 1-*Ho/He*.

Genetic markers also can provide information about ancestry in some cases. Genetic resemblance to domestic horse breeds was calculated using Rogers' genetic similarity coefficient, *S.* This resemblance was summarized by use of a restricted maximum likelihood (RML) procedure.

RESULTS AND DISCUSSION

Variants present and allele frequencies are given in Table 1. No variants were observed which have not been seen in horse breeds. Table 2 gives the values for the genetic variability measures of the Wall Canyon HMA herd. Also shown in Table 2 are values from a representative group of domestic horse breeds. The breeds were selected to cover the range of variability measures in domestic horse populations. Mean values for feral herds (based upon data from 126 herds) and mean values for domestic breeds (based upon 80 domestic horse populations) also are shown.

Mean genetic similarity of the Wall Canyon HMA herd to domestic horse breed types are shown in Table 3. A dendrogram of relationship of the Wall Canyon HMA herd to a standard set of domestic breeds is shown in Figure 1.

Genetic Variants: A total of 72 variants were seen in the Wall Canyon HMA herd which is almost exactly the mean value for feral herds and slightly below the mean for domestic breeds. All other measures of allelic diversity also were essentially right at the average level for feral horse herds.

Genetic Variation: Observed heterozygosity in the Wall Canyon HMA herd is slightly below the feral mean as is *He*. *Ho* and *He* are the same so this herd is at genetic equilibrium.

Genetic Similarity: Overall similarity of the Wall Canyon HMA herd to domestic breeds was at of a little below average for feral herds. Highest mean genetic similarity of the Wall Canyon HMA herd was with Light Racing and Riding breeds, followed by Old World Iberian breeds. As seen in Fig. 1, however, the Wall Canyon HMA herd does not cluster closely with any group but is between the light horses and the "cold blood" draft and pony breeds. These results indicate a herd with mixed origins with no clear indication of primary breed type.

SUMMARY

Genetic variability of this herd is essentially average for a feral herd and for this reason there is little information that can be derived from the variability measures at this time. This herd has not been tested before so it is not possible to see if there have been changes in variability. Genetic similarity results suggest a herd with mixed ancestry.

RECOMMENDATIONS

Current variability levels indicate that no action is needed at this point but the herd should be monitored closely because it is right at the variation average and the possibility of loos of variation moving the herd toward higher risk levels is great if population size is kept at less than 150 adult animals.

Table 1. Allele frequencies of genetic variants observed in Wall Canyon HMA feral horse herd.

VHL20															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**					
0.143	0.036	0.000	0.000	0.391	0.179	0.036	0.000	0.036	0.179	0.000					
HTG4															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.000	0.321	0.143	0.321	0.036	0.036	0.143	0.000	0.000						
AHT4															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**					
0.107	0.071	0.143	0.036	0.071	0.000	0.036	0.536	0.000	0.000	0.000					
HMS7															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.036	0.036	0.714	0.071	0.000	0.143	0.000	0.000	0.000						
AHT5															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.536	0.036	0.071	0.000	0.214	0.143	0.000	0.000	0.000						
HMS6															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.000	0.179	0.000	0.214	0.000	0.000	0.607	0.000	0.000						
ASB2															
B	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**					
0.000	0.000	0.000	0.250	0.000	0.143	0.178	0.036	0.107	0.036	0.250					
HTG10															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**			
0.000	0.071	0.000	0.071	0.107	0.143	0.000	0.429	0.143	0.000	0.036	0.000	0.000			
HMS3															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**				
0.000	0.000	0.000	0.000	0.000	0.321	0.286	0.036	0.286	0.000	0.071	0.000				
ASB17															
D	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**
0.000	0.000	0.036	0.071	0.000	0.000	0.107	0.000	0.071	0.107	0.107	0.000	0.000	0.143	0.358	0.000
ASB2															
G	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**
0.000	0.000	0.000	0.036	0.250	0.179	0.000	0.000	0.000	0.000	0.000	0.000	0.321	0.000	0.214	0.000
LEX33															
F	**G**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**				
0.000	0.000	0.143	0.250	0.000	0.000	0.143	0.036	0.178	0.179	0.000	0.071				

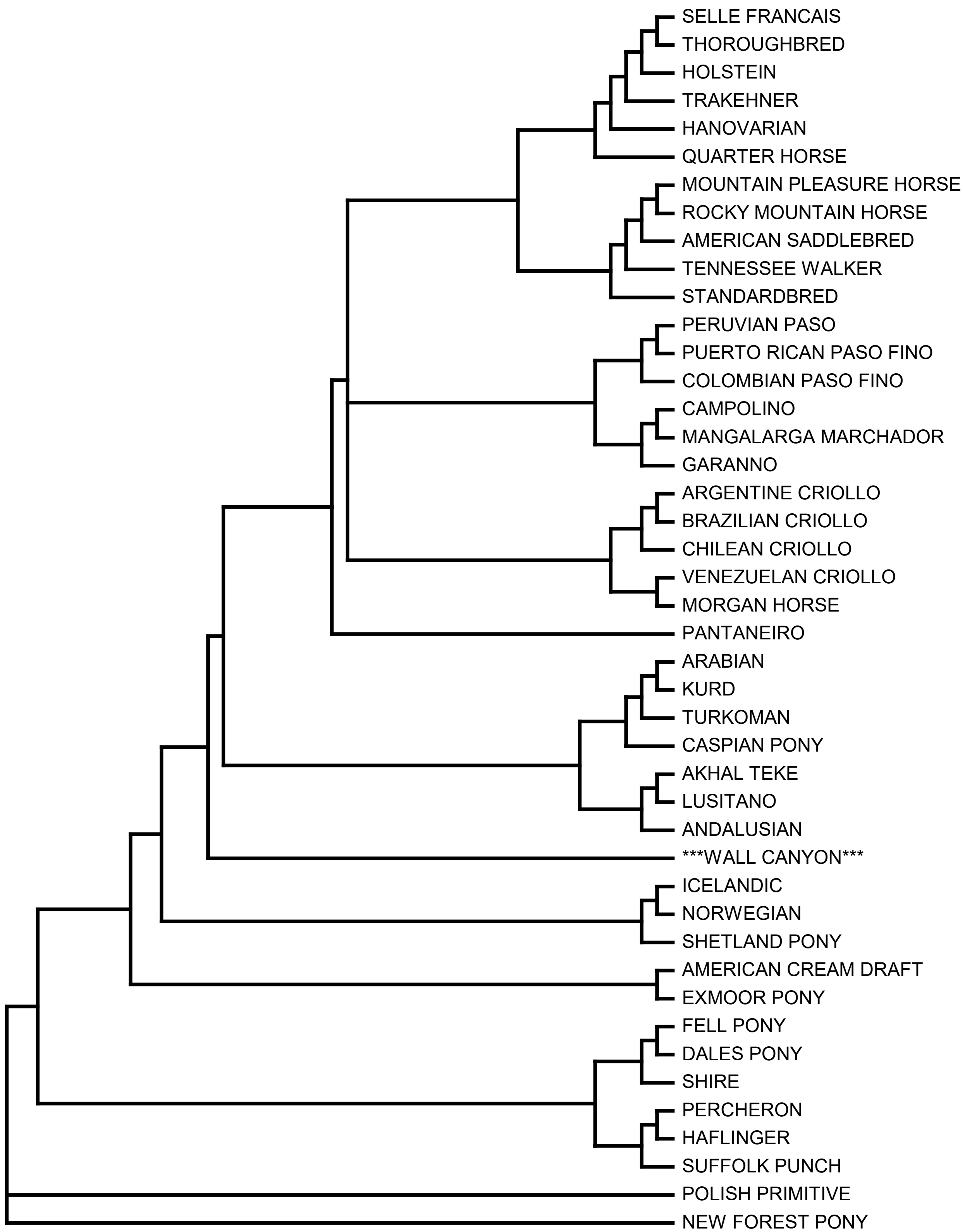
Table 2. Genetic variability measures.

	N	*Ho*	*He*	*Fis*	*Ae*	*TNV*	*MNA*	*Ra*	*%Ra*
WALL CANYON CA	**14**	**0.708**	**0.709**	**0.001**	**3.83**	**72**	**6.00**	**17**	**0.236**
Cleveland Bay	47	0.610	0.627	0.027	2.934	59	4.92	16	0.271
American Saddlebred	576	0.740	0.745	0.007	4.25	102	8.50	42	0.412
Andalusian	52	0.722	0.753	0.041	4.259	79	6.58	21	0.266
Arabian	47	0.660	0.727	0.092	3.814	86	7.17	30	0.349
Exmoor Pony	98	0.535	0.627	0.146	2.871	66	5.50	21	0.318
Friesian	304	0.545	0.539	-0.011	2.561	70	5.83	28	0.400
Irish Draught	135	0.802	0.799	-0.003	5.194	102	8.50	28	0.275
Morgan Horse	64	0.715	0.746	0.041	4.192	92	7.67	33	0.359
Suffolk Punch	57	0.683	0.711	0.038	3.878	71	5.92	13	0.183
Tennessee Walker	60	0.666	0.693	0.038	3.662	87	7.25	34	0.391
Thoroughbred	1195	0.734	0.726	-0.011	3.918	69	5.75	18	0.261
Feral Horse Mean	126	0.716	0.710	-0.012	3.866	72.68	6.06	16.96	0.222
Standard Deviation		0.056	0.059	0.071	0.657	13.02	1.09	7.98	0.088
Minimum		0.496	0.489	-0.284	2.148	37	3.08	0	0
Maximum		0.815	0.798	0.133	5.253	96	8.00	33	0.400
Domestic Horse Mean	80	0.710	0.720	0.012	4.012	80.88	6.74	23.79	0.283
Standard Deviation		0.078	0.071	0.086	0.735	16.79	1.40	10.11	0.082
Minimum		0.347	0.394	-0.312	1.779	26	2.17	0	0
Maximum		0.822	0.799	0.211	5.30	119	9.92	55	0.462

Table 3. Rogers' genetic similarity of the Wall Canyon HMA feral horse herd to major groups of domestic horses.

	Mean *S*	Std	Minimum	Maximum
Light Racing and Riding Breeds	0.750	0.023	0.717	0.777
Oriental and Arabian Breeds	0.731	0.040	0.675	0.783
Old World Iberian Breeds	0.740	0.020	0.722	0.771
New World Iberian Breeds	0.716	0.009	0.696	0.724
North American Gaited Breeds	0.738	0.015	0.712	0.752
Heavy Draft Breeds	0.685	0.048	0.625	0.768
True Pony Breeds	0.677	0.043	0.625	0.726

Figure 1. Partial RML tree of genetic similarity to domestic horse breeds.


SELLE FRANCAIS
THOROUGHBRED
HOLSTEIN
TRAKEHNER
HANOVARIAN
QUARTER HORSE
MOUNTAIN PLEASURE HORSE
ROCKY MOUNTAIN HORSE
AMERICAN SADDLEBRED
TENNESSEE WALKER
STANDARDBRED
PERUVIAN PASO
PUERTO RICAN PASO FINO
COLOMBIAN PASO FINO
CAMPOLINO
MANGALARGA MARCHADOR
GARANNO
ARGENTINE CRIOLLO
BRAZILIAN CRIOLLO
CHILEAN CRIOLLO
VENEZUELAN CRIOLLO
MORGAN HORSE
PANTANEIRO
ARABIAN
KURD
TURKOMAN
CASPIAN PONY
AKHAL TEKE
LUSITANO
ANDALUSIAN
WALL CANYON
ICELANDIC
NORWEGIAN
SHETLAND PONY
AMERICAN CREAM DRAFT
EXMOOR PONY
FELL PONY
DALES PONY
SHIRE
PERCHERON
HAFLINGER
SUFFOLK PUNCH
POLISH PRIMITIVE
NEW FOREST PONY

Appendix 1. DNA data for the Wall Canyon HMA, CA herd.

AID	VHL20	HTG4	AHT4	HMS7	AHT5	HMS6	ASB2	HTG10	HMS3	ASB17	ASB23	LEX33	LEX3
57705	IM	KM	LO	LL	NO	PP	NP	LO	NN	HS	LS	LL	LL
57706	MN	KP	IO	OO	JJ	MP	MN	MP	NP	NO	KK	LQ	LP
57707	MM	LM	HJ	LL	JJ	MP	NO	KO	MR	GR	KU	KR	FF
57708	NQ	KM	HO	KL	NO	PP	KR	OP	NP	OR	SS	OQ	KL
57709	NN	MM	KO	LL	JO	KP	NR	IO	MR	NS	SS	LQ	FH
57710	OR	KM	JO	LL	JJ	MM	RR	PR	MP	RS	LL	RR	LN
57711	MR	KN	OO	LM	JL	PP	KP	OP	MP	KS	UU	LQ	HH
57712	MR	LL	OO	LL	JN	MP	MP	MO	MM	KM	LL	KO	HL
57713	MM	KP	IJ	LO	JJ	KK	MR	KM	MN	MS	JK	QR	HP
57714	IJ	MP	NO	LL	JJ	MP	KQ	OO	NN	HK	SS	OP	FI
57715	IM	MM	LO	JL	JN	KP	KR	LO	PP	SS	KS	RT	IO
57716	NR	LO	HO	LO	NO	PP	KM	IM	MM	NS	KU	KO	LO
57717	IM	KP	JO	LL	JK	KP	KN	LO	OP	RS	KU	KT	IO
57718	MR	KK	OO	LM	LN	PP	KR	OO	NP	OS	SU	LL	HH

Genetic Analysis of the High Rock HMA, CA0264

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May 17, 2012

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The following is a report of the genetic analysis of the High Rock HMA, CA0264.

A few general comments about the genetic variability analysis based upon DNA microsatellites compared to blood typing. The DNA systems are more variable than blood typing systems, thus variation levels will be higher. Variation at microsatellite loci is strongly influenced by allelic diversity and changes in variation will be seen in allelic measures more quickly that at heterozygosity, which is why more allelic diversity measures are calculated. For mean values, there are a greater proportion of rare domestic breeds included in the estimates than for blood typing so relative values for the measures are lower compared to the feral horse values. As well, feral values are relatively higher because the majority of herds tested are of mixed ancestry which results in a relatively greater increase in heterozygosity values based upon the microsatellite data. There are no specific variants related to breed type so similarity is based upon the total data set.

METHODS

A total of 35 samples were received by Texas A&M University, Equine Genetics Lab on January 5, 2012. DNA was extracted from the samples and tested for variation at 12 equine microsatellite (mSat) systems. These were *AHT*4, *AHT*5 *ASB*2, *ASB*17, *ASB*23*, HMS*3, *HMS*6, *HMS*7, *HTG*4, *HTG*10, *LEX*33, and *VHL*20. These systems were tested using an automated DNA sequencer to separate Polymerase Chain Reaction (PCR) products.

A variety of genetic variability measures were calculated from the gene marker data. The measures were observed heterozygosity *(Ho)* which is the actual number of loci heterozygous per individual; expected heterozygosity *(He),* which is the predicted number of heterozygous loci based upon gene frequencies; effective number of alleles *(Ae)* which is a measure of marker system diversity; total number of variants *(TNV)*; mean number of alleles per locus (*MNA*); the number of

rare alleles observed which are alleles that occur with a frequency of 0.05 or less (*RA*); the percent of rare alleles (*%RA*); and estimated inbreeding level *(Fis)* which is calculated as 1-*Ho/He*.

Genetic markers also can provide information about ancestry in some cases. Genetic resemblance to domestic horse breeds was calculated using Rogers' genetic similarity coefficient, *S.* This resemblance was summarized by use of a restricted maximum likelihood (RML) procedure.

RESULTS AND DISCUSSION

Variants present and allele frequencies are given in Table 1. No variants were observed which have not been seen in horse breeds. Table 2 gives the values for the genetic variability measures of the High Rock HMA herd. Also shown in Table 2 are values from a representative group of domestic horse breeds. The breeds were selected to cover the range of variability measures in domestic horse populations. Mean values for feral herds (based upon data from 126 herds) and mean values for domestic breeds (based upon 80 domestic horse populations) also are shown.

Mean genetic similarity of the High Rock HMA herd to domestic horse breed types are shown in Table 3. A dendrogram of relationship of the High Rock HMA herd to a standard set of domestic breeds is shown in Figure 1.

Genetic Variants: A total of 93 variants were seen in the High Rock HMA herd which is very high number well above the mean for feral herds and domestic breeds. Of these, 29 had frequencies below 0.05 which is a high percentage of variants at risk of future loss. Allelic diversity as represented by *Ae* is high while *MNA* is far greater than the mean.

Genetic Variation: Observed heterozygosity in the High Rock HMA herd is well above the feral mean and He is essentially identical to *Ho.* This is consistent with genetic equilibrium.

Genetic Similarity: Overall similarity of the High Rock HMA herd to domestic breeds was above average for feral herds. Highest mean genetic similarity of the High Rock HMA herd was with Light Racing and Riding breeds, followed by the North American Gaited breeds. As seen in Fig. 1 the High Rock HMA herd clusters within the branch that contains these breeds and closest to the North American breeds. These results suggest the herd has ranch and riding stock origins with somewhat mixed breed types.

SUMMARY

Genetic variability of this herd is high. This high genetic diversity may be due to the position of the High Rock herd between other HMAs with genetic exchange among the herds. This is consistent with the high *TNV* and number of rare alleles. It also is consistent with the increase in variability seen compared to that for samples from this herd collected in 2001. The heterozygosity levels suggest this gene flow has been going on for some time but is not great enough to move the herd out of genetic equilibrium. Genetic similarity results suggest a herd with mixed ancestry predominately from North American breed origins.

RECOMMENDATIONS

Current variability levels are high enough that no action is needed at this time. Ensuring the continued possibility of genetic exchange among herd area, at a low level, will preserve high diversity levels for a long time. The high number of alleles at risk is not a concern if this is due to gene flow.

Table 1. Allele frequencies of genetic variants observed in High Rock HMA feral horse herd.

VHL20															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**					
0.186	0.014	0.000	0.071	0.286	0.171	0.086	0.029	0.043	0.114	0.000					
HTG4															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.000	0.229	0.171	0.385	0.043	0.029	0.129	0.014	0.000						
AHT4															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**					
0.271	0.057	0.086	0.157	0.029	0.029	0.000	0.328	0.043	0.000	0.000					
HMS7															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.057	0.029	0.600	0.071	0.128	0.086	0.029	0.000	0.000						
AHT5															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.257	0.071	0.172	0.071	0.172	0.200	0.000	0.057	0.000						
HMS6															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.000	0.086	0.157	0.086	0.014	0.100	0.557	0.000	0.000						
ASB2															
B	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**					
0.000	0.043	0.000	0.214	0.000	0.157	0.228	0.057	0.129	0.029	0.143					
HTG10															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**			
0.000	0.171	0.000	0.029	0.257	0.100	0.000	0.214	0.043	0.029	0.157	0.000	0.000			
HMS3															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**				
0.000	0.086	0.000	0.000	0.000	0.271	0.186	0.014	0.315	0.014	0.114	0.000				
ASB17															
D	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**
0.000	0.000	0.100	0.086	0.000	0.000	0.014	0.043	0.129	0.285	0.043	0.000	0.000	0.157	0.129	0.014
ASB2															
G	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**
0.000	0.000	0.071	0.043	0.357	0.086	0.000	0.000	0.000	0.000	0.000	0.000	0.200	0.043	0.200	0.000
LEX33															
F	**G**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**				
0.000	0.043	0.043	0.300	0.029	0.000	0.114	0.029	0.171	0.214	0.000	0.057				

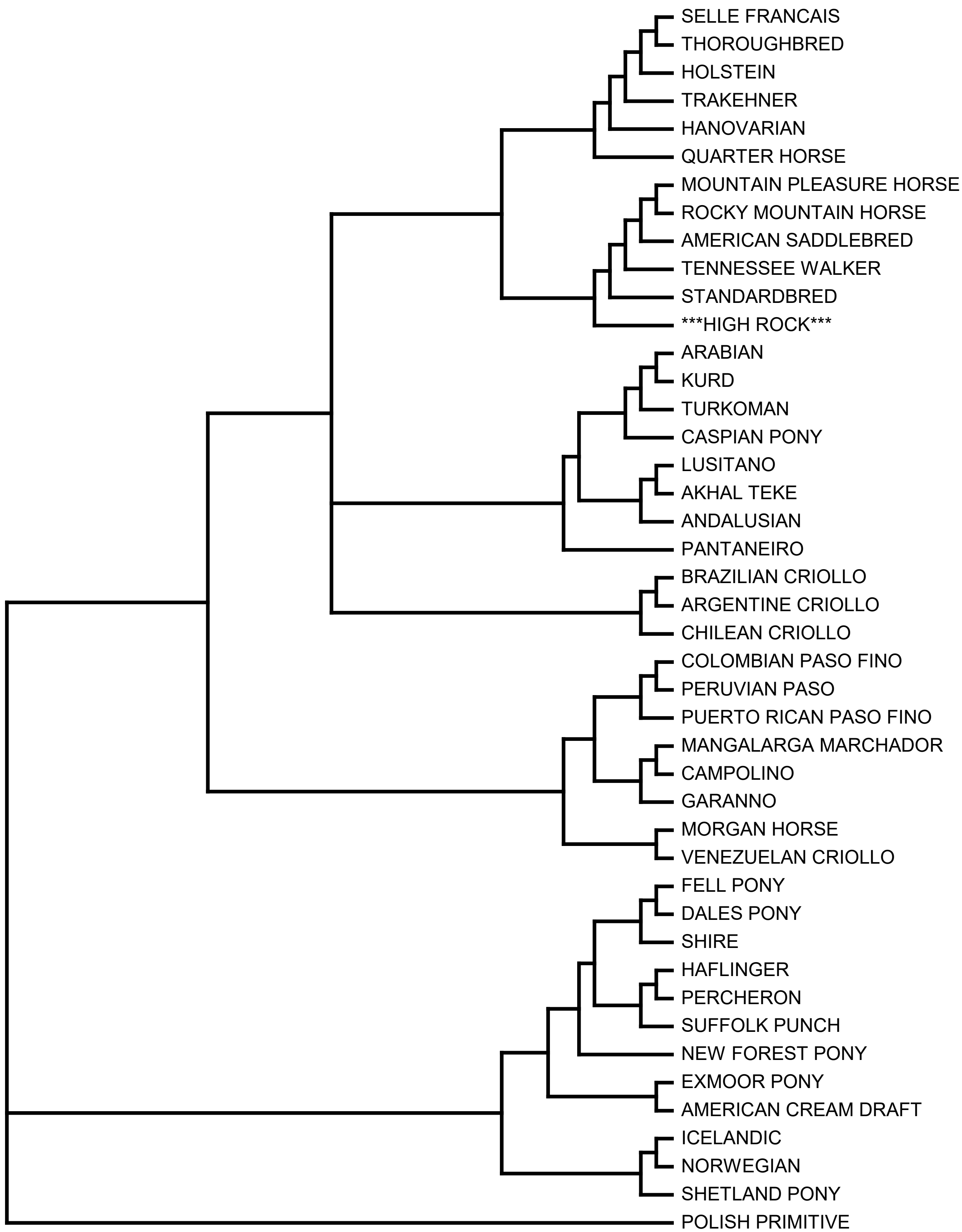
Table 2. Genetic variability measures.

	N	*Ho*	*He*	*Fis*	*Ae*	*TNV*	*MNA*	*Ra*	*%Ra*
HIGH ROCK CA	**35**	**0.774**	**0.773**	**-0.001**	**4.77**	**93**	**7.75**	**29**	**0.312**
Cleveland Bay	47	0.610	0.627	0.027	2.934	59	4.92	16	0.271
American Saddlebred	576	0.740	0.745	0.007	4.25	102	8.50	42	0.412
Andalusian	52	0.722	0.753	0.041	4.259	79	6.58	21	0.266
Arabian	47	0.660	0.727	0.092	3.814	86	7.17	30	0.349
Exmoor Pony	98	0.535	0.627	0.146	2.871	66	5.50	21	0.318
Friesian	304	0.545	0.539	-0.011	2.561	70	5.83	28	0.400
Irish Draught	135	0.802	0.799	-0.003	5.194	102	8.50	28	0.275
Morgan Horse	64	0.715	0.746	0.041	4.192	92	7.67	33	0.359
Suffolk Punch	57	0.683	0.711	0.038	3.878	71	5.92	13	0.183
Tennessee Walker	60	0.666	0.693	0.038	3.662	87	7.25	34	0.391
Thoroughbred	1195	0.734	0.726	-0.011	3.918	69	5.75	18	0.261
Feral Horse Mean	126	0.716	0.710	-0.012	3.866	72.68	6.06	16.96	0.222
Standard Deviation		0.056	0.059	0.071	0.657	13.02	1.09	7.98	0.088
Minimum		0.496	0.489	-0.284	2.148	37	3.08	0	0
Maximum		0.815	0.798	0.133	5.253	96	8.00	33	0.400
Domestic Horse Mean	80	0.710	0.720	0.012	4.012	80.88	6.74	23.79	0.283
Standard Deviation		0.078	0.071	0.086	0.735	16.79	1.40	10.11	0.082
Minimum		0.347	0.394	-0.312	1.779	26	2.17	0	0
Maximum		0.822	0.799	0.211	5.30	119	9.92	55	0.462

Table 3. Rogers' genetic similarity of the High Rock HMA feral horse herd to major groups of domestic horses.

	Mean *S*	Std	Minimum	Maximum
Light Racing and Riding Breeds	0.802	0.031	0.759	0.835
Oriental and Arabian Breeds	0.772	0.048	0.706	0.831
Old World Iberian Breeds	0.790	0.034	0.757	0.842
New World Iberian Breeds	0.771	0.017	0.741	0.793
North American Gaited Breeds	0.794	0.025	0.763	0.836
Heavy Draft Breeds	0.718	0.062	0.636	0.819
True Pony Breeds	0.733	0.043	0.680	0.782

Figure 1. Partial RML tree of genetic similarity to domestic horse breeds.


