BISON
MANAGEMENT
PLAN

Prepared by Curtis Freese,
Kyran Kunkel, Damien Austin
and Betty Holder.
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ABSTRACT

American Prairie Reserve (APR)’s mission is to create in the northern plains of Montana the largest nature reserve in the continental United States, a refuge for people and wildlife preserved forever as part of America’s heritage. Restoration of a large population of bison on APR is central to this mission. APR aims to assemble through land acquisition and collaboration with public land agencies a land base of some 3.5 million acres devoted to biodiversity conservation. APR’s overarching goal for bison restoration is to establish a conservation herd of at least 10,000 bison that interact with the full complement of other native species and ecological conditions that characterized this landscape for thousands of years. At the end of 2017, APR had a land base of 399,379 acres of deeded and leased public lands, most connected to or near the 1.1-million-acre Charles M. Russell National Wildlife Refuge (CMR Refuge)-a combined total of 1.5 million acres representing by far the largest area devoted to wildlife conservation in the Great Plains. Beginning with the first reintroduction in 2005, APR’s bison population reached approximately 860 animals in 2017.

As noted in the first 10-year bison restoration plan for APR (Kunkel et al., no date), reintroduction of wildlife requires careful planning leading up to the initial reintroduction and then many years of close monitoring and adaptive management as the population grows. Most of the objectives of that first plan have now been met and thus this new plan is needed to guide decision-making over the next 5-10 years as the land base for APR’s bison and the bison population continue to grow. Periodically updated plans are particularly important when dealing with a species such as bison because of its role as a foundation species in grassland ecosystems, strong public interest due to the charismatic and iconic nature of bison, concerns about bison effects on the livestock industry, and the intense political and agency scrutiny that bison reintroduction attracts.

APR aims to achieve the following objectives for bison conservation that reinforce and build on the objectives of the original reintroduction plan and incorporate criteria of the Sanderson et al. (2008) scorecard for making an “exceptional contribution” (the highest category) to fulfilling the goals of the “Vermejo Statement” on ecological recovery of bison:

1The “Vermejo Statement,” jointly written by members from indigenous groups, bison ranchers, conservation organizations, and government and private land managers from throughout North America, states: “Over the next century, the ecological recovery of the North American bison will occur when multiple large herds move freely across extensive landscapes within all major habitats of their historic range, interacting in ecologically significant ways with the fullest possible set of other native species, and inspiring, sustaining and connecting human cultures.” Subsequently, they developed a set of biological, cultural and social criteria for characterizing the contribution of bison to the Vermejo Statement of ecological recovery.
• Establish a self-sustaining, naturally regulated, and ecologically effective population of at least 10,000 bison that is free of cattle-gene introgression, semi-free ranging, and subject to all the forces of natural selection;

• Restore all native species and ecological processes and their natural interactions with bison;

• Establish a population that serves as a source of animals for bison restoration throughout the Great Plains;

• Establish a population that enhances the long-term survival of the species genetically, behaviorally and ecologically, and that promotes prairie conservation;

• Establish a population that contributes to removal of wild bison from the list of Species of Greatest Conservation Need by the state of Montana and from “near threatened” on the IUCN Red List of Threatened Species;

• Establish a bison population capable of sustaining a variety of consumptive and nonconsumptive values and that contributes to cultural, aesthetic, economic, and social well-being regionally and nationally;

• Collect and disseminate scientific information on bison biology, reintroduction techniques and the ecological requirements for successful wild bison restoration.

Because of the bison’s central ecological role, these objectives must be integrated into a much broader context of ecological restoration. Thus, the first 8 goals of this plan integrate bison restoration with the 10 ecological conditions of the Freese Scale for Grassland Biodiversity that APR managers use to measure progress toward restoring biodiversity on APR management units. The next 3 goals—conserving bison genetics, climate change mitigation and adaptation, and benefits to and support from the public—are also vital for APR to succeed in comprehensively meeting all 11 goals and, more broadly, the organization’s mission.

Goal 1: Restore and maintain native plant communities. To conserve floristic diversity and meet habitat needs of bison and other wildlife, APR’s goal is to restore all cropland and otherwise highly altered lands to native plant communities, to control non-native plant populations, to maintain all existing native plant communities, and to conserve the soil and other physical conditions on which they depend.
Goal 2: Restore natural herbivory patterns to create habitat heterogeneity. This goal aims to replace the common homogeneity-based rangeland management practice of uniform grazing intensity across the landscape—the “take half leave half” approach—with heterogeneity-based management whereby natural herbivory by native herbivores results in variable grazing intensity and consequent habitat heterogeneity across the landscape. The focus under this goal is the change from cattle to bison as the principal grazer and from rotational grazing to year-round continuous grazing.

Goal 3: Restore natural grassland fires. APR’s goal is to restore the ecological role of grassland fires, including their interaction with grazing by bison and other herbivores.

Goal 4: Restore habitat contiguity. To enable unimpeded movements of bison and other species and reduce other deleterious ecological effects of habitat fragmentation, APR’s goal is to remove interior fences and other artificial structures or, if removal is not possible, to alter their design to minimize ecological impacts, and to restore native plant communities on cultivated and other highly altered lands. This goal applies to both lands within APR and to non-APR lands that are important as buffer zones around the reserve and as ecological corridors for wildlife movement between APR and other areas important for wildlife.

Goal 5: Restore natural stream hydrology and riparian areas. APR aims to restore natural stream hydrology and riparian areas by improved management of ungulate grazing, including the change from cattle to bison, by maintaining and restoring native plant communities in both upland and riparian areas, and, where ecologically sound within the broader landscape, by judiciously altering and removing dams, spreader dikes and other artificial features that have degraded natural hydrological and associated ecological conditions.

Goal 6: Restore temporal ecological variability. APR aims to restore the natural intra- and inter-annual disturbances caused by the interaction of weather extremes, fire and grazing by bison and other herbivores that have been major forces shaping ecological communities and species evolution of the APR region over thousands of years.
Goal 7: Restore populations of native wildlife and their full ecological roles. This goal focuses on restoring to ecologically significant levels populations of those species of wildlife whose populations are well below natural levels and whose restoration is likely to have major effects on native habitats and the recovery and conservation of other species. This includes: (1) restoring herbivore populations, particularly black-tailed prairie dogs, bison and other ungulates; (2) restoring the full ecological role of ungulates as food for predators and scavengers and of ungulate carcasses as highly concentrated nutrient sources for decomposers and plant growth; and (3) if large carnivores naturally recolonize the region, cooperate with relevant institutions and communities to evaluate the socioeconomic and ecological effects of such recolonization and to implement management programs.

Goal 8: Establish a reserve and network of reserve-friendly lands of sufficient size and complexity to be largely ecologically self-sustaining for biodiversity conservation. APR’s goal is to build a reserve of sufficient size—roughly 3.5 million acres—to enable, when combined with APR-supported ecological buffer areas and corridors, the full restoration of ecological conditions described in goals 1 - 9 and of viable populations of all native species. This size will be important for allowing bison to exhibit their wide-ranging foraging patterns, to accommodate natural spatial and temporal fluctuations of wild bison populations, and to support the complex interactions of bison with wildlife and plant communities on the prairie landscape.

Goal 9: Establish a bison population of high genetic variation, integrity and resilience: APR’s goal for bison genetics is to establish a population with no detectable cattle genes in its DNA and with high genetic variation that enables adaptation and evolutionary response to both short-term and long-term changes and challenges ranging from disease to climate change.

Goal 10: Use bison restoration to improve mitigation of and adaptation to climate change. This goal aims to use restoration of bison and associated ecological conditions to mitigate greenhouse gas (GHG) emissions and to improve the capacity of the region’s human, plant and animal communities to adapt to climate change, both of which are largely achieved through the restoration and conservation of native plant communities. The bison’s apparent adaptability to climatic extremes further advances this goal.
Goal 11: Create conditions whereby bison conservation provides a diversity of benefits for the public, from local communities to national and global constituencies, and engenders broad public support for bison conservation and APR’s broader goals of biodiversity conservation. This goal aims to allow people near and far to enjoy the multiple social and cultural benefits of bison and APR and to enable primarily local communities—tribes, ranchers, towns—to benefit economically. The goal also seeks to generate social and financial support for bison conservation (both on APR and across North America) and the realization of APR’s vision. Although APR bison are private property, APR seeks to manage its bison, to the extent practical, as wildlife according to the Public Trust Doctrine of the U.S. and Canada, which means that APR manages bison as a public resource for the common good.
INTRODUCTION

A. APR’s mission and development

Temperate grasslands or savannas historically made up approximately 30% of the Earth’s landmass, but are currently considered among ecosystems that are the most threatened by conversion or degradation, with less than 50% remaining intact (Sala et al. 2000, Hoekstra et al. 2005). In western North America, the loss of native grazers, inappropriate livestock management practices, and human-driven land conversion or degradation have resulted in steadily declining biodiversity and rangeland health (Dreitz et al. 2017). These global and regional trends have resulted in grasslands being cited among the world’s biomes in crisis (Hoekstra et al. 2005). In response, the conservation and restoration of grassland ecosystems has become a popular theme in rangeland ecology (Fuhlendorf and Engle 2001, Briske et al. 2005, Havstad et al. 2007).

APR was legally established as a nonprofit organization in 2001 to help address the urgent need to comprehensively address grassland conservation in western North America. APR’s mission is to create, in the northern plains of Montana, the largest nature reserve in the continental United States, a refuge for people and wildlife preserved forever as part of America’s heritage. The seven-county region includes Blaine, Chouteau, Fergus, Garfield, Petroleum, Phillips and Valley counties (Figure 1.)
Approximate Bison Capacity by Unit
for year-round grazing based on grazing lease AUMs and low AUM alternative for deeded land

Current Bison Range
December 2017
APR Deeded/Leased

This map is intended for general reference only. Land ownership has been generalized/simplified. APR leased land represents grazing leases on multiple jurisdictions of public land. Antelope Creek grazing lease represents a share in a common allotment, not actual boundaries. Data Sources: Montana State Library, Natural Earth.

Figure 1. Map of American Prairie Reserve region and lands, including names of individual management units. The number given with each management unit is the carrying capacity in animal units (excludes calves under 6 months). See discussion and Table 2 under Goal 2 for details regarding how animal units were determined.
No figures are shown for Antelope Creek and Cow Island because there are no plans to stock those properties with bison at this time so their carrying capacity has not been calculated.
Restoration of a large conservation herd of bison is central to APR’s mission. To realize this mission APR is acquiring private land and collaborating with public land agencies to assemble a land base of some 3.5 million acres devoted to biodiversity conservation. As of April 2018 APR had executed 26 acquisitions totalling 399,379 acres of deeded (91,588 acres) and associated leased public (307,791 acres) lands. Much of this land is near or connected to the 1.1-million-acre Charles M. Russell National Wildlife Refuge (CMR Refuge), part of the reserve complex. APR’s overarching goal for bison restoration is to establish a population of at least 10,000 that interact with the full complement of other native species and ecological conditions that characterized this landscape for thousands of years. The first bison were reintroduced on APR in 2005 and the population grew to roughly 860 in 2017.

B. Plains bison: Taxonomic, legal and conservation status

   i. Taxonomic status: Two subspecies of American bison are recognized, wood bison (Bison bison athabascae) and plains bison (B. bison bison). Plains bison is the subspecies native to the Great Plains, including the APR region (Boyd et al. 2010b).

   ii. Legal status: Bison in Montana are classified as either “domestic livestock” or “game animal.” According to Montana statutes (Montana 2017a,b), “‘domestic bison’ means a bison owned by a person.” And “‘Game animals means deer, elk, moose, antelope, caribou, mountain sheep, mountain goat, mountain lion, bear, and wild buffalo.’” The statutes then clarify the definition of wild buffalo by stating “Wild animal means an animal that is wild by nature as distinguished from common domestic animals, whether the animal was bred or reared in captivity, and includes birds and reptiles.” APR-owned bison are therefore legally “domestic bison,” which, like other domestic livestock, fall under the regulatory jurisdiction of MDL. The only “wild bison” in Montana are bison in Yellowstone National Park that move beyond the park boundary in Montana (MFWP 2015a).

The legal status of bison as livestock or wildlife or both at the federal level in the U.S. and Canada and among other states and provinces varies widely and need not be reviewed here (Aune and Wallen 2010). The National Bison Legacy Act in 2016, citing, among many other findings, the bison’s
importance as a “historical symbol of the United States,” its “benefit to grasslands,” and its “historical, cultural and economic significance...to the heritage of the United States,” designated the American bison as the official mammal of the United States

iii. Conservation status: The plains bison and its ancestors have been coevolving with the grassland habitats and wildlife of North America for more than 100,000 years. Until their extermination from the region in the 1880s, plains bison grazed the landscapes of Montana’s northern plains since the last of the ice sheets of the Wisconsin glaciation retreated from the region about 12,000 years ago (Potter et al. 2010). Plains bison once numbered in the tens of thousands in this region and was a “foundation species” (Dayton 1972, Ellison et al. 2005); through grazing and other actions, bison strongly influenced the structure of the grassland ecosystem, including habitats of importance to grassland plants, birds, mammals and other wildlife (Gogan et al. 2010, Gross et al. 2010). As the Natural Resource Conservation Service (NRCS) guide to grassland bird management notes (NRCS 1999, p. 5), “Grazing bison in the west was once a natural means of grassland management.” Numerous buffalo jumps and the accounts of Lewis and Clark and other early explorers testify to the former abundance of bison in the plains of Montana (Laliberte and Ripple 2003). Bison were clearly an important factor in shaping the ecological conditions of the region’s grasslands, soils and waters for thousands of years (Gates et al. 2010, Potter et al. 2010).

Now, however, a majority of conservation herds of bison are small (fewer than 500 individuals) and found in a few small, fenced protected areas in the Great Plains without the full complement of predators and other species with which bison historically interacted (Gates and Ellison 2010, Gates et al. 2010). Bison are therefore no longer the foundation species affecting in diverse ways millions of acres of Great Plains grasslands—they are for the most part ecologically extinct (Freese et al. 2007). Moreover, except for APR, no Great Plains park or reserve—public, private or nonprofit—has the explicit goal of restoring bison and the full complement of other species with which they co-evolved (Freese 2015).
The total number of plains bison in North America was reduced to roughly 200 animals by the 1880s, precariously close to extinction (Gates and Ellison 2010). Concerns about the bison’s plight led to efforts in the early 1900s to establish bison conservation herds. By the 1930s approximately 20,000 bison were in several conservation herds spread across the U.S. and Canada. The number in conservation herds has not changed substantially since that time. The small size of most conservation herds also raises concerns about their genetic diversity and long-term genetic health. In addition, cross-breeding efforts with domestic cattle around the turn of the Century resulted in most conservation herds today harboring a small amount of cattle genes in their DNA (Freese et al. 2007, Boyd et al. 2010a, Gross et al. 2010).

Because of these concerns about bison genetics and loss of the bison’s ecological role in grasslands, there is broad agreement that extraordinary efforts are required to restore large bison herds. The state of Montana lists the plains bison as a Species of Greatest Conservation Need (MFWP 2015b) and the Montana Natural Heritage Program designates it as a Species of Concern with a G4 global ranking and S2 state (Montana Natural Heritage 2016). The IUCN Red List designates the American bison as “near threatened” (Gates and Aune 2008). The Committee on the Status of Endangered Wildlife in Canada has designated the plains bison as “threatened” (COSEWIC 2013). Calls for bison restoration span multiple stakeholders, from the U.S. and Canadian governments (COSEWIC 2013, DOI 2014) and state of Montana (MFWP 2015a) to private ranchers (NBA 2016), Indian Tribes (ITBC 2016), nonprofit organizations (NWF 2016), bison scientists (Sanderson et al. 2008) and the international conservation community (Gates et al. 2010).

C. Need for and purpose of a bison management plan

Reintroduction of wildlife species is generally a long-term process. It requires careful planning leading up to the initial reintroduction and then many years of close monitoring and adaptive management to grow the population. The biological success of a
species reintroduction generally depends as much on getting the socioeconomic and political conditions right as it does on a sound biological foundation for decision making (AZA 2017, IUCN/SSC 2013). The importance of interdisciplinary planning is doubly important when dealing with a species such as bison because of its foundation role in grassland ecosystems, strong public interest due to the charismatic and iconic nature of bison, concerns about bison effects on the livestock industry and, largely as a result of the latter, the intense political and agency scrutiny that almost any bison reintroduction effort attracts.

Bison restoration and management needs to be well integrated with the full suite of biodiversity management goals and actions undertaken on APR lands. Each new land unit acquired, including deeded and leased public lands, will have been managed for decades under an agriculture-production-centered management regime. To make the transition to biodiversity-centered management (Freese et al. 2014) each new land unit must be evaluated with respect to its biodiversity values and ecological condition before determining the goals and actions for conserving biodiversity, including bison, on that land. This bison management plan cannot anticipate the particular conditions for lands that will be acquired in the future; rather, it aims to provide a framework for decision-making about bison restoration as the land base and bison population both grow.

The first bison were reintroduced on APR lands in 2005, guided by a comprehensive reintroduction and management plan and following IUCN reintroduction standards (IUCN/SSC 2013, Kunkel et al., n.d.). Eight 10-year objectives were set forth in that plan:

1. Establish a self-sustaining, naturally regulated, and ecologically effective population of bison that is free of cattle-gene introgression, semi-free ranging and subject to natural selective forces on and around APR lands in north-central Montana;

2. Establish a population that serves as a source of individuals for wild bison restoration throughout the region;

3. Establish a population that enhances the long-term survival of the species genetically, behaviorally, and ecologically and that promotes prairie conservation;
4. Establish a population that contributes to removal of wild bison from the Montana list of species of concern;

5. Establish a bison population capable of sustaining a variety of consumptive and nonconsumptive values and contributing to the cultural, aesthetic, economic, and social well-being regionally and nationally;

6. Collect and disseminate scientific information on reintroduction techniques and the ecological requirements for successful wild bison restoration;

7. Collect and disseminate scientific information on the ecology of bison; and

8. Contribute to restoring and maintaining natural ecological processes and native biological diversity in north-central Montana.

APR has made significant progress toward meeting these objectives. The bison have readily adapted to the region's mixed-grass prairie and sagebrush steppe habitats and are exhibiting the array of natural behaviors and ecological interactions that characterize their long evolutionary history and ecologically important role in the Great Plains. The population harbors good genetic variation and shows no cattle gene introgression. A healthy rate of natural increase has led to a population of more than 800 animals, making it the largest cattle-gene-free conservation herd in the Great Plains. By 2020 the population will likely exceed the 1,000 threshold generally considered the minimum for long-term genetic viability. APR is close to a "large contribution" in most aspects of the Sanderson et al. (2008) scorecard for bison conservation.

APR has donated bison to help establish and enhance the genetic health of federal, state and tribal herds. The bison herd has been a significant part of the more than $1.9 million in average annual expenditures by APR, exclusive of land acquisitions, in the project area during the three-year period of 2015-2017. APR bison have attracted and enriched the cultural experiences of people locally, nationally and internationally, from local school children, ranchers and tribal members to non-resident ecotourists, scientists, artists and writers from around the world. More than 40 “Band of Bison” members have contributed $25,000 each to support conservation of bison and other wildlife on the reserve.
APR staff, collaborators and two master’s degree students have contributed to annual APR bison reports and several publications (e.g., Sanderson et al. 2008, Freese et al. 2008, Gates et al. 2010, Kohl et al. 2013, McMillan 2017), APR’s bison restoration work has been presented at the American Bison Society’s biannual conferences, and APR staff/associates support bison conservation across the continent as members of the IUCN North American Bison Specialist Group. APR has developed the Freese Scale for Grassland Biodiversity, based on Freese et al. (2014), to help ensure that the bison herd and its management are contributing to conserving ecological processes and biodiversity.

As described under the 11 goals of this plan, much remains to be done to meet the long-term biological and socioeconomic objectives for bison restoration on APR. Based on 12 years of APR’s experience with bison management and new information from other research and management programs, this new plan has been prepared to guide the next 5-10 years of APR’s bison restoration work.

Large-scale biodiversity restoration involves the complexity, dynamism and unpredictability inherent in both ecosystems and society. Bison restoration on the scale envisioned here is no exception. This is therefore a living document that will be periodically updated and adjusted in accordance with changing conditions, new information, and APR’s experience with bison management and restoring biodiversity.
A. Geography and habitat

APR straddles two major biogeographic regions—the Northwestern Glaciated Plains on the northern half and the Northwestern Great Plains on the southern half. The southern boundary of the former is roughly the limit of the continental glaciation and thus its soils are derived from glacial till. The unglaciated Northwestern Great Plains is underlain by shale, siltstone and sandstone. Isolated igneous core mountains, represented by the Little Rockies near the core of the APR region and other ranges to the south and west, rise from the plains landscape. Climate is typical of mid-continental regions with long severe winters and hot summers (EPA 2013).

The two major habitats in the area, common on both the glaciated and unglaciated plains, are Big Sagebrush Steppe and Great Plains Mixed Grass Prairie. Less common are Rocky Mountain Foothill Woodland-Steppe Transition, Ponderosa Pine Woodland and Savanna, Great Plains Floodplain/Greasewood Flat, Mat Saltbush Shrubland, Pasture/Hay, Introduced Upland Vegetation, Annual and Biennial Forbland, Cultivated Crops, and Open Water. Numerous streams, mostly intermittent, dissect the region. The Missouri River and associated floodplain and breaks run through the core of the region. Man-made stock-water impoundments are common across the landscape, which, due to clay soils that impede surface infiltration, often remain full throughout the year. Current land use consists primarily of livestock grazing, with some crop production, particularly in bottomlands such as along Telegraph Creek (Montana Natural Heritage 2016). An estimated 90% or more of the APR region remains as mostly native plant communities, but conversion of native grasslands to croplands continues at a rapid pace (Gage et al. 2016).

B. Land ownership

The major landowner categories in the APR region are private lands, BLM, CMR Refuge, Fort Belknap and Rocky Boys Indian Reservations, and state school trust lands (Figure 1).
C. Land use and biodiversity trends

Temperate grasslands are one of the most threatened and, with 4% in protected status, are the least protected of the world’s terrestrial biomes (Coad et al. 2009). Reflecting this situation, just 1% of the Great Plains is in protected areas (CEC and TNC 2005). Tillage for crop production, which continues at a rapid pace in many regions, including the Northern Great Plains, is the most severe threat to temperate grasslands. Poorly managed livestock production, also increasing globally, is the next biggest threat to grassland health and biodiversity. As a result, grassland species and grassland health are declining globally (Samson et al. 2004, MEA 2005).

The glaciated plains of the APR region has been identified as a global priority for conserving grassland biodiversity because of the diversity of its flora and fauna and the relative intactness of its native habitats (Forrest et al. 2004, CEC and TNC 2005). But many species and habitats are under threat.

At least 74% of 39 species classified as grassland obligates with distributions centered in the Northern Great Plains are listed as imperiled by federal, state and provincial governments (Forrest et al. 2004). Among carnivores and ungulates, grasslands lost more species across larger parts of their range than any other biome in North America (Ripple et al. 2013). Apart from the plight of bison, populations of pronghorn, elk and bighorn sheep are suppressed far below pre-EuroAmerican colonization levels and likely below what the habitat could currently support (Laliberte and Ripple 2004). Elk are largely ecologically extinct in the Northern Great Plains. Of the four large carnivores native to the APR region, only cougars and black bears are extant, though likely in suppressed numbers (Laliberte and Ripple 2004).

Smaller species are also at risk. The population of one keystone species of the mixed-grass prairie, the black-tailed prairie dog, has been reduced to 2% of its former range, including in the APR region (Forrest 2005). APR is within the Great Plains region recognized for the highest diversity of grassland-dependent bird species, but several of these species are exhibiting significant population declines (Sauer et al. 2017). Overall, among animals, 62 “Species of Concern”—9 mammals, 35 birds, 5 reptiles, 2 amphibians, 10 fish and
insect—occur in the APR region, as well as several plant species that are species of concern (Montana Natural Heritage 2016). The region is recognized for its high diversity of grassland-dependent bird species, but 12 of these and other grassland bird species in the region have displayed significant population declines ranging from an estimated 0.9% to more than 4.0% annually from 1966-2015 (Sauer et al. 2017).

Thousands of acres of habitat for grassland species are being lost annually in the APR region. During 2014 - 2015, Blaine, Phillips, Valley and Garfield counties each lost more than 18,000 acres of grassland that were converted to crops, the continuation of a long-term trend (Gage et al. 2016). From 2007 - 2015, contracts were not renewed on more than a half million acres of Conservation Reserve Program lands in the seven-county region of APR (USDA 2016); an unknown proportion of this land likely returned to crop production. In addition to being a massive loss of habitat for bison and other native grassland species, the conversion from grassland to cropland has far-reaching effects on soil and water resources. Cultivation disrupts soil structure, increases decomposition rates, accelerates soil erosion and degrades grassland streams and rivers in the region (Ogle et al. 2005, Teply 2013). Cultivation of native grassland in the Northern Plains results in an estimated soil loss of 4.16 – 5.49 tons/acre/year (USDA SCS 2000, FAPRI 2007), massive loss of nitrogen and phosphorus, and the loss of 50% or more of soil organic carbon (Hartman et al. 2011). Historically, when bison were abundant in the Great Plains, soil carbon was likely maintained with little variation (Wang et al. 2014). In semi-arid grasslands such as are found in the APR region, moderate to heavy stocking rates appear to result in greater soil carbon storage than light or no grazing, but excessive stocking rates can reduce soil organic carbon (Conant 2010).

Hydrologic systems of the region have been extensively and intensely altered, with most streams and riparian areas highly degraded and water quality and aquatic organisms negatively impacted (Teply 2013). These and many other factors discussed below provide the rationale for a broad, ecosystem-based approach to bison conservation.
Restoring the bison’s ecological role may, among other measures, help restore and conserve both biodiversity and the soil and water resources of the grassland ecosystem. Nearly all lands acquired and leased by APR will have previously been used for livestock production and to a lesser extent for crop production. These commodity production lands create ecological conditions that to varying degrees are inimical to native biodiversity (Freese et al. 2014). Monoculture croplands, mostly wheat, are common and increasing as previously native prairie and former Conservation Reserve Program lands continue to be newly cultivated for production with resulting degradation of soils and streams. Most of the lands used for livestock production are cross-fenced and have numerous stock ponds and other watering installations to facilitate rotational and uniform grazing practices. Non-native grasses such as crested wheatgrass are common on upland sites and hay fields of other non-native plant species are common in lowland areas. Fire suppression is the general practice. Hydrological engineering is extensive, with stock ponds ubiquitous across the landscape in the upper reaches of watersheds and check dams and spreader dikes common across lowland areas. Numerous forms of infrastructure—roads, fences, old homestead buildings, utility poles and lines, dams, cultivated land and so on—fragment the habitat.

D. Relevant public institutions affecting APR bison management

Various federal, state and county institutions and policies potentially influence bison management by APR.

i. **Bureau of Land Management**: BLM administers 18,000 grazing permits on 155 million acres in the West (BLM 2018). APR currently leases 272,717 acres of BLM grazing allotments, which constitute 68% of all the lands APR uses or may use for bison grazing. These allotments provide important bison habitat and it is APR’s goal to secure approval for change of use on these allotments from one class of domestic livestock (cattle, sheep, horses, etc.) to another—bison. Management of BLM allotments are primarily regulated by the 1934 Taylor Grazing Act (TGA), the 1976 Federal Land Policy and Management Act (FLPMA) and the 1978 Public Rangelands
Improvement Act (PRIA). While the TGA gave preferential privileges for grazing on BLM lands to those “engaged in the livestock business, bona fide occupants or settlers, or owners of water or water rights,” FLPMA expanded the recognized uses of public lands by directing BLM to manage its lands “under principles of multiple use and sustained yield” in a manner that protects “scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values.” PRIA focused on improving public rangeland conditions. BLM, MDL and the DNRC consider APR’s bison and all bison outside Yellowstone National Park and the USFWS National Bison Range as domestic livestock for the purposes of managing grazing leases (BLM 2016, 2017).

BLM permits and leases generally cover a 10-year period and are renewable if BLM determines that the terms and conditions of the expiring permit or lease are being met. BLM, based on NRCS guidance, sets the allowable AUMs for each grazing allotment. BLM and NRCS consider bison and cattle to be equivalent for determining AUMs. Goals for management of BLM grazing allotments in the APR region are established by the BLM HiLine (BLM 2015a) and BLM Lewistown Resource Management Plans (new one currently in draft). All APR leases of BLM allotments are currently in compliance (B.J. Rhodes, BLM, unpublished data, personal communication).

BLM must approve APR’s request for a change of use from cattle to bison and from rotational to year-round continuous grazing on APR’s BLM grazing allotments. BLM has approved these changes on two of APR’s allotments in the past. In 2017 APR requested approval of these changes for most of APR’s allotments, which triggered a National Environmental Policy Act (NEPA) review. The Environmental Assessment is expected to be completed in the spring of 2019 and a final decision by BLM 3 - 4 months later.

