



Inventories 2.0

A Plan for the Next Generation of NPS Natural Resource Inventories

Natural Resource Report NPS/NRSS/NRR—2019/2007



ON THE COVER

Indian paintbrush and penstemon with Crater Lake in the background.

Credit: NPS Photo.

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A Plan for the Next Generation of NPS Natural Resource Inventories

Natural Resource Report NPS/NRSS/NRR—2019/2007

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Approvals Inventories 2.0 Plan

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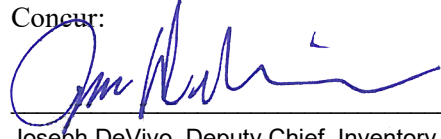


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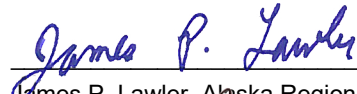
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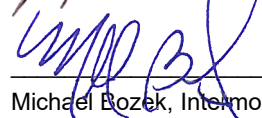
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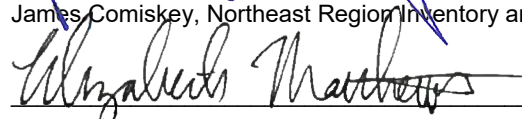
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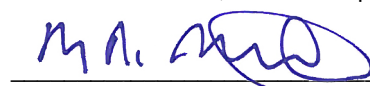
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Executive Summary

Knowing the condition of natural resources in national parks is fundamental to the National Park Service's (NPS) ability to manage park resources unimpaired for the enjoyment of future generations. National park managers across the country are confronted with increasingly complex and challenging issues that require a broad-based understanding of park resources under their purview, and their status and trends as a basis for making decisions and working with other agencies and the public for the benefit of parks. To fulfill the NPS mission of preserving the nation's natural heritage associated with units of the National Park System and affiliated areas, it is essential that park managers know the nature and condition of the existing resources placed under their stewardship.

Inventories—the collection of information about the presence, distribution, or key attributes of resources within an area of interest—are a part of the scientific basis for understanding the condition of natural resources in national parks. Inventories may be conducted at one point in time, span a defined period of time (typical of many mapping efforts), or may accumulate data over time (such as species occurrence observations). Inventories never have a requirement to be repeated at later dates, but repeated inventories may be conducted to update or improve our understanding of resource status. Inventory studies are not designed to detect change over time, but they may identify potential changes that warrant further investigation through research, monitoring, or assessment.

Over the last two decades, the NPS Inventory & Monitoring Division (IMD) has been conducting a series of basic inventories for all NPS units with significant natural resources. In 2014, the Inventory & Monitoring Division convened an Inventory Completion Workgroup to develop a strategy for winding down the remaining basic inventory projects and programs by 2020 so IMD could refocus its inventory efforts on other inventory needs (Martyn et al. 2017). By the end of FY2018, 94% of the originally-planned inventory studies were complete, with the remaining 159 vegetation (52), soils (12), and geology (95) inventories underway (updated from Martyn et al., 2017 based on FY 2018 annual administrative reports).

Recognizing that the first phase of inventories was nearing completion, in October 2016 IMD began a servicewide planning initiative to identify needs for the next generation of natural resource inventories for NPS. To do so, IMD solicited input from parks, I&M Networks, Regional Offices, and national programs to a) identify what information about natural resources or natural resource management are needed by parks and NPS programs, and b) understand how those data are—or can be—used for science-based management of park resources. Ten natural resource inventories were identified as servicewide needs based on a review of park foundation documents, surveys, and 50 scoping sessions held with park, network, regional office, and national program staff:

Species: Presence, distribution, and natural history characteristics of living and paleontological taxa located or potentially located within parks.

Vegetation Community Maps: Completion, update, or expansion of basic Vegetation Mapping inventories.

Surficial Geology & Soils Maps: Maps of geologically-recent management-relevant surficial units that include both surficial geology and soils information.

Management Areas: Boundaries of areas used for management or planning that are explicitly linked to supporting information that describes use, management targets, or other factors relevant for data analysis and reporting.

Inventory & Monitoring Locations: Locations within and near parks where inventory or monitoring data are currently or have historically been collected, with relevant associated metadata such as the types of data collected, periods of record, and how to acquire them.

Resource Management Assessment Points: Catalog of specific numerical thresholds or qualitative categories used for interpreting environmental or ecological inventory and monitoring data.

Natural Resource Hazards: Location, type, and condition of biological, physical, or chemical hazards within and adjacent to parks.

Natural Resource Sounds and Images: Digital photo, video, and audio records that can be used for analysis of resource status and condition within or adjacent to parks.

Citable Science, Records, Collections, and Archives: Data, reports, findings, records, archives, and specimens significant to informing natural resource planning decisions.

Base Cartography: Foundation GIS layers needed for routine cartographic, planning, or spatial analysis activities.

This Inventory 2.0 plan identifies IMD's planned role in each of the ten inventories, and lays out a framework for ensuring the inventories led by IMD result in scientifically credible information for parks resource management, planning, and operations; and also identifies the means by which studies to collect new inventory data will be identified, prioritized, and implemented. Highlights include:

- IMD plans to lead three of the ten inventories (Species, Vegetation Community Mapping, and Surficial Geology/Soils Mapping), and contribute to the others in partnership with other programs. For the three IMD-led inventories, IMD will develop (or work with the Geologic Resources Division to develop) peer-reviewed inventory science plans that will lay out inventory objectives; and methods for data management, analysis, and integration to ensure that credible and useful inventory data are provided to parks in a timely manner.
- IMD will phase in implementation of IMD-led inventories during the first five years of program implementation. This will allow IMD to focus near-term efforts on meeting needs identified by the greatest number of parks (Species) while conducting necessary scoping to further refine needs for Vegetation Community Mapping and Surficial Geology/Soils Mapping inventories.
 - During the next two years, IMD inventory efforts will be focused on implementing the Species Inventory, beginning with foundational work in advance of field data collection efforts to be funded in 2020.

- Additional scoping to identify suitable methods and minimum product specifications for Vegetation Community and Surficial Geology/Soils Mapping will be conducted in 2019-2020. These two new inventories will be phased in based on findings from scoping and progress toward closing out existing (1.0) inventory efforts.
- All I&M parks will be eligible for IMD funding to support inventories (see Appendix A). Non-I&M parks established before 2000 may be eligible for studies and activities to collect new inventory data pending approval of the project by the IMD Leadership Team. Inventories 2.0 funding cannot be spent to collect new data in parks established in 2000 or later, that are not currently served by an I&M network. Existing data from other sources may still be synthesized and delivered to these parks, however.
- Inventories 2.0 funding will not be used to fund programs or initiatives already funded or implemented by other programs or agencies. We will endeavor to partner with these entities when possible and appropriate to meet inventory needs identified in this plan, and to ensure IMD-created inventory (and monitoring) data are available to support other programs.
- Data and other information products resulting from new IMD-funded inventory studies will be managed by IMD rather than third-party repositories. This does not preclude sharing data with third parties or use of third-party tools or data distribution systems. At a minimum IMD commits to make inventory data available to others via the NPS Data Store (<https://irma.nps.gov/DataStore/>) as well as data and/or map services.
- To the extent possible, IMD management of inventory data will use the data management infrastructure used for managing monitoring data. This includes a commitment to leverage data, tools, systems, and expertise where it already exists.
- Because of IMD's explicit mandate to integrate I&M data with planning, wherever practicable, IMD commits to work with NPS Planning to ensure map and data services are integrated into NPS Atlas projects for each park or other planning tools as they are developed over time.

Development of the initial inventory study plan will commence in FY2019.

Acknowledgments

Text was liberally borrowed from the IMD Inventory Completion Workgroup's final report (Martyn et al. 2017), particularly with regard to the purpose and legal & policy background of IMD's inventory program when writing Chapter 1. Much of the language is borrowed verbatim with minimal wordsmithing. Changes were largely focused on the integration of inventories & monitoring, interplay between natural resource and other inventories conducted by NPS, and the shift from basic inventories (the focus of 1.0 efforts) to ongoing inventories (the focus of 2.0 efforts).

Several IMD network and regional program managers facilitated workshops, which greatly assisted with the scoping process and ensured that we were able to include as wide an audience as possible in the development of this plan. Specifically: Dusty Perkins (who conducted the first scoping workshop), Marcia Wilson, Teresa Leibfreid, Kristin Legg, Bill Route, Alice Chung-MacCoubrey, Stacey Ostermann-Kelm, Mark Huff, Geoff Sanders, Kara Paintner-Green, Mike Britten, Lisa Thomas, Mike Bower, Daniel George, Sylvia Haultain, Andy Hubbard, Rob Bennetts, and Amy Miller. Not only were the program managers instrumental in facilitating these workshops, but in many cases the staff who participated did so in lieu of or in addition to other regularly-scheduled discussions planned during their board or technical steering committee meetings.

Josh Lewis provided much logistics, note-taking, and synthesis support during the early phases of the scoping process, particularly in compiling the pre-workshop needs assessment reports and early consolidation of notes from the initial scoping workshops.

Lastly, thanks to everyone who participated in the surveys and all of the workshops. Roughly 800 people provided input through the survey and more than 600 participated in one or more scoping workshops.

Glossary of Terms

Official Inventory and Monitoring Park (aka “I&M Park”): Any of the 270 NPS units listed in Appendix A that were identified by the regional offices and the servicewide I&M Program in FY 2000 to contain significant natural resources. These parks were listed in various strategic plans and requests for budget increases as part of the Natural Resource Challenge to complete inventories and to initiate long-term monitoring. [See Appendix A for complete list.]

Basic Inventory: Any of the 12 natural resource inventories specified in Appendix I of NPS-75, *Natural Resources Inventory and Monitoring Guideline*. The data sets and other products from the initial phase of these 12 basic inventories were selected to provide the minimal set of natural resource information needed by managers and planners to effectively manage and protect park resources. The need for these inventories was common across all parks in the NPS with significant natural resources. High-priority inventories that were not common across all parks, or that could not be undertaken efficiently because of the knowledge and technology available at the time, were deferred until later (see Continuing Inventory).

- Natural Resource Bibliography
- Base Cartography Data
- Air Quality Data
- Air Quality-Related Values
- Climate Inventory
- Geologic Resources Inventory
- Soil Resources Inventory
- Water Body Location and Classification
- Baseline Water Quality Data
- Vegetation Mapping Inventory
- Species Lists
- Species Occurrence and Distribution

Continuing Inventory: Continuing inventories are either (1) high-priority basic inventories that were deferred until after the initial phase when improved technology, taxonomy, and knowledge would make it more cost effective to undertake the inventory, or (2) other inventories identified by parks as high-priority needs, but that were not common across all I&M parks. Examples include inventories of submerged resources (e.g., bathymetry, underwater vegetation, benthic habitat mapping), lichens, invertebrates, paleontological resources, and wetlands. [This definition was used in the 2009 Inventories Strategic Plan, but has been superseded by definitions provided in this document.]

Baseline Inventory: Inventory that describe the resources under NPS stewardship and processes that influence those resources. Allows for comparison of existing conditions to reference conditions or the desired state of parks; establishes a solid basis for making scientifically sound management decisions and for designing long-term monitoring plans that track the health of key park resources. [This definition was used in the 2009 Inventories Strategic Plan, but has been superseded by definitions provided in this document.]

Recurring Inventory: Inventories that need to be repeated or updated at future intervals because of changes in resource status, so that they continue to provide useful and reliable information to parks. An example would be the need to update a park's vegetation map for a park every 10-20 years or so. [This definition was used in the 2009 Inventories Strategic Plan, but has been superseded by definitions provided in this document.]

List of Acronyms

Acronyms

AGOL:	ArcGIS Online
AOA:	Area of Analysis
AQRV:	Air Quality Related Value
ARK:	Archival Resource Key
ATBI:	All-Taxa Biological Inventory
CR:	Cultural Resources
DEM:	Digital Elevation Model
DwC:	Darwin Core (data standard)
DwCA:	Darwin Core Archive
EDRR:	Early Detection & Rapid Response
EPA:	Environmental Protection Agency
EPMT:	Exotic Plant Management Team
FCA:	Focused Condition Assessment
FY:	Fiscal Year
GMP:	General Management Plan
HUC:	Hydrologic Unit Code
IRMA:	Integrated Resource Management Applications
LiDAR:	Light (or Laser) Detection And Ranging
LSID:	Life Science ID
LTDM:	Long Term Data Management
NEPA:	National Environmental Policy Act
NHD:	National Hydrologic Data Set
NPS:	National Park Service
NR:	Natural Resources
NRCA:	Natural Resource Condition Assessment
NVCS:	National Vegetation Classification Standard
PMIS:	Project Management Information System
QA/QC:	Quality Assurance / Quality Control
SME:	Subject-Matter Expert
TEK:	Traditional Ecological Knowledge
USGS:	U.S. Geological Survey

National Park Service Programs & Divisions

ARD:	Air Resources Division
BRD:	Biological Resources Division
GRD, GRI	Geologic Resources Division, Geologic Resources Inventory Program
NRSS:	Natural Resources Stewardship and Science Directorate
IMD:	Inventory & Monitoring Division
I&M:	Inventory & Monitoring; Inventory & Monitoring Program
IMDLT	Inventory & Monitoring Division Leadership Team
NSNSD	Natural Sounds and Night Skies Division
RISD:	Resource Information Services Division
SRI :	Soil Resources Inventory Program
WRD:	Water Resources Division

Chapter 1. Introduction

Knowing the condition of natural resources in national parks is fundamental to the National Park Service's (NPS) ability to manage park resources unimpaired for the enjoyment of future generations. National park managers across the country are confronted with increasingly complex and challenging issues that require a broad-based understanding of park resources under their purview, and their status and trends as a basis for making decisions and working with other agencies and the public for the benefit of parks. To fulfill the NPS mission of preserving the nation's natural heritage associated with units of the National Park System and affiliated areas, it is essential that park managers know the nature and condition of the existing resources placed under their stewardship. During the last 30 years, more than a dozen major studies by both independent panels and NPS have reaffirmed the importance of guiding resource management through the systematic collection of data on these resources through a combination of inventory and monitoring activities (GAO 1997).