SELLE FRANCAIS
THOROUGHBRED
HOLSTEIN
TRAKEHNER
HANOVARIAN
QUARTER HORSE
MOUNTAIN PLEASURE HORSE
ROCKY MOUNTAIN HORSE
AMERICAN SADDLEBRED
TENNESSEE WALKER
STANDARDBRED
HIGH ROCK
ARABIAN
KURD
TURKOMAN
CASPIAN PONY
LUSITANO
AKHAL TEKE
ANDALUSIAN
PANTANEIRO
BRAZILIAN CRIOLLO
ARGENTINE CRIOLLO
CHILEAN CRIOLLO
COLOMBIAN PASO FINO
PERUVIAN PASO
PUERTO RICAN PASO FINO
MANGALARGA MARCHADOR
CAMPOLINO
GARANNO
MORGAN HORSE
VENEZUELAN CRIOLLO
FELL PONY
DALES PONY
SHIRE
HAFLINGER
PERCHERON
SUFFOLK PUNCH
NEW FOREST PONY
EXMOOR PONY
AMERICAN CREAM DRAFT
ICELANDIC
NORWEGIAN
SHETLAND PONY
POLISH PRIMITIVE

Appendix 1. DNA data for the High Rock HMA, CA herd.

AID	VHL20	HTG4	AHT4	HMS7	AHT5	HMS6	ASB2	HTG10	HMS3	ASB17	ASB23	LEX33	LEX3
57631	IM	KK	HO	JL	KO	LP	KM	LQ	MP	HS	KS	KQ	FF
57632	RR	KK	OO	LL	JN	MP	MR	OO	QR	LM	UU	OR	OO
57633	LM	MN	KL	LL	JJ	LP	KM	MP	MP	HR	KL	QT	LL
57634	IO	MP	OP	LM	JM	PP	NQ	LP	MM	NR	KK	QR	MM
57635	MO	KP	IO	LL	JL	LM	MP	OO	MM	HM	KS	KR	MM
57636	IN	MM	KM	LP	KO	MP	NP	OR	MN	HR	KK	LR	LL
57637	NN	LN	IJ	LN	NQ	KP	PR	LO	MP	MR	SU	LR	MM
57638	MQ	KM	HO	LN	LM	LP	RR	IL	PR	NN	IK	LQ	FF
57639	II	MP	KO	NO	LM	PP	QR	MR	PR	GS	KU	PQ	PP
57640	MR	KM	LM	LM	NO	KP	NR	MO	NP	LS	KS	RR	LL
57641	MN	KL	IO	LO	LQ	LP	KM	IO	MN	HS	KS	KL	LL
57642	MN	KM	HO	LO	OO	PP	IN	KL	PR	RR	SU	LQ	HH
57643	NN	OO	KO	LL	KN	KP	NN	LM	PP	MN	KS	GL	LL
57644	OR	KM	HO	KL	KN	OP	KM	OR	MN	GG	KL	LL	FF
57645	LQ	KM	HP	LL	MN	LP	KR	IR	PP	NN	IL	OQ	HH
57646	OR	LM	OO	LL	JN	LM	NN	OR	MM	KM	KL	LO	HH
57647	NN	LL	HI	JL	NN	LP	PR	LO	MO	MO	KS	LR	LL
57648	LM	LM	HH	LO	JO	KP	KR	IM	PP	HL	KU	TT	HH
57649	II	LP	OO	LM	JL	OP	KO	IR	IN	NN	JK	LR	LL
57650	MM	MM	HJ	LL	JJ	PP	IN	KP	II	NN	JU	LO	MM
57651	JM	MM	HK	LN	JL	PP	NP	LO	RR	OR	SS	LM	MM
57652	MP	KM	HO	LN	KO	OP	KM	LL	NP	NT	IU	QQ	MM
57653	IM	LP	HO	LM	LO	PP	KO	IL	IN	NN	JS	LR	LL
57654	MR	LN	KK	LM	OQ	PP	IP	LO	MN	GR	KK	QR	LL
57655	LR	LM	HJ	LN	JJ	OP	NR	MR	MM	GR	IL	LR	FH
57656	IN	LM	OO	LO	LO	OP	KK	IL	NP	NS	KS	LL	LM
57657	MQ	KP	HH	JL	JN	LP	KM	IL	IP	NO	IT	OP	HP
57658	IM	MP	HK	LN	JL	PP	NN	LO	MR	MR	SU	MR	LM
57659	IR	MP	HK	JL	JO	KM	OP	QR	IP	SS	KU	LT	FN
57660	MM	MM	JK	LL	NN	KO	MP	IO	PR	NS	LU	GR	HP
57661	IO	MQ	HO	LP	OQ	PP	NN	MR	NP	MR	KK	OO	FL
57662	LM	KM	JP	LL	JM	NP	MO	LR	MP	GN	KT	GR	FM
57663	IN	LM	OO	LO	LO	OP	KK	IL	NN	NS	KS	LL	LM
57664	MP	KP	JK	KL	LL	LM	MN	II	MN	NN	UU	LQ	MP
57665	NO	KM	HO	NN	JO	LP	KP	LR	PP	GM	TU	OQ	FN

Genetic Analysis of the Fox Hog HMA, CA0263

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May 18, 2012

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The following is a report of the genetic analysis of the Fox Hog HMA, CA0263.

A few general comments about the genetic variability analysis based upon DNA microsatellites compared to blood typing. The DNA systems are more variable than blood typing systems, thus variation levels will be higher. Variation at microsatellite loci is strongly influenced by allelic diversity and changes in variation will be seen in allelic measures more quickly that at heterozygosity, which is why more allelic diversity measures are calculated. For mean values, there are a greater proportion of rare domestic breeds included in the estimates than for blood typing so relative values for the measures are lower compared to the feral horse values. As well, feral values are relatively higher because the majority of herds tested are of mixed ancestry which results in a relatively greater increase in heterozygosity values based upon the microsatellite data. There are no specific variants related to breed type so similarity is based upon the total data set.

METHODS

A total of 115 samples were received by Texas A&M University, Equine Genetics Lab on January 5, 2012. DNA was extracted from the samples and tested for variation at 12 equine microsatellite (mSat) systems. These were *AHT*4, *AHT*5 *ASB*2, *ASB*17, *ASB*23*, HMS*3, *HMS*6, *HMS*7, *HTG*4, *HTG*10, *LEX*33, and *VHL*20. These systems were tested using an automated DNA sequencer to separate Polymerase Chain Reaction (PCR) products.

A variety of genetic variability measures were calculated from the gene marker data. The measures were observed heterozygosity *(Ho)* which is the actual number of loci heterozygous per individual; expected heterozygosity *(He),* which is the predicted number of heterozygous loci based upon gene frequencies; effective number of alleles *(Ae)* which is a measure of marker system diversity; total number of variants *(TNV)*; mean number of alleles per locus (*MNA*); the number of

rare alleles observed which are alleles that occur with a frequency of 0.05 or less (*RA*); the percent of rare alleles (*%RA*); and estimated inbreeding level *(Fis)* which is calculated as 1-*Ho/He*.

Genetic markers also can provide information about ancestry in some cases. Genetic resemblance to domestic horse breeds was calculated using Rogers' genetic similarity coefficient, *S*. This resemblance was summarized by use of a restricted maximum likelihood (RML) procedure.

RESULTS AND DISCUSSION

Variants present and allele frequencies are given in Table 1. No variants were observed which have not been seen in horse breeds. Table 2 gives the values for the genetic variability measures of the Fox Hog HMA herd. Also shown in Table 2 are values from a representative group of domestic horse breeds. The breeds were selected to cover the range of variability measures in domestic horse populations. Mean values for feral herds (based upon data from 126 herds) and mean values for domestic breeds (based upon 80 domestic horse populations) also are shown.

Mean genetic similarity of the Fox Hog HMA herd to domestic horse breed types are shown in Table 3. A dendrogram of relationship of the Fox Hog HMA herd to a standard set of domestic breeds is shown in Figure 1.

Genetic Variants: A total of 89 variants were seen in the Fox Hog HMA herd which is well above the mean for feral herds and high compared to the mean for domestic breeds. Of these, 33 had frequencies below 0.05 which is a very high percentage of variants at risk of future loss. Allelic diversity as represented by *Ae* is somewhat above the average for feral herds while *MNA* is much higher than the mean.

Genetic Variation: Observed heterozygosity in the Fox Hog HMA herd is just above the feral mean while *He* is higher than average. *Ho* is a good bit lower than *He* relative to the values for these measures. Differences such as this can indicate inbreeding or population subdivision.

Genetic Similarity: Overall similarity of the Fox Hog HMA herd to domestic breeds was about average for feral herds. Highest mean genetic similarity of the Fox Hog HMA herd was with Old World Iberian breeds, followed closely by the Oriental and Arabian breeds and North American Gaited breeds with identical mean *S* values. As seen in Fig. 1, however, the Fox Hog HMA herd clusters outside any main breed group and has an unlikely pairing with the New Forest Pony. These results indicate a herd with mixed origins with no clear indication of primary breed type. As with most trees involving feral herds, this tree is distorted compared to a tree that did not include this herd.

SUMMARY

Genetic variability of this herd in general is high based upon allelic diversity (with a high percentage of variation that is at risk) but about average based upon heterozygosity. These results are very similar to results seen in samples taken in 2005, although only blood typing data is available for that sampling. The high allelic diversity could be due to gene flow into the herd from outside and this is consistent with the differences in *Ho* and *He*. Genetic similarity results suggest a herd with mixed ancestry.

RECOMMENDATIONS

Current variability levels are high enough that no action is needed however, if the diversity seen is due to gene flow and that exchange is cut off, this herd could lose variation rapidly based upon the high proportion of rare alleles. This herd should be monitored closely.

Table 1. Allele frequencies of genetic variants observed in Fox Hog HMA feral horse herd.

VHL20															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**					
0.196	0.000	0.000	0.048	0.308	0.222	0.078	0.013	0.039	0.096	0.000					
HTG4															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.000	0.183	0.174	0.460	0.009	0.004	0.170	0.000	0.000						
AHT4															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**					
0.496	0.004	0.339	0.000	0.000	0.000	0.035	0.126	0.000	0.000	0.000					
HMS7															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.030	0.000	0.583	0.130	0.096	0.161	0.000	0.000	0.000						
AHT5															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.004	0.222	0.074	0.017	0.087	0.335	0.261	0.000	0.000	0.000						
HMS6															
I	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**						
0.000	0.000	0.057	0.130	0.004	0.000	0.270	0.517	0.022	0.000						
ASB2															
B	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**					
0.000	0.174	0.000	0.170	0.000	0.157	0.276	0.122	0.057	0.022	0.022					
HTG10															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**			
0.000	0.196	0.000	0.043	0.274	0.070	0.000	0.039	0.126	0.052	0.196	0.004	0.000			
HMS3															
H	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**				
0.000	0.070	0.000	0.000	0.000	0.130	0.039	0.083	0.504	0.135	0.039	0.000				
ASB17															
D	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**
0.000	0.035	0.013	0.004	0.000	0.004	0.017	0.000	0.217	0.276	0.026	0.022	0.000	0.278	0.065	0.043
ASB2															
G	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**V**
0.000	0.000	0.139	0.287	0.213	0.026	0.000	0.000	0.000	0.000	0.000	0.048	0.052	0.096	0.139	0.000
LEX33															
F	**G**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**				
0.000	0.000	0.052	0.374	0.004	0.000	0.357	0.009	0.170	0.000	0.030	0.004				

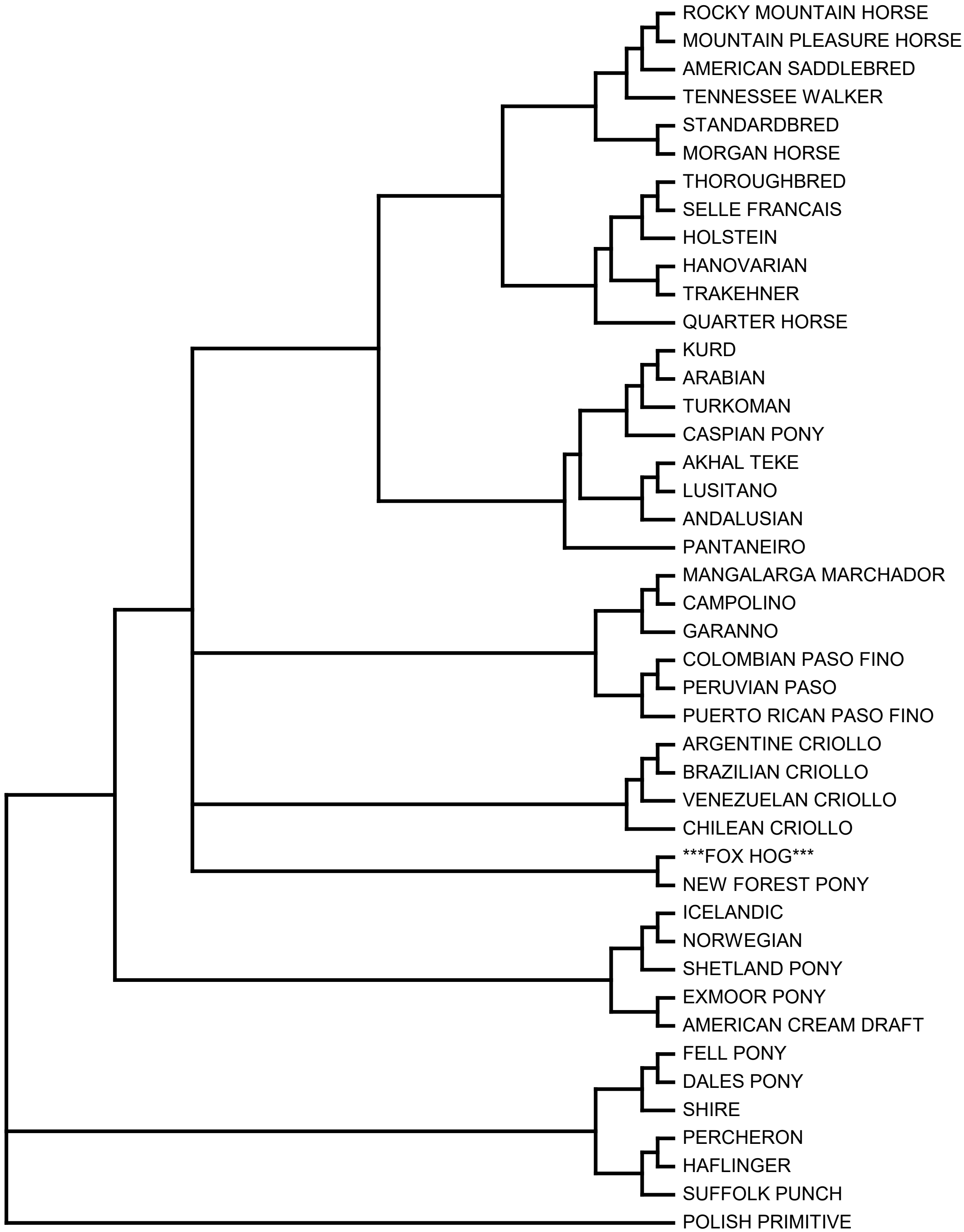
Table 2. Genetic variability measures.

	N	*Ho*	*He*	*Fis*	*Ae*	*TNV*	*MNA*	*Ra*	*%Ra*
FOX HOG CA	**115**	**0.717**	**0.730**	**0.018**	**4.03**	**89**	**7.42**	**33**	**0.371**
Cleveland Bay	47	0.610	0.627	0.027	2.934	59	4.92	16	0.271
American Saddlebred	576	0.740	0.745	0.007	4.25	102	8.50	42	0.412
Andalusian	52	0.722	0.753	0.041	4.259	79	6.58	21	0.266
Arabian	47	0.660	0.727	0.092	3.814	86	7.17	30	0.349
Exmoor Pony	98	0.535	0.627	0.146	2.871	66	5.50	21	0.318
Friesian	304	0.545	0.539	-0.011	2.561	70	5.83	28	0.400
Irish Draught	135	0.802	0.799	-0.003	5.194	102	8.50	28	0.275
Morgan Horse	64	0.715	0.746	0.041	4.192	92	7.67	33	0.359
Suffolk Punch	57	0.683	0.711	0.038	3.878	71	5.92	13	0.183
Tennessee Walker	60	0.666	0.693	0.038	3.662	87	7.25	34	0.391
Thoroughbred	1195	0.734	0.726	-0.011	3.918	69	5.75	18	0.261
Feral Horse Mean	126	0.716	0.710	-0.012	3.866	72.68	6.06	16.96	0.222
Standard Deviation		0.056	0.059	0.071	0.657	13.02	1.09	7.98	0.088
Minimum		0.496	0.489	-0.284	2.148	37	3.08	0	0
Maximum		0.815	0.798	0.133	5.253	96	8.00	33	0.400
Domestic Horse Mean	80	0.710	0.720	0.012	4.012	80.88	6.74	23.79	0.283
Standard Deviation		0.078	0.071	0.086	0.735	16.79	1.40	10.11	0.082
Minimum		0.347	0.394	-0.312	1.779	26	2.17	0	0
Maximum		0.822	0.799	0.211	5.30	119	9.92	55	0.462

Table 3. Rogers' genetic similarity of the Fox Hog HMA feral horse herd to major groups of domestic horses.

	Mean *S*	Std	Minimum	Maximum
Light Racing and Riding Breeds	0.761	0.028	0.720	0.793
Oriental and Arabian Breeds	0.765	0.026	0.725	0.797
Old World Iberian Breeds	0.761	0.030	0.730	0.810
New World Iberian Breeds	0.767	0.028	0.724	0.808
North American Gaited Breeds	0.765	0.020	0.730	0.788
Heavy Draft Breeds	0.692	0.059	0.613	0.784
True Pony Breeds	0.714	0.041	0.667	0.765

Figure 1. Partial RML tree of genetic similarity to domestic horse breeds.



Appendix 1. DNA data for the Fox Hog HMA, CA herd.

AID	VHL20	HTG4	AHT4	HMS7	AHT5	HMS6	ASB2	HTG10	HMS3	ASB17	ASB23	LEX33	LEX3
57666	NR	MP	HJ	LL	NO	OP	MQ	RR	MQ	NR	KU	OO	FN
57667	IN	KM	OO	NN	JO	OP	IN	IQ	PP	RS	IK	LQ	IP
57668	IR	MM	HH	LL	NN	LO	MO	IL	PQ	NR	IS	OQ	FM
57669	IM	MP	HJ	LL	NO	LP	IP	LP	PR	NR	JR	KQ	FP
57670	OO	MP	HJ	LL	NN	LP	KO	LP	PP	NR	JJ	KO	FM
57671	IR	MM	HJ	MO	JN	PP	MN	PR	QQ	MS	JK	OQ	HM
57672	MO	PP	JO	LL	JO	KP	OO	II	PQ	SS	TU	LL	FM
57673	NR	MM	HH	LL	MN	KQ	NO	OR	NP	OR	ST	QQ	FP
57674	IM	KL	JO	LL	JJ	OP	IM	LQ	MP	NN	JU	LO	MP
57675	OR	MM	HH	LL	JN	OP	MN	IR	PQ	NT	IK	LQ	HH
57676	II	MM	HJ	NO	JO	PP	KN	OR	OP	MP	JK	LL	MN
57677	MR	MP	HH	LN	IJ	OP	NR	MQ	MQ	JR	KU	OO	HH
57678	IM	KM	HJ	LL	KK	OO	NP	MR	MP	MN	KK	LL	HM
57679	NR	LM	HH	LO	JN	PP	NP	LR	PQ	MR	JU	LO	HM
57680	IO	KM	HJ	LL	NN	LO	II	RR	MP	MN	RR	LL	FM
57681	NO	LM	HO	LL	KN	LP	IM	IK	PQ	NR	KK	LQ	FO
57682	IM	LM	HJ	LL	JK	OO	MN	IL	MQ	MT	JK	LQ	FH
57683	IL	LM	HJ	LM	KN	LO	II	II	PQ	RT	IK	LQ	FP
57684	IO	LM	HH	LO	NO	OP	KK	MP	MP	MM	JK	LL	FP
57685	IN	KL	JO	LN	NO	PP	IK	IL	PP	MR	IJ	LL	FP
57686	LO	KN	JO	LO	OO	KP	MO	LQ	NP	RR	KU	OO	MP
57687	MR	MP	JJ	LO	JO	PP	MN	RR	MO	RR	LU	LO	FM
57688	MM	MP	HH	JM	JO	PP	IN	LP	RR	MN	JS	LO	MO
57689	LO	LL	JJ	LL	KO	OO	IM	MQ	MQ	NN	IK	LQ	FI
57690	IN	KP	HJ	LM	NN	LO	KO	LP	MP	MR	JL	LQ	FF
57691	LQ	LP	HO	LL	KN	OP	KN	OQ	IM	NR	IK	OQ	IP
57692	IR	LM	HH	LO	JM	OP	KP	IP	PP	MP	JU	LO	MM
57693	II	KL	HH	LM	OO	KL	IP	LL	PP	GM	JT	LO	MM
57694	II	LL	HH	LO	JO	KP	IK	LP	PP	FM	JK	LO	MO
57695	MM	KL	JO	LM	NO	OP	MN	LR	PQ	RS	IJ	LO	HM
57696	MO	LM	JN	MO	OO	PP	MN	LL	OP	KR	IJ	OO	FM
57697	MM	MP	HN	LM	MN	PP	NN	MR	OO	MP	JK	OO	FF
57698	MR	MM	HH	NN	NO	LO	MN	IL	PP	RR	JU	OO	FM
57699	OP	PP	JJ	MO	MN	OP	NN	KL	IP	NR	IJ	OO	MM
57700	LO	LL	JJ	LL	KO	OO	IM	MQ	MQ	NN	IK	LQ	FI
57701	MO	MM	HJ	NO	NN	OP	NN	IK	IO	OR	JU	OO	MM
57702	PR	MP	HJ	LO	NN	OP	MN	IL	OP	RR	JJ	KO	FM
57703	LO	KM	HH	LM	NN	PP	KM	IL	PQ	NR	IJ	LQ	MM
57704	MM	MP	HJ	MN	NN	OP	KN	KL	II	KO	IU	OO	MM
57728	MM	KM	HJ	LL	OO	OP	MN	IL	IP	MN	KT	OO	MM
57729	NN	KK	JJ	LL	MN	LP	IO	PP	MP	MN	RT	KL	FF
57730	MM	MM	HH	JO	JN	KP	IN	KL	PR	MN	JS	OQ	OO
57731	MN	LP	HO	LL	NO	OP	MN	MR	OQ	NR	KS	LO	FF
57732	MN	MP	HJ	LL	OO	KP	IM	IM	OQ	NS	JU	OO	FF
57733	MN	KM	HJ	LL	JN	OP	OP	LP	PP	NS	JR	LL	MM
57734	MQ	LP	JO	LN	NN	PP	NN	LM	MP	NT	IK	QQ	FF
57735	IN	KM	JJ	LL	JN	OP	IK	LP	PP	NN	JT	LL	FF
57736	IM	LP	HJ	LM	JJ	PQ	KR	IR	IP	MM	KT	LL	MM
57737	NN	KM	OO	LO	JO	LP	IO	IO	NR	HN	JT	OO	MM
57738	LN	KK	HO	OO	OO	KO	MM	IL	OP	MR	IK	LO	PP
57739	IM	MM	HJ	OO	NO	PP	KM	LO	NP	MT	JJ	LL	MM
57740	MM	MP	HJ	LL	KO	OO	KN	LR	MM	RT	KK	OO	II
57741	MN	KO	HJ	LN	JO	LP	IM	IL	OP	FN	IK	LQ	PP
57742	IL	MM	HJ	LO	OO	PP	NN	LR	OP	PT	KK	LL	MM
57743	RR	MP	HJ	JL	LO	MP	IO	IP	PQ	NS	KK	LO	NN
57744	NN	MP	HJ	MO	NN	PP	KN	LP	PQ	MR	JT	OQ	FF
57745	NN	MM	HN	JL	JN	OP	KK	IQ	OP	MM	TU	LQ	FF
57746	MN	MM	HO	LL	NN	OP	NP	LR	PR	MN	JL	LM	FF
57747	MQ	KK	HH	MN	KO	LP	IN	LQ	PP	NR	IT	LL	FF
57748	LN	LL	HJ	LL	KO	LO	IM	IM	PQ	NT	IK	QQ	FF
57749	MN	MM	HJ	LL	KM	PP	OP	LR	NP	NN	KU	KO	MM
57750	II	MP	JJ	LM	JN	PP	IM	IP	PQ	NS	JK	LQ	MM
57751	NN	MP	HJ	LL	NN	LP	NO	LR	PQ	MR	LU	LO	MM
57752	RR	MM	HJ	OO	LN	PP	MN	LR	PR	MN	IJ	LP	MM
57753	IM	LP	HH	LL	JN	OP	IK	LP	PP	RR	JJ	LO	FF
57754	NO	MP	HH	LM	NO	LP	OP	LP	PP	MN	JJ	KO	MM
57755	IQ	KK	JO	MM	JN	LO	IM	IQ	PP	NR	KK	LQ	FF
57756	LN	LM	HO	LL	LN	LP	IN	IM	PP	NR	KU	LQ	II
57757	IM	KL	JO	LN	NO	OP	II	IL	PP	GR	JK	LQ	PP
57758	MN	KL	HH	LL	JO	PP	KK	PR	PQ	MR	RU	KO	MM
57759	NO	MP	HO	LL	JO	KP	OO	IL	PP	FS	TU	LQ	MM
57760	IM	KM	HJ	LL	KK	LO	IN	MR	MP	MR	KT	LL	HH
57761	NR	MP	HN	LO	MN	KL	NO	IL	PQ	NR	JS	KO	MM
57762	MM	MP	HH	LN	JO	OP	MO	RR	PP	NN	ST	OS	OO
57763	IN	KM	HJ	LO	JN	OP	KK	LP	PP	MR	JR	KO	MM
57764	IM	KM	HH	LN	NO	LO	MN	IM	MP	RS	IU	LO	HH
57765	IN	KL	HJ	LL	NO	LO	KK	PP	MM	MM	LR	KQ	MM
57766	IM	KL	HJ	LO	JO	OO	KK	OR	MP	NS	JT	LQ	MM
57767	LN	KN	HH	LO	KO	KP	MO	LL	NP	MR	IU	OO	MM
57768	IN	MM	HJ	LL	JM	PP	IO	LP	PP	RR	JJ	LQ	MM
57769	MQ	LM	HJ	LO	JN	OP	NO	RR	OP	NR	LU	LS	MM
57770	RR	MM	HJ	LL	MM	PP	OQ	IM	NP	MR	KS	OO	FF
57771	IO	KM	HJ	LM	NO	OP	IO	LR	MP	FM	JT	KO	FF
57772	IM	LL	HO	LM	JO	OO	PR	IP	MP	MR	JT	LL	MM
57773	MN	KL	HH	JO	NN	PP	IN	KR	PR	NR	TU	LO	FF
57774	IN	KM	JJ	LL	JM	OP	KK	PR	MP	FF	JR	LQ	MM
57775	MQ	PP	JJ	JL	LN	KP	NQ	IR	PQ	MN	KU	OQ	OO
57776	IN	MM	HH	LM	MO	PP	NN	LR	NP	MR	IS	LQ	OO
57777	MN	KP	HN	LL	JN	PP	NO	IR	OO	NR	KS	OS	II
57778	NR	MM	HH	LL	JJ	OP	MN	IR	PQ	NN	KS	LS	HH
57779	IN	KM	HH	LL	KM	PQ	OQ	OS	PP	NR	ST	OQ	PP
57780	IQ	MP	HO	MN	NO	OP	KM	LO	MP	NO	JK	LS	NN
57781	MM	MP	JO	LL	JO	OP	KO	IL	PP	NS	TU	LL	MM
57782	MN	MP	HO	JL	JK	KQ	NQ	LR	MP	MN	IK	OS	OO
57783	IN	KM	HJ	LL	JN	OP	II	PR	MP	GN	JR	LO	FF
57784	MQ	LP	JO	LM	JO	OQ	IR	IR	IM	MR	IT	LL	MM
57785	IN	LL	JO	LN	JJ	OO	MR	IR	IM	MR	II	LL	HH
57786	MN	LP	HJ	OO	JN	PP	KP	PP	PQ	MR	JT	LO	OO
57787	IM	KL	HO	LL	JM	LP	KP	LP	PR	FT	JU	QQ	MM
57788	MN	MP	HH	LL	JO	OP	KN	MQ	IM	MR	IU	LO	HH
57789	NQ	LM	JO	LL	JN	OP	NO	KR	OP	NN	UU	LS	FF
57790	MM	MM	HH	MN	JM	OP	MN	IL	PQ	MN	IK	LQ	PP
57791	NO	MP	HJ	LL	JN	LL	KO	LP	PP	MS	JR	KL	FF
57792	IR	LM	HH	LM	JN	PP	IN	LR	PQ	FR	JU	LO	HH
57793	MN	KM	HO	NN	OO	PP	II	IQ	PP	NS	IK	LQ	II
57794	MM	MM	HN	LO	MN	PP	MN	IM	IP	KR	IJ	OO	MM
57795	MM	MM	JJ	LM	MO	LP	KN	LL	IO	NO	JJ	OO	FF
57796	MN	MM	JJ	LN	NO	LP	KN	LL	IQ	MR	JJ	OO	FF
57797	IM	KK	JO	LO	NN	LL	IP	LR	PP	NR	IK	LO	MM
57798	MM	MM	JN	MO	MN	PP	NN	IL	IO	RR	JJ	OO	MM
57799	MM	MM	HH	NO	MN	LP	KN	IK	IP	RR	IJ	OO	MM
57800	MP	MM	JN	LM	NO	OP	NN	IK	PP	NP	JJ	LO	FF
57801	NR	MM	HJ	LO	MO	PP	NN	KL	IP	KO	JU	OO	MM
57802	MR	MM	HJ	OO	JN	PP	MN	LR	NP	NT	UU	LP	MM
57803	MM	KM	HI	MM	OO	PP	KN	OR	PQ	MM	JK	OT	MM

