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BLM

Spay Feasibility and On-Range Behavioral Outcomes Assessment and Warm Springs HMA Population Management Plan

Environmental Assessment
DOI-BLM-ORWA-B050-2018-0016-EA

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I. INTRODUCTION

This environmental assessment (EA) has been prepared to disclose and analyze the environmental consequences of the Spay Feasibility and On-Range Behavioral Outcomes Assessment and Warm Springs Herd Management Area (HMA) Population Management Plan. The research project is proposed by the United States Geological Survey (USGS) and Colorado State University (CSU) in cooperation with the Burns District Bureau of Land Management (BLM). The Burns District BLM proposes to allow the USGS and CSU to evaluate the safety, complication rate, and feasibility of ovariectomy via colpotomy on wild horse mares and the impacts to mare and band behavior once returned to the range as compared with an untreated herd.

In conjunction with the feasibility study, Burns District BLM also proposes a 10-year population management plan for Warm Springs HMA. The plan includes this study, followed by a gather to low appropriate management level (AML) at the completion of the study, and additional gathers and removals of excess wild horses and burros. Wild horse mares returned to the range following gathers would receive population growth treatments. The study is being initiated to document the BLM experience with this established method for managing the population growth of wild horse herds on public lands; no burros would be involved in the study. The population management plan is being proposed to achieve and maintain a thriving natural ecological balance and manage the wild horse and burro populations within AML over a 10-year timeframe.

A. Background

Under an existing interagency agreement, USGS and CSU would assess the feasibility and on-range behavioral outcomes of ovariectomizing (i.e. spaying) wild horse mares and returning them to the range. Studying the feasibility of the "spay" method includes, but is not limited to, quantifying the safety of the procedure for both the mare and veterinarian performing the surgery, quantifying post-surgical complication rates, quantifying costs associated with the surgical method, and surgery time. On-range behavior assessments would include, but are not limited to, band fidelity of treated/untreated mares, attention and breeding attempts by stallions toward treated/untreated mares, interactions among stallions and treated/untreated mares, and differences in habitat selection and home range size of treated/untreated mares. The study would use horses from and take place at Warm Springs HMA, with surgeries and radio collaring/tagging taking place at the Oregon Wild Horse Corral Facility in Hines.

Various methods of gathering and population control are analyzed in the document. Gathering methods of wild horses and burros include helicopter-drive trapping, bait/water trapping, and horseback-drive trapping. Two methods of wild horse mare fertility control, porcine zona pellucida (PZP) fertility control vaccine and ovariectomy via colpotomy, are analyzed in the document as potential methods of fertility treatment for the remainder of the 10-year timeframe following the completion of the spay feasibility and behavior outcomes assessment.

Warm Springs HMA is located in Harney County, Oregon, approximately 25 air miles southwest of Burns, Oregon (Appendix A – Warm Springs HMA Vicinity Map). The HMA contains approximately 474,547 acres of BLM-managed land. Topography consists of gently rolling, sagebrush covered hills and rimrock with small lake basins between. Elevations range from 4,250 feet at Iron Mountain Flat to 5,584 feet at Jackass Butte. Annual precipitation ranges from 10 to 12 inches, mostly occurring in the form of snow during the months of December through February, with spring rains common. Temperatures range from -30ºF in the winter to 100ºF in the summer.

The Three Rivers Resource Area Resource Management Plan (RMP) and Record of Decision (ROD) (1992) affirmed an AML range of 96 to 178 wild horses and 15 to 24 burros within the HMA; total AML would be 111 to 202 animals. The upper limit of an AML will be the maximum number of wild horses and burros (WHB) that results in a thriving natural ecological balance and avoids a deterioration of the range (BLM Wild Horses and Burros Management Handbook, H-4700-1). The AML lower limit will normally be established at a number that allows the population to grow (at the annual population growth rate) to the upper limit over a 4- to 5-year period, without any interim gathers to remove excess wild horses (H-4700-1). The population growth rate in many HMAs approaches 20 percent or even higher (National Research Council (NRC) Review 2013). Therefore, with a 20 percent population growth rate, the low level of AML would achieve or exceed the high end of AML within 4 to 5 years.

Since 1972, the Warm Springs HMA has been surveyed 19 times and gathered 16 times (partial and full gathers) to maintain the population within AML. A September 27, 2016, simultaneous double-observer aerial survey led to an estimated population size of 586 horses (513 adult horses and 73 foals; Lubow 2016). Assuming a 20 percent annual population growth rate applied to the estimated number of adults over two years, the estimated wild horse population by fall 2018 would be approximately 738 adult horses plus 147 foals. Many burro characteristics make them difficult to detect in aerial surveys; they are relatively small, cryptic-colored, can be hidden by trees and tall shrubs, occur in small groups, and may stand still during surveys (Griffin 2015). Despite this difficulty, several ground counts and aerial burro surveys provided an estimated burro population of 49 adults plus 9 foals by fall 2018. Assuming a 19 percent population growth rate (Ransom et al. 2016), the estimated burro population by fall 2028 would be 279 adults and 53 foals.

Within the Great Basin, drought conditions are common, and water is the main limiting factor within Warm Springs HMA. During the Severe Drought (designated by the National Oceanic and Atmospheric Administration (NOAA)) in 2014, wild horses and burros were forced to congregate closer to the few remaining water sources in the HMA. Livestock permittees (who were authorized less than 50 percent active use that year) had been ordered to remove all remaining livestock from the impacted area, and cooperative agreements were being exercised to operate wells to provide water to horses in the absence of livestock. In an effort to avoid the need for emergency removals or large scale mortality, Burns District began hauling water to an existing waterhole and temporary troughs where approximately 80 wild horses were congregating. At the time, the potential for wild horse mortality was high. NOAA recently released its U.S. Seasonal Drought Outlook for the period of April 19 through July 31, 2018, which shows eastern Oregon with persistent drought and explains that "Below-normal precipitation and above-normal temperatures promoted drought persistence across central and eastern Oregon… monthly and seasonal outlooks both depict enhanced changes for below-normal precipitation and above-normal temperatures, which favors persistence through the end of August" (NOAA 2018). With an estimated 738 adults horses and 147 foals by fall 2018, severe drought in coming years would likely result in loss of life especially as compared to 2014 when the estimated wild horse population was only 253 adults and 44 foals and loss was expected without water hauling. Because water resources are limited in this HMA, especially during drought years wild horse observations show high congregation areas are occurring within 4 miles of all pending Greater Sage-Grouse (GRSG) leks (range of 15–120 horses per lek; average 49 horses per lek). Continuous yearlong impacts from horses to GRSG is a serious concern. Wild horse competition with native wildlife species for water sources is concerning especially in relation to recent GRSG lek trends in the HMA (drastic decline or loss) versus leks outside the HMA (stable). Herbaceous cover and height provide horizontal screening at GRSG nest sites, which obscures the nest from predators. Recent upland forage utilization monitoring documents moderate to high utilization levels in portions of the HMA experiencing concentrated wild horse and livestock use. In 2017, moderate to heavy use was indicated in several areas of the HMA where lower levels of livestock use occurred.

The AML for wild horses and burros across the west is 26,715. The current estimated on-range wild horse and burro adult population is 81,814 (as of March 1, 2018; BLM). There are currently 45,402 wild horses and burros in BLM Off-Range Facilities (as of April, 2018; BLM). Nationally, there is limited available funding and space to care for additional animals in BLM short- and long-term holding facilities. Unrestricted population growth of wild horses and burros eventually leads to overpopulation of herds and consequent detriment to the animals, health of the range, other species, and other users of the range. The BLM has been using a limited number of methods to address high population growth of wild horses and burros. Currently available options include periodic removals and the application of temporary fertility control vaccines. The current criteria for prioritizing gathers are as follows: court orders, public health and safety, sagebrush focal area GRSG habitat gathers, implementation of research, private land encroachment, and emergency removal of imperiled animals. The NRC found in a 2013 review that there were no highly effective, long lasting, easily delivered, and affordable fertility control methods available at the time. Therefore, the BLM aims to develop and apply a variety of population management tools to reduce the number of animals that must be removed from the range as well as the number of animals that must be cared for in off-range facilities. One objective of the Oregon GRSG Approved Resource Management Plan Amendment (ARMPA) (2015) is to "Coordinate with professionals from other Federal and State agencies, researchers at universities, and others to utilize and evaluate new management tools (e.g. population growth suppression, inventory techniques, and telemetry) for implementing the WHB program" (MD WHB 9). Based on a summary of surgical mare sterilization techniques (Bowen 2015), BLM preliminarily identified ovariectomy via colpotomy as the most likely mare surgical sterilization method that could be successfully used as a management tool for long-term management of the Warm Springs HMA. Prior successful application of that spaying method had already been demonstrated at the Sheldon National Wildlife Refuge (NWR) (Collins and Kasbohm 2016) and in privately-owned wild mares that had recently been removed from BLM lands in Oregon (Pielstick, personal communication). In general terms, results from prior spay via colpotomy studies have already found limited surgical and behavioral outcomes for on-range horse management, but BLM identified the desire to quantify outcomes in a more detailed fashion, as part of herd management in the Warm Springs HMA. In the interest of learning as much as possible from the application of this previously-proven surgical spay method, BLM sought a research partner that could document and quantify surgical and behavioral outcomes. The BLM has an existing interagency agreement with the USGS, the Department of the Interior's research agency, to provide research related to wild horse and burro management. The BLM sent a Statement of Research Objectives (included in appendix B) to USGS in February 2018, which identified that two main goals of the research sought would be to quantify surgical and behavioral outcomes of the application of spaying via colpotomy. In response, BLM received a study plan for proposed USGS research and in June 2018, BLM approved funding to proceed with the proposed research described in and attached to this analysis.

In addition to wild horse management in the Warm Springs HMA, various management activities are ongoing in the area including, but not limited to, livestock grazing management, noxious weed treatments, road maintenance, and wildlife habitat improvement projects. Warm Springs HMA lies within the Dry Valley/Jack Mountain GRSG Priority Area of Conservation (PAC); is home to locally important big game species such as elk, mule deer, and pronghorn antelope; and encompasses two separate livestock grazing allotments with seven individual livestock grazing permits. Portions are also designated as the Foster Flat Research Natural Area (RNA) and South Narrows Area of Critical Environmental Concern (ACEC).

B. Purpose and Need for Proposed Action

The USGS and CSU proposed a study to assess the feasibility of using ovariectomy via colpotomy (spaying) to reduce the annual population growth rate of a wild horse herd. The study would allow for a more detailed quantification of morbidity[1] and mortality rates, and of behavioral outcomes on the range when spayed mares are living with other treated and untreated animals.

Currently, the estimated population within Warm Springs HMA exceeds the established AML of 111–202 horses and burros. By fall 2018 there will be an estimated 738 adult

[1] Morbidity is defined as the frequency of the appearance of complications following a surgical procedure or other treatment. In contrast, mortality is defined as an outcome of death due to the procedure.

horses plus burros, which is more than 500 animals over high AML. There is a need to protect rangeland resources from deterioration associated with animal populations which exceed AML. There is also a need to maintain the wild horse and burro population in balance with the four essential habitat components (forage, water, cover, and space), *especially water in this instance*, over the long term.

This action includes two primary purposes. The first purpose is to remove excess wild horses from within and outside the HMA, to manage wild horses in a way that would allow BLM to move toward achieving and maintaining the established AML over a 10-year timeframe, and to reduce the wild horse population growth rate in order to restore and maintain a thriving natural ecological balance and multiple-use relationship on the public lands consistent with the provisions of Section 1333(a) of the *Wild Free-Roaming Horses and Burros Act of 1971(as amended)* (WHB Act).

The second purpose is to determine the feasibility of using ovariectomy via colpotomy as a tool to maintain the wild horse population within Warm Springs HMA at AML, with spayed mares making up a portion of a self-sustaining herd, and maintaining free-roaming behavior. On a broader scale, the purpose of this research is to provide BLM with a more detailed quantification of surgical and behavioral effects than are available in previous descriptions of this method.

These purposes are consistent with the provisions of section 1333(b) of the WHB Act, the multiple-use mandate of the Federal Land Policy and Management Act (FLPMA) of 1976, and the Three Rivers RMP/ROD (1992) that established the AML for the HMA.

C. Decision to be Made

The BLM's authorized officer will determine if excess wild horses and burros exist in Warm Springs HMA. The officer will also decide whether or not to gather and remove excess horses; to proceed with the proposed spay feasibility and on-range behavioral outcomes assessment; and to implement the 10-year population management plan including future fertility control treatments.

The decision would affect wild horses and burros within (and those that have strayed outside) the Warm Springs HMA. The BLM's authorized officer's decision would not set or adjust AML nor would it adjust livestock use, as these were set through previous decisions.

This study represents a feasibility approach, and the results are not policy setting for BLM. Any future proposal by BLM to utilize the spay method analyzed in this EA would be subject to NEPA compliance.

D. Conformance with BLM Resource Management Plan(s)

The proposed action is in conformance with the objectives, rationale, and allocation and management actions from the Three Rivers RMP/ROD (1992) and the Oregon Greater Sage-Grouse Approved Resource Management Plan Amendment (GRSG ARMPA) (2015).

Landscape-level Goals, Objectives, and Management Decisions

<u>Oregon Greater Sage-Grouse Approved Resource Management Plan Amendment (GRSG ARMPA) (September 2015), WHB Objectives (p. 2-21)</u>

Objective WHB 1: Manage wild horses and burros as components of BLM-administered lands in a manner that preserves and maintains a thriving natural ecological balance in a multiple-use relationship.

Objective WHB 2: Manage wild horse and burro population levels within established appropriate management levels.

MD WHB 1: Manage HMAs in GRSG habitat within established AML ranges to achieve and maintain GRSG habitat objectives.

MD WHB 3: Prioritize gathers and population growth suppression techniques in HMAs in GRSG habitat, unless removals are necessary in other areas to address higher priority environmental issues, including herd health impacts.

MD WHB 8: When conducting NEPA analysis for wild horse/burro management activities, water developments, or other rangeland improvements for wild horses, address the direct and indirect effects on GRSG populations and habitat.

MD WHB 9: Coordinate with professionals from other Federal and State agencies, researchers at universities, and others to utilize and evaluate new management tools (e.g., population growth suppression, inventory techniques, and telemetry) for implementing the WHB program.

MD WHB 10: When WHB are a factor in not meeting GRSG habitat objectives or influence declining GRSG populations in priority habitat management areas (PHMA), Oregon's gather priority for consideration by the Washington Office (WO) is as follows:

1. Response to an emergency (e.g., fire, insect infestation, disease, or other events of unanticipated nature).
2. GRSG habitat.
3. Maintain a thriving natural ecological balance.

<u>Three Rivers RMP/ROD (1992) (p. 2-43)</u>

WHB 1: Maintain healthy populations of wild horses within the Kiger, Palomino Buttes, Stinkingwater, and Riddle Mountain HMAs, and wild horses and burros in the Warm Springs HMA.

> WHB 1.1: Continue to allocate the following acres and animal unit months (AUM) in active HMAs: … Warm Springs HMA, 456,855 ac., 2,424 AUMs. This is equivalent to an AML of 111–202 animals, including 15–24 burros (Proposed Three Rivers RMP, September 1991, Volume 1 – Text, p. 3-8).

WHB 1.3: Adjust wild horse and burro population levels in accordance with the results of monitoring studies and allotment evaluations, where such adjustments are needed in order to achieve and maintain objectives for a thriving natural ecological balance and multiple-use relationships in each herd area (HA). Permanent adjustments would not be lower than the established minimum numbers in order to maintain viability. The AML would be based on the analysis of trend in range condition, utilization, actual use and other factors which provide for the protection of the public range from deterioration.

WHB 1.3: Adjust wild horse and burro herd population levels in accordance with the results of monitoring studies and allotment evaluations, where such adjustments are needed in order to achieve and maintain objectives for a thriving natural ecological balance and multiple-use relationships in each herd area (HA).

Procedures to Implement:

1. Use currently approved methods for control of herd population levels.

WHB 2: Enhance the management and protection of HAs and herds in the following HMAs: Kiger, Stinkingwater, Riddle Mountain, Palomino Buttes, and Warm Springs.

WHB 2.3: Select for high quality horses when gathered horses are returned to the range.

WHB 2.4: Provide facilities and water sources necessary to ensure the integrity of the individual herds.

WHB 3: Enhance and perpetuate the special or rare and unique characteristics that distinguish the respective herds in the resource area (RA).

WHB 3.1: Limit any releases of wild horses or burros into an HMA to individuals which exhibit the characteristics designated for that HMA.

WHB 3.2: Manage burros for a maximum of 24 head in the west side of the Warm Springs HMA. The allocation of forage for burros is within the total allocation for the Warm Springs HMA.

E. Consistency with Laws, Regulations and Policies

The proposed action has been designed to conform to Federal regulations, consultation requirements, and other authorities that direct and provide the framework and official guidance for management of BLM lands within the Burns District:

1. *Wild Free-Roaming Horses and Burros Act* (WHB Act) of 1971 (Public Law (PL) 92-195), as amended. The proposed action is consistent with the WHB Act, specifically, but not limited to the following sections:

1332. Definitions

(b) "wild free-roaming horses and burros" means all unbranded and unclaimed horses and burros on public lands of the United States;

(f) "excess animals" means wild free-roaming horses or burros

(1) which have been removed from an area by the Secretary pursuant to application law or,

(2) which must be removed from an area in order to preserve and maintain a thriving natural ecological balance and multiple-use relationship in that area.

1333. Powers and duties of the Secretary. (b) Inventory and determinations; consultation; overpopulations; research study; submittal to Congress. (1) The Secretary shall maintain a current inventory of wild free-roaming horses and burros on given areas of the public lands. The purpose of such inventory shall be to: make determinations as to whether and where an overpopulation exists and whether action should be taken to remove excess animals; determine appropriate management levels of wild free-roaming horses and burros on these areas of the public lands; and determine whether appropriate management levels should be achieved by the removal or destruction of excess animals, or other options (such as sterilization, or natural controls on population levels). In making such determinations the Secretary shall consult with the United States Fish and Wildlife Service, wildlife agencies of the State or States wherein wild free-roaming horses and burros are located, such individuals independent of Federal and State government as have been recommended by the National Academy of Sciences, and such other individuals whom he determines have scientific expertise and special knowledge of wild horse and burro protection, wildlife management and animal husbandry as related to rangeland management.

(3) For the purpose of furthering knowledge of wild horse and burro population dynamics and their interrelationship with wildlife, forage and water resources, and assisting him in making his determination as to what constitutes excess animals, the Secretary shall contract for a research study of such animals with such individuals independent of Federal and State government as may be recommended by the National Academy of Sciences for having scientific expertise and special knowledge of wild horse and burro protection, wildlife management and animal husbandry as related to rangeland management.

2. *Wild Free-Roaming Horse and Burro Management* (43 CFR 4700).

4700.0-6(a) Wild horses and burros shall be managed as self-sustaining populations of healthy animals in balance with other uses and the productive capacity of their habitat.…(c) Management activities affecting wild horses and burros shall be undertaken with the goal of maintaining free-roaming behavior.

4710.4 Constraints on management: Management shall be at the minimum level necessary to attain the objectives identified in approved land use plans and herd management area plans.

4720.1 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….

4740.1(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.

3. *BLM Wild Horses and Burros Management Handbook*, H-4700-1 (June 2010).

2.1.3 Herd Management Areas; “LUPs [Land Use Plans] should also identify: The HMAs to be managed for non-reproducing wild horses to aid in controlling on the range population numbers and the criteria for their selection….Examples of criteria that could be used to select HMAs for management of non-reproducing wild horses include: no special or unique herd characteristics, low ecological condition, limited public land water, and reliance on private water.”

4.1.1 Self-Sustaining: [WHB] shall be managed as self-sustaining populations of healthy animals in balance with other uses and the productive capacity of their habitat. Self-sustaining is defined as the ability of reproducing herds of wild horses and burros to maintain themselves in a healthy condition and to produce healthy foals (H-4700-1).

4.1.2 Free-Roaming Behavior: In accordance with 43 CFR 4700.0-6(c), management activities affecting [WHB] shall be undertaken with the goal of maintaining free-roaming behavior. Free-roaming is defined as [WHB] that are able to move without restriction by fences or other barriers within a HMA (H-4700-1).

4.5.3 Reduce Population Growth Rates; “Additional management alternatives (tools) may be considered in the future, pending further research (see Chapter 8).”

4.5.4 Manage Selected HMAs for Non-Reproducing Wild Horses: “… some selected HMAs may be managed for non-reproducing wild horses to aid in controlling on the range population numbers.” Non-reproducing wild horses are defined as “An HMA composed, in whole or in part, of sterilized wild horses (either stallions or mares) to aid in controlling on the range population numbers” (H-4700-1).

4.5.4.1. LUPs *should* identify the HMAs to be managed for non-reproducing wild horses and the criteria for their selection. Completion of additional site-specific environmental analysis, issuance of a decision, and providing opportunity for administrative review under 43 CFR Part 4.21 *may* also be necessary.

8.1 Strategic Research Plan – “Research results will be used to improve management practices within the [WHB] program.”

8.3.2 Other Possible Fertility Control Tools – “Other possible fertility control tools that could potentially be considered in the future include: spaying mares….”

4. 8.3.2.1 Spaying (Mares) – “Spaying mares involves major abdominal surgery, is risky, and requires good post-operative care. Spaying mares could be considered in the future if safe, effective and humane surgical methods and post-operative care procedures can be perfected for use on wild horses.” *Proposal for Research Effort*: *Evaluating behavior, demography, and ecology of spayed (ovariectomized) free-roaming mares* (May 18, 2018) and Supplemental Mare Spay Proposal (June 2018), from USGS (Appendix C - USGS Research Proposal 2018).

5. *Animal Care and Use Protocols (ACUP) #18-7887A and #18-8013A,* approved by Colorado State University’s Institutional Animal Care and Use Committee (IACUC) (Appendix D).

6. *Rocky Mountains Cooperative Ecosystem Studies Unit Cooperative and Joint Venture Agreement* between the U.S. Department of the Interior, the U.S. Department of Agriculture, the U.S. Department of Defense, and the University of Montana – Missoula (HOST), 2014, and *Ecology of Wild Horses and Burros in the Rocky Mountain Region and Western USA*, Grant and Cooperative Agreement G14AC00138 (Appendix E).

7. *Colorado State University Laboratory Animal Resources Employee Handbook* (LAR 2014) (Appendix F).

8. Colorado State University, Veterinary Teaching Hospital Photography and Audio Visual Recording Policy (Policy ID #VTHADM16-2014) (Appendix G).

9. *Warm Springs Equine Herd Management Area Plan* (1979). This was the first management plan written following the signing of the WHB Act in 1971. It outlined the acreages and pasture of the HMA; the inventory records for burros, horses, and Shetlands; gathering records; vegetative and soil resource data; livestock and wildlife allocations; wild horse and burro populations and characteristics; range improvement projects; and established objectives:

- Remove all Shetlands, all crossbreeds involving horses, burros and Shetlands, and all branded animals from the herd area.
- Maintain a viable herd of 55 to 101 horses in the East Unit and a herd of 56 to 102 horses and 15 to 35 burros in the West Unit. (This is a management decision and may be modified after the Malheur Framework Plan is updated.)
- Provide adequate forage to meet the following (not all included):
  - Provide yearlong water sources so all species will have adequate and reliable water.

10. *Warm Springs Wild Horse Herd Management Area Plan* – Update (December 1987). This plan was written to update the 1979 HMA Plan following the Drewsey, Andrews, and Riley Management Framework Plan Amendment that resulted in a decision affecting management numbers of wild horses in seven herd areas. The plan updated management numbers (AML) and acreage for the HMA as well as set wild horse objectives.

- Maintain a viable herd of 111–202 wild horses. The east unit will be managed at 50–100 horses and the west unit at 61–102 horses. Burros are still found in the west unit but no management objectives nor plans have been identified.
- Provide adequate forage to meet the following:

Maximum herd of wild horses	2,424 AUMs
Adjudicated demand for livestock	19,392 AUMs
Wildlife forage demand	204 AUMs

11. *Warm Springs Herd Management Area Plan Update* (June 2010). This plan outlined the boundaries of the HMA, described other uses and resources within the boundaries, recommended an appropriate management level, and established wild horse and burro objectives. Some of the objectives set forth in this plan include, but are not limited to:

- Maintain the previously established AML range of 111–202 horses and burros (15–24 of the total) within the Warm Springs HMA boundary during a 4-year removal cycle.
- Maintain the relative frequency of occurrence of ground cover of key forage plant species (bluebunch wheatgrass, Thurber's needlegrass, and Idaho fescue) at key areas within known wild horse and burro concentration areas in the Warm Springs HMA over the next 10 years. Upland trend data at these key areas… shall provide the baseline data for determining the achievement of this objective.
- Maintain the healthy, free-roaming nature of wild horses and burros within the Warm Springs HMA emphasizing Appaloosa color phase, saddle type horses, 14 to 16 hands high and 950 to 1,300 pounds across all age classes.

12. *Livestock Grazing Allotment Objectives*. As compared to the Warm Springs HMA Plans that describe general habitat objectives and wild horse population characteristics, the allotment management plans (AMP) for West Warm Springs (1980) and East Warm Springs (1993) allotments establish more specific habitat objectives.
13. *Instruction Memorandum (IM) No. 2009-062*, Wild Horse and Burro Genetic Baseline Sampling.
14. *IM No. 2009-090*, Population-Level Fertility Control Field Trials: Herd Management Area Selection, Vaccine Application, Monitoring and Reporting Requirements.
15. *IM No. 2010-057*, Wild Horse and Burro Population Inventory and Estimation.
16. *IM No. 2013-058*, Wild Horse and Burro Gathers: Public and Media Management.
17. *IM No. 2013-060*, Wild Horse and Burro Gathers Management by Incident Command System.
18. *IM No. 2013-146*, Exception to Policy in BLM Handbook H-4700-1 and Manual 4720.41: Helicopter Gather of Wild Horses and Burros Between March 1 and June 30 Due to Emergency Conditions and Escalating Problems.
19. *IM No. 2014-132*, Guidance for the Sale of Wild Horses and Burros.
20. *IM No. 2015-070*, Animal Health, Maintenance, Evaluation and Response.
21. *IM No. 2015-151*, Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers.
22. *Burns District BLM IM-ORB-000-2018-004*, Oregon Wild Horse and Burro Corral Facility Access for Visitors.
23. *The Federal Land Policy and Management Act* (FLPMA) of 1976, as amended.
24. *National Environmental Policy Act* (NEPA) (42 U.S.C. 4321–4347, 1970).
25. *BLM NEPA Handbook*, H-1790-1 (January 2008), FLPMA (43 U.S.C. 1701, 1976), Section 302(b) of FLPMA states, "all public lands are to be managed so as to prevent unnecessary or undue degradation of the lands."
26. *Public Rangelands Improvement Act* (43 U.S.C. 1901, 1978).

27. *Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands Administered by the BLM in the States of Oregon and Washington* (1997).

28. *Vegetation Treatment Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Final Environmental Impact Statement* (FEIS) (2010) and ROD (2010).

29. *Integrated Invasive Plant Management for the Burns District Revised EA* (DOI-BLM-OR-B000-2011-0041-EA) Decision Record (2015).

30. *BLM Manual 6310*, Conducting Wilderness Characteristics Inventory on BLM Lands (March 2012), Section 201 of FLPMA requires that BLM maintain on a continuing basis an inventory of all public lands and their resources and other values, which includes wilderness characteristics. It also provides that the preparation and maintenance of the inventory shall not, of itself, change or prevent change of the management or use of public lands.

31. *BLM Manual 6320*, Considering Lands with Wilderness Characteristics in the BLM Land Use Planning Process. Section .04 Responsibilities, "C. District Managers and Field Managers shall: 1. Update and maintain the wilderness inventory for lands within the planning area consistent with BLM wilderness characteristics inventory guidance. 2. Ensure that wilderness characteristics inventories are considered and that, as warranted, lands with wilderness characteristics are protected in a manner consistent with this manual in BLM planning processes."

32. *Wilderness Act of 1964*, 16 U.S.C. 1131, et seq.

F. Scoping and Identification of Issues

On May 21, 2018, the BLM Burns District mailed a scoping letter to 127 interested individuals, groups, and agencies regarding the proposed spay feasibility and on-range behavioral outcomes assessment and the proposed population management plan for Warm Springs HMA. The scoping letter was also posted to BLM's ePlanning website. Letters mailed to the Burns District BLM and emails sent to blm_or_spaystudy_warmsprhma@blm.gov were received from 2,044 individuals, groups and agencies during the scoping period.

Permanent sterilization of wild mares, especially ovariectomy, and the possibility of BLM conducting this type of research is not a new topic. At least six years ago the National Wild Horse and Burro Advisory Board (Advisory Board) began discussing the possibility of mare sterilization during their meetings. These meetings are open to the public, with public comment periods provided. The agenda and minutes from these meetings are posted online[2] and are, therefore, available for public review. In October 2012, the Advisory Board recommended that, "BLM add ovariectomy as one additional tool for population growth suppression," and drafted a seven-page description of their interpretation of this specific recommendation (BLM 2012). The 2013 NRC Review of

[2] The minutes can be found at: https://www.blm.gov/programs/wild-horse-and-burro/get-involved/advisory-board.

the BLM Wild Horse and Burro Program evaluated ovariectomy of mares, and explained that ovariectomy via colpotomy was an alternative vaginal approach to ovariectomy, as it avoids an external incision and reduces the chances of complication and infection (NRC Review 2013). The NRC Review (2013) noted that this surgery is not without risk, but also noted that all fertility control measures have some effects on physiology or behavior.

In September 2013, the Advisory Board provided discussion and recommendations to BLM addressing the key findings in the NRC Review (2013). In response finding number seven, the Advisory Board recommended that "no options for reproductive control be eliminated from consideration due to the conflicting data on immune-contraceptives such as intrauterine devices (IUD), ovariectomy, and tubal ligation" (BLM 2013).

The issues identified in the letters and emails from the public during the public scoping period, along with issues identified during Burns District BLM interdisciplinary team (IDT) meetings and through contact with other agencies, are listed below. Comments and the following issues were used to guide the effects analysis in chapter III.

1. Issues for Analysis

Wild Horses and Burros

- *What would be the direct effects of gathering on wild horses and burros?*
- *What are the anticipated complications and rate of complications associated with the ovariectomy via colpotomy procedure (procedure)?*
- *If the mare is pregnant, would the procedure affect the development of the foal?*
- *Would the mare continue to have an estrous cycle following this procedure?*
- *What would be the anticipated long-term effects of the surgical procedure on mares?*
- *What are anticipated on-range effects following the release of spayed mares, including free-roaming behavior?*
- *How would the alternatives affect genetic diversity, health, and self-sustaining nature of Warm Springs HMA wild horses?*
- *What are the potential risks of radio collaring wild horses and how would BLM ensure the animals would not be injured?*
- *What are the effects of PZP on a mare and the herd?*
- *What are the effects of ovariectomy via colpotomy on the population of wild horses in the Warm Springs HMA?*
- *What are the effects of PZP on the population of wild horses in the Warm Springs HMA?*
- *How would the alternatives affect wild horse and burro habitat?*

Cultural Resources

- *What would be the effect of the wild horse and burro population management plan alternatives on cultural resources?*

Riparian Zones, Wetlands, and Water Quality

- *What would be the effects of the alternatives on water quality and riparian conditions within the HMA?*

Livestock Grazing Management

- *What would be the effects of the alternatives on livestock grazing management and associated ranch operations?*

Wildlife and Wildlife Habitat, Including Special Status Species

- *What would be the effects of the alternatives on GRSG habitat?*
- *What would be the effects of the alternatives on pygmy rabbit habitat?*
- *What would be the effects of the alternatives on large ungulate habitat in the HMA?*

Noxious Weeds

- *How would the 10-year population management plan affect the spread and introduction of noxious weeds?*

Economic Values

- *What are the anticipated costs associated with gathering wild horses and burros?*
- *What is the estimated cost per mare to conduct ovariectomy via colpotomy?*
- *What is the estimated cost per mare if PZP were used in the future?*
- *What are the anticipated costs associated with the study?*
- *What are the economic effects to other range users and local economy?*

Soils and Biological Crusts

- *What would be the effects of the alternatives on soils and biological crusts?*

Upland Vegetation

- *What would be the effects of the alternatives on upland vegetation health?*

Lands with Wilderness Characteristics

- *What would be the effects of the alternatives on lands with wilderness characteristics?*

2. Issues Considered but Eliminated from Detailed Analysis

Wild Horses

- *Sterilizing wild horse mares is an action that is contrary to the Wild Free-roaming Horse and Burro Act (1971).*
  This issue was eliminated from detailed analysis because the 1971 WHB Act specifically states that "The Secretary shall maintain a current inventory of wild free-roaming horses and burros…. The purpose of such inventory shall be to… determine whether appropriate management levels should be achieved by the removal or destruction of excess animals, or other options (such as sterilization, or natural controls on population levels)."
- *The availability and success of using PZP fertility control to manage wild horse populations is well documented in the scientific literature; why doesn't BLM just continue using PZP?*
  The use of PZP for fertility control is well documented; however, longer lasting formulations have not proven effective at population growth suppression on a majority of HMAs. Using the two-injection liquid PZP inoculation, BLM would need to gather the horses and treat the mares during the appropriate time period (late winter to early spring) then release those mares back to the HMA. For PZP to remain effective, mares would either need to be gathered or bait/water trapped every year and retreated with PZP, or mares would need to be located, identified, and successfully darted every year with a booster dose of liquid PZP. Locating, identifying, and successfully darting all individual mares during later winter or early spring annually is logistically infeasible across the vast expanse of most HMAs. When identifying the most promising fertility-control methods, the NRC Review (2013) concluded there are HMAs in which remote deliver (i.e., darting) is possible, but these seem to be exceptions where horses are easily approached and individually identifiable. Given the current fertility-control options, remote delivery (darting) appears not be a practical characteristic of an effective population management tool, but it could be useful in some scenarios (NRC Review 2013, p. 147). Access to animals for timely inoculation and other management constraints may affect the utility of PZP as a management tool for western feral horse populations (Ransom et al. 2011). Warm Springs HMA is a large HMA and mares there are not easily approachable. The BLM must explore the use of different methods and techniques for long-term population growth suppression, such as surgical sterilization, which could be applied to horses in HMAs with limited access and other constraints.
- *The Wild Free-Roaming Horse and Burro Act (1971) states that all management activities shall be at the minimal feasible level; is surgical sterilization the most [minimal] feasible level of management that would achieve population growth suppression?*
  The results of the study in this EA may provide BLM with more details on the safety and feasibility of this one-time population growth suppression

tool to curb wild horse population growth. Application of this method on the Warm Springs HMA would come at a time when on-range population levels are 3 times the appropriate management level. The BLM has only applied a population growth suppression tool that is effective for one year or less per vaccine injection. Gathering every mare on all rangelands managed by BLM (currently approximately 40,000+ mares) annually to apply a fertility control vaccine (a cost each year of over $2,000 per mare gathered, plus $30 per vaccine dose) could be considered less feasible than handling and permanently sterilizing a mare with a 15-minute surgical procedure, at a cost of $250–$300 plus the cost of being gathered only once. The most minimal feasible level of fertility control management may be the one-time surgery (spay) with no follow-up treatment required in the mare's lifetime as compared to multiple temporary treatments over her reproductive lifetime to apply an annual fertility control vaccine.

- *The BLM claims an overpopulation of wild horses on the range; however, it has no evidence of excess wild horses and burros because the BLM has failed to use scientifically sound methods to estimate the populations.* As discussed on page 2, the AML for Warm Springs HMA is 111 to 202 wild horses and burros (15–24 animals included in the total AML). Page 2 (above) also explains that a September 27, 2016, simultaneous double-observer aerial survey led to an estimated population size of 586 (513 adult horses and 73 foals) (Lubow 2016) with 19 adults burros and 8 foals also seen, though that survey was not intended or designed to be adequate for estimating burro population size. In addition to Warm Springs HMA having a wild horse and burro population well over the high end of AML, the total AML for public lands across the western USA is 26,715 wild horses and burros while the current estimated on-range population is 81,814 (as of March 1, 2018). In 2013, the NRC reviewed how BLM estimates population size and growth rates (NRC Review 2013, pp. 37–72). The NRC Review (2013) explains that although animals can be missed or double-counted during the same survey, a large body of scientific literature on techniques for inventorying large mammals has demonstrated that failure to detect animals is overwhelmingly more common. The NRC Review (2013) also explains that the animal counts (the total number of animals tallied in a given survey) derived from BLM's typical inventory procedures prior to 2013 did not reflect the true number of animals in an HMA but instead generally led to an estimate of population size that was far lower than the true number present. The raw counts themselves represent the minimum number of animals occupying the HMA (p. 39). The report goes on to state "it is the committee's judgment that the reported annual population statistics are probably substantial underestimates of the actual number of horses occupying the public lands inasmuch as most of the individual HMA population estimates are based on the assumption that all animals are detected and counted in population surveys – that is, perfect detection" (p. 55). The committee went on to explain (p. 66) their conclusions that there are substantially more horses on public rangelands than reported and that horse populations generally are experiencing high population growth rates which have important consequences for management. Since 2013, BLM has been using the statistically validated simultaneous double-observer method (Lubow and Ransom 2016) for collecting data, which allows for statistical analysis of observations and a better estimate of actual population size from survey data, as recommended in the NRC Review (2013).

II. DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

This section of the EA describes the no action alternative and the proposed action alternative. This section also identifies alternatives that were considered but eliminated from detailed analysis.

- Alternative A – No Action – No Spay Assessment, Gather and Removal
- Alternative B – Proposed Action – Spay Feasibility and On-Range Behavioral Outcomes Assessment and 10-year Population Management Plan.

The proposed action was developed, in response to the research proposal submitted by USGS and CSU, to respond to identified resource issues and the purpose and need for action. Alternative A, No Action, would not achieve the identified purpose and need, however it is analyzed in this EA to provide a basis for comparison with the action alternative and to assess the effects of not conducting research for a potential population management tool and not conducting population management on Warm Springs HMA. Alternative A, the no action alternative, does not conform to the WHB Act (1971) that requires BLM to immediately remove excess wild horses and burros.

A. Alternative A – No Action

The no action alternative would reject the spay feasibility and on-range behavioral outcomes assessment proposal. It would not be possible to conduct the research specified in the USGS-CSU financial assistance agreement. The BLM funding for this specific research project would be de-obligated.

Also under the no action alternative, a population management plan for the Warm Springs HMA would not be prepared. No gathers would occur and no additional management actions would be taken to regulate population size, sex ratio, or characteristics of the wild horses and burros at this time. Using a 20 percent population growth rate, within one normal gather cycle (5 years) wild horse numbers would increase from the fall 2018 estimate of 738 adults and 147 foals to approximately 1836 adult horses and 367 foals by fall 2023. By fall 2028, the end of the 10-year timeframe of this EA, the wild horse population could be as large as 4,569 adult horses plus 914 foals. Using an estimated 19 percent population growth rate, the burro population would increase from the fall 2018 estimate of 49 adults to 279 adults plus foals by fall 2028.

Wild horses and burros ranging outside the HMA boundaries would remain in areas not designated for their management, including private lands.

Although the no action alternative does not propose any gathers during the 10-year timeframe, there could be incidents where emergency gathers and removals are required. Emergencies generally are unexpected events that threaten the health and welfare of a WHB population and/or their habitat and immediate action is normally required (e.g. fire, insect infestation, disease, or other events of a catastrophic and unanticipated nature) (BLM, H-4700-1, 2010). In the event of an emergency gather, the effects to horses and burros from gathering, transport, and adoption/sales preparation would be equivalent to those described in Chapter III – Wild Horses and Burros section, Proposed Action.