To comply with legal requirements, fully implement NPS policy, and guide resource management activities, the I&M Program was established to implement the following five goals (see full discussion in NPS-75: Inventory & Monitoring Guidelines; NPS 1992):

1. Establish natural resource inventory and monitoring as a standard practice throughout the National Park System which transcends traditional program, activity, and funding boundaries.
2. Inventory the natural resources and park ecosystems under NPS stewardship to determine their nature and status.
3. Monitor park ecosystems to better understand their dynamic nature and condition to provide reference points for comparison with other, altered environments.
4. Integrate natural resource inventory and monitoring information into NPS planning, management, and decision making.
5. Share NPS accomplishments and information with other natural resource organizations and form partnerships for attaining common goals and objectives.

To ensure that inventories contribute to all long-term IMD programmatic goals, the Inventories 2.0 plan establishes priorities and a framework to:

- Ensure that IMD-supported inventory studies leverage historical and ongoing IMD inventory and monitoring activities and subject-matter expertise, and maximize the benefit of resultant science to parks and programs.
- Ensure that IMD inventory efforts result in scientifically sound information pertaining to natural resources in a manner that integrates and informs science-based studies, planning efforts, programs, or conservation priorities at park, network, regional, and national levels within NPS.
- Ensure that IMD inventory efforts complement, leverage, and do not negatively impact the quality or quantity of monitoring efforts being conducted by IMD's Vital Signs Monitoring Networks.

- Ensure that long-term operational costs associated with implementation of an inventory program are appropriately planned and budgeted for, including costs related to project management, data management, records management, and where appropriate museum/specimen curation and management.

Program History & Status

The design and implementation of the I&M Program during the first ten years (1992-2001) focused on inventorying natural resources common across all natural resource parks that would meet the needs of park managers for the science-based decision making and resource protection. As a result, the I&M program provided guidance, funding, and technical assistance to complete a set of 12 basic natural resource inventories as the first phase of inventory efforts. A total target of 2,767 inventory studies were planned and initiated in all parks with significant natural resources (Martyn et al., 2017). A Strategic Plan for Natural Resource Inventories, FY2008-FY2012 (NPS 2009) described actions to address inventory needs for the next five-year period. The plan addressed three major areas:

1. Completion of the first phase of 12 basic inventories,
2. Scope of inventories to be conducted as a part of the second phase of natural resource inventories, and
3. Operation and maintenance activities such as data management and decision-support systems.

In 2014, the Inventory & Monitoring Division convened the IMD Inventory Completion Workgroup to develop a strategy for completing the remaining basic inventory projects and programs by 2020 so that IMD could refocus its inventory efforts on other inventory needs (Martyn et al. 2017). By the end of FY2018, 94% of the originally-planned inventory studies were complete, with the remaining 159 vegetation (52), soils (12), and geology (95) inventories underway (updated from Martyn et al., 2017 based on FY 2018 annual administrative reports)¹. Recognizing that the first phase of inventories was nearing completion, in 2016 the IMD leadership team began planning efforts to design the next phase of IMD inventory efforts, summarized in this plan.

Key Terms and Concepts

One of the challenges of the Inventories 2.0 planning process was to clearly define what IMD means by “inventory” in the context of all the types of scientific studies typically done to support park resource management: inventories, monitoring, research, or condition/risk assessments, and valuation studies. As defined in NPS-75, inventories serve two broad purposes—documenting the resources present within an area; or establishing a baseline of presence, distribution, or condition. Combined with monitoring, inventories provide core scientific information for resource managers that allow comparison of existing conditions to a set of reference conditions (or to the desired state of particular

¹ The status of Inventory 1.0 studies includes the deferment of 24 Soil Resource Inventory Projects that had not been initiated as of the publication of the Martyn et al. (2017) in accordance with that report’s recommendations to the IMD Leadership Team. Needs for soils inventories at un-inventoried parks will be addressed as a part of the Inventories 2.0 program.

park resources), establish a baseline for making scientifically sound management decisions, and inform the design of long-term management plans designed to maintain or improve the health of key park resources (NPS-75).

NPS-75 defines natural resource inventories as:

Accounts of park resources, including the presence, distribution, and condition of plants, animals, soils, water, air, geological features, biotic communities, natural processes, and human-induced changes in park resources. Inventories are accounts of park natural resources, including the presence, class, distribution, and normal variation of plants, animals, and abiotic components such as water, soils, landforms, and climate. Inventories are designed to contribute to a statement of the condition of park resources, which is best described in relation to a standard condition such as the natural or unimpaired state. Inventories may involve both the compilation of existing information and the acquisition of new information. They may be either intensive in space (synoptic) or intensive in time (i.e., designed to detect temporal variations).

The definition of “inventories” has evolved since the inception of the Inventory & Monitoring Program to include basic inventories, continuing inventories, and recurring inventories (See Glossary, NPS 2009, and Martyn et al. 2017); all of which were based on programmatic implementation of IMD’s inventory program (see glossary) rather than scientific distinctions between inventories, monitoring, and assessment. In many cases these definitions have blurred the lines between the three, and for the purpose of this plan (and IMD operations in general), IMD defines inventories, monitoring, and assessment as follows:

Inventories: Collection of information about the presence, distribution, or key attributes of resources within an area of interest. Inventories may be conducted at one point in time, span a defined period of time (typical of many mapping efforts), or may accumulate data over time (such as species occurrence observations). Inventories never have a requirement to be repeated at later dates, but repeated inventories may be conducted to update or improve our understanding of resource status. Inventory studies are not designed to detect change over time, but they may identify potential changes that warrant further investigation through research, monitoring, or assessment.

Monitoring: Repeated measurements of resource presence, distribution, condition, and/or additional characteristics, parameters, or covariates within an area. Monitoring is conducted using standardized methods and a sampling design that allow for meaningful comparison of those measurements across space or time. Monitoring may be conducted to identify trends, variability, or relationships among ecological properties over time, or to quantify or qualify the magnitude and direction of change between periods of time.

Assessments: Comparison or presentation of relevant information about resources and their condition in the context of values, goals, risks, standards, management objectives, or resource management thresholds. An assessment analyzes or synthesizes information to make a

statement about the condition of resources in response to a stated purpose or question. Assessments can derive their information from one-time visits or from multiple visits, and may rely on already-existing or newly-collected data, including results of inventory, monitoring, or other studies. Assessments may or may not follow protocols that allow for comparison of findings over time.

In all cases data are to be collected and reported in a manner that reflects the *condition* of resources, defined as “the status of resources compared to a reference” (NPS-75; NPS 1993). “Condition” has a different meaning in the context of inventories, monitoring, and assessments:

- For inventories, condition is primarily based on a comparison of resource attribute(s) to reference conditions pertaining to presence, distribution, or context (such as landscape context, or expected or historical data). [*There’s a waterbody in the same place as indicated on the USGS topo map, but its flow is now seasonal rather than year-round*]
- For monitoring, condition is typically based on a comparison of measured characteristics or parameters to reference conditions, assessment criteria, or expected ranges of variation. [*The pH of the waterbody is 2.6, which is below state regulatory standards*]
- For Assessments, condition is based on a comparison and presentation of presence, distribution, attributes, or measurements in the context of NPS’s values, mission, or programmatic goals. [*The low pH is likely to negatively impact visitor experience because it might give visitors who step in the water chemical burns*]

Inventories 1.0 vs. 2.0

New (2.0) inventories differ from 1.0 efforts in that they are updated or amended over time, leverage multiple sources of data (including new studies where appropriate), and aim to provide sufficient information to support science-based management as opposed to providing a minimum baseline of information (Table 1).

Table 1. Comparison between Inventories 1.0 program as defined in NPS-75 and the Inventories 2.0 Program.

Category	Inventories (1.0)	Inventories (2.0)
Scope	Acquisition of information on park resources, including the presence, distribution, and condition of plants, animals, soils, water, air, geological features, biotic communities, natural processes, and human-induced changes in park resources.	Identify, acquire, assemble, synthesize, and interpret comprehensive information on park resources.
Products	Accounts of park resources, including the presence, class, distribution, and normal variation of plants, animals, and abiotic components such as water, soils, landforms, and climate.	Inventory 1.0 products expanded to explicitly include underlying data so that they can be used for synthesis, analysis, and decision support.
Purpose	Contribute to a statement of the condition of park resources, which is best described in relation to a standard condition such as the natural or unimpaired state.	Contribute to a statement of the condition of park resources, but statements regarding the condition of park resources are described in relation to reference conditions, management targets, ecological thresholds, or other frameworks relevant to NPS management.
Relation to Monitoring	Assess the full range of populations, ecosystem components, processes, and stresses from which to subsample long-term vital signs monitoring.	Integrated with monitoring efforts when possible--Includes monitoring data as source information for inventories or inventory work to supplement monitoring.
Approach	Inventories may involve both the compilation of existing information and the acquisition of new information.	Increased focus on compiling existing information due to advances in data management and resultant expansion of data availability. May also include collection of new information.
Study Design	They may be either intensive in space (synoptic) or intensive in time (i.e., designed to detect temporal variations).	May also include data collected ad-hoc where appropriate.
Completeness Goal	Provide baseline/minimum required information for science-informed decision making to park units servicewide with significant natural resources.	Provide sufficient data to contribute meaningfully to science-based decision-support tools, analysis, and/or to identify significant knowledge gaps.

¹ Note that the need to establish baselines for vital signs monitoring may change if NPS is successful in future funding requests to support the addition of more parks to IMD's Vital Signs Monitoring networks. In such cases, there may be a need to collect additional baseline inventory data to inform the selection and design of long-term monitoring protocols. Pilot studies may be necessary prior to initiating other (non-Vital Signs) monitoring efforts.

Chapter 2. Inventory Scoping and Findings

In October 2016, IMD began a year-long scoping process to a) identify what information about natural resources or natural resource management are needed by parks and NPS programs, and b) understand how those data are or can be used in the process of science-based management of park resources. The goal of this planning effort was not to identify specific inventory studies; new inventory study needs will be identified and prioritized in subsequent inventory science planning and project study planning efforts described in Chapter 4.

The scoping process was inclusive of all NPS staff by design, and included a breadth of topics and users of IMD data engaged in the process. IMD defined users of inventory data/information for science-based management as NPS staff at all levels in the following areas of NPS operations: Planning & Compliance; Natural and Cultural Resource Management; Interpretation, Education, & Outreach; Park Research, Collections, and Studies, and; Visitor & Resource Protection.

For the purposes of scoping, natural resource inventory data included any information about natural resources, or information/data critical in the science-based management of natural resources. Some of this information may also have value in science-based management of other areas of NPS operations. However, cultural resource inventory data and monitoring needs were not discussed as a part of the scoping effort because cultural resource inventory & monitoring efforts are considered out of scope for Natural Resource Challenge funding.

Scoping for this plan was conducted in three stages: a review of inventory needs identified in park foundation documents, a survey of current natural resource inventory needs, and a series of scoping workshops to determine how and why inventory data are (or may be) used to support scientific or science-based operations within NPS.

Review of Park Foundation Documents

IMD staff reviewed the first 175 park foundation documents that were complete as of June 2016. Each foundation document identified data or information needs to support park planning and operations. Projects and their priorities were not used to evaluate or pre-determine inventory needs because foundation documents had not been completed for all parks, and the needs identified across foundation documents were highly dependent on the participants and their subject-matter expertise. The roughly 4,200 project needs identified across those documents were, however, used to identify candidate inventories needed by parks. At this stage a broad definition of “inventory” was used, to include any data or information need that was synoptic in nature or that included an explicit use of inventory data. Candidate inventories fell into one of five broad categories:

Natural Resource Inventories: Inventories about natural resources under NPS management purview, including the type, location, abundance, or distribution of natural resources within and around parks.

Natural Resource Management Information: Inventories about the physical, social, historical, cultural, ecological, or scientific context in which natural resources are managed. These types of inventories have potential utilities for multiple aspects of NPS operations.

Assessments Using Natural Resource Inventory Data: Synthetic studies that integrate inventory, monitoring, and other information, and determine/present the status or condition of resources in the context of goals, thresholds, or other assessment points.

Non-Inventories: Park scientific research or monitoring efforts where data are collected to address knowledge gaps and/or to track changes over time. Although these efforts are not inventories, in some cases they may generate data that can be integrated with inventory efforts.

Non-Natural Resource Needs: Studies or projects pertaining to cultural or historical programs that were not designed to address natural resource objectives.

Within these five categories, 33 candidate inventories were identified, and served as the basis for the second and third stages of scoping (Table 2, Appendix B). Three types of project needs were removed from consideration because they were out of scope for IMD inventory funds: Monitoring, General Scientific Research, and Non-Natural Resource projects.

Table 2. Number of inventory project needs identified in park foundation documents completed as of June 30 2016 servicewide. Projects categorized in one of the italicized (also denoted with *) candidate types were determined to be out of scope for the Inventories 2.0 program or not natural resource inventories. See Appendix B for definition of scope of each of the candidate inventory types.

Candidate Inventory Type	Projects Identified
Species Occurrence and Distribution	333
Condition, Vulnerability, or Impact Assessment	127
Monitoring Station Locations	108
Ownership, Designations, and Rights	105
Viewshed Analysis / Visual Resource Assessment / Visual Resource Inventory	72
Base Cartography	65
Night Skies & Lightscape	55
Geologic (and other) hazards	55
Soundscape	53
Light Detection and Ranging (LiDAR)	49
Species Range and Habitat Maps	44
Management Treatment Areas	42
Water Body Locations and Classification	40
Vegetation & Fuels Mapping	38
Wilderness Character	28
Disturbance/Impact/Restorable Lands mapping	28

Table 2 (continued). Number of inventory project needs identified in park foundation documents completed as of June 30 2016 servicewide. Projects categorized in one of the italicized (also denoted with *) candidate types were determined to be out of scope for the Inventories 2.0 program or not natural resource inventories. See Appendix B for definition of scope of each of the candidate inventory types.