Appendix N. WinEquus Population Modeling Results

To complete the population modeling for the Surprise Complex, version 1.40 of the WinEquus program, created 03 April 2002 was utilized. This model was run using projected numbers based on the 2019 population estimate of 1,301 wild horses.

Objectives of Population Modeling

Review of data output for each of the simulations provided useful comparisons of possible outcomes for each alternative. Some questions that need to be answered through the modeling include:

- Do any of the alternatives "crash" the population
- Wat effect does fertility control have on the population growth rate?
- What effects do the different alternatives have on the average population size?
- What effects do the different alternatives have on the genetic health of the herd?

Population Data, Criteria, and Parameters Utilized for Population Modeling

All simulations used the survival probabilities supplied with the WinEquus population model for the Garfield Flat, Nevada (1993) for age-sex ratios and the Garfield Flat for foaling rates and survival probabilities. Age-sex ratio data were derived from horses gathered and marked in 1993 at Garfield Flat, Nevada. Survival probability values were calculated from data reported by Garrott and Taylor in 1990 (Journal of Wildlife Management 54:603-612) based on their 11-year study of the horse population at Pryor Mountain, Montana between 1976 and 1986. The calculations of average survival probabilities exclude one year in which there was catastrophic mortality of greater than 50% of the population due to severe winter weather. Specific rates for the HMAs within the Surprise Complex are not available.

<u>Contraception Parameters (Alternatives 1 and 2):</u>
Modeled data were run with assumed efficacies of 94% in year 1, 82% in year 2, and 68% in year 3.

Age	Percentages for Fertility Treatment
Foal	0%
1	0%
2	100%
3	100%
4	100%
5	100%
6	100%
7	100%
8	100%
9	100%
10-14	100%
15-19	100%
20+	100%

Population Modeling Criteria

The following summarizes the population modeling criteria that are common to all action Alternatives:

- Starting Year: 2020
- Initial gather year: 2020
- Starting population size: 1,301
- Gather interval: regular interval of three years
- Gather for fertility treatment regardless of population size: No
- Continue to gather after reduction to treat females: Yes
- Sex ratio at birth: 49% males
- Percent of the population that can be gathered: 60%
- Minimum age for long term holding facility horses: Not Applicable
- Foals are not included in the AML
- Simulations were run for 10 years with 100 trials each

Results of WinEquus Population Modeling

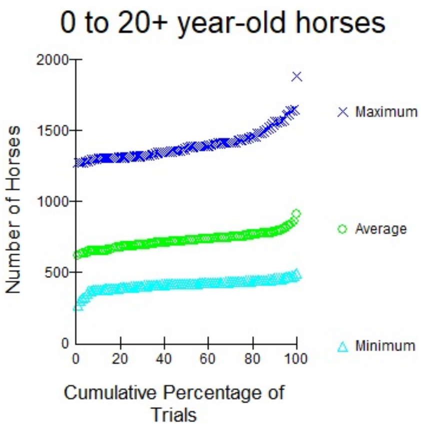
Population modeling was completed for the proposed action and alternatives. One hundred trials were run, simulating population growth and herd demographics to determine the projected herd structure. The computer program used simulates the population dynamics of wild horses. It was written by Dr. Stephen H. Jenkins, Department of Biology, University of Nevada, Reno, under a contract from the National Wild Horse and Burro Program of the Bureau of Land Management and is designed for use in comparing various management strategies for wild horses.

To date, one herd has been studied using the 2-year PZP vaccine. The Clan Alpine study, in Nevada, was started in January 2000 with the treatment of 96 mares. The test resulted in fertility rates in treated mares of 6% year one and 18% year two.

Results – Alternatives 1 & 2 – Phased-in Gather, Selective Removal of Excess Wild Horses to Low AML, Sex Ratio Adjustment, and Population Growth Suppression

Sex ratio adjustment is not able to be modeled as an individual treatment, so results from Alternatives 1 and 2 are identical even though sex ratio adjustment is included in Alternative 1. Starting population 1,301, gather when population exceeds 496, reduce population to 283, gather every 3 years, foals not included in AML, effectiveness of fertility control year 1 = 94%, year 2 = 82%, year 3 = 68%, after that 0, no fertility control to 0-1 years, all age classes = 100% efficacy, 60% of population can be gathered.

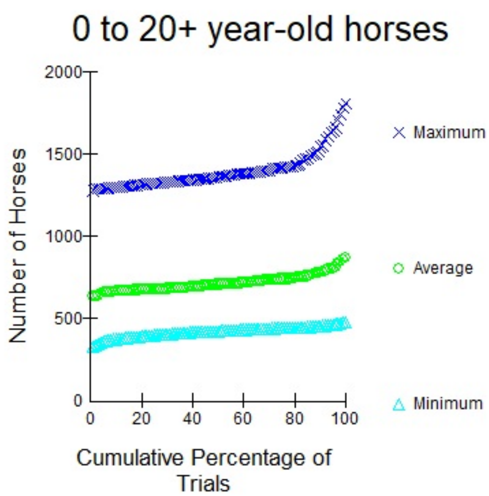
	Minimum	Average	Maximum
Lowest trial	272	617	1,274
10th percentile	380	656	1,308
25th percentile	400	690	1,320
Median trial	420	727	1,382
75th percentile	440	756	1,440
90th percentile	458	789	1,562
Highest trial	498	911	1,884



Results – Alternative 3 – Gather and Removal Only

Explanation

Starting population 1,301, gather when population exceeds 496, reduce population to 283, gather every 3 years, foals not included in AML, 60% of population can be gathered.

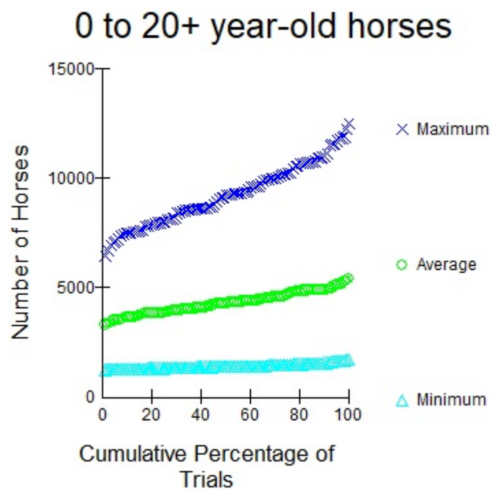


	Minimum	Average	Maximum
Lowest trial	328	638	1,280
10th percentile	377	667	1,304
25th percentile	402	678	1,326
Median trial	424	707	1,364
75th percentile	445	740	1,422
90th percentile	458	782	1,551
Highest trial	482	872	1,804

Results – Alternative 4 – Deferred Gather

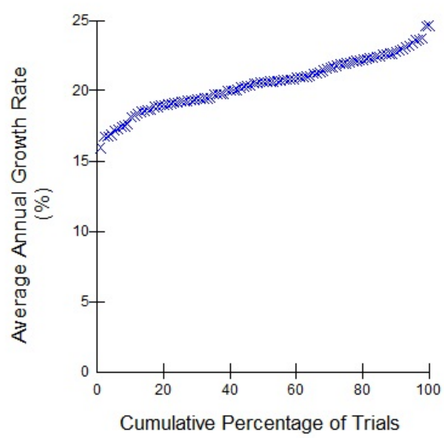
Explanation

In 11 years and 100 trials, the lowest number of 0 to 20+ year-old horses ever obtained was 1,264 and the highest was 12,510. The average population size across 10 years ranged from 3,302 to 5,375.



	Minimum	Average	Maximum
Lowest trial	1,264	3,302	6,449
10th percentile	1,293	3,636	7,529
25th percentile	1,326	3,859	8,092
Median trial	1,397	4,305	9,260
75th percentile	1,484	4,699	10,261
90th percentile	1,562	4,921	11,067
Highest trial	1,741	5,375	12,510

Growth Rate:



Lowest trial	15.9%
10th percentile	18.2%
25th percentile	19.3%
Median trial	20.6%
75th percentile	22.0%
90th percentile	22.8%
Highest trial	24.7%

Appendix O. Effects of Fertility Control; Literature Reviews

Porcine Zona Pellucida (PZP) Vaccine

PZP vaccines have been used on dozens of horse herds by the National Park Service, US Forest Service, Bureau of Land Management, and Native American tribes and its use is approved by the EPA for free-ranging wild horses. Taking into consideration available literature on the subject, the National Research Council concluded in their 2013 report that PZP was one of the preferable available methods for contraception in wild horses and burros (NRC 2013). PZP use can reduce the need for gathers and removals (Turner et al. 1997). PZP vaccines meet most of the criteria that the National Research Council (2013) used to identify promising fertility control methods, in terms of delivery method, availability, efficacy, and side effects. It has been used extensively in wild horses (NRC 2013), and in feral burros on Caribbean islands (Turner et al. 1996, French et al. 2017). PZP is relatively inexpensive, meets BLM requirements for safety to mares and the environment, and is produced as ZonaStat-H, an EPA-registered commercial product (EPA 2012, SCC 2015), or as PZP-22, which is a formulation of PZP in polymer pellets that can lead to a longer immune response (Turner et al. 2002, Rutberg et al. 2017). 'Native' PZP proteins can be purified from pig ovaries (Liu et al. 1989). Recombinant ZP proteins may be produced with molecular techniques (Gupta and Minhas 2017, Joonè et al. 2017a, Nolan et al. 2018a). It can easily be remotely administered in the field in cases where mares are relatively approachable. Use of remotely delivered (dart-delivered) vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached within 50 m (BLM 2010, Rutberg et al. 2017).

The BLM currently uses two PZP formulations for fertility control of wild horse mares, ZonaStat-H (PZP Native) and PZP-22. As other formulations are approved for use by BLM, they may be applied through future gathers or darting activities. For the purpose of this management plan, field or remote darting refers to applying the vaccine using a dart. Darting can be implemented when animals are gathered into corrals or opportunistically by applicators near water sources or along main WH&B trails out on the range. Blinds may be used to camouflage applicators to allow efficient treatment of as many mares as possible. PZP can also be applied via hand injections using plastic syringes when animals are gathered into corrals and chutes. In keeping with the EPA registration for ZonaStat-H (EPA 2012; reg. no. 86833-1), certification through the Science and Conservation Center in Billings Montana is required to apply that vaccine to equids.

When applying native PZP (i.e., ZonaStat-H), first the primer with modified Freund's Complete adjuvant is given and then the booster with Freund's Incomplete adjuvant is given 2-6 weeks later. Preferably, the timing of the booster dose is at least 1-2 weeks prior to the onset of breeding activity. Following the initial 2 inoculations, annual boosters are required to maintain contraception. For maximum effectiveness, PZP would be administered within the December to February timeframe. The procedures to be followed for application of PZP are detailed in Appendix E. *Standard Operating Procedures for Population-level Porcine Zona Pellucida Fertility control treatments.*

For the PZP-22 formulation administered during gathers, each released mare would receive a single dose of the PZP-22 contraceptive vaccine pellets at the same time as a dose of the liquid PZP vaccine with modified Freund's Complete adjuvant. The pellets are applied to the mare with a large gauge needle and jab-stick into the hip. Although PZP-22 pellets have been delivered via darting in trial studies (Rutberg et al 2017), BLM does not plan to use darting for PZP-22 delivery in this HMA until there is more demonstration that PZP-22 can be reliably delivered via dart. Therefore, WH&Bs must be gathered for each application of this formulation.

PZP Direct Effects

The historically accepted hypothesis explaining PZP vaccine effectiveness posits that when injected as an antigen in vaccines, PZP causes the mare's immune system to produce antibodies that are specific to zona pellucida proteins on the surface of that mare's eggs. The antibodies bind to the mare's eggs surface proteins (Liu et al. 1989), and effectively block sperm binding and fertilization (Zoo Montana, 2000). Because treated mares do not become pregnant but other ovarian functions remain generally unchanged, PZP can cause a mare to continue having regular estrus cycles throughout the breeding season. More recent observations support a complementary hypothesis, which posits that PZP vaccination causes reductions in ovary size and function (Mask et al. 2015, Joonè et al. 2017b, Joonè et al. 2017c, Nola et al. 2018b, 2018c). Antibodies specific to PZP protein do not crossreact with tissues outside of the reproductive system (Barber and Fayrer-Hosken 2000).

Research has demonstrated that contraceptive efficacy of an injected liquid PZP vaccine, such as ZonaStat-H, is approximately 90 percent or more for mares treated twice in one year (Turner and Kirkpatrick 2002, Turner et al. 2008). The highest success for fertility control has been reported when the vaccine has been applied November through February. High contraceptive rates of 90 percent or more can be maintained in horses that are boostered annually (Kirkpatrick et al. 1992). Approximately 60 percent to 85 percent of mares are successfully contracepted for one year when treated simultaneously with a liquid primer and PZP-22 pellets (Rutberg et al. 2017, Carey et al. 2019). Application of PZP for fertility control would reduce fertility in a large percentage of mares for at least one year (Ransom et al. 2011).

The contraceptive result for a single application of the liquid PZP vaccine primer dose along with PZP vaccine pellets (PZP-22), based on winter applications, can be expected to fall in the approximate efficacy ranges as follows (based on figure 2 in Rutberg et al. 2017). Below, the approximate efficacy is measured as the relative decrease in foaling rate for treated mares, compared to control mares:

Year 1	Year 2	Year 3
0 (developing fetuses come to term)	~30-75 percent	~20-50 percent

If mares that have been treated with PZP-22 vaccine pellets subsequently receive a booster dose of either the liquid PZP vaccine or the PZP-22 vaccine pellets, the subsequent contraceptive effect is apparently more pronounced and long-lasting. The approximate efficacy following a booster dose can be expected to be in the following ranges (based on figure 3 in Rutberg et al. 2017).

Year 1	Year 2	Year 3	Year 4
0 (developing fetuses come to term)	~50-90 percent	~55-75 percent	~40-75 percent

The efficacies noted above, which are based on results in Rutberg et al. (2017), call into question population and economic models that assume PZP-22 can have an 85 percent efficacy in years 2 and 3 after immunization, such as Fonner and Bohara (2017).

The fraction of mares treated in a herd can have a large effect on the realized change in growth rate due to PZP contraception, with an extremely high portion of mares required to be treated to lead prevent population-level growth (e.g., Turner and Kirkpatrick 2002). Gather efficiency would likely not exceed 85 percent via helicopter, and may be less with bait and water trapping, so there would be a portion of the female population uncaptured that is not treated in any given year. Additionally, some mares may not respond to the fertility control vaccine, but instead may continue to foal normally.

Reversibility and Effects on Ovaries
In most cases, PZP contraception appears to be temporary and reversible, with most treated mares returning to fertility over time (Kirkpatrick and Turner 2002). The NRC (2013) criterion by which PZP is not optimal for wild horse contraception was duration. The ZonaStat-H formulation of the vaccine tends to confer only one year of efficacy per dose. Some studies have found that a PZP vaccine in long-lasting pellets (PZP-22) can confer multiple years of contraception (Turner et al. 2007), particularly when boostered with subsequent PZP vaccination (Rutberg et al. 2017). Other trial data, though, indicate that the pelleted vaccine may only be effective for one year (J. Turner, University of Toledo, Personal Communication).

The purpose of applying PZP treatment is to prevent mares from conceiving foals, but BLM acknowledges that long-term infertility, or permanent sterility, could be a result for some number of wild horses receiving PZP vaccinations. The rate of long-term or permanent sterility following vaccinations with PZP is hard to predict for individual horses, but that outcome appears to increase in likelihood as the number of doses increases (Kirkpatrick and Turner 2002). Permanent sterility for mares treated consecutively 5-7 years was observed by Nuñez et al. (2010, 2017). In a graduate thesis, Knight (2014) suggested that repeated treatment with as few as three to four years of PZP treatment may lead to longer-term sterility, and that sterility may result from PZP treatment before puberty. Repeated treatment with PZP led long-term infertility in Przewalski's horses receiving as few as one PZP booster dose (Feh 2012). However, even if some number of mares become sterile as a result of PZP treatment, that potential result would be consistent with the contraceptive purpose that motivates BLM's potential use of the vaccine.

In some mares, PZP vaccination may cause direct effects on ovaries (Gray and Cameron 2010, Joonè et al. 2017b, Joonè et al. 2017c, Joonè et al. 2017d). Joonè et al. (2017a) noted reversible effects on ovaries in mares treated with one primer dose and booster dose. Joonè et al. (2017c) documented decreased anti-Mullerian hormone (AMH) levels in mares treated with native or recombinant PZP vaccines; AMH levels are thought to be an indicator of ovarian function. Bechert et al. (2013) found that ovarian function was affected by the SpayVac PZP vaccination, but that there were no effects on other organ systems. Mask et al. (2015) demonstrated that equine antibodies that resulted from SpayVac immunization could bind to oocytes, ZP proteins, follicular tissues, and ovarian tissues. It is possible that result is specific to the immune response to SpayVac, which may have lower PZP purity than ZonaStat or PZP-22 (Hall et al. 2016). However, in studies with native ZP proteins and recombinant ZP proteins, Joonè et al. (2017a) found transient effects on ovaries after PZP vaccination in some treated mares; normal estrus cycling had resumed 10 months after the last treatment. SpayVac is a patented formulation of PZP in liposomes that led to multiple years of infertility in some breeding trials (Killian et al. 2008, Roelle et al. 2017, Bechert and Fraker 2018), but unacceptably poor efficacy in a subsequent trial (Kane 2018). Kirkpatrick et al. (1992) noted effects on horse ovaries after three years of treatment with PZP. Observations at Assateague Island National Seashore indicate that the more times a mare is consecutively treated, the longer the time lag before fertility returns, but that even mares treated 7 consecutive years did eventually return to ovulation (Kirkpatrick and Turner 2002). Other studies have reported that continued applications of PZP may result in decreased estrogen levels (Kirkpatrick et al. 1992) but that decrease was not biologically significant, as ovulation remained similar between treated and untreated mares (Powell and Monfort 2001). Permanent sterility for mares treated consecutively 5-7 years was observed by Nuñez et al. (2010, 2017). Bagavant et al. (2003) demonstrated T-cell clusters on ovaries, but no loss of ovarian function after ZP protein immunization in macaques. Skinner et al. (1984) raised concerns about PZP effects on ovaries, based on their study in laboratory rabbits, as did Kaur and Prabha (2014), though neither paper was a study of PZP effects in equids.

Effects on Existing Pregnancies, Foals, and Birth Phenology
If a mare is already pregnant, the PZP vaccine has not been shown to affect normal development of the

fetus or foal, or the hormonal health of the mare with relation to pregnancy (Kirkpatrick and Turner 2003). It is possible that there may be transitory effects on foals born to mares or jennies treated with PZP. In mice, Sacco et al. (1981) found that antibodies specific to PZP can pass from mother mouse to pup via the placenta or colostrum, but that did not apparently cause any innate immune response in the offspring: the level of those antibodies were undetectable by 116 days after birth. There was no indication in that study that the fertility or ovarian function of those mouse pups was compromised, nor is BLM aware of any such results in horses or burros. Unsubstantiated speculative connections between PZP treatment and foal stealing has not been published in a peer-reviewed study and thus cannot be verified. Similarly, although Nettles (1997) noted reported stillbirths after PZP treatments in cynomolgus monkeys, those results have not been observed in equids despite extensive use.

On-range observations from 20 years of application to wild horses indicate that PZP vaccine use in wild mares does not generally cause mares to give birth to foals out of season or late in the year (Kirkpatrick and Turner 2003). Nuñez's (2010) research showed that a small number of mares that had previously been treated with PZP foaled later than untreated mares and expressed the concern that this late foaling "may" impact foal survivorship and decrease band stability, or that higher levels of attention from stallions on PZP-treated mares might harm those mares. However, that paper provided no evidence that such impacts on foal survival or mare well-being actually occurred. Rubenstein (1981) called attention to a number of unique ecological features of horse herds on Atlantic barrier islands, which calls into question whether inferences drawn from island herds can be applied to western wild horse herds. Ransom et al. (2013), though, identified a potential shift in reproductive timing as a possible drawback to prolonged treatment with PZP, stating that treated mares foaled on average 31 days later than non-treated mares. Results from Ransom et al. (2013), however, showed that over 81percent of the documented births in this study were between March 1 and June 21, i.e., within the normal, peak, spring foaling season. Ransom et al. (2013) pointedly advised that managers should consider carefully before using PZP in small refugia or rare species. Wild horses and burros managed by BLM do not generally occur in isolated refugia, nor are they rare species. Moreover, an effect of shifting birth phenology was not observed uniformly: in two of three PZP-treated wild horse populations studied by Ransom et al. (2013), foaling season of treated mares extended three weeks and 3.5 months, respectively, beyond that of untreated mares. In the other population, the treated mares foaled within the same time period as the untreated mares. Furthermore, Ransom et al. (2013) found no negative impacts on foal survival even with an extended birthing season. If there are shifts in birth phenology, though, it is reasonable to assume that some negative effects on foal survival might result from particularly severe weather events (Nuñez et al. 2018).

Effects of Marking and Injection
Standard practices for PZP treatment require that immunocontraceptive-treated animals be readily identifiable, either via brand marks or unique coloration (BLM 2010). BLM has instituted guidelines to reduce the sources of handling stress in captured animals (BLM 2015). Some level of transient stress is likely to result in newly captured mares that do not have markings associated with previous fertility control treatments. It is difficult to compare that level of temporary stress with long-term stress that can result from food and water limitation on the range (e.g., Creel et al. 2013). Handling may include freezemarking, for the purpose of identifying that mare and identifying her PZP vaccine treatment history. Under past management practices, captured mares experienced increased stress levels from handling (Ashley and Holcombe 2001). Markings may also be used into the future to determine the approximate fraction of mares in a herd that have been previously treated, and could provide additional insight regarding gather efficiency.

