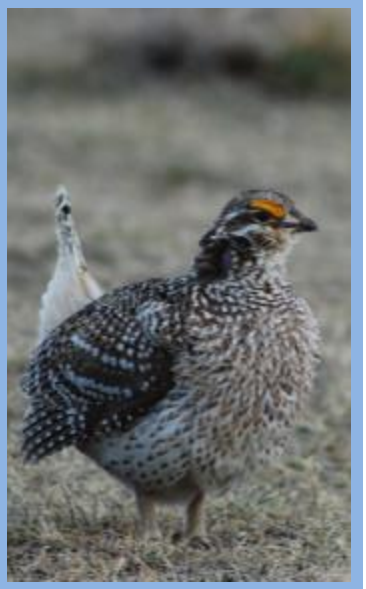
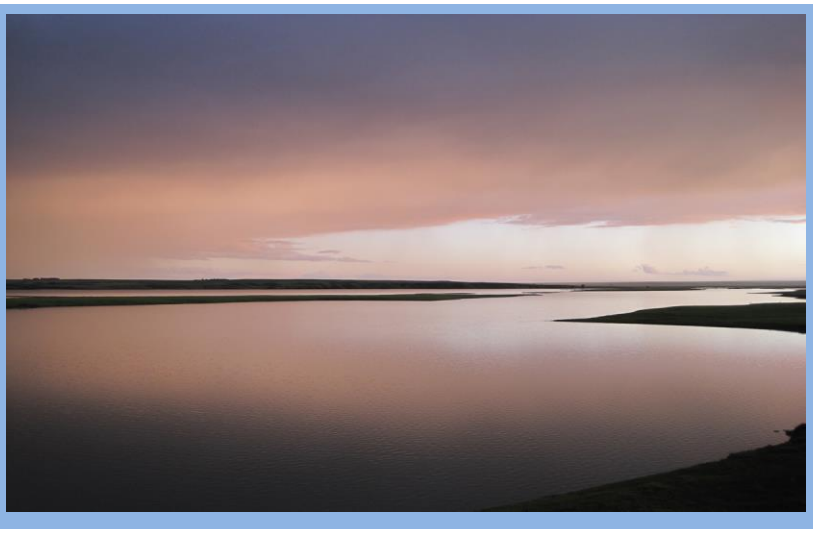
Medicine Lake Wilderness

A Report on Wilderness Character Monitoring

Sarah Shpak



2013



U.S. FISH AND WILDLIFE SERVICE

This report is part of a national initiative to establish baseline wilderness character for all the National Wildlife Refuges with designated wilderness. The measures for each wilderness were developed with refuge staff and reviewed at the national level.

Michelle Chappell 12/05/2013

Michelle Chappell, Refuge Manager, Medicine Lake NWR **Date**

6/10/15

Nancy Roeper, National Wilderness Coordinator, NWRS **Date**

Table of Contents

INTRODUCTION

The Wilderness Act of 1964 was established to protect natural lands from the seemingly endless threat of "expanding settlement and growing mechanization." The primary mandate of the Wilderness Act, Section 4(b), states that "each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area." Today, many wilderness field and program managers perceive steady erosion in wilderness character caused by widespread threats[1], but lack a consistent definition of wilderness character and the means for measuring its loss or preservation or assessing the impact of stewardship.

In 2006, an Interagency Wilderness Character Monitoring Team – representing the Department of the Interior Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, U.S. Geological Survey and the U.S. Forest Service (Department of Agriculture) – was established to promote wilderness stewardship and develop a standard definition of wilderness character and strategy for monitoring trends in wilderness character. The Team identified 5 qualities of wilderness character based on the language of the Wilderness Act[2]:

Untrammeled
"An area where the earth and its community of life are untrammeled by man"

Undeveloped
"An area of undeveloped Federal land … without permanent improvements or human habitation"

Natural
"Protected and managed so as to preserve its natural conditions"

Solitude or Primitive and Unconfined Recreation
"Has outstanding opportunities for solitude or a primitive and unconfined type of recreation"

Other Features of Value
"May also contain ecological, geological, or other features of scientific, educational, scenic, or historical value"

These qualities apply to all designated wilderness areas – regardless of their size, location, administering agency, or other unique place-specific attributes – because they are based on the legal definition of

[1] Cole, D.N. 2002. Ecological impacts of wilderness recreation and their management. *In* Wilderness Management: Stewardship and Protection of Resources and Values (J.C. Hendee and C.P. Dawson, editors). Third Edition. Golden, CO: Fulcrum Publishing: 413-459.

Cole, D.N.; Landres, P.B. 1996. Threats to wilderness ecosystems: impacts and research needs. Ecological Applications 6:168-184.

Hendee, J.C; Dawson, C.P. 2001. Stewardship to address the threats to wilderness resources and values. International Journal of Wilderness 7(3):4-9.

Landres P.; Marsh, S.; Merigliano, L.; Ritter, D.; Norman, A. 1998. Boundary effects on national forest wildernesses and other natural areas. *In* Stewardship Across Boundaries (R.L. Knight and P.B. Landres, editors). Washington, DC:Island Press: 117-139.

[2] Landres, P.; Barns, C.; Dennis, J.G.; Devine, T.; Geissler, P.; McCasland, C.S.; Merigliano, L.; Seastrand, J.; Swain, R. 2008. Keeping it Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System. 81 pages. USDA Forest Service, Rocky Mountain Research Station General Technical Report RMRS-GTR-212, Fort Collins, CO.

wilderness. In addition to the four tangible qualities there are also important intangible aspects of wilderness character that would be difficult or even impossible to quantify or monitor. These intangible aspects are diverse and include the scenic beauty, spiritual experience, immensity of an area, and the opportunity for self-discovery, self-reliancy, and challenge that comes from wilderness settings. Currently, these intangible aspects of wilderness can only be addressed in narrative form.

Wilderness character may be either preserved or degraded by the actions or inaction of managers. The challenge of wilderness stewardship is that decisions and actions taken to protect one aspect of wilderness character may diminish another aspect. In addition, the accumulated result of seemingly small decisions and actions may cause a significant gain or loss of wilderness character over time. Because of this complexity, preserving wilderness character requires that managers document decisions made and the impacts of those decisions.

In 2008, the Team published an interagency strategy for monitoring trends in wilderness character across the National Wilderness Preservation System titled *Keeping it Wild.* The framework is based on the qualities of wilderness character defined above. Each quality is divided into a hierarchical set of monitoring questions, indicators, and measures to assess trends in wilderness character. While the qualities, monitoring questions and indicators are nationally consistent, measures are specific and sometimes unique to individual wilderness areas (Figure 1).

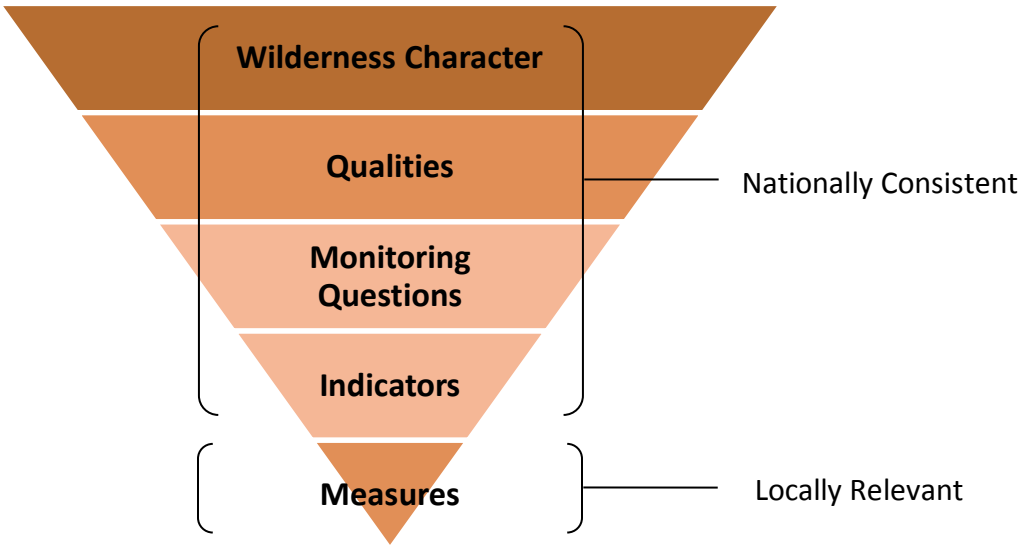


Figure 1. Keeping it Wild Hierarchical Framework

This approach balances national and local needs for monitoring by defining locally relevant measures whose trends can be compiled at higher levels for national or regional reporting. This interagency monitoring strategy:

- Provides on-the-ground information to assess trends and make defensible decisions;

- Provides regional and national information to evaluate policy effectiveness;
- Communicates a positive and tangible vision for what wilderness is within the agency and with the public;
- Allows managers to understand consequences of decisions and actions in wilderness;
- Evaluated and documents the effects of actions taken inside the wilderness and effects from threats outside the wilderness
- Provides solid information for planning;
- Synthesizes data into a single, holistic assessment of wilderness character;
- Guards against legal vulnerability;
- Improves on-the-ground wilderness stewardship.

Under this monitoring strategy, wilderness character in a particular wilderness cannot, and will not, be compared to that of another wilderness. Each wilderness is unique in its legislative and administrative direction, and in its social and biophysical setting. Therefore, comparing wilderness character among different wildernesses is inappropriate. The purpose of this monitoring strategy is to offer a consistent means for documenting trends in wilderness character and wilderness management within a wilderness, not across wildernesses. This strategy has proved to be an effective tool for wilderness managers with limited resources.

The following report establishes a baseline condition and monitoring strategy for the Medicine Lake National Wildlife Refuge wilderness based the interagency strategy outlined in *Keeping It Wild.* A Wilderness Character Monitoring Database accompanies this document including entries for all measures and baseline data specific to this refuge.

HISTORICAL AND ADMINISTRATIVE SETTING OF THE MEDICINE LAKE WILDERNESS

History of establishing the wilderness

Medicine Lake National Wildlife Refuge was established by President Franklin D. Roosevelt in 1935. Originally known as *Medicine Lake Migratory Waterfowl Refuge*, it is located on the glaciated rolling plains of northeastern Montana and contains 31,660 acres. The U.S. Resettlement Administration acquired the major portion of the refuge, consisting of 19,953 acres, through emergency funds. The additional acreage was attained through Migratory Bird Hunting Stamp Act funds and donations. The refuge consists of two noncontiguous areas:

1) The 28,396-acre Main Unit containing the 8,218-acre Medicine Lake, and 17 smaller bodies of water and adjacent grasslands.
2) The 3,264-acre Homestead Unit, including 1,280 acres of wetlands in five water units and the rest of the grassland habitat.

The refuge comprises 11,360 acres of federal wilderness land that was established in 1976. The wilderness includes Medicine Lake with its natural islands and the 2,300-acre Sandhills portion. The refuge is located as part of the central waterfowl flyway on the edge of the prairie pothole highly productive waterfowl area. The area lies within the ancestral flight path of ducks, geese, swans, sandhill cranes, and often whooping cranes moving to and from northern breeding grounds

Refuge purposes

National wildlife refuges are established under a variety of legislative acts, administrative orders and authorities. These orders and authorities include one or more specific purposes for which refuge lands are acquired. The purposes are of key importance in refuge planning, and are the foundation for management decisions. The purposes of a refuge are specified in, or derived from the law, proclamations, executive order, agreement, public order, donation document, or administrative memorandum establishing, authorizing, or expanding a refuge, refuge unit or refuge subunit.

The establishing authorities and related purposes for Medicine Lake National Wildlife Refuge, as established by Franklin D. Roosevelt on August 19, 1935 by Executive Order No. 7148 include:

> *"to effectuate further the purposes of the Migratory Bird Conservation Act (45 Stat. 1222) in Sheridan and Roosevelt counties, Montana… reserved and set aside...as a refuge and breeding ground for migratory birds and other wildlife"*

The Migratory Bird Conservation Act (16 U.S.C. 712d) states that certain lands shall be:

> *"…for use as an inviolate sanctuary, for any other management purposes, for migratory birds."*

Medicine Lake Refuge conserves natural resources by restoring and protecting native mixed-grass prairie and maintaining high-quality nesting habitats within the refuge complex. Although the refuge was established primarily as a breeding ground for migratory waterfowl, all wildlife and wildlands are essential concerns for management. While the original management goals still apply, goals have expanded to include the following responsibilities:

- Full protection of rare and endangered species
- Promoting an understanding of wildlife and the wildlands ecosystem for public enjoyment and educational purposes
- Providing optimized levels of wildlife and wildlands oriented recreation

- Promoting and preserving diversity and healthy abundance of all wildlife on the refuge

Refuge staff continues to preserve, manage, and protect the 11,360-acre Medicine Lake Wilderness. Management practices mimic historical natural disturbances to protect native plant communities, using the minimum tool concept, ensuring compliance with Class I Air-Quality standards, and protecting the vista and aquatic resources of Medicine Lake. Wildlife management will focus on habitat improvement for healthy populations.

As stated in the Comprehensive Conservation Plan, the Medicine Lake Refuge aims to provide:

> *"Visitors…on the western edge of the Missouri Coteau, experience wide-open grasslands, vast lakes and marshes, and one-of-a-kind sunsets, diverse habitats for migratory birds and native wildlife are managed to stimulate the natural processes that historically shaped the prairie landscape. The spring and fall migrations are awe-inspiring against the big Montana sky. The refuge team works collaboratively with partners and the community to conserve, protect, and restore the wildness of the rolling prairies and its natural solitude.*

BIOPHYSICAL SETTING OF THE MEDICINE LAKE WILDERNESS

Geographic setting

Medicine Lake Refuge is situated on the glaciated rolling plains in the northeast corner of Montana. It is located in Sheridan and Roosevelt Counties; the wilderness portion of the refuge is located entirely in Sheridan County. The refuge is bounded on the south by the Missouri River, on the north by Saskatchewan, Canada, and North Dakota on the east. The refuge lies within the highly productive Prairie Pothole Region (fig. 2) of the Northern Great Plains and has topography typical of the glacial drift prairie.

Medicine Lake National Wildlife Refuge lies within the main stem Missouri River ecosystem and the Upper Missouri river ecosystem. The main stem is primarily in South Dakota, with sections extending into southern North Dakota, northern Nebraska, northeastern Wyoming, and eastern Montana. Prairie potholes, a major land feature, were formed during the Pleistocene glaciations, a period 2 million years ago when glaciers swept through the region, scraping the landscape and creating depressions, or "potholes". The glaciated prairies of North Dakota, South Dakota, and Montana cover approximately 60 million acres.

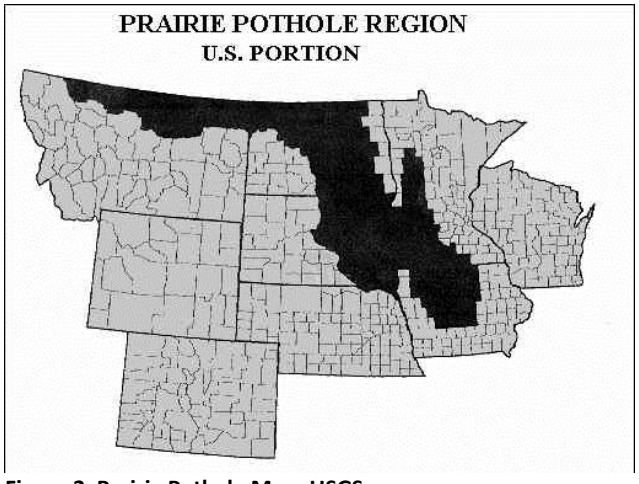


Figure 2. Prairie Pothole Map- USGS

The town of Medicine Lake is located near the northwest boundary of the Medicine Lake National Wildlife Refuge. The Fort Peck Indian Reservation borders the west boundary. The towns of Plentywood and Culbertson are about 20 miles equidistant north and south, respectively, along Montana State Highway 16.

