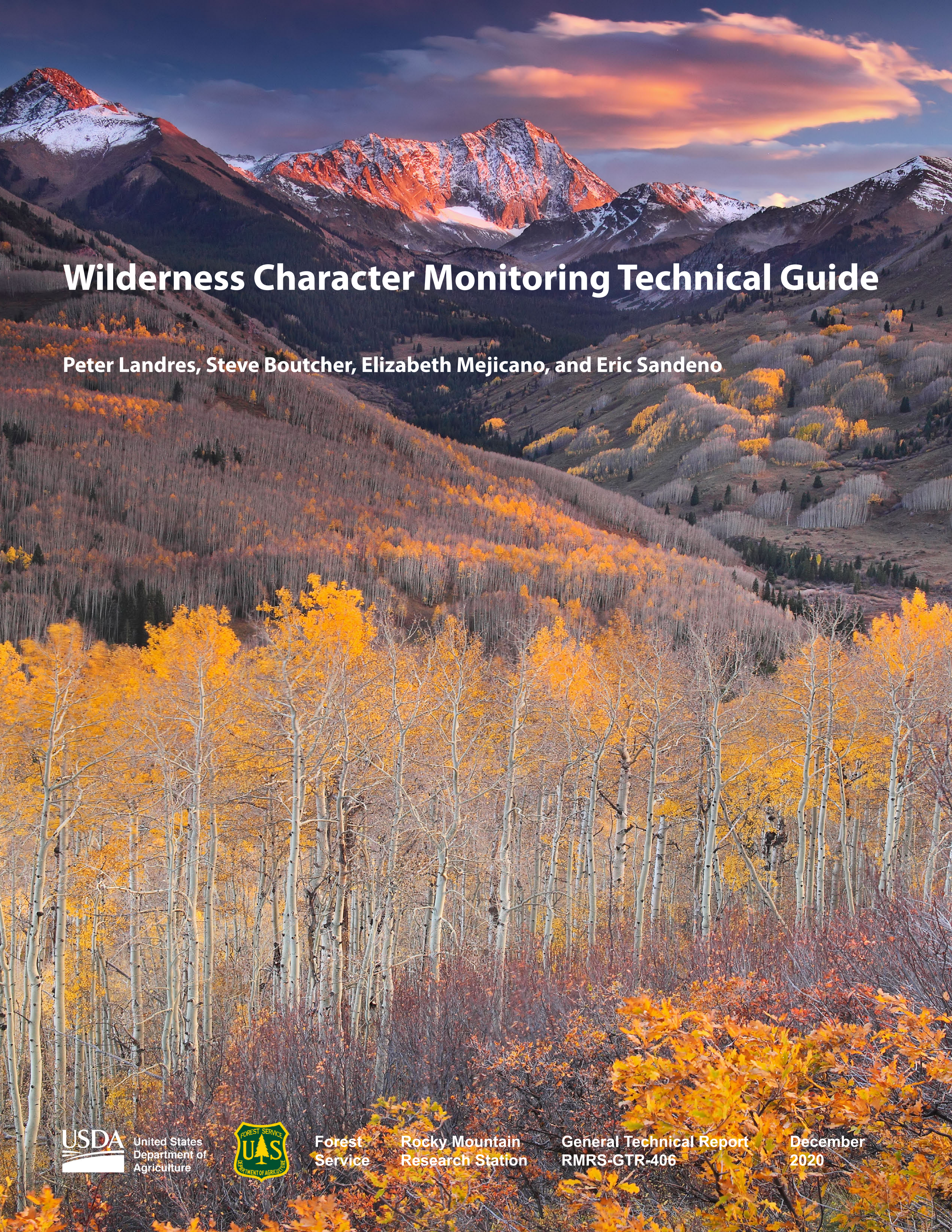

Wilderness Character Monitoring Technical Guide

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Abstract

This *Wilderness Character Monitoring Technical Guide* provides a national framework and detailed protocols to monitor trends in wilderness character within the Forest Service. This document updates and completely replaces the former technical guide that was published in 2009. The approach described in this document is consistent with the interagency wilderness character monitoring strategy used by the other wilderness managing agencies and was endorsed in 2015 by the Federal Interagency Wilderness Policy Council. This technical guide incorporates a wide variety of the best available scientific information to yield a coherent understanding of how wilderness character is changing over time. This monitoring is designed to be nationally consistent across every designated wilderness administered by the Forest Service while allowing for additional local monitoring as necessary to meet wilderness-specific needs. Implementing this monitoring does not guarantee the preservation of wilderness character; rather, it informs and helps improve wilderness stewardship by ensuring that Forest Service line officers and managers are accountable to the central mandate of the Wilderness Act—to preserve the wilderness character of every wilderness for present and future generations.

Keywords: Wilderness Act, wilderness character, monitoring, wilderness stewardship, untrammeled, natural, undeveloped, solitude, primitive recreation, unconfined recreation, other features of value

Cover: Capitol Peak, Maroon Bells–Snowmass Wilderness, Colorado, USA. (©Nate Zeman/ NBP Wilderness Forever Awards, used with permission)

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Table of Contents

Executive Summary

This *Wilderness Character Monitoring Technical Guide* provides a tested and refined methodology for monitoring trends in wilderness character based on lessons learned from 15 years of experience developing and implementing wilderness character monitoring across the National Wilderness Preservation System. This document updates and replaces the *Technical Guide for Monitoring Selected Conditions Related to Wilderness Character* (Landres et al. 2009), and provides protocols for the Forest Service, U.S. Department of Agriculture, to implement a nationally consistent approach to wilderness character monitoring across all 448 wildernesses administered by the agency. This approach also is consistent with the interagency wilderness character monitoring strategy published in *Keeping It Wild 2: An Updated Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System* (Landres et al. 2015) and endorsed in 2015 by the Interagency Wilderness Policy Council.

This technical guide builds on the best available data to yield a coherent understanding of how wilderness character is changing over time. Wilderness character monitoring provides the Forest Service:

- Information to show how agency stewardship makes a difference on the ground based on credible data that are collected consistently and endure over time.
- Accountability for the legal and policy mandate "to preserve wilderness character" by compiling key data to evaluate trends in conditions that tie directly to the Wilderness Act of 1964.
- A communication framework to comprehensively discuss wilderness stewardship needs and priorities related to preserving wilderness character within the Forest Service and with the public.

Wilderness character monitoring in the Forest Service is designed to be nationally consistent while allowing and encouraging local flexibility as necessary to meet wilderness-specific needs. The statutory language of the Wilderness Act is used to identify five qualities of wilderness character that form the foundation of this monitoring: (1) Untrammeled, (2) Natural, (3) Undeveloped, (4) Solitude or Primitive and Unconfined Recreation, and (5) Other Features of Value. This technical guide uses *Keeping It Wild 2's* organizational framework of qualities, monitoring questions, and indicators to ensure consistency across the four wilderness managing agencies (the Forest Service, the National Park Service, the Bureau of Land Management, and the U.S. Fish and Wildlife Service). Each agency identifies measures to evaluate trends in these five qualities. This technical guide describes the Forest Service required as well as optional measures. Locally developed measures to meet wilderness-specific information needs are also discussed.

Photo: Fall Aspens in San Juan County, CO. Original image from Carol M. Highsmith's America, Library of Congress collection.

This technical guide is composed of the following:

- Part 1, National Framework, describes what and why, i.e., the approach the Forest Service will use to implement wilderness character monitoring nationwide, including definitions and key concepts.
- Part 2, Monitoring Protocols, describes how this monitoring will be implemented with detailed, step-by-step protocols; the glossary and references are at the end of this part.
- Appendices summarize key implementation attributes and measures considered but not used.

Implementing wilderness character monitoring does not guarantee the preservation of wilderness character, but it informs and helps improve wilderness stewardship by ensuring that Forest Service line officers and managers are accountable to the central mandate of the Wilderness Act—to preserve wilderness character.

Abbreviations and Acronyms

Abbreviations/Acronyms	Definition
ALP	Automated Lands Project
AML	Abandoned Mine Lands
ANILCA	Alaska National Interest Lands Conservation Act
AQS	Air Quality System
AUMs	Animal Unit Months
BAER	Burned Area Emergency Response
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
CL	Critical Load
EDW	Enterprise Data Warehouse
EPA	Environmental Protection Agency
FACTS	Forest Service Activity Tracking System
FGDC	Federal Geographic Data Committee
FIA	Forest Inventory and Analysis
FIRESTAT	Fire Statistics System
FSH	Forest Service Handbook
FSM	Forest Service Manual
FWS	U.S. Fish and Wildlife Service
GI	Geospatial Interface
GIS	Geographic Information System
gPAS	Geo-Enabled Performance Accountability System
GPS	Global Positioning System
HUC	Hydrologic Unit Code
IM&A	Inventory, Monitoring, and Assessment
IMPROVE	Interagency Monitoring of Protected Visual Environments
LEIMARS	Forest Service Law Enforcement and Investigations Management Attainment Reporting System
LSRS	Land Status Record System
MISIN	Midwest Invasive Species Information Network
MRA	Minimum Requirements Analysis
N	Nitrogen
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NAS	Nonindigenous Aquatic Species
NEPA	National Environmental Policy Act

Abbreviations/Acronyms	Definition
NFS	National Forest System
NFST	National Forest System Trail
NHD	National Hydrography Dataset
NH_3	Ammonia
NID	National Inventory of Dams
NO_X	Nitrogen Oxides
NPS	National Park Service
NRIS	Natural Resource Information System
NRM	Natural Resource Manager
NRM-Air	Natural Resource Manager—Air application
NRM-Buildings	Natural Resource Manager—Buildings application
NRM-Dams	Natural Resource Manager—Dams application
NRM-Features	Natural Resource Manager—Features application
NRM-Heritage	Natural Resource Manager—Heritage application
NRM-Range	Natural Resource Manager—Range application
NRM-Roads	Natural Resource Manager—Roads application
NRM-SUDS	Natural Resource Manager—Special Uses Database System
NRM-TESP-IS	Natural Resource Manager—Threatened, Endangered, and Sensitive Plants—Invasive Species
NRM-Trails	Natural Resource Manager—Trails application
NRM-WCM	Natural Resource Manager—Wilderness Character Monitoring application
NRM-Wildlife	Natural Resource Manager—Wildlife application
NRM-Wilderness	Natural Resource Manager—Wilderness application
NVUM	National Visitor Use Monitoring
NWPS	National Wilderness Preservation System
PALS	Project Activity Levels
QA	Quality Assurance
QC	Quality Control
SDE	Spatial Data Engine
S	Sulfur
SNOTEL	Snow Telemetry
SO_2	Sulfur Dioxide
TDEP	Total Deposition
USDA	U.S. Department of Agriculture

Abbreviations/Acronyms	Definition
USGS	U.S. Geological Survey
WCC	Watershed Condition Classification
WCF	Watershed Condition Framework
WCM	Wilderness Character Monitoring
WCMD	Wilderness Character Monitoring Database
WFDSS	Wildland Fire Decision Support System
WSP	Wilderness Stewardship Performance

Part 1 National Framework

Detailed Table of Contents for Part 1 - National Framework

Photo: Colorado Rocky Mountain National Park: Tyndall Creek and Hallett Peak by Wally Gobetz

1.0 Wilderness Character Monitoring in the Forest Service

The Forest Service, an agency of the U.S. Department of Agriculture (USDA), manages 154 national forests, 20 national grasslands, and 1 national prairie. These 193 million acres (78 million hectares) of federal land in the National Forest System (NFS) represent a broad diversity of landscapes and ecosystems across the nation. Since the Wilderness Act of 1964 was signed into law, Congress has designated 37 million acres (approximately 15 million hectares) of NFS land as **wilderness**[1], about 19 percent of all the land managed by the Forest Service.

The central mandate of the Wilderness Act is to preserve **wilderness character**. This affirmative legal obligation applies to all federal wildernesses across the entire National Wilderness Preservation System (NWPS), including all Forest Service wildernesses. This legal mandate and Forest Service wilderness policy (Forest Service Manual [FSM] 2330) raise the simple question: are we preserving wilderness character?

The Forest Service can answer this question only by monitoring and assessing the **trend in wilderness character** over time. This technical guide provides the Forest Service a strategy and methodology for monitoring trends in wilderness character that is consistent with the revised interagency **wilderness character monitoring** (WCM) strategy published in *Keeping It Wild 2: An Updated Interagency Strategy to Monitor Trends in Wilderness Character Across the National Wilderness Preservation System* (hereafter, *Keeping It Wild 2*; Landres et al. 2015) and endorsed in 2015 by the Interagency Wilderness Policy Council. The **protocols** in this technical guide are designed to be practical and cost effective, and allow the Forest Service to demonstrate accountability for the legal and policy mandates to preserve wilderness character. This updated technical guide supersedes the 2009 *Technical Guide for Monitoring Selected Conditions Related to Wilderness Character* (Landres et al. 2009) and incorporates the **best available scientific information** and best practices for monitoring wilderness character.

For wilderness managers and line officers, part 1 of this technical guide provides extensive background information on wilderness character and the Forest Service approach to monitoring and assessing trends in wilderness character. Part 2 of this guide provides detailed protocols for gathering, analyzing, and interpreting WCM data. This technical guide includes the following major sections:

- Part 1 describes essential concepts for understanding the Forest Service nationwide approach to monitoring and assessing trends in wilderness character, defines each of the five qualities of wilderness character (Untrammeled, Natural, Undeveloped, Solitude or Primitive and Unconfined Recreation, and Other Features of Value) and briefly describes

[1] Terms and phrases in bold text are defined in the glossary at the end of part 2 of this technical guide

Photo: Colorado mountainside. Louisville Cultural Council each of the measures used in this monitoring along with their relevance to Forest Service WCM. Part 1 is the what and the why of the Forest Service approach to WCM.

- Part 2 describes how this Forest Service WCM will be implemented, with an overview of implementation concepts followed by detailed, step-by-step guidance for every measure in all five qualities.
- Appendices 1 and 2 provide a summary of all the key attributes for implementing WCM for every measure in table form and a description of measures that were considered but not used, respectively.

1.1 Purpose and Scope

The purpose of this technical guide is to provide Forest Service protocols on how to monitor and assess trends in wilderness character. This monitoring will provide information to show how agency stewardship makes a difference on the ground, and ensure accountability for upholding the legal and policy mandates of preserving wilderness character (Landres et al. 2012). This monitoring will provide information to help answer two key questions about the outcomes of **wilderness stewardship**:

1. How is agency stewardship affecting wilderness character?
2. Is wilderness character changing over time within a wilderness and across all wildernesses administered by the Forest Service? If so, how and why is it changing?

This technical guide provides detailed protocols for implementing WCM on NFS lands. These protocols establish consistency in WCM across NFS units and with the other wilderness management agencies, increase the credibility of the information collected, and improve the efficiency of the Forest Service WCM. This national consistency allows for determining the trend in wilderness character in a single wilderness, as well as the collective trend in wilderness character across all NFS wildernesses.

The Forest Service WCM strategy is currently being implemented across the NFS and adjustments are anticipated in the future as a result of these activities. For this reason, this technical guide and appendices are being published online to allow the Forest Service to update content that reflects changes or improvements to information and protocols that occur during implementation (e.g., changes in roles and responsibilities for monitoring and evaluating WCM described in section 1.6 or adjustments to the **change management process** described in section 1.8). The target audience for this guide is local Forest Service unit (national forest or grassland, or ranger district) staff charged with managing wilderness consistent with agency policy; the guide is intended to help them implement WCM. Information derived from this monitoring may also be of use to regional and national staff charged with developing wilderness policy and assessing its effectiveness towards meeting the Wilderness Act's legal mandate to preserve wilderness character. The results of this monitoring will provide both groups information to improve wilderness stewardship and wilderness policy.

Line officers may use WCM information to assess the effects of past management decisions on wilderness character and to help inform decisions about future actions. Monitoring by itself does not provide guidance for what to do if the trend in wilderness character is degrading; instead, monitoring can signal the need for follow-up actions or decisions, and can ensure that line officers understand the tradeoffs associated with actions or decisions.

Attributes that are integral to the area's wilderness character, but that are not directly under the jurisdiction of managers, also are included in this monitoring. An example of such an attribute would be air quality. Monitoring these attributes provides a more comprehensive understanding of how wilderness character is changing over time and whether those changes are due to factors within or beyond the agency's jurisdiction. Such a holistic view of wilderness character informs our understanding of broad-scale, regional, and cumulative impacts to wilderness character.

The scope of this technical guide is intentionally limited in several ways because wilderness character is a complex concept with tangible, intangible, ethical, societal, legal, personal, local, and national dimensions. From its outset, the WCM strategy described in this technical guide was designed to create a pragmatic and effective way to assess trends in wilderness character. To practically limit its scope, this WCM strategy:

- Applies to all areas in which the Forest Service has been directed by Congress to "preserve the wilderness character" of the area. This includes all designated wildernesses and congressionally designated Wilderness Study Areas mandated to preserve wilderness character in their authorizing legislation. The strategy does not apply to other types of protected areas outside the mandate of the Wilderness Act or subsequent wilderness legislation, including lands recommended as wilderness through the forest planning process and congressionally designated Wilderness Study Areas lacking specific direction to preserve wilderness character. WCM may still be useful for assessing on-the-ground changes and informing stewardship in areas with future potential for wilderness designation.

- Monitors tangible attributes of the five qualities of wilderness character derived from the Definition of Wilderness, Section 2(c) in the Wilderness Act. This monitoring does not directly monitor the intangible, symbolic, societal, or personal values, meanings, and benefits of wilderness character, although the tangible attributes that are monitored do contribute to these.

- Assesses the trend in wilderness character over time for an entire wilderness, and does not assess how wilderness character is changing in specific locations within a wilderness, or how wilderness character compares across different wildernesses.
- Supports minimum requirements and National Environmental Policy Act (NEPA) analyses by helping staff organize information on the effects of proposed projects, but does not determine the significance of effects or replace agency decision processes.
- Does not fulfill all the monitoring requirements needed to manage an individual wilderness, such as monitoring for specific projects or compliance monitoring for special use permits (SUPs).
- Monitors the outcomes of stewardship, as well as selected outside forces acting on wilderness, and does not monitor the management actions or processes that occur in wilderness (see section 1.3.1 *Wilderness Stewardship Performance* for discussion about these differences).

1.2 Overview of Forest Service Wilderness Character Monitoring

This Forest Service WCM strategy is based on the interagency strategy described in *Keeping It Wild 2*, and is organized around a hierarchical framework (see section 1.5.1) that divides wilderness character into successively finer elements of **qualities, monitoring questions, indicators**, and measures (tables 1.1.1–1.1.5). The qualities, monitoring questions, and indicators used here are consistent with the interagency strategy, whereas the measures are unique to the Forest Service. This technical guide identifies measures required by all wildernesses administered by the Forest Service, these required measures are analogous to the "national core" measures in other Forest Service monitoring protocols. Besides these agency-required measures, locally developed measures to meet wilderness-specific information needs may also be used. The Forest Service WCM strategy is structured as follows:

- The Forest Service uses *Keeping It Wild 2's* organizational framework of qualities, monitoring questions, and indicators to ensure interagency consistency (tables 1.1.1–1.1.5).
- At least one measure must be used for each indicator. For each indicator, this technical guide describes a required measure, or a set of measures from which at least one must be used (tables 1.1.1–1.1.5).
- In addition to the required measures, optional measures described in this technical guide may be chosen for a wilderness if they are highly relevant. Additional locally developed measures may be used for a wilderness, and are encouraged to more fully describe trend in wilderness character, as long as they adhere to the guidelines described in section 1.5.3.

- Data are gathered or compiled for each measure by using the best available information.
- Once there are at least two data points per measure, a trend (improving, stable, or degrading[2]) is determined based on agency established rules, or locally developed rules for locally developed measures. Trends in each measure are reported at 5-year intervals even though data for some measures may need to be gathered annually. See section 1.0 in part 2 for details on determining trend.
- If there is more than one measure within an indicator, trends in these measures are compiled by using consistent rules (see section 1.5.4) to determine the trend in the indicator. Only the trends in the measures, not the data, are compiled. These same rules are then used to determine the trend in each monitoring question, each quality, and ultimately the overall trend in wilderness character.
- Wilderness character is considered "preserved" (i.e., as required by law and Forest Service policy) when there is a stable or improving trend. Once the trend in wilderness character for each wilderness is determined, the percentage of wildernesses with a stable or improving trend in wilderness character within a region and across the entire Forest Service can be derived.

Table 1.1.1—Summary of the monitoring question, indicators, measures, and measure type used to monitor trend in the Untrammeled Quality of wilderness character.

Untrammeled Quality			
Monitoring question	**Indicator**	**Measure**	**Measure type**
What are the trends in actions that intentionally control or manipulate the "earth and its community of life" inside wilderness?	Actions authorized by the Federal land manager that intentionally manipulate the biophysical environment	Number of authorized actions and persistent structures designed to manipulate plants, animals, pathogens, soil, water, or fire	Required
	Actions not authorized by the Federal land manager that intentionally manipulate the biophysical environment	Number of unauthorized actions and persistent structures by agencies, organizations, or individuals that manipulate plants, animals, pathogens, soil, water, or fire	Required

[2] Note that the Forest Service uses the terms improving and degrading even though *Keeping It Wild 2* uses the terms upward and downward, respectively.

Table 1.1.2—Summary of the monitoring question, indicators, measures, and measure types used to monitor trend in the Natural Quality of wilderness character.

Natural Quality			
Monitoring question	**Indicator**	**Measure**	**Measure type**
What are the trends in the natural environment from human-caused change?	Plants	Acres of nonindigenous plant species	Required
	Animals	Index of nonindigenous terrestrial animal species	Required to select at least one
		Index of nonindigenous aquatic animal species	
	Air and water	Concentration of ambient ozone	Required to select at least one
		Deposition of nitrogen	
		Deposition of sulfur	
		Amount of haze	
		Index of sensitive lichen species	
		Extent of waterbodies with impaired water quality	Required
	Ecological processes	Watershed condition class	Required to select at least one
		Number of animal unit months of commercial livestock use	

Table 1.1.3—Summary of the monitoring questions, indicators, measures, and measure types used to monitor trend in the Undeveloped Quality of wilderness character.

Undeveloped Quality			
Monitoring question	**Indicator**	**Measure**	**Measure type**
What are the trends in non-recreational physical development?	Presence of non-recreational structures, installations, and development	Index of authorized non-recreational physical development	Required
	Presence of inholdings	Acres of inholdings	Required
What are the trends in mechanization?	Use of motor vehicles, motorized equipment, or mechanical transport	Index of administrative authorizations to use motor vehicles, motorized equipment, or mechanical transport	Required
		Percent of emergency incidents using motor vehicles, motorized equipment, or mechanical transport	Optional
		Index of special provision authorizations to use motor vehicles, motorized equipment, or mechanical transport	Optional

Table 1.1.4—Summary of the monitoring questions, indicators, measures, and measure types used to monitor trend in the Solitude or Primitive and Unconfined Recreation Quality of wilderness character.

Solitude or Primitive and Unconfined Recreation Quality			
Monitoring question	**Indicator**	**Measure**	**Measure type**
What are the trends in outstanding opportunities for solitude?	Remoteness from sights and sounds of human activity *inside* wilderness	Index of encounters	Required
		Index of recreation sites within primary use areas	Required to select at least one
		Acres of wilderness away from access and travel routes and developments inside wilderness	
		Miles of unauthorized trails	
	Remoteness from sights and sounds of human activity *outside* the wilderness	Acres of wilderness away from adjacent travel routes and developments outside the wilderness	Required
What are the trends in outstanding opportunities for primitive and unconfined recreation?	Facilities that decrease self-reliant recreation	Index of NFS developed trails	Required to select at least one
		Number of authorized constructed recreation features	
	Management restrictions on visitor behavior	Index of visitor management restrictions	Required

Table 1.1.5—Summary of the monitoring questions, indicators, measures, and measure types used to monitor trend in the Other Features of Value Quality of wilderness character.

Other Features of Value Quality			
Monitoring question	**Indicator**	**Measure**	**Measure type**
What are the trends in the unique features that are tangible and integral to wilderness character?	Deterioration or loss of integral cultural features	Condition index for integral cultural features	Required if relevant
	Deterioration or loss of other integral site-specific features of value	Condition index for other features	Required if relevant

1.2.1 Relationship to Interagency Wilderness Character Monitoring

The Forest Service, the National Park Service (NPS), the Bureau of Land Management (BLM) and the U.S. Fish and Wildlife Service (FWS) use *Keeping It Wild 2* as a framework to develop agency-specific WCM programs. All four agencies use the same definition of wilderness character and the same qualities, monitoring questions, and indicators. Each agency also uses the same process for compiling trends across measures to derive a trend in each indicator, monitoring question, quality, and ultimately wilderness character. Use of this nationally consistent interagency framework will allow all four agencies to pool their resulting data to assess trends in wilderness character across the entire NWPS.

Keeping It Wild 2 provides an interagency monitoring strategy, but does not define agency-specific responsibilities for implementing that strategy, ensuring quality control, and fostering interagency consistency into the future. Given their different authorities, policies, and cultures, each agency is responsible for developing its own procedures to ensure implementation of the interagency strategy. This includes determining agency-specific monitoring protocols and processes for training, oversight, use of the online interagency Wilderness Character Monitoring Database (WCMD) reporting, sharing results with the other agencies, and working across all agencies to provide a comprehensive WCM program for the entire NWPS (see section 1.7.3).

The Forest Service currently shares management responsibility for 32 wildernesses (28 with the BLM, 1 with the FWS, and 3 with the NPS). In some cases, the Forest Service manages the majority of the acreage for a wilderness, while in others the agency manages only a small fraction. To implement WCM in an interagency wilderness, the administering agencies may either: (1) each monitor their own portion of the wilderness with agency-specific measures, or (2) agree to follow a single agency's WCM protocols and share a single set of measures. Under either alternative, interagency wildernesses will report the trend in wilderness character for the entire wilderness. Before implementing the WCM strategy described in this technical guide, in all 32 cases, Forest Service wilderness mangers will need to work with their local counterparts in the other managing agency to determine which alternative is most appropriate. If the local units decide to share a single set of measures for the wilderness, consider developing an interagency memorandum of understanding that outlines respective roles and responsibilities and states which agency's WCM protocols will be followed. For example, a wilderness could use the measures from the agency that has the majority of the acreage for a wilderness or another arrangement could be developed. Whichever alternative is selected for an interagency wilderness, include documentation of the decision and its rationale as a reference for future managers.

1.3 Relationship to Forest Service Programs, Monitoring, and Policies

This effort to monitor trends in wilderness character integrates with other Forest Service wilderness programs, agency-wide monitoring efforts, as well as laws, regulations, and policies.

1.3.1 Wilderness Stewardship Performance

The Wilderness Program's performance measure *Number of Wildernesses Meeting Baseline Performance for Preserving Wilderness Character*, commonly known as Wilderness Stewardship Performance (WSP), tracks the stewardship actions undertaken by the agency to fulfill the Wilderness Act's mandate to "preserve wilderness character." It feeds into the geo-enabled Performance Accountability System (gPAS), which annually reports metrics of agency performance to the Department of Agriculture, Congress, and the public. The lead Forest Service unit for a wilderness selects 10 elements, from a possible set of 20, that most closely reflect local stewardship priorities, within prescribed rules. Each element is worth 10 points, and a wilderness is deemed to be managed to an acceptable standard within WSP if it scores 60 points or higher.

The business rules around the selection of elements reinforce the linkages between agency stewardship actions and wilderness character. The elements in WSP are arrayed beneath categories that conform to the five qualities of wilderness character. While local units have some flexibility in the selection of these elements, they must select as least one element for each quality. Not all of the elements under the qualities of wilderness character in WSP track with the placement of measures for wilderness character monitoring because some decisions were made on the organization of WSP prior to the completion of *Keeping It Wild 2*. Most notably, **trails** and user-developed sites are under the Undeveloped Quality in WSP and under the Solitude or Primitive and Unconfined Recreation Quality in WCM.

There also are two additional categories of elements (Special Provisions and Administration) that do not track directly with wilderness character monitoring but do help evaluate the agency's ability to steward the wilderness resource.

Additionally, one mandatory element focuses exclusively on wilderness character: Wilderness Character Baseline. In two-point increments, this element tracks the completion of the steps needed to establish a baseline for wilderness character and then evaluates trends over time. This element also includes writing a Wilderness Character Narrative to provide a qualitative and holistic description of the tangible and intangible aspects of an area's wilderness character.

There is a natural and obvious overlap between WSP and WCM. WSP tracks the stewardship actions taken by the agency, whereas WCM monitors the outcomes of those actions, as well as selected outside forces acting on wilderness. Figure 1.1.1 depicts the relationship between WSP and WCM.

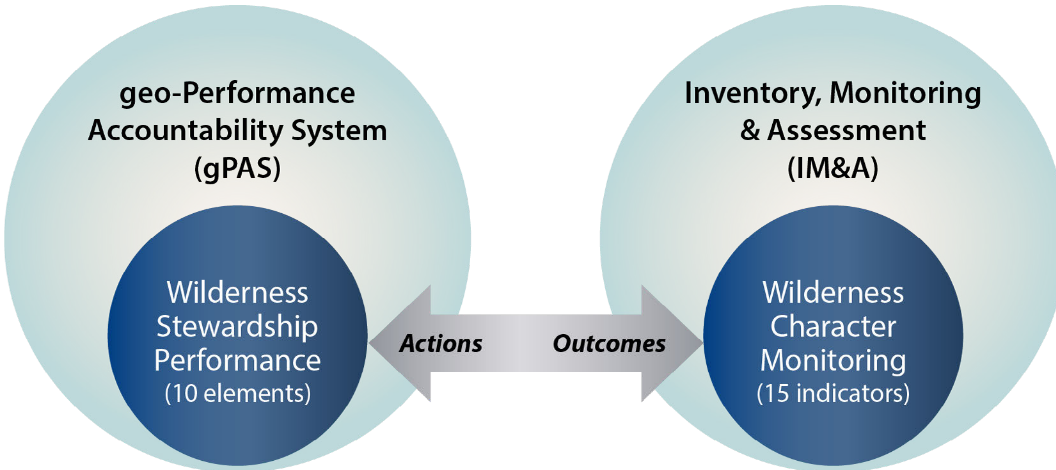


Figure 1.1.1—Relationship between Wilderness Stewardship Performance and WCM.

For example, WSP tracks whether or not a local unit has developed an **invasive species** management plan, conducted an inventory, and taken appropriate management actions, whereas WCM evaluates the trend in the acres of nonindigenous plant species. The two work well together to provide a powerful tool to evaluate the overall effectiveness of the Forest Service's wilderness stewardship program.

1.3.2 Inventory, Monitoring, and Assessment

The Forest Service *Inventory, Monitoring, and Assessment (IM&A) Strategy* (hereafter *IM&A Strategy*; USDA Forest Service 2013a) is an agency-wide strategy to improve data and information used to support implementation of the agency mission. As a requirement for sound stewardship of natural resources, the *IM&A Strategy* places an emphasis on high-quality information resulting from improved IM&A activities. Forest Service WCM follows the principles outlined in the *IM&A Strategy* and is designed to answer critical management questions at the field level, support collaboration with partners, and provide aggregated data to inform decisions at multiple levels.

This technical guide gathers as much data as possible from well-established and scientifically credible national monitoring programs within and outside the Forest Service. Inside the Forest Service, this technical guide draws as much data as is appropriate and possible from Forest Inventory and Analysis (FIA), Natural Resource Manager (NRM), and terrestrial, aquatic, wildlife, and social monitoring programs that are currently being developed and tested. Data from outside the Forest Service used in this technical guide includes data on air pollutants from the National Atmospheric Deposition Program (NADP) and data on 303(d) listed streams from the Environmental Protection Agency (EPA) and states.

Forest Service inventory and monitoring data are collected by using a variety of methods and systems. A current list of standard protocols and methods for different resource areas is published and maintained on a Forest Service website at http://www.fs.fed.us/emc/rig/protocols/master.shtml (also referred to as the Forest Service "master list" of protocols).

Effective collaboration with states, other federal agencies, and non-governmental organizations will result in selection of programs or protocols that reflect general consensus about the most effective methods to meet WCM objectives. Collaboration will also result in more cost effective WCM. Understanding the data provided by these outside monitoring and assessment programs, as well as their basic structures, will minimize duplication of effort and cost and enhance collaboration to monitor and preserve wilderness character.

1.3.3 Laws, Regulations, and Policies

Several laws, regulations, and policies relate directly to the protection of wilderness character and to the IM&A of wilderness resources.

Relevant Laws

While many laws affect the administration of wilderness in NFS lands, the following principal laws bear directly on the mandate to preserve wilderness character and this technical guide. Laws are listed chronologically by the date of enactment:

- The General Mining Act (1872) declared public lands free and open to mineral exploration and purchase, and decreed all lands with valuable mineral deposits open for occupancy. It also established the procedures for mining claims and operations. While mining claims filed prior to wilderness establishment are considered to be valid existing rights, development of these claims affects wilderness character.
- The Antiquities Act (1906), the National Historic Preservation Act (1966), and the Archaeological Resources Protection Act (1979) provide the statutory basis for protecting and managing heritage resources on federal lands. Policies derived from these legal directions seek to balance the need for protecting heritage resources with the need for wilderness to be without permanent developments (as directed in the Wilderness Act).
- The Clean Water Act (1948, 1972, 1977, and 1987) establishes guidelines for protecting water quality and a shift to holistic watershed-based protection strategies. Under the watershed approach, equal emphasis is placed on protecting healthy waters and restoring **impaired watersheds**. Water quality and quantity are vital to natural systems and processes within wilderness.

- The Clean Air Act (1963), as amended, directs the Forest Service to protect Class I air quality standards in certain wildernesses and Class II standards in the remaining wildernesses. It designated all wildernesses larger than 5,000 acres that were in existence as of August 7, 1977, as **Class I areas**. These designations (Class I and Class II) indicate the degree of air quality protection for areas already considered clean air areas (i.e., already meet the National Ambient Air Quality Standards [NAAQS]).

- The Wilderness Act (1964), Section 2(a) Statement of Policy, requires that wilderness "shall be administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, *the preservation of their wilderness character*" (emphasis added). In addition, Rohlf and Honnold (1988) and McCloskey (1999) assert that the statement from Section 4(b) of the Wilderness Act that "... each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area" gives the primary and affirmative management direction for wilderness. Section 4(b) also states that even when the agency administers the area for other purposes, the agency must also "preserve its wilderness character." The Congressional Record (United States Congress 1983) supports this assertion, stating "The overriding principle guiding management of all wilderness areas, regardless of which agency administers them, is the Wilderness Act (Section 4(b)) mandate to preserve their wilderness character."

- The National Environmental Policy Act (1970) requires an analysis of the environmental consequences of proposed management actions on all NFS lands, including management actions taken in wilderness. Analysis of actions within and adjacent to wilderness should consider impacts to wilderness character.

- The Endangered Species Act (1973) provides a program for the conservation of wildlife and plant species that are threatened or endangered with extinction. It establishes specific procedures to determine which plant and animal species are added or removed from protective status. Loss of animal or plant species directly affects the preservation of natural conditions in wilderness.

- The Eastern Wilderness Areas Act (1975) added 16 national forest areas to the NWPS and directed that 17 areas in eastern national forests should be studied such that the Secretary of Agriculture should recommend additions to the NWPS within 5 years. Congress debated the issue of designating severely modified areas as wilderness; they ultimately chose to add such areas to the NWPS and declined to establish a separate "Eastern Wilderness" category of designation.

- The National Forest Management Act (1976), as amended, provides that management direction for wilderness be incorporated into forest plans and sets minimum standards for the content of the plans.
- The Colorado Wilderness Act (1980) includes a specific reference to what are now commonly referred to as the Congressional Grazing Guidelines, and these Guidelines were incorporated into the statutory language of the Arizona Wilderness Act (1990). These guidelines grew out of apparent confusion on the part of agency managers as to how grazing was to be administered in wilderness beyond the general direction in the Wilderness Act's Section 4(d)(4)(2) that it "…shall be permitted to continue…" The guidelines in this Act state that "There shall be no curtailments of grazing in wilderness areas simply because an area is…wilderness." Additional guidance was provided for maintenance and replacement of grazing related improvements.
- The Alaska National Interest Lands Conservation Act (1980) added about 56 million acres to the NWPS in 35 areas administered by the NPS, FWS, and Forest Service. It was the intent of Congress to preserve unrivaled scenic and geological values associated with natural landscapes, and to preserve vast unaltered arctic tundra, boreal forest, and coastal rain forest ecosystems.
- The Information Quality Act (2001) (Data Quality Act, P.L. 100–554, section 515) directs federal agencies to ensure and maximize the quality, objectivity, utility, and integrity of information they disseminate (including statistical information) to make sure it is useful, clear, and sound.

Relevant Regulations

The Code of Federal Regulations (CFR) is based on statutory authority and establish requirements and procedures for federal agencies that comply with law. The primary CFRs applicable to NFS wilderness include 36 CFR 293 that sets forth requirements for management of wilderness and primitive areas, and 36 CFR 261.18 that lists those human activities prohibited within a national forest wilderness.

The 2012 Planning Rule (36 CFR 219) provides direction for land management planning. Section 1.5.6 of this technical guide describes how WCM can provide valuable information to support the Planning Rule's direction for assessment, plan development/amendment/revision, and monitoring. For example, WCM helps measure "progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities." (36 CFR 219.12 [a] [5] [vii]).

<u>*Relevant Policies*</u>

Forest Service Manual (FSM) chapter 2320 – Wilderness Management, outlines agency policy pursuant to the Wilderness Act. This chapter includes the following policies that directly address the need for preserving wilderness character:

> 2320.2 – Objectives, 4. *Protect and perpetuate wilderness character and* ***public values*** *including, but not limited to, opportunities for scientific study, education,* ***solitude****, physical and mental challenge and stimulation, inspiration, and* ***primitive recreation*** *experiences…*
>
> 2323.14 – Visitor Management. Plan and manage public use of wilderness in such a manner that preserves the wilderness character of the area.

FSM 1940 establishes the information management framework for all Forest Service IM&A activities. The policy at FSM 1940.3 directs that IM&A activities shall:

1. Be coordinated through a national integrated program planning process that addresses information needs related to all agency business requirements;
2. Use a standards-based approach and framework for information management and related business operations; and
3. Foster and realize opportunities for collaboration, cooperation, and coordination across Forest Service deputy area programs and with agency partners, including the public; local, state, and other federal agencies; and non-governmental organizations.

FSM 1920 and Forest Service Handbook (FSH) 1909.12 provide policy and detailed guidance for land management planning, including conducting assessments and monitoring.

1.4 Defining and Monitoring Wilderness Character

To ensure that wilderness character is preserved, it must first be defined. The Wilderness Act does not define wilderness character, nor is a definition discussed in the congressional testimony leading to the Act's passage. An interagency wilderness team (Landres et al. 2015) recently defined wilderness character:

> Wilderness character is a holistic concept based on the interaction of (1) **biophysical environments** primarily free from modern human manipulation and impact, (2) personal experiences in natural environments relatively free from the encumbrances and signs of modern society, and (3) symbolic meanings of humility, restraint, and interdependence that inspire human connection with nature. Taken together, these tangible and intangible values define wilderness character and distinguish wilderness from all other lands.

Focusing on wilderness character connects on-the-ground wilderness conditions and management actions to the mandates of the Wilderness Act and agency policy to "preserve wilderness character." Connecting conditions and actions to policy helps:

- *Improve wilderness stewardship*—Wilderness stewardship has traditionally been fraught with uncertainty and subjective opinions about what should, or should not, be done. More consistent, standardized protocols for monitoring wilderness character can help professionalize wilderness stewardship and contribute to agency accountability, transparency, and defensibility.
- *Clarify how management decisions and actions influence trends in wilderness character*—There are tradeoffs in almost all aspects of wilderness stewardship, and evaluating what is gained and what is lost in terms of wilderness character helps staff determine priorities for which actions should and should not be taken in a wilderness. Openly discussing these tradeoffs can help agency staff understand how their actions directly or indirectly contribute to preserving wilderness character, which in turn helps inform management decisions.
- *Improve communication among staff and with the public about wilderness stewardship*—The standard language of WCM allows staff across different resource areas and disciplines to use common terms in discussing wilderness-related projects, needs, conditions, and impacts. This language also allows staff to discuss wilderness stewardship in a more open and transparent manner with the public, which may in turn improve agency defensibility when legal questions regarding the preservation of wilderness character arise.
- *Create a legacy of experience and knowledge about wilderness locally and broadly within the agency*—Experience and knowledge of a wilderness are often lost with staff turnover, and the baseline understanding of resource conditions may shift over time. Monitoring wilderness character provides a way to assess the changes occurring locally, which in turn builds a legacy about a wilderness, its stewardship, and how wilderness character changes over time.

1.4.1 Five Qualities of Wilderness Character

WCM links the conceptual definition of wilderness character to a practical framework of qualities. The qualities of wilderness character are Untrammeled, Natural, Undeveloped, Solitude or Primitive and Unconfined Recreation, and Other Features of Value. These qualities are derived from the entire statutory definition of wilderness in Section 2(c) of the Wilderness Act, which expresses congressional intent, both ideal and practical, for the meaning of wilderness and wilderness character (McCloskey 1966, 1999; Ochs 1999; Rohlf and Honnold 1988; Scott 2002). These qualities were first identified by the Forest Service (Landres et al. 2005) and subsequently refined by the agency and interagency teams that developed, implemented, and improved WCM over the past 15 years (BLM 2012; Landres et al. 2008; NPS 2014). Collectively, these qualities represent the primary tangible aspects of wilderness character that link on-the-ground conditions in wilderness and the outcomes of wilderness stewardship to the statutory definition of wilderness.

The WCM strategy uses these five qualities to monitor and assess trend in wilderness character. Several important premises frame the use of these qualities:

- *All five qualities are equally important*—The land management agencies must implement laws in their entirety, and the Wilderness Act does not state that one sentence or one portion of the text in Section 2(c) is more important than another. For these reasons, all five qualities are of equal importance for the purpose of this WCM strategy. However, as explained in section 1.5.4, in the process of compiling trends across these qualities to derive an estimate of the overall trend in wilderness character, the Untrammeled Quality is used as a tiebreaker, in essence giving this quality greater weight than the others reflecting the prominence and importance of this quality.
- *These qualities apply to every wilderness*—These qualities apply to all designated wilderness—regardless of size, location, or other unique place-specific attributes. This is because the qualities are based on the legal definition of wilderness and every law designating a wilderness includes specific language that ties it to this definition (Dawson and Hendee 2009). While individual wilderness laws may include specific exceptions or special provisions that apply to the uses and values of particular areas, no federal legislation changes the Wilderness Act's Section 2(c) Definition of Wilderness, and no legislation changes the management responsibility of Section 4(b) for "preserving the wilderness character of the area." Special provisions are, by law, allowed in wilderness even though they may allow actions or uses that degrade wilderness character. The only exception to these qualities applying to every wilderness is the Other Features of Value Quality, which may or may not exist within a given wilderness because of the statement in the legal definition that a wilderness "*may* [emphasis added] also contain...other features."
- *These qualities are uniquely expressed within each wilderness*—Every wilderness is unique: some are swamps while others are rock and ice; some are immense while others are small; some are very remote while others are surrounded by suburban and urban developments; some are iconic and revered by people who never set foot in them while others are relatively unknown. This uniqueness has two important implications for this WCM strategy: (1) trend in wilderness character can only be based on how wilderness character is changing within an individual wilderness and (2) the state of wilderness character should not be compared among wildernesses because such comparisons are meaningless.

- *Wilderness character is more than these qualities*—Besides the tangible qualities used for monitoring wilderness character, there also are important intangible aspects of wilderness character that are difficult or impossible to quantify; these are not included in this WCM strategy. These intangible aspects are diverse and may include the immensity of an area and the connection people may feel to nature, the ethical value to society from having areas that are managed with restraint and humility, and the inspirational and psychological benefits that individuals experience in wilderness (Putney and Harmon 2003; Roggenbuck and Driver 2000; Schroeder 2007). These values and benefits of wilderness, as well as other intangible aspects of an area's wilderness character, can be described holistically and qualitatively in a Wilderness Character Narrative (see NPS 2014). Developing a Wilderness Character Narrative is incorporated into the Forest Service Wilderness Program's Wilderness Stewardship Performance measure.

- *Management decisions and actions may preserve or degrade these qualities*—Wilderness character may be improved, preserved, or degraded by the actions managers choose to take or not take. For example, the choice to not use a chain saw, to not build a footbridge across a stream, or to not suppress a **naturally ignited fire** may preserve certain qualities of wilderness character. In contrast, other management actions that are considered the minimum necessary for the administration of the area—such as requiring visitors to use designated campsites, authorizing administrative use of **motorized equipment** and **mechanical transportation**, or taking actions to restore ecological conditions—may diminish certain qualities of wilderness character. Significantly, protecting one aspect of wilderness character may diminish another aspect. For example, a bridge built to protect a stream bank from erosion caused by people or horses also is a recreational development that may diminish the opportunity for people to experience the primitive challenge of crossing the stream. Similarly, the required use of designated campsites to prevent the proliferation of sites and associated impacts on soil and vegetation may also diminish the opportunity for **unconfined recreation** and the sense of freedom from the constraints of regulation. Besides tradeoffs among the different qualities of wilderness character, the cumulative results of seemingly small decisions and actions may cause a substantial gain or loss of wilderness character over time. With an established framework to discuss these tradeoffs within the context of wilderness character and its five qualities, Forest Service line officers and managers have a tool to approach wilderness stewardship with humility, respect, and restraint, ultimately helping them to preserve wilderness character.

1.5 Approach to Forest Service Wilderness Character Monitoring

This section describes the conceptual framework and key principles used in monitoring wilderness character. The following four successive actions provide the structure for WCM in the Forest Service:

1. Compile baseline data for all required measures presented in this technical guide and for any optional measures, or locally developed measures for a specific wilderness.
2. Continue compiling data for each measure based on the **frequency** recommendation in this technical guide. Determine trend in the measure as improving, stable, or degrading (based on the **threshold** for **meaningful change** and the rules described in section 1.5.4) every 5 years once the baseline has been established.
3. Compile the trends (not the data) from each measure within an indicator—using the rules in section 1.5.4—to determine the trend in the indicator. These same rules are used to compile trends in the indicators to determine the trend in the monitoring question, to compile trends in the monitoring questions to determine the trend in the quality, and likewise compile quality trends to determine the overall trend in wilderness character for each wilderness.
4. Once the trend in wilderness character is determined for every wilderness, the Forest Service can compile these trends to assess broad-scale agency performance in preserving wilderness character. Similarly, trends from all four wilderness managing agencies can be compiled to assess performance in preserving wilderness character across the NWPS.

1.5.1 Organizational Framework

WCM is organized in a hierarchical framework (fig. 1.1.2) that divides wilderness character into successively finer elements. These elements are:

- *Qualities*—Qualities are the primary elements of wilderness character that link directly to the statutory language of the Wilderness Act. The same set of qualities applies nationwide to all wildernesses. In this technical guide, four qualities: (1) Untrammeled, (2) Natural, (3) Undeveloped, and (4) Solitude or Primitive and Unconfined Recreation are all necessary to monitor and assess trend in wilderness character, and each wilderness must report the trend in each of these qualities. Where other features of value exist in a wilderness and are integral to its meaning and significance, a fifth quality, Other Features of Value, must also be reported (see section 6.0).

- *Monitoring questions*—Monitoring questions capture essential components of each quality that are significantly different from one another and address particular management questions and goals.
- *Indicators*—Indicators are distinct and important elements under each monitoring question. In nearly all cases, there is more than one indicator under a monitoring question. The trend in all indicators is reported by each wilderness.
- *Measures*—Measures are the specific elements under each indicator for which data are compiled to assess trend in an indicator. In general, measures are human-caused threats to the indicator: when these threats decrease, wilderness character is improved; when these threats increase, wilderness character is degraded.

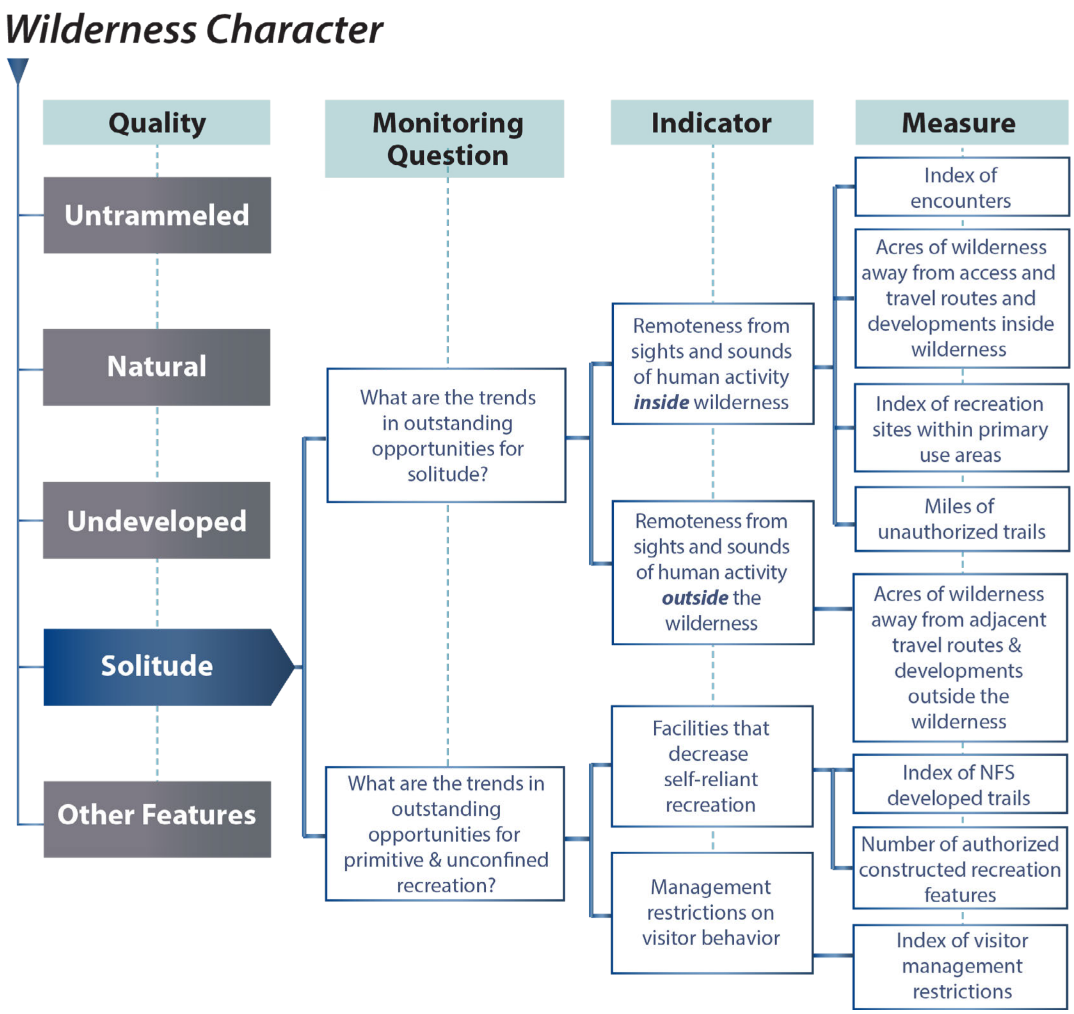


Figure 1.1.2—Hierarchical relationship of the qualities, monitoring questions, indicators, and measures illustrated with the Solitude or Primitive and Unconfined Recreation Quality.

1.5.2 Key Principles of this Monitoring

To implement this monitoring, agency staff need to understand the following key principles:

- *WCM will provide credible data that will be directly useful for assessing the outcomes of wilderness stewardship*—This technical guide has been developed with substantive input from subject matter experts and designed by on-the-ground wilderness managers and regional and national wilderness staff to provide the most useful information possible for the full range of agency staff involved in wilderness stewardship.

- *The WCM baseline, the reference point for evaluating trend in wilderness character, is the time of designation or when WCM is initiated*—The first year that data are compiled for all measures forms the WCM baseline and is the reference point against which change in wilderness character is assessed and evaluated over time. Ideally, the **WCM baseline year** would be the time of wilderness designation. Realistically, however, the WCM baseline year will likely be the first year that WCM is implemented because existing wildernesses generally lack data from the time of designation for most—or even all—measures. **WCM baseline conditions** are the starting point for assessing change over time without value judgment as to whether these are good, bad, or desired. For example, if a wilderness had structures or installations at the time of designation, those features would be part of the baseline condition of the wilderness. WCM would show how the Undeveloped Quality of wilderness, which includes structures and installations, changes over time. When the WCM baseline year is established after wilderness designation, WCM baseline conditions may show improvements or degradations compared to conditions at the time of designation; regardless, these WCM baseline conditions become the de facto reference point for evaluating future trend in wilderness character. If Congress enacts new legislation that adds acreage to an existing wilderness, the WCM baseline year is not reset to the year of this new legislation but remains as is. Likewise, the WCM baseline year would not be reset if a local unit replaces or updates one or more of the measures selected for a wilderness.

- *Trend in wilderness character is determined by change within an individual wilderness*—Each Forest Service wilderness is unique in its combination of geographic setting, biophysical properties, enabling legislation, and administrative direction; therefore, trend in wilderness character can only be determined by assessing change within a given wilderness. When designated, each wilderness enters the NWPS with its own degree of "intactness" of wilderness character, and the intent of management is to maintain or improve this state of wilderness character over time in the face of modern technology and civilization (fig. 1.1.3). Wilderness character monitoring provides a means for showing whether this state of wilderness character is being preserved or is degrading over time; in figure 1.1.3 the management task is to prevent the orange circle from sliding down the line. The uniqueness of wilderness character in each wilderness means that it is inappropriate and misleading to compare wilderness character from one wilderness to another. This is consistent with national direction provided by the Wilderness Act and supported by Forest Service policy to preserve wilderness character relative to the time an area was designated as wilderness, regardless of the size of the area, ecosystem, proximity to urban areas, or any other attribute of a wilderness.

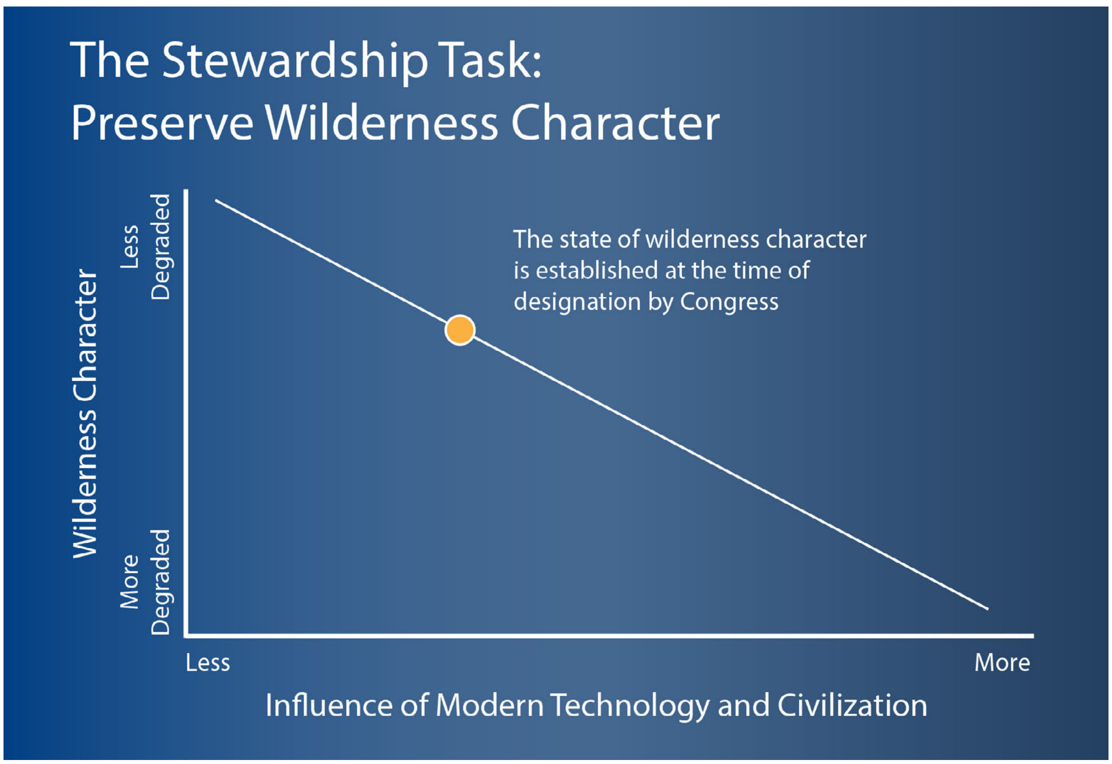


Figure 1.1.3—Relationship between the state of wilderness character and modern technology and civilization.

- *WCM balances national consistency with local relevance—*This technical guide is designed to balance national and local needs for information on trend in wilderness character by using a mix of measures modeled after the approach used in WSP. See section 1.5.3 for details on this approach, which ensures national consistency and the ability to understand trend in wilderness character across different wildernesses for regional and national reporting, while allowing and encouraging local flexibility and relevance within this national structure.

- *Trend in wilderness character is reported every 5 years for every wilderness—*The Wilderness Act mandates that every wilderness be managed to preserve its wilderness character, so the monitoring described in this technical guide needs to be conducted on every wilderness, not just a sample of wildernesses. For some measures, local data compilation will occur annually, while trend in wilderness character will be assessed and reported to regional and national wilderness program staff every 5 years once the baseline has been established. This 5-year period balances workload with providing needed information at a pace that allows for adaptive management.

- *Not all monitoring done in wilderness is WCM*—All wilderness units currently conduct some form of monitoring inside wilderness. Typically, this monitoring is for specific resource purposes such as assessing campsite condition, range condition, or **abundance** and distribution of specific plant or animal species. Such monitoring provides data that may be used in WCM, but by itself, should not be called WCM. In general, to qualify as WCM, all four of the following requirements must be met:

  1. The monitoring is conducted in a designated wilderness or in any other area where the Forest Service is congressionally mandated to preserve wilderness character.
  2. The monitoring includes at least one measure for each of the indicators of the Untrammeled, Natural, Undeveloped, and Solitude or Primitive and Unconfined Recreation qualities, as well as the Other Features of Value Quality if appropriate.
  3. A specific baseline year has been established for the purpose of WCM.
  4. The monitoring is intended to be a long-term monitoring program that synthesizes the trends in all the measures into an integrated assessment of trend in wilderness character and is conducted periodically as long as the area remains designated as wilderness.

1.5.3 Measures

All the measures included in this technical guide were developed to be relevant and cost effective across the agency, because either national data are already available or local units (national forests or grasslands, or ranger districts) should be able to gather or compile the data relatively easily. In this technical guide, detailed monitoring protocols are described for a total of 28 measures (summarized in tables 1.1.1–1.1.5), although not all of these will be used in any one wilderness. For national consistency, all wildernesses are required to select 15 measures, and an additional one or two measures are required for the Other Features of Value Quality if that quality is relevant to a particular wilderness. Some indicators have single measures that apply nationally and are required. Other indicators have multiple potential measures and local units must select at least one, and may choose the one that is most locally relevant. The approach for selecting measures in WCM is similar to that used in WSP. Although the lead local unit for each wilderness will be responsible for the selection of measures, it is important to involve local staff and specialists and engage the support of Supervisors Office, as well as the Regional Office as appropriate. All measures selected by a unit for WCM—including locally developed measures—need to be approved by the local line officer and are used in determining the overall trend in wilderness character.

There are five types of measures.

1. *Required*—The measure is required for all wildernesses.
2. *Required to Select at Least One*—At least one measure must be selected from the set of several potential measures; selections should be based on relevance to a wilderness, and additional measures from the set may also be selected if relevant.
3. *Required if Relevant*—If a wilderness uses the Other Features of Value Quality, one or more of these measures are required to be selected.
4. *Optional*—The measure may be selected if relevant to a wilderness.
5. *Locally Developed Measures*—In addition to the measures identified in this technical guide, the local unit may develop new measures for other attributes considered integral to wilderness character for the individual wilderness. Locally developed measures do not replace any of the required measures. Further, if a local office wants to modify a required measure, this becomes a new locally developed measure that would be used in addition to the required measure.

Key Concepts Related to the Measures

Following the recommendations in *Keeping It Wild 2*, all the measures in this technical guide were selected to be useful, simple, and practical. The following key concepts, learned from experience implementing WCM, apply to the measures in this technical guide:

- *WCM measures should not replicate those used in other monitoring programs*—This technical guide uses existing data whenever and however possible. Importantly, if data already exist in a particular resource monitoring program and are applicable to WCM, those data sources are described for individual measures in part 2 of this technical guide along with guidelines for their use.
- *Frequency of data compilation will depend on the measure*—The type of measure will determine the frequency of data compilation, analysis, and entry.

For example, annual data would be reported for measures that fluctuate annually, such as the number of authorized **trammeling actions** in the Untrammeled Quality. Measures with low variability, such as the number of physical structures in the Undeveloped Quality, would only be reported every 5 years.

- *Measures that are integral to wilderness character are monitored regardless of managerial jurisdiction*—Some resources are integral to wilderness character but are not directly under the management jurisdiction of the Forest Service. For example, visibility is an experiential and ecological attribute of wilderness character but is beyond direct management control. The state of such resources in wilderness can serve as important benchmarks for assessing the magnitude of future anthropogenic impacts such as climate change and regional development, and the consequence of these impacts on wilderness character.

- *Management actions and developments may impact more than one quality of wilderness character, but they are measured only in the quality that is most directly affected*—As a general principle of the WCM strategy described in this technical guide, actions and developments that affect more than one quality of wilderness character will be measured only in the quality that is most directly impacted by that action or development. For example, an agency-built recreation feature such as a toilet would degrade both the Undeveloped and Solitude or Primitive and Unconfined Recreation qualities, but is measured only in the latter quality because of the direct link to recreation. The intent is to avoid double counting actions or developments. Occasionally, separate and distinct impacts from a single management action or development can be measured independently by using different measures, and in such cases, these distinct measures can be included under multiple qualities. For example, a barrier built to prevent nonindigenous fish from moving up a stream has separate and distinct measurable impacts on the Untrammeled, Undeveloped, and Natural qualities. The action to build the barrier would be counted as an **intentional manipulation** in the Untrammeled Quality, the presence of the barrier would be counted as an installation in the Undeveloped Quality, and altered stream flow could be counted as a locally developed measure in the Natural Quality. Likewise, wildlife tracking devices such as radio collars or ear tags have separate and distinct impacts on the Untrammeled and Undeveloped qualities. The action of collaring or tagging an animal would be counted as a trammeling action under the Untrammeled Quality, while the presence of the collar or tag as a mobile installation could be counted as a locally developed measure under the Undeveloped Quality.

- *Local interpretation of monitoring results is necessary because some measures have opposing impacts on different qualities*—Reducing the complex, nuanced, and holistic nature of wilderness character into discrete entities may lead to cases where a single management action has opposing impacts on different qualities. For example, a toilet may be considered necessary to reduce impacts to the natural resources from high amounts of human waste, but this toilet also degrades the Solitude or Primitive and Unconfined Recreation Quality because it is a recreation feature. Wilderness stewardship commonly involves such tradeoffs and monitoring clearly shows the effects of these tradeoffs on wilderness character. To clarify interpretation of monitoring results, reporting will include short narrative text by local staff that provides the context to understand seemingly conflicting trends in the data.

- *Measures and data sources can change over time*—Consistently using the same measures over time is necessary to show trend within a wilderness, but a monitoring program also needs to evolve. Measures and data sources may change because **data adequacy** or availability improves, new issues arise, new policy direction requires a change, or new measures are developed that provide better information on some aspect of wilderness character (see section 1.8). Because WCM is relatively new, Forest Service staff may need to balance the benefits of consistency in using existing measures and data sources against the benefits of using new and better measures if they become available even though a new measure may prevent determining trend until sufficient data have accumulated for the new measure. When staff consider making such a change, they should contact their Regional Wilderness Program Manager and the WCM Central Team to discuss the appropriateness and feasibility of this change. In addition, a statistician should be consulted to help determine the appropriate method of analyzing trend in the new measure. When measures or data sources are changed, it is important to document when the change occurred, the reason(s) for this action, and the potential impact on interpreting trend in wilderness character.

Data Sources

Data used in this technical guide to assess trend in wilderness character for a wilderness come from several sources, generally categorized as:

- Existing data currently residing in a Forest Service corporate database (including NRM), with opportunities for validation and modification.
- Existing data stored in local databases or spreadsheets.
- Existing data from external data sources.
- Professional knowledge.
- Newly compiled data from the field.

All the measures included in this technical guide were developed to reduce the amount of time and effort needed by local units to implement WCM, and existing data are used whenever appropriate and available. Local units, however, may need to compile existing data from the field for a few measures (e.g., tracking the number of authorized trammeling actions in a new NRM application, or assessing the condition of unique features integral to wilderness character). Whenever possible, protocols were developed to use data from national or regional monitoring programs across all appropriate resource disciplines (e.g., air, water, wildlife). For some measures, national staff compile and provide data to the local unit for verification. For other measures, local unit staff compile data from existing databases, administrative records (e.g., minimum requirement decisions), professional knowledge and judgment, or field collection.

Legacy or historical data may be used whenever available and appropriate for WCM. Legacy data from the local unit are an important reservoir of information, and may be used if data were collected (1) after the area was designated as wilderness or managed to preserve wilderness character and (2) using consistent, credible, and documented protocols that are directly relevant to WCM. Although there is no predetermined "use by" date for historical data, there may sometimes be questions about the appropriateness of using legacy data for a measure. For example, if there is a large gap between when the legacy data were collected and the WCM baseline year, or if legacy data adequacy is substandard or unknown. In some situations, legacy data may actually be better than newer data for use in WCM. Local resource specialists always will determine the appropriateness of using legacy data and their applicability for the measure.

The variety of measures used will require a variety of data and data sources, with corresponding variability in data adequacy. Some measures are based on point data (e.g., installations) or professional estimation (e.g., area of invasive plants), some require assumptions about integration over large areas (e.g., **watershed condition**), and some will be biased by the amount of effort (e.g., law enforcement effort for unauthorized trammeling actions). High-quality corporate datasets will be available for some measures, while for others there will only be poor **data quality** or no data available. In these latter cases, local professional knowledge may be used to assign a data value as long as the rationale for the judgment is documented. This includes information about the person making the judgment, the type and amount of field experience the judgment is based on, and any other information needed for outside viewers to understand the basis for the professional judgment. Data adequacy (**data quantity** and data quality) is always reported for each measure (see section 1.0 in part 2 for more information on deriving and using data adequacy).

Measure Baseline

The first year that data are compiled for a measure forms the measure baseline, and is the reference point for evaluating the **trend in a measure** over time. The measure baseline (i.e., the first year that data are compiled for an individual measure) is distinct from the WCM baseline (i.e., the first year that data are compiled for all measures, as explained above in section 1.5.2). While the **measure baseline year** will often be the same as the WCM baseline year, it may predate the WCM baseline year if legacy data are used, or it may post-date the WCM baseline year if the data source or data protocol change. The first value reported for a measure from this measure baseline year is called the measure baseline value.

If new or better data or data sources become available over time, it may be appropriate to adjust the measure baseline value. For example, improved data may result in a recalculation of the miles of system trail from 30 miles to 25 miles, but would not indicate a change on the ground or an improving trend in the measure; instead, 25 miles should become the new measure baseline value. In this situation, the measure baseline value would be reset based on the best available data and future trends in the measure would be assessed against the time of the new measure baseline value. Consult with resource specialists, the Regional Program Manager, and the Wilderness Information Management Steering Team regional representative before resetting an existing measure baseline value to ensure the appropriateness of this action. Guidance on interpreting the impact of resetting the baseline value of one or more measures on WCM baseline conditions will be developed.

Data Handling

How data are handled for a measure depends on the measure and the data used. Some measures quantify a single attribute (e.g., as a simple count, percentage, or average), and some combine two or more disparate attributes in an index. For example, the measure *Acres of Nonindigenous Plant Species* monitors a single attribute: acres. In contrast, the measure *Index of Nonindigenous Terrestrial Animal Species* tracks two attributes—species distribution and estimated impact—which are combined to yield a unit-less **component score** for each selected nonindigenous species. The component scores from each species are then added together to yield a unit-less **index value** for the measure (e.g., see table 2.3.5 in part 2). In addition, not all indices have component scores; for example, the *Index of Encounters* combines two attributes—traveling encounters and camp encounters—in a mathematical formula that produces a unit-less index value.

As described above, the frequency of data compilation also varies across measures from annually to once every 5 years. For annual measures that are likely to experience large fluctuations from year to year, such as the measures quantifying the use of motor vehicles, motorized equipment, and mechanical transport, a 3-year rolling average is calculated from the annual data (e.g., see measures 4.4.1—4.4.3 in part 2). The use of a 3-year rolling average does not obscure actions that degrade wilderness character; rather, this commonly used data handling technique prevents a large and transient increase or decrease in the data from skewing the trend either upwards or downwards.

Regardless of the frequency of data compilation, use of an index or rolling averages, or other data handling procedures, all measures produce a single value for each year of data compilation—the **measure value**—that is used to derive the trend in the measure. A measure value may be a single attribute (e.g., the total number, acres, or miles impacted), an index value, or a 3-year average, and may be calculated annually or every 5 years (see table 1.1.6). For example, for the measure *Acres of Inholdings*, the measure value is the total number of acres. For the measure *Index of Visitor Management Restrictions*, the measure value is the index value. For the measure *Number of Authorized Actions and Persistent Structures Designed to Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire*, the measure value is the 3-year average of the annual number of authorized trammeling actions (e.g., if the annual number of trammeling actions was 4 in 2015, 0 in 2016, and 2 in 2017, the measure value for 2017 would be 2 which is the 3-year average of those annual values). For the measure *Index of Administrative Authorizations to Use Motor Vehicles, Motorized Equipment, or Mechanical Transport*, the measure value is the 3-year average of annual index values (e.g., if the annual index value was 30 in 2015, 100 in 2016, and 50 in 2017, the measure value for 2017 would be 60 which is the 3-year average of those annual index values).

Importantly, as much of the data handling as possible will be done automatically and internally by either NRM, the WCMD, or a central data analyst responsible for data compilation, analysis, and data entry for national measures. For some measures, however, data handling will need to be done by the local unit, as described in the protocol section for such measures in part 2.

Table 1.1.6—The four different derivations of the measure value used to derive the trend in a measure.

	Frequency	Example measure	Measure value
Single attribute	**5 years**	Acres of Inholdings	Total number of acres
Index	**5 years**	Index of Visitor Management Restrictions	Index value
Single attribute using a 3-year rolling average	**1 year**	Number of Authorized Actions and Persistent Structures Designed to Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire	3-year average of the annual number of authorized trammeling actions
Index using a 3-year rolling average	**1 year**	Index of Administrative Authorizations to Use Motor Vehicles, Motorized Equipment, or Mechanical Transport	3-year average of the annual index values

1.5.4 Assessing Trends

Trend in wilderness character is determined by using nationally consistent rules to compile trends across the measures, indicators, monitoring questions, and qualities to derive an overall trend in wilderness character for each wilderness. The overall trend in wilderness character provides a readily interpretable assessment for wilderness managers at the local unit level to evaluate outcomes of their stewardship. Trends in wilderness character examined across several wildernesses provide information for regional and national wilderness program managers to assess whether agency policies and programs are fulfilling the legal mandate of the Wilderness Act to preserve wilderness character.

There are three primary steps to determining the trend in wilderness character:

1. Determining meaningful change in the data and trend in a measure.
2. Determining the trend in an indicator, monitoring question, and quality.
3. Determining the overall trend in wilderness character.

Step 1—Determining Meaningful Change in the Data and Trend in a Measure

A meaningful change in each measure is based on either nationally or locally determined thresholds. For each measure included in this technical guide, the threshold for change was determined based on resource specialists' assessments of how much change in the data qualifies as a meaningful change in the measure. Meaningful change in a measure is not tied directly to, or based on, a national forest's land or resource management plan, nor does it represent significant change or impacts as defined by NEPA. Part 2 of this technical guide describe the thresholds for meaningful change in the data for each measure. Local units must determine thresholds for locally developed measures. The trend in each measure is classified into one of three categories: (1) stable (no meaningful change in the data), (2) improving (a meaningful improvement), or (3) degrading (a meaningful degradation).

To determine the trend in a measure for a given year, compare the most recent measure value with the measure baseline value. In some cases, the most recent measure value may not be for the year the trend is reported; for example, air quality data are often published at set intervals which may not align with the trend reporting cycle, and the most recent measure value may be from a few years prior. Also, if legacy data exist for a measure, these data would be included in determining trend for the measure. Table 1.1.7 provides several examples that illustrate how to derive trends by using measure values from different years for different measures. For some measures that have at least five values, trend is not determined by a comparison of two measure values but instead is derived by using the statistical procedure of regression analysis of all available values (see appendix B in Landres et al. 2009 for background on the use of regression, and section 1.0 in part 2 in this technical guide for details on its use). Regression is generally not appropriate for measures that use “any change” (e.g., an increase of one **dam**) or “categories” (e.g., a change from 10- to 20-percent areal coverage of nonindigenous plants) as thresholds for determining meaningful change. In addition, switching to regression analysis for determining meaningful change once there are five measure values may change the trend in a measure.

Table 1.1.7—Five hypothetical measures showing how trend is derived based on comparing the most recent measure value with the measure’s baseline value.[a]

Measure	Year of data collection								Trend derived
	2008	2009	2010	2011	2012	2013	2014	2015	
1	-	-	●	○	○	○	○	●	2010–2015
2	-	●	○	○	○	○	●	-	2009–2014
3	●	-	○	-	○	-	●	-	2008–2014
4	-	-	●	-	-	-		●	2010–2015
5	●	-	-	○	-	○	●	-	2008–2014

[a] Circles show that data were compiled for the given year. For each measure, trend is assessed from that measure’s baseline year (left black circle) to that measure’s most recent year of data compilation (right black circle) either by comparing them directly or by regression analysis. Open circles show additional years that data were collected. The shaded column under 2010 shows the hypothetical WCM baseline year (the first year for which data are available for all measures), with legacy data from 2008 and 2009. The “Trend derived” column shows the set of years used to determine the trend in each measure for reporting in 2015. A dash mark (-) indicates no data for that year.

Step 2—Determining Trend in an Indicator, Monitoring Question, and Quality

Once trends have been determined for all the measures, use the following rules to derive the trend in an indicator:

- All the trends in the measures of one indicator are combined (including trends from locally developed, optional, and all other types of measures), with each improving-trending measure offsetting each degrading-trending measure.
- The overall trend in the indicator is improving if there are more improving- than degrading-trending measures, and the overall trend is degrading if there are more degrading- than improving-trending measures (regardless of the number of stable measures).
- If there are an equal number of improving- and degrading-trending measures, the overall trend in the indicator is referred to as an **offsetting stable trend**.
- If all the measures are stable, the trend in the indicator is also stable.

By applying the same rules, the resulting trends in the indicators are then used to derive the trends in the monitoring questions, and likewise through each of the qualities (see table 1.1.8). These trends are illustrated by using arrows—a downward arrow showing a degrading trend, an upward arrow showing an improving trend, a horizontal double-headed arrow showing a stable trend, and a vertical double-headed arrow showing an offsetting stable trend. Throughout this technical guide, for brevity, the examples do not include every measure for an indicator, and in some cases the name of the measure has been abbreviated.

Table 1.1.8—An example showing how trends in the qualities are derived from trends in the measures, indicators, and monitoring questions.

	Trend			
	Measure	**Indicator**	**Question**	**Quality**
Untrammeled Quality				
Number of authorized actions and persistent structures	↑	↑	↑	↑
Number of unauthorized actions and persistent structureS	↔	↔		
Natural Quality				
Acres of nonindigenous plant species	↑	↑	↓	↓
Index of nonindigenous terrestrial animal species	↔	↔		
Concentration of ambient ozone	↔	↓		
Deposition of nitrogen	↔			
Extent of waterbodies with impaired water quality	↓			
Watershed condition class	↓	↓		
Undeveloped Quality				
Index of authorized non-recreational physical development	↑	↑	↑	↑
Acres of inholdings	↔	↔		
Index of administrative authorizations to use motorized/mechanized equipment	↑	↑	↑	
Index of special provision authorizations to use motorized/mechanized transport	↑			
Solitude or Primitive and Unconfined Recreation Quality				
Index of encounters	↓	↓	↓	↕
Index of recreation sites within primary use areas	↓			
Acres of wilderness away from access and travel routes and developments inside wilderness	↔			
Acres of wilderness away from adjacent access and travel routes and developments outside the wilderness	↔	↔		
Index of NFS developed trails	↔	↑	↑	
Number of authorized constructed recreation features	↑			
Index of visitor management restrictions	↔	↔		
Other Features of Value Quality				
Condition index for integral cultural features	↑	↑	↑	↑

Step 3—Determining the Overall Trend in Wilderness Character

Trend in wilderness character is derived by combining the trends from all the qualities. The Wilderness Act does not state that any one aspect of the Section 2(c) Definition of Wilderness is more or less important than another, so this WCM strategy assumes that all qualities are equally important, with one exception described below for the Untrammeled Quality. This assumption of equal importance includes the Other Features of Value Quality because even though such features may or may not be present in a wilderness, the Wilderness Act provides no reason to consider this quality (when present) more or less important than the other qualities.

Once trends in each quality have been determined, derive the overall trend in wilderness character by following the same four rules described previously in step 2. However, if there are an equal number of improving- and degrading-trending qualities, an additional rule is applied as a tiebreaker:

- If there are an equal number of improving- and degrading-trending qualities, the trend in the Untrammeled Quality determines the overall trend in wilderness character.

The following three reasons support giving extra weight to the Untrammeled Quality in a tiebreaker situation:

1. The statutory definition of wilderness describes "untrammeled" in a separate sentence.
2. The importance of untrammeled as the essence of wilderness has a long history in wilderness literature.
3. No other land designations are, by law, to be kept untrammeled.

These three factors serve to make the Untrammeled Quality "first among equals," an idea supported by a recent legal review conducted by Long and Biber (2014). Tables 1.1.9 to 1.1.12 apply these rules to four examples to illustrate how the trends in the five qualities are aggregated to assess the overall trend in wilderness character. For brevity, the measures, indicators, and monitoring questions used to determine the trend in each quality are not shown in these tables. In table 1.1.12 that shows how the Untrammeled Quality functions as a tiebreaker in determining overall trend in wilderness character, the trends in the other qualities offset one another so the overall trend in wilderness character is offsetting-stable, rather than the simple stable trend in the Untrammeled Quality.

Table 1.1.9—Two qualities with an improving trend, one quality with a degrading trend.

Quality	Trend in the quality	Trend in wilderness character
Untrammeled	↑	↑
Natural	↓	
Undeveloped	↑	
Solitude or Primitive and Unconfined Recreation	↕	
Other Features of Value	↔	

Table 1.1.10—One quality with an improving trend, two qualities with a degrading trend.

Quality	Trend in the quality	Trend in wilderness character
Untrammeled	↑	↓
Natural	↓	
Undeveloped	↔	
Solitude or Primitive and Unconfined Recreation	↕	
Other Features of Value	↓	

Table 1.1.11—Two qualities with an improving trend, two qualities with a degrading trend; Untrammeled Quality as "tiebreaker."

Quality	Trend in the quality	Trend in wilderness character
Untrammeled	↓	↓
Natural	↑	
Undeveloped	↑	
Solitude or Primitive and Unconfined Recreation	↓	
Other Features of Value	↔	

Table 1.1.12—Two qualities with an improving trend, two qualities with a degrading trend; Untrammeled Quality as "tiebreaker."

Quality	Trend in the quality	Trend in wilderness character
Untrammeled	↔	↕
Natural	↑	
Undeveloped	↑	
Solitude or Primitive and Unconfined Recreation	↓	
Other Features of Value	↓	

Flexibility and Limitations in Assessing Trend

The approach to deriving an overall trend in wilderness character has several important qualifications. First, the approach of compiling trends, and not the data, allows disparate types of data to be used for the measures. This in turn allows different wildernesses to use a single, nationally consistent approach to assessing trends in wilderness character across the entire NWPS (see section 1.5.5 for resulting analyses and reports that can be derived from this consistent approach). Second, the different number of monitoring questions, indicators, and measures within each quality does not affect the overall trend in wilderness character because each quality is represented by a single trend. Third, this hierarchical approach provides different levels of information for the various needs of different audiences. For example, local unit managers need detailed information on specific measures and indicators, while regional and national staff need broader trend information.

A final qualification is that the approach purposefully only shows the change that is occurring and not the magnitude of that change in the indicators, monitoring questions, qualities, and wilderness character. Magnitude is not included because it would:

- Imply a greater level of precision than is possible in this national monitoring strategy.
- Require consistency across wildernesses and agencies in the number and types of measures that is not possible given the variability within the NWPS.
- Make outcomes more vulnerable to gaming or manipulation (whereas this WCM strategy's conservative approach counts any declining trend as a fully, not partially, declining trend).
- Not provide any additional resources to local managers who already have the detailed information they need from the data and trends in the measures.