Most mares recover from the stress of capture and handling quickly once released back to the HMA, and none are expected to suffer serious long term effects from the fertility control injections, other than the direct consequence of becoming temporarily infertile. Injection site reactions associated with fertility control treatments are possible in treated mares (Roelle and Ransom 2009, Bechert et al. 2013, French et al. 2017), but swelling or local reactions at the injection site are expected to be minor in nature. Roelle and Ransom (2009) found that the most time-efficient method for applying PZP is by hand-delivered injection of 2-year pellets when horses are gathered. They observed only two instances of swelling from that technique. Use of remotely delivered, 1-year PZP is generally limited to populations where individual animals can be accurately identified and repeatedly approached. The dart-delivered formulation produced injection-site reactions of varying intensity, though none of the observed reactions appeared debilitating to the animals (Roelle and Ransom 2009). Joonè et al. (2017a) found that injection site reactions had healed in most mares within 3 months after the booster dose, and that they did not affect movement or cause fever. The longer term nodules observed did not appear to change any animal's range of movement or locomotor patterns and in most cases did not appear to differ in magnitude from naturally occurring injuries or scars.

Indirect Effects

One expected long-term, indirect effect on wild horses treated with fertility control would be an improvement in their overall health (Turner and Kirkpatrick 2002). Many treated mares would not experience the biological stress of reproduction, foaling and lactation as frequently as untreated mares. The observable measure of improved health is higher body condition scores (Nuñez et al. 2010). After a treated mare returns to fertility, her future foals would be expected to be healthier overall, and would benefit from improved nutritional quality in the mare's milk. This is particularly to be expected if there is an improvement in rangeland forage quality at the same time, due to reduced wild horse population size. Past application of fertility control has shown that mares' overall health and body condition remains improved even after fertility resumes. PZP treatment may increase mare survival rates, leading to longer potential lifespan (Turner and Kirkpatrick 2002, Ransom et al. 2014a). To the extent that this happens, changes in lifespan and decreased foaling rates could combine to cause changes in overall age structure in a treated herd (i.e., Turner and Kirkpatrick 2002, Roelle et al. 2010), with a greater prevalence of older mares in the herd (Gross 2000). Observations of mares treated in past gathers showed that many of the treated mares were larger than, maintained higher body condition than, and had larger healthy foals than untreated mares.

Following resumption of fertility, the proportion of mares that conceive and foal could be increased due to their increased fitness; this has been called a 'rebound effect.' Elevated fertility rates have been observed after horse gathers and removals (Kirkpatrick and Turner 1991). More research is needed to document and quantify these hypothesized effects in PZP-treated herds. If repeated contraceptive treatment leads to a prolonged contraceptive effect, then that may minimize or delay the hypothesized rebound effect. Selectively applying contraception to older animals and returning them to the HMA could reduce long-term holding costs for such horses, which are difficult to adopt, and may reduce the compensatory reproduction that often follows removals (Kirkpatrick and Turner 1991).

Because successful fertility control would reduce foaling rates and population growth rates, another indirect effect should be to reduce the number of wild horses that have to be removed over time to achieve and maintain the established AML. Contraception would be expected to lead to a relative increase in the fraction of older animals in the herd. Reducing the numbers of wild horses that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild horses, and thereby could eliminate the need to send additional excess horses from this area to off-range holding corrals or pastures for long-term holding. Among mares in the herd that remain fertile, a high level of physical health and future reproductive success would be expected because reduced population sizes should lead to more availability of water and forage resources per capita.

Reduced population growth rates and smaller population sizes could also allow for continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse habitat quality. As the population nears or is maintained at the level necessary to achieve a thriving natural ecological balance, vegetation resources would be expected to recover, improving the forage available to wild horses and wildlife throughout the HMA. With rangeland conditions more closely approaching a thriving natural ecological balance, and with a less concentrated distribution of wild horses across the HMA, there should also be less trailing and concentrated use of water sources. Lower population density would be expected to lead to reduced competition among wild horses using the water sources, and less fighting among horses accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild horses. Wild horses would also have to travel less distance back and forth between water and desirable foraging areas. Should PZP booster treatment continue into the future, there may be fewer instances ofoverpopulation and large gathers and removals, but instead a consistent cycle of balance and stability would ensue, resulting in continued improvement of overall habitat conditions and animal health. While it is conceivable that widespread and continued treatment with PZP could reduce the birth rates of the population to such a point that birth is consistently below mortality, that outcome is not likely unless a very high fraction of the mares present are all treated in almost every year.

Behavioral Effects
The NRC report (2013) noted that all fertility suppression has effects on mare behavior, mostly as a result of the lack of pregnancy and foaling, and concluded that PZP was a good choice for use in the program. The result that PZP-treated mares may continue estrus cycles throughout the breeding season can lead to behavioral differences (as discussed below), when compared to mares that are fertile. Such behavioral differences should be considered as potential consequences of successful contraception.

Ransom and Cade (2009) delineate behaviors that can be used to test for quantitative differences due to treatments. Ransom et al. (2010) found no differences in how PZP-treated and untreated mares allocated their time between feeding, resting, travel, maintenance, and most social behaviors in three populations of wild horses, which is consistent with Powell's (1999) findings in another population. Likewise, body condition of PZP-treated and control mares did not differ between treatment groups in Ransom et al.'s (2010) study. Nuñez (2010) found that PZP-treated mares had higher body condition than control mares in another population, presumably because energy expenditure was reduced by the absence of pregnancy and lactation. Knight (2014) found that PZP-treated mares had better body condition, lived longer and switched harems more frequently, while mares that foaled spent more time concentrating on grazing and lactation and had lower overall body condition. Studies on Assateague Island (Kirkpatrick and Turner 2002) showed that once fillies (female foals) that were born to mares treated with PZP during pregnancy eventually breed, they produce healthy, viable foals.

In two studies involving a total of four wild horse populations, both Nuñez et al. (2009) and Ransom et al. (2010) found that PZP-treated mares were involved in reproductive interactions with stallions more often than control mares, which is not surprising given the evidence that PZP-treated females of other mammal species can regularly demonstrate estrus behavior while contracepted (Shumake and Killian 1997, Heilmann et al. 1998, Curtis et al. 2001, Duncan et al. 2017). There was no evidence, though, that mare welfare was affected by the increased level of herding by stallions noted in Ransom et al. (2010). Nuñez's later analysis (2017) noted no difference in mare reproductive behavior as a function of contraception history.

Ransom et al. (2010) found that control mares were herded by stallions more frequently than PZP-treated mares, and Nuñez et al. (2009, 2014, 2017, 2018) found that PZP-treated mares exhibited higher infidelity to their band stallion during the non-breeding season than control mares. Madosky et al. (2010) and

Knight (2014) found this infidelity was also evident during the breeding season in the same population that Nuñez et al. (2009, 2010, 2014, 2017, 2018) studied. Nuñez et al. (2014, 2017, 2018) concluded that PZP-treated mares changing bands more frequently than control mares could lead to band instability. Nuñez et al. (2009), though, cautioned against generalizing from that island population to other herds. Nuñez et al. (2014) found elevated levels of fecal cortisol, a marker of physiological stress, in mares that changed bands. The research is inconclusive as to whether all the mares' movements between bands were related to the PZP treatments themselves or the fact that the mares were not nursing a foal, and did not demonstrate any long-term negative consequence of the transiently elevated cortisol levels. Nuñez et al. 2014 wrote that these effects "…may be of limited concern when population reduction is an urgent priority." Nuñez (2018) and Jones et al. (2019, 2020) that band stallions of mares that have received PZP treatment can exhibit changes in behavior and physiology. Nuñez (2018) cautioned that PZP use may limit the ability of mares to return to fertility, but also noted that, "such aggressive treatments may be necessary when rapid reductions in animal numbers are of paramount importance…If the primary management goal is to reduce population size, it is unlikely (and perhaps less important) that managers achieve a balance between population control and the maintenance of more typical feral horse behavior and physiology."

In contrast to transient stresses, Creel et al. (2013) highlight that variation in population density is one of the most well-established causal factors of chronic activation of the hypothalamic-pituitary-adrenal axis, which mediates stress hormones; high population densities and competition for resources can cause chronic stress. Creel et al. (2013) also state that "…there is little consistent evidence for a negative association between elevated baseline glucocorticoids and fitness." Band fidelity is not an aspect of wild horse biology that is specifically protected by the Wild Horse and Burro Act of 1971. It is also notable that Ransom et al. (2014b) found higher group fidelity after a herd had been gathered and treated with a contraceptive vaccine; in that case, the researchers postulated that higher fidelity may have been facilitated by the decreased competition for forage after excess horses were removed. At the population level, available research does not provide evidence of the loss of harem structure among any herds treated with PZP. Long-term implications of these changes in social behavior are currently unknown, but no negative impacts on the overall animals or populations overall, long-term welfare or well-being have been established in these studies.

The National Research Council (2013) found that harem changing was not likely to result in serious adverse effects for treated mares:

> "The studies on Shackleford Banks (Nuñez et al., 2009; Madosky et al., 2010) suggest that there is an interaction between pregnancy and social cohesion. The importance of harem stability to mare well-being is not clear, but considering the relatively large number of free-ranging mares that have been treated with liquid PZP in a variety of ecological settings, the likelihood of serious adverse effects seem low."

Nuñez (2010) stated that not all populations will respond similarly to PZP treatment. Differences in habitat, resource availability, and demography among conspecific populations will undoubtedly affect their physiological and behavioral responses to PZP contraception, and need to be considered. Kirkpatrick et al. (2010) concluded that: "the larger question is, even if subtle alterations in behavior may occur, this is still far better than the alternative," and that the "…other victory for horses is that every mare prevented from being removed, by virtue of contraception, is a mare that will only be delaying her reproduction rather than being eliminated permanently from the range. This preserves herd genetics, while gathers and adoption do not."

The NRC report (2013) provides a comprehensive review of the literature on the behavioral effects of contraception that puts research up to that date by Nuñez et al. (2009, 2010) into the broader context of all of the available scientific literature, and cautions, based on its extensive review of the literature that:

> ". . . in no case can the committee conclude from the published research that the behavior differences observed are due to a particular compound rather than to the fact that treated animals had no offspring during the study. That must be borne in mind particularly in interpreting long-term impacts of contraception (e.g., repeated years of reproductive "failure" due to contraception)."

Genetic Effects of PZP Vaccination

In HMAs where large numbers of wild horses have recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses, contraception is not expected to cause an unacceptable loss of genetic diversity or an unacceptable increase in the inbreeding coefficient. In any diploid population, the loss of genetic diversity through inbreeding or drift can be prevented by large effective breeding population sizes (Wright 1931) or by introducing new potential breeding animals (Mills and Allendorf 1996). The NRC report (2013) recommended that single HMAs should not be considered as isolated genetic populations. Rather, managed herds of wild horses should be considered as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements. Introducing 1-2 mares every generation (about every 10 years) is a standard management technique that can alleviate potential inbreeding concerns (BLM 2010).

In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM, such that most alleles that are present in any given mare are likely to already be well represented in her siblings, cousins, and more distant relatives. With the exception of horses in a small number of well-known HMAs that contain a relatively high fraction of alleles associated with old Spanish horse breeds (NRC 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with admixtures from domestic breeds. As a result, in most HMAs, applying fertility control to a subset of mares is not expected to cause irreparable loss of genetic diversity. Improved longevity and an aging population are expected results of contraceptive treatment that can provide for lengthening generation time; this result would be expected to slow the rate of genetic diversity loss (Hailer et al. 2006). Based on a population model, Gross (2000) found that a strategy to preferentially treat young animals with a contraceptive led to more genetic diversity being retained than either a strategy that preferentially treats older animals, or a strategy with periodic gathers and removals.

Even if it is the case that repeated treatment with PZP may lead to prolonged infertility, or even sterility in some mares, most HMAs have only a low risk of loss of genetic diversity if logistically realistic rates of contraception are applied to mares. Wild horses in most herd management areas are descendants of a diverse range of ancestors coming from many breeds of domestic horses. As such, the existing genetic diversity in the majority of HMAs does not contain unique or historically unusual genetic markers. Past interchange between HMAs, either through natural dispersal or through assisted migration (i.e., human movement of horses) means that many HMAs are effectively indistinguishable and interchangeable in terms of their genetic composition. Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity, in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Their results show that the risk of the loss of genetic heterozygosity is extremely low except in case where all of the following conditions are met: starting levels of genetic diversity are low, initial population size is 100 or less, the intrinsic population growth rate is low (5percent per year), and very large fractions of the female population are permanently sterilized.

It is worth noting that, although maintenance of genetic diversity at the scale of the overall population of wild horses is an intuitive management goal, there are no existing laws or policies that require BLM to maintain genetic diversity at the scale of the individual herd management area or complex. Also, there is no Bureau-wide policy that requires BLM to allow each female in a herd to reproduce before she is treated with contraceptives.

One concern that has been raised with regards to genetic diversity is that treatment with immunocontraceptives could possibly lead to an evolutionary increase in the frequency of individuals whose genetic composition fosters weak immune responses (Cooper and Larson 2006, Ransom et al. 2014a).Many factors influence the strength of a vaccinated individual's immune response, potentially including genetics, but also nutrition, body condition, and prior immune responses to pathogens or other antigens (Powers et al. 2013). This premise is based on an assumption that lack of response to PZP is a heritable trait, and that the frequency of that trait will increase over time in a population of PZP-treated animals. Cooper and Herbert (2001) reviewed the topic, in the context of concerns about the long-term effectiveness of immunocontraceptives as a control agent for exotic species in Australia. They argue that imunocontraception could be a strong selective pressure, and that selecting for reproduction in individuals with poor immune response could lead to a general decline in immune function in populations where such evolution takes place. Other authors have also speculated that differences in antibody titer responses could be partially due to genetic differences between animals (Curtis et al. 2001, Herbert and Trigg 2005). However, Magiafolou et al. (2013) clarify that if the variation in immune response is due to environmental factors (i.e., body condition, social rank) and not due to genetic factors, then there will be no expected effect of the immune phenotype on future generations. It is possible that general health, as measured by body condition, can have a causal role in determining immune response, with animals in poor condition demonstrating poor immune reactions (NRC 2013).

Correlations between physical factors and immune response would not preclude, though, that there could also be a heritable response to immunocontraception. In studies not directly related to immunocontraception, immune response has been shown to be heritable (Kean et al. 1994, Sarker et al. 1999). Unfortunately, predictions about the long-term, population-level evolutionary response to immunocontraceptive treatments are speculative at this point, with results likely to depend on several factors, including: the strength of the genetic predisposition to not respond to PZP; the heritability of that gene or genes; the initial prevalence of that gene or genes; the number of mares treated with a primer dose of PZP (which generally has a short-acting effect); the number of mares treated with multiple booster doses of PZP; and the actual size of the genetically-interacting metapopulation of horses within which the PZP treatment takes place.

BLM is not aware of any studies that have quantified the heritability of a lack of response to immunocontraception such as PZP vaccine or GonaCon-Equine in horses. At this point there are no studies available from which one could make conclusions about the long-term effects of sustained and widespread immunocontraception treatments on population-wide immune function. Although a few, generally isolated, feral horse populations have been treated with high fractions of mares receiving PZP immunocontraception for long-term population control (e.g., Assateague Island and Pryor Mountains), no studies have tested for changes in immune competence in those areas. Relative to the large number of free-roaming feral horses in the western United States, immunocontraception has not been used in the type of widespread or prolonged manner that might be required to cause a detectable evolutionary response.

Although this topic may merit further study, lack of clarity should not preclude the use of immunocontraceptives to help stabilize extremely rapidly growing herds.

Gonadotropin Releasing Hormone (GnRH) Vaccine (GonaCon)
This literature review is intended to summarize what is known and what is not known about potential effects of treating mares with GonaCon. As noted below, some negative consequences of vaccination are possible. Anti-GnRH vaccines can be administered to either sex, but this analysis is limited to effects on females, except where inferences can be made to females, based on studies that have used the vaccine in males.

Whether to use or not use this method to reduce population growth rates in wild horses is a decision that must be made considering those effects as well as the potential effects of inaction, such as continued overpopulation and rangeland health degradation.

Reference in this text to any specific commercial product, process, or service, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement, recommendation, or favoring by the Department of the Interior.

Registration and safety of GonaCon-Equine
Taking into consideration available literature on the subject, the National Research Council concluded in their 2013 report that GonaCon-B (which is produced under the trade name GonaCon-Equine for use in feral horses and burros) was one of the most preferable available methods for contraception in wild horses and burros (NRC 2013), in terms of delivery method, availability, efficacy, and side effects. GonaCon-Equine is approved for use by authorized federal, state, tribal, public and private personnel, for application to wild and feral equids in the United States (EPA 2013, 2015). Its use is appropriate for free-ranging wild horse herds. GonaCon-Equine has been used on feral horses in Theodore Roosevelt National Park and on wild horses by BLM (BLM 2015). GonaCon-Equine can be remotely administered in the field in cases where mares are relatively approachable, using a customized pneumatic dart (McCann et al. 2017). Use of remotely delivered (dart-delivered) vaccine is generally limited to populations where individual animals can be accurately identified and repeatedly approached within 50 m (BLM 2010).

GonaCon is an immunocontraceptive vaccine which has been shown to provide multiple years of infertility in several wild ungulate species, including horses (Killian et al., 2008; Gray et al., 2010). GonaCon uses the gonadotropin-releasing hormone (GnRH), a small neuropeptide that performs an obligatory role in mammalian reproduction, as the vaccine antigen. When combined with an adjuvant, the GnRH vaccine stimulates a persistent immune response resulting in prolonged antibody production against GnRH, the carrier protein, and the adjuvant (Miller et al., 2008). The most direct result of successful GnRH vaccination is that it has the effect of decreasing the level of GnRH signaling in the body, as evidenced by a drop in luteinizing hormone levels, and a cessation of ovulation. The lack of estrus cycling that results from successful GonaCon vaccination has been compared to typical winter period of anoestrus in open mares. As anti-GnRH antibodies decline over time, concentrations of available endogenous GnRH increase and treated animals usually regain fertility (Power et al., 2011).

As with other contraceptives applied to wild horses, the long-term goal of GonaCon-Equine use is to reduce or eliminate the need for gathers and removals (NRC 2013). GonaCon-Equine vaccine is an EPA-approved pesticide (EPA 2009a) that is relatively inexpensive, meets BLM requirements for safety to mares and the environment, and is produced in a USDA-APHIS laboratory. The intended effect of the vaccine is as a contraceptive. GonaCon is produced as a pharmaceutical-grade vaccine, including aseptic manufacturing technique to deliver a sterile vaccine product (Miller et al. 2013). If stored at 4° C, the shelf life is 6 months (Miller et al 2013).

Miller et al. (2013) reviewed the vaccine environmental safety and toxicity. When advisories on the product label (EPA 2015) are followed, the product is safe for users and the environment (EPA 2009b).

EPA waived a number of tests prior to registering the vaccine, because GonaCon was deemed to pose low risks to the environment, so long as the product label is followed (Wang-Cahill et al., *in press*).

Under the Proposed Action, the BLM would return to the HMA as needed to re-apply GonaCon-Equine and initiate new treatments in order to maintain contraceptive effectiveness in controlling population growth rates. GonaCon-Equine can safely be reapplied as necessary to control the population growth rate; booster dose effects may lead to increased effectiveness of contraception, which is generally the intent. Even with one booster treatment of GonaCon-Equine, it is expected that most, if not all, mares would return to fertility at some point, although the average duration of effect after booster doses has not yet been quantified. Although it is unknown what would be the expected rate for the return to fertility rate in mares boosted more than once with GonaCon-Equine, a prolonged return to fertility would be consistent with the desired effect of using GonaCon (e.g., effective contraception). Once the herd size in the project area is at AML and population growth seems to be stabilized, BLM could make a determination as to the required frequency of new mare treatments and mare re-treatments with GonaCon, to maintain the number of horses within AML.

GnRH Vaccine Direct Effects
GonaCon-Equine is one of several vaccines that have been engineered to create an immune response to the gonadotropin releasing hormone peptide (GnRH). GnRH is a small peptide that plays an important role in signaling the production of other hormones involved in reproduction in both sexes. GnRH is highly conserved across mammalian taxa, so some inferences about the mechanism and effects of GonaCon-Equine in horses can be made from studies that used different anti-GnRH vaccines, in horses and other taxa. Other commercially available anti-GnRH vaccines include: Improvac (Imboden et al. 2006, Botha et al. 2008, Janett et al. 2009a, Janett et al. 2009b, Schulman et al. 2013, Dalmau et al. 2015), made in South Africa; Equity (Elhay et al. 2007), made in Australia; Improvest, for use in swine (Bohrer et al. 2014); Repro-BLOC (Boedeker et al. 2011); and Bopriva, for use in cows (Balet et al. 2014). Of these, GonaCon-Equine, Improvac, and Equity are specifically intended for horses. Other anti-GnRH vaccine formulations have also been tested, but did not become trademarked products (e.g., Goodloe 1991, Dalin et al 2002, Stout et al. 2003, Donovan et al. 2013, Schaut et al. 2018, Yao et al. 2018). The effectiveness and side-effects of these various anti-GnRH vaccines may not be the same as would be expected from GonaCon-Equine use in horses. Results could differ as a result of differences in the preparation of the GnRH antigen, and the choice of adjuvant used to stimulate the immune response. While GonaCon-Equine can be administered as a single dose, most other anti-GnRH vaccines require a primer dose and at least one booster dose to be effective.

GonaCon has been produced by USDA-APHIS (Fort Collins, Colorado) in several different formulations, the history of which is reviewed by Miller et al. (2013). In any vaccine, the antigen is the stimulant to which the body responds by making antigen-specific antibodies. Those antibodies then signal to the body that a foreign molecule is present, initiating an immune response that removes the molecule or cell. GonaCon vaccines present the recipient with hundreds of copies of GnRH as peptides on the surface of a linked protein that is naturally antigenic because it comes from invertebrate hemocyanin (Miller et al 2013). Early GonaCon formulations linked many copies of GnRH to a protein from the keyhole limpet (GonaCon-KHL), but more recently produced formulations where the GnRH antigen is linked to a protein from the blue mussel (GonaCon-B) proved less expensive and more effective (Miller et al. 2008). GonaCon-Equine is in the category of GonaCon-B vaccines.

Adjuvants are included in vaccines to elevate the level of immune response, inciting recruitment of lymphocytes and other immune cells which foster a long-lasting immune response that is specific to the antigen. For some formulations of anti-GnRH vaccines, a booster dose is required to elicit a contraceptive response, though GonaCon can cause short-term contraception in a fraction of treated animals from one dose (Powers et al. 2011, Gionfriddo et al. 2011a, Baker et al. 2013, Miller et al 2013). The adjuvant used in GonaCon, Adjuvac, generally leads to a milder reaction than Freund's Complete Adjuvant (Powers et al. 2011). Adjuvac contains a small number of killed *Mycobacterium avium* cells (Miller et al. 2008, Miller et al. 2013). The antigen and adjuvant are emulsified in mineral oil, such that they are not all presented to the immune system right after injection It is thought that the mineral oil emulsion leads to a 'depot effect' that is associated with slow or sustained release of the antigen, and a resulting longer-lasting immune response (Miller et al. 2013). Miller et al. (2008, 2013) have speculated that, in cases where memory-B leukocytes are protected in immune complexes in the lymphatic system, it can lead to years of immune response. Increased doses of vaccine may lead to stronger immune reactions, but only to a certain point; when Yoder and Miller (2010) tested varying doses of GonaCon in prairie dogs, antibody responses to the 200µg and 400µg doses were equal to each other but were both higher than in response to a 100µg dose.

The most direct result of successful GnRH vaccination is that it has the effect of decreasing the level of GnRH signaling in the body, as evidenced by a drop in luteinizing hormone levels, and a cessation of ovulation. Antibody titer measurements are proximate measures of the antibody concentration in the blood specific to a given antigen. Anti-GnRH titers generally correlate with a suppressed reproduction system (Gionfriddo et al. 2011a, Powers et al. 2011). Various studies have attempted to identify a relationship between anti-GnRH titer levels and infertility, but that relationship has not been universally predictable or consistent. The time length that titer levels stay high appears to correlate with the length of suppressed reproduction (Dalin et al. 2002, Levy et al. 2011, Donovan et al. 2013, Powers et al. 2011). For example, Goodloe (1991) noted that mares did produce elevated titers and had suppressed follicular development for 11-13 weeks after treatment, but that all treated mares ovulated after the titer levels declined. Similarly, Elhay (2007) found that high initial titers correlated with longer-lasting ovarian and behavioral anoestrus. However, Powers et al. (2011) did not identify a threshold level of titer that was consistently indicative of suppressed reproduction despite seeing a strong correlation between antibody concentration and infertility, nor did Schulman et al. (2013) find a clear relationship between titer levels and mare acyclicity.

In many cases, young animals appear to have higher immune responses, and stronger contraceptive effects of anti-GnRH vaccines than older animals (Brown et al. 1994, Curtis et al. 2001, Stout et al. 2003, Schulman et al. 2013). Vaccinating with GonaCon at too young an age, though, may prevent effectiveness; Gionfriddo et al. (2011a) observed weak effects in 3-4 month old fawns. It has not been possible to predict which individuals of a given age class will have long-lasting immune responses to the GonaCon vaccine. Gray (2010) noted that mares in poor body condition tended to have lower contraceptive efficacy in response to GonaCon-B. Miller et al. (2013) suggested that higher parasite loads might have explained a lower immune response in free-roaming horses than had been observed in a captive trial. At this time it is unclear what the most important factors affecting efficacy are.