Figure 3. Medicine Lake Location Map- USFWS

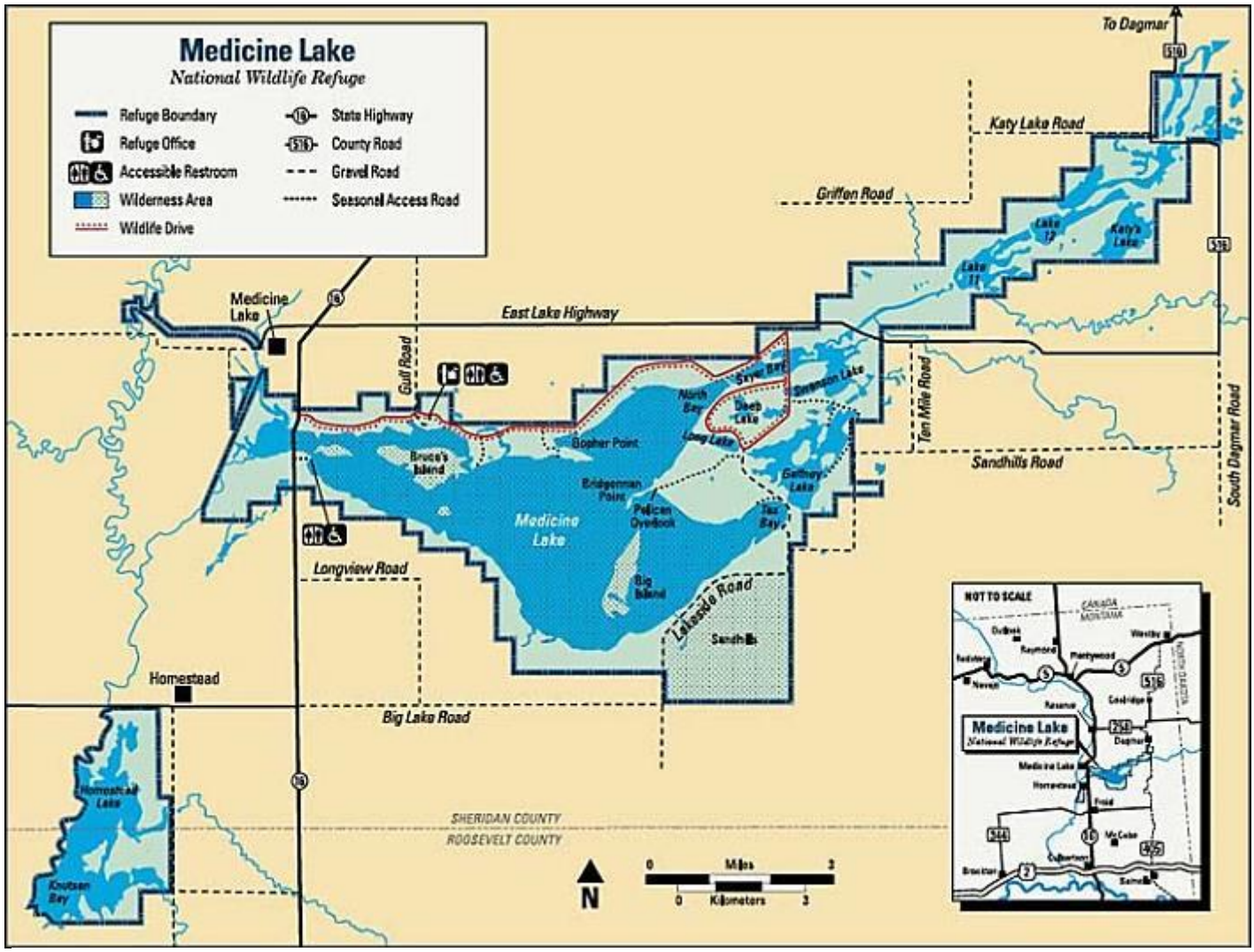


Figure 4. Medicine Lake National Wildlife Refuge Map- FSW

Ecological setting

The refuge consists of two noncontiguous tracts. The main tract includes the 8,218 acre Medicine lake wilderness, five smaller lakes, numerous potholes, and the 2,320 acre Sandhills, consisting of rolling hills, native brush patches, and a few relic stands of quaking Aspen. The smaller tract to the south contains 1,280 acre Homestead Lake. Four locations of the refuge were denoted as research areas in 1972 which include Bruce's Island (376 acres), Big Island (251 acres), Tepee Hills (95 acres), and Homestead (39 acres). To the southeast of the lake are large sand deposits that formed as the wind scoured sand out of the lake bed. Gentle sand plains and small ridge systems developed parallel to the prevailing northwest wind, with resulting choppy sand dunes ranging between 20 and 40 feet in height. These Sandhills comprise over 20 square miles and is one of the most extensive Sandhills formations in Montana. Medicine Lake is a large, shallow, brackish lake with depths averaging 1-2 yards and up to 4 yards in some areas. It is the largest natural lake in eastern Montana. During the 1930s, the Worker's Progress Administration and Civilian Conservation Corps crews installed water control structures throughout the refuge. Prior to the construction of the water control structures, water levels in the lake fluctuated widely and regularly receded during the summer, exposing extensive alkali mud-flats. The water level is maintained at a more constant and deeper water level, which aids in providing the breeding and stopover habitats for migratory birds as well as sustaining a Northern Pike sport fishery. A fish prey-base in refuge lakes fluctuates because the shallow lakes and marshes are prone to periodic winter kills. Natural re-colonization of fish through tributaries and stocking of Northern Pike, however, occur regularly.

Historically, the Medicine Lake National Wildlife Refuge area was a treeless expanse of prairie, with plants kept in relatively short stature by frequent fires and grazing by native mammals, most commonly, bison. Settlement by Europeans during the early 1990s brought extreme changes that impacted the vegetation of Medicine Lake National Wildlife Refuge. These changes included suppression of wildland fires, extirpation of bison and their replacement by domestic livestock, and the tilling and farming of the prairies. Settlers also planted trees as windbreaks and introduced exotic plants to the landscape. Approximately 60 percent of this area is now cultivated, primarily for small grains, with recent increases in oil seed crops such as safflower and canola. The original prairie grasslands have been rapidly dwindling as agriculture has come to dominate the landscape.

The climate of this region is characteristic of the northern Great Plains, with cold winters, hot summers, and peak rainfall during the early-to-mid growing season. Weather is often extreme and variable, with periodic drought, severe blizzards, great fluctuations in temperature both annually and daily, and frequent strong winds. Annual precipitation averages 13 inches, but fluctuates greatly. Total annual snowfall averages 27 inches. Average daily minimum and maximum temperatures are -4°F in January and 85°F in July.

The northeast corner of the refuge complex experienced episodes of glacial advances leaving the distinctive, hummocky, collapsed glacial moraine known as the Missouri Coteau. This steep, irregular terrain produced a high density of wetland basins of assorted shapes and sizes, known as the previously mentioned 'prairie potholes'. Bedded glacial sediments lie in low points of the topography in closed-basin watersheds, forming some of the most extensive alkali lake systems in the state of Montana.

Medicine Lake National Wildlife Refuge has been designated as one of the top 100 Globally Important Bird Areas in the United States by the American Bird Conservancy. Historically, the bird community of Northeast Montana was composed of prairie nesting species. Endemic chestnut-collared longspur, Baird's sparrow, Sprague's pipit, and lark buntings were among the most common songbirds, and ground nesting ferruginous hawks, burrowing owls, shorteared owls, northern harriers, and Swainson's

hawks dominated the raptor community. The changes caused by agriculture and human settlement greatly decreased the abundance of most native prairie-nesting species, while fostering some increases in tree-nesting species such as great-horned owls, red-tailed hawks, black-billed magpie, crows, and many nonendemic songbirds. Sharp-tailed grouse are one of the few native prairie birds that are year-round residents. Grouse breed commonly throughout the refuge with at least 30 leks within the refuge boundaries. Besides song birds, the importance of this area to breeding and migratory waterfowl has long been recognized and was the primary reason for the purchase of the refuge in 1935. The density of breeding duck pairs is highest in the Missouri Coteau and the refuge complex. The most common nesting duck species are mallards, gadwall, northern pintail, northern shoveler, blue-winged teal, and lesser scaup, with a total of 14 species breeding locally.

Besides waterfowl and song bird species, the American White Pelican (AWPE) has bred annually on Medicine Lake National Wildlife Refuge since 1939. The Medicine Lake AWPE colony is the largest in Montana and the fifth largest in North America. The pelican colony is located on two islands (Gull and Big Islands) and a nearby peninsula (Bridgerman Point) in Medicine Lake. Gull Island is a small (<1 acre), mostly rock island that in some years is completely inundated, and Big Island is a vegetated, gravel based island of 247 acres. Bridgerman Point is a narrow peninsula that extends into Medicine Lake

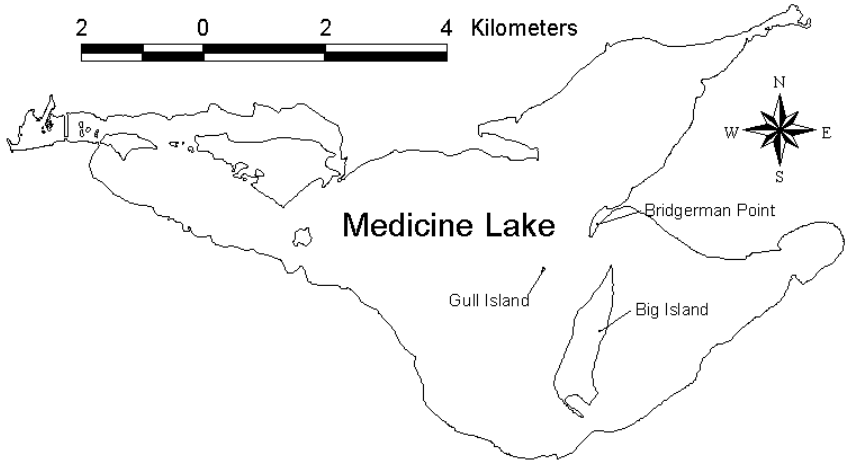


Figure 5. Locations of American White Pelican nesting Colonies on Medicine Lake and its Islands- FWS

DOCUMENTS CONSULTED

- Comprehensive Conservation Plan- Medicine Lake National Wildlife Refuge Complex
- Wilderness Management Plane-Medicine Lake Wildlife Area
- Monitoring Native Prairie Vegetation: The Belt Transect Method
- History and Breeding Ecology of the American White Pelican at Medicine Lake National Wildlife Refuge, Montana. Elizabeth M. Madden and Marco Restani
- Climate Change Impacts on the United States- The Potential Consequences of Climate Variability and Change, *US Global Climate Change Research Program*
- Keeping it Wild: An Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System
- Technical Guide for Monitoring Selected Conditions Related to Wilderness Character- Forest Service
- Impacts of Crude Oil and Natural Gas Developments on Wildlife and Wildlife Habitat in the Rocky Mountain Region, Edited by Theodore A. Bookhout

STAFF CONSULTED

- David Gillund- Project Leader
- Michelle Chappell- Refuge Manager
- Mike Borgreen- Wildlife Biologist
- Damon Taylor- Biological Technician
- Brant Loflin- Region 6 Zone Archaeologist
- Lindy Garner- Mountain- Prairie Region Invasive Species Coordinator

Figure 6. American White Pelicans at Medicine Lake NWR- FWS

PROCESS USED FOR IDENTIFYING MEASURES

An initial understanding of the Medicine Lake National Wildlife Refuge was accomplished through various techniques upon the first few weeks of my arrival. During the first week, I was provided a tour of the wilderness from the refuge biologist. Conversations about the wilderness, in the wilderness, helped begin shaping my thoughts about potential measures. Reading the refuge's Comprehensive Conservation Plan and Wilderness Plan was also completed throughout the first two weeks of my stay at Medicine Lake. Both of these documents provided information to begin drafting a list of measures specific to the monitoring needs and data availability of the refuge. I also explored the shared drive on the refuge's server for additional information and further detail on topic of interest. Meetings were held with individual staff members as well as the entire management team discussing potential measures and my questions about wilderness management. During this meeting, I took notes to refine measures and asked what additional aspects of the wilderness staff considered essential to the wilderness character of Medicine Lake. To ensure that all critical impacts were accounted for and that each measure was feasible and reliable, I continued to present potential measures to refuge staff and refined measures based on their comments.

Once I created a list of measures, I gathered data on each measure. In some cases, the baseline data was available immediately upon identification of the measure was recorded at that time. In other instances, I had to contact other Region 6 employees to acquire more information and data regarding the measure. I then inputted the measures and baseline data into the database. The draft of the Wilderness Character Monitoring report was then finalized and distributed amongst staff for review. Edits were incorporated, and a final report was created.

Figure 7. Bridgerman Point Pelican Colony- FWS

WILDERNESS CHARACTER MONITORING MEASURES

This section describes in detail the measures chosen to monitor the Medicine Lake wilderness. Background information, collection protocol, baseline data, and the data source are described for each measure. Additional details such as frequency, significant change, weight, condition of baseline data (good, caution, or poor), and data adequacy are also addressed. The frequency of a measure is how often the data is collected and entered into the Wilderness Character Monitoring Database usually every one or five years. The significant change tells how much a measure's data point must change from a previous data entry to suggest a change in trend of wilderness character for that measure. A measure's weight tells how important that measure is relative to the other measures within a particular indicator. The sum of the weights of each measure within an indicator equals 100%. The baseline condition conveys what the effects of this measure's data is on wilderness character: whether the data reflects a good or poor condition of wilderness character, or indicates that while the effect is neither good nor poor, there is concern about what this data says about the wilderness' character. In most cases the frequency, significant change, weight, and baseline condition for each measure were assigned by the wilderness fellow and approved by the refuge manager and/or wildlife biologist. The weight of a measure and condition of a baseline data may only be recorded in the Wilderness Character Monitoring Database.

Data adequacy is defined as the reliability of the data to assess trends in the measure. The intention behind evaluating data adequacy is to understand where improvements in data collection need to be made and not to evaluate how well an individual measure represents a particular aspect of wilderness character. For example, if the data indicate a degrading trend in a particular indicator and the data adequacy is deemed "low," this would suggest that the trend be interpreted conservatively, not discounted entirely, and that greater efforts be expended in future years to acquire more or better data.

To determine the data adequacy of each measure for this report, two related but distinct aspects of data adequacy are subjectively evaluated: data quantity and data quality. Data quantity refers to the level of confidence that all appropriate data records have been gathered. Data quality refers to the level of confidence about the source(s) of data and whether the data are of sufficient quality to reliably identify trends in the measure. Data quantity and quality is subjectively evaluated for each measure according to the following categories (Tables 1 & 2).

Table 1. Data Quantity	
Complete	This category indicates a high degree of confidence that all data records have been gathered. For example, to assess the occurrence of nonindigenous invasive plants, a complete inventory of the wilderness was conducted or all likely sites were visited.
Partial	This category indicates that some data is available, but the data is generally considered incomplete (such as with sampling). For example, to assess the occurrence of nonindigenous invasive plants, a partial inventory was conducted or a sampling of sites was conducted where these plants are likely to occur.
Insufficient	This category indicates even less data records have been gathered or perhaps this measure is not dependent on actual field data. For example, no inventory for nonindigenous invasive plants has been conducted, and visitor use was not assessed anywhere.

Table 2. Data Quality	
High	This category indicates a high degree of confidence that the quality of the data can reliably assess trends in the measure. For example, data on the occurrence of nonindigenous invasive plants is from ground-based inventories conducted by qualified personnel; for visitor use, data would come from visitor permit data.
Moderate	This category indicates a moderate degree of confidence about the quality of the data. For example, data on invasive plants could come from national or regional databases; for visitor use, data could come from direct visitor contacts.
Low	This category indicates a low degree of confidence about the quality of the data. For example, data on invasive plants and visitor use could come from professional judgment.

Untrammeled Quality

The Wilderness Act states that Wilderness is "an area where the earth and its community of life are untrammeled by man," and "generally appears to have been affected primarily by the forces of nature." In short, Wilderness is essentially unhindered and free from modern human control or manipulation. This quality is degraded by modern human activities or actions that intentionally control or manipulate the components or processes of ecological systems inside the Wilderness.

Table 3. Untrammeled Measures

Monitoring Question	Indicator	Measure	Frequency	Baseline Value
What are the trends in actions that control or manipulate the "earth and its community of life" inside wilderness?	Actions authorized by the Federal land manager that manipulate the biophysical environment	1-1. Number of fish stocking actions	1	0
		1-2. Number of grazing permits authorized	5	0
		1-3. Acres of prescribed burns	5	2,295 acres
		1-4. Acres of wilderness treated with herbicide	1	57
		1-5. Index of other authorized trammeling actions	5	4
	Actions <u>not</u> authorized by the Federal manager that manipulate the biophysical environment	1-6. Index of unauthorized actions that intentionally manipulate the biophysical environment	5	0

Measure 1-1: Number of fish stocking actions

Background & Context
A fish-stocking program was initiated on Medicine Lake in 1937. Every few years the lake winter kills require additional stockings to maintain a fishery. The stocking program was created to provide a public recreation opportunity in the area. Non-native common carp (*Cyprinus carpio*) have never been stocked into Medicine Lake but have inhabited it since the late 1960s (USFWS, 2007). Northern pike (*Esox Lucius*) were originally stocked in Medicine Lake in 1968 to control the non-native common carp. The stocking of northern pike has been occurring since before Medicine Lake was designated a Wilderness in 1976. Stocking fish is conducted to create or enhance recreational fishing opportunities. Despite these positive reasons, stocking fish, both indigenous and nonindigenous species, significantly affects aquatic systems inside wilderness (Knapp and others 2001) and is a significant trammeling.

Measure Description & Collection Protocol
Count the total number of actions involved with fish stocking into Medicine Lake each year.

Data Source
Medicine Lake fish stocking record files

Data Adequacy
Complete/High

Significant Change
Any increase in fish stocking actions would be a considered a significant impact to the wilderness character.

Frequency- Data is to be recorded annually into the wilderness character monitoring database

2013 Baseline Value- ***0***

Measure 1-2: Number of grazing permits authorized

Background & Context
Management staff works with local ranchers to mimic natural disturbances through livestock grazing. Managed grazing mimics the historical processes when hundreds of bison herds grazed the lands at Medicine Lake during migration. Herbivores such as bison, elk, pronghorn, and black-tailed prairie dogs interact with soils, plants, other animals, and other processes to produce unique successional patterns in the northern Great Plains landscape at multiple scales. Seasonal grazing of the uplands stresses the invasive cool-season grasses and favors native grasses and forbs. Vegetative rigor and diversity are paramount to achieve the landscape description for the refuge. When used correctly, grazing will improve wildlife habitat for many species.