Any U.S. citizen or validly licensed business can apply for a BLM grazing permit or lease. To do so, one must either buy or control private property (known as “base property”) that has been legally recognized by BLM as having preference for the use of public land grazing privileges, or acquire property that
has the capability to serve as base property and then apply to BLM to transfer the preference for grazing privileges from an existing base property to the acquired property (which would become the new “base property”). The first alternative happens when the base property (a private ranch) is sold or leased to a new individual or business; the buyer or lessee then applies to BLM for the use of grazing privileges associated with that property (BLM 2016, 2017). This has thus far been the case for all properties purchased by APR.

APR pays BLM a grazing fee. The federal grazing fee, which applies to public lands managed by the BLM and the U.S. Forest Service in 16 western states, is calculated annually by using a formula originally set by Congress in the Public Rangelands Improvement Act of 1978. Under this formula, as modified and extended by a presidential Executive Order issued in 1986, the grazing fee cannot fall below $1.35 per animal unit month (AUM); also, any fee increase or decrease cannot exceed 25 percent of the previous year’s level. The 2016 grazing fee was $2.11 per AUM and the 2017 fee was $1.87 per AUM (BLM 2017). At these rates the federal government consistently loses money managing federal lands for grazing (Regan 2016).

BLM permittees (BLM grazing allotment permit holders) must make substantial grazing use of their AUMs or risk losing their lease to another operator. Permittees can take temporary non-use for up to 3 consecutive years, however, the BLM could approve another operator to graze the allotment during the permittee’s non-use period. Under Code of Federal Regulations 43 CFR 4130.2(g)(1) another option for BLM leases is “conservation use” for up to 10 years when the authorized official determines the proposed use will promote rangeland resource protection or enhancement of resource values or uses.

Special categories of BLM lands in the region recognize other important ecological and cultural values and the need to manage for them. The 378,000-acre Upper Missouri River Breaks National Monument stretches for 149 miles on both sides of the Missouri River between Fort Benton and the Fred Robinson Bridge. Running through the Monument are the the Upper Missouri National Wild and Scenic River, the Lewis
and Clark National Historic Trail, and the Nez Perce National Historic Trail. The region also includes nine BLM Wilderness Study Areas: Cow Creek (34,050 acres), Woodhawk (4,800 acres), Antelope Creek (12,350 acres), Stafford (12,200 acres), Ervin Ridge (5,150 acres), Dog Creek (8,100 acres), Burnt Lodge (14,000 acres), Billy Creek (3,450 acres) and Seven Blackfoot (20,250 acres). In addition, part of Cow Creek is an Area of Critical Environmental Concern (ACEC).

ii. **Montana Department of Natural Resources and Conservation:**
DNRC manages 34,674 acres of the state trust lands leased by APR, which constitute 9% of all lands APR uses or may use for bison grazing. State trust land leases are contracted for 10-year periods. Grazing fees are adjusted year to year based on market conditions. The 2016 rate was $19.57 per AUM and the 2017 rate was $14.01 per AUM. DNRC is involved with the County Conservation Districts and with APR’s request for a variance of Phillips County Conservation District bison management ordinances. DNRC also oversees the management of rivers and streams for the state (DNRC 2017).

Like BLM, DNRC must approve APR’s request for a change of use from cattle to bison and for the removal of some fences. DNRC has approved these changes on two state leases in the past. In 2018 APR requested approval for these changes on most of their state grazing leases. This request will trigger a MEPA (Montana Environmental Protection Act) review, which is expected to be completed in 2019. The results of the MEPA review will inform DNRC’s decision regarding approval of APR’s request.

iii. **U.S. Fish and Wildlife Service:** The USFWS is relevant to APR’s bison management for seven principal reasons: 1) It manages the CMR Refuge and Bowdoin National Wildlife Refuge and is thus a key partner in collaborative research and management of biodiversity; moreover, the CMR Refuge has been proposed by MFWP as a possible reintroduction site for bison (MFWP 2015a). 2) Other USFWS refuges harbor bison and are therefore collaborators in meta-population management. 3) USFWS has primary responsibility for federally listed endangered, threatened and candidate species found in the APR region. 4) USFWS has primary responsibility for the dozens of migratory...
bird species found on APR. 5) APR has the potential to help the CMR Refuge expand and more fully meet their wildlife management goals by providing more habitat immediately adjacent to the refuge and being a willing partner in biodiversity conservation. 6) More generally, as the U.S.’s lead agency in biodiversity management, USFWS provides a wealth of experience and information regarding wildlife management, including bison management on several wildlife refuges. 7) In 2012 the CMR Refuge completed a comprehensive conservation plan (CCP) and environmental impact statement (EIS) for the refuge, including UL Bend National Wildlife Refuge (USFWS 2017a). The plan includes the option of prescriptive grazing for livestock that may be applicable to APR bison.

iv. National Park Service: NPS harbors more bison in conservation herds than any other U.S. entity and therefore is an important collaborator for meta-population management and for sharing research and experience regarding bison management. Wind Cave National Park was the source of disease-free bison and an excellent partner for the first bison reintroductions into APR, and certified brucellosis-free (through quarantine process) bison may come from Yellowstone National Park in the future.

v. Parks Canada: Elk Island National Park has been an outstanding partner as a source for disease-free and non-introgressed bison recently reintroduced to APR and working with APR regarding bison biology and management. In addition, Grassland National Park, only about 60 miles north of APR in Saskatchewan, reintroduced bison in 2006 and is therefore a valuable partner for learning about bison management and biology under similar ecological conditions.

vi. Natural Resource Conservation Service: NRCS is the lead U.S. agency for providing technical, planning and financial assistance to private rangeland managers. Public agencies ranging from the county conservation districts to BLM generally followed NRCS-established rangeland/grazing management guidelines. NRCS thus has a major influence on how lands in the APR region are managed.

vii. Montana Fish, Wildlife and Parks: MFWP is the primary state agency for managing wildlife in Montana and thus plays
a central role in the management of wildlife on APR lands including, for example, setting hunting quotas, managing block management, working on Montana’s Species of Greatest Conservation Need, and managing conservation easements on the Burnt Lodge and Timber Creek units. MFWP would be the lead agency if a population of bison classified as wildlife were to be established in Montana, with the probable exception of herds established in a national park or national wildlife refuge. MFWP examined this possibility and listed as an alternative the establishment of a wild, publicly managed herd in its 2015 Environmental Impact Statement on Bison Conservation and Management in Montana (MFWP 2015a). APR supports efforts by the State to restore wild bison in Montana, including on the CMR Refuge (Appendix 1). To date there has been no action on the alternative actions proposed in the EIS.

viii. **Montana Department of Livestock:** APR bison are private property of APR and therefore are considered domestic livestock in the state of Montana and fall under the regulatory jurisdiction of the MDL.

ix. **Montana Association of Conservation Districts:** Each county Conservation District in Montana is closely involved in state regulations regarding watershed planning, water quality and rangeland management, and they work closely with NRCS in providing guidance for administering federal conservation programs under the U.S. Farm Bill. The Big Sandy (Chouteau), Fergus, Phillips and Valley County Conservation Districts have passed ordinances imposing strict controls on bison management, which have the potential to restrict how APR manages bison and their natural role in the grassland ecosystem. APR has requested a variance to some of these controls and is working through the DNRC to hold hearings on this request.

x. **Boards of County Commissioners:** Each county board of commissioners oversees many different aspects of the county including the county health care clinic, county road construction/maintenance, permitting, and similar affairs. The county has regulatory authority over the installation of auto gates (cattle guards) on county roads. APR requires double
deep auto gates to help contain bison within pastures where fences cross county roads.

xi. Montana Land Reliance: Though not a public institution, the Montana Land Reliance is included here because it owns conservation easements on two APR properties, Cow Creek/Cow Island and Sun Prairie.

E. Other cooperating institutions and individuals

Numerous individuals, nonprofit organizations, businesses and university staff and students have contributed their time, expertise and energy to assist APR’s bison restoration work. Their help comes in many forms—veterinary care, analysis of bison genetics, bison management planning, monitoring movements of the bison population, research on bison ecology, advice about policy questions, fence removal, and much more. Names of these cooperating individuals and institutions are listed in Acknowledgements.
BISON MANAGEMENT GOALS, OBJECTIVES, RATIONALE AND STRATEGY

“When we try to pick out anything by itself, we find it hitched to everything else in the universe.”–John Muir

Bison restoration is inextricably hitched with both the ecological and human dimensions of biodiversity restoration and conservation on APR. Grazing was a keystone process that shaped Great Plains grasslands and the evolution of their biota for thousands of years, and bison have been the primary grazer in this process. Accordingly, bison have been designated as a “keystone” or “foundation” species because of their inordinately large influence through grazing and other interactions on biodiversity of Great Plains grasslands (Milchunas et al. 1988, Knapp et al. 1999, Gross et al. 2010). Consequently, the goals and strategies for bison management must integrate the goals and strategies for conserving many other species, habitats and ecological conditions and processes, and address the socioeconomic environment in which bison conservation takes place.

Because BLM grazing allotments constitute two-thirds of the land APR plans to use for bison grazing, APR land and biodiversity management—including bison management—is designed to fully meet and often exceed the 5 standards for rangeland health and 14 guidelines for livestock grazing management of BLM’s HiLine and draft Lewistown management plans. The main headings of those five standards are:

• Standard #1: Uplands are in proper functioning condition.
• Standard #2: Riparian and wetland areas are in proper functioning condition.
• Standard #3: Water quality meets Montana state standards.
• Standard #4: Air quality meets Montana state standards.
• Standard #5: Habitats are provided to maintain healthy, productive and diverse populations of native plant and animal species, including special status species (federally threatened, endangered, candidate or Montana species of special concern as defined in BLM Manual 6840, Special Status Species Management)
Standard #5 takes on special importance in light of the large number of BLM Special Status and BLM Sensitive Species with ranges in the APR region. BLM Special Status Species Policy (Manual-6840) “gives the State Director the responsibilities of designating the BLM sensitive species and periodically reviewing/updating the list in cooperation with states and with the Natural Heritage Programs. The Sensitive Species designation is used for species requiring special management consideration to promote their conservation and reduce the likelihood and need for future listing under the Endangered Species Act” (August 18, 2014 Instruction Memorandum No. MT-2014-067). The highly endangered black-footed ferret is a BLM Special Status Species. Among BLM Sensitive Species in northeast Montana are the black-tailed prairie dog and swift fox, roughly two dozen bird species, five reptile species, three amphibian species, five fish species, and numerous species of plants.

In addition to addressing the conservation needs of these species, Rangeland Health Standard #5 in the BLM management plans states “…native plant and animal communities will be maintained or improved to ensure the proper functioning of ecological processes and continued productivity and diversity of native plant lifeforms.” Thus, as Standard #5 notes, indicators include not only “plant and animal diversity” and “species richness” at all taxonomic levels and measures of “reproductive capability and recovery,” but also “connectivity of habitat or presence of corridors [that] prevents habitat fragmentation” and “plant communities in a variety of successional stages [that] are represented across the landscape.” Accordingly, BLM HiLine and draft Lewistown livestock grazing management guidelines include:

- Guideline #11: Grazing management should maintain or improve habitat for federally listed threatened, endangered, and sensitive plants and animals.

- Guideline #12: Grazing management should maintain or promote the physical and biological conditions to sustain native populations and communities.

- Guideline #13: Grazing management should give priority to native species.
APR integrates these standards, guidelines and indicators with its commitment to meet or exceed the HiLine and draft Lewistown Management Plans’ other 4 rangeland standards and 12 grazing guidelines. Almost all of APR’s bison management goals directly address one or more of the 5 BLM standards and associated guidelines for rangeland health. These are reviewed under each of the relevant goals below.

APR’s goals and progress related to these standards are important for helping address needs that BLM has identified for improving land health and management. A 1994 BLM report indicated that rangeland ecosystems are still “not functioning properly in many areas of the West. Riparian areas are widely depleted and some upland areas produce far below their potential. Soils are becoming less fertile.” The agency concluded that riparian areas have “continued to decline to their worst condition in history” (BLM 1994, cited in Regan 2016). A 2012 BLM report noted that nearly one-quarter of allotments are not meeting or making significant progress toward BLM rangeland health standards (BLM 2012, cited in Regan 2016), a condition generally corroborated by others (PEER 2017). To the extent that some of these problems exist on BLM allotments in the APR region (detailed rangeland health assessments by BLM in the area are not available), APR believes the goals presented in this management plan can help resolve them. In addition, the value of federal rangelands has increased with the new and evolving demands for environmental uses (Regan 2016). This argues that grazing permits should be allowed to migrate to their highest value use, whether that is livestock grazing, bison grazing or wildlife conservation.

Several socioeconomic factors also require a broad, integrated approach to bison conservation. Bison restoration is controversial in cattle country, with concerns ranging from disease transmission between bison and cattle to bison conservation threatening a way of life (Aune and Wallen 2010). Others argue that bison and, more broadly, APR and other wildlife and wildlife conservation efforts offer a chance to diversify and improve, through tourism, conservation employment and other means, socioeconomic conditions for rural communities that continue to experience a long-term trend of losing people and jobs (Popper and Popper 1987, Callenbach 1996, Sage and Nickerson 2017).
APR’s bison conservation goals are grouped into four categories of management concern: Goals 1 - 8 are aimed at restoring the ecological conditions required for large-scale and comprehensive biodiversity conservation. Bison are highly adaptable habitat generalists, as evidenced by their historically wide geographic range and the diversity of habitats they inhabit (or once inhabited), from the Canadian boreal forest to Chihuahuan desert and nearly spanning the continent from coast to coast (Potter et al. 2010). Bison are also a highly interactive “foundation species” of the APR region. An important challenge for the conservation of foundation species is to determine and subsequently achieve an ecologically effective population density—the density required for a foundation species to display the effects it has on an ecosystem under natural conditions. Failure to reach this size may result in ecosystem degradation and biodiversity loss (Soule et al. 2003). Goal 9 addresses bison genetics and evolution. Goal 10 deals with mitigation of and adaptation to climate change. And Goal 11 concerns public benefit from and support for bison conservation and APR.

Today bison inhabit both native habitats where they are lightly managed and highly altered habitats where they are intensely managed. APR could meet many of its goals, such as population size and genetic diversity, by artificially feeding and intensively managing the bison population under artificial conditions. But the ecological context matters for many bison-specific management goals and, more broadly, for meeting APR’s mission of restoring and conserving native biodiversity under natural conditions. This mission and the bison’s role in meeting this mission emerge from a combination of ecological and socioeconomic concerns.

To get the ecological conditions right, APR has established the Freese Scale for Grassland Biodiversity, adapted from a paper by C.H. Freese, S.D. Fuhlendorf and K. Kunkel that proposed a management framework for the transition from livestock production toward biodiversity conservation on Great Plains rangelands (Freese et al. 2014). The Freese Scale covers ten ecological conditions that are important to restore in the transition from agriculture-centered management to biodiversity-centered management on Great Plains rangelands. As we review below under the rationale of management goals, rangeland management practices that focus on commodity production alter these conditions in ways that create management efficiencies and
that direct more primary and secondary production toward the desired commodities (e.g., grains, beef). In many cases such management results in the loss of native species and other forms of biodiversity degradation. The most serious losses occur when native grassland is converted to crop production.

Fortunately, state and federal landowners as well as many private landowners in the APR region have maintained much of the land in native grassland and other native habitat for livestock grazing. With good management that maintains the right ecological conditions, many species of wildlife do well on these lands. Nevertheless, even in these situations a few species and some important ecological processes tend to lose out when commodity production is a major driver (Fuhlendorf and Engle 2001). APR’s goal is to restore the most important ecological conditions and processes that existed before agricultural use of the land and thereby create conditions for restoring viable populations of all native species. Long-term success requires that restoration be done on a sufficiently large scale that the ecosystem—all native species and ecological functions—is self-sustaining with little human intervention necessary.

By taking this comprehensive approach, APR has established the following objectives for bison that reinforce and build on the objectives of the original reintroduction plan (Kunkel et al., no date). These new objectives incorporate criteria of the Sanderson et al. (2008) scorecard for making an “exceptional contribution” (the highest category) to fulfilling the goals of the “Vermejo Statement” on ecological recovery of bison:

• Establish a self-sustaining, naturally regulated, and ecologically effective population of at least 10,000 bison that is free of cattle-gene introgression, semi-free ranging, and subject to all the forces of natural selection;

• Restore all native species and ecological processes and their natural interactions with bison;

• Establish a population that serves as a source of animals for wild bison restoration throughout the Great Plains;

• Establish a population that enhances the long-term survival of the species genetically, behaviorally and ecologically, and that promotes prairie conservation;
• Establish a population that contributes to removal of wild bison from list of Species of Greatest Conservation Need by the state of Montana and from “near threatened” on the IUCN Red List of Threatened Species;

• Establish a bison population capable of sustaining a variety of consumptive and nonconsumptive values and that contributes to cultural, aesthetic, economic, and social well-being regionally and nationally;

• Collect and disseminate scientific information on bison biology, reintroduction techniques and the ecological requirements for successful wild bison restoration.

For each of the following 11 goals, we first present a statement of the goal followed by more specific objectives for it. This is followed by the rationale for why the goal and its objectives are important and a review of factors that influence strategies and actions needed to achieve them. We then describe progress to date in meeting the goals and objectives and, lastly, strategies and actions for the next 5-10 years.

Goal 1: Restore and maintain native plant communities.

To conserve floristic diversity and meet habitat needs of bison and other wildlife, APR’s goal is to restore all cropland and otherwise highly altered lands to native plant communities, to control non-native plant populations, to maintain all existing native plant communities, and to conserve the soil and other physical conditions on which they depend.

A. Objectives:

i. Restore native plant communities, within 10 years of acquisition, on all cultivated and other highly degraded lands such as abandoned homesteads.

ii. Maintain all existing and restored lands in native plant cover.

iii. By 2018 prepare results, suggested protocol and questions in need of further research for prairie restoration.

iv. Prevent the spread of invasive non-native plant species and reduce their prevalence where important and practical.

v. Meet or exceed all BLM Rangeland Health Standards, particular those for which restoration and maintenance of
native plant communities is important: # 1--Uplands are in proper functioning condition, #2--Riparian and wetland areas are in proper functioning condition, #3--Water quality meets Montana state standards, and #5--Habitats are provided to maintain healthy, productive and diverse populations of native plant and animal species, including special status species.

B. Rationale

Agriculture and other human activity such as road building have altered to varying degrees the composition of plant communities on every ranch acquired by APR. These range from minor alterations in plant communities due to invasion by one or two non-native plant species to massive changes that occur when native prairie is converted to crop production. As described earlier, native prairie and CRP lands continue to be converted to cropland at a rapid pace, resulting in loss of habitat for bison and other native grasslands species, soil loss of 4.16 - 5.49 tons/acre/year (USDA SCS 2000, FAPRI 2007), loss of soil nitrogen, phosphorus and carbon, and increased sedimentation of streams (Ogle et al. 2005). Stopping and reversing grassland cultivation therefore benefits biodiversity and ecosystem health at multiple levels.

Restoration of native habitats and plant diversity is intrinsically important for conserving and offering the public the chance to experience the biodiversity of this region. The major habitats were described in the introduction. A plant inventory of Phillips and Valley Counties recorded 717 species, 358 genera and 86 families, and 32% of the species were first records for the two counties (Charboneau et al. 2013). Moreover, restoring and maintaining landscapes with a high proportion of grasslands is important for conserving sensitive grassland-dependent bird species such as Sprague’s pipit, Baird’s sparrow, chestnut-collared longspur and McCown’s longspur (Lipsey 2015). This goal supports BLM Rangeland Health Standard #5--“Management for indigenous vegetation and animals is a priority.”

As described in more detail under Goal 5, cultivated lands can degrade streams and aquatic life. Runoff from croplands results in greater water turbidity, unhealthy high nutrient levels in streams, and high rates of sedimentation. Thus, restoring and maintaining
native plant communities on both deeded upland areas (relevant to BLM Standard #1) and deeded lowland areas (BLM Standard #2) is crucial for meeting Montana water quality standards (BLM Standard #3) and for providing habitats for native species of plants and animals (BLM Standard #5). Notably, a Standard #5 indicator is habitat connectivity and the prevention of habitat fragmentation (see Goal 4).

Species-diverse grasslands are resilient to drought in the face of climate change (Craine et al. 2013) (see Goal 10). In many respects, restoring and maintaining native plant communities and thus the ability of the land to adapt to changing environmental conditions is the foundation for all other goals aimed at restoring and conserving natural ecological conditions.

Figure 2. By seeding native grasses and forbs, APR has begun restoring grassland habitat and the carbon it stores on 4,182 acres of previously cultivated land, and in the process also greatly reduced soil erosion and sedimentation of streams. Thousands of additional acres will be restored over the next few years. Photo: Ellen Anderson
C. Progress to date

APR has implemented a policy of maintaining all rangelands on its properties (except for human footprint areas such as campgrounds and building sites) and restoring native plant communities on cropland and lands previously converted for other purposes. APR has begun native plant restoration on 40% (4,182 acres) of cultivated lands acquired thus far (Figure 2). Based on USDA research in the Northern Plains (USDA CSC 2000, FAPRI 2007), APR estimates that restoring native plant cover to this acreage will reduce soil loss by 99% and thereby stop the loss of 4.16-5.49 tons/acre/year. Consequently, APR’s restoration efforts to date result in an estimated total of 19,000 – 25,000 tons of soil per year staying on the land rather than being eroded into streams and reservoirs with degrading consequences for water quality.

APR has implemented a comprehensive weed management plan that identifies priorities and addresses methods of prevention and control. Four main methods are employed for controlling non-native plant species: mechanical, chemical, biological, and fire. APR conducts its own weed monitoring, assessment and control work as well as enlisting the cooperation of County Weed Districts and private contractors to assist in weed control.

APR has three main categories of high priority infestations:

- **Isolated infestations:** These infestations are usually high priorities, even for species that do not pose the greatest impact to the property’s resource base. All weed infestations that are under 0.1 acre in size are priority for eradication.

- **Patches of highest priority weed species and that, if left alone, would soon be uncontrollable:** Leafy spurge spreads rapidly and thus is a priority for control as soon as it observed. Large infestations of leafy spurge are difficult to control.

- **Roadsides, parking areas, trails, ditches, dams, and streams:** Weed infestations in these areas are high priorities for control because they experience frequent disturbance, which creates favorable habitat for weed establishment and spread, and because vehicles and water are two of the most common agents for spreading weeds. Infestations of new weed species may first appear in disturbed sites such as road edges, ditch banks...
and stream banks. Vehicles traveling along roads and trails can spread weed seeds to other areas. Livestock and wildlife may transport seeds in their digestive systems and fur.

D. **Strategy and actions**

APR will continue its policy of maintaining existing natural plant communities on all current and newly acquired lands. Siting and construction of management and visitor infrastructure will minimize disturbance of native habitats.

APR plans to restore the other 5,785 acres of cultivated lands it currently owns. When completed, APR’s restoration of 10,000 acres will reduce soil runoff by an estimated 43,000 – 57,000 tons/year, thereby restoring carbon, nitrogen, phosphorus and other soil nutrients and greatly reducing the multiple negative impacts on water quality and stream health. APR will continue to restore native prairie on newly acquired cultivated lands as soon as it is financially and technically feasible.

APR will help avert further grassland cultivation and resulting soil erosion and aquatic degradation in the region by acquiring properties with grasslands that are vulnerable to cultivation.

APR will continue its three-pronged approach to controlling non-native plants.

APR will develop a work plan for preparing results, protocols and research needs for restoring cultivated/degraded lands.

Through the above actions and others, APR will continue to cooperate with BLM to help meet or exceed all BLM Rangeland Health Standards, particularly those for which the restoration and maintenance of native plants communities is so important: #1--Uplands are in proper functioning condition, #2--Riparian and wetland areas are in proper functioning condition, #3--Water quality meets Montana state standards, and #5--Habitats are provided to maintain healthy, productive and diverse populations of native plant and animal species, including special status species.
Goal 2: Restore natural herbivory patterns to create habitat heterogeneity and to maintain rangeland health.

This goal aims to replace the common homogeneity-based rangeland management practice of uniform grazing intensity across the landscape--the “take half leave half” approach--with heterogeneity-based management whereby natural herbivory by native herbivores results in variable grazing intensity and consequent habitat heterogeneity across the landscape. The focus under this goal is the change from cattle to bison as the principal grazer and the change from rotational grazing to year-round continuous grazing. Inclusion of fire as a factor affecting grazing and heterogeneity is reviewed under Goal 3. This goal will generally follow NRCS calculations for below-normal-precipitation stocking levels on APR’s deeded land and BLM/State-determined stocking levels on BLM/State leases. This results in an average of 81 acres per bison animal unit per year (~8 animals/sq mile) across current APR management units under year-round continuous grazing, or lower densities as required by varying abiotic and biotic factors among management units.

A. Objectives

i. Secure BLM and DNRC approval in 2019 of APR’s request for a change of use from cattle to bison and from rotational to year-round continuous grazing on BLM and state grazing allotments of the following management units: Beauchamp Creek, Burnt Lodge, C.K. Creek, Dry Fork, PN, Sun Prairie North, Timber Creek, White Rock and Two Crow. As part of this request, secure BLM approval to remove interior fences on the Telegraph Creek allotment of the Sun Prairie unit.

ii. Subject to achieving objective i, conduct the transition from cattle to bison on APR management units at a pace that accommodates the projected natural rate of increase of APR’s bison population. This objective should enable the population to grow to more than 5,000 bison by 2029, halfway to the long-term objective of 10,000. Monitor key bison population variables--fertility rate, mortality rate, etc.--for ongoing evaluation of factors affecting population growth.

Instead of “year-round continuous grazing,” we believe the term “year-round heterogeneous grazing” better reflects the goal of allowing bison to graze freely and thereby generate habitat heterogeneity over large landscapes. However, because continuous is widely used by resource management agencies and rangeland scientists cited in this document, to avoid confusion we generally use continuous rather than heterogeneous when discussing grazing regimes.
iii. Make the transition from rotational to year-round continuous grazing on management units simultaneously with replacement of cattle by bison.

iv. Meet or exceed all BLM Rangeland Health Standards, with particular focus on #1--Uplands are in proper functioning condition, #2--Riparian and wetland areas are in proper functioning condition, and #5--Habitats are provided to maintain healthy, productive and diverse populations of native plant and animal species, including special status species.

v. By 2018, prepare and implement a monitoring and research plan for understanding the effects of the change from cattle to bison and from rotational grazing to year-round continuous grazing.

vi. Evaluate integration of patch fires (Goal 3) with these objectives and implement where important and feasible.

vii. Integrate these objectives with those of Goal 7, the restoration of other native wildlife that are also important components of the grazing community.

viii. Maintain contingency plans for each management unit with bison that charts a rapid response to containing and/or providing supplemental forage or water and/or reducing herd size that may be required as a result of events such as a large fire, drought-induced forage or water shortages, flood, and deep snow. See Appendix 2.

B. Rationale

Grasslands of the APR region evolved under conditions of variable grazing pressure by bison and other herbivores. These herbivory patterns were responsive to variations in plant productivity and nutritional value caused by variable soil conditions, by variable precipitation patterns, and by occasional lightning- and human-lit prairie fires (Krueger 1986, Whicker and Detling 1988, Knopf and Samson 1997, Truett et al. 2001, Anderson 2006, Fuhlendorf et al. 2011). The result was a wide range of disturbance intensity that shifted annually across the landscape. Recently burned areas would temporarily be bare ground that then yielded nutritious new growth that was intensively grazed by bison, pronghorn and other
herbivores. The next year bison and other herbivores would move on to other newly burned sites to graze while leaving the now less nutritious vegetation on the previous year’s sites to grow ungrazed. Vegetation and thus fuel for the next fire would continue to grow for potentially many years in these undisturbed sites until fire once again marked the start of a new cycle. Prairie dog colonies (described under Goal 7) added another type of disturbance to the landscape (Figure 3a). At large scales this shifting mosaic of habitat diversity leads to ecological stability (Fuhlendorf et al. 2012). Moreover, it is of central importance to the diversity of plants, mammals, birds and other taxa (Fuhlendorf and Engle 2001, Truett et al. 2001, Samson et al. 2004, Anderson 2006, Jonas and Joern 2007), including numerous BLM Sensitive Species. Restoration of habitat heterogeneity directly addresses BLM Rangeland Health Standard #5 regarding the maintenance of healthy and diverse populations of native species, including the importance of ensuring that “a variety of age classes are present,” that “the environment contains components necessary to support viable populations of a sensitive/threatened and endangered species in a given area relative to the site potential,” and that “plant communities in a variety of successional stages are represented across the landscape.”