Females that are successfully contracepted by GnRH vaccination enter a state similar to anestrus, have a lack of or incomplete follicle maturation, and no ovarian cycling (Botha et al. 2008). A leading hypothesis is that anti-GnRH antibodies bind GnRH in the hypothalamus – pituitary 'portal vessels,' preventing GnRH from binding to GnRH-specific binding sites on gonadotroph cells in the pituitary, thereby limiting the production of gonadotropin hormones, particularly luteinizing hormone (LH) and, to a lesser degree, follicle-stimulating hormone (FSH) (Powers et al. 2011, NRC 2013). This reduction in LH (and FSH), and a corresponding lack of ovulation, has been measured in response to treatment with anti-GnRH vaccines (Boedeker et al. 2011, Garza et al. 1986).

Females successfully treated with anti-GnRH vaccines have reduced progesterone levels (Garza et al. 1986, Stout et al. 2003, Imboden et al. 2006, Elhay 2007, Botha et al. 2008, Killian et al. 2008, Miller et al. 2008, Janett et al. 2009, Schulman et al. 2013, Balet et al 2014, Dalmau et al. 2015) and β-17 estradiol levels (Elhay et al. 2007), but no great decrease in estrogen levels (Balet et al. 2014). Reductions in progesterone do not occur immediately after the primer dose, but can take several weeks or months to develop (Elhay et al. 2007, Botha et al. 2008, Schulman et al. 2013, Dalmau et al. 2015). This indicates that ovulation is not occurring and corpora lutea, formed from post-ovulation follicular tissue, are not being established.

Changes in hormones associated with anti-GnRH vaccination lead to measurable changes in ovarian structure and function. The volume of ovaries reduced in response to treatment (Garza et al. 1986, Dalin et al. 2002, Imboden et al. 2006, Elhay et al. 2007, Botha et al. 2008, Gionfriddo 2011a, Dalmau et al. 2015). Treatment with an anti-GnRH vaccine changes follicle development (Garza et al. 1986, Stout et al. 2003, Imboden et al. 2006, Elhay et al. 2007, Donovan et al. 2013, Powers et al. 2011, Balet et al. 2014), with the result that ovulation does not occur. A related result is that the ovaries can exhibit less activity and cycle with less regularity or not at all in anti-GnRH vaccine treated females (Goodloe 1991, Dalin et al. 2002, Imboden et al. 2006, Elhay et al. 2007, Janett et al. 2009a, Powers et al. 2011, Donovan et al. 2013). In studies where the vaccine required a booster, hormonal and associated results were generally observed within several weeks after delivery of the booster dose.

GnRH Vaccine Contraceptive Effects

The NRC (2013) review pointed out that single doses of GonaCon-Equine do not lead to high rates of initial effectiveness, or long duration. Initial effectiveness of one dose of GonaCon-Equine vaccine appears to be lower than for a combined primer plus booster dose of the PZP vaccine Zonastat-H (Kirkpatrick et al. 2011), and the initial effect of a single GonaCon dose can be limited to as little as one breeding season. However, preliminary results on the effects of boostered doses of GonaCon-Equine indicate that it can have high efficacy and longer-lasting effects in free-roaming horses (Baker et al. 2018) than the one-year effect that is generally expected from a single booster of Zonastat-H.

GonaCon and other anti-GnRH vaccines can be injected while a female is pregnant (Miller et al. 2000, Powers et al. 2011, Baker et al. 2013) – in such a case, a successfully contracepted mare will be expected to give birth during the following foaling season, but to be infertile during the same year's breeding season. Thus, a mare injected in November of 2018 would not show the contraceptive effect (i.e., no new foal) until spring of 2020.

Too few studies have reported on the various formulations of anti-GnRH vaccines to make generalizations about differences between products, but GonaCon formulations were consistently good at causing loss of fertility in a statistically significant fraction of treated mares for at least one year (Killian et al. 2009, Gray et al. 2010, Baker et al. 2013, 2017). With few exceptions (e.g., Goodloe 1991), anti-GnRH treated mares gave birth to fewer foals in the first season when there would be an expected contraceptive effect (Botha et al. 2008, Killian et al. 2009, Gray et al. 2010, Baker et al. 2013). Goodloe (1991) used an anti-GnRH-KHL vaccine with a triple adjuvant, in some cases attempting to deliver the vaccine to horses with a hollow-tipped 'biobullet,'but concluded that the vaccine was not an effective immunocontraceptive in that study.

Not all mares should be expected to respond to the GonaCon-equine vaccine; some number should be expected to continue to become pregnant and give birth to foals. In studies where mares were exposed to stallions, the fraction of treated mares that are effectively contracepted in the year after anti-GnRH vaccination varied from study to study, ranging from ~50 percent (Baker et al. 2017), to 61 percent (Gray et al. 2010), to ~90 percent (Killian et al. 2006, 2008, 2009). Miller et al. (2013) noted lower effectiveness in free-ranging mares (Gray et al. 2010) than captive mares (Killian et al. 2009). Some of these rates are lower than the high rate of effectiveness typically reported for the first year after PZP vaccine treatment

(Kirkpatrick et al. 2011). In the one study that tested for a difference, darts and hand-injected GonaCon doses were equally effective in terms of fertility outcome (McCann et al. 2017).

In studies where mares were not exposed to stallions, the duration of effectiveness also varied. A primer and booster dose of Equity led to anoestrus for at least 3 months (Elhay et al. 2007). A primer and booster dose of Improvac also led to loss of ovarian cycling for all mares in the short term (Imboden et al. 2006). It is worth repeating that those vaccines do not have the same formulation as GonaCon.

Results from horses (Baker et al. 2017) and other species (Curtis et al. 2001) suggest that providing a booster dose of GonaCon-Equine will increase the fraction of temporarily infertile animals to higher levels than would a single vaccine dose alone.

Longer-term infertility has been observed in some mares treated with anti-GnRH vaccines, including GonaCon-Equine. In a single-dose mare captive trial with an initial year effectiveness of 94 percent, Killian et al. (2008) noted infertility rates of 64 percent, 57 percent, and 43 percent in treated mares during the following three years, while control mares in those years had infertility rates of 25 percent, 12 percent, and 0 percent in those years. GonaCon effectiveness in free-roaming populations was lower, with infertility rates consistently near 60 percent for three years after a single dose in one study (Gray et al. 2010) and annual infertility rates decreasing over time from 55 percent to 30 percent to 0 percent in another study with one dose (Baker et al. 2017). Similarly, gradually increasing fertility rates were observed after single dose treatment with GonaCon in elk (Powers et al. 2011) and deer (Gionfriddo et al. 2011a).

Baker et al. (2017) observed a return to fertility over 4 years in mares treated once with GonaCon, but then noted extremely low fertility rates of 0 percent and 16 percent in the two years after the same mares were given a booster dose four years after the primer dose. These are extremely promising preliminary results from that study in free-roaming horses; a third year of post-booster monitoring is ongoing in summer 2017, and researchers on that project are currently determining whether the same high-effectiveness, long-term response is observed after boosting with GonaCon after 6 months, 1 year, 2 years, or 4 years after the primer dose. Four of nine mares treated with primer and booster doses of Improvac did not return to ovulation within 2 years of the primer dose (Imboden et al. 2006), though one should probably not make conclusions about the long-term effects of GonaCon-Equine based on results from Improvac.

It is difficult to predict which females will exhibit strong or long-term immune responses to anti-GnRH vaccines (Killian et al. 2006, Miller et al. 2008, Levy et al. 2011). A number of factors may influence responses to vaccination, including age, body condition, nutrition, prior immune responses, and genetics (Cooper and Herbert 2001, Curtis et al. 2001, Powers et al. 2011). One apparent trend is that animals that are treated at a younger age, especially before puberty, may have stronger and longer-lasting responses (Brown et al. 1994, Curtis et al. 2001, Stout et al. 2003, Schulman et al. 2013). It is plausible that giving ConaGon-Equine to prepubertal mares will lead to long-lasting infertility, but that has not yet been tested.

To date, short term evaluation of anti-GnRH vaccines, show contraception appears to be temporary and reversible. Killian et al. noted long-term effects of GonaCon in some captive mares (2009). However, Baker et al. (2017) observed horses treated with GonaCon-B return to fertility after they were treated with a single primer dose; after four years, the fertility rate was indistinguishable between treated and control mares. It appears that a single dose of GonaCon results in reversible infertility. Although it is unknown whether long-term treatment would result in permanent infertility, such permanent infertility fertility would be consistent with the desired effect of using GonaCon (e.g., effective contraception).

Other anti-GnRH vaccines also have had reversible effects in mares. Elhay (2007) noted a return to ovary functioning over the course of 34 weeks for 10 of 16 mares treated with Equity. That study ended at 34 weeks, so it is not clear when the other six mares would have returned to fertility. Donovan et al. (2013) found that half of mares treated with an anti-GnRH vaccine intended for dogs had returned to fertility after 40 weeks, at which point the study ended. In a study of mares treated with a primer and booster dose of Improvac, 47 of 51 treated mares had returned to ovarian cyclicity within 2 years; younger mares appeared to have longer-lasting effects than older mares (Schulman et al. 2013). Joonè et al. (2017c) analyzed samples from the Schulman et al. (2013) study, and found no significant decrease in anti-Mullerian hormone (AMH) levels in mares treated with GnRH vaccine. AMH levels are thought to be an indicator of ovarian function, so results from Joonè et al. (2017c) support the general view that the anoestrus resulting from GnRH vaccination is physiologically similar to typical winter anoestrus. In a small study with a non-commercial anti-GnRH vaccine (Stout et al. 2003), three of seven treated mares had returned to cyclicity within 8 weeks after delivery of the primer dose, while four others were still suppressed for 12 or more weeks. In elk, Powers et al. (2011) noted that contraception after one dose of GonaCon was reversible. In white-tailed deer, single doses of GonaCon appeared to confer two years of contraception (Miller et al. 2000). Ten of 30 domestic cows treated became pregnant within 30 weeks after the first dose of Bopriva (Balet et al. 2014).

Permanent sterility as a result of single-dose or boostered GonaCon-Equine vaccine, or other anti-GnRH vaccines, has not been recorded, but that may be because no long-term studies have tested for that effect. It is conceivable that some fraction of mares could become sterile after receiving one or more booster doses of GonaCon-Equine, but the rate at which that could be expected to occur is currently unknown. If some fraction of mares treated with GonaCon-Equine were to become sterile, though, that result would be consistent with text of the Wild Horse and Burro Act of 1971, as amended, which allows for sterilization to achieve population goals.

In summary, based on the above results related to fertility effects of GonaCon and other anti-GnRH vaccines, application of a single dose of GonaCon-Equine to gathered or remotely-darted wild horses could be expected to prevent pregnancy in perhaps 30percent-60percent of mares for one year. Some smaller number of wild mares should be expected to have persistent contraception for a second year, and less still for a third year. Applying one booster dose of GonaCon to previously-treated mares should lead to two or more years with relatively high rates (80+percent) of additional infertility expected, with the potential that some as-yet-unknown fraction of boostered mares may be infertile for several to many years. There is no data to support speculation regarding efficacy of multiple boosters of GonaCon-Equine; however, given it is formulated as a highly immunogenic long-lasting vaccine, it is reasonable to hypothesize that additional boosters would increase the effectiveness and duration of the vaccine.

GonaCon-Equine only affects the fertility of treated animals; untreated animals will still be expected to give birth. Even under favorable circumstances for population growth suppression, gather efficiency might not exceed 85percent via helicopter, and may be less with bait and water trapping. Similarly, not all animals may be approachable for darting. The uncaptured or undarted portion of the female population would still be expected to have normally high fertility rates in any given year, though those rates could go up slightly if contraception in other mares increases forage and water availability.

GnRH Vaccine Effects on Other Organ Systems

BLM requires individually identifiable marks for immunocontraceptive treatment; this may require handling and marking. Mares that receive any vaccine as part of a gather operation would experience slightly increased stress levels associated with handling while being vaccinated and freezemarked, and potentially microchipped. Newly captured mares that do not have markings associated with previous fertility control treatments would be marked with a new freezemark for the purpose of identifying that mare, and identifying her vaccine treatment history. This information would also be used to determine the number of mares captured that were not previously treated, and could provide additional insight regarding gather efficiency, and the timing of treatments required into the future. Most mares recover from the stress of capture and handling quickly once released back to the HMA, and none are expected to suffer serious long term effects from the fertility control injections, other than the direct consequence of becoming temporarily infertile.

Injection site reactions associated with immunocontraceptive treatments are possible in treated mares (Roelle and Ransom 2009). Whether injection is by hand or via darting, GonaCon-Equine is associated with some degree of inflammation, swelling, and the potential for abscesses at the injection site (Baker et al. 2013). Swelling or local reactions at the injection site are generally expected to be minor in nature, but some may develop into draining abscesses. When PZP vaccine was delivered via dart it led to more severe swelling and injection site reactions (Roelle and Ransom 2009), but that was not observed with dart-delivered GonaCon (McCann et al. 2017). Mares treated with one formulation of GnRH-KHL vaccine developed pyogenic abscesses (Goodloe 1991). Miller et al. (2008) noted that the water and oil emulsion in GonaCon will often cause cysts, granulomas, or sterile abscesses at injection sites; in some cases, a sterile abscess may develop into a draining abscess. In elk treated with GonaCon, Powers et al. (2011) noted up to 35 percent of treated elk had an abscess form, despite the injection sites first being clipped and swabbed with alcohol. Even in studies where swelling and visible abscesses followed GonaCon immunization, the longer term nodules observed did not appear to change any animal's range of movement or locomotor patterns (Powers et al. 2013, Baker et al. 2017).

The result that other formulations of anti-GnRH vaccine may be associated with less notable injection site reactions in horses may indicate that the adjuvant formulation in GonaCon leads a single dose to cause a stronger immune reaction than the adjuvants used in other anti-GnRH vaccines. Despite that, a booster dose of GonaCon-Equine appears to be more effective than a primer dose alone (Baker et al. 2017). Horses injected in the hip with Improvac showed only transient reactions that disappeared within 6 days in one study (Botha et al. 2008), but stiffness and swelling that lasted 5 days were noted in another study where horses received Improvac in the neck (Imboden et al. 2006). Equity led to transient reactions that resolved within a week in some treated animals (Elhay et al. 2007). Donovan et al. noted no reactions to the canine anti-GnRH vaccine (2013). In cows treated with Bopriva there was a mildly elevated body temperature and mild swelling at injection sites that subsided within 2 weeks (Balet et al. 2014).

Several studies have monitored animal health after immunization against GnRH. GonaCon treated mares did not have any measurable difference in uterine edema (Killian 2006, 2008). Powers et al. (2011, 2013) noted no differences in blood chemistry except a mildly elevated fibrinogen level in some GonaCon treated elk. In that study, one sham-treated elk and one GonaCon treated elk each developed leukocytosis, suggesting that there may have been a causal link between the adjuvant and the effect. Curtis et al. (2008) found persistent granulomas at GonaCon-KHL injection sites three years after injection, and reduced ovary weights in treated females. Yoder and Miller (2010) found no difference in blood chemistry between GonaCon treated and control prairie dogs. One of 15 GonaCon treated cats died without explanation, and with no determination about cause of death possible based on necropsy or histology (Levy et al. 2011). Other anti-GnRH vaccine formulations have led to no detectable adverse effects (in elephants; Boedeker et al. 2011), though Imboden et al. (2006) speculated that young treated animals might conceivably have impaired hypothalamic or pituitary function.

Kirkpatrick et al. (2011) raised concerns that anti-GnRH vaccines could lead to adverse effects in other organ systems outside the reproductive system. GnRH receptors have been identified in tissues outside of the pituitary system, including in the testes and placenta (Khodr and Siler-Khodr 1980), ovary (Hsueh and Erickson 1979), bladder (Coit et al. 2009), heart (Dong et al. 2011), and central nervous system, so it is plausible that reductions in circulating GnRH levels could inhibit physiological processes in those organ systems. Kirkpatrick et al. (2011) noted elevated cardiological risks to human patients taking GnRH agonists (such as leuprolide), but the National Academy of Sciences (2013) concluded that the mechanism and results of GnRH agonists would be expected to be different from that of anti-GnRH antibodies; the former flood GnRH receptors, while the latter deprive receptors of GnRH.

GnRH Vaccine Effects on Fetus and Foal
Although fetuses are not explicitly protected under the Wild Horse and Burro Act of 1971, as amended, it is prudent to analyze the potential effects of GonaCon-Equine or other anti-GnRH vaccines on developing fetuses and foals. GonaCon had no apparent effect on pregnancies in progress, foaling success, or the health of offspring, in horses that were immunized in October (Baker et al. 2013), elk immunized 80-100 days into gestation (Powers et al. 2011, 2013), or deer immunized in February (Miller et al. 2000). Kirkpatrick et al. (2011) noted that anti-GnRH immunization is not expected to cause hormonal changes that would lead to abortion in the horse, but this may not be true for the first 6 weeks of pregnancy (NRC 2013). Curtis et al. (2011) noted that GonaCon-KHL treated white tailed deer had lower twinning rates than controls, but speculated that the difference could be due to poorer sperm quality late in the breeding season, when the treated does did become pregnant. Goodloe (1991) found no difference in foal production between treated and control animals.

Offspring of anti-GnRH vaccine treated mothers could exhibit an immune response to GnRH (Khodr and Siler-Khodr 1980), as antibodies from the mother could pass to the offspring through the placenta or colostrum. In the most extensive study of long-term effects of GonaCon immunization on offspring, Powers et al. (2012) monitored 15 elk fawns born to GonaCon treated cows. Of those, 5 had low titers at birth and 10 had high titer levels at birth. All 15 were of normal weight at birth, and developed normal endocrine profiles, hypothalamic GnRH content, pituitary gonadotropin content, gonad structure, and gametogenesis. All the females became pregnant in their second reproductive season, as is typical. All males showed normal development of secondary sexual characteristics. Powers et al. (2012) concluded that suppressing GnRH in the neonatal period did not alter long-term reproductive function in either male or female offspring. Miller et al. (2013) report elevated anti-GnRH antibody titers in fawns born to treated white tailed deer, but those dropped to normal levels in 11 of 12 of those fawns, which came into breeding condition; the remaining fawn was infertile for three years.

Direct effects on foal survival are equivocal in the literature. Goodloe (1991), reported lower foal survival for a small sample of foals born to anti-GnRH treated mares, but she did not assess other possible explanatory factors such as mare social status, age, body condition, or habitat in her analysis (NRC 2013). Gray et al. (2010) found no difference in foal survival in foals born to free-roaming mares treated with GonaCon.

There is little empirical information available to evaluate the effects of GnRH vaccination on foaling phenology. It is possible that immunocontracepted mares returning to fertility late in the breeding season could give birth to foals at a time that is out of the normal range (Nuñez et al. 2010, Ransom et al 2013). Curtis et al. (2001) did observe a slightly later fawning date for GonaCon treated deer in the second year after treatment, when some does regained fertility late in the breeding season. In anti-GnRH vaccine trials in free-roaming horses, there were no published differences in mean date of foal production (Goodloe 1991, Gray et al. 2010). Unpublished results from an ongoing study of GonaCon treated free-roaming mares indicate that some degree of aseasonal foaling is possible (D. Baker, Colorado State University, personal communication to Paul Griffin, BLM WH&B Research Coordinator). Because of the concern that contraception could lead to shifts in the timing of parturitions for some treated animals, Ransom et al. (2013) advised that managers should consider carefully before using PZP immunocontraception in small refugia or rare species; the same considerations could be advised for use of GonaCon, but wild horses and burros in most areas do not generally occur in isolated refugia, they are not a rare species at the regional, national, or international level, and genetically they represent descendants of domestic livestock with most populations containing few if any unique alleles (NRC 2013). Moreover, in PZP-treated horses that did have some degree of parturition date shift, Ransom et al. (2013) found no negative impacts on foal survival even with an extended birthing season; however, this may be more related to stochastic, inclement weather events than extended foaling seasons. If there were to be a shift in foaling date for some treated mares, the effect on foal survival may depend on weather severity and local conditions; for example, Ransom et al. (2013) did not find consistent effects across study sites.

Indirect Effects of GnRH Vaccination
One expected long-term, indirect effect on wild horses treated with fertility control would be an improvement in their overall health. Many treated mares would not experience the biological stress of reproduction, foaling and lactation as frequently as untreated mares, and their better health is expected to be reflected in higher body condition scores. After a treated mare returns to fertility, her future foals would be expected to be healthier overall, and would benefit from improved nutritional quality in the mares' milk. This is particularly to be expected if there is an improvement in rangeland forage quality at the same time, due to reduced wild horse population size. Past application of fertility control has shown that mares' overall health and body condition can remain improved even after fertility resumes. Anecdotal, subjective observations of mares treated with a different immunocontraceptive, PZP, in past gathers showed that many of the treated mares were larger, maintained better body condition, and had larger healthy foals than untreated mares.

Body condition of anti-GnRH-treated females was equal to or better than that of control females in published studies. Ransom et al. (2014b) observed no difference in mean body condition between GonaCon-B treated mares and controls. Goodloe (1991) found that GnRH-KHL treated mares had higher survival rates than untreated controls. In other species, treated deer had better body condition than controls (Gionfriddo et al. 2011b), treated cats gained more weight than controls (Levy et al. 2011), as did treated young female pigs (Bohrer et al. 2014).

Following resumption of fertility, the proportion of mares that conceive and foal could be increased due to their increased fitness; this has been called by some a 'rebound effect.' Elevated fertility rates have been observed after horse gathers and removals (Kirkpatrick and Turner 1991). More research is needed to document and quantify these hypothesized effects. If repeated contraceptive treatment leads to a prolonged contraceptive effect, then that may minimize or delay the hypothesized rebound effect. Selectively applying contraception to older animals and returning them to the HMA could reduce long-term holding costs for such horses, which are difficult to adopt, and could negate the compensatory reproduction that can follow removals (Kirkpatrick and Turner 1991).

Because successful fertility control would reduce foaling rates and population growth rates, another indirect effect would be to reduce the number of wild horses that have to be removed over time to achieve and maintain the established AML. Contraception would be expected to lead to a relative increase in the fraction of older animals in the herd. Reducing the numbers of wild horses that would have to be removed in future gathers could allow for removal of younger, more easily adoptable excess wild horses, and thereby could eliminate the need to send additional excess horses from this area to off-range holding corrals or pastures for long-term holding. Among mares in the herd that remain fertile, a high level of physical health and future reproductive success would be expected because reduced population sizes should lead to more availability of water and forage resources per capita.

Reduced population growth rates and smaller population sizes could also allow for continued and increased environmental improvements to range conditions within the project area, which would have long-term benefits to wild horse habitat quality. As the local horse abundance nears or is maintained at the level necessary to achieve a thriving natural ecological balance, vegetation resources would be expected to recover, improving the forage available to wild horses and wildlife throughout the HMA or HMAs. With rangeland conditions more closely approaching a thriving natural ecological balance, and with a less concentrated distribution of wild horses across the HMA, there should also be less trailing and concentrated use of water sources. Lower population density would be expected to lead to reduced competition among wild horses using the water sources, and less fighting among horses accessing water sources. Water quality and quantity would continue to improve to the benefit of all rangeland users including wild horses. Wild horses would also have to travel less distance back and forth between water and desirable foraging areas. Should GonaCon-Equine treatment, including booster doses, continue into the future, with treatments given on a schedule to maintain a lowered level of fertility in the herd, there may be less frequent need for large gathers and removals, but instead a consistent abundance of wild horses could be maintained, resulting in continued improvement of overall habitat conditions and animal health. While it is conceivable that widespread and continued treatment with GonaCon-Equine could reduce the birth rates of the population to such a point that birth is consistently below mortality, that outcome is not likely unless a very high fraction of the mares present are all treated with primer and booster doses, and perhaps repeated booster doses.

Behavioral Effects of GnRH Vaccination

Behavioral differences should be considered as potential consequences of contraception with GonaCon. The NRC (2013) noted that all successful fertility suppression has effects on mare behavior, mostly as a result of the lack of pregnancy and foaling, and concluded that GonaCon was a good choice for use in the program. The result that GonaCon treated mares may have suppressed estrous cycles throughout the breeding season can lead treated mares to behave in ways that are functionally similar to pregnant mares or mares in seasonal anoestrus.

While successful in mares, GonaCon and other anti-GnRH vaccines are expected to induce fewer estrous cycles when compared to non-pregnant control mares. This has been observed in many studies (Garza et al. 1986, Curtis et al. 2001, Dalin et al. 2002, Killian et al. 2006, Dalmau et al. 2015). In contrast, PZP vaccine is generally expected to lead mares to have more estrous cycles per breeding season, as they continue to be receptive to mating while not pregnant. Females treated with GonaCon had fewer estrous cycles than control or PZP-treated mares (Killian et al. 2006) or deer (Curtis et al. 2001). Thus, concerns about PZP treated mares receiving more courting and breeding behaviors from stallions (Nuñez et al. 2009, Ransom et al. 2010) are not generally expected to be a concern for mares treated with anti-GnRH vaccines (Botha et al. 2008).

Ransom et al. (2014b) found that GonaCon treated mares had similar rates of reproductive behaviors that were similar to those of pregnant mares. Among other potential causes, the reduction in progesterone levels in treated females may lead to a reduction in behaviors associated with reproduction. Despite this, some females treated with GonaCon or other anti-GnRH vaccines did continue to exhibit reproductive behaviors, albeit at irregular intervals and durations (Dalin et al. 2002, Stout et al. 2003, Imboden et al. 2006), which is a result that is similar to spayed (ovariectomized) mares (Asa et al. 1980). Gray et al. (2009) found no difference in sexual behaviors in mares treated with GonaCon and untreated mares. When progesterone levels are low, small changes in estradiol concentration can foster reproductive estrous behaviors (Imboden et al. 2006). Owners of anti-GnRH vaccine treated mares reported a reduced number of estrous-related behaviors under saddle (Donovan et al. 2013). Treated mares may refrain from reproductive behavior even after ovaries return to cyclicity (Elhay et al. 2007). Studies in elk found that GonaCon treated cows had equal levels of precopulatory behaviors as controls (Powers et al. 2011), though bull elk paid more attention to treated cows late in the breeding season, after control cows were already pregnant (Powers et al. 2011).