Managed grazing is used to improve the natural quality of the wilderness by advancing native plant native plant composition and abundance and decreasing the invasive plant density. However, this is a management action that intentionally manipulates "the earth and its community of life" which therefore degrades the untrammeled quality of the wilderness. The impact that cattle grazing currently has on the wilderness does not equally correspond to the impact that Bison herd migration once had on the prairie integrity.

Measure Description & Collection Protocol
This is the count of the number of permits distributed for managed grazing on the wilderness area at Medicine Lake refuge. The next authorized grazing permit will be in 2014, when the Sandhills is scheduled for grazing. Therefore the value will be one.

Data source
Grazing Special Use Permits and Refuge Manager knowledge

Data adequacy
Complete/High

Significant change
An increase in permits distributed within a 5 year period would cause a significant degradation in wilderness character. A decrease in permits distributed would cause a significant improvement in the untrammeled quality of wilderness character at the Medicine Lake wilderness.

Frequency- 5 year total

2009-2013 Baseline Value- ***0***

Measure 1-3: Acres of prescribed burns

Background & Context
Section 2(c) of the Wilderness Act states that wilderness is "hereby recognized as an area where the earth and its community of life are untrammeled by man." Actions that intentionally manipulate or control ecological systems inside the wilderness degrade the untrammeled quality of wilderness character, even though they may be taken to restore natural conditions or for other purposes. Unlike management on any other Federal land, wilderness legislation directs the managing agency to scrutinize its actions and minimize control or interference with plants, animals, soils, water bodies, and natural processes.

Wilderness is manipulated and the untrammeled quality of wilderness character is diminished when prescription-burning actions occur inside the wilderness. Prescribed fires attempt to replicate how naturally occurring fires once took place in the Medicine Lake Wilderness. The most recent prescription burn was earlier this year in the spring of 2013, and took place in the Sandhills unit of the wilderness. While this is considered a trammeling action within the wilderness, the overall objective of this burn was to maintain and restore native prairie and have a positive impact on the natural quality of the wilderness.

Over time, the native integrity of the prairie grasslands has been declining due to an increase in nonnative grasses and the existence of state listed noxious weeds. Historically, grasslands in the northern Great Plains co-evolved with various disturbance regimes, fire being a main tool. By burning early in the growing season, such as early spring, all prairie plants are given the chance to compete with no residual cover. There is no record of fire suppression on the refuge. Recommendations for prairie grassland habitats suggest prescribed burns should occur every 4-5 years.

Measure Description & Collection Protocol
This measure tracks the areal extent of the trammeling by prescribed burning within the wilderness boundary. The cumulative acres of wilderness applied with prescribed burning over the last five years are reported in the Wilderness Character Monitoring Database.

Data Source
Medicine Lake National Wildlife Refuge fire records

Data Adequacy
Complete/High

Significant Change
It was determined that a 25% change in the percent of prescribed fires that are manipulated within the wilderness would cause a significant enough impact to the wilderness to be interpreted as a degrading or improving trend in wilderness character.

Frequency- Data is to be recorded every 5 years to the wilderness character monitoring database

2013 Baseline Value- ***2295 acres***

Measure 1-4: Acres of wilderness treated with herbicide

Background & Context
Chemical treatment of state listed noxious weeds at Medicine Lake National Wildlife Refuge is conducted regularly. Use of herbicide is reported annually as per the Pesticide Use Policy, but this data is lumped for each refuge; therefore specific use on the Medicine Lake Wilderness has not been delineated. Refuge staff have focused their efforts mainly on attempting to control Leafy spurge, *Euphorbia esula*. Leafy spurge was introduced to the Great Plains over a century ago from Europe and Asia, and has proven to be a formidable opponent. Rangeland and grassland prairies are particularly susceptible to leafy spurge infestation. It has the ability to displace numerous desirable plants, making it a hazard to the threatened habitat of mixed grass prairie.

Measure Description & Collection Protocol
This will be a count of the total acres of wilderness that is treated with herbicide. To get the appropriate annual reading, the total acres sprayed within the sandhills portion will be summed by the Region 6 strike team and entered into the wilderness character monitoring database.

Data Source
Refuge biologist and Region 6 strike team records

Data Adequacy
Complete/High

Significant Change
Any increase or decrease of herbicide use in the wilderness by 25% would cause a significant impact to the wilderness to be interpreted as a degrading or improving trend in wilderness character. Interpreting changes in data as a shifting trend in wilderness character should be done an individual basis.

Frequency- Data is to be recorded annually into the wilderness character monitoring database.

2013 Baseline Value- ***57 acres***

Measure 1-5: Index of other authorized trammeling actions

Background & Context
This measure monitors authorized trammeling actions implemented by refuge staff or other permitted entities (via Special Use Permits) that are not captured by the previous measures.

Fish stocking actions at Medicine Lake National Wildlife Refuge require the use of survey nets, box traps, and other equipment to gather information regarding fish composition in the lake itself. These actions are authorized and have not been accounted for in the previous management actions under the untrammeled quality.

Measure Description & Collection Protocol
This single measure accounts for all other authorized trammeling actions that are not monitored by other measures. Each "other" trammeling action (those not tracked by other measures) taken within the last five years is scored based on its impact to the untrammeled quality according to two parameters: (1) the extent that the activity affects the community of life (spatial extent and species affected) and (2) the temporal extent of the activity. The table below describes how these trammeling actions are scored. The sum of these scores generates a total score for each trammeling action; the summed score for all trammeling actions is reported in the Wilderness Character Monitoring Database. Over time, an increase in this value would signify a degrading trend in wilderness character for this indicator.

Table 4. Authorized Trammeling Action

Question About Action	Score
To what extent does the activity affect the community of life in wilderness?	1 – the activity affected only a single species **or** an area of less than one acre 2 – the activity affected or has the potential to affect many species **or** an area of more than one acre 3 – the activity affected or has the potential to affect many species **and** an area of more than one acre
Length of time?	1 – the activity occurred on 1-5 days 2 – the activity occurred on 5-120 days 3 – the activity occurred throughout the year or more than 120 days in a year

Data source
Fish stocking reports and Refuge manager

Data adequacy
Complete/High- All instances of management actions that would be considered trammeling are reported for this measure. Refuge staff reliably record this information in the refuge's fish stocking records.

Significant change
Any change in this data would be a significant enough impact to be interpreted as a change in trend of wilderness character.

Frequency- Data is entered into the Wilderness Character Monitoring Database every five years

Table 5. Detailed Data: 2013 Trammeling Actions				
Action	**Description of Action**	**Extent Score**	**Temporal Score**	**Total Score (sum)**
Installing gill nets and box traps for fish stocking	Fish stocking occurs each year on the Medicine Lake wilderness. Fish surveys are also conducted on the lake to get a composition of fish species.	3	1	4
Total reported to the Wilderness Character Monitoring Database: 4				

2013 Baseline Value- ***4***

Measure 1-6: Index of unauthorized actions that intentionally manipulate the biophysical environment

Background & Context

While the previous measures monitors authorized actions that manipulate the biophysical environment, this measure monitors unauthorized actions that trammel wilderness. This includes any action undertaken by any individual (visitors), group, or agency without specific approval by the wilderness manager. An example would be actions that would usually require a Special Use Permit (SUP), but the action was carried through without acquiring the permit. For example, predator control by unauthorized entities would be counted in this measure. Other illegal actions, such as intentional illegal grazing and unauthorized hunting, would also be included for monitoring within this measure.

Measure Description & Collection Protocol

This single measure will account for any unauthorized intentional manipulations in the Medicine Lake Wilderness within the past five years. Each such trammeling is scored according to the extent that the activity affects the community of life (spatial extent and species affected) and the temporal extent of the activity. The table below describes how these trammeling actions are scored. The sum of these scores generates a total score for each trammeling action; the summed score for all trammeling activities is reported in the Wilderness Character Monitoring Database. This measure would monitor any action undertaken by an individual (visitors), group, or agency without specific approval by the authorized wilderness manager. Over time, an increase in this value would signify a degrading trend in wilderness character for this indicator.

Table 6. Unauthorized Trammeling Action

Question about Action	Score	
To what extent does the activity affect the community of life in the wilderness?	1-	The activity affected only a single species **or** area of less than one acre
	2-	The activity affected or has the potential to affect many species **or** an area of more than one acre
	3-	The activity affect or has the potential to affect many species **and** an area of more than one acre
Length of time activity occurred?	1-	The activity occurred on 1-5 days
	2-	The activity occurred on 5-120 days
	3-	The activity occurred throughout the year or more than 120 days in the year

Data Source

Refuge manager and law enforcement officer

Data Adequacy

Partial/Moderate- Because these activities are not permitted, and may often be illegal, the violators take measures to avoid detection. Therefore this measure can only speak to the number of violators that are caught conducting these acts without permits.

Significant Change

Any change in this data would be a significant enough impact to be interpreted as a change in trend of wilderness character.

Frequency- Data is to be recorded every 5 years for this measure

2013 Baseline Value- ***0***

Natural Quality

The Wilderness Act states that wilderness is "protected and managed so as to preserve its natural conditions." In short, wilderness ecological systems are substantially free from effects of modern civilization. This quality is degraded by intended or unintended effects of modern people on the ecological systems inside the wilderness since the area was designated.

Table 7. Natural Measures

Monitoring Question	Indicator	Measure	Frequency	Baseline Value
What are the trends in terrestrial, aquatic, and atmospheric natural resources inside wilderness?	Plant and animal species and communities	2-1. Percent occurrence of invasive plants	7	17.4%
		2-2. Total AUM's	5	0
		2-3. Piping plover success	1	0
		2-4. Sharp-tailed grouse census	1	19 males per lek
		2-5. Number of colonial nesting birds	1	112 birds
	Physical resources	2-6. Ozone air pollution	5	59.6 ppb
		2-7. Total nitrogen wet deposition	5	1.7 kg/ha
		2-8. Total sulfur wet deposition	5	0.7 kg/ha
		2-9. Visibility	5	6.8 dV
		2-10. Water Quality	5	TBD
	Biophysical processes	2-11. Occurrence of avian disease	5	3
		2-12. Total precipitation	1	9.45 inches
		2-13. Average high air temperature from May-September	1	62.4°F
		2-14. Average low temperature from November- March	1	21.4°F
		2-15. Medicine Lake water level fluctuations	1	48,580 acre-feet

Measure 2-1: Percent occurrence of invasive plants

Background & Context

To successfully restore and maintain the ecological integrity of native prairies, land managers must periodically assess local plant composition to detect vegetation problems, help plan management treatments (such as prescribed fires and grazing), and evaluate results of these restoration efforts. The Belt Transect Method, part of the Native Prairie Adaptive Management (NPAM), provides a rapid and reliable assessment of prairie health. This method offers an accurate estimate of the natural quality of grassland habitat by classifying the composition of native and non-native plant species in linear transects. Medicine Lake's wilderness designation is important to consider when performing belt transects. The loss of diversity and distribution of prairie grass and forbs are of great concern, but vegetation is not the only victim. Grasslands provide primary nesting habitat for a variety of bird species, and act as important staging and feeding areas for waterfowl and shorebirds during long migratory flights.

Integrity of native vegetation has been compromised by plantings and the subsequent spread of exotic invasive pants. Crested wheatgrass (*Agropyron cristatum*) dominates much of the refuge grasslands. Smooth brome (*Bromus inermis*) is another introduced grass that is prominent throughout the refuge complex, and quackgrass (*Elymus repens*) and Kentucky bluegrass (*Poa pratensis*) are present as well.

Measure Description & Collection Protocol

The belt transect method requires a 25 meter length tape and personnel capable of identifying vegetation classes. Transects should be conducted during mid to late summer. The investigator performing the specific transect is to identify the dominant plant group present at each 0.1 meter x 0.5-meter segment along the tape based off of accepted plant association codes. The investigator must only note points on the meter tape at which the vegetation class changes, and an assistant records the data while the investigator is walking along the transect. One method of data analysis is to categorize each belt into one of the three states of invasion which can then be categorized as indicated by the prairie – invasive category description located in Appendix A. This shows a detailed, hierarchical breakdown of plant association groups. Plant associations were derived using local and regional references that describe common native plant community associations for upland sites in northeastern Montana.

Totals are calculated for each vegetation class (as noted in Appendix A), and then broken down further into classifications of "native" and "non-native". The "non-native" values were summed to get the total percent occurrence of invasive plants in the wilderness. The percentage of points which show infestation greater than 50% but less than 95% is used for this measure. In future years, refuge staff can note whether or not the percentage of points with codes 52, 62, and 72 increase of decrease from previous years' surveys.

It is important to note the value for percent of occurrence of invasive plant species is an overestimation of the total in the wilderness. This is due to the values that are associated with the belt transect codes, noted in Appendix A. For example, the value 52 is associated with Kentucky bluegrass and NATIVE grass-forbs, where Kentucky bluegrass is 50-95%. That being noted, data collected using the belt transect method does not indicate whether or not the percentage is 50% bluegrass or 98% bluegrass, creating these overestimation values. This is the case for values 62 and 72 as well, where the level of brome grass

and crested wheatgrass is overestimated at being a majority. This is important to note for values 13 and 14 as well, where the levels of invasive grasses are not stated, just estimated. Plant association codes 51, 61 and 71 indicate only some level of infestation.

Definitions

- ***Mixed grass prairie****- Dominant grasses are needle and thread, western wheatgrass, and blue grama. This is a prevalent upland type that includes silty and shallow-to-gravel range site. Mixed-grass prairie is found on slopes and wetter sites than sparse prairie.*

Data Source

Medicine Lake National Wildlife Refuge Belt Transect Records and Refuge Biologist consultation I:\Biology\Vegetation\Native Prairie Inventory\final Native prairie inven data_from USGS_2-09, under the *Medicine Lake* excel datasheet.

Data Adequacy

Partial/Complete data adequacy was achieved. Data records for the Medicine Lake wilderness date back only to 2008. To establish a more accurate trend, more datasets need to be established.

Frequency

Data for this measure is to be recorded every 7 years into the wilderness character monitoring database. Seven years was agreed upon with refuge staff as a technique to be in accordance with the managed grazing and burning schedule. The most recent belt transect survey which occurred in the wilderness was in 2008, therefore making 2015 the next survey year.

Significant Change

There are three levels of invasion. Any change of the wilderness from one category to another is considered significant. Movement from a higher to a lower category is considered a significant improvement, and the movement from lower to a higher category is a degradation of the natural quality.

2008 Baseline Value- ***17.4% invasive plant average in the wilderness***

Measure 2-2: Total AUM's

Background & Context

Managed grazing mimics the historical processes when hundreds of bison herds grazed the lands at Medicine Lake during migration. Management staff works with local ranchers to mimic natural disturbances through livestock grazing. The largest threat to the integrity of the native prairie found on refuge lands is the invasion of nonnative plants, such as crested wheatgrass, smooth brome, and Kentucky bluegrass as well as noxious state-listed weeds including leafy spurge. According to the refuge's Comprehensive Conservation Plan, there have been a lack of land management actions to the land, such as livestock grazing, which has thus caused invasive plants to out-compete the native prairie plants and expand their range. When used correctly, grazing will improve wildlife habitat for many species, improving the natural quality of wilderness character.

Relevance

The most important aspects of grazing are timing and intensity. Timing refers to the time of year and length of time the plants are exposed to grazing animals, including the number of grazing periods. Intensity refers to the degree of grazing pressure that plants and plant communities experience. Intensity is a function of stocking density and grazing period length, and is controlled by the number of livestock in a given area (stocking rate) and is measured in AUMs (Animal Unit Months)/ acre.

Measure Description & Collection Protocol

This measure will assess the level of managed grazing within the wilderness. The Sandhills portion of the Medicine Lake Wilderness is the only portion that experiences managed grazing. When the Sandhills is grazed, a calendar system is established for the specific number of cattle used in each specific unit of the wilderness. This measure will be quantified in Animal Unit Months (AUM). Animal unit months are calculated by multiplying the number of animal units (i.e. the actual number of bulls, cows, yearlings and cow/calf pairs) by the number of days the unit is grazed, and then dividing by 30.5. 30.5 is used as the number of days in an 'average month', and thus converts the calculation from days to months. Refuge management would like to see grazing pressure at ½ AUM per acre of land grazed. This measure will ensure that such a trade-off is considered and measured accordingly in an effort to strike the best balance between maintaining both the untrammeled and natural qualities of the wilderness.