1.5.5 Reporting

The Forest Service anticipates that three types of standardized monitoring reports will be required, each designed for a different audience: (1) individual wilderness, (2) regional, and (3) national reports. Collectively, these monitoring reports will help local managers understand how wilderness character is changing and promote understanding of larger regional and national trends in agency wilderness stewardship. Once WCM is fully implemented by the Forest Service, the frequency of these reports will be determined, and will likely be annually or biennially for the local report (to maintain ongoing interest and support for local WCM) and once every 5 years for the regional and national reports. Standard reports will be generated by the interagency WCMD from measures and data entered for each wilderness, with an option for additional user-added qualitative information in the reports.

The intent of the reports outlined in this section is to promote communication and enable discussion of wilderness stewardship at the local unit level and among regional and national wilderness program managers within the Forest Service, key national non-governmental partners, and congressional staff. Standardized reporting formats at different levels provide the ability to compare information across the agency, within and among Forest Service regions, and different wildernesses on a local unit. For reporting purposes, "preserving wilderness character" is defined by a trend in wilderness character that is either stable or improving.

All three levels of reporting will include a short narrative (different from the Wilderness Character Narrative required under the WSP Wilderness Character Baseline element) that provides information about conditions, circumstances, and context that affect the interpretation and use of the trends reported. The short narrative gives local, and regional and national program managers the opportunity to add qualitative information and insights from their professional judgment to complement and help interpret the data and trends. For example, this short narrative is the appropriate place to describe the effects of climate change or an intense fire season on the Natural Quality and on the other qualities of wilderness character. The short narrative becomes a valuable part of the legacy information passed to future wilderness managers and helps ensure consistency in reporting over time. The short narrative also provides insight about the Forest Service WCM that feeds into the change management process.

Individual Wilderness Report

The purpose of the Individual Wilderness Report is to promote understanding of wilderness conditions and facilitate discussion among local staff about preserving wilderness character. The standardized reporting format will show the trend in wilderness character for a specific wilderness, as well as trends in the qualities, monitoring questions, indicators, and measures. This report provides a level of detail suitable for communicating monitoring results with line officers and potentially with interested citizens, and will assist managers with planning and developing informed management actions. Highlights from the Individual Wilderness Report could also be included in monitoring and evaluation reports, as required by planning regulations. Individual Wilderness Reports will likely be produced annually or biennially.

Besides the formal Individual Wilderness Report, local units also will generate a "data dump" of all the information entered into the WCMD for use by the local manager to compare current conditions against thresholds for meaningful change. This data dump would not be used for upward reporting or communicating results to the public, but instead would provide a detailed reservoir of information for local staff.

Refer to figures 1.1.4 through 1.1.9 and table 1.1.13 for the suggested format for the Individual Wilderness Report.

Monitoring Selected Conditions Related to Wilderness Character

A Report on Trends in the Blue Sky Wilderness from 2015 through 2020

•WILDERNESS• AMERICA'S ENDURING RESOURCE

What is Wilderness Character?

For this monitoring, wilderness character is described as five mutually reinforcing qualities derived from the Wilderness Act of 1964:

Untrammeled

The intentional management actions that directly control or manipulate the components or processes of ecological systems inside wilderness.

Natural

The effects of modern people on ecological systems inside wilderness since the time the area was designated.

Undeveloped

The structures, installations, and other evidence of modern human presence or occupation, and the use of motor vehicles, motorized equipment, or mechanical transport.

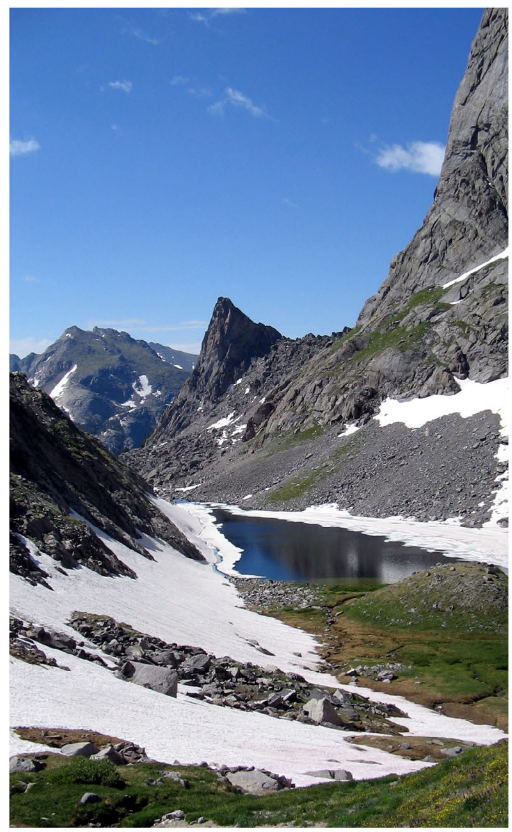
Solitude or Primitive and Unconfined Recreation

The conditions that affect the opportunity for people to experience solitude or primitive, unconfined recreation.

Other Features of Value

The ecological, geological, or other features of scientific, educational, scenic, or historical value.

"...each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area"
Wilderness Act of 1964: (Sec. 4b)



Why Monitor Wilderness Character?

- To fulfill legal and policy mandates to preserve wilderness character.
- To assess the outcomes of wilderness stewardship.
- To improve wilderness stewardship.
- To establish information that will endure as personnel and conditions change.

Trends in the Qualities of Wilderness Character

Quality of Wilderness Character	Trend: 2015-2020
Untrammeled	↑ Improving
Natural	↓ Degrading
Undeveloped	↑ Improving
Solitude	↕ Offsetting Stable
Other Features	↑ Improving
WILDERNESS CHARACTER	↑ **Improving**

The overall trend in wilderness character is improving

Figure 1.1.4—Summary page for the Individual Wilderness Report.

Table 1.1.13—Summary of trends in the measures, indicators, monitoring questions, qualities, and wilderness character overall for the Individual Wilderness Report.

Summary of trends in the Blue Sky Wilderness: 2015–2020					
	Trend				
	Measure	Indicator	Question	Quality	Wilderness character
Untrammeled Quality					↑
Number of authorized actions and persistent structures	↑	↑	↑	↑	
Number of unauthorized actions and persistent structures	↔	↔			
Natural Quality					
Acres of nonindigenous plant species	↑	↑	↓	↓	
Index of nonindigenous terrestrial animal species	↔	↔			
Concentration of ambient ozone	↔	↓			
Deposition of nitrogen	↔				
Extent of waterbodies with impaired water quality	↓				
Watershed condition class	↓	↓			
Undeveloped Quality					
Index of authorized non-recreational physical development	↑	↑	↑	↑	
Acres of inholdings	↔	↔			
Index of administrative authorizations to use motorized/mechanized equipment	↑	↑	↑		
Index of special provision authorizations to use motorized/mechanized transport	↑				
Solitude or Primitive and Unconfined Recreation Quality					
Index of encounters	↓	↓	↓	↕	
Index of recreation sites within primary use areas	↓				
Acres of wilderness away from access and travel routes and developments inside wilderness	↔				
Acres of wilderness away from adjacent access and travel routes and developments outside the wilderness	↔	↔			
Index of NFS developed trails	↔	↑	↑		
Number of authorized constructed recreation features	↑				
Index of visitor management restrictions	↔	↔			
Other Features of Value Quality					
Condition index for integral cultural features	↑	↑	↑	↑	

Blue Sky Wilderness Character Monitoring Results: 2015—2020

Untrammeled Quality

Wilderness is essentially unhindered and free from intentional modern human control or manipulation.

Wilderness Act of 1964

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."

Howard Zahniser, the primary author of the Wilderness Act, noted that the inspiration for wilderness preservation "is to use 'skill, judgment, and ecologic sensitivity' for the protection of some areas within which natural forces may operate without man's management and manipulation."

This quality monitors management activities that intentionally control or manipulate the components or processes of ecological systems inside wilderness.

The trend in the Untrammeled Quality is Improving ↑

Trends in Indicators and Measures for the Untrammeled Quality

Indicator	Trend	Measure	Trend	Data Adequacy
Monitoring Question: What are the trends in actions that intentionally control or manipulate the "earth and its community of life" inside wilderness?				
Actions authorized by the Federal land manager that intentionally manipulate the biophysical environment	↑	Number of authorized actions and persistent structures designed to manipulate plants, animals, pathogens, soil, water, or fire	↑	High
Actions not authorized by the Federal land manager that intentionally manipulate the biophysical environment	↔	Number of unauthorized actions and persistent structures by agencies, organizations, or individuals that manipulate plants, animals, pathogens, soil, water, or fire	↔	Low

Short narrative about the Untrammeled Quality

Despite the continuation of some authorized trammeling actions (including herbicide treatment of noxious weeds) a significant decrease in the number of fire suppression actions resulted in an improving trend in the authorized actions measure. The change in fire suppression tactics is partially due to the low number of fires over the past few years, and partially due to a recent plan amendment that allows natural fire to burn in certain areas of the wilderness. The trend in the unauthorized actions measure remained stable as there have been no known unauthorized trammeling actions. While the decrease in fire suppression activity resulted in an improving trend in the untrammeled quality, the number of authorized trammeling actions remains relatively high for non-fire activities, thus future improvement is possible.

Figure 1.1.5—Summary of the trend in the Untrammeled Quality for the Individual Wilderness Report.

Blue Sky Wilderness Character Monitoring Results: 2015—2020

Natural Quality

Wilderness ecological systems are substantially free from the effects of modern civilization.

Wilderness Act of 1964

Wilderness is "protected and managed so as to preserve its natural conditions."

This statement means that the indigenous species composition, structures, and functions of ecological systems in wilderness are protected and allowed to function and change on their own, without the planned intervention or the unintended effects of modern civilization. Only through such protection may wilderness truly serve as "a laboratory for the study of land-health" and as an ecological baseline for understanding the effects of modern civilization on natural systems.

This quality monitors changes in the natural environment as a result of human-caused change since the area was designated as wilderness.

The trend in the Natural Quality is Degrading ↓

Trends in Indicators and Measures for the Natural Quality

Indicator	Trend	Measure	Trend	Data Adequacy
Monitoring Question: What are the trends in the natural environment from human-caused change?				
Plants	↑	Acres of nonindigenous plant species	↑	Medium
Animals	↔	Index of nonindigenous terrestrial animal species	↔	Medium
Air and water	↓	Concentration of ambient ozone	↔	High
		Deposition of nitrogen	↔	High
		Extent of waterbodies with impaired water quality	↓	Medium
Ecological processes	↓	Watershed condition class	↓	Medium

Short narrative about the Natural Quality

The acres of nonindigenous plants continue to decrease due to the noxious weed treatment program, resulting in an improvement to the plants indicator. The distribution and impact of nonindigenous animal species focuses on mountain goats. Although surveys for this measure do not include the entire wilderness, mountain goat populations remain fairly stable. The largest impacts to the Natural Quality resulted from decreasing water quality. Although we are unsure of why levels of pollutants are increasing, impacts to both stream water quality and watershed function were detected. While ambient ozone levels and total nitrogen deposition remained stable and in good condition, the decrease in stream conditions resulted in a degradation of the air and water indicator. Similarly, impacts to wilderness watersheds resulted in a degradation to the ecological processes indicator. Overall, improvements in the plants indicator were not enough to offset the recent impacts to water quality, resulting in a degrading trend in the quality. However, since the same source of pollution likely affected both stream quality and watershed functioning (under two separate indicators), its impact was likely magnified in the trend calculation.

Figure 1.1.6—Summary of the trend in the Natural Quality for the Individual Wilderness Report.

Blue Sky Wilderness Character Monitoring Results: 2015—2020

Undeveloped Quality

Wilderness is essentially without permanent improvements or modern human occupation.

Wilderness Act of 1964

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."

Some evidence of occupancy and use is acceptable because of special provisions in legislation or because it is considered the "minimum necessary for administration of the area for the purpose of the Act" (Wilderness Act of 1964, Sec. 4(c)). Regardless, managers must exercise restraint so that a wilderness does not increasingly appear developed, occupied, and modified.

This quality monitors the number and development level of structures, construction, habitations, and other evidence of modern human occupation.

The trend in the Undeveloped Quality is Improving ↑

Trends in Indicators and Measures for the Undeveloped Quality

Indicator	Trend	Measure	Trend	Data Adequacy
Monitoring Question: What are the trends in non-recreational physical development?				
Presence of non-recreational structures, installations, and developments	↑	Index of authorized non-recreational physical development	↑	High
Presence of inholdings	↔	Acres of inholdings	↔	High
Monitoring Question: What are the trends in mechanization?				
Use of motor vehicles, motorized equipment, or mechanical transport	↕	Index of administrative authorizations to use motor vehicles, motorized equipment, or mechanical transport	↑	High
		Index of special provision authorizations to use motor vehicles, motorized equipment, or mechanical transport	↓	High

Short narrative about the Undeveloped Quality

The improving trend in the authorized developments indicator is due to an abandoned mine rehabilitation project that restored five inactive mines to a natural condition. The number of developed inholdings remained the same, therefore the overall trend in the development monitoring question is improving. While a concerted effort to reduce administrative authorizations for motorized use succeeded in improving the trend in that measure, the same cannot be said for the measure on special provision authorizations. Increasing visitation has correlated with an increased number of aircraft landings for search and rescue, leading to a degrading trend in that measure. The trend in the motorized use monitoring question is therefore offsetting stable, and the overall trend in the quality is improving.

Figure 1.1.7—Summary of the trend in the Undeveloped Quality for the Individual Wilderness Report.

Blue Sky Wilderness Character Monitoring Results: 2015—2020

Solitude or Primitive and Unconfined Recreation Quality

Wilderness provides outstanding opportunities for people to experience solitude or primitive and unconfined recreation, including the values of inspiration and physical and mental challenge.

Wilderness Act of 1964

Wilderness "has outstanding opportunities for solitude or a primitive and unconfined type of recreation."

The meaning of solitude in wilderness encompasses separation from people and civilization, inspiration, and a sense of timelessness. Primitive recreation encompasses travel by nonmotorized and nonmechanized means and also includes reliance on personal skills to travel and camp in an area rather than reliance on facilities or outside help. Unconfined recreation encompasses self-discovery, exploration, and freedom from societal or managerial controls.

This quality monitors conditions that affect the opportunity for people to experience solitude or primitive, unconfined recreation; it does not monitor visitor experiences directly.

The trend in the Solitude Quality is Offsetting Stable

Trends in Indicators and Measures for the Solitude Quality

Indicator	Trend	Measure	Trend	Data Adequacy
Monitoring Question: What are the trends in outstanding opportunities for solitude?				
Remoteness from sights and sounds of human activity *inside* wilderness	↓	Index of encounters	↓	Low
		Index of recreation sites within primary use areas	↓	Medium
		Acres of wilderness away from access and travel routes and developments inside wilderness	↔	High
Remoteness from sights and sounds of human activity *outside* the wilderness	↔	Acres of wilderness away from adjacent travel routes and developments outside the wilderness	↔	High
Monitoring Question: What are the trends in outstanding opportunities for primitive and unconfined recreation?				
Facilities that decrease self-reliant recreation	↑	Index of NFS developed trails	↔	High
		Number of authorized constructed recreation features	↑	Medium
Management restrictions on visitor behavior	↔	Index of visitor management restrictions	↔	High

Short narrative about the Solitude Quality

In the past few years there has been a notable increase in visitation which has been linked with increases in travel route encounters as well as an increase of user-created recreation sites. While the area of wilderness adjacent to inside and outside travel routes and developments has remained stable, impacts from increased visitation have resulted in an overall degrading trend in the solitude monitoring question. Opportunities for primitive and unconfined recreation have improved. This improvement is due entirely to the removal of a damaged bridge; while there are no plans to replace the bridge at this time, the possibility may be reexamined in the future if visitation increases. The trend for number of management restrictions remained unchanged, this may change in the future depending on visitation rates. The overall trend in this quality is offsetting stable.

Figure 1.1.8—Summary of the trend in the Solitude or Primitive and Unconfined Recreation Quality for the Individual Wilderness Report.

Blue Sky Wilderness Character Monitoring Results: 2015—2020

Other Features of Value Quality

Wilderness may also contain ecological, geological or other features of value including scientific, educational, scenic or historical value.

Wilderness Act of 1964

Section 2(c) of the Wilderness Act defines wilderness as an area that "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

Where ecological, geological or other features of scientific, educational, scenic, or historical value exist and are integral to the meaning and value of the area, including such features as part of this monitoring can provide a more complete picture of wilderness character.

This quality monitors specific, tangible features and how the conditions of these features change over time; it does not monitor the values derived from these features.

The trend in the Other Features of Value Quality is Improving ↑

Trends in Indicators and Measures for the Other Features of Value Quality

Indicator	Trend	Measure	Trend	Data Adequacy
Monitoring Question: What are the trends in the unique features that are tangible and integral to wilderness character?				
Deterioration or loss of integral cultural features	↑	Condition index for integral cultural features	↑	High

Short narrative about the Other Features of Value Quality

The improving trend in this quality is due to a stabilization project carried out on cliff dwellings in the wilderness.

Figure 1.1.9—Summary of the trend in the Other Features of Value Quality for the Individual Wilderness Report.

Regional Report

The Regional Report is intended to promote communication and discussion of monitoring results among the regional wilderness program managers. A standardized reporting format will show trends in wilderness character and trends in the qualities, monitoring questions, indicators, and measures included in this technical guide for all wildernesses in a region. A map may also be produced showing the percentage of wildernesses within each region that are preserving wilderness character. This report provides the level of detail regional wilderness program managers need to help with accountability for wilderness stewardship and policy review.

Regional Reports will likely be produced every 5 years with optional periodic progress reports. Table 1.1.14 is an example that summarizes trends in wilderness character for the 13 wildernesses for which the Northern Region (Region 1) has the lead responsibility. Figures 1.1.10a and 1.1.10b are examples that summarize the trend in the Undeveloped Quality for the Northern Region (for brevity, the other qualities are not presented).

Table 1.1.14—An example summary of the trends in wilderness character across the 13 wildernesses for which the Northern Region has the lead responsibility.

Name of wilderness	Trend in wilderness character
Selway-Bitterroot Gospel-Hump Gates of the Mountain Absaroka-Beartooth	↑ **Improving**
Rattlesnake Mission Mountains Lee Metcalf Anaconda Pintler Bob Marshall Great Bear	↔ **Stable** or ↕ **Offsetting stable**
Cabinet Mountains Scapegoat Welcome Creek	↓ **Degrading**

Region 1 Wilderness Character Monitoring Results: 2015-2020

Undeveloped Quality

Wilderness is essentially without permanent improvements or modern human occupation.

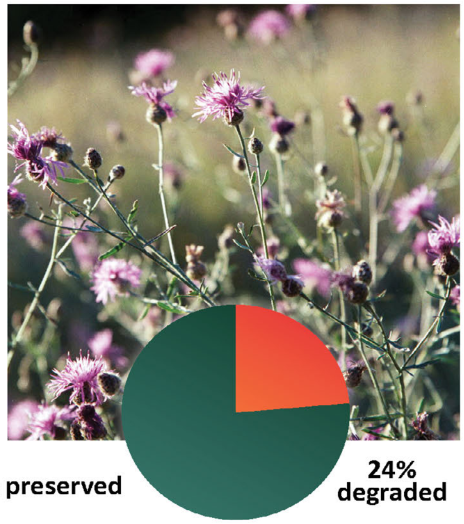
Wilderness Act of 1964

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".

Some evidence of occupancy and use is acceptable because of special provisions in legislation or because it is considered the "minimum necessary for administration of the area for the purpose of the Act" (Wilderness Act section 4(c)). However, managers must exercise restraint so that a wilderness does not increasingly appear developed, occupied, and modified.

This quality monitors the number and development level of structures, construction, habitations, and other evidence of modern human presence or occupation.

Trends in the Undeveloped Quality across the 13 Regional Wildernesses



Trends in the Indicators and Measures across the 13 Regional Wildernesses

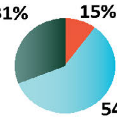
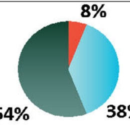
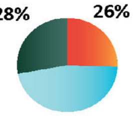
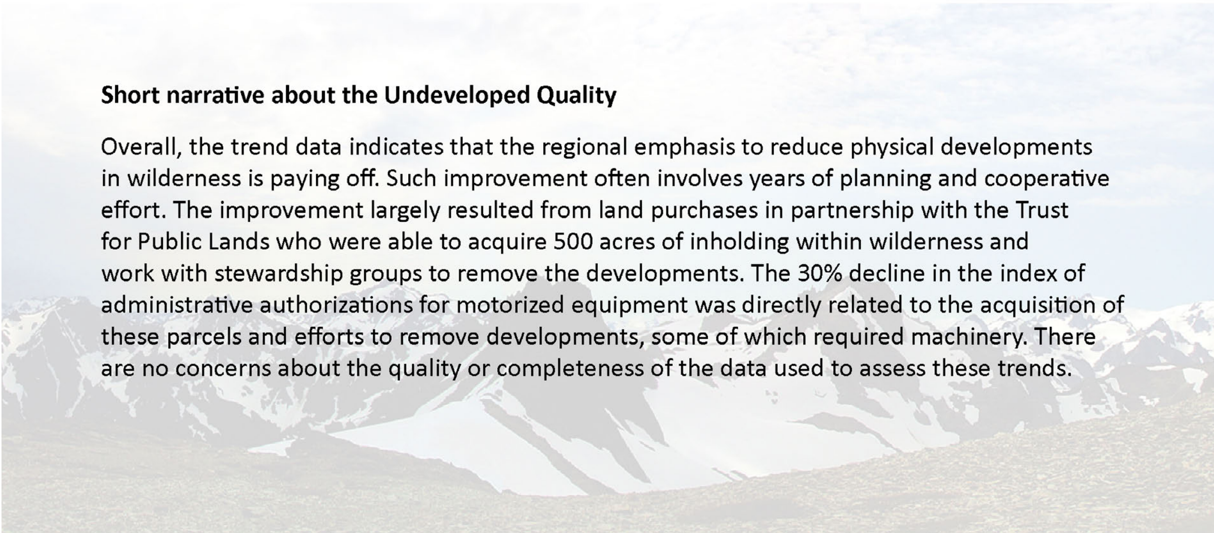
Indicator	Trend	Measure	Trend
Monitoring Question: What are the trends in non-recreational physical development?			
Presence of non-recreational structures, installations, and developments	 31% 15% 54%	Index of authorized non-recreational physical development	15% 54% 31%
Presence of inholdings	 8% 54% 38%	Acres of inholdings	8% 38% 54%
Monitoring Question: What are the trends in mechanization?			
Use of motor vehicles, motorized equipment, or mechanical transport	 28% 26% 46%	Index of administrative authorizations to use motor vehicles, motorized equipment, or mechanical transport	31% 38% 31%
		Percent of emergency incidents using motor vehicles, motorized equipment, or mechanical transport	26% 46% 28%
		Index of special provision authorizations to use motor vehicles, motorized equipment, or mechanical transport.	25% 63% 12%

Figure 1.1.10a—An example summary of the trends in the Undeveloped Quality across the 13 wildernesses for which the Northern Region has the lead responsibility.



Short narrative about the Undeveloped Quality

Overall, the trend data indicates that the regional emphasis to reduce physical developments in wilderness is paying off. Such improvement often involves years of planning and cooperative effort. The improvement largely resulted from land purchases in partnership with the Trust for Public Lands who were able to acquire 500 acres of inholding within wilderness and work with stewardship groups to remove the developments. The 30% decline in the index of administrative authorizations for motorized equipment was directly related to the acquisition of these parcels and efforts to remove developments, some of which required machinery. There are no concerns about the quality or completeness of the data used to assess these trends.

Figure 1.1.10b—An example short narrative summary of the trends in the Undeveloped Quality across the 13 wildernesses for which the Northern Region has the lead responsibility.

National Report

The purpose of the National Report is to promote communication and allow discussion of monitoring results with line officers and program managers to inform policy review and improve wilderness stewardship. The National Report will consist of two parts: (1) a summary of national trends in wilderness character and each of the five qualities suitable for briefings to the National Leadership Team and similar audiences, and (2) a summary of regional trends in wilderness character. Together, these summaries provide the level of detail national and regional wilderness program managers need to assist with accountability for wilderness stewardship and policy review.

The National Report will likely be produced on a 5-year cycle with annual progress reports. Producing an annual progress report will allow national compilation and synthesis work to be spread evenly year to year rather than increasing workloads once every 5 years. Additionally, annual progress reports will provide a consistent flow of information about trends in wilderness character to leaders in the wilderness program, who can use the reports to inform program decisions.

Until all NFS wildernesses implement this Forest Service WCM strategy and have sufficient data to derive trends, producing biennial national progress reports are recommended. These updates will discuss what is happening with WCM, communicate any significant findings from data entered to date, share lessons learned from monitoring done to date, and provide information on what will occur in the next year.

Figures 1.1.11 and 1.1.12 are examples of how monitoring information may be presented in the National Report.

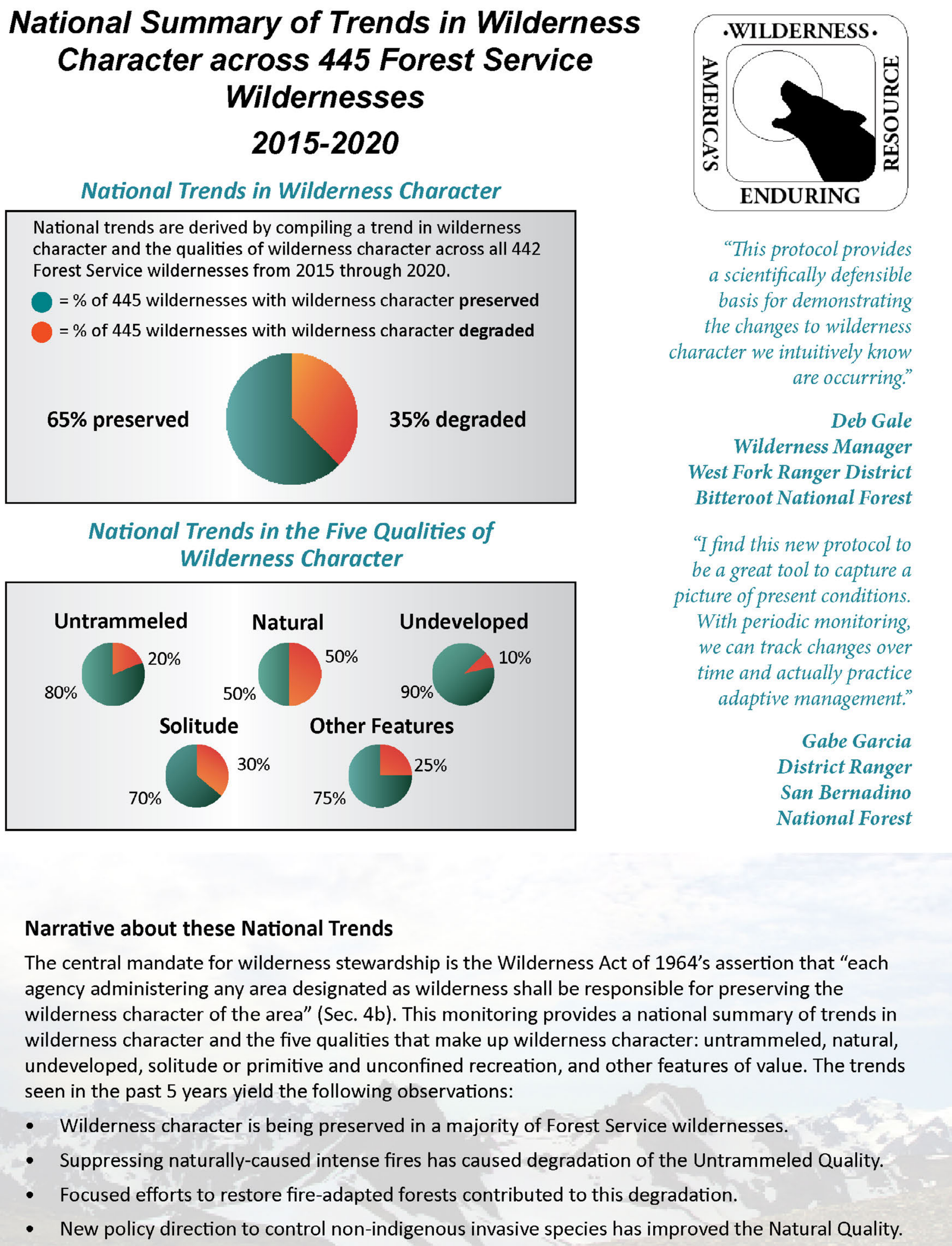


Figure 1.1.11—An example summary of the national trends in wilderness character across all 445 NFS wildernesses.

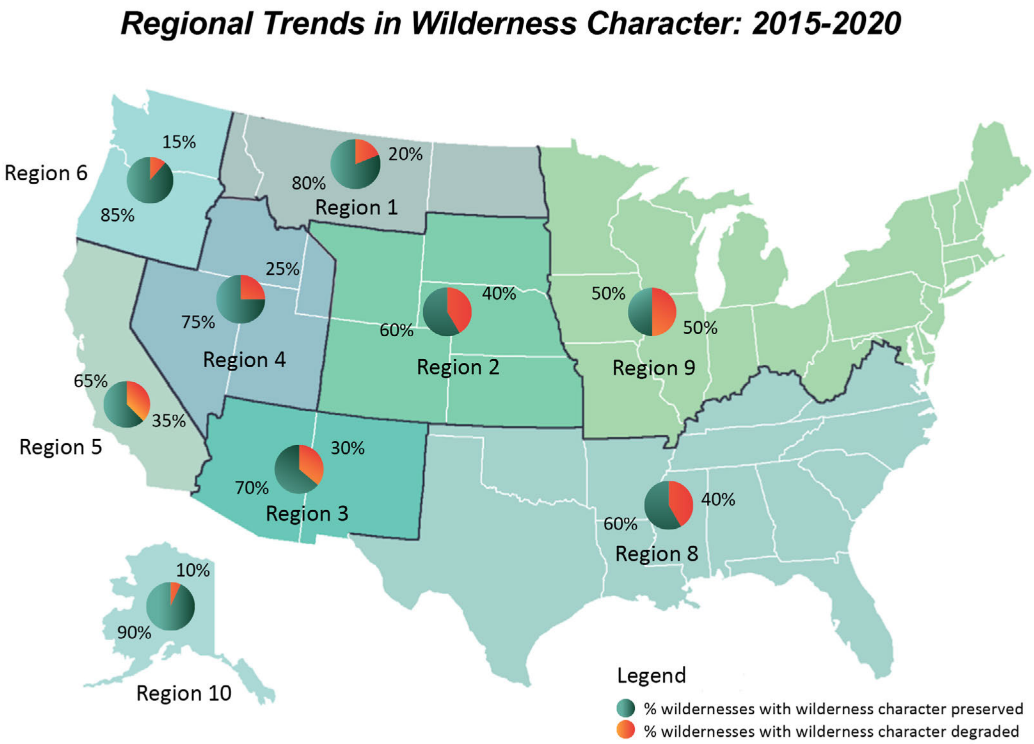


Figure 1.1.12—An example summary of the regional trends in wilderness character across the nine regions of the Forest Service.

1.5.6 Using the Results in Forest Service Planning and Administration

The results of WCM can provide useful information for planning and decision making, including forest-level planning, project-level planning and decisions, and for administrative purposes at the national, regional, or local level.

Forest Planning

Wilderness management direction is prepared as a part of the forest planning process as required by 36 CFR Part 219 and FSM 1922. Forest planning also complies with NEPA (FSM 1950 and FSH 1909.15).

The 2012 Planning Rule (36 CFR 219) was developed to ensure that plans are consistent with and complement existing, related agency policies that guide management of resources on NFS lands, such as the Watershed Condition Framework (WCF; USDA Forest Service 2011c) and the agency's Sustainable Recreation Framework (2010). The three primary planning phases described in the Planning Rule include (1) assessment, (2) plan development/amendment/revision, and (3) monitoring.

Information collected from WCM can contribute to each of the planning framework's phases. WCM provides feedback for the planning cycle by testing relevant assumptions, assessing relevant conditions over time, and measuring management effectiveness. WCM can be an important component of forest plan monitoring programs. Based on the evaluation of the information gathered through monitoring, the responsible official can determine the following:

- Whether a change to a local unit's land management plan may be needed,
- Whether a change to management activities may be needed; or
- Whether an assessment may be needed to determine if there is a preliminary need to change a land management plan.

Project or Activity Decisions

Trend information over five or more years, and information that transcends the time individual wilderness managers are at a wilderness, will be especially powerful in efforts to preserve wilderness character. For example, being able to compare the current number and type of actions taken to manipulate vegetation to the number and type of actions that will be taken 10 years from now is a valuable indicator about whether management programs are trending toward more or less manipulation of natural processes and conditions. Similarly, comparing the number and development level of **buildings, trails,** dams, and other physical developments that exist today to the number and development level that will exist 10 years or more from now is avaluable indicator about whether evidence of human occupation and modification is increasing or decreasing. Such trend information can evaluate the effectiveness of existing stewardship programs and help prioritize what actions can be taken, or not taken, to most improve wilderness character.

Administrative Purposes

At regional and national levels, information derived from WCM has the following two primary uses:

1. *Improves agency accountability (performance measurement)*—Ultimately, once trends in wilderness character are known, a new performance measure will be instituted in the Forest Service to track the number of wildernesses with wilderness character that is stable or improving. This measure will be designed to evaluate only those measures over which the agency has direct control, such as management actions that trammel wilderness and not those where the agency's ability to influence is less certain, such as changes in nitrogen (N) deposition levels. This performance measure combined with the results of WSP

will help evaluate the effectiveness of the agency's wilderness stewardship program. Regional and national reports (see section 1.5.5) will show the number or percentage of wildernesses in which the trend in wilderness character is preserved compared to the number or percentage in which the trend in wilderness character is degrading. These reports will also show which of the five qualities regionally and nationally are contributing to the degradation of wilderness character. Simple displays that capture the essence of complex concepts offer a powerful way to communicate where progress is occurring and where problems still exist.

2. *Improves agency policy review and oversight to support wilderness stewardship needs at the local level*—Information from WCM can help evaluate whether current wilderness management policy is fulfilling the mandate of the Wilderness Act to preserve wilderness character. If wilderness character across much of the NFS is degrading, a review of policy implementation may provide information on whether this decline is due to inconsistent implementation of existing policies or to existing policies that are implemented consistently, but are insufficient to preserve wilderness character. For example, a widespread trend showing an increase in the number of administrative uses of motorized equipment could trigger a review about why this increase is occurring. Such a review could examine whether current policies are sufficient, examine the consistency of policy implementation, and assess the need for higher-level direction to help stabilize or reverse the trend.

1.6 Roles and Responsibilities

Forest Service responsibilities for resource inventory and monitoring are outlined in FSM 1940.04. The following subsections describe the specific roles and responsibilities for monitoring and evaluation of wilderness character. Existing Forest Service personnel typically fulfill these roles and responsibilities.

Roles and responsibilities for data compilation vary depending upon the measure. Tables 1.1.15–1.1.19 identify the measure type, frequency of data compilation for the measure, and whether data compilation and analysis for measures occurs at the national level, local level, or a combination of both (see also Appendix 1 for a summary of local and national tasks for all measures).

Table 1.1.15—Summary of measure type, data compilation frequency, and local or national staff responsibility for the measures in the Untrammeled Quality.

Untrammeled Quality				
Indicator	**Measure**	**Measure type**	**Frequency**	**Responsible staff**
Actions authorized by the Federal land manager that intentionally manipulates the biophysical environment	Number of authorized actions and persistent structures designed to manipulate plants, animals, pathogens, soil, water, or fire	Required	1 year	Local staff
Actions not authorized by the Federal land manager that intentionally manipulate the biophysical environment	Number of unauthorized actions and persistent structures by agencies, organizations, or individuals that manipulate plants, animals, pathogens, soil, water, or fire	Required	1 year	Local staff

Table 1.1.16—Summary of measure type, data compilation frequency, and local or national staff responsibility for the measures in the Natural Quality.

Natural Quality				
Indicator	**Measure**	**Measure type**	**Frequency**	**Responsible staff**
Plants	Acres of nonindigenous plant species	Required	5 years	Local staff
Animals	Index of nonindigenous terrestrial animal species	Required to select at least one	5 years	Local staff
	Index of nonindigenous aquatic animal species		5 years	Local staff
Air and water	Concentration of ambient ozone	Required to select at least one	5 years	Central data analyst
	Deposition of nitrogen		5 years	Central data analyst
	Deposition of sulfur		5 years	Central data analyst
	Amount of haze		5 years	Central data analyst
	Index of sensitive lichen species		5–10 years	Central data analyst
	Extent of waterbodies with impaired water quality	Required	5 years	Local staff, central data analyst
Ecological processes	Watershed condition class	Required to select at least one	5 years	Central data analyst, local staff
	Number of animal unit months of commercial livestock use		1 year	Local staff

Table 1.1.17—Summary of measure type, data compilation frequency, and local or national staff responsibility for the measures in the Undeveloped Quality.

<table>
<tr><th colspan="5">Undeveloped Quality</th></tr>
<tr><th>Indicator</th><th>Measure</th><th>Measure type</th><th>Frequency</th><th>Responsible staff</th></tr>
<tr><td>Presence of non-recreational structures, installations and development</td><td>Index of authorized non-recreational physical development</td><td>Required</td><td>5 years</td><td>Local staff, central data analyst</td></tr>
<tr><td>Presence of inholdings</td><td>Acres of inholdings</td><td>Required</td><td>5 years</td><td>Local staff</td></tr>
<tr><td rowspan="3">Use of motor vehicles, motorized equipment, or mechanical transport</td><td>Index of administrative authorizations to use motor vehicles, motorized equipment, or mechanical transport</td><td>Required</td><td>1 year</td><td>Local staff</td></tr>
<tr><td>Percent of emergency incidents using motor vehicles, motorized equipment, or mechanical transport</td><td>Optional</td><td>1 year</td><td>Local staff</td></tr>
<tr><td>Index of special provision authorizations to use motor vehicles, motorized equipment, or mechanical transport</td><td>Optional</td><td>1 year</td><td>Local staff</td></tr>
</table>

Table 1.1.18—Summary of measure type, data compilation frequency, and local or national staff responsibility for the measures in the Solitude or Primitive and Unconfined Recreation Quality.

<table>
<tr><th colspan="5">Solitude or Primitive and Unconfined Recreation Quality</th></tr>
<tr><th>Indicator</th><th>Measure</th><th>Measure type</th><th>Frequency</th><th>Responsible staff</th></tr>
<tr><td rowspan="4">Remoteness from sights and sounds of human activity inside wilderness</td><td>Index of encounters</td><td>Required</td><td>5 years</td><td>Local staff</td></tr>
<tr><td>Index of recreation sites within primary use areas</td><td rowspan="3">Required to select at least one</td><td>5 years</td><td>Local staff</td></tr>
<tr><td>Acres of wilderness away from access and travel routes and developments inside wilderness</td><td>5 years</td><td>Central data analyst, local staff</td></tr>
<tr><td>Miles of unauthorized trails</td><td>5 years</td><td>Local staff</td></tr>
<tr><td>Remoteness from sights and sounds of human activity outside the wilderness</td><td>Acres of wilderness away from adjacent travel routes and developments outside the wilderness</td><td>Required</td><td>5 years</td><td>Central data analyst, local staff</td></tr>
<tr><td rowspan="2">Facilities that decrease self-reliant recreation</td><td>Index of NFS developed trails</td><td rowspan="2">Required to select at least one</td><td>5 years</td><td>Local staff</td></tr>
<tr><td>Number of authorized constructed recreation features</td><td>5 years</td><td>Local staff</td></tr>
<tr><td>Management restrictions on visitor behavior</td><td>Index of visitor management restrictions</td><td>Required</td><td>5 years</td><td>Local staff</td></tr>
</table>

Table 1.1.19—Summary of measure type, data compilation frequency, and local or national staff responsibility for the measures in the Other Features of Value Quality.

Other Features of Value Quality				
Indicator	**Measure**	**Measure type**	**Frequency**	**Responsible staff**
Deterioration or loss of integral cultural features	Condition index for integral cultural features	Required if relevant	5 years	Local staff
Deterioration or loss of other integral site-specific features of value	Condition index for other features	Required if relevant	5 years	Local staff

1.6.1 National

The National Wilderness Program Leader, WCM Program Manager, and associated staff members are responsible for implementing WCM across all Forest Service wildernesses. They are also responsible for working with the NPS, FWS, and BLM to provide a comprehensive WCM program for the entire NWPS. Specific responsibilities include:

- *Leadership*—Develop and oversee the Forest Service WCM program. Support and evaluate implementation at the regional and forest levels. Ensure WCM needs are met by allocating available funding and establishing and supporting the centralized staffing necessary for implementation (e.g., a central data analyst position). Collaborate with the other wilderness managing agencies to facilitate interagency WCM.

- *Data management*—Understand local versus national responsibilities for data collection and compilation for all measures included in this technical guide. Ensure compliance with **quality assurance** and **quality control** (QA/QC) and metadata standards (see sections 1.7.5 and 1.7.1, respectively). Support regions by providing oversight and training as necessary. Conduct national data collection and compilation and provide results to regional offices or local units (national data collection and compilation will likely be completed by a central data analyst employed at the national level). Coordinate with broader agency, interagency, and national programs as needed. Periodically assess data adequacy across all regions. Collaborate with NRM staff to develop and maintain corporate databases and information standards that integrate WCM information (see section 1.7.2). Collaborate with the WCMD Steering Team to ensure Forest Service WCM needs are met (see section 1.7.3).

- *Evaluation and response*—Assess national trends in wilderness character every 5 years. Prepare a National Report every 5 years as well as annual updates (see section 1.5.5). Evaluate national trend results and determine appropriate management and monitoring responses. Use WCM data and trend results appropriately to inform national Forest Service planning and assessments.

Provide guidance to regions and forests regarding the suitability of results, future needs and priorities, and opportunities to improve the efficiency and effectiveness of WCM and wilderness stewardship. Share trend results with the other federal wilderness managing agencies and evaluate trends in wilderness character across the entire NWPS. Use NWPS trend results appropriately to inform interagency wilderness direction, policies, and guidance. Assess Forest Service protocols annually and update as needed in response to results and experiences at the national, regional, and forest levels (see section 1.8.1). Conduct major change management processes every 5 years (see section 1.8.2).

1.6.2 Regional

Each region is responsible for implementing WCM across all wildernesses under their jurisdiction. Specific responsibilities for Regional Wilderness Program Managers and regional directors with responsibility for resources in wilderness include:

- *Leadership*—Identify who will lead the monitoring effort for all wildernesses within a region. Provide support for implementation at the forest and wilderness level. Review measure selections for each wilderness and facilitate development of additional local measures if necessary. Coordinate with adjoining regions that co-manage a wilderness. Ensure WCM needs are met by assessing the availability of wilderness management specialists and allocating available funding.

- *Data management*—Understand local versus national responsibilities for data collection and compilation for all selected measures. Coordinate and facilitate data collection and compilation across the region, including local data needs, any multi-unit or regional data needs, and the retrieval of national data. Coordinate with other federal, state, and non-governmental programs as needed. Conduct periodic reviews to assess data adequacy. Oversee and facilitate data entry in the appropriate databases, including NRM and the WCMD (see sections 1.7.2 and 1.7.3, respectively). Provide support at the regional level to maintain NRM code tables so local units can enter data appropriately.

- *Evaluation and response*—Assess regional trends in wilderness character every 5 years and prepare Regional Reports (see section 1.5.5). Evaluate regional trend results and determine appropriate management and monitoring responses. Use WCM data and trend results appropriately to inform regional planning, assessments, and management activities. Coordinate with local units to periodically evaluate the need for additional measures or changes to existing measures. Assist national staff in assessing protocols, technical guides, and directives annually (see section 1.8.1). Assist national staff in interpreting trend results for a region. Participate in future activities related to WCM.

1.6.3 National Forests and Grasslands

Each wilderness managed by the Forest Service has a single national forest or grassland identified as lead for that wilderness. Lead forests or grasslands are responsible for implementing WCM across all wildernesses under their jurisdiction. Specific responsibilities include:

- *Leadership*—Identify who will lead the monitoring effort for each wilderness. Coordinate with all other units and agencies that co-manage a wilderness. Select required and optional measures for monitoring each wilderness, and develop additional local measures if necessary (measure selection will likely be completed by the forest staff officer with wilderness responsibilities, with assistance from relevant interdisciplinary personnel and line officers). Ensure that funding is allocated to complete WCM.
- *Data management*—Understand local versus national responsibilities for data collection and compilation for all selected measures. Conduct local data collection and compilation, and retrieve nationally collected and compiled data when necessary. Participate in multi-unit or regionally coordinated data collection and compilation. Ensure that all data meet QA/QC standards. Enter data for all selected measures into the appropriate databases, such as NRM and the WCMD (see sections 1.7.2 and 1.7.3, respectively).
- *Evaluation and response*—Assess trends in wilderness character every 5 years for each wilderness. Prepare an Individual Wilderness Report and a local "data dump" report annually or biennially (see section 1.5.5). Evaluate trend results and determine appropriate management and monitoring responses. Use WCM data and trend results appropriately in forest planning, assessments, and project implementation. Conduct periodic reviews to evaluate the need for additional measures or changes to existing measures. Assist regional and national staff in interpreting trend results for a wilderness.

1.7 Data Management

The WCM strategy is built upon the premise of using existing data whenever appropriate and available to establish a baseline for each measure and evaluate trends over time. This WCM strategy is designed to reduce workload impact on local staff to the maximum degree possible (see figure 1.1.13—Relationship among various databases used for WCM).

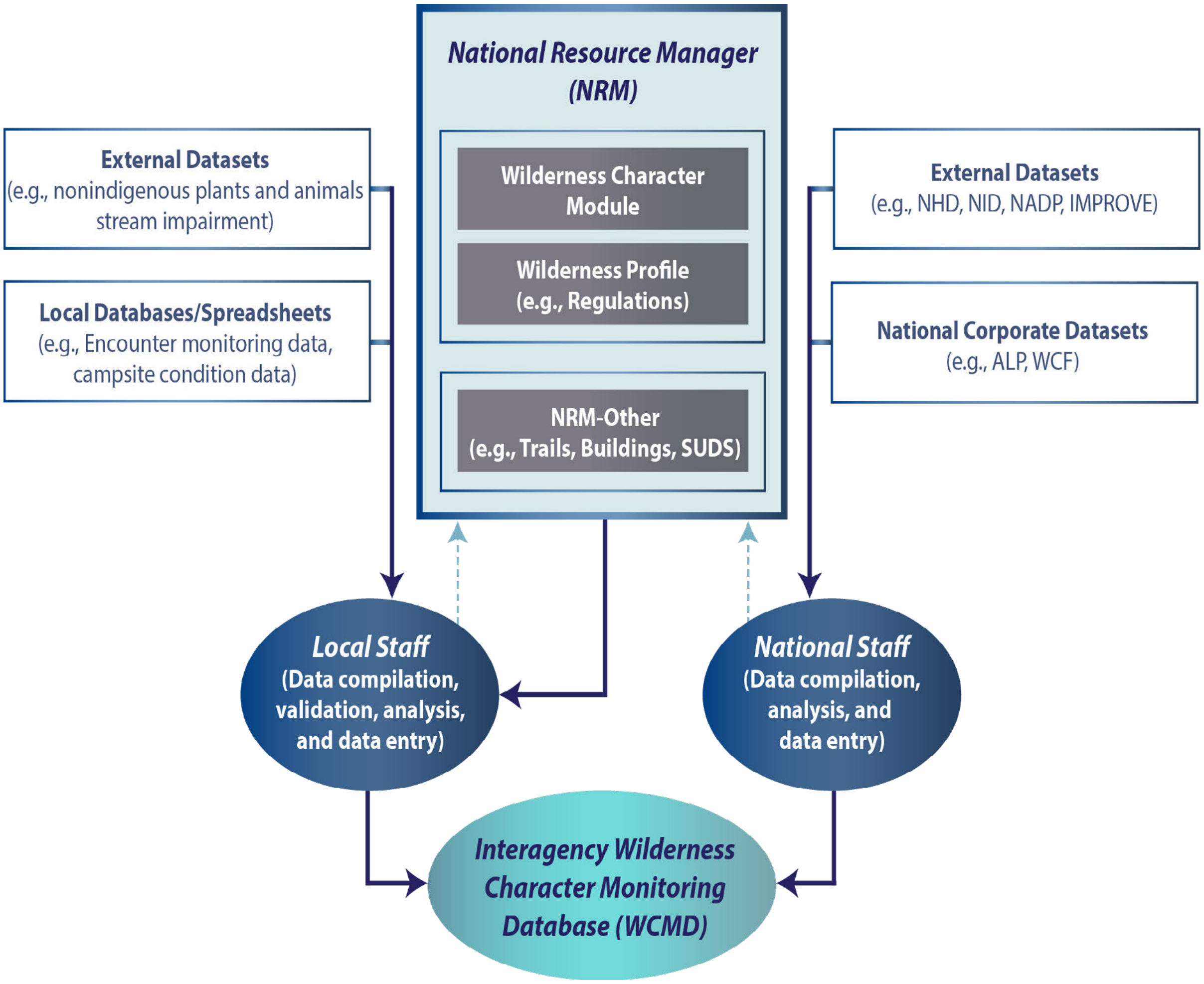


Figure 1.1.13—Relationship among various databases used for WCM.

<u>*Local Data*</u>

Local data may consist of data already entered in NRM, data stored in local databases or spreadsheets, existing data collection, or data derived from local knowledge or professional judgment. Some of the data used in this technical guide are already in the NRM-Wilderness application as part of annual program reporting, such as wilderness regulations used to track unconfined recreation and **administrative authorizations** to use motorized equipment or mechanical transport.

Forest Service program areas, other than the Wilderness Program, may have a data steward for other data that are needed to support certain measures. For example, facility engineers are responsible for maintaining records about roads and buildings in NRM. This technical guide takes advantage of these types of existing data sources, however, in many cases local data need to be linked to the appropriate wilderness to support WCM analysis (e.g., tabular or spatial analysis). This technical guide also acknowledges that local data can be of varying quality, and WCM provides an opportunity to update national corporate datasets with current data.

National Data

National data may consist of data from national corporate datasets or external datasets. These will be accessed by a central data analyst to both reduce workload impact on the field and for efficiencies of scale. Other datasets require Geographic Information System (GIS) skills and these measures will typically be analyzed at the national or regional level.

1.7.1 Wilderness Character Monitoring Metadata

The data used for WCM have metadata. Metadata are information about data—its history and changes—that provide the necessary context for understanding, trusting, and correctly using those data. From defining data attributes and accuracy to providing information about map projection and coordinate systems, metadata provide answers to many users' questions. Metadata also help people find the data they need, determine how best to use the data, and avoid duplication of effort. The Forest Service *Metadata Users Guide* (http://www.fs.fed.us/gac/metadata/) is designed to help users with this information.

Federal Geographic Data Committee (FGDC) standards should be implemented when creating and managing metadata. The Forest Service standards for archiving and managing **FGDC compliant metadata** should conform to retention and disposal requirements and schedules described in FSH 6209.11 and to direction issued by the FGDC Historical Records Working Group of the National Archives and Records Administration.

1.7.2 Natural Resource Manager

Approximately half of the measures in this technical guide will use NRM to access relevant data. Some of the measures will access data currently stored in NRM. To pull and analyze the appropriate data, these measures may require the development of standardized reports, user views, or other extraction utilities. For other measures, the necessary datasets are not presently stored in NRM but may be in the future. Data entry screens and other supporting modules would need to be developed to store and analyze data for any additional measures. These would be developed in the new NRM-WCM application.

The Forest Service designed NRM applications to meet the unique business requirements of the agency, however, the applications follow standards of the FGDC and are therefore compatible in metadata standards with data compiled by other federal agencies.

1.7.3 Interagency Wilderness Character Monitoring Database

All four wilderness managing agencies have contributed to the development of an interagency WCMD to serve as a central portal for data entry, data storage, data analysis, and trend reporting (Adams et al. 2012). The WCMD (available at https://wc.wilderness.net/) is hosted on the Wilderness Connect website with permissioned access for agency and non-agency personnel. Guidance for accessing and using the WCMD will be released after WCM is formally implemented in the Forest Service in 2018.

In the WCMD, local users for each wilderness will select a single set of measures for which data can be entered. The required Forest Service measures described in this technical guide will be built into the WCMD and users will have the option of adding locally developed measures for each wilderness. Local users or a central data analyst at the national level will enter measure values based on the frequency of data compilation for each measure. For some measures, the WCMD will be able to calculate measure values from supporting data (e.g., calculating 3-year rolling averages from annual data). Once enough data have been entered to derive trends in all selected measures, the WCMD will determine the trends in the measures, indicators, monitoring questions, qualities, and overall wilderness character for each wilderness by using the assigned thresholds for meaningful change (see section 1.5.4). The WCMD will generate the Individual Wilderness Reports and "data dumps," Regional Reports, and National Report (section 1.5.5), and an Interagency Report for reporting trends in wilderness character across the entire NWPS.

1.7.4 Data Stewardship

Data stewardship is the oversight and management of data for the program area. This oversight is brought to bear throughout the data lifecycle (FGDC 2010) from defining information needs and data requirements, to using data to support the agency mission. It includes many aspects of the roles discussed in section 1.6 for data acquisition, data management, and evaluation and response, with an emphasis on taking the responsibility to ensure that data are consistent with USDA requirements for Information Quality Activities as described by the Office of the Chief Information Officer (http://www.ocio.usda.gov/policy-directives-records-forms/information-quality-activities).

1.7.5 Quality Assurance and Quality Control

Forest Service WCM fulfills data QA/QC as mandated by the Data Quality Act, USDA, and Forest Service policy. Oversight of data collection, transfer, and accuracy is essential to effective management and occurs throughout the monitoring process.

QA/QC processes are defined in FSM 1940 as follows:

- *Quality assurance*—The total integrated program for ensuring that the uncertainties inherent in inventory and monitoring data are known and do not exceed acceptable magnitudes, within a stated level of confidence. QA encompasses the plans, specifications, and policies affecting the collection, processing, and reporting of data. It is the system of activities designed to provide officials with independent assurance that QC is implemented effectively and uniformly throughout the inventory and monitoring programs (USDA Forest Service 2009).
- *Quality control*—The routine application of prescribed field and office procedures to reduce random and systematic errors and ensure that data are generated within known and acceptable performance limits. QC involves using qualified personnel, using reliable equipment and supplies, training personnel, and strictly adhering to service-wide standard operating procedures for tasks such as information needs assessments, establishment of standards and methods, data collection, data processing, mapping, analysis, and dissemination. (USDA Forest Service 2009).

1.8 Change Management

Information and protocols presented in this technical guide are anticipated to change and improve over time. Change may be necessary if new agency requirements are developed such as a new law or a new management issue that requires change in this monitoring. Changes may also be necessary when attributes tracked in a dataset are modified, resulting in changes that would be needed to the applicable measure protocols. Changes in measures or protocols also may be necessary if the conceptual understanding about wilderness character changes.

Change management is a comprehensive process that begins with the identification of a need for change and ends with the resolution of that request. A change management process is necessary in all monitoring programs, and is especially important for the protocols described in this technical guide because WCM has not been fully implemented across the NFS and adjustments are anticipated as implementation proceeds. A viable change management process is needed to ensure that the protocols reflect contemporary thinking about wilderness character, that lessons learned during implementation are used to improve the protocols, and that the protocols use all available datasets.

Minor and major changes are described separately because they involve considerably different processes. Submit any proposals for change to the WCM Central Team for review.

1.8.1 Minor Change Management Process

The minor change management process will likely be conducted every year and includes:

- Modification of existing measures, necessitated by:
    - Experience gained during the practical implementation of the monitoring protocol;
    - Availability of data sources for existing measures;
    - New research or other perspectives about what constitutes wilderness character; and
    - Need for some level of consistency with the other NWPS agencies.
- Changes to the WCM process and timeline.
- Changes to the NRM-WCM application or the online interagency WCMD.

For minor changes that occur with Forest Service implementation of WCM, no consultation with the other agencies is needed.

1.8.2 Major Change Management Process

The major change management process will likely be conducted every 5 years and is more comprehensive than the minor change process. The major change process includes:

- Reviewing the appropriateness of the qualities of wilderness character from the statutory definition of wilderness, as well as the interagency monitoring questions and indicators recommended in *Keeping It Wild 2*.
- Deleting or adding measures, especially if they are required.
- Reviewing the appropriateness of the data analysis and methods for assessing trend in wilderness character.

Details of the major change management process have not yet been developed. This WCM strategy needs to be reviewed and re-evaluated by those directly associated with the protocols including agency staff at all administrative levels and partners who have been involved with WCM. This process would likely entail conducting a workshop and developing a work plan for the resolution of issues and concerns identified by participants. These changes also need to be coordinated with the Interagency Wilderness Character Monitoring Committee as well as with the WCMD Steering Team.

1.8.3 Coordinating Change with Corporate Data Systems

NRM applications also have a change management process that may not be fully synchronized with updates to this technical guide. Therefore, the rate of change in this technical guide should be fully coordinated with NRM through the program of work proposal process to ensure desired NRM applications are consistent with any technical guide changes.

The Forest Service GIS Data Dictionary also includes a change management process to ensure that changes will meet the business needs of the agency and reduce the impacts to support systems. This process, however, may not be synchronized with future updates to this technical guide. As a result, changes in GIS standards may not be consistent with the current version of this technical guide and may not be consistent with NRM applications.

2.0 Untrammeled Quality

The objective of monitoring the Untrammeled Quality is to assess whether management of a wilderness is trending over time toward more or less human manipulation of plant communities, fish and wildlife populations, insects and disease, soil and water resources, and fire processes. This monitoring focuses on both **authorized actions** and **unauthorized actions** that intentionally control or manipulate "the earth and its community of life" within wilderness.

Section 2(c) of the Wilderness Act defines wilderness as "an area where the earth and its community of life are untrammeled by man," that "generally appears to have been affected primarily by the forces of nature" and is an area "retaining its primeval character and influence." The American Heritage dictionary (1992) defines the term untrammeled as "allowed to run free," and synonyms include unrestrained, unrestricted, unhindered, unimpeded, unencumbered, and self-willed. In his testimony at the Wilderness Act's final Senate hearing, Zahniser (1963) stated that in the bill's definition of wilderness, "...the first sentence [on untrammeled] is definitive of the meaning of the concept of wilderness, its essence, its essential nature...The first sentence defines the character of wilderness." In this technical guide, measures under the Untrammeled Quality monitor the extent to which wilderness is unhindered and free from the intentional actions of modern human control or manipulation.

The Untrammeled and Natural Qualities are closely related, though they differ in a key way—the Untrammeled Quality monitors the number of actions (including **persistent structures**[1]) that intentionally control or manipulate ecological systems inside wilderness, whereas the Natural Quality monitors the effects on these systems from actions taken inside wilderness or from external forces. Separating actions from effects offers a clearer understanding of the trends in each, and a more effective analysis to improve wilderness stewardship.

For the Untrammeled Quality, a single monitoring question provides the broad context and two indicators provide the structure for this monitoring (as summarized in table 1.2.1).

[1] Persistent structures that purposefully alter, hinder, restrict, control, or manipulate "the earth and its community of life" (e.g., dams) are included under the Untrammeled Quality due to their continuous manipulation of ecological systems. The continuous trammeling by persistent structures is distinct from the resulting ecological effects of such manipulation (measured under the Natural Quality) and from the presence of the structures (measured under the Undeveloped Quality).

Photo: The Handies Peak Wilderness Study Area in Colorado by Bob Wick, BLM.

Table 1.2.1—Monitoring question, indicators, measures, and measure type for the Untrammeled Quality.

Untrammeled Quality		
Monitoring Question: What are the trends in actions that intentionally control or manipulate the "earth and its community of life" inside wilderness?		
Indicator	**Measure**	**Measure type**
Actions authorized by the Federal land manager that intentionally manipulate the biophysical environment	Number of authorized actions and persistent structures designed to manipulate plants, animals, pathogens, soil, water, or fire	Required
Actions not authorized by the Federal land manager that intentionally manipulate the biophysical environment	Number of unauthorized actions and persistent structures by agencies, organizations, or individuals that manipulate plants, animals, pathogens, soil, water, or fire	Required

2.1 Monitoring Question

A single monitoring question is used in monitoring the Untrammeled Quality: What are the trends in actions that intentionally control or manipulate "the earth and its community of life" inside wilderness?

The monitoring question for the Untrammeled Quality examines actions that intentionally control or manipulate the components or processes of ecological systems inside wilderness. In this context, intentional manipulation means an action that deliberately alters, hinders, restricts, controls, or manipulates "the earth and its community of life." This includes actions that affect plants or animal species, insects and disease pathogens, physical resources (e.g., water or soil), or biophysical processes (e.g., fire) inside a designated wilderness.

When monitoring the Untrammeled Quality, all trammeling actions are counted the same regardless of the area, intensity, frequency, or duration of their effects. This is because the Untrammeled Quality focuses closely on whether a particular decision to manipulate "the earth and its community of life" is made, not on the magnitude of that decision. In other words, taking any trammeling action degrades the Untrammeled Quality, regardless of its scope and scale. For practical reasons, however, this technical guide considers magnitude when questions arise as to whether a seemingly inconsequential action truly manipulates "the earth and its community of life" and should be included under a measure (see section 2.1 in part 2 for further discussion of this topic).

Actions that degrade the Untrammeled Quality are typically the result of decisions by the agency. However, intentional activities by other federal and state agencies, non-governmental organizations, and the public that are not authorized by the Forest Service may also affect this quality. For this reason, two indicators are used to understand the monitoring question—one that addresses intentional manipulations that are authorized by the agency and another that addresses intentional manipulations that are not authorized by the agency.

2.2 Indicator: Actions Authorized by the Federal Land Manager That Intentionally Manipulate the Biophysical Environment

This indicator focuses on actions and persistent structures authorized by the Forest Service that intentionally manipulate the biophysical environment, including those explicitly allowed under the Wilderness Act or subsequent wilderness legislation. Intentional manipulations taken by other federal, tribal, and state agencies; non-governmental organizations; and private citizens are included under this indicator if the Forest Service authorized those actions.

This indicator illustrates whether the agency, as a steward of wilderness, is controlling and manipulating wilderness or is exercising restraint to allow wilderness to persist in its untrammeled condition. The focus on actions (including persistent structures) rather than authorizations allows managers to track trends in the number of manipulations that actually occur; in contrast, a single authorization may be used to justify a recurring series of actions occurring over multiple years, or alternatively may never be implemented.

2.2.1 Measure: Number of Authorized Actions and Persistent Structures That Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire

This measure assesses the 3-year rolling average of authorized trammeling actions, based on an annual count of authorized actions and persistent structures intended to manipulate any component of the **biophysical environment** within wilderness (including vegetation, fish, wildlife, insects, pathogens, soil, water, or fire). This measure includes discretionary and non-discretionary actions required to uphold Federal law, as well as other actions authorized through SUPs or other instruments (e.g., research actions, state fish and wildlife management actions). Part 2, section 2.1 provides additional information on how to determine what may or may not be a trammeling action.

The measure was selected to assess whether Forest Service management of a wilderness is trending over time toward more or less human manipulation of plant communities, fish and wildlife populations, insects and disease, soil and water resources, and fire processes.

This measure is required for all Forest Service wildernesses. A 5-percent or greater change in the 3-year rolling average number of trammeling actions will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the average number of unauthorized trammeling actions corresponds with a degrading trend.

Refer to part 2, section 2.2.1, for detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

2.3 Indicator: Actions Not Authorized by the Federal Land Manager That Intentionally Manipulate the Biophysical Environment

This indicator focuses on the range of actions not authorized by the agency that intentionally manipulate plants, animals, physical resources, or biophysical processes in wilderness. Other federal, tribal, and state agencies; non-governmental organizations; or private citizens may make unauthorized, intentional manipulations.

These unauthorized trammeling actions are fundamentally different from those authorized by the wilderness managing agency. While most authorized manipulations undergo a review process to determine their impacts on the various components of the wilderness resource, unauthorized manipulations are often undertaken with little to no consideration for the effect on the broader ecosystems within wilderness or on the other qualities of wilderness character. Although unauthorized actions may not currently be an issue in some wildernesses, this indicator captures an important type of trammeling action that can have a large impact on wilderness character.

2.3.1 Measure: Number of Unauthorized Actions and Persistent Structures by Agencies, Organizations, or Individuals That Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire

This measure assesses the 3-year rolling average of unauthorized trammeling actions based on an annual count of known actions not authorized by Forest Service taken by other federal and state agencies, organizations, or individuals that are intended to manipulate any component of the biophysical environment within wilderness (including vegetation, fish, wildlife, insects, pathogens, soil, water, or fire). Actions taken by other federal and state agencies or non-governmental organizations with the knowledge and approval of the Forest Service through a SUP or cooperative agreement are counted under the measure *Number of Authorized Actions and Persistent Structures Designed to Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire* (see section 2.2.1). Actions taken by states or other government agencies with the knowledge of the Forest Service but *without* explicit approval through a SUP or another instrument are counted under this measure. Part 2, section 2.1 provides additional information on how to determine what may or may not be a trammeling action.

The measure was selected to assess how unauthorized actions within a wilderness are trending over time toward more or less human manipulation of plant communities, fish and wildlife populations, insects and disease, soil and water resources, and fire processes.

The ability to monitor unauthorized actions under this measure depends on a combination of the amount of effort spent to find unauthorized actions and incidental, chance encounters. It may not be feasible to reliably gather all applicable data, and knowledge of some unauthorized actions may rely on incidental, chance encounters.

This measure is required for all Forest Service wildernesses. A 5-percent or greater change in the 3-year rolling average number of trammeling actions will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the average number of unauthorized trammeling actions corresponds with a degrading trend.

Refer to section 2.3.1 in part 2 for detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

3.0 Natural Quality

The objective of monitoring the Natural Quality is to assess the effects of modern civilization on the integrity of wilderness ecosystems, with a focus on plants, animals, air and water, and ecological processes. The Wilderness Act defines wilderness as an area that "is protected and managed so as to preserve its natural conditions" and that these areas should be free from the effects of "an increasing population, accompanied by expanding settlement and growing mechanization" (sections 2(c) and 2(a), respectively). Human-caused changes to wilderness ecological systems can be intentional or unintentional. While managers may have control over some impacts to natural ecosystems in wilderness, many threats come from external sources outside of their jurisdiction (e.g., air pollutants and **nonindigenous species**). In contrast to the Untrammeled Quality, which monitors actions that manipulate or control ecological systems, the Natural Quality monitors the effects on wilderness ecosystems from actions as well as external forces. While this quality encompasses all the naturally occurring species, physical resources, and ecological functions and processes in wilderness, practical limitations require that a relatively small but significant subset of possible measures are monitored.

For the Natural Quality, a single monitoring question provides the broad context and four indicators provide the structure for this monitoring (as summarized in table 1.3.1).

Table 1.3.1—Monitoring question, indicators, measures, and measure types for the Natural Quality.

Natural Quality		
Monitoring question: What are the trends in the natural environment from human-caused change?		
Indicator	**Measure**	**Measure type**
Plants	Acres of nonindigenous plants	Required
Animals	Index of nonindigenous terrestrial animal species	Required to select at least one
	Index of nonindigenous aquatic animal species	
Air and water	Concentration of ambient ozone	Required to select at least one
	Deposition of nitrogen	
	Deposition of sulfur	
	Amount of haze	
	Index of sensitive lichen species	
	Extent of waterbodies with impaired water quality	Required
Ecological processes	Watershed condition class	Required to select at least one
	Number of animal unit months of commercial livestock use	

Photo: 3,000' descent into Refrigerator Gulch during the Lost Creek Wilderness Loop trek in Colorado by Amy Taylor.

3.1 Monitoring Question

A single monitoring question is used to monitor the Natural Quality: What are the trends in the natural environment from human-caused change?

This monitoring question assesses the trends in natural wilderness ecosystems that result from human-caused threats occurring since designation of the area as wilderness. Importantly, this monitoring question seeks to distinguish between natural variability, which is integral to all ecosystems and does not degrade wilderness character, and human-caused change. In wilderness, the primary goal is to allow ecosystems to function and change without impacts or interference from modern civilization; therefore, the Natural Quality should not be used to set a target to maintain a particular ecological state or condition. In addition, this monitoring question does not include actions taken to restore ecological systems in wilderness. There are several reasons for not including these actions, including: (1) actions are tracked in the Untrammeled Quality, not the Natural Quality that tracks effects; (2) restoration actions are highly site-dependent and no single national protocol to measure such actions and their effects has been developed; (3) restoration actions typically assume static or historical ecological conditions contrary to wilderness as a place where human-determined states are not appropriate; and (4) the effects of restoration actions should eventually show, with monitoring, as an improving trend in the Natural Quality.

Four indicators assess a range of ecosystem components, structures, and functions in wilderness: (1) plants, (2) animals, (3) air and water, and (4) ecological processes. Practical and conceptual constraints mean that not everything important to wilderness ecosystems can be included in this monitoring. Likewise, not all ecological data currently collected by scientists are relevant or necessary to include in WCM. The measures under each indicator are not all encompassing; rather, the measures are selected because they are known human-caused threats to the indicators. Part 2, section 3.6, provides a detailed discussion of the criteria and process used for selecting measures under the Natural Quality; this section should guide local units considering the use of locally developed measures under this quality.

3.2 Indicator: Plants

This indicator focuses on threats to indigenous plant species and communities. Indigenous plant species (also referred to as native plant species) and plant communities are an essential biological component of natural wilderness ecosystems. Indigenous plant species and plant communities are those that evolved in an area and therefore have intrinsic value within a wilderness. In addition, they are critically important to the entire ecosystem by providing food and habitat to indigenous animals, preventing soil erosion, adding soil nutrients, and maintaining the local environmental conditions and biodiversity

3.2.1 Measure: Acres of Nonindigenous Plant Species

This measure assesses the total number of acres, or the estimated percentage of acres, occupied by selected nonindigenous plant species in wilderness. The introduction and spread of nonindigenous species (also referred to as **non-native**, alien, or **exotic species**) is the second leading cause of plant and animal species endangerment and extinction worldwide (Lowe et al. 2000). Although many nonindigenous species are present throughout the United States, invasive nonindigenous species (i.e., those species that increase quickly in abundance and distribution) are a particular threat to wilderness character and are therefore the focus of this measure.

This measure was selected because nonindigenous plants may directly and indirectly alter the composition, structure, and function of natural communities in significant ways by degrading or eliminating habitat for native plant and animal species, and causing multiple cascading effects throughout the entire ecosystem. The adverse impact of these species on the Natural Quality of wilderness character is significant. Because of established concerns about nonindigenous species, this measure is relatively simple and cost effective to monitor.

This measure is required for all Forest Service wildernesses. A 5-percent or greater change in the number of measured or estimated acres, or any change in defined "percentage occupied" categories, will result in a change in trend for this measure. An increase in the acreage occupied by nonindigenous species corresponds with a degrading trend.

Refer to part 2, section 3.2.1, for detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

3.3 Indicator: Animals

This indicator focuses on threats to indigenous animal species and communities. Indigenous animal species (also referred to as native animal species) and animal communities are an essential biological component of natural wilderness ecosystems. Indigenous animal species and communities are those that evolved in the area and therefore have intrinsic value within a wilderness. Additionally, they are critically important to the entire ecosystem by providing food and habitat to other animals, digesting plant material and thereby making nutrients available in the soil for plants to use, scavenging carcasses of dead animals, and contributing to a wilderness ecosystem in many other ways.

3.3.1 Measure: Index of Nonindigenous Terrestrial Animal Species

This measure is an index that assesses the geographic distribution and estimated impact of selected nonindigenous terrestrial animal species. Nonindigenous animal species generally occur inside a wilderness because of human influence, such as intentional and unintentional introductions and transplants. Once nonindigenous species become established outside a wilderness, they may spread naturally or disperse into that wilderness. Nonindigenous animals include livestock that intentionally graze in wilderness, as well as feral domesticated animals, such as feral livestock, horses, goats, and pigs. Examples of nonindigenous terrestrial insects include: Asian long-horned beetle, emerald ash borer, gypsy moth, and hemlock woolly adelgid. Terrestrial pathogens and diseases are included in this measure because even though they are not animals, they are not considered plants either and creating a separate measure for them is not warranted. Examples of terrestrial pathogens and diseases that would be included in this measure are sudden oak death, chronic wasting disease, and white-nose syndrome.

This measure was selected because nonindigenous terrestrial animals, insects, and pathogens and diseases may significantly alter the composition, structure, and function of natural communities by degrading or eliminating habitat for **indigenous species**, and causing multiple cascading effects throughout the entire ecosystem. The adverse impact of these species on the Natural Quality of wilderness character is significant.

Units are required to select either this measure or the following measure, *Index of Nonindigenous Aquatic Animal Species*, or may select both measures if relevant to the individual wilderness. A 5-percent or greater change in the measure value will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the measure value corresponds with a degrading trend.

Refer to part 2, section 3.3.1, for detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

3.3.2 Measure: Index of Nonindigenous Aquatic Animal Species

This measure is an index that assesses the geographic distribution and estimated impact of selected nonindigenous aquatic species (NAS), including amphibians, fish, crustaceans, mollusks, gastropods, aquatic insects, and aquatic pathogens and diseases. NAS are typically introduced into a given wilderness by anthropogenic vectors, although species introductions may also have originated outside of a wilderness and the species subsequently moved into the wilderness by upstream or downstream movement. Aquatic pathogens and diseases are included in this measure because even though they are not animals, they are not considered plants either and creating a separate measure for them is not warranted. Examples of an aquatic pathogens and diseases that would be included in this measure are: whirling disease, iridoviruses, and chytrid fungus.

This measure was selected because nonindigenous aquatic animal species may alter the composition, structure, and function of natural aquatic communities, and adversely impact indigenous species, reduce biodiversity, and degrade natural aquatic ecosystems.

Local units are required to select either this measure or the preceding measure, *Index of Nonindigenous Terrestrial Animal Species*, or may select both measures if relevant to the individual wilderness. A 5-percent or greater change in the measure value results in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the measure value corresponds with a degrading trend.

Refer to part 2, section 3.3.2, for detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

3.4 Indicator: Air and Water

This indicator focuses on threats to air and water quality. Air and water are fundamental physical resources of wilderness ecosystems, and both are essential to maintain properly functioning natural systems inside wilderness. Both air and water resources are vulnerable to degradation by pollutants produced outside of wilderness as a result of human development and industrial activity.

Units are required to select at least one of the five air quality measures included under this indicator (see sections 3.4.1 through 3.4.5), or may optionally select more than one air quality measure. The Clean Air Act of 1977 mandates special protections for values related to air quality in both Class I and **Class II areas**, many of which are also designated wildernesses. The presence of airborne pollutants in soil and water within wilderness can have direct adverse effects on sensitive plant and animal species and can directly impact essential ecosystem functions, such as nutrient cycling. Certain air pollutants also can reduce visibility. The effects of air pollution on plants, animals, soil, and water are important in all wildernesses, regardless of whether a wilderness is designated as Class I or Class II according to the Clean Air Act.

In addition to air pollutants, water quality and water flows also are vulnerable to the effects of physical manipulations inside and outside of wilderness. For example, dams outside a wilderness can markedly affect water quantity and quality, as well as stream morphology, inside a wilderness. Most existing NFS wildernesses include relatively undeveloped headwater watersheds with few water quality impacts. More recent additions to NFS wildernesses may include areas that are impacted by upstream watershed activities, such as by agriculture, mining, and land development.

3.4.1 Measure: Concentration of Ambient Ozone

This measure assesses the 3-year rolling average of ozone concentration (fourth highest daily maximum 8-hour concentration) based on the Forest Service Air Resource Management Program's annual analyses of national ozone monitoring data. **Ozone** is a pollutant formed when emissions of nitrogen oxides (NO_X) and volatile organic compounds react in the presence of sunlight. Human activities such as the burning of fossil fuels and industrial processes produce these pollutants, which can then travel long distances resulting in elevated ozone levels in wildernesses. In most places in the United States, reductions in human-generated NO_X will cause a reduction in ground-level ozone. Ozone is one of the most toxic air pollutants to plants and its effects include visible injury to leaves and needles, premature leaf loss, reduced photosythesis, and reduced growth in sensitive plant species. Continued exposure of vegetation to ozone over time may also result in increased susceptibility to disease and damage from insects, as well as changes in species diversity and community structure.

This measure of air pollution was selected based on the potential impact of ozone on wilderness vegetation and the availability of ozone measurements. Considering all of the potential negative effects on wilderness vegetation, increasing ozone levels in or near a wilderness are a direct human-caused threat to the Natural Quality of wilderness character. A network of long-term air quality monitors measure ambient ground-level ozone concentrations across the United States. The monitors are primarily intended to track whether NAAQS, established to protect human health and natural resources, are being met. Data from this network receive rigorous QA and QC review before being entered into the EPA's Air Quality System (AQS) database available at https://www.epa.gov/aqs. Using these data, staff in the Forest Service Air Resource Management Program calculate a suite of ozone statistics for all monitoring sites in the United States each year.

If most relevant, local units may select just this measure of the five air quality measures included under this indicator (see sections 3.4.1 through 3.4.5), or may optionally select more than one air quality measure. A finding of statistical significance results in a change in trend for this measure. An increase in the average ozone concentration corresponds with a degrading trend.

Refer to part 2, section 3.4.1, for detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

3.4.2 Measure: Deposition of Nitrogen

This measure assesses the amount of nitrogen deposition in a wilderness by using either the average **total deposition** (based on nationally modeled or measured spatial data) or the trend in **wet deposition** (based on the Forest Service Air Program's annual analyses of spatially interpolated data). Nitrogen oxides (NO_x) are one of the major pollutants emitted into the atmosphere during the burning of fossil fuels. Agricultural activities, especially livestock management and fertilizer application to soils, are the primary source of ammonia (NH_3) released to the atmosphere. These pollutants return to terrestrial and aquatic environments as atmospheric deposition of nitric acids and ammonium. In sensitive ecosystems, these compounds can acidify soil and surface waters, which affects nutrient cycling, impacts the growth of vegetation, and causes the decline or death of aquatic insects and fish. Even in ecosystems that can buffer incoming acid compounds, excess nitrogen deposition can lead to chemical and biological changes that affect plant growth, species composition, and aquatic food webs. Descriptions of the effects of nitrogen deposition on natural resources are available on the Forest Service Air Quality Portal website available at https://www.srs.fs.usda.gov/airqualityportal/critical_loads/atmospheric_deposition.php.

Nitrogen deposition was selected as a measure based on potential and observed negative impacts on wilderness ecosystems and the availability of deposition estimates across most wildernesses. While a few wildernesses may have direct nitrogen deposition measurements available, most will rely on estimates created through modeling based on data derived from long-term air quality monitoring stations that record nitrogen deposition across the United States.

If most relevant, local units may select just this measure of the five air quality measures included under this indicator (see sections 3.4.1 through 3.4.5), or may optionally select more than one air quality measure. A finding of statistical significance, or any change in defined categories, results in a change in trend for this measure. An increase in the amount of nitrogen deposition corresponds with a degrading trend.

Refer to part 2, section 3.4.2, for detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

3.4.3 Measure: Deposition of Sulfur

This measure assesses the amount of sulfur deposition in a wilderness by using either the trend in wet deposition (based on the Forest Service Air Resource Management Program's annual analyses of spatially interpolated data) or the average total deposition (based on nationally modeled spatial data). Sulfur dioxide (SO_2) is emitted during the burning of fossil fuels, especially coal, and can be transported long distances through the atmosphere before being deposited in the form of sulfuric acid. In sensitive ecosystems, sulfuric acid can contribute to acidification of soil and surface waters, affect nutrient cycling and impact the growth of vegetation, as well as lead to the decline and death of aquatic insects and fish. These effects have been more prevalent in the eastern United States due to historically high sulfur deposition levels. Although sulfur deposition has been declining and fish kills from acidification are now infrequent, sulfur bound and held in the soil continues to affect soil chemistry, soil buffering capacity, and the nutrient status of soils. Detailed descriptions of the effects of sulfur deposition on natural resources are available on the Forest Service Air Quality Portal website available at https://www.srs.fs.usda.gov/airqualityportal/critical_loads/atmospheric_deposition.php.

Sulfur deposition was selected as a measure based on observed negative impacts on wilderness ecosystems and the availability of deposition estimates across most wildernesses. While a few wildernesses may have direct suflur deposition measurements available, most will rely on estimates created through modeling based on data derived from networks of long-term air quality monitoring stations that record sulfur deposition across the United States. Eastern national forests are likely to be more interested in using the sulfur deposition measure over the nitrogen measure because sulfur continues to exert a stronger influence on many ecosystems in the Eastern United States.

If most relevant, local units may select just this measure of the five air quality measures included under this indicator (see sections 3.4.1 through 3.4.5), or may optionally select more than one air quality measure. A finding of statistical significance, or any change in defined categories, results in a change in trend for this measure. An increase in the amount of sulfur deposition corresponds with a degrading trend.