Stallion herding of mares, and harem switching by mares are two behaviors related to reproduction that might change as a result of contraception. Ransom et al. (2014b) observed a 50 percent decrease in herding behavior by stallions after the free-roaming horse population at Theodore Roosevelt National Park was reduced via a gather, and mares there were treated with GonaCon-B. The increased harem tending behaviors by stallions were directed to both treated and control mores. It is difficult to separate any effect of GonaCon in this study from changes in horse density and forage following horse removals.

Mares in untreated free-roaming populations change bands; some have raised concerns over effects of PZP vaccination on band structure (Nuñez et al. 2009), with rates of band fidelity being suggested as a measure of social stability. With respect to treatment with GonaCon or other anti-GnRH vaccines, it is probably less likely that treated mares will switch harems at higher rates than untreated animals, because treated mares are similar to pregnant mares in their behaviors (Ransom et al. 2014b). Indeed, Gray et al. (2009) found no difference in band fidelity in a free-roaming population of horses with GonaCon treated mares, despite differences in foal production between treated and untreated mares. Ransom et al. (2014b) actually found increased levels of band fidelity after treatment, though this may have been partially a result of changes in overall horse density and forage availability.

Even in cases where there may be changes in band fidelity, the National Research Council (2013) found that harem changing was not likely to result in serious adverse effects for treated mares:

> "The studies on Shackleford Banks (Nuñez et al., 2009; Madosky et al., 2010) suggest that there is an interaction between pregnancy and social cohesion. The importance of harem stability to mare well-being is not clear, but considering the relatively large number of free-ranging mares that have been treated with liquid PZP in a variety of ecological settings, the likelihood of serious adverse effects seem low."

Kirkpatrick et al. (2010) concluded that "the larger question is, even if subtle alterations in behavior may occur, this is still far better than the alternative."

The NRC (2013) provides a comprehensive review of the literature on the behavioral effects of contraception that puts Nuñez's (2009, 2010) research into the broader context of all of the available scientific literature, and cautions, based on its extensive review of the literature that:

> ". . . in no case can the committee conclude from the published research that the behavior differences observed are due to a particular compound rather than to the fact that treated animals had no offspring during the study. That must be borne in mind particularly in interpreting long-term impacts of contraception (e.g., repeated years of reproductive "failure" due to contraception)."

Gray et al. (2009) and Ransom et al. (2014b) monitored non-reproductive behaviors in GonaCon treated populations of free-roaming horses. Gray et al. (2009) found no difference between treated and untreated mares in terms of activity budget, sexual behavior, proximity of mares to stallions, or aggression. Ransom et al. (2014b) found only minimal differences between treated and untreated mare time budgets, but those differences were consistent with differences in the metabolic demands of pregnancy and lactation in untreated mares, as opposed to non-pregnant treated mares.

Genetic Effects of GnRH Vaccination

In HMAs where large numbers of wild horses have recent and / or an ongoing influx of breeding animals from other areas with wild or feral horses, contraception is not expected to cause an unacceptable loss of genetic diversity or an unacceptable increase in the inbreeding coefficient. In any diploid population, the loss of genetic diversity through inbreeding or drift can be prevented by large effective breeding population sizes (Wright 1931) or by introducing new potential breeding animals (Mills and Allendorf 1996). The NRC (2013) recommended that managed herds of wild horses would be better viewed as components of interacting metapopulations, with the potential for interchange of individuals and genes taking place as a result of both natural and human-facilitated movements. In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM, such that most alleles that are present in any given mare are likely to already be well represented in her siblings, cousins, and more distant relatives. With the exception of horses in a small number of well-known HMAs that contain a relatively high fraction of alleles associated with old Spanish horse breeds (NRC 2013), the genetic composition of wild horses in lands administered by the BLM is consistent with admixtures from domestic breeds. As a result, in most HMAs, applying fertility control to a subset of mares is not expected to cause irreparable loss of genetic diversity. Improved longevity and an aging population are expected results of contraceptive treatment that can provide for lengthening generation time; this result which would be expected to slow the rate of genetic diversity loss (Hailer et al., 2006). Based on a population model, Gross (2000) found that an effective way to retain genetic diversity in a population treated with fertility control is to preferentially treat young animals, such that the older animals (which contain all the existing genetic diversity available) continue to have offspring. Conversely, Gross (2000) found that preferentially treating older animals (preferentially allowing young animals to breed) leads to a more rapid expected loss of genetic diversity over time.

Even if it is the case that booster treatment with GonaCon may lead to prolonged infertility, or even sterility in some mares, most HMAs have only a low risk of loss of genetic diversity if logistically realistic rates of contraception are applied to mares. Wild horses in most herd management areas are descendants of a diverse range of ancestors coming from many breeds of domestic horses. As such, the existing genetic diversity in the majority of HMAs does not contain genetic markers that have been identified as unique or historically unusual (NRC 2013). Past interchange between HMAs, either through natural dispersal or through assisted migration (i.e. human movement of horses) means that many HMAs are effectively indistinguishable and interchangeable in terms of their genetic composition. Roelle and Oyler-McCance (2015) used the VORTEX population model to simulate how different rates of mare sterility would influence population persistence and genetic diversity, in populations with high or low starting levels of genetic diversity, various starting population sizes, and various annual population growth rates. Their results show that the risk of the loss of genetic heterozygosity is extremely low except in cases where all four of the following conditions are met: starting levels of genetic diversity are low, initial population size is 100 or less, intrinsic population growth rate is low (5percent per year), and very large fractions of the female population are permanently sterilized.

Many factors influence the strength of a vaccinated individual's immune response, potentially including genetics, but also nutrition, body condition, and prior immune responses to pathogens or other antigens (Powers et al 2013). One concern that has been raised with regards to genetic diversity is that treatment with immunocontraceptives could possibly lead to an evolutionary increase in the frequency of individuals whose genetic composition fosters weak immune responses (Cooper and Larson 2006, Ransom et al. 2014a). This premise is based on a hypothesis that lack of response to immunocontraceptives could be a heritable trait, and that the frequency of that trait will increase over time in a population of treated animals. Cooper and Herbert (2001) reviewed the topic, in the context of concerns about the long-term effectiveness of immunocontraceptives as a control agent for exotic species in Australia. They argue that immunocontraception could be a strong selective pressure, and that selecting for reproduction in individuals with poor immune response could lead to a general decline in immune function in populations where such evolution takes place. Other authors have also speculated that differences in antibody titer responses could be partially due to genetic differences between animals (Curtis et al. 2001, Herbert and Trigg 2005).

BLM is not aware of any studies that have quantified the heritability of a lack of response to immunocontraception such as PZP vaccine or GonaCon-Equine in horses. At this point there are no studies available from which one could make conclusions about the long-term effects of sustained and widespread immunocontraception treatments on population-wide immune function. Although a few, generally isolated, feral horse populations have been treated with high fractions of mares receiving PZP immunocontraception for long-term population control (e.g., Assateague Island and Pryor Mountains), no studies have tested for changes in immune competence in those areas. Relative to the large number of free-roaming feral horses in the western United States, immunocontraception has not been used in the type of widespread or prolonged manner that might be required to cause a detectable evolutionary response at a large scale.

Magiafolou et al. (2013) clarify that if the variation in immune response is due to environmental factors (i.e., body condition, social rank) and not due to genetic factors, then there will be no expected effect of the immune phenotype on future generations. Correlations between immune response and physical factors such as age and body condition have been documented; it remains untested whether or not those factors play a larger role in determining immune response to immunocontraceptives than heritable traits. Several studies discussed above noted a relationship between the strength of individuals' immune responses after treatment with GonaCon or other anti-GnRH vaccines, and factors related to body condition. For example, age at immunization was a primary factor associated with different measures of immune response, with young animals tending to have stronger and longer-lasting responses (Stout et al. 2003, Schulman et al. 2013). It is also possible that general health, as measured by body condition, can have a causal role in determining immune response, with animals in poor condition demonstrating poor immune reactions (Gray 2009, NRC 2013). Miller et al. (2013) speculated that animals with high parasite loads also may have weaker immune reactions to GonaCon.

Correlations between such physical factors and immune response would not preclude, though, that there could also be a heritable response to immunocontraception. In studies not directly related to immunocontraception, immune response has been shown to be heritable (Kean et al. 1994, Sarker et al. 1999). Unfortunately, predictions about the long-term, population-level evolutionary response to immunocontraceptive treatments would be speculative at this point, with results likely to depend on several factors, including: the strength of the genetic predisposition to not respond to GonaCon-Equine; the heritability of that gene or genes; the initial prevalence of that gene or genes; the number of mares treated with a primer dose of GonaCon-Equine (which generally has a short-acting effect, if any); the number of mares treated with a booster dose of GonaCon-Equine (which appears to cause a longer-lasting effect); and the actual size of the genetically-interacting metapopulation of horses within which the GonaCon treatment takes place.

Intrauterine Devices (IUDs)
Up through the present time (September 2020), BLM has not used IUDs to control fertility as a wild horse and burro fertility control method on the range. The BLM has supported and continues to support research into the development and testing of effective and safe IUDs for use in wild horse mares (Baldrighi et al. 2017, Holyoak et al. unpublished data). However, existing literature on the use of IUDs in horses allows for inferences about expected effects of any management alternatives that might include use of IUDs, and support the apparent safety and efficacy of some types of IUDs for use in horses. Overall, as with other methods of population growth suppression, use of IUDs and other fertility control measures are expected to help reduce population growth rates, extend the time interval between gathers, and reduce the total number of excess animals that will need to be removed from the range. The genetic effects of use of IUDs are expected to be comparable to those expected from fertility control vaccine use, insofar as reversible fertility control treatments can temporarily reduce the fraction of fertile mares in a herd.

The 2013 National Academies of Sciences (NAS) report considered IUDs, and suggested that research should test whether IUDs cause uterine inflammation, and should also test how well IUDs stay in mares that live and breed with fertile stallions. Since that report, a recent study by Holyoak et al. (unpublished data) indicate that a flexible, inert, y-shaped, medical-grade silicone IUD design prevented pregnancies in all the domestic mares that retained the device, even when exposed to fertile stallions. Domestic mares in that study lived in large pastures, mating with fertile stallions. Biweekly ultrasound examinations showed that IUDs stayed in 75% of treated mares over the course of two breeding seasons. The IUDs were then removed so the researchers could monitor the mares' return to fertility. Uterine health, as measured in terms of inflammation, was not seriously affected by the IUDs, and most mares became pregnant within months after IUD removal. The overall results are consistent with results from an earlier study (Daels and Hughes 1995), which used O-shaped silicone IUDs.

IUDs are considered a temporary fertility control method that does not generally cause future sterility (Daels and Hughes 1995). Use of IUDs is an effective fertility control method in women, and IUDs have historically been used in livestock management, including in domestic horses. Insertion of an IUD can be a very rapid procedure, but it does require the mare to be temporarily restrained, such as in a squeeze chute. IUDs in mares may cause physiological effects including discomfort, infection, perforation of the uterus if the IUD is hard and angular, endometritis, uterine edema (Killian et al. 2008), and pyometra (Klabnik-Bradford et al. 2013). In women, deaths attributable to IUD use may be as low as 1.06 per million (Daels and Hughes 1995).

The exact mechanism by which IUDs prevent pregnancy is uncertain (Daels and Hughes 1995), but the presence of an IUD in the uterus may, like a pregnancy, prevent the mare from coming back into estrus (Turner et al. 2015). However, some domestic mares did exhibit repeated estrus cycles during the time when they had IUDs (Killian et al. 2008, Gradil et al. 2019). The main cause for an IUD to not be effective at contraception is its failure to stay in the uterus (Daels and Hughes 1995). As a result, one of the major challenges to using IUDs to control fertility in mares on the range is preventing the IUD from being dislodged or otherwise ejected over the course of daily activities, which could include, at times, frequent breeding.

At this time, it is thought that any IUD inserted into a pregnant mare may cause the pregnancy to terminate, which may also cause the IUD to be expelled. For that reason, it is expected that IUDs would only be inserted in non-pregnant (open) mares. Wild mares receiving IUDs would be checked for pregnancy prior to insertion of an IUD. This can be accomplished by transrectal palpation and/or ultrasound performed by a veterinarian. Pregnant mares would not receive an IUD. The IUD is inserted into the uterus using a thin, tubular applicator similar to a shielded culture tube, and would be inserted in a manner similar to that routinely used to obtain uterine cultures in domestic mares. If a mare has a zygote or very small, early phase embryo, it is possible that it will fail to be detected in screening, and may develop further, but without causing the expulsion of the IUD. Wild mares with IUDs would be individually marked and identified, so that they can be monitored occasionally and examined, if necessary, in the future, consistent with other BLM management activities.

Using metallic or glass marbles as IUDs may prevent pregnancy in horses (Nie et al. 2003), but can pose health risks to domestic mares (Turner et al. 2015, Freeman and Lyle 2015). Marbles may break into shards (Turner et al. 2015), and uterine irritation that results from marble IUDs may cause chronic, intermittent colic (Freeman and Lyle 2015). Metallic IUDs may cause severe infection (Klabnik-Bradford et al. 2013).

In domestic ponies, Killian et al. (2008) explored the use of three different IUD configurations, including a silastic polymer O-ring with copper clamps, and the "380 Copper T" and "GyneFix" IUDs designed for women. The longest retention time for the three IUD models was seen in the "T" device, which stayed in the uterus of several mares for 3-5 years. Reported contraception rates for IUD-treated mares were 80%, 29%, 14%, and 0% in years 1-4, respectively. They surmised that pregnancy resulted after IUD fell out of the uterus. Killian et al. (2008) reported high levels of progesterone in non-pregnant, IUD-treated ponies. Soft IUDs may cause relatively less discomfort than hard IUDs (Daels and Hughes 1995). Daels and Hughes (1995) tested the use of a flexible O-ring IUD, made of silastic, surgical-grade polymer, measuring 40 mm in diameter; in five of six breeding domestic mares tested, the IUD was reported to have stayed in the mare for at least 10 months. In mares with IUDs, Daels and Hughes (1995) reported some level of uterine irritation, but surmised that the level of irritation was not enough to interfere with a return to fertility after IUD removal.

More recently, several types of IUDs have been tested for use in breeding mares. When researchers attempted to replicate the O-ring study (Daels and Hughes 1995) in an USGS / Oklahoma State University (OSU) study with breeding domestic mares, using various configurations of silicone O-ring IUDs, the IUDs fell out at unacceptably high rates over time scales of less than 2 months (Baldrighi et al. 2017). Subsequently, the USGS / OSU researchers tested a Y-shaped IUD to determine retention rates and assess effects on uterine health; retention rates were greater than 75% for an 18-month period, and mares returned to good uterine health and reproductive capacity after removal of the IUDs (Holyoak et al., unpublished results). It is possible that some individual mares may become permanently infertile as a result of IUD use, even after IUD removal or expulsion; however, available evidence indicates that flexible IUDs should be considered a reversible fertility control method for most mares. The University of Massachusetts has developed a magnetic IUD that has been effective at preventing estrus, or prolonging the period of time between estrus, in non-breeding domestic mares (Gradil et al. 2019). After insertion in the uterus, the three subunits of the device are held together by magnetic forces as a flexible triangle. A metal detector can be used to determine whether the device is still present in the mare. In an early trial, two sizes of those magnetic IUDs fell out of breeding domestic mares at high rates (Holyoak et al., unpublished results). In 2019, the magnetic IUD was used in two trials where mares were exposed to stallions, and in one where mares were artificially inseminated; in all cases, the IUDs were reported to stay in the mares without any pregnancy (Gradil 2019). Because IUDs may prolong the time between estrus, but still allow for some degree of estrus behavior, it could be surmised that treated mares would continue to engage in behaviors consistent with estrus, though perhaps at somewhat reduced frequency.

Sex Ratio Manipulation

Skewing the sex ratio of a herd so that there are more males than females is an established BLM management technique for reducing population growth rates. As part of a wild horse and burro gather process, the number of animals returned to the range may include more males, the number removed from the range may include more females, or both. By reducing the proportion of breeding females in a population (as a fraction of the total number of animals present), the technique leads to fewer foals being born, relative to the total herd size.

Sex ratio is typically adjusted in such a way that 60 percent of the horses are male. In the absence of other fertility control treatments, this 60:40 sex ratio can temporarily reduce population growth rates from approximately 20% to approximately 15% (Bartholow 2004). While such a decrease in growth rate may not appear to be large or long-lasting, the net result can be that fewer foals being born, at least for a few years – this can extend the time between gathers, and reduce impacts on-range, and costs off-range. Any impacts of sex ratio manipulation are expected to be temporary because the sex ratio of wild horse and burro foals at birth is approximately equal between males and females (NAS 2013), and it is common for female foals to reproduce by their second year (NAS 2013). Thus, within a few years after a gather and selective removal that leads to more males than females, the sex ratio of reproducing wild horses and burros will be returning toward a 50:50 ratio.

Having a larger number of males than females is expected to lead to several demographic and behavioral changes as noted in the NAS report (2013), including the following. Having more fertile males than females should not alter the fecundity of fertile females. Wild mares may be distributed in a larger number of smaller harems. Competition and aggression between males may cause a decline in male body condition. Female foraging may be somewhat disrupted by elevated male-male aggression. With a greater number of males available to choose from, females may have opportunities to select more genetically fit sires. There would also be an increase the genetic effective population size because more stallions would be breeding and existing females would be distributed among many more small harems. This last beneficial impact is one reason that skewing the sex ratio to favor males is listed in the BLM wild horse and burro handbook (BLM 2010) as a method to consider in herds where there may be concern about the loss of genetic diversity; having more males fosters a greater retention of genetic diversity.

Infanticide is a natural behavior that has been observed in wild equids (Feh and Munktuya 2008, Gray 2009), but there are no published accounts of infanticide rates increasing as a result of having a skewed sex ratio in wild horse or wild burro herds. Any comment that implies such an impact would be speculative.

The BLM wild horse and burro management handbook (BLM 2010) discusses this method. The handbook acknowledges that there may be some behavioral impacts of having more males than females. The handbook includes guidelines for when the method should be applied, specifying that this method should be considered where the low end of the AML is 150 animals or greater, and with the result that males comprise 60-70 percent of the herd. Having more than 70 percent males may result in unacceptable impacts in terms of elevated male-male aggression. In NEPA analyses, BLM has chosen to follow these guidelines in some cases, for example:

- In the 2015 Cold Springs HMA Population Management Plan EA (DOI-BLM-V040-2015-022), the low end of AML was 75. Under the preferred alternative, 37 mares and 38 stallions would remain on the HMA. This is well below the 150 head threshold noted above.
- In the 2017 Hog Creek HMA Population Management Plan EA (DOI-BLM-ORWA-V000-2017-0026-EA), BLM clearly identified that maintaining a 50:50 sex ratio was appropriate because the herd size at the low end of AML was only 30 animals.

It is relatively straightforward to speed the return of skewed sex ratios back to a 50:50 ratio. The BLM wild horse and burro handbook (BLM 2010) specifies that, if post-treatment monitoring reveals negative impacts to breeding harems due to sex ratio manipulation, then mitigation measures could include removing males, not introducing additional males, or releasing a larger proportion of females during the next gather.

Appendix P. Minimum Requirements Decision Guide Book

ARTHUR CARHART NATIONAL WILDERNESS TRAINING CENTER

MINIMUM REQUIREMENTS DECISION GUIDE WORKBOOK

"…except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act…"

-- The Wilderness Act of 1964

Project Title: **Surprise Complex Wild Horse and Burro Gather in the East Fork High Rock Canyon, High Rock Canyon, and Little High Rock Canyon Wilderness Areas.**

MRDG Step 1: Determination

Determine if Administrative Action is ***Necessary***

Description of the Situation

What is the situation that may prompt administrative action?

The Bureau of Land Management (BLM), Northern California District, Applegate Field Office (AGFO) manages wild horses and burros (WH&B) over several Herd Management Areas (HMAs), which overlap designated wilderness managed by the Winnemucca District Office (WDO), Black Rock Field Office (BRFO) (See Attached Map). The BLM manages the WH&B population in HMAs at Appropriate Management Levels (AML), which are set in order to maintain healthy animals on healthy public land. The AML is the population range of WH&B within a HMA that can be maintained in conjunction with other resource needs, mainly public land health, wildlife habitat, and livestock grazing. Excess WH&B populations above AML compete with native populations of wildlife for forage, overgraze riparian areas, and trample native vegetation near springs and other water sources.

Additionally, excess WH&B populations above AML decreases the water quality of riparian areas as a result of surface disturbance, associated with hoof action, removal of vegetation, trampling, compaction, increased nutrient loading, sediment loading, and deposition of manure. These same actions have the potential to accelerate erosion, especially in the aftermath of intense storms or snow melt.

Monitoring data referenced in Surprise Complex EA (DOI-BLM-CA-N070-2011-0004-EA), showed water systems with cattle or wild horse use had more site disturbance, lower stubble heights, and increased levels of bare ground when compared to un-grazed systems. The WH&B and other grazing activates have negative impact on the riparian areas located within the wilderness areas.

The WH&B population is above the designated AML in six HMAs across designated wilderness areas, including the Massacre Lakes, Bitner, Nut Mountain, Wall Canyon, High Rock, and Fox Hog HMAs. The AML in this complex of HMAs is 283-496 wild horses and 0 burros, and the population of the area in June of 2019 was 1,301 wild horses and 11 burros, which is approximately 262 – 460% AML of the area. In order to mitigate impacts to springs, vegetation, and wildlife, the BLM is proposing to remove excess WH&B above AML from this HMA complex.

Options Outside of Wilderness
Can action be taken outside of wilderness that adequately addresses the situation?

☐ YES **STOP – DO NOT TAKE ACTION IN WILDERNESS**

☒ NO **EXPLAIN AND COMPLETE STEP 1 OF THE MRDG**

Explain:

The Surprise Complex consist of approximately 396,674 acres which coincides with 122,820 acres of designated wilderness within the East Fork High Rock Canyon, High Rock Canyon and Little High Rock Canyon Wilderness Areas. The impacts of excess WH&B are prevalent within these wilderness areas. There is no feasible way to remove a sufficient number of WH&B from the HMAs to reduce the population to within AML without conducting gather activities within designated wilderness. Much of the Surprise Complex occurs within wilderness, approximately 30%, there is no feasible way to manage the WH&B population without taking action inside of designated wilderness.

Criteria for Determining Necessity
Is action necessary to meet any of the criteria below?

A. Valid Existing Rights or Special Provisions of Wilderness Legislation

Is action necessary to satisfy valid existing rights or a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that ***requires*** *action? Cite law and section.*

☐ YES ☒ NO

Explain:

B. Requirements of Other Legislation

*Is action necessary to meet the requirements of **other federal laws**? Cite law and section.*

☒ YES ☐ NO

Explain:

The Wild Free-Roaming Horses and Burros Act of 1971 (public law 92-195):

"The Secretary shall manage wild free-roaming horses and burros in a manner that is designed to achieve and maintain a thriving natural ecological balance on public lands."

"(2) where the Secretary determines on the basis of: (i) the current inventory of lands within his jurisdiction; (ii) information contained in any land use planning completed pursuant to section 1712 of title 43; (iii) information contained in court ordered environmental impact statements as defined in section 1902 of title 43; and (iv) such additional information as becomes available to him from time to time, including that information developed in the research study mandated by this section, or in the absence of the information contained in (i-iv) above on the basis of all information currently available to him, that an overpopulation exists on a given area of the public lands and that action is necessary to remove excess animals, he shall immediately remove excess animals from the range so as to achieve appropriate management levels. Such action shall be taken, in the following order and priority, until all excess animals have been removed so as to restore a thriving natural ecological balance to the range, and protect the range from the deterioration associated with overpopulation.

C. Wilderness Character

Is action necessary to preserve one or more of the five qualities of wilderness character?

UNTRAMMELED

☐ YES ☒ NO

Explain:

Untrammeled in relation to wilderness is defined as wilderness ecological systems are unhindered and free from intentional actions of modern human control or manipulation. Action is not needed to preserve this quality of wilderness character because the WH&B population being above the AML is not a trammeling action.

UNDEVELOPED

☐ YES ☒ NO

Explain:

Undeveloped in relation to wilderness is defined by being without structures or installations, the use of motorized vehicles, motorized equipment, or mechanical transport. Action is not needed to preserve this quality of wilderness character as the WH&B population being above the AML is not a development.

NATURAL

☒ YES ☐ NO

Explain:

The natural quality of wilderness character describes a place where ecological systems are substantially free from the effects of modern civilization. The Wilderness Act defines wilderness in part as an area "which is protected and managed so as to preserve its natural conditions" (Section 2 (c)).

The excess population of WH&B above AML impacts the natural quality of wilderness character by competing with native wildlife for forage utilization, trampling native vegetation, and trampling watersheds and riparian areas impacting the natural hydrology.

SOLITUDE OR PRIMITIVE & UNCONFINED RECREATION

☐ YES ☒ NO

Explain:

Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation. Action is not needed to preserve this quality of wilderness character as the WH&B population being above the AML does not hinder opportunities for solitude or primitive and unconfined recreation.

OTHER FEATURES OF VALUE

☐ YES ☒ NO

Explain:

Action is not necessary to preserve this quality of wilderness character.

Step 1 Determination
*Is administrative action **necessary** in wilderness?*

Criteria for Determining Necessity

A. Existing Rights or Special Provisions	☐ YES ☒ NO
B. Requirements of Other Legislation	☒ YES ☐ NO
C. Wilderness Character	
Untrammeled	☐ YES ☒ NO
Undeveloped	☐ YES ☒ NO
Natural	☒ YES ☐ NO
Solitude/Primitive/Unconfined	☐ YES ☒ NO
Other Features of Value	☐ YES ☒ NO

Is administrative action **necessary** in wilderness?