B. Alternative B – Proposed Action

In order to clearly define the phases involved in this project, the proposed action is described in two separate sections:

1. Spay Feasibility and On-Range Behavioral Outcomes Assessment (2018–2022) and,
2. 10-year Population Management Plan (2018–2028).

Implementation of the proposed action would begin in the fall of 2018. Only horses would be involved in the research study. Burro population management is incorporated in the 10-year population management plan. This population management plan describes proposed actions to manage wild horse and burros within AML and existing HMA objectives.

Common to all portions of the proposed action; low stress handling techniques, as described in the BLM's Comprehensive Animal Welfare Program (Appendix G - IM 2015-151) or updated policy, would be utilized to ensure the safety of the animals and minimize stress to the extent possible during the gather, transport, processing, treatments, collaring, and return of animals to the range. In addition to BLM's IM 2012-151, animal handling would follow CSU's IACUC approved animal care and use protocol and USGS's approved animal care and use protocol for testing of radio telemetry collars and radio tags on free-roaming wild horses and burros (FORT-IACUC 2015-10) (Appendix B - USGS Research Proposal 2018).

1. Spay Feasibility and On-Range Behavioral Outcomes Assessment

All aspects of this study would be overseen by an experienced team made up of a professor of equine surgery specializing in minimally invasive surgery and wound healing; a veterinarian experienced in performing ovariectomy via colpotomy on feral mares; an animal welfare specialist experienced in pain management; an ecologist specializing in ungulate population dynamics; and a research scientist specializing in mammalian behavior and ecology.

The Warm Springs HMA was chosen for this study because of the way the HMA is divided into two large pastures with one main fence down the middle and there are comparable topographical, vegetative, and watering features on either side. This study design was chosen to prevent the need to gather twice (a similar USGS/CSU study on the effect of gelding a portion of stallions in an on-range herd required a first gather to collar/mark horses, then conducted behavioral observations for one year prior to a second gather to treat horses then return them to the range for behavioral observations post treatment) (BLM Utah 2016). For this proposed study, one side of the HMA would be the Control segment (no treated (spayed) mares) and the other would be the Treatment segment (treated mares present). There would be 100 horses on the control side and 100 horses on treatment side (200 horses involved in this project total). The terrain consists of rolling hills and valleys, which is acceptable for radio telemetry tracking. For the duration of the study, the gates in the fence line separating the two herd segments would remain closed. Once the study is complete, the gates would remain open along this fence line when livestock are not present.

The first portion of the proposed action would be to gather by helicopter up to 100 percent of the total wild horse population and remove excess horses down to 200, which is the sample size needed for the study. If this gather takes place in the fall of 2018 as proposed, approximately 738 adult horses plus 147 foals could be gathered. A high percentage of the herd would be gathered in order to select horses to return to the HMA by their location on the HMA prior to the gather, their physical characteristics, age, and sex. All horses, along with any burros captured, would be transported to the Oregon Wild Horse Corrals Facility in Hines. All animals would be freeze marked and aged. Only those horses not selected for the study would be dewormed, vaccinated, and prepped for the adoption program.

The horses gathered from either side of the HMA and selected for the study would be kept separate throughout the gather process and while at the Oregon Corral Facility so they can be returned to their original home ranges on the HMA in order to discourage movement from one side to the other during the study.

The BLM would select a candidate pool of horses that can be returned to the range, then researchers would randomly select horses for the study based on age (to include all age classes), sex (50:50 sex ratio), and treatment status (spayed or control). No horses would be selected that have cryptorchidism, inguinal hernia, club feet, or any other congenital or heritable defects, as per BLM policy. All horses returned to the range for this study would receive an individual freeze mark on their neck with a unique BLM identifier using the International Alpha Angle System. In addition to the neck freeze mark, all animals would receive a freeze mark on their left hip with the last four numbers of their BLM identifier. This would aid in identification during the field observations portion of the study.

The BLM acknowledges that not all animals would be collected during the gather. This would not limit the validity of the study design for two reasons. First, researchers would be focusing on the marked subset of the population. Second, researchers would be able to document any unmarked horses in the population once field crews are on the ground monitoring the population.

Both the “spay” (ovariectomy) procedure and the behavior observations portions of this study were presented to CSU’s Institutional Animal Care and Use Committee (IACUC) in an Animal Care and Use Protocol. This IACUC, which is made up of a panel of veterinarians and ethics officials, approved the protocol and it is presented here and attached as Appendix D, Approved Animal Care and Use Protocols IACUC ID:18-7887A and IACUC ID:18-8013A, and the USGS approved Animal Care and Use Protocol FORT-IACUC 2015-10 (in Appendix C, USGS Research Proposal 2018). CSU requires all research to exactly follow the methods approved in the protocol.

a. Specific Aims of the Study

- Determine the approximate stage of gestation of the mares presented for surgery. Because a majority of mares are pregnant when gathered after July 1 of any year, it would be important to understand how gestational stage affects the surgical procedure and how the surgical procedure affects maintenance of pregnancy.
- Determine the feasibility of performing ovariectomies via colpotomy in free-roaming wild horses.
- Evaluate the immediate and short-term effects of the surgical procedure on free-roaming wild mares.
- Measure rates of social and reproductive behavior and group cohesion in free-roaming male and female wild horses evaluating individuals within and between treatment and control HMA segments and comparing their behavior.
- Record body condition and mortality of females and their foals in both treatment and control herd segments, to determine if these factors are affected by spay treatment.
- Test for an effect of spay treatment on spatial ecology of free-roaming horses by monitoring the Global Positioning System (GPS) locations of individuals (22 treatment-herd females, 22 control-herd females, and 12 stallions from each herd segment) within treatment and control herd segments of the population throughout the year.
- Measure demographic characteristics in both treated and untreated herd segments by monitoring foaling rates and natural mortality and by conducting aerial surveys once or twice annually to test for treatment effects on herd segment annual growth rates.

b. Ovariectomy via Colpotomy Procedure

Approximately 28–34 mares would receive ovariectomy treatment and, after recovery (approximately 7 days), would be returned to the HMA for the behavioral and spatial ecology portion of the study. In addition to the mares that would return to the HMA, approximately 70 more mares would receive ovariectomy treatment in order to improve the quantification of the complication rate of the surgical procedure (see Supplement to Mare Spay Study Proposal in Appendix B – USGS Research Proposal, 2018). These mares in the second group of spayed animals would be observed and evaluated for any complications from the treatment, but would not be returned to the HMA. They would receive veterinary care if needed. These additional mares would remain at the Oregon Wild Horse Corral Facility and enter the adoption program.

Mares receiving treatment would be adult females, 3 years of age and older. Taking into account both the mares that would be returned to the range and those that would not, in total approximately 100 mares could receive ovariectomy treatment. Those would include mares 3 years of age and older, and spread evenly across three gestational stages: open (not pregnant), <120 days, and 120–250 days. This would allow adequate quantification of the complication rate of the surgical procedure as it relates to the gestational stages treated. The overall sample size of about 100 is needed to provide adequate statistical power to estimate the complication rate with reliable accuracy and precision. The sample size would allow for the ability to obtain accurate estimates of the complication rate typical for the procedure in each of three gestational stages, without being unduly influenced by one or two unusual outcomes. It would also allow for the ability to obtain precise estimates of overall mortality rate (or morbidity rate), with a 95 percent confidence interval between 0 and 10 percent if the estimated overall rate is 3 percent or lower.

While in the squeeze chute, mares that would be candidates for being returned to the range would have rectal palpation and/or trans-rectal ultrasound performed to determine if the mare is pregnant and to stage the pregnancy if indicated. Mares from the treatment group that are open (not pregnant), early-term (<120 days), or mid-term (120–250 days) would be considered candidates for surgery. Sixty to seventy-five percent of adult mares (≥3 years old) from the treatment herd segment would be spayed. This means that about 30 mares would be treated and returned to the range, depending on the age structure of the herd, leaving about 8 unsterilized adult mares plus juveniles and foals untreated in the treatment segment. The study blocks mares and pairs treated and control mares by age, body condition, and pregnancy status. Mares with (Henneke et al. 1983) body condition scores of ≤3 or any mares in their third trimester of pregnancy (>250 days), as determined by palpation and ultrasound, would not be spayed. Otherwise females would be randomly selected within blocks for treatment. Both treatment and control mares would undergo the same handling through the chute and determination of gestational stage, but only treatment mares would undergo the surgery.

Treatments would be conducted around November to maximize the sample size of mares in their first and second trimesters of pregnancy.

Individuals selected for inclusion in the ovariectomy procedure would be held without feed for 24–36 hours prior to surgery to minimize the risks associated with distended intestines near the surgical region. Water will not be withheld.

The patient would be restrained in a fully-padded chute which allows for access to the horse's neck for injections and to the tail and perineal area to allow for performance of the surgery. Each mare would be intravenously administered a mixture of detomidine hydrochloride (10–20 ug/kg; 5–10 mg), butorphanol tartrate (0.02–0.04 mg/kg; 5–15 mg), and Xylazine hydrochloride (0.2–0.5 mg/kg; 100–300 mg) to sedate and provide analgesia (to minimize discomfort) for surgery (exact dosages may be adjusted as determined by the veterinarian). If further sedation is required the mare would be administered further detomidine, Xylazine, or 100 mg of ketamine hydrochloride. Anti-inflammatory/analgesic (pain) treatment would include flunixin meglumine (Banamine) at 1.1 mg/kg (10 ml of 50 mg/ml). Tetanus toxoid would be given to any unvaccinated individuals. Each mare would also be administered a long-duration antibiotic (Excede – ceftiofur crystalline free acid, Zoetis, Florham Park, New Jersey). Excede is effective for 4 days.

Following sedation, a rectal examination would be performed to evacuate the rectum and double check pregnancy status and gestational stage. The tail would be wrapped and tied straight up. A padded bumper would be placed above the rump of the mare to keep her from jumping up. While the surgical field may not be entirely sterile, all reasonable steps would be taken to ensure that it is disinfected. The perineal region would be cleansed and the vagina would be aseptically prepared for surgery using povidone iodine solution prior to insertion of the surgeon's sterile gloved arm into the vaginal vault. The surgical procedure would involve making an incision, approximately 1–3 centimeters long, in the anterior-dorsal-lateral vagina. Both ovaries are accessed through this one incision. The incision would be enlarged with blunt dissection to perforate the peritoneum and allow the surgeon's hand to enter the abdomen. This method separates rather than transects the muscle fibers so the incision decreases in length when the tissues contract after the tranquilization wanes post-surgery. The ovary and associated mesovarium are isolated by direct manual palpation and local anesthesia (5 ml 5% bupivacaine and 5 ml 2% lidocaine) is injected into each ovarian pedicle. This combination was selected to provide rapid onset (lidocaine) and extended duration (bupivacaine) of effect, reducing pain associated with removal of the ovaries. The surgeon would add epinephrine to the lidocaine/bupivacaine anesthesia of the ovarian pedicle to constrict blood vessels. This may reduce the risk of hemorrhage at the surgical site, and by reducing blood flow at the site of injection the local anesthesia should stay longer at the surgical site. The rate would be 1 ml/100ml of the anesthetic mixture (epinephrine for injection 1:1000). The ovarian pedicle would be transected with a chain ecraseur, seen in the hands of the veterinarian in Figure II-1. If the internal structure of a mare appears or feels abnormal, the surgery would not be completed, and the mare would not be included in the study. Removing such contraindicated mares would prevent complications to the mares and ensure the procedure is only conducted on a uniform group of structurally correct mares. Instruments would be cleaned and soaked in Chlorhexidine between procedures. Duration of surgery for each individual would be recorded, but is expected to take approximately 15 minutes.

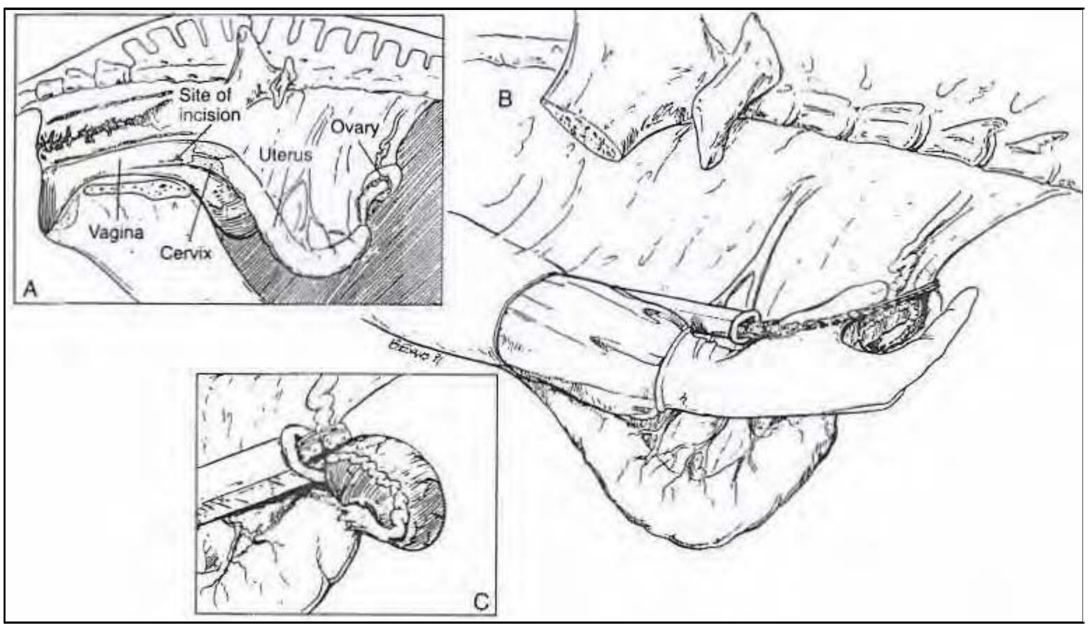

Figure II-1: (A) The site for the vaginal incision is located ventrolateral and caudal to the cervix. (B) The chain loop of the ecraseur is positioned over the hand so that the ovary can be grasped and drawn inside the loop. (C) After ensuring that only the ovarian pedicle is within the loop, the pedicle is slowly crushed and transected. (From Kobluk et al. 1995).

Horses that have received surgery would be turned into an approximately half-acre pen for recovery from sedation. Mares may be held in this pen with other mares that are in the initial hours of post-surgery recovery. Being held with other mares while recovering from sedation would reduce the signs of stress commonly observed when wild horses are held in isolation. Mares would be monitored for any signs of discomfort and for the beginning of fecal production. As soon as mares have become fully alert they can be moved back into a larger pen with other mares and dependent foals. They will remain in this pen until they are returned to the range or made available for adoption.

Mares would be assessed from a distance three times a day for a week by the veterinarians involved in the study. It is expected that any complications would present within the first several days. Indicators to be measured would be: attitude, respiratory rate, fecal production (if possible), signs of abdominal distress (colic), ambulation, and appetite. Any horses that show signs of abdominal distress, lack of appetite, or rapid respiratory rate would be more closely evaluated and further analgesia (Flunixin meglumine 1.1 mg/kg IV) may be given, at the veterinarian's discretion. No postoperative antibiotics would be given.

If within the first 24 hours after surgery animals are refusing food and not moving they would be checked by a veterinarian and given analgesia (Flunixin meglumine 1.1 mg/kg IV or similar) as necessary. The attending veterinarian or BLM staff would decide if euthanasia is necessary and, if so, would follow BLM IM 2015-070, Animal Health, Maintenance, Evaluation and Response, or updated policy. Once released to the range no further veterinary interventions would be possible.

Two to four weeks post-surgery, the 70 mares treated but not returned to the range would be monitored by ultrasound to evaluate pregnancy status. This data would aid in quantification of pregnancy loss related to performing this procedure on mares in early to mid-gestational stages.

c. Post-surgery Welfare Observations

To allow time for the effects of anesthetics, analgesics, and stress-induced analgesia to subside (Wagner 2010), behavioral observations for the post-surgery pain and welfare study would begin the morning after surgery. Studies of expressions of pain in horses have recommended that time budget data be collected to complement pain scoring data (Price et al. 2003, Pader et al. 2011). Thus, every day for 7 days after the surgery, behavioral observation sessions would be conducted of one hour in the morning and afternoon, and would include recording a score from a composite measure pain scale 3 times a day. The sample size for these behavioral observations would be 20 treated mares and 20 control mares. These would be randomly selected, but matched by age class, whether the mare is fitted with a collar, and presence of foal at foot.

Every 10 minutes during the one hour observation periods, the basic state of each individual (i.e., feeding, standing, moving) and distance to the nearest horse in horse lengths would be recorded. All-occurrence sampling would be used to record social interactions (including nursing and blocking nursing), vocalizations, lying down, and drinking. Additionally, incidences of rolling, kicking/stamping, licking/chewing, yawning, the flehmen response, moving head to flank, and stretching would be recorded, as these can be associated with signs of discomfort in horses (Pritchett et al. 2003). The composite measure pain scale to be used (Table II-1) is modified (removing a category only relevant to domestic horses) from the Equine Pain Scale developed by Gleerup and Lindegaard (2016), which was based on findings from a review of studies on recognition and quantification of pain in horses.

Table II-1. Composite Equine Pain Scale, derived from Gleerup and Lindegaard (2016). Each behavior category would be given a score, and the total would be recorded.

	Score				
Behavior category	**0**	**1**	**2**	**3**	**4**
Pain face	No pain face		Pain face present[1]	Intense pain face[1]	
Gross pain behavior	None		Occasional[2]		Continuous[2]
Weight bearing	Normal posture and weight bearing	Foot intermittently off the ground/occasional weight shift	Pinched (groove between abdominal muscles visible)	Continuously taking foot off the ground and trying to replace it	No weight bearing. Abnormal weight distribution
Head Position	Foraging or high	Level of withers	Below withers		
Attention towards the painful area	Does not pay attention to painful area		Brief attention to painful area (e.g. flank watching)		Biting, nudging, or looking at painful area
Response to food	Takes food with no hesitation	Looks at food		No response to food	

[1] As described by Gleerup and Lindgard (2015); [2] As described by Bussières et al. (2008).

d. Opportunity for Public Observation

Public observation during helicopter gather operations would be provided for in accordance with WO IM 2013-058, Wild Horse and Burro Gathers: Public and Media Management, or updated policy.

Public viewing of the surgery would be permitted and managed by BLM. According to the Cooperative Ecosystem Studies Unit (CESU) contract with CSU (Appendix D - Rocky Mountain CESU 2014), Federal agencies are required to follow regulations and policies established by the Host University (CSU) including, in this case, pertaining to veterinary surgical facilities and procedures. As specified in the CSU Laboratory Animal Resources (LAR) Employee Handbook (Appendix F - LAR 2014) and at the discretion of the lab advisor, no cell phones, cameras, photography, audio recording, or video-recording devices of any kind are allowed inside the area where animals are to be treated (in this case that is the working barn portion of the Oregon Wild Horse Corral Facility, where the surgical facility will be located). This legally binding contract requires both Federal agencies (USGS and BLM) to defer to University regulations, rules, and policies regarding professional conduct, health, safety, use of services and facilities, use of animals, recombinant Deoxyribonucleic acid (DNA), infectious agents or radioactive substances, as well as other policies generally applied to Host University and partner institution personnel (Article II, A. 7; Appendix E). As a result, any members of the public that are present within the working barn must leave cell phones and any photography or audio and visual (A/V) recording devices outside the facility, and are expected to be quiet, calm, and respectful of animals and surgery personnel in conformance with CSU Veterinary Teaching Hospital's Photography and A/V Recording Policy (#VTHADM16-2014) (Appendix G).

For those interested in observing the surgeries, see Appendix I - Public Observation Protocol, Spay Feasibility and On-Range Behavioral Outcomes Assessment Project.

In addition, all visitors to the Oregon Wild Horse Corral Facility must follow the instructions outlined in Burns District IM ORB-000-2018-004, Oregon's Wild Horse and Burro Corral Facility Access for Visitors (Appendix J).

e. Radio Collaring/Tagging

GPS collars/tags and very high frequency (VHF) tags would be used to record the spatial ecology of horses and locate animals to record behaviors, births, deaths, body conditions, and group composition.

At the Oregon Corral Facility, a sample of up to 84 horses would be fit with GPS radio collars or GPS/VHF radio tags (FORT-Institutional Animal Care and Use Committee Approval 2015-10, in USGS Research Proposal 2018 (Appendix B)). GPS radio collars would be placed on up to 30 females per herd segment (up to 60 total), and up to 20 stallions per herd segment (up to 40 total) would be fitted with tail tags (GPS or VHF).

Females ≥3 years old would receive radio collars while stallions would be tracked with radio tags braided into their manes and tails and secured to the hair with cable ties and a low temperature curing epoxy resin. Females receiving collars would have a Henneke body condition score of 4 or greater (i.e. "moderately thin" and fatter; Henneke et al. 1983), and stratified by adult age class (3–5, 6–10, 11–15, >16 years old). This is considered a normal level of body condition for horses that are at athletic fitness or living in wild conditions. Animals that are "thin" (Henneke score of ≤3), deformed, or who have any apparent neck problems would not be fitted with a collar. As tags are small (<70g) and are not worn around the neck, they are considered insignificant or minimal burden to the animal and, therefore, could potentially be worn by animals in lower body condition. However, such animals would likely not be selected by BLM as candidates for return to the range. The forty stallions (20 per segment) to be fitted with tail tags would be selected randomly but stratified by age.

Only biologists experienced with fitting radio collars and tags on wild horses would be permitted to place them on animals. Researchers would be following an unpublished protocol titled *The Use of Radio Collars on Wild Horse Mares and Burro Jennies* (in Appendix B - USGS Research Proposal 2018) for the placement of collars.

To monitor horse welfare effects after they are returned to the range, all animals wearing a collar would be visually observed at least once a month during winter (October to March), and twice a month during spring/summer (April to September). This welfare monitoring is to assure collars remain in proper positioning on the animals' necks and do not cause any unforeseen problems for mares. In addition to having a drop-off mechanism with a release date scheduled to coincide with the end of the study (about October 2021), each radio collar would be equipped with a remotely-triggerable emergency release mechanism in case the collar needs to be removed. If this mechanism fails and the collar must be removed, the horse would be captured for collar removal via helicopter drive trapping, bait or water trapping, or darting, depending on the best option for the specific situation.

f. Herd Genetics

While horses are at the BLM facility, hair follicles would be collected from all individuals that would be returned to the range. Also, fecal samples from new foals (and from any individuals that were not captured during the gather) would be collected throughout the study. DNA from these samples would be analyzed to form a pedigree of both herd segments, enabling researchers to assess paternity of foals born during the study and to understand kinship between mares. Should ovariectomy lead to lower group fidelity of mares these genetic data would allow researchers to test whether or not mares move with more closely related individuals, and whether or not having spayed individuals within the population influences foal paternity by non-harem stallions. It would also allow for quantification of the “sneak” mating rate of non-harem holding stallions, and determine age of first reproduction for mares. These parameters could be used in future modelling of population growth.

g. On-Range Behavioral Observations

The control and treatment herd segments (100 each) would be returned to their respective sides of the HMA as soon as possible following the 7-day post-surgery welfare monitoring.

On-range behavioral observations would be conducted during the breeding season (March to September) each year, beginning the March after animals are returned to the range. This allows time for social groups to re-establish over the winter after gather and release are completed. Individual horses would be referred to by the last four digits of their unique BLM numeric identifier or collar/tag frequency (not named). Behavioral observations would be conducted on focal[3] animals and their social groups, using focal animals to determine groups observed rather than selecting focal groups, as horses are likely to change groups during the study. In the treatment segment there would be 8 treatment and 8 control focal collared mares, and in the control segment there would be 16 control collared mares. There would be 4 focal tagged stallions in each segment. As average band size is often approximately 4 adults (Linklater 2000), the outcome is that although the number of focal animals would be relatively small, data would be gathered on a larger number of individuals overall, including a greater number of males than the focal individuals as they are generally associated with females. Focal females would be distributed across adult age classes, and focal males would include stallions that are bachelors and harem stallions at the start of behavioral observations (i.e. March). Focal animals would determine which bands are observed, but otherwise behavior of all animals within a social group would be recorded. It is possible that more than one focal animal may be in a social group; this would not lead to pseudo-replication, but instead would result in more data gathered per individual in that group. If a focal animal changes groups then all members of the new group would be recorded. The same focal individuals would be followed throughout the

[3] A focal animal is one that is randomly selected (but blocked by age class, and treatment status or stallion status where applicable) to be a 'target' for behavioral observations. Behavioral observations would be conducted on this animal and whoever else it is with, or just on that animal if it is alone. Having a focal animal is a way to ensure behavioral data is representative of the population, without a bias towards groups or individuals that are simply close to camp or easy to find. By also recording behavior of the social associates of that animal at the time of the behavioral observation, the researchers get behavioral data on a larger number of individuals than just the focal animal.

study, so that researchers would be able to compare treated animals with un-treated controls in the same population. Observers would remain blind to treatment and control animals to the extent possible.

Due to the logistics of travel around the HMA, groups would be stratified in to regional areas for observations, with focal animals then selected for observation at random, within a region. This would ensure that all focal animals are observed evenly but randomly. Horses spend over 50 percent of their time feeding and 20 percent of their time resting (Duncan 1980), with social interactions being rare. Therefore many hours of observation are required to provide enough data for meaningful statistical analyses. With a crew of four field technicians, the aim is to gather 1600 to 1800 hours of observations per field season, which would be sufficient for statistical analyses. Examining 20 horses and their social associates represents coverage of the majority of the horses within each segment of the HMA. Sample sizes are comparable to other equid studies; up to 19 radio collars were used to examine the ecology of wild equids (Kaczensky et al. 2011), although not all simultaneously, with most studies only having collars on 4 to 10 individuals (Goodloe et al. 2000, Fischhoff et al. 2007, Girard et al. 2013, Owen-Smith and Goodall 2014). While some equid studies have conducted population-wide observations, such as those at the Pryor Mountains, Wyoming (Roelle et al. 2010) and the Granite Range, Nevada (Berger 1986), the number of focal animals proposed is comparable to most fine behavior studies (ranging from Bourjade et al. (2009) n=9, to Krueger et al. (2014) n=55).

Every 10 minutes during a 1-hour observation session the basic state of each individual (e.g., feeding, standing, moving, lying down) within a social group and the identity of their nearest neighbor would be recorded. These data would allow researchers to test whether treatment affects time budget and associations between individuals. All-occurrence sampling (Altmann 1974) would be used to record individuals involved in incidents of social behaviors such as agonistic behavior (e.g., bites, kicks) and affiliative behavior (e.g., mutual grooming, touch), and reproductive behavior (e.g., estrus behavior, mating and mating attempts, and scent marking behavior), as well as other behaviors such as nursing and vocalizations; detailed data would be taken at each event. These data would allow researchers to test whether spaying affects social behavior of treated mares and the animals they associate with.

h. Population Level Effects

Aerial surveys for population estimation would take place in both herd segments before the initial gather, and then once or twice annually for the remainder of the study. Population estimation would follow set BLM guidelines for counting wild horses (BLM IM 2010-057, or update) using published population estimation techniques, primarily simultaneous double observer surveys with sightability covariates (Lubow and Ransom 2016, Schoenecker and Lubow 2016). Foaling rates in both herd segments would be determined by visually observing mares wearing collars approximately twice a month between March and September. Foal survival would be determined by monitoring these same animals monthly during the rest of the year.

i. Schedule

Year 1 (Sep 2018–Sep 2019)

(1) Fall 2018 conduct a gather of Warm Springs HMA. Keep herd segments separate. Flip coin to randomly select herd segment for treatment. Identify over 200 horses, allowing for release of up to 200 (with release of up to 100 into each of 2 herd segments) and remove remaining animals for adoption program.
(2) Assess age and pregnancy status of all females that are potentially to be returned to the range. Place radio tags on 40 adult males and radio collars on 22 females in treatment herd segment, and the same number in control herd segment. Collect tail hair follicle samples from every individual (200 total) for genetic analysis.
(3) Conduct ovariectomy surgery in 60–75 percent of adult females from the treatment herd segment. Conduct ovariectomy surgery on additional 70 mares that would not be returned to the range.
(4) Conduct behavioral observations to document mare welfare and surgery recovery.
(5) Return animals to the HMA and initiate field study. Begin testing radio collars, locating radioed individuals 1–2x/month to check collars or tags, body condition, and presence of foals. Throughout winter 2018/2019, assess body condition and record social associations of radio-marked horses.
(6) Conduct data analyses and write-up results for effects of surgery study.
(7) Winter 2018/2019, fly aerial surveys in both treatment and control segments of the HMA.
(8) March to September 2019, collect data on social behavior, reproductive behavior, and band membership and fidelity using radio collars/tags to locate focal individuals for observation.

Year 2 (Oct 2019–Sep 2020)

(1) Winter 2019/2020, fly aerial surveys in both treatment and control segments of the HMA.
(2) Continue the field study; locate radio-collared individuals 1–2x/month to check collars, body condition, survival, and record presence of foals.

(3) March to September 2020, collect data on social behavior, reproductive behavior, and band membership and fidelity using radio marks to locate focal individuals for observation.

Year 3 (Oct 2020–Sep 2021)

(1) Winter 2020/2021, fly aerial surveys in both treatment and control segments of the HMA.
(2) Continue the field study; locate radio-collared individuals 1–2x/month to check collars, body condition, survival, and record presence of foals.
(3) March to September 2021, collect data on social behavior, reproductive behavior, and band membership and fidelity using radio marks to locate focal individuals for observation.
(4) Upon completion of the field observation portion of the study (i.e., October), BLM will open the gates in the fence that separates the two segments of the HMA.

Year 4 (Oct 2021–Aug 2022)

(1) Conduct data analyses and publish papers.

j. Statistical Methods

A description of the statistical methods used to analyze each portion of this study is described in Appendix B - USGS Research Proposal, 2018.

2. 10-Year Population Management Plan

Following the completion of the research study and during the remainder of the 10-year timeframe of this plan, BLM would conduct additional helicopter gathers of wild horses each time the high end of AML is exceeded. Smaller wild horse bait/water/horseback drive trapping gathers would occur as needed between normal helicopter-drive gather cycles as a tool to remove excess animals in areas where concentrations are detrimental to habitat conditions or other resources within the HMA, to remove animals from private lands or public lands outside the HMA boundary, to selectively remove a portion of excess horses for placement into the adoption program, or to capture, treat, and release horses for application of fertility treatment. Burros would be gathered via bait/water/horseback drive trapping. Gathers would be conducted following future population surveys and a determination that "excess" animals exist within the HMA. All other project design features would be the same irrespective of the number of animals gathered and removed. The first gather to low AML (111 horses and burros) following the completion of the study would be scheduled for 2022. The number of horses and burros gathered and excess removed would be adjusted based upon the estimated herd size and the number of excess animals determined at the time of the gather.

In the absence of an initial gather for the study or consecutive years, the proposed action includes gathering to low AML regardless of population size. For example, if the first gather happened in 2028, up to 5,300 horses and burros could be removed (see description of the no action alternative in chapter II). All other project design features related to gathers would be the same irrespective of the number of animals gathered and removed.

In order to maintain a reduced population growth rate following the study and during the 10-year timeframe, adaptive management would be incorporated to use the most promising methods of fertility control that maintain a self-sustaining herd within AML, and that maintain the free-roaming behavior of the animals. After the gather to low AML following the completion of the study, potential population growth suppression actions that would be applied include spaying additional mares (assuming results of the research confirm previously published work that demonstrated that spaying is a feasible management tool) or PZP (if the results of the research indicate that spaying is *not* a feasible management tool for this HMA).

Many factors play into determining the number of horses that would be required to gather to reach low AML and to treat (with any treatment type) depending on, but not limited to, climatic conditions leading up to the gather, gather efficiency, condition of animals at time of gather, and age structure of animals captured. This is why ranges for animals treated during the remainder of the 10-year timeframe following the study are provided below.

After the 2022 gather to re-establish low AML and if spaying were the management tool chosen for this HMA, up to 25–37 mares ages 2-5 years and older would be spayed and returned to the range (if there is a 100 percent capture rate during the gather). After this treatment, it is anticipated that AML would be exceeded in 2028 and require one additional gather in order to maintain AML. By treating and returning this range of mares at each gather, only 0–76 horses are anticipated to be removed from the range between 2022 and 2028 in order to maintain AML. (See Chapter III, Wild Horses and Burros section discussion on WinEquus Population Modelling). If after the study PZP is the management tool chosen for this HMA, up to 37 mares would be treated and returned to the range in 2022 (if there is a 100 percent capture rate during the gather). It is anticipated that with this treatment regime AML would be exceeded in 2027, and a gather would be required to maintain AML. By following this treatment regimen after both gathers, approximately 110 animals would be removed from the range between 2022 and 2027. (See Chapter III, Wild Horses and Burros section discussion on WinEquus Population Modelling). PZP treatment would follow BLM's protocol in IM 2009-090 (Appendix K), or updated policy.

No fertility control treatments are proposed for burros. Unless immediate removal is required (e.g. private land, public safety, emergency situation), a notice to the public would be sent out 30 days prior to any future gather.

Following the completion of the on-range study, BLM would assess whether analysis in this EA adequately supports future population growth suppression actions (spay or PZP treatment) outlined in this plan, or if BLM needs to prepare new or supplemental analysis. This assessment would also be made for any new fertility control method which may become available during the 10-year time frame of this plan.

In addition to AML helicopter gathers, smaller bait/water, horseback-drive, or helicopter-drive trapping operations would be conducted as needed between normal helicopter-drive gather cycles. These trapping methods would be used as tools to remove excess animals in areas where concentrations are detrimental to habitat conditions or other resources within the HMA, to remove animals from private lands or public lands outside the HMA boundary, to selectively remove a portion of excess horses for placement into the adoption program, or to capture, treat, and release horses for application of fertility treatment. Bait/water, horseback-drive, and helicopter-drive trapping operations could take anywhere from one week to several months depending on the amount of animals to trap, weather conditions, or other considerations. Operations would be conducted either by contract or by BLM personnel. Refer to table II-2 for a summary of the proposed methods of capture of wild horses and burros for removal, relocation, and/or application of fertility treatment.

Table II-2: Proposed Action Methods for Capturing Horses and Burros for Removal, Relocation, and/or Application of Fertility Treatment.

Method	Reason	When
Helicopter Gather (AML Gather)	To remove excess horses and burros to maintain AML.	Fall 2018 and following the research study once population exceeds AML.
Helicopter-drive Trapping	To remove or relocate horses and burros when concentrations are causing detriment to habitat conditions or other resources within the HMA	As needed between Helicopter Gather Cycles (AML Gathers).
Bait/Water Trapping	To selectively remove a portion of excess horses and burros for placement in the adoption program.	
Horseback-drive Trapping	To capture, treat, and release horses for application of fertility treatment.	

Site-specific removal criteria were never set for Warm Springs HMA therefore animals removed from the HMA during helicopter/AML gathers would be chosen based on a selective removal strategy set forth in BLM Manual Section 4720.33, or updated policy. Currently there is no removal criterion set for burros, however

BLM Manual Section 4720.33 states, "When gathers are conducted, emphasis will be placed on the removal of younger, more adoptable animals."

BLM Manual Section 4720.33 further specifies some animals that should be removed irrespective of their age class. These animals include, but are not limited to, nuisance animals and animals residing outside the HMA or in an area of an inactive HA.

Following a helicopter/AML gather, captured wild horses would be released back into the HMA under the following criteria:

- Released horses would be selected to maintain a diverse age structure, at the low AML level, and with a 50/50 sex ratio.
- Horses to be released would be selected to maintain a height of 14 to 16 hands and a weight of 950 to 1,300 pounds. Any color would be selected to return but with an emphasis on Appaloosa.
- Horses selected to return to the HMA may be returned directly from the short-term holding facility constructed during the gather operation. However, it is likely most horses would be transported to the Oregon Wild Horse Corral Facility in Hines for processing (aging, freeze-marking, worming, vaccinating) and/or application of fertility treatment.
- Spay treatments would follow the protocol outlined in this analysis or updated policy, if chosen as a management tool following the study.
- If there is a need to utilize PZP for fertility control, it would be administered following IM No. 2009-090, Population-Level Fertility Control Field Trails: Herd Management Area Selection, Vaccine Application, Monitoring and Reporting Requirements (Appendix K) or updated policy. This would be done at the Oregon Wild Horse Corral Facility as it is a two dose treatment with a two week period in between the primer and booster. If mares would be treated only with the liquid form of PZP vaccine, they would receive the first liquid dose within several days of arriving at the facility. They would be held on hay and water for at least 2 weeks until given the second liquid PZP injection. Following the second dose, mares would be returned to the HMA. If mares would be treated with the PZP-22 vaccine pellet treatment, they would receive a liquid primer dose at the same time as also receiving a dose of the time-release pellets. If these mares are captured in subsequent gathers, they would receive a booster dose of liquid, native PZP or of PZP-22 vaccine pellets and be immediately returned to the range, unless population and characteristics objectives could not be achieved without removal of a previously treated mare.

a. Project Design Features

(1) Implementation of management actions would begin in fall of 2018 and would continue over the next 10 years unless environmental conditions change enough to require analysis of additional management actions.
(2) The BLM would plan each gather as soon as holding space and funding became available and BLM's Washington D.C. Office provides authorization.
(3) All gathers would be initiated following public notice on the BLM Press Releases webpage, or its future equivalent webpage.
(4) No horses found outside of the HMA would be returned to the range.
(5) Depending on the number of animals that must be captured, helicopter/AML gather operations would take approximately 7–14 days to complete. Several factors such as animal populations, animal condition, herd health, weather conditions, or other considerations could result in adjustments in the schedule.
(6) Helicopter gather operations would be scheduled any time from July 1 through February 28 in any year. Bait trapping operations may be scheduled at any time during the year.
(7) Trap sites would be approximately 0.5 acre in size.
(8) Trap sites would be selected in areas where horses are located to the greatest extent possible.
(9) Trap sites and temporary holding facilities would be located in previously used sites or other disturbed areas whenever possible. These areas would be seeded with a seed mix appropriate to the specific site if bare soil exceeds more than 10 square yards per location. The seed applied would be a mix of native and desirable non-native species.
(10) Undisturbed areas identified as trap sites or holding facilities would be inventoried, prior to being used, for cultural and botanical resources. If cultural or botanical resources were encountered, these locations would not be utilized unless they could be modified to avoid detrimental effects to the resources.
(11) Trap sites and temporary holding facilitates would be surveyed for noxious weeds prior to gather activities. Any weeds found would be treated using the most appropriate methods. All gather activity sites would be monitored for at least 2 years post-gather. Any weeds found would be treated using the most appropriate methods, as outlined in the decision record for the Integrated Invasive Plant

Management for the Burns District Revised EA (DOI-BLM-OR-B000-2011-0041-EA) (July 2015).

(12) All vehicles and equipment used during gather operations would be cleaned before and following implementation to guard against spreading noxious weeds.

(13) Efforts would be made to keep trap and holding locations away from areas with noxious weed infestations.

(14) Gather sites would be noted and reported to range and weed personnel for monitoring and/or treatment of new and existing infestations.

(15) Maintenance may be conducted along roads accessing trap sites and holding facilities prior to the start of gather operations to ensure safe passage for vehicles hauling equipment and animals to and from these sites. Any gravel required for road maintenance is to be certified weed-free gravel and obtained by purchase (if from a private mineral material source). Road maintenance would be done in accordance with Appendix I of the Three Rivers RMP, Best Management Practices, and BLM Manual 9113, Roads, and would be in compliance with the Oregon GRSG ARMPA (2015). Maintenance may be conducted along any existing road within the Warm Springs HMA or accessing the Warm Springs wild horses or burros outside the HMA (Appendix A, Warm Springs HMA Vicinity Map).

(16) Gather and trapping operations would be conducted in compliance with the Oregon GRSG ARMPA (2015); specifically:
   - MD SSS-11: No helicopter trapping would occur between March 1 and June 30. Bait trapping and/or moving horses between pastures via helicopter could occur during this time period but would be in compliance with lek hourly restrictions.
   - MD SSS-13: All authorized actions in GRSG habitat would be in compliance with the required design features (RDF) and best management practices (BMP) outlined in appendix C of the GRSG ARMPA (2015).