Table 8. Sandhills Scheduled Cattle Rotation for 2014

Unit	Acreage	Dates
Sandhills Subunit B-1	656 acres	5/1-6/6 (36 days)
Sandhills Subunit B-2	433 acres	8/11-9/4 (24 days)
Sandhills Subunit B-3	648 acres	7/6-8/11 (36 days)
Sandhills Subunit B-4	547 acres	6/6-7/6 (30 days)

Definitions

- ***Animal impact***- *This is the sum total of all the direct physical influences of livestock on grasslands such as trampling, dunging, urinating, salivating, rubbing, digging, etc. Controlled through stock density and time.*
- ***Animal Unit Month (AUM)***- *Measure of the quantity of livestock forage. Equivalent to the amount of forage needed to support a 1,000-pound animal (or 1 cow/calf pair) for one month.*

- ***Defoliation****- Remove of live and residual vegetation by various management methods.*
- ***Grazing****- Feeding on grasses and other herbage by domestic livestock.*
- ***Stocking Density****- The relationship between number of animals and area of land at any instant of time, expressed as animal-units per acre (AU/ac).*
- ***Stocking Rate****: The number of specific kinds and classes of animals grazing a unit of land for a specified time period, expressed in this document as animal unit months per acre (AUM/ac).*

Data Source
Refuge special use permits, refuge manager and biologist knowledge

Data Adequacy
Complete/High

Significant Change
When at least 5 data points have been established, linear regression will be used to determine the occurrence of a significant change in this measure.

Frequency- Data is to be recorded every 5 years into the wilderness character monitoring database.

2014 Baseline Value- ***TBD in 2014***

Figure 8. Managed grazing in the Sandhills- FWS

Measure 2-3: Piping plover success

Background & Context
A significant portion of the Great Plains population of threatened piping plovers breed in the Medicine Lake refuge complex, including the Medicine Lake Wilderness. Plovers nesting in northeast Montana have the highest breeding recruitment of the Great Plains population, due largely to the relatively intact wetland-prairie refuge complexes found in the area. Comprehensive surveys have been conducted annually since 1988. Breeding populations have averaged approximately 153 adult plovers with 60 breeding pairs. Since 1996, Medicine Lake National Wildlife Refuge has participated in a larger cooperative recovery effort with The Nature Conservancy, Montana Fish, Wildlife, and Parks, and North Dakota Game and Fish Department.

Measure Description & Collection Protocol
For this measure, the rate of piping plover nest success on the Medicine Lake wilderness is determined. Add up the total number of hatched nests for this value. The Medicine Lake piping plover census takes place June of every year, during the breeding season. In 2013, there was one nest found along the Medicine Lake wilderness, but it was not successful in hatching due to human causes. 2013 also was a year of unusual weather patterns; including a later than average winter causing high water levels in the lake and cooler than average temperatures in the early months of summer, which play important factors in the overall piping plover nesting success.

Data Source
Medicine Lake National Wildlife Refuge Annual Piping Plover Reports

Data Adequacy
Complete/High

Frequency- Data is to be recorded annually into the wilderness character monitoring database

Significant Change
Variation for this measure is expected. Linear regression is used to determine whether a significant change has occurred once there are five years of data, where 2013 is used as the baseline value.

2013 Baseline Value- ***0***

Measure 2-4: Sharp-tailed grouse census

Background & Context
Native prairie habitat is a highly valuable and increasingly rare resource. To represent the relationship between habitat and animal communities, particularly grassland and upland bird species, Sharp-tailed grouse are considered an indicator species. The presence of this species is reflective both on the quality of native grassland habitat and the presence of native bird species. Regular densities of Sharp-tailed grouse do not populate areas that lack an acceptable range of habitat, and their preferred habitat is the grassland mosaic, which typically supports a wide range of native bird species. Sharp-tailed grouse populations can vary greatly for a number of reasons including harsh winters, drought, and the loss of native prairie.

Present known displaying grounds (leks) have been plotted on the Medicine Lake National Wildlife Refuge since the 1970's. Each year, the leks are surveyed twice for the total number of grouse and displaying males.

Measure Description & Collection Protocol
There are three historic lek sites in the Sandhills portion of the Medicine Lake wilderness: leks number 8, 9, and 27. The date, temperature, wind speed, lek #, and the number of males and females present during each count interval are recorded. The number of males observed in each lek is the most pertinent value during these observations, therefore these are the only values recorded for wilderness character monitoring. In 2013, no lek surveys were completed at Medicine Lake National Wildlife Refuge, but they will continue to be completed in the future. The 2012 number of males per lek will be used as the baseline year. The number of males per lek in the wilderness will be averaged to determine the annual value.

Data Source
Medicine Lake Sharp-tailed grouse census data files

Data Adequacy
Complete/High

Significant Change- A decline in males per lek in the Sandhills wilderness indicates a degrading trend in the wilderness character for this measure.

Frequency- Data for this measure is to be recorded annually into the wilderness character monitoring database.

2012 Baseline Value- ***19 males per lek***

Measure 2-5: Number of colonial nesting birds

Background & Context

Medicine Lake National Wildlife Refuge was established as a refuge and breeding ground for migratory birds. Montana Fish, Wildlife and Parks and Montana Audubon are partnering with the USFWS and American Bird Conservancy to implement the Western Colonial Waterbird Monitoring and Inventory program. This implementation began in 2009. In Montana, 11 colonial-nesting waterbird species identified as high priority species for conservation action or monitoring. Current distribution and abundance of colonial nesting waterbirds is needed for the purpose of conserving populations, resolving management conflicts stemming from increasing and expanding populations, and providing information necessary to manage waterbird populations at the local and regional scale. Several colonial-nesting waterbird species in the western U.S. appear to be declining in overall abundance or increasing in size and expanding in distribution.

Measure Description & Collection Protocol

For this measure, refer to the ***Waterbird Inventory Summary*** form, and get a total of the nesting bird species. All species within all nesting guilds will be inventoried in a portion of a state or defined geographic area in each survey year. Medicine Lake has been surveyed in the past typically in June when nesting is occurring. Specifically, Bridgerman Point, Big Island, and Gull Island have been target survey points. Bridgerman Point counts will not be included for this measure, because it is not part of the Medicine Lake designated wilderness. The species of waterbirds that have been counted in the past are included in Table 9.

Table 9. Waterbird Species for Colonial Nesting Bird Surveys

Species of Concern	Additional Species	Non-target Species, but still noted
Clark's Grebe (CLGR)	Double-Crested Cormorant (DCCO)	Red-necked Grebe (RNGR)
American White Pelican (AWPE)		Horned Grebe (HOGR)
Great Blue Heron (GBHE)		Eared Grebe (EAGR)
Black-crowned Night-heron (BCNH)		Western Grebe (WEGR)
White-faced Ibis (WFIB)		Ring-billed Gull (RBGU)
Franklin's Gull (FRGU)		California Gull (CAGU)
Caspian Tern (CATE)		
Forster's Tern (FOTE)		
Common Tern (COTE)		
Black Tern (BLTE)		

Table 10. 2013 Totals Nesting Totals from Big and Gull Island

Species	Nesting Totals
DCCO	21
CAGU	7
BCNH	84
TOTAL	112

Data Source
Medicine Lake Colonial Nesting Bird Survey Notes

Data Adequacy
Complete/High

Significant Change
Any change in numbers of colonial nesting birds will be significant to wilderness character monitoring

Frequency- Data for this measure is to be recorded annually into the wilderness character monitoring database.

2013 Baseline Value- ***112 colonial nesting birds***

Figure 9. Black- crowned Night Heron- FWS

Measure 2-6: Ozone air pollution

Background & Context
In 1977, Congress acknowledged the uniqueness of the Medicine Lake Wilderness Area by designating it as a Class I air quality area. As a wilderness area it is afforded special protection under the Clean Air Act. Congress gave the U.S. Fish and Wildlife Service, as the federal land manager of Medicine Lake National Wildlife Refuge, the responsibility to protect the air quality and natural resources of the area from man-made air pollution. Despite the protection, many sources of man-made air pollution affect Medicine Lake National Wildlife Refuge including power plants in the U.S. and Canada, oil and gas wells, and motor vehicle emissions. Ozone can be a man-made air pollutant. It is capable of traveling long distances and so may be an unnatural presence in the prairie wilderness.

Measure Description & Collection Protocol
Fourth highest 8-hour average ozone concentration in parts per billion (ppb)

Data Source
National Wildlife Refuge System's Natural Resource Program Center, Inventory and Monitoring Department.

Data Adequacy
Complete/High- Data comes from very accurate data collection stations and therefore the quality of this data is high.

Frequency
Data is entered into the Wilderness Character Monitoring Database every five years.

Significant Change
Any change to/from one of the following categories would be significant enough impact to the wilderness to be interpreted as degrading or improving trend in wilderness character.

Ozone ppb	Status
< 60 ppb	Good
61- 75	Moderate
>76	Significant Concern

Frequency- Data is to be entered into the Wilderness Character Monitoring Database every five years.

2005-2009 Baseline Value- ***59.6 ppb***

Measure 2-7: Total nitrogen wet deposition

Background & Context
In 1977, Congress acknowledged the uniqueness of the Medicine Lake wilderness area by designating it as a Class I air quality area. As a wilderness area it is afforded special protection under the Clean Air Act. Medicine Lake National Wildlife Refuge is particularly affected by regional industrial sources. Acid deposition is the concentration of sulfur and nitrogen in the rain or snow. High concentrations can be detrimental for algae, aquatic invertebrates, amphibians, fish, soil microorganisms, plants, and trees. Nitrogen and sulfur compounds deposited from the air may cause acidification to ecosystems at Medicine Lake National Wildlife Refuge, particularly wetlands. Also, nitrogen deposition may cause nutrient imbalances in ecosystems, sometimes leading to increases in weedy plant species, with loss of native species.

Measure Description & Collection Protocol
Concentration of nitrogen in atmospheric wet deposition (i.e. rain, snow), in units kilogram per hectare (kg/ha).

Data Source
National Wildlife Refuge System's Natural Resource Program Center, Inventory and Monitoring Department.

Data Adequacy
Complete/High data adequacy is established due to Medicine Lake's own air quality monitoring station on site.

Significant Change
Any change to/from one of the following categories would be significant enough impact to the wilderness to be interpreted as degrading or improving trend in wilderness character.

Total Nitrogen (kg/ha)	Status
<1 kg/ha	Good
1-3	Moderate
>3	Significant Concern

Frequency
Data is entered into the Wilderness Character Monitoring Database every five years.

2005-2009 Baseline Value- ***1.7 kg.ha***

Measure 2-8: Total sulfur wet deposition

Background & Context
In 1977, Congress acknowledged the uniqueness of the Medicine Lake wilderness area by designating it as a Class I air quality area. As a wilderness area it is afforded special protection under the Clean Air Act. Medicine Lake National Wildlife Refuge is particularly affected by regional industrial sources (e.g. coal-fired power plants) and biomass burning. Elevated levels of nitrogen and sulfur in air pollution form acid rain and acid fog, which can be deposited into refuge ecosystems, causing significant chances to lakes, ponds, and wetlands. Acid deposition is the concentration of sulfur in the rain or snow. High concentrations can be detrimental for algae, aquatic invertebrates, amphibians, fish, soil microorganisms, plants, and trees.

Measure Description & Collection Protocol
Concentration of sulfur in atmospheric wet deposition (i.e. rain, snow), in units kilogram per hectare (kg/ha).

Data Source
National Wildlife Refuge System's Natural Resource Program Center, Inventory and Monitoring Department.

Data Adequacy
Complete/High- Data comes from very accurate data collection stations and therefore the quality of this data is high.

Significant Change
Any change to/from one of the following categories would be a significant enough impact to the wilderness to be interpreted as a degrading or improving trend in the wilderness character.

Total Sulfur (kg/ha)	Status
<1 kg/ha	Good
1-3	Moderate
>3	Significant Concern

Frequency- Data is to be entered into the Wilderness Character Monitoring Database every five years.

2005-2009 Baseline Value- ***0.7 kg/ha***

Measure 2-9: Visibility

Background & Context
In 1977, Congress acknowledged the uniqueness of the Medicine Lake Wilderness Area by designating it as a Class I air quality area. As a wilderness area it is afforded special protection under the Clean Air Act. Medicine Lake National Wildlife Refuge is particularly affected by regional industrial sources (e.g. coal-fired power plants) and biomass burning.

Many visitors come to refuges to enjoy spectacular vistas. Unfortunately, these vistas are often obscured by haze caused by fine particles in the air. Organic compounds, soot, and dust reduce visibility. Sulfate contributes to 27% of the haze at Medicine Lake NWR and is largely due to large industrial sources such as coal-fired power plants and oil and gas development in the United States and Canada. Nitrate is another important contributor to haze at Medicine Lake, especially during the winter and is a product of many sources including power generation, oil and gas development, motor vehicles, fertilizers, and livestock. Elemental and organic carbon contributes to about 15% of the haze as sources include energy development and motor vehicles.

Measure Description & Collection Protocol
Scenic conditions that determine how well and how far a wilderness visitor can see based on the amount of small particles in the air, in units deciview (dV).

Data Source
National Wildlife Refuge System's Natural Resource Program Center, Inventory and Monitoring Department and Medicine Lake's IMPROVE station data records.

Data Adequacy
Complete/High- Data is collected from an IMPROVE air quality monitoring station located within the refuge; therefore the quantity of this data is complete. Data comes from very accurate data collection stations and therefore the quality of this data is high.

Significant Change
Changes in this measure are significant when the data value indicates a change in qualification from the previous five years based on the following conditions (i.e. the data value must move down from Significant Concern):

Visibility (dV)	Status
<2	Good
2-8	Moderate
>8	Significant Concern

Frequency- Data is to be recorded every 5 years into the wilderness character monitoring database.

2005-2009 Baseline Value- ***6.8 dV***

Measure 2-10: Water quality

Background & Context
The surrounding impacts of the Bakken Formation oil drilling have detrimental impacts to the water quality of nearby areas. The development of oil and gas resources from the Bakken Formation involves the removal of highly saline brines or co-produced waters, from the oil-bearing formation. In addition to concerns associated with oil drilling, the Bakken Formation produces some of the most saline water in the United States which can be up to 10 times saltier than seawater. Co-produced waters are produced at ratios of up to 10 barrels to 1 barrel of extracted oil, resulting in the mass production of sodium chloride dominated brines that have averaged total dissolved solids (TDS) concentrations of 300,000 mg/L. Natural salinity involves concentrations of sodium sulfate, not chloride, therefore brine contamination can be assessed using the Contamination Index (CI) developed by Reiten and Tischmak (1993). The CI is defined as the ratio of the chloride concentration to specific conductance, with values exceeding 0.035 suggesting contamination.

There were 14 data loggers deployed on Medicine Lake NWR in 2011. Twelve of these data loggers record water temperature, water depth, and water conductivity. In addition, a chloride reading is taken once a month at each of these sites using HACH Quantab titrator tabs for chlorine. This reading and conductivity reading is used determine whether produced waters have entered the Medicine Lake Refuge water system.

Measure Description & Collection Protocol
Currently, none of the previously mentioned data loggers are located along the Medicine Lake wilderness. Yet there are a few data loggers, which are located on nearby impoundments that have the same water that flows in the main lake, such as Lake Creek and East Medicine Lake. The Contamination Index of these units will be averaged to determine the current condition of water quality for the late. Management staff aims to have a few data loggers within wilderness boundaries in the near future. Therefore, the Contamination Index will be used to determine whether co-produced waters have contaminated areas of the lake.

Data Source
Medicine Lake Water Use Report files and Montana Board of Oil and Gas conservation records

Data Adequacy- Complete/High

Frequency- Once data loggers are established within the lake boundaries, data is to be recorded every five years into the wilderness character monitoring database.

Significant Change
Values exceeding 0.035 contamination index would indicate the wilderness natural quality is degrading, while values that do not exceed 0.035 indicate stability in the natural quality.

2013 Baseline Value- ***TBD***

Measure 2-11: Occurrence of avian disease

Background & Context
Disease is a significant and persistent threat to the pelican colony and other colonial nesting birds on Medicine Lake. The presence of disease greatly affects the natural quality of the wilderness by altering the number of migratory birds utilizing wilderness habitat. Disease outbreaks can greatly impact migratory bird species, and having a large percentage of the North American population of American White Pelicans nesting on the islands, a severe disease outbreak could have significant implications for the species.

Avian botulism has affected water birds in the Medicine Lake National Wildlife Refuge since refuge establishment. The summer outbreaks vary from none to thousands of mortalities. More recently, West Nile virus has impacted bird species along the refuge. It was first detected in 2003 in the pelican breeding colony, and has been present there in varying degrees every year since. The magnitude with which the virus affects other species is unknown.

Several factors of the lake itself increase or decrease the likelihood of disease being prevalent throughout the nesting bird community. Medicine Lake water levels impact the spread; prolonged static water levels can create anaerobic conditions that limit decomposition and nutrient cycling increasing the presence of disease. Water quality is also a factor in this as well.

Measure Description & Collection Protocol
This measure will count the number of avian diseases present within the colonial nesting bird colony in the Medicine Lake wilderness. Currently, carcass counts are not being conducted therefore the total number of dead birds is unknown. The actual number of birds that are affected by avian disease creates a population risk that can be very significant. This measure is tracking the occurrence of disease and the trends in possible new and emerging diseases within the avian colony. Presently, Avian Botulism, West Nile virus and negative side effects from Blue-green algae occur within colonial nesters and waterfowl species at Medicine Lake.

Data Source
Comprehensive Conservation Plan, Refuge Biologist, and Avian Disease files

Data Adequacy
Complete/High

Frequency- Data is to be recorded every five years into the wilderness character monitoring database.