Refer to part 2, section 3.4.3, for detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

3.4.4 Measure: Amount of Haze

This measure assesses the trend in average **deciview** for the 20 percent most impaired days, based on the Forest Service Air Resource Management Program's annual analyses of national visibility monitoring data. Although air quality managers often refer to visibility (or the lack thereof) in terms of its impacts on human perception, visibility is a general indicator of air quality monitored for its inherent value, just as one would monitor the biophysical condition of water quality.

This measure was selected because visual air quality (visibility) measurements provide a direct link between the concentration of pollutants in the atmosphere and degradation of the natural and physical condition of clean air in wilderness. Reduced visibility can affect local climate and photosynthetic activity. Additionally, visibility directly affects many wildlife and insect species that depend on clear, clean air (e.g., foraging raptors, pollinators).

Particles suspended in the atmosphere that absorb and scatter light cause regional **haze**. Impairment is operationally defined as the portion of haze which results from human activity. Fine particles (particles less than 2.5 μm in diameter) are routinely split into six distinct categories: (1) sulfates, (2) nitrates, (3) organics, (4) elemental carbon, (5) sea salt, and (6) soil.

A simple algorithm is used to identify the 20 percent of sample days each calendar year that are likely to be most affected by anthropogenic pollutants. The visibility conditions on these 20 percent "most impaired" days are converted to deciview and averaged annually.

If most relevant, local units may select just this measure of the five air quality measures included under this indicator (see sections 3.4.1 through 3.4.5), or may optionally select more than one air quality measure. Any change in defined categories results in a change in trend for this measure. An increase in the amount of haze corresponds with a degrading trend.

Refer to part 2, section 3.4.4, for detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

3.4.5 Measure: Index of Sensitive Lichen Species

This measure assesses the trend in air pollution scores for nitrogen and sulfur derived from the presence and abundance of **sensitive lichen species**, based on the Forest Service Air Resource Management Program's analyses of local biomonitoring data. Air pollution scores are calculated for each wilderness biomonitoring plot by surveying epiphytic lichen species (i.e., those growing on trees) with varying sensitivities to nitrogen and sulfur air pollution. Lichens are important contributors to critical ecosystem processes, such as nutrient cycling, and they provide food and nesting material for birds and other animals. The composition of an epiphytic lichen community is a well-known biological indicator of air pollution in forested ecosystems because epiphytic lichens rely completely on atmospheric sources of nutrition.

The lack of a waxy cuticle on the lichen surface permits absorption and leaching of nutrients in very similar proportion to what is present in the atmosphere. Lichen species that are sensitive to nitrogen and sulfur deposition eventually die or diminish from the forest if pollution levels are elevated. Epiphytic lichen communities that retain the species most sensitive to air pollution indicate good air quality. Nitrogen and sulfur air pollutants can cause measurable lichen community changes within a 5-year monitoring period depending on the spatial and temporal extent of deposition.

This measure was selected because the presence or absence of sensitive lichens over time indicates improving or degrading air quality (Matos et al. 2017). Many Forest Service regions routinely collect data on epiphytic lichen communities; this measure of air pollution may be especially useful for wildernesses that are not near other air pollution monitors, such as in Alaska.

If most relevant, local units may select just this measure of the five air quality measures included under this indicator (see sections 3.4.1 through 3.4.5), or may optionally select more than one air quality measure. Any change in defined categories results in a change in trend for this measure. A change in the trend category indicating an increase in air pollution corresponds with a degrading trend.

Refer to part 2, section 3.4.5, for detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

3.4.6 Measure: Extent of Waterbodies With Impaired Water Quality

This measure assesses the miles of streams or number of lakes inside wilderness with impaired water quality, based on national or state 303(d) lists of impaired water bodies or local monitoring data. Water quality is influenced by a wide range of biological and physical variables from both inside and outside a wilderness. This measure focuses on human-caused threats to wilderness water quality and not on natural variation in water quality. Despite the general importance of water and a myriad of national water monitoring programs, water monitoring in wilderness is generally conducted only for site-specific threats. For example, impacts from grazing (sediment, manure), mining (sediment, heavy metals, and other toxins), air pollutants (nitrogen, sulfur), and recreation (sediment, fecal coliform bacteria) vary tremendously from wilderness to wilderness and from one site to another within that wilderness.

This measure was selected because of the fundamental importance of water quality to the Natural Quality of wilderness character. Water quality directly influences the health of plant and animal communities. While many headwater wilderness watersheds have good water quality, degradation from historical activities such as mining or from upstream developments outside a wilderness may impact water quality in wilderness.

Measures related to different aspects of water are included in other indicators under the Natural Quality. For example, changes to biological aspects of water are monitored under the plants or animals indicators. The measure *Watershed Condition Class* (see section 3.5.1) uses the Forest Service WCF, which includes water quality as one of 12 indicators that determine watershed condition. While WCF assesses the overall watershed condition of the entire 6th code **Hydrologic Unit Code (HUC)**, this measure provides a more specific focus on water quality within a wilderness.

This measure is required for all Forest Service wildernesses. A 5-percent or greater change in the miles of impaired streams or number of lakes will result in a change in trend for this measure. An increase in the extent of impaired waterbodies corresponds with a degrading trend.

Refer to part 2, section 3.4.6, for detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

3.5 Indicator: Ecological Processes

This indicator focuses on threats to ecological processes that affect biotic and abiotic components of wilderness ecological systems. Ecological processes are the interactions among the biotic and abiotic components of ecosystems and include disturbance events (e.g., fire and wind storms, insect and pathogen outbreaks), predation, competition, decomposition, symbioses, and nutrient cycling. Ecological processes involve multiple components of wilderness ecosystems and are critical to all aspects of ecosystem composition, structure, and function, resulting in long-term and cascading effects on the natural community in wilderness.

The integrity of ecological processes within wilderness is crucial to maintaining the Natural Quality of wilderness character. Ecological processes are complex and difficult to quantify. Of the vast number of threats to ecological processes that could be used for WCM, this technical guide includes only those that take advantage of existing datasets and provide an overall synthesis of the condition of an ecological process within wilderness. This indicator does not include measures on the effects of climate change on ecological processes in wilderness because of the difficulty in separating the localized effects of natural change from climate change, combined with the general lack of wilderness-specific data on the natural variability of ecological processes (see section 3.6 in part 2, and Appendix 2).

3.5.1 Measure: Watershed Condition Class

This measure assesses the average wilderness **watershed condition class**, based on Forest Service Watershed Condition Classification (WCC) data. The WCF is a nationally consistent, reconnaissance-level approach for classifying NFS watershed conditions that uses a comprehensive set of 12 indicators to represent the underlying ecological, hydrological, and geomorphic functions and processes that affect watershed condition (USDA Forest Service 2011b,c). WCC maps generated from the WCF characterize the health and condition of NFS lands in more than 15,000 watersheds across the country. These maps, instituted in 2011, established watershed baseline conditions along with information on ecological, social, and economic factors, as well as partnership opportunities to establish watershed restoration priorities.

This measure was selected because it reflects the integrity and ecological importance of watersheds, including biotic integrity, resiliency, connectivity, and important ecosystem services such as high-quality water, the recharge of streams and aquifers, maintenance of riparian communities, and the moderation of climate variability and change. Updating the WCC ratings for each watershed is planned at five-year intervals with the next update initiated in 2016.

There is some redundancy between this measure and the *Extent of Waterbodies With Impaired Water Quality* measure. While this measure uses all 12 WCF indicators, including the indicator for water quality, the *Extent of Waterbodies With Impaired Water Quality* measure relies heavily on EPA and individual state 303(d) lists of streams or lakes with impaired water quality. The *Extent of Waterbodies With Impaired Water Quality* is appropriate as a measure under the *Air and Water* indicator as it provides a site-specific assessment of water quality in wilderness. Using all 12 WCF indicators in this measure provides a more complete overall assessment of watershed condition because it includes additional aquatic and terrestrial physical and biological information. This measure is therefore located under the *Ecological Processes* indicator rather than the *Air and Water* indicator.

Local units are required to select either this measure or the following measure, *Number of Animal Unit Months of Commercial Livestock Use*, or may select both measures if relevant to the individual wilderness. Any change in the average wilderness watershed condition class results in a change in trend for this measure. An increase in the watershed condition class corresponds with a degrading trend.

Refer to part 2, section 3.5.1, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

3.5.2 Measure: Number of Animal Unit Months of Commercial Livestock Use

This measure assesses the 3-year rolling average of commercial livestock use, based on an annual count of wilderness **animal unit months** (AUMs) within a wilderness. The Wilderness Act states that, "The grazing of livestock, where established prior to the effective date of this act, shall be permitted to continue subject to reasonable regulations as are deemed necessary by the Secretary of Agriculture" (Section 4(d)(4)(2)). Subsequent wilderness legislation and the Congressional Grazing Guidelines (House Reports 96–617 and 96–1126 that are included in the Colorado Wilderness Act of 1980) uphold this mandate from the Wilderness Act. In practice, this means that livestock grazing cannot be reduced or phased out simply because an area is designated as wilderness—any adjustments in livestock grazing must be made through revisions in the normal rangeland management and land management planning and policy-setting processes. These processes consider legal mandates, range condition, and protection of the range resource from deterioration.

This measure was selected because the presence of livestock, even though allowed under the Wilderness Act, represents a nonindigenous, domestic animal that impacts many aspects of the Natural Quality of wilderness character (Belsky et al. 1999; Beschta et al. 2014). Livestock grazing may impact indigenous plant and animal communities, soil, and watershed conditions within a wilderness. This measure does not directly monitor the ecological impacts of livestock grazing; rather it is based on the assumption that a declining number of AUMs results in an improving trend in ecological processes within wilderness, even though the adverse ecological effects of livestock may persist (Nussle et al. 2017).

The amount of annual livestock use is based on the AUMs of livestock grazing authorized by a grazing permit for allotments located wholly or partially within a wilderness. AUMs are the preferred unit of measurement instead of head months and should be used if available.

Local units are required to select either this measure or the preceding measure, *Watershed Condition Class*, or may select both measures if relevant to the individual wilderness. A 5-percent change in the 3-year rolling average amount of commercial livestock use will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the average amount of commercial livestock use corresponds with a degrading trend.

Refer to part 2, section 3.5.2, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

4.0 Undeveloped Quality

The objective of monitoring the Undeveloped Quality is to assess whether a wilderness is becoming more developed over time, such as by exhibiting increasing evidence of physical infrastructure, or if there is more prevalent use of mechanization, such as helicopters and chainsaws.

The opening sentence of Wilderness Act, Section 2(a) states that the NWPS was created "In order to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States…" Section 2(c) of the Wilderness Act defines wilderness as "an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation" and as a place "where man himself is a visitor who does not remain." Agency policies and case law consistently identify the Undeveloped Quality as one of the principle components that defines wilderness.

For the Undeveloped Quality, two monitoring questions provide the broad context and three indicators provide the structure for this monitoring (as summarized in table 1.4.1).

Table 1.4.1—Monitoring questions, indicators, measures, and measure types for the Undeveloped Quality.

Undeveloped Quality		
Monitoring Question: What are the trends in physical evidence of development inside wilderness?		
Indicator	**Measure**	**Measure type**
Presence of non-recreational structures, installations, and development	Index of authorized non-recreational physical development	Required
Presence of inholdings	Acres of inholdings	Required
Monitoring Question: What are the trends in mechanization?		
Indicator	**Measure**	**Measure type**
Use of motor vehicles, motorized equipment, or mechanical transport	Index of administrative authorizations to use motor vehicles, motorized equipment, or mechanical transport	Required
	Percent of emergency incidents using motor vehicles, motorized equipment, or mechanical transport	Optional
	Index of special provision authorizations to use motor vehicles, motorized equipment, or mechanical transport	Optional

Photo: San Isabel National Forest, Colorado taken by USFS

4.1 Monitoring Questions

Two monitoring questions are used in monitoring the Undeveloped Quality:

1. What are the trends in **non-recreational physical development**?
2. What are the trends in mechanization?

The first monitoring question addresses the presence of physical development that most often typifies evidence of modern human occupation and modification, including both non-recreational physical developments and developments on non-NFS lands interior to a wilderness (also known as **inholdings**). Although most occurrences of physical developments on NFS lands predate the area's designation as wilderness, these developments still have an effect on the undeveloped aspect of a wilderness. Similarly, inholdings, while not technically wilderness, still may be developed and affect a visitor's sense of this quality.

Developments associated with recreation, such as trails, bridges, signs, and campsites, are typically the most prevalent sign of modern human occupation and modification inside wilderness. Recreational developments are not included under this quality, but are instead counted under the Solitude or Primitive and Unconfined Recreation Quality because their primary purpose relates directly to opportunities for primitive recreation. A basic tenet of WCM is that measures are not double counted, but instead are listed under the quality and indicator where they fit best. The decision to include recreational developments under the Solitude or Primitive and Unconfined Recreation Quality was made in *Keeping It Wild 2* (Landres et al. 2015), and this technical guide is consistent with that decision.

The second monitoring question assesses the effect of motorized equipment and mechanical transport on the Undeveloped Quality. This includes authorized uses, such as for administrative, emergency, and special provision purposes, as well as unauthorized uses. For the purposes of the this WCM strategy, it was determined that the level of monitoring needed to track unauthorized uses was outside the scope of this technical guide; therefore, this guide does not include a measure that assesses unauthorized use of motor vehicles, motorized equipment, or mechanical transport (see Appendix 2 for further explanation). Although the Wilderness Act and subsequent legislation allow motorized equipment or mechanical transport under certain conditions, their use diminishes the Undeveloped Quality. Monitoring the use of motorized equipment and mechanical transport over time can help Forest Service line officers make well-informed decisions grounded in the Wilderness Act.

The first monitoring question "What are the trends in non-recreational physical development?" is addressed through two indicators: (1) presence of non-recreational structures, installations, and developments, and (2) presence of inholdings.

These two indicators provide a comprehensive assessment of the various types of physical developments not related to recreational infrastructure that may be present in a wilderness.

The second monitoring question, "What are the trends in mechanization?" is addressed through a single indicator that encompasses the use of motor vehicles, motorized equipment, or mechanical transport.

4.2 Indicator: Presence of Non-Recreational Structures, Installations, and Developments

This indicator focuses on the physical evidence of modern human occupation and modification in wilderness, such as **roads**, buildings, and dams. This indicator excludes developments related to recreational use (e.g., trails) because they are counted under the Solitude or Primitive and Unconfined Recreation Quality.

4.2.1 Measure: Index of Authorized Non-Recreational Physical Development

This measure is an index that assesses selected elements for each type, or component, of non-recreational physical development. These elements are typically selected because they affect the area's undeveloped character and may change based on decisions made by the Forest Service, permittees, or cooperators.

For many people, wilderness is defined by its lack of developments, especially the absence of roads and buildings. Wilderness is intended to be in contrast "with those areas where man and his works dominate the landscape." (Wilderness Act, Section 2[c]). Despite this requirement, few wildernesses have entirely escaped the physical evidence of modern human occupation and modification. Types of developments in wilderness include: buildings, dams and other **instream structures**, roads, **fixed instrumentation sites**, **utility infrastructure**, mines, and grazing infrastructure. Many developments predate the establishment of a wilderness but were grandfathered in by the authorizing legislation. Although developments are not typically allowed in wilderness, their presence does not preclude the formal designation of an area. As a particular piece of infrastructure outlives its intended purpose, it is often removed if the law allows; for example, roads and buildings are torn down and dams **decommissioned**. In contrast, new infrastructure is sometimes put into wilderness, most commonly with fixed instrumentation sites such as volcanic activity sensors and snow water content monitoring stations. A development's benefit or purpose is irrelevant when assessing its impact on the Undeveloped Quality of wilderness character.

This measure excludes those developments intended to support recreational use, such as system trails and bridges as well as administratively provided infrastructure such as hitching posts, bear poles, and shelters because these are evaluated under a separate quality (see section 5.4). It includes all non-recreational infrastructure authorized by the Forest Service, including those implemented by permittees or cooperators under current agreements. The measure also excludes unauthorized developments, such as trash piles and squatters' cabins, because these data are not routinely tracked in corporate databases and the general approach for calculating this index is to rely on data that can predictably be extracted from standard datasets. Additionally, it is generally agency policy to remove these developments soon after being discovered and not have them persist over time.

This measure is required for all Forest Service wildernesses. A 3-percent or greater change in the measure value will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the development measure value corresponds with a degrading trend.

Refer to part 2, section 4.2.1, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

4.3 Indicator: Presence of Inholdings

This indicator focuses on the physical evidence of modern human occupation and modification within inholdings. Due to the vulnerability of these lands to development and the adverse effect this development could have on the surrounding wilderness values, the impact on the Undeveloped Quality of wilderness character can be significant.

4.3.1 Measure: Acres of Inholdings

This measure assesses the acres of inholdings in a wilderness, even if the existence of inholdings is imperceptible to an observer. This measure was selected as the most direct way to track changes to the indicator over time. Although very unlikely to increase, the number of inholding acres may decrease as inholding parcels are acquired through purchase, donation, or exchange. This measure calculates the total acreage of all parcels inside wilderness that are not NFS lands, including both private and state inholdings and patented mining claims.

Wilderness inholdings are defined as non-federal land within the boundary of a wilderness. As such, they do not include partially enclosed lands, such as **cherry-stemmed roads**. Inholdings encompass a variety of lands, including private lands, state lands, and patented mining claims. Unpatented mining claims are not inholdings because the Federal Government retains the surface ownership.

This measure was selected because inholdings are not given the same legal protections and restrictions as the wilderness lands around them, and they can be developed for various purposes at the discretion of the landowner. These lands can be roaded and logged; developed with recreational lodges, facilities, or private residences; and in some instances mined; all of which directly impact the Undeveloped Quality of wilderness character.

This measure is required for all Forest Service wildernesses, even those without inholdings. Wildernesses without inholdings (about half of all NFS wildernesses) will simply report a measure value of zero because a measure must be selected for the *Presence of Inholdings* indicator. Any change in the acres of inholdings will result in a change in trend for this measure. An increase in the acres of inholdings corresponds with a degrading trend.

Refer to part 2, section 4.3.1, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

4.4 Indicator: Use of Motor Vehicles, Motorized Equipment, or Mechanical Transport

This indicator focuses on the use of the three forms of mechanization discussed in Section 4(c) of the Wilderness Act: (1) motor vehicles, (2) motorized equipment, and (3) mechanical transport.

Forest Service regulations and policy restrict the use of motorized equipment and mechanical transport for all NFS wildernesses, requiring authorizations at various levels of the agency when such use is deemed necessary. Forest Service policy for the authorization and use of motorized equipment and mechanical transport is provided in FSM section 2326—Use of Motorized Equipment or Mechanical Transport in Wilderness. Key definitions in FSM 2320.5 are as follows:

- *Mechanical Transport*: Any contrivance for moving people or material in or over land, water, or air, having moving parts, that provides a mechanical advantage to the user, and that is powered by a living or nonliving power source. This includes, but is not limited to, sailboats, hang gliders, parachutes, bicycles, game carriers, carts, and wagons. It does not include wheelchairs when used as necessary medical appliances. It also does not include skis, snowshoes, rafts, canoes, sleds, travois, or similar primitive devices without moving parts.
- *Motorized Equipment*: Machines that use a motor, engine, or other nonliving power sources. This includes, but is not limited to, such machines as chain saws, aircraft, snowmobiles, generators, motorboats, and motor vehicles. It does not include small battery or gas-powered hand-carried devices such as shavers, wristwatches, flashlights, cameras, stoves, or other similar small equipment.

The Forest Service includes motor vehicles in the definition of motorized equipment, and does not track these separately.

4.4.1 Measure: Index of Administrative Authorizations to Use Motor Vehicles, Motorized Equipment, or Mechanical Transport

This measure assesses the 3-year rolling average of a use-level index evaluating administrative authorizations to use motor vehicles, motorized equipment, or mechanical transport, based on the type and number of pieces of equipment and the days of use. Administrative authorizations are defined as an authorization to use motor vehicles, motorized equipment, or mechanical transport determined to be necessary to meet minimum requirements for the administration of the area. This includes mechanized uses conducted by agency staff, as well as by other individuals as authorized under current permits or agreements with the Forest Service. This excludes authorizations that are of an emergency nature or are related to special provisions as provided by statute, both of which are evaluated under separate measures (see section 4.4.2 and section 4.4.3, respectively).

This measure was selected because administrative authorizations should be given great scrutiny as they are at the full discretion of the agency and they are not of an emergency nature. Typically, local units have time for a thorough analysis to evaluate the need for such use, including identification of non-mechanized alternatives that might exist. This measure uses data currently recorded in the NRM-Wilderness application and reported annually during the upward reporting cycle.

This measure is required for all Forest Service wildernesses. Any change in the 3-year rolling average measure value will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the average measure value corresponds with a degrading trend.

Refer to part 2, section 4.4.1, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

4.4.2 Measure: Percent of Emergency Incidents Using Motor Vehicles, Motorized Equipment, or Mechanical Transport

This measure assesses the 3-year rolling average of the percentage of **emergency incidents** resulting in a motorized or mechanized response. For the purposes of this protocol, an emergency incident is an event relating to public health and safety that may require a response from emergency personnel, and of which an emergency responder is aware. Emergency incidents fall into the following categories: aircraft accident investigation, fire, law enforcement, other natural disaster, removal of deceased persons, and search and rescue. Many emergency incidents never receive a response because the parties involved self-rescued before emergency personnel were notified or mobilized. For example, injured persons can self-rescue or lost parties can be found without assistance from emergency personnel. The types of incidents that do not receive a management response are not included in this measure.

Emergency responses may require the use of motorized equipment or mechanical transport or may be accomplished through non-motorized or non-mechanized means. Uses of motorized equipment and mechanical transport for emergency incidents typically involve less discretion than administrative authorizations simply due to the shortened response timeframes and the need to protect public safety and welfare.

Unlike administrative authorizations, the number and type of emergency authorizations often vary significantly from year to year based on external factors. If a simple count of emergency authorizations were tracked, an increase in these authorizations could be the result of a busy fire season, for example, and not indicative of local management control. Instead, this measure assesses the proportion of the total number of incidents in a wilderness requiring an emergency response that were granted authorization to use motorized equipment or mechanical transport.

This measure is optional. This measure may be difficult to assess primarily because of the need to track all emergency incidents that occur within a wilderness in a given year, but if a local unit determines that the emergency use of motorized equipment or mechanical transport has the potential to significantly affect wilderness character, the unit may make the decision to assess this measure.

A 5-percent change in the 3-year rolling average percentage of emergency incidents resulting in a motorized or mechanized response will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the average percentage corresponds with a degrading trend.

Refer to part 2, section 4.4.2, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

4.4.3 Measure: Index of Special Provision Authorizations to Use Motor Vehicles, Motorized Equipment, or Mechanical Transport

This measure assesses the 3-year rolling average of a use-level index evaluating **special provision authorizations** to use motor vehicles, motorized equipment, or mechanical transport, based on the type and number of pieces of equipment and the days of use. For the purposes of this protocol, a special provision authorization is an authorization to use motor vehicles, motorized equipment, or mechanical transport as specified by statute.

This measure excludes those allowances for the public to use motorized equipment from specific statutes, such as motor boat use on certain lakes in the Boundary Water Canoe Area Wilderness. These data are not tracked routinely and are typically outside of the agency capacity to do so. Instead, the focus is on those mechanized uses undertaken by agency employees, or those other entities authorized to do so through existing permits or agreements with the Forest Service.

Examples of special provision authorizations for motorized or mechanized use include helicopter access to a remote water gauging station, heavy equipment use for dam maintenance, and motor vehicle access to support commercial grazing or utility sites. As currently tracked in NRM-Wilderness, special provision authorizations to use motorized equipment and mechanical transport are categorized into the following subtypes:

- Commercial livestock management
- Fixed equipment installation and maintenance
- Military or Border Patrol
- Mineral rights
- State and private land (for access to inholdings)
- Utility corridors
- Water resource projects (including dams)
- Wildlife management

These special provision authorizations do not have the same level of agency discretion as do administrative authorizations. In some instances, the use of motorized equipment is generally allowed in support of an activity specified in the legislation. In others, the use levels are specified to be at or below the historical levels established at the time of designation. Examples include tracking the number of flights taken by a state fish and game agency to stock fish, or the number of days heavy equipment is used to maintain a dam.

However, for some special provision authorizations, use levels simply may not be known and will not be tracked by this measure. For example, the Alaska National Interest Lands Conservation Act of 1980 (commonly referred to as ANILCA) authorized a variety of uses in Alaskan wildernesses, such as motorized access as needed to support subsistence hunting or use of a motorized winch to assist with hauling large game, for which permits are issued annually. In most instances, the Forest Service will not know actual use levels.

This measure is optional. Local units may assess this measure, if relevant, under two conditions: (1) the unit has special provision authorizations occurring in a wilderness, and (2) the unit believes they can assess the level of motorized equipment or mechanical transport use with some degree of confidence.

A 5-percent change in the 3-year rolling average measure value will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the average measure value corresponds with a degrading trend.

Refer to part 2, section 4.4.3, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

5.0 Solitude or Primitive and Unconfined Recreation Quality

The objective of monitoring the Solitude or Primitive and Unconfined Recreation Quality is to assess whether management of a wilderness is trending over time towards protecting outstanding opportunities for specific, unique recreational experiences. This monitoring focuses on three aspects of the quality:

1. Solitude
2. Primitive recreation
3. Unconfined recreation

Wilderness is the only public land designation that mandates **federal land managers** protect outstanding opportunities for a unique recreational experience, namely "solitude or a primitive and unconfined type of recreation" (Wilderness Act, Section 2[c]). Although the Forest Service cannot ensure that visitors will have such experiences, the agency must protect conditions that promote such opportunities and keep them from declining over time. Thus, wilderness should provide opportunities for introspection, natural quiet, challenge, and freedom from societal obligations. Visitors may desire other experiences than those described in the Wilderness Act, but those experiences are not part of the legislated requirement to preserve wilderness character.

Forest Service managers must protect all three aspects of this quality that include (1) solitude, (2) primitive recreation, and (3) unconfined recreation. There are subtle differences in the three aspects of this qualities' meanings (Seekamp and Cole 2009) and they can change independently of each other, which makes it necessary to monitor all three aspects to understand change in the overall quality.

For the Solitude or Primitive and Unconfined Recreation Quality, two monitoring questions provide the broad context and four indicators provide the structure for this monitoring (as summarized in table 1.5.1).

Photo: The Rio Grande National Forest in southwestern Colorado by Michael Blakeman 2014, USFS.

Table 1.5.1—Monitoring questions, indicators, measures, and measure types for the Solitude or Primitive and Unconfined Recreation Quality.

Solitude or Primitive and Unconfined Recreation Quality		
Monitoring question: What are the trends in outstanding opportunities for solitude?		
Indicator	**Measure**	**Measure type**
Remoteness from sights and sounds of human activity *inside* wilderness	Index of encounters	Required
	Index of recreation sites within primary use areas	Required to select at least one
	Acres of wilderness away from access and travel routes and developments inside wilderness	
	Miles of unauthorized trails	
Remoteness from sights and sounds of human activity *outside* the wilderness	Acres of wilderness away from adjacent travel routes and developments outside the wilderness	Required
Monitoring question: What are the trends in outstanding opportunities for primitive and unconfined recreation?		
Indicator	**Measure**	**Measure type**
Facilities that decrease self-reliant recreation	Index of NFS developed trails	Required to select at least one
	Index of authorized constructed recreation features	
Management restrictions on visitor behavior	Index of visitor management restrictions	Required

5.1 Monitoring Questions

Two monitoring questions are used in monitoring the Solitude or Primitive and Unconfined Recreation Quality:

1. What are the trends in outstanding opportunities for solitude?
2. What are the trends in outstanding opportunities for primitive and unconfined recreation?

The first monitoring question addresses the experience of solitude. The Wilderness Act recognizes that wilderness, protected from human development or settlement, can provide an opportunity for solitude not available other places. A review of wilderness writings suggests that solitude encapsulates a range of experiences, including privacy, being away from civilization, inspiration, self-paced activities, and a sense of connection with times past (Borrie and Roggenbuck 2001; Cole 2012). Both the presence of other visitors in wilderness and characteristics of the setting degrade opportunities for solitude (Seekamp and Cole 2009). Specifically, encountering other visitors in wilderness and seeing or hearing signs of modern civilization detract from the experience of solitude. Increasing visitation, population growth (especially near wilderness), and areas of concentrated use within wilderness all have the potential to degrade opportunities for solitude.

The second monitoring question addresses the primitive and unconfined nature of wilderness experiences. The Wilderness Act acknowledges rapidly disappearing opportunities for these types of recreation and it defines wilderness as a place where these opportunities should exist. The inclusion of primitive and unconfined recreation as a separate monitoring question recognizes the importance of non-motorized and non-mechanized travel, self-reliance and self-discovery, and the need for places where people can be free from social constraints.

Primitive recreation encompasses types of recreation that require primitive travel and living in an environment with minimal facilities (Hall and Davidson 2013; Johnson et al. 2005; Seekamp and Cole 2009). The founders of the wilderness idea referred to primitive travel, such as canoeing, horse packing, and hiking, as appropriate activities in wilderness. Because primitive recreation requires self-reliance and demonstration of skills in wilderness travel, opportunities for such experiences are degraded by the presence of facilities that make wilderness travel easier, such as bridges and high-standard trails. Opportunities are greater in wildernesses with areas suitable for off-trail exploration.

Unconfined recreation encompasses the sense of discovery, adventure, and mental challenge presented by large wildernesses in which visitors can travel widely and explore unique and unknown environments on their own without having to conform to society's norms or rules. Outstanding opportunities for unconfined recreation may be associated with large expanses of land suitable for off-trail exploration, as well as places that have relatively low levels of use and are free from management restrictions over visitor activities. Research shows that visitors associate unconfined recreation with the "freedom to roam" and an absence of highly restrictive regulations (Seekamp and Cole 2009).

The first monitoring question "What are the trends in outstanding opportunities for solitude?" is addressed through two indicators:

1. **Remoteness** from sights and sounds of human activity *inside* wilderness.
2. Remoteness from sights and sounds of human activity *outside* the wilderness.

Using two indicators for remoteness allows managers to assess conditions that are subject to management control (inside wilderness) separately from those that are outside of management control (outside wilderness).

The second monitoring question "What are the trends in outstanding opportunities for primitive and unconfined recreation?" is addressed through two indicators, one focused on primitive recreation and the other on unconfined recreation:

1. Facilities that decrease self-reliant recreation.
2. Management **restrictions on visitor behavior**.

5.2 Indicator: Remoteness from Sights and Sounds of Human Activity *Inside* Wilderness

This indicator assesses wilderness visitation and the capacity of a wilderness setting to allow for escape from the sights and sounds of human activity. The opportunity to achieve solitude is addressed as a function of both the density and location of visitors within wilderness—most of whom stay near established trails, destinations, and pre-existing campsites—as well as the opportunity to get away from those visitors and their impacts by accessing more remote areas.

The Merriam-Webster dictionary (Merriam-Webster 2016) defines solitude as "the quality or state of being alone or remote from society." The presence of other visitors, particularly visitors outside one's own group, directly impacts the experience of solitude. Additionally, recreational activities lead to visible signs that remind people of the presence of others, and thereby detract from a feeling of solitude (Seekamp and Cole 2009). Recreation impacts at campsites and other locations where visitors congregate are one of the most prevalent and obvious human impacts that wilderness visitors may encounter.

Remoteness, meaning distance from the sights and sounds of civilization, is important for achieving a sense of solitude (Dawson 2004). Research shows that most wilderness visitors stay on **developed trails** and most wilderness use concentrates within a few miles of trailheads and access points, especially where day use makes up most of the visitation. Therefore, remote locations away from trails within a wilderness provide opportunities for visitors to find solitude.

5.2.1 Measure: Index of Encounters

This measure monitors **encounters** by assessing one of the following, listed in order of preference: (1) an index evaluating traveling and **camp encounters**; (2) the number of **traveling encounters** or camp encounters (but not both); (3) the number of visitors; or (4) the trend in visitation. Given the centrality of encounters to the experience of solitude, combined with the absence of good data for most wildernesses, these alternatives involve a preferred hierarchy of data sources.

There are two preferred direct metrics for encounters that should be used together if data are available for both:

1. *Traveling Encounters*—The average number of other groups (or people) seen per standardized unit of time (typically an 8-hour day) while in wilderness during the primary use season.
2. *Camp Encounters*—The daily average number of camping groups visible or audible from a visitor's campsite during the primary use season.

These definitions are from the national minimum protocol for monitoring solitude (USDA Forest Service 2016). However, wildernesses may use local protocols that tailor these definitions to local circumstances (for instance, including sightings of people outside wilderness, or overflights). The national minimum protocol explains how to include other information. Using these direct metrics captures the two important types of encounters: (1) meeting other people while traveling through an area and (2) seeing or hearing other campers. Research shows that camp encounters are highly salient to campers (Borrie and McCool 2007) and more impactful than traveling encounters (Hall and Irizarry 2014). Ideally, wildernesses will report on both metrics and combine them into an index. However, in many wildernesses, most visitors are on single day trips and camp encounters are not pertinent. In this case, only traveling encounters will be used.

If data are not available for the direct metrics of encounters, other data that provide an indirect metric of encounters may be used. Specifically, visitation data may be collected for all, or part, of a wilderness and may be used to determine trend over time. These data may be derived from mandatory permits, self-issue permits, trailhead registers, car counts at trailheads, or traffic counters. Using the indirect metrics, the measure would be the total count (number of visitors or number of groups) generated during the primary use season.

If visitation data are not available, professional judgment of the trend in visitation or encounters may be used as a last resort. Local units are not asked to make estimates of encounters or visitation, but simply to report their judgment about overall trend and provide additional documentation (e.g., a brief narrative) about their basis for this judgment. It is possible (even likely) that a variety of types of data would be available for a given wilderness. In this case, rather than trying to develop a new measure option, a wilderness would report the trend as professional judgment and provide documentation of the types of data that support the overall conclusion.

This measure is required for all Forest Service wildernesses. A 10-percent change in the measure value, number of encounters, or number of visitors will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. If professional judgment is used, any change in defined categories will result in a change in trend. An increase in the number of encounters or visitors corresponds with a degrading trend.

Refer to part 2, section 5.2.1, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

5.2.2 Measure: Index of Recreation Sites Within Primary Use Areas

This measure is an index that assesses the number of **recreation sites** and their condition, based on the national minimum protocol for recreation site monitoring. A recreation site is a place where visible impacts to vegetation or soil from recreational use are documented. The intent of this measure is to include **user-created sites**, not facilities provided by the agency. However, designated sites such as designated campsites are included in this measure. Administrative recreation facilities, such as bridges or toilets, are not included under this measure because they are captured under a different indicator (see section 5.4.2). Often recreation sites are campsites, but they may also include viewpoints and day use areas. Locally unique situations, such as impacts at the base of climbing routes, may be included at the discretion of local units. The important point is to use consistent guidelines in each monitoring cycle.

It also is important to train field staff to properly measure site impacts and, ideally, to use the same staff over time to conduct the monitoring. Different observers may be more or less thorough in searching for recreation sites, and may judge the same conditions in different ways. When this happens, it is possible that what appear to be changes from one monitoring cycle to another may simply be a reflection of different judgments made by different observers.

If conducted by well-trained staff, monitoring should document accurately the increases and decreases in the number of recreation sites. Detecting significant change in the mean condition of recreation sites is more difficult, in part, due to some inherent subjectivity and because heavily impacted sites can undergo deterioration that will not be captured during subsequent monitoring (i.e., when they were in the maximum impact categories during the initial inventory).

Local units are required to select at least one of the following measures: *Index of Recreation Sites Within Primary Use Areas* (section 5.2.2), *Acres of Wilderness Away from Access and Travel Routes and Developments Inside Wilderness* (section 5.2.3), or *Miles of Unauthorized Trails* (section 5.2.4); units may select more than one measure if relevant to the individual wilderness. A 5-percent or greater change in the measure value will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the measure value corresponds with a degrading trend.

Refer to part 2, section 5.2.2, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

5.2.3 Measure: Acres of Wilderness Away from Access and Travel Routes and Developments Inside Wilderness

This measure assesses the total number of wilderness acres located more than ½ mile from access points, **travel routes** (e.g., authorized trails and roads, aircraft landing sites), and developments inside wilderness. The distance of ½ mile is somewhat arbitrary because the visual and audible impacts of roads and developments depend on the topography and vegetation of a wilderness, among other factors. Also, because a central data analyst computes this measure, it is not possible to customize it for each wilderness. However, this distance is consistent with the Recreational Opportunity Spectrum (Clark and Stankey 1979), and using a consistent buffer allows for the determination of trends over time. The total number of acres is preferred over the percentage of wilderness.

One limitation to this measure is that **the area away from access and travel routes and developments inside wilderness** is unlikely to change because trails, roads, and structures are rarely built or removed in wilderness. Nevertheless, there is potential for change resulting from the addition or removal of recreational sites or other development in a wilderness. For example, conversion of a **user-created trail** to a NFS system trail would decrease the number of acres away from travel routes and developments.

Local units are required to select at least one of the following measures: *Index of Recreation Sites Within Primary Use Areas* (section 5.2.2), *Acres of Wilderness Away from Access and Travel Routes and Developments Inside Wilderness* (section 5.2.3), or *Miles of Unauthorized Trails* (section 5.2.4); units may select more than one measure if relevant to the individual wilderness. A 3-percent or greater change in the total number of acres away from access and travel routes and developments will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. A decrease in the acreage corresponds with a degrading trend.

Refer to part 2, section 5.2.3, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

5.2.4 Measure: Miles of Unauthorized Trails

This measure assesses the number of linear miles of unauthorized (non-system) trails within wilderness. This includes user-created trails as well as other unauthorized routes (e.g., decommissioned roads or trails) that are currently in use. It may also include climbing routes.

Many wildernesses face the potential for rapid expansion in the quantity of user-created trails due to the increasing use of Global Positioning System (GPS) technology for cross-country travel and social networking to share those data. It is extremely difficult to eradicate these trails once created, and **unauthorized trails** can introduce new use into previously pristine areas.

If a wilderness collects data on unauthorized trails, it is strongly recommended that they select this measure, as it is more sensitive to change than the other two measures included under this indicator. As the ability to monitor unauthorized trails improves (with new types of technology and imagery), local units need to verify that apparent change over time reflects the creation of new trails, and not simply the **level of effort** applied to detect trails.

Local units are required to select at least one of the following measures: *Index of Recreation Sites Within Primary Use Areas* (section 5.2.2), *Acres of Wilderness Away from Access and Travel Routes and Developments Inside Wilderness* (section 5.2.3), or *Miles of Unauthorized Trails* (section 5.2.4); units may select more than one measure if relevant to the individual wilderness. A 3-percent or greater change in the miles of unauthorized trails will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the mileage corresponds with a degrading trend.

Refer to part 2, section 5.2.4, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

5.3 Indicator: Remoteness from Sights and Sounds of Human Activity *Outside* the Wilderness

This indicator focuses on human activity occurring outside or on the boundary of a wilderness that is visible or audible from within wilderness. Although legal protections and restrictions of wilderness do not extend to activities occurring outside a wilderness boundary, these activities can still degrade the wilderness experience.

Section 2(c) of the Wilderness Act defines wilderness as an area with "the imprint of man's work substantially unnoticeable." As nearby human population centers expand, the evidence of human activities and developments outside and adjacent to wilderness increases, thereby decreasing opportunities for solitude within wilderness. For example, noise from highways outside of wilderness can sometimes carry a long distance into wilderness (Newman et al. 2012; Park et al. 2010).

Signs of human activity and development outside wilderness manifest in many ways, including sounds from automobiles and off-highway vehicles on nearby travel routes, decreased visibility from air and light pollution, and visual evidence of increasing urbanization from high ridges and peaks. While many activities outside wilderness have the potential to affect the opportunities for solitude within wilderness, data are largely unavailable for either the extent of the activities or their effect within wilderness.

5.3.1 Measure: Acres of Wilderness Away From Adjacent Travel Routes and Developments Outside the Wilderness

This measure assesses the total number of wilderness acres more than ½ mile from roads, structures, and other developments that are located outside a wilderness or on the boundary, including cherry-stemmed access road corridors and developed inholdings. It is recognized that wildernesses will vary in how sights and sounds of activity outside wilderness impact visitors in a wilderness. In particular, monitoring the area away from adjacent travel routes and developments outside the wilderness may underestimate the effects of large urban areas on nearby wildernesses. However, because a central data analyst computes this measure, it is not possible to customize it for each wilderness. Nevertheless, wildernesses can capture some of these impacts through customizing the minimum protocol for encounters. Travel routes and developments on inholdings are included in the analysis for this measure because inholdings are not part of a wilderness. Any route or development should be included in only this measure or *Acres of Wilderness away from Access* and *Travel Routes and Developments Inside Wilderness*, but not both.

This measure is required for all Forest Service wildernesses. A 3-percent or greater change in the total number of acres away from adjacent travel routes and developments outside a wilderness will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. A decrease in the acreage corresponds with a degrading trend.

Refer to part 2, section 5.3.1, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

5.4 Indicator: Facilities that Decrease Self-Reliant Recreation

This indicator focuses on the presence of facilities in wilderness that decrease opportunities for self-reliant recreation. Though many of these facilities are in place to protect natural resources, they may adversely affect opportunities for a primitive and unconfined type of recreation.

Primitive recreation consists of activities that require self-reliance and the absence of modern conveniences (Roggenbuck 2004). Although recreation facilities in wilderness are provided to concentrate user impacts and protect resources, and are appreciated by many visitors, such facilities reduce the feeling of primitiveness (Johnson et al. 2005; Seekamp and Cole 2009). Recreation facilities can include trails, bridges, signs, campsites, and other infrastructure or services that limit opportunities for self-reliance. The type of recreational facility is also important; for example, traveling on a narrow, rocky path creates a more primitive feeling than traveling on a wide, groomed surface (Hall 2001).

This indicator provides a means for measuring trends in the presence of durable or relatively permanent facilities that reduce opportunities for primitive recreation. Although many recreational facilities are physical developments that could be included under the Undeveloped Quality, to avoid double counting, they are only counted under this quality and indicator.

5.4.1 Measure: Index of NFS Developed Trails

This measure is an index that assesses the miles of **NFS trails** and their **trail classes**. The trail class is the prescribed scale of development for a trail, representing its intended design and management standards. Trail classes are general categories reflecting trail development, arranged along a continuum from least developed (class 1) to most developed (class 5). Trail classes are established at the time of trail construction and may be updated infrequently. This measure uses the trail class (design standard) rather than the actual trail condition because only a very small percentage of trails is surveyed each year for condition. The actual condition of trails is likely to be more primitive than the official trail class given shortfalls in staffing and resources to maintain trails. Hence, this is a conservative measure and unlikely to show increases in opportunities for primitive recreation that actually occur.

Data on miles of existing NFS trails for each trail class are currently available in tabular form for all wildernesses. A user view will be created in NRM-Wilderness that serves data back to the local unit for validation.

Local units are required to select either this measure or the following measure, *Number of Authorized Constructed Recreation Features*, or may select both measures if relevant to the individual wilderness. A 3-percent or greater change in the measure value will result in a change in trend for this measure. Once there are five measure values, the threshold for meaningful change will switch to regression analysis, and statistical significance will determine the trend in the measure. An increase in the measure value corresponds with a degrading trend.

Refer to part 2, section 5.4.1, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

5.4.2 Measure: Number of Authorized Constructed Recreation Features

This measure assesses the total number of **authorized constructed recreation features**. It does not include other types of non-recreational developments or structures because those are included in the Undeveloped Quality (see section 4.2.1). Authorized constructed recreation features can include bridges, toilets, fire grates, bear boxes, and others. System trails are not included in this measure because they are monitored under the previous measure (see section 5.4.1). Smaller, less obtrusive facilities, such as trail signs, trail features, and user-created facilities are not included in this measure. Individually authorized recreation features have minimal impact, but collectively they can impact the sense of primitive recreation.

Because the features included in this measure can be measured objectively, and changes occur only because of management action, accurate detection of small changes is possible. These are relatively large, visible structures; therefore, the impact of adding or removing a single feature can be construed as affecting wilderness character.

Local units are required to select either this measure or the preceding measure, *Index of NFS Developed Trails*, or may select both measures if relevant to the individual wilderness. Any change in the number of recreation features will result in a change in trend for this measure. An increase in the number of features corresponds with a degrading trend.

Refer to part 2, section 5.4.2, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

5.5 Indicator: Management Restrictions on Visitor Behavior

Section 2(c) of the Wilderness Act stipulates that wilderness should be managed to protect opportunities for primitive and unconfined recreation. Management restrictions in wilderness are often adopted to protect resources or opportunities for solitude in wilderness. However, unconfined recreation refers to types of recreation in which visitors experience a high degree of freedom over their own actions and decisions (Dustin and McAvoy 2000; Dawson and Hendee 2009). Management restrictions are likely to degrade the opportunities for unconfined recreation.

This indicator addresses Forest Service restrictions on visitor behavior in wilderness, encompassing formally adopted regulations or policies that govern visitor behavior, travel, or equipment. Restrictions may be national, regional, or local in scope, and may apply to the entire wilderness or just certain areas within a wilderness.

5.5.1 Measure: Index of Visitor Management Restrictions

This measure is an index that assesses the relative degree of imposition or inconvenience of certain visitor management restrictions as well as the geographic extent of those restrictions. Management restrictions are put in place through the implementation of wilderness regulations, authorized by regional or forest special orders. The degree of imposition is based on research with wilderness visitors. For instance, research has shown that visitors typically strongly oppose restrictions on day use (Hall et al. 2010; Hall and Irizarry 2013), but are more accepting of restrictions on campfires where fuel is scarce (e.g., Borrie and McCool 2007; Hall et al. 2010). Other regulations may be in place, but were not included in this measure because they do not present significant confinement of the visitor (e.g., anti-littering regulations or requiring food to be hung in bear country) or are uncommon.

The temporal aspect of restrictions is included only for restrictions that occur at the same time each year.

There is some debate about whether regulations imposed outside wilderness differ in the way they affect the wilderness experience from regulations that govern behavior once a person enters a wilderness. This measure does not assess whether regulations affect a person before the trip (e.g., use limits) or after they are inside a wilderness (e.g., campfire prohibitions).

Additionally, although the selection of specific regulations and the determination of the impact rating are informed by survey research with wilderness visitors, they are somewhat subjective. Nevertheless, the index as a whole should do a reasonably good job of assessing the unconfined aspect of the Solitude or Primitive and Unconfined Recreation Quality. Because the regulations included in this measure can be objectively measured, and changes occur only because of management action, detection of small trends is possible.

This measure is required for all Forest Service wildernesses. Any change in the measure value will result in a change in trend for this measure. An increase in the measure value corresponds with a degrading trend.

Refer to part 2, section 5.5.1, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

6.0 Other Features of Value Quality

The objective of monitoring the Other Features of Value Quality is to assess how the condition of important features of historical, geologic, scenic, and educational value that are integral to wilderness character are changing. This monitoring focuses on cultural features and other features of value determined to be integral to wilderness character.

Section 2(c) of the Wilderness Act defines wilderness as an area that "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." Including such features, if they exist and play an integral role to defining the meaning and value of the area as wilderness, can provide a more complete picture of wilderness character. Monitoring this quality focuses on specific, tangible features and how the condition of these features change over time; it does not monitor the values derived from these features. By protecting the physical condition of the features, the values associated with them are likely preserved. The primary challenge with this quality lies in determining which features are truly integral to the character of a particular wilderness (refer to section 6.1 in part 2 for guidance on determining which features are integral to wilderness character).

There are three important distinctions between this quality and the other four qualities:

1. *Use of this quality is not required*—Unlike the other qualities that apply to every wilderness, the Section 2(c) definition notes that other features may be present; they are not required to be present. However, if features exist that are truly integral to wilderness character, then use of this quality is required.

2. *This quality focuses on site-specific features*—Unlike the other qualities that apply to the entirety of a wilderness, the features monitored within this quality usually occur only at specific sites, although some features, such as cultural landscapes and certain geological or paleontological formations may occur over larger areas (Cowley et al. 2012; Meyer 2013). Additionally, for some features, there is not one site-specific feature that adequately represents the feature of value, but rather a collection of individual site-specific features that together are considered integral to wilderness character (e.g., multiple prehistoric vision quest sites).

3. *Where this quality is used, the overall trend in wilderness character will be based on five qualities instead of four*—If the Other Features of Value Quality is used, the overall trend in wilderness character is determined by using all five qualities. Because it will be used in determining the overall trend in wilderness character, local unit staff must carefully consider whether a feature truly defines the wilderness character of an area. This consideration is especially critical if a small number of features are included because the trend in

Photo: White River National Forest by USFS.

condition of an individual feature may determine the trend in the entire quality, thereby influencing the overall trend in wilderness character.

Threats to this quality result primarily from direct human actions (e.g., looting or vandalism) and indirect human disturbance (e.g., camping or trail use) that creates unintended adverse effects. Although such damage is often associated with visitor use, other management activities (e.g., **fire suppression** activities or trail work) could also inadvertently contribute to disturbance. Natural processes also contribute to deterioration in the condition of features over time if there is no intervention.

For the Other Features of Value Quality, a single monitoring question provides the broad context and two indicators provide the structure for this monitoring (summarized in table 1.6.1).

Table 1.6.1—Monitoring question, indicators, measures, and measure type for the Other Features of Value Quality.

Other Features of Value Quality		
Monitoring question: What are the trends in unique, site-specific features integral to wilderness character?		
Indicator	**Measure**	**Measure type**
Deterioration or loss of integral cultural features	Condition index for cultural features	Required if relevant
Deterioration or loss of other integral site-specific features of value	Condition index for other features	Required if relevant

6.1 Monitoring Question

A single monitoring question is used in monitoring the Other Features of Value Quality: What are the trends in the unique features that are tangible and integral to wilderness character?

The monitoring question is intended to address the trend in the condition of specific, tangible features that are integral to wilderness character (i.e., those features that define the meaning and significance of the area). The monitoring does not focus on the scientific, educational, scenic, or historical values derived from these features. Values are difficult, if not impossible, to monitor reliably over time. However, by protecting the physical condition of these features, the values associated with the feature are likely preserved. For example, unique geological and paleontological features may occur in a wilderness and these features may have a wide array of scientific and educational values (Gordon et al. 2017).

WCM assesses the condition of these physical features, whereas the scientific and educational values or benefits derived from these features will not be evaluated by this monitoring. Likewise, intangible resources such as spiritual values, traditional practices, and traditional and historical stories are important aspects of this quality, but only the condition of associated tangible features is included in this monitoring.

For most wildernesses, this quality focuses on tangible features of unique geological, historical, or prehistoric value, such as lava beds, cave formations, dinosaur tracks, cliff dwellings, or rock art (i.e., petroglyphs and pictographs). However, there are situations where iconic natural or physical features may be appropriately monitored under this quality. Such situations arise where site-specific features truly define and distinguish a wilderness but the complexity of separating natural from human-caused change makes determining the trend in measure data difficult or impossible, thus preventing inclusion within the Natural Quality (see section 6.1 in part 2 for more information).

Features included in this quality are, by definition, truly integral to wilderness character; therefore, damage, disturbance, or decline to any feature assessed under this quality should always be interpreted as degrading wilderness character. While it is anticipated that the trends in measures in this quality may often be stable or degrading, projects to improve the condition of features (e.g., successfully removing graffiti from an integral natural feature) could lead to an improving trend in this quality.

Two indicators are used to address the monitoring question:

1. Deterioration or loss of **integral cultural features**.
2. Deterioration or loss of other **integral site-specific features of value**.

The first indicator focuses on cultural features while the second indicator focuses on other site-specific features, such as geologic, paleontological, and other iconic or significant features a local unit determines are integral to wilderness character. Depending on the features that are integral to a wilderness, either one or both indicators may be used.

6.2 Indicator: Deterioration or Loss of Integral Cultural Features

This indicator captures the trend in the condition of specific, tangible cultural features that are integral to wilderness character (i.e., those features that define the meaning and significance of the area). Cultural is defined broadly to include both prehistoric and historical features. Only those features determined to be integral to wilderness character are included in this monitoring. A decline in the condition of cultural features is viewed as degrading wilderness character.

6.2.1 Measure: Condition Index for Integral Cultural Features

This measure is an index that aggregates the condition rating for each cultural feature (or collection of similar cultural features) determined to be integral to wilderness character. The condition rating for each feature focuses on disturbance caused by human activity, but may include some deterioration related to natural processes (e.g., natural weathering, erosion); this rating provides a reliable, accurate, and simple means of describing the overall condition of a feature. A decrease in the measure value indicates an improving trend for this measure. Because cultural features are irreplaceable and the condition classes are relatively broad, small changes in the measure value are considered significant.

This measure is required if relevant—that is, it is required if cultural features integral to wilderness character have been identified. Any change in the measure value will result in a change in trend for this measure. An increase in the measure value corresponds with a degrading trend.

Refer to part 2, section 6.2.1, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

6.3 Indicator: Deterioration or Loss of Other Integral Site-Specific Features of Value

This indicator captures the condition of other site-specific features determined to be integral to wilderness character. This indicator is intended to provide additional flexibility for local units to monitor wilderness character using locally relevant information to capture the trend in certain natural or other features that may be iconic to a wilderness and give it meaning and significance. Paleontological sites, geologic features, glaciers, or iconic plants and animals are examples of features that may be included under this indicator.

6.3.1 Measure: Condition Index for Other Features

This measure is an index that aggregates the condition rating for each site-specific feature (or collection of similar site-specific features) determined to be integral to wilderness character. While the condition rating for each feature should focus on disturbance caused by human activity, it may include some disturbance where the causal factor is unclear. For example, the decline of an iconic plant species included under this measure may be related to natural or human-caused change or some combination of the two causes. A decrease in the measure value indicates an improving trend for this measure. Because other features of value are often irreplaceable and the condition classes are relatively broad, small changes in the measure value are considered significant.

This measure is required if relevant—that is, it is required if other site-specific features integral to wilderness character have been identified. Any change in the measure value will result in a change in trend for this measure. An increase in the measure value corresponds with a degrading trend.

Refer to part 2, section 6.3.1, for more detailed guidance on data sources and compilation protocols, analysis, data adequacy, and interpreting the threshold for meaningful change.

Part 2 Monitoring Protocols

Detailed Table of Contents for Part 2 - Monitoring Protocols

Photo: Vibrant fall color holding on a bit longer. Ottawa National Forest by USFS.

1.0 Overview

Part 2, Monitoring Protocols, provides Forest Service personnel detailed instructions for compiling, analyzing, and interpreting the data and resulting trends for all 28 measures described in this technical guide. This section provides an overview of how to implement wilderness character monitoring (WCM) and describes the standard sections that are included for each measure. The remaining sections 2–6 provide detailed protocols, that is, the step-by-step instructions for all measures, organized by their respective qualities:

- 2.0—Untrammeled Quality
- 3.0—Natural Quality
- 4.0—Undeveloped Quality
- 5.0—Solitude or Primitive and Unconfined Recreation Quality
- 6.0—Other Features of Value Quality

The measures described in sections 2 through 6 use the same section numbering that appears in part 1 of this technical guide to allow users to crosswalk between the measure descriptions in part 1 and the detailed monitoring protocols in part 2. Hyperlinks were created to provide easy access between these two parts. The glossary and references for both part 1 and part 2 are included at the end of the main text in part 2.

In addition, the following appendices are included at the end of part 2:

- Appendix 1—Summary of Key Implementation Attributes for All the Measures in Each Quality
- Appendix 2—Measures Considered but Not Used

1.1 How to Implement Wilderness Character Monitoring

There are three basic steps to implementing Forest Service WCM: (1) select measures, (2) review roles and responsibilities, and (3) begin data compilation, analysis, and entry.

Step 1: Select measures. The local unit that has the lead for each wilderness selects measures. The approach for selecting measures in WCM is similar to that used in Wilderness Stewardship Performance (WSP). There are five types of measures.

1. *Required*—The measure is required for all wildernesses.
2. *Required to Select at Least One*—At least one measure must be selected from the set of several potential measures; selections should be based on relevance

Photo: The Maroon Bells, just outside Aspen in Colorado Rocky Mountains USA. Original image from Carol M. Highsmith's America, Library of Congress collection.

to a wilderness, data availability, and additional measures from the set may also be selected if relevant.

3. *Required if Relevant*—If a wilderness uses the Other Features of Value Quality, one or more of these measures are required to be selected.

4. *Optional*—The measure may be selected if relevant to a wilderness.

5. *Locally Developed Measures*—In addition to the measures identified in this technical guide, the local unit may develop new measures for other attributes considered integral to wilderness character for the individual wilderness.

Required and required if relevant measures were developed to ensure a level of national consistency and cannot be modified by local units. Likewise, the **primary measure selected** from a set of "required to select at least one" measures also cannot be locally modified. If local units are interested in making a small change to a required measure's protocol (e.g., if a unit wants to include unique developments that are not encompassed by the monitoring protocol for the measure *Index of Authorized Non-Recreational Physical Development*, such as radio collars or large trash objects), they should contact their Regional Wilderness Program Manager and their Wilderness Information Management Steering Team representative to discuss the appropriateness and feasibility of this change. Any substantial changes to the protocols described in this technical guide will occur through the change management process (see section 1.8 in part 1).

In contrast to the required measures, optional measures may be adapted as necessary to suit local units. If multiple measures are selected from a set of "required to select at least one" measures, the additional measures may also be locally adapted (although at least one measure from the set must remain unmodified). For example, local units may want to track fire suppression through the optional measure *Percent of Emergency Incidents Using Motor Vehicles, Motorized Equipment, or Mechanical Transport*, but lack data on the other types of emergency incidents included in the monitoring protocol; in this case, they could modify the measure to quantify only the percentage of emergency fire suppression incidents using motor vehicles, motorized equipment, or mechanical transport. Similarly, if local units select both *Index of Recreation Sites Within Primary Use Areas and Miles of Unauthorized Trails* from the same set of "required to select at least one" measures, they could adjust *Miles of Unauthorized Trails* to track only miles of unauthorized outfitter and guide trails (but would then have to leave the measure *Index of Recreation Sites Within Primary Use Areas* as is).

Locally developed measures are expected to be rare, but may be included if (1) an attribute of wilderness character that is not included in this technical guide is integral to the area's wilderness character and is vulnerable to human-caused degradation, and (2) the local unit can reliably monitor that element into the future with sufficient data adequacy. If a locally developed measure is being considered, the local unit must contact their Regional Wilderness Program Manager and their Wilderness Information Management Steering Team regional representative to discuss the appropriateness and feasibility of the proposed measure. A locally developed measure can never replace a required measure. For example, if a resource specialist knows about better or more appropriate local data than what is included for a required measure in this technical guide, for national consistency the required measure must still be used and the better or more appropriate local data could then be used as the basis for an additional locally developed measure.

See section 1.5.3 in part 1 of this technical guide for general information on measures.

Step 2: Review roles and responsibilities. Local units review the roles and responsibilities for data compilation, analysis, and entry for each measure. The protocol for every measure in part 2, sections 2–6, begins with a table that explicitly summarizes the local and national tasks for that measure, followed by step-by-step instructions. Appendix 1 describes the local and national tasks for all measures, as well as other key implementation attributes. Definitions of the terms related to data compilation, analysis, and entry and how they are used in part 2 of this technical guide are described below:

- *Data compilation*—Refers to acquiring data for use in WCM. This includes collecting or gathering data from the field (e.g., counting the number of administrative installations) or retrieving existing data from Natural Resource Manager (NRM) or other local or external sources (e.g., acquiring state data on the spread of aquatic invasive species). This may also include compiling legacy data if appropriate and available for a measure (see section 1.5.3 in part 1 for additional information on data sources and legacy data).

- *Data analysis*—Refers to actions taken to manipulate data to derive a single value for the measure. This includes processing data retrieved from NRM (e.g., deriving the average Animal Unit Months [AUMs] across all wilderness allotments), calculating an index value (e.g., multiplying the trail distance by the trail class), or analyzing spatial data (e.g., performing a GIS analysis of wilderness acreage away from internal developments). Throughout part 2, average and mean are used interchangeably to describe the central tendency of the data.

- *Data entry*—Refers to entering the data into the appropriate NRM database, local database, or the Wilderness Character Monitoring Database (WCMD). While not all measures require data to be entered in NRM or a local database, all measures require data to be entered in the WCMD. Guidance for accessing and using the WCMD will be released now that WCM was formally implemented in the Forest Service in 2018 (see section 1.7.3 in part 1).

Some measures, such as *Number of Authorized Actions and Persistent Structures That Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire*, require data compilation, analysis, and data entry in the WCMD to be completed by local units. For other measures, such as *Concentration of Ambient Ozone and Deposition of Nitrogen*, a central data analyst at the national level compiles, analyzes, and enters data in the WCMD. Finally, for a few measures, such as Extent of Waterbodies with Impaired Water Quality, local units and a central data analyst must work together to complete data compilation, analysis, and data entry in the WCMD. In some cases, the data analysis for a measure may be performed automatically by the WCMD or by NRM-WCM. Data analyses by NRM-WCM may also automatically retrieve data from other NRM applications (e.g., data entered annually in NRM-Wilderness may be retrieved by NRM-WCM to calculate a measure value). As NRM is currently undergoing extensive revisions, for certain measures it is unknown at this time whether data analyses will be performed by NRM or whether users will need to do them by hand; therefore, instructions are included in part 2 for all measures even though local users may not need to perform these calculations in the future. Similarly, for certain measures the location of NRM data for compilation (including the specific NRM application that data are stored in and which attributes are relevant for a measure) may change in the future; the WCM Program Manager will be responsible for tracking and updating changes to NRM data compilation protocols.

Step 3: Begin data compilation, analysis, and entry. Local units and the central data analyst begin data compilation, analysis, and entry for the selected measures using the standard procedures described in part 2, sections 2–6. For all measures in these sections, detailed instructions describe the logical steps for data compilation, analysis, and entry that either a central data analyst or local user would follow. The instructions in these sections were developed to be at the appropriate geographical scale (either national or local) and to minimize the time required to gather the information. The measure value reported for each measure should be rounded to the nearest whole number (i.e., values from 1.1 to 1.4 become 1, and values from 1.5 to 1.9 become 2) unless stated otherwise in the protocol for a measure.

1.2 Standard Implementation Sections Described for Each Measure

For every measure included in sections 2–6, the following sections, in order, provide guidance for compiling, analyzing, and entering the data into the WCMD, as well as for determining and interpreting the trend in these measures.

1.2.1 Protocol

The protocol provides step-by-step instructions on how to compile, analyze, and enter the data necessary to determine the trend in the measure. Each protocol produces a single value for each measure (the measure value) that is used to derive the trend in this measure (see section 1.5.3 in part 1 for definitions and procedures on data handling). Protocols described in the sections 2–6 are based on the best available scientific information for monitoring wilderness character and comply with requirements of the 2012 Planning Rule (36 CFR 219) and the Data Quality Act (P.L. 100–554).

While most measures have a single set of instructions for the protocol, a few measures have several "protocol options." These protocol options take into account differences among wildernesses in data sources, data availability, and data adequacy, and allow local users to select the most appropriate protocol option for their unit. For example, the measure Index of Encounters has several protocol options based on the type of data currently being collected for a wilderness: camp encounter data, traveling encounter data, visitation data, or no data collection. When multiple protocol options are described for a measure, local units must select which one they will follow to compile, analyze, and enter the data. If more than one protocol option is relevant and feasible for a local unit to monitor, the unit may include additional protocol options as locally developed measures. For example, if a wilderness collects data on both campsite encounters and total visitation, they could use the encounter data as the selected protocol option for the required *Index of Encounters* measure and include the visitation data as an additional locally developed measure.

If better data sources become available, it may be appropriate to change to a different protocol option. The decision to change protocol options must be weighed carefully as it may alter the trend in the measure. When local units consider making such a change, they should contact their Regional Wilderness Program Manager and their Wilderness Information Steering Team regional representative to discuss the appropriateness and feasibility of this change. When protocol options are changed, it is important to document when the change occurred, the reason(s) for this action, and the potential impact on interpreting trend in wilderness character. Sections 1.5.3 and 1.8 in part 1 provide information on making changes to data sources and measures.

1.2.2 Caveats and Cautions

For each measure, caveats and cautions related to use of the protocol are described. This section may expand on concerns about the availability or quality of data or provide additional information about assessing the trend in the measure. For example, caveats may include availability and variability of data by geographic region, concerns about the locations of monitoring sites, and pending changes in databases or data sources.

1.2.3 Data Adequacy

Data adequacy is the reliability of the data to assess trends in the measure. It encompasses both data quality and data quantity (described below). Each measure included in this technical guide contains an evaluation and discussion of data adequacy. The data adequacy rating is based on a broad national assessment of existing databases and other sources of information about a measure. For each measure, local units must validate the general determinations of data adequacy that appear in this technical guide for their specific wilderness. Data adequacy is not used in determining the trend in a measure, but it is crucial information for interpreting this trend (e.g., if there is a degrading trend but data adequacy is low, then confidence in this trend would also be low) and for revealing if more effort is needed to collect more or better data to improve confidence in the resulting trend.

Each local unit is required to use the best available scientific information for all selected measures. In some cases, older legacy data (e.g., a plant survey or encounter monitoring conducted 10 or 20 years ago) may be all that is available; in these cases local resource specialists need to carefully scrutinize these data to see if they are still valid or appropriate to use in WCM. If such data are used, data adequacy also needs to be carefully evaluated. When measures have multiple potential data sources, data adequacy helps determine which sources are most appropriate to use for an individual wilderness. In addition, some measures incorporate multiple sources of data to produce a single measure value. Sections 2–6 provide an assessment of data adequacy for each data source, but do not integrate those evaluations into a single overall determination of data adequacy for the measure if multiple data sources are combined. Each local unit must determine the overall data adequacy of these types of measures on a case-by-case basis.

Data quantity refers to the level of confidence that all appropriate data records have been gathered. In determining the best available scientific information for a local unit, "available" refers to information that currently exists in a useful form, and that does not require further data collection, modification, or validation. If the available data are insufficient in quantity, they may still be considered the best available scientific information for the local unit. Data quantity is described by the following three categories:

1. *Complete*—This category indicates a high degree of confidence that all data records have been gathered. For example, to assess the occurrence of nonindigenous plants, a complete inventory of a wilderness was conducted or all likely sites were visited. Similarly, to assess encounters, all trailheads were inventoried.
2. *Partial*—This category indicates a medium degree of confidence that all data records have been gathered. Some data are available but are generally considered incomplete, such as with sampling. For example, to assess the occurrence of nonindigenous plants, only a partial inventory was conducted; to assess encounters, only selected trailheads were sampled.

3. *Insufficient*—This category indicates a low degree of confidence that all records have been gathered. Few or no data records are available. For example, no inventory for nonindigenous plants has been conducted, and encounters were not assessed anywhere, requiring professional judgment in both cases.

Data quality refers to the level of confidence about the data source and whether the data are of sufficient quality to reliably identify trends in the measure. Data quality is assessed by the data's accuracy (the degree to which the data express the true condition of the measure and not other sources of variation affecting the measure), reliability (the degree to which the data follow established or well-developed scientific protocols), and relevance (the degree to which the data are spatially and temporally appropriate for the measure). In general, the highest quality data will be considered the best available scientific information. Data quality is described by the following three categories:

1. *Good*—This category indicates a high degree of confidence that the quality of the data can reliably assess trends in the measure. Data are highly accurate, reliable, and relevant for the measure. For example, data on the occurrence of nonindigenous plants are from ground-based inventories conducted by qualified personnel; for encounters, data comes from encounter monitoring following the national minimum solitude monitoring protocol.

2. *Moderate*—This category indicates a medium degree of confidence about the quality of the data. Data are only moderately accurate, reliable, or relevant. For example, data on nonindigenous plants could come from national or regional databases; for encounters, data could come from visitor permit data.

3. *Poor*—This category indicates a low degree of confidence about the quality of the data. The accuracy, reliability, or relevancy of the data is minimal or unknown. For example, data on nonindigenous plants and encounters data could come from professional judgment.

Local resource specialists must evaluate data quantity and quality for all potential data sources. An overall determination of data adequacy is derived by combining the assessments of both data quality and quantity (see table 2.1.1) and is categorized as high, medium, or low.

Table 2.1.1—Data adequacy matrix displaying data quantity and data quality to determine data adequacy.

		Data quality		
		Good	**Moderate**	**Poor**
Data quantity	**Complete**	High	Medium	Medium
	Partial	Medium	Medium	Low
	Insufficient	Medium	Low	Low

1.2.4 Frequency

Frequency is how often data are compiled, analyzed, and entered into the WCMD. Some measures only need data compilation, analysis, and entry at 5-year intervals because the data are unlikely to change during this period (e.g., the number of dams or communication installations in the measure *Index of Authorized Non-Recreational Physical Development*). Other measures, however, will require annual data compilation, analysis, and entry because the data are likely to change from year to year (e.g., the number of administrative uses of motorized equipment in the measure *Index of Administrative Authorizations to use Motor Vehicles, Motorized Equipment, or Mechanical Transport*). Units may compile, analyze, and enter data for a measure at more frequent intervals than required for each measure, but may not compile, analyze, and enter data at less frequent intervals.

1.2.5 Threshold for Change

For each measure, a threshold, or the amount of change in the data necessary to qualify as a meaningful change in the measure, is identified. This threshold varies across measures due to (1) how inherently variable the data for the measure are likely to be from one year to the next, and (2) the adequacy of the data. Three standard categories are used for thresholds:

1. Any change
2. Percent change
3. Statistically significant change based on regression

The any-change threshold applies to measures for which any change in the data would be meaningful from the perspective of wilderness character. This threshold is typically used for measures where change over time is unlikely or where there is high certainty about changes in the data. For example, this threshold applies to the measure *Acres of Inholdings* because change over time is relatively infrequent and any increase or decrease in inholding acres would be a meaningful change. The any-change threshold is also used for measures where categories are used to determine the trend in the measure. For example, when professional judgment is used for the measure *Acres of Nonindigenous Plant Species*, the any-change threshold is used because any change between the defined categories (none, low-, moderate-, or high-estimated percentage of a wilderness occupied by nonindigenous plants) would be, by definition, a meaningful change.

The percent-change threshold applies to measures that are less sensitive to change, that show variation from year to year, or that have medium data adequacy. Three types of percent-change thresholds are assigned to measures: 3-percent change, 5-percent change, and 10-percent change. The larger percentages indicate a higher likelihood of annual variation or a lower expected data adequacy. For example, the measure *Index of Encounters* uses a 10-percent change threshold due to the natural variation in visitation from year to year and the high likelihood of a low sampling intensity. Similarly, the measure *Index of Nonindigenous Terrestrial Animal Species* uses a 5-percent threshold because species distributions vary naturally over time and data adequacy is likely to be low for many wildernesses. Finally, the measure *Index of Non-Recreational Physical Development* uses a 3-percent change threshold to screen out minor or insignificant changes in the number of developments, such as those discovered when validating data from NRM or from a minor extension of a grazing fence line.

The regression threshold applies to certain measures once they have accumulated a sufficient amount of data and is used because it provides statistical rigor in the long-term analysis of trends in the measures. Regression is a commonly used and relatively simple statistical technique to determine if there is a significant change in one variable, for example, the amount of nitrogen deposition or the number of trammeling actions, in relation to another variable, such as time over several years. There are many different regression models (that is, types or forms of regression) and the appropriate model will be chosen by the central data analyst in consultation with a statistician based on the properties of the data used for each measure.

Using regression to determine whether a trend is statistically significant requires the user to assign the desired degree of confidence, or certainty, in the results, called the alpha level (there is an extensive literature on this topic that is beyond the scope of this technical guide). For all measures that use regression in this technical guide, an alpha level of 0.1 will be used in determining statistical significance, meaning that there is a 10-percent chance of concluding that there is a significant trend when in reality there is not a trend, or conversely that there is 90-percent confidence or certainty that the trend is real. This alpha level allows an appropriate balance between the need to catch trends early while maintaining as much statistical rigor as possible in correctly identifying meaningful trends (see appendix B in Landres et al. 2009 for details on the selection of this alpha level and use of regression).

Typically, at least five data values are needed when using regression, however other factors need to be considered and the central data analyst will need to consult with a statistician to ensure that the data are sufficient and appropriate for using regression. For measures that use an annual frequency (e.g., *Index of Administrative Authorizations to Use Motor Vehicles, Motorized Equipment, or Mechanical Transport*), regression can be used after 5 years of data compilation (measures that use a 3-year rolling average will need 7 years of data compilation) and the trend that is reported for the 5-year WCM cycle will be based on the results of the regression analysis. For measures that use a 5-year frequency (e.g., *Index of Authorized Non-Recreational Physical Development*), regression can be used after 20 years of data compilation. When regression is used, all the available and appropriate data, including legacy data, will be used in the analysis. The WCMD will automatically perform the regression analysis to calculate the trend for the measure, and local and national staff will not need to conduct this analysis.

Several measures start with a percent-change threshold and then switch to using regression once there are sufficient data, which is typically five measure values. Switching to regression is generally not appropriate for measures that use the any-change threshold and measures that use categories for the measure value (such as when professional judgment is used for the measure Acres of Nonindigenous Plant Species as described above). Switching from a rule-based, percent-change threshold to regression may change the resulting trend because the rule-based method determines trend by comparing the most recent measure value with the measure baseline value, whereas regression determines trend using all of the available data. Even if switching to regression causes a change in the trend from one 5-year monitoring cycle to the next, this change is appropriate because of the greater statistical rigor in using regression.

For measures that use the any-change and percent-change thresholds, trend is determined generally by comparing the most recent measure value with the measure baseline value. The WCMD will automatically calculate trends in the measures based on the thresholds for meaningful change described in sections 2–6; neither local nor national staff will need to calculate trends. However, wilderness staff interested in understanding the effects of recent administrative actions, or for other reasons, may choose to assess short-term trends by comparing the two most recent measure values even though these short-term trends are not required for Forest Service WCM upward reporting.

2.0 Untrammeled Quality

Monitoring the Untrammeled Quality assesses how management of a wilderness is trending over time toward more or less human manipulation of plant communities, fish and wildlife populations, insects and disease, soil and water resources, and fire processes. Key indicators and measures monitor actions that are either authorized or unauthorized intentional manipulations of the biophysical environment. This section first provides guidance on what a trammeling action is (section 2.1) and then describes detailed protocols for monitoring the following indicators and measures:

- 2.2 Indicator: Actions Authorized by the Federal Land Manager that Intentionally Manipulate the Biophysical Environment
    - 2.2.1 Measure: Number of authorized actions and persistent structures designed to manipulate plants, animals, pathogens, soil, water, or fire.
- 2.3 Indicator: Actions Not Authorized by the Federal Land Manager that Intentionally Manipulate the Biophysical Environment
    - 2.3.1 Measure: Number of unauthorized actions and persistent structures by agencies, organizations, or individuals that manipulate plants, animals, pathogens, soil, water, or fire.

2.1 What is a Trammeling Action?

This section provides guidelines and examples to clarify what is and is not a trammeling action, based on the recommendations in *Keeping It Wild 2* (Landres et al. 2015). These guidelines and examples should be sufficient to help staff decide most of the cases whether an action is a trammeling or not and provide sufficient guidance for local units to determine novel and rarer cases as they occur. A trammeling action is defined as an action or persistent structure that intentionally manipulates "the earth and its community of life" inside a designated wilderness or inside an area that, by Congressional legislation or agency policy, is managed to preserve wilderness character.

The following terms and phrases clarify the trammeling action definition described above:

- *Intentional*—An action done on purpose, deliberately, or willfully.
- *Manipulation*—An action that alters, hinders, restricts, controls, or manipulates "the earth and its community of life" including the type, amount, or distribution of plants, animals, or physical resources.
- *Intentional manipulation*—An action that purposefully alters, hinders, restricts, controls, or manipulates "the earth and its community of life."

Photo: Red Pine Lake in Little Cottonwood Canyon on the Uinta-Wasatch-Cache National Forest in Utah. Forest Service Photo by Timothy Kennedy.

Two concepts are crucial for understanding what is, and is not a trammeling action: (1) restraint and (2) intention. The first concept, restraining our power to manipulate or control "the earth and its community of life," is at the core of the Untrammeled Quality of wilderness character. Wilderness legislation and policies mandate that federal land managers exercise restraint when authorizing actions that interfere with or control wilderness ecosystems. While other agencies, organizations, and the public are not beholden to these same restraints, activities not authorized by the federal land manager that manipulate the wilderness environment are counted as trammeling actions.

The second concept central to the idea of trammeling is intentionality. Actions that deliberately interfere with, manage, or control an aspect of wilderness ecosystems are intentional and clear instances of trammeling. Section 2.0 of this technical guide, Untrammeled Quality, explains that intentional actions are counted as a trammeling regardless of the magnitude of their effects (including aerial extent, intensity, and duration). For pragmatic reasons, however, some actions are not monitored if they fall below a minimum practical threshold of scale and scope (e.g., hand pulling a few individual nonindigenous invasive plants). In general, when such actions have substantial and foreseeable effects on a wilderness ecosystem, they are counted as a trammeling, as shown in figure 2.2.1 in section 2.1.4 in part 2.

Actions initiated outside the boundaries of a designated wilderness generally do not affect the Untrammeled Quality. However, some actions taken outside of wilderness boundaries do intentionally alter, hinder, restrict, control, or manipulate the "the earth and its community of life" within wilderness. Examples include, but are not limited to, the introduction of game species outside a wilderness with the intention that the animals will occupy habitat within a wilderness, ignition of fire outside of wilderness with the anticipation that fire will burn into wilderness, installation of a dam outside of a wilderness boundary that results in the containment of a watershed within wilderness, or seeding of clouds for weather manipulation over wilderness.

This section describes three types of activities:

1. Activities that are trammeling actions
2. Activities that are not trammeling actions
3. Activities that may be trammeling actions

At the end of this section, a flowchart provides general guidance for making determinations about the three types of activities. Additionally, line officers often make (difficult) decisions to exercise restraint and not take action in wilderness, despite a perceived need. Decisions to not take action in wilderness are not explicitly monitored under this quality, but would be reflected in a lower overall tally of intentional actions taken in wilderness, which equates to less impact to the Untrammeled Quality.

2.1.1 Activities That Are Trammeling Actions

There are two broad classes of trammeling actions: (1) those authorized by the federal land manager, and (2) those that are not. Three subclasses under each broad class reflect whether the action is taken on (a) a biological resource, (b) a physical resource, or (c) a resource outside a wilderness with the intent to manipulate biophysical resources within a wilderness.

Agency authorized trammeling actions are actions that are authorized by the Forest Service as well as actions by other agencies, organizations, or individuals that have been approved or permitted by the Forest Service.

- Examples of actions taken inside wilderness on a biological resource to intentionally affect "the earth and its community of life" include the following:
    - Administrative actions to remove or kill indigenous or nonindigenous vegetation, fish, or wildlife.
    - Adding or restoring indigenous or nonindigenous vegetation, fish, or wildlife.
    - Using chemicals or biocontrol agents to control indigenous or nonindigenous vegetation, fish, or wildlife.
    - Collecting, capturing, or releasing fish and wildlife under a research permit.
    - Enclosing or excluding fish and wildlife from an area.
    - Permitting livestock grazing.
- Examples of actions taken inside wilderness on a physical resource or natural process to intentionally affect "the earth and its community of life" include the following:
    - Taking suppression action on naturally ignited fire.
    - Igniting fire (under management prescription) for any purpose.

    - Constructing or maintaining a dam, water diversion, guzzler, fish barrier, or other persistent installation intended to continuously alter wilderness hydrology.
    - Installing a bat gate on a cave or constructing fencing to an extent sufficient to alter wildlife behavior (e.g., elk or cattle exclosures).
    - Adding acid-buffering limestone to water to neutralize the effects of acid deposition.
    - Collecting fossils, rocks, paleontological specimens under a collection or research permit.
    - Implementing Burned Area Emergency Response (BAER) activities.
- Examples of actions taken outside wilderness on a physical or biological resource or process to intentionally affect "the earth and its community of life" inside a wilderness include the following:
    - Cloud seeding to intentionally increase precipitation inside wilderness.
    - Damming a river outside a wilderness to intentionally alter the hydrology inside wilderness.
    - Killing fish and wildlife outside wilderness, or planting or stocking fish or wildlife outside wilderness, to intentionally affect the population or distribution of this species inside wilderness.

Unauthorized trammeling actions are actions taken by other agencies, organizations, or individuals that the federal land manager has not authorized, approved, or permitted.

- Examples of actions taken inside wilderness on a biological resource to intentionally affect "the earth and its community of life" include the following:
    - Unauthorized removal of or killing indigenous or nonindigenous vegetation, fish, or wildlife with the intent of altering distribution or population dynamics (e.g., predator control).
    - Unauthorized addition or restoration of indigenous or nonindigenous vegetation, fish, or wildlife.
    - Indirect manipulation of fish and wildlife, such as changing hunting regulations with the goal of decreasing predator populations within wilderness.

  - Illegal livestock grazing, provided that there is reasonable certainty that grazing activities in wilderness were intentional as opposed to unintentional (e.g., resulting from poorly maintained fencing).