(17) Gather and trapping operations would be conducted in accordance with the standard operating procedures (SOP) described in the Comprehensive Animal Welfare Program (CAWP) for Wild Horse and Burro Gathers (IM No. 2015-151) which defines standards, training, and monitoring for conducting safe, efficient, and successful wild horse and burro gather operations while ensuring humane care and treatment of all animals gathered (Appendix H). In addition, all personnel involved in handling animals at the

Oregon Corral Facility would have previously completed the BLM's CAWP training.

(18) An Animal and Plant Health Inspection Service (APHIS) veterinarian would be onsite during helicopter gathers, as needed, to examine animals and make recommendations to BLM for care and treatment of the wild horses and burros.

(19) Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy (Appendix L, IM 2015-070).

(20) On all horses gathered (removed and returned), data including sex and age distribution would be recorded. Additional information such as color, condition class information (Henneke et al. 1983), size, disposition of the animal, and other information may also be recorded.

(21) Excess animals would be transported to the Oregon Wild Horse Corral Facility via truck and trailer where they would be prepared (freeze marked, vaccinated, and dewormed) for adoption.

(22) Hair samples would be collected to assess genetic variability of the herd, as outlined in WO IM 2009-062, Wild Horse and Burro Genetic Baseline Sampling, or updated policy. Hair samples would be collected from a minimum of 25 percent of the post-gather population. Gathering allows BLM to collect DNA samples, closely monitor the genetic variability of the herd, and make appropriate changes (i.e. translocation from other HMAs) when testing deems them necessary.

(23) Public and media management during gather operations would be conducted in accordance with WO IM 2013-058 (Wild Horse and Burro Gathers: Public and Media Management), or updated policy. This IM establishes BLM policy and procedures for safe and transparent visitation by the public and media at wild horse and burro gather operations, while ensuring the humane treatment of wild horses and burros.

(24) Emergency gathers: BLM Manual 4720.22 defines an emergency situation as an unexpected event that threatens the health and welfare of a wild horse or burro population, its habitat, wildlife habitat, or rangeland resources and health. Emergency gathers may be necessary during this 10-year timeframe for reasons including disease, fire, insect infestation, or other events of catastrophic nature and/or unanticipated natural events that affect forage and water availability for wild horses and burros. Emergency gather operations would follow the project design features described in this section and BLM IM 2009-085, Managing

Gathers Resulting from Escalating Problems and Emergency Situations, or updated policy.

(25) Trapping activities would be scheduled in coordination with the rangeland management specialist to avoid conflict with authorized grazing rotations.

b. Monitoring

(1) The BLM contracting officer's representative (COR) and project inspectors (PI) assigned to the gather would be responsible for ensuring contract personnel abide by the contract specifications in the Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers (Appendix G, IM No. 2015-151).

(2) Ongoing monitoring of forage condition and utilization, water availability, and animal health, as well as aerial population surveys, would continue on the Warm Springs HMA. Aerial inventories are conducted every 2 to 3 years for each HMA on Burns District. Population estimates for Warm Springs HMA would be updated as inventories are conducted in the future.

(3) Genetic monitoring (as outlined in IM 2009-062 or updated policy) would also continue following gathers and/or trapping. If genetic monitoring indicates a loss of genetic diversity, the BLM would consider introduction of horses from HMAs in similar environments to maintain the projected genetic diversity.

(4) Fertility control monitoring would be conducted in accordance with the population-level fertility control treatment SOPs in IM 2009-090, Population Level Fertility Control Field Trials: Herd Management Area Selection, Vaccine Application, Monitoring and Reporting Requirements (Appendix J), or updated policy.

C. Alternatives Considered but Eliminated from Further Analysis

1. Closure of HMA to Livestock Use

This alternative was not brought forward for detailed analysis because such an action would not be in conformance with the multiple-use mandate of the FLPMA (1976) and the existing LUP, Three Rivers RMP/ROD/Rangeland Program Summary (RPS) (1992), which authorizes AUMs for wild horses and burros and for livestock grazing in the allotments within the Warm Springs HMA (Appendix 9, pp. Appendices 116–118). Livestock grazing is identified as a major use of the public land and is to be conducted in a manner which will meet multiple-use and sustained yield objectives (Three Rivers RMP/ROD 1992, p. 2-33). Livestock grazing management is designed to achieve standards for rangeland health and conform to guidelines for livestock grazing management (S&G). For both West and East Warm Springs Allotments, indicators for rangeland health and riparian monitoring data through 2015 indicate standards for rangeland health are either not present, achieved, or if not achieved, livestock are not a causal factor. The closure of the HMA to livestock grazing without maintaining wild horse and burro populations within AML would be inconsistent with the WHB Act (1971) which directs the Secretary to immediately remove excess animals. Livestock grazing is reduced or eliminated following the process outlined in the regulations found at 43 CFR Part 4100. This alternative would not achieve the purpose and need.

2. Complete Removal of Wild Horse and Burros from the HMA

Complete removal of wild horses and burros from Warm Springs HMA was eliminated from detailed analysis because it would not be in conformance with the WHB Act (1971) nor the multiple-use mandate of FLPMA (1976); this alternative would therefore not achieve the purpose and need of this document. The Three Rivers RMP/ROD (1992) specifically authorizes AUMs and reestablished AML for wild horse and burro use in Warm Springs HMA on page 2-43. This LUP provides a management objective to "Maintain healthy populations of wild horses within the Kiger, Palomino Buttes, Stinkingwater, and Riddle Mountain Herd Management Areas, and wild horses and burros in Warm Springs HMA" (p. 2-43). That LUP does not include management direction to eliminate AML for wild horse and burros. Elimination of wild horses and burros and closure of HMAs can only be conducted during the land use planning process or within an RMP revision or amendment; this project is neither.

3. Spaying via Flank Laparoscopy

This alternative proposes using flank laparoscopy as the method for ovariectomizing (spaying) mares instead of ovariectomy via colpotomy. Flank laparoscopy is now commonly used in domestic mares due to its minimal invasiveness and full observation of the operative field (Lee and Hendrickson 2008). Although ovariectomy via flank laparoscopy was seen as the lowest risk method in terms of mortality and morbidity (Bowen 2015), it is a method that would not appear to be logistically applicable for wild horses brought to most BLM facilities. Flank laparoscopy requires a far longer surgical duration than ovariectomy via colpotomy and requires that the patient remain standing still for the duration of the surgery, which may be over 45 minutes (Bowen 2015). During that time, the horse must be maintained in an anesthetic plane that prevents it from sudden movements. If the mare is not still during surgery, there is a risk that the instruments placed inside the body cavity may damage internal organs, or that the instruments may become malfunctional. The long duration and requirement that mares stand peacefully reduce the likelihood that this surgical method would be feasible for most wild horses. While ovariectomy via colpotomy has been proven to be applicable and effective in another herd of federally managed feral horses (Collins and Kasbohm 2016), no studies document the use of ovariectomy via flank laparoscopy in recently caught wild mares.

This surgical approach entails three small incisions on the animal's flank, through which three cannulae (tubes) allow entry of narrow devices to the body cavity: these are the insufflator, endoscope, and surgical instrument. The surgical procedure involves the use of narrow instruments introduced into the abdomen via cannulas for the purpose of transecting the ovarian pedicle, but the insufflation should allow the veterinarian to navigate inside the abdomen without damaging other internal organs. The insufflator blows air into the cavity to increase the operating space between organs, and the endoscope provides a video feed to visualize the operation of the surgical instrument. This procedure can require a relatively long duration of surgery, but tends to lead to the lowest post-operative rates of complications. Flank laparoscopy may leave three small (<5 cm) visible scars on one side of the horse's flank, but even in performance horses these scars are considered minimal. Because of the three external wounds, mares recovering from surgery are typically confined alone in small pens after surgery for several days. Few BLM facilities could accommodate this level of post-surgical care for any more than a handful of animals. Rolling on the ground is not conducive to wound healing. If the patient does not roll and remove bandages to expose the wound, it is expected that the tissues and musculature under the skin at the site of the incisions in the flank will heal quickly, leaving no long-lasting effects on horse health.

The above discussions indicate to BLM that spaying via flank laparoscopy is both technically and economically infeasible for application on wild horse mares due to the higher risk of infection at external incision sites, the time required to perform each surgery, and the accommodations necessary for adequate post-surgical care.

4. Sterilization via Tubal Ligation or Laser Ablation of the Oviduct Papilla

The BLM is aware of only one published study that tested tubal ligation in domestic mares (McCue et al. 2000), and no studies of laser ablation in mares. The safety and effectiveness of these procedures is largely unknown for domestic or wild horses. In 2016, BLM considered conducting research at the Oregon Wild Horse and Burro Corral Facility that would have included novel studies of mare sterilization via tubal ligation and via laser ablation of the oviduct papilla (BLM 2016). The EA that analyzed that research made clear that the purpose and need of that study was to "…conduct research on three methods of permanent mare sterilization…." Tubal ligation and laser ablation were promising in principle, but had not been tested. Neither method has been proven elsewhere to be effective in wild or feral mares. Partners withdrew from the BLM-funded study that would have examined the safety and efficacy of those procedures and the study did not take place. Because this study did not take place and the techniques have not been tested on wild horse mares, they are remote or speculative. In contrast, ovariectomy via colpotomy is a well-established veterinary method that has been in practice for over a century, including in feral mares (Collins and Kasbohm 2016).

5. Intensive Fertility Control Using PZP Vaccine via Remote Darting

This alternative would encompass a 10-year timeframe with an initial helicopter gather to bring the population down to the low end of AML. Mares returned to the HMA to re-establish low AML would be treated with a liquid primer dose of PZP vaccine (or other available and effective fertility control vaccine) followed by a liquid PZP booster vaccination or PZP-22 vaccine pellets two weeks later. Treated mares would be age 2 and older as outlined in IM 2009-090. In order to maintain a reduced population growth rate on the range, annual remote darting of these treated wild horse mares would be required. The on-range program would be designed to treat mares ages 2 through 4 and ages 11 through 20. Following the initial primer and booster doses at the time of the gather, all mares ages 5–10 would not be retreated on the range until age 11. The intent of such an alternative would be to reduce the population growth rate each year with annual PZP application, thereby eliminating or reducing the need to remove horses through future bait or helicopter gathers.

A majority of the horses in Warm Springs HMA are not approachable by humans within 0.5 mile of them for identification and darting of the fertility control vaccine. The size of the HMA (nearly 500,000 acres) and the limited access during late winter or early spring for annual darting make this alternative technically infeasible for this HMA. As a result, administering annual PZP treatments to mares from the Warm Springs HMA would require first capturing them with either helicopter drive trapping or bait-water trapping. When identifying the most promising fertility-control methods, the NRC Review (2013) concluded there are HMAs in which remote delivery (i.e. darting) is possible, but these seem to be exceptions. Access to animals for timely inoculation and other management constraints may affect the utility of PZP as a management tool for western feral horse populations (Ransom et al. 2011). Given the currently available fertility-control options, remote delivery appears not to be a practical characteristic of an effective population management tool, but it could be useful in some scenarios (NRC Review 2013). In addition, annual gathering of the entire herd is economically infeasible due to the associated gather costs. (Refer to the Economic Values section of this EA for costs of gathering wild horses.)

Longer lasting formulations of PZP have not proven effective at population growth suppression on a majority of HMAs where they have been applied (see analysis of PZP literature, in Chapter III – Wild Horse and Burro section, below). The BLM must explore the use of other methods and techniques for long-term population growth suppression not currently in widespread use, such as surgical sterilization of females, which could ultimately be applied to horses in HMAs with limited access and other constraints. Intensive fertility control using PZP to remotely dart horses would be ineffective and technically infeasible for population control in this HMA and would not respond to the purpose and need for action described above.

6. Bait and Water Trapping Only

An alternative considered but eliminated from detailed analysis was the use of bait and/or water trapping as the primary or sole gathering method. The use of only bait and water trapping, although effective in other HMAs with varying circumstances, would not be cost-effective or practical as the primary gather method for this HMA. However, water or bait trapping may be used as a supplementary approach to help achieve the desired goals of the proposed action following the research study, if a helicopter gather cannot be scheduled. Water and bait trapping is an effective tool for specific management purposes such as removing groups of horses from an accessible concentration area. The use of only bait and water trapping was dismissed from detailed analysis because much of this HMA has limited road access capable of handling pickups and livestock trailers. The lack of adequate road access would make it technically infeasible to construct traps and safely transport captured wild horses and burros form these areas of the HMA. Also, the logistics of bait or water trapping 800+ horses over approximately 500,000 acres of land in a relatively short amount of time render that option infeasible.

7. Manage the Warm Springs HMA Wild Horse and Burro Population by Natural Predation

Cougars are the only large predator in the area that may prey on wild horses or burros, mainly foals. The estimated maximum cougar population in the Southeast Oregon Zone F is 985 (including all age classes) with an estimated 2015 population of 946 (ODFW 2017a). Even with high and growing cougar populations across Oregon and in the Southeast Oregon Cougar Management Zone F, there is no evidence to suggest cougars have an effect on wild horse recruitment in this area. Canadian biologists (Knopff et al. 2010) confirmed that wild horses were killed by cougars but all kills were of animals less than 2 years of age, "Although our seasonal result is novel, that cougar predation on large ungulate species tends to focus on animals <1 year old has been well-documented (Hornocker 1970, Turner et al. 1992, Ross and Jalkotzy 1996, Murphy 1998, Husseman et al. 2003)." They also found 0.5 percent of an adult female's diet made up of feral horse in the summer. Thirteen percent of adult males' summer diet was feral horse while 10 percent of their winter diet was feral horse. Subadult cougars did not prey on feral horses. There was no discussion on how this amount of predation would affect wild horse population growth. The NRC Review (2013) confirms foals are usually the prey of cougars and goes on to explain population size is not affected as much by foal survival as it is by adult survival (Eberhardt et al. 1982); foal survival is strongly affected by other variables (such as weather). The BLM does not make decisions on predator management but can make recommendations to Oregon Department of Fish and Wildlife (ODFW). Changes to predator management are inconsistent with BLM's basic policy objectives.

III. AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

A. Introduction

This chapter details the affected environment which is the baseline resource data displaying current conditions of each identified resource with an issue (i.e., the physical, biological, and resources) that could be potentially affected by any of the alternatives discussed in chapter II. For example, in the affected environment section for wild horses and burros in this EA, the wild horse and burro population in the area of the potential effect is currently estimated as 943 animals, including foals. Without this baseline data there can be no effective comparison of alternatives. The intent of this chapter is to give enough information for the reader to compare the present with the predicted future condition resulting from enactment of the project activities (environmental effects discussed next), and for the decision maker to make an informed decision.

This chapter also details the environmental effects section, which is the analytic basis for comparing the potential effects of enacting each of the alternatives detailed in chapter II. Direct effects are caused by the action and occur at the same time and place. Indirect effects are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. For example in the environmental consequences discussion for riparian zones in this EA, it is stated that, "The proposed action would reduce and maintain the wild horse and burro population to within AML therefore reducing and minimizing their potential effect on riparian zones and wetlands. Maintaining populations within AML in this water limited HMA aids in limiting the pressure placed on riparian exclosure fences. Currently Thorns Springs remains unfenced and may maintain or improve in condition with maintenance of wild horse and burro numbers within AML."

Cumulative effects are those impacts resulting from the incremental impact of an action when added to other past, present, or reasonably foreseeable future actions (RFFA), regardless of what agency or person undertakes such other actions. RFFAs include those Federal and non-federal activities not yet undertaken, but sufficiently likely to occur, that a responsible official of ordinary prudence would take such activities into account in reaching a decision. These Federal and non-federal activities that must be taken into account in the analysis of cumulative impact include, but are not limited to, activities for which there are existing decisions, funding, or proposals identified by the Bureau. RFFAs do not include those actions that are highly speculative or indefinite. RFFAs for this project are continued livestock grazing, weed treatments, road maintenance, recreation and hunting activities, range improvement/maintenance projects, and treatments associated with the rehabilitation of wildfires, such as the Miller Homestead Emergency Stabilization and Rehabilitation (ESR) (DOI-BLM-OR-B060-2012-0047-EA) and the

Coyote Fire ESR (DOI-BLM-ORWA-B050-2018-004-CX). These RFFAs are discussed under each resource, as applicable.

B. Identified Resource with Issue

Issues are analyzed when—

- Analysis is necessary for making a reasoned choice from among the alternatives (e.g., is there a measurable difference between the alternatives with respect to the issue?);
- The issue identifies a potentially significant environmental effect; or,
- Public interest or a law/regulation dictates that effects should be displayed.

Through internal and external scoping the BLM Burns District IDT has reviewed and identified issues affected by the alternatives.

1. Wild Horses and Burros

The following issues are addressed in this section.

- *What would be the direct effects of gathering on wild horses and burros?*
- *What are the anticipated complications and rate of complications associated with the ovariectomy via colpotomy procedure (procedure)?*
- *If the mare is pregnant, would the procedure affect the development of the foal?*
- *Would the mare continue to have an estrous cycle following this procedure?*
- *What would be the anticipated long-term effects of the surgical procedure on mares?*
- *What are anticipated on-range effects following the release of spayed mares, including free-roaming behavior?*
- *How would the alternatives affect genetic diversity, health, and the self-sustaining nature of Warm Springs HMA wild horses?*
- *What are the potential risks of radio collaring wild horses and how would BLM ensure the animals would not be injured?*
- *What are the effects of PZP on a mare and the herd?*
- *What are the effects of ovariectomy via colpotomy on the population of wild horses in the Warm Springs HMA?*
- *What are the effects of PZP on the population of wild horses in the Warm Springs HMA?*
- *How would the alternatives affect wild horse and burro habitat?*

a. Affected Environment – Wild Horses and Burros

Habitat for wild horses and burros is comprised of four essential components: forage, water, cover, and space. These components must be present within the HMA in sufficient amounts to sustain healthy wild horse populations and healthy rangelands over the long term (H-4700-1 2010, chapter 3). Escalating problems are defined as conditions that deteriorate over time (H-4700-1 2010, 4.7.7). The key indicator of an escalating problem is a decline in the amount of forage or water available for wild horse use, which results in negative impacts to animal condition and rangeland health, causing horses to seek resources outside the HMA boundaries. Causal factors are normally drought or animal numbers in excess of AML (H-4700-1 2010, 4.7.1). In this HMA, water is the main limiting resource.

In 1979, the first Warm Springs Equine Herd Management Area Plan was written to "protect, manage, control, and maintain a viable population of wild horses [and burros] on the Warm Springs Herd Management Area on a continuing basis in coordination with forage, soil, watershed, wildlife and recreation resource values." The plan outlines the area the HMA encompassed as a total of 468,360 acres of public, state, and private lands. It also discusses the construction of the east-west division fence in fall 1977, existing inventory records, history and influence of horse type on the horses living in the HMA, gather records, resource data, and grazing capacity. The plan provided detail on the horse and burro type and color present in the area. "Horses are of domestic saddle horse variety. Due to present and past presence of Shetlands in the area, crossbreeding has occurred and these vary in size. Draft horse bloodlines are also apparent within the herd. Color varies greatly within the horse herd, from palominos, buckskins, bays, appaloosa, sorrels and browns. Crossbreeding between Shetlands and the other horse type have resulted in paints within the herd. The burros are all of the grey and dark brown color" (pp. 10–11). The plan recommended an objective to maintain a viable herd of 111 to 202 horses and 15 to 35 burros (p. 15).

The Drewsey, Andrews and Riley Management Framework Plan (MFP) Amendment (1987) resulted in an LUP decision that affirmed the AML in Warm Springs HMA at 111 to 202. Following this LUP amendment, an update to the Warm Springs HMA Plan occurred in December 1987. This plan establishes an objective to "Maintain a viable herd of 111 to 201 wild horses…. Burros are still found in the west unit but no management objectives nor plans have been identified."

Finally, the Three Rivers RMP/ROD (1992) reaffirmed the AML for Warm Springs HMA at a total AML of 111 to 202 animals. A management action (p. 2-45) called to "Manage burros for a maximum of 24 head in the west side of the Warm Springs HMA. The allocation of forage for burros is within the total allocation for the Warm Springs HMA."

The most common wild horse and burro management actions that have occurred in Warm Springs HMA are gathers, which are to be done when the herd surpasses the maximum established AML number and when monitoring data (census, utilization, use supervision, etc.) indicate that a thriving natural ecological balance would be disrupted. Depending on reproductive rates, results of rangeland monitoring data, funding and off-range holding space, horses and burros within the HMA have typically been gathered with removals to low AML on a four to five year cycle. The Warm Springs wild horse population has been gathered 14 times since 1978, most recently in 2010 (see appendix O). A majority of the horses gathered in 2010 exhibited saddle horse conformation with color phases including many appaloosa, roans, appy-roans, buckskins, duns, bays, sorrels, blacks, and four pintos. A majority also were gathered in fair to excellent body condition (body condition score 4–8, Henneke 1983), with only a few older horses in lower body condition.

Burros are typically captured via bait/water or horseback drive trapping. Burro trapping operations have been sporadic over the years due to the irregular nature of their population growth. Very low population growth was observed in this burro herd for many years, so in 1998 BLM translocated four burros (two males and two females) from a California herd to boost genetic variability. Since these introductions, field observations by BLM and range users indicate a notable population increase, despite the difficulty in collecting accurate population data (burro aerial surveys would require transect line spacing that is far closer than that of horse aerial surveys, and burros can be difficult to see during surveys). The most recent trapping of burros occurred in 2014 and 2015 on two separate private land parcels, one inside the HMA and another outside. A total of 11 burros were removed during those bait trap gathers.

Figure III-1: Examples of conformation and variety of color found in Warm Springs HMA.

From 1978 to present, 18 inventories of the HMA have been completed. Data from these inventories and wild horse gathers have helped define the needs of current and future horse population management. The most recent September 2016 inventory was conducted using the simultaneous double-observer method (Lubow 2016) recommended by BLM policy (BLM 2010, IM 2010-057) and discussed in a recent NRC review (2013, p. 42–43). During this survey, 497 adult horses and 47 foals were observed. Sightability bias correction was then applied to the raw counts. This analysis estimated the sighting probabilities for horses with the raw counts corrected for systematic biases (undercounts) that are known to occur in aerial surveys (Lubow and Ransom 2016). These results included confidence intervals (which are measures of uncertainty) associated with the estimated population sizes. This analysis (Appendix M, Statistical analysis for horse survey - 2016 Warm Springs HMA and Stinkingwater HMA, Oregon, Lubow 2016) provided an estimated population size of 513 adult horses and 73 foals at the time of the survey. Of the total number observed during the September 2016 survey, only 9 adult horses were outside the HMA boundaries (Appendix N, September 2016 Warm Springs HMA Survey Map).

Using the raw count data (Appendix O, Inventory, Gather and Release History since 1972) from the 2010 gather where the population was re-established at 105 adult horses, the 2014 inventory of 253 adult horses and the 2016 inventory of 497 adult horses, calculations of "apparent annual population growth rate" indicate a rate of nearly 35 to 40 percent. Such high rates are much higher than the overall wild horse average of 20 percent and are possible, but not probable. Horses were gathered in fair to excellent body conditions (BCS 4-8 = moderately thin to fat) in 2010. These horses have ample feed year-round and tend to reduce their home range size during the hot season so as not to overexert and travel long distances for water, and there are very few natural predators in the area; thus allowing for a higher than average population growth rate. The NRC review (2013) recognized that adequate studies conducted on the population growth rate of free-ranging horses on western rangelands have "clearly demonstrated that growth rates approaching 20 percent or even higher are realized in many horse populations" (p. 65). The most likely explanation for the high apparent annual population growth rate is that the raw counts of horses seen during the 2010 and 2014 surveys represented a lower fraction of the true total numbers of animals present than the same fraction in 2016. Variable rates of observer bias (fraction of animals not seen) are specifically the problems that the simultaneous double-observer survey method is designed to overcome, because the observed data can be analyzed in a way to estimate the fraction of animals not seen by any observer. Reliable estimates of actual annual growth rates will be possible to estimate when a greater number of simultaneous double-observer surveys have been conducted and analyzed.

The gestation period for a burro is approximately 12 months (Asdell 1964, Douglas and Hurst 1993), which allows for one foal per year in years with adequate precipitation. Studies cited in Douglas and Hurst (1993) indicate high levels of pregnancy in burros >2 years of age as well as a high adult survival rate. Like wild horses, feral burros are not known to be preyed upon by predators, with the possible exception of mountain lions. This combination of foaling rate, survivability, and lack of predators provides for a rapid rate of increase in burro populations. Annual rates of increase for feral burro populations in North America range from 1.2–29 percent (Douglas and Hurst 1993, White 1980, Morgart 1978), with a global average of 19 percent (Ransom et al. 2016). Consistent and accurate surveys have not taken place on burros in this HMA, making it difficult to estimate a population growth rate specific to this herd.

Genetic analysis of the Warm Springs wild horse herd was completed by E. Gus Cothran from Texas A&M University using blood samples collected from 56 horses during the 2001 gather and using hair samples collected from 83 horses during the 2010 gather. Genetic analysis was not conducted or required to have been conducted for the 2006 gather. Table

III-1 is a summary of the two genetic reports within the Warm Springs HMA associated with the 2001 and 2010 gathers. As described in BLM Manual H-4700-1, WHB Management Handbook, Section 4.4.6.2 Interpreting Genetics Data, the observed heterozygosity (*Ho*) is a measure of how much diversity is found, on average, within individual animals in a wild horse herd. *Ho* is insensitive to sample size, although the larger the sample, the more robust the estimate. *Ho* values below the mean for feral populations are an indication that the wild horse herd may have diversity issues. Herds with *Ho* values that are one standard deviation below the mean are considered at critical risk; critical risk levels are shown in table III-1 below. The *Fis* is the estimated inbreeding level. *Fis* levels greater than 0.25 are considered critical level and suggestive of an inbreeding problem.

Table III-1: Warm Springs HMA 2001 and 2010 Genetic Variability Measures Comparison.

Warm Springs HMA - Genetic Variability Measures		
	Ho	*Fis*
2001 (blood samples)	0.387	-0.038
Critical Level (blood)	0.309	>0.25
Wild Horse Mean	0.360	-0.035
Standard Deviation	0.051	0.118
Domestic Horse Mean	0.371	-0.014
Standard Deviation	0.049	0.065
2010 (hair samples)	0.766	0.015
Critical Level (hair)	0.660	>0.25
Wild Horse Mean	0.716	-0.012
Standard Deviation	0.056	0.071
Domestic Horse Mean	0.710	0.012
Standard Deviation	0.078	0.086
*Data derived from Cothran 2002 and Cothran 2011.		

Following the 2001 gather, Cothran (2002) summarized that, "Genetic variability in the Warm Springs herd was above the average for horses in both individual variation and population diversity… [and] Genetic parameters indicate the Warm Springs herd is of mixed origins." In the recommendations section, Cothran (2002) noted that "No actions are indicated. Population size within the planned management levels are high enough to minimize loss of genetic variation."

Genetic similarity results following the 2010 gather indicated a herd with mixed ancestry (Cothran 2011). Cothran (2011) summarized that the genetic variability of this herd, in general, is on the high side but there was a high percentage of variation at risk, heterozygosity levels had declined since 2001, and *Fis* values went from an excess to a deficit. "Comparison of the two years indicates that diversity is in decline" (Cothran 2011). Recommendations stated that because variability levels were high enough, no action was needed at that point, but that the herd should continue to be monitored closely due to the high proportion of rare alleles and the apparent trend of declining variability. It is notable that this herd had undergone a number of gathers to low AML, but still had higher than average heterozygosity measures in both 2001 and 2010. Since the 2010 genetic sampling, the herd has increased exponentially; such population growth tends to preserve genetic diversity.

Warm Springs HMA encompasses both the East Warm Springs (#7001) and West Warm Springs (#7002) Allotments. Cattle are the livestock type authorized for these allotments. Refer to the livestock grazing management section for the details associated with livestock use.

Within the Great Basin, drought conditions are common, and water is the main limiting factor within Warm Springs HMA. In Oregon in 2009 and in 2014 drought conditions affected water availability in several HMAs. In 2014, an emergency gather was conducted to remove imperiled animals from a portion of Palomino Buttes HMA where water was unavailable, but not before several died from water starvation or were euthanized as an act of mercy. Also in 2014, due to severe drought, emergency water hauling for wild horses was conducted in the East Warm Spring Allotment portion of the HMA; this action is thought to have saved approximately 80 horses. Extreme water scarcity does not happen each year but is an annual concern. The four essential habitat components (water, forage, cover, and space) for wild horse and burros "must be present within the HMA in sufficient amounts to sustain healthy wild horse and burro populations and healthy rangelands over the long term" (H-4700-1, p. 12, 2010).

There are large areas (upwards of 5 air miles across) of this HMA that remain ungrazed by both livestock and horses due to their distance from water sources. When adequate water is available, wild horses have been observed to be well dispersed across the HMA. With the severe drought the region has seen in recent years, the wild horse use areas grew smaller and became more concentrated around the limited water sources that remained. This was the same for the use areas of livestock and native ungulates. Limited resources and an overpopulation of wild horses can lead to competition for available resources with other users of the land (such as wildlife and permitted livestock, as summarized by Chambers et al. 2017). McInnis and Vavra (1987) found at least 88 percent of the mean annual diets of horses and cattle consisted of grasses; therefore, there is potential for direct competition for forage. However, dietary overlap is not sufficient evidence for exploitative competitions (Colwell and Futuyma 1971), and consequences of overlap partially depend upon availability of the resource (McInnis and Vavra 1987). Site observations indicate wild horses will typically use range farther from water than cattle and that adequate forage remains available in the major wild horse use areas. Miller (1983) found that wild horses generally stay within 4.8 km (2.98 miles) of a water source during the summer, while Pellegrini (1971) found wild horses will roam up to seven miles from water before returning, and Hampson et al. (2010a) found that horses may move back and forth 10 miles per day between forage and water. Green and Green (1977) found wild horses range from three to seven miles from a water source, but the distance is related to forage availability. When water and forage are available together the range will be smaller, and when they are not available together wild horses concentrate in areas of ample forage and travel further distances to water (Green and Green 1977, as cited in Miller 1983). Nevertheless, horses can only travel so far before their condition or the condition of their young is affected. Research has also shown when wild horses have to share water sources with cattle and antelope, there is direct competition (Miller 1983). When resources become scarce, whether due to drought or overpopulation, resource concentration can create an aggregation of animals where direct contact between competing species is more common, increasing the likelihood of interference behavior (Valeix et al. 2007, Atwood et al. 2011, Gooch et al. 2017). "Feral horses have been found to be typically dominant in their social interactions with native Great Basin ungulates, due to their large size… and often aggressive behavior (Gooch et al. 2017, Berger 1985)." Work by Perry et al. (2015) and Hall et al. (2016a) confirms this. In a study of interactions with desert bighorn sheep (*Ovis canadensis nelsoni*), domestic horses were experimentally placed near water sources ,which resulted in no direct aggression; however, the mere presence of horses resulted in a 76 percent decline in bighorn use of water holes at those locations (Ostermann-Kelm et al. 2008, Gooch et al. 2017). Gooch and others (2017) investigated the interference competition between pronghorn antelope and feral horses at water sources within the Great Basin, particularly the Sheldon National Wildlife Refuge (NWR), which is approximately 100 miles south of Warm Springs HMA. They found that nearly half of the pronghorn/horse interactions observed were negative and resulted in pronghorn being excluded from the water source as a result of horse activity (Gooch et al. 2017). Although they did not measure the consequences of these interactions on pronghorn antelope water consumption and fitness, since about 40 percent of interactions resulted in pronghorn antelope exclusion from water, these pronghorn/horse interactions are likely associated with some costs of fleeing (the cost of leaving the water source prematurely and the energy expended on departure; Frid and Dill, 2002) for pronghorn antelope (Gooch et al. 2017). These effects could have detrimental impacts on pronghorn fitness and population dynamics, particularly under adverse conditions when surface water availability is limited and monopolized by horses (Gooch et al. 2017). With the current estimated wild horse populations in the HMA, interference competition and the indirect consequences are more likely to occur and impact other species sharing the HMA.

Overall, forage availability has not been an issue in this HMA; therefore, if adequate water is available year round then horses and burros will maintain adequate body condition. However, BLM has observed the impacts of limited water on wild horses and burros as well as wild ungulates in the area. During the Severe Drought (designated by the National Oceanic and Atmospheric Administration (NOAA)) in 2014, wild horses and burros were forced to congregate closer to the few remaining water sources in the HMA. Livestock permittees (who were authorized less than 50 percent active use that year) had been ordered to remove all remaining livestock from the impacted area, and cooperative agreements were being exercised to operate wells to provide water to horses in the absence of livestock. In an effort to avoid the need for emergency removals or large scale mortality, Burns District began hauling water to an existing waterhole and temporary troughs where approximately 80 wild horses were congregating. At the time, the potential for wild horse mortality was high. During ODFW's summer 2014 flights to check antelope composition, they noticed congregations of antelope near the same dwindling water source as the horses; this was the only remaining water for miles. ODFW was pleased to see BLM hauling water as the additional sources were a benefit to the fitness of wildlife (Autumn Larkins, ODFW, personal communication, 2014).

The Wild Horse and Burro Management Handbook explains that to maintain a thriving ecological balance "an adequate year round quantity of water must be present within the HMA to sustain wild horse and burro numbers within AML" (H-4700-1, 2010). The Merck Veterinary Manual (accessed June 22, 2017) states that "[w]ater requirements depend largely on environment, amount of work or physical activity being performed, nature of the feed, and physiologic status of the horse." The manual suggests the minimum daily water requirement is 0.4 gallon per 100 pounds of weight, with the average daily intake being closer to 0.65 gallon per 100 pounds. The manual also recognizes this will increase under specific conditions, such as sweat loss, increased activity, and lactation, with the increase being as much as 200 percent, up to 1.3 gallons per 100 pounds per day. Wild horses within the Warm Springs HMA range from 950 to 1,300 pounds. Assuming an average weight of 1,125 pounds, horses within Warm Springs HMA require a minimum daily water intake of 4.5 gallons, with an average daily intake of 7.3 gallons, but the requirement may be as high as 14.6 gallons. This water requirement ranges from about 432 gallons per day at low AML for horses (96 animals) and using only the minimum amount of water, to almost 2,599 gallons per day at high AML for horses alone (178 animals) and requiring a water intake 200 percent above average. Over the course of a year, this translates to a range of 157,680 gallons of water (minimum) to 948,635 gallons of water (maximum), plus use by burros. The maximum water requirements would be even higher for the HMA when horse and burro numbers exceed the AML.

As the wild horse and burro population continues to grow well above the AML, there is cause for concern regarding the potential for degradation of rangeland resources in typical home ranges surrounding the limited reliable water sources. Unlike managed livestock grazing, wild horse and burro grazing occurs year round. If there are ample, well distributed resources then there is little to no concern for resource degradation. However, when resources are limited and habitat use is concentrated into a small number of areas, desirable key forage species receive heavier levels of use during the growing season. This type of use is acceptable if it occurs only on a periodic basis, but not annually. Repetitive use during the growing season that prevents key forage species from completing their growth and reproductive cycles tends to reduce plant vigor as carbohydrate reserves are spent on regrowth, as opposed to seed production. Maintaining the herd sizes of wild horses and burros within AML would decrease this concern.

b. Environmental Consequences – Wild Horses and Burros

Effects Common to Both Alternatives

Results of WinEquus Population Modeling
Both alternatives were run through the WinEquus wild horse population model for comparison (see table III-2 below).

The on-range spay study treatment and control populations were run through the WinEquus wild horse population model for years 2018–2022, the extent of the study. In addition, four separate treatment options were run though the model separately to compare outcomes over the 7 remaining years of this analysis (2022–2028). These options for 2022–2028 were all run with a gather to low AML (96 horses) in year 2022, so they all had the same starting population. Results of these four management options provide estimates on average population growth rate, gather frequency and removal numbers, and anticipated number of animals to be treated. The no action alternative was also run through the model. Refer to Appendix P, Warm Springs HMA WinEquus Simulations, for descriptions of model inputs for all trials and results. As stated in the Wild Horse and Burro Management Handbook (H-4700-1, 2010, p. 28), an objective of the modelling is to identify whether any of the alternatives would be likely to cause a “crash” of the population, based on a number of stochastic factors (varying environmental conditions). None of the simulations run through the model for this analysis caused a “crash” in the population or influenced the population’s ability to self-sustain.

Table III-2: WinEquus Population Modelling Comparison Table

		Avg. Growth Rate (%)	Next Projected Gather	Est'd. No. of Horses Removals in 7 yrs. [C]	Est'd. No. Females Treated in 7 yrs.	Est. Pop. Size by Next Projected Gather
No Action (2018–2028)		20.1	n/a	0	0	5,546
Proposed Action						
On-Range Study 2018–2022	Control Population	19.5	2022[a]	146	0	210[d]
	Treatment Population	14.0	2022[a]	102	26	168[d]
Post Study 2022–2028	Option 1: Spay all females 2+ yrs old	10.4	2028/2029[b]	0	64	175
	Option 2: Spay all females 5+ yrs old	13.8	2027	76	28	192
	Option 3: Removals Only, No Treatments	19.9	2027	136	0	245
	Option 4: PZP all females 2+ years old	17.5	2027	110	45	218

[a] End of on-range behavioral study; gather to low AML.

[b] Option 1 does not exceed high AML 178 until after 2028, likely within 2029.

[c] Estimated removals in options 1–4 do not include those animals removed during the 2022 gather to low AML.

[d] The Control and Treatment populations would be gathered to the low end of AML at the end of the study (2022).

No Action

Under this alternative, any risks to horses and burros due to gathering, handling, and transport would be avoided. However, it is not possible to predict whether or when wild horses may need to be gathered in an emergency situation. If growth continues unabated and the region enters another severe drought, it is inevitable that there would be episodes of water starvation as a result.

Based upon the most recent aerial survey (September 2016) and the normal 20 percent annual population growth rate for wild horse herds, the no action alternative (no gather or removal) would begin with 885 horses (738 adults and 147 foals) in the HMA by fall 2018. Results from the WinEquus population modelling program using the no action alternative indicate by 2028 there could be approximately 5,546 horses in the HMA. Or, calculating the population size over a 10-year period using a 20 percent annual growth rate provides an estimated 4,569 adults and 914 foals: 5,483 total horses. WinEquus is not designed for modelling burro populations, however, by using a 19 percent annual growth to estimate the burro population based on the current estimate of 49 adults, the estimated burro herd would be approximately 279 adult animals by 2028.

The no action alternative allows unchecked growth of wild horses and burros and would therefore only exacerbate the threat to wild horses and burros during periods of drought. In 2014, the raw count of wild horses seen during an aerial survey was 253 adults and 44 foals; for reasons already discussed, this number is lower than the true number of horses present at that time, but it is not clear by how much. Based on the 2016 simultaneous double-observer survey and expected 20 percent growth rates, in the fall of 2018 it is expected that there would be an estimated 885 total horses. NOAA recently released its U.S. Seasonal Drought Outlook for the period of April 19 through July 31, 2018, which shows eastern Oregon with persistent drought and explains that "Below-normal precipitation and above-normal temperatures promoted drought persistence across central and eastern Oregon… monthly and seasonal outlooks both depict enhanced changes for below-normal precipitation and above-normal temperatures, which favors persistence through the end of August" (NOAA 2018).