Candidate Inventory Type	Projects Identified
Paleontological Resources	27
Models and Forecasts	26
Significant Natural Resource Features	25
Bedrock Geology	20
Imagery	18
Research Catalog	16
Soils Inventory	14
Contaminant sources	14
Resource extraction sites	11
Surficial Geology	10
Watershed Characteristics	8
Scientific Literature	7
Resource Management Thresholds	7
Ecosystem services	5
Climate & Climate-Sensitive Features	2
<i>Natural Resource Research*</i>	<i>171</i>
<i>Monitoring*</i>	<i>130</i>
<i>Other Non-NR Inventory*</i>	<i>1,973</i>

Several candidate inventory types were considered inventories for the purposes of scoping with the intent to determine whether they aligned with IMD’s definition of inventories or were instead programs or efforts that rely on inventory data. Examples included Condition, Vulnerability, or Impact Assessments (lumped into a general “Condition Assessments” category), Viewshed Analyses (because they were referenced in foundation documents explicitly as analyses, inventories, and assessments), and Wilderness Character (because Wilderness Character Assessments are upcoming studies as precursors to mandated Wilderness Character Monitoring). In these cases we did ask stakeholders how inventory data could be used in the context of performing such assessments during the scoping workshops (see below). It was expected that the scope of the remaining candidate inventory types would be refined and several would be combined based on the results of scoping.

Survey of Current Inventory Data Use

In February 2017, IMD conducted a survey of NPS personnel who had a potential use for natural resource inventory data (See Appendix B for the survey and results). This survey was designed to gauge *current uses* of inventory data, and determine whether there were differences in needs across

program areas/job duties or the type of organizational unit where employed (park, network, regional office, or national program). The survey focused on three areas:

- Demographics of the respondents so that results could be analyzed by geography, organizational hierarchy, and program area.
- Inventories of interest: identification of natural resource inventory data typically needed to perform one's job duties. The list of options was derived from the 30 identified from the review of park foundation documents.
- Where NPS staff currently obtain inventory data, and how they get it.

Survey responses were received from 779 staff across NPS, representing all targeted end-users servicewide (Tables 3 and 4; Appendix C). Park and network staff submitted the majority of responses, with park staff providing nearly two thirds of all responses. At least one staff member from each I&M network participated in the survey. Staff with science and research duties made up the majority of respondents, with nearly half of all respondents having planning responsibilities.

Table 3. Number of Inventory 2.0 pre-workshop survey respondents by NPS organizational hierarchy.

Org Type	Responses	%
Park	513	65.8
Network	153	19.6
Regional Office Program	45	5.8
National Program or Division	68	8.7
Total	779	—

Table 4. Number of Inventory 2.0 pre-workshop survey respondents by NPS job type or duties. Note that job type categories are not mutually exclusive (NPS staff may operate in one or more of the categories presented).

Job Type or Duties	Responses	%
Planning	375	48.1
Compliance	288	37.0
Integrated NR/CR Management	258	33.1
Interpretation	161	20.7
Visitor & Resource Protection	156	20.0
Science & Research	493	61.5
Citizen Science	159	20.4

Key Findings from the Survey:

- Species was the most-cited inventory need across all job functions and program offices. Roughly 75% of respondents listed Species Occurrence and 58% listed Species Ranges as

typical needs to do work, representing the top two needs identified among survey respondents.

- Vegetation Communities, Base Cartography, Management Areas, and Scientific Literature were also frequently cited as needs, but only the two Species inventories (occurrence, and range maps), Vegetation Communities, and Basic Cartography were cited as needs by more than 50% of respondents).
- IMD Network staffs cited a lesser need for Night Skies, Soundscape, Paleontological, or Viewshed (visual resource) data compared to other hierarchical levels within NPS.
- Parks reported a lesser need for scientific literature than other hierarchical levels within NPS.
- National programs have a greater need for hazards, and surficial and bedrock geology inventories than other levels, but this may be due to a skewed response rate from Geologic Resource Inventory staff, who made up nearly 1/3 of national program respondents.
- NPS staff look to IMD more than any other sources when trying to find inventory data (73% of respondents reported using IMD as a source of natural resource inventory data), with USGS being a secondary source. Only 24% of respondents said they look to other NPS programs for inventory data.
- 83% of respondents occasionally-to-frequently reuse inventory data for multiple purposes. Only 17% of respondents said that they rarely or never (re)use inventory products after they're created.
- Data or GIS clearinghouses are the most preferred sources for acquiring inventory data, but those data must be accessible via ArcGIS and R software packages to fully support planning and scientific activities.

Scoping Workshops

Fifty scoping workshops were held between April and August 2017 to gauge how inventory data may be used in the course of performing science-based management of park resources. Meetings were held at the network (targeting park staff), region (targeting IMD staff), regional office, and national program levels and designed such that they followed the same agenda regardless of facilitator, and each resulted in a standard report so that findings could be collated across workshops. Park-level workshops were conducted at the network level, with the majority of park-level scoping workshops being facilitated by network program managers as a part of (or in addition to) regularly-scheduled board or technical steering committee meetings. All IMD, national program, regional office, and a few park-level workshops were facilitated by the IMD Deputy Chief using MeetingSphere as a standard web-based facilitation platform.

Prior to each workshop, participants were provided reports that summarized results from the surveys and foundation document reviews appropriate to the workshop participants—either at the multi-park (by network or region), multi-network (by IMD region), or national level as background material for scoping workshops. Pre-workshop summary reports are available in Appendix D.

The primary goal of each workshop was to understand how inventory data are (or could be) used to perform science-based management of resources in the course of each participant's job duties. This was done using a semi-structured interview process with an included case study discussion. All workshops had a common agenda, discussion topics, and questions, with a goal of getting broad sense of needs above and beyond what was identified during surveys and foundation document reviews. Case studies were designed to facilitate in-depth discussions of how inventory data could or might be used.

No voting or prioritizing of needs was conducted as a part of the standard process, and polls to determine what case studies to discuss were not used to inform decisions about what inventories IMD will lead or what studies will be funded. Note that some workshops did take time to prioritize inventories and projects, but this information is not presented. Participants were told that comments on how inventory data are used and why they need the data would be used as a part of our decision-making process, and that facilitators' roles and follow-up questions would be geared toward understanding such.

At the conclusion of each scoping workshop, participants were provided a draft report of discussion notes and a 1-3 week period to add additional comments, including on any topics/case studies not discussed during the workshops. Results from workshops were summarized in workshop-specific reports provided to stakeholders (Appendix D). Information was pooled across 50 workshops, and comments from discussions about critical needs and case studies were categorized, evaluated for emergent themes, and evaluated for linkages and dependencies among categories (see below).

Categorization of Inventory of Needs

Responses were categorized based on the prior-defined candidate inventory types used to frame surveys and scoping workshops. Candidate inventories were further refined (lumped) into ten natural resource inventories needed to support NPS operations: Species, Vegetation Community Mapping, Management Areas, Inventory & Monitoring Locations, Assessment Points, Surficial Geology & Soils Mapping, Natural Resource Hazards, Natural Resource Digital Media Data, Citable Science, and Base Cartography (Table 5). A full description of the scope of the final ten inventories is presented in Chapter 3.

Three candidate inventory types were dropped from consideration. Ecosystem Services and Condition Assessment were determined to be studies to which inventory data contribute. Bedrock Geologic Mapping—a nearly-complete basic inventory—was not discussed in any scoping workshop as a critical need and was therefore considered complete.

Table 5. Resolution of candidate inventory types used for scoping to the ten natural resource inventories used for design of the IMD Inventories 2.0 program. Full description of the scope of each NR inventory is presented in Chapter 3.

NR Inventory	Brief Description	Candidate Inventory Types
Species Occurrence & Distribution	Presence, distribution, and natural history characteristics of extant and extinct taxa located or potentially located within parks.	Species Occurrence & Distribution, Species Range, Paleontological Resources
Vegetation Communities (AKA Vegetation Maps)	Completion, update, or expansion of basic vegetation community mapping inventories.	Vegetation Maps
Surficial Geology & Soils (AKA hybrid Surficial Geology and Soils Maps)	Maps of geologically-recent management-relevant surficial units that include surficial geology and soils information.	Surficial Geologic Mapping, Soils Mapping
Management Areas	Boundaries of areas used for management or planning that are explicitly linked to supporting information that describes use, management targets, or other factors relevant for data analysis and reporting.	Management Treatment Areas, Viewsheds (boundaries used for Visual Resource Inventories), Wilderness Character (boundaries thereof), Disturbed & Restorable Lands, Research Catalog (study areas)
Inventory & Monitoring Locations	Locations within and near parks where inventory or monitoring are currently or have historically been collected, with relevant associated metadata such as the types of data collected, periods of record, and how to acquire them.	Monitoring Stations
Resource Management Assessment Points	Catalog of specific numerical thresholds or qualitative categories used for interpreting environmental or ecological inventory and monitoring data.	Management Thresholds
Resource Hazards	Location, type, and condition of biological, physical, or chemical hazards within and adjacent to parks.	Hazards, Contaminant Sources
Natural Resource Sounds and Images	Digital photo, video, and audio records that can be used for analysis of resource status and condition within or adjacent to parks.	Night Skies, Soundscape
Citable Science	Data, reports, findings, records, archives, and specimens significant to informing natural resource planning decisions.	Scientific Literature, Models & Forecasts, Research Catalog (findings and reports)
Base Cartography	General GIS layers needed for routine cartographic, planning, or spatial analysis activities.	Base Cartography, LiDAR, Climate-Sensitive Resources, Imagery, Water Bodies, Boundaries, Watershed Characteristics, Natural Resource Features, Resource Extraction Locations
Not 2.0 Inventories	—	Ecosystem Services, Condition Assessments, Bedrock Geologic Inventories (complete)

Key Findings From Scoping Workshops

- Species and Base Cartography were the most-cited critical natural resource inventory needs, being discussed at 100% and 84% of workshops respectively. The quantity of specific needs, examples, and descriptions of how data from those inventories would be used were also highest for those two inventories (Figure 1; Appendix E).
- No natural resource inventories were identified during scoping that are needed across all NPS units. Although Species was a universal inventory need, the type of Species inventories needed spans all taxonomic groups and life forms, extant and extinct taxa, and includes genetics.
- The most-frequently-mentioned Base Cartography needs were LiDAR data, better GIS coverages related to water features (including streams, lakes, groundwater, and marine currents), and locations of climate-sensitive resources.
- Participants provided the most details on why Species, Base Cartography, Vegetation Communities, and Management Areas Inventories are necessary to support management (Appendix E).
- Based on the critical needs identified across scoping workshops, Vegetation Communities was the third-most needed inventory for both parks and networks, but was not a top-five-mentioned need for regional office or national programs. Vegetation Community information needs are largely driven by its utility for habitat management and modeling efforts tied to species management or analysis of vital signs monitoring data.
- Management Areas, Surficial Geology/Soils, and Natural Resource Digital Media Data were consistently in the top five most-mentioned critical needs across all levels of hierarchy (Natural Resource Digital Media Data not for networks, though).
- Case studies or needs associated with “Night Skies,” “Viewsheds,” and “Condition Assessments” identified natural resource natural resource needs that spanned four of the ten natural resource inventories, which were not parsed in this analysis:
 - Inventory & Monitoring Locations: locations where Natural Resource Digital Media data are collected, including locations of audio recording devices, dark sky monitoring equipment, visibility monitoring equipment, or photopoint stations.
 - Management Areas: delineated areas of viewsheds and associated vantage points; sampling or sampleable areas associated with monitoring stations, or study areas for condition or risk assessments.
 - Citable Science: peer reviewed studies (e.g., simulation studies of views and night skies), modeling outputs (e.g., those from dark skies and natural sounds programs, including noise exposure maps or light pollution or exposure maps).
 - Condition Assessments: Results of visual resource inventories include both a valuation study and a condition assessment. Products may include reports or data files that could be included in the Citable Science inventory.

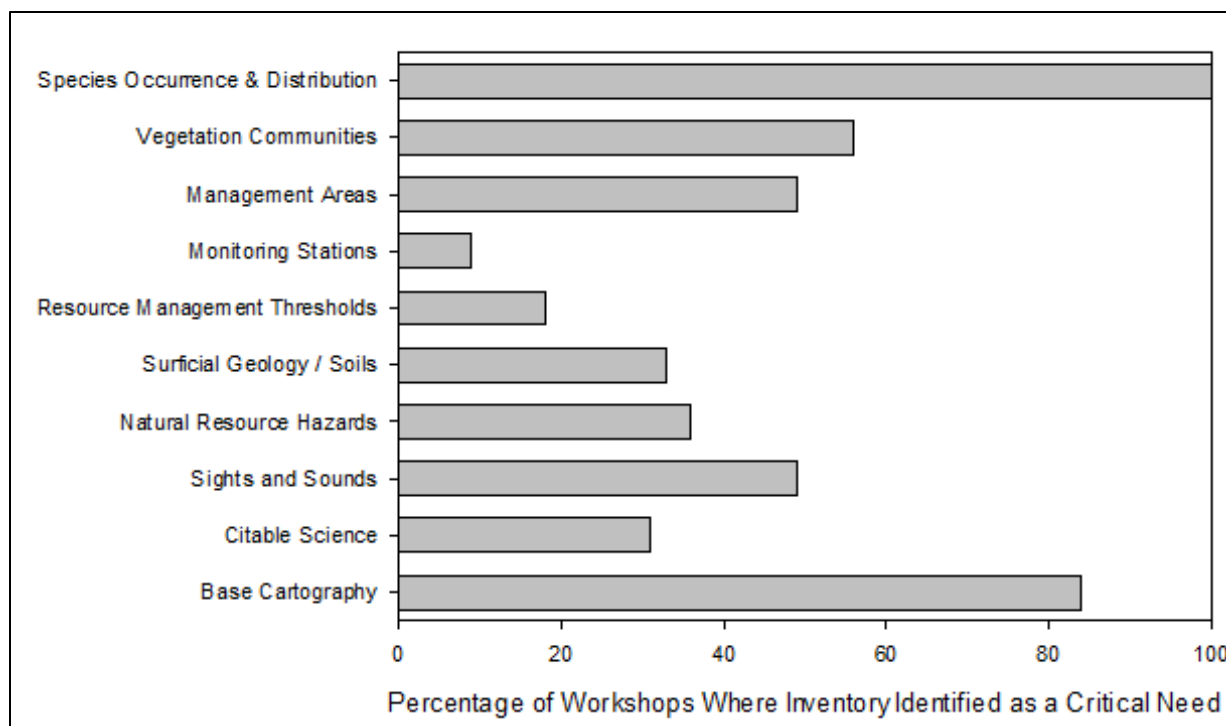


Figure 1. Percentage of scoping workshops in which each inventory was identified as a critical need.