- Examples of actions taken inside wilderness on a physical resource or natural process to intentionally affect "the earth and its community of life" include the following:

  - Setting arson fire.

  - Modifying water resources to provide water for wildlife, or otherwise store water or alter the timing of water flow.

- Examples of actions taken outside wilderness on a physical or biological resource to intentionally affect "the earth and its community of life" inside a wilderness includes the following:

  - Killing individual animals outside of wilderness with the intention to affect populations whose ranges expand into wilderness.

  - Releasing individual animals outside of wilderness with the intention to affect populations whose ranges expand into wilderness.

In some situations, Forest Service land managers may assume that they do not have an opportunity for restraint because an action is required to comply with other laws or agency policies, or to protect human life or property. Examples of such situations include restoring habitat for a listed endangered species, spraying herbicides to eradicate an invasive nonindigenous plant that is degrading wildlife habitat, transplanting an **extirpated species** back into a wilderness, or suppressing a naturally ignited fire. These are still considered trammeling actions because even in these situations there is a decision to take action, as well as a decision about the type and intensity of action.

2.1.2 Activities That Are Not Trammeling Actions

Actions for which there is no opportunity for restraint are not considered a trammeling. For example, climate change, air pollutants drifting into a wilderness, and the presence of nonindigenous species that naturally dispersed into a wilderness are not the result of deliberate decisions or actions, and therefore, do not provide an opportunity for restraint. Accidental unauthorized actions, such as escaped campfires and oils spills, similarly lack an opportunity to restrain individuals' power over the landscape. Past actions that manipulated the biophysical environment before the designation of the area as wilderness are not considered a trammeling because the provisions of the 1964 Wilderness Act did not apply to the area prior to designation.

Another group of examples that are not a trammeling encompass those small-scale actions with no intent to manipulate "the earth and its community of life," such as installing meteorological or other science instrumentation, landing a helicopter for search and rescue operations, and removing trash. Camping violations, incidental development of campsites, unauthorized motorized incursions, littering, and other illegal activities not intended to manipulate the biophysical environment also are not counted as trammeling actions because legality is irrelevant in determining whether an action is a trammeling.

Hunting, for sport or subsistence, has provoked an enormous amount of interagency discussion about whether it degrades the Untrammeled Quality. The general interagency consensus is that hunting is not a trammeling action because individual hunters are taking individual animals without the intention to manipulate the wildlife population. However, if a state wildlife agency increases predator bag limits in a wilderness to purposefully alter the predator-prey relationship to maximize the viability of a game species, this manipulation of the "community of life" would degrade the Untrammeled Quality.

2.1.3 Activities That May Be Trammeling Actions

There are two types of actions that may or may not be considered trammeling actions. The first includes intentional manipulations that interfere with or control an aspect of wilderness ecosystems but are too small in scale or scope to be practically monitored. The second type encompasses those nuanced cases where the primary purpose of the action is not to manipulate the ecosystem, but a foreseeable and substantial effect on the earth and its community is required to achieve this purpose. This second type of action can be confusing because it still results in intentional manipulations of the biophysical environment even though that was not the primary purpose. As shown in table 2.2.1, several example situations illustrate how an action may or may not be a trammeling, depending on the extent of the action and its effects. The table columns "Likely Not a Trammeling" and "Likely a Trammeling" present situations where the action being taken would not, or would be considered a trammeling.

Table 2.2.1—Examples of actions that likely are not and likely are trammeling actions based on the scale and scope of the action and its effects on "the earth and its community of life."

Action	Likely not a trammeling	Likely a trammeling
Treating nonindigenous invasive plants	Hand pulling a small area of nonindigenous invasive plants	Spraying any herbicide
Permitting scientific activities	• Installing research plot monumentation, such as rebar stakes or nails • Installing most scientific instrumentation • Collecting a limited number of voucher specimens with no impact on species distribution or abundance	• Installing enclosures or exclosures • Installing instrumentation that disrupts the movement or behavior of plants, fish, or wildlife • Capturing, collaring, and releasing wildlife
Building system trail	• Rerouting a small section of trail • Building a bridge across a stream to prevent stream bank erosion • Installing a small section of corduroy across a wet area • Installing waterbars or building rock-cribbing	• Routing a trail through an area of sensitive alpine butterfly habitat • Constructing a large amount of trail to reroute around an obstacle • Building a trail that requires extensive earth movement or tree cutting
Obliterating non-system trail	Piling vegetation or rocks at the beginning and end of trail sections that cut a switchback	Obliterating a large section of non-system trail that requires extensive earth movement
Restoring campsites	• Restoring a single, isolated campsite • Restoring a number of campsites that do not require disrupting the soil or vegetation in the surrounding area	Restoring a number of campsites that requires moving a significant amount of soil or number of plants in the surrounding area
Removing hazard trees	Removing one or a few hazard trees that threaten designated campsites	Removing all of the hazard trees over large area

2.1.4 Trammeling Flowchart

The flowchart depicted in figure 2.2.1 provides general guidelines using a series of questions to help agency staff determine when an action should be considered a trammeling. The first question asks if there is an opportunity for restraint, and is placed first to help avoid confusing those actions that are beyond the scope of management control, or are unauthorized accidents, from actions that Forest Service land managers or others do have an opportunity to influence. Political considerations are not a factor in determining whether or not there is an opportunity for restraint. The second question examines the intentionality of the action and whether the purpose is to manipulate "the earth and its community of life." If there is a clear intent to manipulate, then the action is counted as a trammeling unless it does not meet a minimum threshold for practicable monitoring. If the purpose of the activity is not to manipulate the ecological system, the action is nonetheless considered a trammeling if it results in foreseeable and substantial effects to the wilderness ecosystem.

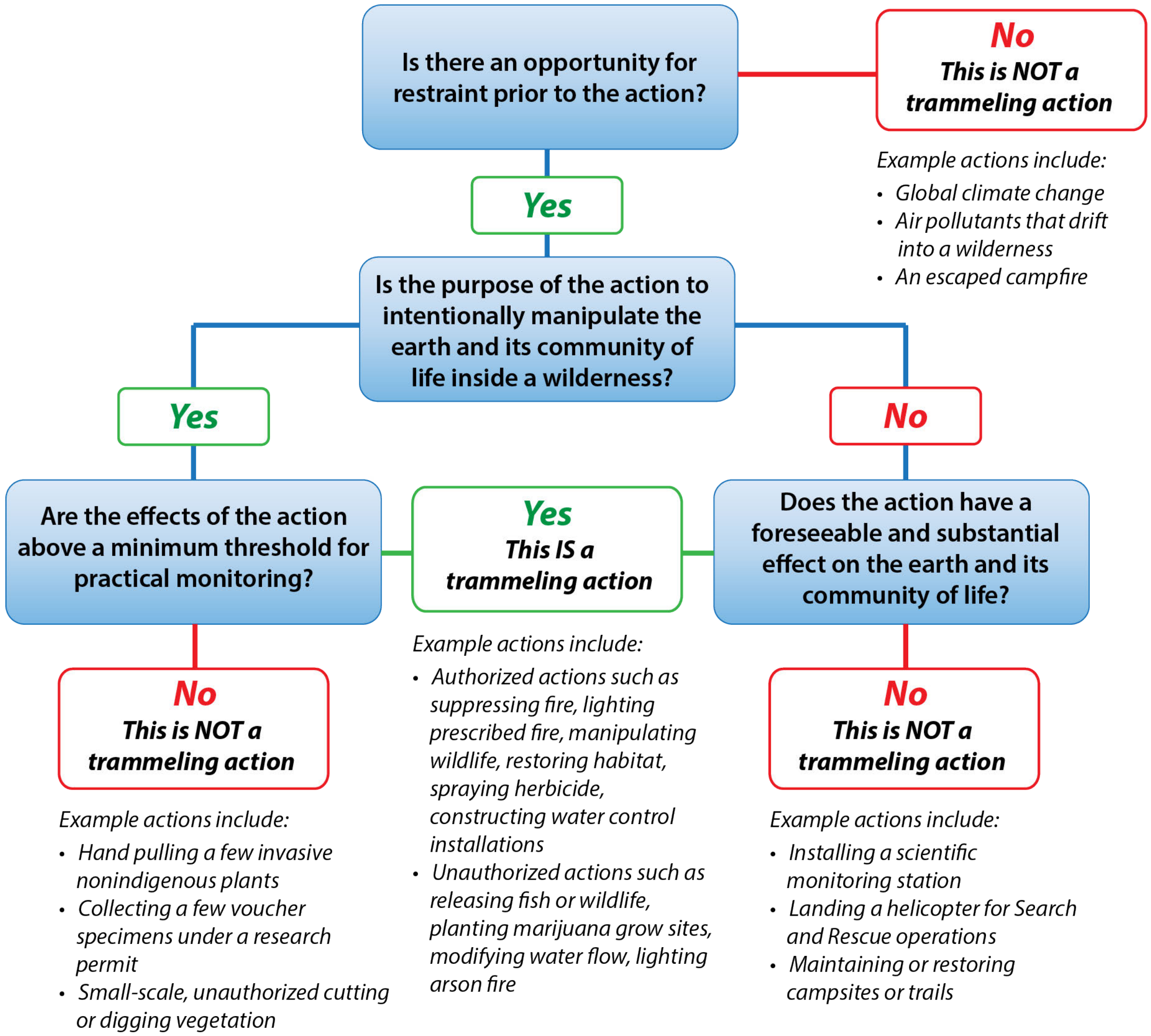


Figure 2.2.1—Flowchart to determine if an action qualifies as a trammeling.

2.2 Indicator: Actions Authorized by the Federal Land Manager that Intentionally Manipulate the Biophysical Environment

This indicator focuses on actions and persistent structures authorized by the agency that intentionally manipulate the biophysical environment. There is one required measure for this indicator.

2.2.1 Measure: Number of Authorized Actions and Persistent Structures Designed to Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire

This measure assesses the 3-year rolling average of authorized trammeling actions, based on an annual count of authorized actions and persistent structures intended to manipulate any component of the biophysical environment within wilderness (including vegetation, fish, wildlife, insects, pathogens, soil, water, or fire). Local data are compiled and entered in NRM-WCM annually. NRM-WCM calculates the annual value, and the WCMD then calculates the 3-year rolling average (the measure value). Table 2.2.2 describes the key tasks for this measure.

Table 2.2.2—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for the measure "Number of Authorized Actions and Persistent Structures Designed to Manipulate Plants Animals, Pathogens, Soil, Water, or Fire."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required	None	Step 1: Ensure users understand what constitutes authorized trammeling and then compile data. Step 2: Count the number of authorized trammeling actions that occurred during the fiscal year. Step 3: Enter data in NRM and the WCMD.	None	1 year

Protocol

Step 1: Ensure users understand what constitutes authorized trammeling and then compile data. Detailed information about how to determine what is, is not, and may be a trammeling action, including numerous examples, can be found in section 2.1 in part 2. This measure includes discretionary and non-discretionary actions required to uphold Federal law, including those explicitly allowed under the Wilderness Act and subsequent wilderness legislation. For example, permitted livestock grazing authorized by the designating legislation for a wilderness is counted as a trammeling action. Intentional manipulations taken by other federal agencies, tribal or state agencies, organizations, and private citizens are also included under this measure if these actions are authorized by the Forest Service. This includes actions authorized through special use permits (SUPs) or other instruments (e.g., research actions, state fish and wildlife management actions).

Due to the wide variety of types of actions counted under this measure, there is no single source for data. The complexity of data compilation for this measure depends on the size of a given wilderness, its location, whether its management is shared with another district, forest, or agency, and on other factors that may not be predictable on a year-to-year basis. A recommended starting point in the compilation of data for this measure is to coordinate with wilderness rangers, wilderness managers, forest and district specialists, and the unit line officer to compile a list of readily known actions (including persistent structures), and to gauge the level of confidence that this list is comprehensive. If this initial list of actions is not comprehensive, other potential data sources to confirm whether or not additional actions were implemented include **minimum requirements analyses (MRA)**, National Environmental Policy Act (NEPA) documents, Pesticide Use Proposals, SUPs, fire narratives, (ICS-209 forms), Forest Service corporate databases (e.g., NRM-Wilderness, Forest Service Activity Tracking System [FACTS], Project Activity Levels [PALS], Fire Statistics System [FIRESTAT], Wildland Fire Decision Support System [WFDSS]), and state agency records.

Step 2: Count the number of authorized trammeling actions that occurred during the fiscal year. Where questions arise as to whether a seemingly inconsequential action truly manipulates "the earth and its community of life," the scale of an action can help determine whether or not the action constitutes trammeling. If the magnitude of an action's consequences will exceed a certain threshold, the action is counted as a trammeling. All trammeling actions that cross this threshold are counted equally, regardless of the extent of their effects (e.g., spraying herbicide on a small population of noxious weeds is equivalent to spraying herbicide across 1,000 acres; an herbicide treatment of weeds targeting one species is equivalent to an herbicide treatment targeting five species simultaneously). Below the established threshold, actions are not considered to be of sufficient magnitude to be counted as a trammeling for this monitoring effort (e.g., hand pulling a small number of invasive plants, removing a downed tree across a trail, or restoring a campsite).

The counting protocol for authorized trammeling actions is as follows, with counting instructions grouped in categories including scale of action, timing of action, location of action, fire-related actions, persistent structures, and other clarifications:

Scale of Action

- Only count actions that are of sufficient scale to qualify as trammeling actions for practicable monitoring, as described above and in section 2.1 in part 2.
- All actions that meet the scale requirements for monitoring trammeling actions are counted equally, regardless of the magnitude of their effects.
- Actions that are individually too small in scale to be counted as trammeling actions are considered a trammeling if their **cumulative effects** crossed the threshold described above and in section 2.1 in part 2. For instance, removing a single hazard tree in a campsite is not considered a trammeling. However, an

insect or disease event that killed many trees in an area with many campsites and resulted in the removal of a large number of hazard trees could be considered a trammeling. Local units must use their discretion and judgment in determining when cumulative effects cross the threshold resulting in a series of otherwise minor actions constituting a trammeling, including whether subsequent yet discrete actions add to these cumulative effects and constitute additional trammeling actions.

Timing of Action

- Ongoing, multi-year actions are counted once annually per fiscal year.
- A single action that incidentally spans the fiscal year is only counted as a trammeling action for the initial fiscal year. For example, a watershed stabilization project implemented between September 15 and October 15, 2015, counts as one action for fiscal year 2019 and zero actions for fiscal year 2020.

Location of Action

- The decision to take an action that occurs simultaneously in multiple locations in a wilderness is counted as a single action. For example, treatments of discrete invasive species populations located in different areas using herbicide counts as a single action. Similarly, concurrently stocking fish in multiple lakes across a wilderness counts as a single trammeling action.
- Actions that occur outside of wilderness with the explicit intent of manipulating the biophysical environment within wilderness count as trammeling actions.

Fire-related Actions

- Management or suppression of a wildfire —whether naturally ignited or human-caused—counts as a single trammeling action per fire, regardless of the number or type of fire management actions taken. Types of fire management actions may include:
    - Fireline construction (handline, tree felling, explosives, dozer line, wet line, leaf blowers, sprinkler systems, or mechanical clearing of safety zones).
    - Burn operations (backfiring, burn outs, or black lining).
    - Extinguishing fire (use of water, dirt, or flappers).
    - Application of fire retardant.

For example, suppression of a single wildfire by constructing a fireline and conducting burn operations during the course of the incident would count as one trammeling action. However, the construction of a fireline on two discrete wildfires in a wilderness in the same fiscal year counts as two trammeling actions.

- The issue of scale described in section 2.1 does not apply to management of wildfire because seemingly minor attempts to alter the behavior of a natural fire can have significant consequences. For instance, cutting down and suppressing a burning snag started by lightning—an action that is seemingly small in scale—may prevent a natural fire that otherwise may burn thousands of acres. Note, however, that actions taken on campfires that are not yet wildfires do not count as trammeling actions. For example, putting out an abandoned campfire that is still contained within a fire ring as part of routine wilderness maintenance would not count as a trammeling action.

- Suppression of a fire adjacent to but outside of wilderness constitutes a trammeling action when there is reasonable certainty that it would have likely burned into wilderness absent any suppression action (given factors such as slope, terrain, fuels, weather, fire behavior, and specific suppression actions taken) and when the action is taken with the explicit intent of preventing or limiting fire within wilderness. For example, suppression action taken on a fire 20 miles from the wilderness boundary may count as a trammeling action if conditions are extremely dry and there are high winds in the direction of the wilderness. In contrast, suppression action taken on a creeping fire in leaf litter 75 feet from the wilderness boundary may not count as a trammeling action if there's 78% percent humidity and it is unlikely the fire will spread.

- The use of **prescribed fire**, regardless of the tactics used to manage the burn, counts as a single trammeling action because of the decision to intervene in natural processes in accordance with the management prescription developed by the agency. The implementation of multiple prescribed fires in a wilderness in a single fiscal year also counts as a single trammeling action if each burn was authorized via the same burn plan. Prescribed fires conducted in the same fiscal year authorized by multiple burn plans—for instance in a wilderness managed by two Forest Service regions or forests—counts as multiple trammeling actions.

- Different types of BAER treatments—where they pass the threshold for scale—constitute separate trammeling actions for each incident they are associated with.

Persistent Structures

- To be counted as a trammeling action, a persistent structure must be intended to purposefully alter, hinder, restrict, control, or manipulate the "the earth and its community of life." Examples of persistent structures that would be counted under this measure include, but are not limited to fish barriers, dams, water diversions, guzzlers, bat gates, or fencing (e.g., wildlife or cattle enclosure areas). Each unique persistent structure that manipulates any component of the biophysical environment is counted for each year that it exists.

- An action to install a persistent structure that alters the biophysical environment in wilderness is counted once as a trammeling in the year that the installation occurred and once per year subsequently, as long as the structure persists. The installation and existence of the structure in the first year are not double counted as two trammeling actions. Persistent structures that are no longer functioning as intended are not counted as a trammeling if it can be demonstrated they do not alter or manipulate any component of the biophysical environment (e.g., fencing previously used to form a cattle exclosure that has fallen down).

Other Clarifications

- Single projects or decisions that involve related yet distinct actions count as multiple trammeling actions. For example, a stream restoration project that involves both the release of piscicide and restocking native fish count as two trammeling actions. Treating one or more species of invasive plants with herbicide and a biological control agent also count as two trammeling actions—one action for the use of herbicide, and one action for the release of the biological control agent. The number of species affected by each treatment is incidental.
- Actions intended to manipulate the biophysical environment within wilderness that are unsuccessful are still counted as trammeling actions.

Step 3: Enter data in NRM and the WCMD. Track trammeling actions annually and enter them into the NRM-WCM application for each fiscal year. NRM-WCM will sum the counts of all authorized trammeling actions to generate an annual value. Local units must then validate the value generated by NRM-WCM and correct records in NRM as necessary. Once validated, enter the annual value in the WCMD. The WCMD automatically calculates 3-year rolling averages based on the annual values. The measure value is the 3-year rolling average number of trammeling actions.

<u>*Caveats and Cautions*</u>

When a unit experiences a large wildfire managed by an Incident Management Team, these data can be difficult to obtain. Units are therefore encouraged to seek out data on trammeling actions during or soon after the incident. In addition, interpretation of the number of trammeling actions associated with an action or decision—in particular with fire management, and occasionally with other types of management actions—may vary due to the potential complexity of determining what constitutes a trammeling action. Units should therefore provide a narrative in the WCMD describing the methodology and considerations behind any nuanced or complex trammeling interpretations.

When deciding which specific 3 years of data to include to calculate the rolling average for this measure, always defer to the highest data adequacy available (section 1.2.3 in part 2). Ideally the data with the highest degree of adequacy will also be the most recent data collected, but this might not always be the case.

Data Adequacy

Data adequacy is typically medium to high, though this should be verified and documented locally. In many cases it is likely that all data records related to authorized actions and persistent structures that manipulate the biophysical environment can be gathered, although this may be difficult for large wildernesses or wildernesses managed by more than one forest or Forest Service region. Data quantity is therefore often complete and data quality is good.

Frequency

Data are compiled, analyzed, and entered into the WCMD annually due to the variable nature of trammeling actions.

Threshold for Change

The threshold for meaningful change is a 5-percent change in the 3-year rolling average number of authorized actions and persistent structures. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the 3-year rolling average beyond the threshold for meaningful change results in an improving trend in this measure.

2.3 Indicator: Actions Not Authorized by the Federal Land Manager that Intentionally Manipulate the Biophysical Environment

This indicator focuses on actions that are not authorized by the agency, but that intentionally manipulate ecological systems in wilderness. There is one required measure for this indicator.

2.3.1 Measure: Number of Unauthorized Actions and Persistent Structures by Agencies, Organizations, or Individuals That Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire

This measure assesses the 3-year rolling average of unauthorized trammeling actions based on an annual count of known actions not authorized by the Forest Service taken by other federal and state agencies, organizations, or individuals that are intended to manipulate any component of the biophysical environment within wilderness (including vegetation, fish, wildlife, insects, pathogens, soil, water, or fire). Local data are compiled and entered in NRM-WCM annually. NRM-WCM calculates the annual value, and the WCMD then calculates the 3-year rolling average (the measure value). Table 2.2.3 describes key features for this measure.

Table 2.2.3—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure “Number of Unauthorized Actions that Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire.”

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required	None	Step 1: Ensure users understand what constitutes unauthorized trammeling and then compile data. Step 2: Count the number of unauthorized trammeling actions that occurred during the fiscal year. Step 3: Enter data in NRM and the WCMD.	None	1 year

<u>*Protocol*</u>

Step 1: Ensure users understand what constitutes unauthorized trammeling and then compile data. Section 2.1 provides detailed information about how to determine what is, is not, and may be a trammeling action, including numerous examples. Unauthorized trammeling actions may be taken by different branches of the Forest Service, other federal agencies, tribal and state agencies, organizations, or private citizens. Actions taken by state or other government agencies with the knowledge and approval of the Forest Service through a SUP or cooperative agreement are considered authorized actions and counted under the measure *Number of Authorized Actions and Persistent Structures Designed to Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire* (see section 2.2.1 in part 2). Actions taken by states or other government agencies with the knowledge of the Forest Service but *without* explicit approval through a SUP or another instrument are counted under this measure.

Due to the wide variety of types of actions counted under this measure, there is no single source for data. The complexity of data compilation for this measure depends on the size of a given wilderness, its location, and whether its management is shared with another local unit, national forest, or federal agency. The complexity is also influenced by the fact that unauthorized actions are not predictable on a year-to-year basis, and unauthorized actions often go unreported or even undiscovered.

A recommended starting point in the compilation of data for this measure is to coordinate with wilderness rangers, wilderness managers, interdisciplinary team members, law enforcement, and the local unit line officer to compile a list of readily known unauthorized actions and persistent structures, and to gauge the level of confidence that the list is comprehensive. Other potential data sources include the Forest Service Law Enforcement and Investigations Management Attainment Reporting System (LEIMARS), state agency records, partner or watchdog organizations, and volunteers.

Step 2: Count the number of unauthorized trammeling actions that occurred during the fiscal year. Where questions arise as to whether a seemingly inconsequential action truly manipulates “the earth and its community of life,” the scale of an action can help determine whether or not the action constitutes trammeling. If the magnitude of an action’s consequences will exceed a certain threshold, the action is counted as a trammeling. All trammeling actions that cross this threshold are counted equally, regardless of the extent of their effects. Below the established threshold, actions are not considered to be of sufficient magnitude to be counted as a trammeling for this monitoring effort.

The counting protocol for unauthorized trammeling actions is as follows, with counting instructions grouped in categories including scale of action, timing of action, location of action, persistent structures, and other clarifications:

Scale of Action

- Only count actions that are of sufficient scale to qualify as trammeling actions for practicable monitoring, as described above and in section 2.1 in part 2.
- All actions that meet the scale requirements for monitoring trammeling actions are counted equally, regardless of the magnitude of their effects. Due to the uncertainty as to who is responsible for a given trammeling action, evidence of each unauthorized trammeling action that is discovered at different times or in different places is counted as a distinct trammeling action.
- Actions taken by a single individual or entity that are individually too small in scale to be counted as trammeling actions are considered a trammeling action if their cumulative effects crossed the threshold described above and in section 2.1 in part 2. For instance, illegal cutting of a single tree is not considered a trammeling action. However, illegal theft of timber over a larger area or the illegal cutting of a ski run may be considered trammeling actions. Local units must use discretion and judgment in determining when cumulative effects cross the threshold resulting in a series of otherwise minor actions constituting a trammeling, including whether subsequent yet discrete actions add to these cumulative effects and constitute additional trammeling actions.

Timing of Action

- Ongoing, multi-year unauthorized actions are counted once annually per fiscal year (e.g., marijuana cultivation or repeated unauthorized state fish and game agency management actions).

Location of Action

- Unauthorized actions taken in multiple locations in a wilderness by a single individual or entity is counted as a single action. For example, concurrently stocking fish in multiple lakes across a wilderness counts as a single trammeling action.
- Unauthorized actions that occur outside of wilderness intended to manipulate the biophysical environment within wilderness count as trammeling actions. For example, the introduction of game species outside of wilderness with the intent that they travel into wilderness, when not explicitly authorized by the agency based on the results of a minimum requirements analysis (MRA), counts as a trammeling action.

Persistent Structures

- To be counted as a trammeling action, a persistent structure must be intended to purposefully alter, hinder, restrict, control, or manipulate the "the earth and its community of life." Examples of persistent structures that would be counted under this measure include, but are not limited to fish barriers, dams, water diversions, guzzlers, bat gates, or fencing (e.g., wildlife or cattle enclosure areas). Each unique, unauthorized persistent structure that manipulates any component of the biophysical environment is counted for each year that it exists.
- The unauthorized installation of a persistent structure that alters the biophysical environment in wilderness (e.g., an impoundment and irrigation tubing for illegal marijuana cultivation, unauthorized installation of fencing) is counted once as a trammeling in the year that the installation occurred, and once per year subsequently as long as the structure persists. The installation and existence of the structure in the first year are not double counted as two trammeling actions. Persistent structures that are no longer functioning are not counted as a trammeling if it can be demonstrated they do not alter or manipulate any component of the biophysical environment (e.g., fencing previously used to form a cattle exclosure that has fallen down).

Other Clarifications

- Evidence of an unauthorized trammeling, as opposed to an agency employee witnessing the trammeling action in progress (e.g., the discovery of an abandoned marijuana grow site), is sufficient to count as a trammeling action.
- Related yet distinct types of actions count as multiple trammeling actions. For example, an unauthorized state wildlife management project that involves

introducing game species and controlling predators via increased bag limits count as two trammeling actions. The magnitude or effects of these actions does not have any bearing on the number of trammeling actions reported.

Step 3: Enter data in NRM and the WCMD. Track trammeling actions annually and enter them into the NRM-WCM application for each fiscal year. NRM-WCM will sum the counts of all unauthorized trammeling actions to generate an annual value. Local units must then validate the value generated by NRM-WCM and correct records in NRM as necessary. Once validated, enter the annual value in the WCMD. The WCMD automatically calculates 3-year rolling averages based on the annual values. The measure value is the 3-year rolling average number of trammeling actions.

Caveats and Cautions

This measure depends on a combination of incidental, chance encounters and the amount of effort spent to find unauthorized actions. For instance, the reintroduction of game species by a state agency without explicit authorization might be incidentally discovered through media reports. Conversely, water diversions associated with a marijuana grow site are typically discovered because of law enforcement investigations, though such a use could also be discovered after an incidental report from the public. Due to the unpredictable nature by which unauthorized trammeling actions and persistent structures are discovered, information about the method and level of effort required for a given discovery should be documented in the WCMD to allow for an understanding of data adequacy when comparing results across multiple years of reporting.

When deciding which specific 3 years of data to include to calculate the rolling average for this measure, always defer to the highest data adequacy available (section 1.2.3 in part 2). Ideally the data with the highest degree of adequacy will also be the most recent data collected, but this might not always be the case.

Data Adequacy

Data adequacy is medium or low, though this should be verified and documented by the local unit. It may not be feasible to reliably gather all applicable data, and knowledge of some unauthorized actions may rely on incidental, chance encounters. Data quantity is partial and data quality is moderate. Additionally, knowledge of unauthorized actions is dependent on field or law enforcement presence and the amount of effort put into identifying unauthorized actions, which should be documented in the WCMD.

Frequency

Data are compiled, analyzed, and entered into the WCMD annually due to the variable nature of trammeling actions.

Threshold for Change

The threshold for meaningful change is a 5-percent change in the 3-year rolling average number of unauthorized actions and persistent structures. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the 3-year rolling average beyond the threshold for meaningful change results in an improving trend in this measure.

3.0 Natural Quality

Monitoring the Natural Quality assesses how human-caused change affects ecological systems. Key indicators and measures monitor plants, animals, air and water, and ecological processes. This section provides detailed guidance for monitoring the following indicators and measures:

- 3.2 Indicator: Plants
  - Measure: Acres of Nonindigenous Plant Species
- 3.3 Indicator: Animals
  - Measure: Index of Nonindigenous Terrestrial Animal Species
  - Measure: Index of Nonindigenous Aquatic Animal Species
- 3.4 Indicator: Air and Water
  - Measure: Concentration of Ambient Ozone
  - Measure: Deposition of Nitrogen
  - Measure: Deposition of Sulfur
  - Measure: Amount of Haze
  - Measure: Index of Sensitive Lichen Species
  - Measure: Extent of Waterbodies With Impaired Water Quality
- 3.5 Indicator: Ecological Processes
  - Measure: Watershed Condition Class
  - Measure: Number of Animal Unit Months of Commercial Livestock Use

Section 3.6, Selecting Measures for the Natural Quality, provides recommendations for identifying and establishing locally developed measures in the Natural Quality. It discusses the general considerations for developing these measures, explains why certain types of measures are problematic, offers examples to clarify what are and are not appropriate measures, and provides a flowchart outlining the general process.

Photo: Buckwheat in bloom. Fishlake National Forest. Forest Service photo by Kelly L Memmott, Forest Service, Intermountain Region

3.2 Indicator: Plants

This indicator focuses on threats to indigenous plant species and communities. There is one required measure for this indicator.

3.2.1 Measure: Acres of Nonindigenous Plant Species

This measure assesses the total number of acres, or the estimated percentage of acres, occupied by selected nonindigenous plant species in wilderness. Local units may select the appropriate protocol option as described in step 2 below. Data are compiled from a variety of local, state, regional, and national data sources. Local staff calculate the measure value. Table 2.3.1 describes key features for this measure.

Table 2.3.1—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Acres of Nonindigenous Plant Species."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required	Protocol Option 1: Total Acres Protocol Option 2: Categories Based Partially on Data Protocol Option 3: Categories Based on Professional Judgment	Step 1: Develop a list of known nonindigenous plants in the wilderness and select species for monitoring. Step 2: Determine the wilderness acreage currently occupied by each selected species and calculate the total number of acres, or the estimated percentage of acres, for all species. Step 3: Enter data in the WCMD.	None	5 years

<u>*Protocol*</u>

Step 1: Develop a list of known nonindigenous plants in the wilderness and select species for monitoring. There may be many nonindigenous plants within a wilderness, but for practical reasons, it is recommended that local units select up to five species that pose the greatest ecological risk to native plant communities for use in this measure. Local units, however, may select as many species as they want but will need to balance practicality with the number of species selected considering the quality and availability of inventory data for the selected species. Selecting these species should consider the invasiveness or ability to spread and occupy new habitat, the amount of habitat at risk, and the potential impact of these species on indigenous plants and animals. If there is certainty that only natural vectors enabled a nonindigenous plant species to become established in a wilderness (i.e., via natural range expansion or movement), then that species would not be included. If, however, there is ambiguity about how the species was introduced (whether natural or human-caused), then the species would be included. Nonindigenous plant species that were present at the time of wilderness designation should be included for consideration in this measure. Consult the local botanist, invasive species program manager, ecologist, range conservationist, or other local sources of knowledge on nonindigenous plants to select species for this measure. Over time, new species can be added to the list of

selected species, and species already on the list can be replaced with different species; any modification of the list of selected species should be considered carefully as changes in the acreage occupied by selected nonindigenous plant species may affect the trend in this measure.

Step 2: Determine the wilderness acreage currently occupied by each selected species and calculate the total number of acres, or the estimated percentage of acres, for all species. A variety of data sources may be necessary for this measure, and data sources may vary by species. Acreage data for each selected species can be based on actual surveys, observation, or professional knowledge. Current and past nonindigenous plant data are available from the NRM application for Threatened, Endangered, and Sensitive Plants, and Invasive Species (NRM-TESP-IS). To retrieve spatial data on selected species from NRM for this measure, consult a specialist familiar with the NRM application and GIS to perform the necessary queries. Examples of other sources of data concerning nonindigenous plant species for a particular area include the following:

- Forest Service resource specialist on the local unit where a wilderness is located (i.e., forest botanist, range specialist ecologist, or invasive species coordinator).
- Individual state Department of Natural Resources invasive species program.
- The Natural Heritage Program.
- Local weed associations by state or county.
- Forest Inventory and Analysis (FIA)

Data adequacy for all data sources likely varies greatly depending on the wilderness and the species of interest. It is strongly recommended that local natural resource specialists, such as forest botanists, ecologists, or invasive species coordinators, be consulted to validate the data, especially if national datasets are used. If the determination of species extent is based partially or entirely on professional judgment, include additional documentation (e.g., a brief narrative) explaining who made the assessment and their basis for the estimation.

To accommodate the reality that data may not be available for a wilderness, or that data adequacy may be insufficient to accurately assess the total number of acres for one or more selected species, the following section describes three protocol options for using this measure in order of decreasing data adequacy.

Protocol Option 1—Total Acres. The first protocol option assesses the total number of acres occupied by the selected species (e.g., 10 acres). Use this protocol option if the acreage of all selected species can be determined with sufficient data adequacy. Calculate the total number of wilderness acres occupied by one or more selected nonindigenous species to attain the measure value; do not double count acres if more than one of the species occur in the same location. For example, if there are four selected species that each occupy 10 acres and the distribution of all four species does not overlap, the total area reported would be 40 acres (10 for species a + 10 for species b + 10 for species c + 10 for species d). If the distribution of two of these species completely overlapped, the total area reported would be 30 acres (10 for species a + 10 for species b + 10 for the overlapped distribution of species c and species d).

Protocol Option 2—Categories Based Partially on Data. The second protocol option assesses the estimated percentage of acres occupied by selected nonindigenous plant species, using set "percent occupied" categories. Use this protocol option if data exist but there are concerns about how recent the data are, or about the quality or spatial coverage of the data. Similarly, if data adequacy is variable for different species, it may be appropriate to use this protocol option. For this protocol option, resource specialists must estimate the percentage of wilderness acres occupied by the selected nonindigenous plant species based on existing data as well as supplementary professional knowledge. Assign the applicable "percent occupied" amount from the seven categories described in the list below. These categories are scaled conservatively to emphasize the impact on the Natural Quality of wilderness character.

- *None*—0% of total wilderness acreage.
- *Very Low*—less than 1 percent of the total wilderness acreage.
- *Low*—1 to 5 percent of the total wilderness acreage.
- *Moderate*—6 to 20 percent of the total wilderness acreage.
- *High*—21 to 35 percent of the total wilderness acreage.
- *Very high*—36 to 50 percent of the total wilderness acreage.
- *Extreme*—greater than 50 percent of the total wilderness acreage.

Protocol Option 3—Categories Based on Professional Judgment: The third protocol option also assesses the estimated percentage of acres occupied by selected species, but uses broader "percent occupied" categories than the previous option. Use this protocol option when there are little or no data on which to base an estimate of the acreage of selected species and there is lower confidence in the estimate. Resource specialists must estimate the percentage of wilderness acres occupied by the selected nonindigenous plant species based on professional knowledge. Assign the applicable "percent occupied" amount from the following four categories:

- *None*—less than 1 percent of the total wilderness acreage.
- *Low*—1 to 5 percent of the total wilderness acreage.

- *Moderate*—6 to 20 percent of the total wilderness acreage.
- *High*—greater than 20 percent of the total wilderness acreage.

Step 3: Enter data in the WCMD. If protocol option 1 was selected, enter the total number of acres; if protocol options 2 or 3 were selected, enter the applicable "percent occupied" category of the estimated percentage of acres. The measure value is either the number of acres or the "percent occupied" category.

Caveats and Cautions

Comprehensive and systematic surveys in wilderness for nonindigenous terrestrial plants are typically lacking, with data coming from sporadic and infrequent visits from resource specialists who have the knowledge to identify these species. Wildernesses are typically remote and often viewed as not needing basic resource inventories to guide management so even if a systematic survey has been conducted, it may not be repeated. If either the second or third protocol option based on categories is used, resource specialists should note in a narrative if there are particular species that currently occur across less than 1 percent of the wilderness acreage but have the potential for significant spread and advese impacts if environmental or other conditions change.

Data Adequacy

Data adequacy varies depending on the protocol option used. For the first protocol option that relies on existing data, overall data adequacy is generally considered medium or high; data quality is generally good (e.g., ground level inventory) or moderate (e.g., data from regional or national databases), and data quantity is partial or complete as there are likely data on selected species for most or all of a wilderness. For the second protocol option that relies on a combination of existing data and professional judgment, data adequacy is generally considered medium or low because data quality is likely moderate or poor and data quantity is likely partial or insufficient. For the third protocol option that relies extensively on professional knowledge, data adequacy is likely low because data quality is poor and data quantity is likely insufficient or partial. Data adequacy must be verified locally for all protocol options.

Frequency

Every 5 years, the spatial extent of selected nonindigenous plant species is assessed and the total number of acres (protocol option 1), or the applicable "percent occupied" category of the estimated percentage of acres (protocol options 2 and 3), is entered in the WCMD.

Threshold for Change

The threshold for meaningful change differs depending on the protocol option used. If the first protocol option is used, the threshold is a 5-percent change in the total number of acres occupied by selected nonindigenous plant species. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. If either the second or third protocol option is used, the threshold is any change in categories. Either a decrease in the total acreage beyond the 5-percent threshold for meaningful change, or a change to a lower "percent occupied" category, results in an improving trend in the measure.

3.3 Indicator: Animals

This indicator focuses on threats to indigenous animal species and communities. There are two measures for this indicator and units are required to select at least one.

3.3.1 Measure: Index of Nonindigenous Terrestrial Animal Species

This measure is an index that assesses the geographic distribution and estimated impact of selected nonindigenous terrestrial animal species. Data are compiled from a variety of local, state, regional, and national data sources. The WCMD calculates the measure value. Table 2.3.2 describes key features for this measure.

Table 2.3.2—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Index of Nonindigenous Terrestrial Animal Species."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the two animal measures	None	Step 1: Develop a list of known nonindigenous terrestrial animals in the wilderness and select species for monitoring. Step 2: Determine the distribution and impact of each selected species. Step 3: Enter data in the WCMD.	None	5 years

Protocol

Step 1: Develop a list of known nonindigenous terrestrial animals in the wilderness and select species for monitoring. This includes all nonindigenous terrestrial animal species, and domestic (and feral) livestock, swine, horses, and burros; terrestrial insects such as Asian long-horned beetle, emerald ash borer, gypsy moth, and hemlock woolly adelgid; and terrestrial pathogens and diseases such as sudden oak death, chronic wasting disease, and white-nose syndrome. For some terrestrial animal species, distribution can vary seasonally and if the species occurs within a wilderness at any time, it could be included in this list. If there is certainty that only natural vectors enabled a nonindigenous animal species to become established in wilderness (i.e., via natural range expansion or movement), then that species would not be included; however, if there is ambiguity about how the species was introduced (whether natural or human-caused), then the species would be included. Nonindigenous animal species that were present at the time of wilderness designation should be included for consideration in this measure. Consult the local wildlife biologist, invasive species program manager, ecologist, or other local sources of knowledge to first identify nonindigenous terrestrial animals in a wilderness and then select species for inclusion in this measure.

As not all nonindigenous species have the same degree of ecological impact on wilderness, select species to monitor based on their potential to displace **native species** or do ecological harm to a wilderness environment. For practical reasons, local units may choose to limit the number of species selected based on their impact and data adequacy. Over time, new species can be added to the list of selected species, and species already on the list can be replaced with different species; any modification of the list of selected species should be considered carefully as changes in the index may affect the trend in this measure.

Step 2: Determine the distribution and impact of each selected species. The index used for this measure combines the numerical ratings for distribution and impact that are assigned for each selected species. These numerical ratings are based on defined distribution and impact categories, described below. If the determination of distribution or impact categories for any species is based partially or entirely on professional judgment, include additional documentation (e.g., a brief narrative) explaining who made the assessment and their basis for the estimation. Both distribution and impact must be reassessed for all selected species each monitoring cycle.

Distribution is the known or estimated geographic extent inside wilderness of each selected nonindigenous terrestrial animal species. For this measure, distribution is measured as the percentage of the total wilderness occupied by each selected species that permanently resides in a wilderness, or the maximum geographic extent of each selected species that occurs seasonally in a wilderness. A variety of data sources, including national and local data sources as well as professional knowledge, may be necessary for determining distribution, and data sources may vary by species. In order of priority, use surveys, observations, or professional knowledge to assess species distribution. A primary data source for this measure is the Forest Service Natural Resource Information System (NRIS). This application is a good starting place if data are available. Other relevant databases are NRM-Wildlife and NRM-TESP-IS. Examples of additional sources of data concerning nonindigenous terrestrial animal species include:

- Forest Service resource specialist on the local unit where a wilderness is located (i.e., wildlife biologist, ecologist, or invasive species coordinator).
- Individual state Department of Natural Resources invasive species program.
- NatureServe Explorer database (https://explorer.natureserve.org/) and its state Natural Heritage Program members.
- Local invasive species programs by county or city.

Forest Service and BLM wild horse and burro herd data (http://www.fs.fed.us/rangelands/ecology/wildhorseburro/territories/index.shtml and https://www.blm.gov/programs/wild-horse-and-burro/herd-management).

- Forest Service Forest Health Protection mapping and reporting tools (https://www.fs.fed.us/foresthealth/).

Data adequacy for all data sources likely varies greatly depending on the wilderness and the species of interest. It is strongly recommended that local natural resource specialists, such as biologists, ecologists, or invasive species coordinators, be consulted to validate the data, especially for datasets that extend beyond a wilderness boundary.

Assign one of the following **distribution categories** for each selected species based on the known or estimated percent distribution over the entire wilderness:

- *Trace*—the species occupies less than 1 percent of a wilderness.
- *Sparse*—the species occupies 1 to 5 percent of a wilderness.
- *Moderate*—the species occupies 6 to 25 percent of a wilderness.
- *Wide*—the species occupies more than 25 percent of a wilderness.

These distribution categories are scaled conservatively to emphasize the ecological effects of increased distribution of nonindigenous species. Once the distribution category has been assigned for each selected species, note the associated numerical rating according to the following table 2.3.3.

Table 2.3.3—Numerical ratings for the distribution of terrestrial nonindigenous animal species.

Distribution category	Numerical rating
Trace (<1%)	1
Sparse (1–5%)	2
Moderate (6–25%)	3
Wide (>25%)	4

Impact is the estimated relative effect of each selected nonindigenous terrestrial animal species on the Natural Quality of wilderness character. Impact may change over time due to a variety of changing ecological circumstances. Consult the local wildlife biologist, invasive species program manager, ecologist, or other local sources of knowledge to determine the impact of each species. Resource specialists should base their impact assessments for each species on the scientific literature or their professional observation or knowledge. Assign one of the following **impact categories** for each species:

- *Low*—the species has a relatively small or localized impact on the natural ecosystems and plant and animal communities.
- *Moderate*—the species has a noticeable effect on plant or animal communities or natural ecosystems and eradication efforts may or may not be in place because of uncertainty about impact.
- *High*—the species has a large or significant effect on plant or animal communities or natural ecosystems and plans for eradication or reduction are likely in place because of the known large impact of the species.

Once the impact category has been assigned, note the associated numerical rating according to the following table 2.3.4.

Table 2.3.4—Numerical ratings for the impact category of nonindigenous terrestrial animal species.

Impact category	Numerical rating
Low	1
Moderate	2
High	3

Step 3: Enter data in the WCMD. The final measure value is derived through an index combining all selected species' numerical ratings for distribution and impact. While this index is described for reference, users will not be responsible for calculating the measure value themselves; instead, users will enter the assigned numerical distribution and impact ratings for each species in the WCMD, and the WCMD will calculate the measure value automatically. The measure value is the index value.

In calculating the index value for this measure, there are two basic steps. First, generate a component score for each selected species by multiplying the numerical rating for distribution by the numerical rating for impact. Second, sum the component scores for all species to produce the final index value. Table 2.3.5 provides an example showing how to calculate the index value for this measure.

Table 2.3.5—An example of how to calculate the index value for selected nonindigenous terrestrial animal species.

Animal species	Distribution rating	x	Impact rating	=	Component score	Comments
Feral hogs	3	×	3	=	9	Estimated based on habitat modeling
Burmese python	2	×	3	=	6	Estimated
Emerald ash borer	2	×	3	=	6	Surveyed
Starling	4	×	1	=	4	Surveyed
Norway rat	4	×	2	=	8	Professional judgment
Domestic cattle	2	×	2	=	4	Agency records
Report this index value: 37						

Caveats and Cautions

Comprehensive and systematic surveys in wilderness for nonindigenous terrestrial animals are typically lacking, with data coming from sporadic and infrequent visits from resource specialists who have the knowledge to identify these species. Even if a systematic survey is conducted, it may not be repeated.

Data Adequacy

Data quantity varies depending on the geographic area and the species of interest, and is generally expected to be insufficient to partial. Data quality also varies considerably across wildernesses because surveys and comprehensive, statistically robust inventories of nonindigenous terrestrial animal species in wildernesses are often lacking; data quality is therefore generally expected to be poor to moderate. Combining these two aspects yields an estimated low to medium data adequacy. Because of high variability, local units must verify these determinations for each data source used; for example, national data sources may have high data adequacy while evaluations based on professional judgment will often have low data adequacy.

Frequency

Every 5 years, assess the geographic distribution and estimated impact of selected nonindigenous terrestrial animal species. Enter the assigned distribution and impact ratings for each species into the WCMD. The measure value is automatically calculated by the WCMD based on the entered data.

Threshold for Change

The threshold for meaningful change is a 5-percent change in the measure value for all selected nonindigenous terrestrial animal species. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the measure value beyond the threshold for meaningful change results in an improving trend in this measure.

3.3.2 Measure: Index of Nonindigenous Aquatic Animal Species

This measure is an index that assesses the geographic distribution and estimated impact of selected nonindigenous aquatic species (NAS), including amphibians, fish, crustaceans, mollusks, gastropods, aquatic insects, and aquatic pathogens and diseases. Data are compiled from a variety of local, state, regional, and national data sources. The WCMD calculates the measure value. Table 2.3.6 describes key features for this measure.

Table 2.3.6—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Index of Nonindigenous Aquatic Animal Species."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the two animal measures	None	Step 1: Develop a list of known nonindigenous aquatic animals in the wilderness and select species for monitoring. Step 2: Determine the distribution and impact of each selected species. Step 3: Enter data in the WCMD.	None	5 years

<u>*Protocol*</u>

Step 1: Develop a list of known nonindigenous aquatic animals in the wilderness and select species for monitoring. This includes all NAS and water-borne pathogens and diseases such as whirling disease, iridoviruses, and chytrid fungus. Locally or regionally **indigenous species** introduced in fishless waters would also be included in this list. Stocking of indigenous species into waters where they may already occur, or introducing indigenous fish species into waters that already have other fish species, are unlikely to have a measurable effect on the Natural Quality and are therefore not included under this measure. If there is certainty that only natural vectors enabled a NAS to become established in a wilderness (i.e., via natural range expansion or movement), then that species would not be included; however, if there is ambiguity about how the species was introduced (whether natural or human-caused), then the species would be included. Nonindigenous aquatic animal species that were present at the time of wilderness designation should be included for consideration in this measure. Consult with forest and district resource specialists to first identify known NAS in a wilderness and then select species for inclusion in this measure.

As NAS have varying degrees of ecological impact on wilderness, select species to monitor based on their potential to displace native species or do ecological harm to the wilderness environment. For practical reasons, local units may choose to limit the number of species selected based on their impact and data adequacy. Over time, new species can be added to the list of selected species, and species already on the list can be replaced with different species; any modification of the list of selected species should be considered carefully as changes in the index will likely affect the trend for this measure.

Step 2: Determine the distribution and impact of each selected species. The index used for this measure combines the numerical ratings for distribution and impact that are assigned for each selected species. These numerical ratings are based on defined distribution and impact categories, described below. If the determination of distribution or impact categories for any species is based partially or entirely on professional judgment, include additional documentation (e.g., a brief narrative) explaining who made the assessment and their basis for the estimation. Both distribution and impact must be reassessed for all selected species each monitoring cycle.

Distribution is the known or estimated geographic extent inside wilderness of each selected NAS. For this measure, distribution is measured as the percentage of the total wilderness waterbodies occupied by each selected species that resides in a wilderness or the maximum geographic extent of each selected species that seasonally occurs in a wilderness.

A variety of data sources, including national and local data sources and professional knowledge, may be necessary for determining distribution, and data sources may vary by species. In order of priority, use surveys, observations, or professional knowledge to assess species distribution. Data adequacy for all data sources may vary greatly depending on the wilderness and the species of interest. Consult with local natural resource specialists, such as fisheries biologists, ecologists, or invasive species coordinators to validate the data, especially for datasets that extend beyond a wilderness boundary.

A useful source of data for this measure is the U.S. Geological Survey (USGS) national database for NAS, located at the Southeast Ecological Science Center and available at http://nas.er.usgs.gov/. This site is a central repository for accurate, spatially referenced biogeographic accounts of NAS in the United States. It provides detailed records, collection locations, and dates, and can searched by state, county, or watershed (Hydrologic Unit Code [HUC] 2 to HUC 8) for nonindigenous aquatic groups, taxa, and species. The Southeast Ecological Science Center can also be contacted to run specific queries for watersheds associated with an individual wilderness. After navigating to the website (http://nas.er.usgs.gov/), follow these steps to retrieve data:

1. Go to “Database & Queries” (top of home page).
2. Select “Search by Drainage Area [HUC 8].”
3. Select appropriate state from map of the U.S.
4. Select “All” groups and sort by “Taxonomic Group.”

5. Select desired HUC 8 sub basin and records will be displayed.
6. Select "Collection Information" under the "More Information" column heading for each species listed.
7. Assess the distribution of each species using these results, especially the information in the "Locality" and "Year" columns. For additional details on a given collection or sighting, select "Specimen ID." This provides information on the collection date and accuracy, pathway, status, and any references that are available.

Examples of additional sources of data concerning nonindigenous aquatic animal species are listed below.

- Forest Service resource specialist on the unit where a wilderness is located (i.e., fisheries biologist, hydrologist, or invasive species coordinator).
- Forest Service NRM-TESP-IS.
- Forest Service regional aquatic invasive species databases (e.g., Region 4's database available at http://www.fs.usda.gov/detail/r4/landmanagement/resourcemanagement/?cid=fsbdev3_016101).
- Individual state Department of Natural Resources invasive species program, or state fish and game agencies (especially useful for obtaining fish stocking or fish assessment records).
- Regional, state, or local invasive aquatic species programs (e.g., the Portland State University Center for Lakes and Reservoirs has excellent data for the state of Oregon—Center for Lakes and Reservoirs - Portland State University; Michigan State University's Midwest Invasive Species Information Network [MISIN] has similar data for the Midwest—Midwest Invasive Species Information Network [MISIN]).

Assign one of the following distribution categories for each selected species based on the known or estimated percent distribution over the entire wilderness:

- *Low*—the species occupies 10 percent or less of the waterbodies in a wilderness.
- *Moderate*—the species occupies 11 to 20 percent of the waterbodies in a wilderness.
- *Wide*—the species occupies more than 20 percent of the waterbodies in a wilderness.

Once the distribution category has been assigned for each selected species, note the associated numerical rating shown in table 2.3.7.

Table 2.3.7—Numerical ratings for the distribution category of nonindigenous aquatic animal species.

Distribution category	Numerical rating
Low (<10%)	1
Moderate (11–20%)	2
High (>20%)	3

Impact is the estimated relative effect of each selected nonindigenous aquatic animal species on the Natural Quality of wilderness character. Impact may change over time due to a variety of changing ecological circumstances. Assign one of the following an impact categories for each species:

- *Low*—the species has a relatively small or localized impact on the natural ecosystems and plant and animal communities.
- *Moderate*—the species has a noticeable effect on plant or animal communities or natural ecosystems and eradication efforts may or may not be in place because of uncertainty about impact.
- *High*—the species has a large or significant effect on plant or animal communities or natural ecosystems and plans for eradication or reduction are likely in place because of the known large impact of the species.

Once the impact category has been assigned, note the associated numerical rating according to the following, table 2.3.8.

Table 2.3.8—Numerical ratings for the impact category of nonindigenous aquatic animal species.

Impact category	Numerical rating
Low	1
Moderate	2
High	3

These recommended impact categories and numerical ratings are assigned to reflect relative impacts. The setting (location, climate, other species) plays a key role in influencing the relative impact of an individual NAS. As a general rule, nonindigenous fish should likely receive the highest impact rating because they are often the top predator in aquatic systems and can have significant and lasting effects on the character and function of aquatic systems. Indigenous fish introduced into fishless waters should be considered nonindigenous and assigned a rating of 3. Aquatic invasive species (including invasive nonindigenous aquatic pathogens) would generally be assigned the second highest rating due to their potential to increase in numbers and distribution relatively quickly and have significant impacts on indigenous species by direct competition for limited resources such as water, nutrients, food, and shelter (Office of Technology Assessment 1993). Low impact species would often include certain, nonindigenous aquatic organisms that are found at the current extreme edge of their range of conditions for survival where the stress of the environment limits their productivity and competitiveness. (Jim Capurso, U.S. Forest Service, R6 Fish Program Leader and Aquatic Invasive Species Coordinator, personal communication, December 1, 2016).

The general categories and ratings presented in table 2.3.8 may not fit local conditions or the specific circumstances found in an individual wilderness. Units are encouraged to adjust these ratings based on local information and professional knowledge. For example, the availability of a risk assessment for a particular invasive species, such as New Zealand mud snails or zebra mussels, could allow a local office to increase the impact rating to the maximum level of 3. Although there is no national database that provides relative risk ratings for invasive aquatic animals, such ratings may be available on a local, state, or regional level and could provide a basis for increasing the ratings for individual invasive species. Document the rationale for these adjustments.

Step 3: Enter data in the WCMD. The final measure value is derived through an index combining all selected species' numerical ratings for distribution and impact. While this index is described for reference, users will not be responsible for calculating the measure value themselves; instead, users will enter the assigned numerical distribution and impact ratings for each species in the WCMD, and the WCMD will then calculate the measure value automatically. The measure value is the index value.

In calculating the index value for this measure, there are two basic steps. First, generate a component score for each selected species by multiplying the numerical rating for distribution by the numerical rating for impact. Second, sum the component scores for all species to produce the final index value. Table 2.3.9 provides an example showing how to calculate the index value for this measure.

Table 2.3.9—An example of how to calculate the index value for selected nonindigenous aquatic animal species.

Animal species	Distribution rating	x	Impact rating	=	Component score	Comments
Brook trout	3	×	3	=	9	Agency records
Rainbow trout	1	×	3	=	3	Surveyed
Crawfish	2	×	1	=	2	Surveyed
Whirling disease	1	×	2	=	2	Estimated based on habitat modeling
Mud snail	1	×	2	=	2	Professional judgment
Report this index value: 18						

<u>Caveats and Cautions</u>

Currently, comprehensive surveys for NAS, in both lakes and streams, are generally lacking, especially in wilderness. Where they do exist, data often are not entered into a national NAS database, but may be available in a local database. Also, there is often a lack of periodic follow-up sampling. Although progress has been made in the last few years, lack of data on NAS for many water bodies makes treatment, protection, and management extremely difficult. It also puts a premium on coordinated data gathering and data sharing among management, research interests, and users in general.

Data Adequacy

For data used in the NAS index, there is a fair degree of varibility depending on a given geographic area and species of interest. Data quantity for the measure ranges from complete (e.g., fish stocking records) to insuficient (e.g., estimates and professional judgment), and is given an overall rating of partial. Data quality similarly ranges from high (e.g., fish stocking records) to low (e.g., estimates and professional judgment), resulting in an average moderate rating. This provides an overall data adequacy rating of medium. Because of high variability, local units must verify these determinations for each data source used.

Frequency

At least every 5 years, assess the geographic distribution and estimated impact of selected nonindigenous aquatic animal species. Enter the distribution and impact ratings for each species into the WCMD. The measure value is automatically calculated by the WCMD based on the entered data.

Threshold for Change

The threshold for meaningful change is a 5-percent change in the measure value for all selected nonindigenous aquatic animal species. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the measure value beyond the threshold for meaningful change results in an improving trend in this measure.

3.4 Indicator: Air and Water

This indicator focuses on threats to air and water quality. There are six measures for this indicator: five measures on air quality from which units are required to select at least one, and one required measure on water quality.

Guidance for Selecting Air Quality Measures

Section 3.4 describes the five air quality measures:

1. Measure: Concentration of Ambient Ozone
2. Measure: Deposition of Nitrogen
3. Measure: Deposition of Sulfur

4. Measure: Amount of Haze
5. Measure: Index of Sensitive Lichens

Local units are required to select at least one of these air quality measures, or may select multiple measures if relevant to the individual wilderness. For all five measures, the central data analyst will complete the protocols by retrieving data from the Forest Service Air Resource Management Program or other national monitoring networks. The purpose of this section is to provide additional guidance for local units to consider when selecting air quality measures because some measures are more appropriate for certain geographic regions of the U.S., and available data may vary by geographic region.

Air quality measures are selected based on their relevancy to the local wilderness. Contact local or regional air resource specialists for assistance in determining which air quality measure(s) is/are most appropriate and feasible to monitor for each wilderness. Factors to consider include the availability of data as well as the relative impacts of various pollutants in a wilderness. Air quality monitoring plans for the forest or local unit may also identify the pollutant(s) most likely affecting a wilderness. The following general guidelines for each air quality measure may help guide the selection process.

- *Concentration of Ambient Ozone*—This measure will be particularly important for wildernesses located within or near areas that are exceeding the National Ambient Air Quality Standard (NAAQS) for ozone. Fortunately, these also are wildernesses most likely to have access to the data necessary to use this measure. There is limited data availability for the Pacific Northwest and Alaska.
- *Deposition of Nitrogen*—This measure will be of more interest to local units located west of the Mississippi River and in areas of the East where nitrogen deposition is of greater concern than sulfur deposition.
- *Deposition of Sulfur*—This measure will be of most interest for Forest Service Regions 8 and 9 in the eastern U.S. This is especially true for New England and the Appalachian Mountain range where sulfur has accumulated over decades of high deposition and continues to be released into, and negatively affect, watersheds and aquatic systems.
- *Amount of Haze*—This measure will be of interest to local units with noticeable haze or other impacts to visibility. Almost all wildernesses (except those in Alaska and Puerto Rico) have representative visibility data.
- *Index of Sensitive Lichen Species*—This measure is primarily for wildernesses where air pollution monitoring stations are limited or not available. It will be especially useful in Alaska where air quality monitoring equipment is very

limited, and in Forest Service regions 1, 4, and 6 where lichen monitoring data are readily available. Use of this measure is limited to wildernesses with forested habitats. At this time, nitrogen and sulfur are the only pollutants modeled for lichen sensitivity.

Table 2.3.10 shows the air quality measures that may be most relevant for each Forest Service region (Regions 1–10). While this table may help narrow the selection process, it should not replace recommendations of local or regional air resource specialists. In this table, the protocol options mentioned under nitrogen and sulfur are discussed in sections 3.4.2 and 3.4.3, respectively.

Table 2.3.10—Recommended air measures for Forest Service regions. A dash (-) in the column generally means not relevant or not recommended.

		Recommended air measures				
		Concentration of ambient ozone	Deposition of nitrogen	Deposition of sulfur	Amount of haze	Index of sensitive lichen species
Region	1	–	Yes	–	Yes	Yes
	2	Yes	Yes	–	Yes	–
	3	Yes	Yes	–	Yes	–
	4	Yes	Yes	–	Yes	Yes
	5	Yes	Yes	–	Yes	–
	6	–	–	–	Yes	Yes
	8	Yes	Yes	Yes	Yes	–
	9	Yes	Yes	Yes	Yes	–
	10	–	–	–	–	Yes

3.4.1 Measure: Concentration of Ambient Ozone

This measure assesses the 3-year rolling average of ozone concentration (fourth highest daily maximum 8-hour concentration) based on the Forest Service Air Resource Management Program's annual analyses of national ozone monitoring data. Unless stated otherwise, the protocol steps are intended to be completed by the central data analyst. Data are compiled from the Forest Service Air Resource Management Program NAAQS website. The central data analyst calculates the measure value. Table 2.3.11 describes key features for this measure.

Table 2.3.11—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Concentration of Ambient Ozone.

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the five air quality measures	None	None	Step 1: Determine the ozone monitor that is representative of air quality for the wilderness. Step 2: Retrieve ozone data from the Forest Service Air Resource Management Program. Step 3: Enter data in the WCMD.	5 years

Protocol

Step 1: Determine the ozone monitor that is representative of air quality for the wilderness. Although ozone data are available for all 50 states and Puerto Rico, not all wildernesses have a monitoring site located near them. Monitoring data from sites located within 25 miles of a wilderness boundary are generally considered representative (see Caveats and Cautions). If confronted with multiple viable monitors, a large disparity in elevation either between the monitoring site and a wilderness or across a wilderness, or any other questionable situations, contact an air resource specialist for assistance in selecting the single most representative site. If an air resource specialist confirms that there are no representative ozone monitors for a specific wilderness, do not use this measure and refer back to the local unit to select one of the other air quality measures.

In addition to consulting with air resource specialists, the central data analyst has the following two tools available to locate monitoring sites:

1. *NRM-Air*—This NRM application contains spatial layers for ozone monitoring sites (called fixed equipment sites) and wilderness boundaries. Use these layers within the Geospatial Interface (GI) ArcMap extension to buffer a wilderness and identify monitoring sites within 25 miles. Consult a GIS specialist or a specialist familiar with the application for assistance if necessary.

2. *Forest Service Air Resource Management Program mapping tool*—This tool is available online at https://webcam.srs.fs.fed.us/maps/index.php and displays locations of ozone monitors as dots on the map.

Figure 2.3.1 is a screen capture from the Forest Service Air Resource Management Program online tool showing ozone monitoring site locations. When the user zooms in on the map, forest and wilderness boundaries and scale are revealed. Information is available for all 50 states and Puerto Rico. The tool allows users to select the area of interest to see whether any ozone monitoring sites are located within approximately 25 miles of a wilderness boundary.

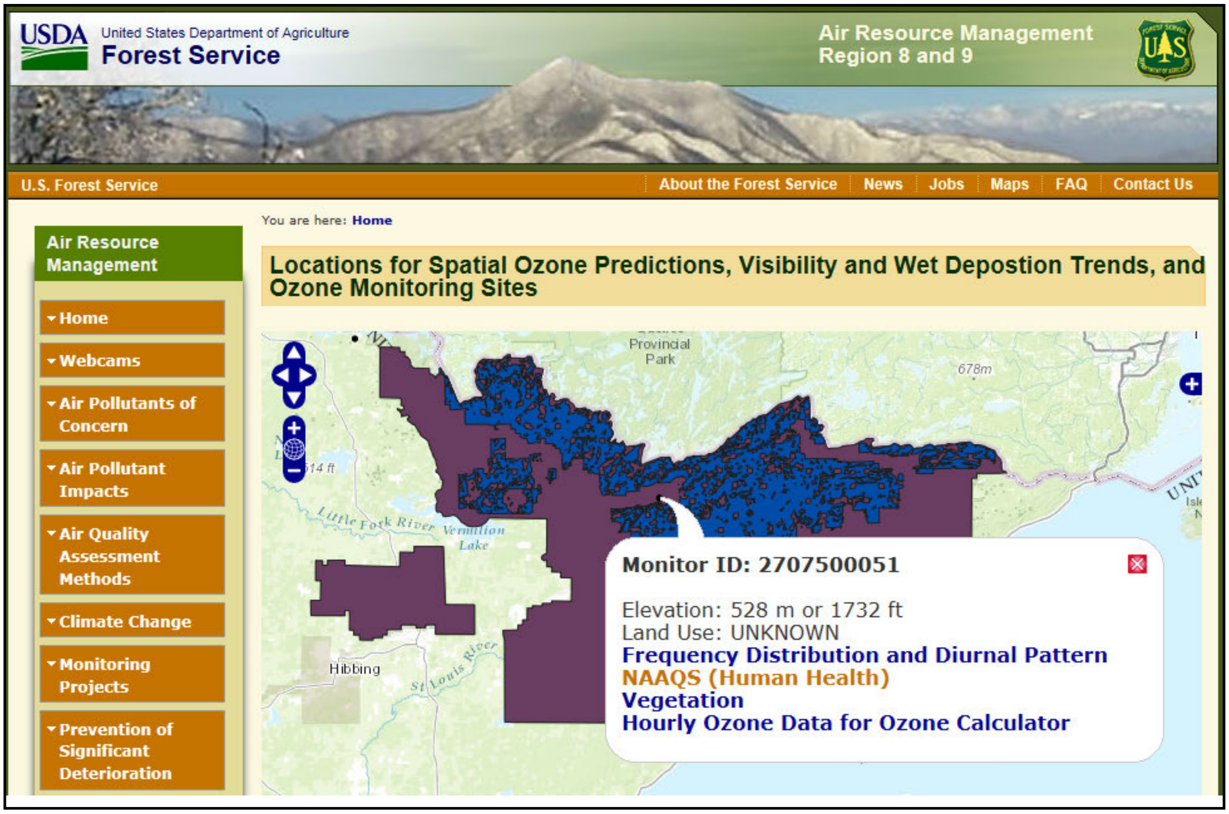


Figure 2.3.1—Screen capture from the Forest Service Air Resource Management Program online tool showing ozone monitoring site locations for the Boundary Waters Canoe Area Wilderness.

Once a representative monitoring site is identified for a wilderness, record the last five digits of the monitor ID as well as the state and county it is located in.

Step 2: Retrieve ozone data from the Forest Service Air Resource Management Program. Navigate to the Forest Service Air Resource Management Program NAAQS website (http://webcam.srs.fs.fed.us/graphs/o3calc/health.php) to access ozone summary data (shown in fig. 2.3.2). In the boxes under "Select a New Location" (found in the upper right hand corner of the page), enter the state, county, and monitor ID for the selected monitoring site; ignore the check box for "Class 1 only" and click "Load Data."

Figure 2.3.2—An example of a summary graph for the 3-year average ozone statistic from the Forest Service Air Resource Management Program website.

The first graph in the summary report depicts the NAAQS for ozone: the annual fourth highest daily maximum 8-hour concentration, averaged over 3 calendar years. The 3-year averages are calculated using values from the current and previous two years of data (e.g., the 3-year average for 2018 combines data from 2016, 2017, and 2018), and are represented in the graph by red triangles. Note that there may be up to a year delay in posting data. To retrieve the data depicted in the graph, click on "NAAQS Results" to the right of the graph. The data appear in columns, with each row representing a single year. To identify which column contains the 3-year rolling averages, click on the "Readme" (metadata) file (located below "NAAQS Results").

Record the "3-year average (parts per million [ppm])" data for all relevant years since the year of wilderness designation. For example, for a wilderness designated in 2000, the first 3-year average to record would be from 2002 (combining data from 2000—the year of designation, 2001, and 2002). Not all ozone monitoring sites have legacy data dating from the year of designation, in which case begin recording the ozone data when monitoring began. Only ozone data from 1990 forward are considered valid for this measure, even though some monitoring sites may have data from earlier years. Since the ozone monitoring network was expanded and became more stable around 1990, using data from that year forward minimizes the amount of missing data that could adversely affect the trend analysis. For wildernesses designated from 1964 to 1989, therefore, the first 3-year average to record should be from 1992 at the earliest (combining data from 1990, 1991, and 1992).

Step 3: Enter data in the WCMD. Enter the 3-year average fourth highest daily maximum 8-hour ozone concentration, rounded to the nearest tenth (i.e., 0.1), for all recorded years. If a null value is recorded for a certain year (i.e., a value of "-999" indicating missing annual data), include documentation of the null value but do not enter data for that year in the WCMD. The measure value is the 3-year average ozone statistic.

Caveats and Cautions

One problem with this measure is that ozone monitors are frequently located near urban areas, and not all Forest Service wildernesses have a representative monitor. Wildernesses without a representative monitor will not be able to use this measure.

There are cases when a monitor located more than 25 miles away may be considered representative of a wilderness. Many factors determine how broad an area a single ozone monitor can represent, including topography, elevation, and distance to major pollution sources. Ozone monitors located further than 25 miles from a wilderness may still be representative if the air mass is similar to that over a wilderness, or if the terrain is relatively flat and the monitor is located at a similar elevation and downwind distance from major air pollution sources.

It is acceptable to use ozone data from a monitor that may represent only a portion of a wilderness, a situation that may arise for very large wildernesses and those with highly complex terrain. Ozone data from one monitor may not accurately evaluate ozone levels in all areas of a wilderness, but the data from one well-managed monitor should provide a representative ozone trend for a wilderness. The goal of this measure is to evaluate the trend in ozone concentration over time, not to establish exact ozone concentrations for a particular location in a wilderness.

If there is any question about the representativeness of a monitoring site, consult an air resource specialist to help identify the most representative monitor to use for this measure. Finally, the Forest Service Air Resource Management Program website does not have up to date ozone data or graphics. Until the lapse in maintenance ends, annual ozone concentration data are sourced from EPA [https://aqs.epa.gov/aqsweb/airdata/download_files.html] and trends are calculated by the WCM Central Team using the protocol described above.

Data Adequacy

The ozone data used in this measure comes from a network of permanent monitoring sites managed by the EPA and other federal, state, tribal, and local air quality agencies (including some national forests that participate in cooperative ozone monitoring with state or local air regulatory agencies). The data collected from these monitoring sites receive rigorous quality assurance (QA) and quality control (QC) review before being entered into the EPA's Air Quality System (AQS) database, from which the Forest Service Air Resource Management Program pulls and analyzes the data. The method of analysis used by the Forest Service Air Resource Management Program follows national protocols from the EPA and state and local air regulators.

Data adequacy must be verified for each wilderness individually. While data quality is considered good for all ozone monitoring sites, data quantity may vary and this will affect the data adequacy rating. Data quantity is considered complete only if there is a continuous data record. If there are data gaps of more than 2 years, data quality is moderate. Ozone monitoring sites with complete data will have a high data adequacy rating. Sites with partial data will have a medium data adequacy rating.

Frequency

Every 5 years, obtain the most current ozone data from the Forest Service Air Resource Management Program (that draws the data from the EPA) and enter these data in the WCMD. Although the data are released annually, data compilation, analysis, and entry of all new years may take place on a 5-year interval rather than annually (i.e., rather than retrieving, analyzing, and entering data every year, the central data analyst may retrieve, analyze, and enter 5 years of data at a time). There can be up to a year delay in ozone data being available (e.g., 2014 data may not be available until the end of 2015) and the central data analyst should plan to compile data for this measure just prior to the reporting interval.

Threshold for Change

The threshold for meaningful change is statistical significance as determined by regression analysis. A statistically significant decreasing trend in the 3-year rolling average of the fourth highest 8-hour ozone concentration results in an improving trend in the measure.

3.4.2 Measure: Deposition of Nitrogen

This measure assesses the amount of nitrogen deposition in a wilderness by using either the average total deposition (based on nationally modeled or measured spatial data) or the trend in wet deposition (based on the Forest Service Air Resource Management Program's annual analyses of spatially interpolated data). Local units may select the appropriate protocol option as described in step 1 below. Unless stated otherwise, the protocol steps are intended to be completed by the central data analyst. Data are compiled from either the NADP website, the Forest Service Air Resource Management Program website, or other local or regional databases. The central data analyst calculates the measure value. Table 2.3.12 describes key features for this measure.

Table 2.3.12—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Deposition of Nitrogen."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the five air quality measures	Protocol Option 1: Total Deposition Protocol Option 2: Wet Deposition	Validate the nationally selected protocol option.	Step 1: Determine which protocol option is appropriate for the wilderness. Step 2: Retrieve and process the deposition data. Step 3: Enter data in the WCMD.	5 years

<u>*Protocol*</u>

Step 1: Determine which protocol option is appropriate for the wilderness. The two protocol options for this measure are described below. Consult with an air resource specialist to confirm which protocol option is most appropriate. While the central data analyst may make a preliminary recommendation, local units must validate and approve the selected protocol option, and may choose to use local or regional deposition data if available and appropriate.

Protocol Option 1—Total Deposition. This protocol option uses modeled spatial data to assess the average total nitrogen deposition in a wilderness. These data are available for wildernesses in the lower 48 states. Use this protocol option unless more accurate, regionally refined deposition information is available.

Protocol Option 2—Wet Deposition. This protocol option uses spatially interpolated data to assess the trend in wet deposition of nitrogen. The wet deposition data used for this protocol option are interpolated at a finer resolution than for protocol option 1, and therefore better reflect variation in deposition across the landscape and provide a more accurate average deposition value. These data are only available for eastern wildernesses in the continental U.S. where wet deposition trends mirror total deposition trends.

In addition to the two protocol options described in this technical guide, other local or regional nitrogen deposition data may be available for a given wilderness. For example, El Toro Wilderness in Puerto Rico is not covered by the data described in protocol option 1 or 2, however there is a National Atmospheric Deposition Program (NADP) monitoring site (PR20) located near the wilderness and those data could be used to describe wet deposition trends. An air resource specialist should be consulted to assist with this analysis. Similarly, forests in Regions 1, 4, 6, and 10 have access to a regionally specific alternative to the protocol options described in this section: nitrogen deposition estimates based on lichen sampling and elemental analysis of lichen tissue. These are considered the best nitrogen deposition data for the Pacific Northwest and Alaska where deposition-monitoring sites are scarce and the extremely complex (i.e., mountainous) terrain located adjacent to the ocean makes air quality modeling difficult. Wilderness-specific nitrogen deposition trends based on lichen elemental analyses are available for units in Washington, Oregon, Montana, and Alaska on the Forest Service National Lichens and Air Quality Database and Clearinghouse at http://gis.nacse.org/lichenair/ Local Forest Service units in Regions 6 and 10 should consider using these nitrogen deposition trends as well as the air pollution scores described in the measure *Index of Sensitive Lichens* (section 3.4.5 in part 2) to monitor wilderness air quality.

Other local or regional deposition data sources might be preferred for a wilderness if they are available at a finer spatial resolution, especially in areas of mountainous terrain. If a local unit is considering using regionally refined deposition data other than those described in protocol options 1 and 2, consult with an air resource specialist to ensure that the data are relevant and used appropriately.

Step 2: Retrieve and process the deposition data. This step is described below for each protocol option.

Protocol Option 1—Total Deposition. The best total nitrogen deposition values available nationally are the result of a hybrid approach that combines measured and modeled deposition into spatial coverages (Schwede and Lear 2014). This approach combines monitoring data with output from the Community Multiscale Air Quality modeling system, giving priority to measurement data near the location of the monitor and priority to modeled data in areas where monitoring data are not available. The Total Deposition (TDEP) Science Committee of the NADP http://nadp.slh.wisc.edu/committees/tdep/ creates these deposition values. Although TDEP products include values for many components of deposition, this protocol option uses only the annual total nitrogen data. Annual nitrogen deposition data are available from 2000 forward. GIS analysis will be required to calculate annual total nitrogen deposition within each wilderness for each year of interest.

If protocol option 1 is selected, TDEP data are obtained from the NADP through the website: http://nadp.slh.wisc.edu/committees/tdep/tdepmaps/. To retrieve data, navigate to the website and follow these steps:

1. Open the "README file for data" (found on the bottom of the page) and record the TDEP version number. The version number consists of a 4-digit year and a 2-digit release number (e.g., 2016.01), and can be found in the lower left corner of the ReadMe file. It is critical to document which TDEP version is used because each subsequent release updates all of the previous years to reflect modifications and enhancements in the underlying model.

2. Return to the bottom of the main page and click "Download Grids." Next, click on the folder labeled "n_tw" that contains the total wet and **dry deposition** data. Other similarly named folders contain different nitrogen statistics, so it is important to use the "n_tw" folder and no other.

3. Download the zip files for all years of interest. The first time data are compiled for this measure, and every time a new version is released, all available years of data since the year of wilderness designation must be downloaded and analyzed. If the version number has not changed since the previous data compilation, only new years of data must be downloaded. Be advised that the most recent years posted will usually be 1 to 2 years behind the current date.

Consult with a GIS specialist to analyze the downloaded spatial data. Once the files have been unzipped and imported from the .e00 extension, each will show a gridded coverage of the modeled estimates of total nitrogen deposition for the calendar year, at a resolution of 12 kilometers by 12 kilometers. The GIS specialist will need to buffer the wilderness boundary by 12 kilometers before clipping the data.

Because the total deposition estimates are in 12 kilometer squares (approximately 35,600 acres), there likely will be a significant number of wildernesses that are entirely encompassed in a single square (e.g., many of the 270 Forest Service wildernesses smaller than 35,600 acres). For wildernesses contained within a single square, use that value as the wilderness average. For wildernesses that take up more than one square, however, the average TDEP value for a wilderness will need to be calculated. Record the wilderness average total deposition for all years of downloaded data.

Protocol Option 2—Wet Deposition. If protocol option 2 is selected, wet deposition data are obtained through the Forest Service Air Resource Management Program website at http://webcam.srs.fs.fed.us/graphs/dep/ (see fig. 2.3.3). In the boxes under "Select a New Location," enter the state, national forest, and wilderness, and click "Load Data" (ignore the check box for "Class 1 only").

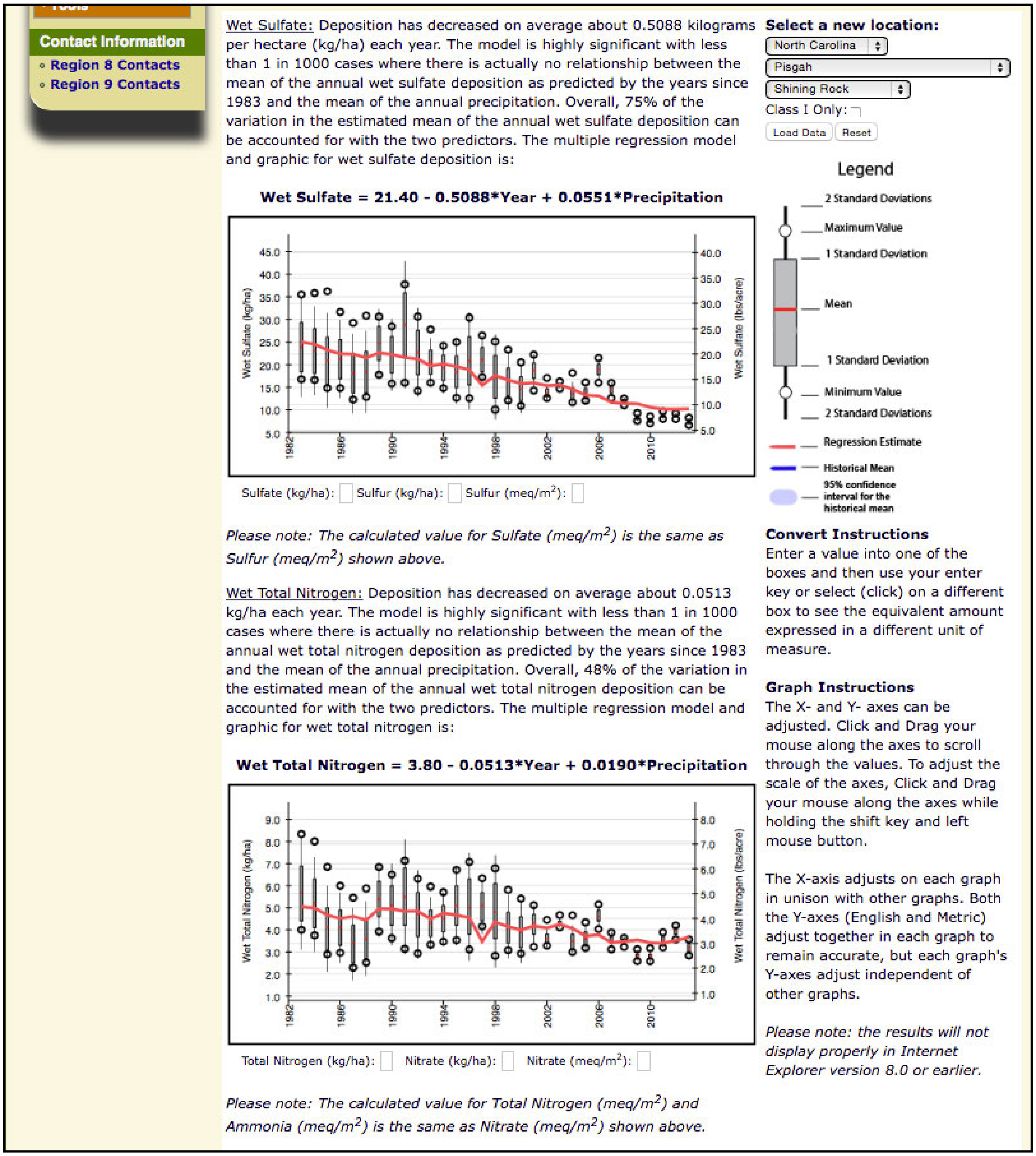


Figure 2.3.3—An example of a summary for wet total nitrogen deposition from the Forest Service Air Resource Management Program website.