Significant Change
An increase in new and emerging diseases will degrade the natural quality of the wilderness. A decrease in avian disease occurrence will improve the natural quality of the wilderness.

2013 Baseline Value- ***3***

Measure 2-12: Annual precipitation

Background & Context

Extreme climate and weather events have been present in the Great Plains region; primarily being severe drought, while in other years extreme flooding. The potential for new patterns in climate extremes raises questions about the ability of current coping strategies to deal with future impacts. Mean annual precipitations levels are beneficial for assessing water quality in and around the Medicine Lake wilderness. Precipitation is an environmental factor affected by climate change and feasible to monitor because of data accessibility. Average annual precipitation is thirteen inches at Medicine Lake National Wildlife Refuge, however this value fluctuates greatly.

Measure Description & Collection Protocol

Weather data is recorded from an official weather station located at the refuge headquarters. Data is reported to NOAA where it stored on the following website, <http://wxcoder.org/observations/>. This allows recorders to submit data quickly via a spreadsheet. Data recorded includes amount of precipitation and daily minimum and maximum temperatures. Monthly forms automatically sum and average temperature, precipitation, and snowfall to assist the observer in an accurate observation.

Station Details	
Station Name:	Medicine Lake 3 SE
Station ID:	24-5572-06
Elevation	1975’
Lat/Long	48.49°, -104.4761°

Data Source

Refuge weather reports, NOAA website

Frequency

Data is entered into the Wilderness Character Monitoring Database annually.

Table 11. Detailed Data: Total monthly precip in 2012 at Medicine Lake NWR

Month - 2012	Total Precipitation (in)
January	0
February	0.29
March	0
April	0
May	2.04
June	1.40
July	2.18
August	1.25
September	0.01
October	1.64
November	0.45
December	0.19
2012 Total	**9.45**

Data Adequacy

Complete/High – All temperature data collected at the refuge’s weather station is reported for this measure. Data comes from a very accurate data collection station and therefore the quality of this data is high. While the data station is not in the wilderness, it is within the refuge and is the best available data.

Significant Change

The amount of change in this data that would indicate an improving or degrading trend in wilderness character will have to be determined at a later date when more data is available for analysis.

Measure 2-13: Average high air temperature from May- September

Background & Context

Across the Northern and Central Great Plains, temperatures have risen more than 2°F in the past century, with increases up to 5.5°F in parts of Montana, North Dakota, and South Dakota. Seasonally, more warming is expected in winter and spring than in summer and fall. This may be in part due to human activities, such as forest clearing and fossil fuel burning, the latter of which emits large amounts of greenhouse gases into the atmosphere. Average temperature plays a role in the formation, location, and maintenance of native plant and animal communities. Models predict future extreme precipitation event, greater likelihood warmer/dryer summers and wetter/reduced winter temperatures are possible trends for the Great Plains region.

Measure Description & Collection Protocol

Weather data is recorded at an official weather station located at the refuge headquarters. Data is reported to NOAA, who stores it on the following website, <http://wxcoder.org/observations/>. The desired year and month is selected allowing a window to open with a quick data view of the record of climatological observations. Monthly forms automatically sum and average temperature, precipitation, and snowfall to assist the observer in an accurate observation Total high and low temperatures for the month are displayed at the bottom of the table.

Station Details	
Station Name:	Medicine Lake 3 SE
Station ID:	24-5572-06
Elevation	1975’
Lat/Long	48.49°, -104.4761°

Table 12. Detailed Data: Total monthly temp in 2012 at Medicine Lake NWR

Month – 2012	High Temp	Low Temp	Average Temp
May	66.6	41.3	53.95
June	77.4	49.0	63.2
July	89.4	56.2	72.8
August	84.4	47.0	65.7
September	76.3	36.7	56.5
TOTAL			62.4

Data Source

Refuge weather reports, NOAA website

Data Adequacy

Complete/High – All temperature data collected at the refuge’s weather station is reported for this measure. Data comes from a very accurate data collection station and therefore the quality of this data is high. While the data station is not in the wilderness, it is within the refuge and is the best available data.

Frequency

Data is entered into the Wilderness Character Monitoring Database annually

Significant Change

The amount of change in this data that would indicate an improving or degrading trend in wilderness character will have to be determined at a later date when more data is available for analysis.

Measure 2-14: Average low air temperature from November- March

Background & Context
Extreme low temperatures are prevalent at Medicine Lake National Wildlife Refuge during the winter months. The high natural variability of climate is a characterizing feature of this region. Projected climate change is likely to alter the current biodiversity present in the Great Plains region. Models predict future extreme precipitation event, greater likelihood warmer/dryer summers and wetter/reduced winter temperatures are possible trends for the Great Plains region.

Measure Description & Collection Protocol
Weather data is recorded at an official weather station located at the refuge headquarters. Data is reported to NOAA, who stores it on the following website, <http://wxcoder.org/observations/>. The desired year and month is selected allowing a window to open with a quick data view of the record of climatological observations. Total high and low temperatures for the month are displayed at the bottom of the table.

Station Details	
Station Name:	Medicine Lake 3 SE
Station ID:	24-5572-06
Elevation	1975’
Lat/Long	48.49°, -104.4761°

Table 12. Detailed Data: Total monthly temp in 2012 at Medicine Lake NWR

Month – 2012	High Temp	Low Temp	Average Temp
January	27.8	7.1	17.45
February	31.0	9.3	20.15
March	41.5	17.7	29.6
November	37.0	18.0	27.5
December	21.0	3.6	12.3
TOTAL			21.4

Data Source
Refuge weather reports, NOAA website

Data Adequacy
Complete/High – All temperature data collected at the refuge’s weather station is reported for this measure. Data comes from a very accurate data collection station and therefore the quality of this data is high. While the data station is not in the wilderness, it is within the refuge and is the best available data.

Frequency
Data is entered into the Wilderness Character Monitoring Database annually

Significant Change
The amount of change in this data that would indicate an improving or degrading trend in wilderness character will have to be determined at a later date when more data is available for analysis.

Measure 2-15: Medicine Lake water fluctuations

Background & Context
Medicine lake water level is vitally important to support nesting migratory bird populations. Historically this water system was very dynamic with years when the lake was completely dry. Water levels impact available nesting and brooding habitat, and changes to water level significantly alter the Lake's capacity in providing adequate habitat for the number of migratory birds it currently supports. Water levels fluctuate at Medicine Lake due to the amount of groundwater feeding into the lake, precipitation levels, and runoff. The water level is expected to continue to fluctuate.

This measure will monitor an important biophysical process which impacts the use of Medicine Lake by migratory bird species. Prolonged static water levels can create anaerobic conditions that limit decomposition and nutrient cycling. High water levels can also adversely influence the growth and development of aquatic vegetation my limiting light penetration and oxygen availability, and allowing water temperatures to remain cool. Continuous high-level water management also causes increasing rates of erosion to shores and islands. Appropriate water-level manipulation creates sufficient habitat for open-water areas with submerged vegetation and shallow areas with emergent food resources and cover for migrating waterbird species. These natural water cycles provide a mosaic of habitats for shorebirds, amphibians, reptiles, waterfowl, invertebrates, water birds, and other wildlife, and also help recycle nutrients.

Measure Description & Collection Protocol
This measure will be quantified through units of acre-feet which calculate the capacity of the lake itself. Every year, a water-use report is completed by refuge staff which is a combination of water level and use information for 28 water units throughout the Medicine Lake Refuge complex.

Data Source
Medicine Lake Water Use Report files

Data Adequacy
Complete/High

Significant Change
Any increase of decrease in water level can impact the natural quality of the wilderness. A decrease in water level would indicate a negative impact to the wilderness quality.

Frequency- Data should be recorded annually into the wilderness character monitoring database.

2012 Baseline Value- ***48,580 acre-feet***

Undeveloped Quality

The Wilderness Act states that Wilderness is "an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation," "where man himself is a visitor who does not remain" and "with the imprint of man's work substantially unnoticeable." This quality is degraded by the presence of structures, installations, habitations, the use of motor vehicles, motorized equipment, or mechanical transport that increases people's ability to occupy or modify the environment, or other evidence of modern human presence or occupation.

Table 13. Undeveloped Measures

Monitoring Question	Indicator	Measure	Frequency	Baseline Value
What are the trends in non-recreational development inside the wilderness?	Non-recreational installations, structures and developments	3-1. Index of temporary non-recreational structures, structures, and developments	5	225
	Inholdings	3-2. Acres of inholdings within the wilderness boundary	10	0
What are the trends in mechanization inside the wilderness?	Use of motor vehicles, motorized equipment, and mechanical transport	3-3. Index of motor vehicles, motorized equipment and mechanical transport	5	TBD

Measure 3-1: Index of temporary non-recreational installations, structures, and developments

Background & Context
The refuge makes use of temporary structures to protect the breeding Pelican colony from predators. These developments include the annual installation of predator exclusion fences. Temporary electric fencing is also established on wilderness during grazing periods. The fencing is removed once the grazing period has been completed throughout the year. Twenty foot seines are used once a year during fish stocking of Medicine Lake. Gill nets are also set-up throughout different sections of the lake during fish stocking as well.

Measure Description & Collection Protocol
Count the number of gill nets, predator exclusion fences and other non-recreational temporary structures installed in the wilderness each year. Multiply each development by the number of days it remained in the wilderness (round to the nearest whole number). For this measure, 30 will be used as the average number days per month

Data Source
Fisheries data files, Predator data files, and Grazing SUP

Data Adequacy
Complete/High

Frequency
Data is entered into the Wilderness Character Monitoring Database every five years.

Significant Change
Any change in this measure will be considered significant. Besides for the temporary grazing fencing, the types of temporary installations in the Medicine Lake wilderness are consistent each year. Annual variation is not expected.

Table 14. Index of Temporary Installations for 2013

Item	Amount Present	Length of Time	Totals
Predator exclusion fence	**1**	**April- October; 7 months, 210 days**	**210**
Gill nets	**9- 6 ft high, 250 ft long** **3- 6 ft high, 300 ft long**	**1 day**	**9** **3**
Fish box traps	**3**	**1 day**	**3**
TOTAL			**225**

2013 Baseline Value- ***225***

Measure 3-2: Acres of inholdings within the wilderness boundary

Background & Context
Since inholdings interior to designated wilderness are not given the same protections as wilderness lands around them, these lands can be developed for various purposes at the discretion of the landowner, and thereby have a large impact on the surrounding wilderness. There are no inholdings in the Medicine Lake Wilderness. While the vulnerability of this measure is very low, this measure is highly relevant to the undeveloped quality of wilderness character.

Measure Description & Collection Protocol
This measure is a reporting of the acreage of inholdings found within the wilderness boundary. Over time, an increase in this value would signify a degrading trend in wilderness character for this indicator.

Definitions

- ***Inholding****- private or other federal or state agency lands entirely within the wilderness boundary.*

Data Source
Refuge manager and refuge biologist

Data Adequacy
Complete/High- All records of inholdings in wilderness are reported for this measure. This data is common refuge knowledge and therefore the quality of this data is high.

Significant Change
Any change in this data would be a significant enough impact to be interpreted as a change in trend of wilderness character.

Frequency- Data for this measure is to be recorded every ten years in the wilderness character monitoring database.

2013 Baseline Value- ***0***

Measure 3-3: Index of authorized mechanical transport and motorized equipment use in wilderness

Background & Context

The wilderness Act discusses three forms of mechanization that degrade wilderness character: motor vehicles (aircraft and motorboats are included here), motorized equipment, and mechanical transport. Agency policies restrict the use of motor vehicles, motorized equipment, and mechanical transport, requiring authorization when deemed necessary. Mechanical transport and motorized equipment will only be used in the Medicine Lake Wilderness when such equipment is considered the minimum requirement necessary to accomplish refuge goals and protect the wilderness resource.

Measure Description & Collection Protocol

This single measure directly tracks the status and trends in all motorized and mechanized use that is authorized by the Federal land manager in wilderness. Not all equipment types have the same impact level associated with them. To account for these differences, an inherent weighting has been assigned to each equipment type based on its perceived impact to social and biophysical resources, as shown in the table below. Motorized equipment with a relatively low level of impact are assigned a value of 1, motorized equipment with a moderate level of impact is assigned a value of 2, and motorized equipment with a high level of impact is assigned a 3. A total use level value will be calculated for each motorized/mechanized use by multiplying the inherent weight of each type of equipment by the amount of actual use, as shown in the table below. The resulting products for each motorized/mechanized use are summed to generate a total score for the entire wilderness. This sum is reported in the Wilderness Character Monitoring Database.

Equipment Type	Inherent Weight		Amount of Use	Use Weight	Total
Wheelbarrow	1		One piece, 1 day	1	
Helicopter used for emergencies involving the health and safety of persons within the area	1		Multiple pieces, 1 day	2	
'Weed whacker'	2				
Chain saw	2				
Heavy equipment	6				
Generator	2				
Motorized vehicle/boat	3		One piece, multiple days	2	
All-terrain vehicle (ATV)	3		Multiple pieces, multiple days	3	

Data Source

Region 6 Invasive Species Coordinator and Refuge Manager

Data Adequacy
Complete/High- All records of mechanized and motorized uses in wilderness are reported for this measure. This data is common refuge knowledge and therefore the quality of this data is high.

Frequency
Data is entered into the Wilderness Character Monitoring Database annually.

Significant Change
Any change in this data would be significant enough impact to be interpreted as a change in trend in wilderness character.

Table 15. Detailed Data: Mechanical transport and motorized equipment use in the Medicine Lake Wilderness 2013

Date & Description of Use	Inherent Weight	Use Weight	Total
ATV (8 large ATVs used to treat the Sandhills with herbicide during the summer and several were used during the prescribed burn)	3	3	TBD
Motorized Boat (used to survey fish in Medicine Lake)	3	1	3
			Total: TBD

Solitude or Primitive and Unconfined Recreation

The Wilderness Act states that Wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality is about the opportunity for people to experience Wilderness; it is not directly about visitor experience per se. This quality is degraded by settings that reduce these opportunities, such as visitor encounters, signs of modern civilization recreation facilities and management restrictions on visitor behavior.

Table 16. Solitude or Primitive and Unconfined Recreation Measures

Monitoring Question	Indicator	Measure	Frequency	Baseline Value
What are the trends for outstanding opportunities for solitude within wilderness?	Remoteness from sights and sounds of people inside the wilderness	4-1. Estimated number of hunters in the wilderness	5	50 hunters
		4-2. Estimated number of anglers in the wilderness	5	400 anglers
	Remoteness from occupied and modified areas outside the wilderness	4-3. Miles of adjacent travel routes	5	27 miles
		4-4. Index of energy development and production infrastructure	5	125
What are the trends in outstanding opportunities for primitive and unconfined recreation inside wilderness?	Facilities that decrease self-reliant recreation	4-5. Agency provided recreation facilities	5	0
	Management restrictions on visitor behavior	4-6. Index of restrictions on visitor behavior	5	12

Measure 4-1: Estimated number of hunters in the wilderness

Background & Context
The Wilderness Act states that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation". The Wilderness Act acknowledges that wilderness, being protected from human development or settlement, could provide an opportunity for solitude not available in many other places. This quality focuses on the tangible aspects of the setting that affect the opportunity for people to directly experience wilderness. Although managers cannot ensure that visitors will have such experiences, they must protect these opportunities and not allow them to decline over time. Opportunities for solitude are degraded by both visitor use in wilderness and certain characteristics of the setting. Specifically, encountering other visitors in wilderness, or seeing or hearing the signs of modern civilization, may detract from the opportunity to experience solitude. Increasing visitation, human population growth (especially near wilderness), and areas of concentrated use within wilderness all have the potential to degrade the opportunities for solitude.

This measure is an estimated number of hunters that visit the Sandhills portion of Medicine Lake Refuge. Hunting season occurs between September 1 and late December at Medicine Lake National Wildlife Refuge. The Sandhills unit of the wilderness is part of hunting area two which is open to upland game birds, mourning doves, ducks, geese, coots, jackrabbits, deer, pronghorn, and predator hunting in accordance with State seasons and bag limits. All of the hunting on the Refuge is in accordance with Federal and State laws and regulations.

Measure Description & Collection Protocol
Inquiries are made to refuge staff with knowledge on public use, including the refuge manager, refuge biologist, and law enforcement ranger officer.

Data Source
Refuge staff with knowledge on public use, including the refuge manager, law enforcement officer, refuge biologist, Montana Block Management records.

Data Adequacy
Complete/low- The quantity of this data is complete because all refuge staff with knowledge on public use were consulted. However, since the data relies heavily on professional judgment and best estimates, the quality of this data is low.

Significant Change
A 25% change from the 2013 baseline would be a significant enough impact to the wilderness to be interpreted as a degrading or improving trend. Increasing wilderness visitation results in increases in the likelihood of encounters among visitors, and thus, decreases the opportunities for solitude.

Frequency- Data is to be entered into the Wilderness Character Monitoring Database annually.