As wild horse and burro populations increase, not only would the horses and burros have competition for forage and water from wildlife and livestock, but amongst themselves as well. Horses usually occupy home ranges (undefended, nonexclusive areas), however, when resources are limited, mutual avoidance occurs but can intensify into increased aggression for territories (defended, exclusive areas). In a wild horse behavior study in the Grand Canyon, Berger (1977) found that home ranges for all bands decreased in size in successive warm months, probably due to increased ambient temperature and drought, resulting in greater utilization of spring areas that led to increased interband confrontation and agonistic display. Miller and Denniston (1979) reported that even females participated along with male group mates when threatening another group of horses at water. Increased occurrences of aggressive activities, caused by lack of necessary resources, and the consequent acute injuries or effects to the health and wellbeing of wild horses and burros would not follow BLM's mandate of managing for a thriving natural ecological balance within an HMA.

The objectives set forth in the HMA plans from 1979 through 2010 to maintain AML, provide yearlong water sources so all species will have adequate and reliable water; and maintain the healthy, free-roaming nature of wild horses and burros within the HMA would not be achieved under the no action alternative with the existing estimated population size and the projected population size within the 10-year timeframe of this analysis. The no action alterative would also be in non-conformance with several objectives of the Oregon GRSG ARMPA (2015) including the objective to "Coordinate with professionals from other Federal and State agencies, researchers at universities, and others to utilize and evaluate new management tools (e.g., population growth suppression, inventory techniques, and telemetry) for implementing the WHB program" (MD WHB 9) and objectives from the Three Rivers RMP/ROD (1992), specifically to "Provide facilities and water sources necessary to ensure the integrity of the individual herds" (WHB 2.4).

Although BLM is unable to quantify cumulative effects under the no action alternative, the effects of this alternative on present and RFFAs and in wild horse and burro habitat would be detrimental. Failure to achieve objectives from HMA plans (HMAP), the Three Rivers RMP/ROD (1992), and the Oregon GRSG ARMPA (specifically the AML, population growth suppression research, and water resources objectives) would be realized more rapidly under the no action alternative as compared to the action alternative, which aims to maintain populations within AML. The no action alternative does not encourage the success of noxious weed treatments, wildfire rehabilitation efforts, and livestock grazing management activities. Similarly, the success of the wildfire rehabilitation projects would be hindered as the wild horse and burro populations continued to increase. As forage and water availability would dwindle due to expected wild horse and burro population increases, BLM would work with the livestock grazing permittees to make further adjustments to their authorized use and rotations to prevent additional resource damage. However, as the wild horse and burro populations grow, increased competition for forage, water, and home ranges between wild horse bands would become apparent, increasing risk to herd health as forage and water quantity and quality become more limited.

In its 2013 review, the NRC concluded that "free-ranging horse populations are growing at high rates because their numbers are held below levels affected by food limitation and density dependence. Regularly removing horses holds population levels below food-limited carrying capacity. Thus, population growth rate could be increased by removals through compensatory population growth from decreased competition for forage" (NRC Review 2013). This portion of the NRC Review (2013) often leads interested publics to believe that no gathers and "self-regulation" would be an acceptable manner of wild horse and burro management. However, the review also pointed out that animal responses to density dependence, due to food limitation, will increase the number of animals that are in poor body condition and dying from starvation (NRC Review 2013). In addition, rangeland health, as well as food and water resources for other animals that share the range, would be affected by resource limited horse populations, which could be in conflict with the legislative mandate that BLM maintain a thriving natural ecological balance (NRC Review 2013). Populations growing to the point where resources are limited would not only be in conflict with this legislative mandate, but would have far harsher impacts (e.g. starvation) than alternatives that propose fertility control techniques.

The BLM would continue to have limited information quantifying the feasibility of spaying wild horse mares and the on-range behavioral outcomes under the no action alternative.

Proposed Action

This alternative initiates with a gather intended to remove excess animals and allow for study of a method to slow the population growth before additional damage to the range occurs. Over the past 35 years, various effects to wild horses resulting from gather activities have been observed. Under the proposed action, effects to wild horses and burros would be both direct and indirect, occurring to both individual horses and the population as a whole. 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 effects to the animals during gather operations. The procedures outlined in IM 2015-151 (Appendix G) would be implemented to ensure a safe and humane gather occurs, which would minimize potential stress and injury to wild horses and burros.

Effects of Gathers

In any given gather, gather-related mortality averages about 0.5 percent (Government Accountability Office, GAO-09-77, p. 49), which is considered very low when handling wild animals. An average of about 0.7 percent of the captured animals are humanely euthanized in accordance with BLM policy (refer to Appendix K, IM 2015-070) due to pre-existing conditions (Government Accountability Office, GAO-09-77, p. 49). These data affirm that 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 public lands. BLM Manual 4720.41 prohibits the capture of wild horses by using a helicopter during the foaling period (generally March 1 to June 30), which is defined as 6 weeks on either side of the peak foaling period. However, IM 2013-146 allows for the use of helicopter gathers during peak foaling season due to emergency conditions and escalating problems.

Both helicopter gathers and bait/water trapping can be stressful to wild horses and burros. There is policy in place for gathers (both helicopter and bait/water) to enable efficient and successful gather operations while ensuring humane care and treatment of the animals gathered (IM 2015-151). This policy includes SOPs such as time of year and temperature ranges for helicopter gathers to reduce physical stress to the horses while being herded toward a trap; maximum distances to helicopter herd horses based on climatic conditions, topography, and condition of horses; and handling procedures once the animals are in the trap. In Oregon, wild horse or burro fatalities related to gather operations are less than 1 percent of the animals captured for both helicopter and bait/water trap gathers. Injuries generally occur once the animal is in the confined space of the trap. When capture and handling of wild animals is required to achieve management objectives, it is the responsibility of the management professionals to plan and execute operations that minimize the animals' risks of injury and death. However, when capturing any type of large, wild animal one must expect a certain percentage of injury or death. Multiple studies in the wildlife research and management field have worked to improve understanding of the margins of safe capture and handling and have documented their findings of capture-related mortality. Delgiudice and others (2005) reported 984 captures and recaptures of white-tailed deer (*Odocolleus virginianus*), primarily by Clover trap,[4] under a wide range of winter weather conditions. Their results showed the incidence of capture accidents (e.g., trauma-induced paralysis or death) was 2.9 percent. ODFW Assistant District Wildlife Biologist, Autumn Larkins, stated the general consensus between biologists on capture-related mortality in wildlife is that, "…anything up to 4 percent is the reality of the aerial capture process. Once you get over 5 percent you need to reevaluate because something is not working, either the conditions are too poor, the methods are inappropriate, etc." (Autumn Larkins, ODFW, pers. comm. 2014).

Individual effects to wild horses and burros include the stress associated with the roundup, capture, sorting, handling, and transport. The intensity of these effects 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 and brush. Rarely, because of their experience with the locations of fences in the HMA, wild horses encounter barbed wire fences and receive wire cuts. These injuries are treated onsite until a veterinarian can examine the animal and determine if additional treatment is required. Other injuries may occur after a horse or burro has been captured and is either within the trap site corral or the temporary holding corral, or during transport between facilities, or during sorting and handling.

Occasionally, animals may sustain a spinal injury or a fractured limb, but based on prior gather statistics, serious injuries requiring humane euthanasia occur in less than one animal per every 100 captured. Similar injuries could be sustained if captured through bait and/or water trapping, as the animals still need to be sorted, aged, transported, and otherwise

[4] Clover trap: A portable net trap to capture deer. This trap has been modified over the years since its original design by Clover in 1954. The trap is constructed with a pipe or tubing frame with netting stretched over the frame. A drop gate is activated by a trip cord (Schemnitz 1980).

handled following their capture; these injuries result from kicks and bites, or from collisions with corral panels or gates.

To minimize potential for injuries from fighting, horses are transported from the helicopter trap site to the temporary (or short-term) holding facility where stallions are sorted from mares and foals 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 receive injuries or die. On some gathers, due to the temperaments and physical conditions of the horses, they are not as calm and injuries are more frequent.

Indirect individual effects are those that occur to individual animals after the initial event. These may include miscarriages in females, increased social displacement, and conflict between dominant males. These effects, like direct individual effects, are known to occur intermittently during gather operations. An example of an indirect individual impact would be the brief, 1- to 2-minute skirmish between older stallions that ends when one stallion retreats. Injuries typically involve a bite or kick with bruises that do not break the skin. Like direct individual effects, the frequency of these effects varies with the population and the individuals. Observations following capture indicate the rate of miscarriage varies, but can occur in about 1 to 5 percent of the captured mares, particularly if the mares are in very poor body condition or health.

A few foals may be orphaned during a helicopter gather. This can occur 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 mothers rejected them or died. These foals are usually in poor condition. Every effort is made to provide appropriate care to orphan foals. Electrolyte solutions may be administered or orphan foals may be fed milk replacer as needed to support their nutritional needs. Orphan foals may be placed in foster homes in order to receive additional care. Despite these efforts, some orphan foals may die or be humanely euthanized as an act of mercy if the prognosis for survival is very poor.

During a summer helicopter gather, foals are smaller than during gathers conducted during the winter months. Water requirements are greater than in the winter due to the heat. If forage or water is limiting, animals may be travelling long distances between water and forage, and may become more easily dehydrated. To minimize potential for distress during summer gathers, capture operations are often limited to early morning hours when temperatures are cooler. The distance animals must travel to the trap is also shortened to minimize potential stress. The BLM and gather contractor make sure there is plenty of clean water for the animals to drink once captured. A supply of electrolytes is kept on hand to apply to the drinking water if necessary. Electrolytes help to replace the body fluids that may be lost during capture and handling.

Through the capture and sorting process, wild horses and burros are examined for health, presence of injuries, and other physical defects. Decisions to humanely euthanize animals in field situations would be made in conformance with BLM policy. BLM's Animal Health, Maintenance, Evaluation and Response (IM 2015-070, Appendix K) is used as a guide to determine if animals meet the criteria and should be humanely euthanized.

Wild horses and burros not captured may be temporarily disturbed and move into another area during the gather operation. With the exception of changes to herd demographics from removals, direct population dynamics effects have proven to be temporary in nature with most, if not all, effects disappearing within hours to several days of release. No observable effects would be expected within 1 month of release, except for a heightened awareness of human presence.

By maintaining wild horse and burro population size within the AML, there would be a lower density of animals across the HMA, reducing competition for resources and allowing all species to utilize their preferred habitat. Maintaining population size within the established AML would be expected to improve forage quantity and quality and promote healthy populations of wild horses and burros in a thriving natural ecological balance and multiple-use relationship on the public lands in the area. Deterioration of the range associated with overpopulation would be avoided. Managing populations in balance with available habitat and other, multiple uses would lessen potential for individual animals or the herd to be affected by climatic fluctuations such as drought and reductions in available forage and water. Population management would lead to avoidance of or minimize the need for emergency gathers and increase success of the herd over the long term.

<u>Transport, Short-term Holding, Adoption Preparation, and Sale or Transfer to Government Agency</u>

All captured animals would be transported from the capture/temporary holding corrals to the designated BLM short-term holding corral facility(s). As noted above, BLM would identify a subset of animals that would be candidates for return to the range, and other animals that would be prepared for BLM off-range management, including making them available for adoption or sale to qualified individuals or sent to long-term holding (grassland) pastures. Over the 10-year implementation of management actions, the disposition of removed excess horses and burros would follow existing or updated policies.

Animals selected for removal from the range are transported to the receiving short-term holding facility by straight deck semi-trailers or gooseneck stock trailers. Vehicles are inspected by the BLM COR or PI prior to use to ensure wild horses and burros can be safely transported and the interiors of the vehicles are in sanitary condition. Animals are segregated by age and sex and loaded into separate compartments.

A small number of mares/jennies may be shipped with foals. Transportation of recently captured wild horses and burros is limited to a maximum of 8 hours. During transport, potential effects to individual animals can include stress, as well as slipping, falling, kicking, biting, or being stepped on by another animal. Unless animals are in extremely poor condition, it is rare for them to be seriously injured or die during transport.

Upon arrival at the short-term holding facility, recently captured wild horses and burros are off-loaded by compartment and placed in holding pens where they are fed good-quality hay and water. Most animals begin to eat and drink immediately and adjust rapidly to their new situation. Any animals affected by a chronic or incurable disease, injury, lameness, or serious physical defect (such as severe tooth loss or wear, clubfeet, and other severe congenital abnormalities) would be humanely euthanized using methods under the guidelines in IM 2015-070 (Appendix K). Wild horses and burros in underweight condition or animals with injuries are sorted and placed in hospital pens, fed separately, and/or treated for their injuries as indicated. Recently captured animals, generally mares/jennies, in underweight condition may have difficulty transitioning to feed. Some of these animals are in such poor condition it is unlikely they would have survived if left on the range. Similarly, some mares/jennies may lose their fetuses. Every effort is taken to help the mare/jennies 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 are prepared for adoption or sale or transfer. Preparation involves freeze marking the animals with a unique identification number, drawing a blood sample to test for equine infectious anemia, vaccinating against common diseases, castration (of males) as necessary, and deworming. During the preparation process, potential effects to wild horses and burros are similar to those that can occur during handling and transportation. Serious injuries and deaths from injuries during the preparation process can occur.

At short-term corral facilities, a minimum of 700 square feet per animal is provided. Mortality at short-term holding facilities averages approximately 5 percent per year (GAO-09-77, p. 51), and includes animals euthanized due to pre-existing conditions, animals in extremely poor condition, animals that are unable to transition to feed, and animals that are seriously injured or accidentally die during sorting, handling, or preparation.

Adoption or Sale with Limitations, Transfer, and Long-Term Pasture

Adoption applicants are required to have at least a 400 square foot corral with panels at least 6 feet tall for horses over 18 months of age. Fences must be at least 4.5 feet high for ungentled burros. Applicants are required to provide adequate shelter, feed, and water. The BLM retains title to the animal for 1 year, and the animals and facilities are inspected to ensure the adopter is complying with the BLM's requirements. After 1 year, the adopter may take title to the animal, at which point the horse/burro 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 or burro. A sale-eligible wild horse or burro is any animal more than 10 years old; or which has been offered unsuccessfully for adoption 3 times. The application also specifies all buyers are not to resell the animal to slaughter buyers or anyone who would sell the animal to a commercial processing plant. Sales of wild horses and burros would be conducted in accordance with BLM policy under IM 2014-132 or any future BLM direction on sales.

Potential effects to animals from transport to adoption, sale, transfer, or long-term holding are similar to those previously described. One difference is when shipping wild horses and burros for adoption, sale, transfer, or long-term holding, 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 (adjusted accordingly for larger or smaller horses, burros, and foals) 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 stress of offloading and reloading is likely to be greater than the stress involved in the additional period of uninterrupted travel.

Transfer of excess wild horses and burros to Federal, State and local government agencies for use as work animals would follow the policy outlined in the IM of the same name (IM 2018-052).

Long-term pastures are designed to provide excess wild horses with humane, lifelong care in a natural setting off public rangelands. Currently, no burros are being cared for in long-term pastures. Wild horses are maintained in grassland pastures large enough to allow free-roaming behavior and with forage, water, and shelter necessary to sustain them in good condition. About 34,000 wild horses, in excess of the existing adoption or sale demand (because of age or other factors), are currently being held in long-term pastures. These animals are generally more than 10 years of age. Located in mid or tall grass prairie regions of the United States, these long-term holding pastures are highly productive grasslands as compared to more arid western rangelands.

Generally, mares and castrated stallions (geldings) are segregated into separate pastures. No reproduction occurs in the long-term grassland pastures, but foals born to pregnant mares are gathered and weaned when they reach about 8 to 10 months of age and are then shipped to short-term facilities where they are made available for adoption.

Handling by humans is minimized to the extent possible, although regular on-the-ground observation and weekly counts of 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 underweight 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 long-term holding pastures averages approximately 8 percent per year, but can be higher or lower depending on the average age of the horses pastured (GAO-09-77, p. 52).

Ovariectomy via Colpotomy Procedure

The anticipated effects of the spay treatment are both physical and behavioral. Physical effects would be due to post-surgical healing and the possibility for complications. Colpotomy is a surgical technique in which there is no external incision, reducing susceptibility to infection. For this reason, ovariectomy via colpotomy has been identified as a good choice for feral or wild horses (Rowland et al. 2018). Ovariectomy via colpotomy is a relatively short surgery, with a relatively quick expected recovery time.

In 1903, Williams first described a vaginal approach, or colpotomy, using an ecraseur to ovariectomize mares (Loesch and Rodgerson 2003). The ovariectomy via colpotomy procedure has been conducted for over 100 years, normally on open (non-pregnant), domestic mares. It is expected that the surgeon should be able to access ovaries with ease in mares that are in the early- or mid-stage of pregnancy. The anticipated risks associated with the pregnancy are described below. When wild horses are gathered or trapped for fertility control treatment there would likely be mares in various stages of gestation. Removal of the ovaries is permanent and 100 percent effective, however the procedure is not without risk. In its review, the NRC (2013) briefly discussed surgical ovariectomy (removal of the ovaries) as a method of female-directed fertility control, noting that although ovariectomy is commonly used in domestic species, it has been seldom applied to free-ranging species. The committee cautioned that "the possibility that ovariectomy may be followed by prolonged bleeding or infection makes it inadvisable for field application" (NRC Review 2013); however, they explained that ovariectomy via colpotomy was an alternative approach which avoids an external incision and reduces the chances of complication and infection (NRC Review 2013). This NRC Review (2103) was prior to the Collins and Kasbohm (2016) publication where 114 feral horse mares were treated with ovariectomy via colpotomy with results showing a less than two percent mortality rate. The NRC (2013) also noted that no fertility control method existed that did not affect physiology or behavior. The committee warned that the impacts of not managing population numbers were potentially harsher than contraception, as population numbers would likely be limited by starvation (NRC Review 2013).

The proposed alternative would allow for researchers to quantify the outcomes of using ovariectomy via colpotomy for mares that are in various gestational stages. The proposed alternative would also allow researchers to record in detail and test for any behavioral effects on the range.

<u>Anticipated Effects of Surgery on a Pregnancy</u>

The average mare gestation period ranges from 335 to 340 days (Evans et al. 1977). There are few peer reviewed studies documenting the effects of ovariectomy on the success of pregnancy in a mare. A National Research Council (NRC) committee that reviewed research proposals in 2015 explained, "The mare's ovaries and their production of progesterone are required during the first 70 days of pregnancy to maintain the pregnancy" (BLM 2015). In 1977, Evans and others stated that by 200 days, the secretion of progesterone by the corpora lutea is insignificant because removal of the ovaries does not result in abortion (p. 376). "If this procedure were performed in the first 120 days of pregnancy, the fetus would be resorbed or aborted by the mother. If performed after 120 days, the pregnancy should be maintained. The effect of ovary removal on a pregnancy at 90–120 days of gestation is unpredictable because it is during this stage of gestation that the transition from corpus luteum to placental support typically occurs" (BLM 2015). In 1979, Holtan and others evaluated the effects of bilateral ovariectomy at selected times between 25 and 210 days of gestation on 50 mature pony mares. Their results show that abortion (resorption) of the conceptus (fetus) occurred in all 14 mares ovariectomized before day 50 of gestation, that pregnancy was maintained in 11 of 20 mares after ovariectomy between days 50 and 70, and that pregnancy was not interrupted in any of 12 mares ovariectomized on days 140 or 210. Those results are similar to the suggestions of the NRC committee (BLM 2015).

For those pregnancies that are maintained following the procedure, likely those past approximately 120 days, the development of the foal is not expected to be affected. However, because this procedure is not commonly conducted on pregnant mares the rate of complications to the fetus has not yet been quantified. There is the possibility that entry to the abdominal cavity could cause premature births related to inflammation. However, after five months the placenta should hormonally support the pregnancy regardless of the presence or absence of ovaries. Gestation length was similar between ovariectomized and control mares (Holtan et al. 1979).

<u>Anticipated Complication Rates Associated with Ovariectomy via Colpotomy</u>

Between 2009 and 2011, the Sheldon NWR in Nevada conducted ovariectomy via colpotomy surgeries (August through October) on 114 feral mares and released them back to the range with a mixture of sterilized stallions and untreated mares and stallions (Collins and Kasbohm 2016). Gestational stage was not recorded, but a majority of the mares were pregnant (Gail Collins, US Fish and Wildlife Service (USFWS), pers. comm.). Only a small number of mares were very close to full term. Those mares with late term pregnancies did not receive surgery as the veterinarian could not get good access to the ovaries due to the position of the foal (Gail Collins, USFWS, pers. comm.). After holding the mares for an average of 8 days after surgery for observation, they were returned to the range with other treated and untreated mares and stallions (Collins and Kasbohm 2016). During holding the only complications were observed within 2 days of surgery. The observed mortality rate for ovariectomized mares following the procedure was less than 2 percent (Collins and Kasbohm 2016, Pielstick pers. comm.).

During the Sheldon NWR ovariectomy study, mares generally walked out of the chute and started to eat; some would raise their tail and act as if they were defecating; however, in most mares one could not notice signs of discomfort (Bowen 2015). In their discussion of ovariectomy via colpotomy, McKinnon and Vasey (2007) considered the procedure safe and efficacious in many instances, able to be performed expediently by personnel experienced with examination of the female reproductive tract, and associated with a complication rate that is similar to or less than male castration. Nevertheless, all surgery is associated with some risk. Bilateral ovariectomy through either a colpotomy or flank approach can be performed efficiently in a standing mare, but potentially serious complications can occur with these approaches; unidentified and potentially fatal hemorrhage from the mesovarium, intestinal and mesenteric trauma, peritonitis, adhesions, and death are complications associated with both approaches (Rodgerson et al 2001). Loesch and and Rodgerson (2003) add to the potential risks with colpotomy: pain and discomfort; delayed vaginal healing; evisceration of the bowel; incisional site hematoma; intra-abdominal adhesions to the vagina; and chronic lumbar or bilateral hind limb pain. Shock is also a possibility that could be associated with any surgery. Most horses, however, tolerate ovariectomy via colpotomy with very few complications, including feral horses (Collins and Kasbohm 2016). Prado and Schumacher (2017) considered evisceration a possibility, but considered it rare. Mortality due to surgery or post-surgical complications is not anticipated, but it is a possibility and therefore every effort would be made to mitigate risks.

In September 2015, the BLM solicited the USGS to convene a panel of veterinary experts to assess the relative merits and drawbacks of several surgical ovariectomy techniques that are commonly used in domestic horses for potential application in wild horses. A table summarizing the various methods was sent to the BLM (Bowen 2015) and provides a concise comparison of several methods. Of these, ovariectomy via colpotomy was found to be relatively safe when practiced by an experienced surgeon and was associated with the shortest duration of potential complications after the operation. The panel discussed the potential for evisceration through the vaginal incision with this procedure. In marked contrast to a suggestion by the NRC Review (2013) who explained that domestic mares are typically cross-tied to keep them standing for 48 hours post-surgery to prevent evisceration through the unclosed incision in the anterior vagina, this panel of veterinarians (Bowen 2015) identified evisceration as not being a probable risk associated with ovariectomy via colpotomy and “none of the panel participants had had this occur nor had heard of it actually occurring.”

One reason why evisceration is rarely observed could be the small, vaginal incision (1–3 cm long) enlarged by blunt dissection. “This method separates rather than transects the muscle fibers so the incision decreases in length when the vaginal muscles contract after the tranquilization wanes post-surgery. Three days postop the incision edges are adhered, and healed after 7–10 days” (Bowen 2015).

Most spay surgeries on mares have low morbidity[5] and with the help of medications, pain and discomfort can be mitigated. Pain management is an important aspect of any ovariectomy (Rowland et al. 2018); according to the proposed surgical protocols (Appendix D – IACUC Approved Protocols #18-7887A and #18-8013A), a long-lasting direct anesthetic would be applied to the ovarian pedicle, and systemic analgesics in the form of butorphanol and flunixin meglumine would be administered. In a study of the effects of bilateral ovariectomy via colpotomy on 23 mares, Hooper and others (1993) reported that post-operative problems were minimal (1 in 23, or 4%). Hooper and others (1993) noted that four other mares were reported by owners as having some problems after surgery, but that evidence as to the role the surgery played in those subsequent problems was inconclusive. In contrast, Röcken and others (2011) noted a morbidity of 10.8 percent for mares that were ovariectomized via a flank laparoscopy. “Although 5 mares in our study had problems (repeated colic in 2 mares, signs of lumbar pain in 1 mare, signs of bilateral hind limb pain in 1 mare, and clinical signs of peritonitis in 1 mare) after surgery, evidence is inconclusive in each as to the role played by surgery” (Hooper et al. 1993). A recent study showed a 2.5 percent complication rate where one mare of 39 showed signs of moderate colic after laparoscopic ovariectomy (Devick 2018, personal communication).

An NRC (BLM 2015) who reviewed an ovariectomy via colpotomy protocol on wild horse mares believed “this procedure could be operationalized immediately to sterilize mares, with the caveat that fatalities may be higher than the 1% reported in the literature”…and “quoted in the protocol, which is based on domestic mares.” The NRC did not explain what literature they were referencing. However, the near 1 percent reference in the protocol was referring to the, at that time, unpublished (now Collins and Kasbohm 2016) ovariectomy via colpotomy study conducted on feral horse mares at the Sheldon NWR where they documented a less than 2 percent loss.

Anticipated Effects on Mare Health and Behavior on the Range

No fertility control method exists that does not affect physiology or behavior of a mare (NRC Review 2013). Any action taken to alter the reproductive capacity of an individual has the potential to affect hormone production and therefore behavioral interactions and ultimately population dynamics in unforeseen ways (Ransom et al. 2014a). The health and behavioral effects of spaying wild horse mares that live with other fertile and infertile wild horses has not been well documented, but the literature review below can be used to make reasonable inferences about their likely behaviors.

[5] Morbidity is defined as the frequency of the appearance of complications following a surgical procedure or other treatment. In contrast, mortality is defined as an outcome of death due to the procedure.

Horses are anovulatory (do not ovulate/express estrous behavior) during the short days of late fall and early winter, beginning to ovulate as days lengthen and then cycling roughly every 21 days during the warmer months, with about 5 days of estrus (Asa et al. 1979, Crowell-Davis 2007). Estrus in mares is shown by increased frequency of proceptive behaviors: approaching and following the stallion, urinating, presenting the rear end, clitoral winking, and raising the tail towards the stallion (Asa et al. 1979, Crowell-Davis 2007). In most mammal species other than primates estrus behavior is not shown during the anovulatory period, and reproductive behavior is considered extinguished following spaying (Hart and Eckstein 1997). However, mares may continue to demonstrate estrus behavior during the anovulatory period (Asa et al. 1980). Similarly, ovariectomized mares may also continue to exhibit estrous behavior (Scott and Kunze 1977, Kamm and Hendrickson 2007, Crabtree 2016), with one study finding that 30 percent of mares showed estrus signs at least once after surgery (Roessner et al. 2015) and only 60 percent of ovariectomized mares cease estrous behavior following surgery (Loesch and Rodgerson 2003). Mares continue to show reproductive behavior following ovariectomy due to non-endocrine support of estrus behavior, specifically steroids from the adrenal cortex. Continuation of this behavior during the non-breeding season has the function of maintaining social cohesion within a horse group (Asa et al. 1980, Asa et al. 1984, NRC Review 2013). This may be a unique response of the horse (Bertin et al. 2013), as spaying usually greatly reduces female sexual behavior in companion animals (Hart and Eckstein 1997). In six ponies, mean monthly plasma luteinizing hormone[6] levels in ovariectomized mares were similar to intact mares during the anestrous season, and during the breeding season were similar to levels in intact mares at mid-estrus (Garcia and Ginther 1976).

The likely effects of spaying on mares' social interactions and group membership can be inferred from available literature, even though wild horses have rarely been spayed and released back into the wild, resulting in few studies that have investigated their behavior in free-roaming populations. Wild horses and burros are instinctually herd-bound and this behavior is expected to continue. However, no study has documented the rate at which spayed mares will continue to remain with the stallion and band from which the mare was most recently attached. Overall, the BLM anticipates that some spayed mares may continue to exhibit estrus behavior that could foster band cohesion. If free-ranging ovariectomized mares show estrous behavior and occasionally allow copulation, interest of the stallion may be maintained, which could foster band cohesion

[6] Luteinizing hormone (LH) is a glycoprotein hormone produced in the pituitary gland. In females, a sharp rise of LH triggers ovulation and development of the corpus luteum. LH concentrations can be measured in blood plasma.

(NRC Review 2013). This last statement could be validated by the observations of group associations on the Sheldon NWR where feral mares were ovariectomized via colpotomy and released back on to the range with untreated horses of both sexes (Collins and Kasbohm 2016). No data were collected on inter- or intra-band behavior (e.g. estrous display, increased tending by stallions, etc.). During multiple aerial surveys in years following treatment, all treated individuals appeared to maintain group associations, and there were no groups consisting only of treated males or only of treated females (Collins and Kasbohm 2016). In addition, of solitary animals documented during surveys, there were no observations of solitary treated females (Collins and Kasbohm 2016). These data help support the expectation that ovariectomized mares would not lose interest in or be cast out of the social dynamics of a wild horse herd. As noted by the NRC Review (2013), the ideal fertility control method would not eliminate sexual behavior or change social structure substantially.

A study conducted for 15 days in January 1978 (Asa et al. 1980), compared the sexual behavior in ovariectomized and seasonally anovulatory (intact) pony mares and found that there were no statistical differences between the two conditions for any measure of proceptivity or copulatory behavior, or days in estrous. This helps explain why treated mares at Sheldon NWR continued to be accepted into harem bands; they were basically acting the same as a non-pregnant mare. Five to ten percent of pregnant mares exhibit estrous behavior (Crowell-Davis 2007). Although the physiological cause of this phenomenon is not fully understood (Crowell-Davis 2007), it is thought to be a bonding mechanism that assists in the maintenance of stable social groups of horses year round (Ransom et al. 2014b). The complexity of social behaviors among free-roaming horses is not entirely centered on reproductive receptivity, and fertility control treatments that suppress the reproductive system and reproductive behaviors should contribute to minimal changes to social behavior (Ransom et al. 2014b, Collins and Kasbohm 2016).

The BLM expects that wild horse family structures would continue to exist under the proposed action because fertile mares, stallions, and their foals would continue to be a component of the herd. It is not expected that spaying a subset of mares would significantly change the social structure or herd demographics (age and sex ratios) of fertile wild horses.

<u>Movement, Body Condition, and Survival of Ovariectomized Mares</u>
The free-roaming behavior of wild horses is not anticipated to be affected by this alternative as the definition of free-roaming is the ability to move without restriction by fences or other barriers within an HMA (H-4700-1, 2010) and there are no permanent physical barriers being proposed.

However, the study would document the movement patterns of both herd segments to determine any difference in use areas and distances travelled.

In domestic animals spaying is often associated with weight gain and associated increase in body fat (Fettman et al. 1997, Beckett et al. 2002, Jeusette et al. 2006, Belsito et al. 2009, Reichler 2009, Camara et al. 2014). Spayed cats had a decrease in fasting metabolic rate, and spayed dogs had a decreased daily energy requirement, but both had increased appetite (O'Farrell and Peachey 1990, Hart and Eckstein 1997, Fettman et al. 1997, Jeusette et al. 2004). In wild horses, contracepted mares tend to be in better body condition than mares that are pregnant or that are nursing foals (Nuñez et al. 2010); the same improvement in body condition is likely to take place in spayed mares. In horses spaying has the potential to increase risk of equine metabolic syndrome (leading to obesity and laminitis), but both blood glucose and insulin levels were similar in mares before and after ovariectomy over the short term (Bertin et al. 2013). In wild horses the quality and quantity of forage is unlikely to be sufficient to promote over-eating and obesity.

Coit and others (2009) demonstrated that spayed dogs have elevated levels of LH-receptor and GnRH-receptor mRNA in the bladder tissue, and lower contractile strength of muscles. They noted that urinary incontinence occurs at elevated levels in spayed dogs and in post-menopausal women. Thus, it is reasonable to suppose that some ovariectomized mares could also suffer from elevated levels of urinary incontinence.

Sterilization had no effect on movements and space use of feral cats or brushtail possums (Ramsey 2007, Guttilla and Stapp 2010), or greyhound racing performance (Payne 2013). Rice field rats (*Rattus argentiventer*) tend to have a smaller home range in the breeding season, as they remain close to their litters to protect and nurse them. When surgically sterilized, rice field rats had larger home ranges and moved further from their burrows than hormonally sterilized or fertile rats (Jacob et al. 2004). Spayed possums and foxes (*Vulpes vulpes*) had a similar core range area after spay surgery compared to before, and were no more likely to shift their range than intact females (Saunders et al. 2002, Ramsey 2007).

The likely effects of spaying on mares' home range and habitat use can also be surmised from available literature. Bands of horses tend to have distinct home ranges, varying in size depending on the habitat and varying by season, but always including a water source, forage, and places where horses can shelter from inclement weather or insects (King and Gurnell 2005). It is unlikely that spayed mares will change their spatial ecology, but being emancipated from constraints of lactation may mean they can spend more time away from water sources and increase their home range size. Lactating mares need to drink every day, but during the winter when snow can fulfill water needs or when not lactating, horses can traverse a wider area (Feist and McCullough 1976, Salter 1979). During multiple aerial surveys in years following the mare ovariectomy study at the Sheldon NWR, it was documented that all treated individuals appeared to maintain group associations, no groups consisted only of treated females, and none of the solitary animals observed were treated females (Collins and Kasbohm 2016). Since treated females maintained group associations, this indicates that their movement patterns and distances may be unchanged.

Spaying wild horses does not change their status as wild horses under the WHB Act (as amended). In terms of whether spayed mares would continue to exhibit the free-roaming behavior that defines wild horses, BLM does expect that spayed mares would continue to roam unhindered in the Warm Springs HMA where this action would take place. Wild horse movements may be motivated by a number of biological impulses, including the search for forage, water, and social companionship that is not of a sexual nature. As such, a spayed animal would still be expected to have a number of internal reasons for moving across a landscape and, therefore, exhibiting 'free-roaming' behavior. Despite marginal uncertainty about subtle aspects of potential changes in habitat preference, there is no expectation that spaying wild horses will cause them to lose their free-roaming nature.

In this sense, a spayed wild mare would be just as much "wild" as defined by the WHB Act as any fertile wild mare, even if her patterns of movement differ slightly. Congress specified that sterilization is an acceptable management action (16 U.S.C. 1333.b.1). Sterilization is not one of the clearly defined events that cause an animal to lose its status as a wild free-roaming horse (16 U.S.C. 1333.2.C.d). BLM must adhere to the legal definition of what constitutes a wild free-roaming horse[7], based on the WHB Act (as amended). The BLM is not obliged to base management decisions on personal opinions, which do not meet the BLM's principle and practice to "Use the best available scientific knowledge relevant to the problem or decision being addressed, relying on peer reviewed literature when it exists" (Kitchell et al. 2015).

Spaying is not expected to reduce mare survival rates. Individuals receiving fertility control often have reduced mortality and increased longevity due to being released from the costs of reproduction (Kirkpatrick and Turner 2008). Similar to contraception studies, in other wildlife species a common trend has been higher survival of sterilized females (Twigg et al. 2000, Saunders et al. 2002, Ramsey 2005, Jacob et

[7] "Wild free-roaming horses and burros" means all unbranded and unclaimed horses and burros on public lands of the United States.

al. 2008, Seidler and Gese 2012). Observations from the Sheldon NWR provide some insight into long-term effects of ovariectomy on feral horse survival rates. The Sheldon NWR ovariectomized mares were returned to the range along with untreated mares. Between 2007 and 2014, mares were captured, a portion treated, and then recaptured. There was a minimum of 1 year between treatment and recapture; some mares were recaptured a year later and some were recaptured several years later. The long-term survival rate of treated wild mares appears to be the same as that of untreated mares (Collins and Kasbohm 2016). Recapture rates for released mares were similar for treated mares and untreated mares.

Bone Histology

The BLM knows of no scientific, peer-reviewed literature that documents bone density loss in mares following ovariectomy. A concern has been raised in an opinion article (Knock 2013) that ovary removal in mares could lead to bone density loss. That paper was not peer reviewed nor was it based on research in wild or domestic horses, so it does not meet the BLM's standard for "best available science" on which to base decisions (Kitchell et al. 2015). Hypotheses that are forwarded in Knock (2013) appear to be based on analogies from modern humans leading sedentary lives. Post-menopausal women have a greater chance of osteoporosis (Scholz-Ahrens et al. 1996), but the BLM is not aware of any research examining bone loss in horses following ovariectomy. Bone loss in humans has been linked to reduced circulating estrogen. There have been conflicting results when researchers have attempted to test for an effect of reduced estrogen on animal bone loss rates in animal models; all experiments have been on laboratory animals, rather than free-ranging wild animals. While some studies found changes in bone cell activity after ovariectomy leading to decreased bone strength (Jerome et al. 1997, Baldock et al. 1998, Huang et al. 2002, Sigrist et al. 2007), others found that changes were moderate and transient or minimal (Scholz-Ahrens et al. 1996, Lundon et al. 1994, Zhang et al. 2007), and even returned to normal after 4 months (Sigrist et al. 2007).

Consistent and strenuous use of bones, for instance using jaw bones by eating hard feed, or using leg bones by travelling large distances, may limit the negative effects of estrogen deficiency on micro-architecture (Mavropoulos et al. 2014). The effect of exercise on bone strength in animals has been known for many years and has been shown experimentally (Rubin et al. 2001). Dr. Simon Turner, Professor Emeritus of the Small Ruminant Comparative Orthopaedic Laboratory at Colorado State University, conducted extensive bone density studies on ovariectomized sheep, as a model for human osteoporosis. During these studies, he did observe bone density loss on ovariectomized sheep, but those sheep were confined in captive conditions, fed twice a day, had shelter from inclement weather, and had very little distance to travel to get food and water (Simon Turner, Colorado State University Emeritus, written comm. 2015). Dr. Turner indicated that an estrogen deficiency (no ovaries) could potentially affect a horse's bone metabolism, just as it does in sheep and human females when they lead a sedentary lifestyle, but indicated that the constant weight bearing exercise, coupled with high exposure to sunlight ensuring high vitamin D levels, are expected to prevent bone density loss (Simon Turner, Colorado State University Emeritus, written comm. 2015).

Home range size of horses in the wild has been described as 4.2 to 30.2 square miles (Green and Green 1977) and 28.1 to 117 square miles (Miller 1983). A study of distances travelled by feral horses in "outback" Australia shows horses travelling between 5 and 17.5 miles per 24 hour period (Hampson et al. 2010a), travelling about 11 miles a day even in a very large paddock (Hampson et al. 2010b). Thus extensive movement patterns of wild horses are expected to help prevent bone loss. The expected daily movement distance would be far greater in the context of larger pastures typical of BLM long-term holding facilities in off-range pastures. A horse would have to stay on stall rest for years after removal of the ovaries in order to develop osteoporosis (Simon Turner, Colorado State University Emeritus, written comm. 2015) and that condition does not apply to any wild horses turned back to the range or any wild horses that go into off-range pastures.

<u>Effects on Genetic Diversity</u>

It is true that spayed mares are unable to contribute to the genetic diversity of a herd, but that does not lead to an expectation that the Warm Springs HMA would necessarily experience high levels of inbreeding, because there would continue to be a core breeding population of mares present, because there was high genetic heterozygosity in the herd at the last measurement, because horses could always be introduced to augment genetic diversity if future monitoring indicates cause for that management action, and because there is an expectation of continued positive growth in the herd (Cothran 2002, 2011). "Fertility control application should achieve a substantial treatment effect while maintaining some long-term population growth to mitigate the effects of environmental catastrophes" (BLM IM 2009-090). This statement applies to all population growth suppression techniques, including spaying. According to the WinEquus population model trials of removal with fertility control (for both trials with PZP treatment and with spay treatments), the health of individual animals or the long-term viability of the herd would not be threatened because between 2022–2028 the lowest possible population growth rate would be 10.4 percent (refer to Table III-2: WinEquus Comparison Table and Appendix P, Warm Springs HMA WinEquus Simulations). The WinEquus trials run for this proposed action also include a gather to low AML at the end of the study (2022) and a proposed gather the next time high AML is achieved. Under this scenario there would be another gather anywhere from 2025 to 2029, depending on the treatment type chosen, at which time hair samples would be collected and genetic analysis completed to determine if appropriate management changes (such as translocations from a nearby HMA) are needed. Periodic gathers allow BLM to collect DNA samples, closely monitor the genetic variability of the herd, and make appropriate changes (e.g. translocation from other HMAs) when testing deems them necessary.