Relevant information for this measure is found in the second section of the summary titled "Wet Total Nitrogen," which includes both a graphic presentation of the data and an explanatory narrative. (In this case, total refers to the sources of nitrogen, rather than the type of deposition.) The graph depicts the average total wet deposition for a wilderness (in kilograms per hectare) for each calendar year, and contains either a red regression estimate line or a blue historical mean line. Note that there may be up to a year delay in posting data.

Determine whether wet nitrogen deposition has increased, decreased, or remained stable over time by using both the graph and the explanatory narrative. A blue line on the graph indicates a stable (not statistically significant) trend in the data. A red regression line on the graph indicates a statistically significant trend in the data, either increasing or decreasing. Look at the first sentence in the narrative to confirm the direction of the data; this sentence will read: "Deposition has decreased on average…" or "Deposition has increased on average…." Be aware that these analyses are based upon the entire data record, whereas WCM determines trend comparing the most recent measure value with the baseline measure value. As a result, the central data analyst will need to consult with an air resource specialist to determine whether it is more appropriate to use the narrative description or estimate the trend from the year of designation to the present day. Assign the applicable trend category from the options described in the following list. For the measure baseline year, the stable wet deposition of nitrogen category should be selected. If there is any question about which category to assign, contact an air resource specialist for assistance in interpreting the graph and narrative.

- *Decreasing wet deposition of nitrogen*—there is a statistically significant decreasing trend in the average annual wet deposition.
- *Stable wet deposition of nitrogen*—there is no statistically significant trend in the average annual wet deposition.
- *Increasing wet deposition of nitrogen*—there is a statistically significant increasing trend in the average annual wet deposition.

Step 3: Enter data in the WCMD. For protocol option 1, enter the wilderness average total deposition values, rounded to the nearest tenth (i.e., 0.1), for all years that were assessed. For protocol option 2, enter the assigned trend category for wilderness wet deposition. The measure value is either the average total deposition or the trend category for wet deposition.

Caveats and Cautions

The Forest Service will soon be able to use exceedance of identified **critical loads** (CL) to monitor the trend in nitrogen deposition. A CL is the amount of pollutant loading, below which negative impacts to sensitive resources do not occur. In other words, a CL is a threshold for air pollution effects. By comparing a CL to total deposition (and determining whether the CL has been exceeded) it is possible to directly address effects of pollution on natural resources within a wilderness and not just the pollution trend, as is used currently. Use of total deposition estimates from TDEP, as outlined in protocol option 1 of the current guidance, sets the stage for an easy transition to using CL exceedance in the future when units have identified CLs for nitrogen. For more information on CLs, see the Forest Service Air Portal, available at http://www.srs.fs.usda.gov/airqualityportal/critical_loads/index.php, and the EPA Global Change Impacts & Adaptation CLs Mapper (currently in beta version and regularly updated), available at https://clmapper.epa.gov/.

Data Adequacy

For protocol option 1, data quantity is considered complete and data quality is considered good, resulting in a high data adequacy rating. TDEP is considered the best available approach for estimating total deposition of nitrogen, in part because it maximizes the use of measured data from nationally recognized monitoring networks. The included monitoring networks produce high quality measurements following documented protocols for monitor site selection, equipment maintenance, sample collection and handling, sample analysis, data processing, and data reporting.

For protocol option 2, data quantity is considered complete and data quality is considered good, resulting in a high data adequacy rating for the continental eastern U.S. The regionally refined spatial interpolations of wet deposition created by Grimm and Lynch (2004) are considered the best available approach for tracking deposition in the eastern U.S. This approach uses measured deposition data (similar to what is described for TDEP), measured precipitation, and topography to model wet deposition. The resulting product has a finer resolution than TDEP estimates, which better reflects variation in deposition across the landscape and provides a more accurate average deposition value for each wilderness.

Frequency

Every 5 years, the amount of nitrogen deposition is assessed and the total deposition annual averages (protocol option 1) or applicable trend category (protocol option 2) are entered in the WCMD. For protocol option 1, although the data are released annually, data compilation, analysis, and entry of all new years may take place on a 5-year interval rather than annually (i.e., rather than retrieving, analyzing, and entering data every year, the central data analyst may retrieve, analyze, and enter 5 years of data at a time). The central data analyst should plan to compile data for either protocol option of this measure just prior to the 5-year trend reporting interval because there can be up to a year delay in posting national air quality data to websites (e.g., 2014 data may not be available until the end of 2015).

Threshold for Change

The threshold for meaningful change differs depending on the protocol option used. For protocol option 1, the threshold is statistical significance as determined by regression analysis. For protocol option 2, the threshold is any change in categories. A statistically significant decreasing trend in the data, or a change in categories towards decreasing deposition, results in an improving trend in the measure.

3.4.3 Measure: Deposition of Sulfur

This measure assesses the amount of sulfur deposition in a wilderness by using either the trend in wet deposition (based on the Forest Service Air Resource Management Program's annual analyses of spatially interpolated data) or the average total deposition (based on nationally modeled spatial data). Local units may select the appropriate protocol option as described in step 1 below. Unless stated otherwise, the protocol steps are intended to be completed by the central data analyst. Data are compiled from either the Forest Service Air Resource Management Program website, the NADP website, or other local or regional databases. The central data analyst calculates the measure value. Table 2.3.13 describes key features for this measure.

Table 2.3.13—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Deposition of Sulfur."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the five air quality measures	Protocol Option 1: Wet Deposition Protocol Option 2: Total Deposition	Validate the nationally selected protocol option.	Step 1: Determine which protocol option is appropriate for the wilderness. Step 2: Retrieve and process the deposition data. Step 3: Enter data in the WCMD.	5 years

Protocol

Step 1: Determine which protocol option is appropriate for the wilderness. The two protocol options for this measure are described below. Protocol Option 1—Wet Deposition, applies to the eastern U.S. (the area most likely to select this measure), while Protocol Option 2—Total Deposition, applies to the rest of the continental U.S. Consult with an air resource specialist to confirm which protocol option is most appropriate. While the central data analyst may make a preliminary recommendation, local units must validate and approve the selected protocol option, and may choose to use local or regional deposition data if available and appropriate.

Protocol Option 1—Wet Deposition. This protocol option uses spatially interpolated data to assess the trend in wet deposition of sulfur. The wet deposition data used for this protocol option are interpolated at a finer resolution than data for Protocol Option 2–Total Deposition, and therefore better reflect variation in deposition across the landscape and provide a more accurate average deposition value. These data are only available for eastern wildernesses in the continental U.S. where wet deposition trends mirror total deposition trends. Wildernesses in Forest Service Regions 8 and 9 (excluding Puerto Rico) should strongly consider using this protocol option.

Protocol Option 2—Total Deposition. This protocol option uses modeled spatial data to assess the average total sulfur deposition in a wilderness. These data are available for wildernesses in the lower 48 states. Use this protocol option unless more accurate, regionally refined deposition information is available.

In addition to the two protocol options described in this technical guide, other local or regional sulfur deposition data may be available for a given wilderness. For example, sulfur deposition trends at El Toro Wilderness is Puerto Rico are not covered by protocol options 1 or 2 but could be described using data from the nearby NADP wet deposition monitoring site (PR20). Other local or regional deposition data sources might be preferred if they are available at a finer spatial resolution, especially in areas of mountainous terrain. If a local unit is considering using regionally refined deposition data other than those described here, consult with an air resource specialist to ensure that the data are relevant and used appropriately.

Step 2: Retrieve and process the deposition data. This step is described for each protocol option.

Protocol Option 1—Wet Deposition. If the first protocol option is selected, wet deposition data are obtained through the Forest Service Air Resource Management Program website at http://webcam.srs.fs.fed.us/graphs/dep/ (shown in fig. 2.3.4). In the boxes under “Select a New Location,” enter the state, national forest, and wilderness, and click “Load Data” (ignore the check box for “Class 1 only”).

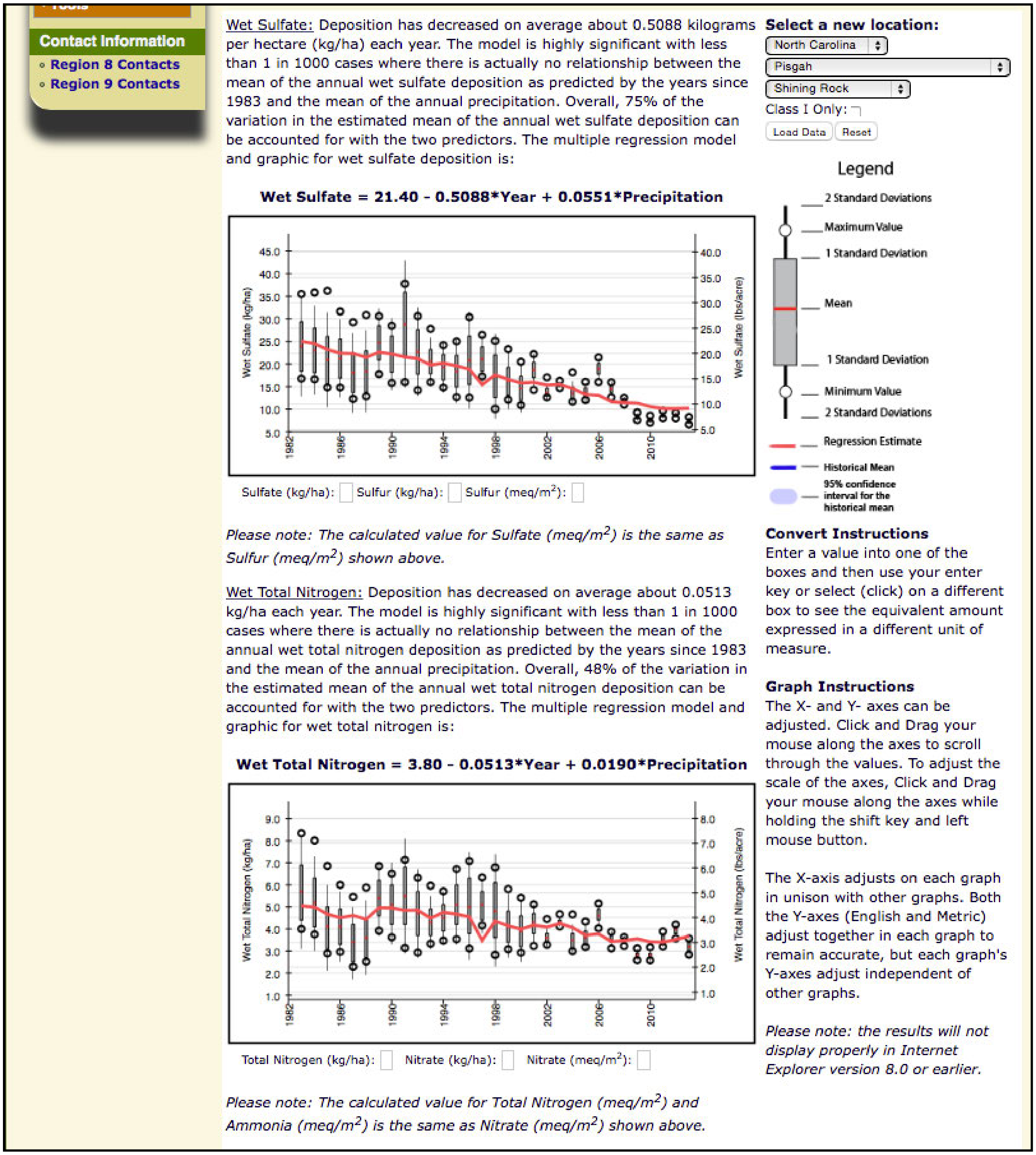


Figure 2.3.4—An example of a summary for wet sulfate deposition from the Forest Service Air Resource Management Program website.

Relevant information for this measure is found in the second section of the summary titled “Wet Sulfate,” which includes both a graphic presentation of the data and an explanatory narrative. The graph depicts the average total wet deposition for a wilderness (in kilograms per hectare) for each calendar year, and contains either a red regression estimate line or a blue historical mean line. Note that there may be up to a year delay in posting data.

Determine whether wet sulfate deposition has increased, decreased, or remained stable over time by using both the graph and the explanatory narrative. A blue line on the graph indicates a stable (not statistically significant) trend in the data. A red regression line on the graph indicates a statistically significant trend in the data, either increasing or decreasing. Look at the first sentence in the narrative to confirm the direction of the data; this sentence will read: “Deposition has decreased on average...” or “Deposition has increased on average....” Be aware that these analyses are based upon the entire data record, whereas WCM determines trend comparing the most recent measure value with the baseline measure value. As a result, the central data analyst will need to consult with an air resource specialist to determine whether it is more appropriate to use the narrative description or estimate the trend from the year of designation to the present day. Assign the applicable trend category from the options described in the following list. For the measure baseline year, the stable wet deposition of sulfur category should be selected. If there is any question about which category to assign, contact an air resource specialist for assistance in interpreting the graph and narrative.

- *Decreasing wet deposition of sulfur*—there is a statistically significant decreasing trend in the average annual wet deposition.
- *Stable wet deposition of sulfur*—there is no statistically significant trend in the average annual wet deposition.
- *Increasing wet deposition of sulfur*—there is a statistically significant increasing trend in the average annual wet deposition.

Protocol Option 2—Total Deposition. If the second protocol option is selected, TDEP data are obtained from the NADP through the website http://nadp.slh.wisc.edu/committees/tdep/tdepmaps/. To retrieve data, navigate to the website and follow these steps:

1. Open the “README file for data” (found on the bottom of the page) and record the TDEP version number. The version number consists of a 4-digit year and a 2-digit release number (e.g., 2016.01), and can be found in the lower left corner of the ReadMe file. It is critical to document which TDEP version is used because each subsequent release updates all of the previous years to reflect modifications and enhancements in the underlying model.

2. Return to the bottom of the main page and click “Download Grids.” Next, click on the folder labeled “s_tw” that contains the total (wet and dry) sulfur deposition data. Other similarly named folders contain different sulfur statistics, so it is very important to use the “s_tw” folder and no other.
3. Download the zip files for all years of interest. The first time data are compiled for this measure, and every time a new version is released, all available years of data since the year of wilderness designation must be downloaded and analyzed. If the version number has not changed since the previous data compilation, only new years of data must be downloaded. Be advised that the most recent years posted will usually be 1 to 2 years behind the current date.

Consult with a GIS specialist to analyze the downloaded spatial data. Once the files have been unzipped and imported from the .e00 extension, each will show a gridded coverage of the modeled estimates of total sulfur deposition for the calendar year, at a resolution of 12 kilometers by 12 kilometers. The GIS specialist will need to buffer the wilderness boundary by 12 kilometers before clipping the data.

Because the total deposition estimates are in 12 kilometer squares (approximately 35,600 acres), there likely will be a significant number of wildernesses that are entirely encompassed in a single square (e.g., many of the 270 Forest Service wildernesses smaller than 35,600 acres). For wildernesses contained within a single square, use that value as the wilderness average. For wildernesses that take up more than one square, however, the average TDEP value for a wilderness will need to be calculated. Record the wilderness average total deposition for all years of downloaded data.

Step 3: Enter data in the WCMD. For protocol option 1, enter the assigned trend category for wilderness wet deposition. For protocol option 2, enter the wilderness average total deposition values, rounded to the nearest tenth (i.e., 0.1), for all years that were assessed. The measure value is either the trend cateogry for wet deposition or the average total deposition.

Caveats and Cautions

The Forest Service will soon be able to use exceedance of identified CLs to monitor the trend in sulfur deposition. By comparing a CL to total deposition (and determining whether the CL has been exceeded) it is possible to directly address effects of pollution on natural resources within wilderness and not just the pollution trend, as is used currently. This is especially important for areas where pollution trends are decreasing but resources continue to be negatively affected by accumulated pollutants. A prime example can be found in the southern Appalachians, where sulfur emissions and deposition have decreased dramatically since 2006, but the accumulated sulfur in some watersheds slows recovery from acidification. Therefore, even with decreasing trends in sulfur deposition, sensitive resources may still show negative effects from acidification. Use of total deposition estimates from TDEP, as outlined in protocol option 2 of the current guidance, sets the stage for an easy transition to using CL exceedance in the future when units have identified CLs for sulfur. See the Forest Service Air Portal for more information on CLs, available at http://www.srs.fs.usda.gov/airqualityportal/critical_loads/index.php.

Data Adequacy

For the protocol option 1, data quantity is considered complete and data quality is considered good, resulting in a high data adequacy rating for the continental eastern U.S. The regionally refined spatial interpolations of wet deposition created by Grimm and Lynch (2004) are considered the best available approach for tracking deposition in the eastern U.S.

For the protocol option 2, data quantity is considered complete and data quality is considered good, resulting in a high data adequacy rating. TDEP is considered the best available approach for estimating total deposition of sulfur, in part because it maximizes the use of measured data from nationally recognized monitoring networks.

Frequency

Every 5 years, the amount of sulfur deposition is assessed and the applicable trend category (protocol option 1) or total deposition annual averages (protocol option 2) are then entered in the WCMD. For protocol option 2, although the data are released annually, data compilation, analysis, and entry of all new years may take place on a 5-year interval rather than annually (i.e., rather than retrieving, analyzing, and entering data every year, the central data analyst may retrieve, analyze, and enter 5 years of data at a time). The central data analyst should plan to compile data for either protocol option of this measure just prior to the 5-year trend reporting interval because there can be up to a year delay in posting national air quality data to websites (e.g., 2014 data may not be available until the end of 2015).

Threshold for Change

The threshold for meaningful change differs depending on the protocol option used. For protocol option 1, the threshold is any change in categories. For protocol option 2, the threshold is statistical significance as determined by regression analysis. A change in categories towards decreasing deposition, or a statistically significant decreasing trend in the data, results in an improving trend in the measure.

3.4.4 Measure: Amount of Haze

This measure assesses the trend in average deciview for the 20 percent most impaired days, based on the Forest Service Air Resource Management Program's annual analyses of national visibility monitoring data. Unless stated otherwise, the protocol steps are intended to be completed by the central data analyst. Data are compiled from the Forest Service Wilderness Air Quality website. The central data analyst calculates the measure value. Table 2.3.14 describes key features for this measure.

Table 2.3.14—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Amount of Haze."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the five air quality measures	None	None	Step 1: Retrieve visibility data from the Forest Service Air Resource Management Program. Step 2: Enter data in the WCMD.	5 years

Protocol

Step 1: Retrieve visibility data from the Forest Service Air Resource Management Program. The visibility data used for this measure are collected through the IMPROVE (Interagency Monitoring of Protected Visual Environments) program and analyzed by staff in the Forest Service Air Resource Management Program. Data will be uploaded to the Forest Service Wilderness Air Quality website (http://www.fs.fed.us/air/wilderness_monitoring.htm) once development of this site is completed. Each wilderness with a representative monitoring site will be listed with a link to the summary of visibility data from that monitor.

Relevant information for this measure will be found in the visibility graph (shown in fig. 2.3.5). The graph depicts IMPROVE data of the average deciview for the 20 percent most impaired days within a calendar year, averaged over 5 years. Deciview is a measurement of the amount of haze, with higher values of deciview indicating increased haze and greater levels of visibility impairment. Five year averages are calculated using values from the current and previous four years of data (e.g., the 5-year average for 2015 combines data from 2011, 2012, 2013, 2014, and 2015), and are represented in the graph by blue dots. Note that there may be up to a year delay in posting data.

The Forest Service Air Resource Management Program conducts a statistical analysis of the IMPROVE 5-year averages using a non-parametric regression technique: the **Theil-Sen slope**. This technique minimizes the influence of data outliers (e.g., so that a 5 year period with very favorable weather conditions for sulfate aerosol formation does not unduly affect the trend calculation). The statistical analysis is based on the available data record since the year of wilderness designation. For example, for a wilderness designated in 2000, the first 5-year average to be included in the statistical analysis would be from 2004 (combining data from 2000—the year of designation, 2001, 2002, 2003, and 2004). Not all IMPROVE monitoring sites will have legacy data dating from the year of wilderness designation, in which case the statistical analysis would use the entire data record available.

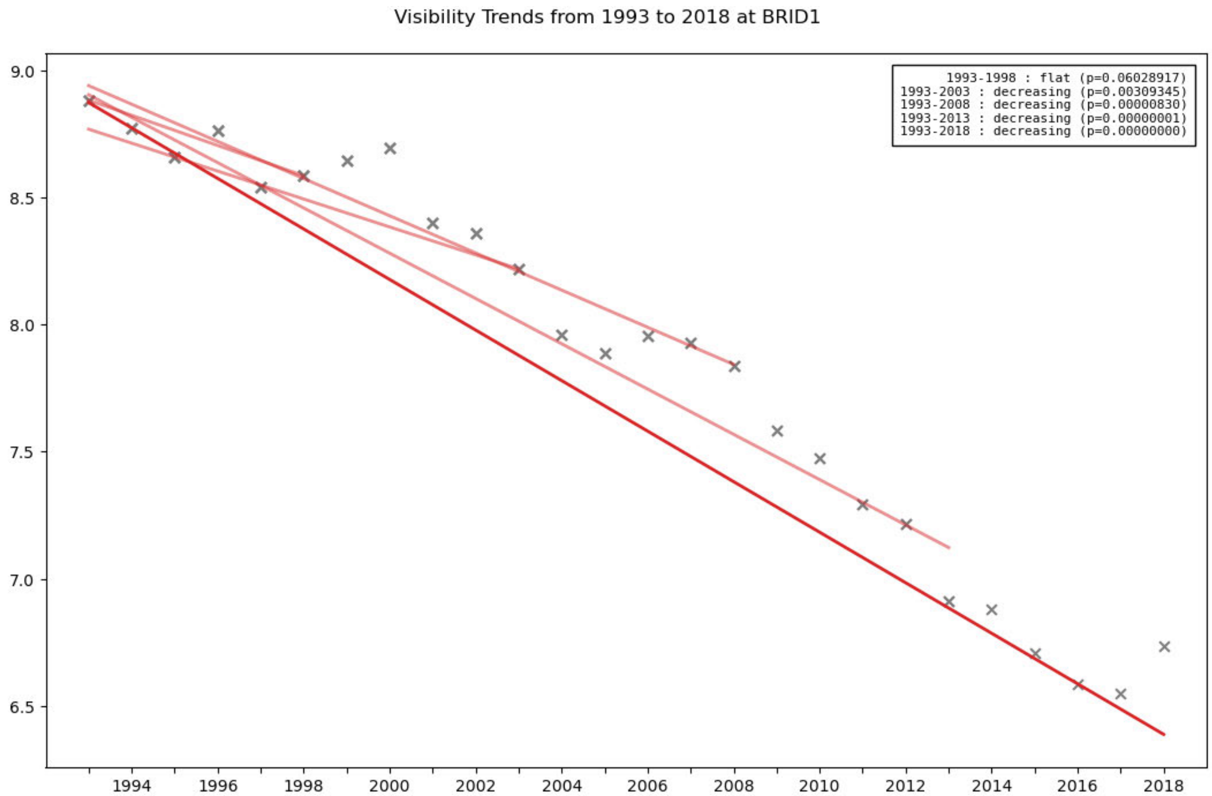


Figure 2.3.5—Visibility trends for the Bridger Wilderness, 2000–2015.

For this measure, a p-value less than 0.10 indicates a statistically significant trend in the data. The p-value from the most recent statistical analysis is shown on the graph. If the p-value is less than 0.10, use the trend line on the graph (the blue dotted line) to determine if average deciview has increased or decreased over time. For example, in figure 2.3.5, the low p-value and downward trend line indicate a statistically significant decreasing trend in deciview. Assign the applicable trend category from the options described in the following list. For the measure baseline year, the stable deciview category should be selected. If there is any question about which category to assign, contact an air resource specialist for assistance in interpreting the graph.

- *Decreasing deciview*—there is a statistically significant decreasing trend in the 5-year average deciview for the 20 percent most impaired days.
- *Stable deciview*—there is no statistically significant trend in the 5-year average deciview for the 20 percent most impaired days.
- *Increasing deciview*—there is a statistically significant increasing trend in the 5-year average deciview for the 20 percent most impaired days.

Step 2: Enter data in the WCMD. Enter the assigned trend category for the average deciview in the WCMD for this measure. The measure value is the trend category for deciview.

Caveats and Cautions

Representative IMPROVE sites were assigned to each Class I wildernesses based on distance and elevation criteria established by the IMPROVE Steering Committee. Subsequent studies of the spatial variability in IMPROVE data and model results suggest that most Class I wildernesses are well represented by their regulatorily assigned IMPROVE site. Based on the same criteria, most Class II wildernesses are also well represented by an IMPROVE site, but there are several, especially in southeast Alaska, which cannot be reasonably represented by IMPROVE data. Wildernesses without a representative monitor will not be able to use this measure.

IMPROVE sites that represent Class I areas are likely to remain operational in some capacity until 2064. However, a small number of other sites will most likely move or be shut down over time, in which case wildernesses will be evaluated for representativeness at a different IMPROVE monitor site. Gaps in the data record should not affect the regression.

While higher haze values indicate a less natural air quality condition, the EPA's Regional Haze Rule is designed to make steady progress towards natural conditions by 2064. As a result, the trend is a more important measure for WCM than the absolute impairment value.

Complete visibility data were not available on the Forest Service Wilderness Air Quality website during the initial implementation years of WCM, so visibility trends were calculated by the Central Team from tabular data provided by the IMPROVE coordinator. Because the website was still under development when this technical guide was published, there may need to be some reconciliation between the protocol currently described here for retrieving the haze data and the approach used once the website is finalized.

Data Adequacy

Visibility data are routinely collected and reported through the IMPROVE program. QA of the data is extensive. The number of observations per site is quite high, and the data record is generally greater than 10 years. In addition, data completeness for each site and year is determined as part of the calculation of the 5-year rolling average deciview, and site-years that do not meet standard completeness criteria are removed from the statistical analysis. For wildernesses with representative IMPROVE sites, data quantity is considered complete and data quality is considered good, resulting in a high data adequacy rating.

Frequency

Every 5 years, the trend in the 5-year average deciview for the 20 percent most impaired days is assessed and the applicable trend category is then entered in the WCMD. The central data analyst should plan to compile data for this measure just prior to the 5-year trend reporting interval because there can be up to a year delay in posting data to the Forest Service Air Resource Management Program website (e.g., 2014 data may not be available until the end of 2015).

Threshold for Change

The threshold for meaningful change is any change in categories. A change towards decreasing deciview results in an improving trend in the measure.

3.4.5 Measure: Index of Sensitive Lichen Species

This measure assesses the trend in air pollution scores for nitrogen and sulfur derived from the presence and abundance of sensitive lichen species, based on the Forest Service Air Resource Management Program's analyses of local biomonitoring data. Unless stated otherwise, the protocol steps are intended to be completed by the central data analyst. Data are compiled from the Forest Service National Lichens and Air Quality database. The central data analyst calculates the measure value. Table 2.3.15 describes key features for this measure.

Table 2.3.15—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Index of Sensitive Lichen Species."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the five air quality measures	None	None	Step 1: Retrieve lichen data from the Forest Service Air Resource Management Program. Step 2: Conduct a statistical analysis to determine the trend in the data. Step 3: Enter data in the WCMD.	5–10 years

Protocol

Step 1: Retrieve lichen data from the Forest Service Air Resource Management Program. Navigate to the Forest Service National Lichens and Air Quality database (http://gis.nacse.org/lichenair/index.php) and follow these steps:

1. Go to “Database Queries” on the left and click on “Lichen Plot Data.” Select the desired wilderness from the list in the rightmost box (fig. 2.3.6) and click “Minimize.”

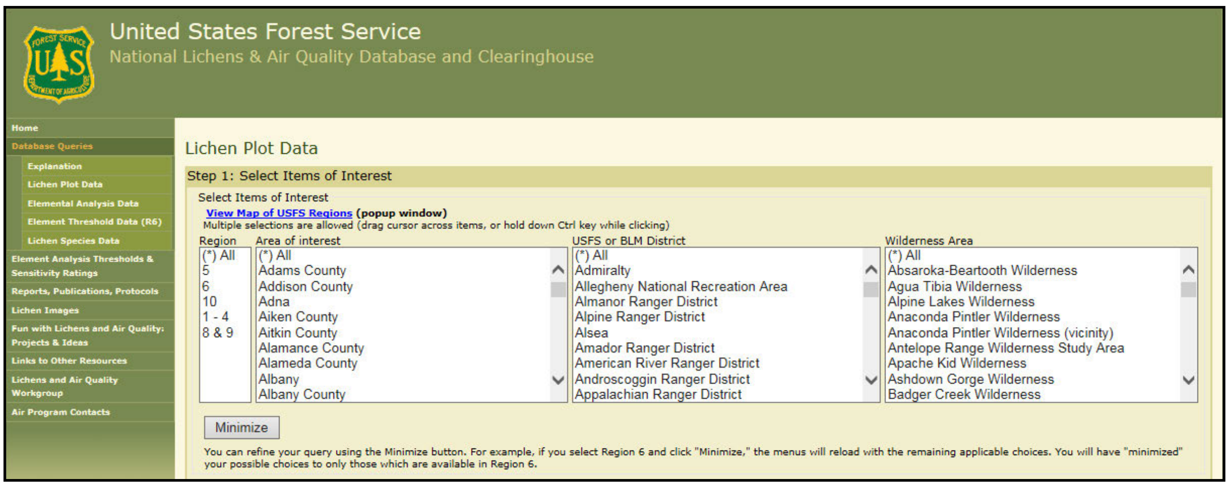


Figure 2.3.6—Example of lichen plot data from the National Lichens and Air Quality Database.

2. Scroll down to the section titled “Select Database Fields to Include in Query.” Check the boxes for “Field collection date,” “Plot name” and “Air pollution score” (fig. 2.3.7), then click “Retrieve Tabular Data.”

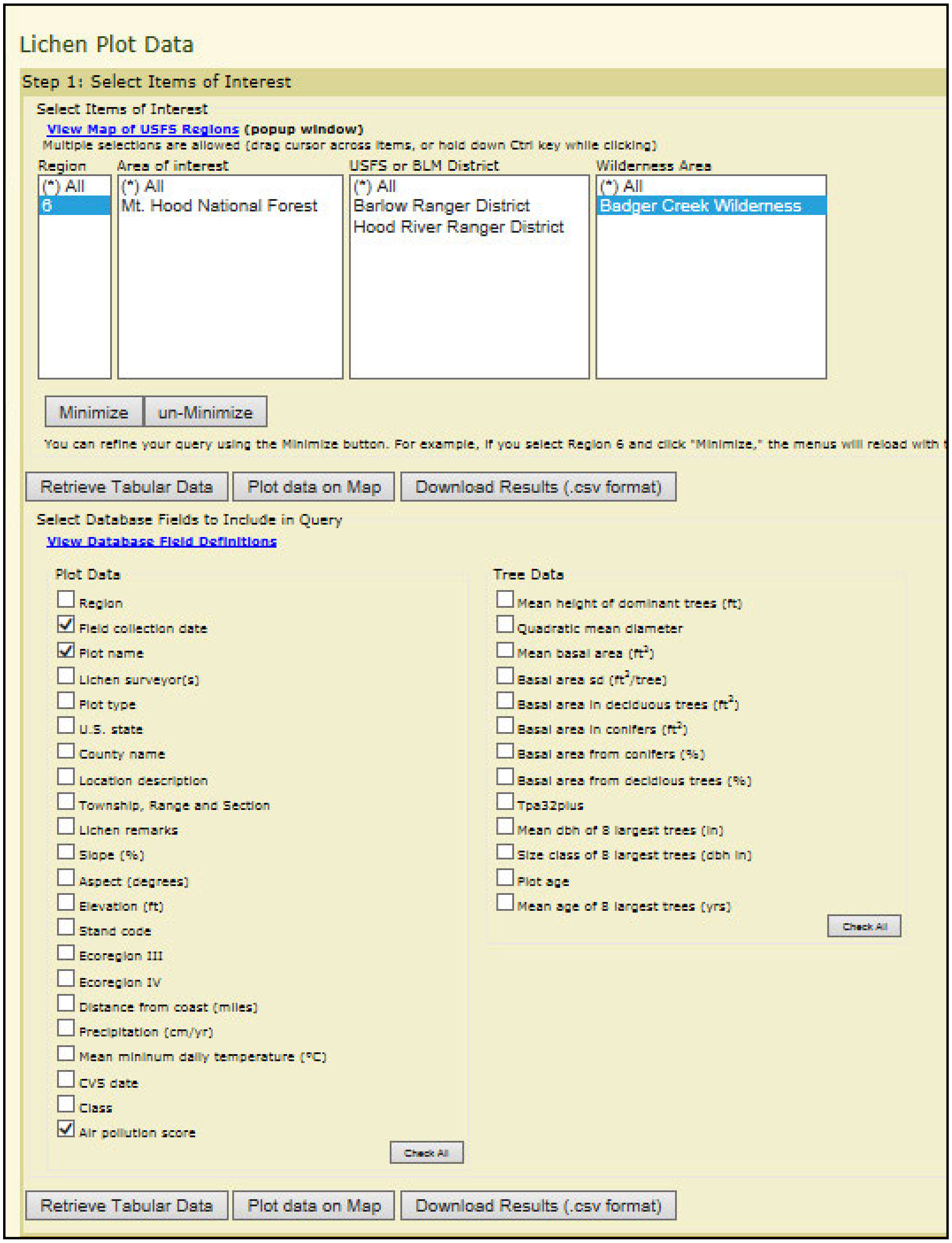


Figure 2.3.7—An example of the database fields included in the query for this measure.

3. Record relevant air pollution scores. In the table that appears, each row records a different plot number (fig. 2.3.8). The three fields selected for the query are found as columns on the far right of the table. Air pollution scores for nitrogen and sulfur are derived from an analysis of the lichen community and lichen abundances. Higher

(more positive) scores indicate that more pollution (i.e., nitrogen and sulfur) is impacting the lichens on the plot. Plots without an air pollution score have not yet had their data analyzed; they will be updated in 2017 to reflect the most up to date information available. Sulfur air scores will also be calculated and uploaded here so that forests in the westen U.S. and eastern U.S. have two scores. Click on the title of the "Plot name" column to sort the plots alphabetically, and identify which plots have been sampled more than once by comparing the plot name and field collection date. For example, in the figure 2.3.8, Plot 1142184 was sampled in 1995 and 2005 (first two rows) while Plot 1140188 has only been sampled once in 1996 (third row). Record the air pollution scores for all plots that have multiple field collection dates (table 2.3.16); ignore plots that have only been sampled once.

Lichen Plot Data

Step 1: Select Items of Interest

Step 2: Your Results

Returned 8 results *(in 0.056 seconds)*
Click on column titles to sort results.

Row #	Plot number	National Forest or other area	Latitude (decimal degrees)	Longitude (decimal degrees)	Wilderness Area	Field collection date	Plot name ↑	Air pollution score
6	1142184	Mt. Hood National Forest	45.35	-121.49	Badger Creek Wilderness	8/1/1995	1142184	-0.2678
2	1142184	Mt. Hood National Forest	45.35	-121.49	Badger Creek Wilderness	6/13/2005	1142184	-0.4108
1	1140188	Mt. Hood National Forest	45.3	-121.42	Badger Creek Wilderness	8/22/1996	1140188	0.111
8	1140184	Mt. Hood National Forest	45.3	-121.49	Badger Creek Wilderness	6/12/1997	1140184	-0.2774
4	1140180	Mt. Hood National Forest	45.3	-121.56	Badger Creek Wilderness	8/1/1995	1140180	-0.244
3	1140180	Mt. Hood National Forest	45.3	-121.56	Badger Creek Wilderness	6/14/2005	1140180	-0.5537
5	1140176	Mt. Hood National Forest	45.3	-121.63	Badger Creek Wilderness	9/6/1995	1140176	-1.154
7	1140176	Mt. Hood National Forest	45.3	-121.63	Badger Creek Wilderness	6/15/2005	1140176	0.0884

Figure 2.3.8—An example of the tabular summary of lichen plot data.

Step 2: Conduct a statistical analysis to determine the trend in the data. Consult a statistician or an air resource specialist for assistance with this step to determine if the number of sites is adequate and if the use of these statistical methods is appropriate. Use a two-tailed, paired t-test with an alpha level of 0.05 to determine if the air pollution scores are significantly different from one year to another. The earliest field collection date after the year of wilderness designation should be compared to the most recent field collection date to complete this analysis. There may be instances where a wilderness has multiple sampling dates across a period of up to 10 years (e.g., in fig. 2.3.8 the first year of sampling for each plot varies from 1995 to 1997). These wilderness areas may compare values from the earliest 10-year period to the most recent 10-year period. For example, in table 2.3.14, air pollution scores from 1990–1999 could be compared to air pollution scores from 2000–2010 for the three sites with more than 1 year of sampling. A *p*-value greater than 0.05 (as in the example in table 2.3.16) indicates that air pollution scores have not changed significantly over time, while a p-value less than or equal to 0.05 would be reasonable statistical evidence that the air pollution scores from the most recent field collection date are significantly different than those from the earliest field collection date. If a statistically signficant difference is found, determine whether the air pollution scores are increasing or decreasing over time by comparing the mean air pollution score for the first field collection year with the mean score for the most recent year.

Table 2.3.16—An example of data retrieved from the tabular summary of lichen plot data placed into a period of the decade the data were collected.

Air pollution scores—Badger Creek Wilderness		
Plot number	**1990–1999**	**2000–2010**
Plot 1142184	-0.2678	-0.4108
Plot 1140180	-0.244	-0.5537
Plot 1140176	-1.154	0.0884
Average	-0.5553	-0.2920
***p*-value**	0.6461	

Assign the applicable trend category from the options described in the list below. For the measure baseline year—that is, the first period of data collection after the year of wilderness designation (e.g., 1990–1999 in the table above)—the stable air pollution category should be selected. If there is any question about which category to assign, contact an air resource specialist for assistance in interpreting the air pollution scores.

- *Decreasing air pollution*—there is a statistically significant decreasing trend in the air pollution scores.
- *Stable air pollution*—there is no statistically significant trend in the air pollution scores.
- *Increasing air pollution*—there is a statistically significant increasing trend in the air pollution scores.

Step 3: Enter data in the WCMD. Enter the assigned trend category for air pollution in the WCMD for this measure. The measure value is the trend category for air pollution.

<u>*Caveats and Cautions*</u>

Sensitive lichen species respond to both air pollutants as well as changes in climatic conditions, such as prolonged drought. Consult with an air resource specialist to understand if changes in sensitive lichen species are a response to changes in air pollution, climate, or both.

The data collection rate, or the amount of time between field collection dates, may be a concern for this measure. Plots are generally sampled on a 10-year monitoring cycle, and the data may not be updated on the same timeline as needed for WCM. In many wildernesses in the western U.S., lichen air plots are co-located with FIA plots, which are evenly spaced across a sampling grid that covers the country. Larger wildernesses may have more lichen biomonitoring plots because there are more FIA plots. Units may choose to locate more lichen biomonitoring plots in a wilderness to fill in the data gaps if threats due to air pollution are detected. For the Pacific Northwest, the goal is to establish one plot per 20,000 acres of wilderness, and a minimum of three plots in wildernesses under 40,000 acres.

In 2019, data will be uploaded that will result in two air pollution scores: one for nitrogen and one for sulfur. When this transition occurs, local units will need to select the metric that best descibes the air condition of their forest based on individual wilderness air concerns. In general, nitrogen is more of a concern in the western U.S. whereas sulfur is a greater concern in the eastern U.S., but local conditions may vary greatly. Consult an air resource specialist for assistance in selecting which metric to use.

Data Adequacy

Data quantity for this measure is considered to be partial with a moderate degree of confidence that all data records have been gathered. Data quality is considered to be good due to a high degree of confidence that the quality of the data can reliably access trends in the measure. These ratings indicate that overall data adequacy is medium for this measure. Some wildernesses may have more lichen biomonitoring plots than others, and some plots are monitored more frequently than others based on when they were first established, funding cycles, and accessibility. Ideally, there would be one lichen biomonitoring plot per 20,000 wilderness acres even though in many cases this standard will not be met. As expected, more plots and more frequent plot re-measurments will mean that air pollution trends from a particular area will be more representative of the air conditions. Data adequacy of the lichen biomonitoring plots should be verifiied with the appropraite air quality specialist.

Frequency

Every 10 years, lichen data are analyzed and the applicable trend cateogry is then entered in the WCMD. Be aware that this is the only measure based on a 10-year monitoring cycle. If this measure is selected, trends in wilderness character will not be determined until 10 years after the WCM baseline year. If deteriorating air pollution trends are detected, the frequency could be shortened to every 5 years. Consult with an air resource specialist to determine if a 5-year frequency may be appropriate.

Threshold for Change

The threshold for meaningful change is any change in categories. A change towards decreasing air pollution results in an improving trend in the measure.

3.4.6 Measure: Extent of Waterbodies With Impaired Water Quality

This measure assesses the miles of streams or number of lakes inside wilderness with impaired water quality, based on national or state **303(d) list of impaired water bodies** or local monitoring data. Local units may select the appropriate protocol options as described in step 1 below. Data are compiled from national or state 303(d) databases, or other local, state, regional, or national data sources. Local staff calculate the measure value. Table 2.3.17 describes key features for this measure.

Table 2.3.17—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Extent of Waterbodies with Impaired Water Quality."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required	Protocol Option 1: Miles of Streams Protocol Option 2: Number of Lakes	Step 1: Determine which protocol option is appropriate for the wilderness. Step 2: Determine which wilderness streams or lakes are impaired. Step 3: Assess the miles of impaired streams or number of impaired lakes in the wilderness. Step 4: Enter data in the WCMD.	Assist local units with compiling national or state impairment data and complete a spatial analysis as necessary. Submit results to the local unit for validation.	5 years

Protocol

Step 1: Determine which protocol option is appropriate for the wilderness. The two protocol options for this measure are described below:

> *Protocol Option 1—Miles of Streams*. Assesses the miles of streams with impaired water quality within wilderness.
>
> *Protocol Option 2—Number of Lakes*. Assesses the number of lakes with impaired water quality within wilderness.

Local units should select the protocol option that is most relevant for a wilderness. Wildernesses with both streams and lakes should also consider the quality and availability of impairment data (see step 2) when selecting which protocol option to use. If there is any question about which protocol option to select, local units should consult with a hydrologist, fishery biologist, or other water resource specialist to help identify which is most relevant for a wilderness.

Step 2: Determine which wilderness streams or lakes are impaired. All levels of impairment are counted equally for this measure—waterbodies are either impaired or not impaired. Impaired streams and lakes that are only partially inside wilderness also are included in this measure. Given the variability in threats to water quality for each wilderness, units are encouraged to identify locally relevant water quality impairment metrics and data sources. For example, for Protocol Option 2—Number of Lakes, units could use local data on mercury levels in fish to determine whether lakes are impaired. The type of local metric and the data source(s) should be determined by a hydrologist, fishery biologist, or other water resource specialist based on both relevancy and data adequacy.

In lieu of a locally-specific impairment metric, the simplest way to assess impaired waters is by using 303(d) listings. The 303(d) refers to the section of the Clean Water Act that requires the listing of impaired waters, including streams and lakes. The central data analyst can assist local units in compiling and processing 303(d) impairment data. Methods for retrieving these data are described below:

- Spatial 303(d) data can be downloaded from the EPA's website (https://www.epa.gov/waterdata/waters-geospatial-data-downloads, select ESRI 10.x File Geodatabase under the "303(d) Listed Impaired Waters" heading). A "rad_303d.mxd" ARCMAP project contains the relevant feature classes:
    - rad_303d_a—depicts impaired lakes (the "a" is for area).
    - rad_303d_l—depicts impaired streams (the "l" is for line).
    - rad_303d_p—depicts impaired points (the "p" is for point); for example, fish sampling may yield impaired points if pollutants are found in fish tissue. Impaired points are expected to be rare but may be relevant for either the miles of streams or number of lakes protocol options. If there are impaired points inside a wilderness, consult a hydrologist, fishery biologist, or other water resource specialist to determine whether and how those points should be included in counting the mileage of impaired streams or number of impaired lakes.
- An interactive map of the 303(d) data is also available through the EPA's "How's My Waterway" website (http://watersgeo.epa.gov/mywaterway/map.html). This website is recommended for quick initial assessments of how many streams or lakes are impaired, but it may be difficult to extract impairment data for further analysis. Detailed information on each waterbody, such as the cause of impairment, can be found through the list view by clicking on the name of the waterbody and selecting "Technical Report(s)." Note that some records may include multiple waterbodies, and the same waterbody may be included under multiple records; make sure to note the waterbody ID if there is any confusion.
- Many states have their own websites with 303(d) data. State websites will usually provide similar information as the EPA websites listed above, but may

be more up to date and may contain additional references to segment-specific reports or other data.

In many cases the 303(d) listings will be sufficient to determine which waterbodies are impaired; if necessary, however, they may be supplemented with other water quality data. Consult a hydrologist, fishery biologist, or other water quality specialist to validate the national or state 303(d) data and determine whether any other water quality data are necessary, appropriate, and available to supplement those data. Examples of other sources of water quality data include the following:

- Considerable information on lake and stream impairment may be available from local unit staff, NEPA documents, wilderness plans, and various reports, publications, and university and private sector databases. Many Forest Service regions and national forests also have extensive monitoring databases for wilderness lakes.
- Forest Service monitoring data and reports for wilderness lake chemistry can be retrieved from the Federal Land Manager Environmental Database at http://views.cira.colostate.edu/fed/.
- Other national or regional water quality data may also be available with monitoring sites near wilderness areas (e.g., the USGS maintains a water quality data mapping tool at http://maps.waterdata.usgs.gov/mapper/index.html). Because instrumentation within wilderness is limited, water quality data for streams are often collected downstream from a wilderness boundary. Consult a hydrologist, fishery biologist, or other water quality specialist to help interpret what impairment of streams adjacent to a wilderness area (upstream or downstream) means for water quality impairment inside a wilderness.
- If there are limited or no data on water quality for a wilderness, a local hydrologist, fishery biologist, or other water quality specialist may use their professional knowledge to determine which waterbodies are impaired.

To ensure confidence in tracking trends, impairment data must be tracked consistently over time. Given the amount of variability in data sources and protocol options for this measure, it is essential that local units document the data compilation strategy for each wilderness (including the metric of impairment, primary data source including the date accessed, and any supplemental data sources). If professional judgment is used, additional documentation (e.g., a brief narrative) explaining who made the assessment and their basis for the determination should also be included. Documentation may be stored locally, on shared drives, or uploaded to the WCMD.

Step 3: Assess the miles of impaired streams or number of impaired lakes in the wilderness. This is described below for each protocol option. Wildernesses with no impaired streams or lakes may skip this step and proceed to step 4.

Protocol Option 1—Miles of Streams. Calculate the total miles of impaired streams inside wilderness, as determined from the data sources described above. For impaired streams that continue beyond a wilderness boundary, only the mileage inside wilderness should be counted for this measure. Where impaired streams flow through lakes, the mileage distance through the lake should not be counted. Each monitoring cycle, document which streams were counted as impaired. Table 2.3.18 provides an example summary of how the impaired miles of streams could be documented for the wilderness. The measure value is the total miles of impaired streams inside wilderness.

Table 2.3.18—An example summary of impaired miles of streams.

Stream	Miles impaired
West Fork Stony Creek	5
Bluestone Creek	11
Montana Creek	9
Report this value: 25	

Regardless of the metric or data source(s) used to determine impairment, a spatial analysis is likely to be the simplest way to assess the total miles of impaired streams. Consult a GIS specialist for assistance with the spatial analysis if necessary. The central data analyst can also assist local units in analyzing the national or state 303(d) impairment data. The following steps provide an example of how to complete the spatial analysis using the spatial 303(d) data downloaded from the EPA's website at https://www.epa.gov/waterdata/waters-geospatial-data-downloads.

1. Intersect the wilderness boundary (available from the Enterprise Data Warehouse [EDW]) and the rad_303d_l (i.e., impaired streams) feature classes.

2. Remove impaired stream segments flowing through lakes, if necessary, by erasing the rad_303d_a (i.e., impaired lakes) feature class from the intersect output.

3. Add a "Miles" field and calculate the mileage of each stream segment using the calculate geometry tool.

4. Copy the records to a spreadsheet similar to table 2.3.16 and sum results to derive the total miles of impaired streams inside wilderness.

Protocol Option 2—Number of Lakes. Count the total number of wilderness lakes with impaired water quality, as determined from the data sources described in step 2. A lake partially inside wilderness is counted as one lake, it is not assessed proportionally based on the percentage of area inside wilderness. Each monitoring cycle, document which lakes were counted as impaired. Table 2.3.19 provides an example summary of how the impaired number of lakes could be documented for the wilderness. The measure value is the total number of impaired lakes.

Table 2.3.19—An example summary of the number of lakes with impaired water quality.

Lake	Total impaired
Meadowlark Lark	3
Granite Lake	
Island Lake	
Report this value: 3	

Step 4: Enter data in the WCMD. For protocol option 1, enter the total mileage of impaired streams. For protocol option 2, enter the total number of impaired lakes. If there are no streams or lakes with impaired water quality in a wilderness, enter zero in the WCMD. The measure value is either the miles of streams or the number of lakes.

Caveats and Cautions

Although some wildernesses only have a small number of lakes, or a small number of impaired lakes, they may still select protocol option 2 if that is considered to be most relevant for a wilderness. For wildernesses that have a measure baseline value of 20 or fewer impaired lakes, it may be helpful to note that the 5-percent threshold for change effectively means that any change in the number of impaired lakes is considered meaningful change. For example, if a wilderness has a measure baseline value of 10 impaired lakes, a 5-percent change would be equal to 0.5 lakes; because an increase or decrease of just a single impaired lake would exceed 0.5 lakes, any change in the total number of impaired lakes would therefore result in a change in trend for the measure.

Data Adequacy

The 303(d) assessment procedures are fairly rigorous in most states so the impaired databases are generally good. However, the data adequacy varies greatly by state, and consideration of 303(d) status on NFS lands is not necessarily thorough, particularly for wildlernesses where assessment information is limited. Some of the data sources for assessment information are old and should be reviewed by a local specialist for current applicability. The EPA and states are working constantly to improve the accuracy of 303(d) lists and to prepare and implement Total Maximum Daily Load plans for rehabilitation work, which will ultimately allow removal of some of the impaired waterbodies from listing. Data quantity is considered to be partial and data quality is considered to be moderate, resulting in a medium data adequacy rating for 303(d) listings.

Data adequacy for other data sources varies widely. Professional judgment typically has low data adequacy. In many cases, historical water quality data and reports are dated and of limited use. For other sources, the water quality protocols, analytical methods, and data QC may not be well documented. In a few cases, such as a proposed mining operation near a wilderness, extensive recent water quality data may have been collected. Because of this high variability, the data adequacy of all data sources must be assessed for each wilderness individually.

Frequency

Every 5 years, assess water quality impairment in wilderness streams or lakes, and enter the total mileage of impaired streams or the total number of impaired lakes in the WCMD.

Threshold for Change

The threshold for meaningful change is a 5-percent change in either the total mileage of impaired streams or the total number of impaired lakes. Once there are five measure values, the threshold for meaningful change will switch to regression analysis for both protocol options. A decrease in the amount of impaired waterbodies beyond the threshold for meaningful change results in an improving trend in this measure.

3.5 Indicator: Ecological Processes

This indicator focuses on threats to ecological processes that affect biotic and abiotic components of wilderness ecological systems. There are two measures for this indicator and units are required to select at least one.

3.5.1 Measure: Watershed Condition Class

This measure assesses the average wilderness watershed condition class, based on Forest Service Watershed Condition Classification (WCC) data. Unless stated otherwise, the protocol steps are intended to be completed by the central data analyst. Data are compiled from the Forest Service Watershed Condition Framework website and validated locally. The WCMD calculates the measure value. Table 2.3.20 summarizes key features for this measure.

Table 2.3.20—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Watershed Condition Class."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the two ecological process measures	None	Validate the condition class for watersheds that are only partially within wilderness and adjust if necessary.	Step 1: Identify wilderness watersheds. Step 2: Retrieve watershed condition class data from the Forest Service Watershed Condition Framework (WCF) website. Step 3: Enter data in the WCMD.	5 years

Protocol

Step 1: Identify wilderness watersheds. The most efficient way to determine which watersheds are inside wilderness is to use GIS to overlay a wilderness boundary over a watershed layer. Watershed and wilderness layers are available on the Forest Service T drive (T:\FS\Reference\GIS drive). Watershed layers can also be downloaded from http://www.fs.fed.us/biology/watershed/condition_framework.html by clicking on the link to "download a shapefile with WCC and Prioritization information." Make sure to use the 6th code HUC (HUC 12) watershed layer rather than a different HUC level. For each watershed partially or entirely within wilderness, determine the acreage inside wilderness. Consult a GIS specialist for assistance with the spatial analysis if necessary. Record the watershed names/codes and area inside wilderness for all watersheds that are partially or entirely within wilderness.

Step 2: Retrieve watershed condition class data from the Forest Service Watershed Condition Framework (WCF) website. The WCF website (http://www.fs.fed.us/biology/watershed/condition_framework.html) provides several methods for accessing watershed condition information: an interactive map, tabular data, and spatial data. The links to the following methods are on the website:

- Interactive map—The USDA Forest Service Watershed Condition and Prioritization Interactive map (fig. 2.3.9) can be accessed at https://apps.fs.usda.gov/wcatt/.

- Tabular data—Download a table containing the WCC and prioritization information for the entire NFS summarizing watershed class, **watershed score**, and metric (attribute) and watershed class scores (fig. 2.3.10) at http://www.fs.fed.us/biology/resources/pubs/watershed/maps/USDAFS-WCF2011.htm.

- Spatial data—For GIS application, users can download a shapefile with WCC and Prioritization information. (This is the same link described in step 1 to download watershed layers.)

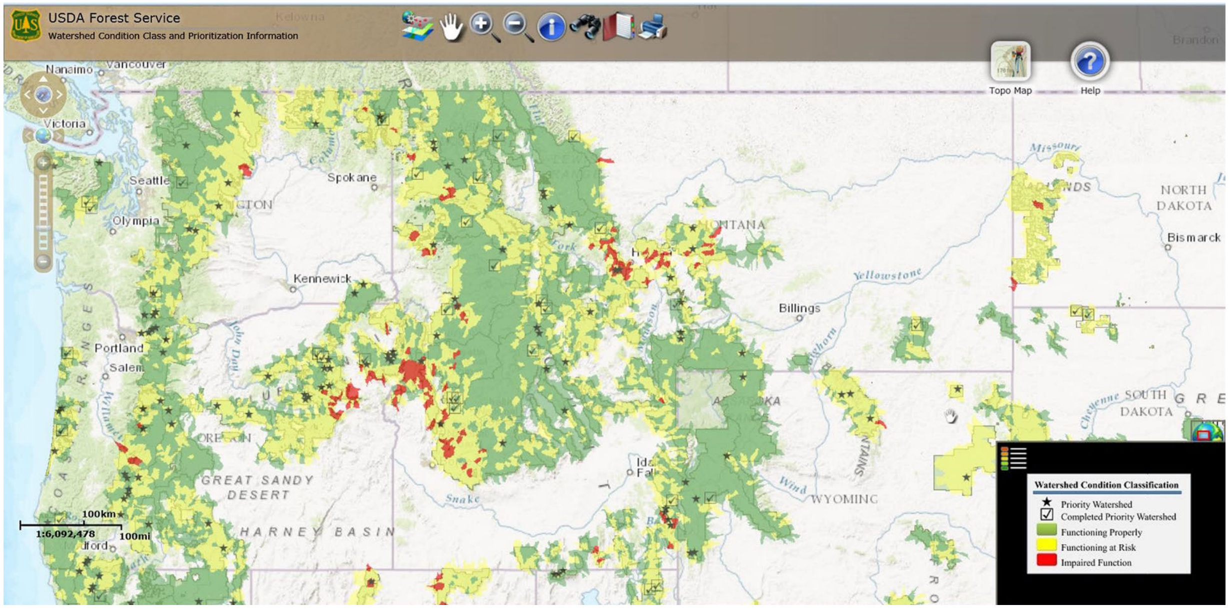


Figure 2.3.9—A screenshot of the Forest Service watershed condition and prioritization interactive map for portions of Idaho, Montana, Oregon, and Washington.

www.fs.fed.us/biology/resources/pubs/watershed/maps/USDAFS-WCF2011.htm

FOREST_NAME	WATERSHED_CODE	WATERSHED_NAME	WATERSHED_CONDITION_FS_AREA
Humboldt-Toiyabe National Forest	160503010501	Rockland Canyon	Functioning at Risk
White Mountain National Forest	010801030301	Headwaters Gale River	Functioning at Risk
Tongass National Forest	190102031902	Goon Dip River	Functioning Properly
Arapaho-Roosevelt National Forest	140100010208	Strawberry Creek	Functioning at Risk
Medicine Bow-Routt National Forest	101201070105	Fiddler Creek	Functioning at Risk
Nebraska National Forest	101402010506	Chadron Creek	Functioning at Risk
Lewis And Clark National Forest	100301030102	North Fork Smith River-Stud Horse Creek	Functioning at Risk

Figure 2.3.10—Example WCC table with watershed condition ratings for several national forests.

All three links provide information at the 6th code HUC (HUC 12) watershed level, for all national forests and grasslands. Use whatever method is easiest to obtain the condition class data. Condition class may be described or titled differently for each method; for example, the table uses the heading "Watershed_Condition_FS_Area" while the spreadsheet uses "Watershed_Class_FS_Land." There are only three viable watershed condition classes: 1, 2, or 3. Equivalent descriptions for these three condition classes are displayed in table 2.3.21.

Table 2.3.21—Equivalent watershed condition class descriptions.

		Equivalent descriptions			
		Watershed score ranges	**Explanation**	**Color in interactive map viewer**	**Description**
Watershed condition class	**1**	1.0–1.6	Functioning properly	Green	Good condition
	2	1.7–2.2	Functioning at risk	Yellow	Fair condition
	3	2.3–3.0	Impaired function	Red	Poor condition

The listed condition class is based on an assessment of the entire watershed. As watershed boundaries often extend beyond a wilderness boundary, a watershed may therefore be classified as "functioning at risk" or "impaired function" based on conditions outside wilderness. For watersheds that are only partially within a wilderness, a local hydrologist or other water resource specialist must validate that the listed condition class is appropriate for the portion of a watershed inside wilderness. Hydrologists or other water resource specialists may use professional judgment or the best available data to assess the listed condition class for these partial wilderness watersheds. If a water resource specialist determines that the wilderness portion of a watershed should be assigned a different condition class than the whole watershed, they may modify the condition class for that watershed. Additional documentation (e.g., a brief narrative) explaining who made the assessment and their basis for the determination should be included if a condition class is modified.

Once the data have been validated locally and any changes have been documented, the information is sent back to the central data analyst for data entry. Record the watershed condition class (using whole numbers 1, 2, or 3) for all wilderness watersheds identified in step 1.

Step 3: Enter data in the WCMD. Enter each watershed's name, area inside wilderness, and condition class in the WCMD, and the WCMD will then calculate the average wilderness condition class automatically. Local units are not responsible for calculating the average condition class themselves, but the formula is described below for reference. The measure value is the average wilderness watershed condition class.

The calculation for the average wilderness watershed condition class consists of two basic steps. First, the WCMD multiplies the wilderness acreage in each watershed by the condition class rating for that watershed. Second, the WCMD sums these calculated values and divides the result by the total number of wilderness acres. Table

2.3.22 provides a hypothetical example of how to calculate the average wilderness watershed condition class.

Table 2.3.22—An example of how to calculate the average wilderness condition class.

Watershed	Wilderness acreage	x	Condition class	=	Acres x condition class
Alpha	5,000	×	1	=	5,000
Beta	5,000	×	1	=	5,000
Gamma	5,000	×	2	=	10,000
Average condition class	Sum = 15,000		20,000 / 15,000 = 1.3 *(round to the nearest whole number)*		Sum = 20,000
Report this value: 1					

Caveats and Cautions

As stated above, the watershed condition class is for an entire 6th code HUC (HUC 12). As watersheds often extend beyond a wilderness boundary, conditions outside a wilderness may drive the condition class listed for a watershed. Local knowledge and professional judgment must be applied to determine if the listed condition class is appropriate for the wilderness portion of a watershed.

Data Adequacy

The WCC database provides a complete dataset for all national forests and grasslands using consistent rating protocols with nationwide maps and data tables. Local units periodically update the database, with nationwide updates conducted at 5-year intervals. While the WCC condition class ratings are moderately subjective, the quality of data should improve with future updates. Data adequacy is complete for data quantity and moderate for data quality for an overall data adequacy rating of medium. If professional judgment or other data sources are used to modify a watershed condition class, additional subjectivity is added to the data quality. Data adequacy must therefore be verified locally for each wilderness.

Frequency

Every 5 years, watershed condition class is assessed, and the condition class for each wilderness watershed is then entered in the WCMD.

Threshold for Change

The threshold for meaningful change is any change in the average wilderness watershed condition class. A decrease in the average condition class score results in an improving trend in this measure.

3.5.2 Measure: Number of Animal Unit Months of Commercial Livestock Use

This measure assesses the 3-year rolling average of commercial livestock use, based on an annual count of Animal Unit Months (AUMs) within a wilderness. Local data are compiled and entered in NRM-Range annually and are automatically retrieved by NRM-WCM. NRM-WCM calculates the annual value. The WCMD calculates the annual value and the 3-year rolling average (the measure value). Table 2.3.23 summarizes key features for this measure.

Table 2.3.23—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for the measure "Number of Animal Unit Months of Commercial Livestock Use."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the two ecological process measures	None	Step 1: Identify wilderness allotments. Step 2: Compile data on the amount of livestock use authorized in wilderness allotments. Step 3: Enter data in the WCMD.	None	1 year

<u>Protocol</u>

Step 1: Retrieve and validate data on annual count of AUMs within wilderness from NRM. Livestock use is evaluated by monitoring the number of permitted AUMs of livestock grazing that are authorized for allotments located entirely or partially within wilderness. AUMs – the quantity of forage required by one mature cow and her calf (or the equivalent in sheep or horses) for 1 month – are the preferred unit of measurement rather than head months.

Retrieve data for this measure in NRM-WCM by accessing the "commercial livestock" option under the "Natural" quality in the "Navigator" tab. This will display the annual count of AUMs for the wilderness. The following attributes are automatically uploaded to NRM-WCM from NRM-Range:

- Range Management Unit Name
- Range Management Unit ID
- Total Allotment Acres
- Acres in Wilderness
- Percent in Wilderness
- Authorized AUM
- Wilderness AUM

NRM-WCM will display each of these attributes for every allotment on record in NRM-Range. Each allotment listed in NRM-WCM has an "Include" option, in which allotments can be unselected if they no longer are active. NRM-WCM also contains a “Remarks” tab in order to record specific details about each range management unit (i.e. allotment A was in nonuse this year). The Local wilderness staff must review and validate all of the information pulled for each of these attributes for accuracy and completeness. If data are incorrect, work with range specialists to correct the original data in NRM-Range.

Step 2: Calculate the annual value. The NRM-WCM application will automatically calculate the annual count of AUMs within wilderness. The method NRM-WCM uses to calculate these values is described below for reference.

The calculation for the annual number of authorized wilderness AUMs consists of three basic steps. First, NRM-WCM determines which allotments are completely within the wilderness boundary and which allotments extend outside the wilderness boundary. For the allotments that extend outside the wilderness boundary NRM-WCM determines the percentage of allotment acres located inside wilderness. Next, NRM-WCM calculates the wilderness AUMs for each allotment by multiplying the number of authorized AUMs by the percentage of the allotment inside wilderness. Lastly, NRM-WCM sums the number of wilderness AUMs for all allotments to produce the total amount of authorized livestock use in wilderness for the fiscal year. Table 2.3.24 provides a hypothetical example of how to calculate the annual number of authorized wilderness AUMs.

Table 2.3.24—Example of how to calculate the total number of authorized wilderness animal unit months (AUMs).

Allotment	Percentage inside wilderness	×	Authorized AUMs	=	Wilderness AUMs	Comments
East Fork Bear River	57%	×	446	=	254	
East Fork Blacks Fork	94%	×	3,120	=	2,933	
East Fork Smiths Fork	25%	×	1,834	=	459	Allotment was in non-use from 1997–2003. Re-stocked in 2004.
Report this value: 3,646						

If NRM-WCM cannot be used to retrieve data on authorized AUMs, the data may be determined by a range specialist evaluating range allotment maps, range annual operating instructions, or actual use reports. This type of evaluation relies on estimation and is less accurate, but can provide data to determine the trend in the measure if used consistently over time. Additional documentation (e.g., a brief narrative) explaining who made the assessment and their basis for the determination should be included if data are compiled this way. If local units only track head months, they should convert those units to AUMs using factors relating to days of use, livestock kind, and class. Consult a range specialist for assistance with this conversion if necessary.

Step 3: Enter data in the WCMD. Enter each allotment's name, percentage inside wilderness, and number of authorized AUMs retrieved from NRM-WCM in the WCMD. The WCMD will also automatically calculate the total number of wilderness AUMs authorized for the fiscal year. Make sure this calculation matches the NRM-WCM calculation. The WCMD will also automatically calculate 3-year rolling averages based on these annual values. The measure value is the 3-year rolling average number of authorized wilderness AUMs.

Caveats and Cautions

This measure does not directly monitor the ecological impacts of livestock grazing in wilderness; however, for the purposes of this measure and WCM, the number of AUMs is considered a good proxy for assessing impacts to the Natural Quality from livestock use. In addition, the protocol for determining the number of wilderness AUMs may or may not accurately reflect actual wilderness use. Assessing wilderness use as a simple proportion of the total allotment use, and using authorized AUMs rather than actual use, may not capture on-the-ground wilderness use due to a variety of factors, including rotational grazing programs, seasonality, difficult terrain, and lack of forage.

Data Adequacy

The data quantity for this measure is generally considered to be complete, as the data are available for all Forest Service grazing allotments. The data quality is considered to be moderate due to some uncertainty of actual use inside wilderness on an annual basis. As the overall use on the allotment is apportioned based on acres of wilderness in the allotment, actual use may vary from year to year and is difficult to ascertain. Therefore, the overall data adequacy is considered to be medium. If locally stored data or professional judgment are used in lieu of data from NRM-Range, and NRM-WCM data adequacy is likely to be lower. Data adequacy must be verified locally for each wilderness.

Frequency

Each year, data are compiled and calculated on the amount of authorized livestock use in NRM-WCM. The percentage of allotment acres inside wilderness and the number of authorized AUMs for each wilderness allotment are then entered in the WCMD.

Threshold for Change

The threshold for meaningful change is a 5-percent change in the 3-year rolling average number of authorized wilderness AUMs. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the 3-year rolling average beyond the threshold for meaningful change results in an improving trend in this measure.

3.6 Selecting Measures for the Natural Quality

This section provides recommendations for selecting locally developed measures for the Natural Quality, based on *Keeping It Wild 2* (Landres et al. 2015). It discusses the general considerations for selecting these measures, explains why certain types of measures are problematic, offers examples to clarify what are and are not appropriate measures, and provides a flowchart outlining the general selection process.

The essential requirement for all measures in WCM is the ability to assign a degrading, improving, or stable trend based on changes in their condition. Applying this seemingly straightforward idea to the Natural Quality can be fraught because ecological conditions typically do not have a single natural state from which a trend can be assigned. Instead, ecological systems are complex. Individuals of a species tend to move around, and ecological conditions and processes vary over time from one location to another (e.g., species come and go, some years are warm and some are cold, snowfields and glaciers expand and melt).

Natural change over time and from one place to another is a fundamental aspect of ecological systems, and is an essential aspect of the Natural Quality of wilderness character. To allow for this change, the Natural Quality should not be used to recreate historical conditions from an arbitrary point in time (e.g., pre-European settlement or the date of wilderness designation), target a subjective set of desired conditions (e.g., a specific game species population), or otherwise maintain unchanging ecological conditions. When combined with the Untrammeled Quality, the basic legal and philosophical tenet in wilderness is to watch what happens and not direct this change. This tenet means that there is no target for the species that occur there, or for abiotic conditions such as temperature or precipitation.

Given this principle, the most direct and simple measures in the Natural Quality are those that quantify known direct threats to the ecological system. For example, air pollutants or nonindigenous species are known threats that generally have good reference information. Even these threats, however, require sufficient understanding of whether changes are primarily natural or anthropogenic (e.g., separating the effects of volcanic air pollutants from human-caused pollutants, or the natural dispersal of nonindigenous species from human-caused spread). Today, many changes in the Natural Quality are due to the interacting effects of natural variation and human-caused threats, and our ability to distinguish between the two is frequently lacking. Moreover, even if these interactions are understood on a global or regional scale, this knowledge may be lacking for the smaller spatial scale of a wilderness. Therefore, measures of threats should be selected only if they are determined (either by data or professional judgment) to be primarily anthropogenic and if they can show meaningful change within the timeframe that is appropriate for WCM (i.e., 5–10 years) as opposed to requiring decades or centuries of data collection.

The Forest Service currently collects much natural resource information, and in some cases this information may be directly used in WCM. The data collected from resource programs provide valuable insight into regional and local ecosystems, but may not be appropriate or feasible to include in WCM. Importantly, not all threats or features of the natural environment important to wilderness character need to be included as measures in WCM if other resource programs already monitor these threats or features. In such cases, only those measures that are appropriate and the highest priority would be included, typically selected because they quantify threats to features that are truly integral to and representative of the area's wilderness character.

There are some cases in which a measure is inappropriate to monitor under the Natural Quality but is clearly integral to wilderness character. For example, the return of extirpated bears and wolves to wildernesses may be, from a wilderness perspective, a significant improvement in the Natural Quality. Counting populations of naturally occurring species, however, does not monitor a human-caused threat, nor can a trend in the measure be assigned without assuming a target ecological state. For such cases, the importance of the measure that was not selected should be acknowledged in the Wilderness Character Narrative (required under the WSP Wilderness Character Baseline element) or by including it in other monitoring programs.

Occasionally, a measure may be included under the Other Features of Value Quality instead of the Natural Quality. For example, the Other Features of Value Quality may include measures related to iconic features (e.g., glaciers) or species (e.g., wolves) that define how people think about wilderness or are specifically identified in the enabling legislation. This can be appropriate because trends in measures under the Other Features of Value Quality may be defined by human values (e.g., the presence of the feature or the species within a wilderness), whereas trends in measures under the Natural Quality are defined by the more stringent criterion of whether the ecological system is free from the effects of modern civilization.

Examples of Appropriate and Inappropriate Measures

The following examples show how measures are and are not appropriate, based on the guidelines presented in this section.

Appropriate Measures

Appropriate measures are those that meet four criteria: (1) they are current or potential threats to the ecological systems in wilderness, (2) they are primarily human-caused, (3) they do not rely on a static or target ecological state to make an assessment about trend, and (4) they can show change within 5–10 years. The discussion below describes two example measures and includes a brief explanation of why each measure is appropriate for use in WCM.

1. Example Measure: *Index of Nonindigenous Terrestrial Animal Species*.
    a. Nonindigenous species are a direct and significant threat to ecological systems in wilderness.
    b. Nonindigenous species are most commonly introduced or spread in wilderness by humans. Even populations of nonindigenous invasive species that are spreading naturally into a wilderness were likely initially introduced outside of a wilderness by humans. In most cases, therefore, changes in the data result primarily from human agency.
    c. This measure monitors an effect of modern civilization and does not reference a specific ecological state (any ecological state is natural so long as it is substantially unaffected by human-caused introductions of nonindigenous invasive species). A trend can be assigned for the measure such that increasing distribution or impact of nonindigenous species degrades the Natural Quality and decreasing distribution or impact improves it.
    d. A meaningful trend in the measure value can be observed in a short timeframe.
2. Example Measure: *Concentration of Ambient Ozone*.
    a. Ozone in the lower atmosphere is a pollutant formed primarily from reactions involving emissions from cars, industrial facilities, power plants, and other types of combustion. It can have a significant effect on ecological components, structures, and functions and is therefore a threat to the Natural Quality.
    b. Air pollutants such as ozone are a by-product of modern civilization and changes in the data result primarily from human agency.
    c. This measure monitors an effect of modern civilization and does not reference a specific ecological state (any ecological state is natural so long as it is substantially unaffected by human-caused air pollution). A trend can be assigned for the measure such that an increasing concentration of ozone degrades the Natural Quality and decreasing concentration improves it.
    d. A meaningful trend in the data can be observed in a short timeframe.

Inappropriate Measures

Inappropriate measures are those that do not meet the criteria described above for appropriate measures. The discussion below describes two example measures and includes a brief explanation of why the measure is inappropriate for use in WCM.

1. Example Measure: *Average Annual Summer or Winter Temperature (related to climate change).*

    a. Temperature naturally varies within a wilderness from year to year without necessarily degrading wilderness character. Although changes in global temperature reflect human agency, making that determination for local change—especially in the short term—may not be feasible.

    b. Changing average temperature simply represents change, and cannot be considered to improve or degrade wilderness character. To state that any change in average temperature would degrade the Natural Quality sets a static target for what "natural" is in a wilderness.

    c. If data are not already being collected in close proximity to a wilderness, a long-time scale would be required before a meaningful trend in the data could be observed.

    d. Established climatology monitoring programs already exist within wilderness managing agencies and other federal agencies. This science is complex, nuanced, time-consuming, and already conducted by specialists at a much higher level than is generally possible for an individual wilderness. WCM should not duplicate or create new monitoring programs.

2. Example Measure: *Index of Animal (or Plant) Species of Concern (primarily state or federally listed threatened or endangered species).*

    a. Monitoring a listed species does not directly monitor the threat to the Natural Quality. A species may be listed because of threats occurring outside a wilderness, and change in the abundance or distribution of such species in a wilderness may not be indicative of a threat inside a wilderness.

    b. Measures that quantify the loss of an indigenous species must be able to determine that the change in species abundance or distribution is due primarily to anthropogenic impacts and not to natural variation. Few wildernesses have adequate historical or current data to make this determination.

    c. Change in a population of an indigenous species does not necessarily improve or degrade the Natural Quality of wilderness character because populations change naturally over time. Identifying a trend in the measure would require setting a static historical, current, or desired abundance and distribution as a target state, which is inappropriate in wilderness.

d. Determining if there is a change in species abundance and distribution would require sampling over periodic intervals and over a large area, which may be difficult to accomplish for a wilderness. The sampling protocol would also need to account for annual and seasonal migrations and probable immigration-emigration dispersal patterns.

Flowchart

The flowchart depicted in figure 2.3.11 provides general guidelines, using a series of questions, for selecting measures for the Natural Quality. The first question is whether the measure is a threat to the Natural Quality, with threat defined as human agency in directly or indirectly causing a significant change to the composition, structure, and functioning of ecological systems in wilderness (Landres et al. 2009). The second question is whether the measure will provide an interpretable trend. This question, based on the discussion above, can be summarized as asking the following: (1) whether the measure holds a wilderness to a static or target ecological state, (2) if changes can be primarily attributed to human agency, and (3) if there is sufficient information or data to make a reasonable assessment of trend within approximately 5–10 years. For this flowchart, it is assumed that all measures being considered have already been determined to be integral to wilderness character, significant or meaningful to understanding change in the indicator of the Natural Quality, and vulnerable to human-caused threats. It also is assumed that measures are able to be reliably monitored with a high degree of confidence in the data, and can feasibly be monitored into the future.

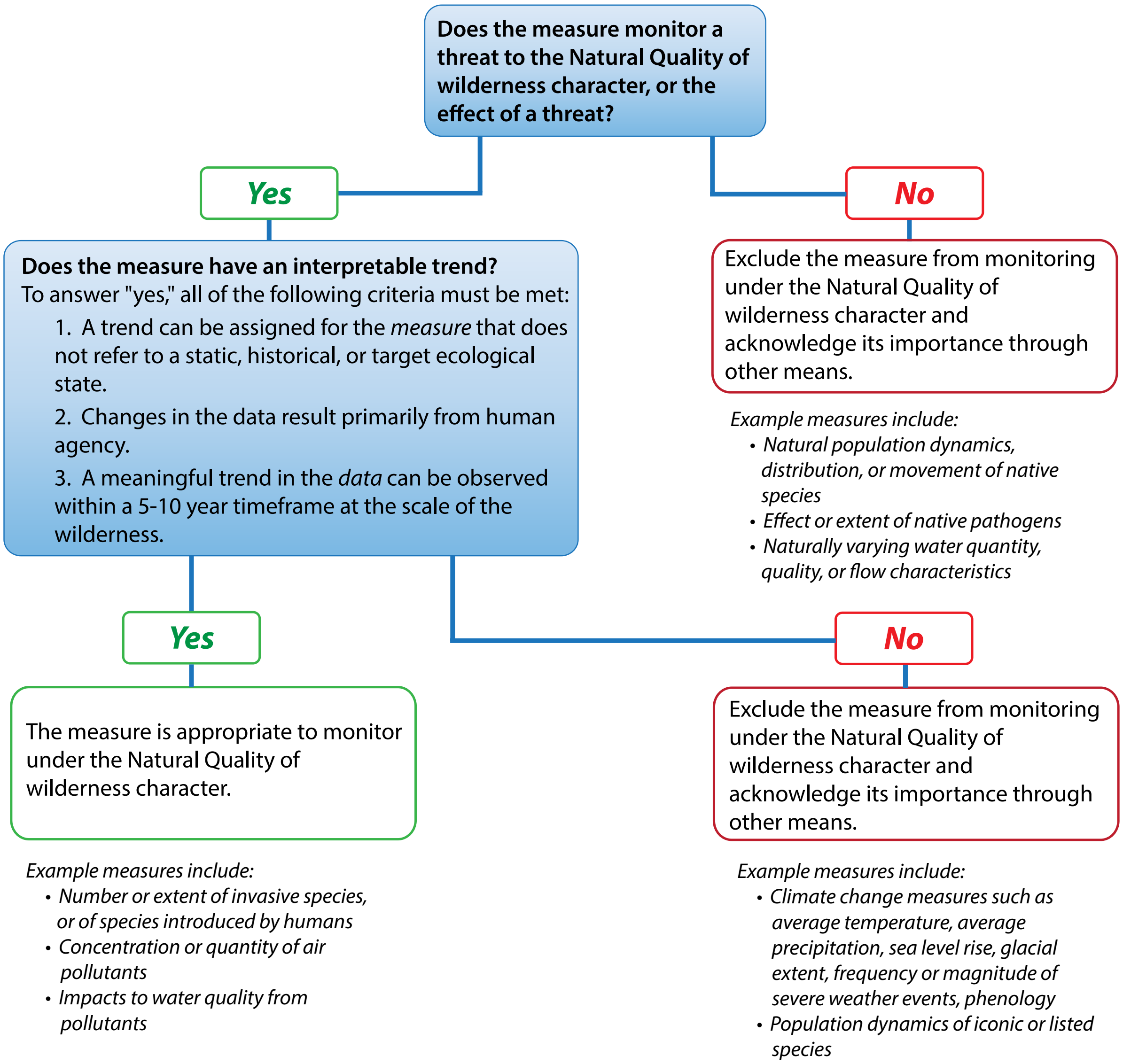


Figure 2.3.11—Flowchart for selecting measures for the Natural Quality.

4.0 Undeveloped Quality

Monitoring the Undeveloped Quality assesses how physical developments as well as motorized and mechanized use within wilderness are trending over time. Key indicators and measures monitor authorized developments, inholdings, and various types of motorized and mechanized use. This section provides detailed guidance for monitoring the following indicators and measures:

- 4.2 Indicator: Presence of Non-Recreational Structures, Installations, and Developments
    - 4.2.1 Measure: Index of Authorized Non-Recreational Physical Development
- 4.3 Indicator: Presence of Inholdings
    - 4.3.1 Measure: Acres of Inholdings
- 4.4 Indicator: Use of Motor Vehicles, Motorized Equipment, or Mechanical Transport
    - 4.4.1 Measure: Index of Administrative Authorizations to Use Motor Vehicles, Motorized Equipment, or Mechanical Transport
    - 4.4.2 Measure: Percent of Emergency Incidents Using Motor Vehicles, Motorized Equipment, or Mechanical Transport
    - 4.4.3 Measure: Index of Special Provision Authorizations to Use Motor Vehicles, Motorized Equipment, or Mechanical Transport

4.2 Indicator: Presence of Non-Recreational Structures, Installations, and Developments

This indicator focuses on the physical evidence of human occupation and modification. There is one required measure for this indicator.