2013 Baseline Value- ***50 hunters***

Measure 4-2: Estimated number of anglers in the wilderness

Background & Context
The Wilderness Act states that wilderness has "outstanding opportunities for solitude or a primitive and unconfined type of recreation." The Wilderness Act acknowledges that wilderness, being protected from human development or settlement, could provide an opportunity for solitude not available in many other places. This quality focuses on the tangible aspects of the setting that affect the opportunity for people to directly experience wilderness. Although managers cannot ensure that visitors will have such experiences, they must protect these opportunities and not allow them to decline over time. Opportunities for solitude are degraded by both visitor use in wilderness and certain characteristics of the setting. Specifically, encountering other visitors in wilderness, or seeing or hearing the signs of modern civilization, may detract from the opportunity to experience solitude. Increasing visitation, human population growth (especially near wilderness), and areas of concentrated use within wilderness all have the potential to degrade the opportunities for solitude. The Medicine Lake Wilderness offers opportunity for wildlife observation, photography, wild lands appreciation, hunting, and fishing. Public access is limited to daylight hours.

This measure is an estimated number of anglers that utilize Medicine Lake for recreation purposes. There are eight public access points for fishing located around Medicine Lake. The most commonly-used areas are those off of Montana State Highway 16 and along the Environmental Education Area shoreline. Due to the lack of available fishing lakes in northeastern Montana and the stocking of Pike in Medicine Lake make it a popular place for anglers. Fishing within the Medicine Lake National Wildlife Refuge is subject to state regulations.

Measure Description & Collection Protocol
Inquiries are made to refuge staff with knowledge of public use including refuge manager, biologist, and law enforcement ranger. The number of fishermen is estimate to the best degree.

Data Source
The annual RAPP report and refuge manager consultation was used to acquire data.

Data Adequacy
Complete/Low- The quantity of this data is complete because refuge staff and RAPP reports were consulted. The data relies heavily on professional judgment and estimates, the quality is low.

Frequency- Data is to be entered into the Wilderness Character Monitoring Database annually.

Significant Change
A 25% change from the 2013 baseline would be a significant enough impact to the wilderness to be interpreted as a degrading or improving trend. Increasing wilderness visitation results in the likelihood of more visitor encounters, thus degrading opportunities for solitude.

2013 Baseline Value- ***400 anglers***

Measure 4-3: Miles of adjacent travel routes

Background & Context
Surrounding roads and trails impact the perception of remoteness within a wilderness. Currently there are no trails or roads within the Medicine Lake wilderness; their absence represents a high quality of solitude or primitive and unconfined recreation. However, there are roads that are immediately adjacent and go along the perimeter of the wilderness. This measure will monitor selected conditions occurring on the lands adjacent to the wilderness that affect visitors' opportunities for solitude.

The current refuge road system consists of 50 miles of designated roads; 31 miles are classified as administrative roads, and 19 miles are classified as open public roads. A 14-mile auto tour route, known as Wildlife Drive, is located on the refuge. This route is passable by passenger vehicles approximately 8 months of the year, and often is open at other times of the year depending on weather conditions. The 2.3 miles entrance road is an improved all-weather gravel road from Montana State Highway 16 to the refuge complex office. The county administers an additional 8 miles of roads transecting the refuge.

The Environmental Education Area is located off of Montana State Highway 16. A 0.25-mile road leads to a mowed grass loop with benches, interpretive signs, lake access, and an outdoor restroom. Three kiosks exist on the refuge provide the public general information and direction, interpretation, and brochures. They are located at the entrance to the Environmental Education Area off of Montana State Highway 16; at the junction of Wildlife Drive and the headquarters access road; and the junction of East Lake Highway and Lakeside Road.

The Pelican Overlook site is located at the end of the 1.2-mile vehicle trail leading to Bridgerman Point. An elevated platform overlooks a breeding colony of pelicans, cormorants, and herons.

Measure Description & Collection Protocol
To get the appropriate value for this measure, add up the miles of refuge roads which are adjacent to the wilderness area (Medicine Lake itself and the Sandhills portion). Specifically, the auto tour route (14 miles), the Refuge Entrance Road (2.3 miles), the Environmental Education Area (0.25 miles), and the seasonal access roads (8 miles) will be counted for this measure. The only non-refuge road which will be considered for this measure is State Highway 16 which is the west boundary of the wilderness and runs directly parallel to the lake, equaling about two miles. Data will be counted to the nearest whole mile.

Data Source- Comprehensive Conservation Plan

Data Adequacy- Complete/High

Frequency- Data is to be recorded into the wilderness character monitoring database every five years.

Significant Change
Any increase in adjacent travel routes and trails are considered to be significant and degrading to the opportunities for solitude and unconfined recreation quality.

2013 Baseline Value- ***27 miles***

Measure 4-4: Index of energy development and production infrastructure

Background & Context

Medicine Lake National Wildlife Refuge is located in a remote, sparsely populated part of Montana. It is surrounded primarily by agricultural land, and additional public grasslands. This measure quantifies the amount of oil and gas development in the surrounding area. This measure is relevant to the indicator because it monitors selected conditions occurring on lands adjacent to the wilderness that affect visitors' opportunities for solitude. Wilderness character is degraded by these developments, and land managers have little to no control on the continuing establishments of said developments. Renewed oil exploration activity began in the mid-1990s with the advent of horizontal drilling and 3-dimensional seismic technology. Approximately 900 oil wells have been drilled in Sheridan County, and over half of these are located in the eastern portion of Sheridan County. In addition to oil wells and their associated tank batteries, Sheridan County also has a large number of oil and produced –water pipelines. Spills from produced-water lines are common, and impacts to wetlands in the area are visually evident.

Adverse effects from environmental contaminants generated in conjunction with oil exploration and production include drilling muds, produced water, hydrocarbons and production activity wastes. The dominant waste product from the oil production process is produced water. Contaminants in produced water vary by region, depth-to-production zone, and age of the well. Frequently occurring production-water contaminants include oil, trace elements, radionuclides, additives, and salt. In the Bakken Formation, drilling wastes and initial production fluids are placed into reserve pits. Until the late 1970s these reserve pits were unlined; although they now are required to be lined, the linings do not prevent the migration of contaminants into nearby wetlands. The influx of salts from co-produced waters to wetlands can impact waterfowl and shorebirds dependent on these systems in several ways. Invertebrate populations can shift so that an important food source is eliminated from the wetlands. Waters can become directly toxic, and birds' feathers can be degraded by salts.

Measure Description & Collection Protocol

This measure will be a total index count of the development infrastructure within a two mile buffer of the wilderness boundary. An index is created which gives each development a score dependent upon the level of impact such development has to the adjacent lands of the wilderness. Lower scores are given to lower-impact developments and higher scores are given to higher-impact developments (i.e. public roads and developing wells), according to the table below. This score is multiplied by the number of specific developments seen in the allotted two mile buffer. The number of developments was acquired through GIS files as well as the Montana's industrial commissions' website. These developments were also chosen with their established scores through discussions with the refuge manager and biologist as an appropriate catch-all of what is seen in lands surrounding the refuge. A two mile buffer was established around the wilderness boundary which was decided as appropriate amongst the management staff. Beyond two miles, visual and auditory disturbances from within the wilderness would be considered negligible due to the topography of surrounding lands. If additional developments are established in future years that are not included in the table below, use the table as a reference to give it an appropriate score.

Table 17. Index of Infrastructure Development

Type of Development	Score
Producing gravel pit	**2**
Idle gravel pit	**1**
Producing well	**2**
Developing well	**3**
Building/Farmstead	**1**
New road commissioned	**2**
Public road	**3**
Pipeline	**2**

Table 18. 2013 Medicine Lake Wilderness Data of Infrastructure Development

Type of Development	Score	Number of Developments	Comments	Score x Value
Producing gravel pit	**2**	**6**		**12**
Idle gravel pit	**1**	**0**		**1**
Producing well	**2**	**7**		**14**
Building/farmstead	**1**	**16**		**16**
Public road	**3**	**27**	**Measured in miles**	**81**
Developing well	**1**	**1**		**1**
			TOTAL (sum)	**125**

Definitions

- ***Producing well****- all-inclusive term used to describe the infrastructure seen at a well site. Includes the oil tank and wells, the pump jack and the well pads, as well as any additional oil production storage units that are visible.*
- ***Access road****- Cut through land so equipment and workers can get to drilling site. Will be included under "new road commissioned".*
- ***Drilling rig****- Set up and drilling takes several weeks. Rig is removed to control gas extraction. Well can produce for several decades. The initial set-up of this equipment will be noted under "developing wells". Due to the amount of set-up, this receives a higher score for the index.*
- ***Site prep****- Area has to be cleared and prepped for drilling operations*
- ***Gas pipelines****- Needed to move gas off site once well is producing.*
- ***Extraction-*** *The drill shaft is perforated with explosives. A slurry of water and sand is then pumped down into the shale. The pressurized mix fractures the shale, and forces the gas out and up the shaft.*

Data Source- Montana Board of Oil and Gas conservation Records, <http://bogc.dnrc.mt.gov/>, and Medicine Lake GIS Files, I:\GIS Data\Management\Oil and Gas\Wilderness Map O_G

Data Adequacy- Partial/High- Data quality is partial complete through the use of aerial ArcGIS mapping. The latest version has 2012 imagery, yet this is of high quality data.

Frequency- Data for this measure is to be recorded into the Wilderness Character Monitoring Database every five years.
Significant Change- Any increase in value to this measure will degrade the opportunities for solitude or primitive and unconfined recreation, and a decrease in value will improve this quality.

Measure 4-5: Number of agency-provided recreation facilities

Background & Context
This measure tracks trends in authorized durable or permanent facilities that are used primarily for recreational purposes, regardless of whether they were established by resource protection or visitor convenience. Recreational facilities decrease a visitor's opportunity for primitive recreation.

Measure Description & Collection Protocol
Count the number of recreation facilities provided or permitted by the refuge. Currently there are none in the Medicine Lake wilderness.

Data Source
Comprehensive Conservation Plan

Data Adequacy
Complete/High

Frequency
Data for this measure is to be recorded every five years into the wilderness character monitoring database.

Significant Change
Any change in this measure is significant.

2013 Baseline Value- *0*

Measure 4-6: Index of restrictions on visitor behavior

Background & Context
Opportunities for primitive and unconfined recreation are most outstanding where visitors must rely on their own skills to navigate and travel and where they have a high degree of freedom over their own actions and decisions. This measure tracks trends in restrictions that the agency places on visitor behavior inside wilderness. Visitors' opportunities to experience freedom from management are significantly affected by the number and type of regulations in place.

The restrictions on visitor behavior in the Medicine Lake Wilderness are in place to protect the natural quality of wilderness character. The core mission of the Service's National Wildlife Refuge System is conservation of native fish, wildlife, plants, and their habitats.

- *Camping* is prohibited at the Medicine Lake National Wildlife Refuge.
- *Hunting* is an existing use on the refuge and is conducted by the general public under regulation authority of the National Wildlife Refuge System Improvement Act. Hunting is currently allowed for upland game birds, geese, coots, jackrabbits, deer, and pronghorn in the wilderness. Hunters must comply with applicable state and federal regulations.
- *Access* is permitted during daylight hours only, not including hunting season, but current use by the public is minimal.
- *Fishing* is an existing use on the refuge. Anglers must follow all Federal and State regulations while fishing.
- *Dogs* are only permitted as a hunting tool, in pursuit of upland game birds and waterfowl, etc.

Measure Description & Collection Protocol
The wilderness is scored on its visitor restrictions according to the table below. This weighted index of restrictions on visitor behavior assigns scores to the type of restriction with more onerous restrictions weighted more heavily. If a wilderness has more than one type of regulation within a given category, the score will be assigned that corresponds to the most restrictive regulation in place. Scores are summed for the entire wilderness to get an overall score of visitor restrictions. This sum is reported in the Wilderness Character Monitoring Database.

Data Source
Comprehensive Conservation Plan

Data Adequacy
Complete/High

Frequency- Data is entered every five years into the wilderness character monitoring database.
Significant Change- Any change would be a significant impact to be interpreted as a change in trend of wilderness character. Over time, a decrease in this value would signify an improving trend in wilderness character for this indicator.

Category	Type of Restriction	Score	Data: 2013 Medicine Lake Wilderness Score
Camping	No restriction	0	3
	Assigned sites, setback	1	
	Restricted to certain users (i.e. permit required)	2	
	Total prohibition	3	
Campfires	No restriction	0	3
	Assigned sites, setback	1	
	Restricted to certain users (i.e. permit required)	2	
	Total prohibition	3	
Fees	No fees	0	0
	Fees charged of selected user type	1	
	Fees charged of all visitors	2	
Permits	No permit or registration	0	1
	Permits required for certain user-types	1	
	Permits required for all users	2	
Length of Stay	No restriction	0	1
	Length of stay limited (daylight use only)	1	
Area Closure	No restriction	0	1
	Partial closure	1	
	Total closure	3	
Group Size Limits	No restriction	0	0
	Group size limits in place	1	
Hunting and Fishing	No restriction	0	2
	Restrictions in accordance with State of Montana regulations	1	
	Restrictions in addition to State of Montana regulations	2	
	Total prohibition	3	
Dogs	No restriction	0	1
	Leash requirement or restricted to certain users (i.e. permit required)	1	
	Prohibited	2	
		Total reported	**12**

MEASURES SUGGESTED FOR FUTURE USE

The following measures were considered for inclusion in the wilderness character monitoring strategy, but were ultimately eliminated for one or more reasons. Measures were eliminated based on their reliability, relevance, feasibility, and data availability. The reliability of a measure is the possibility that it can be monitored accurately with a high degree of confidence and would yield the same result if measured by different people at different times. Low feasibility means that the data collections would require significant refuge effort beyond the current efforts. The 'Prioritizing Measures of Wilderness Character' worksheet (Appendix B) can offer additional insight as to why these measures were eliminated.

QUALITY: Natural
INDICATOR: Plant and animal species and communities
Measure: Plant species of concern

There are a number of rare plants and species of concern that are located in the Sandhills portion of the wilderness. Currently, there is not enough information to establish a trend in wilderness character regarding the status of their plants that are found in the wilderness. No official refuge surveys are conducted. Rare plants have been loosely documented; both refuge staff and the strike team members have made efforts for rare plant documentations in the Sandhills. The reliability for this data is the main reason why it is not currently being used in the framework. Exact locations were not documented and only a small portion of the Sandhills was surveyed. The following has been noted in the Sandhills:

- Painted Milkvetch- *Astragalus ceramicus var. apus*
- Pale Evening-primrose- *Oenothera pallisa ssp. Pallida*
- Ute Lady's-tresses- *Spiranthes diluvialis*

DROPPED MEASURES

QUALITY: Natural
INDICATOR: Biophysical Processes
Measure: Acres of islands

There are several large islands that make up the wilderness at Medicine Lake. The main ones include Big Island, Bruce's Island, and Gull Island. Island acreage can fluctuate. This is mainly due to the water level fluctuations. Because water level values are recorded annually in the Medicine Lake Water Use Reports, island acreage was not considered relevant for wilderness character monitoring.

QUALITY: Undeveloped
INDICATOR: Non-recreational installations, structures, developments
Measure: Frequency of collared/tagged animals entering the wilderness

This measure was intended to track the trends in numbers of collared animals that spend time in the Medicine Lake wilderness. Waterfowl banding takes place on refuge grounds, outside the wilderness, each year. Band records are recorded duck species, age, and gender. Tracking the numbers of banded ducks which enter and exit the wilderness was not feasible. The value was also discussed to be negligible in degrading the undeveloped quality of wilderness character monitoring.

QUALITY: Undeveloped

INDICATOR: Non-recreational installations, structures, developments

Measure: Count of abandoned infrastructure, installations and developments

This measure is not being used for wilderness character monitoring, because no trend will be established through its use. Currently, there are three abandoned structures in the wilderness which were all present before wilderness establishment. These three structures include two windmills and an earthen dam, all located in the Sandhills. There are no plans to remove these structures from the wilderness.

QUALITY: Solitude or Primitive and Unconfined Recreations

INDICATOR: Remoteness from sights and sounds of people inside the wilderness

Measure: Number of visitors

According the refuge's Comprehensive Conservation Plan, hunting and fishing are the main activities which attract visitors to Medicine Lake. Hunters account for 45% of annual refuge visits and the majority of the fishing at the refuge takes place on Medicine Lake itself. Therefore, having separate measures which count number of hunters and number of fishermen, respectively, is a sufficient estimation to use for overall visitor use of the wilderness.

QUALITY: Other Features

INDICATOR: Loss of Cultural Resources

Measure: Status of Cultural Resources

Currently, there are no known documented cultural resource sites in the wilderness area; therefore it was eliminated as an option for wilderness character monitoring. The refuge itself has several recorded cultural sites including the "Tipi Hills" which has been nominated for the National Registry of Historic Places. This site is described as being "on hilly formation with many steep slopes. Over 15 tipi rings remain on these bluffs that overlook Medicine Lake." Many tipi rings are believed to exist around Medicine Lake and many buffalo bones have been found around Big Island and Bridgeman Point, which indicates the region would be good for hunting. Besides these few records of documentation, nothing else is known regarding the cultural resources of the Medicine Lake wilderness area.