Although BLM is unable to precisely quantify cumulative effects under the proposed action, the effects of this alternative on present and RFFAs and in wild horse and burro habitat would aid in the long-term maintenance of habitat conditions necessary for a thriving natural ecological balance within the HMA. By maintaining AML and potentially slowing the population growth rate of wild horses, the objectives from HMAPs, the Three Rivers RMP/ROD (1992), and the Oregon GRSG ARMPA (specifically the AML, population growth suppression research, and water resources objectives) would be achieved and maintained over the long term (at least 10 years). Maintenance of an appropriate wild horse and burro population under this alternative encourages the success of noxious weed treatments, wildfire rehabilitation efforts, and livestock grazing management activities. Maintenance of AML provides consistency in the annual livestock grazing authorizations, with the exception of climatic fluctuations that may influence timing or level of use. Interference competition and/or direct competition for resources among wild horses, burros, wildlife, and livestock would be reduced or avoided by maintaining AML.

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 Review (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. 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 HMA 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. Introducing 1–2 mares every generation (about every 10 years) is a standard management technique that can alleviate potential inbreeding concerns (BLM 2010). There would be little concern for effects to genetic variability of the herd because the proposed action incorporates BLM's management plan for genetic monitoring and maintenance of genetic variability.

In the last 10 years, there has been a high realized growth rate of wild horses in most areas administered by the BLM, including Warm Springs HMA. As a result, most alleles that are present in any given mare are likely to already be well represented in her siblings, cousins, and more distant relatives on the HMA. Fifty-six blood samples were used for Warm Springs HMA genetic diversity monitoring in 2001 (Cothran 2002), and 83 hair follicle samples were used for monitoring in 2010 (Cothran 2011). Both recent genetic monitoring reports for the Warm Springs HMA indicate that: the horses there come from a mixed ancestry of domestic breeds; that there were no unique blood type, biochemical markers, or alleles found there; and that there was high genetic diversity there both in terms of observed heterozygosity and allelic diversity (Cothran 2002, 2011). In the 2001 sample, one unusual variant associated with Spanish or heavy draft breeds was identified, but it was not flagged as unique. The Warm Springs HMA herd has not been identified as containing a high contribution of Iberian bloodlines (NRC 2013). A number of microsatellite alleles had frequencies below 0.05, which is to be expected with such a high allelic diversity (Cothran 2011); the fact that the alleles present at Warm Springs are not unique means that they are also represented in other HMAs. 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 Review 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.

The Warm Springs HMA would have only a low risk of loss of genetic diversity because the proposed action incorporates BLM's management plan for genetic monitoring and maintenance of genetic variability. After the initial gather, subsequent sterilization and PZP vaccine treatments would take place only after gathers. Wild horses in most HMAs are descendants of a diverse range of ancestors coming from many breeds of domestic horses, and this is apparently true in Warm Springs HMA as well. Genetic monitoring did not identify any unique alleles in Warm Springs HMA. 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 the 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 (5% per year), and very large fractions of the female population are permanently sterilized.

Risks Associated with Radio Collaring

Relatively few studies have incorporated the use of radio collars on wild equids. Nevertheless, those studies have successfully generated data for the study of animal movement, behavior, and habitat use (Collins et al. 2014). In this study, radio collars and tags would be used to locate and monitor wild horse individuals and gain an understanding of their home range and habitat use. Radio collars and tags are also important for locating animals to conduct behavioral observations and to record data on fertility and fecundity.

Based on other studies that have used radio collars and tags to study the ecology of wild ungulates, these devices are expected to have minimal effects on the animals wearing them. However, while every effort is being made to develop a collar that is safe and comfortable, and experienced personnel would fit them, one cannot rule out the possibility of an accident, complication, or mortality of a horse wearing a collar as part of research. Although in the past 3 years USGS researchers have reported only minor rubbing abrasions from collars and a few instances of the collar going over the ears (and then removed using the remote release mechanism), the following effects are possible:

- Collar going over the ear: In other equids this has been observed to happen in males (G. Collins, USFWS and P. Kaczensky Vetmeduni Vienna, pers. comm.), which would therefore be fitted with tags rather than collars in this study. In a current BLM-funded study in Wyoming, radio collars have also been observed to go over mares' ears. All animals wearing collars and tags would be observed at least once a month throughout the year. Should the collar go over the ears of mares, the remote-release (also known as the drop-off mechanism) would be deployed remotely (by radio-tracking the individual and walking to within 200m of it), as has been done in Wyoming. If this fails the collar would be removed after capturing the animal via helicopter drive trapping, bait or water trapping, or darting, depending on what options are best in the specific situation.

- Neck abrasions/sores: Rubbing and sores have not been reported in other studies where equids have been collared (e.g., Collins et al. 2014), and were not seen in any mares during the first 5 months of USGS's collar test at Paul's Valley adoption facility, Oklahoma. Minor rubbing and small wounds have been observed in current BLM-funded studies involving radio collars in Utah and Wyoming. Therefore this problem can be anticipated, but is expected to happen only at a low rate and with minor wounds possible. All horses would be visually checked at least 1–2 times monthly, and this check includes looking for rubbing or sores. Horses in the wild are susceptible to wounds, most of which heal relatively quickly. If sores caused by a collar have not healed within 4 weeks of when they were sighted, that individual would have its collar remotely triggered to drop off. If this fails the collar would be removed after capturing the animal via helicopter drive trapping, bait or water traps, or darting, depending on what options are best in the specific situation.
- Collar too tight: Every effort would be made to put collars on at the correct tightness, which for horses means snug when the head is raised and looser when the head is lowered. Should an individual put on an unusually large amount of weight, it is conceivable that the collar may become too tight. In this case the collar would be removed with the remote release mechanism or the individual would be captured and the collar removed.
- Tags: No negative effects of the tags are expected; however, it is possible that they may form an irritation to individuals should vegetation get tangled in the tail. In this case, the tag would be ultimately expected to rip out of the hair (leaving no injury) as the horse rubs it.

Effects of PZP

Gathers following the completion of the research study could implement the use of PZP fertility control treatment if the results of the spay study indicate the method is not feasible as a long-term management tool for this HMA. Up to 90 percent of the mares released following an AML gather would be treated with the 2-injection liquid PZP (ZonaStat-H; Science and Conservation Center, Billings, Montana) or the PZP-22 vaccine pellets or another comparable fertility treatment if one becomes available during the

10-year timeframe of analysis. PZP acts as a vaccine against pregnancy by stimulating the production of zona pellucida antibodies in female mammals (Ransom et al. 2011, Liu et al. 1989, Sacco 1977). These antibodies provide a barrier that prevents sperm from binding to the surface of an ovum and results in limited penetration of the zona pellucida and subsequent limited pregnancy in horses (Ransom et al. 2011, Kirkpatrick et al. 1990, Liu et al. 1989).

In a study where 2-injection PZP was applied to wild mares in Nevada, Turner and others (1997) determined that the 2-injection protocol brought the reproductive success rate to around 4.5 percent versus the 53 percent success rate of untreated mares. However, the effect of PZP treatment in 2-injection mares was sustained through 1, but not 2, breeding seasons, indicating a return to fertility after 1 year (Turner et al. 1997). Some mares given the standard 2-injection protocol will become fertile the second breeding season following the treatment but some will remain infertile for another or even 2 years, thus, there should be some reduction in foaling up to 4 years out (Dr. Jay Kirkpatrick, written comm. 2013). However, continued research on PZP-22 by Turner indicates that current formulations of PZP-22 lead to only 1 year of contraception, not 2 (2014 Progress Report to BLM). Instances of PZP-22 application in HMAs within the Burns District BLM indicate that it remains minimally effective at slowing population growth between gather cycles (4–5 years). A multi-year, high efficacy rate would be more desirable for long-term (3–5 years) population management, specifically in HMAs where wild horses are inaccessible. In an effort to broaden the scope for successful contraceptive management with the use of a single-treatment, multi-year contraceptive vaccine, results from Rutberg and others (2017) found that initial PZP-22 primer treatments on mares showed disappointing effectiveness, although a single PZP booster administered 2–3.2 years later effectively reduced fertility across 3 consecutive years (Rutberg et al. 2017). Whether delivered by dart or by hand, PZP boosters reduced foaling rates in treated mares by roughly 65–72 percent relative to untreated control mares over 3 years (Rutberg et al. 2017). Authors were encouraged by the demonstration of management flexibility in PZP-22 application because data suggested that the interval between initial and booster treatments (2–3.2 years) does not obviously influence effectiveness or longevity of the booster (Rutberg et al. 2017). Their findings provide evidence of a double-treatment, multi-year contraceptive that is already available for use, which is a major step toward improving vaccine longevity. The treatments by Rutberg et al. (2017) would be similar to treatments in the proposed action.

Contradictory evidence exists regarding the effect of PZP on the behavior of mares treated and on the social structure of a herd. Powell (1999) reported that PZP-treated mares continually undergo non-conceptive cycles (demonstrated estrous behavior throughout the season), causing stallions to continue to tend and mate with mares until they ceased to cycle in the fall. In addition, results of a study conducted by Madosky and others (2010) on Shackleford Banks Island horses indicated that PZP used to control population numbers has a significant negative effect on harem stability. Ransom and others (2010) found that direct effects of PZP treatment on the behavior of feral horses appear to be limited primarily to reproductive behaviors, and most other differences detected were attributed to the effects of body condition, band fidelity, or foal presence. Ransom and others (2010) found that treated females received considerably (54.5 percent) more reproductive behaviors from stallions than did control females. However, Madosky (2011) found that PZP contracepted mares changed harems significantly more often than control mares (PZP caused a decrease in harem fidelity regardless of season), and Nuñez and others (2014) found that PZP-treated mares exhibited higher infidelity to their band stallion during the non-breeding season than control mares. Results from the study by Nuñez and others (2014) show that mares in the midst of changing groups exhibit increased fecal cortisol levels. They acknowledge that the results show that PZP treatment itself does not increase cortisol levels in recipient animals, however, consistent band changes may put them at higher risk of chronic stress (Nuñez et al. 2014). While studying the return of previously PZP-treated mares to their physiological and behavioral baselines, Nuñez and others (2017) found that mares previously receiving 4+ treatments changed groups more frequently than did untreated mares. However, the results also show that with less frequent treatment (i.e. PZP-22 applied during the gather cycles of the proposed action) some of these effects can be ameliorated with time and therefore enable more flexible population management.

An additional concern associated with the use of PZP is the potential for late foaling dates on previously treated mares. Nuñez and others (2010) concluded that PZP recipient mares exhibited a change in their reproductive schedule; recipient mares gave birth over a broader time period than did non-recipients. The study by Nuñez and others (2010) provides the first evidence that mares treated with PZP can extend ovulatory cycling beyond the normal breeding season. Results from a study by Ransom and others (2011) support early investigations by Liu and others (1989) and Kirkpatrick and others (1990) that application of PZP does not affect pregnancies in progress. Parturition phenology (birthing season) for North American feral horses has been shown to peak during May (Berger 1986, Garrott and Siniff 1992, Nuñez et al. 2010) and photoperiod and temperature are powerful inputs driving the biological rhythms of conception and birth in horses. With an 11-month gestation period, this timing maximizes the likelihood that foals will be born and spend their first few months of life at a time when the weather is warm and food is plentiful (Crowell-Davis 2007). Ransom and others (2013) 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 and others (2013), however, showed that over 81 percent of the documented births in this study were between March 1 and June 21, that is, within the normal, peak, spring foaling season. Ransom and others (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 and others (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 and others (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).

Another concern that has been raised is that persistent use of any immunocontraceptive could lead to an increase in the prevalence of genes associated with a poor immune response (Cooper and Larson 2006, Ransom et al. 2014a). 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. The BLM is not aware of any studies that have quantified the heritability of a lack of response to PZP vaccine in horses. Magiafoglou and others (2003) clarify that if the variation in immune response is due to environmental factors (e.g. body condition or social rank) and not due to genetic factors, then there will be no expected effect of the immune phenotype on future generations.

Concern has been raised over the potential that repeated PZP treatment may lead to longer-term sterility, and that sterility may result from PZP treatment before puberty. In their study of reversibility of PZP treatments of wild horses, Kirkpatrick and Turner (2002) showed that most mares receiving 2 initial injections and up to 1 subsequent annual booster returned to fertility within 1 year, whereas mares receiving 3 or 4 consecutive years of treatment experienced delays of 3 to 4 years in return to foaling (Rutberg et al. 2017). In the study that began in 1988 by Kirkpatrick and Turner (2002), mares were treated with PZP vaccine for 1, 2, 3, 4, 5, or 7 consecutive years. "All five mares treated for 4 or 5 consecutive years have also returned to fertility, but over longer periods of time. Mares treated for 7 consecutive years have not returned to fertility, but several, while still infertile, have started ovulating again" (Kirkpatrick and Turner 2002). The proposed action does not include annual treatment of mares with PZP (refer to Alternatives Considered but Eliminated from Further Analysis, Intensive Fertility Control, II.C.5) and would be similar to treatments conducted by Rutberg and others (2017). Therefore, mares would return to fertility within 3–4 years. In her graduate thesis, Knight (2014) reported evidence of sterility caused by timing of the initial dose of PZP prior to puberty. Based on BLM's removal criteria for horses removed from the HMA, it is not likely that any of the mares returned to the range would have not passed puberty because the 1–4 year olds are the first priority for removal. Even if there is potential for sterility of mares treated by PZP prior to puberty, there would be little concern for effects to genetic variability of the herd because all action alternatives incorporate BLM's management plan for genetic monitoring and maintenance of genetic variability. The effects of mare sterility on genetic diversity in this herd are noted above under consideration of the effects of spaying. Effects of PZP on genetic diversity would be expected to be similar, but less pronounced as it is expected that most PZP-treated mares would return to fertility.

For additional effects analysis related to the use of PZP, refer to Appendix Q, PZP Literature Review.

2. Cultural Resources

The following issue is addressed in this section.

- *What would be the effect of the wild horse and burro population management plan alternatives on cultural resources?*

a. Affected Environment – Cultural Resources

Two hundred and one archaeological sites are known to occur within the Warm Springs HMA. Of this number, 42 sites (21 percent) are located within 200 feet of water developments, primarily playa lake stock reservoirs. The remaining 159 sites are not located near man-made water developments but some are located near areas of natural ponding from seasonal run-off. A small fraction of the HMA has been inventoried for cultural resources. It is likely that hundreds and, potentially, thousands more archaeological sites occur in the nearly half million acre HMA. Based on past observations and experience on Burns District, it is likely that at least 20 percent of these additional un-discovered sites are near man-made or natural water sources.

The 400-foot diameter zone around man-made or natural water sources is considered a "congregation" area where the effects of livestock/horse/burro trampling, wallowing, and scuffing the ground surface are concentrated. Any surface or shallowly buried archaeological site within this zone is susceptible to the abovementioned effects and can be disturbed to a depth of at least 12 inches. Within this zone of disturbance, archeological material can be mixed both up and down and in a horizontal direction and artifacts can be broken. What results is total loss of site context and scientific value.

The extent that sites have been affected by livestock trampling in the past has not been adequately measured and quantified due to a historic lack of information on the sites themselves prior to the late 1970s when archaeologists were first employed by the BLM for inventory and monitoring.

"Generalized" grazing (i.e. grazing away from congregation areas) is not believed to affect archaeological sites because it is believed that historic grazing before 1935 was at a much higher level than today. However, increasing the horse and burro herd to over 5,000 animals could expand congregation areas and produce additional congregation areas that are not evidenced under the current grazing regime.

b. Environmental Consequences – Cultural Resources

No Action

The no action alternative would result in greater numbers of horses and burros over the next 10 years to the point that their grazing effects would be at least five times the current effects in congregation areas. Increasing the horse and burro herd to over 5000 animals could expand congregation areas and produce additional congregation areas that are not evidenced under the current grazing regime. If fertility control and gathers are not implemented then over 20 percent of the known archaeological sites in this HMA would be damaged below a 12-inch depth from increased congregation near man-made or natural water sources.

Congregation areas could expand under the no action alternative and grazing effects in what is currently considered "generalized" grazing areas and additional archaeological sites could be affected.

For the purposes of this analysis, the cumulative effects analysis area (CEAA) for cultural resources is within the HMA. The extent that sites have been affected by livestock trampling in the past has not been adequately measured and quantified due to a historic lack of information on the sites themselves prior to the late 1970s when archaeologists were first employed by the BLM for inventory and monitoring. Therefore, with the increased number of horses and burros in the HMA far and above AML, cumulative effects from wild horse and burro congregation could increase the size of congregation areas, thereby having a greater effect on a greater number of cultural resources than under the proposed action.

Proposed Action
The proposed action, with its focus on fertility control and gathers would eliminate or minimize additional effects to archaeological sites within 200 feet of any man-made or natural water source. Archaeological sites within generalized grazing areas would remain unaffected.

For the purposes of this analysis, the cumulative effects analysis area (CEAA) for cultural resources is within the HMA. The proposed action and other ongoing and RFFAs would not lead to cumulative effects to cultural resources because proposed projects would be localized or the sites would be completely avoided per incorporated project design features. Potential direct and cumulative effects to cultural resources would be mitigated through project-specific cultural resource inventory and mitigation measures prior to any project implementation.

3. Riparian Zones, Wetlands, and Water Quality

The following issue is addressed in this section.

- *What would be the effects of the alternatives on water quality and riparian conditions within the HMA?*

a. Affected Environment – Riparian Zones, Wetlands, and Water Quality

Riparian areas within the Warm Springs HMA are monitored through permanent photo points, proper functioning condition (PFC) assessments, and site visits. Riparian monitoring occurs approximately every 2–5 years, depending on the monitoring type. Perennial water sources are regularly monitored while intermittent streams are periodically evaluated.

Buzzard Creek is a temporal and spatially intermittent stream that flows into Silver Lake playa. Water is dispersed into the creek from spring runoff, other high-water events, and subsurface flow from Buzzard Spring. Primary use is as a water source for wildlife, wild horses, burros, and livestock. This stream is not an Oregon Department of Environmental Quality (ODEQ) 303(d) listed stream, is not fish-bearing, does not contribute to any fish-bearing stream, and is not a source for public drinking water.

Ross Springs is a spring that is excluded from livestock, wild horse, and burro grazing and has high species diversity, with vegetation that appears vigorous. Photo monitoring shows a stable trend and this site was rated at PFC in 2015.

Seiloff Dikes is a wetland habitat created by a series of constructed dikes to pond water supplied by Seiloff Spring. This area is excluded from livestock and wild horse and burro grazing, with water piped outside the exclosure to a watering trough. A PFC assessment was conducted in 2015 and the site was rated at PFC. The site capability is that of an altered/created wetland. A series of dikes and headgates pond the water that historically would have flowed onto a larger playa lakebed. The dikes/ponds were built to create waterfowl habitat and an exclosure fence surrounds most of the wetland. Monitoring photos show a stable trend.

Thorn Springs is a highly productive spring with high species diversity and vegetation that appears vigorous. This is the only perennial water source that is not fenced. A PFC assessment was conducted in 2015 and the site was rated at the upper end of functioning at risk (FAR). The primary reasons for the FAR category were due to the recent, unauthorized waterhole/dugout that had been created near the wetlands spring source and the presence of a small patch of the noxious weed, perennial pepperweed. Monitoring photos show a stable trend.

Bigfoot Reservoir is located on the East Warm Springs Allotment. It was expanded from a 1.8-acre waterhole to a 160-acre reservoir and fenced in 1975. Two goose nesting islands were created at that time and various woody species, riparian, and aquatic vegetation were planted throughout the area. Since then, willows have survived, expanded, and show high vigor along with cattails, reed canary grass, and various sedges and rushes. This area has been under drought conditions over the past 5 years, severely reducing the water level in the reservoir. Monitoring has not been conducted on this reservoir.

Numerous playa lakebeds exist within the HMA with many containing waterholes. Presently, these areas receive seasonal use by livestock, wild horses, burros, and wildlife each year. Indicators for rangeland health and riparian monitoring data from 2015, for both West and East Warm Springs Allotments, indicate all standards for rangeland health are either not present, achieved, or if not achieved, livestock/wild horses/burros are not a causal factor.

b. Environmental Consequences – Riparian Zones, Wetlands, and Water Quality

Common to both Alternatives

The CEAA for both alternatives for riparian zones, wetlands, and water quality is the thirteen watersheds that overlap the HMA boundary. The thirteen watersheds are Big Stick Creek, Wilson Creek, Flybee Lake, Buzzard Creek, Jackass Creek, Juniper Creek-Dry Valley, Little Tank Creek, Big Tank Creek, Lower Silver Creek, Harney Lake-Malheur Lake, Lower Donner und Blitzen River, Middle Donner and Blitzen, and Walls Lake Reservoir. No cumulative effects under any of the alternatives to the Little Tank Creek-Big Tank Creek and Juniper Creek-Dry Valley watersheds are expected because so little of these watersheds fall within the HMA.

Past and present actions, such as those described in the affected environment above, have influenced the existing environment within the CEAA. The RFFAs in the CEAA that may contribute to cumulative effects to riparian zones, wetlands, and water quality include recreation, maintenance of existing range improvements, fire rehabilitation actions, and noxious weed treatments.

<u>No Action</u>
The no action alternative could cause an increase in the wild horse and burro population up to 5000+ in the HMA, which would result in greater use and degradation of the unfenced Thorn Springs wetland area. This would result in a decline in riparian function. Riparian area vegetation would be degraded, as additional horse and burro use would decrease vegetation recruitment, reproduction, and survivability. In addition, riparian vegetation community types and distribution would be changed, root density lessened, and canopy cover reduced. This would lead to reduced spring/seep dynamics and further deterioration of this system. The year-round grazing within riparian zones favors the increase of xeric species within the plant communities. The removal of riparian herbaceous species cover due to heavy grazing from horse and burro populations exceeding AML would also affect the function of this vegetation for the retention of sediment during high water events.

Although BLM is unable to quantify cumulative effects under the no action alternative, the effects of this alternative on past, present, and RFFAs on riparian zones, wetlands, and water quality would be detrimental. The no action alternative would negatively affect the resources listed above. Riparian zones, wetlands, and water quality would see increased impact due directly to increased numbers in wild horses and burros. The population increase would strain the above resources causing degradation that is difficult and expensive to restore.

Greater pressure would be placed on wetland/riparian exclosure fences as wild horse and burro populations exceed carrying capacity and water availability. Fences would likely be breached and horses and burros would have access to these habitats. Under this scenario, effects to fenced riparian areas would be the same as those described above for Thorn Springs.

<u>Proposed Action</u>
The proposed action would reduce and maintain the wild horse and burro population to within AML, therefore reducing and minimizing their potential effect on riparian zones and wetlands. Maintaining populations

within AML in this water-limited HMA aids in limiting the pressure placed on riparian exclosure fences. Currently Thorns Springs remains unfenced and may maintain or improve in condition with maintenance of wild horse and burro numbers within AML.

Although BLM is unable to quantify cumulative effects under the proposed action, the effects of past, present, and RFFAs would benefit riparian zones, wetlands, and water quality. By maintaining AML and applying population growth suppression to wild horses, the population would potentially slow and provide opportunity for improvement in riparian areas, wetlands, and water quality.

4. Livestock Grazing Management

The following issue is addressed in this section.

- *What would be the effects of the alternatives on livestock grazing management and associated ranch operations?*

a. Affected Environment – Livestock Grazing Management

Within the Warm Springs HMA, there are two grazing allotments. All of the allotments and pastures are entirely inside the HMA boundaries. Refer to Appendix R, Allotment and Water Development Map. There are a total of nine livestock operators currently authorized to graze livestock in the HMA. The BLM allocated forage for livestock use through the Three Rivers RMP/ROD (1992) and specifically allocated 19,392 AUMs of active preference to livestock for forage each year within these allotments. These allocations were based on the analysis of monitoring data that included actual use, utilization, climate data, long-term trend studies, and professional observations. Table III-3, following, summarizes the livestock use information for the allotments in the HMA. Actual livestock use across the HMA has varied due to drought and the 2012 Miller Homestead Wildfire causing periods of rest from grazing. Average actual use since 2008 for the allotments are found in Table III-4 and Table III-5.

Table III-3: Authorized Livestock Use Within the Warm Springs HMA.

Allotment	BLM Administered Acres	% of Allotment in HMA	Permittees	Permitted Season of Use	Permitted Active Use AUMs
East Warm Springs	178,144	100%	5	4/11–8/31	8,225
West Warm Springs	297,375	100%	4	4/1–9/15	11,167

Table III-4: Actual Use within Warm Springs HMA by Allotment

Allotment	Year	Actual AUMs Used	Percent of Permitted AUMs
East Warm Springs	2017	6,530	79%
	2016	5,713	69%
	2015	4,889	59%
	2014	4,612	56%
	2013	4,701	57%
	2012	5,592	68%
	2011	7,004	85%
	2010	5,798	70%
	2009	5,802	71%
	2008	6,483	79%
West Warm Springs	2017*	7,548	68%
	2016*	8,046	72%
	2015*	7,966	71%
	2014*	6,569	59%
	2013	7,158	64%
	2012	6,109	55%
	2011	6,399	57%
	2010	6,530	58%
	2009	4,916	44%
	2008*	6,415	57%

*Not all users actual use was turned in these years so billed use was used to supplement these calculations, as it was the best available information.

Table III-5: Total Combined Actual Use within Warm Springs HMA by Year

YEAR	Combined Actual Use AUMs	Percent of Permitted AUMs
2017	14,078	73%
2016	13,759	71%
2015	12,855	66%
2014	11,181	58%
2013	11,859	61%
2012	11,701	60%
2011	13,403	69%
2010	12,328	64%
2009	10,718	55%
2008	12,898	67%

The allotment management plans (AMP) associated with these two allotments established objectives to maintain or improve key herbaceous species in the respective allotments. These AMPs provide grazing prescriptions that allow for periodic growing season rest for key forage species to aid in maintaining plant vigor and reproduction. Both of the AMPs also set target utilization levels of a maximum of 50 percent on native species and 60 percent on non-native species (e.g. crested wheatgrass). Burns District BLM monitors annual utilization levels on key forage species by all uses (i.e. livestock, horses, and wildlife). The method most commonly used on Burns District to monitor utilization levels is the Landscape Appearance Method.[8] These target levels aid in determining the need for action or adjustments if utilization levels exceed 50 or 60 percent, respectively. Utilization is not specific to domestic livestock. If utilization objectives are reached prior to turnout or early in the grazing schedule, then removal of domestic livestock would occur. For both West and East Warm Springs Allotments, indicators for rangeland health and riparian monitoring data through 2015 indicate standards for rangeland health are either not present, achieved, or if not achieved, livestock are not a causal factor. Monitoring of trend in condition of upland vegetation at representative sites in both East and West Warm Springs Allotments is static overall with some areas seeing a downward trend and some areas indicating an upward trend in key herbaceous species. Long-term upland trend plots have been revisited approximately every 5 years across the

[8] Landscape Appearance Method is defined as a qualitative assessment technique that uses an ocular estimate of forage utilization based on the general appearance of the rangeland. Utilization levels are determined by comparing observations with written descriptions of each utilization class. An example description of a utilization class is as follows: (21–40 percent) *The rangeland may be topped, skimmed, or grazed in patches. The low value herbaceous plants are ungrazed and 60 to 80 percent of the number of current seed stalks of herbaceous plants remain intact. Most young plants are undamaged*. There are 6 Utilization Classes; No Use (0–5%), Slight (6–20%), Light (21–40%), Moderate (41–60%), Heavy (61–80%), and Severe (81–100%).

HMA with the most recent for East Warm Springs Allotment in 2013 and 2015 and for West Warm Springs Allotment in 2012, 2015, and 2017. Although assessments have found portions of the HMA are achieving upland rangeland health standards, local areas of declining bunchgrass health have been observed, generally in areas around the limited reliable water sources, and within some of the wild horse and livestock congregation areas.

It is estimated that by fall 2018, the wild horse population would be approximately 738 adult horses plus 147 foals. Wild horses and burros within the Warm Springs HMA have 2,424 AUMs of forage allocated to their use at high AML of 202 animals. If the population reaches the 738 adult horses, estimate they would be utilizing 8,856 AUMs; exceeding their allocated use by 6,432 AUMS. Upland forage utilization monitoring documents moderate to high utilization levels in portions of the HMA experiencing concentrated wild horse and livestock use. In 2017, moderate to heavy use was indicated in several areas of the HMA where lower levels of livestock use occurred.

Some horse herds make a substantial part of their use in areas not used by cattle. However, in this HMA many of the areas of major horse and burro use are also major use areas for cattle. This, in general, is due to the availability of reliable water sources. There are a few wells within the HMA; however, most of the water sources in this HMA are constructed stock reservoirs that are fed by winter snow melt leading to runoff and filling the reservoirs or playas. During the late summer grazing period, water becomes limited through evaporation and use. In addition, in years where snow accumulation is limited, water scarcity restricts use in this HMA to very few areas, generally just at the well sites.

b. Environmental Consequences – Livestock Grazing Management

There are many similarities between livestock use and wild horse and burro use. However livestock use in the HMA is managed to provide periodic growing season rest to desirable forage species to help maintain or achieve a healthy functioning landscape. This is achieved through management of timing, duration, and intensity of livestock use. These tools are not available for wild horse and burro management. One result is horses will spend much of the year in their preferred area causing grazing pressure year-round.

For the purposes of this analysis, the CEAA for livestock grazing management consists of the pastures within the HMA. Past and present actions, such as those described in Affected Environment, have influenced the existing environment within the CEAA. Past and RFFAs that have and would affect livestock grazing management and would contribute to cumulative effects are fence and water developments and maintenance, wildfires, prescribed burns, wild horse and burro utilization, periodic wild horse and burro gathers, wildlife use, hunting and other recreational pursuits, ongoing noxious weed treatments, and road maintenance. Maintaining existing water developments, and constructing new water sources, would allow for more reliable water for horses throughout the year and disperse their use more evenly across the HMA into areas previously not available for use due to the lack of water. Increasing the composition of perennial grasses, forbs, and shrubs in these communities inherently increases herbaceous forage production for all grazers.

<u>No Action</u>

Under the no action alternative, no gathers with removals would occur and the population would continue to grow. Using a 20 percent population growth rate, wild horse numbers would increase from the fall 2018 estimate of 738 adults and 147 foals to approximately 1,836 adult horses and 367 foals by 2023 (5 years is one normal gather cycle). That would mean forage utilized by wild horses would increase dramatically and AUMs used by adult horses would be up to 22,032. By fall 2028, the end of the 10-year timeframe of this EA, the wild horse population would be estimated at 4,569 adult horses plus 914 foals, or 54,828 AUMs for adult horses. To put that into perspective, the current total allocated AUMs for cattle, wild horses, burros, deer, and antelope within the Warm Springs HMA is 22,149 AUMs. The horse use, alone, would be more than double that.

Wild horse and burro numbers above the AML result in utilization of more AUMs than they were allocated. At the current estimated use level, horses alone are using 8,856 AUMs, which is 6,432 AUMs more than they and burros are allocated. In order to meet annual utilization targets and continue to achieve land health standards, permitted livestock grazing would likely be reduced below full permitted use as wild horse and burro numbers continue to exceed AML. Heavy utilization is occurring in areas used by livestock, wild horses, burros, and wildlife, specifically around water sources. The indirect effects of the no action alternative would be damage to the forage resources, which would likely lead to land health standards not being achieved in the future. The no action alternative would lead to competition between livestock, wild horses, burros, 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 fully use the forage they are authorized, possibly leading to the operators having to reduce numbers (Table III-4 and Table III-5).

Without the maintenance of AML, the allotment is at risk for not meeting standards in the future, despite management of livestock grazing animals.

"Unmanaged or poorly managed non-native grazers, including horses, can have substantial impacts on ecosystem integrity, influencing a wide array of native flora (Smith 1986, Levin et al. 2002, Zalba and Cozzani 2004, Beever et al. 2008, Davies et al. 2014), fauna (Beever 2003, Beever and Brussard 2004, Beever and Herrick 2006, Hall et al. 2016a, Gooch et al. 2017), and ecosystem processes (Beever and Brussard 2000, Zeigenfuss et al. 2014)" (Collins and Kasbohm 2016).

The cumulative effects of the no action with past, present, and RFFAs would be detrimental to the outcome and efforts put toward completing successful projects such as noxious weed treatments, wildfire rehabilitation, and livestock grazing management actions to maintain or improve rangeland conditions.

Proposed Action

Livestock grazing would be expected to continue to occur in a manner that achieves the standards for land health and conforms to the Three Rivers RMP/ROD (1992) and to the GRSG ARMPA (2015). Utilization of the available vegetation would also be expected to continue at similar levels (up to 50 percent on native perennial grasses). Grazing management that provides for periodic grazing deferral and forage recovery would continue. In some years, this may result in livestock being removed from the area prior to utilizing all of their permitted AUMs. Continuing to graze livestock in a manner consistent with grazing permit terms and conditions would be expected to achieve or make significant progress toward achieving land health standards.

Gather activities could result in direct effects by disturbing and dispersing the livestock present for a period of 5 to 7 days. Trapping activities would be scheduled in coordination with the rangeland management specialist to avoid conflicts with the authorized grazing rotations. Any removal of wild horses and burros would result in some level of reduced competition between the species for available forage and water. Indirect effects would include an increase in the quality and quantity of the available forage for the remainder of the grazing year. This benefit would decrease as wild horse and burro numbers increased until the next gather.

Under this alternative, the wild horse and burro herd size would be decreased periodically to the low end of AML as the population reaches high AML. Wild horse mares would be treated by spaying and/or PZP fertility control treatments following subsequent gathers during the 10-year timeframe of this analysis. The combination of these design features would result in a slower increase in the wild horse population. This would allow wild horse and burro use to remain within their allocated AUMs for the 10-year timeframe of this analysis, providing the availability of forage for livestock up to their full permitted use (dependent on annual rangeland conditions). The ability to continue gathers and wild horse fertility control treatments, as needed, over the next 10 years would decrease the risk of wild horse and burro numbers interfering with the ability of livestock to utilize permitted AUMs.

The cumulative effect of the proposed action with past, present, and RFFAs would be favorable to the outcome and efforts put toward completing successful projects such as noxious weed treatments, wildfire rehabilitation, and livestock grazing management actions to maintain or improve rangeland conditions. Maintaining wild horse populations within AML avoids competition with other uses and impacts on habitat requirements for other species.

5. Wildlife and Wildlife Habitat, Including Special Status Species

The following issue is addressed in this section.

- *What would be the effects of the alternatives on Greater Sage-Grouse habitat?*
- *What would be the effects of the alternatives on pygmy rabbit habitat?*
- *What would be the effects of the alternatives on large ungulate habitat in the HMA?*

a. Affected Environment – Wildlife and Wildlife Habitat, Including Special Status Species

The affected environment for wildlife habitat for each alternative at the Warm Springs HMA scale is described as predominately warm-dry (arid) sagebrush habitat with ecological site inclusions of low sagebrush, Wyoming big sagebrush, basin big sagebrush, old-growth western juniper (>150 years of age), and playas. Examples of common ecological sites are Claypan 10–12 precipitation zone (PZ), Loamy 10–12 PZ, and Cold Plateaus and Uplands 10–12 PZ, all of which are potential sagebrush steppe plant communities if alterations have not yet changed the vegetative reference plant community. Arid sagebrush steppes are vulnerable to threats that include wildfire, invasive exotic annual grasses, and continuous grazing by large herbivores such as cattle and wild horses.

The range of alternatives would affect potential habitats of documented Burns District terrestrial special status species (SSS), migratory birds, and locally important wildlife that occur in the HMA. For SSS this includes: Greater Sage-Grouse (GRSG) (*Centrocercus urophasianus*), Western bumblebee (*Bombus occidentalis*), golden eagle (*Aquila chrysaetos*), pygmy rabbit (*Brachylagus idahoensis*), pallid bat (*Antrozous pallidus*), Townsend's big-eared bat (*Corynorhinus townsendii*), and spotted bat (*Euderma maculatum*). Affected migratory birds include species such as Brewer's sparrow (*Spizella breweri*), vesper sparrow (*Pooecetes* *gramineus*), sage sparrow (*Artemisiospiza nevadensis*), mountain bluebird (*Sialia currucoides*), ferruginous hawk (*Buteo regalis*), and others that depend on habitats mentioned above to be in a functioning state. The Migratory Bird Treaty Act of 1918 identifies migratory birds, regardless of their status, as common or rare. Locally important species are pronghorn antelope (*Antilocapra Americana*) and mule deer (*Odocoileus hemionus*), with antelope being the majority big game animal across the HMA. This HMA is in one of ODFW's higher priority management units of highest quality for antelope.

This analysis is focused on GRSG habitat objectives (GRSG ARMPA 2015, table 2-2). All other sagebrush obligate species, such as pygmy rabbits, and the associated sagebrush steppe habitat would fall under the umbrella of analysis for each alternative. GRSG use the HMA yearlong and there are 18 pending leks within the HMA.

Warm Springs HMA is defined as both priority and general habitat management areas (PHMA and GHMA) for sage-grouse. Approximately 18 percent of the HMA is designated as PHMA and is part of the Dry Valley/Jack Mountain Priority Area of Conservation (PAC), 74 percent is GHMA, and the remaining 8 percent is designated as non-habitat. In Oregon, approximately 11,775 km^2 of sage-grouse current range overlaps with BLM HMAs (11,991 km^2) (Beever and Aldridge 2011). Priority sage-grouse habitat are areas that have been identified as having the highest conservation value to maintain sustainable GRSG populations. These areas include breeding, late brood rearing, and winter concentration areas. General sage-grouse habitat is seasonally or year-round occupied habitat outside of priority habitat. The BLM has identified PHMA and GHMA in coordination with respective State wildlife agencies.

The Oregon GRSG ARMPA (2015) describes three general habitat types: breeding (lekking, nesting, and early brood rearing, March 1–June 30), brood rearing (summer and autumn, July 1–October 31), and winter (November 1–February 28), and the desired vegetative conditions/objectives for each (GRSG ARMPA, table 2-2). All three habitat types are present or there is the potential based on ecological sites that if restored could support a plant community with these habitat characteristics. Current GRSG use in the HMA is based on annual spring lek counts, 4-mile lek buffers, and in-the-field observations.

Most GRSG hens nest during late March to mid-June (late May to June nests are typically second attempts.). New growth of perennial herbaceous plants is minimal for early established nests and previous years' (residual) vegetation provides cover for those nests (Gregg et al 1994). The probability for nest success increases when there are available patches of sagebrush canopy cover greater than 15 percent and grass cover of both residual and current year's perennial grass growth is greater than 10 percent for arid sagebrush steppe. Furthermore, perennial grass and forb height have been measured to be critical for nest success and early brood rearing with ≥ 7 inches for arid sites (GRSG ARMPA, table 2-2). Herbaceous cover and height provide horizontal screening at the nest site, which obscures the nest from predators. Shrub and herbaceous cover is also critical during early brood rearing when GRSG chicks are small and vulnerable to predators. Brood-rearing habitat also occurs within the HMA, which includes the numerous playas in the HMA (>100 playas). During summer months GRSG hens would be predicted to move broods to these areas for foraging and water. These areas are also important to wild horses and burros because by mid to late summer developed waterholes in playas are some of the last places to have water. During winter months GRSG rely heavily on sagebrush leaves for food, especially winters with deep snow and cold weather that limits herbaceous forage availability.