☒ YES **EXPLAIN AND COMPLETE STEP 1 OF THE MRDG**

☐ NO **STOP – DO NOT TAKE ACTION IN WILDERNESS**

Explain:

The excess WH&B populations degrade the natural quality of wilderness character by competing with native populations of wildlife, overgrazing riparian areas, and trampling native vegetation near springs and other water sources. By removing the excess WH&B, the BLM is able to manage HMAs at appropriate AMLs, ensuring protection of the overall ecological health of the associated wilderness areas and herd health of the WH&B.

Additionally, the BLM is mandated by The Wild Free-Roaming Horses and Burros Act of 1971 to manage horses as part of the ecological balance in areas where they are found. Management relies on the mandated need to maintain AMLs within areas they exist, to protect the ecological balance of the range from the threats of degradation associated with overpopulation.

MRDG Step 2

*Determine the **Minimum** Activity*

Other Direction

*Is there "special provisions" language in legislation (or other Congressional direction) that explicitly **allows** consideration of a use otherwise prohibited by Section 4(c)?*

AND/OR

Has the issue been addressed in agency policy, management plans, species recovery plans, or agreements with other agencies or partners?

☒ YES	**DESCRIBE OTHER DIRECTION**
☐ NO	**SKIP AHEAD TO TIME CONSTRAINTS BELOW**

Describe Other Direction:

Black Rock RMP:

WHB-5: Horses and burros will be gathered from the HMAs to maintain horses and burros within the AML as funding permits. Aircraft will continue to be used for the management of, and when necessary, removal of wild horses and burros. Gather activities will be scheduled to avoid high visitor use periods whenever possible.

WHB-6: Gathers in Wilderness will continue to be conducted by herding the animals by helicopter or on horseback to temporary corrals, generally located outside of Wilderness. No landing of aircraft will occur in Wilderness Areas except for emergency purposes, and no motorized vehicles will be used in Wilderness in association with the gather operations unless such use was consistent with the minimum tool requirement for management of Wilderness.

Black Rock WMP:

Objective: Manage sustainable populations of wild horses in nine Herd Management Areas (HMAs) and wild burros in two HMAs consistent with the intent of the Black Rock Desert-High Rock Canyon Emigrant Trails National Conservation Act of 2000 within established AMLs to maintain a thriving ecological balance among wild horse and burro populations, wildlife, livestock, vegetation resources, and other values and uses. Maintain free roaming behavior of wild horses and burros.

BLM Manual 6340:

Background: When managing wild horses and burros within wilderness the BLM must ensure that both herd population numbers and management techniques are compatible with the preservation of the area's wilderness character.

Appropriate management level. When determining the appropriate management level for heard management areas HMAs that are within or partially within wilderness areas, the BLM will ensure that the herd population does not exceed the productive capacity of the habitat, as determined by the best available science and monitoring activities, in order to maintain a thriving natural ecological balance and prevent degradation of wilderness character, watershed function, and ecological processes.

Herd management area plans. Herd management area plans (HMAPs) for HMAs that are within or partially within wilderness must identify management actions required to preserve wilderness character in addition to maintaining healthy populations of wild horses and burros.

Prohibited uses and herd management. In managing wild horses and burros within wilderness, the BLM may only employ uses prohibited by Section 4(c) of the Wilderness Act when they are necessary to meet the minimum requirements for administering the area for the purpose of the Wilderness Act or where the uses are required under the Wild Free-Roaming Horse and Burro Act of 1971. The MRDG will be used to determine when prohibited uses—such as motorized or mechanized vehicles, motorized equipment, and installations (such as traps, temporary corrals, and fences)—are permissible for the management of wild horses and burros. The location, frequency, and timing of prohibited uses that have been analyzed through the MRDG and determined to be the minimum requirements will be identified in the HMAP and the applicable wilderness BLM Manual 6340—Management of BLM Wilderness 1-56 BLM MANUAL Rel. No. 6-135 7/13/2012 management plan. Installations associated with wild horse and burro management activities should not be built within wilderness areas where alternative non-wilderness public land locations are available.

Time Constraints

What, if any, are the time constraints that may affect the action?

BLM policy prohibits the gathering of WH&B with a helicopter (unless under emergency conditions) during the period of March 1 to June 30, for wildlife concerns.

Gathers may occur year round, weather permitting. However, if helicopter use is determined to be the minimum tool, the above time constraint applies.

The most popular time of use for the wilderness areas is during the fall hunting season; the BLM will make every effort to avoid conducting gathers during hunting season.

Components of the Action

What are the discrete components or phases of the action?

Component X:	*Example: Transportation of personnel to the project site*
Component 1:	Transportation of personnel and equipment to and from project sites
Component 2:	Installation and staging of equipment at project sites
Component 3:	Location of WH&B
Component 4:	Capture WH&B

Component 5:	Transportation of captured WH&B
Component 6:	Condition after gather operation
Component 7:	
Component 8:	
Component 9:	

Proceed to the alternatives.

Refer to the MRDG Instructions regarding alternatives and the effects to each of the comparison criteria.

MRDG Step 2: Alternatives

Alternative 1: Do Not Conduct WH&B Gather Activities in Wilderness

Description of the Alternative
What are the details of this alternative? When, where, and how will the action occur? What mitigation measures will be taken?

Under the No Action Alternative, the BLM would not gather WH&B.

Component Activities
How will each of the components of the action be performed under this alternative?

Comp #	Component of the Action	Activity for this Alternative
X	*Example: Transportation of personnel to the project site*	*Example: Personnel will travel by horseback*
1	Transportation of personnel and equipment to and from project sites	No activity from this Alternative
2	Installation and staging of equipment at project sites	No activity from this Alternative
3	Location of WH&B	No activity from this Alternative
4	Capture WH&B	No activity from this Alternative
5	Transportation of captured WH&B	No activity from this Alternative
6	Condition after gather operation	No activity from this Alternative
7		
8		
9		

Wilderness Character
What is the effect of each component activity on the qualities of wilderness character? What mitigation measures will be taken?

UNTRAMMELED

Activity #	Component Activity for this Alternative	Positive	Negative	No Effect

X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	No activity from this Alternative	☐	☐	☒
2	No activity from this Alternative	☐	☐	☒
3	No activity from this Alternative	☐	☐	☒
4	No activity from this Alternative	☐	☐	☒
5	No activity from this Alternative	☐	☐	☒
6	No activity from this Alternative	☐	☐	☒
7		☐	☐	☐
8		☐	☐	☐
9		☐	☐	☐
	Total Number of Effects	0	0	NE

Untrammeled Total Rating	**0**

Explain:

No activity is taken under this alternative; therefore, there are no impacts to the untrammeled quality of wilderness character.

UNDEVELOPED

Activity #	Component Activity for this Alternative	Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	No activity from this Alternative	☐	☐	☒
2	No activity from this Alternative	☐	☐	☒
3	No activity from this Alternative	☐	☐	☒
4	No activity from this Alternative	☐	☐	☒
5	No activity from this Alternative	☐	☐	☒
6	No activity from this Alternative	☐	☐	☒
7		☐	☐	☐
8		☐	☐	☐
9		☐	☐	☐

Total Number of Effects	0	0	NE

Undeveloped Total Rating	**0**

Explain:

No activity is taken under this Alternative; therefore, there are no impacts to the undeveloped quality of wilderness character.

NATURAL

Activity #	Component Activity for this Alternative	Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	No activity from this Alternative	☐	☐	☒
2	No activity from this Alternative	☐	☐	☒
3	No activity from this Alternative	☐	☐	☒
4	No activity from this Alternative	☐	☒	☐
5	No activity from this Alternative	☐	☐	☒
6	No activity from this Alternative	☐	☐	☒
7		☐	☐	☐
8		☐	☐	☐
9		☐	☐	☐
	Total Number of Effects	0	-1	NE

Natural Total Rating	**-1**

Explain:

No activity is taken under this Alternative; therefore, the degradation of the natural quality of wilderness character may be negatively impacted by excess WH&B and associated impacts to the naturalness of the area. The excess population of WH&B above AML impacts the natural quality of wilderness character by competing with native wildlife for forage utilization, trampling native vegetation, and trampling watersheds and riparian areas impacting the natural hydrology. (refer to the description section)

SOLITUDE OR PRIMITIVE & UNCONFINED RECREATION

Activity #	Component Activity for this Alternative	Positive	Negative	No Effect

X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	No activity from this Alternative	☐	☐	☒
2	No activity from this Alternative	☐	☐	☒
3	No activity from this Alternative	☐	☐	☒
4	No activity from this Alternative	☐	☐	☒
5	No activity from this Alternative	☐	☐	☒
6	No activity from this Alternative	☐	☐	☒
7		☐	☐	☐
8		☐	☐	☐
9		☐	☐	☐
	Total Number of Effects			NE

Solitude or Primitive & Unconfined Rec. Total Rating	

Explain:

No activity is taken under this Alternative; therefore, there are no impacts to opportunities for solitude or primitive and unconfined recreation.

OTHER FEATURES OF VALUE

Activity #	Component Activity for this Alternative	Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	No activity from this Alternative	☐	☐	☒
2	No activity from this Alternative	☐	☐	☒
3	No activity from this Alternative	☐	☐	☒
4	No activity from this Alternative	☐	☐	☒
5	No activity from this Alternative	☐	☐	☒
6	No activity from this Alternative	☐	☐	☒
7		☐	☐	☐
8		☐	☐	☐
9		☐	☐	☐
	Total Number of Effects	0	0	NE

Other Features of Value Total Rating	0

Explain:

No other features of value are impacted by this alternative.

Summary Ratings for Alternative 1

Wilderness Character	Rating Summary
Untrammeled	0
Undeveloped	0
Natural	-1
Solitude or Primitive & Unconfined Recreation	0
Other Features of Value	0
Wilderness Character Summary Rating	**-1**

MRDG Step 2: Alternatives

Alternative 2: Gather WH&B Utilizing Helicopter Drive-Trap Method and Wilderness Trap Site

Description of the Alternative

What are the details of this alternative? When, where, and how will the action occur? What mitigation measures will be taken?

In order to capture the excess WH&B, BLM proposes to utilize the helicopter drive-trap method to locate and herd WH&Bs to temporary traps. The majority of the temporary trap sites are located outside of the wilderness boundaries. However, one temporary trap site (Bernard's Corral) occurs within the East Fork High Rock Canyon Wilderness. Bernard's Corral has been used as a wild horse trap site for decades and prior to the establishment of the East Fork High Rock Wilderness Area (see attached photos). The High Rock HMA is nearly 95,000 acres and the established AML 78 – 120 wild horses. In June of 2019, an aerial survey was completed, and the estimated population is more than 214 wild horses in the HMA and 120 that have moved outside the HMA in search of forage and/ or water. During this aerial census, 151 of the 214 (70%) wild horses in the census were located within 10 miles of the Bernard's Corral trap site.

In both the 2006 (BLM EA# CA-370-06-16) and 2011 (DOI-BLM-CA-N070-2011-04-EA) gathers, it was assumed that the Bernard's Corral trap site was located outside the East Fork High Rock Canyon Wilderness Area, so no accommodations were made. It was only discovered in 2020 that a cartographic error had been made, and the trap site is actually mapped inside the wilderness area.

It should be noted that animal numbers are potentially variable due to other gathers (Calico Complex, which has historically been gathered prior to or just after the Surprise Complex) and disrepair of fences between AGFO and BRFO. There may be many more or many fewer animals than observed during the 2019 census, which would affect the number of days needed to be in the wilderness area, the number of trips in and out of the trap site, and the number of helicopter overpasses.

Bernard Trap Site Materials

Item	Number	Weight	Dimensions
Heavy duty panels	30	120 lbs each	12' L x 6' H
Connecting posts	30	70 lbs each	3" diameter x 6'H
Walk-through gates	4	160 lbs each	4' W x 6' H
Steel posts	60	3 lbs each	5' H
Rolls of jute netting	5	100 lbs each	4' H x 100' L
Gate ropes	10	<1 lb each	1" diameter x 8' L
Snow fence (for covering panels) rolls	4	50 lbs each	5' H x 100' L

Bernard Trap Site Dimensions

Area	Length	Width	Area
Trap site	500 feet	100 feet	1.0 acre
Truck and trailer turnaround	500 feet	130 feet	0.60 acres
Semi turnaround, truck and trailer material off-loading	700 feet	300 feet	3.5 acres
South jute netting	800 feet		
North jute netting	940 feet		
North canyon rim public observation	300 feet	70 feet	0.55 acres
South canyon rim public observation	250 feet	70 feet	0.40 acres
Entire disturbance footprint	***3,100 feet***	***1,430 feet***	***6.05 acres***

See attached map with diagram

WH&B traps are installed by personnel off-loading the heavy duty metal panels by hand and connecting the panels to posts that are hand-pounded in to the ground. Two to three people are required to lift panels off the trailer and set into place. Panels are hand-carried from the trailer to the actual trap (generally less than 100 feet). The Jute netting is rolled out by hand, then attached to the steel posts which are installed by man-powered post pounder. No power tools or motorized equipment are needed for trap site assembly. The time needed for set up, trapping, and tear down would be approximately three weeks.

The Bernard's Corral trap site occurs within wilderness and would be placed by motorized vehicles. Motorized vehicles would be used to transport materials because the materials (such as metal panels and bundles of steel fence posts) are too heavy to hand carry to the trap site. Motorized vehicles would also be used to transport wild horses as there is no other way to safely remove and haul wild horses from the trap site. A water truck would also access the trap site to spry with water to reduce dust and improve air quality during gathering activities. Using a water truck for dust abatement at the trap site is part of the Comprehensive Animal Welfare Program SOPs for Wild Horse and Burro Gathers. Motorized vehicles would follow a temporary road (as defined in MS 6340) which was previously an existing route and was also previously disturbed. The temporary road extends 820 feet beyond the boundary of the Wilderness Area (see attached map). Motorized vehicles would use the same path for each trip as there is one road to the Bernard's Corral trap site.

For the two sets of trucks and flatbed trailers that are hauling panels and other heavy trap materials, there is one trip to transport in the material and one trip to haul out the material (four trips total for two trucks). For trucks and stock trailers, the number of trips is extremely difficult to estimate, as it is completely dependent on the number of animals caught in the trap. In 2011, approximately 200 horses were caught in this trap site. Using this logic, if 12 horses can fit in a stock trailer; there would be approximately 17 trips to transport 200 horses (200/12 = 16.6 (round up to 17) trips. This would be true only if the trailers were full for every trip, which they are often not. Based on previous knowledge, it is estimated that the stock trailers would need 25 trips in and out from the trap site. It is anticipated that the water truck would need 25 trips to come into the wilderness area, spray down the trap, leave the wilderness and park outside the boundary. Animal health and safety is the determining factor for the minimum number of trips.

Daily, there would be approximately up to 30 people at the trap site: 10 contractors, 10 BLM personnel, and 10 public viewers. This may change due to weather and availability. Non-

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essential vehicles would be parked outside of wilderness. Personnel would walk from the parking at the end of the cherry-stemmed road. Additionally, there may be up to five riders on horseback to assist at the trap site and one Prada horse (a domestic horse used to lure wild horses into the trap).

During gather operations, a helicopter would be flown below 300 feet to locate the WH&B. Once the WH&B are located, the helicopter would be used to herd the WH&B towards the temporary traps. The jute netting is used as a chute to funnel the WH&B into the traps. The helicopter drive-trap method would be repeated for the duration of the gather operations. The number of helicopter overpasses and motorized use for WH&B transport are dependent on the number of excess WH&B being gathered. Helicopter overpasses are highly dependent on animal distribution and movement. Generally, there are around 10 horse gather overpasses and 3 fuel trips per day. Previous flight logs are not available.

After the WH&B are trapped, the helicopter would land outside of the wilderness boundary, and staff would prepare the WH&B for transport. When animals enter the trap, foals are separated from the adults. Animals are then immediately loaded in stock trailers and hauled to the temporary holding corrals located out of the wilderness area. The WH&B captured from the range would be transported, by vehicle and trailer, to off-range corrals and would be managed from those facilities.

At the end of the WH&B gather, all installations would be removed and transported out of wilderness. No installations would remain. As the temporary road followed existing disturbance, no new disturbance would be created from the use of the Bernard's Corral trapsite. Restoration activities for the temporary road and temporary trapsite would include removing signs of vehicle tracks using rakes/mcclouds or other hand tools (no motorized equipment would be used). The temporary road and trapsite would be inspected to ensure the signs of vehicle tracks and installations were removed from wilderness. The condition of the temporary road and temporary trapsite is expected to be the same as before the gather operations.

After gather operations, the range would be monitored for forage condition and utilization, watershed function, ecological processes, aerial population inventories, wildlife, and herd health. A helicopter, horseback, and foot travel are all potential monitoring methods. Managing the WH&B populations to be within the AML is expected to improve resource conditions that are currently not meeting standards (attributed to high utilization from WH&B). After gather operations reduce WH&B populations to be within AML, the public land condition, watershed function, forage condition and utilization, and ecological processes of the HMAs and wilderness areas are expected to improve. WH&B populations managed within AML would also help maintain a thriving ecological balance between WH&B populations, wildlife, livestock, and vegetation, and to protect the land from the deterioration associated with overpopulation of WH&B.

The most popular time of use for the wilderness areas is during the fall hunting season; the BLM would make every effort to avoid conducting gathers during hunting season. Gather operations would not occur from March 1 to June 30. However, gathers may occur anytime in the remaining 8 months of each year. Each individual gather operation typically lasts less than three weeks, with multiple helicopter overflights.

Occasional gather operations would be conducted each year to reduce WH&B populations to AML and then retain populations within the AML. Such activities would continue until there is a change in management direction.

Component Activities
How will each of the components of the action be performed under this alternative?

Comp #	Component of the Action	Activity for this Alternative
X	*Example: Transportation of personnel to the project site*	*Example: Personnel will travel by horseback*
1	Transportation of personnel and equipment to and from project sites	Materials for all trap sites would be transported by vehicles. Motorized vehicles would access the trap site within wilderness via a temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past. It is estimated that two trucks with trailers would use the temporary road four trips to transport heavy material to and from the trap site. One water truck would access the trap site for dust abatement. It is estimated that the water truck would use the temporary road 25 trips. Personnel would walk in at the end of the cherry stemmed road or ride in with personnel who are actively hauling animals out. Up to five personnel would access the wilderness on horseback to assist at the trap site.
2	Installation and staging of equipment at project sites	Trap sites include multiple components (see Alternative 2 Description for full list). All the trap sites would be installed by personnel connecting heavy duty metal panels with steel posts (which are hand-pounded into the ground) and rolling out jute netting by hand. No motorized equipment would be used to install trap sites. For the temporary trapsite in wilderness, a stock truck and trailer would be staged within wilderness to transport captured WH&B from temporary trap site.

		All other trap sites would have motorized vehicles and trailers staged outside of wilderness.
3	Location of WH&B	WH&B would be located by helicopter use, including overflights under 300 feet.
4	Capture WH&B	WH&B would be captured utilizing the helicopter drive-trap method.
5	Transportation of captured WH&B	Motorized vehicles with stock trailers would access the one temporary trap site within wilderness via the temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past. It is estimated that a motorized vehicle with a stock trailer would need 25 trips on the temporary road to transport captured WH&B from the temporary trapsite to corrals (outside of wilderness). For the remaining trapsites outside of wilderness, motorized vehicles and trailers would use existing routes outside of wilderness to transport WH&B to holding facilities.
6	Condition after gather operation	After gathers, a combination of hiking, horseback, and potentially helicopter overflight would be used to monitor post-gather conditions.
7		
8		
9		

Wilderness Character
What is the effect of each component activity on the qualities of wilderness character? What mitigation measures will be taken?

UNTRAMMELED

Activity #	Component Activity for this Alternative	Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	All but one temporary trap site would be set up outside of wilderness boundaries on pre-existing disturbance sites. One temporary trap would be set up within wilderness. Materials for all trap sites would be transported by vehicles. Motorized vehicles would access the trap site within wilderness via a temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past). It is estimated that two trucks with trailers would use the temporary road four trips to transport heavy material to and from the trap site. One water truck would access the trap site for dust abatement. It is estimated that the water truck would use the temporary road 25 trips. Personnel would walk in at the end of the cherry stemmed road or ride in with personnel who are actively hauling animals out. Up to five personnel would access the wilderness on horseback to assist at the trap site.	☐	☐	☒
2	Trap sites include multiple components (see Alternative 2 Description for full list). All the trap sites would be installed by personnel connecting heavy duty metal panels with steel posts (which are hand-pounded into the ground) and rolling out jute netting by hand. No motorized equipment would be used to install trap sites. For the temporary trapsite in wilderness, a stock truck and trailer would be staged within wilderness to transport captured WH&B from temporary trap site. All other trap sites would have motorized	☐	☐	☒

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	vehicles and trailers staged outside of wilderness.			
3	WH&B would be located by helicopter use, including overflights under 300 feet.	☐	☐	☒
4	WH&B would be captured utilizing the helicopter drive-trap method.	☐	☒	☐
5	Motorized vehicles with stock trailers would access the one temporary trap site within wilderness via the temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past). It is estimated that a motorized vehicle with a stock trailer would need 25 trips on the temporary road to transport captured WH&B from the temporary trapsite to corrals (outside of wilderness). For the remaining trapsites outside of wilderness, motorized vehicles and trailers would use existing routes outside of wilderness to transport WH&B to holding facilities.	☐	☐	☒
6	After gathers, a combination of hiking, horseback, and potentially helicopter overflight would be used to monitor post-gather conditions.	☐	☐	☒
7		☐	☐	☐
8		☐	☐	☐
9		☐	☐	☐
	Total Number of Effects	0	-1	NE

Untrammeled Total Rating	-1

Explain:

Herding WH&B within wilderness for capture is a trammeling activity, as it is a human manipulation of the natural processes or conditions that exist within the wilderness boundary. In this case, the presence of WH&B is the natural condition, as legislated by the Wild Free-Roaming Horses and Burros Act of 1971 (P.L. 92-195), and herding WH&B in wilderness is a manipulation of the natural condition; therefore, the proposed action of herding and gathering WH&B is considered a trammeling action.

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UNDEVELOPED

Activity #	Component Activity for this Alternative	Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	All but one temporary trap site would be set up outside of wilderness boundaries on pre-existing disturbance sites. One temporary trap would be set up within wilderness. Materials for all trap sites would be transported by vehicles. Motorized vehicles would access the trap site within wilderness via a temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past). It is estimated that two trucks with trailers would use the temporary road four trips to transport heavy material to and from the trap site. One water truck would access the trap site for dust abatement. It is estimated that the water truck would use the temporary road 25 trips. Personnel would walk in at the end of the cherry stemmed road or ride in with personnel who are actively hauling animals out. Up to five personnel would access the wilderness on horseback to assist at the trap site.	☐	☒	☐
2	Trap sites include multiple components (see Alternative 2 Description for full list). All the trap sites would be installed by personnel connecting heavy duty metal panels with steel posts (which are hand-pounded into the ground) and rolling out jute netting by hand. No motorized equipment would be used to install trap sites. For the temporary trapsite in wilderness, a stock truck and trailer would be staged within wilderness to transport captured WH&B from temporary trap site. All other trap sites would have motorized vehicles and trailers staged outside of wilderness.	☐	☒	☐
3	WH&B would be located by helicopter use, including overflights under 300 feet.	☐	☐	☒

4	WH&B would be captured utilizing the helicopter drive-trap method.	☐	☒	☐
5	Motorized vehicles with stock trailers would access the one temporary trap site within wilderness via the temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past). It is estimated that a motorized vehicle with a stock trailer would need 25 trips on the temporary road to transport captured WH&B from the temporary trapsite to corrals (outside of wilderness). For the remaining trapsites outside of wilderness, motorized vehicles and trailers would use existing routes outside of wilderness to transport WH&B to holding facilities.	☐	☒	☐
6	After gathers, a combination of hiking, horseback, and potentially helicopter overflight would be used to monitor post-gather conditions.	☐	☐	☒
7		☐	☐	☐
8		☐	☐	☐
9		☐	☐	☐
	Total Number of Effects	0	-4	NE

Undeveloped Total Rating	-4

Explain:

Impacts to the undeveloped quality of wilderness character would occur from the use of motorized vehicles, motorized equipment, or mechanical travel within wilderness, among other actions, including the presence of structures or installations. The use of motorized vehicles and trailers along a temporary road and the installation and use of a temporary trapsite within wilderness would result in a negative impact to the undeveloped quality of wilderness character. For motorized transport to occur by aircraft within wilderness, a landing would have to occur. A landing is defined by 43 CFR 6302.20(e) as "dropping or picking up any material, supplies, or person by means of aircraft; it does not include overflights" (BLM Manual 6340). Because no helicopter landings would occur within the wilderness boundary, there would be no impacts to the undeveloped quality of wilderness character from the use of helicopters. However, visitors to the wilderness that witness WH&B gather activities may be affected by the presence of the aircraft in low overflight and their related exposure to the sights and sounds of civilization.