CONCLUSIONS

Preserving the wilderness character in the Medicine Lake wilderness area is stated to be of great importance in the Medicine Lake National Wildlife Refuge's Wilderness Plan. Except for some management actions in practices that ultimately are in an effort to preserve the natural quality of the wilderness character, administrative degradations to wilderness character are few. After conducting an assessment of the current status of wilderness character at Medicine Lake Refuge, the biggest threat posing the refuge is the decline in native mixed grass prairie seen widespread throughout the entirety of the Sandhills. Management staff aims to continue conducting prairie assessments through the Native Prairie Adaptive Management Program (NPAM) program with the use of belt transects, to identify what sort of management actions are needed for prairie restoration. These management efforts always come down to increasing cattle grazing pressure, establishing a prescribed long-term burn plan, and conducting native prairie reconstructions. Despite these efforts and the knowledge of prairie composition, it is difficult to apply what is needed in a timely fashion due to lack of funds and resources at the refuge.

Another factor concerning the wilderness and the Medicine Lake Refuge Complex as a whole is the threats caused by the oil and gas industry and the recent increase in production seen in western North Dakota and the encroachment into eastern Montana. The Bakken Formation is Montana's top oil producing area, accounting for 81 percent of all oil produced in the state. Because these developments are outside of the boundaries of Medicine Lake NWR, little to no refuge management efforts can be performed to lessen the impacts of this industry. In addition to concerns associated with oil drilling, the Bakken Formation produces some of the most saline water in the United States. The likelihood of spills is common and impact wetlands in the area. Adverse effects from environmental contaminants generated in conjunction with oil exploration and production include drilling muds, co-produced water, and production activity wastes. The influx of salts in co-produced water to wetlands can impact waterfowl and shorebirds dependent on these habitats. Increasing water quality investigations and wetland assessments are being conducted within the Lostwood Wetland Management District Complex to begin assessing the possible impacts the industrial developments are having on the integrity of refuge habitat. Besides having potential degrading impacts to the natural quality, the oil and gas industry also impact the opportunities for solitude or primitive and unconfined recreations. Even though the oil production developments occur outside the wilderness, many of these developments can be seen and heard from within the wilderness. The Wilderness Act states the importance for visitors to experience wilderness without any disturbances. Settings that reduce these above mentioned opportunities degrade this quality.

The wilderness character monitoring protocol established in this report will be a useful tool for acknowledging other trends in wilderness character of the Medicine Lake NWR. The plan consists of 30 measures total, (6 untrammeled, 15 natural, 3 undeveloped, and 6 solitude or primitive and unconfined recreation), developed from data that is already collected by refuge staff. Although this list is not exhaustive, the measures selected represent the most significant and measurable features of wilderness in the Medicine Lake NWR and adequately represent the qualities of wilderness character. As additional or more precise information becomes regularly available to refuge staff, it can easily be incorporated into the wilderness character monitoring protocol. This plan will promote wilderness stewardship and support future management decisions in the Medicine Lake wilderness

APPENDIX A – Medicine Lake NWR Upland Plant Associations 2008 (from North Dakota List, from Grant et. al 2004)

• Record 1 of the below codes per 0.5 meter segment
• Based on ≥50% canopy cover dominance, unless otherwise specified

SHRUB and TREE TYPES

low shrub (generally <1.5m tall)
11 snowberry dense (other low shrub species total 0-25%); *other plants few or none*
12 snowberry (and other low shrub spp.); remainder mostly NATIVE grass-forb types
13 snowberry (and other low shrub spp.); remainder mostly Kentucky bluegrass
14 snowberry (and other low shrub spp.); remainder mostly smooth brome (or quackgrass)
16 snowberry (and other low shrub spp.); remainder mostly crested wheatgrass
15 silverberry; add modifier 15[2] = NATIVE grass-forb, 15[3] = KY bluegrass, 15[4] = brome (or quack)
17 greasewood; add modifier
18 winterfat; add modifier
19 silver sagebrush; add modifier
tall shrub/tree (generally ≥1.5m tall)
21 chokecherry, buffaloberry, juneberry, willow
23 exotic shrub: caraganna, Russian olive, Siberian elm, etc.
33 shade-tolerant woodland tree: green ash, box elder, elm

NATIVE GRASS-FORB and FORB TYPES (*>95% dominance by native herbaceous plants, including forbs*)[a]
41 sparse mixed grass (grama, needle&thread, junegrass, upland sedge)
42 mixed grass (needle&thread, western wheatgrass, grama) (wetter than 41)
43 mesic mixed grass (porcupine grass, thick-spike, green needle, w.wheat. Little/no grama/sedge)
44 sand prairie (prairie sandreed, needle&thread, grama, sedge, p. dropseed, Indian ricegrass)
45 western wheat grassland (monotypic stands)
46 sub-irrigated wet meadow within upland (fowl bluegrass, foxtail barley, n. reedgrass, baltic rush, sedges, cordgrass, also saline lowland plants)
47 cactus
48 clubmoss

EXOTIC and INVADED NATIVE GRASS-FORB TYPES [a]
51 Kentucky bluegrass >95% (or >50% if mixed with other non-natives)
52 Kentucky bluegrass and NATIVE grass-forbs, *KY bluegrass 50-95%*
53 NATIVE grass-forbs and Kentucky bluegrass, *KY bluegrass 5-50%*

61 smooth brome (or quackgrass) *>95%* (or >50% if mixed with other non-natives)
62 smooth brome (or quackgrass) and NATIVE grass-forbs, *brome 50-95%*
63 NATIVE grass-forbs and smooth brome (or quackgrass), *brome 5-50%*

71 crested wheatgrass *>95%* (or >50% if mixed with other non-natives)
72 crested wheatgrass and NATIVE grass-forbs, *crested wheatgrass 50-95%*
73 NATIVE grass-forbs and crested wheatgrass, *crested wheatgrass 5-50%*

78 tall, intermediate, or pubescent wheatgrass
98 tall exotic legume: sweet clover or alfalfa

NOXIOUS WEED TYPES
81 leafy spurge
85 Canada thistle
87 wormwood
88 other noxious weeds (user-defined)

OTHER
99 other – user defined
91 barren/unvegetated (e.g., rock, anthill, bare soil); dead, horizontal/flattened litter layer only
00 wetland vegetation (e.g., wet-meadow or shallow marsh plants)

---

[a]Prairie rose is considered native forbs with respect to these categories.

APPENDIX B – Priority ranking of all measures considered

Directions: In each row, write the potential measure in the left column under the appropriate indicator. Add or delete rows as needed. Use the criteria and ranking guide below to create an overall score for each measure. If the combined score for criteria A and B is ≤ 2, STOP and do not score criteria C and D. Those measures with the highest overall scores should be the highest priority for assessing trends in wilderness character.

A. Level of significance (the measure is highly relevant to the quality and indicator of wilderness character, and is highly useful for managing the wilderness):
High = 3 points, Medium = 2 points, Low = 1 point

B. Level of vulnerability (measures an attribute of wilderness character that currently is at risk, or might likely be at risk over 10-15 years): High = 3 points, Medium = 2 points, Low = 1 point

C. Degree of reliability (the measure can be monitored accurately with a high degree of confidence, and would yield the same result if measured by different people at different times):
High = 3 points, Medium = 2 points, Low = 1 point

D. Degree of feasibility (the measure is related to an existing effort or could be monitored without significant additional effort):
High = 1 point, Low = 0 point (if 0 is given, do not use)

POTENTIAL MEASURE	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	
Untrammeled Quality					
Indicator: Authorized actions that manipulate the biophysical environment **Measure:** Number of fish stocked	3	3	3	1	10
Indicator: Authorized actions that manipulate the biophysical environment **Measure:** Number of grazing permits authorized	2	2	3	1	8
Indicator: Authorized actions that manipulate the biophysical environment **Measure:** Acres of wilderness treated with herbicide	3	2	3	1	9
Indicator: Authorized actions that manipulate the biophysical environment **Measure:** Acres of prescribed burns	3	2	3	1	9

POTENTIAL MEASURE	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	
Indicator: Authorized actions that manipulate the biophysical environment **Measure:** Index of other authorized trammeling actions	3	3	3	1	10
Indicator: Unauthorized actions that manipulate the biophysical environment **Measure:** Index of actions unauthorized	3	2	1	0	6
Natural Quality					
Indicator: Plant and animal species and communities **Measure:** Percent occurrence of invasive plants	3	3	1	1	8
Indicator: Plant and animal species and communities **Measure:** Total AUM's	3	3	3	1	10
Indicator: Plant and animal species and communities **Measure:** Number of colonial nesting birds	3	3	3	1	10
Indicator: Plant and animal species and communities **Measure:** Sharp-tailed grouse census	3	3	3	1	10
Indicator: Plant and animal species and communities **Measure:** Piping plover success	3	3	3	1	10
Indicator: Physical resources **Measure:** Air quality measures (ozone pollution, total sulfur wet deposition, total nitrogen wet deposition, visibility)	3	3	3	1	10
Indicator: Physical resources **Measure:** Water quality	3	3	3	1	10
Indicator: Biophysical processes **Measure:** Occurrence of avian disease	3	3	2	1	9
Indicator: Biophysical processes **Measure:** Average precipitation	3	3	3	1	10
Indicator: Biophysical processes **Measure:** Average high air temperature	3	3	3	1	10
Indicator: Biophysical processes **Measure:** Average low air temperature	3	3	3	1	10
Indicator: Biophysical processes **Measure:** Medicine lake water level fluctuations	3	3	2	1	9

POTENTIAL MEASURE	Criteria for Prioritizing Potential Measures				OVERALL SCORE
	A. Significance	B. Vulnerability	C. Reliability	D. Feasibility	
Undeveloped Quality					
Indicator: Non-recreational structures, installations, or developments **Measure:** Index of temporary non-recreational installations, structures, and developments	3	1	2	1	7
Indicator: Inholdings **Measure:** Acres of inholdings	3	1	3	1	8
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport **Measure:** Index of motor vehicles, motorized equipment, or mechanical transport	3	1	3	1	8
Solitude or Primitive and Confined Recreation Quality					
Indicator: Remoteness from sights and sounds of people inside the wilderness **Measure:** Estimated number of hunters in the wilderness	3	2	2	1	8
Indicator: Remoteness from sights and sounds of people inside the wilderness **Measure:** Estimated number of anglers in the wilderness	3	2	2	1	8
Indicator: Remoteness from occupied and modified areas outside the wilderness **Measure:** Miles of adjacent travel routes	3	2	2	1	8
Indicator: Remoteness from occupied and modified areas outside the wilderness **Measure:** Index of energy development and production infrastructure	3	3	2	1	9
Indicator: Facilities that decrease self-reliant recreation **Measure:** Number of agency provided recreation facilities	1	3	3	1	8
Indicator: Management restrictions on visitor behavior **Measure:** Index of visitor restriction	3	1	3	1	8

APPENDIX C – Summary of effort required for wilderness character monitoring

Quality	Indicator	Measure	Type of Data Source	Time spent gathering data for each measure (in whole hours)	Comments
Untrammeled	Authorized action	Number of fish stocking actions	Fish records, refuge staff	1	Inquiries to wildlife biologist
Untrammeled	Authorized action	Number of grazing permits authorized	Grazing special use permits	1	
Untrammeled	Authorized action	Acres of wilderness treated with herbicide	Region 6 strike team records	1	Inquiries to invasive plants coordinator of region 6
Untrammeled	Authorized action	Acres of prescribed burns	Fire records, refuge staff	1	
Untrammeled	Authorized action	Index of other authorized trammeling actions	Fish stocking records, refuge staff	1	Inquiries to staff that might conduct such actions
Untrammeled	Authorized action	Index of actions non-authorized	Refuge staff	1	

Quality	Indicator	Measure	Type of Data Source	Time spent gathering data for each measure (in whole hours)	Comments
Natural	Plant and animal species and communities	Percent occurrence of invasive plants	Belt transect records	2	Inquiries to wildlife biologist
Natural	Plant and animal species and communities	Total AUM's	Grazing special use permits	<1	Inquiries to wildlife biologist
Natural	Plant and animal species and communities	Number of colonial nesting birds	Annual colonial bird survey files	1	
Natural	Plant and animal species and communities	Sharp tailed grouse census	Sharp tailed grouse survey files	1	
Natural	Plant and animal species and communities	Piping plover success	Piping plover annual reports	1	
Natural	Physical resources	Air quality (ozone pollution, total nitrogen wet deposition, total wet sulfur, visibility)	Inventory and monitoring data	<1	National Wildlife Refuge System's Natural Resource Program Center, Inventory and Monitoring Department.

Quality	Indicator	Measure	Type of Data Source	Time spent gathering data for each measure (in whole hours)	Comments
Natural	Physical resources	Water Quality	Water use reports	1	Inquiries to wildlife biologist
Natural	Biophysical processes	Occurrence of avian disease	Avian disease files	1	Inquiries to wildlife biologist
Natural	Biophysical processes	Average precipitation	Online NOAA database	1	http://wxcoder.org/home/ in cooperation with the National Weather Service, Regional Climate Centers, and National Climatic Data Center
Natural	Biophysical processes	Average high air temperature	Online NOAA database	1	http://wxcoder.org/home/ in cooperation with the National Weather Service, Regional Climate Centers, and National Climatic Data Center
Natural	Biophysical processes	Average low air temperature	Online NOAA database	1	http://wxcoder.org/home/ in cooperation with the National Weather Service, Regional Climate Centers, and National Climatic Data Center
Natural	Biophysical processes	Medicine Lake water level fluctuations	Water use reports	1	Inquiries to wildlife biologist

Quality	Indicator	Measure	Type of Data Source	Time spent gathering data for each measure (in whole hours)	Comments
Undeveloped	Non-recreational installations, structures and developments	Index of temporary non-recreational installations, structures, and developments	Predator fence files and fish reports	1	Inquiries to wildlife biologist
Undeveloped	Inholdings	Acres of inholdings	Common refuge knowledge, CCP	<1	
Undeveloped	Use of motor vehicles, motorized equipment, or mechanical transport	Index of motor vehicles, motorized equipment, and mechanical transport	Refuge staff knowledge	1	Inquiries to refuge manager and region 6 invasive species coordinator
Solitude or primitive and unconfined recreation	Remoteness from sights and sounds of people	Estimated number of hunters in wilderness	Refuge staff knowledge, professional judgment	1	Inquiries to refuge staff
Solitude or primitive and unconfined recreation	Remoteness from sights and sounds of people inside the wilderness	Estimated number of anglers in the wilderness	RAPP report, refuge staff, professional judgment	1	Inquiries to refuge manager
Solitude or primitive and unconfined recreation	Remoteness from sights and sounds of people outside the wilderness	Miles of adjacent travel routes	CCP	1	

Quality	Indicator	Measure	Type of Data Source	Time spent gathering data for each measure (in whole hours)	Comments
Solitude or primitive and unconfined recreation	Remoteness from sights and sounds of people outside the wilderness	Index of energy development and production infrastructure	Montana Board of Oil and Gas conservation Records, , and Medicine Lake GIS Files	2	http://bogc.dnrc.mt.gov/ and inquiries to wildlife biologist
Solitude or primitive and unconfined recreation	Facilities that decrease self-reliant recreation	Number of agency provided recreation facilities	CCP	<1	
Solitude or primitive and unconfined recreation	Management restrictions on visitor behavior	Index of visitor restriction	CCP	<1	

APPENDIX D – Data sources and protocols for all measures used

Keeping Track of Wilderness Character Monitoring Measures

Measure	Priority (H, M, L)	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
Untrammeled Quality		
Number of fish stocking actions	H	This measure tracks the number actions that take place to stock fish into Medicine Lake each year. The value will be reported annually.
Number of grazing permits authorized	H	This is the count of the number of permits distributed for managed grazing on the wilderness area at Medicine Lake refuge. This value is to be recorded every 5 years.
Acres of prescribed burns	H	This measure tracks the areal extent of the trammeling by prescribed burning within the wilderness boundary. The cumulative acres of wilderness applied with prescribed burning over the last 5 years will be reported.
Acres of wilderness treated with herbicide	H	This measure tracks the number of acres that are treated with herbicide each year. The region 6 strike team performs these treatments in the Sandhills. The acreage value will be reported annually.
Index of other authorized trammeling actions	H	This single measure accounts for all other authorized trammeling actions that are not monitored by other measures. Each "other" trammeling action (those not tracked by other measures) taken within the last five years is scored based on its impact to the untrammeled quality according to three parameters: (1) the extent that the activity affects the community of life (spatial extent and species affected) and (2) the temporal extent of the activity. The table in the detailed measure description describes how these trammeling actions are scored. The sum of these scores generates a total score for each trammeling action; the summed score for all trammeling actions is reported in Wilderness Character Monitoring Database. Over time, an increase in this value would signify a degrading trend in wilderness character for this indicator.
Index of unauthorized actions that intentionally manipulate the biophysical environment	M	This single measure will account for any unauthorized intentional manipulations in the Bosque del Apache Wilderness within the last five years. Each such trammeling is scored according to the extent that the activity affects the community of life (spatial extent and species affected) and the temporal extent of the activity. The table in the detailed measure description describes how these trammeling actions are scored. The sum of these scores generates a total score for each trammeling action; the summed score for all trammeling activities is reported in Wilderness Character Monitoring Database. This measure would monitor any action undertaken