Greater sage-grouse habitat objectives were determined by the 2015 GRSG ARMPA (table 2-2) and can be quantified by using Earth Sense Technology (EST), which uses remote sensing at multiple spatial and temporal scales. EST can be used to group GRSG habitat suitability into states as described in the State and Transition Models (STM) for GRSG (Sant et al. 2014). This is a threat based model that identifies specific desirable or undesirable transitions in sagebrush habitat (Oregon Sage-SHARE 2017). The STMs are defined as State A: Sagebrush/Perennial Herbaceous State, State B: Perennial Herbaceous State, State C: Degraded Sagebrush State, and State D: Exotic Annual Grass State. State A is the most desirable habitat condition for sagebrush obligate species such as GRSG, whereas State D is the least desirable and considered unsuitable habitat.

Arid sagebrush STM data show 66 percent GRSG habitat is in State A, 4 percent State B, 15 percent State C, and 12 percent State D (Table III-6 and Appendix S – State Transition Model and Sage-grouse Habitat Map.) Overall, lek populations have seen a drastic decline. In 2016, the Dry Valley/Jack Mountain PAC tripped a soft trigger by crossing a population threshold. This trigger is tripped when the population five-year running mean drops below the lower 95 percent confidence interval value. In 2017 this PAC tripped a hard trigger caused by a further decline in population. This trigger is tripped when the five-year running mean population drops below the lower standard deviation value.

Causal factors or plausible threats to habitat degradation and the drastic decline in population are wildfires, specifically the Miller Homestead Fire in 2012, invasive exotic annual grasses, prolonged drought limiting available water for brood rearing, and possibly yearlong grazing and competition for water resources by wild horses within the 4-mile lek buffer.

Table III-6. HMA STMs Sage-Grouse Habitat States Invasive Annual Grass Threat Model

Threat Model	Habitat State	Acres	Percent	Causal Factor Disturbance(D) or Succession(S)	State Trending Towards
Arid – Invasive annual grass	State A	316,916	66	S	State A
	State B	21,011	4	S	State A
	State C	72,629	15	D	State D
	State D	59,827	12	S & D	State D
Other Habitat Types	Juniper	5,436	1		
	Sparse Vegetation = Large Playas	10,964	2		

<u>Color Code</u>: Green = potential year round habitat; Yellow = seasonal habitat; Orange = seasonal habitat winter; Red = non-habitat

<u>Arid</u>: State A = sagebrush-perennial herbaceous; State B = perennial herbaceous; State C = degraded sagebrush; & State D = exotic annual grass

b. Environmental Consequences – Wildlife and Wildlife Habitat

<u>Effects Common to All Alternatives</u>
For the purposes of this analysis, the CEAA for wildlife includes the Jack Mountain/Dry Valley PAC and Warm Springs HMA boundaries to encompass possible movements/home range of GRSG that would be affected by management actions within the HMA. The total acreage of this HMA plus the CEAA is approximately 775,453 acres, with the HMA making up 64 percent of the CEAA. Primary threats to GRSG habitat are improper grazing management by wild horses or livestock, wildfire, exotic invasive annual grasses, and drought. The STM was also used to describe

the current conditions of GRSG habitat across the CEAA (table III-7). Suitable sagebrush habitat availability is becoming limited with only about 58 percent in State A. The other remaining states are either unsuitable habitat or transitioning from marginal to unsuitable.

Table III-7 CEAA STMs Sage-Grouse Habitat States Invasive Annual Grass Threat Model

Threat Model	Habitat State	Acres	Percent	Causal Factor Disturbance(D) or Succession(S)	State Trending Towards
Arid – Invasive annual grass	State A	445,324	58	S	State A
	State B	31,177	4	S	State A
	State C	195,593	25	D	State D
	State D	83,532	11	S & D	State D
Other Habitat Types	Juniper	6,322	< 1		
	Sparse Vegetation = Large Playas	10,964	1		

Color Code: Green = potential year round habitat; Yellow = seasonal habitat; Orange = seasonal habitat winter; Red = non-habitat

Arid: State A = sagebrush-perennial herbaceous; State B = perennial herbaceous; State C = degraded sagebrush; & State D = exotic annual grass

The RFFAs and current actions in the CEAA that may contribute to cumulative effects to GRSG and sagebrush habitat include management activities associated with livestock grazing, recreational activities, herbicide treatment of invasive weeds (in particular exotic annual grasses), wildland fire, seeding treatments, and other disturbed areas. Both completed and future treatments are to improve sagebrush habitat for species such as GRSG, migratory birds, and other sagebrush obligates.

Past and RFFAs that have affected or may affect SSS or their habitat in the CEAA are found in table III-8.

Table III-8: Special Status Species – Sage-grouse & Locally Important Wildlife Past and RFFAs within the CEAA on BLM Managed Lands.

Action	Past Actions			Future Actions		
	Acres	Miles	Number	Acres	Miles	Number
Wildfires	254,331			Unknown		Unknown
Maintenance Level 1 Roads		1,122				
Maintenance Level 2 Roads		380				
Maintenance Level 3 Roads		265				
Maintenance Level 4 Roads		13				
Highways/Paved		7				
Fences		433			69	
Water Developments			455			66
Pipeline		31			3	
Juniper Treatments	745			0		
Crested or Rehabilitation Seedings	75,814			19,006		

<u>Improper Grazing - Wild Horse and Burro Overpopulation Threat</u>

The sagebrush plant communities that support GRSG are very complex spatially and successionally, as are the effects of livestock grazing within these communities, often making it difficult to form large-scale conclusions about the impacts of current livestock grazing practices on GRSG populations (Crawford et al. 2004). However, research suggests it is possible for grazing to be managed in a way that promotes forage quality for GRSG since grazing can set back succession, which may result in increased forb production (Vavra 2005). When grazing management is periodic and allows forbs to regrow or prevents utilization by livestock such as season of use, the number of forbs available to GRSG may increase (Vavra 2005). Anderson and McCuistion (2008) found grazing management, when upland birds are present, should be flexible but limited to a light to moderate use (30–50 percent utilization), such as using deferred or rest-rotation grazing disturbance during critical GRSG life stages such as nesting. Anderson and McCuistion also acknowledged the complexity of managing grazing within GRSG habitat and determined no one grazing system is best suited in all cases, but should be site specific, such as the allotment and pasture scale. While these references specifically refer to livestock, it is concluded that they apply to wild horses as well, since they are both large grazing animals. The differences between wild horse and livestock management are clear: wild horses are free roaming and develop congregation areas year round where impacts are mitigated by keeping populations within AML, whereas livestock are moved from pasture to pasture in a designed rotation each year to prevent congregation areas and impacts to key forage plant species.

Wild horse observations show high congregation areas are occurring within 4 miles of all pending leks (range of 15–120 horses per lek; average 49 horses per lek). Continuous yearlong impacts from horses to GRSG and species mentioned is a serious concern. Water resources are limited in this HMA, especially during drought years. Wild horse competition with native wildlife species for water sources is concerning especially in relation to recent GRSG lek trends in the HMA (drastic decline or loss) versus leks outside the HMA (stable). Research has found that horses, being the larger and more aggressive species, can dominate water sources and limit use by native wildlife species such as pronghorn antelope and elk by limiting their access to water, which reduced their time foraging and decreased overall species fitness (Perry et al. 2015; Gooch et al. 2017; Hall et al. 2016a; Hall et al. 2018). These findings are concerning and show that as wild horse numbers increase, native wildlife species richness and diversity decrease and are being displaced by the horses (Hall et al. 2016a; Beever and Brussard 2000). It is difficult to discern if horse congregation areas within the 4-mile lek buffers are the casual factor or one of several causal factors to the decline in GRSG populations in this HMA since unburned habitats appear to support adequate shrub and grass cover. However, recent research indicates there is a correlation of wild horses having negative effects on native wildlife species associated with limited water resources, which could be a link that influences the decline of wildlife populations (Davies et al. 2014). Furthermore, this HMA makes up 64 percent of potential GRSG habitat that would be negatively affected if wild horse and burro numbers are not consistently managed within AML.

In general, GRSG persist when grazing regimes are managed to provide residual vegetation and seasonal rest for key forage species. Grazing animals that are well distributed across the landscape and managed to reduce the scale and duration of congregation areas will not impact GRSG habitat; but poor grazing management would result in increased areas of heavy and even severe utilization that not only reduce available cover but, in time, can cause mortality of targeted forage plant species, such as blue bunch wheatgrass. When the resistance and resilience of an ecosystem/plant community is breached, degradation is eminent. In examples observed in arid sagebrush habitat, invasion by exotic annual grasses such as cheatgrass can be irreversible (Davies et al. 2009).

The Greater Sage-grouse Conservation Assessment and Strategy for Oregon, Hagen 2011 (hereafter referred to as the Strategy), and the GRSG ARMPA contain guidelines for wild horse and burro management as it relates to sagebrush habitat management (Strategy, p. 104 and GRSG ARMPA, p. 2-21).

The recommended conservation guidelines for wild horses and burros from the Strategy are incorporated into the recommended objectives for WHB from the GRSG ARMPA that are addressed in this EA, Chapter I, Purpose and Need for Action.

Wild Fire Threat

Wild fires have altered sagebrush steppe habitat across approximately 150,000 acres within the HMA and 254,331 acres across the CEAA. The Miller Homestead Fire in 2012 burned approximately 160,000 acres that directly impacted four pending leks. These leks are located on the southeast quarter of the HMA and eastern half of the CEAA, and were completely burned. This fire resulted in habitat alteration depicted as States D and B (table III-8). This area does not meet habitat objectives and is marginal at best for herbaceous cover, but much of the area has exotic invasive annuals throughout the landscape and is unsuitable for all general habitat types (GRSG ARMPA 2015). Furthermore, this fire impacted four other leks within 2 miles of the fire boundary. These eight leks were located in some of the most populated GRSG habitats in the HMA. There had already been observed population declines on many of these leks; however, following the fire GRSG have not been observed on these leks. Spring of 2018 flights were made in the attempt to locate new leks in the HMA, but none were found. Wildfires are an annual threat to sagebrush steppe habitats and on any given year habitat can be lost.

Exotic Invasive Annual Grass Threat

The dominant species found on disturbed areas in the HMA and CEAA is cheatgrass. Cheatgrass readily invades disturbed sites such as wildfires, rodent mounds, livestock watering areas, and continuous year-round congregation areas (Miller et al. 2013). Free-roaming horses have been shown to have the ability to spread cheatgrass successfully via their dung (King and Schoenecker 2018 *in press*). Arid sites are particularly vulnerable to these exotics, and once species such as cheatgrass become established it takes great economic investments to reduce this exotic plant and then to rehabilitate the treated site (Miller et al. 2013; Davies et al. 2011). Often rehabilitation in arid sites requires the use of non-native perennial grasses such as crested wheatgrass (Davies 2010; Davies et al. 2010; Davies et al. 2011).

Drought Threat

Data from three Remote Automated Weather Stations (RAWS) was gathered from Western Regional Climate Center (WRCC) 2018. The three RAWS sites are Foster Flat (5,000 ft.), which is in the CEAA; Rock Creek (5,640 ft.), which is located near the Hart Mountain Refuge headquarters about 18.5 miles southwest of the CEAA; and P Hill (4,860 ft.), which is located just outside the CEAA on the southeastern side and just above Frenchglen, Oregon. Data from 1994 to present was collected for each site since the Foster Flat RAWS site was established in 1994. The other two sites had data from prior years that was not used to have a comparable timeframe for each of the sites. Calculations were based on the water year, which starts October 1 and goes through September 30 the following calendar year.

Precipitation averages for the three sites for 1994–2016 (22 years) are Foster Flat – 8.40 inches, Rock Creek – 8.10 inches, and P Hill – 10.57 inches. At all three sites, the highest average monthly precipitation was in April, May, and June, with May being the highest of the three months. August is on average the driest month for each of the sites. Foster Flat and P Hill sites had 10 out of 22 years with precipitation less than 90 percent of average. The Rock Creek site had 9 of 22 years with precipitation less than 90 percent of average. All three sites had less than 90 percent of average precipitation in 5 out of 6 years between 1998–99 water year and 2003–04 water year. The Foster Flat site had very dry years – less than 70 percent of average in 2007–08, and 2011–12 through 2013–14 water years. The Rock Creek and P Hill sites had similar patterns of drought years with 2006–07, 2007–08, 2011–12, and 2013–14. The Rock Creek site had less than 70 percent of average in the last two drought water years while P Hill site had less than 70 percent in the first three of those drought years.

Precipitation data collected prior to 1994 exists as is presented in scientific papers produced from the Jack Creek telemetry study (Drut et al. 1994). Drut states that precipitation data for the Jack Creek telemetry study area on average was 25 cm (9.8 in.) with the two years of the study precipitation as 24 cm (9.4 in.) and 13 cm (5.1 in.). The Foster Flat RAWS station is within the Jack Creek study area and was probably the site for the rain gage before the RAWS station was installed. For Hart Mountain Refuge headquarters, the average precipitation was 29 cm (11.4 in.) with the two years precipitation data as 30 cm (11.8 in.) and 21 cm (8.3 in.). If this is the case, average precipitation for the Foster Flat area has decreased by 1.4 inches from the time period before 1990 to the time period after 1994. Drought occurrences have been one of the primary effects to water availability for wild horses and burros, livestock, and wildlife. In 2014, water was hauled in by the BLM WHB Program to save animals from dehydration. With no perennial streams or springs, drinking water availability depends on snow pack and heavy rains. The unpredictability of climate will continue to limit water resources and be a threat to wildlife as wild horse and burro numbers increase and outcompete native species.

<u>Alternative A - No Action</u>
The primary effect under this alternative would be the increase in horse and burro numbers, resulting in increased congregation area size and occurrence within the HMA. This would result in an exponential increase in herbaceous utilization of key grass and forb species in current congregation areas, and as the population grows, new congregation areas would be established where water sources are available. This would have direct detrimental impacts to the 18 leks in the HMA since increased use would occur within the 4-mile lek buffer, which is the most critical habitat use area for GRSG.

Cumulative effects by wild horses and burros would be continuous yearlong grazing and heavy to severe utilization levels that would reduce horizontal nesting cover for GRSG nests and chicks. These heavy use areas become more extensive as populations increase, which is occurring in this HMA with more than 700 horses and burros estimated to be in the HMA currently and with an estimated annual population growth rate of at least 20 percent. This is concerning for GRSG populations where critical nesting, early brood-rearing, and late brood-rearing habitat is being degraded at this level of disturbance. This alternative would expand heavy to severe use areas with an indefinite increase in wild horse and burro numbers. Findings from France and others (2008) suggest cattle initially concentrate grazing on plants between shrubs, and begin foraging on perennial grasses beneath shrubs as interspace plants are depleted. It can be assumed wild horse and burro use would mimic cattle use of perennial grasses, as the more accessible plants would be grazed first. France and others (2008) found cattle use of the under-canopy perennial grass was minimal until standing crop utilization reached about 40 percent, although this utilization level would likely vary depending on sagebrush density, sagebrush arrangement (e.g. patchy vs. uniform distribution), bunchgrass structure, forage production levels, and distance to water. As utilization levels increase across the HMA with increased wild horse numbers, it is expected that horizontal screening cover of GRSG nests would decline.

Increasing wild horse and burro numbers would also decrease the likelihood that individual perennial plants could receive a full growing season of rest from grazing use. When perennial plants lack adequate growing season rest periods (where they are able to complete a full reproductive cycle), the plant community composition, age class distribution, and productivity of healthy habitats is negatively affected, thus influencing the ability to achieve rangeland health standards 1 (watershed function – uplands) and 5 (native, SSS, migratory birds, and locally important species). Continued increases in wild horse and burro numbers could also lead to indirect effects on GRSG (e.g. grazing of nesting cover, reduction of available forbs for chicks and hens, disturbance of nests, etc.) during critical stages of the GRSG life cycle (nesting and brood rearing). Peak spatial overlap of free-roaming equids typically occurs during the breeding or late brood–rearing periods (Beever and Aldridge 2011). This overlap makes rangelands susceptible to changes in vegetation composition associated with free-roaming equid grazing and may contribute to decreases in grass height. Doherty et al. (2014) found that decreases in grass height were directly correlated with a decrease in sage-grouse nest survival. If wild horse and burro numbers continue to increase without any population controls the threat from invasive exotics would also increase.

This alternative would be expected to compound the cumulative effects to GRSG habitat across these populations' home range, and result in lower habitat quality for GRSG and contribute to the further decline of GRSG habitat and population numbers already occurring in the HMA.

The U.S. Fish and Wildlife Service (FWS) has a Candidate Conservation Agreement with Assurances (CCAA) for sage-grouse in place within Harney County. There are currently multiple landowners enrolled within the Dry Valley/Jack Mountain PAC (FWS 2018). No action to maintain wild horse and burro numbers within AML has potential to decrease rangeland conditions for livestock operators who may have enrolled private inholdings within the HMA and are permitted for grazing in allotments within this area (FWS 2018).

<u>Alternative B - Proposed Action</u>

In this alternative, GRSG would maintain resource availability as are currently present within the HMA. Habitat degradation is likely to continue across the analysis area, caused by the primary threats to sagebrush habitat (wildfires and exotic invasive annual grasses); however, maintaining good grazing practices and AML would be two less threats to habitat degradation. Horse and burro numbers within AML would reduce the occurrence of areas of critical GRSG habitat receiving continuous utilization at heavy intensities on a year-round basis.

Areas within the HMA near water sources would continue to be affected by concentrated grazing uses, but to a much lesser scale. When the HMA is at AML observations show horse numbers at water sources to be less than 20. However, with current horse numbers and predicted population growth, horse numbers would exceed 50 to 100 per water source. Wild horses not only compete with native wildlife for water, but also have intraspecific competition amongst themselves. Both interspecific and intraspecific competition for water would cause reduced fitness and eventually area abandonment or mortality for all fauna species. Portions of the HMA located away from existing waterholes and springs would have non-grazed areas, which would be expected to provide more suitable nesting sites for GRSG due to more residual grass cover. This would be expected to be highest in areas outside of the current use areas during drought years and lowest in these areas during wet years, since in those years it would be expected that all water sources would have water and attract grazers while dispersing their use. Residual grass cover provides horizontal screening at nest sites, in addition to screening from shrubs, which is believed to reduce predation (Gregg et al. 1994). Maintaining wild horse and burro numbers within AML would aid BLM land managers in their ability to provide quality GRSG habitat in the quantities needed for their survival and the maintenance of populations. This alternative would maintain achievement of rangeland health standard 5 for habitats that are still in State A with the goal of providing habitats that support healthy, productive, and diverse populations and communities of native plants and animals (including SSS and species of local importance) appropriate to soil, climate, and landform.

Cumulative effects as a result of wild horse and burro grazing within AML would not contribute to the decline of sagebrush habitat for GRSG or reduction of GRSG populations. Maintenance of the wild horse and burro population within AML has the potential to improve rangeland conditions for livestock operators who may have enrolled private inholdings within the HMA in the CCAA with FWS and are permitted for grazing in allotments within the area (FWS 2018).

6. Noxious Weeds

The following issue is addressed in this section.

- *How would the 10 year population management plan affect the spread and introduction of noxious weeds?*

a. Affected Environment – Noxious Weeds

Noxious weeds have been documented within the Warm Springs HMA (Table III-9).

Table III-9: Noxious Weeds

Weed Species	Number of Sites	Acres
Cheatgrass	22	804.52
Whitetop	20	6.34
Bull Thistle	17	75.92
Canada Thistle	36	82.17
Russian Olive	6	10.04
Perennial Pepperweed	7	32.04
Dalmation Toadflax	1	0.01
Scotch Thistle	36	262.34
Totals	**145**	**1,273.38**

Most of the weed sites receive ongoing treatments and are monitored annually. Each site is entered in the National Invasive Species Information Management System (NISIMS), monitored, and treated where weeds still occur. Noxious weeds are treated using the most appropriate methods as analyzed in the district's current Integrated Invasive Plant Management EA (DOI-BLM-OR-B000-2011-0041-EA) or subsequent NEPA.

Cheatgrass, a very problematic weed to manage, is prevalent throughout the HMA. Cheatgrass contributes to fire spread and can become a component of an invasive annual grass – fire cycle vegetation state. Continued surveys and weed treatments are ongoing to reduce the opportunities of spread to further acres of the area.

Canada thistle occurs in many of the riparian areas. Improving desirable riparian vegetation, along with aggressive weed treatments, will reduce the dominance of this noxious weed and allow the riparian areas to recover and function properly. Scotch thistle has historically infested most of the disturbed areas (waterholes and animal congregation areas). It is still present, but has been reduced from aggressive monitoring and treatments. Unfortunately, the longevity of the seed lends itself to reappearing when conditions are right.

b. Environmental Consequences – Noxious Weeds

For the purpose of this analysis, the CEAA for noxious weeds encompasses the Warm Springs HMA. Past actions affecting noxious weeds in the Warm Springs HMA include large fires which have occurred throughout the HMA, including the Miller Homestead Fire that occurred in 2012. These past fires have been treated and continue to be monitored for noxious weeds. Present actions include ongoing ground treatments and surveys for noxious weeds. Future actions include treatments that are deemed necessary to control the spread of noxious weeds within the

HMA, including proposed aerial cheatgrass treatments in the 2017 Coyote Fire ESR.

No Action

The continued increase in wild horse and burro numbers above AML would lead to areas of higher concentrations causing more severe impacts to the vegetation due to overgrazing. This opens up more niches for noxious weeds to establish and spread. Areas of horse concentration and consequent heavy use typically are highest near water sources. This can lead to increases in Canada thistle and other riparian associated weeds such as perennial pepperweed and whitetop. Heavier use around already disturbed areas such as waterholes and congregation areas would lead to increased disturbance and consequent increases in noxious weed establishment. Heavy grazing during the active growth period of native perennial bunchgrasses in the spring gives a competitive advantage to cheatgrass. During this growth stage, the native perennials are more palatable and usually larger than the annual grasses. As a result, grazers eat the perennial bunchgrasses and leave the invasive annual grasses.

The no action alternative would adversely affect the current and future planned weed treatments within the HMA. Treatments would be less effective, with increased disturbed areas and a decrease in competitive vegetation allowing for the reintroduction of noxious weeds that were previously treated. Desirable grass species are competitive vegetation that the high concentration of horses and burros use as feed and trample. These plants are essential for the success of invasive annual grass treatments.

Proposed Action

By maintaining wild horse and burro populations within AML, vegetation in use areas within the HMA would receive less grazing pressure, allowing the desirable vegetation to be more vigorous and competitive and providing fewer opportunities for new weed infestations.

The general timing of helicopter gathers, after June 30, would minimize the opportunities for noxious weed introduction and spread due to dry conditions. Bait trapping may occur year round and could happen during wet, muddy conditions where the spread of noxious weed seed can increase. This concern is avoided by the trap placement, monitoring, and treatment project design features in place. Trap sites may be highly disturbed and would be monitored at least 2 years post gather. Any weeds found need to be treated in a timely manner using the most appropriate methods as analyzed in the district's current Integrated Invasive Plant Management EA (DOI-BLM-OR-B000-2011-0041-EA) or subsequent NEPA.

The proposed action would be beneficial for past, current, and future treatments. Decreasing and maintaining wild horse and burro populations to within AML would reduce disturbed areas and increase desirable competitive vegetation, which are essential factors for the success of weed treatments. The increase in desirable competitive vegetation is key to invasive annual grass treatments that were done in the past, are currently happening, and are planned for the future within the HMA.

7. Economic Values

The following issues are addressed in this section.

- *What are the anticipated costs associated with gathering wild horses and burros?*
- *What is the estimated cost per mare to conduct ovariectomy via colpotomy?*
- *What is the estimated cost per mare if PZP were used in the future?*
- *What are the anticipated costs associated with the study?*
- *What are the economic effects to other range users and the local economy?*

a. Affected Environment –Economic Values

As stated in an Office of Inspector General report (2010), "fiercely competing interests and highly charged differences of opinion currently exist between BLM and private individuals and organizations concerning the need for wild horse gathers, the methods used to gather, [methods for population growth suppression,] and whether horses are treated humanely by BLM and its contractors during and after gathers." Scoping comments received on this EA and previous NEPA documents proposing wild horse population management activities include a wide range of both support and opposition to various methods of population management.

Many of the individuals and groups showing concern derive benefit from the presence of wild horse and burro herds by actively participating in recreation to view the horses. A certain number of these individuals believe that any type of capturing and active management of wild horses is inhumane. Others value the existence of wild horses and burros without actually encountering them. This value represents a non-use or passive value commonly referred to as existence value. Existence values reflect the willingness to pay to simply know these resources exist. Conversely, a separate group of individuals may or may not support the existence of wild horses and burros on public land yet express concern about their current numbers and the adverse impacts on other resources and rangeland habitats. These "other resources" include, but are not limited to, the economic impacts that could result from reduced livestock grazing opportunities, impacts on recreational activities influenced by overpopulation of wild horses and burros, the impacts to wildlife and their habitat, and the resultant decline in hunting opportunities.

For the purposes of the Economic Values portion of this analysis, it is important to recognize the number of horses BLM manages across the United States in order to fully understand the effects analysis area and economic costs of the decision to be made. The national AML is 26,715 wild horses and burros. Currently there are an estimated 81,814 (as of March 1, 2018) wild horses and burros on the range with an additional 46,431 in BLM off-range facilities (as of February 2018). These numbers made it simple for the Office of Inspector General of the U.S. Department of the Interior (2016) to find that, "*BLM does not have a strategic plan in place to manage the wild horse and burro populations. The consistent on-range population growth drives the constant need for additional off-range holding and increased spending. If no plan is in place to control the on-range population source, the off-range holding and financial need will continue in this unsustainable pattern.*" In fiscal year (FY) 2017, $47.536 million (58 percent of the WHB Program budget) were allocated to off-range holding costs (WHB Quick Facts, BLM 2018).

The BLM placed 3,517 horses and burros into private care in 2017 through adoption, with another 582 sold to good homes. The estimated (20 percent) on range population growth in 2017 was approximately 14,535 animals. Therefore the amount adopted or sold is only 28 percent of the on range growth in 2017. The existing adoption and sale demand cannot keep up with the annual population growth on the range without effective population growth suppression methods.

The costs associated with certain activities included in the alternatives are described below. Not all activities are included in the list as it is extremely difficult to put a numerical value on such things as vegetative resource damage or decreased recreational opportunities, yet there are certainly economic values associated with their improvement, maintenance, or loss. The costs associated with holding, gathering, bait/water/horseback trapping, PZP fertility treatment, conducting an ovariectomy via colpotomy, radio collaring, and monitoring are listed below. A detailed budget for the study can be found in Appendix B, USGS Research Proposal (2018).

- Holding horses at the Oregon Wild Horse Corral Facility costs approximately $5 per day per horse. This includes the costs of hay, BLM staff, and equipment to operate the facility. Currently there are an average of 500 horses being held at the Oregon Facility. The cost per day to run the facility is approximately $2,500 or approximately $76,042 per month.

- Long-term holding (off-range corral) costs average about $5.05 per day per horse. Un-adopted animals receive an estimated 25 years of care, which adds up to approximately $46,000 per horse for the remainder of his or her life.
- Helicopter-drive gather operations are currently costing around $600 per horse captured.
- Bait, water, and horseback-drive trap gathers are currently averaging $1,100 per horse captured.
- Ovariectomy via colpotomy costs approximately $250–$300 per mare. The cost includes the expense of the antibiotic ($30 per dose), the sedation drugs, and the veterinarian's labor and travel.
- PZP-22 fertility treatment costs approximately $500 per mare treated. This includes the costs of one dose liquid primer (similar to ZonaStat-H used for remote darting) and one dose time-release pellets; plus holding and application costs – approximately $5 per day per horse.
- ZonaStat-H (used for remote darting) costs approximately $35 per dose.
- The cost of 44 radio collars, emergency drop-off mechanisms and replacements, 40 radio tags, 4 telemetry receivers, and miscellaneous supplies for tracking during this study averages approximately $1,514 per individual animal tracked. This includes the cost of labor associated with collar placement and deployment. See Appendix B, USGS Research Proposal (2018) for the budget breakdown.
- Simultaneous Double-Observer method for aerial surveys of the wild horse and burro populations cost approximately $1,450 per hour with an average flight time for this HMA of 8 hours.

Livestock raising and associated feed production industries (growing hay) are major contributors to the Harney County economy. The highest individual agricultural sales revenue in the County was derived from cattle production, providing $51,065,000 in sales in Harney County in 2012, the most recent complete agriculture census in Oregon (USDA 2012).

The Federal government has a substantial economic and environmental presence in the area; nearly 73 percent of the land in Harney County is federally managed, with 59.2 percent managed by the BLM. Many ranching operations rely on public lands for livestock grazing during some portion of the year. Regulations and management decisions concerning these lands have the potential to affect the operation of ranches throughout the county.

b. Environmental Consequences –Economic Values

Given the complexity of issues surrounding free-ranging horses and burros, it is not surprising that Nimmo and Miller (2007) refer to them as having a pluralistic status: their bodies and behavior are sites of conflict (NRC Review 2013). Control methods for feral horses vary and must be weighed against logistic and economic constraints (Nimmo and Miller 2007). Some methods, while economically and ecologically viable, may be politically tenuous and vice versa (Nimmo and Miller 2007).

The CEAA for this EA is the extent of Harney County. Past actions such as wild horse gathers to maintain AML have influenced the existing environment within the CEAA. Present and foreseeable future actions including livestock grazing, weed treatments, recreation and hunting activities, range improvement/maintenance projects, and treatments associated with fire rehabilitation projects have the potential to improve rangeland health, thereby, maintaining or possibly increasing economic opportunities and fostering more desirable recreation opportunities (e.g., hiking, hunting, wild horse viewing, and photography) with associated economic benefits to the local economy. Under both alternatives, public lands in and around the HMA would continue to contribute to other public amenities such as open space and recreation. These amenities encourage tourism in the surrounding region and provide economic benefits to nearby communities. However, the specific contribution of this portion of public land to such amenities cannot be accurately estimated.

<u>No Action</u>
Under the no action alternative, the financial assistance agreement with USGS and CSU would be cancelled, and further research on spay feasibility and on-range behavioral outcomes would not be conducted in Warm Springs HMA.

Due to the lack of long-term and widely effective population control methods available to BLM, the no action alternative would continue the seemingly endless cycle of allowing horse populations to grow at a rapid rate, gathering excess horses, and sending removed horses to off-range holding facilities. In 2017, the total appropriations for the entire WH&B Program were $80.555 million; of which $47.536 million (58 percent) went to off-range holding costs (WHB Program Budget, BLM 2018).

A percentage of the public believes it is unacceptable for the BLM to fail to pursue additional methods of population growth suppression with some of the current populations of wild horses causing a decline in rangeland conditions, causing conflict with other land uses, and creating the growing costs to tax payers of maintaining horses in holding facilities. These concerns are evidenced by public comments observed during National

Wild Horse Advisory Board meetings, during scoping for population control projects, and in various types of media. In choosing the no action alternative, BLM would be passing up an opportunity to pursue all the options made available in the WHB Act (§ 1333(b)(1)) to achieve AMLs.

The no action alternative would be disregarding the multiple-use mandate of FLMPA (1976) as the dramatic increase in the wild horse and burro population to approximately 5,000 animals at the end of the 10-year timeframe of this analysis would quite likely cause livestock permittees to find feed for their animals elsewhere. Competition for forage and limited water between wild horses, burros, livestock, and wildlife would become even more evident in the HMA. It is anticipated that within 10 years of no population management actions, portions of the range would be deteriorated and water sources would be unavailable, causing a situation where livestock active preference would be reduced accordingly to prevent further degradation to range conditions under authority of 43 CFR Ch. II, Subpart 4110.3, Changes in grazing preference (2017). Livestock permittees would have to find feed elsewhere, probably at the private land lease rate, which is significantly higher than the BLM lease rate, or sell their cattle. The BLM's rate per AUM in 2018 is $1.41 while private land lease rate is around $20.00 per AUM, or more, in Oregon. The existing grazing permits may become ineffective toward the sustainability of the livestock operations associated with this HMA if livestock are not turned out because the AUMs allocated to livestock are being utilized by wild horses and burros. The permits associated with the allotments in this HMA are held by small, family businesses. The no action alternative would have the potential of putting at least nine families out of business. A livestock operation in Harney County that is not sustainable economically would further burden the struggling economy of Harney County. In a county with a population of only about 7,300 residents and where agriculture, specifically livestock ranching, is the lead economic driver, losing four ranches and the families that depend on them is a substantial blow.

Aerial surveys to estimate wild horse and burro populations would continue, as funding allows, on a 2–3 year cycle. Within the 10-year timeframe of this analysis there would likely be at least three surveys at an estimated cost of $12,000 each.

Should a gather take place only after the 10-year timeframe of this plan, there would be a higher initial cost to BLM to capture and remove horses and burros as there would need to be more animals removed from the HMA and an expected higher number of animals sent to long-term holding facilities. The cost of the no action alternative would eventually become higher than any of the costs associated with the proposed action. The cost associated with rehabilitation of rangeland resources could total millions of dollars in noxious weed treatments, seeding treatments, and other rehabilitation efforts if the population of wild horses and burros continues to grow unchecked. Past research has elaborated that free-roaming horses can exert notable direct influences on sagebrush communities on structure and composition of vegetation and soils, as well as indirect influences on numerous animal groups whose abundance collectively may indicate the ecological integrity of such communities (Beever and Aldridge 2011). In a study to better understand feral horse effects on semi-arid rangeland ecosystems, Davies and others (2014) conclude that feral horse effects likely vary by intensity and frequency of use and that feral horses have some ecological impacts on semi-arid rangelands. Despite their conclusions that wild equids could cause ecosystem alterations that may increase the vulnerability of other species, Beever and Aldridge (2011) recognize free-roaming horses are undeniably charismatic, and have been used to symbolize power, freedom, wildness, and toughness. The BLM's mission is to sustain the health, diversity, and productivity of America's public lands for the use and enjoyment of present and future generations. Therefore, the benefits wild horses provide for various publics within society must be weighed against actual and potential ecological costs (Beever and Aldridge 2011).

Proposed Action

Under the proposed action the USGS/CSU study would proceed, allowing for BLM to take steps toward a better understanding of the feasibility of spaying wild horse mares and the behavioral outcomes of returning them to the range. The analysis of this technique for application in any other HMA would be included in separate NEPA.

For a segment of the public, neither capturing and removing horses nor letting horses perish on the range as a result of limited resources is acceptable (Collins and Kasbohm 2016). Removing and holding horses has become a major expense to American taxpayers as described above in the discussion on holding costs. Methods to control population growth (e.g., fertility control or contraception) may reduce the need for intensive and controversial removals while ensuring that free-roaming horse populations do not become self-limited (NRC Review 2013, Collins and Kasbohm 2016). Controlling population growth would also provide significant cost savings to the American taxpayer (Bartholow 2007, de Seve and Griffin 2013, Collins and Kasbohm 2016) by affecting the ability to attain free-roaming horse management goals (NRC Review 2013).

If the initial gather in the proposed action occurred in fall 2018 it would cost approximately $531,000 to capture up to 100 percent of the estimated population of 738 adult horses and 147 foals. WinEquus population model trials predict an additional 2–3 helicopter gathers from 2022 (end of study gather to low AML) through 2028 under any management option run under the proposed action (See Appendix O, Warm Springs HMA WinEquus Simulations). The four management options run through

WinEquus under the proposed action following the completion of the on-range study resulted in estimated numbers of animals removed from 2022–2028: *Option 1, Spay all females 2+ yrs. old* – zero animals removed; *Option 2, Spay all females 5+ yrs. old* – 76 removed; *Option 3, Removals Only* – 136 animals removed; and *Option 4, PZP all females 2+ yrs. old* – 110 animals removed (refer to WinEquus Population Modelling Comparison Table III-2). If all of these animals went unadopted and were cared for by BLM in off-range corrals, the estimated cost for their care for the remainder of their lives would be: $0, $3.49 million, $6.25 million, and $5.06 million, respectively.

The cost of ovariectomizing 100 mares for the initial study would be approximately $25,000. If the method is deemed feasible and a population growth suppression tool valuable for continued use, future costs of the procedure would likely remain the same per mare. Options 1 and 2 in Appendix O, Warm Springs HMA WinEquus Simulations, estimate that approximately 64 mares would be spayed following the completion of the research study, between 2022 and 2028, to maintain AML. These treated mares would never need handling again for any type of follow-up fertility control treatments, a cost savings to the American taxpayer as compared to repeat fertility control vaccine treatments and additional offspring being gathered and placed in holding facilities. Some would consider permanent sterilization more humane than short-duration fertility control vaccinations insofar as the mare would only require capture one time as compared to multiple captures or human interactions for fertility control inoculation. The BLM acknowledges that sterilized mares would likely be captured again if running in a band, but they would not receive the additional handling associated with application of fertility control and identification.

Duration of fertility inhibition has major practical importance and therefore longer-acting methods are preferable to minimize requirements for personnel and financial resources and to decrease the frequency of animal handling (NRC Review 2013). The lack of available fertility control vaccines with effectiveness longer than 1 year, along with a dwindling adoption demand, has led to a seemingly endless cycle of allowing horse populations to grow at a rapid rate, gathering excess horses, and sending removed horses to off-range holding facilities. Long-term holding of horses creates exorbitant costs to the American taxpayer, $47,536,000 in FY 2017 (WHB Program Budget, BLM 2018). The inability to remove excess horses from the range due to the lack of available holding space has led to a snowball effect of consequences to rangeland resources. Slowing the population growth rate using a relatively inexpensive single treatment method, reducing gather frequency, and maintaining or improving rangeland conditions within the HMA would have a positive economic influence for local land users and managers and the community.

Under this alternative, livestock permittees would be able to continue grazing their livestock at permitted levels in this HMA, further securing the possibility of economic benefits (e.g. income) for those permittees. This contributes to the local economies through taxes, the purchase of supplies, and other contributions to the local communities.

In addition, few horses would be removed from the range and sent to long-term holding facilities; therefore reducing the percentage of the WHB budget spent on care and maintenance of horses off range. That money could be allocated toward beneficial range improvement projects to improve habitat conditions for wild horses and burros and other species using the habitat within the HMA. Habitat quality for wildlife, livestock, and wild horses and burros would be maintained or improved with management of populations within AML. When horse and burro numbers are kept within AML, BLM is able to maintain healthy herds even during periods of extreme climatic fluctuation (e.g. drought or winters with heavy snow pack). This means horses and burros would have enough forage and water to maintain a healthy body condition throughout the year. Animals in good health are what range users and the public want to see, no matter if they are opposed to or proponents to gathers.

8. Soils and Biological Crusts

The following issue is addressed in this section.

- *What would be the effects of the alternatives on soils and biological crusts?*

Current discussion and analysis of potential effects to soils are tiered to the 1991 Three Rivers Proposed Resource Management Plan (PRMP)/Final Environmental Impact Statement (FEIS) and relevant information contained in the following sections is incorporated by reference: Three Rivers - Chapter 2, p. 2-15 (Soils Management) and Chapter 3, p. 3-3. For the purposes of this analysis, the CEAA for soils and biological crusts is at the HMA scale. Past activities that had the potential to affect soils and biological crusts within the HMA include the construction of range improvements, livestock grazing, wild horse and burro use, wildfire, ESR projects, noxious weed treatments, and recreation.

a. Affected Environment – Soils and Biological Crusts

Soils within the Warm Springs HMA are composed mainly of Raz-Brace-Anawalt soil association (greater than 95 percent). Additionally, trace amounts of the Fury-Skunkfarm-Housefield, Spangenburg-Enko-Catlow, Realis-Vergas-Lawen, Poujade-Ausmus-Swalesilver, Felcher-Skedaddle and Ninemile-Westbutte-Carryback associations are also present.