Loss of such heterogeneity may be contributing to long-term population declines of several species of grassland-obligate birds, particularly those with breeding ranges centered on the Northern Great Plains (Knopf 1996) (Figure 3b, Figure 4). Species found in the APR region that have shown statistically significant population declines from 1966-2015 are (precision-adjusted estimates of population declines in parentheses, from Sauer et al. 2017): chestnut-collared longspur (-4.0%), McCown’s longspur (-3.7%), mountain plover (-3.4%), Sprague’s pipit (-2.9%), lark bunting (-2.5%), horned lark (-2.4%), bobolink (-2.0%), Baird’s sparrow (-2.0%), savannah sparrow (-1.4%), western meadowlark (-1.3%), northern harrier (-1.2%), burrowing owl (-1.0%) and vesper sparrow (-0.9%). Nearly all of these are BLM Sensitive Species and Montana Natural Heritage Program Species of Concern. Based on research in the APR region, Lipsey (2015) proposes that a reasonable goal for conserving grassland bird diversity is to increase areas with extreme values in vegetative cover and that this is most effective if done over large grassland landscapes of at least 368,640 acres.
Rangeland management for bison must also address sage-grouse conservation needs. The bison’s strong preference for grass forage and general avoidance of woody riparian habitats, even during summer, should be compatible with maintaining sage-grouse habitats.

Figure 3. a) General representation of postulated disturbance intensity across the landscape caused by bison grazing, fire and prairie dogs before Euro-American colonization of the Great Plains and by traditional “take half leave half” livestock grazing management. b) General representation of vegetation response to the two disturbance gradients and of selected bird species preferences for vegetation structure (horizontal line indicates range of preferred vegetation structure). The two vegetation responses to evolutionary disturbance patterns are shown to indicate that the proportion of each vegetation structure may vary considerably across the landscape and from year to year. See text for further explanation. Adapted from Knopf 1996, Fuhlendorf et al. 2008, Alberta Conservation Association 2017.
including shrub cover and herbaceous plants of varying heights. BLM’s HiLine Management Plan, for example, calls for the reduction of summer grazing in riparian areas to help conserve sage grouse habitat.

Ranchers and resource management agencies in the APR region have widely followed the common “take-half-leave-half” rule of thumb in rangeland management whereby livestock are managed to graze half of the standing forage down to a uniform height across the land. This goal is generally met by some form of rotational grazing, which nearly always involves the installation of cross fencing and of watering facilities to help uniformly distribute grazing across the landscape (Holechek et al. 2011).

The goal of natural herbivory merits extensive review here because the bison’s central role in restoring natural herbivory patterns involves fundamental and often controversial changes in management practices with rigorous public scrutiny and federal and state agency oversight on each property and associated leases that APR acquires.

**From cattle to bison**

Cattle and bison are ruminants of the family Bovidae. New World cattle evolved and were domesticated, relative to bison, in warmer and more forested regions of southern Europe and tropical/subtropical regions of the Middle East, Africa and India (McTavish et al. 2013), whereas American bison and their ancestors evolved under colder temperate and subarctic conditions as their dispersal and evolution in the central grasslands of North America tracked the expansion and retreat of glacial ice sheets beginning 75,000-130,000 years ago. Since then, however, bison adapted as a habitat generalist to diverse ecological conditions by expanding their range to both humid and arid sub-tropical conditions of current-day southern U.S. and northern Mexico (Potter et al. 2010).

Cattle and bison have a large rumen compartment in relation to both body size and nutrient requirements (Demment and Van Soest 1985). Both are classified as “bulk/roughage grazers” in that they graze comparatively indiscriminately on herbaceous vegetation, in contrast to “concentrate selectors,” such as deer and elk, which feed more selectively on desired plants and plant parts (Hofmann and Stewart 1972). NRCS estimates average forage intake by cattle and bison to be the same, both with animal unit equivalents of 1, and thus considers them identical for AUM calculations (NRCS 2003).
Both cattle and bison consume primarily grasses and sedges in short-grass, mixed-grass and shrub-steppe ecosystems in North America. Bison, however, usually include a greater proportion of grass and sedge in their diet—more than 90%—than cattle, whose diet often consists of more than 15% forbs and shrubs (Peden et al. 1974, Van Vuren 1984, Van Vuren and Bray 1983, Plumb and Dodd 1993, Hartnett et al. 1997, Gogan et al. 2010). Bison appear to show greater ability to digest and absorb nitrogen from low protein, high fiber forage than cattle, which may be related to significantly longer retention times of digesta in bison than cattle. Accordingly, bison have been reported to select rougher, less digestible forage (Peden et al. 1974, Schaefer et al. 1978).

The different evolutionary histories of bison and cattle and their ability to adapt to the mixed-grassland and shrub-steppe ecosystems of eastern Montana are reflected in their different bioenergetic
requirements and responses to cold. To retain body heat bison possess a layer of subcutaneous fat and much denser hair coat than cattle (Peters and Slen 1964). Although responses may vary substantially among cattle breeds, bison and cattle display distinctly different metabolic responses to severe cold, with bison reducing their metabolic rate while cattle increase theirs as the temperature drops. For example, a temperature decrease from 0ºC to -30ºC (32ºF - -22ºF) resulted in an average increase of 33% in the metabolic rate of Hereford calves whereas bison calves showed a 19% decrease, and even at -30ºC (-22ºF) the bison showed no sign of the decline being reversed. Bison calves are as cold tolerant at 6 months as Herefords calves are at 13-17 months (Christopherson et al. 1978, 1979). This low-temperature tolerance by bison may be particularly adaptive in the APR region where for 3 months of the year the average high never exceeds 0ºC (32ºF), for 6 months the average low is below 0ºC (32ºF), and for 3 months the average low is below -14ºC (6ºF) (data for Malta, Western Regional Climate Center 2017).

NRCS places the thermal-neutral zone for cattle at 5ºC – 20ºC (41-68ºF) (NRCS 2003). The average high for the town of Malta exceeds this range for 5 months of the year and the average low falls below it during 7 months of the year. Kohl et al. (2013) found little difference in time spent per visit at water between cattle and bison at 20ºC (68ºF), but as the temperature rose from 20ºC to 35ºC (95ºF) cattle spent increasingly more time at water than bison.

Projected increased temperatures in the Great Plains due to climate change (see Goal 10) may affect both cattle and bison through the direct effects of heat stress on animal behavior and health and through reduced forage production and quality (Craine 2013, Hatfield et al. 2014, Craine et al. 2015). We found no studies that compare how cattle and bison respond behaviorally to heat stress with respect to foraging patterns.

Adaptation to cold environments is also displayed by the bison’s ability, in contrast to cattle, to forage in deep snow (Meagher, 1973, Carbyn et al. 1993). Because of these differences, bison are able to occupy and forage over the rangeland throughout winter whereas cattle are generally concentrated and provided supplemental forage during winter; this also results in lower input costs for bison than cattle.
Bison and cattle display similarities as well as important differences in foraging behavior, movement and other activities. Compared to cattle, commonly reported differences are that bison tend to use more open, upland habitats and avoid forests and riparian areas, spend less time grazing during the growing season, move greater distances each day and forage over larger areas, and spend less time at and forage at far greater distances from water (Peden et al. 1974, Plumb and Dodd 1993, van Vuren 2001, Allred et al. 2011, Kohl et al. 2013).

In mixed-grass prairie systems of the Dakotas and Nebraska, bison exhibited a stronger preference compared to cattle for perennial grasses and they were strongly attracted to open landscapes during the growing season. Cattle included more forbs in their diet, and they use wooded areas and riparian zones more intensively. Despite greater grass consumption by bison than cattle, at similar annual stocking rates the amount of grass remaining at the start of the dormant season was higher under year-round bison grazing compared to growing-season cattle grazing (Steuter and Hidinger 1999). Plumb and Dodd (1993), in the mixed-grass prairie of Wind Cave National Park, South Dakota, also reported bison consume proportionally more grass than cattle, exhibited greater daily movements over larger areas, spent less time at water and foraged at greater distances from water.

In the mixed-grass/shrub-steppe region of two study sites in northeast Montana (American Prairie Reserve) and southern Saskatchewan (Grassland National Park), Kohl et al. (2013) reported that cattle spent a higher proportion of time grazing (45–49%) than bison (26–28%), grazed sites of higher plant biomass, spent more time at water, and had a foraging patch size 20 or more times smaller (Figure 5). The foraging patch size of cattle was 119 - 1,519 acres (48 – 615 ha). Range management guidelines assume distances of 1.0 - 2.0 miles (1.6 – 3.2 km) from water to be of moderate forage availability and further distances as much less accessible to cattle (Holechek et al. 2011, Lyons and Machen n.d.). The forage patches of 119 - 1,519 acres found by Kohl et al., if centered on single water sources, would indicate cattle were seldom moving more than a mile from water.

In contrast, the 8,781-acre (3,555-ha) pasture unit on the APR study site revealed no small-scale patch use by bison, suggesting that a single bison foraging patch encompasses a larger area. This was confirmed by the larger pasture unit in the Grassland National
Park study site where the bison summer foraging patch was 28,874 acres (11,690 ha) (Kohl et al. 2013). Kohl et al. (2013) commented that increased grazing and decreased movements by cattle found in their study, when combined with livestock stocking levels that they suggest are twice that of historic bison, are compatible with the hypothesis that current range practices are resulting in homogeneous grazing at a landscape scale and thus contributing to the decline of prairie-obligate species (Knopf 1996; Fuhlendorf et al. 2006).

If increased biological diversity facilitated by vegetation heterogeneity at the landscape scale is an objective (Fuhlendorf et al. 2006) and domestic livestock are used as the dominant grazer, Fuhlendorf and Engle (2001) suggest that alteration of grazing intensity across many pasture units may be effective. If increased vegetation heterogeneity through bison grazing is an objective, they conclude, similar to Kohl et al. (2013), that larger pasture units may facilitate bison movement, behavior, and resource use that more closely approximate historical bison populations.

McMillan et al. (2017) evaluated three treatments on APR: where livestock continuously grazed, livestock were removed for 10 years, and bison have been introduced and resident for 10 years. They found higher species richness and compositional heterogeneity (β-diversity).
in the bison treatment than either the livestock retention or livestock removal treatments. Bison restoration, however, resulted in lower forb abundance and comparable bare ground and plant height heterogeneity compared to sites where livestock were retained.

A comparative study on The Nature Conservancy Tallgrass Prairie Reserve in Oklahoma (Fuhlendorf et al. 2010) found that both cattle and bison strongly preferred recently burned areas and avoided steeper slopes. Cattle selected areas that were closer to water and preferred areas with woody vegetation, while bison were not limited by distance to water and avoided woody vegetation. GPS information did not allow determination if woody vegetation was used by cattle for resting or grazing. Preferences by both species for burned areas have been reported in other studies (Coppedge et al. 1998, Fuhlendorf and Engle 2001).

At another tallgrass study site, the Konza Prairie Biological Station in the Kansas, a 10-year study compared vegetation changes in prairie that was burned and grazed season-long at a moderate stocking rate by either bison or cattle. Trends in species cover and diversity indices in the bison and cattle pastures were compared with ungrazed prairie that also was burned annually. Grazing by either herbivore increased the canopy cover of annual forbs, perennial forbs, and cool-season graminoids, but both annual and perennial forb cover increased at a greater rate in bison pastures than in cattle pastures. Species richness at both small (10 m$^2$) and large (200 m$^2$) spatial scales increased at a greater rate in bison pastures than in cattle pastures, but richness did not change through time in ungrazed prairie. The number of annual forb species was significantly greater in bison pastures than in cattle pastures. Residual graminoid biomass at the end of the grazing season was lower in bison pastures than in cattle pastures, whereas forb residuum increased over time at a greater rate in bison pastures than in cattle pastures. Despite these differences, the plant communities in bison and cattle pastures were 85% similar after 10 years of grazing. The authors conclude that most measurable differences between bison-grazed and cattle-grazed pastures in tallgrass prairie are minor, and differences in how the herbivores are typically managed may play a larger role in their impact on prairie vegetation than differences between the species (Towne et al. 2005).
Observations on Konza Prairie suggest that bison alter plant community composition at the patch scale by selecting species-poor, grass-dominated sites and converting them to sites of higher diversity (Knapp et al. 1999). At the watershed and landscape scales, the long-term consequences of bison activities include a reduction in cover, dominance, and productivity of grasses; the competitive release of many subdominant species, resulting in an increase in the abundance of forbs; an overall increase in plant species richness and diversity; and increased spatial heterogeneity (Knapp et al. 1999). Bison grazing of short- and mixed-grass prairie has been shown to increase rates of nutrient cycling (Day and Detling 1990), modify plant species composition (Coppock and Detling 1986) and increase the nutritive value of grasses (Coppock et al. 1983a, 1983b, Krueger 1986).

Based on observations of a change of use from cattle to bison in place since 2008 on APR’s Box Elder Allotment, BLM (2015b) reported in their assessment of the Flat Creek Allotment Change of Use that no change in grassland species is expected to occur in the transition from cattle to bison and from seasonal rotational grazing to year-round continuous grazing. BLM noted that this conclusion is in agreement from observations of a number of long-term grazing exclosures on BLM lands scattered throughout Phillips County.

In the arid, semi-arid and alpine habitats of the Henry Mountains of south-central Utah, bison used steeper slopes and higher elevation than cattle and spent less time close to water (van Vuren 2001, Ranglack and du Toit 2015). In northern Colorado, Peden et al. (1974) found that bison spent less time near water and only watered once a day. Pinchak et al. (1991) reported that 77% of the observations of cattle grazing foothill ranges in Wyoming were within 0.23 miles of water. Other studies have shown that cattle are attracted to the shade of woodlands and riparian zones, both during the heat of the summer and for protection from wind and cold during winter (Smoliak and Peters 1955, Sneft et al. 1985, Van Vuren 1984, 2001).

What are the effects of grazing bison and cattle simultaneously on the same rangeland? Bison and cattle exhibit spatial segregation on rangelands because bison range widely across the landscape whereas cattle are central place foragers and commonly focus grazing around water sources (van Vuren 2001, Allred et al. 2011, Ranglack et al. 2015). Nevertheless, the potential for exploitative
competition (one species’ consumption decreases forage available for another species) and interference competition (physical displacement of one species by another) between cattle and bison exists. Intense summer grazing by bison of cattle winter range in the Henry Mountains of Utah likely created short-term reductions in forage availability, but no differences in plant community composition or productive potential was found compared to areas used by cattle only and to sites totally ungrazed by cattle and bison (Ware et al. 2014). Also in the Henry Mountains, lagomorphs were found to account for 34%, bison 14% and cattle 52% of the total grass biomass removed by all herbivores on the shared range, and thus cattle faced greater competition from lagomorphs than from bison in the study area. At least in the Henry Mountains, purported effects regarding the negative impacts of bison on cattle appear to have been overstated (Ranglack et al. 2015).

Interference competition between cattle and bison is minor to nonexistent. In the Henry Mountains of Utah, where bison and cattle have coexisted since the 1940s, interactions between the two species have shown that they will sometimes graze within close proximity of one another, with neither affecting the behavior of the other until about 13 ft (4 m) apart, at which point cattle either altered their direction away from bison or moved aside as the bison approached. Aggressive behavior of bison (usually yearlings) toward cattle was rare, and when it did occur cattle were submissive and driven an average of 13 ft (4 m) away (Van Vuren 1980, 2001). There are no known reports of bison preventing cattle from utilizing vegetation or water sources nor are there reports of bison goring cattle (MFWP 2015a). In central Saskatchewan, ranchers have observed wild Sturgeon River Plains Bison herd in the presence of cattle, but they have had no incidents of bison harassing the cattle and note that the two species appear to tolerate each other (Adams and Dood 2011, MFWP 2015a).

No reports of bison attempting to breed domestic cattle in rangeland conditions are known (MFWP 2015a).

In upland systems, the above comparative studies demonstrate no major differences between cattle and bison in terms of effects on rangeland health and biodiversity, particularly in semi-arid grasslands. Though cattle and bison differ significantly with respect
to foraging patch size and minor differences exist in proportion of grasses and forbs consumed, both species are primarily grass grazers and habitat generalists. As shown in one tallgrass prairie site, long-term bison grazing may favor an increase, relative to cattle grazing, in forb diversity and abundance. This would benefit forb foragers such as greater sage-grouse (Dahlgren et al. 2015) and pronghorn (Bayless 1967, Wentland 1968). As Biodini et al. (1998) note, however, their study of mixed-grass prairie in North Dakota confirms previous observations that, in northern mixed-grass prairie, climatic variations, particularly droughts, control major trends in plant species composition and net primary productivity, with grazing and grazing systems playing a secondary role.

We agree with a broad consensus among rangeland scientists and managers that, under current NRCS and BLM rangeland management conditions and measures of success, the most important variables affecting biodiversity and overall rangeland health are stocking rate, weather, and adaptive management. Excessive stocking and bad management decisions, regardless of the grazer, will lead to ecological degradation. Light to moderate stocking levels and good management generally result in good outcomes (Heitschmidt and Taylor 1991, Biondini et al. 1998, Steuter and Hidinger 1999, Holechek et al. 2011, Towne et al. 2005, Allred et al. 2011, Briske et al. 2011, Krausman et al. 2011).

By following BLM and NRCS rangeland management guidelines and maintaining moderate stocking levels, rangeland science therefore suggests that BLM rangeland health and biodiversity will be at least maintained in the transition from cattle to bison. Moreover, APR’s work to restore native grassland on cropland on base properties offers the opportunity to improve conditions of BLM allotments by increasing the amount of intact rangelands with which they are associated.

Grassland plants and animals of the mixed-grass prairie and sagebrush steppe of eastern Montana co-evolved with bison for thousands of years. Through grazing and other actions, bison played a central role in the functioning of grassland ecosystems (Day and Detling 1990, Knopf and Samson 1997). As a foundation species, bison have a disproportionate and likely stabilizing effect on the diversity and structure of ecosystems (Dayton 1972, Ellison et al. 2005). Domestic cattle replaced bison on these landscapes approximately 150 years ago—just 1% of the 12,000-year post-glacial period during
which bison were the region’s dominant grazer. Bison became ecologically extinct because the few herds remaining were too small, confined and isolated to exert the ecological roles they once had in the Great Plains (Freese et al. 2007). The transition back to bison offers an evolutionarily tested means for restoring habitats that, as set forth in the BLM HiLine Rangeland Health Standard #5, “maintain healthy, productive and diverse populations of native plant and animals species.” Streams and riparian systems present additional management questions relative to cattle versus bison. We review these questions under goal 5, restoration of stream hydrology and riparian areas.

**From rotational to year-round continuous grazing**

A major change involved in the goal to restore natural herbivory patterns is to convert from rotational to year-round continuous grazing when bison replace cattle on the land. Year-round continuous grazing by multiple herbivores, including bison, characterized the region since the retreat of the last ice sheet some 12,000 years ago until the mid-1900s. Rotational grazing was supported by NRCS and implemented by BLM and many ranchers across the Great Plains in the 1970s. With rotational grazing came the extensive construction of interior fencing with negative consequences for many wildlife species; the removal of interior fencing in the transition back to year-round continuous grazing offers multiple benefits to wildlife and other environmental services (see Goal 4).

NRCS, as part of their “Conservation Effects Assessment Project,” published a comprehensive evaluation based on peer-reviewed literature titled *Conservation Benefits of Rangeland Practices: Assessment, Recommendations, and Knowledge Gaps* (Briske 2011). Its purpose was to provide evidence-based information to guide the development and assessment of NRCS-recommended management practices and conservation programs on the nation’s rangelands. Three chapters in this review are relevant to rotational and continuous grazing questions. These reviews were based on grazing practices for common domestic livestock, primarily cattle, not bison.

The chapter by Briske et al. (2011) assessed grazing systems, including rotational and continuous grazing. The authors concluded that “The vast majority of experimental results indicate that there is no clear advantage of any one grazing system over another in terms
of ecological benefits” (p. 52). They noted that this agrees with earlier reviews (Holechek et al. 1999, 2006) and reflects findings in an earlier report by Briske et al. (2008).

At a more detailed level, in comparing continuous with rotational grazing experiments at similar stocking rates, their NRCS review found that:

• Of 25 experiments, 86% indicated no difference in species composition;

• Of 19 experiments, 89% found no differences for plant productivity/standing crop;

• Of 28 experiments, 57% reported no difference for animal production per head and 36% found greater per head production for continuous grazing;

• Of 28 experiments, 57% reported no difference in animal production per unit of land area and 36% reported more production for continuous grazing.

Two studies reviewed by Briske et al. (2011) found no difference in livestock preference for site selectivity between rotational and continuous grazing. Forage availability, rather than stocking density or grazing system, appeared to be the primary mechanism affecting animal selectivity (Kirby et al. 1986, Heitschmidt et al. 1989).

Of four studies that Briske et al. (2011) found that directly compared forage quality between the two systems, forage quality was comparable in two cases and one each favored continuous and rotational grazing.

The above studies, according to Briske et al. (2011, p. 32), “indicate that rotational grazing does not promote primary or secondary production compared to continuous grazing within rangeland systems. These interpretations are consistent with those of previous reviews over the past 50 years (Heady 1961, Van Poollen and Lacey 1979, Holechek et al. 2001), and they clearly support the long-standing conclusion that stocking rate and weather variation account for the majority of variability associated with plant and animal production on rangelands.”

Similarly, based on results of a change of use from cattle to bison and from rotational to year-round grazing on APR’s Box Elder Allotment, BLM (2015) concluded that on APR’s Flat Creek Allotment the same change of use is not expected to result a change in grassland species.
BLM noted that this conclusion is in agreement from observations of a number of long-term grazing exclosures on BLM lands scattered throughout Phillips County.

A review by Briske et al. (2011) of the effects of the two grazing systems on water and soil resources found that, at moderate stocking rates, rotational grazing systems lead to similar or improved soil hydrologic function. Again, however, stocking rate overrides the grazing system in terms of effects on soil hydrologic function. They note that under moderate stocking, which is proposed for APR allotments, both continuous and rotational grazing may maintain a consistently higher level of hydrologic function compared to periodic heavy stocking followed by prolonged deferment. Concerning soil erosion, Briske et al. found no strong evidence that one grazing system is better than the other.

Briske et al. (2011) also reviewed effects of grazing practices on wildlife, and a separate NRCS review by Krausman et al. (2011) focused specifically on the effects of grazing practices on wildlife. Both reviews concluded that the small number of studies comparing effects on wildlife precluded making general conclusions. Of the studies Briske et al. reviewed, 17 showed no difference in wildlife responses to the two grazing system, 8 indicated rotational grazing was better and 8 indicated continuous was better. None of the studies reviewed provides conclusive information for comparing wildlife responses to rotational and continuous grazing in the mixed-grass/shrub-steppe habitats of eastern Montana.

Although controversy remains regarding the pros and cons of continuous grazing compared to various types of rotational grazing (Budd and Thorpe 2009, Teague et al. 2013), we note that almost all research and management are conducted within the framework of (1) cattle as the primary grazing animal and (2) a goal of ensuring profitability for the ranching operation. In many cases, especially on public lands, the goal also includes managing for biodiversity and other ecosystem services (Havstad et al. 2007).

APR, in contrast, is managing bison as the primary grazer and APR’s primary goal is the provision of biodiversity and other ecosystem services for public benefit. As such, APR’s grazing plan for bison is similar to many other areas that are managed for biodiversity and public benefit and where there is year-round, continuous grazing by
bison. These include national parks (e.g., Yellowstone N.P., Theodore Roosevelt N.P. in North Dakota, Badlands N.P. and Wind Cave N.P. in South Dakota), national wildlife refuges (e.g., Wichita Mountains NWR in Oklahoma and Neal Smith NWR in Iowa), state parks and reserves (e.g., House Rock Wildlife Area in Arizona and Henry Mountains and Antelope Island in Utah), and nonprofit reserves (e.g., The Nature Conservancy’s Tallgrass Prairie Reserve in Oklahoma and Zapata Ranch in Colorado).

Although the above NRCS review found little evidence that rotational grazing is needed to conserve wildlife and environmental services, one can probably create habitat heterogeneity or particular habitat types to meet particular biodiversity conservation goals through careful, evidence-based management of rotational grazing by cattle (Krausman et al. 2009). With good rotational management, one can likely mimic the natural conditions under which bison and other species and ecological processes created a shifting mosaic of habitat heterogeneity at larger landscape scales in the plains of eastern Montana. As Budd and Thorpe (2009, p. 13) observed, “Much of the attraction to rotational grazing systems comes from historic observations and perceptions of herbivore behavior in extensive unfragmented landscapes, where constant motion and different utilization patterns created and maintained highly variable, biologically rich ecosystems.”

This observation suggests that the conversion from cattle grazing to bison grazing, if done on sufficiently large landscapes, removes the need for rotational grazing to mimic the natural grazing conditions that existed in the plains of eastern Montana before EuroAmerican colonization. APR’s goal is to return to these natural conditions by enabling bison to graze across large landscapes. Compared to cattle, bison are particularly well adapted to such conditions. As noted above, individual bison herds cover much more ground and have much larger grazing patches than cattle (Plumb and Dodd 1993, Kohl et al. 2013).

The above observations argue for not managing bison like cattle and even less so for managing bison with cross-fencing and rotational management units. Researchers and managers alike have reached this conclusion. Kohl et al. (2013) conclude that although they did not quantify the rangeland unit size that would permit approximations of historical use, their results indicate that allowing bison to graze across
large landscapes contributes to vegetation heterogeneity. Steuter and Hidinger (1999) comment that based on evolutionary history and domestication traits, cattle may be more appropriate in intensely managed agricultural systems, but “bison may be more appropriate in extensively managed, larger grasslands.” Fuhlendorf and Engle (2001) suggest that if bison is the primary grazer and increased biological diversity facilitated by vegetation heterogeneity at the landscape scale is an objective, compared to cattle, much larger pasture units may be required to facilitate bison movement, behavior, and resource use that more closely approximates historical bison populations.

**Need for contingency plans**
Although APR strives to enable bison to exhibit their natural behavior as wildlife, bison cannot move as they once did--over tens or hundreds of miles--in search of water and forage. Thus, for example, in a case where an extensive fire or severe drought eliminates forage or water on a management unit, APR may have to provide supplemental feed or water and (or) reduce the herd size to sustainable levels. Also, if a fire destroys long sections of perimeter fence APR must be able to respond quickly to round up and contain the herd. APR’s contingency plans for situations such as a large fire, extended drought, flood, and deep snow are in Appendix 2.

**C. Progress to date**
In 2005, APR reintroduced 16 animals from Wind Cave National Park, South Dakota, onto APR’s deeded lands on the Sun Prairie Unit (Figure 6). Subsequent translocations from Wind Cave and other source herds are shown in Table 1. All reintroductions are conducted through soft release--the bison are corralled for one month before being released onto the land. The importance of these source populations for bison genetics on APR is reviewed under Goal 9. Natural recruitment in the population has been good, with a cow fertility rate of 80-90% and roughly a 20% annual growth of the population, similar to that found during the early years of bison restoration on the National Bison Range and in Yellowstone National Park (Gogan et al. 2010).

After BLM approved a change of use from cattle to bison on the Telegraph Creek allotment in 2005 and for the Box Elder allotment in 2008, the herd occupied the entire Sun Prairie unit. The switch from rotational to year-round continuous grazing occurred in 2008 for portions of the Box Elder and Telegraph Creek allotments and in 2014 for all of both allotments after BLM approved that change.
Table 1. Year, number and source of bison reintroduced to APR.

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</tbody>
</table>

In the fall of 2016 APR decided, with concurrence from BLM, to submit a request for change of use from cattle to bison and from rotational to year-round continuous grazing on most remaining BLM allotments leased by APR. BLM determined that an Environmental Assessment under NEPA was required. APR contracted with Environmental Management and Planning Solutions, Inc. (EMPSi) to assist BLM in conducting the EA. In November 2016 a project management plan was completed to establish responsibilities, schedules, and procedures for the project team conducting the EA. Completion of the EA and a final decision by BLM are expected in 2019. APR submitted a similar request to DNRC for change of use on state lands it leases.

For these requests APR compiled information on the bison carrying capacity of each APR management unit and prepared a tentative bison reintroduction schedule (Tables 2 and 3). Carrying capacities for BLM and state land are based on their calculations and resulting permits/leases. AUMs for deeded acres are calculated according to NRCS guidelines for “below normal precipitation.”

Additionally, carrying capacities for deeded acres are calculated as if they are all native prairie and therefore do not account for higher forage production that is likely found on previous pastures planted with tame forage species or irrigated through various dike systems. This conservative approach to calculating AUMs ensures that bison on APR deeded acres will be maintained at “low” to “moderate” stocking rates, similar to those on leased BLM and State acres. It also averts the need to recalculate carrying capacities as pastures are planted back to native species and dike irrigation systems are removed. For reference, appendix 3 shows NRCS-based below-,
normal- and above-normal-precipitation stocking rates for each management unit.