Thematic Assessment and Linkages Among Inventories

Several themes emerged from scoping that span job type and organizational hierarchy.

Consistency in Types of Inventory Data Needed

NPS typically needs the same natural resource inventory data across all programs and organizational levels (Table 6), but how those data are used varies. Chapter 3 discusses the multiple uses of natural resource inventory data that were identified during the scoping process.

Table 6. Most-cited natural resource inventory needs by organizational hierarchy based on the number of workshops in which each was raised as a critical need or discussed during case study development. Inventories in the same row were tied.

Rank	Parks	Networks	Regional Offices	National Programs
1	Species	• Species • Base Carto • Veg Communities	• Species • Base Carto	• Species • Base Carto
2	Base Carto	—	—	—

Table 6 (continued). Most-cited natural resource inventory needs by organizational hierarchy based on the number of workshops in which each was raised as a critical need or discussed during case study development. Inventories in the same row were tied.

Rank	Parks	Networks	Regional Offices	National Programs
3	Veg Communities	–	• Management Areas • Management Thresholds • Surficial Geology/Soils • Natural Resource Sounds and Images	• Management Areas • Surficial Geology/Soils • Natural Resource Sounds and Images
4	• Management Areas • Natural Resource Sounds and Images	Hazards	–	–
5	–	Surficial Geology/Soils	–	–

Integration of Inventory Data

Parks and programs generally need to base science-informed decisions on “holistic” data that are credible, relevant, current, and generally sourced from multiple programs spanning natural and cultural resources, historical and social sciences, and traditional science and knowledge. Inventory data/information from single programs or projects is in most cases insufficient. Typically NPS needs to know what data are available, and a minimum of information about those data to know what (if any) we can use and what (if any) we need to collect to fill information gaps. Data sources include IMD data, data from other national-level NPS programs, other agency and tribal data, park data, and science conducted by partners (Non-government organizations, academia, and citizen science groups). In many cases information from one inventory contributes to another inventory.

Several programs within NPS were identified as potential sources of information that should be leveraged as a part of an integrative inventory program, including programs managed by most NRSS divisions, Fire, Lands, Museums, Cultural Landscapes, the American Indian Liaison Office, and parks.

Use of Inventory Data from Multiple Inventories

The ten final inventories fall into three groups: locations of interest, resources of interest, and information necessary to understand management context (Figure 2). Parks and programs typically need to use inventory data in combination with other inventories across the three categories.

Examples include:

- Filtering/querying resource inventory data by management treatment area, project area, or boundary.
- Presenting inventory data in the context of resource management thresholds or assessment criteria.

- Including observation data from Natural Resource Sounds and Images and Vegetation Community studies in the Species Inventory.
- Using data from multiple inventories to model natural resource risks or hazards.

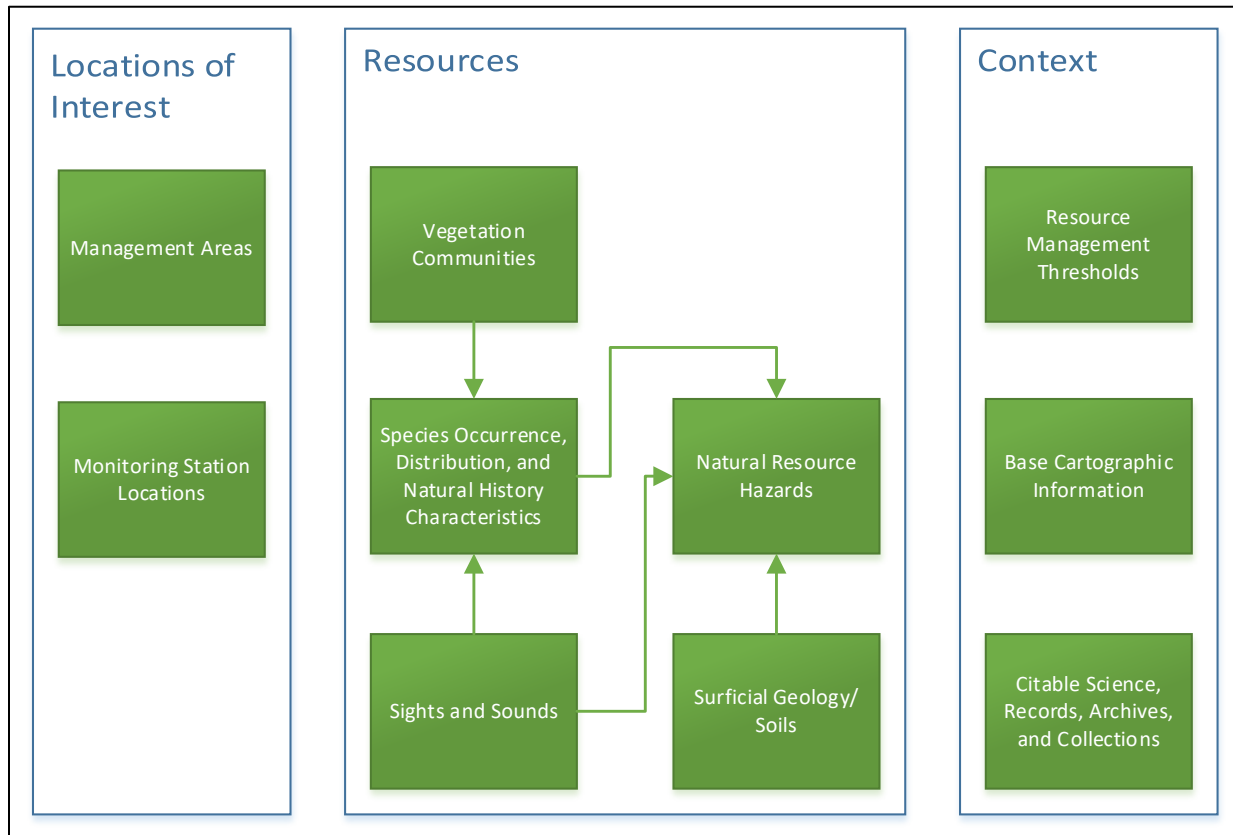


Figure 2. Groupings of the ten Inventory needs by type.

In nearly all scoping workshops, multiple other federal and state agencies, NGOs, academic institutions, and other local partners were identified as potential sources of useful data, but data collected and managed by other organizations varies widely in terms of accessibility, content, format, and quality. If external data are to be used as a part of Inventories 2.0 efforts, resources must be allocated to evaluate the quality and quantity of available data from potential sources to ensure parks and programs have sufficient information to support operations. However, using Inventory funds to make other programs' data available or to improve the adequacy of quality of those data was not recommended.

Need for Inventory Data from Outside Park Boundaries

Fourth, parks and programs at all levels need data from beyond park boundaries to carry out their resource management responsibilities under the NPS mission. As a result, such data needs are part of NPS Natural Resource inventories. These data are critical for understanding the context, threats, and significance of the resources under NPS management purview. In many cases, there are needs to

access, analyze, interpret, and report data at the multi-park or regional level to support collaborative science and resource management efforts.

Planning for Project and Data Management, Analysis, and Reporting Costs

Data management, program management, and interpretation and analysis costs must also be planned and budgeted. In some cases this may include costs associated with completion of 1.0 inventory data management tasks. There was wide recognition that much of inventory data already exist within NPS and beyond, including data from Inventories 1.0, Vital Signs Monitoring, other NPS programs, and the parks. But much like when the Natural Resource Challenge was funded, much data management is still required to make those data open, accessible, and available for use. Managing these data must be a part of Inventories 2.0 to ensure that results from historical or ongoing studies are available for use and that any new studies strategically augment the body of science that already exists.

A wide variety of examples of applications, dashboards, portals, etc., for accessing, acquiring, and visualizing inventory data, as well as tools for integrating inventory data into management were also identified during scoping. Although these provide good examples or models for integrating inventory science into park operations, the specific needs of parks and programs will likely be project dependent and there was no “one size fits all” application identified at either the inventory or multiple-inventory levels.

Other Inventory-Type Programs

Many programs within NPS span inventories, monitoring, or assessment, especially in cases where sampling at any given location may occur only once. In particular, inventory studies often collect more data than the presence, distribution, or attributes of resources—when conducting field studies we often want to maximize the amount of data collection at any given location while we have boots on the ground. Examples encountered during scoping included studies that combine inventories, monitoring, or assessments, and inventories that include cultural resources or other program areas outside the scope of this plan.

Combined Studies (Integrated Inventories, Monitoring, and Assessments)

During scoping, IMD identified several programs or ongoing science initiatives that we further investigated. In cases where such programs were found to be integrative in nature, we used the information gained during scoping sessions and a review of methods to identify a) the core inventory components of such programs, b) opportunities where NR inventory data could support those programs, and c) information from those programs that could potentially contribute to the natural resource inventories as defined in the plan.

Examples included planning and assessment efforts that frequently require an inventory as a first step in the process to identify the target resources within an area or topic of interest. IMD did not consider planning or assessment programs to be inventories in and of themselves because NPS-75 clearly indicates that inventories—in conjunction with monitoring—are intended to contribute to such efforts.

Interdisciplinary Inventories

Programs at the park, regional, and national level are typically designed to synthesize inventory, monitoring, and assessment, often in ways that integrate information across inventories and other scientific endeavors from multiple internal and external programs. Designing inventories in a manner that allows for integration across programs and disciplines was a recurring theme across most, if not all, scoping sessions.

During scoping, we identified several programs or initiatives that collect or rely upon natural—and other—inventory data to assess the condition, significance, or value of resources within and adjacent to parks. Because of their interdisciplinary nature and broader-than-NR-inventory scope, we considered these to be beyond the scope of inventories described in this plan, but we endeavored to identify ways natural resource inventories can contribute significantly to those programs’ success. Examples include:

- NPS National Rivers Inventory, managed by the National Wild and Scenic Rivers System Program, which assesses whether rivers are suitable or eligible for inclusion in the National Wild and Scenic Rivers System in accordance with the Wild and Scenic Rivers Act. Eligibility is based on a combination of hydrologic conditions, any man-made alterations, and an inventory of its natural, cultural, and recreational resources.
- Wilderness Character Assessments, which are designed to provide a holistic assessment of “biophysical environments primarily free from modern human manipulation and impact, personal experiences in natural environments relatively free from the encumbrances and signs of modern society, and symbolic meanings of humility, restraint, and interdependence that inspire human connection with nature.” These are accomplished through the use of existing inventory and monitoring data to assess the degree to which wilderness areas are natural, untrammeled, undeveloped, provide opportunities for solitude or primitive & unconfined recreation, and the presence of other features of value.
- Visual Resource Inventories, which identify, map, describe, and evaluate scenic views so that they can be managed and protected like other natural or cultural resources (NPS 2016). Visual Resource Inventories encompass the landscape and all visible natural and human-made elements within a viewable area, and include an assessment of scenic quality (landscape character integrity, vividness, and visual harmony) as well as the importance of the view and the vantage point to visitors and park programs. Scenic quality and view importance ratings are combined into an overall scenic inventory rating that can be used to inform collaborative efforts to protect views within and beyond park boundaries.

Chapter 3. Servicewide Natural Resource Inventory Needs

Specific Inventory Needs and Role of the Inventory & Monitoring Division

The following sections summarize the scope of needs for each inventory, and IMD's intended contributions toward meeting those needs. Each inventory will require information and partnership between many stakeholders within NPS to fully implement. For each, we present the full breadth of servicewide needs and then identify IMD's role and commitments to help meet those servicewide needs.

Because the scope and intent of inventories is to provide comprehensive information to parks and maintain the currency and relevance of that information over time, the design of each inventory requires implementation of several interconnected focus areas designed to aggregate, collect, disseminate, and integrate inventory data into park operations. The amount and sources of existing data differ among the ten inventories, but the following four focus areas must be included to fully meet identified needs:

1. **Aggregation of existing inventory data.** Several potentially-useful high-quality data sources for each inventory were identified during scoping sessions. At a minimum, NPS staff need access to data created for or by NPS parks and programs in an integrated manner, which includes data from Inventories 1.0 efforts and monitoring data collected/managed by the networks and the Central Office. Aggregation efforts include identification of data sources and evaluation or qualification of data based on their quality and suitability. In most cases, data from disparate sources must also be converted or transformed to common standards prior to use, with an end goal of integrating data sets across time, spatial scale, sources, as well as other inventory & monitoring programs.
2. **Collection of new inventory data where it's needed.** For each ongoing inventory, new data will likely need to be collected to fill information gaps, or to refresh data that are no longer timely or relevant. Collection of new inventory data will occur only after an evaluation of the quality and suitability of existing inventory data. Newly-collected inventory data will be included with other aggregated data sources once studies are completed.
3. **Dissemination of inventory data.** Within NPS, primary outlets for all inventories are a combination of data repositories (for publishing discrete or continuously-amended authoritative data sets), other file repositories (for publishing other digital inventory products), and data & mapping services (for publishing "live" data). In all cases, inventory data and other information must be made accessible, useable and discoverable, with full consideration of data that must be protected.
4. **Integration of inventories with park operations and planning.** Ensuring that inventory data are used in the course of park management and planning is also an NPS requirement (and one of the five I&M Program goals). Successful implementation of the Inventories 2.0 program includes integration of inventory data into existing tools designed to support NPS operations (such as Park Atlas or the NPS Content Management System), development of new tools (such as development of R packages to access, analyze and report inventory data),

and the development of subject-matter expertise to analyze, interpret, report, and apply inventory science.