4.2.1 Measure: Index of Authorized Non-Recreational Physical Development

This measure is an index that assesses selected elements for each type, or component, of non-recreational physical development. Data are compiled from a variety of local and national data sources and entered in various NRM applications. NRM-WCM calculates the measure value. Table 2.4.1 describes key features for this measure.

Photo: Forest Service Road 54 (Pearson Creek); Pacific Northwest Region by USFS.

Table 2.4.1—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Index of Authorized Non-Recreational Physical Development."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required	None	Step 1: Ensure users understand what developments and elements are counted under each measure component. Step 2: Retrieve the data for each of the measure components; evaluate and update the data as necessary. Step 3: Calculate individual development ratings and measure component scores. Step 4: Calculate the overall development index value and enter data in the WCMD.	Assist local units with compiling regional or national data as necessary. Submit results to the local unit for validation.	5 years

<u>*Protocol*</u>

Individual developments monitored under this measure are categorized under seven distinct measure components:

1. Buildings
2. Dams and other instream structures
3. Roads
4. Fixed instrumentation sites
5. Utility infrastructure
6. Mines
7. Grazing infrastructure

For this measure, the protocol first provides a general description of the required steps (1–4), followed by detailed instructions on completing steps 1–3 for each component.

Step 1: Ensure users understand what developments and elements are counted under each measure component. First, it is important to note that only developments categorized under the seven measure components are monitored here. While the measure components are not exhaustive, they do assess the most common occurrences of non-recreational developments and should reliably track changes in the measure. Second, for this measure all relevant developments are counted regardless of their length or size. For example, a short 0.1 mile road would still be included in this measure; it would not be rounded down to 0 miles and discounted. Other general guidelines that apply to all measure components are described below.

Exclude recreational developments

- Developments intended to support recreational use, such as system trails and bridges, as well as administratively provided infrastructure such as hitching posts, bear poles, and shelters are not included under this measure. Instead, they are evaluated in the measure *Number of Authorized Constructed Recreation Features* (section 5.4.2 in part 2) under the Solitude or Primitive and Unconfined Recreation Quality to avoid double counting.

Include all infrastructure authorized by the Forest Service and exclude unauthorized developments

- This measure includes developments managed directly by the Forest Service as well as those installed or maintained by permittees or cooperators under current agreements.
- Some developments may be installed by other governmental entities, such as Forest Service Research or affiliated federal, state, or local government agencies, without the prior knowledge or approval of NFS staff or line officers. When discovered, this protocol assumes either these developments will be put under a valid permit or agreement and subsequently assessed under this measure, or they will be removed from a wilderness.
- Additionally, there are other types of recent, unauthorized developments typically installed by the general public, such as squatters' huts and infrastructure related to marijuana plantations. While these items may also affect the Undeveloped Quality, they are typically removed when discovered as a general management practice. Therefore, these generally "ephemeral" types of developments are not counted in this measure.

Include some types of abandoned or historical developments

- Many wildernesses contained abandoned or unauthorized developments that pre-date the area's designation as wilderness. In general, abandoned developments are rarely included in this measure, and only if they are considered to be significant or large enough to warrant practicable data collection. For example, small abandoned developments, such as trash dumps, building foundations, or the remnants of former structures are not included under this measure. Larger abandoned developments, such as cars and planes, and military infrastructure are similarly not tracked under this measure.
- Regardless of their size or significance, abandoned mines are always included in this measure until they are fully rehabilitated and no longer observable.
- Developments determined to have historical value may be included in this measure if they are considered to be significant or large enough and if adequate

data exist. For example, **buildings of historical value** are usually counted under this measure while historical utility infrastructure may not be. Historical developments may also be included in the measure *Condition Index for Integral Cultural Features* (section 6.2.1 in part 2) under the Other Features of Value Quality. Double counting is not a concern in such cases because the Undeveloped Quality tracks the presence and impact of the development (e.g., the type and size of a historical building) as a degradation to wilderness character while the Other Features of Value Quality tracks the condition of the feature (e.g., the integrity and lack of disturbance) as having a positive effect on wilderness character.

Exclude temporary developments

- This measure avoids tracking temporary developments, but does track permanent or long-term features. Long-term features are those that occur in a wilderness for a cumulative period of 12 months or longer during a 5-year time span (not necessarily in sequential time).

Exclude developments on inholdings

- Developments located on private inholdings and other non-NFS lands within wilderness are not included under this measure.

Step 2: Retrieve the data for each of the measure components; evaluate and update the data as necessary. Most, but not all, of the relevant data for developments counted under this protocol should already reside in various NRM applications. For developments that are not currently tracked in NRM, new records must be added using local knowledge and other available data sources. The central data analyst can assist local units in compiling national data and entering new records in NRM-WCM. All new or existing records must also be validated by local units and linked to the specific wilderness in which they are located. While these linkages are automatically established for NRM applications with spatial data (such as NRM-Roads), for non-spatial NRM applications these connections must be made manually through the use of database tables. In such cases, the association between a development and a wilderness is managed through various linking features provided in NRM (such as the "Feature x Land Unit Link" form). Over time this approach will become obsolete and all linkages will be made automatically through spatial analysis.

Consult a specialist familiar with the appropriate NRM application for assistance with any of the measure components, if necessary. For each component, units must complete the following three basic tasks to retrieve, evaluate, and update the data:

1. Retrieve the existing data from NRM by running a report in NRM-WCM that displays all features of interest linked to a particular wilderness. If additional non-NRM data sources are described for a measure component, retrieve the

existing data from those sources as well. The central data analyst can assist local units in compiling data from any regional or national databases and entering new records in NRM-WCM.

2. Review the existing data for accuracy and completeness with local wilderness staff and other relevant resource specialists (e.g., range specialists for grazing infrastructure, facility engineers for buildings). The purpose of this review is to identify whether any individual developments are missing from NRM, and to determine whether any existing records contain incorrect or incomplete attribute information or are not linked to a wilderness.

3. Work with relevant local staff to compile missing and corrected data. For developments with data already tracked in NRM, update existing records and link features to the appropriate wilderness as necessary. For developments that are not currently tracked in NRM, enter new records in the relevant NRM application. Data in NRM may be updated using any available data sources or professional judgment. If professional judgment is used, include additional documentation (e.g., a brief narrative) explaining who provided the information and the basis for their determination.

Step 3: Calculate individual development ratings and measure component scores. Individual development ratings are numerical values for each feature monitored under this measure (e.g., the rating for one specific dam). Measure component scores are the numerical values for each measure component, derived by summing the individual development ratings for all features monitored under a component (e.g., the measure component score for all dams and other instream structures inside wilderness). The NRM-WCM application will calculate the individual development ratings and the component scores. Table 2.4.2 summarizes the scoring rules for all the measure components in this index and these calculations are described in detail under the section for each measure component.

Table 2.4.2—Summary table of the scoring rules for all seven measure components.

Measure component	Element scoring rules				
Buildings	**Type**		×	**Size**	
	Category	**Value**	×	**Category**	**Value**
	Unoccupied, abandoned, or non-residential	1	×	Small (<500 square feet)	1
	Part-time residential (seasonal)	2	×	Moderate (500–1,000 square feet)	2
	Full-time residential (year-round)	3	×	Large (≥1,000 square feet)	3
Dams and other instream structures	**Size**		×	**Materials**	
	Category	**Value**	×	**Category**	**Value**
	Instream structures	1	×	Native	1
	Dams not meeting NID criteria	3	×	Non-native	2
	Dams meeting NID criteria	5	×		
Roads	**Status**		×	**Length**	
	Category	**Value**	×	**Category**	**Value**
	Non-system roads, decommissioned roads, and existing system roads with level 1 operational maintenance	1	×	Short (<¼ mile)	1
	Exisitng system roads with level 2 operational maintenance	5	×	Medium (¼–1 mile)	2
	Existing system roads with level 3+ operational maintenance	7	×	Long (>1 mile)	3
Fixed instrumentation sites	**Value**				
	1 point per site				
Utility infrastructure	**Scale**				
	Category				**Value**
	Small (point site <1 acre)				2
	Moderate (point site ≥1 acre or linear feature <½ mile)				5
	Large (linear feature ≥½ mile)				9
Mines	**Scale**		×	**Status**	
	Category	**Value**	×	**Category**	**Value**
	Small (<1,000 square feet)	1	×	Inactive	2
	Moderate (1,000 square feet to 1 acre)	2	×	Active	3
	Large (>1 acre)	3	×		

Measure component	Element scoring rules				
	Scale		×	Materials	
	Category	Value	×	Category	Value
Grazing infrastructure	Point site	1	×	Primitive	1
	Linear feature	Length in miles	×	Non-primitive	2

NID = National Inventory of Dams.

Local units must review and validate the individual development ratings and component scores, and correct them in the original NRM application as necessary. As part of validating the component scores, it is important to verify that individual features are only tracked under a single measure component and are not double counted. For example, while a water impoundment used by livestock could reasonably be tracked under either the grazing infrastructure component or the dams and other instream structures component, for this measure it must only be counted under one of those components, not both. If the same feature has multiple records under different components, ensure that it is not double-counted by deselecting the record for the less relevant component in NRM-WCM. Local units may use their discretion to determine which component is less relevant. Deselected records will still appear in NRM-WCM reports, but will not be included in calculations for the component scores. Local units may also deselect records automatically retrieved by NRM-WCM if they are inaccurate or represent features that no longer exist on the ground. If a feature is deselected, include additional documentation (e.g., a brief narrative) explaining who made the decision and why.

Step 4: Calculate the overall development index value and enter data in the WCMD. The NRM-WCM application will also calculate the final index value by summing the component scores (table 2.4.3). Local units must validate the index value generated by NRM-WCM. Once validated, enter the overall development index value in the WCMD. The measure value is the index value.

Table 2.4.3—An example of how to calculate the development index value for a wilderness.

Measure component	Component score
Buildings	15
Dams and other instream structures	13
Roads	24
Fixed instrumentation sites	3
Utility infrastructure	12
Mines	0
Grazing infrastructure	12
Report this index value: 79	

The following sections provide detailed instructions on how to complete steps 1–3 for each measure component.

Measure Component: Buildings

This component tracks two elements for buildings: type and size. Local data are compiled and periodically entered in NRM-Buildings or NRM-Features. NRM-WCM calculates the component score.

Step 1: Ensure users understand what developments and elements are counted under the buildings measure component. A building is defined as "a structure to support, shelter, or enclose persons, animals, or property of any kind" (FSH 6509.11k, section 56.05 and 7309.11, section 05). Historical buildings are included under this measure component, but buildings on inholdings or other non-NFS lands are not. The two elements used to calculate individual development ratings for buildings are type and size.

The type element is categorized by the amount of time a structure serves to house people. The more time people are housed at an individual structure, the greater the likelihood they will modify the surrounding environment, thereby increasing the associated development level. The following categories are used to assess the type element:

- *Unoccupied, abandoned, or* ***non-residential***—buildings that are not occupied by people. This includes non-residential buildings that are designed and built to support functions other than human habitation, such as storage sheds, as well as residential buildings that were occupied in the past but no longer are, such as repurposed or abandoned structures. Examples of residential buildings that would be counted under this category include: a cabin originally built for human occupation that has now been repurposed as an administrative storage unit, a historical lookout preserved by heritage staff but restricted from visitor entry or occupation, and a dilapidated cabin that is still standing but is no longer maintained and unsafe to enter.

- ***Part-time residential (seasonal)***—buildings occupied by people for a cumulative total of 6 months or less each year, such as functioning fire lookouts.

- ***Full-time residential (year-round)***—buildings occupied by people for a cumulative total of more than 6 months each year, such as certain crew quarters.

The size element is categorized by the gross area of a structure. The larger the building, the greater the impact on a visitor's sense of the undeveloped nature of wilderness character (to key off the phrase "substantially unnoticeable" in Section 2(c) of the Wilderness Act). The following categories are used to assess the size element:

- *Small*—buildings with a gross area less than 500 square feet.

- *Moderate*—buildings with a gross area between 500 and 1,000 square feet.
- *Large*—buildings with a gross area greater than 1,000 square feet.

Step 2: Retrieve the data for the buildings measure component; evaluate and update the data as necessary. Data on buildings are currently stored in NRM-Buildings and NRM-Features; however, the completeness of these existing data is likely to vary considerably from wilderness to wilderness. For example, buildings with existing records in NRM may not be linked to a wilderness or may be missing critical attribute information, while other buildings may not be recorded in NRM at all. Any building that is not currently tracked in NRM-Buildings and NRM-Features must be manually entered in that application. For the measure baseline year, it is especially important to follow the steps described below to ensure all non-recreational wilderness buildings have accurate records in NRM. In subsequent years, less work will be required as local units will only need to update records if buildings have been added, altered, or removed since the previous monitoring cycle. Complete the following steps in NRM:

1. Retrieve existing data by running a report in NRM-WCM that displays all features of interest for the buildings measure component that are linked to a particular wilderness. (Data for this report are pulled from existing records in NRM-Buildings and NRM-Features.) The following attributes will be displayed for all buildings:
    - Building name
    - Building ID
    - Category (e.g., family housing, storage)
    - Sub-category
    - Gross square feet
    - Status (e.g., existing-active)
    - Building use (select recreational or non-recreational)
    - Building type
2. Enter the new "Building use" and "Building type" attributes in NRM-WCM—these attributes cannot be entered in NRM-Buildings. For "Building use," select whether each building is "recreational" or "non-recreational." For "Building type," select the amount of time each structure is used to house people based on the categories for the type element described in step 1. Use the "Category" and "Sub-category" attributes as well as local knowledge to make these determinations.

3. Review the results of the NRM-WCM report for accuracy and completeness by working with local wilderness staff and facilities specialists.

    - Determine if any attributes are incomplete or incorrect for an individual building.

    - Determine if any known non-recreational wilderness buildings are missing from the NRM-WCM report. If buildings are missing, there are two possible explanations: (1) records exist in NRM-Buildings or NRM-Features but have not been linked to the wilderness, or (2) records have never been entered in NRM. To rule out the first explanation, consult specialists with access to NRM-Buildings and NRM-Features to identify and retrieve any existing records for missing buildings that have not yet been linked to the wilderness.

4. Update the data in NRM-Buildings and NRM-Features as necessary. Records in NRM-Buildings and NRM-Features can only be edited or added by specialists with access to that application. Consult specialists with access to NRM-Buildings and NRM-Features, as well as wilderness staff and facilities specialists, to complete this step

    - If any incomplete or incorrect attributes were found, update the existing records in NRM-Buildings or NRM-Features using local knowledge or any other available data sources.

    - If any missing buildings were identified that have existing records in NRM-Buildings or NRM-Features but are not yet linked to the wilderness, link those records through the "Feature x Land Unit Link" form ("Link type" should be "Overlay"). This linking step can be accomplished by any user with access to the NRM-Wilderness application and does not require specialist involvement.

    - If any missing buildings were identified that are not currently included in NRM, create new records in NRM-Buildings or NRM-Features using local knowledge or any other available data sources. Be sure to link new records to the wilderness (see step 4b, immediately above). Note that local staff will not be able to create new records in NRM-WCM for this component; if, for any reason, specialists cannot add new records in NRM-Buildings or NRM-Features for missing buildings, those developments will not be included in the measure value calculation.

5. Re-run the NRM-WCM report for the buildings measure component once all necessary updates have been made and validate the results (i.e., repeat steps 1–4 above until all information is correct and up to date). Note that certain attributes must be assigned a value for this component and cannot be left

blank; if information for a required attribute is unknown, estimate the value using professional judgment and include additional documentation (e.g., a brief narrative) explaining who provided the information and the basis for their estimation.

Step 3: Calculate individual development ratings and the buildings measure component score. The NRM-WCM application will automatically calculate the measure component score for buildings. Local units must review and validate component score generated by NRM-WCM and correct as necessary. The method NRM-WCM uses to calculate these values is described below for reference.

For each building marked as "Non-recreational" under the "Building use" attribute, NRM-WCM assigns categories for the two elements tracked under this component—type and size—using the categories described in step 1 (summarized below in table 2.4.4). The category for the type element is determined using the "Building type" attribute, and the category for the size element is determined using the "Gross square feet" attribute. For both elements, each category is associated with a numerical value. To calculate the individual development rating for each non-recreational building, NRM-WCM multiplies the numerical value assigned for the type element by the numerical value assigned for the size element (table 2.4.4).

NRM-WCM calculates the measure component score by summing the individual development ratings for all non-recreational buildings in a wilderness.

Table 2.4.4—Element categories and numerical values used to calculate individual development ratings for features tracked under the buildings measure component.

Measure component: Buildings				
Type		**×**	**Size**	
Category	**Value**		**Category**	**Value**
Unoccupied, abandoned, or non-residential	1	×	Small (<500 square feet)	1
Part-time residential (seasonal)	2	×	Moderate (500–1,000 square feet)	2
Full-time residential (year-round)	3	×	Large (≥1,000 square feet)	3

Measure Component: Dams and Other Instream Structures

This component tracks two elements: size and materials. Data are compiled from local and national databases and periodically entered in NRM-WCM; data from NRM-Dams are automatically compiled via the EDW and entered in NRM-WCM. NRM-WCM calculates the component score.

Step 1: Ensure users understand what developments and elements are counted under the dams and other instream structures measure component. Dams are defined as "any artificial barrier… which impounds or diverts water" (Forest Service Manual 7505). Other instream structures include constructed features found within a river channel, such as diversions, fish ladders, weirs, gaging stations, gates, water intake/outflow structures, canals/ditches, flumes, levees, and spillways. Some impoundments are constructed and maintained to support livestock use, and could reasonably be tracked under either this measure component or the grazing infrastructure component; to avoid double counting such features, only include them under a single component. Typically, if such a feature is included in NRM-Dams it should be tracked exclusively under this component, even if it is also included in NRM-Features as a range feature. The two elements used to calculate individual development ratings for dams and instream structures are size and materials.

The size element is categorized by the type and scale of dams or instream structures. Instream structures that are not dams are generally smaller in scale and do not have as great an impact on the Undeveloped Quality. Dams are further categorized by whether they meet the criteria for inclusion in the National Inventory of Dams (NID). The NID contains information on large dams that either: (1) equal or exceed 25 feet in height and exceed 15 acre-feet in storage, (2) equal or exceed 50 acre-feet of storage and exceed 6 feet in height, or (3) are considered a significant hazard if they were to fail. Inclusion in the NID is used as a surrogate for the general impact of a dam on the Undeveloped Quality of wilderness character. The following categories are used to assess the size element:

- *Instream structures*—instream structures that are not dams, including: diversions, fish ladders, weirs, gaging stations, gates, water intake/outflow structures, canals/ditches, flumes, levees, spillways, etc.
- *Dams not meeting NID criteria*—smaller dams that are not included in the NID.
- *Dams meeting NID criteria*—larger dams that are included in the NID.

The materials element is categorized by whether features are constructed from native or non-native materials. The following categories are used to assess the materials element:

- *Native*—dams or instream structures constructed from native materials, such as earthen dams or features built of natural stone.
- *Non-native*—dams or instream structures constructed from non-native materials, such as more developed concrete or masonry features.

<u>*Step 2: Retrieve the data for the dams and other instream structures measure component; evaluate and update the data as necessary.*</u> Data on dams are currently stored in NRM-Dams. This dataset is linked to spatial data and retrieved by NRM-WCM through the EDW.

The completeness of the existing dam data is likely to vary considerably from wilderness to wilderness. For example, dams with existing records in NRM may not be linked to a wilderness or may be missing critical attribute information, while other features may not be recorded at all. Any dam that is not currently tracked must be manually entered in NRM-Dams or NRM-WCM.

In contrast to data on dams, data on instream features are unlikely to be stored in NRM-Dams and instead will need to be compiled manually. Contact local wilderness staff, hydrologists, and other relevant resource specialists to retrieve data on instream structures in wilderness. Data on instream structures may also be stored in the USGS National Hydrography Dataset (NHD). All compiled data on wilderness instream structures will need to be manually entered in NRM-WCM for the measure baseline year. The central data analyst can assist local units in compiling national instream structure data and entering new records in NRM-WCM.

For the measure baseline year, it is especially important to follow the steps described below to ensure all wilderness dams and instream structures have accurate records in NRM. In subsequent years, less work will be required as local units will only need to update records if dams or instream structures have been added, altered, or removed since the previous monitoring cycle. Complete the following steps in NRM:

1. Create new records in NRM-WCM for all identified instream structures within wilderness for the measure baseline year. Work with local wilderness staff, hydrologists, and other relevant resource specialists, and use any available data sources, to assign an appropriate value for the "Construction material" attribute. For this attribute, select whether each instream structure is made of native or non-native materials based on the categories for the materials element in step 1. The material may be estimated using the most accurate means available: the NHD, any other available data sources, or local knowledge. Once baseline records are entered in NRM-WCM for all known wilderness instream structures, this step will not need to be completed in subsequent monitoring periods unless instream structures have been added, altered, or removed.

2. Retrieve existing data by running a report in NRM-WCM that displays all features of interest for the dams and other instream structures measure component that are linked to a particular wilderness. The following attributes will be displayed for dams automatically retrieved by NRM-WCM from the EDW:

    - Dam name
    - Dam ID
    - NID ID (only retrieved when applicable for large dams)

- Construction material (select native or non-native)
- Size

The following attributes will be displayed for dams originally entered in NRM-WCM:

- Dam name
- Dam ID NID ID (only retrieved when applicable for large dams)
- Construction material (select native or non-native)
- Size

The following attributes will be displayed for instream structures originally entered in NRM-WCM:

- Structure ID
- Event Type
- Construction material (select native or non-native)

3. Enter the new “Construction material” and “Size” attributes in NRM-WCM—these attributes cannot be entered in NRM-Dams or the EDW. For “Construction material,” select whether each dam or instream structure is made of native or non-native materials based on the categories for the materials element in step 1. For “Size,” manually select whether each dam meets or does not meet NID criteria based on the categories for the size element described in step 1. Use the “NID ID” attribute and local knowledge to make these determinations. Instream structures originally entered in NRM-WCM do not have an associated “Size” attribute because NRM-WCM automatically assigns them to the “instream structures” category under the “size” element

4. Identify superfluous records and ensure only one record per feature is selected in NRM-WCM. This report displays records for all individual features, and may include separate records for closely related features. For example, a dam and an associated gaging station may be tracked as separate records in NRM-Dams and the EDW, however, because of their close association and co-location, both sites would be considered part of the same dam or instream structure for this measure component, and should not be double counted. In addition, errors in the spatial data—such as duplicate records—may be replicated in NRM. To avoid double counting duplicate or closely related records, work with local wilderness staff, hydrologists, and other relevant resource specialists to identify such features and ensure that only one record per dam or instream structure is selected in NRM-WCM. Deselected records will still appear in NRM-WCM reports, but will not be included in calculations for the component score.

5. Review the results of the NRM-WCM report for accuracy and completeness by working with local wilderness staff, hydrologists, and other relevant resource specialists.

    a. Determine if any attributes are incomplete or incorrect for an individual feature.

    b. Determine if any known dams or instream structures are missing from the NRM-WCM report. If features are missing, there are two possible explanations: (1) records exist in NRM-Dams but have not been linked to the wilderness, or (2) records have never been entered in NRM. Records in NRM-Dams are already linked to spatial data and retrieved through the EDW and do not need to be manually linked to the wilderness; therefore, only the second explanation is likely for this component.

Update the data in NRM-Dams and NRM-WCM as necessary. Records in NRM-Dams can only be edited or added by specialists with access to that application. Consult specialists with access to NRM-Dams, as well as wilderness staff, hydrologists, and other relevant resource specialists, to complete this step. If data cannot be updated via NRM and instead need to be corrected in the EDW, contact the EDW team (https://fsweb.wo.fs.fed.us/cio/mission-support-systems/ediscovery-enterprise-content-management/enterprise-data-warehouse-edw).

    c. If any incomplete or incorrect attributes were found, update the existing records in NRM-Dams or NRM-WCM using local knowledge or any other available data sources.

    d. If any missing features were identified that are not currently included in NRM, create new records in NRM-Dams or NRM-WCM using local knowledge or any other available data sources. NRM-Dams is generally the preferred option for adding new dam records, but NRM-WCM may be used if NRM-Dams is decommissioned or otherwise unavailable for data entry. NRM-WCM is the preferred option for adding new instream structure records.

6. Re-run the NRM-WCM report for the dams and other instream structures measure component once all necessary updates have been made and validate the results (i.e., repeat steps 2–6 above until all information is correct and up to date). Note that certain attributes must be assigned a value for this component and cannot be left blank; if information for a required attribute is unknown, estimate the value using professional judgment and include additional documentation (e.g., a brief narrative) explaining who provided the information and the basis for their estimation.

Step 3: Calculate individual development ratings and the dams and other instream structures measure component score. The NRM-WCM application will automatically calculate individual development ratings and the measure component score for dams and other instream structures. Local units must review and validate the ratings and component score generated by NRM-WCM and correct them as necessary. It is especially important to verify that individual dams and instream structures are only counted once for this measure component, and that those included in multiple data sources or in closely-related records are not double counted. Similarly, be sure to verify that livestock-related water impoundments are only counted under one measure component, and not double counted under both this component and the grazing infrastructure component. The method NRM-WCM uses to calculate these values is described below for reference.

For each dam or instream structure, NRM-WCM assigns categories for the two elements tracked under this component—size and materials—using the categories described in step 1 (summarized below in table 2.4.5). The category for the size element is determined using the "Size" attribute (or is automatically assigned for instream structures originally entered in NRM-WCM), and the category for the materials element is determined using the "Construction material" attribute. For both elements, each category is associated with a numerical value. To calculate the individual development rating for each dam or instream structure, NRM-WCM multiplies the numerical value assigned for the size element by the numerical value assigned for the materials element (table 2.4.5). NRM-WCM calculates the measure component score by summing the individual development ratings for all dams and instream structures in a wilderness.

Table 2.4.5—Element categories and numerical values used to calculate individual development ratings for features tracked under the dams and other instream structures measure component.

Measure component: Dams and other instream structures			
Size	x	Materials	
Category	**Value**	**Category**	**Value**
Instream structures	1	Native	1
Dams not meeting NID criteria	3	Non-native	2
Dams meeting NID criteria	5		

NID = National Inventory of Dams.

Measure Component: Roads

This component tracks two elements for roads: status and length. Local data are compiled and periodically entered in NRM-Roads, NRM-SUDS (Special Uses Database System), or NRM-WCM; data from the EDW are automatically compiled and entered in NRM-Roads. NRM-WCM calculates the component score.

Step 1: Ensure users understand what developments and elements are counted under the roads measure component. Roads are defined as "a motor vehicle travel way over 50 inches, unless classified and managed as a trail." (36 Code of Federal Regulations 212.1). Typically, these roads are an acknowledged responsibility of the Forest Service, and as such, will appear in NRM-Roads as being either currently maintained or purposefully decommissioned. Decommissioned roads are included in this measure unless they have been converted to a system trail (in which case they are considered recreational and not counted here). **Non-system roads** are also tracked under this measure and may include ghost roads, user-created roads, and any road not considered part of the **NFS road** system. The two elements used to calculate individual development ratings for roads are status and length.

The status element is categorized by the degree to which a road is currently maintained. For system roads, this is determined using the **operational maintenance level**—"the maintenance level currently assigned to a road considering today's needs, road condition, budget constraints, and environmental concerns" (FSH 7709.59, sec. 62.3). Operational maintenance levels range from level 1 (least maintained), to level 5 (highest degree of maintenance), with lower levels corresponding with a smaller impact on the Undeveloped Quality. The following categories are used to assess the status element:

- *Non-system roads, decommissioned roads, and existing system roads with level 1 operational maintenance*—roads that are not officially maintained, such as non-system roads (including ghost roads and user-created roads) and decommissioned roads, or system roads with level 1 operational maintenance. Level 1 is assigned to roads not currently in use but receiving basic custodial maintenance to prevent damage to adjacent resources and to perpetuate the road for future resource management needs (FSH 7709.59, sec. 62.32).

- *Existing system roads with level 2 operational maintenance*—roads with level 2 operational maintenance. Level 2 is assigned to roads open for use by high clearance vehicles (FSH 7709.59, sec. 62.32).

- *Existing system roads with level 3+ operational maintenance*—roads with level 3–5 operational maintenance. Levels 3–5 are assigned to roads open and maintained for travel by a standard passenger car with increasing levels of user comfort and convenience (FSH 7709.59, sec. 62.32).

The length element is categorized by the miles of road within wilderness. This element is scaled conservatively to emphasize the impact of roads on the Undeveloped Quality of wilderness character. The following categories are used to assess the length element:

- *Short*—roads less than ¼ mile in length.

- *Medium*—roads between ¼ and 1 mile in length.

- *Long*—roads more than 1 mile in length.

Step 2: Retrieve the data for the roads measure component; evaluate and update the data as necessary. Data on roads are currently stored in two primary datasets:

- NRM-Roads—this dataset is georeferenced and linked to national spatial transportation data stored in the EDW. These data primarily consist of system roads.
- NRM-SUDS—this dataset only includes "permitted roads" that are reserved for exclusive use by permittees, are not available for administrative use, and are not maintained by the Forest Service.

The completeness of the existing data is likely to vary considerably from wilderness to wilderness. For example, roads with existing records in NRM may not be linked to a wilderness or may be missing critical attribute information, while other roads may not be recorded in NRM at all. Any road that is not currently tracked in NRM-Roads or NRM-SUDS must be manually entered in NRM-Roads, NRM-SUDS, or NRM-WCM (depending on feature ownership). For the measure baseline year, it is especially important to follow the steps described below to ensure all wilderness roads have accurate records in NRM. In subsequent years, less work will be required as local units will only need to update records if roads have been added, altered, or removed since the previous monitoring cycle. Complete the following steps in NRM:

1. Retrieve existing data by running a report in NRM-WCM that displays all features of interest for the roads measure component that are linked to a particular wilderness. (Data for this report are pulled from existing records in NRM-Roads, NRM-SUDS, and NRM-WCM; the first time this report is run, no records will be available from NRM-WCM as data will not have been entered yet.) The following attributes will be displayed for roads originally entered in NRM-Roads:

   - Road name
   - Road ID
   - System (e.g., NFS road)
   - Length
   - Linear event—route status (e.g., existing, decommissioned, or converted)
   - Operational maintenance level

   The following attributes will be displayed for roads originally entered in NRM-SUDS:

   - Authorization ID

- Length category
- Use name

The following attributes will be displayed for roads originally entered in NRM-WCM:

- Road name
- Length category

2. Enter the new "Length category" attribute in NRM-WCM for records retrieved from NRM-SUDS—this attribute cannot be entered in NRM-SUDS. (Confusingly, there is a different text-based "Length" attribute that can be added in NRM-SUDS; however, because this text-based NRM-SUDS "Length" attribute may not provide sufficient detail to determine the road mileage, it is not retrieved for this measure component.) For the new "Length category" attribute, select the mileage of each road based on the categories for the length element described in step 1. "Length category" values may be estimated using the most accurate means available: local spatial data, aerial imagery, any other available data sources, or local knowledge. (Note that the NRM-WCM "Length category" attribute only needs to be entered for roads originally recorded in NRM-SUDS or new roads entered in NRM-WCM; records in NRM-Roads already contain a viable "Length" attribute that NRM-WCM will retrieve and use.)
3. Identify superfluous records and ensure only one record per feature is selected in NRM-WCM. Records retrieved from NRM-Roads are linked to the national spatial transportation data, and errors in the spatial data—such as duplicate records—may be replicated in NRM. To avoid double counting multiple records for the same road, work with local wilderness staff and other relevant resource specialists to identify duplicate records from NRM-Roads and ensure that only one record per road is selected in NRM-WCM. Deselected records will still appear in NRM-WCM reports, but will not be included in calculations for the component score.
4. Assess the accuracy of roads included in this report against actual conditions. If roads are no longer evident on the landscape, their associated records may be deselected in NRM-WCM if local units decide it is appropriate to do so. Deselected records will still appear in NRM-WCM reports, but will not be included in calculations for the component score. Use observations and local knowledge of field conditions to determine if roads are still evident on the landscape. If available, aerial imagery may also be used to make this determination as evidence of roads can vary depending on the context of the view—patterns may show up on imagery that cannot be seen on the ground and

vice versa. Decisions to deselect roads in NRM-WCM are judgment calls that should be made consistently over the years in accordance with the guidelines in this technical guide. If a road is deselected, include additional documentation (e.g., a brief narrative) explaining who made the decision to exclude the road and why. For the measure baseline year, it is recommended that all roads be included as a reference point for change over time.

5. Review the results of the NRM-WCM report for accuracy and completeness by working with local wilderness staff and other relevant resource specialists.
    a. Determine if any duplicate records for the same feature have been entered in both NRM-Roads and NRM-SUDS. Duplicate records are expected to be unlikely.
    b. Determine if any attributes are incomplete or incorrect for an individual road.
    c. Determine if any known roads in wilderness are missing from the NRM-WCM report. If roads are missing, there are two possible explanations: (1) records exist in NRM but have not been linked to the wilderness, or (2) records have never been entered in NRM (for example, non-system ghost roads may not be included in either NRM-Roads or NRM-SUDS). To rule out the first explanation, consult specialists with access to NRM-SUDS to identify and retrieve any existing records for missing roads that have not yet been linked to the wilderness (records in NRM-Roads are already linked to spatial data stored in the EDW and do not need to be manually linked to the wilderness).
6. Update the data in NRM-Roads, NRM-SUDS, and NRM-WCM as necessary. Records in NRM-Roads and NRM-SUDS can only be edited or added by specialists with access to those applications. Consult specialists with access to NRM-Roads and NRM-SUDS, as well as wilderness staff and other relevant resource specialists, to complete this step.
    a. If any duplicate records were identified, ensure they are not double counted by updating records in NRM-Roads and/or NRM-SUDS to eliminate the repetition.
    b. If any incomplete or incorrect attributes were found, update the existing records in NRM-Roads, NRM-SUDS, or NRM-WCM using local spatial data, local knowledge, or any other available data sources.
    c. If any missing features were identified that have existing records in NRM-SUDS but are not yet linked to the wilderness, link those records through the “Accomplishment Instrument x Land Unit Link” form (“Link type” should be “Overlay”).

d. If any missing features were identified that are not currently included in NRM, create new records in NRM-Roads (for system roads), NRM-SUDS (for permitted roads), or NRM-WCM (for ghost roads or other non-system roads)—consult relevant specialists to determine which application is most appropriate—using local spatial data, local knowledge, or any other available data sources. Be sure to link new records in NRM-SUDS to the wilderness (see step 6c, immediately above).

7. Re-run the NRM-WCM report for the roads measure component once all necessary updates have been made and validate the results (i.e., repeat steps 1–6 above until all information is correct and up to date). Note that certain attributes must be assigned a value for this component and cannot be left blank; if information for a required attribute is unknown, estimate the value using professional judgment and include additional documentation (e.g., a brief narrative) explaining who provided the information and the basis for their estimation.

Step 3: Calculate individual development ratings and the roads measure component score. The NRM-WCM application will automatically calculate individual development ratings and the measure component score for roads. Local units must review and validate the ratings and component score generated by NRM-WCM and correct them as necessary. It is especially important to verify that individual roads are only counted once for this measure component, and that those included in multiple data sources are not double counted. The method NRM-WCM uses to calculate these values is described below for reference.

For each road, NRM-WCM assigns categories for the two elements tracked under this component—status and length—using the categories described in step 1 (summarized below in table 2.4.6). The category for the status element is determined using various attributes including “System,” “Linear event-route status,” and “Operational maintenance level” (NRM-WCM automatically counts permitted roads tracked in NRM-SUDS and ghost roads or other records entered in NRM-WCM as non-system roads). The category for the length element is determined using the “Length” or “Length category” attributes (the “Length” attribute is used for features tracked in NRM-Roads, and the “Length category” attribute is used for features tracked in NRM-SUDS or entered in NRM-WCM). For both elements, each category is associated with a numerical value. To calculate the individual development rating for each road, NRM-WCM multiplies the numerical value assigned for the status element by the numerical value assigned for the length element (table 2.4.6). NRM-WCM calculates the measure component score by summing the individual development ratings for all roads in a wilderness.

Table 2.4.6—Element categories and numerical values used to calculate individual development ratings for features tracked under the roads measure component.

Measure component: Roads				
Status		**×**	**Length**	
Category	**Value**		**Category**	**Value**
Non-system roads, decommissioned roads, and existing system roads with level 1 operational maintenance	1	×	Short (<¼ mile)	1
Exisitng system roads with level 2 operational maintenance	5	×	Medium (¼–1 mile)	2
Existing system roads with level 3+ operational maintenance	7	×	Long (>1 mile)	3

Measure Component: Fixed Instrumentation Sites

This component counts the number of fixed instrumentation sites. Local data are compiled and periodically entered in NRM-Features or NRM-SUDS. NRM-WCM calculates the component score.

Step 1: Ensure users understand what developments and elements are counted under the fixed instrumentation sites measure component. This protocol defines fixed instrumentation sites as unattended measurement devices left in place for at least one year. These sites typically contain measuring equipment, a data logger, and a power source. Some of these devices transmit data offsite for storage and analysis. Many types of instrumentation, such as trail counters for recreation use or automated cameras for wildlife, may be temporarily installed at various locations around a wilderness for days, weeks, or in some cases, months. Such temporary installations do not have the same ability to affect the Undeveloped Quality due to their generally smaller scale and lack of permanence. For this component, only long-term fixed instrumentation sites in place for 12 months or more during the previous 5-year period are tracked. This time span covers instrumentation in place for an entire year, as well as recurring short-term instrumentation that is re-installed seasonally for a cumulative total that meets or exceeds 12 months. For example, trail counters installed for three months each year, or 15 months in a 5-year period, would be counted here.

This measure component does not assess any elements; instead, the component score is a simple count of the number of fixed instrumentation sites within a wilderness. A site is counted a single time regardless of the number of different measurement devices that may be co-located. Local units may use their discretion to determine what proximity between devices constitutes co-location; as a general guideline, devices within 100 feet of one another may be considered a single fixed instrumentation site.

Step 2: Retrieve the data for the fixed instrumentation sites measure component; evaluate and update the data as necessary. Data on fixed instrumentation sites are currently stored in two datasets:

- *NRM-Features*—this application tracks long-term fixed instrumentation sites that are owned by the Forest Service.
- *NRM-SUDS*—this application tracks long-term fixed instrumentation sites that are owned by cooperators or permittees and managed under SUPs with the Forest Service.

The completeness of these existing data is likely to vary considerably from wilderness to wilderness. For example, sites with existing records in NRM may not be linked to a wilderness or may be missing critical attribute information, while other sites may not be recorded in NRM at all. Any fixed instrumentation site that is not currently tracked in NRM-Features or NRM-SUDS must be manually entered in one of those applications (depending on feature ownership). For the measure baseline year, it is especially important to follow the steps described below to ensure all long-term wilderness fixed instrumentation sites have accurate records in NRM. In subsequent years, less work will be required as local units will only need to update records if fixed instrumentation sites have been added, altered, or removed since the previous monitoring cycle. Complete the following steps in NRM:

1. Identify all relevant records and manually link them to the wilderness for the measure baseline year. It is likely that most fixed instrumentation sites in NRM-Features are not currently linked (and therefore cannot be retrieved automatically by NRM-WCM). The linking process for records in NRM-Features must be completed in NRM-Wilderness—it cannot be completed in NRM-Features. Consult specialists with access to NRM-Wilderness and NRM-Features to complete the following.

    a. Compile a list of all relevant records in NRM-Features by querying the “Feature type” attribute for “Recording site.” The results of this query will show all existing NRM-Features records for fixed instrumentation sites, but will not distinguish wilderness features from non-wilderness features. Work with wilderness staff and other relevant resource specialists to identify which of the “Recording site” records are inside wilderness. Note the “Feature ID” for all wilderness features.

    b. Enter the NRM-Wilderness application and click the “link” icon on the toolbar to navigate to the NRM-Features page. For each wilderness feature, select “Recording site” from the “Type” dropdown menu, enter the individual “Feature ID” number under “ID,” and select the “Link type.” Once all features have been linked, click save.

This step is most critical for the measure baseline year. Once existing records in NRM-Features have been linked to a particular wilderness, NRM-WCM will be able to retrieve them automatically and this step will not need to be completed in subsequent monitoring periods unless new records are added to NRM-Features.

2. Retrieve existing data by running a report in NRM-WCM that displays all features of interest for the fixed instrumentation sites measure component that are linked to a particular wilderness. (Data for this report are pulled from existing records in NRM-Features and NRM-SUDS.) The following attributes will be displayed for features originally entered in NRM-Features:

   - Feature type (e.g., recording site)
   - Feature category (e.g., MS air quality)
   - Feature ID
   - Feature name
   - Ownership

   The following attributes will be displayed for features originally entered in NRM-SUDS:

   - SUDS feature
   - Authorization ID
   - Use name

3. Identify superfluous records and ensure only one record per feature is selected in NRM-WCM. This report displays records for individual measurement devices, regardless of whether devices are co-located in the same fixed instrumentation site. For example, a snow gauge and a seismological measurement device would be tracked as two separate records in NRM, even if they were co-located in a single site that should only be counted once under this protocol. To avoid double counting sites with multiple devices, work with local wilderness staff and other relevant resource specialists to identify co-located devices and ensure that only one device per fixed instrumentation site is selected in NRM-WCM. (It does not matter which device is selected as long as it is only one device per site.) Deselected records will still appear in NRM-WCM reports, but will not be included in calculations for the component score.

4. Review the results of the NRM-WCM report for accuracy and completeness by working with local wilderness staff and other relevant resource specialists.

   a. Determine if any inappropriate records are included. This may include records for short-term features in place in wilderness for less than 12 months of cumulative time during the previous 5 years, or duplicate records for the same feature that have been entered in both NRM-Features and NRM-SUDS. Inappropriate records are expected to be unlikely.

b. Determine if any attributes are incomplete or incorrect for an individual feature.

c. Determine if any known long-term fixed instrumentation sites in wilderness are missing from the NRM-WCM report. If sites are missing, there are two possible explanations: (1) records exist in NRM-Features or NRM-SUDS but have not been linked to the wilderness, or (2) records have never been entered in NRM. To rule out the first explanation, consult specialists with access to NRM-Features and NRM-SUDS to identify and retrieve any existing records for missing features that have not yet been linked to the wilderness. (Relevant records in NRM-Features should already have been identified and linked to the wilderness in step 1; therefore, only the second explanation is likely for that application.)

5. Update the data in NRM-Features and NRM-SUDS as necessary. Records in NRM-Features and NRM-SUDS can only be edited or added by specialists with access to those applications. Consult specialists with access to NRM-Features and NRM-SUDS, as well as wilderness staff and other relevant resource specialists, to complete this step.

   a. If any inappropriate records for short-term features were identified, deselect them from NRM-WCM to ensure they are not counted for this component. Deselected records will still appear in NRM-WCM reports, but will not be included in calculations for the component score. If any duplicate records were identified, update records in NRM-Features and/or NRM-SUDS to eliminate the repetition.

   b. If any incomplete or incorrect attributes were found, update the existing records in NRM-Features or NRM-SUDS using local knowledge or any other available data sources.

   c. If any missing features were identified that have existing records in NRM-Features but are not yet linked to the wilderness, link those records through NRM-Wilderness (see step 1, above). Similarly, if any missing features were identified that have existing records in NRM-SUDS but are not yet linked to the wilderness, link those records through the “Accomplishment Instrument x Land Unit Link” form (“Link type” should be “Overlay”).

   d. If any missing features were identified that are not currently included in NRM, create new records in NRM-Features (for features owned by the Forest Service) or NRM-SUDS (for features owned by cooperators or permittees and managed under SUPs with the Forest Service) using local knowledge or any other available data sources. Be sure to link new records to the wilderness (see step 1 for NRM-Features and step 5c for NRM-SUDS). Note that local staff will not be able to create new records in NRM-WCM for this component; if, for any reason, specialists cannot add new records in NRM-Feature or NRM-SUDS for missing features, those developments will not be included in the measure value calculation.

6. Re-run the NRM-WCM report for the fixed instrumentation site measure component once all necessary updates have been made and validate the results (i.e., repeat steps 2–5 above until all information is correct and up to date).

Step 3: Calculate individual development ratings and the fixed instrumentation sites measure component score. The NRM-WCM application will automatically calculate individual development ratings and the measure component score for fixed instrumentation sites. Local units must review and validate the ratings and component score generated by NRM-WCM and correct them as necessary. It is especially important to verify that individual sites are only counted once for this measure component, and that co-located devices with multiple records or features included in multiple data sources are not double counted. The method NRM-WCM uses to calculate these values is described below for reference.

To calculate the individual development rating for each fixed instrumentation site, NRM-WCM counts each permanent or long-term site (i.e., each record selected in the NRM-WCM report) as one point. NRM-WCM calculates the measure component score by summing the individual development ratings for all fixed instrumentation sites in a wilderness.

Measure Component: Utility Infrastructure

This component tracks a single element: scale. Local data are compiled and periodically entered in NRM-Features or NRM-SUDS. NRM-WCM calculates the component score.

Step 1: Ensure users understand what developments and elements are counted under the utility infrastructure measure component. Utility infrastructure consists of two main types: point sites (e.g., repeater sites and telecommunication facilities) and linear features (e.g., water pipelines and telephone lines). This measure component only includes utility infrastructure that is in place on a permanent basis (i.e., 12 months or more of cumulative time over a 5-year period), and does not include infrastructure installed temporarily, such as repeaters installed to support fire management activities for a specific incident. Historical utility infrastructure, such as old water pipes and phone lines that are no longer in service, may be included in this protocol at the discretion of the unit. These data are not routinely tracked in NRM and an initial inventory may be time consuming and costly; therefore, historical infrastructure is generally only included when adequate data already exist. The single element used to calculate the component score for utility infrastructure is scale.

The scale element is categorized by the area and length of utility infrastructure to differentiate between the impacts of a small point site and a long utility corridor. The following categories are used to assess the scale element:

- *Small*—utility infrastructure that consists of an individual site occupying less than one acre in total size, such as a repeater site.
- *Moderate*—utility infrastructure that either: (1) consists of an individual site that equals or exceeds 1 acre, or (2) requires an above-ground linear corridor that is typically less than a ½ mile in length.
- Large—utility infrastructure that requires an above-ground linear corridor that is typically equal to or greater than a ½ mile in length.

Step 2: Retrieve the data for the utility infrastructure measure component; evaluate and update the data as necessary. Data on utility infrastructure are currently stored in two datasets:

- NRM-Features—this application tracks long-term utility infrastructure that is owned by the Forest Service.
- NRM-SUDS—this application tracks long-term utility infrastructure that is owned by cooperators or permittees and managed under SUPs with the Forest Service.

The completeness of these existing data is likely to vary considerably from wilderness to wilderness. For example, features with existing records in NRM may not be linked to a wilderness or may be missing critical attribute information, while other features may not be recorded in NRM at all. Any utility infrastructure that is not currently tracked in NRM-Features or NRM-SUDS must be manually entered in one of those applications (depending on feature ownership). For the measure baseline year, it is especially important to follow the steps described below to ensure all long-term wilderness utility infrastructure has accurate records in NRM. In subsequent years, less work will be required as local units will only need to update records if utility infrastructure has been added, altered, or removed since the previous monitoring cycle. Complete the following steps in NRM:

1. Identify all relevant records and manually link them to the wilderness for the measure baseline year. It is likely that most utility infrastructure in NRM-Features is not currently linked (and therefore cannot be retrieved automatically by NRM-WCM). The linking process for records in NRM-Features must be completed in NRM-Wilderness—it cannot be completed in

NRM-Features. Consult specialists with access to NRM-Wilderness and NRM-Features to complete the following.

a. Compile a list of all relevant records in NRM-Features by querying the "Feature type" attribute for: "Communication system," "Other utility," "Power system," "Wastewater system," and "Water system." The results of this query will show all existing NRM-Features records for utility infrastructure, but will not distinguish wilderness features from non-wilderness features. Work with wilderness staff and other relevant resource specialists to identify which of the queried records are inside wilderness. Note the "Feature ID" for all wilderness features.

b. Enter the NRM-Wilderness application and click the "link" icon on the toolbar to navigate to the NRM-Features page. For each wilderness feature, select the relevant "Feature type" from the "Type" dropdown menu, enter the individual "Feature ID" number under "ID," and select the "Link type." Once all features have been linked, click save.

This step is most critical for the measure baseline year. Once existing records in NRM-Features have been linked to a particular wilderness, NRM-WCM will be able to retrieve them automatically and this step will not need to be completed in subsequent monitoring periods unless new records are added to NRM-Features.

2. Retrieve existing data by running a report in NRM-WCM that displays all features of interest for the utility infrastructure measure component that are linked to a particular wilderness. (Data for this report are pulled from existing records in NRM-Features and NRM-SUDS.) The following attributes will be displayed for features originally entered in NRM-Features:

   - Feature type (e.g., communications system, power system, wastewater system, water system, or other utility)
   - Feature category
   - Feature ID
   - Feature name
   - Property type
   - Size

   The following attributes will be displayed for features originally entered in NRM-SUDS:

   - Authorization ID
   - Status

- Use code/name
- Use acres
- Size

3. Enter the new “Size” attribute in NRM-WCM—this attribute cannot be entered in NRM-Features or NRM-SUDS. Select the acreage or mileage of each feature based on the categories for the scale element described in step 1. Use local knowledge, as well as the “Use acres” attribute for records in NRM-SUDS, to make these determinations.
4. Review the results of the NRM-WCM report for accuracy and completeness by working with local wilderness staff and other relevant resource specialists.
    a. Determine if any inappropriate records are included. This may include records for short-term features in place in wilderness for less than 12 months of cumulative time during the previous 5 years, or duplicate records for the same feature that have been entered in both NRM-Features and NRM-SUDS. Inappropriate records are expected to be unlikely.
    b. Determine if any attributes are incomplete or incorrect for an individual feature.
    c. Determine if any known long-term utility infrastructure features in wilderness are missing from the NRM-WCM report. If sites are missing, there are two possible explanations: (1) records exist in NRM-Features or NRM-SUDS but have not been linked to the wilderness, or (2) records have never been entered in NRM. To rule out the first explanation, consult specialists with access to NRM-Features and NRM-SUDS to identify and retrieve any existing records for missing features that have not yet been linked to the wilderness. (Relevant records in NRM-Features should already have been identified and linked to the wilderness in step 1; therefore, only the second explanation is likely for that application.)
5. Update the data in NRM-Features and NRM-SUDS as necessary. Records in NRM-Features and NRM-SUDS can only be edited or added by specialists with access to those applications. Consult specialists with access to NRM-Features and NRM-SUDS, as well as wilderness staff and other relevant resource specialists, to complete this step.
    a. If any inappropriate records for short-term features were identified, deselect them from NRM-WCM to ensure they are not counted for this component. Deselected records will still appear in NRM-WCM reports, but will not be included in calculations for the component score. If any duplicate records were identified, update records in NRM-Features and/or NRM-SUDS to eliminate the repetition.
    b. If any incomplete or incorrect attributes were found, update the existing records in NRM-Features or NRM-SUDS using local knowledge or any other available data sources.

c. If any missing features were identified that have existing records in NRM-Features but are not yet linked to the wilderness, link those records through NRM-Wilderness (see step 1, above). Similarly, if any missing features were identified that have existing records in NRM-SUDS but are not yet linked to the wilderness, link those records through the "Accomplishment Instrument x Land Unit Link" form ("Link type" should be "Overlay").

d. If any missing features were identified that are not currently included in NRM, create new records in NRM-Features (for features owned by the Forest Service) or NRM-SUDS (for features owned by cooperators or permittees and managed under SUPs with the Forest Service) using local knowledge or any other available data sources. Be sure to link new records to the wilderness (see step 1 for NRM-Features and step 5c for NRM-SUDS). Note that local staff will not be able to create new records in NRM-WCM for this component; if, for any reason, specialists cannot add new records in NRM-Feature or NRM-SUDS for missing features, those developments will not be included in the measure value calculation.

6. Re-run the NRM-WCM report for the utility infrastructure measure component once all necessary updates have been made and validate the results (i.e., repeat steps 2–5 above until all information is correct and up to date). Note that certain attributes must be assigned a value for this component and cannot be left blank; if information for a required attribute is unknown, estimate the value using professional judgment and include additional documentation (e.g., a brief narrative) explaining who provided the information and the basis for their estimation.

Step 3: Calculate individual development ratings and the utility infrastructure measure component score. The NRM-WCM application will automatically calculate individual development ratings and the measure component score for utility infrastructure. Local units must review and validate the ratings and component score generated by NRM-WCM and correct them as necessary. It is especially important to verify that individual features are only counted once for this measure component, and that those included in multiple data sources are not double counted. The method NRM-WCM uses to calculate these values is described below for reference.

For each permanent or long-term feature, NRM-WCM assigns a category for the single element tracked under this component—scale—using the categories described in step 1 (summarized below in table 2.4.7). The category for the scale element is determined using the "Size" attribute for features stored in NRM-Features and NRM-SUDS. For the single element tracked under this component, each category is associated with a numerical value. NRM-WCM uses the numerical value as the individual development rating for each feature (table 2.4.7). NRM-WCM calculates the measure component score by summing the individual development ratings for all utility infrastructure in a wilderness.

Table 2.4.7—Element categories and numerical values used to calculate individual development ratings for features tracked under the utility infrastructure measure component.

Measure component: Utility infrastructure	
Scale	
Category	**Value**
Small (point site <1 acre)	2
Moderate (point site ≥1 acre or linear feature <½ mile)	5
Large (linear feature ≥½ mile)	9

Measure Component: Mines

This component tracks two elements: scale and status. Data are compiled from local, state, or BLM databases and periodically entered in NRM-WCM. NRM-WCM calculates the component score.

Step 1: Ensure users understand what developments and elements are counted under the mines measure component. Mines are only counted under this protocol if they are discernible. Once mines are fully rehabilitated, are no longer observable, and natural recovery has occurred, they are dropped from scoring. The two elements used to calculate individual development ratings for mines are scale and status.

The scale element is categorized by the area of all above-surface disturbance associated with a mine. The following categories are used to assess the scale element:

- *Small*—mines with an above-surface disturbance area less than 1,000 square feet.
- *Moderate*—mines with an above-surface disturbance area between 1,000 square feet and 1 acre.
- *Large*—mines with an above-surface disturbance area greater than 1 acre.

The status element is categorized by whether a mine is active or inactive. Active mines on NFS lands are extremely rare in wilderness; instead, most active mines interior to wilderness are on patented mining claims that are not NFS lands. Only mines on NFS lands (not patented mining claims) are counted under this measure. Much more commonly, mining activities inside wilderness occurred prior to the area's designation and have long since been abandoned. Where these inactive mines do exist, they can be an intrusive presence, often consisting of pits, tailing piles, and various other constructed features associated with mineral extraction. The following categories are used to assess the status element:

- *Active*—mines with visible evidence of mining or current reclamation activities.

- *Inactive*—mines that are no longer actively being reclaimed or rehabilitated.

Step 2: Retrieve the data for the mines measure component; evaluate and update the data as necessary. Contact local geological resource specialists to retrieve data on wilderness mines, including site location, operational status, and scale (area). Potential data sources may include local, state, or BLM mining databases. (While Forest Service data on mines have previously been stored in NRM-Abandoned Mine Lands [AML], this application is being decommissioned and will not be available in the future.)

All compiled data on wilderness mines will need to be manually entered in NRM-WCM for the measure baseline year. The central data analyst can assist local units in compiling regional or national mine data and entering new records in NRM-WCM. For the measure baseline year, it is especially important to follow the steps described below to ensure all wilderness mines have accurate records entered in NRM. In subsequent years, less work will be required as local units will only need to update records if mines have been added, altered in scale or status, remediated, or naturally recovered since the previous monitoring cycle. Complete the following steps in NRM:

1. Create new records in NRM-WCM for all identified mines within wilderness for the measure baseline year. Work with local wilderness staff and geological resource specialists, and use any available data sources, to assign appropriate values for the “Area” and “Operational status” attributes. For “Area,” select the above-ground surface disturbance area for each mine based on the categories for the scale element described in step 1. “Area” values may be estimated using the most accurate means available: local, state, or BLM mining databases, any other available data sources, or local knowledge. For “Operational status,” select whether each feature is active or inactive based on the categories for the status element described in step 1. Once baseline records are entered in NRM-WCM for all known wilderness mines, this step will not need to be completed in subsequent monitoring periods unless mines have been added, altered, remediated, or naturally recovered.

2. Retrieve existing data by running a report in NRM-WCM that displays all features of interest for the mines measure component that are linked to a particular wilderness. (Data for this report are pulled from existing records in NRM-WCM; the first time this report is run, no records will be available as data will not have been entered yet.) The following attributes will be displayed for all mines:

    - Site ID
    - Site name
    - Area

- Operational status

3. Review the results of the NRM-WCM report for accuracy and completeness by working with local wilderness staff and geological resource specialists.

    a. Determine if any attributes are incomplete or incorrect for an individual mine.

    b. Determine if any known wilderness mines are missing from the NRM-WCM report.

4. Update the data in NRM-WCM as necessary. Consult wilderness staff and geological resource specialists to complete this step.

    a. If any incomplete or incorrect attributes were found, update the existing records in NRM-WCM using local knowledge or any other available data sources.

    b. If any missing mines were identified that are not currently included in NRM, create new records in NRM-WCM using local knowledge or any other available data sources.

5. Re-run the NRM-WCM report for the mines measure component once all necessary updates have been made and validate the results (i.e., repeat steps 2–4 above until all information is correct and up to date). Note that certain attributes must be assigned a value for this component and cannot be left blank; if information for a required attribute is unknown, estimate the value using professional judgment and include additional documentation (e.g., a brief narrative) explaining who provided the information and the basis for their estimation.

Step 3: Calculate individual development ratings and the mines measure component score. The NRM-WCM application will automatically calculate individual development ratings and the measure component score for mines. Local units must review and validate the ratings and component score generated by NRM-WCM and correct them as necessary. The method NRM-WCM uses to calculate these values is described below for reference.

For each mine, NRM-WCM assigns categories for the two elements tracked under this component—scale and status—using the categories described in step 1 (summarized below in table 2.4.8). The category for the scale element is determined using the "Area" attribute and the category for the status element is determined using the "Operational status" attribute. For both elements, each category is associated with a numerical value. To calculate the individual development rating for each mine, NRM-WCM multiplies the numerical value assigned for the scale element by the numerical value assigned for the status element (table 2.4.8). NRM-WCM calculates the measure component score by summing the individual development ratings for all mines in a wilderness.

Table 2.4.8—Element categories and numerical values used to calculate individual development ratings for features tracked under the mines measure component.

Measure component: Mines				
Scale		**×**	**Status**	
Category	**Value**		**Category**	**Value**
Small (<1,000 square feet)	1	×	Inactive	2
Moderate (1,000 square feet to 1 acre)	2	×	Active	3
Large (>1 acre)	3			

Measure Component: Grazing Infrastructure

This component tracks two elements: scale and materials. Local data are compiled and periodically entered in NRM-Features. NRM-WCM calculates the component score.

Step 1: Ensure users understand what developments and elements are counted under the grazing infrastructure measure component. Commercial grazing is associated with certain developments, known as improvements, which are needed to support the transport and management of livestock. The most common improvements include fences, handling facilities, and water systems. Water impoundments previously tracked under the dams and other instream structures measure component should not be double-counted here, even if they are also included in NRM-Features as a range feature. The two elements used to calculate individual development ratings for grazing infrastructure are scale and materials.

The scale element is categorized by whether the grazing infrastructure is a point or line feature. The scale of grazing infrastructure varies greatly from a single site, such as a water tank, to miles of fence line. The following categories are used to assess the scale element:

- *Point site*—a non-linear range improvement, such as a stock tank or a handling facility.
- *Linear fea*ture—a range improvement that is a line, most typically a fence.

The materials element is categorized by whether features are made from native or non-native materials. The following categories are used to assess the materials element:

- *Primitive*—**primitive grazing related infrastructure** constructed of native materials or native materials and wire.
- *Non-primitive*—**non-primitive grazing related infrastructure** constructed predominantly of non-native materials, such as metal or treated wood posts.

Step 2: Retrieve the data for the grazing infrastructure measure component; evaluate and update the data as necessary. Data on grazing infrastructure are currently stored in NRM-Features; however, the completeness of these existing data is likely to vary considerably from wilderness to wilderness. For example, features with existing records in NRM may not be linked to a wilderness or may be missing critical attribute information, while other features may not be recorded in NRM at all. Any grazing infrastructure that is not currently tracked in NRM-Features must be manually entered in that application. For the measure baseline year, it is especially important to follow the steps described below to ensure all wilderness grazing infrastructure has accurate records in NRM. In subsequent years, less work will be required as local units will only need to update records if grazing infrastructure has been added, altered, or removed since the previous monitoring cycle. Complete the following steps in NRM:

1. Identify all relevant records and manually link them to the wilderness for the measure baseline year. It is likely that most grazing infrastructure in NRM-Features is not currently linked (and therefore cannot be retrieved automatically by NRM-WCM). The linking process for records in NRM-Features must be completed in NRM-Wilderness—it cannot be completed in NRM-Features. Consult specialists with access to NRM-Wilderness and NRM-Features to complete this step.

    a. Compile a list of all relevant records in NRM-Features by querying the “Feature type” attribute for: “Handling facility,” “Water system range,” or “Fence.” The results of this query will show all existing NRM-Features records for grazing infrastructure, but will not distinguish wilderness features from non-wilderness features. Work with wilderness and range specialists to identify which of the queried records are inside wilderness. (To narrow the list of possibly relevant features, it may be helpful to query NRM-Range for the same “Feature types” listed above and compare them with allotment boundaries. However, because grazing features that appear in NRM-Range are linked to and retrieved from original records in NRM-Features, errors in linking to NRM-Range may cause records to be missed using this method.) Note the “Feature ID” for all wilderness features.

    b. Enter the NRM-Wilderness application and click the “link” icon on the toolbar to navigate to the “Features” page. For each wilderness feature, select the relevant “Feature type” from the “Type” dropdown menu, enter the individual “Feature ID” number under “ID,” and select the “Link type.” Once all features have been linked, click save.

This step is most critical for the measure baseline year. Once existing records in NRM-Features have been linked to a particular wilderness, NRM-WCM will be able to retrieve them automatically and this step will not need to be completed in subsequent monitoring periods unless new records are added to NRM-Features.

2. Retrieve existing data by running a report in NRM-WCM that displays all features of interest for the grazing infrastructure measure component that are linked to a particular wilderness. (Data for this report are pulled from existing records in NRM-Features.) The following attributes will be displayed for all features:
   - Range Management Unit ID
   - Improvement ID
   - Improvement name
   - Feature type (e.g., handling facility, water system range, or fence)
   - Length (only retrieved for the fence feature type)
   - Materials detail
   - Materials (select primitive or non-primitive)
3. Enter the new “Materials” attribute in NRM-WCM—this attribute cannot be entered in NRM-Features. Select whether each feature is made predominantly of native or non-native materials based on the categories for the materials element described in step 1. Use the “Materials detail” attribute, as well as local knowledge, to make these determinations.
4. Identify superfluous records and ensure only one record per feature is selected in NRM-WCM. This report displays records for all individual grazing features, and may include separate records for closely related features. For example, a handling facility and an associated fence may be tracked as two separate features in NRM-Features. However, because these types of fences are typically of a short length, for this protocol they are considered to be included as part of their associated point site’s individual development rating, and should not be double counted as a separate linear feature. To avoid double counting closely related records, work with local wilderness and range specialists to identify such features and ensure that only the point site, and not the linear feature, is selected in NRM-WCM. Deselected records will still appear in NRM-WCM reports, but will not be included in calculations for the component score.
5. Review the results of the NRM-WCM report for accuracy and completeness by working with local wilderness and range specialists.
   a. Determine if any attributes are incomplete or incorrect for an individual feature.
   b. Determine if any known wilderness grazing infrastructure is missing from the NRM-WCM report. If features are missing, there are two possible

explanations: (1) records exist in NRM-Features but have not been linked to the wilderness, or (2) records have never been entered in NRM. (Relevant records in NRM-Features should already have been identified and linked to the wilderness in step 1; therefore, only the second explanation is likely for that application.)

6. Update the data in NRM-Features as necessary. Records in NRM-Features can only be edited or added by specialists with access to that application. Consult specialists with access to NRM-Features, as well as wilderness staff and range specialists, to complete this step.

    a. If any incomplete or incorrect attributes were found, update the existing records in NRM-Features using local knowledge or any other available data sources.

    b. If any missing features were identified that have existing records in NRM-Features but are not yet linked to the wilderness, link those records through NRM-Wilderness (see step 1, above).

    c. If any missing features were identified that are not currently included in NRM, create new records in NRM-Features using local knowledge or any other available data sources. Be sure to link new records to the wilderness (see step 1, above). Note that local staff will not be able to create new records in NRM-WCM for this component; if, for any reason, specialists cannot add new records in NRM-Features for missing features, those developments will not be included in the measure value calculation.

7. Re-run the NRM-WCM report for the grazing infrastructure measure component once all necessary updates have been made and validate the results (i.e., repeat steps 2–6 above until all information is correct and up to date). Note that certain attributes must be assigned a value for this component and cannot be left blank; if information for a required attribute is unknown, estimate the value using professional judgment and include additional documentation (e.g., a brief narrative) explaining who provided the information and the basis for their estimation.

Step 3: Calculate individual development ratings and the grazing infrastructure measure component score. The NRM-WCM application will automatically calculate individual development ratings and the measure component score for grazing infrastructure. Local units must review and validate the ratings and component score generated by NRM-WCM and correct them as necessary. It is especially important to verify that individual grazing features are only counted once for this measure component, and that closely related records are not double counted. Similarly, be sure to verify that livestock-related water impoundments are only counted under one measure component, and not double counted under both this component and the dams and other instream structures component. The method NRM-WCM uses to calculate these values is described below for reference.

For each feature, NRM-WCM assigns categories for the two elements tracked under this component—scale and materials—using the categories described in step 1 (summarized below in table 2.4.9). The category for the scale element is determined using the "Feature type" attribute (point sites are listed as "Handling facility" or "Water system range," while linear features are listed as "Fence"). The category for the materials element is determined using the "Materials" attribute. For both elements, each category is associated with a numerical value (for the scale element, the numerical value for linear features is determined using the "Length" attribute, with linear features shorter than 0.5 miles rounded up to 1). To calculate the individual development rating for each feature, NRM-WCM multiplies the numerical value assigned for the scale element by the numerical value assigned for the materials element (table 2.4.9). NRM-WCM calculates the measure component score by summing the individual development ratings for all grazing infrastructure in a wilderness.

Table 2.4.9—Element categories and numerical values used to calculate individual development ratings for features tracked under the grazing infrastructure measure component.

Measure component: Grazing infrastructure				
Scale		×	Materials	
Category	**Value**		**Category**	**Value**
Point site	1	×	Primitive	1
Linear feature	Length in miles	×	Non-primitive	2

Caveats and Cautions

This measure relies heavily on NRM data that are validated and supplemented by local knowledge. It should not be assumed that the data currently recorded in NRM are sufficient; instead, units should use the implementation of this protocol as an opportunity to validate, clean, and improve these datasets.

Data Adequacy

Data adequacy is difficult to evaluate accurately for this measure because of the number of components and different datasets, but it is generally rated medium. In general, data quantity is rated as partial because there is a moderate degree of confidence in the data for each of the measure components. Data quality is generally rated as moderate because these data are typically of average accuracy and reliability. Because the quantity and quality of the data will vary considerably from wilderness to wilderness, data adequacy must be verified locally.

Frequency

Every 5 years, changes to the components of the development index are assessed, the component scores and total index value are calculated, and the index value is then entered in the WCMD.

Threshold for Change

The threshold for meaningful change is a 3-percent change in the development measure value. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the development measure value beyond the threshold for meaningful change results in an improving trend in this measure.

4.3 Indicator: Presence of Inholdings

This indicator focuses on wilderness inholdings. There is one required measure for this indicator.

4.3.1 Measure: Acres of Inholdings

This measure assesses the acres of inholdings in a wilderness, even if the existence of the inholding is imperceptible to an observer. Data from the Land Status Record System (LSRS) are automatically compiled via the EDW and entered in NRM-WCM. NRM-WCM calculates the measure value. Table 2.4.10 describes key features for this measure.

Table 2.4.10—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Acres of Inholdings."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required	None	Step 1: Retrieve and validate data on inholding acres from NRM. Step 2: Enter data in the WCMD.	None	5 years

Protocol

Step 1: Retrieve and validate data on inholding acres from NRM. Inholdings are defined as non-federal land within the boundary of a wilderness and encompass private lands, state lands, and patented mining claims. Unpatented mining claims are not considered inholdings because the Federal Government retains surface ownership. Partially enclosed lands, such as cherry-stemmed roads, are not considered inholdings.

Retrieve data for this measure by running a report in NRM-WCM that displays the acres of inholdings in wilderness. Spatial data on inholdings are uploaded to NRM-WCM automatically from the Land Status Record System (LSRS), also available at https://www.fs.fed.us/land/ALPLandStatusandEncumbrance/. NRM-WCM will display the data using the following attributes:

- Ownership
- Acres in wilderness

NRM-WCM does not display data for individual inholding parcels, but instead records the total acres of wilderness inholdings for each national forest. A wilderness administered by multiple national forests may therefore have more than one entry for inholdings, which NRM-WCM will sum to derive the total inholding acreage for the wilderness. Local wilderness staff must review and validate the inholding acreages retrieved through NRM-WCM for accuracy and completeness. If inholding data are incorrect, work with lands and realty specialists to correct the original spatial data in the LSRS.

In subsequent monitoring periods, estimates of inholding acres can change for two reasons: (1) a new method or assumptions were used in the calculation of the estimate; or (2) the number of acres can change due to various land transactions, such as acquisition, exchange, or donation. Local units need to verify if the acres have changed since the last assessment, and if so, determine if the difference is due to the particular calculation method used or an actual change on the ground. This determination is best made in conversation with the forest or regional land status staff. Document any change in acres and the cause of that change.

Step 2: Enter data in the WCMD. NRM-WCM will automatically calculate the total acres of inholdings from the validated data. Enter the total acres in the WCMD. The measure value is the number of acres.

Caveats and Cautions

Any change in the acres of inholdings should be confirmed with the local land status staff to ensure the change was due to a land action and not simply a recalculation of acres, which occurs periodically.

Data Adequacy

The data quantity is rated as complete and data quality is good because of the high degree of confidence that the Lands Program can accurately determine the acres inside wilderness that are not managed by the Forest Service. This results in an overall high data adequacy. Data adequacy must be verified locally for each wilderness.

Frequency

Every 5 years, the total acres of inholdings are calculated and then entered in the WCMD.

Threshold for Change

The threshold for meaningful change is any change in the number of inholding acres. A decrease in the total number of acres results in an improving trend in this measure.

4.4 Indicator: Use of Motor Vehicles, Motorized Equipment, or Mechanical Transport

This indicator focuses on the use of the three forms of mechanization discussed in Section 4(c) of the Wilderness Act: (1) motor vehicles, (2) motorized equipment, and (3) mechanical transport. There are three measures under this indicator: one required measure on administrative use, and two optional measures on other types of uses.

4.4.1 Measure: Index of Administrative Authorizations to Use Motor Vehicles, Motorized Equipment, or Mechanical Transport

This measure assesses the 3-year rolling average of a use-level index evaluating administrative authorizations to use motor vehicles, motorized equipment, or mechanical transport, based on the type and number of pieces of equipment and the days of use. Local data are compiled and entered in NRM-Wilderness annually. NRM-WCM calculates the annual value, and the WCMD then calculates the 3-year rolling average (the measure value). Table 2.4.11 describes key features for this measure.

Table 2.4.11—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Index of Administrative Authorizations to Use Motor Vehicles, Motorized Equipment, or Mechanical Transport."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required	None	Step 1: Ensure users understand what types of administrative authorizations to use motorized equipment or mechanical transport are counted under this measure and retrieve data from NRM. Step 2: Calculate the index value. Step 3: Enter data in the WCMD.	None	1 year

Protocol

Step 1: Ensure users understand what types of administrative authorizations to use motorized equipment or mechanical transport are counted under this measure and retrieve data from NRM. Administrative use is defined as use authorized by the Forest Service that is considered to be necessary to meet minimum requirements for the administration of the area. This includes administrative motorized and mechanized uses conducted by agency staff, as well as by other individuals as authorized under current permits or agreements with the Forest Service. It excludes authorized uses that are of an emergency nature or are related to special provisions as provided by statute, both of which may be evaluated under separate, optional measures (see sections 4.4.2 and 4.4.3 in part 2, respectively).

This measure is designed to take advantage of currently collected and reported data. Data on administrative use authorizations (or rather, data on actual administrative use) are already reported through NRM-Wilderness by local units during annual upward reporting. Run a report in NRM-WCM to display relevant data for this measure at the end of each fiscal year. (Data for this report are pulled from existing records entered in the NRM-Wilderness Profile module); only records with an “Authorization type” of “Administrative” are retrieved.) Local units must validate the data displayed in NRM-WCM and, if necessary, correct records in NRM-Wilderness.

The following attributes will be displayed for each authorized administrative use:

- Fiscal year
- Authorization ID
- Authorization name
- Equipment type
- Number of pieces of equipment
- Number of days of use
- Inherent weight

The “Inherent weight” attribute is automatically assigned in NRM-WCM based on the “Equipment type” attribute. “Inherent weights” represents the relative impact of motorized equipment or mechanized transport, and are used in recognition that not all equipment types have the same impact level on the Undeveloped Quality. For example, a wheelbarrow has a significantly different impact level than a bulldozer. To account for these differences, each type of equipment is associated with an “Inherent weight” from 1 (low impact) to 4 (high impact) based on its perceived impact to social and biophysical resources inside wilderness (determined subjectively by a sampling of Forest Service wilderness managers). Table 2.4.12 describes the “Inherent weights” used by NRM-WCM for this measure. If the “Equipment type” attribute is expanded in the future to include additional types of motorized equipment and mechanical transport, associated “Inherent weight” values will also be assigned at the same time.

Table 2.4.12—Inherent weights of different types of motorized equipment and mechanical transport used in wilderness.

Equipment type	Inherent weight
Battery powered hand tool Bicycle Hand truck Horse-drawn wagon Wheelbarrow Wheeled litter	1
Air compressor Brush cutter Generator Leaf blower Mist blower Motorized winch Portable pump Welder	2
Air tanker All-terrain vehicle Chainsaw Concrete equipment Fixed-wing aircraft Float plane Helicopter Motorcycle Motorized watercraft Power auger Rock drill Snow machine Truck	3
Heavy equipment	4

Step 2: Calculate the index value. The index used for this measure combines values for the type, amount, and duration of administrative motorized use or mechanized transport. The NRM-WCM application will automatically calculate the index value for this measure. Local units must review and validate the value generated by NRM-WCM and correct records as necessary. The method NRM-WCM uses to calculate these values is described below for reference.

In addition to assigning inherent weights based on the “Equipment type” attribute, NRM-WCM will also use the “Number of pieces of equipment” and “Number of days of use” attributes directly to assess the extent of each administrative use. NRM-WCM calculates a component score for each administrative use authorization using the following formula:

Number of pieces of equipment **×** *Number of days of use* **×** *Inherent weight* **=** *Component score* .

The NRM-WCM application will sum the component scores for all administrative use authorizations to provide a single total use-level index value for this measure. Table 2.4.13 illustrates an example of how to calculate the use-level index value. Note that each administrative authorization is counted for the fiscal year in which the equipment was used. If the period of actual use spans two fiscal years, NRM-WCM will prorate the number of days of use across each fiscal year.

Table 2.4.13—Example of use-level index calculation for administrative motor vehicle, motorized equipment, and mechanical transport.

Fiscal year	Authorization ID	Authorization name	Equipment type	Number of pieces of equipment	×	Number of days of use	×	Inherent weight	=	Component score
2017	043-0030	Hell Roaring Road decommissioning	Heavy equipment	1	×	2	×	4	=	8
2017	043-0045	Big burn noxious weed control	Helicopter	1	×	3	×	3	=	9
								Report this index value: 17		

Step 3: Enter data in the WCMD. Validate the use-level index value generated by NRM-WCM for the fiscal year and correct records in NRM-Wilderness as necessary. Once validated, enter the annual index value in the WCMD. The WCMD automatically calculates 3-year rolling averages based on the annual index values. Due to the availability of legacy data for this measure, a 3-year rolling average can likely be calculated the first year this protocol is implemented. The measure value is the 3-year rolling average index value.

Caveats and Cautions

When deciding which specific 3 years of data to include to calculate the rolling average for this measure, always defer to the highest data adequacy available (section 1.2.3 in part 2). Ideally the data with the highest degree of adequacy will also be the most recent data collected, but this might not always be the case.

Data Adequacy

Data quantity is rated as complete. Administration authorizations are not as frequent as those for emergency purposes and the agency has the ability to track them closely. Data quality is rated as good. Because of the discretionary control the agency has over these authorizations, and the level of analysis documented through the MRA process, there is a high degree of confidence in the accuracy of the number of pieces of equipment and number of days of use. This results in a high data adequacy. Data adequacy must be verified locally for each wilderness.

Frequency

Data are compiled, analyzed, and entered into the WCMD annually due to the variable nature of administrative authorizations.

Threshold for Change

The threshold for meaningful change is any change in the 3-year rolling average measure value. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the 3-year rolling average beyond the threshold for meaningful change results in an improving trend in this measure.

4.4.2 Measure: Percent of Emergency Incidents Using Motor Vehicles, Motorized Equipment, or Mechanical Transport

This measure assesses the 3-year rolling average of the percentage of emergency incidents resulting in a motorized or mechanized response. Local data are compiled and entered in NRM-Wilderness and NRM-WCM annually. NRM-WCM calculates the annual value, and the WCMD then calculates the 3-year rolling average (the measure value). Table 2.4.14 describes key features for this measure.

Table 2.4.14—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Percent of Emergency Incidents Using Motor Vehicles, Motorized Equipment, or Mechanical Transport."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Optional	None	Step 1: Ensure users understand what types of emergency incidents and responses are counted under this measure and retrieve data from NRM. Step 2: Calculate the percentage of emergency incidents resulting in authorized use. Step 3: Enter data in the WCMD.	None	1 year

Protocol

Step 1: Ensure users understand what types of emergency incidents and responses are counted under this measure and retrieve data from NRM. For the purposes of this protocol, an emergency incident is defined as an event relating to public health and safety that may require a response from emergency personnel, and of which an emergency responder is aware. Emergency incidents fall into the following six "Authorization subtypes":

1. Aircraft accident investigation
2. Fire

3. Law enforcement
4. Other natural disaster
5. Removal of deceased persons
6. Search and rescue

Emergency incidents occurring inside wilderness, such as a fire start or a law infraction, will be counted even if the response of emergency personnel occurred outside the boundary. In the case of search and rescue or law enforcement actions taken by other federal, state, or local organizations as authorized through a previous agreement such as a Memorandum of Understanding, this measure only counts authorized responses that are consistent with the agreement. Actions taken by these entities outside of existing agreements are considered to be unauthorized and typically are not included under this measure.

This measure is designed to take advantage of currently collected and reported data. Data on emergency use authorizations (or rather, data on actual emergency use) are already reported through NRM-Wilderness by local units during annual upward reporting. Run a report in NRM-WCM to display relevant data for this measure at the end of each fiscal year. (Data for this report are pulled from existing records entered in NRM-Wilderness; only records with one the six “Authorization subtypes” listed above are retrieved.) The following attributes will be displayed for each authorized emergency use:

- Fiscal year
- Authorization subtype
- Number of mechanized responses
- Number of non-mechanized responses
- Total number of responses

Local units must validate the “Number of mechanized responses” displayed in NRM-WCM and, if necessary, correct records in NRM-Wilderness. NRM-WCM will only display the number of incidents for each “Authorization subtype,” and will not include details about specific emergencies; therefore, it may be necessary to check records in NRM-Wilderness directly to ensure that all emergencies with mechanized responses have been counted.

The “Number of non-mechanized responses” attribute is new and must be entered in NRM-WCM—it cannot be entered in NRM-Wilderness. For this attribute, enter the number of emergency incidents that did not receive a motorized or mechanized response for a specific fiscal year. To determine the number of non-mechanized emergency incidents, consult agency staff that respond to emergencies, such as law enforcement, search and rescue, and fire suppression. Note that this number should include not only those incidents that received a non-mechanized response from the Forest Service, but also those involving other federal, state, or local organizations, such as county search and rescue. Use the same six “Authorization subtypes” to help identify all emergency incidents that might have occurred. Once the “Number of non-mechanized responses” has been entered, NRM-WCM will automatically sum the numbers non-mechanized and mechanized responses to calculate the “Total responses.”

Step 2: Calculate the percentage of emergency incidents resulting in authorized use. The NRM-WCM application will automatically calculate the percentage of emergency incidents that resulted in authorized motorized use or mechanized transport for this measure. Local units must review and validate the annual value generated by NRM-WCM and correct records as necessary. The method NRM-WCM uses to calculate these values is described below for reference.