Table 2. APR management units with breakdown of deeded and leased BLM and state acres, carrying capacity (in BLM animal units, thus excluding calves <6 months old), and years/projected years of first bison reintroductions, based on assumption that BLM and DNRC will approve APR’s requested change of use. All APR deeded/leased lands are not slated for bison reintroduction and thus totals given here are less than total APR acres. However, plans may be subject to change with the acquisition of new properties or other unforeseen circumstances. *The animal units were derived by using the NRCS method for calculating carrying capacity at “below normal” precipitation for APR deeded land and then adding the permitted and leased AUMs for BLM and State lands. Bison introduction dates may change if approved by BLM and State or as changes in APR land ownership dictate.

<table>
<thead>
<tr>
<th>APR Unit</th>
<th>BLM acres</th>
<th>State acres</th>
<th>Deeded acres</th>
<th>Total acres</th>
<th>Carrying Capacity (Animal Units for 12 Months)*</th>
<th>1st bison reintroduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun Prairie</td>
<td>18,034</td>
<td>640</td>
<td>8,911</td>
<td>27,585</td>
<td>356</td>
<td>2005</td>
</tr>
<tr>
<td>Sun Prairie North</td>
<td>13,075</td>
<td>640</td>
<td>7,075</td>
<td>20,772</td>
<td>212</td>
<td>2016 on 3,900 acres of APR deeded</td>
</tr>
<tr>
<td>Dry Fork</td>
<td>15,445</td>
<td>680</td>
<td>8,013</td>
<td>24,138</td>
<td>327</td>
<td>2017 on 5,900 acres of APR deeded</td>
</tr>
<tr>
<td>White Rock</td>
<td>21,121</td>
<td>3,492</td>
<td>12,432</td>
<td>37,045</td>
<td>557</td>
<td>2018 on 7,350 acres of APR deeded</td>
</tr>
<tr>
<td>Two Crow</td>
<td>38,073</td>
<td>3,200</td>
<td>5,002</td>
<td>46,275</td>
<td>598</td>
<td>2023</td>
</tr>
<tr>
<td>PN</td>
<td>16,562</td>
<td>10,034</td>
<td>20,764</td>
<td>47,360</td>
<td>733</td>
<td>2025</td>
</tr>
<tr>
<td>Timber Creek</td>
<td>130,399</td>
<td>9,343</td>
<td>18,178</td>
<td>157,920</td>
<td>1,627</td>
<td>2027</td>
</tr>
<tr>
<td>Beauchamp</td>
<td>2,375</td>
<td>640</td>
<td>961</td>
<td>4,336</td>
<td>47</td>
<td>2030</td>
</tr>
<tr>
<td>Burnt Lodge</td>
<td>5,245</td>
<td>640</td>
<td>4,495</td>
<td>10,380</td>
<td>161</td>
<td>2030</td>
</tr>
<tr>
<td>C.K. Creek</td>
<td>204</td>
<td>0</td>
<td>613</td>
<td>817</td>
<td>13</td>
<td>2030</td>
</tr>
<tr>
<td>Total</td>
<td>260,893</td>
<td>29,309</td>
<td>86,426</td>
<td>376,628</td>
<td>4,631</td>
<td></td>
</tr>
</tbody>
</table>

APR has maintained bison numbers well within carrying capacity of the rangeland and at levels that result in a moderate level of grazing intensity or has provided supplemental feed if the stocking level temporarily exceeded forage capacity. When the population on Sun Prairie reached the carrying capacity of around 620 animals equalling approximately 420 animal units in 2016, 210 bison equalling 158 animal units were moved to deeded land on Sun Prairie North. (An animal unit, according to BLM’s definition, is a 1,000-lb cow with a calf less than one-half year old.) The combined carrying capacity of Sun Prairie (deeded and leased) and Sun Prairie North (deeded and
leased) is 568 animals units. The total population on these two units at the end of 2016 was approximately 725 animals equalling 540 animal units. To keep bison numbers within carrying capacity of each unit, in 2017 APR moved 144 bison from Sun Prairie North to Dry Fork deeded land and 85 from Sun Prairie North to White Rock deeded and, in January 2018, 74 bison were moved from Sun Prairie to White Rock deeded land. Numbers were further controlled during 2017 and early 2018 by donating 130 bison to tribal and public herds (details provided under Goal 7) and by contracepting all cows in the Dry Fork herd, 90% of cows in White Rock herd, and several cows in the Sun Prairie and Sun Prairie North herds.

Depending on the circumstances, APR has used both rotational grazing and year-round continuous grazing by bison to create spatially heterogeneous grazing pressure and thereby generate habitat heterogeneity. APR has cooperated closely with BLM to meet BLM-approved stocking rates and grazing management to maintain wildlife habitats. APR has also worked with BLM to alter or remove fences that facilitate wildlife movements and to reduce fence-caused wildlife mortality, among other means to help BLM meet its biodiversity conservation objectives as set forth in the HiLine and Lewistown Resource Management Plans.

BLM assessments of how well allotments are meeting BLM land health standards provide a general baseline for monitoring allotments, although greater detail is needed in most cases to fully understand long-term trends and specific management needs (Veblen et al. 2014).

APR has worked with BLM to ensure that bison stocking levels are compatible with BLM’s “Desired Conditions” for Greater Sage-Grouse habitat and, as stated in the HiLine Resource Management Plan, to “ensure that proposed land uses initiated or authorized by the BLM minimize damage to wildlife habitat and populations of special status species.”

Other progress includes APR’s support of research by Michel Kohl, University of Montana, and by Nicholas McMillan, Clemson University, that assessed grazing behavior by cattle and bison and effects on vegetation on APR lands and similar habitats in the region (Kohl et al. 2013, McMillan et al. 2017). See the discussion under “Rationale” for a review of this and other relevant research.
APR, with support from Landmark volunteers and others, has closely monitored the bison population by radio collaring bison to track movements and habitat use and by periodically taking blood samples for disease and genetic testing. All animals that are sampled receive a dangle tag, PIT tag and (or) RFID tag.

D. Strategy and actions

APR will continue to work closely with BLM to help meet or exceed all BLM Rangeland Health Standards, with particular focus on #1--Uplands are in proper functioning condition, #2--Riparian and wetland areas are in proper functioning condition, and #5--Habitats are provided to maintain healthy, productive and diverse populations of native plant and animal species, including special status species.

A first priority is to secure approval by BLM and DNRC in 2019 for the change of use from cattle to bison and from rotational to year-round continuous grazing on the nine management units cited in objective ii. Included in this request by APR is approval by BLM to remove interior fences on the Telegraph Creek allotment. APR will submit comments
with information pertinent to its request for a change of use during the public review and comment period after the EA report is released.

Until such approval is secured, APR will continue to maintain bison numbers within the carrying capacity through various methods. The primary method during 2018 and 2019 will be contraception of cows through the use of porcine zona pellucida (PZP), an immunocontraceptive widely and effectively used on many wildlife species, including bison (Kirkpatrick et al. 2011, Duncan et al. 2013). APR may also continue to translocate bison to other APR deeded lands, to donate bison to important public and tribal herds, and to issue permits for bison harvest. Supplemental feeding may occasionally be required as a bridge until BLM and DNRC approvals are obtained.

Pending BLM and DNRC approvals, APR will begin to replace domestic livestock with bison and transition from rotational to year-round continuous grazing on combined deeded/public leased lands of APR management units (Table 3). The transition should increase total carrying capacity available for bison on the APR management units listed in Table 3 at a rate that accommodates the projected natural increase of the bison population through 2028. Because of the young age-class structure of the herd, animal unit estimates in column 2 of Table 3 are based on a low--4%--annual attrition rate of the herd. We expect most or all of this attrition to be due to natural causes; however, if necessary, culling will be used to keep numbers within carrying capacity. Additional future property acquisitions are projected to enable APR to readily keep carrying capacity ahead of bison population growth.
Table 3. Projected mid-year total bison population, animal units and associated carrying capacity of current APR management units, 2016 - 2030. Acquisition of additional properties will greatly increase future cumulative carrying capacity beyond what is shown here. Population projections are based on planned herd size controls during 2018 and 2019 and, for 2020 and beyond, on a 20% annual rate of population growth. Per BLM regulations, calves of the year (calves <6 months) are excluded from estimated animal units. Carrying capacity for all years on BLM and State lands is based on their current permitted and leased AUMs; deeded land carrying capacity is based on NRCS guidelines for “normal” precipitation for 2016-2018 and for “below normal” precipitation for 2019 and beyond. Abbreviations: SP = Sun Prairie, SPN (Sun Prairie North), DF (Dry Fork), WR (White Rock), TWO (Two Crow), B (Beauchamp), BL (Burnt Lodge), CK (C.K. Creek), PN (PN), TC (Timber Creek). *Supplemental feeding provided because animals temporarily exceeded carrying capacity. **Upon 2019 approval by BLM and DNRC of APR’s Proposed Action.

<table>
<thead>
<tr>
<th>Year</th>
<th>Estimated mid-year total population</th>
<th>Estimated animal units</th>
<th>Year’s end projected management units with bison (deeded + leased unless indicated otherwise)</th>
<th>Cumulative carrying capacity (animal units for 12 months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>728</td>
<td>540</td>
<td>SP, 3,900 deeded acres SPN</td>
<td>502*</td>
</tr>
<tr>
<td>2017</td>
<td>864</td>
<td>699</td>
<td>SP, 3,900 deeded acres SPN, and 5,900 deeded acres DF</td>
<td>649*</td>
</tr>
<tr>
<td>2018</td>
<td>850</td>
<td>829</td>
<td>SP, 3,900 deeded acres SPN, 5,900 deeded acres DF, and 7,350 deeded acres WR</td>
<td>894</td>
</tr>
<tr>
<td>2019</td>
<td>955</td>
<td>816</td>
<td>SP, SPN, DF, WR</td>
<td>1,452**</td>
</tr>
<tr>
<td>2020</td>
<td>1,150</td>
<td>917</td>
<td>SP, SPN, DF, WR</td>
<td>1,452**</td>
</tr>
<tr>
<td>2021</td>
<td>1,363</td>
<td>1,104</td>
<td>SP, SPN, DF, WR</td>
<td>1,452**</td>
</tr>
<tr>
<td>2022</td>
<td>1,636</td>
<td>1,308</td>
<td>SP, SPN, DF, WR</td>
<td>1,452**</td>
</tr>
<tr>
<td>2023</td>
<td>1,963</td>
<td>1,571</td>
<td>SP, SPN, DF, WR, TWO</td>
<td>2,050**</td>
</tr>
<tr>
<td>2024</td>
<td>2,356</td>
<td>1,884</td>
<td>SP, SPN, DF, WR, TWO</td>
<td>2,050**</td>
</tr>
<tr>
<td>2025</td>
<td>2,827</td>
<td>2,262</td>
<td>SP, SPN, DF, WR, TWO, PN</td>
<td>2,783**</td>
</tr>
<tr>
<td>2026</td>
<td>3,391</td>
<td>2,714</td>
<td>SP, SPN, DF, WR, TWO, PN</td>
<td>2,783**</td>
</tr>
<tr>
<td>2027</td>
<td>4,069</td>
<td>3,255</td>
<td>SP, SPN, DF, WR, TWO, PN, TC</td>
<td>4,410**</td>
</tr>
<tr>
<td>2028</td>
<td>4,883</td>
<td>3,906</td>
<td>SP, SPN, DF, WR, TWO, PN, TC</td>
<td>4,410**</td>
</tr>
<tr>
<td>2029</td>
<td>5,860</td>
<td>4,688</td>
<td>SP, SPN, DF, WR, TWO, PN, TC</td>
<td>4,410**</td>
</tr>
<tr>
<td>2030</td>
<td>7,032</td>
<td>5,626</td>
<td>SP, SPN, DF, WR, TWO, PN, TC, BL, B, CK</td>
<td>4,631**</td>
</tr>
</tbody>
</table>
To implement this change of use on each management unit, APR will remove interior fences and convert existing perimeter fences to wildlife-friendly fences according to MFWP specifications (Paige 2012). APR will continue to radio-collar animals to monitor movements and habitat use of each bison herd translocated to a new management unit. At the beginning of 2018, seven bison were being monitored with GPS collars—four on Sun Prairie, two on Sun Prairie North and two on Dry Fork. APR will prepare baseline assessments of major or key habitats on each unit, including areas that may be of particular importance to species of concern, and design and implement long-term monitoring of these habitats. Research by Nicholas McMillan, Clemson University, that assessed the effects of bison grazing on plant community structure and composition, has provided the baseline and template for ongoing, long-term monitoring by APR. BLM conducts its own assessment of rangeland health on BLM allotments.

Contingency plan if change of use is not approved in 2019: If the change of use is not approved in 2019, APR will undertake various measures to maintain the bison population within the carrying capacity of the available units. One of the first measures may be to translocate animals to deeded lands on Two Crow and the PN. The combined carrying capacity of the deeded acres in these two areas is approximately 500 animal units, which would readily support projected population growth through the year 2020. As noted earlier, APR may also control herd numbers by donating animals to other herds, by using contraceptives to reduce birth rates, and by harvesting.

Goal 3: Restore the ecological role of grassland fires.

APR’s goal is to restore the ecological role of grassland fires, including their interaction with grazing by bison and other herbivores.

A. Objectives

i. Work with USFWS to create and implement Fire Management Plans for APR deeded land and possibly with USFWS, BLM, and State for integrated Fire Management Plans for entire parcels, including public lands. These plans should cover both prescribed fires and fires due to natural causes, and should be informed by guidelines for meeting or exceeding BLM
Rangeland Health Standards, with a focus on # 1--Uplands are in proper functioning condition, and #5--Habitats are provided to maintain healthy, productive and diverse populations of native plant and animal species, including special status species.

ii. Design and implement research and monitoring to evaluate the interaction of fire and grazing by bison and other herbivores and its effects on plant communities, habitat heterogeneity, grassland birds, and other biodiversity attributes.

B. Rationale

Before EuroAmerican settlement, the interplay of grazing and periodic fires ignited by both lightning and indigenous peoples was a major ecological driver shaping grassland biodiversity in the APR region and elsewhere in the Great Plains (Knopf and Samson 1997, Fuhlendorf et al. 2009). Pre-settlement frequency of grassland fires in the Northern Great Plains appears to have been greatest during moist periods due to increased plant growth and thus fuel loads (Umbanhowar 1996). Plant production after grassland fires is higher in nutrient value than unburned sites. Pyric herbivory, whereby grazers preferentially graze recently burned sites and tend to avoid tall, rank and increasingly fire-prone vegetation, created a shifting mosaic of grassland habitats and influenced ecosystem structure and functioning, including nutrient cycling and control of invasives. The interplay between these two distinct disturbance regimes--high-disturbance (fire and intensive grazing) and low-disturbance (no fire and no grazing)--results in a habitat structure that is distinct from “take half leave half” uniform grazing (Figure 3). In the former case, bare ground/short vegetation and tall vegetation are common and mid-height vegetation is rare; under uniform grazing, mid-height vegetation is common and the two extremes are rare. Grassland bird diversity in the region is adapted to the former (Knopf 1997, Fuhlendorf and Engle 2004, Fuhlendorf et al. 2006, Coppedge et al. 2008, Augustine and Derner 2012). However, because sagebrush steppe habitat in the region is slow to recover after fire, with negative consequences for greater sage-grouse (Cooper et al. 2011), special precautions are required in considering the role of fire in this habitat.
Other species populations that may benefit from grassland fires include black-tailed prairie dogs (Augustine et al. 2007), pronghorn (Augustine and Derner 2015) and swift fox (Thompson et al. 2008).

Livestock ranching in the APR region led to widespread suppression of grassland fires and thus the end of pyric herbivory as an ecological process. Restoring fire to the prairie and the interaction of grazing by bison and other herbivores with this disturbance is expected to enhance structural diversity of grassland habitats of importance to many grassland species (Anderson 2006, Fuhlendorf et al. 2008, 2012).

C. Progress to date

APR may use prescribed burning as a potential management tool to improve rangeland health for bison and other wildlife. APR has thus far conducted one prescribed burn of nearly 900 acres on Sun Prairie in 2012 in an effort to expand prairie dog habitat and restore an important ecological process to the landscape. The fire was a result of collaboration between APR, USFWS, which provided expertise, personnel and equipment to conduct the burn, and World Wildlife Fund, which was instrumental in project design and funding. BLM personnel assisted during the operation.

D. Strategy and actions

APR is exploring the development of an MOU with USFWS to continue experimental prescribed burns on APR and adjacent CMR Refuge lands.

Once protocols and best practices for prescribed burns are determined, APR and the USFWS will implement prescribed burns.

APR will explore with BLM the potential for using prescribed burns to help meet Rangeland Health Standards, particularly Standards #1 and #5.

APR will conduct research and monitoring of bison response to prescribed burns.
Goal 4: Restore habitat contiguity.

To enable unimpeded movements of bison and other species and reduce other deleterious ecological effects of habitat fragmentation, APR’s goal is to remove interior fences and other artificial structures or, if removal is not possible, to alter their design to minimize ecological impacts, and to restore native plant communities on cultivated and other highly altered lands. This goal applies to both lands within APR and to non-APR lands that are important as buffer zones around the reserve and as ecological corridors for wildlife movement between APR and other areas important for wildlife.

A. Objectives

i. Remove all interior fences on management units once changes in use from cattle to bison and from rotational to year-round continuous grazing are approved and implemented.

ii. Before stocking a property with bison convert all perimeter fences to wildlife-friendly fences to meet MFWP standards for wildlife-friendly fencing (Paige 2012) and the State of Montana’s definition of a “legal fence” (81-4-101 MCA).

iii. Remove all abandoned buildings and other structures, except those of historical significance or utility for APR operations, on abandoned homesteads within 10 years after property is acquired as funding and workloads allow.

iv. Remove or bury all utility poles/lines to extent possible.

v. Per goal 1, reduce habitat fragmentation by restoring native plant communities on cultivated and other converted lands.

B. Rationale

Many grassland species require a two-dimensional landscape. Novel vertical structures--fences, trees, buildings, utility lines--that are higher than native prairie vegetation fragment the landscape with diverse negative effects on wildlife. Fences alter natural foraging patterns, movements and migration of ungulates which may reduce reproduction and survival (Harris et al. 2009, Whyte et al. 1988, Gates et al. 2012). The wide-ranging foraging behavior of bison are highly constrained by cross-fencing that creates small grazing units.
(Kohl et al. 2013). Entanglement in fences is a common cause of mortality in pronghorn, bighorn sheep, mule deer and elk (Harrington and Conover 2006). Movements and habitat use by pronghorn are strongly influenced by fence location and density, and long-range migration routes, such as those undertaken by pronghorn in the HiLine region of Montana (Poor et al. 2014), are disrupted by fencing. Fencing may prevent migrating pronghorn from reaching higher quality habitat, causing them to expend energy walking fencelines without finding better conditions (Oakley and Riddle 1974, Ockenfels et al. 1994, Berger 2004, Sheldon 2005, Collins 2016).

Fence collisions kill a diversity of avian species (Allen 1990, Paige 2012) and are a potentially important source of mortality in greater sage-grouse populations (Call and Maser 1985, Allen 1990, Connelly et al. 2000, NRCS 2012, Stevens et al. 2012, 2013). This is of particular concern in the Hi-Line/APR region of Montana, a nationally important area for sage-grouse populations (Doherty et al. 2010) and where sage-grouse have been shown to undertake annual migrations of 50-100 km (31-62 miles) between lek areas and winter habitat (Tack et al. 2011). Old buildings on abandoned homesteads may harbor raccoons that prey on grassland birds. For many grassland birds, fences and other novel vertical structures, which may serve as perches for raptors or for nest parasites such as cowbirds, reduce nesting and brood rearing success (Freilich et al. 2003, Shaffer et al. 2003, Coppedge et al. 2008).

Figure 7. Fence removal (70 miles to date), often by APR volunteers, is important for creating habitat contiguity on the prairie. If removal is not possible, APR replaces or alters fences to meet wildlife-friendly specifications. Photo: Lars Anderson
Three- and four-stranded barb-wire fences and mesh woven fences are common in Montana’s Hi-Line region, with an estimated average fence density 3.8 miles/sq mile in 2009 (Poor et al. 2014). To restore habitat contiguity, APR’s goal is to remove all interior fencing, to install wildlife-friendly fencing on all perimeter fencing, and to remove all abandoned homestead buildings, power poles and other artificial structures. This goal is linked to the goal of restoring natural herbivory patterns by bison.

The other major cause of habitat fragmentation is cropland. An estimated 90% of the APR region is still in native or semi-native vegetation but, as noted under Goal 1, plowing of native prairie continues at a rapid pace. Cultivated lands are unsuitable habitat for bison and a vast majority of other native species and negatively influence the value of nearby grassland habitat for some species. In southern Alberta, four species, chestnut-collared longspur, horned lark, savannah sparrow, and Sprague’s pipit, increased in abundance as distance to crop edge increased, and two species, clay-colored sparrow and western meadowlark, decreased in abundance. The negative effect on chestnut-collared longspurs was observed up to 1 mile or more from cropland and on Sprague’s pipit at more than 0.5 mile (Sliwinski and Kiper 2012). In the APR region, a 640-acre grassland patch was three times more likely to be occupied by Sprague’s pipit in landscapes with a high proportion compared to a low proportion of grassland cover (Lipsey 2015).

Cropland is also a major cause of soil erosion and aquatic degradation and may serve as reservoirs for non-native plant colonization.

Removal of fences, power lines, abandoned buildings and other artificial structures also helps fulfill goal 11 by creating a natural landscape to enhance visitor experiences.

C. Progress to date

Based on design recommendations from NRCS and MFWP (Paige 2012, NRCS 2013), APR has replaced or altered existing fences to make them more wildlife friendly, totalling nearly 125 miles, and has removed almost 70 miles of interior fence (Figure 7). APR has implemented monitoring of the efficacy of wildlife-friendly fencing by installing camera traps and using visual inspection to evaluate fence
crossing by wildlife along important wildlife movement corridors, especially for deer, elk and pronghorn. Despite concerns by some about APR’s bison fence, there is no significant difference in wildlife crossing rates compared to standard cattle fencing and the fence has equaled or exceeded the efficacy of any bison fence tested to date. APR has cooperated closely with the CMR Refuge wherever bison graze adjacent to refuge lands to create wildlife-friendly fences between the Refuge and APR lands and in monitoring rangeland health and wildlife populations.

APR fence specifications are as follows: a four-wire fence with two barbed wires, one high tensile electric wire, and one barbless wire. The top barbed wire is 42” above ground, the high tensile electric wire is 30” above ground, the middle barbed wire is 24” above ground and the barbless wire is at least 18” above ground. T-posts are spaced 16.5 feet apart and H-braces are installed approximately every ¼ mile. The 42” top wire height facilitates wildlife movement over the fence, the 12” between the top and second wire reduces the potential for entanglement of animals jumping over the fence, and the bottom wire being at least 18” above ground and smooth facilitates wildlife movement under the fence. APR converts all exterior fences to these specifications.

The high tensile electric wire is powered by solar panels. Each solar panel operates up to 10 miles of fence at 6kV to 9kV depending on lighting and weather conditions. APR has fence indicators near commonly traveled roads: if a fence has lost power the fence indicator activates a small blinking red light notifying passing employees that it has lost power. Gates are also electrified and have an underground wire installed to allow electricity to pass through even if the gate is opened. The gate has a separate insulated handle for the electric wire. Once that handle is disengaged the gate is disconnected and ready to open with no chance of electric shock.

Auto gates are constructed to meet county requirements. They are generally at least double the length of a standard auto gate. The length is the distance of the auto gate perpendicular to the road width. This length of auto gate has been shown to be effective for bison containment. Auto gates are routinely checked and maintained by APR employees.
APR has committed to perform 100% of the maintenance of all perimeter fences of areas stocked with bison, thereby relieving adjacent landowners of any fence maintenance responsibilities they would otherwise have under Montana State Statute. APR has a team of full-time and seasonal employees to oversee and maintain fences. Once bison have been stocked, APR employees routinely check fences. While checking fence, employees look for any problems that may render the fence ineffective, and take voltage readings with a fault-finder to ensure the electric wire is working effectively. A fence maintenance logging system has recently been instituted to record each time an employee checks the fence—noting which fence was checked, voltage readings, repairs, weather, and anything else that is noteworthy.

APR employs a highly organized and efficient protocol for dealing with the rare occasion when bison escape from APR lands (see appendix 4 for escape management protocol). The Reserve team is notified immediately and, within 24 hours, action must be taken to notify any affected landowners/agencies and to contain the bison. Staff are well trained in the most effective methods for moving bison. If more than a few bison have escaped, a helicopter may be used to round them up. Lethal force is used if necessary, particularly when the animal is out for more than 48 hours, there is considerable landowner concern, the bison is aggressive, and (or) there is no reasonable way to get the bison back in a timely manner.

APR monitors its wildlife-friendly fences for efficacy in containing bison. Since the reintroduction of bison onto Sun Prairie through 2017, only twice has a portion of the cow herd escaped—once in 2011 when record snowfall followed by chinook winds allowed the entire herd to walk up a crusted snow bank over the perimeter fence, and in January of 2015 when someone chained a perimeter gate open leading into the CMR Refuge. Other instances of bison outside the perimeter are bull bison and typically involve one to two animals. The number of beef bull trespasses onto APR property and the number of bison bull trespasses onto property of APR neighbors are roughly equal.

To increase fence visibility and thus decrease collisions by wildlife, particularly near greater sage-grouse leks and movement areas, APR has flagged 10.5 miles of fence on deeded land and BLM allotments according to NRCS guidelines for sage-grouse (NRCS 2012, 2013).
APR has recycled more than 50 tons of scrap metal, hauled dozens of yards of trash for proper disposal in a landfill, collected more than 300 old tires for recycling, and burned dozens of yards of woody debris, all associated with former homestead and building sites.

APR has also removed about 4.8 miles of power lines.

Through the above work, APR has strongly supported the BLM indicator for Standard #5 that “connectivity of habitat or presence of corridors prevents habitat fragmentation.”

D. Strategy and actions

APR will continue to remove interior fences on deeded lands it acquires and on BLM and State allotments where BLM and DNRC approval of year-round continuous grazing is approved.

APR will continue to convert all remaining fences to wildlife-friendly fence design and, where sage grouse concerns exists, to flag fences.

Removal of above-ground utility lines and of structures and debris from abandoned homesteads will continue as resources permit.

Goal 5: Restore natural stream hydrology and riparian areas.

*APR aims to restore natural stream hydrology and riparian areas by improved management of ungulate grazing, including the change from cattle to bison, by maintaining and restoring native plant communities in both upland and riparian areas, and, where ecologically sound within the broader landscape, by judiciously altering and removing, where possible, dams, spreader dikes and other artificial features that have degraded natural hydrological and associated ecological conditions.*

A. Objectives

i. Evaluate and develop priorities for stream and riparian restoration within 5 years of acquiring new properties, and implement restoration actions as resources permit.

ii. Assess effects of impoundments on bison grazing patterns and recommendations for removal to better approximate natural conditions.
iii. On deeded land conduct an assessment of ecological impacts of removal of check dams, alteration of spreader dikes, and breaching of impoundment dams as determined under objective 1. As needed convert irrigation water rights to instream water rights.

iv. Work with BLM and DNRC to determine where similar work is appropriate on their properties.

v. Meet or exceed Rangeland Health Standards #2, Riparian and wetland areas are in proper functioning condition, #3, Water quality meets Montana state standards, and #5, Habitats are provided to maintain healthy, productive and diverse populations of native plant and animals species.”

vi. Design during 2018 a protocol for monitoring riparian and stream conditions and the effects of the change from cattle to bison and from rotational to year-round continuous grazing on these conditions. Establish photo points on both APR private land and on BLM allotments (installed by BLM) on streams and reservoirs to enable long-term monitoring of stream and reservoir conditions, which will be used to evaluate and adjust management activities and results.

vii. Design and implement a protocol to monitor water sources (reservoirs, pits, pipelines, etc.) on BLM and DNRC lands for which APR has maintenance responsibility.

viii. As a contingency for periods of drought, evaluate where emergency water sources for bison may be required and install as necessary.

ix. Replace cattle with bison on management units to facilitate stream and riparian restoration by taking advantage of less frequent use of these habitats by bison.

x. Stop conversion of grassland habitat to cropland and restore native vegetation on previous cropland and in degraded riparian areas, thereby greatly reducing erosion of soil into streams and reservoirs.

B. Rationale

Large variations in flow of intermittent and perennial streams are vital to biogeochemical and ecological processes that create diverse habitats and support unique assemblages of prairie fish and other
organisms (Smith et al. 2002, Dodds et al. 2004). Fluctuation in stream flows and availability of water also influence grazing patterns; scarce water sources can be expected to create variable grazing conditions across the landscape as animals must travel further between water and grazing sites (Allred et al. 2011). This factor is important in the transition from grazing by cattle, which preferentially graze close to water sources, to grazing by bison, which readily graze at much greater distances from water (Kohl et al. 2013).