Based on a review of needs identified during scoping and consideration of available resources and IMD scientific and data management expertise, the IMD Leadership Team has identified its strategic role in each of the inventories in either a leadership or contributing capacity. IMD only plans to lead three inventories—Species, Vegetation Community Mapping, and Surficial Geology/Soils Mapping—but does intend to contribute to all, as described below (Table 7). Broadly, IMD’s roles for each of the inventories are as follows:

- **IMD Leads.** IMD explicitly commits to investing inventory funding in all four focus areas of a given inventory previously described, ensuring that all components of that inventory are implemented such that that scientifically credible and useable inventory data are available, managed over time, kept current and relevant, and integrated into park operations, or
- **IMD Contributes.** IMD works in partnership with parks and programs in a manner that moves NPS toward meeting identified inventory needs in a coordinated fashion. At a minimum, inventory-relevant data collected or managed by IMD through vital signs monitoring efforts will be made available in a manner such that they can be accessed, aggregated, and integrated into park operations by other programs that manage similar inventory data.

Table 7. IMD role in the implementation of each natural resource inventory. Note that roles may shift over time based on available resources, need, and emerging technology.

Inventory	IMD Leads	IMD Contributes
Species	X	–
Vegetation Communities	X ¹	–
Management Areas	–	X
Inventory & Monitoring Locations	–	X
Assessment Points	–	X
Surficial Geology/Soils	X ¹	–
Resource Hazards	–	X
Natural Resource Sounds and Images	–	X
Citable Science	–	X
Base Cartography	–	X

¹ Vegetation Communities and Surficial Geology/Soils are considered second and third in line (after Species) as we phase in Inventory 2.0 projects. However, inventory projects will not be funded until after the completion of targeted scoping sessions to determine appropriate methods and standards to acquire management-relevant information in a timely, appropriate, and cost-effective manner.

Species

The Species Inventory (Table 8) covers the completion, update, or expansion of basic species inventories, but the scope is expanded to include all taxa, including those inventoried under initial

inventory plans plus invertebrates, non-vascular plants, invasives, or other species of management concern. The inventory includes the ability to generate species lists for parks or management areas based on current and available observation data, areas of potential species occurrences based on a combination of observed data, published literature, and/or modeled relationships between occurrence data and physical, chemical, or biological environmental covariates in terrestrial and aquatic environments. Finally, this inventory also includes management-relevant information about taxa related to ecology, management objectives, behavior, growth & development, etc. IMD will lead this inventory.

Table 8. Core species inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs	Purpose/Need	• The ability to generate a list of known and expected species within any given area of interest. • The ability to determine changes in the occurrence or distribution of a taxon within any given area of interest. Note that changes in abundance may not be possible in all (or even most) cases using inventory data alone. • The ability to communicate uncertainty in known and expected species lists or changes in occurrence based on quality of data source(s) and changes in taxonomy over time. • The ability to lump or query species information by management-relevant categories. • The ability to compare species information among areas of interest.
	Type of Data Needed	• Where and when a taxon has been observed. • Where a taxon might be observed or potentially occurs. • Ancillary data about the taxon relevant to scientific analysis and park operations. Park operations include natural & cultural resource management, interpretation & education, and more.
	Scope	• Taxa ○ All currently-living taxa at any relevant level of taxonomic hierarchy. ○ Hybrids, crosses, and varieties. ○ Paleontological species. ○ No specific taxa were identified as servicewide species inventory needs. ○ Although some parks expressed a desire to conduct all-taxa biotic inventories (ATBIs), these were not identified as a servicewide need during scoping.

Table 8 (continued). Core species inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs (continued)	Scope	• Observation Information ○ The ability to access and use observational data from multiple authoritative sources with known/assumed level of credibility. ○ Data from external sources must be regularly updated to ensure they are current and relevant. ○ Observation data should wherever possible include the specific location where the observation was made as well as an identification that includes both the taxon and identification standard used. ○ Wherever possible, sources of observation data should include non-detect data (locations and taxa that were actively searched for but not observed).
	Scope	• Distribution Information: ○ The ability to access and use published range maps from multiple authoritative sources with known/assumed level of credibility. ○ Covariate-constrained “habitat” maps. ○ Migration maps & conservation corridors. ○ Distribution information primarily required for taxa of management concern, and may include species, subspecies, and (in some cases) populations within species
	Scope	• Ancillary Management-Relevant Characteristics: ○ Ecological Characteristics (structure, function, behavior, phenology, migration, growth form). ○ Indicator categories & values (water quality, air quality, focal spp., climate-sensitive, watchlists, Coefficient of Conservatism scores, AQRVs). ○ Conservation Status (T&E, Exotic/Invasive). Geospatially explicit. Inclusive of Historical, Cultural, or Ethnobiological significance & context. ○ Paleontological data (first/last occurrence dates). ○ Socioeconomic parameters (incl. pests, game spp., commercially valuable, dangerous). ○ TEK characteristics and uses. ○ Importance of species to visitor experience. ○ Data protection and dissemination rules. ○ Genetic & Phenotypic variability. ○ Demographic variability.

Table 8 (continued). Core species inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
How Inventory Data are Used	Project Planning, Design, and Implementation	• NEPA (species lists are a common required element). • Development of Resource Stewardship Strategies. • Planning EPMT controls (EDRR). • Facilities/maintenance planning and design (avoidance of sensitive species). • Research study design (targeting or avoiding taxa). • General permit and proposed action review: evaluating potential impacts of planned/proposed actions on species of management concern. • Permitting, managing, or protecting consumptive and traditional uses. • Protection and management of poachable species. • Siting of decontamination stations or inspection stations. • Identifying high-value conservation locations (areas in need of protection, acquisition, where section 7 consultation may be required, or that are of ecological significance). • Damage assessments. • Prioritizing and timing of actions and projects.
	Reporting	• T&E annual reporting. • Recovery plan reporting. • Cultural Resource Management. • Determining or ensuring representativeness and completeness of park collections. • Modify or update museum scopes of collection. • Plan and mitigate use of facilities by wildlife (i.e., bats).
	Policy Development	• Boating and fishing regulation development and review (annual process). • Commenting on changes to fish and wildlife management proposals or regulations. • Developing management targets for population size, demographics, and distribution.
	Science & Research	• Source & vector identification (exotics, pests, pathogens). • Predict invasion speed or locations. • Habitat associations, habitat suitability modeling, and habitat vulnerability assessments. • Fire behavior and impact. • Biodiversity hot spots. • Human/non-human interaction potential.

Table 8 (continued). Core species inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
How Inventory Data are Used (continued)	Outreach, Education, and Visitor Experience	• Lists, habitat associations, and pictures used for interpretive materials and programs. • Checklists. • Determining potential species that could be seen for any given date and location.
	Monitoring	• Providing distribution and abundance context for understanding or interpreting monitoring data. • Understanding impacts of species augmentations & removals. • QA/QC of observations (particularly identifying new taxa observed).
Considerations to Maximize Utility	Timeliness	• Data sources should be as close to “live” as possible, recognizing that each will have its own time lags. • Goal is to capture the dynamism of what's present. • Users need on-demand queries for observation data with the latest and greatest data. • Annual updates to range/distribution maps, particularly for T&E, noxious, or other reportable spp.
	Accuracy	• Will vary based on the type of data source (not necessarily mutually exclusive): ○ Presence/absence data and/or data collected using a documented sampling design that potentially allow specialized use for analysis. ○ Data with a QA/QC plan where observations (or a subset thereof) are considered to be high-quality. ○ Data from credible source institutions & programs where identifications are assumed to be valid (i.e., museums). ○ Observations from trusted individuals or subject-matter experts. ○ Validated or substantiated observations from non-subject-matter experts where observations are assumed to be suitable for some uses. ○ Observations from other sources.
	Accuracy	• Accuracy requirements vary by use, but in general more-useable observation data is: ○ Collected by a subject-matter expert following standard methods using a documented circumscription. ○ Location-specific.
	Accuracy	• Must include metadata to informing appropriate use: ○ Sampling or data collection information. ○ Identification info. ○ Collector & Identifier info.

Table 8 (continued). Core species inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility (continued)	Audience	• Internal, external, with adequate filtering of protected data. • Mobile access and acquisition is important. • Observations and distribution maps need to be available via NPS Atlas and AGOL to support planning. • Information needs to be provided as an ArcGIS service to support activities such as interagency wildland decision-support systems such as WFDSS (Wildland Fire Decision Support System) and IFTDSS (Interagency Fuels Treatment Decision Support System).
	Other Associated Data Important for Context and Use	• Gene banks. • Population studies. • Paleoecological information. • Supporting data (field notes, photos, vouchers).
	Other Associated Data Important for Context and Use	• Other inventory data sets: ◦ Areas of Analysis, Boundaries, and Management Areas (including past actions). ◦ Geology. ◦ Vegetation Maps. ◦ Soils. ◦ Imagery. ◦ Base Cartography.
	Other Associated Data Important for Context and Use	• Other national data sets: ◦ Landscape Dynamics/Land Use/Land Cover. ◦ Climate. ◦ Hydrology. ◦ Air Quality.
	Opportunities	• Integration with Museum collection data (internal and external) to provide access to voucher information. Preferably e-access. • Lots of park-collected data that can be harnessed & integrated. • High potential for citizen science data collection using existing applications.
	Challenges	• Curation costs for specimens. However, there is no requirement to collect specimens and/or vouchers. But if they are collected their long-term management must be planned for. • QA/QC on what's currently in NPSpecies. • Understanding/communicating variability in quality and completeness among taxa based on effort, distribution, and detectability.

IMD Priorities and Commitments

IMD will lead the Species 2.0 inventory.

1. IMD will identify and review species inventory data collected during Inventories 1.0 and external sources, ensure those data are properly documented and published, and wherever data are suitable, ensure those data are aggregated and made available to parks along with other species information. This will be done for all NPS units where data currently exist.
2. IMD will fund field-based studies to collect new species inventory data and/or studies to acquire data from other sources. Data will be aggregated with existing data and made available to parks for use across projects, programs, and sources. This will be supported in all current I&M parks and in non-I&M parks with IMD Leadership Team approval.
3. The focus of new species inventory studies will be on extant species within or potentially within parks, with priority being on collecting new inventory data intended to be used to support or inform park planning or management decisions. This is expected to vary across parks based on resources, available information, and management need. Taxon and spatial scale for new data collection is entirely park-needs-driven: studies may be targeted to one or more taxa, one or more parks, or taxa within a subset of a park.
4. Species inventory data management tools may be used to support management, delivery, and reporting of paleontological data where it already exists.
5. IMD will develop tools and criteria for species inventory studies that facilitate consideration of existing data and their quality/utility, and product specifications that ensure that all new species inventory data can contribute to future study development.
6. In general specimens collected during the course of inventory studies are assumed to be consumed in analysis. The collection or creation of voucher specimens is neither mandated nor a goal of Species inventory studies, but it is also not discouraged. If vouchering is desired,
 - a. A one-time long-term maintenance cost will be accounted for in project costs using a 10-year time frame. Maintenance costs beyond 10 years must be borne by the unit where vouchers are permanently held.
 - b. Priority will be on vouchering new park records rather than generating additional voucher specimens where they already exist.
 - c. Photo vouchering will be encouraged whenever possible to minimize long-term curation costs.
7. Additional needs identified during scoping to improve access, quality, and value of data collected by NPS parks and programs will be evaluated and prioritized during annual work planning based on need, available resources, analysis of existing data, and partnership opportunities.

Vegetation Community Maps

This inventory involves the completion, update, or expansion of basic Vegetation Community Mapping inventories (Table 9). While Vegetation Mapping 1.0 efforts focused on generating

nationally-consistent park-wide maps, Inventories 2.0 will focus on studies that leverage existing vegetation mapping data to expand, update, or enhance vegetation maps. New inventory studies may develop maps at finer resolutions, remap areas after disturbance, update outdated maps, or map previously-unmapped lands using existing classification systems. Mapping may include submerged lands if suitable classification standards and methods are identified. IMD will lead this inventory.

Table 9. Core vegetation community inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs	Purpose/Need	• Map of where vegetation community types are located within and surrounding parks, with some evaluation of uncertainty. Uncertainty must be based on map class error/uncertainty; not mapping product uncertainty. • Community classification types, definitions, and type locations. These may be tied to one or more classification systems. • Crosswalk between classes mapped/identified and management relevance.
	Type of Data Needed	• Park-wide base map that can be updated in project-scale subunits as needed over time.
	Scope	• Community Classifications: ○ NVCS is the default for new mapping efforts but others may be appropriate. ○ NPS needs to be able to use and crosswalk maps made using other classification systems. ○ Classification system must account for natural vegetation, disturbance, and management relevance.
How Inventory Data are Used	Project Planning, Design, and Implementation	• Selecting and siting of monitoring locations. • Planning EPMT controls (EDRR). • Used in most park natural resource management plans. • Fire risk assessment and management planning. Any vegetation plot data must be available to support Landfire (national veg and fuels map) mapping efforts. • Restoration planning and design. • Research study design. • General permit review: evaluating potential impacts of planned/proposed actions based on veg community, habitat associations, and potential species distributions. • Permitting and managing consumptive and traditional uses. • Vulnerability assessments (climate, species). • Visual Resource Inventories. • Ecological site descriptions. • Cultural landscape analysis/inventories.

Table 9 (continued). Core vegetation community inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
How Inventory Data are Used (continued)	Reporting	• Basic cartographic layer used as background layers for maps in multiple products, including NEPA.
	Science & Research	• Change detection: ○ Damage assessment (storm, fire, insect pests, pathogens, exotic invasions, recreation impacts). ○ Climate change impact analysis.
	Science & Research	• Modeling: ○ Species distribution or occupancy ○ Used to identify “high-value” areas for species conservation and management, including community types with conservation status, habitat refugia, and wetlands. ○ Water balance. ○ Fire behavior and fuel loads. ○ Travel costs for field work. ○ Ecosystem services (particularly carbon balance and flux). • Used to identify and map habitat connectivity and travel corridors.
	Monitoring	• Used as a habitat covariate or for defining reference locations for use in effectiveness monitoring or analysis of park vital signs data.
Considerations to Maximize Utility	Timeliness	• Need to be updated after significant ecological events such as wildfire, beetle kills, flooding, storms, landslides, or significant changes in land use following park management activities. • Need to be validated and updated as a part of management planning activities. • For parks/lands without a base map, an approach to developing an area-wide veg map baseline is needed that can be implemented quickly and cheaply with an understanding that it will be augmented or amended as needed by project-scale studies. • For supporting management planning and design, a rapid approach needs to be developed to ensure that veg mapping data are not outdated by the time they’re published, or can be rapidly updated to reflect current conditions when needed. Note that planning cycles occur on the days-to-weeks time scale. • Interim products must be made available as soon as possible. Particularly imagery, which has multiple secondary uses and value. • Recognizing that value decreases with age, scheduled or routine updates must be timed as follows: ○ Every 10 years or so is ideal, but even 15-25 years is likely adequate for most uses. ○ Timed to enhance the utility of new Resource Stewardship Strategies.

