Appendix A. Specific Priority Research Topics and Goals

The Strategic Research Plan identifies topics that are of high priority to the BLM's WHB program. In this appendix, each priority research *topic* is listed, along with the *central management issues* that motivate the topic's importance. Each topic's *overall goals* and *research objectives* are described, along with some example *specific research directions*. The identified topics do not preclude other research that may be of value in wild horse and burro management. The BLM will continue to accept unsolicited research proposals that arise from processes and analyses outside of the framework described below.

Highest Priority

Development and Testing of Long-lasting Mare Fertility Control

The *central management issue* motivating the BLM to name this research topic as the primary priority for research is the high and increasing number of WHB living on the range. The *overall goal* for this research is to identify methods that provide long-lasting mare fertility control. *Research objectives* for this topic include but are not limited to: a) develop and test new fertility control methods, and b) refine or improve existing fertility control methods. The *specific research directions* listed below are examples, and are not intended to limit potential studies.

- Identify and explore new, safe, long-lasting or permanent contraceptive treatments for wild horse mares and burro jennies that have not been previously considered or tested. These could be injectable, non-surgical or surgical treatments or procedures.
- Identify improvements to existing contraceptive or sterilization treatments or procedures that could increase their practicality, efficacy or duration.
- Explore fertility control vaccine delivery methods that BLM could use in addition to hand injection and traditional darting methods.
- Test applications of new technology (i.e., incorporation of radio-telemetry, facial and feature recognition using artificial intelligence, permanent marking techniques that could be used across the program, use of transponders that can be read remotely or from a distance, smartphone applications, databases) that could improve animal identification and fertility control application, and could be used in the field with limited or no internet connection.

Secondary Priority

WHB and the Environment

The *central management issue* for this research priority is that BLM's mission includes managing to ensure that thriving natural ecosystems are found where WHB occur on the public lands, while also protecting WHB populations. The *overall goal* of this research is to address interactions between wild horses and burros and their environment. Research objectives under this topic include a) quantifying how a range of WHB population densities affects the environment (e.g., water, wildlife, vegetation, soil carbon sequestration), and b) quantifying how a range of environmental conditions (e.g., current and future climate, WHB density, predation pressure, forage availability) affect WHB populations. The *specific research directions* listed below are examples, and are not intended to limit potential studies.

- Assess how a range of wild horse and burro herd densities affects habitat resilience in the face of climate change. Specific effects could be measured in terms of fire frequency and severity, public lands biodiversity value, and annual soil carbon sequestration potential.
- Forecast site-specific changes in forage and water availability under different climate scenarios, to help identify the possible adaptation strategies that will ensure self-sustaining WHB populations under future climate conditions.
- Develop methods and protocols for differentiating wild horse and burro environmental impacts from those of livestock and wildlife, and quantify those differences.
- Predict effects of variable WHB densities on ecosystem attributes, drawing from WHB habitat use models that are based on recorded WHB GPS locations.
- Determine wild horse and burro influences on post-wildfire recovery of vegetation.
- Identify interactions that occur between wild horses and burros and sage-grouse/sagebrush obligate species.
- Assess suitability of WHB AML values, with respect to needs of wildlife, plants, and other biota.
- Identify carbon sequestration effects of overgrazing due to WHB, in different climatic / ecological settings.
- Quantify variation in regional and local herd growth rates, and test for the influence of WHB density on environmental conditions.
- Quantify survival and fertility rate variation across different HMAs, over time, and as a function of WHB density and environmental conditions.

Other Research Priorities

The following areas of research could directly improve BLM's ability to manage free-ranging equids. However, these are not the highest priorities for BLM research funding allocation. Other federal or state agencies or tribal governments may be better positioned to pursue some of the following research; and this would allow the WHB Program to focus research support on fertility control and WHB interactions with their environments. The order below does not indicate relative prioritization.

Herd Size Estimates and Demographic Modeling

The *central management issues* this research priority addresses are the ongoing needs for accurate, precise, safe, and cost-effective methods to inventory the number of WHB on the range, and the need to predict the demographic effects of different management scenarios on managed WHB herd sizes. Existing methods appear to provide reliable measures of abundance and demographic rates, but they entail costs, risks to humans and animals, and, in some cases, animal handling. The *overall goal* of this research is to provide reliable estimates of abundance and demographic rates. Research objectives include a) improving methods for abundance estimation, in terms of accuracy, precision, cost, and risk, and b) improving the accuracy, precision, geographic scale of demographic rates (e.g., fertility, survival). The *specific research directions* listed below are examples, and are not intended to limit potential studies.