The intensive use of riparian areas and streams by cattle has been extensively reviewed in the literature. An NRCS-sponsored comprehensive review—the Conservation Effects Assessment Project—demonstrated the high level of cattle use of streams and riparian areas and the resulting ecological degradation of these habitats under most commonly used grazing regimes in the West. Degradation or loss of hydrologic function, water quality, riparian and stream habitat, and biodiversity are common (Briske et al. 2011, George et al. 2011), similar to the findings of earlier reviews (Kauffman and Krueger 1984, Belsky et al. 1999).

The negative impacts on streams and aquatic life caused by cultivated land also require remediation and highlight the importance of maintaining and restoring native plant communities (see Goal 1). Run-off from croplands results in greater water turbidity, unhealthy high nutrient levels in streams, and high rates of sedimentation (USDA 2013). Stream surveys in 2008 and 2009 that included sites in the APR region found 77% of warm-water streams and rivers in the Montana plains had “high levels of riparian disturbance,” greatly exceeding natural rates of disturbance. Only 6% had low levels of disturbance. Similarly, 77% of riparian vegetation cover was classified as “poor,” while 47% of in-stream fish habitat was rated as “poor” and 35% as “good.” Measures of streambed sediment found 50% “good,” 22% “fair” and 24% “poor” (Teply 2013). As another biological indicator of these poor stream and wetland conditions, ten species of fish and two species of amphibians found in the region are Montana Species of Concern (Montana Natural Heritage 2016). In addition, three species of amphibians and five species of fish are BLM Sensitive Species, and one bird that depends on proper wetland conditions (piping plover) and one fish species (pallid sturgeon) are a BLM Special Status Species.
APR’s conversion from cattle to bison will help address concerns about the effect that the change from rotational to year-round continuous grazing may have on streams and riparian areas. These concerns emerge from the well-known preference of cattle to use riparian areas and for grazing close to water sources. Regarding riparian areas, George et al. (2011, p. 216) concluded from their NRCS review that “continuous grazing often results in heavy grazing use of the riparian area because livestock are attracted to riparian areas from adjacent uplands.” For this reason, they reported that the case histories they reviewed suggest that continuous grazing is not compatible with riparian areas. While they note that rest rotation or deferment grazing tends to improve riparian habitats, they also caution (p. 216) that “Improperly applied rotational grazing systems can also result in heavy grazing and damage to riparian areas.” In contrast, bison tend to avoid wooded riparian areas, come to water less frequently than cattle, and spend much less time grazing near water sources. Thus when bison are allowed to graze at moderate stocking levels over large landscapes with a diversity of habitats, they are much less likely to cause degradation of streams and riparian habitats (Figure 8). Where restricted or total cessation of use by bison of a stream or riparian habitat is required for restoration purposes, temporary fencing and/or temporary provision of other water sources may be employed.

Figure 8. Bison generally avoid grazing or resting in riparian areas such as the one along Telegraph Creek on APR’s Sun Prairie Unit in the background of this photo. Photo: C. Freese
Because natural year-round sources of water such as streams and marshes are scarce across landscapes of the APR region, water impoundments constructed for livestock and water diversions and spreader dikes for irrigating hay meadows are ubiquitous on 1st to 4th order streams. Cattle generally will not graze more than 1 - 2 miles from water sources (Holechek et al. 2011, Lyons and Machen n.d.); the 1-mile range translates to a grazing area of about 2,000 acres around each impoundment, an area similar in size to the upper limit of forage patch size for cattle found by Kohl et al. (2013) in the project area. This roughly accords with an estimated density in the APR region of one impoundment per 247 - 2,470 acres (Renwick et al. 2005). In addition to fostering uniform grazing by livestock, stock ponds alter upland biodiversity by fragmenting prairie streams, thereby impeding movement and recolonization by aquatic organisms, modulating downstream flow resulting in reduced flooding and recharge of ephemeral pools and alteration of biogeochemical processes, and providing exotic habitats which act as stepping stones to upland areas for invasion by non-native aquatic and riparian species (Smith et al. 2002, Dodds et al. 2004, Havel et al. 2005, Renwick et al. 2005).

Removal of impoundments and diversions coupled with bison grazing behavior farther from streams are thus tightly linked to the restoration of natural hydrologic conditions. Restoration of bison habitat by restoring native plant communities on cultivated land will reduce stream sedimentation. Restoration of naturally fluctuating and often scarce distribution of water sources across the landscape combined with the change from rotational to year-round continuous grazing may create more natural bison grazing patterns of importance to habitat heterogeneity. And stream and riparian restoration may be facilitated by substantially less use of water sources and woody riparian areas as APR replaces cattle with bison.

During this early phase of bison restoration when growing the population is a priority and bison are confined to areas of tens of thousands of acres rather than hundreds of thousands or millions of acres, APR needs to carefully manage bison response to conditions such as extreme drought and large fires. Under natural conditions during droughts, for example, bison may have moved great distances to find sufficient forage and water. Nevertheless, droughts likely caused episodic reductions in bison populations. Current fenced
APR bison management units and surrounding agricultural lands preclude long-distance movements and allowing large die-offs would retard progress toward APR’s goal of 10,000 bison. Thus, APR has planned various management interventions, such as artificial water sources and supplemental feeding, that may be taken when drought, fire and other extremes conditions affect the bison population (see appendix 2). The need for such interventions should decline as APR management units and the bison population both become much larger.

C. Progress to date

Many streams and riparian areas are degraded on properties that APR has already or may acquire. Because bison are less dependent on permanent water sources and come to water sources less frequently and for shorter periods than cattle (Kohl et al. 2013), the transition to bison grazing is expected to improve water quality in streams and reservoirs and to aid in the restoration of streams and riparian areas for wildlife.

In 2007, APR worked with World Wildlife Fund, Oxbow Inc., and Hoitsma Ecological to restore a half-mile segment of Box Elder Creek that was farmed as an alfalfa field for at least 70 years. Supported by a grant from MFWP’s Future Fisheries Fund, the restoration project involved digging a new channel that reconnects Box Elder’s 27-square-mile watershed to Telegraph Creek. The Montana Conservation Corps supported the project by installing 1,500 plants along the channel. The same year, three dams were removed on Telegraph Creek to help restore natural flows and connectivity. APR has removed five dams from Beaver Creek on the White Rock unit and has converted some of the irrigation water rights to instream water rights on Beaver Creek. The removal of one dam from Telegraph Creek and one from Third Creek on the Sun Prairie unit, combined with breaching of some spreader dikes, has returned more natural flooding and desiccation cycles to the riparian habitats and floodplains of Telegraph Creek.

Restoration of native grassland species to more than 4,000 acres of previously cultivated lands is an important step toward improving stream health. As noted earlier (see Goal 1), APR estimates that restoring native plant cover to this acreage will reduce soil loss by
99% and result in a total of 19,000 – 25,000 tons of soil per year staying on the land rather than being eroded into streams and wetlands. Transport soil and chemicals to streams and wetlands has been further reduced and wildlife habitat improved by restoring woody plant cover in riparian areas and protecting streambanks. As with any stream restoration project, some have been successful and others have failed. The APR region has experienced a few hundred-year events such as the fall floods of 2014 and 2016, which have made this work more challenging.

Where BLM grazing allotments are involved, APR has complied with the HiLine Resource Management Plan’s guidance for riparian and wetland vegetation to, as stated in the plan: 1) “Develop site-specific objectives and management strategies for riparian and wetland areas during the development and implementation of proposed actions and activity plans.” 2) “Enhance or restore riparian composition and structure beyond Properly Functioning Condition in riparian areas where and when appropriate for other resource values.” 3) Maintain, restore, or improve riparian and wetland areas to achieve a healthy and productive ecological condition that provides benefits and values within site capability. 4) Grazing techniques and practices will be implemented to reduce hot season (summer) grazing on riparian and meadow complexes within Greater Sage-Grouse Priority Habitat Management Areas.”

In addition, APR will install solar watering facilities to facilitate bison management during droughts and to manage grazing intensity at existing wells if needed.

APR and BLM staff regularly inspect rangeland conditions. If accelerated erosion, sediment damage or other negative impacts on soil and water are found due to bison grazing, APR, in cooperation with BLM as necessary, is prepared to take remedial action by reducing or excluding bison from the area and/or through other means as necessary.

APR is in the process of revegetating about a mile and half of Third Creek on the Sun Prairie unit to enhance wildlife habitat, protect surface water quality, increase channel pools, improve water retention, and reduce sedimentation. APR employees and volunteers will plant over 4,000 native shrub and trees such as western
snowberry, Wood’s rose, silver buffaloberry, chokecherry, sandbar willow, and plains cottonwood sourced from Montana Conservation Seedling Nursery. Beaver dam analogs will be placed on sites in the creek channel.

D. **Strategy and actions**

APR will evaluate and develop priorities for stream and riparian restoration within 5 years of acquiring new properties.

APR will continue restoration activities that have been initiated on Third Creek.

APR will assess the effects of impoundments on bison grazing patterns and assess the feasibility and consequences of their removal on stream and riparian restoration.

APR will continue to evaluate the effects of check dams and spreader dikes on stream, riparian and floodplain restoration and, where deemed desirable, remove and breach them.

APR will implement a system for monitoring riparian and stream conditions and the effects of the change from cattle to bison and from rotational to year-round continuous grazing on these conditions.

Per Goal 1, APR will continue to restore native plant communities to cropland and degraded lands to reduce soil erosion and stream sedimentation.

APR will install two solar-powered watering sources on Sun Prairie and on Dry Fork during 2018.

As each new unit is scheduled for reintroduction of bison, APR will evaluate where emergency water sources may be required and install them as necessary.

Through the above actions and other, APR will continue to assist BLM in meeting or exceeding the goals of BLM Rangeland Health Standards #2--Riparian and wetland areas are in proper functioning condition, #3--Water quality meets Montana state standards, and #5--Habitats are provided to maintain healthy, productive and diverse populations of native plant and animals species.
Goal 6: Restore temporal ecological variability.

APR aims to restore the natural intra- and inter-annual disturbances caused by the interaction of weather extremes, fire and grazing by bison and other herbivores that have been major forces shaping ecological communities and species evolution of the APR region over thousands of years.

A. Objectives

i. Carry out objectives under goals 2 (restoration of natural grazing), 3 (restoration of patch fires) and 5 (restoration of natural hydrologic conditions) to create more natural disturbance regimes.

ii. To the extent practical, given existing artificial barriers to long-distance movement by bison to water and food sources, allow populations of bison, other wildlife and their resources—primarily water and food—to fluctuate over time in response to changes in natural biotic and abiotic factors.

B. Rationale

Bison restoration is linked to restoration of temporal ecological variability. Great Plains biodiversity was shaped by the effects of extreme intra- and interannual variation in temperature and precipitation and, as described under Goals 2 and 3, associated fire and grazing patterns (Knopf and Samson 1997, Anderson 2006, Fuhlendorf et al. 2012). Accordingly, grasslands show more interannual variability in above-ground productivity than any other biome in North America (Knapp and Smith 2001). These disturbances and other factors interact to create highly dynamic ecological conditions at the local scale and, at larger scales, a shifting mosaic of habitat diversity and ecological stability (Fuhlendorf et al. 2012, Freese et al. 2014). Such diversity and stability is important for meeting the various habitat needs of native species of plants and animals as set forth by BLM Rangeland Standard #5. BLM Standard #2 concerning the health of riparian areas recognizes the importance of such disturbances by citing periodic floodplain inundation as an indicator.
Biotic and abiotic disturbances are also major factors, through natural selection acting on genetic variation, in the evolution of bison and other species. To enable these conditions, APR avoids where practical artificial feeding and watering and eliminates artificial shelters for bison, and over the long term aims to create more natural and extreme hydrologic conditions that over evolutionary time characterized the APR region.

In contrast, traditional rangeland management practices, including on lands acquired by APR, aim for steady-state conditions by modulating the effects of these extremes in weather, fire and grazing. Modulation is sought by managing for uniform production and grazing of preferred forage species over space and time (Holechek et al. 2011). Hay fields and supplemental feeding bridge productivity gaps. Artificial water sources bridge periods of low rainfall. Traditional management practices for huntable wildlife also tend to modulate natural populations of game animals (Sutherland 2001), as indicated by populations goals established for elk and other game species in the APR region where limits on population size are also based on mitigating wildlife conflicts with agricultural interests (MFWP 2016). As reviewed earlier, bison exhibit extraordinary tolerance to temperature extremes. This trait may be particularly adaptive in the APR region where the monthly average high ranges from 28°F (-2°C) to 87°F (31°C) and the monthly average low from 4°F (-15°C) to 54°F (12°C), and where the extremes frequently range from below -20°F (-29°C) to more than 100°F (38°C). Compared to cattle, the reduced need by bison to frequent water and greater mobility in getting to scarce water resources (Peden et al. 1974, van Vuren 2001, Kohl et al. 2013) offers an adaptive edge to tolerating temperature and precipitation extremes and periods of drought. Bison may be preadapted to projected increased temperatures in the Great Plains due to climate change.

C. Progress to date

See “progress to date” under goals 2 (restoration of natural grazing), 3 (restoration of patch fires) and 5 (restoration of natural hydrologic conditions) for management actions that have created more natural disturbance regimes that characterize temporal ecological variability of the APR region.
Because, compared to cattle, bison exhibit greater tolerance to extremes of cold, are better able to forage in deep snow, and are better adapted to scarce water resources, bison should be more adaptable than cattle to increased ecological variability on the four management units where bison have been reintroduced. APR’s implementation of year-round continuous grazing by bison on Sun Prairie and on the deeded land of Sun Prairie North, Dry Fork and White Rock takes advantage of the bison’s adaptability to fluctuations in temperature, water, and forage availability.

D. **Strategy and actions**

This also means restoring, as described under Goals 2 and 3, the heterogeneous grazing patterns and their relation with prairie fires that create larger year-to-year variability in plant productivity and structural complexity across the landscape.

APR will continue to evaluate how and where the reduction or removal of artificial water sources can result in a more natural response by bison as well as other wildlife to the ebbs and flows of water resources across the landscape.

APR will maintain its policy of not providing artificial forage to bison apart from exceptional circumstances.

**Goal 7: Restore populations of native wildlife and their full ecological roles.**

*This goal focuses on restoring to ecologically significant levels populations of those species of wildlife whose populations are well below natural levels and whose restoration is likely to have major effects on native habitats and the recovery and conservation of other species. This includes: (1) restoring herbivore populations, particularly black-tailed prairie dogs, bison and other ungulates; (2) restoring the full ecological role of ungulates as food for predators and scavengers and of ungulate carcasses as highly concentrated nutrient sources for decomposers and plant growth; and (3) if large carnivores naturally recolonize the region, cooperate with relevant institutions and communities to evaluate the socioeconomic and ecological effects of such recolonization and to implement management programs.*
A. Objectives

*Herbivore restoration*

i. Achieve goal 2 of replacing cattle with bison and converting from rotational to year-round continuous grazing on APR management units. As noted under Goal 2, this requires that, first, APR secure approval by BLM and DNRC in 2019 for a change of use from cattle to bison and from rotational to year-round continuous grazing.

ii. Build bison population to more than 5,000 by 2029, halfway to APR’s long-term goal of 10,000. As noted under Goal 2, based on BLM moderate stocking rates this goal can be achieved on the current APR land base of 399,379 acres.

iii. Encourage and support a well designed initiative by MFWP to establish wild bison in Montana, including on the CMR Refuge.

iv. Allow bison to display their full range of natural behavior and ecological relationships with biotic and abiotic features of the land.

v. More specifically regarding objective iv, tightly control non-native pathogens and allow only native pathogens, in the absence of countervailing circumstances, to affect the bison population.

vi. Support restoration of wild bison elsewhere in the Great Plains by contributing APR bison to public, tribal and nonprofit bison restoration programs.

vii. Cooperate with MFWP and CMR Refuge to increase populations of other ungulates, particularly elk, bighorn sheep and pronghorn, in the APR region.

viii. Prepare and implement a plan to expand prairie dog colonies (BLM Sensitive Species), with a focus on areas suitable for black-footed ferret (BLM Special Status Species) restoration and a goal of 10-15% annual colony growth. A priority is to connect Sun Prairie and UL Bend prairie dog colonies and to expand colonies on White Rock. This objective will also facilitate restoration of other prairie dog associates such as burrowing owls, mountain plovers and ferruginous hawks (all BLM Sensitive Species).
ix. Through restoration and conservation of these herbivores, help meet BLM Rangeland Health Standard #5 aimed at improving and maintaining native species populations, including special status species.

*Restore full ecological role of ungulates*

x. Collaborate with MFWP to allow diverse causes of mortality—predation by carnivores, hunting by humans, fighting among males, and so on—to control ungulate populations and the disposition of their carcasses on APR lands.

xi. Increase collaboration with CMR Refuge in management of native ungulates.

xii. Design and implement monitoring and research to better understand the ecological effects of these changes on predators, grassland heterogeneity around carcass sites, and scavengers. Effects on coyote populations and on coyote predation on species of concern should be a priority.

xiii. Support BLM Rangeland Health Standard #5, particularly the Standard’s call for maintaining “ecological processes including...energy flow and plant succession” to support healthy biotic populations, as indicated by “species richness (including plants, animals, insects and microbes).”

*Natural recolonization of large carnivores*

xiv. Considering that cougars and black bears have already naturally recolonized the APR region and that wolves and grizzly bears have shown increasing movement from the mountains onto the prairies and may also eventually recolonize the region, APR will cooperate with MFWP, CMR Refuge, communities, and others, as it has already done with respect to cougars, to evaluate the socioeconomic and ecological effects of such recolonization and to implement management programs.

xv. Cooperate with MFWP and CMR Refuge to increase the cougar population through harvest reductions and other means to ensure long-term population viability.

xvi. Work with MFWP, public and private landowners, and others to establish ecological corridors between APR and other areas
with cougar and black bear populations to facilitate genetic exchange. These and other ecological corridors may become important if wolves or grizzly bears also naturally recolonize the APR region.

xvii. Help BLM meet the goals of Rangeland Health Standard #5 with respect to the management of indigenous plants and animals being a priority and that calls for native plant and animal communities to “be maintained or improved to ensure the proper functioning of ecological processes.”

B. Rationale

Herbivore restoration
This goal overlaps considerably with Goal 2, restoration of natural herbivory patterns. We present these as separate goals because Goal 2 addresses one of the most fundamental changes in the transition from traditional livestock management to biodiversity management on APR—the alteration of the principal grazer (from cattle to bison) and grazing regime (from rotational to year-round continuous) and their interaction with fire. Goal 7 focuses on restoring the array of other ecological roles that prairie dogs, ungulates, and other wildlife species play on the landscape.

Goal 7 recognizes the importance of BLM Standard #5 which states that “Management of indigenous vegetation and animals is a priority” and that “plant and animal communities are maintained or improved to ensure proper functioning of ecological processes and continued productivity and diversity of native plant lifeforms.” As suggested in the objectives, supporting MFWP work to establish wild bison in Montana, including on the CMR Refuge, further helps BLM meet BLM Standard #5. APR has expressed such support in writing (appendix 1).

Arguably the two ecologically most important herbivorous mammals of the APR region and Great Plains generally were the bison and black-tailed prairie dog (Truett et al. 2001, Samson et al. 2004). Both, compared to other herbivorous mammals of the APR region, have undergone severe population declines without any substantial recovery of wild populations since EuroAmerican colonization. (Within the Missouri Breaks habitat, bighorn sheep have suffered similar declines.). As noted earlier, plains bison are listed as a Species of Greatest Conservation Need by the state of Montana (MFWP 2015b).
and have a G4 global ranking and S2 state ranking by the Montana Natural Heritage (Montana Natural Heritage 2016). The International Union for Conservation of Nature (IUCN) lists the American bison as “near threatened” (Gates and Aune 2008). The Committee on the Status of Endangered Wildlife in Canada has designated the plains bison as “threatened” (COSEWIC 2013). Under coordination by the InterTribal Bison Cooperative (ITBC), bison restoration is also a priority for cultural, spiritual, ecological and economic purposes on Indian lands.

Prairie dogs, a keystone species in the prairie ecosystem and a BLM Sensitive Species/Montana Species of Concern, interact with plant and animal species and ecological conditions in multiple ways (Figure 9). They are prey for dozens of species of predators, including swift fox, ferruginous hawk, golden eagle and black-footed ferret—all Montana Species of Concern and BLM Sensitive Species, except the ferret which is a BLM Special Status Species. Prairie dogs are crucial for survival of the highly endangered ferret. APR’s Sun Prairie unit is 10 miles from a black-footed ferret recovery area on the UL Bend National Wildlife Refuge (within CMR Refuge) but recovery work has been stymied by the limited size of prairie dog colonies in the area and the negative effect of sylvatic plague on colony populations (USFWS 2017b). Thus restoration of large prairie dog colonies on Sun Prairie could benefit this ferret recovery effort and help address BLM’s responsibility for assisting in the recovery of both species.

Prairie dogs also create habitat heterogeneity and den sites for other species through burrowing and herbivory. The burrowing owl, a BLM Sensitive Species/Montana Species of Concern, nests in prairie dog burrows and mountain plovers, also a BLM Sensitive Species/Montana Species of Concern, frequently forage on prairie dog colonies. Prairie dog colonies and associated ungulate grazing create floristic communities and vegetative successional stages seldom found elsewhere in mixed-grass prairie. Changes in plant species composition and increased plant nutritional value in and around prairie dog colonies in mixed-grass prairie attract grazing by bison, elk and pronghorn. Bison grazing of grasses combined with nitrogen enrichment from bison urine leads to increased forb abundance and quality, which benefits pronghorn because of their preference for forbs. Grazing and browsing by bison and other species may reduce

Enabling natural behavior and ecological interactions of bison is inextricably linked to APR’s goal of securing a large landscape over which bison can freely roam. Minimizing manipulation of the bison population to allow the population to develop a natural sex ratio and age structure is important for enabling bison to fully express their natural behavior and ecological relationships. Social relationships, including mate selection by cows and mating competition among bulls, cow-offspring relationships, and overall herd social structure and interactions are important for allowing “bison to be bison” as well as for enabling natural selection and long-term evolutionary
change in bison. Natural herd movement in relation to forage, water, landscape features, predation risk and other factors may have significant effects on the grassland ecosystem. Restoring ecological interactions depends on restoring the ecological conditions--fire, drought, predators, other herbivores and so on--that characterized bison ecology and evolution on the Great Plains (Gates et al. 2010, Gogan et al. 2010, Gross et al. 2010).

During this early phase of bison restoration when growing the population is a priority and bison are confined by fences to areas of thousands of acres rather than hundreds of thousands or millions of acres, APR needs to carefully manage bison response to conditions such as extreme drought and large fires. Under natural conditions during droughts, for example, bison may have moved great distances to find sufficient forage and water. Nevertheless, droughts likely caused episodic reductions in bison populations. Fenced APR bison management units currently preclude long-distance movements and allowing large die-offs would retard progress toward goals for the herd’s growth. Thus, APR has designed management interventions to use when drought, fire and other extremes conditions affect the bison population (see appendix 2). The need for such interventions should decline as APR management units and the bison population both become larger.

**Restore full ecological role of ungulates**

In addition to their effects as dominant grazers, bison are the largest prey for the region’s large predators, which, historically, included humans. Bison wallowing also creates disturbed sites and ephemeral pools of standing water, which support a variety of wetland plant species, particularly forbs (Collins and Uno 1983, Polley and Wallace 1986, Knapp et al. 1999), and provide breeding habitat for the Great Plains toad (Bragg 1940), a BLM Sensitive Species/Montana Species of Concern. Bison engage in horning by rubbing an object, typically a shrub or small tree, with its head, horns, neck and shoulders (Coppedge and Shaw 1997). Horning damage to trees along grassland borders slows invasion of trees into shrub and grassland communities and may enable grassland to penetrate the forest margin (Gogan et al. 2010). Bison horning, in combination with fire, drought and other factors, may have limited the historic distribution of woody vegetation in the Great Plains (Campbell et al. 1994,
Coppedge and Shaw 1997, Edwards 1978). Bison, facilitated by their dense hair, may be important dispersers of both graminoid and forb seeds. Hair samples from 111 bison in a tallgrass prairie yielded 2,768 seeds representing at least 76 graminoid and forb species. Dung sampling yielded at least 70 species (Rosas et al. 2008).

Populations of elk and pronghorn are likely below those of pre-EuroAmerican colonization. Their restoration to larger numbers will help restore ecological interactions with bison and increase the prey base for predators. Because the diets of pronghorn (primarily forbs and browse), elk (grass, forbs and browse) and bison (primarily grass) are different, their combined effects on vegetative composition and productivity are complex. In some cases, such as under conditions of drought and low plant productivity and (or) high ungulate densities, they may compete with each other for forage. In other circumstances, foraging by one species may increase forage availability for another. For example, reduction in grass cover due to foraging by bison may reduce competition with--and thus increase productivity of--forbs for pronghorn (bison wallows also favor forb production). Similarly, reduction in shrub cover due to browsing by elk and pronghorn may result in more grass for bison (Hobbs et al. 1996, Truett et al. 2001, Weisberg et al. 2002).

Native pathogens are an integral component of ecosystems and an important factor in natural selection and evolution of wildlife (Ashley et al. 2003, Vander Wal et al. 2014). Disease management is essential to the wellbeing of APR’s bison herd and is important to neighboring livestock owners. Disease management of APR’s bison falls under the policies and regulations of the MDL and U.S. Department of Agriculture, which include requirements regarding bison imports, reportable diseases, animal disease traceability, and other measures (MDL 2016, USDA 2017). APR also follows IUCN guidelines for managing bison health (Gross et al. 2010). IUCN guidelines are particularly concerned with controlling pathogens that: (1) significantly limit bison population growth directly by reducing survival and (or) reproduction; (2) pose threats to livestock and wildlife populations because this can lead to opposition to bison recovery. These pathogens are generally exotic, having originated from domestic livestock populations, and include bovine tuberculosis, brucellosis, Mycoplasma bovis, and malignant catarrhal fever (Gross et al. 2010).
The switch to livestock production on the Great Plains, including the APR region, has severely truncated the fate of ungulate production as nearly all surplus livestock production is removed from the landscape (Freilich et al. 2003, Towne 2000). Moreover, native ungulate biomass is greatly reduced and substantial portions of it are removed from the land by hunters. All ranches acquired by APR and destined for bison restoration will have been under livestock production for decades.

Under natural conditions almost all ungulate biomass remains on the land and is involved in diverse trophic interactions. Ungulates are important prey for large predators, the ungulate carcass provides food for diverse scavengers and, by creating a combination of toxic (leachates from the carcass) and nutrient-rich hotspots, it affects soil biochemistry, microbial diversity and processes, plant diversity and productivity, and herbivory patterns. Large populations of pronghorn, bighorn sheep, deer, elk and bison under natural conditions in the APR region would constitute a major food source for predators and scavengers. A cautionary note here is that an increase in carcasses may lead to an increase in coyote numbers, with deleterious cascading effects due to coyote predation on species of concern (Ripple et al. 2013.)

Further down the food chain, a large ungulate carcass, particularly those of bison and elk, creates a major disturbance marked by a large nutrient pulse, increased soil microbial activity and nematode abundance, and a succession of new plant growth that is distinct from surrounding prairie vegetation. Plant growth in a nutrient-rich ring around the disturbance may create positive nutrient feedback by attracting grazers whose urine and dung expand the nutrient-rich patch (Towne 2000, Truett et al. 2001, Wilmers et al. 2003, Carter et al. 2007, Bump et al. 2009). Decaying ungulate carcasses may thereby contribute to habitat heterogeneity and to species richness at all taxonomic levels--from plants to insects to soil microbes. Historically, this effect may have been magnified by episodic bison die-offs that produced a slew of carcasses (Knapp et al. 1999, Freese et al. 2014).
Natural recolonization of large carnivores

Early explorers commented on the abundance of cougars, wolves and grizzly bears along the Missouri River and on the plains of Montana (Laliberte and Ripple 2003). Wolves were more widely found across upland prairies as they followed bison herds, whereas cougars and grizzly bears were more confined to riverine areas, Missouri Breaks habitats and the region’s isolated mountain ranges. Ungulates, including bison, were likely an important food source for these predators.