Table 9 (continued). Core vegetation community inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility (continued)	Accuracy	- Scale & Resolution: - Do coarse-scale more frequently; finer scale less frequently. - Do coarse-scale at broader spatial extent; finer scale at smaller-spatial extent. - May need to adjust scale and resolution to support fuels modeling in cases where it's an intended secondary use of veg mapping data. Does not need to drive all veg mapping specifications though.
	Classification Standards	- NVCS a good Classification standard, but also allow: - Flexibility to adapt/align classification systems used by adjacent units to allow continuous mapping beyond borders when possible. Particularly useful where we share boundaries and management goals. - Augment NVCS with "modifications" to natural classes to indicate disturbance, invasives (use a dual or bifurcated classification system). - Classification by management significance/relevance.
	Classification Standards	- Association or coarser level likely suitable for modeling. Finer is better. Recommendation: - Alliance or coarser level for park-wide or large-area mapping beyond park boundaries. - Association for project-scale mapping.
	Comparability	- Need to be able to do something repeatable to allow for comparisons over time. Given expected changes and variability in field methods, imagery sources, and photointerpretive methods, this must be based on comparisons of the mapping results (cell/polygon/classification system used) rather than designing methods to be repeated over time. - No need for consistency across areas: - Acceptable to have higher-detail in some sections of parks. - Acceptable to have lower-detail classification in some areas, particularly outside of park boundaries. - Acceptable to have differing classifications across boundaries. Consistency preferred, but coverage is higher priority.
	Audience	Park staff who use it for project-scale planning, permitting, and site condition assessments/evaluations. In most cases, the map is a starting point that is validated prior to implementation of a project (where risk of harm to resources is of concern), or assumed to be suitable (where risk of harm to resources is assumed to be negligent).

Table 9 (continued). Core vegetation community inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility (continued)	Audience (continued)	• Park, regional, network, and national-scale scientists who use the map as a part of analyses to support resource management decision making. • Cartographers, interpreters, and communicators who use the map coverage/image as a part of product and program development to further communications or messaging goals. • Stakeholders need the data in GIS format with descriptive data that tie classes to resource management in order to support the decision-making process. Ideally accuracy is explained in terms of concrete uncertainties wherever known (low accuracy in a polygon is due to confusion among class X and Y, for example). Should be available in both office/desktop and mobile-friendly formats. • Data/information also need to be available via data/mapping services for integration into NPS Atlas.
	Other Associated Data Important for Context and Use	• Species observation data. • Management treatment areas (planned and historical). • DEMs & Canopy structure (derived from LiDAR, for example). • Historical imagery. • Climate. • Soils. • Fuels. • TEK characteristics and uses associated with vegetation community classes.
	Opportunities	• Many partners, most of which are known from 1.0. • Many data sources, most of which are known from 1.0. • Tools to investigate for delivery and integration: ○ USFS Forest Health website has forest insect and disease info https://foresthealth.fs.usda.gov/portal/Flex/IDS ○ Explore Natural Communities is a website by NatureServe that uses this data: http://www.explorenaturalcommunities.org/ ○ PACN AGOL web mapping application: http://www.arcgis.com/home/item.html?id=35541aff101446a790503c85ccbba0b0
	Challenges	• Cost, time, and complexity will be an ongoing challenge/roadblock without changes to methodology. • Use of a veg map isn't intuitive for many users; integration with management will continue to be challenging.

Table 9 (continued). Core vegetation community inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility (continued)	Challenges (continued)	• Size/scale of new projects needs to be small enough to be completed in a short amount of time (ideally one field season & a compact analysis and reporting time) to ensure completion without turnover, and integration with park operations driving the need. • Baseline inventory maps for additions to existing I&M parks and full-park remapping efforts will not typically be funded, except in cases of small parks or areas where the potential mapping extent is effectively “project scale” as described in #3 above. • Development of baseline maps for new parks or non-I&M parks will not be considered for Inventory 2.0 funding unless specific directives and additional funding become available.

IMD Priorities and Commitments

Vegetation Community Mapping is the second inventory to be implemented by IMD.

1. IMD will conduct further scoping with NPS stakeholders and subject-matter experts to develop recommended product specifications and suggested methods. Because methods and specifications will vary by study scale and intended data use, IMD seeks to develop a menu of appropriate methods and final product specifications options and guidance for method/specification selection. Scoping will also include methods for mapping vegetation and structure in submerged areas. Scoping will be designed to identify:
 - a. Appropriate methods to be used when conducting new inventories or updates to existing inventories
 - b. Updated methods for conducting accuracy assessments that leverage existing knowledge (prior mapping, monitoring, or other program data).
 - c. Final product specifications that ensure new data (maps, plots, accuracy assessment, and other ancillary data) are useful in the short- and long-term, and contribute to other inventory efforts as appropriate.
2. Study methods and specifications will be reviewed to ensure that studies and inventory data will be cost effective, and result in timely delivery of products (under two years). Methods will be reviewed from both a programmatic and scientific/statistical perspective prior to adoption.
3. Assuming appropriate and cost-effective methods and standards are identified during scoping, IMD will fund studies to conduct new or update existing vegetation maps. New studies will be funded that:
 - a. Are designed such that the scale, minimum mapping unit, and methods are selected to ensure rapid delivery of products in a management-relevant timeframe,

- b. Use existing classification systems and community type definitions,
 - c. Use existing imagery wherever possible (though new imagery may be acquired if necessary), and
 - d. Include accuracy assessments, though criteria and standards may be different for 2.0 products than they were for 1.0 products.
4. Key inventory products will include maps, plot data, accuracy assessment data, and reporting.
5. IMD will identify and review vegetation mapping inventory data developed during Inventories 1.0 and external sources, ensure those data are properly documented and published, and wherever data are suitable, ensure those data are aggregated and made available to parks via mapping and data services with any 2.0 inventory study results.
6. IMD will fund projects to “crosswalk” classification systems, including versions of systems as they evolve over time, and across parks, where there is a need to “scale up” mapping products beyond single park boundaries. IMD will also use crosswalks to translate maps across classification systems so that data can be interpreted in the context of historical, future, or adjacent mapping efforts rather than updating or republishing 1.0 products solely to upgrade existing inventory products to new versions of classification systems.

Surficial Geology & Soils Maps

Based on scoping, better surficial geology is needed at multiple parks, augmented with management-relevant soils information (Table 10). Although Inventories 1.0 versions of soils maps are completed for most parks with significant resources, stakeholders indicated that some of the resultant products are not suitable for informing most resource management decisions. Because methods for hybrid Surficial Geology/Soils mapping have not yet been identified, this inventory will need further scoping and methods development to fully understand NPS needs and potential approaches.

Table 10. Core surficial geology and soils inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs	Purpose/Need	• Provide geologic information that distinguishes among geologically-recent management-relevant formations/features not presented in existing GRI geologic data sets. • Provide information related to ability of soils to support resource management needs. • <i>Note: Core needs and requirements still need definition as information provided during the scoping sessions focused on misalignments between existing geologic/soils mapping products and resource management needs.</i>
	Type of Data Needed	• Soil porosity. • Soil parent material and substrate considerations for infrastructure development.

Table 10 (continued). Core surficial geology and soils inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs (continued)	Scope	Still to be determined.
How Inventory Data are Used	Project Planning, Design, and Implementation	- Informing decisions related to ranching/stocking rates and capacity. - Identification of surficial geologic features and units in need of protection or management. - Understanding drivers of vegetation productivity and wildlife movement/migration. - Determining suitability of sites for restoration or development.
	Science & Research	- Modeling: - Identifying or forecasting location, distribution, and type of geologic hazards and potential risk to other natural and cultural resources. - Identification of potential locations where paleontological resources may be exposed. - Erosion potential. - Permafrost response to climate change - Habitat suitability. - Water balance. - Management, Planning, and Permitting.
	Science & Research	- Change detection: - Evaluating magnitude and type of landform and geomorphic changes.
Considerations to Maximize Utility	Timeliness	Varies, but no imminent needs were identified. Time-sensitive derivative products (such as hazards maps) can be generated using other means, potentially less-efficiently, using other methods.
	Accuracy	- Conducted at management-relevant scales, and updatable as lands are disturbed by natural and anthropogenic processes. - Will need to be done at a scale comparable to imagery or landcover data sets if used for habitat analysis and some other modeling uses.
	Audience	Primarily for NPS uses, who will be using the data for modeling purposes or for deriving other data sets (such as hazards maps).
	Other Associated Data Important for Context and Use	- Vegetation Maps and associated data. - Species distribution and occurrence (extant and paleo). - Geologic Maps and associated data.

Table 10 (continued). Core surficial geology and soils inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility (continued)	Other Associated Data Important for Context and Use (continued)	• Soils Maps and associated data. • TEK characteristics and uses associated with surficial geology or soils features.
	Challenges	• Producing maps at scales relative to resource management, particularly for large parks. • Identifying what and how to map features or units in dynamic systems

IMD Priorities and Commitments

This is the third IMD-led inventory to be implemented, along with Species and Vegetation Community Mapping.

1. IMD and GRD will conduct further scoping with NPS stakeholders and subject-matter experts to develop recommended product specifications and suggested methods. Because methods and specifications will vary by study scale and intended data use, IMD seeks to develop a menu of allowable options and guidance for method/specification selection. Scoping will also include methods for mapping bathymetry and soils/habitats in submerged areas.
2. IMD will fund projects when methods and specifications have been identified, reviewed, and determined to be appropriate and cost effective, and result in timely delivery of products (two years or less). Methods to be reviewed from a programmatic and scientific/statistical perspective prior to adoption.
3. Assuming appropriate and cost-effective methods and standards are identified during scoping, IMD will fund studies for field-based collection of new data or acquisition of data from other sources.
4. IMD will work with GRD to ensure that all Inventory 1.0 soils and surficial geology products are made available in an open/accessible/discoverable format, are available via mapping and data services, and are presented in conjunction with results from 2.0 inventory efforts.

Management Areas

The Management Areas Inventory includes delineated areas/polygons necessary for planning and conducting management or scientific activities and subsequent analysis and reporting of information (Table 11). Areas are explicitly linked to supporting information that describes, prescribes or limits any aspect of NPS operations, including associated information related to mandates, goals, management objectives/targets, or use. IMD will contribute to this inventory.

Table 11. Core inventory information needs about management areas, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs	Purpose/Need	• Need to be able to query data from other data sources based on these boundaries. This includes querying records within individual data sets as well as the ability to provide a comprehensive list of what information is available within any given area (to support condition assessments or other synthetic analyses). • Some management areas may need to be routinely updated to account for or evaluate change over time. • Need to be able to overlay boundaries to evaluate competing or complementary requirements, uses, and expectations. • Need to be able to understand the management history of any location.
	Type of Data Needed	• Polygon bounding an area relevant for management, analysis, or reporting. • Linked information pertaining to the purpose, designation, or relevance of the area. • (optional) Point locations within, on the perimeter of, or outside the area of management relevance.
	Scope	• Areas of Interest: ○ Park boundaries and management units. ○ Areas of Analysis for monitoring or other scientific activities. ○ Type and timing of park management treatments (recent, planned, and historical). Treatments include: ▪ Fire. ▪ Land management e.g. mowing, agricultural use, forest management. ▪ Exotics management. ▪ Vegetation management or silvicultural operations. ▪ Disturbed lands or restoration areas. ▪ Event-based damage and disturbance areas, including those that are natural and human-caused. ▪ Viewsheds (vantage points and viewable areas for visual resource management). ▪ Designations and designated uses (including Wilderness and Wild and Scenic Reivers). ▪ Rights domains. ▪ Project footprints.

Table 11 (continued). Core inventory information needs about management areas, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs (continued)	Scope (continued)	• Areas of Interest: (continued) • Type and timing of park management treatments (recent, planned, and historical). Treatments include (continued): ▪ Commercial, visitor, or subsistence use areas (including access nodes/routes). ▪ Noise abatement zones. ▪ Lighting zones.
	Scope	• Linked Information: ○ Enabling legislation, GMPs or other management plans, management objectives, and fundamental values related to designated or authorized boundaries. ○ Protocols, sampling designs, study plans, data sets, and reports related to areas of analysis used for park science. ○ Compliance documents, Requirements Analyses, Decisions (actions proposed, approved, and denied). ○ Event timing, magnitude, type, etc. ○ Values, historical context, or other social/cultural related contextual information. ○ Condition, damage, risk, or vulnerability assessments. ○ Contracts, agreements, obligations, rights, and responsibilities. ○ Ownership.
	Scope	• Point Locations ○ Access points. Typically on the perimeter and joined to an access pathway (the buffer around which might be another management area). ○ Reporting locations. Centroid or other designated location for reporting of protected information. ○ Vantage points. Location from which an area is defined, such as the viewing location that defines a viewshed.
	Scope	• Additional considerations ○ May include areas outside of park boundaries. ○ May include (or not include) the water column below and air column above ground-delineated areas.
How Inventory Data are Used	Project Planning, Design, and Implementation	• Identification and engagement of partners for collaborative project design and implementation. • Integration of natural history data with archaeological, ethnographic, and historic landscapes to develop integrated NR/CR picture of resources.