Measure	Priority (H, M, L)	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
		by any individual (visitors), group, or agency without specific approval by the authorized wilderness manager. Over time, an increase in this value would signify a degrading trend in wilderness character for this indicator.
Natural Quality		
Percent occurrence of invasive plants	H	Using the belt transect method, the percent of invasive species will be calculated. Totals are calculated for each vegetation class (as noted in Appendix A), and then broken down further into classifications of "native" and "non-native". The "non-native" values were summed together to get the total percent occurrence of invasive plants in the wilderness.
Total AUM's	H	This measure will assess the level of managed grazing within the wilderness. The Sandhills portion of the Medicine Lake Wilderness is the only portion that experiences managed grazing. When the Sandhills is grazed, a calendar system is established for the specific number of cattle used in each specific unit of the wilderness. This measure will be quantified in Animal Unit Months (AUM). Animal unit months are calculated by multiplying the number of animal units by the number of days the unit is grazed, and then divided by 30.5.
Piping plover success	H	For this measure, the rate of piping plover nest success on the Medicine Lake wilderness is determined. Add up the total number of hatched nests to determine this value. The Medicine Lake piping plover census takes place June of every year, during the breeding season.
Sharp-tailed grouse census	H	There are three historic lek sites in the Sandhills portion of the Medicine Lake wilderness; leks number 8, 9, and 27. The number of males-per lek is recorded to the database.
Number of colonial nesting birds	M	For this measure, refer to the ***Waterbird Inventory Summary*** form, and get a total of the nesting bird species. Specifically, Bridgerman Point, Big Island, and Gull Island have been target survey points. Bridgerman Point counts will not be included for this measure.
Air Quality (Ozone air pollution, Total nitrogen wet deposition, total sulfur wet deposition, visibility)	H	Data is provided by the National Wildlife Refuge System's Natural Resource Program Center, Inventory and Monitoring Department.
Water Quality	H	Management staff aims to have a few data loggers within wilderness boundaries to establish water quality for the lake in the near future. The Contamination Index will be used to determine whether areas of the lake are experiencing co-produced water levels.
Occurrence of avian disease	H	This measure will count the number of avian diseases present within the colonial nesting bird colony in the Medicine Lake wilderness. This measure is tracking the occurrence of disease and the trends in possible new and emerging diseases within

Measure	Priority (H, M, L)	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
		the avian colony.
Total precipitation	H	Weather data is recorded t an official weather station located at the refuge headquarters. Data is reported to NOAA.
Average high air temperature from May-September	H	Weather data is recorded at an official weather station located at the refuge headquarters. Data is reported to NOAA.
Average low temperature from November- March	H	Weather data is recorded at an official weather station located at the refuge headquarters. Data is reported to NOAA.
Medicine Lake water level fluctuations	H	This measure will be quantified through units of acre-feet which calculate the capacity of the late itself. Every year, a water-use report is completed by refuge staff which is a combination of water level and use information for 28 water units throughout the Medicine Lake Refuge complex.
Undeveloped Quality		
Index of temporary non-recreational structures, structures, and developments	M	Count the number gill nets, predator exclusion fences and other non-recreational temporary structures installed in the wilderness each year. Multiply each development by the number of days it remained in the wilderness (round to the nearest whole number). For this measure, 30 will be used as the average number days per month.
Acres of inholdings within the wilderness boundary	L	This measure is a reporting of the acreage of inholdings found within the wilderness boundary. Over time, an increase in this value would signify a degrading trend in wilderness character for this indicator.
Index of motor vehicles, motorized equipment and mechanical transport	H	This measure directly tracks the status and trends of all motorized and mechanized use that are authorized by the Federal land manager in wilderness. Not all equipment types have the same impact level associated with them. For example, a wheelbarrow has a significantly different impact level than a helicopter. To account for these differences, an inherent weighting has been assigned to each equipment type based on its perceived impact to social and biophysical resources. Mechanized equipment and motorized equipment with a relatively low level of impact are assigned a value of 1, motorized equipment with a moderate level of impact is assigned a value of 2, and motorized equipment with a high level of impact is assigned a 3. A total use level value will be calculated for each motorized/mechanized use by multiplying the inherent weight of each type of equipment by the amount of actual use. See measure description for details on scoring. The resulting products for each motorized/mechanized use are summed to generate a total score for the entire wilderness. This sum is reported in the Wilderness Character Monitoring Database.
Solitude or Primitive and Unconfined Quality		

Measure	Priority (H, M, L)	Detailed Description of the Data Source(s) and Protocols for How the Data Were Gathered
Estimated number of hunters in the wilderness	M	Inquiries are made to refuge staff with knowledge on public use, refuge manager, law enforcement officer, and wildlife biologist. All types of hunting should be estimated to the best degree.
Estimated number of anglers in the wilderness	M	Inquiries are made to refuge staff with knowledge on public use, refuge manager, law enforcement ranger, and wildlife biologist. All types of hunting should be estimated to the best degree.
Miles of adjacent travel routes	M	To get the appropriate value for this measure, add up the miles of refuge roads which are adjacent to the wilderness area (Medicine Lake itself and the Sandhills unit). Specifically, the auto tour route (14 miles), education area road (0.25 miles) the entrance road (2.3 miles), and the seasonal access roads (8 miles) will be counted for this measure. The only non-refuge road which will be considered for this measure is State Highway 16
Index of energy development and production infrastructure	H	This measure will be a total index count of the development infrastructure within a two mile buffer of the wilderness boundary. An index is created which gives each development a score dependent upon the level of impact such development has to the adjacent lands of the wilderness. Lower scores are given to lower-impact developments and higher scores are given to higher-impact developments (i.e. public roads and developing wells), according to the table below. This score is multiplied by the number of specific development seen in the allotted two mile buffer.
Agency provided recreation facilities	L	Count the number of recreation facilities provided or permitted by the refuge. Currently there are none in the Medicine Lake wilderness.
Index of restrictions on visitor behavior	L	The wilderness is scored on its visitor restrictions according to the table below. This weighted index of restrictions on visitor behavior assigns scores to the type of restriction with more onerous restrictions weighted more heavily. If a wilderness has more than one type of regulation within a given category, the score will be assigned that corresponds to the most restrictive regulation in place. Scores are summed for the entire wilderness to get an overall score of visitor restrictions. This sum is reported in the Wilderness Character Monitoring

APPENDIX E – What is a trammeling action? Draft Document

Peter Landres, Aldo Leopold Wilderness Research Institute,

The purpose of this short document is to provide guidelines and examples to clarify what is and is not a trammeling action. This document does not discuss how to weight such actions, how to find or record the data for these actions, or any other aspect of using this information in wilderness character monitoring. These guidelines and examples are intended to capture about 90% of the cases and provide sufficient guidance for local staff to figure out the novel and rarer cases as they occur.

The following definitions are used in this document:

- Trammeling action: an action that intentionally manipulates "the earth and its community of life" inside a designated wilderness or inside an area that by agency policy is managed as wilderness.
- Intentional: done on purpose; deliberate; willful
- Intentional manipulation: an action that purposefully alters, hinders, restricts, controls, or manipulates the "the earth and its community of life" including the type, amount, or distribution of plants, animals, or physical resources inside a designated wilderness or inside an area that by agency policy is managed as wilderness.

Trammeling actions are often considered only in terms of how they degrade the Untrammeled Quality, but the agency takes all sorts of such actions for many different reasons that support or sustain the other qualities of wilderness character. For example, controlling non-native species, restoring degraded habitat, or protecting species from harm such as installing gates across caves to prevent people from entering are all actions taken to protect and sustain the Natural Quality. All resource management actions involve tradeoffs, and this is no different in wilderness. The framework of wilderness character simply allows agency staff to be transparent about these tradeoffs, for example the tradeoffs between the Untrammeled and Natural qualities, and make the decision that is deemed best overall for the wilderness.

TYPES OF TRAMMELING ACTIONS

There are two broad classes of trammeling actions, those that are authorized by the federal land manager and those that are not. Under each of these broad classes there are several subclasses that reflect whether the action is taken on a biological resource, a physical resource, and whether the effect of the action is on a biological or physical resource. Almost always the concern is for actions that occur inside a designated wilderness, but the last subclass provides examples of actions taken outside a designated wilderness that would be included as a trammeling action because the intention is to affect biological or physical resources inside the wilderness.

<u>Agency authorized trammeling actions</u>

1. Taking action on plants or animals inside the wilderness to intentionally and directly affect these plants and animals. Examples:
    a. Removing or killing native plants or animals
    b. Adding or restoring native plants or animals such as fish
    c. Adding non-native plants for erosion control

d. Adding non-native animals such as fish or biocontrol species
e. Spraying chemicals to control non-native plants
f. Releasing biocontrol agents to control non-native plants or animals
g. Capturing plants or animals to study them
h. Inclosing or excluding animals from an area to protect plants or animals or to study the effects of inclosing or excluding animals on protecting plants or animals
i. Adding piscicides to water

2. Taking action on a physical resource inside the wilderness to intentionally and directly affect this physical resource. Examples:
    a. Suppressing naturally-ignited fire
    b. Lighting fire to reduce fuels
    c. Building a dam to alter the quantity or seasonal flow of water
    d. Adding acid-buffering limestone to water to neutralize the effects of acid deposition

3. Taking action on a physical resource inside the wilderness that intentionally affects the physical resource to directly or indirectly affect plants and animals. Examples:
    a. Installing a gate across a cave that will protect bats but exclude other animals from using the cave
    b. Building a dam to exclude non-native species from moving up or down a stream
    c. Installing guzzlers to provide water for wildlife
    d. Lighting fire or any other vegetation manipulation to improve wildlife habitat

4. Taking action on a physical resource outside the wilderness that intentionally affects the physical resources inside a wilderness. Examples:
    a. Cloud seeding to increase precipitation inside the wilderness
    b. Killing wildlife outside of the wilderness with the intention of affecting wildlife inside the wilderness

<u>Unauthorized trammeling actions</u>

1. Taking action on plants or animals inside the wilderness to intentionally and directly affect these plants and animals. Examples:
    a. Adding plants or animals by a federal agency (other than the federal land managing agency) or a state agency or the public
    b. Removing plants or animals by a federal or state agency or the public
    c. Inclosing or excluding animals to study the effects on the plants and animals

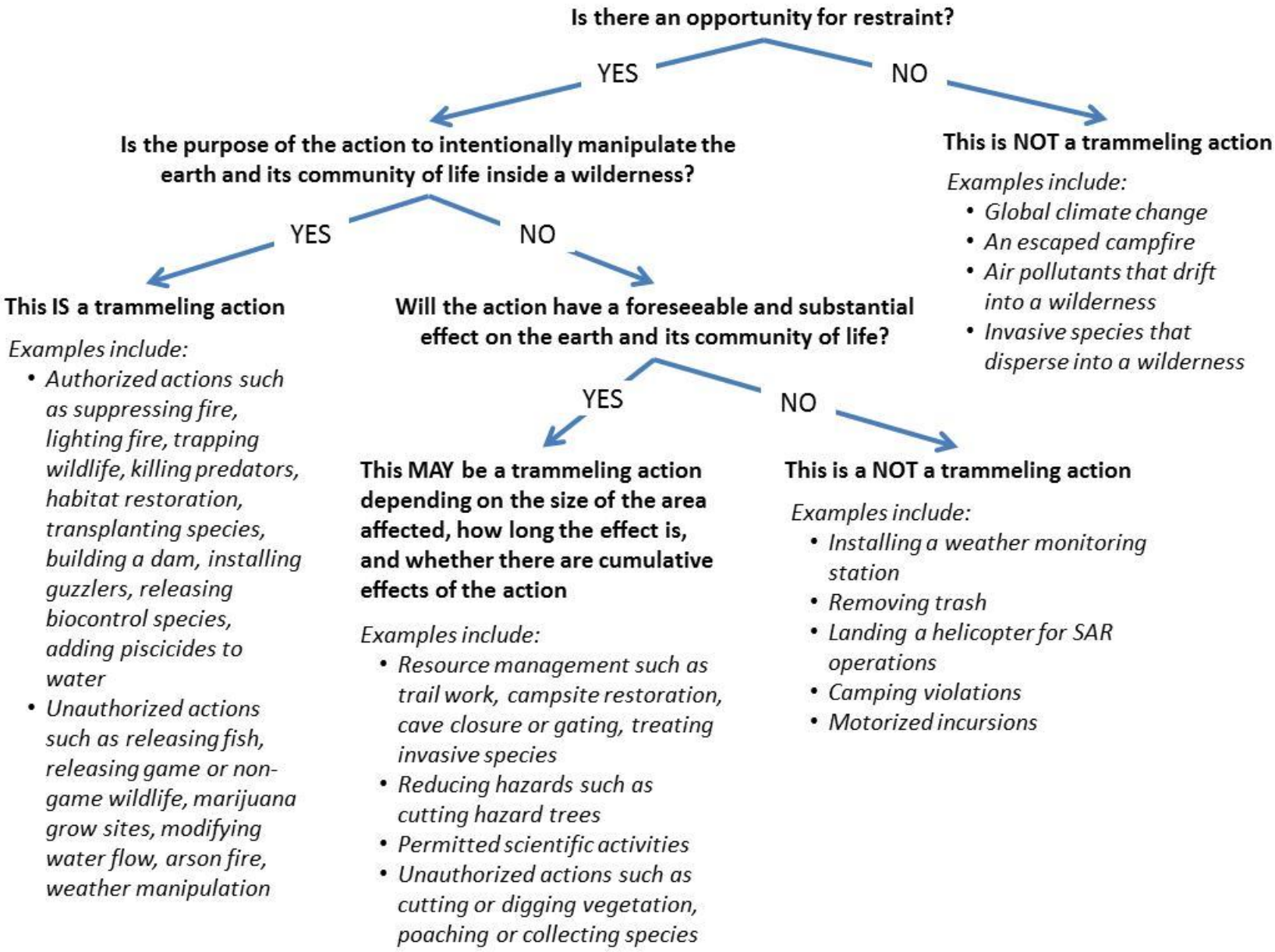
2. Taking action on a physical resource inside the wilderness to intentionally and directly affect this resource.
    a. Modifying water flow to store water or alter the timing of water flow
    b. Setting arson fire

3. Taking action on a physical resource inside the wilderness that intentionally affects the physical resource to intentionally (either directly or indirectly) affect plants and animals. Examples:
    a. Modifying water resources to provide water for wildlife

4. Taking action on plant or animal species outside the wilderness to intentionally affect the occurrence of these or other species inside a wilderness. Examples:
    a. Releasing species outside a wilderness with the intention that the species will disperse into and populate the wilderness
    b. Killing wildlife outside of the wilderness with the intention of affecting wildlife inside the wilderness

In addition to the examples above, the flowchart below is intended to help agency staff determine when an action should be considered a trammeling action. In this flowchart, all of the examples described above would typically fall under the far left branch, although they may occur under the middle branch depending on the circumstances. The flowchart begins with the question "Is there an opportunity for restraint?" because at root the idea behind "untrammeled" is the legislative and policy mandate that managers use restraint in wilderness stewardship. Simply, if there is no opportunity for managerial restraint, or for managers to try and restrain unauthorized action taken by others, then there is no impact to the Untrammeled Quality even though there may be large impacts to the Natural Quality. This question is placed first in the flowchart to help avoid confusing those actions and their effects for which managers typically lack the opportunity for restraint and that there is no intention to manipulate wilderness, such as global climate change, air pollutants, and many others, from actions that intentionally affect "the earth and its community of life" and that managers do have an opportunity to influence.

If there is such an opportunity, then the manager must consider the intent of the action. In many cases deciding whether an action is a trammel is straightforward, but in other cases it is more complex and nuanced. These nuanced cases typically involve some type of action where the intent is not to manipulate "the earth and its community of life" but to have some other outcome that is limited in its scope and effect. On the flowchart these situations are under the question "Will the action have a foreseeable and substantial effect on the earth and its community of life?" These nuanced cases may be confusing because even though the primary intention is not to manipulate species or physical resources, action is nonetheless intentionally being taken and there may be a substantial effect on "the earth and its community of life."


Is there an opportunity for restraint?
YES
NO
This is NOT a trammeling action
Examples include:
• Global climate change
• An escaped campfire
• Air pollutants that drift into a wilderness
• Invasive species that disperse into a wilderness
Is the purpose of the action to intentionally manipulate the earth and its community of life inside a wilderness?
YES
NO
This IS a trammeling action
Examples include:
• Authorized actions such as suppressing fire, lighting fire, trapping wildlife, killing predators, habitat restoration, transplanting species, building a dam, installing guzzlers, releasing biocontrol species, adding piscicides to water
• Unauthorized actions such as releasing fish, releasing game or non-game wildlife, marijuana grow sites, modifying water flow, arson fire, weather manipulation
Will the action have a foreseeable and substantial effect on the earth and its community of life?
YES
NO
This MAY be a trammeling action depending on the size of the area affected, how long the effect is, and whether there are cumulative effects of the action
Examples include:
• Resource management such as trail work, campsite restoration, cave closure or gating, treating invasive species
• Reducing hazards such as cutting hazard trees
• Permitted scientific activities
• Unauthorized actions such as cutting or digging vegetation, poaching or collecting species
This is a NOT a trammeling action
Examples include:
• Installing a weather monitoring station
• Removing trash
• Landing a helicopter for SAR operations
• Camping violations
• Motorized incursions