The cougar, wolf, grizzly bear and black bear were extirpated from Montana’s plains by the early 1900s. Only the cougar and black bear have returned to portions of their former ranges in eastern Montana. The cougar probably recolonized the APR region during the period 1960-1995 when their distribution in the state tripled (Riley and Malecki 2001). Cougar inhabit the Missouri River Breaks and Little Rockies of the APR region, although their numbers remain low in the region (Prugh et al. 2009, Kunkel et al. 2012). The PN, Antelope Creek, Burnt Lodge, Cow Island/Cow Creek and parts of Timber Creek

Figure 10. A bison carcass is a rich source of nutrients for a diversity of prairie biota--avian and mammalian scavengers, insects and microbial decomposers, and plants--which add to the species richness of the prairie landscape. Photo: C. Freese
management units provide good cougar habitat, all with mule deer and elk populations, the cougar’s principal prey. The black bear has recently recolonized the Little Rocky Mountains.

Wolves and grizzly bears have shown increasing movement from the mountains of Montana into the prairies in recent years and thus, like cougars and black bears, they may eventually naturally recolonize the APR region. If this occurs, APR must be prepared to work with natural resource management and research institutions, community groups, landowners and others to understand the ecological and socioeconomic effects of recolonization and to cooperate in management. APR has already done this for cougars by cooperating with institutions to conduct research on cougar populations and habitat use in the region and, through its Wild Sky Beef program, by working with landowners who have cougars on their properties.

APR recognizes that, while the region’s prey base may offer sufficient biological carrying capacity for small populations of large carnivores, the social carrying capacity--local human tolerance--is presently low. The Wild Sky Beef program offers a way to ameliorate landowner concerns by paying ranchers who co-exist with large carnivores. An extensive body of literature examines and proposes methods for creating such coexistence (e.g., Western et al. 1994, Dickman et al. 2011, Oriol-Cotterill et al. 2015).

Research in other western ecosystems offers insights to the potential ecological effects of recolonization by large carnivores. Large carnivore depression of ungulate populations and alteration of ungulate herbivory patterns were apparently crucial for maintaining native plant communities of deciduous trees and bushes in both upland and riparian habitats across several western U.S. ecosystems. Extirpation of large carnivores likely resulted in more intensive browsing of shrubs and trees and, eventually, loss of the associated plant communities (Ripple and Beschta 2007, Beschta and Ripple 2009). Ripple and Beschta (2007, p. 241) conclude “Results indicate that Great Plains ecosystems may have been profoundly altered by mounting levels of ungulate herbivory following the removal of large carnivores.”

Wolves commonly kill and displace coyotes. Extirpation of wolves across the western U.S. may have led to a large increase in the
number and distribution of coyotes, with cascading effects on birds, reptiles and small mammals killed by coyotes. Of importance to the APR region, coyotes can be effective predators of two endangered species, the interior population of the least tern and the black-footed ferret, and of another Montana species of concern, the swift fox, which APR wishes to re-establish on reserve lands (Ripple et al. 2013). More research is required to better understand these relationships and to guide management.

Humans have for thousands of years been another predator of this region and, considering the long co-evolution of bison and human hunters, bison harvests may be considered a component of natural regulation of the bison population. APR will retain human hunting as a factor regulating bison numbers and other ungulate populations.

C. Progress to date

Herbivore restoration

Progress in restoring APR’s bison population is reviewed under Goal 2. APR has contributed to bison restoration elsewhere by donating bison to several federal and state agencies, including Fort Niobrara National Wildlife Refuge in Nebraska, Rocky Mountain Arsenal National Wildlife Refuge in Colorado, USDA-APHIS National Wildlife Refuge in Fort Collins, and the Rocky Mountain Arsenal. These donations were made under the guidance of the U.S. Fish and Wildlife Service to support the recovery of bison populations in these regions.
Research Center at Colorado State University, Smithsonian’s National Zoo in Washington, D.C. (for public education purposes) and Arizona Game and Fish Department for the House Rock Wildlife Area. Most recently, in January 2018, under an agreement with the InterTribal Bison Cooperative, APR donated 42 bison to the Fort Belknap Indian Reservation (includes 12 in a bull exchange with Fort Belknap), 30 bison to Fort Peck and Blackfeet Indian Reservations, and 25 bison to Pe’ Sla in South Dakota.

Acquisition by APR of ranches with grazing permits in the CMR Refuge has enabled the Refuge to retire livestock grazing on 63,777 acres, thereby re-allocating more primary productivity to native herbivores.

To foster expansion of prairie dog colonies and creation of new colonies, APR, with support of Defenders of Wildlife, The Humane Society’s Prairie Dog Coalition, Adventure Scientists and many other volunteers, has mapped all prairie dog colonies on APR, prohibited shooting of prairie dogs, mowed areas to create more open habitat that prairie dogs can readily colonize, installed artificial burrows and nest boxes, applied insecticide to colonies to prevent the spread of sylvatic plague by fleas, and translocated animals to increase the rate of colony growth. As of 2017, approximately 50 black-tailed prairie dog colonies existed on APR. APR has also cooperated with the USFWS to restore prairie dog populations on the CMR Refuge, a critical aspect of black-footed ferret restoration efforts on the refuge.

APR has followed and exceeded MDL and USDA requirements for importing, managing and monitoring bison for disease. All bison imported to establish APR’s herd came from source herds that have been free of brucellosis and tuberculosis for at least three decades. All imported animals were certified to be free of brucellosis before their release on APR lands. For bison imported to Montana, APR complied with MDL and USDA requirements for bison veterinary inspection, disease testing, vaccination, identification, and quarantine. APR staff consulted with the Montana State Veterinarian and U.S. Department of Agriculture staff veterinarian to ensure that APR’s bison import practices satisfied state and federal requirements. The federal veterinarian and his staff attended and reviewed APR’s disease testing methods. Local veterinarians conducted required vaccinations. APR management plans have been reviewed by consulting veterinarians. APR retains a consulting veterinarian.
APR has conducted additional, voluntary disease testing pursuant to a Memorandum of Understanding (“MOU”) cooperatively developed by APR and the South Phillips County Rancher Stewardship Alliance in 2005. APR agreed to implement herd health management protocols that exceed MDL and USDA requirements through this “good neighbor” agreement, which respects the rights and interests of private property owners in the vicinity of APR’s lands while advancing APR’s mission to return bison to the region. During the five-year MOU implementation period, APR conducted routine disease screening of a sample of bison annually through the MDL Diagnostic Laboratory. APR closely monitors its herd and visible signs of herd health by radio-collaring select animals, by on-the-ground surveillance by staff and collaborating institutions, and, as needed, by anesthetizing animals for closer inspection, blood sampling and so on. APR follows standard modeling software to determine the number of bison to sample for proper statistical power for disease screening. If a potentially problematic pathogen is detected, APR will consult with neighbors, agencies and veterinarians and may follow one of three management approaches: 1) a passive approach that primarily involves ongoing monitoring, which may or may not lead to implementing approaches 2 and 3; 2) a control strategy where actions are taken to limit disease prevalence, spread, or risk; 3) eradication, where actions are taken to remove the disease from the population (Gross et al. 2011). APR will notify neighbors and appropriate state and federal agencies about this. Since expiration of the MOU, APR has continued voluntary disease monitoring and periodic testing of 5-20 bison.

All disease screening is done by Montana State Diagnostic Laboratory in Bozeman. To provide a cross-check, APR also sent samples for screening to the Washington Animal Disease Diagnostic Lab (WADDL) in Pullman, which reported the same results as the Montana Lab. APR has never had positive returns for brucellosis or tuberculosis. Since the establishment of the herd APR has seen no active clinical signs of any disease. Herd vigor and reproduction have been excellent. APR is happy to share the most recent diagnostic data from 2017 with anyone who wishes to review them.
**Restore full ecological role of ungulates**
Except for the possible rare predation of a bison calf by coyotes and cougars, non-human predation of bison is not yet of consequence to the bison population or the ecosystem. However, bison that have died of natural causes have not been moved and have been scavenged by various species and allowed to decompose and the nutrients recycled on the prairie.

**Natural recolonization by large carnivores**
USFWS, in collaboration with MFWP, Rocky Boy’s Indian Reservation, Fort Belknap Indian Reservation, Montana Cooperative Wildlife Research Unit and World Wildlife Fund, conducted research to better understand cougar ecology in the region, with the study area focused on the north side of the Missouri River of the CMR Refuge in Phillips County, north side of the Missouri River in the Upper Missouri River Breaks National Monument, and the Little Rockies (Ft. Belknap Indian Reservation) and Bears Paw (Rocky Boy’s Indian Reservation) Mountains. APR and the CMR Refuge do not permit hunting of cougars, but it is generally permitted elsewhere in the study areas. More than a dozen cougars were fitted with GPS collars in the Bears Paw Mountains, Little Rocky Mountains, and the refuge.

Findings indicate that cougar populations in the Little Rockies and Bear Paws are not sustainable over the long term due to excessive human harvest. The CMR Refuge may be a source of cougars moving into these two areas. The researchers estimated that the 2,158-square-mile study area could potentially support a population of 116-156 cougars. Despite cougar ranges overlapping areas occupied by people and livestock, no conflicts with either were reported (Kunkel et al. 2012).

Camera traps have recorded the presence of at least one cougar as well as one black bear on the ranch of a Wild Sky Beef participant (Figure 10) who, according to the agreement with Wild Sky, receives payment for harboring these species. Neither species has caused problems for the landowner.

Through its Wild Sky Beef program, APR has offered assistance to other landowners who may currently or in the future harbor large carnivores on their land.
D. Strategy and actions

Herbivore restoration

APR will slow the bison population’s rate of increase to approximately 10% annually during 2018 and 2019 to stay within the carrying capacity of the land. Pending approval of the change of use from cattle to bison on APR's BLM and state grazing allotments, the bison population will be allowed in 2020 to resume a natural rate of increase, estimated at roughly 20%. Pending the availability of sufficient habitat, the herd is projected to grow to more than 5,000 by 2029.

APR will continue to encourage and offer support to MFWP to initiate a well designed plan to establish wild bison in the State of Montana, including on the CMR Refuge. Appendix 1 is a letter that offers such support.

APR will conduct an experimental bison harvest in 2018 to evaluate its effects on bison behavior and demography and to design harvest management guidelines for the long term. APR will also explore on-site harvest and processing similar to Wild Idea Buffalo Co. (https://wildideabuffalo.com).

APR will work with MFWP, CMR Refuge, local landowners, hunters and other wildlife interests to increase populations of elk, bighorn sheep, and pronghorn in the region.

APR will collaborate with BLM to assist in meeting Rangeland Health Standard #5's priority for maintaining and improving indigenous plant and animal communities as it relates to ungulates, prairie dogs and associated species.

APR will continue to employ various methods to foster the growth of prairie dog colonies on APR and their interaction with bison grazing and continue to assist the CMR Refuge in similar work. Related to this will be increased collaboration with USFWS/CMR Refuge, BLM and MFWP to restore the black-footed ferret population, with the long-term goal of enabling its removal from the U.S. Endangered Species list.

For disease monitoring of bison, APR will continue to follow MDL, USDA and IUCN requirements and guidelines, and continue monitoring procedures as outlined in the Progress to Date section.
**Restore full ecological role of ungulates**

In the transition from commercial livestock production to bison conservation on APR, APR will continue to allow natural causes to increasingly be the primary causes of bison mortality and the disposition of bison carcasses on the landscape.

APR will begin in 2018 to assess the effects of bison and other ungulate carcasses on the behavior of predators and scavengers and on species richness and habitat heterogeneity.

**Natural recolonization of large carnivores**

During 2018 APR will cooperate with other institutions and local landowners to prepare plans to understand and prepare for the ecological, socio-economic and cultural effects that recolonization by wolves and (or) grizzly bears, if it occurs, may have in the region.

APR will work with MFWP, public and private landowners, and others to establish ecological corridors between APR and other areas with cougar and black bear populations to facilitate genetic exchange. These and other ecological corridors may become important if wolves or grizzly bears also naturally recolonize the APR region.

Beginning in 2018 APR will initiate discussions to encourage MFWP to collaborate toward managing for an increase in the region’s cougar population.

APR, through its Wild Sky Beef program and other means, will continue to offer payments and technical assistance to landowners who harbor large carnivores on their properties.

APR will cooperate with BLM to help it meet Rangeland Health Standard #5’s priority for maintaining and improving indigenous plant and animal communities as it relates to large carnivores.

**Goal 8: Establish a reserve and network of reserve-friendly lands of sufficient size and complexity to be largely ecologically self-sustaining for biodiversity conservation.**

*APR’s goal is to build a reserve of sufficient size—roughly 3.5 million acres—to enable, when combined with APR-supported ecological buffer areas and corridors, the full restoration of ecological conditions described in goals 1 - 7 and of viable populations of all native species.*
This size will be important for allowing bison to exhibit their wide-ranging foraging patterns, to accommodate natural spatial and temporal fluctuations of wild bison populations, and to support the complex interactions of bison with wildlife and plant communities on the prairie landscape.

A. Objectives

i. Build APR deeded and leased public lands to a total land base of at least 1 million acres by 2027, a base that would be sufficiently large to support the long-term goal of 10,000 bison. Priorities for acquisition are properties that help consolidate and provide connectivity among existing APR management units and with the CMR Refuge and Upper Missouri River Breaks National Monument.

ii. Cooperate with the CMR Refuge to enable nearly seamless management of biodiversity across contiguous APR and CMR Refuge lands.

iii. Through Wild Sky Beef and other means, by 2027 create a network of reserve-friendly lands around APR and as ecological corridors between APR and other important wildlife areas.

iv. By building a sufficiently large land base for biodiversity conservation, assist BLM in meeting Rangeland Health Standard #5--“Habitats are provided to maintain healthy, productive and diverse populations of native plant and animal species, including special status species.

B. Rationale

Species with large home ranges and/or that occur at low population densities, such as bison, golden eagles and large carnivores, require large areas to accommodate their movements and to support viable population sizes (Figure 12). Large-area requirements, however, are not limited to these species. Conserving a high diversity and abundance of small grassland birds in the APR region depends on grassland structural diversity at large landscape scales of
several hundred thousand acres (Lipsey 2015). Nearly all native species require or do best with large tracts of native habitat without fragmentation. Every acre of land purchased by APR prevents its potential conversion to cropland and, if already in cropland, enables APR to restore it to native grassland habitat.

Large management units are especially important for bison restoration because natural bison behavior and grazing patterns, particularly when interacting with the shifting habitat mosaic generated by fire, variable precipitation patterns, and other factors, require large landscapes of tens of thousands to hundreds of thousands of acres. Large-scale ecological processes such as pyric herbivory and natural stream flows require large landscapes. A large reserve more readily accommodates habitat complexity and disturbances that interact with complex landscapes to form multi-scale habitat mosaics (Sanderson et al. 2008, Gates et al. 2010, Fuhlendorf et al. 2012). No existing public or nonprofit nature reserve in the Great Plains is sufficiently large or appropriately configured to readily accommodate all native species and associated large-scale ecological conditions and processes of these historic grasslands (Freese 2015).

No reserve can stand alone and maintain its native biodiversity for long. Wildlife migrations, large-scale ecological processes and encroachment of unfavorable human influences require that reserves be buffered by reserve-friendly lands and that ecological corridors or stepping stones be available to enable gene flow among populations, to accommodate migratory species, and to facilitate adaptation and range shifts caused by climate change (Soulé and Terborgh 1999, Alagador et al. 2016, Freese et al. 2016).

Bison biologist Dale Lott, in his book *American Bison: A Natural History*, suggested that “A Great Plains Park must be very large--at least 5,000 square miles--and must include both upland and river bottom habitat” (Lott 2002, p. 203). APR’s goals for the reserve fulfill Lott’s vision both in terms of habitat complexity and size (5,000 square miles = 3.2 million acres). Reaching the goal of 3.5 million acres for the core of the reserve requires that APR closely collaborate with the CMR Refuge, BLM and DNRC to achieve seamless management across jurisdictional boundaries.

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Footnote: The late Dr. Lott was an early supporter of APR’s vision; he provided financial support, served as an expert on early fundraising safaris, and began research to write a book about the reserve. A plaque memorializing Dr. Lott’s inexhaustible commitment to bison conservation and APR is mounted on a boulder overlooking a valley commonly grazed by bison on the reserve.
The most basic requirement for achieving the goal of 10,000 bison is to secure sufficient bison habitat. Bison are habitat generalists and adapt to a diversity of climatic and ecological conditions, including those of the plains of eastern Montana. This gives APR considerable flexibility in terms of securing sufficient land with optimal configurations for bison conservation.

Almost all lands secured by APR for bison have previously been used for livestock production and, to a lesser extent, for crop production. Most of the lands used for livestock production are cross-fenced and have numerous stock ponds and other watering installations to facilitate rotational and uniform grazing practices. Non-native grasses and other exotic plant species may be abundant on some of these lands, and fire suppression would have been the general practice.

APR’s current grazing lands, including APR deeded and public land allotments, total 399,379 acres. Using an NRCS-determined low-precipitation-year stocking level, this acreage would support approximately 4,600 bison animal units—46% of APR’s long-term goal—under year-round use. At 81 acres/bison, a total of 810,000 acres would be needed to support the minimum of 10,000 bison, but a larger area is desirable to accommodate temporal fluctuations in precipitation, primary productivity and many other biotic and abiotic factors in the boom-and-bust environment of this region.

Figure 12. Large landscapes of intact habitat—hundreds of thousands to millions of acres—are vital for conserving the ecological conditions and processes of Great Plains grasslands and of the rich diversity of life they support. Photo: C. Freese
In addition to the core reserve, APR looks to cooperation by private landowners and public resource management agencies to help create buffer zones of wildlife-friendly ranching practices around reserve lands and the establishment of ecological connectivity for wildlife movement between the reserve and other areas of suitable habitat, ranging from the Rocky Mountain front to the extensive intact prairie lands, Missouri River Breaks lands, and isolated mountain ranges of eastern Montana and beyond.

C. Progress to date

APR has employed three interrelated strategies to create large management units. The primary strategy is fee-simple acquisition of land and the associated public-land grazing privileges. To date, 399,379 acres of deeded and leased land have been secured in this manner. Removal of fences and other artificial structures have contributed to defragmenting management units. Approval by BLM and DNRC of year-round continuous grazing on the Sun Prairie unit has enabled a unified and seamless management approach across this unit.

The second strategy has been to acquire properties that border or partially fall within the CMR Refuge and Upper Missouri River Breaks National Monument to enable collaborative management with these lands. Acquisition of properties with grazing permits on the CMR Refuge enabled the refuge to retire 63,777 acres from livestock grazing. APR deeded lands and leased BLM allotments now share 49 miles of a common boundary with the CMR Refuge. All of APR’s Cow Island/Cow Creek management unit, nearly all of the PN unit and much of the Antelope Creek unit fall within the boundary of the Upper Missouri River Breaks National Monument.

The third strategy has been to create ecological corridors and soft boundaries between and around APR management units. The Wild Sky Beef program, which fosters wildlife-friendly ranching practices, is important to this effort. To date, seven ranches totaling approximately 100,000 acres have enrolled.

D. Future strategies and actions

Purchase of deeded land and leasing associated BLM and state lands will continue be the primary mechanism for securing bison habitat going forward, at least over the next several years.
APR will explore options with the CMR Refuge for more seamless management between the two reserves to improve conditions for biodiversity conservation. Priorities for seamless species management include prairie dogs, bison and other ungulates, whereas fire, grazing and stream restoration are priorities for improving ecological conditions and processes.

APR will continue to improve buffer zones and ecological connectivity by increasing the number of ranchers enrolled in the Wild Sky Beef program.

APR will evaluate options to work with relevant agencies, Indian Reservations, and landowners to create ecological corridors and improve overall ecological connectivity between APR and other important wildlife areas.

Goal 9: Establish a bison population of high genetic variation, integrity and resilience.

*APR’s primary goal for bison genetics is to establish a population with no detectable cattle genes in its DNA and with high genetic variation that enables adaptation and evolutionary response to both short-term and long-term changes and challenges ranging from disease to climate change.*

A. Objectives

i. Maintain the genetic variation of APR’s bison population by increasing the population size to at least 3,000 by 2026, a secure size for long-term conservation of genetic variation.

ii. Following recommendations of bison geneticists, increase genetic variation in APR bison by introducing bison from conservation herds of different genetic ancestry.

iii. Support, through donation of APR bison, the genetic health of other important bison herds.

iv. Employ scientifically sound culling and harvest practices that maintain genetic variation and avoid artificial selection for particular traits.

v. Maintain cattle-gene-free status of the population by ensuring any imported animals come from genetically pure herds and by avoiding mixing/interbreeding with other bison herds in the APR region that are not known to be genetically pure.
vi. Allow the bison population to have a natural sex ratio (generally between 40:60 and 50:50 male:female) and ensure that natural selection operating through mate competition, predation, and other natural factors is the primary factor affecting survival and reproductive success.

B. Rationale

Genetic variation (heterozygosity and number of alleles) is important for the fitness of individual animals and provides the mechanism for evolutionary change and adaptation of populations (Allendorf and Leary 1986, Boyd et al. 2010a). Four interrelated mechanisms can reduce genetic variation: demographic bottlenecks, founder effects, genetic drift and inbreeding. Bison have been subjected to all of these mechanisms since their near extinction in the late 1800s. Despite these potential problems, plains bison appear to have retained good genetic variation at levels similar to other North American ungulates. Moreover, significant differences in genetic variation exist among public conservation herds (Wilson and Strobeck 1999, Halbert 2003, Halbert and Derr 2008, Boyd et al. 2010a). However, because only approximately 20,000 plains bison occur in roughly 55 conservation herds, and a large majority of those herds number fewer than 400 individuals, genetic conservation of plains bison remains a concern and a conservation priority (Gates and Aune 2008, Boyd et al. 2010a, Dratch and Gogan 2010).

Another concern regarding bison genetic conservation is artificial selection for certain traits. More than 400,000 plains bison in North America are in private commercial herds. Herds undergoing purposeful selection for domestication and commercial purposes, such as docility and a particular body conformation, can develop genetically determined differences in morphology, behavior and physiology compared to wild populations (Boyd et al. 2010a).

Bison were crossbred with cattle at the turn of the 20th century in hopes of creating a mixed breed with the handling and commercial benefits of cattle and the hardiness of bison. The legacy of this unsuccessful effort is that fewer than 7,000 plains bison in North America display no evidence of cattle gene introgression. Although the amount of cattle genes is generally low—less than 2% in most non-commercial conservation herds—and bison with low levels of cattle genes look like wild bison, there has been little research to
assess what effects, if any, cattle genes may have on bison. Some cattle genes, particularly those in the mitochondria, for example, might affect the metabolism of bison, which, unlike cattle, slows down significantly in winter. Bison with cattle mitochondrial DNA may have a smaller body size than bison without mitochondrial DNA (Hedrick 2009). Maintenance and growth of cattle-gene-free bison conservation herds is considered a priority (Gates and Aune 2008, Hedrick 2009, Boyd et al. 2010a, COSEWIC 2013).

Maintaining genetic variation is also important because reduced variation may constrain the ability of bison to evolutionarily adapt through natural selection to new or evolving disease pathogens and to changing ecological conditions due to climate change and other factors (Hoffmann and Sgro 2011, Vander Wal et al. 2014)

APR’s goals for the size of its bison population and for conserving bison genetics address the above threats to conserving the wild bison genome. A relaxed goal of a 90% probability of retaining 90% of selectively neutral genetic variation over 200 years can likely be met with a census population of 1,000 bison, assuming equal number of bulls and cows and a stable population size (Gross et al. 2010). This is the level recommended by the Department of the Interior for federal herds (Dratch and Gogan 2010). Hedrick (2009) recommends a census population 2,000-3,000 to avoid inbreeding depression and loss of genetic variation.

APR’s goal for bison genetics includes close collaboration with managers of other conservation herds in North America to support the development of multiple herds that, collectively, will help restore and maintain the genetic variation and integrity of the plains bison.

C. Progress to date

APR has acquired bison from three source herds representing two genetic ancestries (Table 1). The Wind Cave National Park herd exhibits a good level of genetic variation and heterozygosity compared to other Department of the Interior herds (Halbert and Derr 2008, Dratch and Gogan 2010). TNC’s Broken Kettle Grassland Preserve bison originally came from Wind Cave also. The Elk Island National Park herd was established from several source herds, although most came from the Pablo-Allard herd in Montana (Parks Canada 2017). Although the Elk Island herd’s genetic variation is rather low (Pertoldi et al. 2009), when combined with the Wind Cave animals it served to enhance the overall genetic variation of the APR herd.
To further enhance genetic variation in the APR herd, APR and the Fort Belknap Indian Reservation, which has bison of Yellowstone National Park lineage, have agreed to swap 12 bulls. Fort Belknap received 12 bulls from APR in January 2018, and APR is scheduled to receive 12 bulls in exchange during 2018-2020. Contribution of APR bison to other bison conservation programs are described earlier under Goal 7.

Genetic testing of mitochondrial DNA and a suite of nuclear DNA microsatellites and SNPs (single nucleotide polymorphism) analyses show that the APR herd has substantial genetic variation and heterozygosity. When the herd was small, genetic testing revealed that one bull was dominating breeding and consequently that animal was donated to Fort Niobrara National Wildlife Refuge to enhance the genetic variation in its herd (Figure 13).

In accordance with guidelines for genetic management (Gross et al. 2010, Dratch and Gogan 2010), APR minimizes manipulation of the population to allow it to develop a natural sex ratio and age structure. Removal of bison by whatever means is carefully designed to avoid loss of genetic diversity or directional selection for certain traits. Mortality from competition among bulls, from native predators and from other natural causes is permitted.
APR’s bison herd is one of only a handful of herds in North America that shows no signs of cattle genes. APR has therefore taken a precautionary approach to avoiding cattle-gene introgression. APR now follows established guidelines for sourcing from populations that have been rigorously genetically screened for cattle gene introgression and, if necessary, for culling of animals with detected cattle DNA (Dratch and Gogan 2010, Gross et al. 2010). Because Wind Cave bison were discovered to have low levels of cattle gene introgression after APR reintroduced them, APR undertook intensive genetic screening of all Wind Cave animals which resulted in 73% of Wind Cave animals being removed from the herd in 2010. 

Apart from ensuring the conservation of APR’s rare non-introgressed population, this approach averts any potentially deleterious effects of cattle genes on bison physiology and behavior. This management policy also ensures that APR bison meet any standard for cattle-gene introgression that state or federal wildlife agencies might impose if, someday, they want to use APR bison to establish a wild herd.

APR’s bison management follows the recommendations of leading geneticists and bison managers convened by the American Bison Society and U.S. Department of the Interior who confirmed the importance of conserving bison herds without signs of cattle-gene introgression. Nevertheless, APR recognizes that conservation herds with low levels of cattle-gene introgression are important because they also conserve genetic diversity and some potentially unique alleles and can fulfill the ecological role of bison.

**D. Future strategies and actions**

APR will continue to grow and manage the bison population under conditions that enable natural selection–mate competition, natural sources of mortality, and so on—to be the primary selective forces affecting the population’s gene pool.

APR will continue periodic testing for genetic variation, heterozygosity and cattle-gene introgression.

To further enhance genetic variation, APR, through its agreement to exchange bulls with the Fort Belknap Indian Reservation, will receive 12 bulls of Yellowstone National Park lineage from Fort Belknap during 2018-2020. APR will continue to evaluate the need to further increase genetic variation in its herd through introductions from other
conservation herds. Strictly avoiding introductions of bison with cattle genetics will continue to be a priority. Another ongoing APR priority will be to carefully evaluate and manage the potential for disease coming into its herd from bison introductions.

APR will continue to collaborate with managers of other bison conservation herds in North America to advance the shared goal of conserving the wild bison genome.

Goal 10: Use bison restoration to improve mitigation of and adaptation to climate change.

This goal aims to use restoration of bison and associated ecological conditions to mitigate greenhouse gas (GHG) emissions and to improve the capacity of the region’s human, plant and animal communities to adapt to climate change, both of which are largely achieved through the restoration and conservation of native plant communities. The bison’s adaptability to climatic extremes further advances this goal.

A. Objectives

i. In concurrence with Goal 1, mitigate the release of GHG by allowing no cultivation of intact prairie.

ii. In concurrence with Goal 1, begin the process of sequestering soil organic carbon by restoring native vegetation to cultivated lands.

iii. In concurrence with nearly all ecological goals, restore natural ecological processes and conditions and foster high, natural levels of native species diversity and of genetic variation within species, including bison, to enhance ecological resilience and adaptive capacity of species and the ecosystem to climate change.

iv. In concurrence with Goal 8, greatly increase GHG mitigation effects and enhance ecosystem resilience and species adaptations to climate change by expanding the land base of APR and, through the Wild Sky Beef program and other means, securing buffers areas and ecological connectivity to other intact habitats.
B. Rationale

Climate change will increasingly be a major driver of land management decisions and of socioeconomic conditions in the grassland ecosystems of North America’s Great Plains. The Northern Great Plains has already experienced some of the greatest increases in temperature in the continental U.S. in recent decades, increases that are projected to continue with multiple effects on agriculture, biodiversity and the socioeconomic wellbeing of its residents (USGCRP 2014).