The Raz-Brace-Anawalt association includes cobbly or stony loams that evolved on hills and tablelands. These soils are shallow to moderately deep, generally well drained, and have a low potential for wind erosion and low to moderate potential for water erosion. These soils of cold plateaus and uplands support native vegetative communities dominated by Wyoming big sagebrush, low sagebrush, needlegrass species, and bluebunch wheatgrass.

The Fury-Skunkfarm-Housefield soil associations consists of very deep, somewhat poorly to very poorly drained soils that are formed in alluvium. They consist of fine silty to fine loamy soils which are found in lake basins, floodplains, floodplain steps, in depressions on stream terraces, and along drainage-ways. Slopes are generally 0–4 percent. Ponding in this soil series is frequent, with occasional flooding. Native vegetation associated with Fury-Skunkfarm-Housefield soils includes: hardstem bulrush (*Schoenoplectus acutus)*, sedges (*Carex* ssp), tufted hairgrass (*Deschampsia cespitosa)*, rushes (*Juncus* ssp), quackgrass (*Elymus repens)*, Sandberg bluegrass (*Poa secunda*), saltgrass (*Distichlis spicata)*, yarrow (*Achillea* ssp*)*, lupine (*Lupinus* ssp*)*, three-tip sagebrush (*Artemisia tripartite*), silver sagebrush (*Artemisia cana*), shrubby cinquefoil (*Dasiphora* ssp*)*, willow (*Salix* ssp), wildrye (*Leymus cinereus)*, creeping wildrye (*Leymus triticoides),* and wild rose (*Rosa woodsii*).

The Spangenburg-Enko-Catlow association consists of very deep, well-drained and moderately well-drained soils that formed in lacustrine sediments and deposits and alluvium derived from volcanic rocks and is generally found on lake terraces and alluvial fans and swales. Textures range from silty clay loam to very stony loams and can be found on slopes of 0–30 percent at elevations of 4,200 to 5,500 feet. There is a high potential for wind erosion. Dominant vegetation for this soil association includes: Basin big sagebrush (*Artemisia tridentata tridentata*), Wyoming big sagebrush (*Artemisia tridentata wyomingensis*), beardless wildrye (*Leymus triticoides)*, bluebunch wheatgrass (*Pseudoroegneria spicata)*, Thurber needlegrass (*Achnatherum thurberianum)*, basin wildrye (*Leymus cinereus)*, Indian ricegrass (*Achnatherum hymenoides,)* and needle-and-thread (*Hesperostipa comate).*

The Reallis-Vergas-Lawen soil association consists of very deep, well-drained soils that formed in gravelly or loamy alluvium and eolian materials derived from volcanic rocks and wind and water deposited sediments. This complex is found on alluvial fans, lake terraces, and in depressions on plateaus and has slopes of 0–8 percent. The association ranges from a loamy to sandy loam texture and is well drained with slow to moderate permeability resulting in a low to moderate risk of wind and water erosion. Native vegetation commonly found in this soil association is: basin big sagebrush (*Artemisia tridentata tridentata*), Wyoming big sagebrush (*Artemisia tridentata wyomingensis*), bluebunch wheatgrass (*Pseudoroegneria spicata)*, Thurber's needlegrass (*Achnatherum thurberianum)*, Sandberg's bluegrass (*Poa secunda*), needle-and-thread grass (*Hesperostipa comate)*, Indian ricegrass (*Achnatherum hymenoides)*, basin wildrye (*Leymus cinereus)*, and western needlegrass (*Achnatherum occidentale).*

The Poujade-Ausmus-Swalesilver soil association consists of very deep, somewhat poorly to moderately well-drained soils formed from lacustrine deposits derived from volcanic rocks and ash. The complex consists of very fine sandy loams to ashy silt loams and is generally found on low lake terraces and depressions on plateaus with slopes ranging from 0–5 percent. These soils are susceptible to frequent ponding from November through May, depending on the annual precipitation. Potential native vegetation associated with this complex is: basin big sagebrush (*Artemisia tridentata tridentata*), black greasewood (*Sarcobatus vermiculatus)*, basin wildrye (*Leymus cinereus)*, inland saltgrass (*Distichlis spicata)*, silver sagebrush (*Artemisia cana)*, Sandberg's bluegrass (*Poa secunda*), creeping wildrye (*Leymus triticoides)*, and mat muhly (*Muhlenbergia richardsonis).*

The Felcher-Skedaddle association consists of very shallow to moderately deep, well-drained soils which formed in colluvium and residuum derived from andesite, basalt, and volcanic rocks. Texture ranges from very stony clay loam to very cobbly loam. This association is found on mountains, hills, and plateaus with slopes of 4–75 percent. Erosion potential is moderate for water and slight for wind. Native vegetation associated with this soil association includes: bluebunch wheatgrass (*Pseudoroegneria spicata)*, Thurber's needlegrass (*Achnatherum thurberianum)*, Wyoming big sage (*Artemisia tridentata wyomingensis*), purple sage (*Salvia dorrii),* and squirreltail.

Ninemile-Westbutte-Carryback association is composed of well-drained, shallow and moderately deep soils that formed in residuum and colluvium and tend towards gravelly to very cobbly loams or stony to cobbly clays with areas of silty clay loam. They are found on plateaus, hills, and mountains that receive 12 to 16 inches of precipitation. Slopes range from 0–65 percent leading to a moderate hazard of water erosion. The associated native vegetation communities are: mountain big sagebrush (*Artemisia tridentata vaseyana*) and low sagebrush (*Artemisia arbuscula*) with needlegrass species (*Achnatherum* ssp*)* and Idaho fescue (*Festuca idahoensis*).

Identification of biological soil crusts (BSC) at the species level is often not practical for fieldwork. The use of some basic morphological groups simplifies the situation. Morphological groups are also useful because they are representative of the ecological function of the organisms (BLM

Technical Reference (TR) 1730-2, p. 6). Using a classification scheme proposed in 1994, one can divide microbiota such as BSCs into three groups based on their physical location in relation to the soil: hypermorphic (above ground), perimorphic (at ground), and cryptomorphic (below ground).

The morphological groups are:
1. Cyanobacteria - Perimorphic/cryptomorphic
2. Algae - Perimorphic/cryptomorphic
3. Micro-fungi - Cryptomorphic/perimorphic
4. Short moss (under 10mm) - Hypermorphic
5. Tall moss (over 10mm) - Hypermorphic
6. Liverwort - Hypermorphic
7. Crustose lichen - Perimorphic
8. Gelatinous lichen - Perimorphic
9. Squamulose lichen - Perimorphic
10. Foliose lichen - Perimorphic
11. Fruticose lichen - Perimorphic

Morphological groups 4, 5, 7, 8, and 9 will likely be the dominant groups represented in the project area. Depending on precipitation amounts and microsites, groups 6, 10, and 11 may also be well represented where the site-specific conditions required for their growth exist. Morphological groups 1, 2, and 3 are difficult to discern in the field, as they require specialized tools that are not easily useable in the field. Soil surface micro topography and aggregate stability are important contributions from BSCs, as they increase the residence time of moisture and reduce erosional processes. The influence of BSCs on infiltration rates and hydraulic conductivity varies greatly; generally speaking, infiltration rates increase in pinnacled crusts and decrease in flat crust micro topography. The northern Great Basin has a rolling BSC micro topography, and the infiltration rates are probably intermediate compared to flat or pinnacled crustal systems. Factors influencing distribution of BSCs (TR-1730-2) include, but are not limited to, elevation, soils, and topography, percent rock cover, timing of precipitation, and disturbance. Possible disturbances that have occurred within the HMA include, but are not limited to, effects from livestock grazing, vehicles, wild horse and burro use, and human footprints. The specific contribution of these activities to current BSC condition and cover is not discernable from other historic disturbances.

b. Environmental Consequences – Soils and Biological Crusts

No Action

Under the no action alternative, gathers and removals would be deferred until horses and burros reach critical mass or an emergency dictates their removal. Like livestock, horses and burros tend to congregate in areas where resources, such as watering sites, are plentiful resulting in compacted soils and the permanent removal of complex BSCs. As horse and burros numbers increase, these areas will become larger, compacting more soil and removing more BSCs.

As an example, a 5-acre area of compaction would double in size in 4–5 years to 10 acres based on the 15–20 percent annual population growth. In another 4–5 years, that acreage would be 20 acres. If left unmanaged, this number would continue to grow. Once soils have been compacted, they would require active rehabilitation to return them to pre-existing conditions. By not gathering on a regular basis or providing some sort of population growth suppression, there would be more rehabilitation required within the HMA. Additionally, BSCs would permanently remain in the early successional stages, cyanobacteria, with continued compaction as per the BLM TR 1730-2, page 21. Additionally, horses and burros outside the HMA would not be gathered, and there would be similar impacts to soils and BSCs outside the HMA, including areas where BLM-designated special status plants could be located.

Past, present, and reasonably foreseeable future actions include, but are not limited to: wildfire, livestock grazing, hunting, recreational use, off and on-road vehicle use, and increases in horse and burro numbers. As populations grow, resulting in soil compaction and the loss of BSCs, the possibility of the establishment and increase in noxious and invasive weeds and annual grass could occur. Cumulative effects would be the reduction of intact rangeland, loss of wildlife and plant biodiversity, erosion, and an increase in time and funds spent to rehabilitate the affected areas. In addition to the loss of soils and BSCs, the increase in noxious and invasive weeds and annual grasses could increase the fire return interval in the area requiring emergency removal and causing loss of wildlife and habitat and loss of recreational usage due to potential closures after a fire.

Proposed Action

Gathering to the low AML and the application of fertility control treatments would prevent future impacts to soils and BSCs. Current soil compaction and early successional states of BSCs would remain in high use areas, such as watering sites; however, the areas would not increase in disturbance size and large scale (outside the current disturbance footprint) active rehabilitation would be avoided by not allowing these areas to increase exponentially.

Past, present, and reasonably foreseeable future actions include, but are not limited to, wildfire, livestock grazing, hunting, recreational use, off- and on-road vehicle use, and increases in horse and burro numbers. Cumulative effects of keeping horses and burros within the authorized AML, gathering on a regular basis, and taking action to reduce the annual population growth rate for horses would prevent additional loss of soils and BSCs by maintaining an acceptable level of disturbance instead of continually adding acres of compacted soils resulting in additional acres of lost BSCs. Additionally, current uses would be able to continue into the future without additional impacts stemming from wild horse and burro use.

9. Upland Vegetation

The following issue is addressed in this section.

- *What would be the effects of the alternatives on upland vegetation health?*

a. Affected Environment – Upland Vegetation

The dominant vegetation communities throughout the HMA are listed in the following table. These community types are based on the Natural Resource Conservation Service (NRCS) Ecological Site Descriptions found online (USDA-NRCS 2018). Approximately 75 percent of the HMA's ecological sites fit under the description cold plateaus and uplands in the 10–12 inch precipitation range with the dominant vegetation of big sagebrush and perennial grass species. Approximately 20 percent of the HMA falls under the cold plateaus and uplands in the 10–12 inch precipitation range with low sage and perennial grasses as the dominant vegetation. The remaining five percent is variable dependent on the soil type inclusion and does not affect vegetation communities within the HMA.

Table III-10: Warm Springs HMA Ecological Site Descriptions

Ecological Site ID	Site Name	Dominant Vegetation Community
023XY200OR	PONDED CLAY	/*Artemisia cana* ssp. *bolanderi/Poa nevadensis-Leymus triticoides*
023XY202OR	SWALE	/*Artemisia tridentata* ssp. *tridentata/Leymus cinereus-Pseudoroegneria spicata* ssp. *spicata*
023XY212OR	LOAMY	/*Artemisia tridentata* ssp. *wyomingensis/Achnatherum thurberianum-Pseudoroegneria spicata* ssp. *spicata*
023XY214OR	CLAYPAN	/*Artemisia arbuscula/Pseudoroegneria spicata*
023XY300OR	SOUTH SLOPES	/*Artemisia tridentata* ssp. *wyomingensis/Pseudoroegneria spicata* ssp. *spicata-Achnatherum thurberianum*
023XY308OR	NORTH SLOPES	/*Artemisia tridentata* ssp. *tridentata/Festuca idahoensis-Pseudoroegneria spicata* ssp. *spicata*
023XY316OR	DROUGHTY LOAM	/*Artemisia tridentata* ssp. *tridentata-Artemisia tridentata* ssp. *vaseyana/Festuca idahoensis-Achnatherum thurberianum*
023XY318OR	LOAMY	/*Artemisia tridentata* ssp. *vaseyana/Festuca idahoensis*
024XY001OR	SODIC FLAT	/*Sarcobatus vermiculatus/Distichlis spicata*
024XY003OR	SODIC BOTTOM	/*Sarcobatus vermiculatus/Leymus cinereus-Distichlis spicata*
024XY008OR	CLAYEY PLAYETTE	/*Artemisia tridentata* subsp. *wyomingensis/Elymus elymoides-Poa secunda*
024XY012OR	SANDY	/*Atriplex canescens-Artemisia tridentata* ssp. *tridentata/Hesperostipa comata-Achnatherum hymenoides*
024XY013OR	LOW SODIC TERRACE	/*Sarcobatus vermiculatus-Atriplex confertifolia/Elymus elymoides*
024XY015OR	DESERT LOAM	/*Atriplex confertifolia-Picrothamnus desertorum/Elymus elymoides*
024XY016OR	LOAMY	/*Artemisia tridentata* var. *wyomingensis/Achnatherum thurberianum-Pseudoroegneria spicata* ssp. *spicata*
024XY017OR	SHALLOW LOAM	/*Artemisia tridentata* subsp. *wyomingensis/Achnatherum thurberianum-Achnatherum hymenoides*
024XY113OR	SODIC FAN	/*Artemisia tridentata* subsp. *tridentata-Sarcobatus vermiculatus/Achnatherum hymenoides-Leymus cinereus*

Visual effects to vegetation from livestock grazing and wild horse and burro use are more obvious near congregation areas and not easily observed in other portions of the HMA. Bunchgrass vigor has the potential to decline in locally heavily-grazed areas due to utilization levels in excess of 50 percent over successive years. Conversely, bunchgrass vigor may also decline in lightly-grazed or non-grazed areas, due to plant decadence (growth may be limited by accumulation of old and dead tissue; Oesterheld and McNaughton 1991), especially where no fire or other event has occurred that would remove accumulations of dead material. Both conditions have been observed in the HMA.

Vigor of bunchgrass plants may be maintained, or even improved, by some disturbance that removes buildup of previous years' growth, either infrequently through large, sudden events such as wildfire (which may kill the plant), or more frequently with less intensity, as with grazing. The effect of defoliation to bunchgrasses, before and after wildfire, can be directly observed within the HMA. The effect on plant vigor from grazing is more subtle, and involves interplay between a plant's ability to reestablish photosynthetic activity and its ability to retain a competitive position in the plant community (Oesterheld and McNaughton 1991).

Monitoring of trend in condition of upland vegetation at representative sites in both East and West Warm Springs Allotments is static overall with some areas seeing a downward trend and some areas indicating an upward trend in key herbaceous species. Although assessments have found portions of the HMA are achieving upland rangeland health standards, local areas of declining bunchgrass health have been observed, generally in areas around the limited reliable water sources, and within some of the wild horse and livestock congregation areas.

For the purposes of this analysis, the CEAA for vegetation is at the HMA scale. Past activities that had the potential to affect vegetation within the HMA include the construction of range improvements, livestock grazing, wild horse and burro use, wildfire, ESR projects, noxious weed treatments, and recreation.

b. Environmental Consequences – Upland Vegetation

The CEAA for upland vegetation under the proposed action is the HMA boundary as this alternative aims to maintain the wild horse and burro population within AML within the HMA boundary. The no action alternative would have a CEAA for upland vegetation of an estimated 10 miles outside the HMA boundary in all directions. This area was chosen because the AML is currently exceeded and wild horses are residing outside the HMA boundary in two known locations. No action to maintain population within AML often causes animals to drift outside of an HMA as resources inside the HMA become limited. Past, present, and reasonably foreseeable future actions affecting upland vegetation include, but are not limited to: wildfire, livestock grazing, hunting, recreational use, off- and on-road vehicle use, and increases in horse and burro numbers.

No Action

Under the no action alternative, no removals of wild horses or burros would occur until the amount becomes critical or an emergency dictates their removal. Nor would actions be taken to slow the population growth rate. The increased number of horses and burros on the range would increase the level of utilization and decrease the amount of available forage. Consistent heavy utilization in wild horse and burro use areas could lead to rangeland health standards not being achieved in the future. No action to maintain the wild horse and burro population within AML would be expected to reduce vigor and resiliency of perennial grasses in the HMA as utilization levels increase, therefore increasing the potential for annual grass invasion. Invasive annual grasses can lead to an invasive annual grass fire cycle successional state. This completely transforms the characteristics of the plant community and reduces or eliminates most desirable ecological values. Annual grass communities lack the plant community structure, root occupancy of the soil profile, and ability to provide the amount and distribution of plant litter that native communities provide. Annual grass communities, as compared to the potential and capability of native perennial communities, lack the ability to protect the soil surface from raindrop impact; to provide detention of overland flow; to provide maintenance of infiltration and permeability; and to protect the soil surface from erosion (Rangeland Health Standards 1997). Under this alternative, increases in annual grasses would occur, and the condition of the range would deteriorate. These effects would influence future livestock, wild horse and burro, and wildlife carrying capacity if continued. The loss of native vegetation would lead to soil loss due to exposure to wind and water erosion and would expose previously uninfested areas to noxious and invasive weeds. Increases in erosion directly influence the potential to achieve rangeland health standards 1 - Uplands and 3 - Ecological Processes.

Cumulative effects under the no action alternative would include the reduction of intact rangeland, loss of wildlife and plant biodiversity, erosion, and an increase in time and funds spent to rehabilitate the affected areas. In addition to replacement of native perennial vegetation with invasive annual grasses, the increase in noxious and invasive weeds and annual grasses could increase the fire return interval in the area requiring emergency removal and causing loss of wildlife and habitat, and loss of recreational usage due to potential closures after a fire. Consequently, the potential for the success of any rangeland improvement project would decrease.

Proposed Action

Under the proposed action, wild horse and burro numbers would be reduced to the low AML with an initial gather in fall 2018 and periodic gathers as high AML is exceeded within the 10-year timeframe of analysis. Reducing wild horse and burro numbers to AML would reduce or minimize the potential for heavy annual utilization levels in their use areas.

Gathering the horses and burros in this HMA and removing excess animals may aid in breaking up the use patterns in the heavier use sites. A change in the intensity of use and timing of use (with fewer animals) would lessen the effects to upland vegetation by providing time to complete a full reproductive cycle and consequently increasing plant vigor. Managing duration, intensity, and timing of use on vegetation largely influences maintaining a thriving natural ecological balance and maintaining rangeland health standards, specifically Standard 1 - Watershed Function, Uplands. This standard is achieved when upland soils exhibit infiltration and permeability rates, moisture storage, and stability appropriate to soil, climate, and landform. Potential indicators of achieving this standard include amount and distribution of plant cover and bare ground and plant composition and community structure. Potential indicators of the condition of rangeland health are influenced by the timing and amount of utilization pressure received over a period of years.

Applying wild horse population growth suppression techniques to slow down the reproductive rate would reduce the grazing pressure over a longer period of time, disperse wild horse use areas, and give native vegetation a greater stronghold. Healthy, diverse, and productive plant communities promote improved resiliency, reducing the threat of noxious weed establishment and spread. Maintaining wild horses and burros within AML secures an adequate carrying capacity and prevents conditions where competition and limitations are placed on livestock, wild horses, burros, and wildlife.

Direct effects of trapping include hoof action and vehicle use that cause upland vegetation to become trampled and/or uprooted around trap sites. To minimize these effects, trap sites would be located in areas previously used or which have been disturbed in the past. The trap sites would be approximately 0.5 acre in size, which would have a minimal effect. Keeping gather sites in previously used areas or areas previously disturbed would minimize or reduce potential new effects to upland vegetation since vegetation would already have been impacted.

Cumulative effects under the proposed action alternative would include the maintenance of intact rangeland, maintenance of wildlife and plant biodiversity, and general soil stability. Native perennial vegetation would be maintained with limited invasive annual grasses. Limiting the amount of noxious weeds and invasive annual grasses could maintain a normal fire return interval in the area. Reducing the chance of wildfire reduces the need for emergency removals due to fire and reduces the loss of wildlife and habitat and the loss of recreational usage due to potential closures after a fire. Consequently, the potential for the success of any rangeland improvement project would increase.

10. Lands with Wilderness Characteristics

The following issue is addressed in this section.

- *What would be the effects of the alternatives on lands with wilderness characteristics?*

a. Affected Environment – Lands with Wilderness Characteristics

The West Warm Springs HMA contains eleven units of land with wilderness characteristics. In order for an area to qualify as lands with wilderness characteristics, it must possess sufficient size, naturalness, and outstanding opportunities for either solitude or primitive and unconfined recreation. Wilderness characteristics are defined in the following manner:

Size: Roadless areas with over 5,000 acres of contiguous BLM lands.

Naturalness: The area must appear to have been affected primarily by the forces of nature, and any work of human beings must be substantially unnoticeable.

Solitude or Primitive and Unconfined Recreation: The Wilderness Act states that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." Wilderness provides opportunities for people to experience: natural sights and sounds; remote, isolated, unfrequented, or secluded places; and freedom, risk, and the physical and emotional challenges of self-discovery and self-reliance. Any one wilderness does not have to provide all these opportunities, nor is it necessary that they be present on every acre of a given wilderness.

Some of the unit boundaries extend beyond the HMA boundaries. The area of analysis is the eleven wilderness character units comprising 371,103 acres of public land. The temporal timeframe is the ten-year plan identified in the EA.

Inventories of public lands for wilderness character are a snapshot in time. Lands with wilderness characteristics were identified in the BLM Wilderness Inventory for Oregon and Washington November 1980 Final

Intensive Wilderness Inventory Decisions. The inventory decisions are not land use designations. They are inventories of acreages that contain wilderness characteristics.

Section 201 of FLPMA requires the BLM to maintain on a continuing basis an inventory of all public lands and their resources and other values, which includes wilderness characteristics. It also provides that the preparation and maintenance of the inventory shall not, of itself, change or prevent change of the management or use of public lands. Regardless of past inventory, the BLM must maintain and update as necessary, its inventory of wilderness resources on public lands. In some circumstances, conditions relating to wilderness characteristics may have changed over time, and an area that was once determined to lack wilderness characteristics may now possess them.

During the 2017 field season, a route analysis was conducted in the West Warm Springs Allotment on historic units named in the 1980 Final Intensive Wilderness Inventory Decisions. Some wilderness boundary roads described in the 1980 inventory were found to no longer meet the criteria for a boundary. As a result, some units were combined into larger units.

Once route analysis was completed, determinations of wilderness character were made. Criteria used to determine wilderness character were taken from BLM Manual 6310 “Conducting Wilderness Characteristics Inventory on BLM Lands.” Using the criteria from BLM Manual 6310, it was found that of the eleven units evaluated for wilderness character, ten units had wilderness characteristics, and one unit did not.

Wilderness Character Inventory Units within area of analysis:

<u>Units *with* Wilderness Characteristics</u>
Lake Unit – ORB05-03209 – 68,127 acres. Extends onto Lakeview District.
Buzzard Lake Unit – ORB05-03208 – 22,238 acres. Extends onto Lakeview District.
Buckaroo Flats Unit – ORB05-03207 – 11,403 acres.
Yellow Spot Unit – ORB05-03206 – 25,063 acres.
Silver Lake Unit – ORB05-03205 – 7,660 acres.
Big Stick Unit – ORB05-03204 – 25,633 acres.
Wilson Lake Unit – ORB05-03212 – 30,367 acres.
Rimrock Lake Unit – ORB05-03203 – 19,118 acres.
Wilson Butte Unit – ORB05-03202 – 10,004 acres.
Deadhorse Unit – ORB05-03201 – 145,985 acres. Extends onto Lakeview District.

Units *without* Wilderness Characteristics
Weed Lake Unit – ORB05-03210 – 5,505 acres.

With the exception of the Weed Lake Unit, units in West Warm Springs Allotment were found to be in a natural condition. Primary uses in all units are livestock grazing and recreational activities. The unnatural features found in the units were typical livestock grazing installations such as waterholes, reservoirs, fences, wells, troughs, pipelines, and seedings. These installations were found along the boundary roads or on cherry-stemmed routes that ended where the features are located. Some features were found in the middle of the units, such as waterholes that captured drainage water. These features were created and left to do their job with little or no maintenance. Features such as seedings were considered unnatural due to the drill rows left behind by the seeding implement, however the size of the seedings is small (except the Weed Lake unit) compared to the size of the units they are in.

All ten units found to be in a natural condition were also found to have outstanding opportunities for solitude. Contour maps showing elevations were used to describe the variation in topography. Monitoring data provided dominate ground cover in the units. Topography and vegetation provide screening opportunities in each of the ten units.

All ten units were also found to have outstanding opportunities for a primitive type of unconfined recreation. All the units have a diverse assortment of opportunities available. Typical activities associated with primitive unconfined types of recreation are horseback riding, hunting, dispersed camping, hiking off trail, viewing wildlife, exploring, bush crafting, viewing the night sky, and many others.

All the units were found to have supplemental values as well. The units are rich in archeological history, they are on a migratory bird flyway, contain deer and antelope winter range, sage-grouse habitat, pygmy rabbit habitat, rare plants, and are in a wild horse and burro HMA.

b. Environmental Consequences – Lands with Wilderness Characteristics

Reasonably foreseeable future actions that may contribute to the cumulative effects analysis include livestock grazing management, wildfires, wild horse and burro gathers, and BLM road maintenance activities. Potential effects would include changes to the size of units having wilderness character due to road maintenance activities possibly creating new boundaries. Other effects would be changes to naturalness through actions that affect ecological conditions such as drill seeding or installations that are substantially noticeable. Additional wild horse and burro gathers contribute to naturalness by controlling the number of animals on the range, which effects the quantity of surface disturbances around places where animals gather for water or forage.

No Action

Taking no action to maintain wild horse and burro population levels over the 10-year timeframe of this analysis would have the following effects on wilderness characteristics (size, naturalness, and solitude).

Size: No maintenance activities associated with gather vehicle access on roads and routes in the area of analysis would take place under this alternative. There would be no effect to size of the units.

Naturalness: There would be no bait trap installations or helicopter gathers in this alternative. Wild horse and burro herd size would increase over time. An increase in herd size would increase surface disturbances near water sources and foraging areas. After ten years of not gathering and removing horses or burros, their population is estimated to increase to approximately 5,000 animals. That would be a seven-fold increase over the current population levels. Effects to naturalness, measured in acres of surface disturbance, would become larger each year.

Outstanding Opportunities for Solitude or a Primitive Type of Unconfined Recreation: Outstanding opportunities would not be affected in this alternative. There would be no gather, no helicopters, and no bait traps to create disturbances.

Proposed Action

Actions associated with population management in the proposed action would have the following effects on wilderness characteristics (size, naturalness, and solitude).

Size: Bait traps would be located on or near routes that are easily accessed by vehicles towing horse and equipment trailers. Site specific route maintenance activities are not anticipated to affect wilderness character unit boundaries. Route maintenance on existing wilderness character unit boundary roads would have no effect to the size of the units and therefore no effect to wilderness character.

Naturalness: Bait trap stations are temporary installations set up in areas where there are existing surface disturbances (e.g. near sources of water or existing roads). The stations are temporary and substantially unnoticeable in appearance. Naturalness is not affected.

Outstanding Opportunities for Solitude or a Primitive Type of Unconfined Recreation: Helicopter use during the gather creates temporary effects to outstanding opportunities. During the gather the sights and sound of the helicopter as it herds wild horses would disturb visitors seeking solitude. Recreational activities such as camping, hiking, wildlife viewing, and others would be temporarily affected during the gather. Contractors on horseback or in helicopters, visitors who have come to view the gather, media personnel, and others would occupy the area near where the horses are herded into a corral. This group of people and the vehicles that transported them to the site would disturb visitors who are in the area to recreate. The disturbance to outstanding opportunities is temporary and would last only for the time of the gather.

IV. CONSULTATION AND COORDINATION

A. Tribes, Individuals, Organizations, or Agencies Consulted

Table IV.1 Tribes, Individuals, Organizations, or Agencies Consulted		
Name	**Purpose & Authorities for Consultation or Coordination**	**Findings & Conclusions**
Burns Paiute Tribe	Consultation as required by the American Indian Religious Freedom Act of 1978 (42 U.S.C. 1531) and the National Historic Preservation Act (NHPA) (PL 89-665; 54 U.S.C. 300101, et seq.).	A letter was mailed to the Burns Paiute Tribal Council Chairman on May 21, 2018, requesting government-to-government consultation. The Tribe has not responded identifying any concerns. Lack of response is interpreted by BLM to indicate that the Tribe has no concerns relative to the proposed action.
Fort McDermitt Paiute and Shoshone Tribes	Consultation as required by the American Indian Religious Freedom Act of 1978 (42 U.S.C. 1531) and NHPA (PL 89-665; 54 U.S.C. 300101, et seq.).	A letter was mailed to the Burns Paiute Tribal Council Chairman on May 21, 2018, requesting government-to-government consultation. The Tribe has not responded identifying any concerns. Lack of response is interpreted by BLM to indicate that the Tribe has no concerns relative to the proposed action.
Livestock Grazing Permittees	An effort to coordinate with permitted land users directly affected by the management of wild horse and burro populations with Warm Springs HMA.	A scoping letter was mailed to all livestock grazing permittees within the HMA on May 21, 2018.
U.S. Fish and Wildlife Service	No official consultation is required for this project, however a letter was written by BLM to announce the project in the Warm Springs HMA which is approximately 36% PHMA and is in the Dry Valley/Jack Mountain PAC for GRSG.	The USFWS support maintaining the wild horse and burro population within AML to improve rangeland conditions and prevent further adverse impacts on GRSG and their habitat. They support the use of fertility control vaccines, but suggest finding a less expensive, long-term solution to equid population growth (FWS 2018).

B. Summary of Public Participation

On February 22, 2018, a BLM IDT met to discuss alternatives to the proposed action and issues to analyze in detail in this EA. On May 21, 2018, the BLM mailed a scoping letter to 127 interested individuals, groups, and agencies regarding the proposed study and population management plan. The scoping letter was also posted to BLM's ePlanning website. Letters mailed to Burns District BLM and emails sent to blm_or_spaystudy_warmsprhma@blm.gov were received from 2,044 individuals, groups, and agencies during the scoping period. The comments and issues identified in those letters and emails, along with the issues identified during the IDT meetings and through contact with other agencies, have been addressed by the BLM IDT. The Issue Identification section of chapter I identifies those issues analyzed in detail in chapter III. Chapter I also identifies issues considered but eliminated from further analysis.

C. List of Preparers

Interdisciplinary Team
Chad Rott, Supervisory Fuels Management Specialist (Air Quality and Fire Management)
Scott Thomas, District Archaeologist (American Indian Traditional Practices, Areas of Critical Environmental Concern, Cultural Resources, and Paleontological Resources)
Lindsay Davies, Planning and Environmental Coordinator (Environmental Justice)
Breanna O'Connor, Riparian Specialist (Fisheries, SSS Fish, Threatened and Endangered (T&E) Fish, Water Quality, and Wetland and Riparian Zones)
Lisa Grant, District Wild Horse and Burro Specialist (Project Lead: Wild Horses and Burros and Economic Values)
Tim Newkirk, Forester (Forestry and Woodlands)
Kyle Jackson, Rangeland Management Specialist (Grazing Management and Rangelands, Upland Vegetation)
Marsha Reponen, Resource Protection Specialist (Hazardous Materials or Solid Waste)
Travis Miller, Wildlife Biologist (Migratory Birds, SSS Wildlife, T&E Wildlife, and Wildlife or Locally Important Species and Habitat).
Ty Cronin, Environmental Protection Specialist (Noxious Weeds)
Tara McLain, Realty Specialist (Realty and Lands)
Dory Seeley, Outdoor Recreation Planner
Caryn Burri, Natural Resource Specialist (Soils and Biological Crusts, SSS Plants, T&E Plants)
Connie Pettyjohn, Management and Program Analyst (Transportation and Roads)
Thomas Wilcox, Outdoor Recreation Planner (Wild and Scenic Rivers, Wilderness Study Areas, and Lands with Wilderness Characteristics)

Advisory Team
Robert Sharp, Supervisory Wild Horse Management Specialist
Paul Griffin, Wild Horse and Burro Program Research Coordinator
Stacy Fenton, Geographic Information Specialist
Lindsay Davies, Planning and Environmental Coordinator
Jeffrey Rose, District Manager, Burns District BLM

Brenda Lincoln-Wojtanik, Program Analyst, Oregon State Office
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V. REFERENCES

Altmann, J. 1974. Observational study of behavior: sampling methods. Behaviour 49:227–267.

Anderson, A., and K.C. McCuistion. 2008. *Evaluating Strategies for Ranching in the 21st Century: Successfully Managing Rangeland for Wildlife and Livestock*. Rangelands, Vol. 30, No. 2, pp. 8–14.

Asa, C.S., D.A. Goldfoot, O.J. Ginther. 1979. Sociosexual behavior and the ovulatory cycle of ponies (Equus caballus) observed in harem groups. *Horm. Behav.* 13:49–65.

Asa, C.S., D.A. Goldfoot, M.C. Garcia, and O.J. Ginther. 1980. Sexual behavior in ovariectomized and seasonally anovulatory pony mares (Equus caballus). *Horm. Behav.* 14:46–54.

Asa, C.S., D.A. Goldfoot, M.C. Garcia, and O.J. Ginther. 1984. The effect of estradiol and progesterone on the sexual behavior of ovariectomized mares. *Physiol. Behav.* 33:681–686.

Asdell, S.A. 1964. *Patterns of mammalian reproduction* (2nd edition). Pp. 530–532. Cornell University Press.

Atwood, T.C., T.L. Fry, and B.R. Leland. 2011. *Partitioning of Anthropogenic Watering Sites by Desert Carnivores.* Journal of Wildlife Management 75(7):1609–1615.

Baldock, P.A.J., H.A. Morris, A.G. Need, R.J. Moore, and T.C. Durbridge. 1998. Variation in the short-term changes in bone cell activity in three regions of the distal femur immediately following ovariectomy. *J. Bone Miner. Res.* 13:1451–1457.

Bartholow, J. 2007. Economic benefit of fertility control in wild horse populations. The Journal of Wildlife Management 71:2811–2819.

Beckett, T., A. Tchernof, and M.J. Toth. 2002. Effect of ovariectomy and estradiol replacement on skeletal muscle enzyme activity in female rats. *Metabolism* 51:1397–1401.

Beever, E. 2003. *Management implications of the ecology of free-roaming horses in semi-arid ecosystems of the western United States.* Wildlife Society Bulletin 31(3):887–895.

Beever, E.A. and P.F. Brussard. 2000. *Examining ecological consequences of feral horse grazing using exclosures.* Western North American Naturalist 60(3):236–254.

Beever, E.A. and P.F. Brussard. 2004. *Community- and landscape-level responses of reptiles and small mammals to feral-horse grazing in the Great Basin*. Journal of Arid Environments 59:271–297.

Beever, E.A., and J.E. Herrick. 2006. *Effects of feral horses in Great Basin landscapes on soil and ants—direct and indirect mechanisms*. Journal of Arid Environments 66:96–112.

Beever, E.A., R.J. Tausch, and W.E. Thogmartin. 2008. *Multi-scale responses of vegetation to the removal of horse grazing from the Great Basin (USA) mountain ranges*. Plant Ecology 196:163–184.

Beever, E.A. and C.L. Aldridge. 2011. Influences of free-roaming equids on sagebrush ecosystems, with a focus on Greater Sage-Grouse. Pp. 273–290 in S T. Knick and J.W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA.

Belsito, K.R., B.M. Vester, T. Keel, T.K. Graves, and K.S. Swanson. 2009. Impact of ovariohysterectomy and food intake on body composition, physical activity, and adipose gene expression in cats. *J. Anim. Sci.* 87:594–602.

Berger, J. 1977. *Organizational Systems and Dominance of Feral Horses in the Grand Canyon*. Behavioral Ecology and Sociobiology, Vol. 2, No. 2, pp. 131–146.

Berger, J. 1985. *Interspecific interactions and dominance among wild Great Basin ungulates*. J. Mammal. 66:571–573.

Berger, J. 1986. *Wild Horses of the Great Basin, Social Competition and Population Size*. Wildlife Behavior and Ecology Series. The University of Chicago Press.

Bertin, F.R., K.S. Pader, T.B. Lescun, and J.E. Sojka-Kritchevsky. 2013. Short-term effect of ovariectomy on measures of insulin sensitivity and response to dexamethasone administration in horses. *Am. J. Vet. Res.* 74:1506–1513.

Bourjade, M., L. Tatin, S.R.B. King, and C. Feh. 2009. Early reproductive success, preceding bachelor ranks and their behavioural correlates in young Prezewalski's stallions. Ethology Ecology and Evolution 21:1–14.

Bowen, Z. 2015. Assessment of spay techniques for mare in field conditions. Letter from US Geological Survey to D. Bolstad, BLM. November 24, 2015.

Bussières, G., C. Jacques, O. Lainay, G. Beauchamp, A. Leblond, J.L. Cadorè, L.M. Desmaizières, S.G. Cuvelliez, E. Troncy. 2008. *Development of a composite orthopaedic pain scale in horses*. Research in Veterinary Science 85:294–306.

Camara, C. *et al.* 2014. Effect of ovariectomy on serum adiponectin levels and visceral fat in rats. *J. Huazhong Univ. Sci. Technol. Medical Sci.* 34:825–829.

Chambers, J.C.; J.L. Beck, J.B. Bradford, J. Bybee, S. Campbell, J. Carlson, T.J. Christiansen, K.J. Clause, G. Collins, M.R. Crist, J.B. Dinkins, K.E. Doherty, F. Edwards, S. Espinosa, K.A. Griffin, P. Griffin, J.R. Haas, S.E. Hanser, D.W. Havlina, K.F. Henke, J.D. Hennig, L.A. Joyce, F.M. Kilkenny, S.M. Kulpa, L.L. Kurth, J.D. Maestas, M. Manning, K.E. Mayer, B.A. Mealor, C. McCarthy, M. Pellant, M.A. Perea, D.A. Pyke, L.A. Wiechman, A. Wuenschel. 2017. Science Framework for Conservation and Restoration of the Sagebrush Biome: Linking the Department of the Interior Secretarial Order 3336 to Long-Term Strategic Conservation Actions. Part 1. Science Basis and Applications. RMRS-GTR-360. USGS, CO: U.S Department of Agriculture, Forest Service, Rocky Mountain Research Station. https://www.treesearch.fs.fed.us/pubs/53983.

Code of Federal Regulations. 2017. 43 CFR Ch. II, Subchapter D – Range Management (4000), Part 4100 – Grazing Administration.

Code of Federal Regulations. 2017. 43 CFR Ch. II, Subchapter D - Range Management (4000), Part 4700 – Protection, Management, and Control of Wild Free-Roaming Horses and Burros.

Coit V.A., F.J. Dowell, and N.P. Evans. 2009. Neutering affects mRNA expression levels for the LH-and GnRH-receptors in the canine urinary bladder. Theriogenology 71:239–247.

Colorado State University. 2014. Veterinary Teaching Hospital Photography and Audio Visual Recording Policy (Policy ID #VTHADM16-2014).

Collins, G.H. and J.W. Kasbohm. 2016. *Population Dynamics and Fertility Control of Feral Horses*. The Journal of Wildlife Management 81(2):289–296.

Collins, G.H., S.L. Petersen, C.A. Carr, and L. Pielstick. 2014. Testing VHF/GPS collar design and safety in the study of free-roaming horses. PLoS ONE 9:e103189.