NRM-WCM application calculates the total percentage for the fiscal year by using the following formula:

$$\left(\text{Number of emergency incidents with an authorized motorized or mechanized response} \div \text{Total number of emergency incidents} \right) \times 100 = \text{Percentage of emergency incidents with an authorized motorized or mechanized response.}$$

Table 2.4.15 illustrates an example of how the NRM-WCM application will calculate the fiscal year percentage of emergency incidents with an authorized motorized or mechanized response. If no emergency incidents occur in a fiscal year, the application will display a 0 for the total number of responses. In that case, the annual percentage of incidents with a mechanized response should be recorded as a null value, not as 0 percent.

Table 2.4.15—Summary of emergency authorizations for a wilderness in a single fiscal year.

Fiscal year	Authorization subtype	Number of mechanized responses	+	Number of non-mechanized responses	=	Total number of responses
2017	Aircraft accident investigation	0	+	0	=	0
	Fire	3	+	0	=	3
	Law enforcement	0	+	1	=	1
	Other natural disaster	0	+	0	=	0
	Removal of deceased persons	0	+	0	=	0
	Search and rescue	2	+	3	=	5
Percentage of incidents with mechanized response		Sum = 5		(5 / 9) x 100 = 56		Sum = 9
				Report this value: 56%		

Step 3: Enter data in the WCMD. Validate the percentage calculated by NRM-WCM for emergency incidents in a fiscal year that received a motorized or mechanized response, and correct records in NRM-Wilderness or NRM-WCM as necessary. Once validated, enter the annual percentage in the WCMD. The WCMD automatically calculates 3-year rolling averages based on the fiscal year percentages. The measure value is the 3-year rolling average percentage of mechanized responses.

Although legacy data will be available for some emergency incidents (i.e. those that received a motorized or mechanized response and were included in annual reporting), unless the total number of emergency incidents in previous years is known, the baseline 3-year rolling average for this measure likely won't be calculated until 3 years after this protocol is implemented.

If a null value (i.e., no emergency incidents) is recorded for a certain fiscal year (i.e., no emergency incidents occurred—the total number of responses is 0), include documentation of the null value but do not enter data for that year in the WCMD. This will create some challenges with determining the 3-year rolling average as 3 years with data will be required to determine this value, requiring an additional year, or perhaps more, before this calculation can be made. If this is a frequent occurrence, the selection of this optional measure should be re-evaluated.

Caveats and Cautions

To accurately record the number of emergency incidents, it is imperative that units have close working relationships with local emergency response agencies. The adequacy of the data improves over time as local law enforcement and search and rescue entities are made aware of this monitoring requirement. Reporting and notification specifications should be included in Memorandums of Understanding, if not already present.

When the measure baseline 3-year rolling average is low, a greater than 5-percent change is often going to be any change at all, especially if the average number of emergency incidents per year continues to be low. Therefore, incidental changes and variability in the data are likely to be the norm until wildernesses have at least five measure values to be able to use regression analysis.

When deciding which specific 3 years of data to include to calculate the rolling average for this measure, always defer to the highest data adequacy available (section 1.2.3 in part 2). Ideally the data with the highest degree of adequacy will also be the most recent data collected, but this might not always be the case.

Data Adequacy

Data quantity is rated as partial. While the Forest Service should be aware of emergency incidents with which they were involved, it is not uncommon for external partner agencies, such as county search and rescue, to conduct an emergency response in wilderness without notifying the local unit. Therefore, the total number of emergency incidents may not be known with a high degree of confidence. The completeness of the data often varies based on the relationship with external emergency personnel. Data quality is rated as good. For the known responses, data should be accurate and reliable. This results in a medium data adequacy. Data adequacy must be verified locally for each wilderness.

Frequency

Data are compiled, analyzed, and entered into the WCMD annually due to the variable nature of emergency authorizations.

Threshold for Change

The threshold for meaningful change is a 5-percent change in the 3-year rolling average of the percentage of emergency incidents resulting in a motorized or mechanized response. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the 3-year rolling average beyond the threshold for meaningful change results in an improving trend in this measure.

4.4.3 Measure: Index of Special Provision Authorizations to Use Motor Vehicles, Motorized Equipment, or Mechanical Transport

This measure assesses the 3-year rolling average of a use-level index evaluating special provision authorizations to use motor vehicles, motorized equipment, or mechanical transport, based on the type and number of pieces of equipment and the days of use. Local data are compiled and entered in NRM-Wilderness annually. NRM-WCM calculates the annual value, and the WCMD then calculates the 3-year rolling average (the measure value). Table 2.4.16 describes key features for this measure.

Table 2.4.16—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Index of Special Provision Authorizations to Use Motor Vehicles, Motorized Equipment, or Mechanical Transport.

Measure type	Protocol options	Local tasks	National tasks	Frequency
Optional	None	Step 1: Ensure users understand what types of special provision authorizations to use motorized equipment or mechanical transport are counted under this measure and retrieve data from NRM. Step 2: Calculate the index value. Step 3: Enter data in the WCMD.	None	1 year

Protocol

Step 1: Ensure users understand what types of special provision authorizations to use motorized equipment or mechanical transport are counted under this measure and retrieve data from NRM. For the purposes of the protocol, special provision use is defined as use authorized by statute, such as the use of remote landing strips or maintenance of wilderness dams. The special provision authorizations tracked in NRM are those mechanized uses undertaken by agency employees, or those authorized to do so through existing permits or agreements with the Forest Service, excluding those uses authorized through specific statutes that allow the general public to use motorized equipment. More general use, such as motorboat use allowed in certain lakes in the Boundary Waters Canoe Area Wilderness, is not tracked at the level needed to support this index calculation. Though certain motorized uses authorized by the Alaska National Interest Lands Conservation Act (ANILCA) require an annual permit and are tracked in NRM (e.g., use of a motorized winch to harvest game), they are factored out of the calculation for this measure because the actual use levels are not known.

This measure is designed to take advantage of currently collected and reported data. Data on special provision use authorizations (or rather, data on actual special provision use) are already reported through NRM-Wilderness by local units during annual upward reporting. Run a report in NRM-WCM to display relevant data for this measure at the end of each fiscal year. (Data for this report are pulled from existing records entered in the NRM-Wilderness; only records with an "Authorization type" of "Special provisions," where the "Authorization subtype" is not "ANILCA," are retrieved.) Local units must validate the data displayed in NRM-WCM and, if necessary, correct records in NRM-Wilderness. The following attributes will be displayed for each authorized special provision use:

- Fiscal year
- Authorization ID
- Authorization name

- Equipment type
- Number of pieces of equipment
- Number of days of use
- Inherent weight

The "Inherent weight" attribute is automatically assigned in NRM-WCM based on the "Equipment type" attribute. "Inherent weights" represents the relative impact of motorized equipment or mechanized transport, and are used in recognition that not all equipment types have the same impact level on the Undeveloped Quality. For example, a wheelbarrow has a significantly different impact level than a bulldozer. To account for these differences, each type of equipment is associated with an "Inherent weight" from 1 (low impact) to 4 (high impact) based on its perceived impact to social and biophysical resources inside wilderness (determined subjectively by a sampling of Forest Service wilderness managers). Table 2.4.17 describes the "Inherent weights" used by NRM-WCM for this measure. If the "Equipment type" attribute is expanded in the future to include additional types of motorized equipment and mechanical transport, associated "Inherent weight" values will also be assigned at the same time.

Table 2.4.17—Inherent weights of different types of motorized equipment and mechanical transport used in wilderness.

Equipment type	Inherent weight
Battery powered hand tool Bicycle Hand truck Horse-drawn wagon Wheelbarrow Wheeled litter	1
Air compressor Brush cutter Electro-shocker Generator Leaf blower Mist blower Motorized winch Portable pump	2
Welder	

Equipment type	Inherent weight
Air tanker All-terrain vehicle Chainsaw Concrete equipment Fixed-wing aircraft Float plane Helicopter Motorcycle Motorized watercraft Power auger Rock drill Snow machine Truck	3
Heavy equipment	4

Step 2: Calculate the index value. The index used for this measure combines values for the type, amount, and duration of special provision motorized use or mechanized transport. The NRM-WCM application will automatically calculate the index value for this measure. Local units must review and validate the value generated by NRM-WCM and correct records as necessary. The method NRM-WCM uses to calculate these values is described below for reference. In addition to assigning inherent weights based on the "Equipment type" attribute, NRM-WCM will also use the "Number of pieces of equipment" and "Number of days of use" attributes directly to assess the extent of each special provision use. NRM-WCM calculates a component score for each special provision use authorization using the following formula:

$$\textit{Number of pieces of equipment} \times \textit{Number of days of use} \times \textit{Inherent weight} = \textit{Component score}\ .$$

The NRM-WCM application will sum the component scores for all special provision uses to provide a single total use-level index value for this measure. Table 2.4.18 illustrates an example of how to calculate the use-level index value. Note that each special provision use is counted for the fiscal year in which the equipment was used. If the period of actual use spans two fiscal years, NRM-WCM will prorate the number of days of use across each fiscal year.

Table 2.4.18—Example of use-level index calculation for special provision authorizations.

Fiscal year	Authorization ID	Authorization name	Equipment type	Number of pieces of equipment	x	Number of days of use	x	Inherent weight	=	Component score
2017	067-0007	Emigrant dam maintenance	Heavy equipment	1	×	2	×	4	=	8
2017	067-0010	Big Timber grazing allotment	All-terrain vehicle	1	×	21	×	3	=	63
2017	067-0014	SNOTEL site maintenance	Helicopter	1	×	1	×	3	=	3
										Report this index value: 74

Step 3: Enter data in the WCMD. Validate the use-level index value generated by NRM-WCM for the fiscal year and correct records in NRM-Wilderness as necessary. Once validated, enter the annual index value in the WCMD. The WCMD automatically calculates 3-year rolling averages based on the annual values. Due to the availability of legacy data for this measure, a 3-year rolling average can likely be calculated the first year this protocol is implemented. The measure value is the 3-year rolling average index value.

Caveats and Cautions

When deciding which specific 3 years of data to include to calculate the rolling average for this measure, always defer to the highest data adequacy available (section 1.2.3 in part 2). Ideally the data with the highest degree of adequacy will also be the most recent data collected, but this might not always be the case.

Data Adequacy

Data quantity is rated as complete. Units should generally be aware of all of the motorized equipment and mechanical transport uses to support legislated special provisions in a particular wilderness. These provisions, such as use of remote landing strips and maintenance of wilderness dams, are well known. Data quality, however, is rated as moderate. The reality is, while such provisions are well known, the actual use levels conducted by cooperators and partners are often not monitored very closely, particularly those authorizations of a more routine nature, such as commercial grazing allotment management. Local data adequacy may vary depending on how well actual use levels are known in a given wilderness. This results in a medium data adequacy. Data adequacy must be verified locally for each wilderness.

Frequency

Data are compiled, analyzed, and entered into the WCMD annually due to the variable nature of special provision authorizations.

Threshold for Change

The threshold for meaningful change is a 5-percent change in the 3-year rolling average measure value. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the 3-year rolling average beyond the threshold for meaningful change results in an improving trend in this measure.

5.0 Solitude or Primitive and Unconfined Recreation Quality

Monitoring the Solitude or Primitive and Unconfined Recreation Quality assesses whether management of a wilderness is trending over time towards protecting outstanding opportunities for specific unique recreational experiences. Key indicators and measures monitor solitude (from activities occurring both inside and outside of wilderness), primitive recreation, and unconfined recreation. This section provides detailed guidance for monitoring the following indicators and measures:

- 5.2 Indicator: Remoteness from Sights and Sounds of Human Activity Inside Wilderness
    - 5.2.1 Measure: Index of Encounters
    - 5.2.2 Measure: Index of Recreation Sites Within Primary Use Areas
    - 5.2.3 Measure: Acres of Wilderness Away From Access, Travel Routes and Developments Inside Wilderness
    - 5.2.4 Measure: Miles of Unauthorized Trails
- 5.3 Indicator: Remoteness from Sights and Sounds of Human Activity Outside the Wilderness
    - 5.3.1 Measure: Acres of Wilderness Away From Adjacent Travel Routes and Developments Outside the Wilderness
- 5.4 Indicator: Facilities That Decrease Self-Reliant Recreation
    - 5.4.1 Measure: Index of NFS Developed Trails
    - 5.4.2 Measure: Number of Authorized Constructed Recreation Features
- 5.5 Indicator: Management Restrictions on Visitor Behavior
    - 5.5.1 Measure: Index of Visitor Management Restrictions

5.2 Indicator: Remoteness from Sights and Sounds of Human Activity Inside Wilderness

This indicator focuses on wilderness visitation and the capacity of the wilderness setting to allow for escape from the sights and sounds of human activity. There are four measures under this indicator: one required measure on encounters and three measures on other aspects of remoteness from human activity inside wilderness from which units are required to select at least one.

Photo: A glimpse of fall colors across Cass Lake, Chippewa National Forest by USFS.

5.2.1 Measure: Index of Encounters

This measure monitors encounters by assessing one of the following, listed in order of preference: (1) an index evaluating traveling and camp encounters; (2) the number of traveling encounters or camp encounters (but not both); (3) the number of visitors; or (4) the trend in visitation. Local units may select the appropriate protocol option as described in step 1 below. Local data are compiled and stored in local archives. Local staff calculate the measure value. Table 2.5.1 describes key features for this measure.

Table 2.5.1—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Index of Encounters."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required	Protocol Option 1: Index of Traveling and Camp Encounters Protocol Option 2: Number of Traveling or Camp Encounters Protocol Option 3: Number of Visitors Protocol Option 4: Trend in Visitation	Step 1: Determine which protocol option is appropriate for the wilderness. Step 2: Document the data compilation strategy. Step 3: Compile and process the data. Step 4: Enter data in the WCMD.	None	5 years

<u>*Protocol*</u>

Step 1: Determine which protocol option is appropriate for the wilderness. The four protocol options for this measure are summarized below, listed in order of preference from highest to lowest data adequacy.

Protocol Option 1—Index of Traveling and Camp Encounters. This protocol option requires encounter data on both traveling encounters and camp encounters. The mean number of traveling encounters per hour and the mean number of camps seen from occupied sites are combined in an index to derive the measure value.

Protocol Option 2—Number of Traveling or Camp Encounters. This protocol option only requires one type of encounter data—either traveling encounters or camp encounters—but not both. The measure value is either the mean number of traveling encounters per hour or the mean number of camps seen from occupied sites.

Protocol Option 3—Number of Visitors. If direct data on encounters are not available, indirect (proxy) data on visitation may be used instead. For this protocol option, the measure value is the number of visitors.

Protocol Option 4—Trend in Visitation. If there are no direct data on encounters or data on visitation, professional judgment may be used to determine the trend in this measure. For this protocol option, the measure value is the perceived trend in visitation, reported as increasing, stable, or decreasing.

To determine which protocol option is most appropriate, local units must first identify which types of data sources (encounter data, visitation data, or professional judgment) are available for a wilderness. Given the great amount of local variability in data collection, there is no strict formula for selecting the preferred data source. If a wilderness has multiple types of data (e.g., traffic counter data for some areas, traveling encounter data for other areas), select the best source, taking into account the geographical coverage, amount of data collected (i.e., number of days of monitoring), and accuracy of the method. In some cases the local unit may choose one of the options as the required measure and then one of the other options as a locally developed measure. And in some cases, it may be that combining different data sources generates the best overall assessment; if so, this should be considered professional judgment and the Protocol Option 4–Trend in Visitation, should be selected. Additional considerations for determining the most appropriate data source are described below by data type.

Encounter data (for Protocol Options 1 and 2). Valid traveling or camp encounter data should follow the Forest Service national minimum protocol for monitoring outstanding opportunities for solitude, or should be compiled using a locally defined protocol that provides data quality and quantity comparable to, or better than, the national minimum protocol. The national minimum protocol, available online at http://www.wilderness.net/toolboxes/documents/WC/National_Minimum_Protocol_Solitude.pdf, was used in the 10-year Wilderness Stewardship Challenge, and it provides detailed instructions for sampling, collecting data, standardizing data, and reporting results for WSP.

Use of informal encounter data collected opportunistically is not recommended unless these records include the basic data fields required in the national minimum protocol to standardize encounter rates across locations and dates. Specifically, information for each observation session must include the interval of time when data were collected and the location of data collection. If such information is not collected, it is not possible to track trends over time with confidence, and the data should not be used for this measure. If encounter data are used to evaluate this measure, local units must be confident that data from each monitoring period are comparable, meaning data come from the same location and use season.

Visitation data (Protocol Option 3). Visitation data may be collected under locally developed protocols through a variety of data sources, including permits, trailhead registers, traffic counters, or other means. To determine whether visitation data are appropriate to use for this measure, or to choose the best visitation data from multiple potential sources, consider two primary factors:

1. *Data accuracy—***Data accuracy** is similar to data adequacy (see section 1.2.3 of part 2). Monitoring systems vary considerably in the accuracy of the data collected. For instance, mechanical counters (e.g., car counters, TRAFx trail counters) can be highly accurate with complete 24/7 coverage, while self-issue permits can have low and variable compliance rates, resulting in poor data accuracy. The data source with the highest accuracy should be chosen. Traffic count data are often more accurate and complete than ranger reports, so if both types of data are available, it is advisable to use the traffic count data.

2. *Geographical coverage—*Many units collect visitation data for limited locations. This is not necessarily a problem if data for the same locations are collected in subsequent years, and if the protocols provide at least as complete coverage as required in the national minimum protocol. Ideally, data from more locations would be preferable, but coverage will often be less of a concern than data accuracy.

Professional Judgment (Protocol Option 4). If data for encounters or visitation are not available, professional judgment may be used to determine the trend in visitation. Local units would not be expected to report actual estimates of encounters or visitation; instead they would report the perceived trend at 5-year intervals. If a wilderness has multiple types of data (e.g., visitation data for some areas, encounter data for others), the best decision might be to combine these sources through professional judgment.

Step 2: Document the data compilation strategy. To ensure confidence in tracking trends, data must be compiled consistently over time. Given the amount of variability in data sources and protocol options for this measure, it is essential that local units document the data compilation strategy (including the unit of measure as well as the timing, location, and intensity of data collection) for each wilderness. From year to year, local units should also document any special circumstances that may have affected data collection (e.g., equipment failures, gaps in data, or weather events that may have affected visitor use). Documentation may consist of a brief narrative or detailed instructions, and may be stored locally, on shared drives, or uploaded to the WCMD.

If encounter or visitation data are used, local units must document the unit of measure as “people,” “vehicles,” or “groups” (see table 2.5.2). The specific choice of unit of measure is not critical as long as each monitoring cycle uses the same units over time to assess trends. For some data sources (e.g., permits or trail registers), it is simpler to use “groups” as the unit of analysis, rather than “people,” because this requires only counting the total number of entries rather than summing the number of people in each group.

Table 2.5.2—Choices for units of measure for encounters and visitation.

Data source	Possible units of measure
Traveling and camp encounters	People or groups
Trail counters	People
Vehicular traffic counters	Vehicles
Trailhead car counts	Vehicles
Mandatory permits	People or groups
Trailhead registers	People or groups
Self-issue permits	People or groups
Professional judgment	Not applicable

To be able to track change over time, data must be collected in the same places and during the same seasons each monitoring cycle. Documentation for each wilderness should include a map that clearly identifies locations of data collection (e.g., zones monitored for encounters or trailheads where traffic counters are placed). Given the extreme variation of visitor use across the year, it is advised only to collect and report data for the primary use season (additional guidance on this is provided in the national minimum protocol). The primary use season will vary depending on where a wilderness is and the type of visitor use it receives. If National Visitor Use Monitoring (NVUM) data are used (see Caveats and Cautions for concerns about using NVUM), document specific sampling sites and dates from each monitoring cycle. This information provides context for inferring whether differences in NVUM's visitor use estimates are due to actual changes in use, or whether they are an artifact of changes in sampling times or locations.

Documentation for this measure should also include information on the sampling intensity and data accuracy. Because visitor use is highly dependent on weather, fire, publicity about specific locations, and other factors, measures based on a small sample of dates in any given year may be a poor indicator of overall visitor use or encounter rates. The more dates included in sampling, the greater the likelihood of drawing correct interpretations about trends over time. Similarly, including assessments of data accuracy (e.g., documenting compliance rates for self-issue permits) allows for more confidence in interpreting trends over time. If traffic counters are used, local units also need to perform calibration tests to ensure the accuracy of the data. TRAFx provides links to various studies and documents to help local units design calibration studies (https://www.trafx.net/counting_methodology.htm).

If professional judgment is used to assess trends in visitation, local units must document who made the assessment and the basis for their determination. For example, if informal encounter data were combined with self-issue permit data to derive the trend in visitation, those data sources and the data adequacy of each should be recorded.

Step 3: Compile and process the data. Data may be collected over a span of multiple years within the 5-year reporting period for this measure. For example, encounter data may be collected in different locations in different years, with a full cycle of monitoring (all identified monitoring areas) completed after 5 years. Or, partial data may be collected for a single area across multiple years. Data are considered complete when a sufficient amount of data (per the national minimum protocol) have been collected for all monitoring areas. Ideally, it would be better to collect encounter or visitation data annually (i.e., more frequently than the minimum 5-year frequency required for this measure) because wilderness visitation can be quite variable and can depend on many factors, such as snowpack, weather conditions, fire events, and economic conditions. It is recognized, however, that most wildernesses will not be able to collect complete data for all locations every year.

Once all data have been compiled, the data are processed to derive the measure value. Data processing requirements are described below for each protocol option.

Protocol Option 1—Index of Traveling and Camp Encounters. Traveling encounters are generally reported as the number of encounters (people or groups) per hour, while camp encounters are generally reported as the number of camps (i.e., the number of groups) seen from occupied sites. While traveling and camp encounter data may be processed in a variety of ways, the national minimum protocol suggests recording the mean number of encounters per hour (i.e., the mean encounter rate) separately for each monitoring area. For this protocol option, local units must compute the grand mean (i.e., the mean of means) for a wilderness for both traveling and camp encounters by averaging the mean encounter rate across all monitoring areas within a wilderness, as illustrated in tables 2.5.3 and 2.5.4.

Table 2.5.3—Example of computing the grand mean number of traveling encounters per hour based on data collected using the national minimum protocol.

Monitoring area	Mean encounters per hour
Marion Lake	12.5
Santiam Lake	3.2
Jefferson Park	15.7
Grand mean	**(12.5 + 3.2 + 15.7) ⁄ 3 = 10**

Table 2.5.4—Example of computing the grand mean number of camp encounters based on data collected using the national minimum protocol.

Monitoring area	Mean number of camps seen from occupied sites
Marion Lake	0.2
Santiam Lake	1.3
Jefferson Park	5.5
Grand mean	**(0.2 + 1.3 + 5.5) ⁄ 3 = 2**

Local units then combine the grand means for traveling encounters and camp encounters into an index using the following formula:

$$\textit{Traveling encounters} + (2 \times \textit{Camp encounters}) = \textit{Index of encounters}.$$

For example, using the grand means from tables 2.5.3 and 2.5.4, the calculation for the index of encounters would be:

$$10 + (2 \times 2) = 10 + 4 = 14$$

This index weights camp encounters twice as heavily as traveling encounters because research has shown that seeing or hearing other campers is substantially more impactful on visitors' experiences than encountering people on the trail. The measure value reported for this protocol option is the index value.

Protocol Option 2—Number of Traveling or Camp Encounters. This protocol option follows the same initial steps described above for the Index of Traveling and Camp Encounters protocol option using whichever encounter data are available for a wilderness. Once the grand mean of either traveling or camp encounters has been calculated, however, no further data processing is required. The measure value reported for this protocol option is either the grand mean of traveling encounters or the grand mean of camp encounters.

Protocol Option 3—Number of Visitors. If visitation data are used, sum the total number of people, groups, or vehicles across all trailheads or access points monitored for a wilderness. If traffic counters are used, the data may need to be corrected to account for entries and exits and ensure visitors are only counted once. This would be the case whenever vehicles must travel both in and out over the sensor. (If the site layout and counters are arranged so that each vehicle is only counted once, correction is not needed.) To correct the data, divide traffic counter totals by two. The measure value reported for this protocol option is the total number of people, groups, or vehicles. Table 2.5.5 shows variations of the measure value based on the data source.

Table 2.5.5—Values to report for various data sources used for indirect measures for the index of encounters

Data source	Report
Trail counters	Total number of people for all trails monitored; whether counts are raw data or adjusted to account for entries and exits.
Traffic counters	Total number of vehicles for all access points monitored; whether counts are raw data or adjusted to account for entries and exits.
Mandatory permits, self-issue permits, trailhead registers	Total number of people or groups for all trailheads/access points.
Car counts at trailheads	Total number of vehicles for all trailheads/access points.

Protocol Option 4—Trend in Visitation. If professional judgment is used, consult with individuals with the best knowledge of on-the-ground conditions (e.g., lead wilderness rangers) to assign an applicable trend category from the following options:

- *Decreasing visitation*—visitation levels appear to be trending over time towards fewer visitors.
- *Stable visitation*—visitation levels appear to be remaining about the same.
- *Increasing visitation*—visitation levels appear to be trending over time towards more visitors.

For the measure baseline year, the stable visitation category should be selected. In subsequent monitoring cycles, trends in visitation should be assessed by comparing current perceptions of visitation levels with perceptions from the measure baseline year. Given the subjective nature of professional judgments, it is important to include additional documentation (e.g., a brief narrative) for each monitoring period that explains who assigned the trend category and the basis for their determination. The measure value reported for this protocol option is the selected trend category.

Step 4: Enter data in the WCMD. Enter the appropriate measure value for the selected protocol option in the WCMD. The measure value is either the index value, the grand mean of encounters, the number of visitors, or the trend category for visitation.

As described above, it would be ideal if complete encounter or visitation data were collected annually for this measure, although it is recognized that most units will be unable to do this. If a wilderness using protocol options 1, 2, or 3 (but not protocol option 4) does have complete data collection each year, however, the measure value is instead calculated as a 3-year rolling average. With annual (complete) data collection, local units must still enter the values described above in the WCMD, but the WCMD then automatically calculates 3-year rolling averages from those data.

Caveats and Cautions

Encounter and visitation monitoring protocols tend to change frequently. For example, local unit managers decide to monitor different areas, collect different data, or implement (or discontinue) self-registration systems. Because of such changes, units should not simply assume that differences over time reflect real change. Before drawing conclusions about meaningful change, verify that the data collected in different time periods are in fact comparable.

The suitability of the NVUM program (https://www.fs.fed.us/recreation/programs/nvum/) to generate wilderness visitation data should be addressed. NVUM provides a measure of wilderness visits for each national forest, along with the 90-percent confidence interval. Because NVUM was designed to generate estimates for the NFS as a whole, some features of the methodology make it problematic to use for estimating use of a specific wilderness. Using NVUM as a proxy for the number of encounters in a wilderness is not recommended for the following reasons:

- All wildernesses in a single Forest Service unit are combined in a single sampling stratum so only a few sites may represent data for any given wilderness. Professional judgment would have to be used to apportion visits across the different wildernesses.
- Sampling intensity is low, with as few as eight sample days for wilderness for any given Forest Service unit.
- Confidence intervals for visitation tend to be wide.
- If a wilderness is shared across units, it is not possible to assemble data for an individual wilderness.

The current NVUM report (USDA Forest Service 2013b) (http://www.fs.fed.us/recreation/programs/nvum/2012%20National_Summary_Report_061413.pdf) states that data "currently cannot be used to identify trends or make assumptions about changing use patterns." Changes have been made in the NVUM protocols concerning reclassification of wilderness sampling sites as high, medium, or low use. This means that data in some cases will not be comparable, or will produce questionable trends. For example, table 2.5.6 shows data for two rounds or cycles of data collection for the Deschutes, Mt. Hood, and Willamette National Forests in Oregon. The wide confidence intervals around the estimated number of visits (± 50 to 60%) make it extremely difficult to detect trends. Moreover, the data suggest that wilderness use in the Deschutes and Willamette National Forests decreased during a time in which the local population grew considerably and local permit data show increased use, calling into question the validity of the NVUM data.

Table 2.5.6—NVUM estimates of wilderness visits for three Region 6 National Forests (Deschutes, Mt. Hood, and Willamette) for years 2005–2009 and 2010–2014.

NFS unit	Round 2 (2005–2009)	Round 3 (2010–2014)
Deschutes National Forest	42,000 ± 60%	38,000 ± 52%
Mt. Hood National Forest	58,000 ± 29%	203,000 ± 19%
Willamette National Forest	135,000 ± 19%	105,000 ± 21%

Despite these limitations, there may be a few situations when NVUM is appropriate for documenting visitation, such as if a local unit has only one wilderness or if a forest conducted additional data collection in conjunction with the standard NVUM surveying. If NVUM data are used the measure value is the total annual number of wilderness visits.

Data Adequacy

Data adequacy must be assessed for each wilderness individually based on the quality and quantity of local data. A general overview of data adequacy for various data sources is provided below as a starting point for local data adequacy assessments.

Data on the number of encounters collected in accordance with the national minimum protocol should be of good quality, but in most cases will only be available for selected monitoring zones, so data quantity will usually be partial. In some wildernesses, such as a small wilderness with only two or three **primary use areas**, data from the national minimum protocol will capture overall encounter conditions and can confidently be used for assessing trends. However, in large wildernesses with variable use across different locations, the data only reflect conditions within the areas monitored, which may or may not be representative of a wilderness as a whole. Even if not representative, trends in those selected areas could be very informative in terms of suggesting the need for more intensive monitoring. Thus, the overall data adequacy is medium.

Data on visitation collected by traffic or trail counters are generally of good data quality, and depending on coverage will range from insufficient to complete data quantity. Data are usually complete for each location because counters record continuously, but only a few locations may have counters installed. Overall data adequacy is therefore medium to high.

Data on visitation collected by trail registers or self-issue permits can have significant limitations. For example, compliance rates with self-issue permits tend to be low and variable (Cole and Hall 2008), and if observational data are not collected to calibrate the counts generated, accuracy may be low. Moreover, self-issue stations may run out of forms or pens, leading to gaps in data, particularly during high use times. However, mandatory registration systems can provide good coverage, and public contact reports or other observations can generate correction factors to adjust for non-compliance and improve confidence in data quality. Thus, data adequacy can range from medium to high.

The other widely available data source, NVUM, is not designed to monitor individual wildernesses separately, and therefore should be used cautiously, if at all. While consistent protocols and a trained workforce ensure moderate to good quality data, representation of individual wildernesses is poor, making data quantity insufficient unless additional sampling has been conducted. NVUM reports provide a 90-percent confidence interval for wilderness visits, which gives local units information about the precision of the estimates. Data accuracy is usually low to medium.

Professional judgment about trends in visitor use can be good in some cases, if it is based on multiple years of on-the-ground experience. However, professional judgment is not acceptable for estimating actual encounter rates or visitation levels.

Additionally, natural human tendencies to focus on anomalies may call into question the validity of professional judgment. Thus, data adequacy can range from low to high depending on the sources of data used.

Frequency

Every 5 years, data on encounters or visitation are compiled and the index of encounters, number of encounters, number of visitors, or trend category is then entered in the WCMD. Field data collection may span multiple years within the 5-year reporting interval. Although the minimum frequency for this measure is every 5 years, data compilation, analysis, and entry may occur more frequently if so desired for the Index of Traveling and Camp Encounters, Number of Traveling or Camp Encounters, or Number of Visitors protocol options.

Threshold for Change

The threshold for meaningful change differs depending on the protocol option used. If Protocol Option 1—Index of Traveling and Camp Encounters, Protocol Option 2—Number of Traveling or Camp Encounters, or Protocol Option 3—Number of Visitors are used, the threshold is a 10-percent change in the measure value or number of encounters or visitors. Once there are five measure values, the threshold for meaningful change will switch to regression analysis for these three protocol options. (If a wilderness has annual data collection for any of these protocol options, the threshold would be a 10-percent change in the 3-year rolling average or, once there are five measure values, switching to regression analysis of the rolling averages). If Protocol Option 4—Trend in Visitation is used, the threshold is any change in categories. A decrease in the encounter or visitation measure value beyond the threshold for meaningful change, or a change in categories towards decreasing visitation, results in an improving trend in the measure.

5.2.2 Measure: Index of Recreation Sites Within Primary Use Areas

This measure is an index that assesses the number of recreation sites and their condition, based on the national minimum protocol for recreation site monitoring. Local data are compiled and stored in local archives. Local staff calculate the measure value. Table 2.5.7 describes key features for this measure.

Table 2.5.7—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure “Index of Recreation Sites within Primary Use Areas.”

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the three remaining remoteness inside wilderness measures	None	Step 1: Ensure users understand what types of recreation sites are counted under this measure and compile data. Step 2: Calculate the index value and enter data in the WCMD.	None	5 years

Protocol

Step 1: Ensure users understand what types of recreation sites are counted under this measure and compile data. A recreation site is defined as a place where visible impacts to vegetation or soil are documented as a result of recreational use. For this measure, recreation sites may include both designated sites and user-created sites. Recreation sites are often campsites (both designated and user-created), but may also include viewpoints and day use areas. Locally-unique recreation sites, such as impacts at the base of climbing routes, may be included at the discretion of local units. If locally-defined recreation sites are included in this measure, the types of additional sites being monitored must be documented to ensure consistency from year to year. Recreation sites do not include travel routes, such as trails or portages, because those are captured under different measures: user-created trails are counted under the measure *Miles of Unauthorized Trails* (section 5.2.4 in part 2) and designated trails are counted under the measure *Index of NFS Developed Trails* (section 5.4.1 in part 2). Viewpoints along trails where vegetation is trampled may be considered recreation sites. Similarly, administrative facilities associated with recreation sites, such as toilets or fire grates, are not monitored under this measure because they are captured under the measure *Number of Authorized Constructed Recreation Features* (section 5.4.2 in part 2).

The recommended approach for collecting data for this measure is to follow the Forest Service national minimum protocol for recreation site monitoring. The national minimum protocol (available online at http://www.wilderness.net/toolboxes/documents/recsitemonitor/National%20Minimum%20Recreation%20Site%20Monitoring%20Protocol.pdf) was used in the 10-year Wilderness Stewardship Challenge, and it provides detailed information on sampling, collecting data, standardizing data, and reporting results for WSP. It describes how to search for and identify sites within primary use areas and provides instructions for assessing site condition by measuring impacts to groundcover, documenting damage to trees, and estimating the spatial extent of the disturbed area. These variables are then summed to generate a condition rating of 1 (least impacted) to 8 (most impacted) for each recreation site.

A locally defined protocol that provides data quality and quantity comparable to, or better than, the national minimum protocol may also be used to compile data for this measure if it too generates a condition rating for each recreation site. Locally defined condition rating values may extend beyond the 1–8 scale described in the national minimum protocol as long as higher condition ratings still correspond with greater site impacts. If a local protocol is used instead of the national minimum protocol, document the process for searching for and identifying sites, assessing site condition, and deriving a condition rating for each site.

Recreation site monitoring data may be collected over a span of multiple years within the 5-year reporting period for this measure. For example, recreation site data may be collected in different locations in different years, with a full cycle of monitoring (all identified monitoring areas) completed after 5 years. Regardless of whether the national minimum protocol or a local protocol is used, it is important to train field staff to properly measure site impacts and, ideally, to use the same staff over time to conduct the monitoring. Different observers may be more or less thorough in searching for recreation sites, and people can judge the same conditions in different ways. When this happens, it is possible that what appear to be changes from one monitoring cycle to another may simply be a reflection of different judgments made by different observers. To ensure data are compiled consistently over time, documentation for each wilderness should also include a map that clearly identifies the areas surveyed for recreation sites for each monitoring cycle.

Step 2: Calculate the index value and enter data in the WCMD. Once recreation site data have been collected, calculate the total sum of recreation site condition ratings to derive the measure value. There are two possible methods for calculating this value. The first method is to simply sum the condition ratings for all recreation sites in a wilderness. The second method is to use an index in which users multiply the numerical condition rating (1 to 8) by the number of sites with that rating, and then sum the results (the component scores) for all condition ratings. Table 2.5.8 provides an example of the second method. Once the total sum is calculated, enter the measure value in the WCMD. The measure value is the index value.

Table 2.5.8—An example of how to calculate the index of recreation sites for a wilderness.

Condition rating	×	Number of sites	=	Component score
1	×	85	=	85
2	×	33	=	66
3	×	15	=	45
4	×	18	=	72
5	×	7	=	35
6	×	1	=	6
7	×	2	=	14
8	×	0	=	0
Report this index value: 323				

Caveats and Cautions

If conducted by well-trained staff, recreation site monitoring should accurately document increases and decreases in the number of recreation sites. Detecting meaningful change in the condition of recreation sites is more difficult due to some inherent subjectivity and because heavily impacted sites can undergo deterioration that will not be captured during subsequent monitoring. For example, sites that were assigned the highest impact categories during the initial inventory may deteriorate further without showing an increase in the condition rating.

Data Adequacy

If the national minimum protocol is used to compile data for this measure, the overall data adequacy is medium. Data quantity for the total number of sites should be complete, as long as all likely locations are surveyed, and if all types of recreation sites are included (and not just campsites). Data quality is moderate due to subjectivity in identifying the edges of the disturbed area and in estimating the area of impact, as well as differences associated with observers using different approaches to search for sites and impacted trees. Data adequacy must be assessed for each wilderness individually based on the quality and quantity of local data.

If locally developed protocols are used, data quantity will likely range from partial to complete, and data quality will be moderate to good. The determination of data adequacy will have to be made at the local level, based on quality and quantity of data.

Frequency

Every 5 years, recreation sites are surveyed and assigned a condition rating. An index value is calculated for all sites, and that value is then entered in the WCMD. Field data collection may span multiple years within the 5-year reporting interval.

Threshold for Change

The threshold for meaningful change is a 5-percent change in the recreation site measure value. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the measure value beyond the threshold for meaningful change results in an improving trend in this measure.

5.2.3 Measure: Acres of Wilderness Away From Access and Travel Routes and Developments Inside Wilderness

This measure assesses the total number of wilderness acres located more than ½ mile from access points, travel routes (e.g., authorized trails and roads, aircraft landing sites), and developments inside wilderness. Unless stated otherwise, the protocol steps are intended to be completed by the central data analyst. Data are compiled from the EDW, or other local or national data sources, and validated locally. The central data analyst calculates the measure value. Table 2.5.9 describes key features for this measure.

Table 2.5.9—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Acres of Wilderness Away from Access and Travel Routes and Developments Inside Wilderness."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the three remaining remoteness inside wilderness measures	None	Validate the national data.	Step 1: Ensure users understand what types of routes and developments are counted under this measure and retrieve spatial data. Step 2: Perform the spatial analysis to calculate the acres of wilderness away from access and travel routes and developments inside wilderness. Step 3: Enter data in the WCMD.	5 years

Protocol

Step 1: Ensure users understand what types of routes and developments are counted under this measure and retrieve spatial data. Only those access and travel routes and developments inside wilderness for which there are existing spatial data are included in this measure. Locally unique or less common types of routes and developments that affect this indicator, such as travel routes on water, are not tracked under this measure due to the lack of nationally available data. Table 2.5.10 lists the types of routes and developments that are and are not included in this measure.

Table 2.5.10—Specific access points, travel routes, and developments used in this measure.

	Included	Not included
Access and travel routes	• NFS trails • Motorized travel routes (e.g., roads) • Aircraft landing sites	• Unauthorized (user-created) trails • Aircraft travel routes over wilderness
Developments	• Authorized recreation sites and features (e.g., designated campsites, bridges, toilets) • Administrative developments (e.g., administrative buildings)	• Non-administrative developments (e.g., grazing infrastructure, mines, dams, utility infrastructure, fixed instrumentation) • Archaeological and historical sites (unless in active use for administrative or recreational purposes) • Unauthorized (user-created) recreation sites

There is the possibility of confusion about whether to include travel routes and developments that are on the boundary of a wilderness (including cherry-stemmed roads) under this measure or under the related measure *Acres of Wilderness Away from Adjacent Travel Routes and Developments Outside the Wilderness* (section 5.3.1 in part 2). Travel routes and developments should only be included in one of the measures, not both. Features located on the boundary should only be included in the measure *Acres of Wilderness Away from Adjacent Travel Routes and Developments Outside the Wilderness.*

The spatial data used for this measure come from a variety of data sources. Contact a GIS specialist to assist with this measure, if necessary. Finding data may require searching forest Spatial Data Engine (SDE) GIS libraries, the EDW, NRM, or contacting the local unit. All local units maintain roads, motorized routes, and NFS trails data in a GIS, and some data are stored in NRM, but data are not necessarily linked together or validated. Some units have made their road and trail data available in the EDW and on websites like the Forest Service Interactive Travel Map. Spatial data on small-scale developments may be challenging to find; while some units maintain spatial data on developments in a GIS, others do not. FSTOPO feature classes (available from the EDW) may depict some developments inside wilderness as well. Data sources for this measure include:

- The EDW
- Forest GIS data in SDE data linked to NRM
- Other local GIS
- Forest Service Interactive Travel Map (https://apps.fs.usda.gov/TravelAccess/)
- Forest Service Interactive Visitor Map (https://www.fs.fed.us/ivm/)

A recommended starting point in the compilation of data for this measure is to retrieve the following FSTOPO feature classes and additional "RoadCore" transportation feature classes from the EDW.

FSTOPO feature classes:

- S_USA.FSTopo_Building_PT
- S_USA.FSTopo_Culture_LN
- S_USA.FSTopo_Culture_PT
- S_USA.FSTopo_Culture_PL
- S_USA.FSTopo_RecFacility_PT
- S_USA.FSTopo_BuiltupArea_PL
- S_USA.FSTopo_LargeTank_PT
- S_USA.FSTopo_Airfield_LN
- S_USA.FSTopo_Airfield_PT
- S_USA.FSTopo_Railroad_LN
- S_USA.FSTopo_Transport_LN
- S_USA.FSTopo_Transport_PT

Additional “RoadCore” transportation feature classes:

- S_USA.RoadCore_Existing
- S_USA.RoadCore_FS

Note that some routes may be depicted in both FSTOPO’s S_USA.FSTopo_Transport_LN feature class and one or both of the “RoadCore” transportation feature classes. Where there are multiple depictions of the same route, data from either of the “RoadCore” transportation feature classes are likely to be more accurate, and are therefore preferred over transportation data from FSTOPO.

Given questions about the completeness and accuracy of national spatial data, a map must be sent to the local unit for validation once all data have been located. Local wilderness specialists and other relevant local resource specialists must review the map for accuracy and completeness and identify any routes or developments that are missing or incorrect. (Corrections to these components in the corporate GIS will have to be made through appropriate channels.) The iterative process of evaluating and correcting the map of routes and developments inside wilderness is most critical for the measure baseline year.

Step 2: Perform the spatial analysis to calculate the acres of wilderness away from access and travel routes and developments inside wilderness. To complete the spatial analysis, first buffer all identified routes and developments inside wilderness by ½ mile on all sides. Subtract the buffered area from the wilderness polygon and then calculate the remaining area to determine the acres of wilderness away from internal routes and developments.

Step 3: Enter data in the WCMD. Enter the acres of wilderness away from access and travel routes and developments inside wilderness in the WCMD. The measure value is the number of acres.

Caveats and Cautions

One major limitation to this measure is that it is unlikely to change because trails, roads, and developments are rarely built or removed in wilderness (although conversion of a user-created trail to a NFS system trail would increase the total route mileage included in this measure). However, if initial spatial data have errors or omissions corrected later, the baseline measure can be updated (recalculated) prior to computing trends over time.

Data Adequacy

Wilderness boundary spatial data are complete and accurate. Currently, however, the quality and quantity of data in travel route layers varies. Centerline data for system trails should be complete and accurate by the end of 2017. Data on cartographic features are presumed to be complete and accurate (see www.fs.fed.us/database/cff.htm). They are maintained at the Geospatial Technology and Application Center (GTAC) and are updated on a 7-year cycle. Overall, data adequacy is considered to be medium to high, because data quantity is likely to be partial to complete and data quality is likely to be moderate to good.

Frequency

Every 5 years, the acres of wilderness away from access and travel routes and developments inside wilderness are assessed, and the total acres are then entered in the WCMD.

Threshold for Change

The threshold for meaningful change is a 3-percent change in the acres of wilderness away from access and travel routes and developments inside wilderness. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. An increase in the number of wilderness acres beyond the threshold for meaningful change results in an improving trend in this measure.

5.2.4 Measure: Miles of Unauthorized Trails

This measure assesses the number of linear miles of unauthorized (non-system) trails inside wilderness. Local data are compiled and are either stored in local archives or entered in NRM-Trails. Local staff or NRM-WCM calculate the measure value. Table 2.5.11 describes key features for this measure.

Table 2.5.11—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Miles of Unauthorized Trails."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the three remaining remoteness inside wilderness measures	None	Step 1: Ensure users understand what types of trails are counted under this measure and compile data. Step 2: Calculate the total miles and enter data in the WCMD.	None	5 years

Protocol

Step 1: Ensure users understand what types of trails are counted under this measure and compile data. For this measure, unauthorized trails include user-created trails as well as other unauthorized routes (e.g., decommissioned roads or trails) that are currently in use. It may also include climbing routes. If a wilderness collects data on unauthorized trails, it is strongly recommended that they select this measure as it is relatively more sensitive to change than the other two measures in this "required to select at least one" suite of measures. As the ability to monitor social trails improves (e.g., with new types of technology and imagery), local units will need to verify that apparent change over time reflects the creation of new trails, and not simply the level of effort applied to detect trails.

The recommended approach for collecting data for this measure is to follow the Forest Service national minimum protocol for monitoring user-created trails. The national minimum protocol, available online at http://www.wilderness.net/toolboxes/documents/recsitemonitor/National%20Minimum%20Recreation%20Site%20Monitoring%20Protocol.pdf, provides detailed information on sampling, collecting data, standardizing data, and reporting results for WSP. A locally defined protocol that provides data quality and quantity comparable to, or better than, the national minimum protocol may also be used to compile data for this measure. Use of professional judgment to identify the routes of known unauthorized trails is not recommended without validation of trail locations through objective data (e.g., field reconnaissance or imagery). If a local protocol is used instead of the national minimum protocol, document the process for searching for and identifying unauthorized trails.

For monitoring trends over time, it is important that the same areas are searched for trails each monitoring cycle—although it is not required that the entire wilderness be monitored. To ensure data are compiled consistently over time, documentation for each wilderness should include a map that clearly identifies the areas surveyed for unauthorized trails for each monitoring cycle. Data on unauthorized trails may be also collected over a span of multiple years within the 5-year reporting period for this measure. For example, unauthorized data may be collected in different locations in different years, with a full cycle of monitoring (all identified monitoring areas) completed after 5 years.

Step 2: Calculate the total miles and enter data in the WCMD. Once unauthorized trails data have been collected, calculate the total miles of trails to derive the measure value. While many units are likely to archive unauthorized trails data in local spreadsheets or geospatial databases, some may enter the data in NRM-Trails. If data are stored in NRM-Trails, the NRM-WCM application will calculate the measure value automatically. Local units must then validate the value generated by NRM-WCM and correct records in NRM-Trails as necessary. Enter the total miles in the WCMD. The measure value is the miles of unauthorized trails.

Caveats and Cautions

If local units choose to use data stored in NRM-Trails for this measure, it should not be assumed that the data currently recorded in NRM are accurate or complete. Records from NRM-Trails must be scrutinized carefully for both mileage errors and missing unauthorized trails. If data from NRM-Trails are insufficient, local units must either: (1) update and improve the data in NRM, (2) use other data sources to complete the measure protocol, or (3) choose not to use this measure. Note that unauthorized trail segments less than 0.5 miles are rounded down to 0 in NRM-WCM and are not included in the total mileage calculation.

Data Adequacy

Most units do not have data for unauthorized trails. Data quantity is insufficient to partial, and quality will vary from poor to good, depending on the level of effort made and the ability to locate unauthorized trails. Overall, data adequacy at this time is low. Data adequacy must be assessed for each wilderness individually based on the quality and quantity of local data.

Frequency

Every 5 years, unauthorized trails are assessed, and the total number of miles is then entered in the WCMD. Field data collection may span multiple years within the 5-year reporting interval.

Threshold for Change

The threshold for meaningful change is a 3-percent change in the miles of unauthorized trails. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the miles of unauthorized trails beyond the threshold for meaningful change results in an improving trend in this measure.

5.3 Indicator: Remoteness from Sights and Sounds of Human Activity Outside the Wilderness

This indicator focuses on human activity occurring outside or on the boundary of a wilderness that is visible or audible from within wilderness. There is one required measure for this indicator.

5.3.1 Measure: Acres of Wilderness Away From Adjacent Travel Routes and Developments Outside the Wilderness

This measure assesses the total number of wilderness acres more than ½ mile from roads, structures, and other developments that are located outside a wilderness or on the boundary, including cherry-stemmed access road corridors and developed inholdings. Unless stated otherwise, the protocol steps are intended to be completed by the central data analyst. Data are compiled from the EDW, or other local or national data sources, and validated locally. The central data analyst calculates the measure value. Table 2.5.12 describes key features for this measure.

Table 2.5.12—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for the measure "Acres of Wilderness Away from Adjacent Travel Routes and Developments Outside the Wilderness."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required	None	Validate the national data.	Step 1: Ensure users understand what types of routes and developments are counted under this measure and retrieve spatial data. Step 2: Perform the spatial analysis to calculate the acres of wilderness away from travel routes and developments outside the wilderness. Step 3: Enter data in the WCMD.	5 years

Protocol

Step 1: Ensure users understand what types of routes and developments are counted under this measure and retrieve spatial data. Only those travel routes and developments outside wilderness for which there are existing spatial data are included in this measure. Locally unique or less common types of routes and developments that affect this indicator, such as travel routes on water, are not tracked under this measure due to the lack of nationally available data. Table 2.5.13 lists the travel routes and developments that are and are not included in this measure.

Table 2.5.13—Specific access points, travel routes, and developments used in this measure.

	Included	Not included
Adjacent travel routes	• NFS Trails • Motorized travel routes (e.g., roads) • Aircraft landing sites	• Unauthorized (user-created) trails • Aircraft travel routes over wilderness
Developments	• Authorized recreation sites and features (e.g., designated campsites, bridges, toilets) • Administrative developments (e.g., administrative buildings) • Housing and tourism developments	• Non-administrative developments (e.g., grazing infrastructure, mines, dams, utility infrastructure, fixed instrumentation) • Archaeological and historical sites (unless in active use for administrative or recreational purposes) • Unauthorized (user-created) recreation sites

There is the possibility of confusion about whether to include travel routes and developments that are on the boundary of a wilderness (including cherry-stemmed roads) under this measure or under the related measure *Acres of Wilderness Away From Adjacent Travel Routes and Developments Inside Wilderness* (see section 5.2.3 in part 2). Travel routes and developments should only be included in one of the measures, not both. Features located on a wilderness boundary should be included in this measure. Likewise, travel routes and developments on inholdings should also be included in this measure because inholdings are, by definition, not part of a wilderness.

The spatial data used for this measure come from a variety of data sources. Contact a GIS specialist to assist with this measure, if necessary. Finding data may require searching forest SDE GIS libraries, the EDW, NRM, or contacting the local unit. All local units maintain roads, motorized routes, and NFS trails data in a GIS, and some data are stored in NRM, but data are not necessarily linked together or validated. Some units have made their road and trail data available in the EDW and on websites like the Forest Service Interactive Travel Map. FSTOPO feature classes (available from the EDW) depict both Forest Service and non-Forest Service developments and travel routes. Spatial data on small-scale developments, however, may be challenging to find; while some units maintain spatial data on local developments in a GIS, others do not. Data sources for this measure include:

- The EDW
- Forest GIS data in SDE data linked to NRM
- Other local GIS
- Forest Service Interactive Travel Map (https://apps.fs.usda.gov/TravelAccess/)
- Forest Service Interactive Visitor Map (https://www.fs.fed.us/ivm/)

A recommended starting point in the compilation of data for this measure is to retrieve the following FSTOPO feature classes and additional "RoadCore" transportation feature classes from the EDW:

FSTOPO feature classes:

- S_USA.FSTopo_Building_PT
- S_USA.FSTopo_Culture_LN
- S_USA.FSTopo_Culture_PT
- S_USA.FSTopo_Culture_PL
- S_USA.FSTopo_RecFacility_PT
- S_USA.FSTopo_BuiltupArea_PL
- S_USA.FSTopo_LargeTank_PT
- S_USA.FSTopo_Airfield_LN
- S_USA.FSTopo_Airfield_PT
- S_USA.FSTopo_Railroad_LN
- S_USA.FSTopo_Transport_LN

- S_USA.FSTopo_Transport_PT

Additional "RoadCore" transportation feature classes:

- S_USA.RoadCore_Existing
- S_USA.RoadCore_FS

Note that some routes may be depicted in both FSTOPO's S_USA.FSTopo_ Transport_LN feature class and one or both of the "RoadCore" transportation feature classes. Where there are multiple depictions of the same route, data from either of the "RoadCore" transportation feature classes are likely to be more accurate, and are therefore preferred over transportation data from FSTOPO.

Given questions about the completeness and accuracy of national spatial data, a map must be sent to the local unit for validation once all data have been located. Local wilderness specialists and other relevant local units review the map for accuracy and completeness and identify any routes or developments that are missing or incorrect. (Corrections to these components in the corporate GIS will have to be made through appropriate channels.) The iterative process of evaluating and correcting the map of routes and developments outside wilderness is most critical for the measure baseline year.

Step 2: Perform the spatial analysis to calculate the acres of wilderness away from travel routes and developments outside the wilderness. To complete the spatial analysis, first buffer all identified routes and developments outside wilderness by ½ mile on all sides. Subtract the buffered area from the wilderness polygon and then calculate the remaining area to determine the acres of wilderness away from external routes and developments.

Step 3: Enter data in the WCMD. Enter the acres of wilderness away from travel routes and developments outside wilderness in the WCMD. The measure value is the number of acres.

Caveats and Cautions

This measure will not capture all important impacts on the visitor experience from sources outside wilderness, such as impacts from nearby urban areas or overflights. To some extent, such impacts could be captured locally through tailoring the national minimum protocol for solitude monitoring. If initial spatial data have errors or omissions corrected later, the baseline measure can be updated (recalculated) prior to computing trends over time.

Data Adequacy

Wilderness boundary spatial data are complete and accurate. Currently, however, the quality and quantity of data in travel route layers varies. NRM anticipates that the centerline data for system trails should be complete and accurate by 2017. Data on cartographic features are presumed to be complete and accurate (see www.fs.fed.us/database/cff.htm). These data are maintained at the Geographic Technology Applications Center and are updated on a 7-year cycle. Data on non-Forest Service roads, trails, and developments outside wilderness will vary in quantity and quality. Overall, data adequacy is considered to be medium to high, because data quantity is likely to be partial to complete, and data quality is likely to be moderate to good.

Frequency

Every 5 years, the acres of wilderness away from travel routes and developments outside wilderness are assessed, and the total acres are then entered in the WCMD.

Threshold for Change

The threshold for meaningful change is a 3-percent change in the acres of wilderness away from travel routes and developments outside wilderness. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. An increase in the number of wilderness acres beyond the threshold for meaningful change results in an improving trend in this measure.

5.4 Indicator: Facilities That Decrease Self-Reliant Recreation

This indicator focuses on the presence of facilities in wilderness that decrease opportunities for self-reliant recreation. There are two measures for this indicator and units are required to select at least one.

5.4.1 Measure: Index of NFS Developed Trails

This measure is an index that assesses the miles of NFS trails and their trail classes. Local data are compiled and periodically entered in NRM-Trails. NRM-WCM calculates the measure value. Table 2.5.14 describes key features for this measure.

Table 2.5.14—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure “Index of NFS Developed Trails.”

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the two facilities decreasing self-reliant recreation measures	None	Step 1: Retrieve NFS trail data from NRM. Step 2: Calculate the index value and enter data in the WCMD.	None	5 years

Protocol

Step 1: Retrieve NFS trail data from NRM. This measure uses data on both the miles and trail classes of NFS trails within wilderness to derive the measure value. Note that designated trail classes are used rather than actual trail conditions. Trail classes range from trail class 1 (minimally developed) to trail class 5 (fully developed) and describe the prescribed scale of development for a trail (i.e., its intended design and management standards).

This measure is designed to take advantage of currently collected and reported data on NFS trails. In NRM-WCM, retrieve existing data by running a report that displays all wilderness trails and trail classes. (Data for this report are pulled from existing records in NRM-Trails; only records where the "Jurisdiction" is "Forest Service," the "Trail status" is "Existing," and the "Trail system" is "NFST," are retrieved.) The following attributes will be displayed for all wilderness trails:

- Trail class
- Total miles (note that this refers to the total miles of trail inside wilderness)

Local wilderness staff must review the miles and trail classes of wilderness trails retrieved through NRM-WCM for accuracy and completeness. If discrepancies are found (e.g., if the trail condition on the ground does not match the assigned trail class), corrections to these attributes will have to be made through appropriate channels in NRM-Trails.

Step 2: Calculate the index value and enter data in the WCMD. The measure value is derived through an index combining the miles and trail classes for all wilderness trails. The NRM-WCM application will automatically calculate the index value for this measure. Local units must review and validate the value generated by NRM-WCM and correct records as necessary. Once validated, enter the index value in the WCMD. The method NRM-WCM uses to calculate these values is described below for reference. The measure value is the index value.

For each trail class, NRM-WCM multiplies the numerical trail class value (1 to 5) by the miles of wilderness trails in that class. NRM-WCM then sums all the component scores (the scores for all trail classes) to calculate the index value for a wilderness. Table 2.5.15 provides an example showing how to calculate the index value for this measure.

Table 2.5.15—An example of how to calculate the index of NFS trails for a wilderness.

Trail class	×	Total miles	=	Component score
1	×	0	=	0
2	×	5	=	10
3	×	30	=	90
4	×	0	=	0
5	×	0	=	0
Report this index value: 100				

Caveats and Cautions

Trail classes are established at the time of trail construction and may be updated infrequently. Conditions of many trails are likely to be more primitive than the official trail class because of declining maintenance. Hence, this is a conservative measure that is unlikely to show increases in opportunities for primitive recreation should they actually occur.

Note that if the total miles are less than 0.5 miles for a given trail class, NRM-WCM rounds the value down to 0 and it is not included in the final index value calculation.

Data Adequacy

Information about trail classes are considered relatively good in NRM-Trails because of the agency's focus on travel management as well as the need for interagency common standards. Data are also fairly complete, making data adequacy high. Data adequacy must be assessed for each wilderness individually based on well the national data reflect local conditions.

Frequency

Every 5 years, NFS trails are assessed and the index value is calculated. The index value is then entered in the WCMD.

Threshold for Change

The threshold for meaningful change is a 3-percent change in the measure value for NFS trails. Once there are five measure values, the threshold for meaningful change will switch to regression analysis. A decrease in the measure value beyond the threshold for meaningful change results in an improving trend in this measure.

5.4.2 Measure: Number of Authorized Constructed Recreation Features

This measure assesses the total number of authorized constructed recreation features. Local data are compiled and are either stored in local archives or entered in NRM-Wilderness. Local staff or NRM-WCM calculate the measure value. Table 2.5.16 describes key features for this measure.

Table 2.5.16—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Number of Authorized Constructed Recreation Features."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required to select at least one of the two facilities decreasing self-reliant recreation measures	None	Step 1: Ensure users understand what types of recreation features are counted under this measure and compile data. Step 2: Count the number of features and enter data in the WCMD.	None	5 years

Protocol

Step 1: Ensure users understand what types of recreation features are counted under this measure and compile data. This measure counts authorized constructed recreation features located within wilderness, such as bridges, toilets, fire grates, and bear boxes. General guidelines for what features to include and exclude from this measure are described below.

- This measure records authorized features (i.e., installed and maintained by the Forest Service, or historical structures used by visitors). It may also include user-created structures (e.g., tent pads or outfitter camp structures) that managers maintain or permit to exist, but it does not include unauthorized user-created features that are routinely removed when found.
- To avoid double counting, non-recreational developments are not counted under this measure because they are monitored for the measure *Index of Authorized Non-Recreational Physical Development* under the Undeveloped Quality (see section 4.2.1 in part 2).
- System trails are not included in this measure because they are monitored under the measure *Index of NFS Developed Trails* (see section 5.4.1 in part 2).
- Campsites (including designated campsites) that have natural rock fire pits or user-flattened tent pads are captured under the measure *Index of Recreation Sites Within Primary Use Areas* (section 5.2.2 in part 2), and not this measure; however, recreation features associated with designated campsites (e.g., toilets, fire grates) are counted here.
- Several types of trail-related features (e.g., trail turnpikes, trail signs, or blazes) are not included because they may have minimal impact on the sense of primitive recreation (relative to major facilities) or because local units are unlikely to maintain accurate counts of those features. Likewise, climbing anchors (e.g., bolts) are not included because it is presumed difficult to obtain accurate counts.

Existing data on recreation features are generally archived locally in spreadsheets or geospatial databases. Some local units, however, may enter and store these data in NRM-Wilderness. The recommended approach for this measure is to use data on recreation features collected as part of the Forest Service national minimum protocol for recreation site monitoring (available online at http://www.wilderness.net/toolboxes/documents/recsitemonitor/National%20Minimum%20Recreation%20Site%20Monitoring%20Protocol.pdf). Provide counts of each of the following types of authorized constructed recreation features:

- Toilets and toilet buildings
- Forest Service-constructed tent pads or tent platforms (fabricated with wood, cement, or other material and designed to be permanent installations)
- Picnic tables
- Benches
- Bear poles or other food storage structures
- Permanent fire rings, grills, fireplaces, or wood stoves
- Shelters and cabins
- Developed recreational water sources (if not counted under the Undeveloped Quality)
- Corrals or hitchrails for recreational stock holding
- Large bridges (bridges with railings or decking)
- Airstrips

Step 2: Count the number of features and enter data in the WCMD. Each feature included in this measure is weighted equally, and all recreation features at a site are counted separately. For example, a toilet and a fire ring at one site are counted as two features. Likewise, a bear box attached to a shelter would count as two features. Sum the total number of recreation features to derive the measure value. Alternatively, if data are stored in NRM-Wilderness, the NRM-WCM application will calculate the total number of recreation features automatically. Local units must then validate the value generated by NRM-WCM and correct records in NRM-Wilderness as necessary. Enter the measure value in the WCMD. The measure value is the total number of recreation features.

Caveats and Cautions

If local units choose to use data stored in NRM-Wilderness for this measure, it should not be assumed that the data currently recorded in NRM are accurate or complete.

Records from NRM-Wilderness must be scrutinized carefully for missing recreation features. If data from NRM-Wilderness are insufficient, local units must either: (1) update and improve the data in NRM, (2) use other data sources to complete the measure protocol, or (3) choose not to use this measure.

Data Adequacy

Units should be able to accurately report these features with minimal effort and without the need for new field data collection. Therefore, it is assumed that data quality will be good, data quantity is complete, and overall data adequacy is high. Data adequacy must be assessed for each wilderness individually based on the quality and quantity of local data.

Frequency

Every 5 years, changes to the number of authorized constructed recreation features are assessed, and the total number of features is then entered in the WCMD.

Threshold for Change

The threshold for meaningful change is any change in the total number of authorized constructed recreation features. A decrease in the number of features beyond the threshold for meaningful change results in an improving trend in this measure.

5.5 Indicator: Management Restrictions on Visitor Behavior

This indicator focuses on management restrictions that degrade opportunities for unconfined recreation. There is one required measure for this indicator.

5.5.1 Measure: Index of Visitor Management Restrictions

This measure is an index that assesses the relative degree of imposition or inconvenience of certain visitor management restrictions as well as the geographic extent of those restrictions. Local data are compiled and entered in NRM-Wilderness and NRM-WCM annually. NRM-WCM calculates the measure value. Table 2.5.17 describes key features for this measure.

Table 2.5.17—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Index of Visitor Management Restrictions."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required	None	Step 1: Ensure users understand what types of visitor management restrictions are counted under this measure and retrieve data from NRM. Step 2: Calculate the index value. Step 3: Enter data in the WCMD.	None	5 years

Protocol

Step 1: Ensure users understand what types of visitor management restrictions are counted under this measure and retrieve data from NRM. Management restrictions are put in place through the implementation of wilderness regulations authorized by regional or forest special orders. Restrictions may be national, regional, or local in scope, and may apply to the entire wilderness or just certain areas within a wilderness. This measure monitors the following 11 categories of regulations deemed most likely to affect the perception of unconfined recreation:

1. Area closure
2. Campfire restrictions
3. Camping restrictions
4. Dogs and domesticated animals
5. Fees
6. Group size limits
7. Human waste
8. Length of stay
9. Permits
10. Stock use
11. Swimming/bathing

Although these categories are not exhaustive, they represent a selected group of more common types of visitor management restrictions (forest or regional regulations) and should reliably track changes in the measure. Other types of Forest Service regulations are not tracked for this measure because they either do not present significant confinement of the visitor (e.g., anti-littering regulations) or they are uncommon. In addition, regulations or restrictions imposed by other agencies (e.g., state park fees) as well as common practices (e.g., Leave No Trace guidelines) are not monitored under this measure. Seasonal restrictions are only included in this measure for restrictions that occur at the same time each year.

The data on visitor management restrictions that are used for this measure are already reported through NRM-Wilderness by local units during annual upward reporting. Run a report in NRM-WCM to display relevant data for this measure. (Data for this report are pulled from existing records entered in the Wilderness Regulations module in NRM-Wilderness.)

NRM-WCM automatically assigns an impact rating of 0 to 3 for each regulation category based on the relative restrictiveness of a wilderness's regulations entered in NRM-Wilderness. A higher impact rating indicates a greater degree of restriction on visitor behavior, with the highest rating of 3 reserved for regulations that cause substantial imposition on visitors. For example, mandatory use-limiting permits (an impact rating of 3) require advance planning and may require visitors to change their planned trip dates or make a special trip to a permitting office. Similarly, requiring visitors to pack out their human waste (an impact rating of 3) likewise necessitates advance planning as well as considerable inconvenience during the trip. General guidelines for impact ratings are described in table 2.5.18, while table 2.5.19 shows the specific impact rating scales used by NRM-WCM for each category of regulation. If a wilderness has more than one type of regulation within a given category, NRM-WCM will use the most restrictive regulation in place to assign the impact rating. For example, if there are mandatory use-limited permits required in summer (an impact rating of 3) but mandatory non-use-limiting permits required in winter (an impact rating of 2), NRM-WCM will assign an impact rating of 3 for the permits regulation category.

Table 2.5.18—Guidelines for assigning impact ratings to regulations.

Impact rating	General description
0	No regulation with the category.
1	Some restriction, but retention of some individual choice. For example, designated site camping policies enable visitors to choose from available sites when they arrive at their destination. An impact rating of 1 is also assigned in cases in which regulations are restrictive but affect only one segment of the population (e.g., group size limits generally will not affect most users, and leash laws affect only those with dogs).
2	No choice is permitted. For example, assigned site policies that require visitors to select campsites before beginning their trip would receive an impact rating of 2.
3	The most restrictive regulations: use limits, waste pack-out requirements, closures to stock, and area closures to all use.

Table 2.5.19—A list of categories, impact ratings, and types of restrictions for computing the visitor restriction index.

Regulation category	Impact rating	Type of restriction
Area closure	0	No restriction
	3	Area closed to all recreational use
Campfire restrictions	0	No regulation
	1	Designated site, above designated elevation, or mandatory setback
	2	Total prohibition
Camping restrictions	0	No restriction
	1	Any mandatory setback; designated sites
	2	Assigned sites; camping prohibited
Dogs and domesticated animals	0	No restriction
	1	Required to be on leash or under control
	2	Prohibited

Regulation category	Impact rating	Type of restriction
Fees	0	No fees
	1	Fees charged of selected user type
	2	Fees charged of all visitors
Group size limits	0	No restriction
	1	Group size limits in place, or limits to the number of watercraft
Human waste	0	No regulation beyond sanitary burial of fecal waste
	3	Pack out required
Length of stay	0	No restriction on length of stay
	1	Length of stay limited
Permits	0	No permit or registration
	1	Voluntary self-registration
	2	Mandatory, non-limiting permit or registration
	3	Mandatory, use limited
Stock use	0	No restriction
	1	Mandatory setbacks; no hitching, tethering; no free trailing; number of stock limited
	2	Grazing prohibited or feed restricted
	3	No camping with stock; area closures to all stock
Swimming/Bathing	0	No restriction
	2	Prohibited

Local units must validate the impact ratings displayed in NRM-WCM and, if necessary, correct records in NRM-Wilderness. It may be necessary to check records in NRM-Wilderness directly to ensure that all visitor management restrictions have been entered and that NRM-WCM has retrieved the most restrictive regulation (with the highest impact rating) for each category.

For each regulation category, local units must also enter the geographic weight—that is, whether the restriction applies to a subarea of a wilderness or to the entire wilderness. This is a new attribute that must be entered in NRM-WCM and cannot be entered in NRM-Wilderness. If local units set the geographic extent as the entire wilderness, NRM-WCM will automatically assign a weight of 2 to that regulation category; if local units set the geographic extent as only part of the wilderness, NRM-WCM will assign a weight of 1. If there is more than one type of restriction within a given regulation category, use the restriction with the highest impact rating to determine the geographic weight. For example, if there is a wilderness-wide requirement to use weed-free feed for stock (an impact rating of 2, geographic weight of 2), but a specific riparian area is also closed to all stock use (an impact rating of 3, geographic weight of 1), NRM-WCM will use the riparian area closure restriction to assign the higher impact rating for the stock use regulation category, and local units should assign a corresponding geographic weight of 1 (part of the wilderness) for that restriction.

Each regulation category is then assigned a weight for geographic extent based on whether restrictions apply to a subarea of a wilderness (a weight of 1) or to the entire wilderness (a weight of 2). NRM-WCM automatically determines the appropriate weight for a restriction by using the new geographic extent attribute local units entered in step 1. If there is more than one type of regulation within a given category, NRM-WCM will use the geographic extent for the restriction with the highest impact rating. For example, if there is a wilderness-wide requirement to use weed-free feed for stock (an impact rating of 2, geographic extent weight of 2), but a specific riparian area is also closed to all stock use (an impact rating of 3, geographic extent weight of 1), NRM-WCM will use the area closure restriction, with the higher impact rating, to assign a geographic extent weight of 1 for the stock use regulation category.

Step 2: Calculate the index value. The index used for this measure combines impact ratings and geographic weights for each of the 11 regulation categories. The NRM-WCM application will automatically calculate the index value for this measure. Local units must review and validate the value generated by NRM-WCM and correct records as necessary. The method NRM-WCM uses to calculate these values is described below for reference.

Once an impact rating and a geographic weight are assigned for each regulation category, NRM-WCM calculates the visitor management restrictions index in two basic steps. First, a component score is generated for each regulation category by multiplying the impact rating by its geographic weight. Second, the component scores for all categories are summed to produce the final index value. Table 2.5.20 provides an example showing how NRM-WCM calculates the index value for this measure.

Table 2.5.20—An example of how to calculate the visitor management restrictions index value. A dash (-) in the column means that geographic weight is not applicable because there is no restriction for the regulation category (impact rating = 0). If there is no restriction, there can be no geographic extent and no geographic extent weight.

Regulation category	Impact rating	×	Geographic weight	=	Component score
Area closure	0	×	-	=	0
Campfire restrictions	1	×	2	=	2
Camping restrictions	2	×	1	=	2
Dogs and domesticated animals	1	×	1	=	1
Fees	0	×	-	=	0
Group size limits	1	×	2	=	2
Human waste	0	×	-	=	0
Length of stay	0	×	-	=	0
Permits	1	×	2	=	2
Stock use	1	×	1	=	1
Swimming/bathing	0	×	-	=	0
					Report this index value: 10

Step 3: Enter data in the WCMD. Local units must validate the visitor management restrictions index value generated by NRM-WCM and correct records in NRM-WCM or NRM-Wilderness as necessary. Once validated, enter the index value in the WCMD. The measure value is the index value.

Caveats and Cautions

Regulations entered in NRM-Wilderness must be accurate to apply the proper geographic weight and provide a component score. Missing regulations in NRM-Wilderness or the use of an inaccurate regulation type could provide an incorrect component score.

Data Adequacy

Data are of reasonably good quality and data quantity is complete. Efforts have been made recently to ensure that regulations are correctly reported through NRM because the website www.wilderness.net publishes these data. Therefore, data adequacy is high. Data adequacy must be assessed for each wilderness individually based on the quality and quantity of local data.

Frequency

Every 5 years, data on visitor restrictions are retrieved and the index value is calculated. The index value is then entered in the WCMD.

Threshold for Change

The threshold for meaningful change is any change in the measure value. A decrease in the measure value beyond the threshold for meaningful change results in an improving trend in this measure.

6.0 Other Features of Value Quality

Monitoring the Other Features of Value Quality assesses how the condition of specific, tangible features that are integral to wilderness character change over time; it does not evaluate the other values (e.g., educational, scientific or inspirational values) derived from these features. Key indicators and measures monitor cultural features and other integral features of value. These indicators and measures are only included as part of WCM where ecological, geological, or other features of scientific, educational, scenic, or historical value exist and are integral to the meaning and value of a wilderness. This section first provides guidance on determining which features may be integral to wilderness character (section 6.1) and then describes detailed protocols for monitoring the following indicators and measures:

- 6.2 Indicator: Deterioration or Loss of Integral Cultural Features
    - 6.2.1 Measure: Condition Index for Integral Cultural Features
- 6.3 Indicator: Deterioration or Loss of Other Integral Site-Specific Features of Value
    - 6.3.1 Measure: Condition Index for Other Features

6.1 What Features are Integral to Wilderness Character?

A feature that is integral to wilderness character is one that makes the area's meaning and significance as wilderness clearer and more distinct. What is considered integral is anticipated to be a subset of the full suite of important site-specific geological, historical, cultural, and other features within a wilderness. Line officers will make the decision on whether or not a feature is integral to wilderness character with input from, and discussion between, wilderness managers and resource specialists, particularly regarding cultural resources. The following questions can help local unit staff and line officers determine whether a site-specific feature should be considered integral to wilderness character:

- *Is the feature specifically identified in the enabling legislation for the wilderness?* Features identified in the enabling legislation for a particular wilderness should be strongly considered as integral to wilderness character. Features not listed in the enabling legislation may still be considered, but the determination of whether or not to include them will require considerably more discussion and scrutiny.
- *Does the feature define how people think about the wilderness or how they value the wilderness? Is the name of the wilderness associated with the feature?* The focus here is on selecting those features that play a central role in defining the meaning and significance of a wilderness, rather than features that relate to broader, non-wilderness themes. In particular, if a wilderness

Photo: South Dakota, Spearfish Canyon State and National Forest Service Scenic Byway. by USFS.

is named after an iconic natural or cultural feature, the feature may define the area's meaning and significance as wilderness. For example, a wilderness may be integrally associated with a plant, fish, or animal such as Big Gum Swamp Wilderness, Golden Trout Wilderness, or Great Bear Wilderness. Similarly, a wilderness may be integrally associated with a physical, geological, or paleontological feature such as Glacier View Wilderness, Shining Rock Wilderness, or Fossil Ridge Wilderness.

- *Is the feature nationally recognized or considered a priority heritage asset (i.e., identified as significant in an agency plan)?* Features recognized by some type of national designation, such as a site listed on the National Historic Register, National Geological Site, or National Natural Landmark, should be strongly considered as integral to wilderness character. Historical and prehistoric features identified as priority assets should also be considered, particularly if the feature has a national designation. However, if a feature is primarily identified as a priority asset because of prior management investment, it may not be considered integral to wilderness character, but still could be monitored as part of the Heritage monitoring program (e.g., monitoring Priority Heritage Assets on a 5-year cycle).
- *Was the feature selected as an element for Wilderness Stewardship Performance?* Each local unit selected 10 elements to assess WSP as part of the Forest Service performance accountability system. Cultural resources were one of the 19 possible elements that could be selected. If this element was selected as a key aspect of stewardship performance, wilderness and cultural resource staff should discuss whether some cultural resource features should also be considered integral to wilderness character.

These questions inform whether a feature helps define the area's significance and distinguish its meaning as wilderness. Local units should consider a feature's past, present, and potential future educational, scientific, or scenic values when deciding whether to include it in WCM, even though these values will not be monitored directly. Additionally, for prehistoric or historical features, the physical evidence should convey a story about the distinctive interwoven human relationship with the land that helps enrich the meaning of the area as wilderness. Important features that are not considered integral to wilderness character may still be part of a larger wilderness monitoring program or monitored under other resource programs. For example, cultural resource staff may track the condition of historical cabins even if these features are not included as part of the Other Features of Value Quality of wilderness character. Obviously, before any discussion of potential cultural or other features of value can occur, staff must have reasonable knowledge about what features exist in a wilderness (i.e., some inventory of cultural and integral other resources has occurred). If an inventory has not been done and there is no reasonable expectation that reliable data can be obtained and monitored, then the Other Features of Value Quality should not be included as part of WCM. If only partial inventory has been done, adding additional features in future years will change the baseline number of features, thus necessitating a recalculation of previous year index values.

When considering non-cultural features that contribute unique ecological, scientific, educational, or scenic value to an area's wilderness character, it may be more appropriate to monitor such features in one of the other four qualities. For example, while an iconic mountain peak may have scenic or other values integral to wilderness character, it may be appropriately monitored by measures tracking viewshed degradation from pollutants or developments, such as Amount of Haze in the Natural Quality or a measure of visual impacts in the Solitude or Primitive and Unconfined Recreation Quality. However, there are situations where iconic natural or physical features should be monitored under the Other Features of Value Quality, such as when the complexity of ecological systems makes it difficult to determine a trend in the measure under the Natural Quality (see section 3.6 in part 2). For example, an iconic mountain bald in a southern Appalachian Mountain wilderness may make the wilderness distinctive and provide rare habitat for indigenous species; however, if it is unknown whether ecological changes to the bald are due to natural or human-caused forces, such a feature would be more appropriately monitored in the Other Features of Value Quality. This is appropriate because trends in measures under the Other Features of Value Quality may be defined by human values (e.g., the continued existence of the unique feature), whereas trends in measures under the Natural Quality are defined by threats to ecological systems from modern civilization.

This quality focuses on identifying discreet, site-specific features that are integral to wilderness character, however, there may be situations where no single feature captures what gives a wilderness meaning and significance. Instead, the local unit may believe it is the cumulative total of numerous sites that define the meaning and significance of a wilderness. An example might be numerous prehistoric pit houses, none of which are significant on their own. Likewise, it may be the accumulation of numerous fossil sites that are significant, not a specific site in particular. In these situations, the monitoring effort will clearly require more effort compared with monitoring only a few sites.

6.2 Indicator: Deterioration or Loss of Integral Cultural Features

This indicator focuses on the condition of specific, tangible cultural features that are integral to wilderness character. There is one measure for this indicator that is required if relevant to the individual wilderness.

6.2.1 Measure: Condition Index for Integral Cultural Features

This measure is an index that aggregates the condition rating for each cultural feature (or collection of similar cultural features) determined to be integral to wilderness character. Local data are compiled and periodically entered in NRM-Heritage, NRM-

Buildings, local archives, or other state or regional database. NRM-WCM calculates the measure value. Table 2.6.1 describes key features for this measure.

Table 2.6.1—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Condition Index for Integral Cultural Features."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required if relevant	None	Step 1: Determine which cultural features are integral to wilderness character and feasible to monitor. Step 2: Determine the condition of each integral cultural feature. Step 3: Enter data in the WCMD.	None	5 years

<u>*Protocol*</u>

Step 1: Determine which cultural features are integral to wilderness character and feasible to monitor. For this measure, cultural is defined broadly to include both prehistoric and historical features. Only those cultural features determined to be integral to wilderness character should be included in this monitoring (i.e., those features that define the meaning and significance of the area). Detailed information about how to determine what features are integral to wilderness character can be found in section 6.1 in part 2. Wilderness staff will need to work closely with heritage and facilities staff to identify what cultural features exist inside wilderness, determine if those features are integral to wilderness character, and assess monitoring feasibility. Note that when consulting with heritage staff, the word *feature* as used in this measure is functionally equivalent to the word sites used in the FS Heritage Program and in the NRM-Heritage application.

Local units currently monitor select cultural sites as part of the existing heritage program (e.g., Priority Heritage Assets), and may also monitor some structural cultural features through the facilities program (e.g., historical buildings). Additional information on cultural resources inside wilderness may be found in NRM-Heritage, NRM-Buildings, State Historic Preservation databases, Tribal Historic Preservation Offices, local archives, and local knowledge from tribal and community members not recorded elsewhere. Where there is little or no information about cultural resources within a wilderness, some inventory may be necessary before local managers determine whether any features are integral to wilderness character.

In deciding which cultural features to include in this measure, it is essential to consider monitoring feasibility. While some cultural features are regularly assessed by the heritage or facilities programs, many are not. If an integral feature is *not* currently monitored, inclusion in this measure would require that an initial site condition assessment be conducted by a qualified resource specialist, a 5-year monitoring schedule be established, and condition data be regularly entered into NRM-Heritage, NRM-Buildings, or a locally maintained database. If a cultural feature is considered integral to wilderness character but local units lack the resources to feasibly assess its initial condition or monitor it over time, do not include the feature in this measure. Such features may be added to this measure in the future if site condition monitoring becomes feasible; however, any modification of the list of integral features should be considered carefully as changes in the measure value may affect the trend in this measure.