Table 11 (continued). Core inventory information needs about management areas, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
How Inventory Data are Used (continued)	Project Planning, Design, and Implementation (continued)	• Plan for, evaluate impacts of, and mitigate visitor uses and impacts. • Prioritization of areas for action or treatment (and to determine appropriate management actions). • Designing appropriate potential outcomes of management actions or planning activities • Logistics and safety planning.
	Reporting	• Summary of available data and information for an area of interest, queryable or sortable by topic (largely dependent on how other information is documented). • Quantify level of management occurring within park.
	Outreach, Education, and Visitor Experience	• Identification of high-risk areas based on vulnerabilities (to one or more threats), exposure (to one or more stressor). • Forecasting changes or impacts to intended uses, expectations, or requirements of an area due to climate change. • Forecasting or planning for changes in point locations (particularly access points).
	Monitoring	• Understanding and interpreting monitoring or assessment information in terms of desired conditions, treatment effects, and/or mandates, and long-term vital signs trends. • Evaluating effectiveness of management treatments. • Synthesizing or rolling up assessment or valuation information from sub-areas.
Considerations to Maximize Utility	Timeliness	• Data for treatments, management actions, and particularly those used in the context of adaptive management must be available as quickly as possible because of the potential conflict/complement to other potential actions. • Data for areas used for analysis and reporting must be updated annually, though some, if governed by law or contract, likely will change less frequently.
Considerations to Maximize Utility (continued)	Accuracy	• No identified standards other than those used/mandated by the Department of Interior for surveying boundaries. • In practice, this will vary and it will be important to know the accuracy of the boundary area as it is collected—this will inform appropriate use. • Variability among sources and designating & using authoritative versions is necessary.

Table 11 (continued). Core inventory information needs about management areas, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility (continued)	Audience	• In general boundaries and most associated linked information should be available publicly. Reports and linked data sets will in some cases contain protected information that will need to be appropriately screened. • Boundaries and a subset of information about the boundaries should be field-available via mobile device.
	Other Associated Data Important for Context and Use	• DEMs & Imagery. • Base Cartography. • Species inventory data (including monitoring data).
	Opportunities	• Including or leveraging administrative and environmental histories.
	Challenges	• Efficiently integrating footprints for park and regional operations currently not tracked digitally in most park units.

IMD Priorities and Commitments

IMD will contribute to this inventory.

1. Area of Analysis information (custom boundaries for use in analysis of landscape dynamics data) pertaining to the implementation of IMD's National Park Environmental Settings Monitoring Protocol will be managed in a way that allows networks, parks, and programs to use those data for other purposes (DeVivo et al. 2018). These areas will be managed in a way that is consistent with and inclusive of other areas of interest such as EPMT treatment areas, burn areas, viewsheds, network sampling frames, wilderness areas, and designated use areas.
2. All management area information managed by IMD will be made available for use in analysis and reporting via data and mapping services. New management areas of interest can be added annually as a part of protocol implementation in consultation with networks following existing standard operating procedures.
3. IMD recognizes that this is a high-value inventory servicewide, with such information currently managed inconsistently across many parks and programs. IMD will cooperate with other programs and regularly reevaluate its role in this inventory to determine whether to expand its contributory role based on technical, scientific, and organizational feasibility of ensuring fully-successful implementation.

Inventory & Monitoring Locations

The Inventory & Monitoring Location Inventory catalogs the location of monitoring stations or sampling locations in use (or historically in use by) NPS and partners where natural resource data have been collected (Table 12). This inventory does not collect or manage the data being monitored at each station, but instead catalogs what parameters are being collected, the periods of record for each parameter, and information on where and how to obtain the data/summary reports. This

inventory combines and augments several Inventory 1.0 inventories, including water quality stations, air quality stations, and climate stations.

Table 12. Core information needs pertaining to inventory and monitoring locations, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs	Purpose/Need	Must be able to identify and query existing monitoring locations by polygon, type of data being collected, period of record, and/or station type in order to identify what monitoring data are being collected in any given area of interest.
	Type of Data Needed	- For any station, need to be able to retrieve/display: - What data are being collected (type, as well as measure- and parameter-specifics). - Period of record available. - Type of station (synoptic, temporary, permanent). - Link to data source. - Relocation or other site identification information (if available). - Photo (if available).
	Scope	- Station Types: - Synoptic. Locations of purpose- or design-driven data collection at single points in time with no planned recurrence intervals. Limited to stations where the data collected are presumed to have a long use window (such as geophysical stations) or where data collected are integrative of conditions surrounding the locations (as in the case of condition assessments). Does not include ad-hoc, incidental, or reconnaissance observations. - Temporary. Designed and installed to collect repeat measures over a discrete/defined period of time, such as those used in damage/recovery assessments, short-term trend investigations, or Before-After-Control-Impact comparisons. - Permanent. Long-term repeated data collection that, when installed, did not have a planned station retirement date (though some permanent monitoring stations may have been discontinued).
	Scope	- Data Types: - Monitoring (current and historical): - IMD monitoring locations. - Park or partner monitoring locations. - Weather/climate. - Night Skies.

Table 12 (continued). Core information needs pertaining to inventory and monitoring locations, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs (continued)	Scope (continued)	- Data Types (continued): - Monitoring (current and historical) (continued): - Natural Sounds/soundscape. - Elevation. - Stream gauge. - Water Quality (all waterbody types). - Air Quality (e.g., NADP). - Tides. - Sea level. - MAPS. - Other biological, physical, or chemical monitoring stations. - Visual resource / scenic views - Inventory (current and historical): - Vegetation plots. - Soil pits. - Geologic cores. - Ice cores. - Other observational point location data.
	Scope	- Geographic Scope: - Within and around parks. Around parks defined either based on buffer/distance, or by HUC (for hydrologic-related stations).
How Inventory Data are Used	Project Planning, Design, and Implementation	- Identifying what data are available when beginning planning stages of a project in order to establish baseline conditions or to identify knowledge gaps. - Identification of partners or subject-matter experts with whom to engage in project design, implementation, or evaluation. - Identification and evaluation of opportunities for coordinating laboratory analyses & contracts. - Identification of infrastructure or locations that may be at risk of damage or loss of scientific integrity from park operations (fire management; exotic plant management)
	Reporting	Presentation or dissemination of real-time data to evaluate current conditions (particularly for weather, hydrologic, and tidal data).
	Science & Research	Identification of appropriate data sources and types for use in synthetic analyses or model development.
	Monitoring	Identification of locations with data collected using similar or comparable methods.

Table 12 (continued). Core information needs pertaining to inventory and monitoring locations, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility	Timeliness	Station locations and periods of record must be updated no less frequently than annually, but must be updatable from sources “on demand.”
	Accuracy	Must be accurate enough to (re)locate in the field based on information provided by the data provider. Assumption is that location and station metadata are appropriately QA/QCed before being published and disseminated by source.
	Audience	- Primary audience is internal NPS staff. - Some monitoring locations will need to be screened/filtered because they are at protected locations and subject to park-specific dissemination rules. - NPS-managed or sponsored stations should be publicly available to external users (no need to republish data provided by other agencies).
	Other Associated Data Important for Context and Use	- Underlying sampling design used when setting up the station and/or collecting data (this informs how data may be used). Should link to sample frame Area of Analysis (AOA) included in the management area inventory. - For hydrologic stations, need to know which are collecting data on resources entering parks, leaving parks, outside parks, or within parks.
	Opportunities	Crosswalking data parameters with the National Environmental Methods Index.
	Challenges	Within NPS there are many data sources to wrangle, many of which are not available via data or mapping services.

Note that there are other information needs associated with inventory & monitoring locations, including management of historical documentation (installation and maintenance logs), station maintenance, and collection or management of data at those locations. These are considered outside the scope of the Inventory & Monitoring Location inventory.

IMD Priorities and Commitments

1. Hydrologic and climate monitoring station information pertaining to the implementation of IMD’s National Park Environmental Settings Monitoring Protocol will be managed in a way that allows networks, parks, and programs to use those data for other purposes. Monitoring station data will be managed in a way that is consistent with and inclusive of other monitoring stations identified as a part of Inventories 1.0 (water quality stations and air quality stations).

2. IMD will ensure that all monitoring station locations associated with network vital signs monitoring protocols and locations associated with 1.0 Inventories are also made available for use by parks and programs.
3. IMD recognizes that this is a high-value inventory servicewide, with such information currently managed inconsistently across many parks and programs. IMD will cooperate with other programs to determine whether to integrate additional monitoring station information based on technical, scientific, and organizational feasibility.

Resource Management Assessment Points

The Resource Management Assessment Points inventory is a comprehensive catalog of specific assessment points (numerical thresholds or qualitative categories) used for interpreting environmental or ecological inventory and monitoring data (Table 13). This inventory allows for consistent audience-, location-, and resource-specific uses of assessment points across programs, and includes all types of assessment points defined in Bennetts et al. (2007): ecological thresholds, critical loads, regulatory or policy limits/standards, management thresholds, desired future conditions, range of natural variation, and thresholds of potential concern.

Table 13. Core information needs pertaining to resource management assessment points, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs	Purpose/Need	• Ability to find existing relevant assessment points or thresholds for use in reporting conditions of park natural resources. Must be able to query thresholds that have been developed for other similar systems, sites, or resources. • Ability to consistently apply assessment points for reporting or understanding the condition of park resources across parks and programs.
	Type of Data Needed	• Criteria and appropriate use information for relevant assessment points recognizing that some assessment points are geography-, method-, analysis-, assessment framework-, life stage-, and audience-specific. • Thresholds must be applied to any combination of management area and parameter.
	Scope	• Categories of assessment points: ○ Ecological thresholds. ○ Critical loads. ○ Regulatory or policy limits/standards. ○ Baseline conditions. ○ Management thresholds/triggers.

Table 13 (continued). Core information needs pertaining to resource management assessment points, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs (continued)	Scope (continued)	- Categories of assessment points (continued): - Desired future conditions. - Range of natural variation. - Thresholds of potential concern.
	Scope	- Types of assessment points: - Status thresholds are basis of comparison for a particular measurement in space & time. - Spatial status thresholds can apply to point locations or polygons (for example water chemistry exceedences at single locations or averaged across all sampled locations). - Temporal dimensions can be a single point in time, or averaged across sampling periods (for example, applied to single measurements or monthly averages). - Trend thresholds are a basis of comparison for changes in measurements over time, and can apply to measurement value/magnitude (differences or rates of change), or measurement variability.
	Scope	- Not assessment points: - Categories of resources (climate-sensitive, management-relevant, sensitive, allowable uses, level of data protection). These are handled as attributes to features/objects/taxa in source data sets.
How Inventory Data are Used	Project Planning, Design, and Implementation	- Establishing triggers to initiate actions in an adaptive management framework. - Evaluating cumulative impacts of actions. - Defining new assessment points based on those used in similar systems or for similar resources. - Updating or establishing targets used/referenced in GMPs, resource management plans, or resource stewardship strategies. - Defining and managing park zones for appropriate uses.
	Reporting	- Structured condition assessments or “report cards”. - Tracking progress toward management goals.
Considerations to Maximize Utility	Timeliness	- Thresholds need to be available for use on demand. - Thresholds must be current—particularly for thresholds based in law and policy, where they must be updated as laws and policies change.

Table 13 (continued). Core information needs pertaining to resource management assessment points, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility (continued)	Accuracy	- Consistency in use of assessment points will be important. Although use is situationally dependent, it's important that situational use is designed rather than arbitrary. Especially for thresholds that trigger action. - Need to be clear on sourcing of assessment points (law/policy, citation, best professional judgement).
	Audience	All.
	Other Associated Data Important for Context and Use	- Must have data to compare thresholds to. - Management areas, including park boundaries, particularly where assessment points are geographically specific in their application.
	Opportunities	- This inventory can add value and context to any data source, particularly in reporting, analysis and decision-support stages. - Potential to use initial monitoring data sets and inventory 1.0 data as baselines in some cases. - Identifying and collating thresholds as a part of condition assessment and planning activities.
	Challenges	There are a lot of assessment points out there. Selecting where to start and focusing on those that are useful and relevant will be a priority.

IMD Priorities and Commitments

1. A number of networks are currently creating and managing management assessment points for use in interpreting monitoring results. IMD may assist other programs that are actively involved in developing, cataloging, and reporting to resource management thresholds to facilitate consistent use across programs.
2. IMD will work with the Natural Resource Condition Assessment (NRCA) program to meet the data management needs associated with this inventory. The Water Resources Division (WRD) is currently funding IMD to develop a condition reporting system that will need to house park- and resource-specific assessment point criteria. The current assumption is that IMD will want to continue to be involved because of our programmatic requirement/expectation to report inventory & monitoring data in the context of thresholds.
3. IMD will contribute assessment point information relevant to IMD-funded inventory and monitoring efforts to the NRCA system.

Natural Resource Hazards

The Natural Resource Hazards inventory includes the location, type, and condition of natural resources that pose a significant risk to visitor safety or the condition of other resources (either

natural or cultural) (Table 14). Hazards include potential and actual biological, physical, or chemical hazards within and adjacent to parks.

Table 14. Core natural resource hazards inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs	Purpose/Need	• Need to know the location of specific hazards or potential hazards with associated information pertaining to what is threatened, mitigation costs, and why NPS cares from management standpoint. • Must be able to list and map hazards based on what is at risk, where, and by management area of concern (i.e., where do we have known threats to visitor safety?).
	Type of Data Needed	• Physical: ○ Slope, aspect, topography. ○ Light sources. ○ Road stability. ○ Slope stability. ○ Erosion hazards. ○ Floods. ○ Volcanic. ○ Earthquakes
	Type of Data Needed	• Chemical: ○ Disposal/remediation sites. ○ Spills. ○ Emission sources and what's emitted. ○ Incidence/presence of contaminants of concern. ○ Point-source effluent. ○ Septic systems.
	Type of Data Needed	• Biological: ○ Disease or pathogen incidence or presence. ○ Species affected by or vectors of biological hazards.
	Scope	• Data from mapping sources: ○ Much info in base carto (or the 2.0 version of it), but data need to be "tagged" as hazard-related at the product or feature level for discovery and use. ○ New field-collected data, particularly for things that are relatively stationary.