Land use, particularly agriculture, forest management and rangeland management, contributes an estimated 24% of direct GHG emissions and thus has a pivotal role in addressing climate change (IPCC 2014). Improved land use can reduce GHG levels by reducing emissions and by removing CO₂ from the atmosphere via photosynthesis and sequestering the carbon in organic material. With rangelands covering 40% of the Earth’s land surface, storing 50% more carbon than forests worldwide, and storing around 20% of global soil organic carbon (SOC), their wise stewardship is crucial for mitigating climate change (Conant 2010).

Before plow-up of native grassland for crop production in the late 1800s and early 1900s, Great Plains grasslands were probably modest carbon sinks or near equilibrium (Zhang et al. 2011). Conversion of grasslands to croplands quickly altered this balance by initiating large increases in both CO₂ and N₂O emissions (Hartman et al. 2011). On average, plowing of native grasslands and crop production result in approximately a 50% loss of SOC (Hartman et al. 2011), although this varies widely depending on ecological conditions, cultivation practices and other variables. Whereas SOC is rapidly lost after grasslands are first cultivated, cultivated lands left fallow may require hundreds of years to reach pre-cultivation SOC levels. Active grassland restoration accelerates carbon sequestration but, depending in part on how long a site has been cultivated, achieving pre-cultivation carbon levels still requires decades (Conant et al. 2001, Fuhlendorf et al. 2002).

Nitrous oxide (N₂O), a GHG with 300 times greater global-warming potential than CO₂ and 12 times greater than methane (NH₃), is naturally released into the atmosphere from Earth’s ecosystems including, at low levels, from temperate grasslands. Soil disruption
when native grasslands are first plowed causes a surge in $N_2O$ emissions (Grandy and Robertson 2006). Of much greater long-term importance, however, is the increased emission of $N_2O$ caused by the application of nitrogen fertilizers (Venterea et al. 2012, EPA 2015b). Globally, more nitrogen fertilizer is applied in the production of wheat, the primary crop of the APR region, than any other crop (Snyder et al. 2014).

Effects of grazing on SOC loss are highly variable under different ecological conditions and different grazing intensities and histories. Moderate to heavy grazing in semi-arid grasslands of the Great Plains, where there is an evolutionary history of large ungulate grazing, appears to often result in greater SOC storage compared to ungrazed areas (Conant et al. 2001, Derner et al. 2006, Reeder et al. 2004). No significant difference in carbon sequestration has been found between rotational and continuous grazing on native rangelands (Eagle et al. 2012).

Effects of grazing on SOC, however, are highly site specific and can vary widely among apparently similar sites. This has led to broad consensus that the interaction of abiotic and biotic factors—rainfall patterns, temperature, soil conditions, plant communities, grazing history and so on—will usually override the effects of current grazing management on SOC. Consequently, except in circumstances where grazing has clearly degraded the grassland community and soil, grazing management is generally not considered a reliable method for managing carbon sequestration rates, especially over time periods of a few years (Derner and Schuman 2005, McDermot and Elavarthi 2014, McSherry et al. 2013, Wilcox et al. 2015). There is no clear evidence that the net effect of patch fires on SOC and GHG emissions in grassland systems is significantly positive or negative. Where periodic fires and grazing are allowed to interact (pyric herbivory), primary productivity generally increases, which suggests maintenance or an increase in SOC (Fuhlendorf et al. 2011). Even in the absence of fire most carbon in above-ground growth in grasslands ends up in 1 – 2 years cycling through to the atmosphere as CO$_2$ via plant decomposition and consumption by herbivores (heterotrophic transpiration) (Follett 2001).

Approximately 26% of CH$_4$ emissions in the U.S. are from enteric fermentation, primarily from ruminants (EPA 2015b). All native and nearly all domestic ungulate grazers in the Great Plains are
ruminants. Thus, the historical switch in principal grazers from bison to cattle on rangelands has probably had a minor effect on CH$_4$ emissions. One analysis estimated that pre-EuroAmerican-settlement emissions from bison, elk and deer were 86% of current emissions from livestock (assuming a pre-settlement bison population of 50 million) for the continental U.S. (Hristov 2015). Another estimated a 14% lower CH$_4$ emission rate from 30 million pre-settlement bison than from 36.5 million cattle currently in the historic range of bison (Kelliher and Clark 2010). Cattle feedlots, however, contribute significantly to CH$_4$ emissions from manure (EPA 2015b).

Because Great Plains ecosystems and species evolved under boom-and-bust climatic conditions, the region’s biodiversity may be pre-adapted to withstand the greater extremes that climate change portends. Compared to the ecologically homogenized landscape of agriculture—particularly crop production—a biologically diverse landscape offers the best chance for ecological adaptation to climate change. The diversity of native grasses and forbs may be crucial for enabling pre-adaption and thereby for creating ecosystem resilience to climate change. Grass species in grassland systems display a broad range of tolerance to drought—up to a ten-fold difference among species. Where high grass diversity is maintained, grasslands may be resilient to climate change because drought-tolerant species can replace less drought-tolerant species as drier conditions prevail. Thus high grass diversity may be crucial for maintaining ecosystem function, including the capacity for GHG mitigation (Craine et al. 2013).

Compared to livestock, native ungulates demonstrate greater tolerance to climatic extremes and should exhibit greater resilience to projected climate change in the Northern Great Plains. Tolerance to water scarcity by bison (Christopher et al. 1978, Kohl et al. 2013) may make them adaptable to predicted warmer and drier conditions. However, hotter temperatures may lead to increased nutritional stress for grazers as increased CO$_2$ levels may lead to decreased protein concentrations in grass forage; grazers may respond by increasing consumption of nitrogen-fixing forbs (Craine 2013, Craine et al. 2015).

Large and genetically diverse populations of plant and animal species increase the potential for them to evolve and adapt, thereby enhancing ecosystem resilience to a changing climate (Sgrò et al. 2011). A resilient ecosystem, in turn, will better maintain an ability
to mitigate GHG emissions than a degraded ecosystem. Species adaptation to climate change may also require range shifts and thus large areas and ecological corridors of suitable habitat are also important (Alagador et al. 2016). This is already apparent among migratory birds of the Northern Great Plains as most species are arriving earlier on their breeding grounds and/or shifting their breeding ranges further north (Hitch and Leberg 2007, Johnsgard 2015, Swanson and Palmer 2009, Travers et al. 2015).

As APR becomes an increasingly prominent landowner and land manager in the Great Plains, it has an extraordinary opportunity to provide leadership in managing grasslands for climate change mitigation and adaptation on a large scale (Freese et al. 2016).

C. Progress to date

APR has avoided the potential conversion of grassland to cropland and the GHG emissions that would have resulted in approximately 76,000 acres of intact habitat on deeded land it has acquired. APR policy prohibits alteration of intact habitat except for small areas such as building envelopes and campgrounds. APR has placed conservation easements on 8,912 acres. APR has also purchased 22,702 acres with conservation easements already in place, for a total of 31,614 acres, or 30% of its private land holdings, protected by conservation easements. A rough estimate is that the soil on these acres holds 66 t CO$_2$/acre, an estimated half of which–33 t CO$_2$–would be lost if the land was converted to crops (Freese et al. 2016). The U.S. government has assessed the social cost of carbon—the economic damage to property, agriculture, human health and other values caused by an increase in CO$_2$—at $37 per metric ton of CO2 released into the atmosphere (The White House 2013). This yields a social cost of $1,221 per acre of converted grassland, or a value of approximately $92.8 million in social cost that would be incurred if APR’s intact deeded lands were cultivated. Additional intact grasslands and their SOC are being protected through APR’s Wild Sky Beef program, which requires enrollees to maintain intact grasslands.

APR has begun restoring grassland on 4,182 acres, representing 40% of the cropland it owns. Using a conservative sequestration rate in the range of 0.1 – 1.0 t CO$_2$/acre/yr (see Diaz et al., no date), this restoration may be sequestering 418 - 4,182 t CO$_2$/acre/year (Freese et al. 2016).
This is roughly equivalent to the average annual CO$_2$ emissions of 90 – 900 U.S. passenger vehicles (EPA 2015a). At a social cost of $37 per metric ton of carbon, this represents a reduction in social costs of $15,466 - $154,660 annually (Freese et al. 2016).

APR released a white paper in 2016 on the potential effects of climate change on APR and how APR might respond both in terms of mitigating GHG emissions and enhancing ecological adaptation and resilience (Freese et al. 2016).

D. Strategies and action for the future

APR will continue its policy of prohibiting cultivation of intact habitats on lands it currently owns and any future lands acquired, and of restoring native plant communities on croplands it acquires.

APR will continue to require that intact habitats be protected from cultivation on lands enrolled in the Wild Sky Beef program, and to offer a premium for restoring native plant communities on cropland. APR will encourage and endorse efforts by landowners who are not enrolled in the program to do likewise on their properties.

APR will continue to manage for high levels of native species and genetic diversity and for extensive habitat connectivity, thereby enhancing ecosystem resilience to climate change, maintaining GHG mitigation functions of ecosystems, and enabling climate-change-induced species range shifts.
Goal 11: Create significant public (local, regional and national) benefits from and engender broad public support for bison conservation.

This goal aims to allow people and communities—locally, nationally and internationally—to enjoy the multiple social and cultural benefits of bison and APR and to enable primarily local communities—tribes, ranchers, towns—to benefit economically. The goal also seeks to generate social and financial support for bison conservation (both on APR and across North America) and the realization of APR’s vision. Although APR bison are private property, APR seeks to manage its bison, to the extent practical, as wildlife according to the Public Trust Doctrine of the U.S. and Canada, which means that APR manages bison as a public resource for the common good.

A. Objectives

i. Develop and implement a plan to promote the APR-Yellowstone-Glacier Triangle of natural and cultural history tourism.

ii. Develop guides, interpretive materials and facilities for visitors that offer opportunities for visitors to observe and appreciate bison in their natural environment.

iii. Increase number of visitors to APR by 20% annually.

iv. Design and implement a program of bison harvest with diverse cultural and socioeconomic benefits.

v. Provide facilities for students, researchers, conservationists, writers, artists and others interested in learning about, contributing to, sharing with others knowledge and appreciation of bison and APR.

vi. Implement a communications strategy that engenders strong public support locally, nationally and internationally for APR’s bison conservation goals, and encourage supporters to promote legislation and public policies that further those goals.

vii. Enable and encourage supporters to promote legislation and public policies that further APR’s bison conservation goals.

viii. Through “Band of Bison” and other fundraising tools, harness the iconic status of bison and APR’s role in its conservation to
generate financial support for APR and its bison conservation work.

ix. Whenever possible and practical, buy local goods and services for bison management and other APR activities.

x. Through Wild Sky Beef and other mechanisms, offer opportunities for local landowners and communities to benefit economically from APR’s success in conserving bison and other wildlife.

xi. Develop and implement protocols for measuring the economic effects of APR and, where possible, the contribution of APR bison to these effects.

xii. Measure assumed/perceived negative impacts of bison on local communities, including economic effects such as fence damage, crop depredation, cattle harassment and “overgrazing.”

B. Rationale

Public benefits

Bison are an icon of Great Plains human and natural history, an animal of cultural, aesthetic and spiritual value for millions of people, from Indian tribes of the APR region to people across the North American continent. The 2016 National Bison Legacy Act that designated the American bison as the official mammal of the U.S. codified the bison’s special place in the minds of Americans. People are fascinated by and drawn to bison for its strength and striking appearance as North America’s largest land mammal. More deeply, the bison’s place in the American psyche is evidenced by the myriad stories told, books written and paintings painted about its central role in both human history and the ecology of the Great Plains for thousands of years before and during Euro-American settlement of the Great Plains (Dary 1989, Isenberg 2000, Wallen and White 2015). Visitors to APR and others interested in the reserve are attracted to the vision of thousands of bison thundering across the landscape. This, as much as any biological need, is justification for the goal of 10,000 bison. APR assigns a high priority to meeting these social, cultural and aesthetic benefits and consequently offers diverse opportunities for tourists, hunters, educators, students, artists, scientists and others to experience and benefit from bison conservation (Figure 15).
Bison conservation on APR can economically benefit people and communities in the APR region in multiple ways, including: 1) APR investments in fencing, veterinary care and other infrastructure and services required for bison management; 2) APR investments in facilities and services to host hunters, nature tourists, researchers, students and other groups; 3) personal expenditures by APR staff for goods and services; 4) expenditures by hunters, tourists, researchers, students and others for outfitters, lodging, food, gas and other products and services; 5) premium payments to ranchers who support bison conservation under the Wild Sky Beef program; 6) contributions by APR, made possible in part by support for bison conservation, to local community programs.

Northeast Montana (“Missouri River Country”), including the APR region, receives far less spending by non-resident visitors than any other region in the state. In 2015, non-resident visitor expenditures were $113 million, just 28% of the figure ($402 million) for southeast Montana and 9% of the total ($1.229 billion) for Glacier Country (Sage and Nickerson 2017). The CMR Refuge offers the only local example for examining the economic impact of visitors to a wildlife conservation area. Non-local refuge visitors (thus representing new money coming into the area) spent an estimated $20.9 million
annually in the CMR Refuge’s six-county area. This spending was estimated to account for $14.6 million in local output, 204 jobs, and $4.2 million in labor income in the local economy. The secondary or multiplier effects generated an additional $5.9 million in local output, 60 jobs, and $1.6 million in labor income. Accounting for both the direct and secondary effects, spending by non-local visitors generated total economic impacts of $20.5 million (2007$) in local output, 264 jobs and $5.8 million (2007$) in labor income (Koontz et al. 2013).

The CMR Refuge, however, is capturing a small share of wildlife-oriented visitors to Montana and, more specifically, to north-central (Russell Country) and northeast (Missouri River Country) Montana. In 2006, 950,000 residents and non-residents participated in wildlife-associated activities in Montana, generating $11 billion, with $231 million from fishing, $311 million from hunting, and $376 million from wildlife-watching activities (USFWS 2008, Koontz et al. 2013). In 2005, Russell Country received 976,140 non-resident visitors who spent $216.8 million; 40% cited wildlife watching as one of the reasons for their visit and 8% visited the CMR refuge. Missouri River Country in 2005 had 283,013 nonresident visitors who spent $32.9 million; 39% cited wildlife watching as important and 14% visited the refuge (Koontz et al. 2013). Given the refuge’s modest infrastructure and interpretive materials for visitors this low visitation level by wildlife watchers might be expected. The absence of bison may be another reason.

A recent analysis suggests that the development of APR and its association with the CMR Refuge could generate $12.6 - $38.6 million dollars in additional non-resident expenditures in the region under the current scenario and $13.4 - $56.3 million dollars when APR’s vision is fully realized. These non-resident expenditures would result, respectively, in an additional 143 - 469 new jobs (15% - 46% increase) and 163 - 683 new jobs (16% - 67% increase) compared to current conditions (Sage and Nickerson 2017).

Nearby national parks offer another perspective on the potential economic effects of building a 3.5-million-acre prairie reserve with 10,000 bison and the full complement of other wildlife (Table 4). Badlands, Theodore Roosevelt and Wind Cave National Parks are, like APR, mixed-grass prairie ecosystems with similar wildlife. All three have
bison. Glacier and Yellowstone are mountain ecosystems, but both are within roughly 200 miles of APR and thus visitors to these parks could readily include APR in a wildlife and wildland oriented tour.

Table 4. Impact of park visitors in 2015 on local gateway economies surrounding five national parks within 350 miles (day’s drive) of APR. Source: Cullinane Thomas and Koontz 2016.

<table>
<thead>
<tr>
<th>National Park</th>
<th>Visitor expenditures (millions $)</th>
<th>Jobs created</th>
<th>Labor income (millions $)</th>
<th>Value added (millions $)</th>
<th>Economic output (millions $)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badlands</td>
<td>62.2</td>
<td>1,000</td>
<td>24.4</td>
<td>40.1</td>
<td>77.5</td>
</tr>
<tr>
<td>Theodore Roosevelt</td>
<td>35.9</td>
<td>494</td>
<td>13.4</td>
<td>21.4</td>
<td>38.2</td>
</tr>
<tr>
<td>Wind Cave</td>
<td>60.6</td>
<td>1,000</td>
<td>25.3</td>
<td>41.8</td>
<td>80.4</td>
</tr>
<tr>
<td>Glacier</td>
<td>199.0</td>
<td>3,500</td>
<td>93.5</td>
<td>143.4</td>
<td>268.6</td>
</tr>
<tr>
<td>Yellowstone</td>
<td>493.6</td>
<td>7,700</td>
<td>224.8</td>
<td>361.9</td>
<td>638.6</td>
</tr>
</tbody>
</table>

Even in Yellowstone, where there are many high-profile attractions other than bison, bison represent an important component of the visitor experience. One survey found that about 50% of visitors indicated seeing bison was a reason for their trip, and about 5% said they would not have come to Yellowstone if bison had not been present (Duffield et al. 2000a,b). For a crude calculation of the value of bison in terms of visitor expenditures in Yellowstone, a 5% reduction in the number of visitors to Yellowstone in 2015 would have resulted in an estimated $24.7 million less in visitor expenditures in surrounding communities.

As noted above, APR manages its bison for public benefit following principles of the Public Trust Doctrine of the U.S. (Organ et al. 2012). With a solid legal basis and sufficient and rigorous assurances from the relevant public agencies that the bison would be well managed, APR is prepared to transfer ownership of its bison to the American public so that the bison are legally “wildlife” under U.S. and state law.

Public support
Public support is vital for realizing APR’s bison conservation goals. To help finance the sizeable costs of bison management, bison generate financial support from APR donors and, potentially, from fees paid by bison hunters.
Supportive public opinion is critical for influencing federal and state legislation and county, state and federal agency policies affecting APR’s bison conservation goals. As evidenced, for example, by the restrictive bison ordinances created by several Montana counties, Montana’s EA process for bison restoration, and the NEPA process for change in use from cattle to bison on BLM allotments, policies and decisions from the local to state to federal level strongly influence both day-to-day management and long-term planning for bison conservation. The possibility of eventually transferring APR’s bison to public ownership hinges in large part on strong public support.

Support and collaboration by local tribes, ranchers and other community members benefit APR bison conservation in multiple ways, from day-to-day cooperation and knowledge-sharing with neighboring landowners to good working relationships with local businesses and spiritual support from tribal elders.

Research on bison and factors affecting their conservation by students and scientists and the institutions that support them leads to improved bison management.

C. Progress to date

APR has contributed significantly to the economy of the APR region and the state of Montana. APR made their first land purchase in 2004 and introduced bison to the project area in 2005. As the land base, bison herd, and operation have grown so have APR employment opportunities. This trend is expected to continue. From 2015-2017 APR average expenditures in the region, not including land acquisition and associated fees, exceeded $1.9 million per year. The expenditures included wages, good and services, and capital expenditures excluding land purchases.

<table>
<thead>
<tr>
<th>Years of Expenditures</th>
<th>In APR Region</th>
<th>In Montana But Outside APR Region</th>
<th>Total in Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-2014</td>
<td>$6,200,000+</td>
<td>$15,900,000+</td>
<td>$22,100,000+</td>
</tr>
<tr>
<td>2015-2017</td>
<td>$5,700,000+</td>
<td>$12,500,000+</td>
<td>$18,200,000+</td>
</tr>
<tr>
<td>TOTAL</td>
<td>$11,900,000+</td>
<td>$28,400,000+</td>
<td>$40,300,000+</td>
</tr>
</tbody>
</table>

Table 5. APR 2002-2017 expenditures in APR region and Montana (based on address of entity paid), rounded to nearest $100,000, not including land acquisition or fees associated with land acquisition. Expenditures include the APR purchase of goods and services and the payment of wages and government taxes and fees. The APR region area is defined as Phillips, Valley, Blaine, Fergus, Petroleum, Garfield, and Chouteau counties.
These figures do not account for expenditures made by APR guests and visitors or the personal expenditures of APR employees and their families.

Table 6. Major categories of 2015-2017 expenditures in APR region and Montana (based on address of entity paid), rounded to the nearest $10,000, not including land acquisition or fees associated with land acquisition.

<table>
<thead>
<tr>
<th>Categories of Expenditures</th>
<th>In APR Region</th>
<th>In Montana But Outside APR Region</th>
<th>Total in Montana</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages</td>
<td>$1,410,000+</td>
<td>$5,100,000</td>
<td>$6,510,000</td>
</tr>
<tr>
<td>Professional Fees and Contractors</td>
<td>$40,000</td>
<td>$1,290,000+</td>
<td>$1,330,000+</td>
</tr>
<tr>
<td>Taxes</td>
<td>$240,000+</td>
<td>$30,000+</td>
<td>$270,000+</td>
</tr>
<tr>
<td>Travel Expenses</td>
<td>$230,000+</td>
<td>$280,000+</td>
<td>$510,000+</td>
</tr>
<tr>
<td>Other Reserve Operating Expenses</td>
<td>$900,000+</td>
<td>$550,000</td>
<td>$1,450,000+</td>
</tr>
<tr>
<td>Other APR Operating Expenses (Insurance, Marketing/Communication, Phone/Internet, Other Office/Organization Costs, Events/Visitation, and Training/Education)</td>
<td>$160,000</td>
<td>$1,730,000</td>
<td>$1,890,000</td>
</tr>
<tr>
<td>Capital Expenditures</td>
<td>$2,720,000+</td>
<td>$3,560,000+</td>
<td>$6,280,000+</td>
</tr>
</tbody>
</table>

During the 14-year period from 2004-2017 APR invested over $50 million for land acquisition and related fees. Land was purchased from 22 distinct owners, of which 14 lived in the APR region when they sold to APR (not all locals lived on the land they sold or even in the APR region). Thirteen of those 14 local landowners remained in the APR region after selling to APR. The thirteen that remained in the APR region received just under 50% of APR’s total land acquisition payments.

As of January 2018 APR employs 7 full-time, permanent employees and 7 seasonal or part-time employees in the APR region. At least 3 other full-time, permanent positions and 2 seasonal or part-time positions are to be filled in 2018. APR employees are subject to the same state and federal income taxes and other state and local taxes as employees of for-profit organizations. Similar to other residents,
APR employees support the local businesses and organizations in the region.

In Montana, APR currently employs approximately 30 full-time permanent employees and 10 part-time seasonal employees, inclusive of those in the APR region. APR is actively recruiting for 4 more full-time permanent employees for work outside the APR region.

For the 3 years from 2014-2016, APR helped support a crew of 3-6 Landmark volunteers at a time, for a total of 85 individuals. These volunteers lived and worked in the region and contributed to the area’s economy by shopping locally, using local services, and other activities.

In 2017 the Montana per capita livestock fee rate on bison, which APR pays, was almost three times the rate on cattle ($6.38 per bison vs. $2.29 for cattle). The difference in fees was similar in past years.

In the 3 years from 2014 - 2016, expenditures of APR’s Wild Sky Beef Program exceeded $255,000 to support wildlife-friendly ranching in the APR region and other areas of Montana. Montana ranchers enrolled in the program were paid in excess of $200,000, more than $35,000 was spent on contractors, services and in support of collaborating organizations in the APR region, and $20,000 was spent on Montana contractors and services outside the region. In 2017, 7 ranchers were enrolled in the Wild Sky Beef program covering a total of approximately 100,000 acres.

Wild Sky Beef is managed by Montana Prairie Holdings, a for-profit company owned by APR. Wild Sky Beef products are sourced from Strauss, an 80-year-old company specializing in 100 percent grass-fed and finished, all natural beef, with a percentage of proceeds supporting wildlife-friendly practices on Wild Sky Ranches. The Wild Sky Beef program currently sells over 40,000 lbs of Wild Sky Beef per month in several retail locations in the U.S. available online at wildskybeef.com. Wild Sky jerky and beef sticks are sold on Amazon and Backcountry.com. At the end of 2017 Montana Prairie Holdings employed three full-time employees. Montana Prairie Holdings has paid Montana salaries in excess of $300,000 in the 3 years it has been owned or partially owned by APR.

During 2015-2016 APR paid $30,000 to fund a dinosaur dig in the APR region. The dinosaur trail is a major tourist attraction in northeastern Montana.
In 2017 APR leased grazing and hay land to 15 local ranchers/operators. This number will fluctuate over time as land is acquired and the bison herd grows.

In its 26 land acquisitions APR also acquired a small rental used by hunters and fishermen, a hunting lodge, a historical mansion, and other historically significant buildings. The small rental has been converted to a permanent residence for an APR employee. The lodge and one other residence have been remodeled to accommodate up to 26 overnight guests. Up to another 10 overnight guests can be accommodated in APR’s yurts at Kestrel Camp and APR offers 7 RV sites with electrical hookups and 6 tent camping sites at its Buffalo Camp Campground. In addition, tent platforms near APR’s Enrico Education and Science Center provide another option for overnight guests.

APR has paid the State in excess of $30,000 in lodging tax. The number of known overnight guests on APR at Kestrel Camp, Enrico Center, White Rock Lodge, Buffalo Camp Campground, PN Ranch, and Cow Island has shown steady growth—230 in 2014, 261 in 2015, 448 in 2016, and 551 in 2017, for a 4-year total of 1,490. These figures only tally guests who registered at the campground or were directly hosted by APR. These figures do not count the 85 individual Landmark Volunteers who camped at the campground for periods of time. Recorded Buffalo Camp Campground use from 2012-2017 is shown in Table 7.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Overnight Guests</th>
<th>Number of Parties</th>
<th>Number of Nights Stayed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>21</td>
<td>9</td>
<td>32</td>
</tr>
<tr>
<td>2013</td>
<td>40</td>
<td>17</td>
<td>Unknown</td>
</tr>
<tr>
<td>2014</td>
<td>55</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>2015</td>
<td>115</td>
<td>47</td>
<td>114</td>
</tr>
<tr>
<td>2016</td>
<td>264</td>
<td>91</td>
<td>236</td>
</tr>
<tr>
<td>2017</td>
<td>246</td>
<td>132</td>
<td>256</td>
</tr>
</tbody>
</table>

The population of Phillips County has been declining since the 1920s with the decline exceeding 10% between the years of 1920-1930 (11.8%), 1940-1950 (19.7%), 1960-1970 (10.6%), and 1990-2000 (10.9%).
Historically in the project area when a ranch was for sale a neighbor or group of neighbors bought the ranch and incorporated it into their existing operation. While this potentially increased the financial viability of the ranchers making the purchase it did not necessarily result in maintaining the resident population or employment opportunities. Mechanization also had a significant impact on human populations and local employment opportunities.

While it is difficult to determine what effect APR has had on the population of the APR region, two possible indicators related to direct effects of APR land purchases and local APR employment, leases, and Wild Sky are: 1) Households (previous land owners and their relatives and employees) that left the region after the property they owned and/or resided/worked on was purchased by APR; and 2) number of households established or partially supported in the region through APR employment, leases, or Wild Sky Beef.

Of the 23 households in the region directly associated with a property just before it was sold to APR, only 4 (17%) of those households left the region within a year of the APR purchase.

After the planned hires in 2018 APR will have increased the net number of occupied households associated with APR properties in the region by 6 as a result of its property purchases, employment, and leases. APR also partially supports 24 households in the region through employment, leases, and/or the Wild Sky Beef program.
Other contributions of APR include policies that support local lifestyles and traditions and that offer opportunities for new activities by the public. Grazing, hunting, and some fishing have been the prevalent uses of the public and private land in the region, but only hunting and fishing are focused on the general public. APR fosters multiple use of public lands and APR deeded land in the region by facilitating access, by promoting diverse recreational, educational and research opportunities, by offering infrastructure for visitors such as

<table>
<thead>
<tr>
<th>Household Categories</th>
<th>Number of Households</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of households in the region who sold all or a portion of their property to APR</td>
<td>14</td>
</tr>
<tr>
<td>Number of households in the region that were the property owner’s relatives or employees and who immediately prior to APR purchase lived or worked extensively on the property sold to APR</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total number of households in the region who immediately prior to APR purchase were directly associated with property sold to APR</strong></td>
<td><strong>23</strong></td>
</tr>
<tr>
<td><strong>Number of households that left the region within a year of APR buying the property they were directly associated with</strong></td>
<td><strong>-4</strong></td>
</tr>
<tr>
<td>(Two Crow employee left but was replaced by another local resident; this is still counted as a loss since no new resident was established)</td>
<td></td>
</tr>
<tr>
<td>Number of new households added in the region through APR employment</td>
<td>+9</td>
</tr>
<tr>
<td>(counting three new hires planned in 2018)</td>
<td></td>
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<tr>
<td>Number of new households added in the region through employment related to APR leases</td>
<td>+1</td>
</tr>
<tr>
<td>(PN)</td>
<td></td>
</tr>
<tr>
<td><strong>Net gain in number of households in the region that were and are now directly associated with APR property</strong></td>
<td><strong>+6</strong></td>
</tr>
<tr>
<td>Number of households established in the region prior to APR that are now partially supported by APR employment</td>
<td>3</td>
</tr>
<tr>
<td>Number of households established in the region prior to APR which are now partially supported by APR lease and/or Wild Sky Ranching</td>
<td>21</td>
</tr>
<tr>
<td>(17 via leases [15 lessees and 2 lessee employees] and 6 via Wild Sky [2 are also APR lessees so are only counted once])</td>
<td></td>
</tr>
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</table>
campgrounds, and by providing information for visitors such as maps and signage. As a result, both public and APR land in the region are becoming popular destinations for biking, hiking, camping, wildlife viewing, photography, education, and research, in addition to the traditional uses of hunting and fishing.