Cultural features integral to wilderness character are retrieved from NRM-WCM by pulling data from the NRM-Heritage application. Appropriate NRM-Heritage staff must check a box to identify a feature as being integral to wilderness character. Work with appropriate heritage staff to complete this process. More information may be found on the NRM Heritage Support page in NRM.

Step 2: Determine the condition of each integral cultural feature. Condition assessments for integral features may be stored in NRM-Heritage, NRM-Buildings, State Historic Preservation databases, Tribal Historic Preservation Offices, or local databases. For cultural features monitored by either the heritage or facilities programs, condition records are likely to be available from NRM-Heritage or NRM-Buildings, respectively. When a feature is linked to a wilderness in Step 1, above, the condition assessment in NRM-Heritage is retrieved by NRM-WCM.

The condition categories used in this measure are simplified from those used in NRM-Heritage; for example, sites coded as either "100% surface disturbance" or "destroyed" in NRM-Heritage would both be assigned as "destroyed" for this measure, and sites coded as either "intact" or "excellent" in NRM-Heritage would both be assigned as "excellent" here. The condition categories used for this measure focus on disturbance caused by human activity, but may include some deterioration related to natural processes (e.g., natural weathering, erosion). Although the condition categories primarily describe deterioration from unauthorized actions, adverse effects from authorized activity (e.g., erosion from designated campsites that are co-located on cultural sites) may also be taken into consideration when determining the appropriate condition category. Assign one of the following condition categories for each site:

- *Excellent*—Less than 25 percent of the feature is disturbed. There is little to no evidence of disturbance from unauthorized activity resulting in any loss of information potential.

- *Good*—25–50 percent of the feature is disturbed. There is minor disturbance by unauthorized activity (e.g., moving of potshards, user-created trails).

- *Poor*—51–75 percent of the feature is disturbed. There is moderate disturbance by unauthorized activity. Although not apparent to the untrained eye, some material may be missing from the site.

- *Bad*—76–99 percent of the feature is disturbed. There is clear evidence of major disturbance by unauthorized activity (e.g., pot hunting, graffiti).
- *Destroyed*—100 percent of the feature is disturbed, including subsurface damage or disturbance of the entire surface. The feature has so deteriorated from unauthorized activity that it is no longer eligible for national designation or no longer provides wilderness value (e.g., dismantled and removed, wildfire, flood).

Once the condition category has been assigned for each cultural site, note the associated numerical rating according to the following table 2.6.2.

Table 2.6.2—Numerical rating for the condition category of integral cultural features.

Condition category	Numerical rating
Excellent	1
Good	2
Poor	3
Bad	4
Destroyed	5

Step 3: Retrieve Data from NRM. Local wilderness staff must review the information retrieved through NRM-WCM for accuracy and completeness. If discrepancies are found, corrections will have to be made through the appropriate staff with access to NRM-Heritage.

Step 4: Enter data in the WCMD. The NRM-WCM applications will automatically calculate the index value for this measure based on data retrieved from NRM-Heritage. NRM-WCM calculates the index value for this measure in two basic steps.

First, a component score for each integral cultural feature is generated. For simple features that are composed of a single cultural site, the component score is the numerical rating assigned for that site. For features that cover multiple sites, the component score is the average of the numerical ratings for all individual sites that make up that integral feature. Second, NRM-WCM then sums the component scores for all integral cultural features to produce the final index value. Table 2.6.3 provides an example showing how to calculate the index value for this measure. In this table, the Feature/Site Type is a general narrative description that does not provide any specific location reference; the Feature/Site ID is preferably the Forest Service Site Number (to facilitate interaction between the heritage and wilderness programs), or may be the Smithsonian ID number, State Historic Protection Office ID number, or another form of identification.

Table 2.6.3—An example of how to calculate the index value for integral cultural features.

Feature/Site type	Feature/Site ID	Condition rating	Component score	Comments
Vision quest sites (six sites)	040304A	1	1 (round to the nearest whole number)	Sites 040304 A, B, C, and D all are rated in excellent condition. However site 040304 E and F have lost some of their integrity due to visitor-created trails through the sites and some rock displacement, thus are rated in good condition.
	040304B	1		
	040304C	1		
	040304D	1		
	040304E	2		
	040304F	2		
Wicki-up teepee	040304D	3	3	Some poles are missing but the structure is still largely intact.
Stone Lake petroglyphs	021401000023	1	1	Petroglyph panel is intact with no signs of vandalism or degradation due to natural causes.
Ranger Johnson cabin	021401000009	5	5	Cabin burned in the 2017 Wild Fire and it no longer exists as a standing cabin although archaeological remains may still be present.
Sheeptrap	021401000062	3	3	Location and materials in place, deteriorating from exposure.
Three door ruin	031505A	2	2	Digging in midden observed; monitoring schedule has been adjusted to monitor more frequently.
Report this index value: 15				

Caveats and Cautions

Local units will first need to mark integral sites in NRM-Heritage and NRM-Buildings, and thereafter condition data for those sites can be retrieved from NRM-WCM.

Data Adequacy

Data adequacy is considered to be high. Features determined to be integral to wilderness character are likely those which have some level of existing documentation. Data quantity is likely to be complete and data quality is likely to be good—if the assessments are done by qualified, cultural resource program or facilities specialists. Data adequacy must be verified locally for each wilderness.

Frequency

Every 5 years, data on features integral to wilderness character are retrieved and the index value is calculated. The index value is then entered in the WCMD. Field data collection may span multiple years within the 5-year reporting interval.

Threshold for Change

The threshold for meaningful change is any change in the measure value for all integral cultural features. A decrease in the measure value beyond the threshold for meaningful change results in an improving trend in this measure.

6.3 Indicator: Deterioration or Loss of Other Integral Site-Specific Features of Value

This indicator focuses on the condition of other site-specific features determined to be integral to wilderness character. There is one measure for this indicator that is required if relevant to the individual wilderness.

6.3.1 Measure: Condition Index for Other Features

This measure is an index that aggregates the condition rating for each site-specific feature (or collection of similar site-specific features) determined to be integral to wilderness character. Local data are compiled and stored in local archives. The WCMD calculates the measure value. Table 2.6.4 describes key features for this measure.

Table 2.6.4—Summary of measure type, protocol options, local tasks, national tasks, and frequency of data reporting for measure "Condition Index for Other Features."

Measure type	Protocol options	Local tasks	National tasks	Frequency
Required if relevant	None	Step 1: Determine which other features are integral to wilderness character and feasible to monitor. Step 2: Develop condition assessments and determine the condition of each integral feature. Step 3: Enter data in the WCMD.	None	5 years

Protocol

Step 1: Determine which other features are integral to wilderness character and feasible to monitor. This measure includes non-cultural features such as iconic geological, paleontological, and other features integral to wilderness character. Only those features determined to be integral to wilderness character should be included in this monitoring (i.e., those features that define the meaning and significance of the area). Detailed information about how to determine what features are integral to wilderness character can be found in section 6.1 in part 2. Where there is little or no information about other features of value within a wilderness, some inventory may be necessary before local managers determine whether any features are integral to wilderness character. Local units can also acquire information from the Automated Lands Program (ALP) to help identify significant special interest areas within a wilderness. For example, the EDW contains ALP information about botanical areas, geological areas, national natural landmarks, paleontological areas, research natural areas, and other areas.

In deciding which features to include in this measure, it is essential to consider monitoring feasibility. For integral features included in this measure, a qualified resource specialist will need to conduct an initial site condition assessment, establish a 5-year monitoring schedule, and regularly enter condition data into a locally maintained database. Consult local resource specialists or wilderness staff to evaluate the feasibility of establishing condition monitoring for integral features that are not currently being assessed. If a feature is considered integral to wilderness character but local units lack the resources to feasibly monitor it over time, do not include the feature in this measure. Such features may be added to this measure in the future if site condition monitoring becomes feasible; however, any modification of the list of integral other features should be considered carefully as changes in the measure value may affect the trend in this measure.

Step 2: Develop condition assessments and determine the condition of each integral feature. Once integral features have been identified for monitoring, work with local wilderness staff and relevant resource specialists to develop a meaningful condition assessment for each type of feature. It is recommended that units develop a five category rating system (e.g., excellent, good, fair, poor, or destroyed) for each type of feature. The qualitative definitions for each condition category are recommended to be similar to those used for cultural features if possible (see measure *Condition Index for Integral Cultural Features*, section 6.2.1 in part 2). For example, condition categories for paleontological features could be defined based on percentage of site integrity. However, some integral other features may require different condition categories to provide locally relevant information. An example might be for an iconic plant or tree species where the categories could be based on aerial coverage, sapling recruitment, or a combination of population metrics. Likewise, categories for a glacial feature could be based solely on aerial extent. While condition categories should focus on disturbance caused by human activity, they may include some disturbance where the causal factor is unclear. For example, the decline of an iconic plant species included under this measure may be related to natural or human-caused change, or some combination of the two. Local units must document the condition categories developed for all types of integral features.

Even though the qualitative category descriptions may vary depending on the type of feature, the scale of their associated numerical ratings should be the same as the scale used for cultural features (e.g., the numerical ratings should range from 1 [excellent condition] to 5 [destroyed or worst condition]). This consistent scaling is necessary to calculate the index value and apply the same threshold of change. Table 2.6.5 shows the recommended framework for developing condition categories and their associated numerical ratings.

Table 2.6.5—Recommended framework for developing condition categories and numerical ratings for other features of value.

Condition category	Numerical rating
Excellent	1
Good	2
Poor	3
Bad	4
Destroyed	5

Once a condition assessment has been developed for each type of integral feature included in this measure, qualified resource specialists must complete condition assessments for each feature every 5 years and store the data in a locally maintained database. For integral features that encompass multiple sites (e.g., numerous fossil sites that cumulatively are an integral feature of value), the individual sites may be assessed collectively or separately. Condition assessments for integral features may also be conducted over a span of multiple years within the 5-year reporting period for this measure. For example, condition assessments may be completed for a fraction of integral paleontological sites each year, with a full cycle of monitoring (all integral paleontological sites included in this measure) completed after 5 years. Record the condition category and associated numerical rating for all identified features or sites.

Step 3: Enter data in the WCMD. The final measure value is derived through an index combining all integral features' numerical ratings. While this index is described below for reference, users will not be responsible for calculating the measure value themselves; instead, users will enter the assigned numerical ratings for each integral site in the WCMD (for features that encompass multiple sites, users must enter the numerical ratings for all individual sites). The WCMD will then calculate the measure value automatically. The measure value is the index value.

In calculating the index value for this measure, there are two basic steps. First, generate a component score for each integral feature. For simple features that are composed of a single site, the component score is the numerical rating assigned for that site. For features that encompass multiple sites, the component score is the average of the numerical ratings for all individual sites that make up that integral feature. Second, sum the component scores for all integral features to produce the final index value. Table 2.6.6 provides an example showing how to calculate the index value for this measure.

Table 2.6.6—An example of how to calculate the index value for integral other features.

Feature name	Feature/Site ID	Condition rating	Component score	Comments
Big Glacier	040307G	3	3	The aerial extent of the Big Glacier has receded 100 feet since the last monitoring visit 5 years ago.
Fossil Ridge	041505F	2	2	There is evidence of minor user-created trails on the fossil ridge suggesting some potential for exposed fossils to have been removed but the overall integrity of the site is good.
Report this index value: 5				

Caveat/Cautions

None.

Data Adequacy

Data adequacy is considered to be medium to high. Data quantity is anticipated to be complete because features that are truly integral to wilderness character are likely ones that have received some level of study and staff attention. However, data quantity may vary depending on the number of features considered integral to wilderness character, especially if a local unit determines that an integral feature includes a collection of numerous sites. Data quality is more variable because it depends on having qualified resource specialists available to complete the assessments, and may range from good to moderate. Data adequacy must be verified locally for each wilderness.

Frequency

Every 5 years, site condition assessments are completed by a qualified resource specialist, and the assigned condition ratings for all integral sites are then entered in the WCMD. The measure value is automatically calculated by the WCMD based on the entered data. Field data collection may span multiple years within the 5-year reporting interval.

Threshold for Change

The threshold for meaningful change is any change in the measure value for all integral cultural features. A decrease in the measure value beyond the threshold for meaningful change results in an improving trend in this measure.

Glossary

303(d) list of impaired water bodies—The list of impaired and threatened waters that the Clean Water Act requires all states to identify. This list specifies where required pollution controls are not sufficient to attain or maintain applicable water quality standards, and helps establish priorities for development of total maximum daily loads based on the severity of the pollution and the sensitivity of the uses to be made of the waters, among other factors.

abundance—The number of individuals in a population.

administrative authorization—An authorization to use motor vehicles, motorized equipment or mechanical transport determined as necessary to meet minimum requirements for the administration of the area that are not of an emergency nature, or allowed through a special provision in legislation.

animal unit months—The amount of forage required by a 1,000-pound cow, or the equivalent, for 1 month.

area away from access and travel routes and developments inside wilderness—The area of a wilderness located more than ½ mile from wilderness trails, roads, and developments. The sights and sounds of human activity inside wilderness are generally less likely to impact this area.

area away from adjacent travel routes and developments outside the wilderness—The area of a wilderness located more than ½ mile from non-wilderness roads, structures, and developments, including infrastructure located on inholdings and cherry-stemmed roads. The sights and sounds of human activity outside the wilderness are generally less likely to impact this area.

authorized action—An action which is approved by an employee of the Forest Service to whom the appropriate authority has been delegated.

authorized recreation features—Recreation features installed and maintained by the Forest Service, or historical structures used by visitors. These facilities include toilets, picnic tables, bear poles or other food storage structures, permanent fire rings/grates, shelters, developed water sources, corrals for recreational stock holding, large bridges, and Forest Service-constructed tent pads or sleeping platforms.

baseline conditions—The starting point for assessing change over time without value judgment as to whether these conditions are good, bad, or desired.

best available scientific information—Scientific information which each local wilderness unit is required to use for all selected measures. Determined by subjective evaluation of data quantity, quality, and adequacy by resource specialists for all potential data sources considered for each measure. "Available" refers to information that currently exists in a useful form, and that does not require further data collection, modification, or validation. If the only available data are insufficient in quantity, they may still be considered the best available scientific information for the local unit. In general, the highest quality data will be considered the best available scientific information.

biophysical environment—"The earth and its community of life" including, but not limited to, vegetation, fish, wildlife, insects, pathogens, soil, and water.

building—A structure to support, shelter, or enclose persons, animals, or property of any kind.

building of historical value—Any prehistoric or historic building included in, or eligible for inclusion in, the National Register of Historic Places or which qualify for protection and preservation under the Archaeological Resources Protection Act (P.L. 96-95).

camp encounters—The daily mean number of camping groups visible or audible from a visitor's campsite during the primary use season.

central data analyst—A Washington Office staff position that is responsible for gathering the data from national-level monitoring programs, e.g., the Forest Service Air Resource Management Program, and preparing these data and then entering them into the WCMD for each wilderness. This position is also responsible for consulting with a statistician to determine the appropriate type or form of regression used for statistically analyzing trend in the measures.

change management process—A comprehensive process necessary in all monitoring programs that begins with the identification of a need for change and ends with the resolution of that request.

cherry-stemmed roads—A road or trail that is excluded from a wilderness by a non-wilderness corridor with designated wilderness on both sides.

Class I area—Areas of the country protected under the Clean Air Act and afforded the opportunity for the highest level of air quality protection. As defined by the Clean Air Act, Class I areas include the following areas that were in existence as of August 7, 1977: national parks larger than 6,000 acres, national wilderness areas and national memorial parks larger than 5,000 acres, and international parks.

Class II area—Areas of the country protected under the Clean Air Act, but identified for somewhat less stringent protection from air pollution damage than a Class I area (except in specified cases).

component score—The score calculated for an individual component of an index. All component scores are combined to generate the index value.

critical load—The amount of pollutant loading below which negative impacts to sensitive resources do not occur; a threshold for air pollution effects.

cumulative effects—The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

dam—Any artificial barrier, including appurtenant works, that impounds or diverts water, either temporarily or long term.

data accuracy—The degree to which the data express the true condition of the measure.

data adequacy—The reliability of data to assess trends in a measure. Determined by combining the assessments of data quality and data quantity, and classified as “high,” “medium,” or “low.”

data quality—The level of confidence about the data source and whether the data are of sufficient quality to reliably identify trends in the measure. Assessed by data accuracy, data reliability, and data relevance, and classified as "good," "moderate," or "poor."

data quantity—The level of confidence that all appropriate data records have been gathered; classified as "complete," "partial," or "insufficient."

deciview—The unit of measurement of haze. Deciview is a measure of visibility derived from light extinction that is designed so that incremental changes in the haze index correspond to uniform incremental changes in visual perception, across the entire range of conditions from pristine to highly impaired. The haze index (in units of deciviews [dv]) is calculated directly from the total light extinction.

decommissioned—A road that has been withdrawn from service. Decommissioning is defined as the “Demolition, dismantling, removal, obliteration or disposal of a deteriorated or otherwise unneeded asset or component, including necessary cleanup work” (Financial Health–Common Definitions for Maintenance and Construction Terms, July 22, 1998).

developed trails—Maintained National Forest System trails in Trail Classes 3 to 5.

distribution categories—Categories based on the known or estimated geographic distribution of a species over the entire wilderness. Used for the measures Index of Nonindigenous Terrestrial Animal Species and Index of Nonindigenous Aquatic Animal Species (sections 3.3.1 and 3.3.2 in part 2, respectively).

diversion—A dam built to divert water from a waterway or stream into another watercourse.

dry deposition—The fraction of atmospheric deposition deposited in dry weather through such processes as settling, impaction, and adsorption.

emergency incident—An event relating to public health and safety that may require a response from emergency personnel and of which an emergency responder is aware.

encounter—Meeting other people while traveling through an area as well as seeing or hearing other campers.

exotic species—Non-native species that are not considered invasive.

extirpated species—An indigenous species that formerly occurred within an area but is no longer present there. An extirpated species is different from an extinct species in that extinction is the loss of all the individuals of a species on Earth, whereas a species may be extirpated from one area but still living in another area.

Federal Geographic Data Committee (FGDC) compliant metadata—File of information which captures the basic characteristics of a data or information resource by representing the who, what, when, where, why and how of the resource. These metadata must meet standards that are endorsed by the FGDC.

Federal land manager—The federal official(s) who have the authority to administer federal lands.

fire suppression—Management action to extinguish a fire or contain fire spread, beginning with its discovery.

fixed instrumentation site—An unattended measurement device left in place for at least one year for the purpose of recording environmental data, such as meteorology or seismic activity.

frequency—Within this technical guide, frequency refers to how often data are compiled, analyzed, and entered into the WCMD.

full-time residential (year-round) building—Buildings occupied by people for a cumulative total of more than 6 months each year, such as certain crew quarters.

grazing infrastructure—Structural range "improvements" on or relating to rangelands which are designed to improve production of forage, change vegetative composition, control patterns of use, provide water, stabilize soil and water conditions, and provide habitat for livestock and wildlife. These improvements can be permanent (e.g., dams, ponds, pipelines, wells, and fences) or temporary (e.g., portable troughs, pumps, and electric fences).

haze—An atmospheric aerosol of sufficient concentration to be visible caused by suspended particles that absorb and scatter light. The particles are so small that they cannot be seen individually, but are still effective at attenuating light and reducing visual range.

Hydrologic Unit Code (HUC)—Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits based on the six levels of classification: 2-digit HUC first-level (region) 4-digit HUC second-level (subregion) 6-digit HUC third-level (accounting unit) 8-digit HUC fourth-level (cataloguing unit) 10-digit HUC fifth-level (watershed) 12-digit HUC sixth-level (subwatershed).

impact categories—Categories which estimate the relative effect of a nonindigenous animal species on the Natural Quality of wilderness character. Used for the Index of Nonindigenous Terrestrial Animal Species and Index of Nonindigenous Aquatic Animal Species measures (sections 3.3.1 and 3.3.2, respectively).

impaired watershed—According to the Watershed Condition Framework (WCF), a class of watersheds with significant impairment to beneficial uses of the water bodies in the watershed. These watersheds have impaired function because some physical, hydrological, or biological threshold has been exceeded.

index value—The value calculated by totaling the component scores for all components in an index. For measures that use an index based on an annual or 5-year frequency of data compilation and analysis, the index value is the same as the measure value. For measures that use an index based on a 3-year rolling average, the index value is calculated each year and the measure value is the 3-year rolling average.

indicators—Distinct and important components under each monitoring question.

indigenous species—A species that originally inhabited a particular wilderness; same as native species.

inholdings—Land parcels that are not federally owned, including patented mining claims, which occur entirely inside a wilderness.

instream structures—Constructed features found within a river channel, including dams and other instream structures such as diversions, fish ladders and weirs.

integral cultural features—Prehistoric and historical features which make an area's meaning and significance as wilderness clearer and more distinct. The physical feature should convey a story about a distinctive interwoven human relationship with the land that helps enrich the meaning of the area as wilderness and may have educational, scientific, or scenic values.

integral site-specific features of value—Certain features which make an area's meaning and significance as wilderness clearer and more distinct (e.g., geological, paleontological, biological, cultural, and other significant features).

intentional manipulation—An action that purposefully alters, hinders, restricts, controls, or manipulates "the earth and its community of life," including effects to the type, amount, or distribution of plants, animals, soil, water, or biophysical processes (such as fire) inside a designated wilderness.

invasive species—A species that is alien (or non-native) to a wilderness and whose introduction causes or is likely to cause economic or environmental harm, or harm to human health.

legacy or historical data —Data that pre-date the WCM baseline year. Legacy data may be used in WCM if they were collected (1) after the area was designated as wilderness or managed to preserve wilderness character and (2) using consistent, credible, and documented protocols that are directly relevant to WCM.

level of effort—The amount of work, time, and energy put into data collection.

meaningful change—The amount of change in the data that would result in a change in trend for a measure. Thresholds for meaningful change are defined for each measure. Meaningful change in a measure is not directly tied to, or based on, a national forest's land or resource management plan, nor does it represent significant change or impacts as defined by NEPA.

measure baseline year—The first year that data for a measure have been compiled; the reference point against which the trend in a measure is assessed and evaluated.

measure value—The single value produced for each year of data compilation for a measure; this value is used to derive the trend in the measure. For measures that use an index based on an annual or 5-year frequency of data compilation and analysis, the index value is the same as the measure value. For measures that use an index based on a 3-year rolling average, the index value is calculated each year and the measure value is the 3-year rolling average.

measures—The specific elements under each indicator on which data are collected to assess the trend of each indicator of each wilderness character quality; data compiled for a measure must be relevant, reliable, and cost-efficient.

mechanical transportation—Any contrivance for moving people or material in or over land, water, or air, having moving parts, that provides a mechanical advantage to the user, and that is powered by a living or nonliving power source. This category includes, but is not limited to, sailboats, hang gliders, parachutes, bicycles, game carriers, carts, and wagons. It does not include wheelchairs when used as necessary medical appliances. It also does not include skis, snowshoes, rafts, canoes, sleds, travois, or similar primitive devices without moving parts.

metadata—A set of data that describes and gives information about other data.

minimum requirements analyses (MRA)—Analyses designed for use when making a determination that one of the 'prohibited uses,' listed in Section 4(c) of The Wilderness Act of 1964, is the minimum necessary requirement. The determination that an administrative action is necessary in wilderness and the selection of the minimum method or tool to be used is made within the constraints of law and agency policy. Once a determination has been made that action is necessary, Forest Service policy sets conditions under which exceptions to the prohibited uses (e.g., motorized equipment, mechanical transport) may be considered and guidelines for when the exceptions should be applied.

monitoring questions—Questions which capture the essential components of each wilderness character quality that are significantly different from one another and address specific management questions and monitoring goals.

motorized equipment—Machines that use a motor, engine, or other nonliving power sources. This category includes, but is not limited to, such machines as chain saws, aircraft, snowmobiles, generators, motor boats, and motor vehicles. It does not include small battery or gas-powered hand-carried devices such as shavers, wristwatches, flashlights, cameras, stoves, or other similar equipment.

National Forest System (NFS) road—A road wholly or partly within or adjacent to the NFS that the Forest Service determines is necessary for the protection, administration, and utilization of the NFS and the use and development of its resources. This is a forest road other than a road which has been authorized by a legally documented right-of-way held by a state, county, or local public road authority.

National Forest System (NFS) trail—A forest trail other than a trail which has been authorized by a legally documented right-of-way held by a state, county, or local public road authority.

native species—A species that originally inhabited a particular wilderness; same as indigenous species.

Natural Quality—A quality of wilderness character; wilderness ecological systems are substantially free from the effects of modern civilization.

naturally ignited fire—Any fire ignited by natural means such as a lightning strike.

Natural Resource Manager (NRM)—A system of database tools for managing Agency data across the Forest Service. Natural Resource Manager includes: Forest Service Activity Tracking System (FACTS), Infrastructure (Infra), Natural Resource Information System (NRIS), and Timber Information Manager (TIM) applications. NRM applications provide tools for most of the agency's natural resource business areas.

nonindigenous species—Any species that occurs inside a wilderness because of human influence, including intentional and unintentional introductions and transplants, as well as feral domesticated animals such as feral horses; same as non-native species.

non-native species—Any species that occurs inside a wilderness because of human influence, including intentional and unintentional introductions and transplants, as well as feral domesticated animals such as feral horses; same as nonindigenous species.

non-primitive grazing related infrastructure—Grazing related infrastructure which is constructed predominantly of non-native materials (metal or treated wood posts).

non-recreational physical development—Any physical development that is constructed for any purpose other than recreation such as a dam or utility infrastructure.

non-residential, unoccupied, or abandoned building—A building that is not occupied by people, including non-residential buildings that are designed and built to support functions other than human habitation, such as storage sheds, as well as residential buildings that were occupied in the past but no longer are, such as repurposed or abandoned structures.

non-system roads—Roads that are not actively managed as NFS roads, but that are still visible to the visitor and are clearly distinguishable as having been constructed or used as a road. They may have fallen into disrepair, been actively decommissioned, been constructed by users, or may pre-date wilderness designation.

offsetting stable trend—The trend in an indicator when there is an equal number of improving- and degrading-trending measures.

operational maintenance level—FSH 7709.59, section 62.3, defines this as: "...the level of service provided by, and maintenance required for, a specific road. Maintenance levels must be consistent with road management objectives and maintenance criteria."

Other Features of Value Quality—A quality of wilderness character; ecological, geological, or other features of scientific, educational, scenic, or historical value.

ozone—A pollutant formed when emissions of nitrogen oxides and volatile organic compounds react in the presence of sunlight.

part-time residential (seasonal) building—Buildings occupied by people for a cumulative total of 6 months or less each year, such as functioning fire lookouts.

persistent structure—Anything built with the intent of altering the biophysical environment in wilderness (e.g., fish barriers, dams, water diversions, trail systems, guzzlers, bat gates, fencing).

piscicide—A chemical substance that is poisonous to fish.

prescribed fire—Any fire ignited by management actions under certain, predetermined conditions to meet specific objectives related to hazardous fuels or habitat improvement. A written, approved prescribed fire plan must exist, and National Environmental Policy Act requirements must be met before ignition. Prescribed fires are ignited and managed within a "window" of very specific conditions, including winds, temperatures, humidity, and other factors specified in the burn plan.

preserved—In the context of wilderness character monitoring, wilderness character is preserved if the overall trend is either stable or improving.

primary use areas—Locally identified areas that receive approximately 80 percent of the total use of a wilderness. The following link provides information about primary use areas: http://www.wilderness.net/toolboxes/documents/recsitemonitor/National%20Minimum%20Recreation%20Site%20Monitoring%20Protocol.pdf.

primary measure—Cannot be locally modified, must be assigned when multiple "Required to Select At Least One" measures are selected.

primitive grazing related infrastructure—Grazing related infrastructure which is constructed of native materials or native materials and wire.

primitive recreation—A type of recreation that requires self-reliance and demonstration of skills in wilderness travel that reinforce the connection to our ancestors and our American heritage. This encompasses reliance on personal skills to travel and camp in an area (rather than reliance on facilities or outside help), travel by non-motorized and non-mechanical means (such as horse, foot, canoe), and living in an environment with minimal facilities.

protocol—Step by step instructions on how to compile, analyze, and enter data for a measure.

public values—Within wilderness, these include, but are not limited to, opportunities for scientific study, education, solitude, physical and mental challenge and stimulation, inspiration, and primitive recreation experiences.

qualities—The primary elements of wilderness character that link directly to the statutory language of the 1964 Wilderness Act. The following qualities apply nationwide to every wilderness managed by the Forest Service: Untrammeled, Natural, Undeveloped, and Solitude or Primitive and Unconfined Recreation. Another quality, Other Features of Value, may also apply to a wilderness managed by the Forest Service.

quality assurance (QA)—The total integrated program for ensuring that the uncertainties inherent in inventory and monitoring data are known and do not exceed acceptable magnitudes, within a stated level of confidence. QA encompasses the plans, specifications, and policies affecting the collection, processing, and reporting of data. It is the system of activities designed to provide officials with independent assurance that quality control is being effectively implemented uniformly throughout the inventory and monitoring programs.

quality control (QC)—The routine application of prescribed field and office procedures to reduce random and systematic errors and ensure that data are generated within known and acceptable performance limits. QC involves using qualified personnel, using reliable equipment and supplies, training personnel, and strictly adhering to service-wide standard operating procedures for tasks such as information needs assessments, establishment of standards and methods, data collection, data processing, classification, mapping, analysis, and dissemination.

recreation site—A place where visible impacts to vegetation or soil are documented as a result of repeated recreational use.

regression—A commonly used statistical technique to determine if there is a significant change in one variable, for example, the amount of nitrogen deposition or the number of trammeling actions, in relation to another variable, such as time over several years. There are many different regression models (that is, types or forms of regression), and the appropriate model for each measure will be chosen by the central data analyst in consultation with a statistician based on the properties of the data used for each measure.

remoteness—Having distance from the sights and sounds of civilization.

restrictions on visitor behavior—Formally adopted regulations or policies that govern visitor behavior, travel, or equipment.

road—A motor vehicle route over 50 inches wide, unless identified and managed as a trail.

sensitive lichen species—Species of lichen that develop structural changes in response to air pollution, including reduced photosynthesis and bleaching. Sensitive lichen species eventually die or diminish if pollution levels are elevated. Lichen communities that retain the species most sensitive to air pollution indicate good air quality.

solitude—The quality or state of being alone or remote from society. This encapsulates a range of experiences, including privacy, being away from civilization, inspiration, self-paced activities, and a sense of connection with times past.

Solitude or Primitive and Unconfined Recreation Quality—A quality of wilderness character; these outstanding opportunities must be provided for people to experience in a wilderness, including opportunities for inspiration, introspection, natural quiet, physical and mental challenge, and freedom from society and regulation.

special provision authorization—An authorization to use motor vehicles, motorized equipment, or mechanical transport as specified by statute.

Theil-Sen slope—A non-parametric regression which minimizes the influence of data outliers (e.g., an extreme value will not unduly affect the trend calculation).

threshold—The amount of change in the data necessary to qualify as a meaningful change in the measure.

total deposition—The sum of atmospheric deposition from wet and dry deposition.

trail—A route 50 inches or less in width or a route over 50 inches wide that is identified and managed as a trail.

trail class—The prescribed scale of development for a trail, representing its intended design and management standards. Each trail class is defined in terms of applicable tread and traffic flow, obstacles, constructed feature and trail elements, signs, typical recreation environment, and experience. Trail classes range from trail class 1 (minimally developed) to trail class 5 (fully developed).

trammeling action—An action or persistent structure 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.

travel routes—Trails, roads, and aircraft landing sites.

traveling encounters—The mean number of other groups (or people) seen per standardized unit of time (typically an 8-hour day) while in wilderness during the primary use season.

trend in a measure—How a measure is changing over time to evaluate whether a certain measure is improving, degrading or remaining stable since the baseline year of data collection.

trend in wilderness character—How wilderness character is changing over time; whether wilderness character has remained stable or improved (i.e., has been preserved), or has degraded, since the year of designation.

unauthorized action—An action which is not approved by an employee of the U.S. Forest Service to whom the appropriate authority has been delegated.

unauthorized trail—A trail that is not a forest trail or a temporary trail and that is not included in a forest transportation atlas. This includes user-created trails as well as other routes (e.g., decommissioned roads or trails) that are in use.

unconfined recreation—A type of recreation in which visitors experience a high degree of freedom over their own actions and decisions. This encompasses the sense of discovery, adventure, exploration, and mental challenge presented by large wildernesses in which one can travel widely and explore unique and unknown environments on one's own without having to conform to society's norms or rules.

Undeveloped Quality—A quality of wilderness character; wilderness retains its primeval character and influence, and is essentially without permanent improvements or modern human occupation.

Untrammeled Quality—A quality of wilderness character; wilderness is essentially unhindered and free from modern human control or manipulation.

user-created sites—Unauthorized developments or infrastructure which has not been authorized by a Forest Service Federal land manager. In wilderness, these areas are often constructed to support recreational use, such as hitching posts, fire rings, and temporary shelters.

user-created trails—Trails which were not created by an authorized action.

utility infrastructure—The constructed features used to convey or support basic services such as electricity, telecommunication, gas, or water. Utility infrastructure is classified as "small scale" (an individual site occupying less than one acre in total size), "moderate scale" (either (a) an individual site that equals or exceeds one acre in size or (b) requires an above-ground linear corridor, but is of a generally small scale, typically less than a half-mile in length), or "large scale" (requires an above-ground linear corridor, but is of a generally large scale, typically equal to or greater than a half-mile in length).

watershed condition—The state of the physical and biological characteristics and processes within a watershed that affect the soil and hydrologic functions supporting aquatic ecosystems. Watershed condition reflects a range of variability from natural pristine (functioning properly) to degraded (severely altered state or impaired).

watershed condition class—Within the Watershed Condition Framework (WCF), this describes the watershed condition in terms of discrete categories (or classes) that reflect the level of watershed health or integrity; classified as Class 1 = functioning properly, Class 2 = functioning at risk, or Class 3 = impaired function.

watershed score—Within the Watershed Condition Framework (WCF), this numerical value reflects the level of watershed health or integrity based on 12 different indicators: water quality, water quantity, aquatic habitat, aquatic biota, roads and trails, soils, riparian/wetland vegetation, fire regime or wildfire, forest cover, rangeland vegetation, terrestrial invasive species, and forest health. Watershed condition scores are tracked to one decimal point and reported as watershed condition classes 1, 2, or 3. Class 1 = scores from 1.0 to 1.6, Class 2 = scores from 1.7 to 2.2, and Class 3 = scores from 2.3 to 3.0.

WCM baseline year—The first year that data for all measures have been compiled; the reference point against which the trend in wilderness character is assessed and evaluated.

wet deposition—The fraction of atmospheric deposition contained in precipitation, predominantly rain and snow.

wilderness—"A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." (1964 Wilderness Act, Public Law 88-577, Section 2c).

wilderness character—"Wilderness character is a holistic concept based on the interaction of (1) biophysical environments primarily free from modern human manipulation and impact, (2) personal experiences in natural environments relatively free from the encumbrances and signs of modern society, and (3) symbolic meanings of humility, restraint, and interdependence that inspire human connection with nature. Taken together, these tangible and intangible values define wilderness character and distinguish wilderness from all other lands." (Landres et al. 2015).

wilderness character monitoring (WCM)—The process of assessing the overall trend in wilderness character using the interagency strategy described in Keeping it Wild 2 (Landres et al. 2015).

Wilderness Character Monitoring Database (WCMD)—A single place for all agencies to enter their wilderness character monitoring data, store these data, and develop trend reports.

wilderness stewardship—Mandated by the Wilderness Act of 1964 such that each agency administering any area designated as wilderness shall be responsible for preserving the wilderness character of the area.

Wilderness Stewardship Performance (WSP)—A framework to track how well the U.S. Forest Service is meeting our primary responsibility under the Wilderness Act- which is to preserve wilderness character.

References

Adams, A.; Landres, P.; Kingston, S. 2012. A database application for monitoring wilderness character. Park Science. 28 (Winter 2011–2012): 58–59.

American Heritage Dictionary. 1992. Boston, MA: Houghton Mifflin Company.

Belsky, A.J.; Matzke, A.; Uselman, S. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation. 54: 419–431.

Beschta, R.L.; Boone Kauffman, J.; Dobkin, D.S.; [et al.]. 2014. Long-term livestock grazing alters aspen age structure in the northwestern Great Basin. Forest Ecology and Management. 329: 30–36.

Borrie, W.T.; McCool, S.F. 2007. Describing change in visitors and visits to the "Bob." International Journal of Wilderness. 13(3): 28–33.

Borrie, W.T.; Roggenbuck, J.W. 2001. The dynamic, emergent, and multi-phasic nature of on-site wilderness experiences. Journal of Leisure Research. 33(2): 202–228.

Bureau of Land Management (BLM). 2012. Measuring attributes of wilderness character. BLM implementation guide version 1.5. Washington, DC: U.S. Department of the Interior, Bureau of Land Management. https://www.wilderness.net/toolboxes/documents/WC/BLM%20Implementation%20Guide.docx [Accessed 3 April 2017].

Clark, R.N.; Stankey, G.H. 1979. The recreation opportunity spectrum: A framework for planning, management, and research. Gen. Tech. Rep. PNW-GTR-098. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 32 p.

Cole, D.N. 2012. Wilderness visitor experiences: A selective review of 50 years of research. Park Science. 28(3): 66–70.

Colorado Wilderness Act of 1980. Pub. L. 96-560. 94 Stat. 3265. (December 22, 1980).

Dawson, C. 2004. Monitoring outstanding opportunities for solitude. International Journal of Wilderness. 10(3): 12–14, 20.

Dawson, C.P.; Hendee, J.C. 2009. Wilderness management: Stewardship and protection of resources and values. 4th ed. Golden, CO: Fulcrum Publishing. 544 p.

Dustin, D.L.; McAvoy, L.H. 2000. Of what avail are forty freedoms? The significance of wilderness in the 21st century. International Journal of Wilderness. 6(2): 25–26.

Federal Geographic Data Committee (FGDC). 2010. Stages of the geospatial data lifecycle pursuant of OMB Circular A-16 sections 8(E)(D), 8(E)(F), and 8(E)(G). 23 p. http://www.fgdc.gov/policyandplanning/a-16/index.html. [Accessed 2014 December].

Gordon, J.E.; Crofts, R.; Diaz-Martinez, E.; [et al.]. 2017. Enhancing the role of geoconservation in protected area management and nature conservation. Geoheritage. doi: 10.1007/s12371-0240-5.

Grimm, J.W.; Lynch, J.A. 2004. Enhanced wet deposition estimates using modeled precipitation inputs. Environmental Monitoring and Assessment. 90: 243–268.

Hall, T.E. 2001. Hikers' perspectives on solitude and wilderness. International Journal of Wilderness. 7(2): 20–24.

Hall, T.E.; Davidson, A. 2013. Changes in Bridger Wilderness visitors' experiences of crowding and attitudes toward management from 1969 to 2010. Journal of Park and Recreation Administration. 31(4): 45–61.

Hall, T.E.; Irizarry, S. 2014. 2013 Yosemite wilderness visitor study. Report prepared for Yosemite National Park. Moscow, ID: Department of Conservation Social Sciences. 133 p.

Hall, T.E.; Seekamp, E.; Cole, D.N. 2010. Do recreation motivations and wilderness involvement relate to support for wilderness management? A segmentation analysis. Leisure Sciences. 32(2): 109–124.

Intergovernmental Panel on Climate Change (IPCC). 2013. Summary for policymakers. In: Stocker, T.F.; Qin D.; Plattner, G.-K.; et al., eds. Climate change 2013: The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York: Cambridge University Press. http://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_SPM_FINAL.pdf. [Accessed February 2017].

Johnson, B.J.; Hall, T.E.; Cole, D.N. 2005. Naturalness, primitiveness, remoteness, and wilderness: Understanding and experience of wilderness qualities. Moscow, ID: University of Idaho and ALWRI. 82 p. http://www.wilderness.net/visitoruse. [Accessed 2017 April].

Joyce, L.A.; Running, S.W.; Breshears, D.D.; [et al.]. 2014. Chapter 7: Forests. In: Climate change impacts in the United States: The third national climate assessment. Melillo, J.M.; Richmond, Terese (T.C.); Yohe, G.W.; eds. U.S. Global Change Research Program. 175–194. doi:10.7930/J0Z60KZC. http://nca2014.globalchange.gov/report/sectors/forests. [Accessed April 2017].

Keane, Robert E.; Cary, Geoffrey J.; Flannigan, Mike D.; [et al.]. 2013. Exploring the role of fire, succession, climate, and weather on landscape dynamics using comparative modeling. Ecological Modelling. 266 (September): 172–86. doi:10.1016/j.ecolmodel.2013.06.020.

Landres, P.; Barns, C.; Boutcher, S.; [et al.]. 2015. Keeping it wild 2: An updated interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System. Gen. Tech. Rep. RMRS-GTR-340. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 114 p.

Landres, P.; Barns, C.; Dennis, J.G.; [et al.]. 2008. Keeping it wild: An interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System. Gen. Tech. Rep. RMRS-GTR-212, Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 81 p.

Landres, P.; Boutcher, S.; Blett, T.; [et al.]. 2009. Technical guide for monitoring selected conditions related to wilderness character. Gen. Tech. Rep. WO-80. Washington, DC: U.S. Department of Agriculture, Forest Service, U.S. Government Printing Office. 293 p.

Landres, P.; Boutcher, S.; Merigliano, L.; [et al.]. 2005. Monitoring selected conditions related to wilderness character: A national framework. Gen. Tech. Rep. RMRS-GTR-151. Rocky Mountain Research Station, Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 38 p.

Landres, P.; Vagias, W.N.; Stutzman. S. 2012. Using wilderness character to improve wilderness stewardship. Park Science. 28 (Winter 2011–2012): 44–48.

Long, E.; Biber, E. 2014. The Wilderness Act and climate change adaptation. Environmental Law. 44: 623–694.

Lowe, S.; Browne, M.; Boudjelas, S.; [et al.]. 2000. 100 of the World's worst invasive alien species: A selection from the Global Invasive Species Database. Aukland, New Zealand: World Conservation Union, Species Survival Commission, The Invasive Species Specialist Group. 12 p.

Matos, P., Geiser, L.; Hardman, A.; [et al.]. 2017. Tracking global change using lichen diversity: Towards a global-scale ecological indicator. Methods in Ecology and Evolution. doi: 10.1111/2041-210X.12712.

McCloskey, M. 1966. The Wilderness Act of 1964: its background and meaning. Oregon Law Review. 45: 288–321.

McCloskey, M. 1999. Changing views of what the wilderness system is all about. Denver University Law Review. 76: 369–381.

Merriam-Webster. 2016. The Merriam-Webster Dictionary New Edition. Springfield, MA: Merriam-Webster, Inc. 939 p.

National Park Service (NPS). 2014. Keeping it wild in the National Park Service: A user guide to integrating wilderness character into park planning, management, and monitoring. WASO 909/121797. Lakewood, CO: U.S. Department of Interior, National Park Service, Denver Service Center. 219 p.

Newman, P.; Fristrup, K.; Trevino, K.; [et al.]. 2012. Protecting soundscapes in US National Parks: Lessons learned and tools developed. The Journal of the Acoustical Society of America. 131(4): 3381–3381.

Nussle, S.; Matthews, K.R.; Carlson, S.M. 2017. Patterns and dynamics of vegetation recovery following grazing cessation in the California golden trout habitat. Ecosphere. 8(7): e01880. doi: 10.1002/ecs2.1880.

Ochs, M.J. 1999. Defining wilderness: From McClosky to legislative, administrative and judicial paradigms. Denver University Law Review 76: 659–679.

Office of Technology Assessment. 1993. Harmful non-indigenous species in the United States. OTA-F-565. Washington DC: U.S. Government Printing Office.

Putney, A.D.; Harmon, D. 2003. Intangible values and protected areas: Towards a more holistic approach to management. In: Harmon, D.; Putney, A.D., eds. The full value of parks: from economics to the intangible. Lanham, MD: Rowman and Littlefield Publishers. 311–326.

Roggenbuck, J.W. 2004. Managing for primitive recreation in wilderness. International Journal of Wilderness. 10(3): 21–24.

Roggenbuck, J.W.; Driver, B.L. 2000. Benefits of nonfacilitated uses of wilderness. In: McCool, Stephen F.; Cole, David N.; Borrie, William T.; et al., comps. Wilderness science in a time of change conference—Volume 3: Wilderness as a place for scientific inquiry; 1999 May 23–27; Missoula, MT. Proceedings RMRS-P-15-VOL-3. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 33–49.

Rohlf, D.; Honnold, D.L. 1988. Managing the balance of nature: The legal framework of wilderness management. Ecology Law Quarterly. 15: 249–279.

Schroeder, H.W. 2007. Symbolism, experience, and the value of wilderness. International Journal of Wilderness. 13(1): 13–18.

Schwede, D.B.; Lear, G.G. 2014. A novel hybrid approach for estimating total deposition in the United States. Atmospheric Environment. 92: 207–220. doi: 10.1016/j.atmosenv.2104.04.008.

Scott, D.W. 2002. Untrammeled, wilderness character, and the challenges of wilderness preservation. Wild Earth. 11(3/4): 72–79.

Seekamp, E.; Cole, D.N. 2009. Deliberating the experiential qualities of wilderness: Similar meanings, but divergent standards. International Journal of Wilderness. 15(3): 23–28.

Staudinger, M.D.; Grimm, N.B.; Staudt, A.; [et.al.]. 2012. Impacts of climate change on biodiversity, ecosystems, and ecosystem services: Technical input to the 2013 national climate assessment. Reston, VA: U.S. Geological Survey. 296 p.

Sustainable Recreation Framework. 2010. Connecting people with America's great outdoors: A framework for sustainable recreation. Washington, DC: U.S. Department of Agriculture, Forest Service, Recreation, Heritage and Volunteer Resources Program. 8 p. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5346549.pdf. [Accessed April 2017].

United States Congress. 1983. U.S. House Report 98–40 from the Committee on Interior and Insular Affairs, March 18, p. 43.

USDA Forest Service. 2009. Forest Service Manual 1940. Inventory, monitoring, and assessment activities. Washington, DC: U.S. Department of Agriculture, Forest Service, Ecosystem Management Coordination Staff. 20 p.

USDA Forest Service. 2011a. Navigating the climate change performance scorecard: A guide for national forests and grasslands. Version 2.0. Washington, DC: U.S. Department of Agriculture, Forest Service, Office of Sustainability and Climate Change. https://www.fs.fed.us/climatechange/advisor/scorecard/monitoring.html. [Accessed April 2017].

USDA Forest Service. 2011b. Watershed condition classification technical guide. FS-978. Washington, DC: U.S. Department of Agriculture, Forest Service, Watershed, Fish, Wildlife, Air, and Rare Plants Program. https://www.fs.fed.us/sites/default/files/legacy_files/media/types/publication/field_pdf/watershed_classification_guide2011FS978_0.pdf [Accessed April 2017].

USDA Forest Service. 2011c. Watershed condition framework. FS-977. Washington, DC: U.S. Department of Agriculture, Forest Service, Watershed, Fish, Wildlife, Air, and Rare Plants Program. https://www.fs.fed.us/sites/default/files/legacy_files/media/types/publication/field_pdf/Watershed_Condition_Framework.pdf [Accessed April 2017].

USDA Forest Service. 2013a. Inventory, monitoring, and assessment strategy. Washington, DC: U.S. Department of Agriculture, Forest Service. 27 p.

USDA Forest Service. 2013b. National visitor use monitoring results: USDA Forest Service national summary report. Data collected FY 2008 through FY 2012. Washington, DC: U.S. Department of Agriculture, Forest Service, Recreation, Heritage and Volunteer Resources Programs. http://www.fs.fed.us/recreation/programs/nvum/2012%20National_Summary_Report_061413.pdf. [Accessed April 2017].

USDA Forest Service. 2014. U.S. Forest Service national minimum protocol for monitoring outstanding opportunities for solitude: Element 5 of the 10-year wilderness stewardship challenge. Solitude Minimum Protocol Version 1.0. http://www.wilderness.net/toolboxes/documents/WC/National_Minimum_Protocol_Solitude.pdf. [Accessed December 2016].

Zahniser, H. 1963. Hearings before the Committee on Interior and Insular Affairs, United States Senate, 88th Congress, 1st session, on S.4, February 28 and March 1, 1963.

Appendix 1. Summary of Key Implementation Attributes for All the Measures in Each Quality

Table A1.1—Summary of key implementation attributes for each measure in the Untrammeled Quality.

Untrammeled Quality						
Measure	**Measure type**	**Local tasks**	**National tasks**	**Data compilation and storage**	**Measure value calculation**	**Frequency**
Monitoring Question: What are the trends in actions that intentionally control or manipulate the "earth and its community of life" inside wilderness?						
Indicator: Actions authorized by the Federal land manager that intentionally manipulate the biophysical environment						
Number of authorized actions and persistent structures designed to manipulate plants, animals, pathogens, soil, water, or fire	Required	Step 1: Ensure users understand what constitutes authorized trammeling and then compile data. Step 2: Count the number of authorized trammeling actions that occurred during the fiscal year. Step 3: Enter data in NRM and the WCMD.	None	Local data are compiled and entered in NRM-WCM annually.	NRM-WCM calculates the annual value, and the WCMD then calculates the 3-year rolling average (the measure value).	1 year
Indicator: Actions not authorized by the Federal land manager that intentionally manipulate the biophysical environment						
Number of unauthorized actions and persistent structures by agencies, organizations, or individuals that manipulate plants, animals, pathogens, soil, water, or fire	Required	Step 1: Ensure users understand what constitutes unauthorized trammeling and then compile data. Step 2: Count the number of unauthorized trammeling actions that occurred during the fiscal year. Step 3: Enter data in NRM and the WCMD.	None	Local data are compiled and entered in NRM-WCM annually.	NRM-WCM calculates the annual value, and the WCMD then calculates the 3-year rolling average (the measure value).	1 year

Table A1.2—Summary of key implementation attributes for each measure in the Natural Quality.

Natural Quality						
Measure	**Measure type**	**Local tasks**	**National tasks**	**Data compilation and storage**	**Measure value calculation**	**Frequency**
Monitoring Question: What are the trends in the natural environment from human-caused change?						
Indicator: Plants						
Acres of nonindigenous plant species	Required	Step 1: Develop a list of known nonindigenous plants in the wilderness and select species for monitoring. Step 2: Determine the wilderness acreage currently occupied by each selected species and calculate the total number of acres, or the estimated percentage of acres, for all species. Step 3: Enter data in the WCMD.	None	Data are compiled from a variety of local, state, regional, and national data sources.	Local staff calculate the measure value.	5 years
Indicator: Animals						
Index of nonindigenous terrestrial animal species	Required to select at least one	Step 1: Develop a list of known nonindigenous terrestrial animals in the wilderness and select species for monitoring. Step 2: Determine the distribution and impact of each selected species. Step 3: Enter data in the WCMD.	None	Data are compiled from a variety of local, state, regional, and national data sources.	The WCMD calculates the measure value.	5 years
Index of nonindigenous aquatic animal species		Step 1: Develop a list of known nonindigenous aquatic animals in the wilderness and select species for monitoring. Step 2: Determine the distribution and impact of each selected species. Step 3: Enter data in the WCMD.	None	Data are compiled from a variety of local, state, regional, and national data sources.	The WCMD calculates the measure value.	5 years

Natural Quality						
Measure	**Measure type**	**Local tasks**	**National tasks**	**Data compilation and storage**	**Measure value calculation**	**Frequency**
Monitoring Question: What are the trends in the natural environment from human-caused change?						
Indicator: Air and water						
Concentration of ambient ozone	Required to select at least one	None	Step 1: Determine the ozone monitor that is representative of air quality for the wilderness. Step 2: Retrieve ozone data from the Forest Service Air Resource Management Program. Step 3: Enter data in the WCMD.	Data are compiled from the Forest Service Air Resource Management Program NAAQS website.	The central data analyst calculates the measure value.	5 years
Deposition of nitrogen		Validate the nationally selected protocol option.	Step 1: Determine which protocol option is appropriate for the wilderness. Step 2: Retrieve and process the deposition data. Step 3: Enter data in the WCMD.	Data are compiled from either the NADP website, the Forest Service Air Resource Management Program website, or other local or regional databases.	The central data analyst calculates the measure value.	5 years
Deposition of sulfur		Validate the nationally selected protocol option.	Step 1: Determine which protocol option is appropriate for the wilderness. Step 2: Retrieve and process the deposition data. Step 3: Enter data in the WCMD.	Data are compiled from either the Forest Service Air Resource Management Program website, the NADP website, or other local or regional databases.	The central data analyst calculates the measure value.	5 years
Amount of haze		None	Step1: Retrieve visibility data from the Forest Service Air Resource Management Program. Step 2: Enter data in the WCMD.	Data are compiled from the Forest Service Wilderness Air Quality website.	The central data analyst calculates the measure value.	5 years

Natural Quality						
Measure	**Measure type**	**Local tasks**	**National tasks**	**Data compilation and storage**	**Measure value calculation**	**Frequency**
Monitoring Question: What are the trends in the natural environment from human-caused change?						
Index of sensitive lichen species		None	Step 1: Retrieve lichen data from the Forest Service Air Resource Management Program. Step 2: Conduct a statistical analysis to determine the trend in the data. Step 3: Enter data in the WCMD.	Data are compiled from the Forest Service National Lichens and Air Quality database.	The central data analyst calculates the measure value.	5–10 years
Extent of waterbodies with impaired water quality	Required	Step 1: Determine which protocol option is appropriate for the wilderness. Step 2: Determine which wilderness streams or lakes are impaired. Step 3: Assess the miles of impaired streams or number of impaired lakes in the wilderness. Step 4: Enter data in the WCMD.	Assist local units with compiling national or state impairment data and complete a spatial analysis as necessary. Submit results to the local unit for validation.	Data are compiled from national or state 303(d) databases, or other local, state, regional, or national data sources.	Local staff calculate the measure value.	5 years

Natural Quality						
Measure	**Measure type**	**Local tasks**	**National tasks**	**Data compilation and storage**	**Measure value calculation**	**Frequency**
Monitoring Question: What are the trends in the natural environment from human-caused change?						
Indicator: Ecological processes						
Watershed condition class	Required to select at least one	Validate the condition class for watersheds that are only partially within wilderness and adjust if necessary.	Step 1: Identify wilderness watersheds. Step 2: Retrieve watershed condition class data from the Forest Service Watershed Condition Framework (WCF) website. Step 3: Enter data in the WCMD.	Data are compiled from the Forest Service Watershed Condition Framework website and validated locally.	The WCMD calculates the measure value.	5 years
Number of animal unit months of commercial livestock use		Step 1: Identify wilderness allotments. Step 2: Compile data on the amount of livestock use authorized in wilderness allotments. Step 3: Enter data in the WCMD.	None	Local data are compiled and entered in NRM-Range annually.	The WCMD calculates the annual value and the 3-year rolling average (the measure value).	1 year

Table A1.3—Summary of key implementation attributes for each measure in the Undeveloped Quality.

Undeveloped Quality						
Measure	**Measure type**	**Local tasks**	**National tasks**	**Data compilation and storage**	**Measure value calculation**	**Frequency**
Monitoring Question: What are the trends in non-recreational physical development?						
Indicator: Presence of non-recreational structures, installations, and developments						
Index of authorized non-recreational physical development	Required	Step 1: Ensure users understand what developments and elements are counted under each measure component. Step 2: Retrieve the data for each of the measure components; evaluate and update the data as necessary. Step 3: Calculate individual development ratings and measure component scores. Step 4: Calculate the overall development index value and enter data in the WCMD.	Assist local units with compiling regional or national data as necessary. Submit results to the local unit for validation.	Data are compiled from a variety of local and national data sources and entered in various NRM applications. Buildings component: Local data are compiled and periodically entered in NRM-Buildings. Dams and other instream structures component: Data are compiled from local and national databases and periofically entered n NRM-WCM; data from NRM-Dams are automatically compiled via the EDW and entered in NRM-WCM.	NRM-WCM calculates the measure value. Buildings component: NRM-WCM calculates the component score. Dams and other instream structures component: NRM-WCM calculates the component score.	5 years

Undeveloped Quality						
Measure	**Measure type**	**Local tasks**	**National tasks**	**Data compilation and storage**	**Measure value calculation**	**Frequency**
				Roads component: Local data are compiled and periodically entered in NRM-Roads, NRM-SUDS (Special Uses Database System), or NRM-WCM; data from the EDW are automatically compiled and entered in NRM-Roads. Fixed instrumentation sites component: Local data are compiled and periodically entered in NRM-Features or NRM-SUDS. Utility infrastructure component: Local data are compiled and periodically entered in NRM-Features or NRM-SUDS. Mines component: Data are compiled from local, state, or BLM databases and periodically entered in NRM-WCM. Grazing infrastructure component: Local data are compiled and periodically entered in NRM-Features.	Roads component: NRM-WCM calculates the component score. Fixed instrumentation sites component: NRM-WCM calculates the component score. Utility infrastructure component: NRM-WCM calculates the component score. Mines component: NRM-WCM calculates the component score. Grazing infrastructure component: NRM-WCM calculates the component score.	

Undeveloped Quality						
Measure	**Measure type**	**Local tasks**	**National tasks**	**Data compilation and storage**	**Measure value calculation**	**Frequency**
Indicator: Presence of inholdings						
Acres of inholdings	Required	Step 1: Retrieve and validate data on inholding acres from NRM. Step 2: Enter data in the WCMD.	None	Data from the Land Status Record System (LSRS) are automatically compiled via the EDW and entered in NRM-WCM.	NRM-WCM calculates the measure value.	5 years
Monitoring Question: What are the trends in mechanization?						
Indicator: Use of motor vehicles, motorized equipment, or mechanical transport						
Index of administrative authorizations to use motor vehicles, motorized equipment, or mechanical transport	Required	Step 1: Ensure users understand what types of administrative authorizations to use motorized equipment or mechanical transport are counted under this measure and retrieve data from NRM. Step 2: Calculate the index value. Step 3: Enter data in the WCMD.	None	Local data are compiled and entered in NRM-Wilderness annually.	NRM-WCM calculates the annual value, and the WCMD then calculates the 3-year rolling average (the measure value).	1 year
Percent of emergency incidents using motor vehicles, motorized equipment, or mechanical transport	Optional	Step 1: Ensure users understand what types of emergency incidents and responses are counted under this measure and retrieve data from NRM. Step 2: Calculate the percentage of emergency incidents resulting in authorized use. Step 3: Enter data in the WCMD.	None	Local data are compiled and entered in NRM-Wilderness and NRM-WCM annually.	NRM-WCM calculates the annual value, and the WCMD then calculates the 3-year rolling average (the measure value).	1 year
Index of special provision authorizations to use motor vehicles, motorized equipment, or mechanical transport	Optional	Step 1: Ensure users understand what types of special provision authorizations to use motorized equipment or mechanical transport are counted under this measure and retrieve data from NRM. Step 2: Calculate the index value. Step 3: Enter data in the WCMD.	None	Local data are compiled and entered in NRM-Wilderness annually.	NRM-WCM calculates the annual value, and the WCMD then calculates the 3-year rolling average (the measure value).	1 year

Table A1.4—Summary of key implementation attributes for each measure in the Solitude or Primitive and Unconfined Recreation Quality.

Solitude or Primitive and Unconfined Recreation Quality						
Measure	**Measure type**	**Local tasks**	**National tasks**	**Data compilation and storage**	**Measure value calculation**	**Frequency**
Monitoring Question: What are the trends in outstanding opportunities for solitude?						
Indicator: Remoteness from sights and sounds of human activity inside wilderness						
Index of encounters	Required	Step 1: Determine which protocol option is appropriate for the wilderness. Step 2: Document the data compilation strategy. Step 3: Compile and process the data. Step 4: Enter data in the WCMD.	None	Local data are compiled and stored in local archives.	Local staff calculate the measure value.	5 years
Index of recreation sites within primary use areas	Required to select at least one	Step 1: Ensure users understand what types of recreation sites are counted under this measure and compile data. Step 2: Calculate the index value and enter data in the WCMD.	None	Local data are compiled and stored in local archives.	Local staff calculate the measure value.	5 years
Acres of wilderness away from access and travel routes and developments inside wilderness		Validate the national data.	Step 1: Ensure users understand what types of routes and developments are counted under this measure and retrieve spatial data. Step 2: Perform the spatial analysis to calculate the acres of wilderness away from access and travel routes and developments inside wilderness. Step 3: Enter data in the WCMD.	Data are compiled from the EDW, or other local or national data sources, and validated locally.	The central data analyst calculates the measure value.	5 years
Miles of unauthorized trails		Step 1: Ensure users understand what types of trails are counted under this measure and compile data. Step 2: Calculate the total miles and enter data in the WCMD.	None	Local data are compiled and are either stored in local archives or entered in NRM-Trails.	Local staff or NRM-WCM calculate the measure value.	5 years

Solitude or Primitive and Unconfined Recreation Quality						
Measure	**Measure type**	**Local tasks**	**National tasks**	**Data compilation and storage**	**Measure value calculation**	**Frequency**
Indicator: Remoteness from sights and sounds of human activity outside the wilderness						
Acres of wilderness away from adjacent travel routes and developments outside the wilderness	Required	Validate the national data.	Step 1: Ensure users understand what types of routes and developments are counted under this measure and retrieve spatial data. Step 2: Perform the spatial analysis to calculate the acres of wilderness away from travel routes and developments outside the wilderness. Step 3: Enter data in the WCMD.	Data are compiled from the EDW, or other local or national data sources, and validated locally.	The central data analyst calculates the measure value.	5 years
Monitoring Question: What are the trends in outstanding opportunities for primitive and unconfined recreation?						
Indicator: Facilities that decrease self-reliant recreation						
Index of National Forest System (NFS) developed trails	Required to select at least one	Step 1: Retrieve NFS trail data from NRM. Step 2: Calculate the index value and enter data in the WCMD.	None	Local data are compiled and periodically entered in NRM-Trails.	NRM-WCM calculates the measure value.	5 years
Number of authorized constructed recreation features		Step 1: Ensure users understand what types of recreation features are counted under this measure and compile data. Step 2: Count the number of features and enter data in the WCMD.	None	Local data are compiled and are either stored in local archives or entered in NRM-Wilderness.	Local staff or NRM-WCM calculate the measure value.	5 years
Indicator: Management restrictions on visitor behavior						
Index of visitor management restrictions	Required	Step 1: Ensure users understand what types of visitor management restrictions are counted under this measure and retrieve data from NRM. Step 2: Calculate the index value. Step 3: Enter data in the WCMD.	None	Local data are compiled and entered in NRM-Wilderness and NRM-WCM annually.	NRM-WCM calculates the measure value.	5 years

Table A1.5—Summary of key implementation attributes for each measure in the Other Features of Value Quality.

Other Features of Value Quality						
Measure	**Measure type**	**Local tasks**	**National tasks**	**Data compilation and storage**	**Measure value calculation**	**Frequency**
Monitoring Question: What are the trends in the unique features that are tangible and integral to wilderness character?						
Indicator: Deterioration or loss of integral cultural features						
Condition index for integral cultural features	Required if relevant	Step 1: Determine which cultural features are integral to wildernesss character and feasible to monitor. Step 2: Determine the condition of each integral cultural feature. Step 3: Enter data in the WCMD.	None	Local data are compiled and periodically entered in NRM-Heritage, NRM-Buildings, local archives, or other state or regional databases.	The WCMD calculates the measure value.	5 years
Indicator: Deterioration or loss of other integral site-specific features of value						
Condition index for other features	Required if relevant	Step 1: Determine which other features are integral to wildernesss character and feasible to monitor. Step 2: Develop condition assessments and determine the condition of each integral feature. Step 3: Enter data in the WCMD.	None	Local data are compiled and stored in local archives.	The WCMD calculates the measure value.	5 years

Appendix 2. Measures Considered But Not Used

Measures included in appendix 2 were initially considered for the Forest Service WCM protocol, but were eventually dropped for a variety of reasons. This appendix lists the dropped measures and explains why they were eliminated from the monitoring protocol.

A2.1 Untrammeled Quality

A2.1.1 Indicator: Actions Authorized by the Federal Land Manager that Intentionally Manipulate the Biophysical Environment

Measure: Number of Authorized Actions to Manipulate Fire

Rather than have a separate measure in recognition of the importance of fire in wilderness systems, this was included in the measure *Number of Authorized Actions and Persistent Structures Designed to Manipulate Plants, Animals, Pathogens, Soil, Water, or Fire* (section 2.2.1 in part 2).

A2.2 Natural Quality

A2.2.1 Indicator: Plants

Measure: Index of Plant Species Introduced/Supplemented

This potential measure was eliminated because measures in the Natural Quality are required to be a human-caused threat and to have a clear and consistently interpretable trend (see section 3.6 in part 2). Although introduced and supplemented species can significantly impact the composition, structure, and function of wilderness ecosystems, the trend of those impacts is not always clear or interpretable.

In addition, few plant surveys are conducted in wilderness. Data availability for wildernesses will not be equal for all Forest Service regions and historical plant data records are rare to determine if a plant may have been introduced. Alternatively, assuming this is primarily a concern for nonindigenous introduced species, this element is covered in the measure *Acres of Nonindigenous Plants* (section 3.2.1 in part 2). The Untrammeled Quality also addresses actions involving large scale plant introduction and supplementation (section 2.2.1 for authorized actions, and section 2.3.1 for unauthorized actions, in part 2).

Measure: Index of Plant Species of Concern

This potential measure was eliminated because measures in the Natural Quality are required to be a human-caused threat and to have a clear and consistently interpretable trend (see section 3.6 in part 2). Although the loss of indigenous plant species can significantly impact wilderness ecosystems, deriving a trend would require setting a static historical or desired abundance or distribution range as a target state, which is inappropriate in wilderness. Additionally, few plant surveys are conducted in wilderness and data availability will not be equal for all Forest Service regions.

Measure: Acres of Restored Native Plant Communities

This potential measure was eliminated because, in terms of wilderness character, deriving a trend for acres of native plant communities restored would require setting a historical or desired population or distribution range as a target state, which is inappropriate in wilderness. Although it is understandable to want to use a measure such as this to show positive actions taken in wilderness, this type of measure poses significant challenges to interpret a degrading or improving trend (see section 3.6 in part 2 for more discussion about measures such as this).

Measure: Number of Extirpated Plant Species

This potential measure was eliminated because measures in the Natural Quality are required to be a human-caused threat and to have a clear and consistently interpretable trend (see section 3.6 in part 2). Although the loss of indigenous plant species can significantly impact wilderness ecosystems, deriving a trend would require setting a static historical or desired suite of species as a target state, which is inappropriate in wilderness. In addition, few plant surveys are conducted in wilderness and data availability will not be equal for all regions. Historical records are generally difficult to obtain, or are non-existent for plant extirpations. To determine if a plant is extirpated, it can take many years to adequately survey the entire wilderness.

A2.2.2 Indicator: Animals

Measure: Number of Extirpated Terrestrial and Aquatic Species

The previous *Technical Guide for Monitoring Selected Conditions Related to Wilderness Character* (Landres et al. 2009)[1] recommended this measure, and it was re-evaluated as a potential measure for this current technical guide. On further consideration, this measure was eliminated because measures in the Natural Quality are required to be a human-caused threat and to have a clear and consistently interpretable trend (see section 3.6 in part 2). Although the loss of indigenous animal species can significantly impact wilderness ecosystems, deriving a trend would require setting a static historical or desired suite of species as a target state, which is inappropriate in wilderness. There were also concerns about data availability and interpretation. Few wildernesses have comprehensive inventories of animal species inhabiting that area, and historical data are generally lacking. In addition, sampling protocols would need to be sufficiently robust to account for annual and seasonal migrations and probable immigration-emigration dispersal patterns, which will be beyond the means for most wildernesses.

Measure: Index of Animal Species Introduced/Supplemented

This potential measure was eliminated because measures in the Natural Quality are required to be a human-caused threat and to have a clear and consistently

[1] References in this appendix can be found in the References section after the main text.

interpretable trend (see section 3.6 in part 2). Although introduced and supplemented animal species can significantly impact the composition, structure, and function of wilderness ecosystems, the trend of those impacts is not always clear or interpretable.

Nonindigenous introduced species are included in the measures *Index of Nonindigenous Terrestrial Animal Species* (section 3.3.1 in part 2) and *Index of Nonindigenous Aquatic Animal Species* (section 3.3.2 in part 2). In addition, the Untrammeled Quality addresses actions involving the introduction and supplementation of animals—for example, both authorized and unauthorized fish stocking actions are included in measures under the Untrammeled Quality (sections 2.2.1 and 2.3.1 in part 2, respectively).

Measure: Index of Animal Species of Concern

This potential measure was eliminated because measures in the Natural Quality are required to be a human-caused threat and to have a clear and consistently interpretable trend (see section 3.6 in part 2). Although the loss of indigenous animal species can significantly impact wilderness ecosystems, deriving a trend would require setting a static historical or desired abundance or distribution range as a target state, which is inappropriate in wilderness. In addition, few units have comprehensive inventories of animal species inhabiting wilderness, and historical data are also typically lacking. Sampling protocols would need to be sufficiently robust to account for annual and seasonal migrations and probable immigration-emigration dispersal patterns, which will be beyond the means for most wildernesses.

Measure: Stream and Aquatic Habitat Conditions

This potential measures was eliminated primarily due to the lack of a national program to regularly assess stream and lake habitats using random sampling that would allow area-wide descriptions of habitat conditions and trends over time. Although such assessments (e.g., Pacfish-Infish Biological Opinion Monitoring and the Northwest Forest Plan Aquatic and Riparian Effectiveness Monitoring Program) do occur in some Forest Service regions for long-term status and trend monitoring, these assessments cover less than 50 percent of the total Forest Service wildernesses nationally. The WCF, a national program to assess watershed health, also includes stream and aquatic habitat conditions, and is encompassed by the measure *Watershed Condition Class* (section 3.5.1 in part 2).

Measure: Index of Stocked/Supplemented Water Bodies

This potential was eliminated as a "stand alone" measure but is included in the measure *Index of Nonindigenous Aquatic Animal Species* (section 3.3.2 in part 2). That measure assesses the introduction of a full array of aquatic organisms and is not just limited to fish. This provides a more comprehensive assessment of nonindigenous aquatic species to better reflect the growing importance of the wide array of other potential nonindigenous and invasive aquatic organisms that can impact the Natural Quality of a wilderness. In addition, the action of stocking fish in a wilderness is included in the Untrammeled Quality in two measures representing authorized and unauthorized manipulations (sections 2.2.1 and 2.3.1 in part 2, respectively).

A2.2.3 Indicator: Air and Water

Measure: Critical Load Exceedance

A CL is defined as the estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment are not expected to occur. The Forest Service will soon use exceedance of identified CLs to monitor the trends in the effects of nitrogen and sulfur on the Natural Quality of wilderness character. This measure would directly address the effects of pollution on natural resources within a wilderness and not just the amount of pollution, as is used currently. This is especially important for areas where pollution trends are decreasing, but resources continue to be negatively affected by accumulated pollutants. A prime example can be found in the southern Appalachians, where sulfur emissions and deposition have decreased dramatically since 2006, but the accumulated sulfur in some watersheds slows recovery from acidification. Therefore, even with decreasing trends in sulfur deposition, sensitive resources may still show negative effects from acidification. Use of total deposition estimates from TDEP, as outlined in the current measures *Deposition of Nitrogen* (section 3.4.2 in part 2) and *Deposition of Sulfur* (section 3.4.3 in part 2), sets the stage for an easy transition to using CL exceedance as a measure under the Natural Quality in the future when forests have identified CLs for specific resources.

Measure: W126 and N100

The previous *Technical Guide for Monitoring Selected Conditions Related to Wilderness Character* (Landres et al. 2009) recommended using the W126 and N100 ozone statistics to track trends in ozone, instead of using the 8-hour concentration used for the NAAQS. The primary reason for selecting those statistics was that W126 and N100 have been demonstrated (through experimentation) to better represent the ozone exposures that result in negative effects on vegetation, while the NAAQS for ozone in 2009 was not considered to be protective of the most sensitive vegetation.

There are several reasons for now recommending using the NAAQS ozone statistic (fourth highest 8-hour ozone concentration, averaged over 3 years) to evaluate ozone trends in the measure *Concentration of Ambient Ozone* (see section 3.4.1 in part 2) instead of using W126 and N100. The most compelling reasons include: reducing the number of values from two to one simplifies interpretation; bringing consistency to ozone measures between federal agencies (NPS and FWS both evaluate trends using the fourth highest 8-hour ozone concentration statistic); and recognizing the recent change by the EPA to a more stringent threshold for this NAAQS that is now considered to be protective of vegetation. In addition, by using the NAAQS ozone statistic instead of W126 and N100, both human health and natural resource concerns are addressed with one measure.

Measure: Elemental Content of Epiphytic Lichens

Epiphytic lichens live in and under most forest canopies, receive their nutrients primarily from the atmosphere, lack regulatory structures such as stomata and a cuticle, and are sensitive to acidifying and fertilizing pollutants. Because of these characteristics, lichens are good indicators of air quality and can provide an economical and practical means to maximize monitoring resolution, especially in remote areas or areas further than 25 miles from the nearest air quality monitor. FIA lichen plots only have lichen community data that are used in the index of sensitive lichens measure, but in addition to these FIA plots, several regions (1, 4, 6, and 10) have other lichen plots that can yield information on the elemental (or chemical) content of selected lichen species. In local areas with data, elemental content can be used in addition to sensitive lichens and air scores to provide insight about which element may be affecting lichen communities and the wilderness. Furthermore, regions 1, 4, 5, 6, and 10 have done calibration studies allowing estimates of nitrogen deposition from the nitrogen percentage in the lichen thalli. Elemental content may also be used without community data especially in areas where climate is strongly affecting the presence of lichen species.

Measure: Index of Water Quantity Condition

This potential measure was eliminated due to lack of quality data to measure water quantity. The measure originally planned to track changes in dams and stream diversions, which may or may not affect water quantity. Diversions and dams are instead tracked as persistent structures in the Untrammeled Quality (section 2.2.1 in part 2 for authorized persistent structures, and section 2.3.1 in part 2 for unauthorized persistent structures) and as physical developments in the *Index of Authorized Non-Recreational Physical Development* measure under the Undeveloped Quality (section 4.2.1 in part 2). Water quantity is also one of the indicators tracked by the WCF, which is encompassed by the measure *Watershed Condition Class* (section 3.5.1 in part 2).

A2.2.4 Indicator: Ecological Processes

Measure: Index of Fire Exclusion on the Landscape

An index of the effects of fire exclusion on the landscape (e.g., years of fire absence, or average Fire Regime Condition Class rating) is a strongly desired measure. However, while fire is a key ecological process in most if not all Forest Service wildernesses, the complexity of using a single index of the impacts from fire exclusion is beyond the scope of WCM for three primary reasons. First, discussion with fire experts indicates that there is no agreed upon single index or metric. Second, the occurrence of fire and its effects on the landscape are controlled by plethora of dynamic and chaotic factors (Keane et al. 2013, Peterson et al. 2013) that operate well beyond the 5-year timeframe of WCM. Third, measures that rely on a historical ecological state impose stasis on ecological systems that, in wilderness, are allowed to change. Despite the importance of fire, the combination of these three factors means a single measure of the impacts of fire exclusion cannot be currently used as a required or required if relevant measure.

Measure: Index of Fragmentation/Connectivity

The previous *Technical Guide for Monitoring Selected Conditions Related to Wilderness Character* (Landres et al. 2009) evaluated fragmentation as a potential indicator of the Natural Quality in the context of vegetation. Specifically, it considered "Change in fragmentation and aggregation of vegetation (patch distribution and size) due to human actions." Ultimately the measure was dropped from consideration because of insufficient quality of available data and insufficient data coverage across all wildernesses.

Indices of vegetation fragmentation, habitat fragmentation, and connectivity were re-evaluated as potential measures for this technical guide. While extensive literature addresses various aspects of forest fragmentation, vegetation fragmentation, habitat fragmentation, and habitat connectivity, it is dependent largely on one or more species of interest and influenced by the scale of observation and analysis. Vegetation pattern and fragmentation metrics are highly variable through space and time due to both natural and anthropogenic factors. Difficulty in separating these causes would make an assignment of trend problematic. It is also unknown whether these potential measures would change in the time interval appropriate for WCM. For these reasons, fragmentation/connectivity measures were dropped from consideration as Natural Quality measures.

Measure: Climate Change

Humans are causing warming of the atmosphere and oceans, changes in the type, amount, timing, and location of precipitation, sea level rise, and climate extremes (IPCC 2013). Despite these anthropogenic changes that are affecting wilderness ecosystems, climate change measures were not included in WCM for the following reasons:

- *Natural Variability and Uncertainty*: High natural variability in temperature, precipitation, extreme weather events, and other climate parameters at local and regional scales make it difficult to parse out local climate trends and ecological effects between natural variability and human caused changes. In addition, the adaptive capacity of species and ecosystems adds to the uncertainty about being able to clearly label local climate trends and ecosystem impacts as "human-caused" and to identify what would be considered a significant or meaningful change. Regardless of the source of climate change, biological systems respond to fluctuations in local climate conditions, and do not partition their responses to anthropogenic and natural climate variation (Joyce et al. 2014, Staudinger et al. 2012). Finally, as with several other measures in the Natural Quality, using a historical or desired set of climate metrics inappropriately imposes stasis on wilderness conditions that are allowed to change over time.

- *Other Climate Change Monitoring Programs, Policies, and Data Sources*: Wilderness managers have access to climate change information through other high quality national, regional, and local programs and policies. Examples include the National Climatic Data Center, National Climate Assessment, and Forest and Rangeland Renewable Resources Planning Act Assessment. The Forest Service 2012 Planning Rule and directives (USDA Forest Service 2012) require each national forest to address climate change in forest plan assessments and plan monitoring programs. Element 8 and appendix E of the Forest Service Climate Change Scorecard Guide (USDA Forest Service 2011a) provide additional advice on climate change monitoring.

A2.3 Undeveloped Quality

A2.3.1 Indicator: Presence of Non-Recreational Structures, Installations, and Developments

Measure: Number of Radio Collars

Tracking the movement of wildlife such as elk and wolves using radio collars is a commonly used technique that provides a variety of data to federal and state agencies. Radio collars degrade the Undeveloped Quality of wilderness character because they typically are highly visible scientific installations and obvious evidence of human activity (NPS 2014; Landres et al. 2015). Although radio collars and other devices used to identify and track wildlife, such as ear tags, are installed on animals rather than at fixed locations, their mobility does not diminish their negative impact on wilderness character because the Wilderness Act's Section 4(c) prohibition on installations does not specify whether the installations are fixed or mobile, only that "…there shall be no…installation." Despite the negative impact of radio collars on the Undeveloped Quality, this potential measure was not included in this technical guide because radio collars do not occur in a majority of NFS wildernesses and because few wildernesses are likely to have the resources and practical ability to track them consistently. However, a locally developed measure may still be used to count radio collars if they are prevalent in a wilderness and it is feasible for the local unit to monitor their presence over time.

A2.3.2 Indicator: Presence of Inholdings

Measure: Number of Developed Inholding Parcels

An attempt was made during the development of this technical guide to define a measure that gauged the level of development on inholdings. The measure would address the question that if an inholding does not display any obvious signs of development and is totally transparent to a wilderness visitor, does it truly have an impact on the Undeveloped Quality? Attempting to gauge the level of development resulted in several issues including how to characterize the impact, and how to measure persistence and visual impacts of such developments over time. As a result of these issues, a less subjective measure, *Acres of Inholdings*, was used instead.

A2.3.3 Indicator: Use of Motor Vehicles, Motorized Equipment, or Mechanical Transport

Measure: Number of Unauthorized Uses of Motor Vehicles, Motorized Equipment, or Mechanical Transport

The incidence of illegal mechanical transport or motorized equipment incursions, most notably from mountain bikes, motorcycles, snowmobiles and other types of snow machines, and all-terrain vehicles, is unfortunately common in many parts of the country. However, the primary challenge posed in the development of a valid monitoring protocol to track this measure is the need to account for the "level of effort" of law enforcement or other agency observers to discern if a rise in the level of incursions is due to an actual increase in the frequency of illegal trespass or simply due to increased law enforcement or wilderness patrols. While the development of this protocol is feasible, it was determined to be outside the scope of this technical guide as few wildernesses would probably have the resources to commit to the level of monitoring that would be required. For this reason, it was determined that this measure should be dropped as a standard part of the protocol.

A2.4 Other Features of Value

A2.4.1 Indicator: Deterioration or Loss of Integral Cultural Features

Measure: Number of Actions That Damage or Disturb Integral Cultural Features

This measure was dropped due to lack of data and the difficulty in collecting data to monitor the trend in the measure. The difficulty with monitoring actions that damage features of value is the need to account for the "level of effort" of law enforcement or other agency observers to discern if an increase in the number of actions is due to an actual increase in frequency or simply due to increased law enforcement or wilderness patrols.