Colwell, R.K., and D.J. Futuyma. 1971. *On the Measurement of Niche Breadth and Overlap*. Ecology, Vol. 52, No. 4, pp. 567–576.

Cooper, D.W. and E. Larsen. 2006. Immunocontraception of mammalian wildlife: ecological and immunogenetic issues. Reproduction 132:821–828.

Cothran, E.G. 2002. Genetic analysis of the Warm Springs, OR HMA. University of Kentucky, Department of Veterinary Science, Report to BLM.

Cothran, E.G. 2011. Genetic analysis of the Warm Springs, OR HMA. University of Kentucky, Department of Veterinary Science, Report to BLM.

Crabtree, J.R. 2016. Can ovariectomy be justified on grounds of behaviour? *Equine Vet. Educ.* 28:58–59.

Crawford, J.A., R.A. Olson, N.E. West, J.C. Mosley, M.A. Schroeder, T.D. Whitson, R.F. Miller, M.A. Gregg, C.S. Boyd. 2004. *Synthesis Paper: Ecology and management of sage-grouse and sage-grouse habitat.* J. Range Management, 57:2–19.

Crowell-Davis, S.L. 2007. Sexual behavior of mares. *Horm. Behav.* 52:12–17.

Davies, K.W. 2010. *Revegetation of Medusahead-Invaded Sagebrush Steppe*. Rangeland Ecology and Management 63:564–571.

Davies, K.W., A.M. Nafus, and R.L. Sheley. 2010. *Non-native competitive perennial grass impedes the spread of an invasive annual grass*. Biological Invasions 12:3187–3194.

Davies, K.W., T.J. Svejcar, and J.D. Bates. 2009. *Interaction of historical and nonhistorical disturbances maintains native plant communities*. Ecological Applications 19(6):1536–1545.

Davies, K.W., C.S. Boyd, J.L Beck, J.D. Bates, T.J. Svejcar, and M.A. Gregg. 2011. *Saving the sagebrush sea: An ecosystem conservation plan for big sagebrush plant communities*. Biological Conservation 144:2573–2584.

Davies, K.W., G. Collins, and C.S. Boyd. 2014. *Effects of feral free-roaming horses on semi-arid rangeland ecosystems: an example from the sagebrush steppe*. Ecosphere 5(10):127. http://dx.doi.org/10.1890/ES14-00171.1.

de Seve, C.W. and S.L. Boyles-Griffin. 2013. An economic model demonstrating the long-term cost benefits of incorporating fertility control into wild horse (*Equus caballus*) management in the United States. Journal of Zoo and Wildlife Medicine 44(4s:S34–S37).

Delgiudice, G.D., B.A. Sampson, D.W. Kuehn, M. Carstensen Powell, and J. Fieberg. 2005. Understanding margins of safe capture, chemical immobilization, and handling of free-ranging white-tailed deer. *Wildlife Society Bulletin*. Summer 2005, 33(2):677.

Doherty, K.E., D.E. Naugle, J.D. Tack, B.L. Walker, J.M. Graham, and J.L. Beck. 2014. *Linking conservation actions to demography: grass height explains variation in greater sage-grouse nest survival*. Wildlife Biology, 20(6):320–325.

Douglas, C.L., and T.L. Hurst. 1993. *Review and Annotated Bibliography of Feral Burro Literature*. Western Region National Park Service, Department of the Interior and University of Nevada, Las Vegas.

Drut, M.S., W.H. Pyle, and J.A. Crawford. 1994. *Diets and Food Selection of Sage Grouse Chicks in Oregon*. Journal of Range Management, Vol. 47, No. 1, pp. 90–93.

Duncan, P. 1980. Time-Budget of Camargue Horses: II. Time-Budgets of Adult Horses and Weaned Sub-Adults. Behaviour, Vol. 72, No. ½, pp. 26–49.

Eberhardt, L.L., A.K. Majorowicz, and J.A. Wilcox. 1982. *Apparent Rates of Increase for Two Feral Horse Herds*. Journal of Wildlife Management, Vol. 46, No. 2, pp. 367–374.

Evans, J. Warren, A. Borton, H.F. Hintz, and L.D. Van Vleck. 1977. *The Horse*. San Francisco, California: W.H. Freeman and Company, pp. 373–377.

Federal Land Policy and Management Act (FLPMA). 1976, as amended.

Feist, J.D. & D.R. McCullough. 1976. Behavior patterns and communication in feral horses. *Zietschrift für Tierpsychologie* 41:337–371.

Fettman, M.J. *et al.* 1997. Effects of neutering on bodyweight, metabolic rate and glucose tolerance of domestic cats. *Res. Vet. Sci.* 62:131–136.

Fischoff, I.R., S.R. Sundaresan, J.E. Cordingley, and D.I. Rubenstein. 2007. Habitat use and movements of plains zebra (*Equus burchelli*) in response to predation danger from lions. Behavioral Ecology 18:725–729.

France, K.A., D.C. Ganskopp, and C.S. Boyd. 2008. *Interspace/Undercanopy Foraging Patterns of Beef Cattle in Sagebrush Habitat*. Rangeland Ecology and Management, Vol. 61, No. 4, pp. 389–393.

Frid, A. and L.M. Dill. 2002. *Human-caused disturbance stimuli as a form of predation risk*. Conservation Ecology 6(1):11.

Garcia, M.C., and O.J. Ginther. 1976. Effects of Ovariectomy and Season on Plasma Luteinizing Hormone in Mares. Endocrinology, Vol. 98(4), pp. 958–962.

Garrott, R.A. and D.B. Siniff. 1992. *Limitations of male-oriented contraception for controlling feral horse populations.* Journal of Wildland Management 56(3):456–464.

Girard, T.L., E.W. Bork, S.E. Nielson, and M.J. Alexander. 2013. Seasonal variation in habitat selection by free-ranging feral horses within Alberta's Forest Reserve. Rangeland Ecology and Management 66:428–437.

Gleerup, K.G., and C. Lindegard. 2016. Recognition and quantification of pain in horses: A tutorial review. Equine Veterinary Education 28:47–57.

Gooch, A.M, S.L. Petersen, G.H. Collins, T.S. Smith, and B.R. McMillan. 2017. *The impacts of feral horses on the use of water by pronghorn in the Great Basin*. Journal of Arid Environments: in press.

Goodloe, R.B., R.J. Warren, D.A. Osborn, and C. Hall. 2000. Population characteristics of feral horses on Cumberland Island, Georgia and their management implications. Journal of Wildlife Management 64:114–121.

Government Accountability Office (GAO). October 2008. *Bureau of Land Management; Effective Long-Term Options Needed to Manage Unadoptable Wild Horses*, GAO-09-77.

Green, N.F. and H.D. Green. 1977. *The Wild Horse Population of Stone Cabin Valley, Nevada: A Preliminary Report*. Proceedings National Wild Horse Forum April 4–7, 1977.

Gregg, M.A., J.A. Crawford, M.S. Drut, and A.K. DeLong. 1994. *Vegetational Cover and Predation of Sage Grouse Nests in Oregon.* The Journal of Wildlife Management, Vol. 58, No. 1, pp. 162–166.

Griffin, P.C. 2015. Estimated Abundance of Wild Burros Surveyed on Bureau of Land Management Lands in 2014. U.S. Department of the Interior and U.S. Geological Survey Open-File Report 2015-1084.

Gross, J.E. 2000. A dynamic simulation model for evaluating effects of removal and contraception on genetic variation and demography of Pryor Mountain wild horses. Biological Conservation 96:319–330.

Guttilla, D.A. and P. Stapp. 2010. Effects of sterilization on movements of feral cats at a wildland-urban interface. *J. Mammal.* 91:482–489.

Hailer, F., B. Helander, A.O. Folkestad, S.A. Ganusevich, S. Garstad, P. Hauff, C. Koren, T. Nygård, V. Volke, C. Vilà, and H. Ellegren. 2006. Bottlenecked but long-lived: high genetic diversity retained in white-tailed eagles upon recovery from population decline. Biology Letters 2:316–319.

Hagen, C. 2011. *Greater Sage-Grouse Conservation Assessment and Strategy for Oregon: A Plan to Maintain and Enhance Populations and Habitat*. Oregon Department of Fish and Wildlife. April 22, 2011.

Hall, L.K., R.T. Larsen, M.D. Westover, C.C. Day, R.N. Knight, and B.R. McMillan. 2016a. Influence of exotic horses on the use of water by communities of native wildlife in a semi-arid environment. Journal of Arid Environments 127:100-105.

Hall, L.K., R.T. Larsen, R.N. Knight, and B.R. McMillan. 2018. Feral horses influence both spatial and temporal patterns of water use by native ungulates in a semi-arid environment. Ecosphere 9:1–15. e02096. 10.1002/ecs2.2096

Hall, S.E., B. Nixon, and R.J. Aiken. 2016b. Non-surgical sterilization methods may offer a sustainable solution to feral horse (*Equus caballus*) overpopulation. Reproduction, Fertility and Development, published online: https://doi.org/10.1071/RD16200.

Hall, L.K., R.T. Larsen, R.N. Knight, and B.R. McMillan. 2018. *Feral horses influence both spatial and temporal patterns of water use by native ungulates in a semi-arid environment*. Ecosphere 9(1):e02096

Hampson, B.A., M.A. De Laat, P.C. Mills, and C.C. Pollitt. 2010a. Distances travelled by feral horses in outback Australia. *Equine Vet. J.* 42:582–586.

Hampson, B.A. *et al.* 2010b. Monitoring distances travelled by horses using GPS tracking collars. *Aust. Vet. J.* 88:176–181.

Hart, B.L. and R.A. Eckstein. 1997. The role of gonadal hormones in the occurrence of objectionable behaviours in dogs and cats. *Appl. Anim. Behav. Sci.* 52:331–344.

Henneke, D.R., G.D. Potter, J.L. Kreider, and B.F. Yeates. 1983. Relationship between condition score, physical measurements and body fat percentage in mares. Equine Veterinary Journal 15(4):371–372.

Holtan, D.W., F.L. Squires, D.R. Lapin, and O.J. Ginther. 1979. Effect of Ovariectomy on Pregnancy in Mares. *Journal of Reproduction and Fertility Suppl.* 27:457–463.

Hooper, N.R., T.S. Taylor, D.D. Varner, and T.L. Blanchard. 1993. *Effects of Bilateral Ovariectomy Via Colpotomy in Mares: 23 Cases (1984–1990).* Journal of the American Veterinary Medical Association 203(7):1043–1046.

Huang, R.Y., L.M. Miller, C.S. Carlson, and M.R. Chance. 2002. Characterization of bone mineral composition in the proximal tibia of Cynomolgus monkeys: effect of ovariectomy and nandrolone decanoate treatment. *Bone* 30:492–497.

Jacob, J., J. Matulessy, and Sudarmaji. 2004. Effects of Imposed Sterility on Movement Patterns of Female Ricefield Rats. *J. Wildl. Manage.* 68:1138–1144.

Jacob, J., G.R. Singleton, and L.A. Hinds. 2008. Fertility control of rodent pests. *Wildl. Res.* 35:487–493.

Jerome, C. P., Turner, C. H. & Lees, C. J. Decreased bone mass and strength in ovariectomized cynomolgus monkeys (\emph{Macaca fascicularis}). *Calcif. Tissue Int.* 60, 265–270 (1997).

Jeusette, I., J. Detilleux, C. Cuvelier, L. Istasse, and M. Diez. 2004. Ad libitum feeding following ovariectomy in female Beagle dogs: effect on maintenance energy requirement and on blood metabolites. *J. Anim. Physiol. Anim. Nutr. (Berl).* 88:117–121.

Jeusette, I. *et al.* 2006. Effect of ovariectomy and ad libitum feeding on body composition, thyroid status, ghrelin and leptin plasma concentrations in female dogs*. *J. Anim. Physiol. Anim. Nutr. (Berl).* 90:12–18.

Kaczensky, P., R. Kuehn, B. Lhagvasuren, S. Pietsch, W. Yang, and C. Walzer. 2011. Connectivity of the Asiatic wild ass population in the Mongolian Gobi. Biological Conservation 144:920–929.

Kamm, J.L. and D.A. Hendrickson. 2007. Clients' perspectives on the effects of laparoscopic ovariectomy on equine behavior and medical problems. *J. Equine Vet. Sci.* 27:435–438.

King, S.R.B., and J. Gurnell. 2005. Habitat use and spatial dynamics of takhi introduced to Hustai National Park, Mongolia. Biological Conservation 124:277–290.

King, S.R.B., and K. Schoenecker. 2018. Potential spread of cheatgrass (*Bromus tectorum*) by feral horses (*Equus caballus*) in western Colorado. Rangeland Ecology & Management. *In press*.

Kirkpatrick, J.F., I.K.M. Liu, and J.W. Turner, Jr. 1990. *Remotely delivered immunocontraception in feral horses.* Wildlife Society Bulletin 18:326–330.

Kirkpatrick, J., and A. Turner. 2002. *Reversibility of action and safety during pregnancy of immunization against porcine zona pellucida in wild mares (Equus caballus*). Reproduction. Supplement, 60:197–202.

Kirkpatrick, J.F. and A. Turner. 2008. Achieving population goals in a long-lived wildlife species (Equus caballus) with contraception. *Wildl. Res.* 35:513.

Kirkpatrick, J.F. 2013. Director, the Science and Conservation Center. 2100 S. Shiloh Road, Billings, MT 59106. Written communication.

Kitchell, K., S. Cohn, R. Falise, H. Hadley, M. Herder, K. Libby, K. Muller, T. Murphy, M. Preston, M.J. Rugwell, and S. Schlanger. 2015. Advancing Science in the BLM: An Implementation Strategy. Department of the Interior, Bureau of Land Management, Washington, DC.

Knight, C.M. 2014. The effects of porcine zona pellucida immunocontraception on health and behavior of feral horses (*Equus caballus*). Graduate thesis, Princeton University.

Knock, B. 2013. *Liberated Horsemanship: Menopause …and Wild Horse Management.* Liberated Horsemanship Press, Warrenton, MO.

Knopff, K.H., A.A. Knopff, A. Kortello, and M.S. Boyce. 2010. Cougar Kill Rate and Prey Composition in a Multiprey System. Journal of Wildlife Management, Vol. 74, No. 7, pp. 1435–1447.

Kobluk, C.N., T.R. Ames, and R.J. Geor. 1995. *Surgery of the Reproductive Tract in the Horse: Diseases and Clinical Management*. Philadelphia: W.B. Saunders. Pp. 1036–1038.

Krueger, K., B. Flauger, K. Farmer, and C.K. Hemelrijk. 2014. Movement initiation in groups of feral horses. Behavioral Processes 103:91–101.

Laboratory Animals Resources (LAR) Employee Handbook. 2014. Colorado State University.

Lee, M. and D.A. Hendrickson. 2008. *A Review of Equine Standing Laparoscopic Ovariectomy*. Journal of Equine Veterinary Science. Vol. 28, No. 2.

Levin, P.S., J. Ellis, R. Petrik, and M.E. Hay. 2002. *Indirect effects of feral horses on estuarine communities.* Conservation Biology 16:1364–1371.

Linklater, W.L. 2000. Adaptive explanation in socio-ecology: lessons from the Equidae. Biological Reviews 75:1–20.

Liu, I.K.M., M. Bernoco, and M. Feldman. 1989. Contraception in mares heteroimmunized with pig zonae pellucidae. Journal of Reproduction and Fertility, 85:19–29.

Loesch, D.A. and D.H. Rodgerson. 2003. *Surgical Approaches to Ovariectomy in Mares*. VetLearn.com. Compendium 25(11). November 2003.

Lubow, B. 2016. *Statistical analysis for 2016 horse survey of horse populations in Warm Springs HMA and Stinkingwater HMA, Oregon*. Report to United States Department of the Interior, Bureau of Land Management, IIF Data Solutions.

Lubow, B.C., and J.I. Ransom. 2016. Practical bias correction in aerial surveys of large mammals: validation of hybrid double-observer with sightability method against known abundance of feral horse (*Equus caballus*) populations. PLoS ONE 11(5):e0154902. doi:10.1371/journal.pone.0154902

Lundon, K., M. Dumitriu, and M. Grynpas. 1994. The long-term effect of ovariectomy on the quality and quantity of cancellous bone in young macaques. *Bone Miner.* 24:135–149.

Madosky, J.M., D.I. Rubenstein, J.J. Howard, and S. Stuska. 2010. The effects of immunocontraception on harem fidelity in a feral horse (*Equus caballus*) population. Applied Animal Behaviour Science, 128:50–56.

Madosky, J.M. 2011. *Factors that affect harem stability in a feral horse (Equus caballus) population on Shackleford Banks Island, NC.* Department of Biological Sciences. University of New Orleans, New Orleans, LA, USA.

Magiafoglou, A., M. Schiffer, A.A. Hoffman, and S.W. McKechnie. 2003. Immunocontraception for population control: will resistance evolve? Immunology and Cell Biology 81:152–159.

Mavropoulos, A., S. Kiliaridis, R. Rizzoli, and P. Ammann. 2014. Normal masticatory function partially protects the rat mandibular bone from estrogen-deficiency induced osteoporosis. *J. Biomech.* 47:2666–2671.

McCue, P.M., D.A. Hendrickson, and M.B. Hess. 2000. *Fertility of Mares after Unilateral Laparoscopic Tubal Ligation*. Veterinary Surgery 29:543–545.

McInnis, M.L., and M. Vavra. 1987. *Dietary Relationships among Feral Horses, Cattle, and Pronghorn in Southeastern Oregon.* Journal of Range Management. 40(1), January 1987.

McKinnon, A.O. and J.R. Vasey. 2007. *Current Therapy in Equine Reproduction: Selected Reproductive Surgery of the Broodmare.* St. Louis, Missouri: Saunders Elsevier, pp. 146–160.

Merck Veterinary Manual. 2017. *Nutritional Requirements of Horses*. https://www.merckvetmanual.com/management-and-nutrition/nutrition-horses/nutritional-requirements-of-horses. Accessed June 22, 2017.

Merrill, J.A., E.G. Cooch, and P.D. Curtis. 2006. Managing an overabundant deer population by sterilization: effects of immigration, stochasticity and the capture process. *J. Wildl. Manage.* 70:268–277.

Miller, R. 1983. Habitat Use of Feral Horses and Cattle in Wyomings's Red Desert. Journal of Range Management, Vol. 36, No. 2, pp. 195–199.

Miller, R. and R.H. Denniston. 1979. *Interband Dominance of Feral Horses*. Z. Tierpsychol., 51:41–47.

Miller, R.F., J.C. Chambers, D.A. Pyke, F.B. Pierson, and C.J. Williams. 2013. *A Review of Fire Effects on Vegetation and Soils in the Great Basin Region: Response and Ecological Site Characteristics*. United States Department of Agriculture, Forest Service, Rocky Mountain Research Station, General Technical Report RMRS-GTR-308.

Mills, L.S. and F.W. Allendorf. 1996. The one-migrant-per-generation rule in conservation and management. Conservation Biology 10:1509–1518.

Morgart, J.R. 1978. *Burro Behavior and Population Dynamics, Bandelier National Monument, New Mexico.* (Thesis). Arizona State University.

National Environmental Policy Act (NEPA). 1970. 42 U.S.C. 4321-4347.

National Oceanic and Atmospheric Administration (NOAA). 2018. *U. S. Seasonal Drought Outlook*. http://www.cpc.ncep.noaa.gov/products/expert_assessment/sdo_discussion.php. Accessed May 14, 2018.

National Research Council (NRC). 2013. Using science to improve the BLM wild horse and burro program: a way forward. National Academies Press. Washington, DC.

Nimmo, D.G. and K.K. Miller. 2007. *Ecological and human dimensions of management of feral horses in Australia: a review.* Wildlife Research 34:408–417.

Nuñez, C.M., J.S. Adelman, and D.I. Rubenstein. 2010. Immunocontraception in wild horses (*Equus caballus*) extends reproductive cycling beyond the normal breeding season. PLoS one, 5(10), p.e13635.

Nuñez, C.M.V, J.S. Adelman, J. Smith, L.R. Gesquiere, and D.I. Rubenstein. 2014. Linking social environment and stress physiology in feral mares (*Equus caballus*): group transfers elevate fecal cortisol levels. General and Comparative Endocrinology. 196:26–33.

Nuñez, C.M., J.S. Adelman, H.A. Carr, C.M. Alvarez, and D.I. Rubenstein. 2017. Lingering effects of contraception management on feral mare (*Equus caballus*) fertility and social behavior. Conservation Physiology 5(1): cox018; doi:10.1093/conphys/cox018.

Nuñez, C.M.V. 2018. Consequences of porcine zona pellucida immunocontraception to feral horses. Human-Wildlife Interactions 12:131–142.

O'Farrell, V. and E. Peachey. 1990. Behavioural effects of ovariohysterectomy on bitches. *J. Small Anim. Pract.* 31:595–598.

Oesterheld, M. and S.J. McNaughton. 1991. *Effect of Stress and Time for Recovery on the Amount of Compensatory Growth after Grazing.* Oecologia 85(3):305–313.

Office of Inspector General, U.S. Department of the Interior. 2010. *Bureau of Land Management Wild Horse and Burro Program*. Report No.: C-IS-BLM-0018-2010. December 2010.

Office of Inspector General, U.S. Department of the Interior. 2016. *The Bureau of Land Management's Wild Horse and Burro Program Is Not Maximizing Efficiencies or Complying with Federal Regulations*. Report No.: 2016-WR-027.

Oregon Department of Fish and Wildlife. 2017a. *Oregon Cougar Management Plan*. October 2017.

Oregon Department of Fish and Wildlife. 2017b. *Pronhorn Antelope Regulations*. http://www.eregulations.com/oregon/17orhd/pronghorn-antelope-regulations/. Accessed March 22, 2018.

Oregon Sage-SHARE. 2017. *Sage-grouse Conservation: Linking Practices to Habitat Metrics*. Outcomes and Impacts: Executive Summaries and Full Reports, USDA-Natural Resources Conservation Innovation Grant.

Ostermann-Kelm, S., E.R. Atwill, E.S. Rubin, M.C. Jorgensen, W.M. Boyce. 2008. *Interactions between Feral Horses and Desert Bighorn Sheep at Water*. Journal of Mammalogy, 89(2):459–466.

Owen-Smith, N. and V. Goodall. 2014. Coping with savanna seasonality: comparitive daily activity patterns of African ungulates as revealed by GPS telemetry. Journal of Zoology 293:181–191.

Pader, K., L.J. Freeman, P.D. Constable, C.C. Wu, P.W. Snyder, and T.B. Lescun. 2011. Comparison of Transvaginal Natural Orifice Transluminal Endoscopic Surgery (NOTES{®}) and Laparoscopy for Elective Bilateral Ovariectomy in Standing Mares. Veterinary Surgery 40:998–1008.

Payne, R.M. 2013. The effect of spaying on the racing performance of female greyhounds. *Vet. J.* 198:372–375.

Pellegrini, S.W. 1971. *Home Range, Territoriality and Movement Patterns of Wild Horses in the Wassuk Range of Western Nevada* (thesis). University of Nevada - Reno.

Perry, N.D., P. Morey and G.S. Miguel. 2015. Dominance of a Natural Water Source by Feral Horses. The Southwestern Naturalist 60:390–393.

Powell, D.M. 1999. Preliminary evaluation of porcine zona pellucida (PZP) immunocontraception for behavioral effects in feral horses (*Equus caballus*). Journal of Applied Animal Welfare Science 2:321–335.

Prado, T., and J. Schumacher. 2017. How to perform ovariectomy through a colpotomy. Equine Veterinary Education 13:doi: 10.1111/eve.12801

Price, J., S. Catriona, E.M. Welsh, and N.K. Waran. 2003. Preliminary evaluation of a behaviour-based system for assessment of post-operative pain in horses following arthroscopic surgery. Veterinary anaesthesia and analgesia 30:124–137. Association of Veterinary Anaesthetists and American College of Veterinary Anesthesia and Analgesia.

Pritchett, L.C., C. Ulibarri, M.C. Roberts, R.K. Schneider, and D.C. Sellon. 2003. Identification of potential physiological and behavioral indicators of postoperative pain in horses after exploratory celiotomy for colic. Applied Animal Behaviour Science 80:31–43.

Public Rangelands Improvement Act (PRIA). 1978. 43 U.S.C. 1901. Public Law 95-514—October 25, 1978.

Ramsey, D. 2005. Population dynamics of brushtail possums subject to fertility control. *J. Appl. Ecol.* 42:348–360.

Ramsey, D. 2007. Effects of fertility control on behavior and disease transmission in brushtail possums. *J. Wildl. Manage.* 71:109–116.

Ransom, J.I., B.S. Cade, and N.T. Hobbs. 2010. Influences of immunocontraception on time budgets, social behavior, and body condition in feral horses. Applied Animal Behaviour Science 124:51–60.

Ransom, J.I., J.E. Roelle, B.S. Cade, L. Coates-Markle, and A.J. Kane. 2011. Foaling rates in feral horses treated with the immunocontraceptive porcine zona pellucida. Wildlife Society Bulletin 35:343–352.

Ransom, J.I., N.T. Hobbs, and J. Bruemmer. 2013. Contraception can lead to trophic asynchrony between birth pulse and resources. PLoS one, 8(1), p.e54972.

Ransom, J.I., J.G. Powers, N.T. Hobbs, and D.L. Baker. 2014a. Ecological feedbacks can reduce population-level efficacy of wildlife fertility control. Journal of Applied Ecology 51:259–269.

Ransom, J.I., J.G. Powers, H.M. Garbe, M.W. Oehler, T.M. Nett, and D.L. Baker. 2014b. Behavior of feral horses in response to culling and GnRH immunocontraception. Applied Animal Behaviour Science 157:81–92.

Ransom, J.I., L Lagos, H. Hrabar, H. Mowrazi, D. Ushkhjargal, and N. Spasskaya. 2016. Wild and feral equid population dynamics. Pages 68–86 in J.I. Ransom and P. Kaczensky, eds., Wild equids; ecology, management and conservation. Johns Hopkins University Press, Baltimore, Maryland.

Reichler, I.M. 2009. Gonadectomy in Cats and Dogs: A Review of Risks and Benefits. *Reprod. Domest. Anim.* 44:29–35.

Röcken, M., G. Mosel, K. Seyrek-Intas, D. Seyrek-Intas, F. Litzke, J. Verver, and A.B.M. Rijkenhuizen. 2011. *Unilateral and bilateral laparoscopic ovariectomy in 157 mares: a retrospective multicenter study*. Veterinary Surgery 40:1009–1014.

Rodgerson, D.H., J.K. Belknap, and D.A. Wilson. 2001. *Laparoscopic Ovariectomy Using Sequential Electrocoagulation and Sharp Transection of the Equine Mesovarium*. Veterinary Surgery, 30:572–579.

Roelle, J.E., F.J. Singer, L.C. Zeigenfuss, J.I. Ransom, F.L. Coates-Markle, and K.A. Schoenecker. 2010. Demography of the Pryor Mountain Wild Horses, 1993–2007. U.S. Geological Survey Scientific Investigations Report 2010–5125.

Roelle, J.E. and S.J. Oyler-McCance. 2015. Potential demographic and genetic effects of a sterilant applied to wild horse mares. US Geological Survey Open-file Report 2015-1045.

Roessner, H.A., K.A. Kurtz, and J.P. Caron. 2015. Laparoscopic ovariectomy diminishes estrus-associated behavioral problems in mares. *J. Equine Vet. Sci.* 35:250–253.

Rowland, A.L., K.G. Glass, S.T. Grady, K.J. Cummings, K. Hinrichs, and A.E. Watts. 2018. *Influence of caudal epidural analgesia on cortisol concentrations and pain-related behavioral responses in mares during and after ovariectomy via colpotomy*. Veterinary Surgery 2018;00:1–7.

Rubin, C., A.S. Turner, S. Bain, C. Mallinckrodt, and K. McLeod. 2001. Low mechanical signals strengthen long bones. *Nature* 412:603–604.

Rutberg, A., K. Grams, J.W. Turner, and H. Hopkins. 2017. Contraceptive efficacy of priming and boosting doses of controlled-release PZP in wild horses. Wildlife Research: http://dx.doi.org/10.1071/WR16123.

Sacco, A.G. 1977. *Antigenic Cross-Reactivity Between Human and Pig Zona Pellucida*. Biology of Reproduction 16:164–173.

Salter, R.E. 1979. Biogeography and habitat-use behavior of feral horses in western and northern Canada. in *Symposium on the Ecology and Behaviour of Wild and Feral Equids* 129–141.

Sant, E.D., G.E. Simmonds, R.D. Ramsey, and R.T. Larsen. 2014. *Assessment of sagebrush cover using remote sensing at multiple spatial and temporal scales*. Ecological Indicators 43:297–305.

Saunders, G. *et al.* 2002. The effects of induced sterility on the territorial behaviour and survival of foxes. *J. Appl. Ecol.* 39:56–66.

Schemnitz, S.D. (editor). 1980. *Wildlife Management Techniques Manual*. The Wildlife Society, Washington D.C. p. 67.

Schoenecker, K.A. and B.C. Lubow. 2015. Application of a hybrid model to reduce bias and improve precision in population estimates for elk (Cervus elaphus) inhabiting a cold desert ecosystem. Journal of King Saud University – Science, Special Issue on Arid Ecosystems.

Scholz-Ahrens, K.E., G. Delling, P.W. Jungblut, E. Kallweit, and C.A. Barth. 1996. Effect of ovariectomy on bone histology and plasma parameters of bone metabolism in nulliparous and multiparous sows. *Z. Ernahrungswiss.* 35:13–21.

Science and Conservation Center (SCC). 2015. Materials Safety Data Sheet, ZonaStat-H. Billings, Montana.

Scott, E.A. and D.J. Kunze. 1977. Ovariectomy in the mare: presurgical and postsurgical considerations. *J. Equine Med. Surg.* 1:5–12.

Seidler, R.G. and E.M. Gese. 2012. Territory fidelity, space use, and survival rates of wild coyotes following surgical sterilization. *J. Ethol.* 30:345–354.

Sigrist, I.M., C. Gerhardt, M. Alini, E. Schneider, and M. Egermann. 2007. The long-term effects of ovariectomy on bone metabolism in sheep. *J. Bone Miner. Metab.* 25:28–35.

Smith, M.A. 1986. *Impacts of feral horse grazing on rangelands: an overview*. Journal of Equine Veterinary Science 6:236–239.

Turner, J.W., I.K. Liu, A.T. Rutberg, and J.F. Kirkpatrick. 1997. Immunocontraception limits foal production in free-roaming feral horses in Nevada. Journal of Wildlife Management 61:873–880.

Turner, J.W. Jr., Ph.D. 2014. *Progress Report: BLM Wild Horse Fertility Control Project (Cooperative Agreement L10AC20431*). January 20, 2015.

Turner, A. Simon, Professor Emeritus (retired). 2015. Department of Clinical Sciences, Colorado State University, August 2011–present. October 29, 2015. Written Communication.

Twigg, L.E. *et al.* 2000. Effects of surgically imposed sterility on free-ranging rabbit populations. *J. Appl. Ecol.* 37:16–39.

United States Department of Agriculture (USDA). 2012. National Agriculture Statistics Service, Quick Stats. https://quickstats.nass.usda.gov/. Accessed April 6, 2018.

United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). 2018. Ecological Site Description. https://esis.sc.egov.usda.gov/Welcome/pgReportLocation.aspx?type=ESD. Accessed April 24, 2018.

United States Department of the Interior, Bureau of Land Management. 1979. *Warm Springs Equine Herd Management Area Plan*. Burns District.

United States Department of the Interior, Bureau of Land Management. 1980. *Wilderness Inventory, Oregon and Washington: Final Intensive Inventory Decisions*. November 1980.

United States Department of the Interior, Bureau of Land Management. 1980. *West Warm Springs Allotment Management Plan*.

United States Department of the Interior, Bureau of Land Management. 1987. *Warm Springs Wild Horse Herd Management Area Plan – Update.*

United States Department of the Interior, Bureau of Land Management. 1991. *Proposed Three Rivers Resource Management Plan and Environmental Impact Statement*. September 1991. Burns District Office.

United States Department of the Interior, Bureau of Land Management. 1992. *Three Rivers Resource Management Plan, Record of Decision, and Rangeland Program Summary*. Burns District Office.

United States Department of the Interior, Bureau of Land Management. 1993. *East Warm Springs Allotment Management Plan.*

United States Department of the Interior, Bureau of Land Management. 1997. *Standards for Rangeland Health and Guidelines for Livestock Grazing Management for Public Lands Administered by the United States Department of the Interior, Bureau of Land Management in the States of Oregon and Washington*.

United States Department of the Interior, Bureau of Land Management. 2008. *National Environmental Policy Act* (NEPA) Handbook, H-1790-1.

United States Department of the Interior, Bureau of Land Management. 2009. Instruction Memorandum (IM) 2009-062, Wild Horse and Burro Genetic Baseline Sample.

United States Department of the Interior, Bureau of Land Management. 2009. IM 2009-085, Managing Gathers Resulting from Escalating Problems and Emergency Situations.

United States Department of the Interior, Bureau of Land Management. 2009. IM 2009-090, Population-Level Fertility Control Field Trials: Herd Management Area Selection, Vaccine Application, Monitoring and Reporting Requirements.

United States Department of Interior, Bureau of Land Management. 2010. *Warm Springs Herd Management Area Plan Update.*

United States Department of the Interior, Bureau of Land Management. 2010. IM 2010-057, Wild Horse and Burro Population Inventory and Estimation.

United States Department of the Interior, Bureau of Land Management. 2010. *Wild Horse and Burro Management Handbook 4700-1*.

United States Department of the Interior, Bureau of Land Management. 2010. *Vegetation Treatment Using Herbicides on Bureau of Land Management Lands in 17 Western States Programmatic Final Environmental Impact Statement and Record of Decision*.

United States Department of the Interior, Bureau of Land Management. 2010. BLM Manual 4720, *Removal*.

United States Department of the Interior, Bureau of Land Management. 2012. BLM Manual 6310, *Conducting Wilderness Characteristics Inventory on BLM Lands.*

United States Department of the Interior, Bureau of Land Management. 2012. BLM Manual 6320, *Considering Lands with Wilderness Characteristics in the BLM Land Use Planning Process*.

United States Department of the Interior, Bureau of Land Management. 2012. Miller Homestead Fire Emergency Stabilization and Rehabilitation Plan Environmental Assessment (EA) (DOI-BLM-OR-B060-2012-0047-EA). BLM Burns District, Hines, Oregon.

United States Department of the Interior, Bureau of Land Management. 2013. IM 2013-058, Wild Horse and Burro Gathers: Public and Media Management.

United States Department of the Interior, Bureau of Land Management. 2013. IM 2013-060, Wild Horse and Burro Gathers: Management by Incident Command System.

United States Department of the Interior, Bureau of Land Management. 2013. IM 2013-146, Exceptions to Policy in BLM Handbook H-4700-1 and Manual 4720.41: Helicopter Gather of Wild Horses and Burros between March 1 and June 30 Due to Emergency Conditions and Escalating Problems.

United States Department of the Interior, Bureau of Land Management. 2014. IM 2014-132, Guidance for the Sale of Wild Horses and Burros.

United States Department of the Interior, Bureau of Land Management. 2015. IM 2015-070, Animal Health, Maintenance, Evaluation and Response.

United States Department of the Interior, Bureau of Land Management. 2015. IM 2015-151, Comprehensive Animal Welfare Program for Wild Horse and Burro Gathers.

United States Department of the Interior, Bureau of Land Management. 2015. *Integrated Invasive Plant Management for the Burns District Revised EA (DOI-BLM-OR-B000-2011-0041-EA) Decision Record.*

United States Department of the Interior, Bureau of Land Management. 2015. *Oregon Greater Sage-Grouse Approved Resource Management Plan Amendment*. September 2015.

United States Department of the Interior, Bureau of Land Management Utah (BLM Utah). 2015. *Population Control Research Wild Horse Gather for the Conger and Frisco Herd Management Areas* (DOI-BLM-UT-W020-2015-0017-EA).

United States Department of the Interior, Bureau of Land Management. 2015. *Memorandum regarding - National Research Council's 2015 report to BLM*.

United States Department of the Interior, Bureau of Land Management. 2016. Mare sterilization research EA (DOI-BLM-OR-B000-2015-0055-EA). BLM Burns District Office, Hines, Oregon.

United States Department of the Interior, Bureau of Land Management. 2018. *Coyote Fire Emergency Stabilization and Rehabilitation Categorical Exclusion* (DOI-BLM-ORWA-B050-2018-0004-CX). BLM Burns District Office, Hines, Oregon.

United States Department of the Interior, Bureau of Land Management. 2018. *Wild Horse and Burro Quick Facts*. Retrieved from https://www.blm.gov/programs/wild-horse-and-burro/about-the-program/program-data. Accessed April 5, 2018.

United States Department of the Interior, Bureau of Land Management. 2018. *Wild Horse and Burro Program Data*. https://www.blm.gov/programs/wild-horse-and-burro/about-the-program/program-data. Accessed February 12, 2018.

United States Department of the Interior, Bureau of Land Management. 2018. IM 2018-052, Transfer of Excess Wild Horses and Burros to Federal, State, and Local Government Agencies for Use as Work Animals.

United States Department of the Interior, Bureau of Land Management. 2018. Oregon Wild Horse and Burro Corral Facility Access for Visitors (BLM IM-ORB-000-2018-004). Burns District BLM.

United States Department of the Interior, U.S. Fish and Wildlife Service. 2018. *Warm Springs Herd Management Area, Scoping Comments (DOI-BLM-ORWA-B050-2018-0016-EA).* June 4, 2018.

United States Department of the Interior, Bureau of Land Management and U.S. Geological Survey. 2001. Technical Reference 1730-2, *Biological Soil Crusts: Ecology and Management*.

Valeix, M., H. Fritz, R. Matsika, F. Matsvimbo, and H. Madzikanda. 2007. *The role of water abundance, thermoregulations, perceived predation risk and interference competition in water access by African herbivores. Afr. J. Ecol*. 46:402–410.

Vavra, M. 2005. *Livestock Grazing and Wildlife: Developing Compatibilities*. Rangeland Ecology and Management, 58(2):128–134.

Wagner, A.E. 2010. Effects of Stress on Pain in Horses and Incorporating Pain Scales for Equine Practice. Veterinary Clinics of North America – Equine Practice 26:481–492.

Wakefield, S. and O. Attum. 2006. *The effects of human visits on the use of a waterhole by endangered ungulates*. Journal of Arid Environments 65:668–672.

Western Regional Climate Center. 2018. Recent Climate in the West. https://wrcc.dri.edu/. Accessed June 7, 2018.

White, L. 1980. *A Study of Feral Burros in Butte Valley, Death Valley National Monument*. Cooperative National Park Resources Studies Unit, University of Nevada, Las Vegas.

Wild Free-Roaming Horses and Burros Act (WHB Act) of 1971 (Public Law (PL) 92-195), as amended.

Williams, W.L. 1903. *Surgical and Obstetrical Operations*. Ithaca, NY: W.L. Williams, pp. 97–106.

Wright, S. 1931. Evolution in Mendelian populations. Genetics 16:97–159.

Zalba, S.M., and N.C. Cozzani. 2004. *The impact of feral horses on grassland bird communities in Argentina.* Animal Conservation 7:35–44.

Zeigenfuss, L.C., K.A. Schoenecker, J.I. Ransom, D.A. Ignizio, and T. Mask. 2014. *Influence of nonnative and native ungulate biomass and seasonal precipitation on vegetation production in a Great Basin ecosystem*. Western North American Naturalist 74(3):286–298.

Zhang, Y., W.-P. Lai, P.-C. Leung, C.-F. Wu, and M.-S. Wong. 2007. Short- to Mid-Term Effects of Ovariectomy on Bone Turnover, Bone Mass and Bone Strength in Rats. *Biol. Pharm. Bull.* 30:898–903.