- Determine the environmental circumstances under which aerial infrared surveys provide good or poor results.

- Repeat assessments of the accuracy of currently used simultaneous double-observer method, based on a meta-analysis of areas surveyed since 2013.
- Determine the conditions under which stratified sampling can be used to reduce aerial survey costs, while still ensuring high levels of accuracy and precision.
- Test the accuracy of population projection models, after they are updated to account for regional or local variation in average annual growth rates.

Population Genetics

The *central management issue* for this research priority is the BLM's interest in understanding the existing genetic diversity in free-roaming populations of WHB, and ameliorating that diversity where appropriate. The *overall goal* for research in this topic is to provide measures of population genetic status or trends that would improve the BLM's current and ongoing WHB genetic diversity monitoring efforts, or provide entirely new insights into population genetics. *Research objectives* for this topic include but are not limited to: a) develop and test new population genetic methods and understandings for WHB, and b) use existing genetic methods or data in a new way, to address WHB population genetics. The *specific research directions* listed below are examples, and are not intended to limit potential studies

- Determine the metapopulation structure of wild horses under BLM management, as measured at several spatial scales.
- Assess whether other genetic markers discern finer-scale metapopulation structure, and whether such fine-scale metapopulation structure is biologically significant for management. [Analysis of wild horses sampled from over 150 sample sets has shown little genetic differentiation between herds, based on microsatellite DNA.]
- Determine the metapopulation structure of wild burros under BLM management, as measured at several spatial scales.
- Identify and analyze additional information about WHB genetics that may be learned from existing genetic monitoring data, based on from previously-genotyped individuals (13 microsatellite loci).
- Test whether relatively new genetic monitoring methods (SNP chips, etc.) would be a tangible improvement over variable nuclear tandem repeat microsatellite markers, identifying any advantages and disadvantages.

WHB Health, Handling and Welfare

The *central management issue* for this research priority is that the BLM aims to protect the health and welfare of WHB. The *overall goal* of this research is to identify practices that would improve WHB management, related to animal health, handling, and welfare. *Research objectives* include a) testing methods to improve on-range care and management, and b) testing methods to improve off-range care and management. The *specific research directions* listed below are examples, and are not intended to limit potential studies.

- Establish critical thresholds for measurable factors related to on-range survival, to help forecast when and where critical shortages of water or forage will occur before they begin to impact animal welfare.
- Identify noninvasive, practical parameters that can be measured to assess stress levels and the welfare of animals during gathers and during the initial period of captivity and adaptation to the domestic world.
- Compare the outcomes of different feeding strategies (e.g., high vs. low protein) for horses and burros that come off the range in thin and very thin condition due to starvation.

Private Care Placement

The *central management issue* for this research priority is that BLM must care for, or find good homes for, a large and growing number of excess animals that have been removed from the range. The *overall goal* of this research is to explore ways to increase the number of WHB placed with private citizens and organizations that will responsibly care for their welfare. *Research objectives* for this topic include a) identifying practices that increase WHBs' desirability for placement, and b) identify marketing and management strategies that increase the number of people who would consider adopting or purchasing a WHB. The *specific research directions* listed below are examples and are not intended to limit potential studies.

- Identify wild horse attributes that reliably predict successful training and placement outcomes.
- Analyze the allocation of BLM resources that would maximize WHB placement.
- Identify geographic areas, niche markets or groups of equestrian enthusiasts that have previously not been reached by BLM's marketing efforts, *and* where changes in outreach effort or messaging would lead to increases in private care placement.
- Test the effectiveness of additional training, clinics, video series, mentoring, or other resources for adopters that may improve their experience training wild horses, and reduce wild horses being returned to the BLM.

Human Dimensions of WHB Management

The *central management issue* for this research priority is that, while it is guided by science in decision-making, the BLM is also influenced by society. The *overall goal* of this research is to help the BLM anticipate and address human dimensions of WHB management. *Research objectives* include identifying socioeconomic factors that could enhance or constrain WHB management. The *specific research directions* listed below are examples and are not intended to limit potential studies.

- Quantify the general public's current knowledge of the WHB program and management activities, and preferences for WHB management objectives and actions.
- Quantify and characterize how different segments of the public define successful or unsuccessful WHB management. Identify which sociological factors and management actions combine in contributing to the perception of successful or unsuccessful WHB management by federal, state, or local agencies, or sovereign tribes.

- The Wildlife and WHB programs provide public goods with significant non-market value. Quantify the costs and benefits of competing range land uses, including benefits related to livestock grazing, wildlife, and wild horses and burros.