In 2017, APR hosted an annual community day to discuss bison management with local residents and hosted students from Great Falls, Montana Wilderness School, University of Nebraska, Clemson University, New York City SEO Scholars, Montana State University International Students, Rocky Mountain College, and Aaniih Nakoda College. Volunteer groups and artists from around the U.S. and the world have been guests of APR at the Reserve. APR has also hosted visits of Montana elected officials, federal and state resource managers, Audubon organizations, native plant society groups, and scientists from the Smithsonian Institution, National Geographic Society and other institutions.

Gros Ventre and Assiniboine tribal leaders and members have participated in the reintroduction of bison to APR and in APR’s first “transect” that enabled people to hike, bike and camp across the reserve.

Numerous individuals and institutions have contributed financially in support of bison conservation on APR. In particular, more than 60 individuals have each contributed at least $25,000 to become members of APR’s “Band of Bison.”

D. Strategy and Actions

APR has scheduled several new construction projects for 2018. A new campground and Welcome Center on APR property along Highway 191 will continue to be installed at a cost of at least $2.5 million. The facility will include 4 small cabins, 12 RV sites with electrical hookups, 8 tent sites, a host site, restroom with flush toilets and showers, and an RV dump station. APR has designed a hut-to-hut traverse system with huts located across the approximately 200 miles of the project area. The system will include at least 10 rental huts and construction of the first three huts, at a cost of $250,000 each, started in 2017 and will continue in 2018. Additionally, APR is exploring options for a larger Visitor/Interpretive Center in Lewistown.
APR intends to raise funds to restore the historical mansion and other historical buildings on the PN management unit for public enjoyment, similar to APR's restoration of the Prairie Union School on the Sun Prairie unit.

APR will develop a bison harvest program for Montana residents and non-residents that supports the tradition of hunting in Montana and that can be used for population regulation and to generate revenues for bison management.

APR will conduct social science research on assumed/perceived negative impacts of bison on local communities, including economic effects such as fence damage, crop depredation, cattle harassment and alleged “overgrazing.”
SUMMARY

Bison conservation on APR is a cornerstone for both comprehensive restoration of the reserve’s biodiversity and for generating multiple benefits for and support by the public. A variety of ecological, genetic and socioeconomic conditions must be met to achieve the long-term goal of a population of more than 10,000 bison that (1) exhibits their historical ecological role in the grassland ecosystem and (2) harbors robust genetic variation that is adaptive to current environmental conditions and through evolutionary processes to long-term changes in their environment. A highly supportive public, from local to national to even international levels, is vital for APR to succeed in meeting these goals.

The first ten goals of this plan are aimed at restoring the bison’s ecological role based on the ten conditions of the Freese Scale for Grassland Biodiversity that APR uses as a guidepost for ecological restoration. Figure 16 summarizes how bison restoration both supports and is supported by the restoration of those ten ecological conditions and their relationship to the other three goals of this plan.
Goals of Freese Scale that support bison restoration

1. Restore plant communities
   - More & greater diversity of bison habitat; more natural behavior by bison

3. Restore role of fire
   - Nutritious post-fire forage attracts bison & foster natural grazing patterns.

4. Restore habitat contiguity
   - More natural bison movement & foraging patterns

8. Create large, ecologically self-sustaining reserve
   - More habitat; larger bison population; conserves bison genetics; conserves genetic variation and adaptive response of plant communities to climate change

Figure 16. Summary of how the plan’s 11 goals support bison restoration, how bison restoration supports the goals, and other potential effects on biodiversity. The arrows and boxes indicate only principal pathways and interactions among the goals; many indirect feedback connections among goals are not shown.
Goals of Freese Scale that bison restoration supports & examples of potential 2° effects

2. Restore herbivory patterns

5. Restore streams & riparian habitats

6. Restore temporal ecological variability

7. Restore herbivores & full role of ungulates; understand effects of natural recolonization of large carnivores

Greater habitat heterogeneity supports bird diversity & intense grazing supports prairie dog populations.

Reduced impact by bison & fewer dams & stock ponds improve stream/riparian health & fosters heterogeneous grazing.

Maintains disturbance regime under which bison & region’s other biota evolved & are adapted and will continue to evolve & adapt.

Bison grazing supports habitat diversity & improves habitat for pronghorn & prairie dogs; grazing by prairie dogs improves bison habitat. Ungulate carcasses feed scavengers & decomposers & alter floristic diversity. Trophic cascade effects of large carnivores—regulation of ungulate populations, altered ungulate foraging affects flora; coyote suppression fosters ferret & swift fox recovery

9. Genetics: 10,000 bison solid basis for long-term genetic conservation; high genetic variation enables adaptation to disease & climate change & offers gene source for other conservation herds

10. Climate change: Large areas of intact habitat & high diversity of—& genetic variation in—plants mitigate GHG emissions & increase resilience to climate change; bison more resilient than cattle to climate change

11. Public benefits: Large bison population in natural environment offers recreational, cultural & economic benefits; such benefits may increase public support for APR & grassland biodiversity

Relationships to goals 9-11

Greater habitat heterogeneity supports bird diversity & intense grazing supports prairie dog populations.

Reduced impact by bison & fewer dams & stock ponds improve stream/riparian health & fosters heterogeneous grazing.

Maintains disturbance regime under which bison & region’s other biota evolved & are adapted and will continue to evolve & adapt.

Bison grazing supports habitat diversity & improves habitat for pronghorn & prairie dogs; grazing by prairie dogs improves bison habitat. Ungulate carcasses feed scavengers & decomposers & alter floristic diversity. Trophic cascade effects of large carnivores—regulation of ungulate populations, altered ungulate foraging affects flora; coyote suppression fosters ferret & swift fox recovery

9. Genetics: 10,000 bison solid basis for long-term genetic conservation; high genetic variation enables adaptation to disease & climate change & offers gene source for other conservation herds

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11. Public benefits: Large bison population in natural environment offers recreational, cultural & economic benefits; such benefits may increase public support for APR & grassland biodiversity
This plan also recognizes the role of institutions and individuals in meeting APR’s goals for bison and for biodiversity conservation. Collaboration with Montana Fish, Wildlife and Parks, Montana Department of Natural Resources, U.S. Fish and Wildlife Service, National Park Service, Parks Canada, Bureau of Land Management, multiple nonprofit organizations, university researchers, local ranchers, tribal and community leaders, and scores of other institutions and volunteers contributes to the success of this work. BLM and the BLM lands that APR leases are particularly important, and thus this plan highlights the contributions that APR can make to enabling BLM to meet and exceed its land management goals, specifically the five Standards for Rangeland Health elucidated in the HiLine and draft Lewistown Management Plans.

This plan sets forth goals, objectives and strategies for the next 5-10 years. It is an adaptive, living document. Strategies, objectives and even goals may change as bison managers learn more about bison and their grassland ecosystem, as new lands are acquired by APR, as local, state and federal land and wildlife management policies change, and as public interest in and, we predict, support for bison conservation and APR’s mission grows.
ACKNOWLEDGEMENTS

We sincerely thank two outside reviewers—Samuel Fuhlendorf and Kathryn Schoenecker—for taking the considerable time required to review this document and for offering constructive comments. We also appreciate the input of the following APR staff: Ellen Anderson, Lars Anderson, Siri Eliasen, Alison Fox, Sean Gerrity, Pete Geddes, and Scott Heidebink.

Numerous institutions and individuals have generously offered advice, assistance and inspiration to APR bison restoration work. It is impossible here to describe the contributions that each has made, but we offer a sincere thanks to all helping restore bison on the lands of APR and in many other places across North America.

Keith Aune, WCS
Band of Bison Members
James Derr and associates
Tom France, NWF
Sam Fuhlendorff
Dr. Comack Gates and others from IUCN Bison Specialist Group
George Horsecapture, Jr., the rest of the Ft Belknap Reservation bison team, and Ft. Belknap students and drummers
Michel Kohl
Gerald Kvill
Matt McCullom and Jack Rhyan, USDA Ft. Collins Veterinary Services
Nicholas McMillan
William J. McShea
Kate Schoenecker

Dr. Schnabel, University of Missouri
Turner Enterprises
Don “Doc” Woerner
MFWP
MT Veterinary Diagnostics Lab, Bozeman
World Wildlife Fund—Northern Great Plains Program
USFWS CMR Refuge
Landmark Adventure Scientists
Mars Corporation groups that volunteer on the Reserve
Other individuals and groups that have volunteered or worked on bison handlings, fence removal, or in countless other ways
Others who have also provided feedback on this Plan
REFERENCES


Oakley, C., and P. Riddle. 1974. The impact of a severe winter and fences on antelope


USDA SCS. 2000. 1997 National Resources Inventory.


Appendix 1: Letter from APR to MFWP regarding Montana’s Draft Environmental Impact Statement for Bison Conservation and Management

August 25, 2015

Mr. Jeff Hagener
Montana Fish Wildlife and Parks


I write to express American Prairie Reserve’s support for and interest in participating in Alternative #2 and/or #4 as described in the State of Montana’s Draft Environmental Impact Statement for Bison Conservation and Management. APR will be pleased to engage with principles from the relevant parties, e.g., the Charles M. Russell National Wildlife Refuge and the State of Montana, to explore a cooperative arrangement that advances either of these alternatives.

The mission of American Prairie Reserve is to create and manage a prairie-based wildlife reserve that, when combined with public lands already devoted to wildlife, will protect a unique natural habitat, provide lasting economic benefits, and improve public access to and enjoyment of the prairie landscape.

As you indicate in EIS, and documented in IUCN North American bison conservation guidelines (2010), bison are classified as near threatened and bison are ecologically extinct in Montana and the US. They are a tier 1 species in the state’s comprehensive wildlife management plan. No viable wild population exists in the state and nationwide the only large population is in Yellowstone. As proposed by Sanderson et al (2008) and others, populations need to be greater 1,000 to provide a “large contribution” to ecological recovery. This is also true from a genetics standpoint.

Among American Prairie Reserve’s primary objectives is the development of one of the largest, most genetically-diverse, disease-free, and ecologically effective conservation bison herds in North America. This will secure the long term ecological restoration of bison in Montana and be a significant share of restoration in North America.

In 2005, we began this effort with the introduction of 16 bison imported from Wind Cave National Park. Today, with natural growth and additional imports from Canada’s Elk Island National Park, our herd numbers in excess of 600 animals, all of which currently reside on 31,000 acres (48 square miles) of our Sun Prairie property (see map). On Sun Prairie alone we have removed more than 45 miles of interior fencing, allowing bison to graze unencumbered and wildlife to move without hindrance. As the herd grows, we will expand the land base to keep pace with our ultimate goal of over 10,000 bison.

In the past decade, American Prairie Reserve’s bison management track record is known for its lack of contention with our neighbors. In fact, most of them consider American Prairie Reserve an excellent example of how bison can be managed effectively on a relatively large landscape with no negative effect on nearby livestock operations. This state of affairs
speaks to American Prairie Reserve’s effective and responsible management as well as our demonstrated commitment to securing the resources necessary to nurture and grow this herd. Our bison have not caused any cattle disturbance, competition for forage, disease transmission, or fence damage to our neighbors. We have had only 6 documented cases of bison moving beyond APR fence and these were handled as promised by quick removal or return to APR with no associated costs to neighbors proving such can be done on a large landscape in the presence of cattle. There has been no risk to public safety.

Bison have been compatible with/beneficial to other wildlife. Our research done in collaboration with the University of Montana and Clemson University and grazing monitoring done by BLM have indicated no negative, but rather beneficial impacts to range conditions. We have documented bison grazing in a significantly different way than cattle, less uniform creating a greater diversity of habitats. Bison also spend less time in riparian areas and near water than cattle. We also have documented significant public interest in viewing our bison and significant positive economic benefit.

APR’s long term goal for bison restoration related to the Montana EIS process is to build an ecologically effective population of over 10,000 bison co-managed for the benefit of the public of Montana and the nation across a large blended jurisdiction landscape of APR, BLM and USFWS lands. Regarding Alternatives #2 and/or #4, American Prairie Reserve is willing to:

• Provide, free of charge to the State of Montana, an ecologically significant number of bison toward a five-year experiment in which these animals occupy an appropriately large area of the UL Bend (and beyond) in the Charles M. Russell National Wildlife Refuge. The final number will be large enough to assure genetic diversity is maintained.

• Participate in annual evaluations conducted by the management team made up of representatives from FWP, CMR and American Prairie Reserve to identify progress and address concerns.

• Help develop local community involvement, assessment, and review

• Commit the financial and human resources necessary to construct wildlife-friendly fencing (successfully tested for almost a decade on American Prairie Reserve lands, including those along the boundary of Sun Prairie and the CMR) and allocate American Prairie Reserve staff time and equipment to provide other containment tools, conduct research and co-manage this experiment.

• Finally, we will take back the bison and reestablish them in American Prairie Reserve’s herd should the experiment not prove successful.

American Prairie Reserve is a uniquely-suited collaborator. We have a decade of proven success restoring, researching, monitoring, and managing bison in this region of Montana. Our positive reputation with neighbors and federal and state land management partners has been earned over many years of doing what we say we are going to do. We have not documented any single significant conflict with our neighbors. This was most recently evidenced at Malta bison EIS meeting on August 19 where a significant number of general anti-bison comments were made, but almost none of those were directed at APR bison management.
We believe we have not only the best source herd of bison in the nation (no cattle gene introgression, no disease, genetically diverse, already on the landscape under natural management and yielding significant ecological benefits) but also the talent, resources and organizational willingness and enthusiasm to help make this effort a stunning success.

Sincerely,

[Signature]

Sean Gerrity
President

CC:

Mr. Jeff Hagener, Director, Montana Department of Fish, Wildlife, and Parks
Mr. Mike Volesky, Chief of Staff, Montana Department of Fish, Wildlife, and Parks
Mr. Paul Santavy, Project Leader, Charles M. Russell National Wildlife Refuge
Mr. Michael Bean, Deputy Assistant Secretary for Fish and Wildlife and Parks, United States Department of the Interior
Mr. Tom France, National Wildlife Federation
Appendix 2. APR Bison and Lessee Cattle Management Plans During Wildfire, Drought, Flood, and Deep Snow

Following are American Prairie Reserve’s specialized bison and lessee cattle management plans for natural events such as wildfire, drought, flood, and deep snow. This document is a guide for actions to consider at the time of these events. Actual decisions and actions will be based on a case-by-case basis at the time of the event and will be documented, along with the rationale for the decisions. This is a living document that will be modified as circumstances dictate or better information becomes available.

When possible, haying will be done at the level necessary to maintain the needs of the bison, as shown below, and to reduce fuel loads. Haying is often done by grazing lessees for a share of the hay, in lieu of their grazing the hay pastures. Generally, tame forage species are not maintained to provide hay pastures.

Prescribed fire is used to improve rangeland heterogeneity, improve nutritional value of forage and/or strategically reduce or manage the distribution and/or level of fuel loads.

A. Wildfire - APR Bison and Lessee Cattle Management

Depending on weather and fuel moisture, wildfires on the prairie can spread extremely rapidly, leaving little time to take action before the fire impacts an APR land unit, and cover a good portion of the project area. APR’s top priorities in relation to wildfire will be the safety of people—employees, employee’s families, the public—and then livestock (APR’s bison and lessees’ cattle). Bison and lessee cattle management decisions in relation to fire will be made specific to each fire and each APR land unit.

1. Pre-Wildfire Preparation Actions

   a. An assigned APR employee, the Reserve Facilities Supervisor, is responsible for becoming familiar with BLM and FWS web-based tools and information related to wildfires in the project area. Starting in May of each year the assigned employee keeps other APR employees informed daily regarding fire danger, fire restrictions, wildfire starts, fire teams, and fire suppression actions in the project area.

   b. Identify and establish hay storage facilities that are fire resistant and maintain at least 30 days of hay for the entire herd in those facilities.

   c. Have enough fencing materials on hand and in fire resistant storage to fence bison on deeded land in case BLM and State land is burned and will be unavailable for use for a period of time.

2. During Wildfire Actions

   a. When there is a wildfire within 15 air miles of an APR land unit APR will convene a group of at least two bison managers to map the fire in relation to APR properties and to determine trigger points for subsequent bison management actions. Those trigger points will take into consideration the expected rate and direction of fire spread given fuel modeling, current and expected wind speeds and direction, and drought index. At least once a day the fire location and trigger points will be reviewed by at least two bison managers, until the fire is declared contained. Trigger points to establish include:

      i. When and where to open gates, turn off electric fences, and/or cut wires to allow bison to escape the oncoming fire. When and where
to remove solar panels and batteries and where to store them. Be sure to allow ample time for APR employees to safely leave the area after accomplishing these tasks. If potentially impacted properties are leased to cattle ranchers notify the lessees of the risk and coordinate plans with them.

ii. When and how to evaluate the fence situation, if necessary, post fire and to identify necessary resources for containing bison.

iii. When and how to locate and retrieve livestock (bison) if necessary, post fire. Note that helicopters/aircraft may not be an option during times when fire suppression activities include air traffic because of a flight restrictions or heavy smoke. During a busy fire season helicopters and pilots can also be difficult to obtain.

iv. Based on properties potentially impacted identify bison or cattle populations at each and what percent of property could burn before we need to remove animals (bison or lessees cattle).

b. When implementing trigger point actions document what actions are taken and where so after the fire is contained the necessary closing of gates, fixing fence, reinstalling solar panels and batteries, etc., can be accomplished in an efficient and effective manner.

1. Post Wildfire Actions

a. As per timing identified in the trigger points, assess fencing needs and locate bison.

b. If needed euthanize badly injured bison.

c. Contact BLM and State to determine any grazing restrictions on allotments and leases and inform them of the status of the bison. Continue to keep BLM and State informed on bison status as they are gathered, if necessary to gather. BLM and State treat fire on a case-by-case basis depending on acres burned, severity of burn, season, and allotment.

d. If bison were released from fenced areas contact appropriate neighbors to inform them the status of bison and keep them informed as bison are gathered.

e. Assess fire impacts to deeded land and based on that and input from BLM and State determine bison feeding needs for next 30 days.

f. Fix fence and/or build temporary fence and feed bison with hay as necessary.

g. Decide within 7 days post-fire if any animals will be shipped and their destination. Animals will not be moved to another APR property for fire relief as this only necessitates a complete shift in future bison stocking plans. Any modifications to the Bison Management stocking plan must be approved by the Bison Management Team.

h. Buy more hay if feeding time is expected to extend beyond a month and to replace hay that is expected to be used.

i. Monitor and document burned area for regrowth, erosion, and hazards.
B. Drought – APR Bison and Lessee Cattle Management

Drought in the project area is common. Partially because of this APR has proposed a stocking rate on their deeded land calculated using the NRCS method at the Below Normal Precipitation stocking rate. APR also reviewed BLM and State stocking rates in relation to the NRCS method of calculations and found the BLM permitted and State leased AUMs were lower than the Below Normal Precipitation stocking level or somewhere between the Below Normal and Normal Precipitation stocking levels. These lower stocking rates give APR some additional flexibility in responding to drought conditions.

Drought management decisions will be made specific to each APR land unit and based in part on the number of bison and/or lessee cattle on those units. As per the fire section, listed in A above, enough hay to feed the entire herd for 30 days and fencing materials to keep bison on deeded land will be located in fire-resistant storage facilities.

Animals will not be moved to another APR property for drought relief as this only necessitates a complete shift in future bison stocking plans. Any modifications to the Bison Management stocking plan must be approved by the Bison Management Team.

Haying of native vegetation and prescribed fire will be used as necessary to improve general range conditions, improve forage nutritional value, reduce fuels, and provide for stockpiled hay needs.

The US drought monitor at http://droughtmonitor.unl.edu/ will be used to identify drought intensity and to trigger actions described below. An APR employee, the Bison Management Specialist, is responsible for tracking the drought intensity ratings for the project areas through the year and especially during the summer months. This assigned employee will regularly inform other APR employees on any drought situation and impending management actions that will be needed.

As drought indexes change at least two APR bison managers will meet to determine actions they will take, based on the following. If the actions below are not taken APR will document their rationale for deviating from the plan below.

Many of the following actions may initially seem drastic or too heavy-handed. Strong actions at the beginning of a drought make it much easier to manage if it is an extended or multi-year event. It is easier to take more time to build the herd than to remove numerous animals from several properties at the same time. The actions ramp up quickly and wind down slowly for the same reason.

Herd size reduction decisions will be made on a case-by-case basis because it is unknown until then which, if any, of the property units will be fully stocked at the time of drought. This plan identifies how APR will closely monitor the drought situation and stocking levels on each property unit and how they will ensure availability of necessary forage/hay.

1. No Drought Rating – Normal or Above Normal Precipitation and Drought Rating of D0 – Abnormally Dry

   a. Manage for NEPA-permitted bison numbers.

2. Drought Rating of D1 – Moderate Drought

   a. Assess stocking level and forage conditions and determine if herd size reduction is necessary on affected management units.

   b. Buy an additional 2 weeks of whole-herd hay for affected management units.
c. Identify and contact possible bison recipients.

d. If herd size reduction is deemed necessary, remove animals by increasing the harvest through issuance of additional bison harvest tags and other harvest methods and/or by translocating bison, preferably to other conservation herds.

e. Ensure operation of supplemental waterers. (Document the watering capacity of supplemental waterers and the calculations of the watering needs.)

3. Drought Rating of D2 – Severe Drought

a. Assess stocking level and forage conditions and decide if herd size reduction is necessary on affected management units.

b. Identify and contact possible bison recipients.

c. If herd size reduction is deemed necessary, remove animals by increasing the harvest through issuance of additional bison harvest tags and other harvest methods and/or by translocating bison, preferably to other conservation herds.

d. Monitor stock dam water levels and salinity and document results. Determine if results warrant additional actions.


a. Assess stocking level and forage conditions and decide if herd size reduction is necessary on affected management units.

b. Buy an additional 2 weeks whole-herd hay for affected properties (now at 8 weeks feed).

c. If herd size reduction is deemed necessary, remove animals by increasing the harvest through issuance of additional bison harvest tags and other harvest methods and/or by translocating bison, preferably to other conservation herds.

d. Contact agencies about likelihood of destocking or grazing restriction.

e. Ensure equipment or contractors are available to build temporary fence to restrict animals to deeded.

f. Monitor stock dam levels and salinity and document results. Determine if results warrant additional actions.

5. Drought Rating of D4 – Exceptional Drought

a. Assess stocking level and forage conditions and decide if herd size reduction is necessary on affected management units.

b. Consider buying 2 more weeks of hay depending on hay prices, resource condition, and season.

c. If herd size reduction is deemed necessary, remove animals by increasing the harvest through issuance of additional bison harvest tags and other harvest methods and/or by translocating bison, preferably to other conservation herds.

d. Feed as needed.

e. Monitor stock dam levels and salinity and document results. Determine if results warrant additional actions.

f. Monitor stock dam levels and salinity. Determine if results warrant additional actions.
If drought intensity persists for more than one growing season, move up 2 intensity levels for actions (e.g., D0 for more than one year → take actions for D2). Extended D4 will result in extreme destocking.

6. Post Drought Actions

Maintain highest intensity management actions until the index drops 2 levels (e.g., In D4 and managing that way until index drops to D2, then take on those actions.)

C. Flood – APR Bison and Lessee Cattle Management

1. Pre-Flood
   a. Pre-identify areas and facilities most apt to be impacted by floods.
   b. At least two APR bison managers will meet to determine actions they will take, based on the following. If the actions below are not taken APR will document their rationale for deviating from the plan below.

2. During Flood
   a. Monitor bison locations using GPS collars.
   b. As possible, monitor flood locations and impacts.

3. Post Flood
   a. Determine where bison and/or cattle are located and if any have escaped. If escapes have occurred make the necessary plans and arrangements for the immediate retrieval of bison as per the bison escape protocol.
   b. Assess flood damage starting at areas most likely to be impacted first and make needed repairs, especially to fences and bison holding facilities.

D. Deep Snow – APR Bison and Lessee Cattle Management

1. Pre-Snow
   a. Pre-identify areas and facilities most apt to be impacted by heavy snows.
   b. At least two APR bison managers will meet to determine actions. If the actions below are not taken APR will document their rationale for deviating from the plan below.

2. During Deep Snow
   a. Monitor bison locations using GPS collars.
   b. As possible, monitor heavy snow locations and impacts and remove snow.
   c. Feed as necessary.

3. Post Deep Snow
   a. Determine where bison and/or cattle are located and if any have escaped. If escapes have occurred make the necessary plans and arrangements for the immediate retrieval of bison as per the bison escape protocol.
   b. Assess snow damage starting at areas most likely to be impacted first and make needed repairs, especially to fences and bison holding facilities.
Appendix 3. AUMs for each APR management unit using NRCS method and calculated by Environmental Planning and Management Solutions, Inc. (EMPSi). Totals may not reflect the sums of deeded, BLM, and State because of rounding. Base data for these calculations can be obtained from EMPSi, APR, BLM, or DNRC.

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<th>AUMS at Normal Precipitation</th>
<th>AUMS at Above Normal Precipitation</th>
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Appendix 4: Bison Escape Protocol

In the event APR is notified bison have escaped from APR deeded and/or leased property:

• Notify a core member of the Reserve Team immediately! Core members of the Reserve Team are Reserve Operations Manager, Reserve Assistants, Bison Management Specialist, and Reserve Land Manager.

• Within 24 hours of notification of a bison escape the Reserve Team will search for and attempt to return the animal(s) to APR deeded and/or leased property. Once the bison are located the Reserve Team will assess the situation and create an action plan to safely return the bison back to APR deeded and/or leased property. Use of immobilization drugs and transport by trailer is a safe and efficient method of bison retrieval and will be one of the first methods to consider. The Reserve Team will determine who owns the property where the bison are located and which properties they will have to cross to be returned.

  • When herding bison remember:
    ■ Take it slow and try not to startle the bison into running.
    ■ Do not run bison through a fence. We need the bison to respect fences.
    ■ Bison move more effectively when they feel outnumbered. Sometimes it just takes adding one or two more people to move them.

• A member of the Reserve Team will be assigned the responsibility to communication APR bison return plans and actions to all the landowners and land management agencies where the bison are located or where the bison will need to travel to be returned. The assigned Reserve Team member will obtain land owners and land managers approval of APR’s proposed activities/actions on their property. The assigned Reserve Team member will continue at least daily communication with the landowners and land managers until they have been notified the bison have been returned to APR deeded and/or leased property or have been harvested and removed.

• Once the bison are returned to APR deeded and/or leased property or have been harvested and removed an assigned member of the Reserve Team will coordinate with the affected landowners and land managers to assess damages and agree to repairs or damage reimbursements.

• If more than 3 or 4 bison escape a helicopter will likely be used to return them to APR deeded and/or leased property. A Reserve Team member will be assigned to arrange for a helicopter. Explain to the dispatcher what you are doing and they send the best model of helicopter for the job. Many times we use a Jet Ranger. A Reserve Team member may be assigned to ride in the helicopter. When in the helicopter it is important to remember that you are in charge of the situation and you need to clearly instruct the pilot how and where to move the bison.

  • Flying Resources:
    ■ Central Air Service (Lewistown) fixed wing and helicopter 406-535-3767
    ■ Central Copter (Bozeman) helicopter 406-586-9185
    ■ Choice Aviation (Hamilton) helicopter 406-360-6842
    ■ Dixon Hitch (Malta) fixed wing 406-390-0114
The decision to use lethal force resides with Reserve Operations Manager or if they are unavailable, Reserve Assistants, Bison Management Specialist, or Reserve Land Manager. Decisions regarding lethal force will be made on a case-by-case basis. The decision-maker may authorize another individual (a neighbor, FWP, etc.) to use lethal force.

- Reasons to use lethal force:
  - Bison is out for more than 48 hours.
  - Landowner concerns regarding damage or harm.
  - The bison will not be herded and is aggressive.
  - There is no reasonable way to get a bison back in a timely manner.
  - Bison have potentially been exposed to transmittable disease that could negatively impact the remainder of the bison herd, neighboring livestock, or local wildlife.

It is important to save the meat of the bison if possible. Call ahead to a locker to have it processed:

- Smith Wild Game Cutting (Zortman) 406-673-3269 or 406-250-3423
- Quality Meats of Montana (Miles City) 406-232-0689