NATURAL

Activity #	Component Activity for this Alternative	Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	All but one temporary trap site would be set up outside of wilderness boundaries on pre-existing disturbance sites. One temporary trap would be set up within wilderness. Materials for all trap sites would be transported by vehicles. Motorized vehicles would access the trap site within wilderness via a temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past). It is estimated that two trucks with trailers would use the temporary road four trips to transport heavy material to and from the trap site. One water truck would access the trap site for dust abatement. It is estimated that the water truck would use the temporary road 25 trips. Personnel would walk in at the end of the cherry stemmed road or ride in with personnel who are actively hauling animals out. Up to five personnel would access the wilderness on horseback to assist at the trap site.	☐	☐	☒
2	Trap sites include multiple components (see Alternative 2 Description for full list). All the	☐	☐	☒

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	trap sites would be installed by personnel connecting heavy duty metal panels with steel posts (which are hand-pounded into the ground) and rolling out jute netting by hand. No motorized equipment would be used to install trap sites. For the temporary trapsite in wilderness, a stock truck and trailer would be staged within wilderness to transport captured WH&B from temporary trap site. All other trap sites would have motorized vehicles and trailers staged outside of wilderness.			
3	WH&B would be located by helicopter use, including overflights under 300 feet.	☐	☐	☒
4	WH&B would be captured utilizing the helicopter drive-trap method.	☐	☐	☒
5	Motorized vehicles with stock trailers would access the one temporary trap site within wilderness via the temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past). It is estimated that a motorized vehicle with a stock trailer would need 25 trips on the temporary road to transport captured WH&B from the temporary trapsite to corrals (outside of wilderness). For the remaining trapsites outside of wilderness, motorized vehicles and trailers would use existing routes outside of wilderness to transport WH&B to holding facilities.	☒	☐	☐
6	After gathers, a combination of hiking, horseback, and potentially helicopter overflight would be used to monitor post-gather conditions.	☐	☐	☒
7		☐	☐	☐
8		☐	☐	☐
9		☐	☐	☐
	Total Number of Effects	1	0	NE

Natural Total Rating	1

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Explain:

The goal of the WH&B gathers are to manage the WH&B population at the AML. The AML are mandated for management to "ensure that the herd population does not exceed the productive capacity of the habitat, as determined by the best available science and monitoring activities, in order to maintain a thriving natural ecological balance and prevent degradation of wilderness character, watershed function, and ecological processes" (BLM manual 6340). By removing the excess WH&B the natural quality of wilderness character may be preserved and enhanced by reducing the degradation due to excess animals within the wilderness. Removing the excess WH&B may reduce or eliminate the impact of excess animals competing with native wildlife for forage utilization, excess trampling of native vegetation and reduce trampling watersheds and other riparian areas within the wilderness areas.

SOLITUDE OR PRIMITIVE & UNCONFINED RECREATION

Activity #	Component Activity for this Alternative	Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	All but one temporary trap site would be set up outside of wilderness boundaries on pre-existing disturbance sites. One temporary trap would be set up within wilderness. Materials for all trap sites would be transported by vehicles. Motorized vehicles would access the trap site within wilderness via a temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past). It is estimated that two trucks with trailers would use the temporary road four trips to transport heavy material to and from the trap site. One water truck would access the trap site for dust abatement. It is estimated that the water truck would use the temporary road 25 trips. Personnel would walk in at the end of the cherry stemmed road or ride in with personnel who are actively hauling animals out. Up to five personnel would access the wilderness on horseback to assist at the trap site.	☐	☒	☐
2	Trap sites include multiple components (see Alternative 2 Description for full list). All the trap sites would be installed by personnel	☐	☒	☐

	connecting heavy duty metal panels with steel posts (which are hand-pounded into the ground) and rolling out jute netting by hand. No motorized equipment would be used to install trap sites. For the temporary trapsite in wilderness, a stock truck and trailer would be staged within wilderness to transport captured WH&B from temporary trap site. All other trap sites would have motorized vehicles and trailers staged outside of wilderness.			
3	WH&B would be located by helicopter use, including overflights under 300 feet.	☐	☒	☐
4	WH&B would be captured utilizing the helicopter drive-trap method.	☐	☒	☐
5	Motorized vehicles with stock trailers would access the one temporary trap site within wilderness via the temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past). It is estimated that a motorized vehicle with a stock trailer would need 25 trips on the temporary road to transport captured WH&B from the temporary trapsite to corrals (outside of wilderness). For the remaining trapsites outside of wilderness, motorized vehicles and trailers would use existing routes outside of wilderness to transport WH&B to holding facilities.	☐	☒	☐
6	After gathers, a combination of hiking, horseback, and potentially helicopter overflight would be used to monitor post-gather conditions.	☐	☒	☐
7		☐	☐	☐
8		☐	☐	☐
9		☐	☐	☐
	Total Number of Effects	0	-6	NE

Solitude or Primitive & Unconfined Rec. Total Rating	**-6**

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Explain:

Opportunities for solitude would be impacted during the gather operation from the presence and use of helicopter, semitruck, stock trailer, and the installation of a trap site within wilderness. The entirety of the wilderness areas would not be negatively impacted as the action is ephemeral by nature, though this quality wilderness character would be impacted for the duration of gather and monitoring operations where the presence and sound of helicopter and motorized transport is prevalent.

OTHER FEATURES OF VALUE

Activity #	Component Activity for this Alternative	Positive	Negative	No Effect
X	*Example: Personnel will travel by horseback*	☐	☐	☒
1	All but one temporary trap site would be set up outside of wilderness boundaries on pre-existing disturbance sites. One temporary trap would be set up within wilderness. Materials for all trap sites would be transported by vehicles. Motorized vehicles would access the trap site within wilderness via a temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past). It is estimated that two trucks with trailers would use the temporary road four trips to transport heavy material to and from the trap site. One water truck would access the trap site for dust abatement. It is estimated that the water truck would use the temporary road 25 trips. Personnel would walk in at the end of the cherry stemmed road or ride in with personnel who are actively hauling animals out. Up to five personnel would access the wilderness on horseback to assist at the trap site.	☐	☐	☒
2	Trap sites include multiple components (see Alternative 2 Description for full list). All the trap sites would be installed by personnel connecting heavy duty metal panels with steel posts (which are hand-pounded into the ground) and rolling out jute netting by hand. No motorized equipment would be used to install trap sites. For the temporary trapsite in	☐	☐	☒

	wilderness, a stock truck and trailer would be staged within wilderness to transport captured WH&B from temporary trap site. All other trap sites would have motorized vehicles and trailers staged outside of wilderness.			
3	WH&B would be located by helicopter use, including overflights under 300 feet.	☐	☐	☒
4	WH&B would be captured utilizing the helicopter drive-trap method.	☐	☐	☒
5	Motorized vehicles with stock trailers would access the one temporary trap site within wilderness via the temporary road, which follows previously existing disturbance as this area has previously been used as a WH&B trapsite in the past). It is estimated that a motorized vehicle with a stock trailer would need 25 trips on the temporary road to transport captured WH&B from the temporary trapsite to corrals (outside of wilderness). For the remaining trapsites outside of wilderness, motorized vehicles and trailers would use existing routes outside of wilderness to transport WH&B to holding facilities.	☐	☐	☒
6	After gathers, a combination of hiking, horseback, and potentially helicopter overflight would be used to monitor post-gather conditions.	☐	☐	☒
7		☐	☐	☐
8		☐	☐	☐
9		☐	☐	☐
	Total Number of Effects	0	0	NE

Other Features of Value Total Rating	**0**

Explain:

No other features of value are impacted by this alternative.

Summary Ratings for Alternative 2

Wilderness Character	Rating Summary
Untrammeled	-1
Undeveloped	-4
Natural	+1
Solitude or Primitive & Unconfined Recreation	-6
Other Features of Value	0
Wilderness Character Summary Rating	-10

MRDG Step 2: Alternatives Not Analyzed

Alternatives Not Analyzed
What alternatives were considered but not analyzed? Why were they not analyzed?

Use of Bait and Water Trapping Only:
Bait and water trapping involves setting up portable panels around existing water sources, in an active wild horse and burro area, or around a pre-set water or bait source. These panels would allow the WH&B to go freely in and out of the corral until they have adjusted to it. When animals are within the corral, its gate system traps them in the area. This requires BLM personnel to check the trap daily. Gathers like this require intensive motorized or vehicle use, as the traps must be checked every day. This alternative is also not feasible to address the number of excess WH&B within the Surprise Complex. The area covered by the HMA complex is too large for bait and water trapping methods to be effective. Additionally, this alternative would require a long period of time and intensive motorized vehicle use, including motorized vehicle use that would be proposed within wilderness. For these reasons, this alternative was determined not to be appropriate or feasible, and it was not fully analyzed.

Use of Horseback and Roping:
BLM staff would ride the HMAs on horseback and rope WH&B gather the excess animals. Given the number of excess WH&B and the size of the HMAs in the Surprise Complex, there is no feasible way for staff to ride and rope enough animals to protect the ecosystem from the impacts of the animals above AML. This alternative was determined not to be feasible, and it was not fully analyzed.

Use of Trap Sites Outside of Wilderness Only:
There are 18 temporary trap sites identified for the proposed Surprise Complex WH&B Gather Project. 17 temporary trap sites are located outside of wilderness within previously disturbed areas. The remaining temporary trap site is located at Bernard's Corral within the East Fork High Rock Canyon Wilderness Area, which has been previously disturbed from past horse gathers (1981 - 2011). Bernard's Corral trap site includes the use of a canyon, which is used as a natural chute to aid in herding WH&B into the temporary corral. The Bernard's Corral trap site is the only trap site located within High Rock Canyon and within High Rock Canyon HMA (97% of the High Rock Canyon HMA is BLM managed wilderness). Bernard's Corral trap site is critical to managing wild horse populations in the High Rock HMA and within wilderness because the majority of the animals are located in the northern part of the High Rock HMA (per the Tri-State aerial census completed in June of 2019).

Eliminating the use of Bernard's Corral trap site is not feasible due to animal health and safety. It is too far to move horses, particularly if mares have young foals outside of the High Rock HMA without the trap site at this location. The closest trap site to the Bernard's Corral site is approximately 7 miles away (outside of wilderness). The general rule followed by the wild horse and burro program is that horses should not be moved further than 10 miles. The Comprehensive Animal Welfare Program SOPs for Wild Horse and Burro Gathers is Appendix D in the EA. Text from the SOPs regarding gather distances states: "The rate of movement and distance the animals travel must not exceed limitations set by the LCOR/COR/PI who will consider terrain, physical barriers, access limitations, weather, condition of the animals, urgency of the operation (animals facing drought, starvation, fire, etc.) and other factors. The trap site shall be moved close to WH&B locations whenever possible to minimize the distance the animals need to travel.".

Placement of the trap site at the end of the mapped cherry-stemmed road would not be possible because the road ends on top of a hill which the horses could see and would likely escape out of the trap and possibly cause injuries to themselves, or personnel and public attending gather operations. In 2011, personnel attempted to open the fence on the northern boundary of the wilderness area and HMA and drive horses to a trap located outside of the wilderness area. This resulted in injuries, cuts, and abrasions to individual animals when they attempted to run through the fence that was still up. In addition, most horses refused to cross the fence-line, even with the open fence, and turned back into the HMA resulting in additional helicopter time in the wilderness area and additional stresses to individual animals having to be pursued further. Most of the other canyons that are cherry-stemmed into the wilderness area (such as High Rock Creek Canyon) are full of riparian vegetation including willows and tall shrubs which are not possible to drive horses down.

Without the Bernard's Corral trap site, it would not be possible to gather and remove excess WH&B without violating WH&B gather SOPs. Without this trap site, WH&B would need to be herded for longer distances and over steep terrain, which could increase risk of injury and stress of the animals. For these reasons, this alternative was determined not to be feasible, and it was not fully analyzed.

Alternative to hand carry material into wilderness
Two to three people are required to lift the heavy duty metal panels off the trailer and set into place. Panels are hand-carried from the trailer to the actual trap (generally less than 100 feet). From the existing end of the current cherry stem could be up to 1,000 feet over rugged terrain which is not feasible to hand carry with 2-3 people. This alternative was determined not to be feasible, and it was not fully analyzed.

MRDG Step 2: Alternative Comparison

Alternative 1:	Do Not Conduct WH&B Gather Activities in Wilderness
Alternative 2:	Gather WH&B Utilizing Helicopter Drive-Trap Method and Wilderness Trap Site

Wilderness Character	Alternative 1 +	Alternative 1 -	Alternative 2 +	Alternative 2 -
Untrammeled	0	0	0	-1
Undeveloped	0	0	0	-4
Natural	0	-1	+1	0
Solitude/Primitive/Unconfined	0	0	0	-6
Other Features of Value	0	0	0	0
Total Number of Effects	0	-1	+1	-11
Wilderness Character Rating	-1		-10	

MRDG Step 2: Determination

Refer to the MRDG Instructions before identifying the selected alternative and explaining the rationale for the selection.

Selected Alternative

☐	Alternative 1:	Do Not Conduct WH&B Gather Activities in Wilderness
☒	Alternative 2:	Gather WH&B Utilizing Helicopter Drive-Trap Method and Wilderness Trap Site

Explain Rationale for Selection:

Alternative 2 is consistent with the Wild Free-Roaming Horses and Burros Act of 1971 which mandates the BLM to "protect the range from the deterioration associated with overpopulation," "remove excess animals from the range so as to achieve appropriate management levels," and "to preserve and maintain a thriving natural ecological balance and multiple-use relationship in that area." This alternative aims at maintaining AML of WH&B, which would benefit the natural quality of wilderness character of the areas over the long term, as excess WH&B may compete with native populations of wildlife, overgraze riparian areas, and trample native vegetation near springs and other water sources.

Alternative 2 was determined to be the minimum necessary action to manage WH&B populations in the Surprise Complex at AML. Alternative 2 is consistent with the Wilderness Act, Wild Free-Roaming Horses and Burros Act of 1971, Black Rock Desert-High Rock Canyon Emigrant Trails NCA Act of 2000 (as amended), and Resource and Wilderness Management Plans for these areas. Alternative 2 uses a minimal Section 4(c) prohibited uses, such as a combination of people hiking into wilderness and the use of installations and mechanized and motorized vehicles to transport heavy items and haul WH&B outside of wilderness. Alternative 2 does not propose the use of motorized equipment within wilderness.

Alternative 2 utilizes helicopter overflights to herd WH&B, motorized vehicles to transport heavy materials & WH&B, installations (temporary corral), and a temporary road within wilderness at one trap site. Motorized vehicles, installations, and temporary roads are uses prohibited by Section 4(c) of the Wilderness Act. However, the use of motorized vehicles, installations, and a temporary road are permissible for the management of WH&B if they are determined to be the minimum required to manage WH&B (BLM Manual 6340). The analysis within this MRDG supports that the use of helicopter overflights, motorized vehicles, temporary installations, and a temporary road for the trap site within wilderness are the minimum required tools to conduct the Surprise Complex WH&B Gather operation.

Describe Monitoring & Reporting Requirements:

The BLM Contracting Officer and Project Inspectors assigned to the gather would be responsible for ensuring contract personnel abide by stipulations in the contract that are consistent with the determination of the minimum requirements analysis. The temporary road and trapsite within wilderness would be inspected after gather operations to ensure signs of disturbance and installations were removed from wilderness. Ongoing terrestrial, riparian, and WH&B monitoring would continue through the year, including periodic aerial population counts.

Surprise Complex Wild Horse and Burro Gather in the East Fork High Rock Canyon, High Rock Canyon, and Little High Rock Canyon Wilderness Areas MRDG

Approvals

Which of the prohibited uses found in Section 4(c) of the Wilderness Act are approved in the selected alternative and for what quantity?

Approved?	Prohibited Use	Quantity
☐	Mechanical Transport:	
☐	Motorized Equipment:	
☒	Motor Vehicles:	Semitruck & Semi Trailer (4 trips), truck & stock trailer (25 trips), water truck (25 trips)
☐	Motorboats:	
☐	Landing of Aircraft:	
☒	Temporary Roads:	820 feet of temporary road (total of 54 trips), 0.6 acre truck and trailer turn around area, 3.5 acre semi turnaround, truck and trailer material off-loading area (see attached map)
☐	Structures:	
☒	Installations:	1 temporary corral (see Alt 2 description for full list of materials and dimensions)

Record and report any authorizations of Wilderness Act Section 4(c) prohibited uses according to agency policies or guidance. Refer to agency policies for the following signature authorities:

Prepared:

Name: Kathleen Torrence — Position: Wilderness Specialist

Signature: KATHLEEN CADIGAN Digitally signed by KATHLEEN CADIGAN Date: 2020.11.30 11:52:07 -08'00' — Date: ____________

Recommended:

Name: Braydon Gaard — Position: (Acting) NV State ORP-Wilderness Specialist

Signature: BRAYDON GAARD Digitally signed by BRAYDON GAARD Date: 2020.11.30 11:38:19 -08'00' — Date: ____________

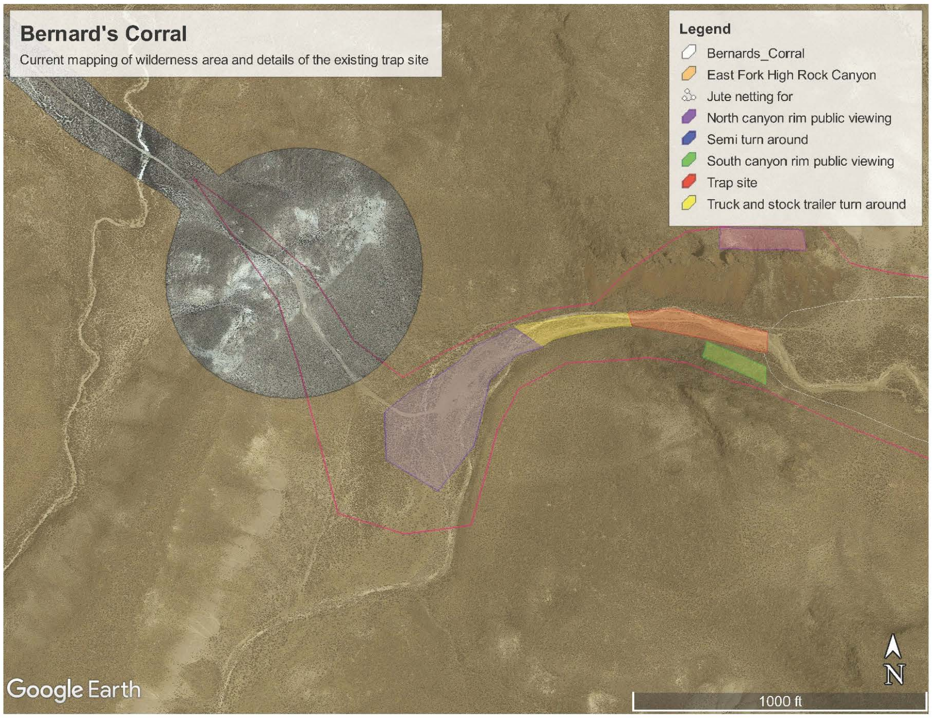
Surprise Complex Wild Horse and Burro Gather in the East Fork High Rock Canyon, High Rock Canyon, and Little High Rock Canyon Wilderness Areas MRDG

Recommended:

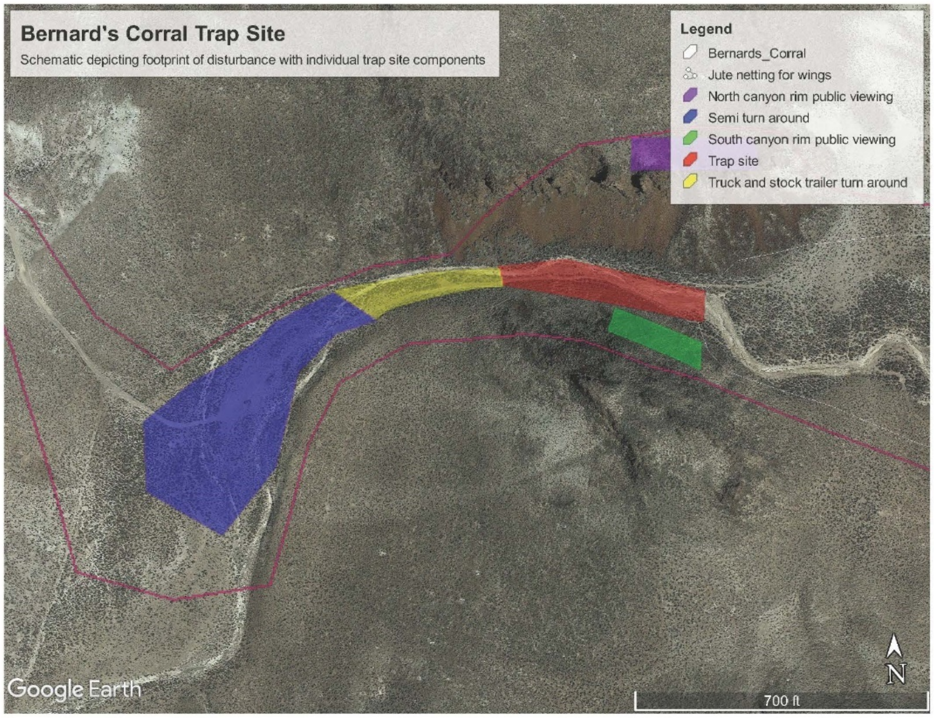
Name	Mark E. Hall, PhD.	Position	Black Rock Field Manager
Signature	MARK HALL Digitally signed by MARK HALL Date: 2020.12.11 13:15:41 -08'00'	Date	

Approved:

Name	Ester M. McCullough	Position	Winnemucca District Manager
Signature	ESTER MCCULLOUGH Digitally signed by ESTER MCCULLOUGH Date: 2020.12.15 13:52:18 -08'00'	Date	



MRDG 12/15/16
Step 2: Determination 37



MRDG 12/15/16
Step 2: Determination 38

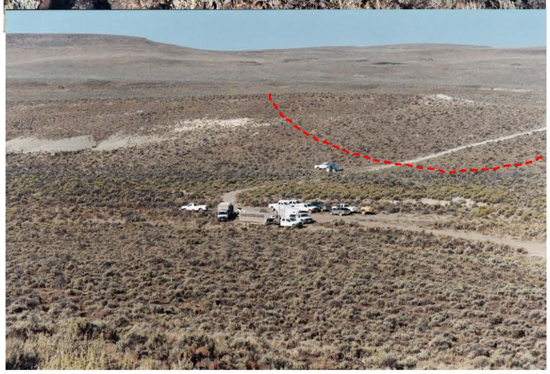
Photos from 2011 gather at Bernard's Corral trap site:

MRDG 12/15/16
Step 2: Determination 39

MRDG 12/15/16
Step 2: Determination 40

Photos from 2006 gather at Bernard's Corral trap site:

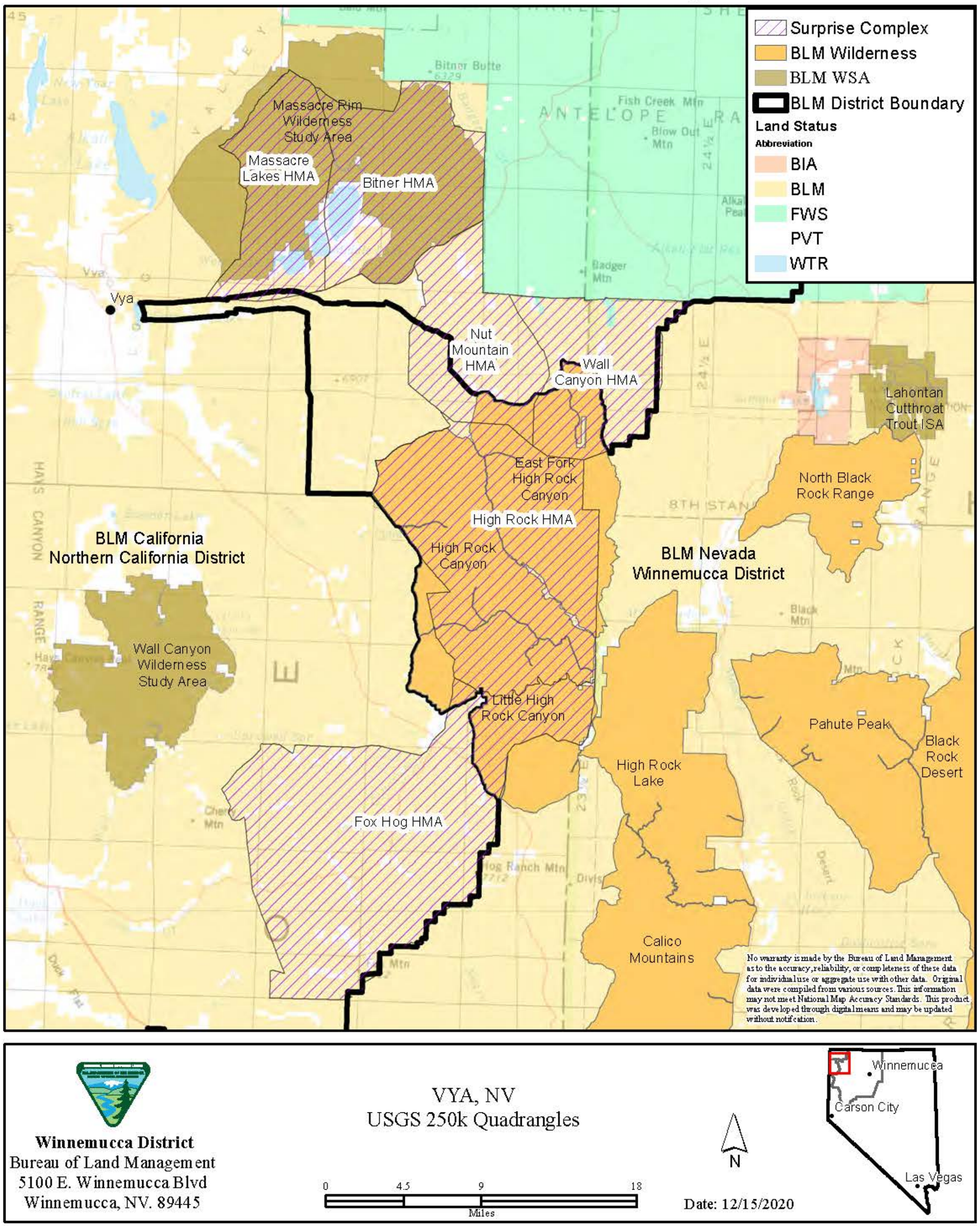
Trap site overview from public viewing area on south canyon rim.



Parking area 50 m east of the current wilderness boundary. Approximate current wilderness boundary depicted by dashed red line.

MRDG 12/15/16
Step 2: Determination 41

Surprise Complex Wild Horse & Burro Gather
Wilderness & Wilderness Study Areas



Surprise Complex Wild Horse & Burro Gather
Bernard's Corral Trap Site