Table 14 (continued). Core natural resource hazards inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs (continued)	Scope	• Geospatially-explicit models: ○ Exposure pathways, flows, fluxes (for biological and chemical hazards). ○ Inundation risk. ○ Impacts of external drivers based on type of stressor, intensity, and proximity. ○ Soil erosion potential. ○ Species distribution maps (for destructive species). ○ Emergence of new risks.
How Inventory Data are Used	Project Planning, Design, and Implementation	• Establishing total mitigation costs for proposed projects and actions. • Siting of facilities or infrastructure. • Planning of field work. • Endangered Species and Wild and Scenic River Section 7 determinations • Identifying threats to visitor or personnel safety, mitigating threats, or minimizing exposure to threats. • Identifying areas of high erosion potential and where those areas coincide with other resources of value. • Informing appropriate use of resources and areas within parks.
	Reporting	• Advising visitors and staff to new threats and appropriate mitigations. • Modeling or forecasting changes in risk over time. This includes hazards expected to emerge as a result of climate change (from permafrost thawing, for example).
Considerations to Maximize Utility	Other Associated Data Important for Context and Use	• Landscape dynamics monitoring data (national protocol). • Geology maps. • Surficial Geology/Soils maps (if completed). • Base cartographic information, including imagery. • Observation and distribution of vectors or taxa at risk
	Opportunities	• There are also a multitude of hazards information contained in trip reports, STAR requests, Geoscientist-in-the-Parks products, state geological survey websites/publications, Federal Highways, US Geological Survey websites/publications. NRCS products (Web Soil Survey) and SRI products also include soil stability information which can be used as another indicator of hazard potential

Table 14 (continued). Core natural resource hazards inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility (continued)	Challenges	• Low frequency of occurrence, but high consequence of not being aware of where they are. • Communicating information about hazards without scaring people off unnecessarily.

IMD Priorities and Commitments

1. Hazard mapping is currently coordinated and conducted by the Geologic Resource Division and the Water Resource Division. IMD will partner with these divisions and other programs and ensure that IMD information (geology and soils maps, and monitoring data, for example) are useful, accessible, and available for use to map or model resource hazards.

Natural Resource Sounds and Images

The Natural Resource Sounds and Images inventory includes digital photo, video, and audio records that can be used for analysis of the status and condition of resources within and adjacent to parks (Table 15). This inventory is limited to fully-documented multimedia data collected under standardized methodologies by IMD, the Natural Sounds and Night Skies Division, the Air Resource Division, parks, and others. It does not include multimedia files collected or used as a part of communication activities, though inventory information of this type may be used to support communication activities.

Table 15. Core natural resource sounds and images inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs	Purpose/Need	• Document the state of resources at a given location and time using digital multimedia techniques/formats. • Must be able to query multimedia assets geographically, temporally, by type, and by format. • Must be able to access and integrate with digital assets managed as a part of other inventories & programs (particularly GIS and museum programs) to inform management decisions.
	Type of Data Needed	• Natural Resource Data: ○ Photo/video documentation of night skies and nocturnal environments ○ Recordings of Natural Sounds. ○ Acoustic species monitoring (birds, bats, amphibians) conducted by parks, networks, and partners.

Table 15 (continued). Core natural resource sounds and images inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs (continued)	Type of Data Needed (continued)	- Natural Resource Data (continued): - Video transects. - Photopoints. - Photoplots. - Photodocumentation of scenic views - Visibility Monitoring. - Scenic Views.
	Type of Data Needed	- Museum & Archives: - Photo vouchers.
	Type of Data Needed	- Imagery: - Aerial photos and imagery.
	Scope	- Digital photo, audio, and video files that record the presence or condition of natural resources. - Digital photo, audio, and video files that have the potential to be used as a source of information in science-based natural or cultural resource management. - Includes multimedia files pertaining to above-ground and submerged resources. - Does <i>not</i> include multimedia files solely used to record operations or to support NPS communications.
How Inventory Data are Used	Project Planning, Design, and Implementation	- Facilities design & planning (from both a noise, light, and visual impact perspective). - Habitat restoration and management goals (species or ecosystem process). - Dark Sky designation. - Park planning and compliance document development. - Condition Assessments: - Exposure, risk, and effects of noise type, magnitude, or other variable. - Exposure, risk, and effects of light source type, magnitude, or other variable. - Exposure, risk, and effects of visual resource impacts, magnitude, or other variable. - Overflight detection or impact assessment.
	Science & Research	Phenology studies.

Table 15 (continued). Core natural resource sounds and images inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
How Inventory Data are Used (continued)	Outreach, Education, and Visitor Experience	• Multimedia contribution to interpretive programs or communication efforts. • Citizen science and collaboration with gateway communities
	Monitoring	• Detecting, identifying, counting, and/or measuring natural and cultural resources of interest and/or threats or stressors to those resources. • Identification of source, type, and magnitude of impacts or stressors (vessels, vehicles, structures, light sources, overflights, others). • Detecting and quantifying change in noise or light contamination. • Assessing visitor use and visitor use impacts. • Stratifying or categorizing monitoring locations by degree of anthropogenic influence. • Establishing Natural Sound or soundscape baseline. • Establishing Night Skies or lightscape baseline. • Establishing Visual Resource baseline. • Wilderness character assessment & monitoring (for solitude quality).
Considerations to Maximize Utility	Timeliness	• For many parks, need for monitoring and subsequent modeling is imminent.
	Accuracy	• Files must be location- and date-specific and date/time stamped.
	Audience	• Inventory data are primarily for park managers and staff but are managed to be available for secondary uses & users beyond their originally-collected intent. Includes internal and external cooperators.
	Other Associated Data Important for Context and Use	• Thresholds for light- or sound-disturbed, both for parks as a whole and for sensitive species or other resources. • Many assets are collected as a part of other inventory & monitoring efforts. Need to be able to integrate data sources (and metadata requirements) in a way that eliminates the need to double-manage multimedia files. • Monitoring stations (where possible, sampling areas and detection areas as well). • Derived monitoring data (what resources were detected, not detected, and ancillary measurements). • Digital elevation and surface models • Base cartographic information • Human dimensions data (visitor experience survey data).

Table 15 (continued). Core natural resource sounds and images inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility (continued)	Other Associated Data Important for Context and Use (continued)	• Local zoning information and/or sources of impacts to park resources and visitor experience • Land use and land cover data.
	Opportunities	• Engaging RISD for long-term management and curation of assets.
	Challenges	• Currently no servicewide standards to adopt; but need consistent metadata standards to allow for efficient discovery and to inform appropriate uses. • Large volume of existing data, large files, and needed storage capacity and bandwidth requirements. • Dealing with protected species observations data.

IMD Priorities and Commitments

1. Inventories 2.0 investments will focus on what the IMD needs to support, analyze, and report Natural Resource Digital Media data as a part of I&M monitoring protocols. This includes photo, video, and audio data collected as a part of vital signs monitoring and inventory 1.0 and 2.0 efforts funded by IMD.
2. IMD will ensure that all IMD-funded Natural Resource Digital Media data are available/accessible and will also collaborate to define or identify appropriate metadata standards to promote discovery, utility, and consistency so that they may ultimately contribute to a servicewide Natural Resource Sounds and Images inventory. This may include one or more repositories established by other programs within NPS.
3. Achieving accessibility may vary by data type and file format. If making data accessible is not possible or practical (such as in the case of large audio or video files), IMD's priority will be to ensure that metadata are accessible & discoverable and that data are appropriately managed in long-term centralized repositories.

Citable Science, Records, Collections, and Archives.

This inventory includes existing scientific information suitable for use as the basis for science-based management (Table 16). NPS-75 defines the scope and purpose of this inventory as an effort to identify and organize scientific information and associated metadata in such a manner that allows for the generation of automated bibliography of current/relevant documents, studies, records, and data pertaining to park resources, including documents from outside NPS, which are important for informing natural resource planning and management decisions. This inventory includes results from current and historical studies performed or funded by NPS and external literature of subject-matter relevance. This inventory assembles and organizes topically relevant information from multiple sources in a manner that is accessible and discoverable.

Table 16. Core inventory information needs pertaining to citable science, records, collections and archives; description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs	Purpose/Need	• Ability to create, store, update, and retrieve current topical bibliographies or reviews, including references from both internal and external sources. • Ability to generate lists of cited works with links to products and data services referenced and created by projects or studies. • Ability to identify all information NPS has on any given topic, for any given area based on a subset of holdings created for/by NPS (often used to support national reporting requests).
	Type of Data Needed	• Reports, journal articles, or other published documents. • Data, maps, multimedia files, models, analysis code, or other digital data assets. • Records. • Archives. • Collections (primarily natural history).
	Scope	• Any information that can be cited or referenced as a credible source of information to support planning, implementation, and reporting of NPS natural resource science-based activities. • Includes information pertaining to natural resources and other scientific information that may be considered in the management of natural resources, including information pertaining to cultural resources & values, human dimensions, law & policy, plans, etc. • Historical and current science.
How Inventory Data are Used	Project Planning, Design, and Implementation	• Construct or assemble background information about specific resources, topics, threats, or geographies as a part of written planning documents or funding proposals. • Identify potential NPS subject-matter experts based on product authorship and other product metadata. • Identify potential partnerships among parks or subject-matter experts. • Identify similar relevant data, reports, and information resulting from work conducted in other park units. • Reduce redundant research & development activities and associated expenditures. • Evaluate need and potential impact of new projects based on similarity, co-location, and redundancy of prior work within and among parks.
	Reporting	• Identify information/products created by a program within NPS. • Track use and value of NPS-created/funded reports and data based on citation frequency.

Table 16 (continued). Core inventory information needs pertaining to citable science, records, collections and archives; description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
How Inventory Data are Used (continued)	Science & Research	• Identify knowledge gaps and knowledge baselines to support new research activities or proposals. • Provide historical context of new work and findings. • Validate novel findings. • Determine state of the science for any given topic. Written synthesis paired with references, ideally ranked in terms of relevance/value. • Identify key findings on any given topic within a given period of time between a point in the past and the current date.
Considerations to Maximize Utility	Timeliness	• Information retrieval must be on demand. • For topical synthesis requests, the turnaround would have to be quick in order to be responsive & relevant. • Access to underlying source information (especially externally-identified journal articles) must be quick.
	Accuracy	• Must be citable, with citation being traceable to a specific version of any given product. • Ideally (and required for all NPS-managed assets), “tagged” with a persistent identifier, including one or more of the following: ○ DOI (digital object identifier) (primarily for reports or digital assets). ○ ARK (primarily for records and archives). ○ LSID (Life Science ID) used for biological specimens, concepts, and associated information. • Queries must present the end-user with the most-recent authoritative version of any given asset.
	Audience	• Internal and external users for all NPS-generated information, with appropriate screening of protected information from public. • Internal-use-only for some non-NPS-generated information where restricted by licensing. • To the greatest extent possible, provide access to cited works to public and internal audiences (even for those products disseminated by non-NPS entities).
	Other Associated Data Important for Context and Use	• Management areas for bounding queries spatially.
	Opportunities	• Data Store, the new LTDM solution, and RISD’s library program should provide a solid foundation for asset management from which internal information can be aggregated.

Table 16 (continued). Core inventory information needs pertaining to citable science, records, collections and archives; description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility (continued)	Challenges	- Syntheses or topical reviews have a “shelf life,” as well as a requirement for quick turnarounds that will be difficult to achieve. Likely cannot be (fully) automated as much of the synthesis work is the role of a scientist with an understanding of the intended audience. - Providing access to information in a manner complementary to and not duplicative of other tools designed to search, locate, and retrieve background information to support scientific activities.

IMD Priorities and Commitments

IMD will contribute to this inventory.

1. IMD will develop and maintain tools to ensure that all documents, collections/archives, studies, records, and data resulting from IMD-funded activities are available for others to discover and use. IMD’s efforts will build upon existing work related to the 1.0 Bibliographic inventory, IRMA, and the NPS Data Store.
2. IMD will ensure that NPS scientific products can be appropriately cited using persistent URLs (such as digital object identifiers) through the Natural Resource Report Series and Data Store.
3. IMD will ensure that NPS science in the Natural Resource Report Series and Data Store is made available through common discovery tools used by the scientific community, including tools such as Google Scholar.

Base Cartography

This inventory includes fundamental GIS layers needed for routine cartographic or planning activities available in formats for use with commercial and open source GIS software (Table 17). Includes all of the “static” layers included in the original baseline inventories and others (such as the locations of dams, culverts, or others).

Table 17. Core base cartographic inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs	Purpose/Need	Must have access to current, accurate, and authoritative geospatial data sets used for routine cartographic purposes. Ideally this is available through one place to discover and access authoritative data.

Table 17 (continued). Core base cartographic inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Core Information Needs (continued)	Purpose/Need (continued)	• Must be able to query or aggregate data across parks at the watershed, regional, or national level with consistent cartographic presentation. • Need clear place(s) to publish authoritative versions of data created for & by IMD and NPS.
	Type of Data Needed	• Most cartographic data have associated parameters/data that are useful for efficient analysis and reporting that remain static over time. • Similar needs & design to what was done in 1.0, with updates and changes based on newly-recognized information gaps, newly-available data, and new uses of information. • Model/Planning inputs for decision support tools such as the Wildland Fire Decision Support System
	Scope	• Things added to Base Cartography: ○ LiDAR data. ○ Watersheds and watershed characteristics. ○ Waterbodies, to include lakes, aquifers, springs & seeps. ○ Significant NR Features, including thermal features. ○ Glaciers. ○ Permafrost. ○ Flowpath maps (particularly for groundwater). ○ Current maps (nearshore marine). ○ Archaeological locations. ○ Infrastructure. ○ Flow impoundments and discontinuities. ○ Cave resources: entrances, extent/network, features, and hydrology.
	Scope	• Things from 1.0 Base Cartography Inventory in need of updates: ○ Hydrology (Update to NHD3+), with identification of anadromous waters. ○ DEMs (ideally derived from LiDAR); extending below sea level for marine/riverine/lacustrine bathymetric maps. ○ Imagery.
	Scope	• Things removed from Base Cartography: ○ NPS boundaries (moved to management areas because of linkages to areas' purpose, goals, etc.).
	Scope	• Data sources can be static or dynamic data files, layers, or services.

Table 17 (continued). Core base cartographic inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
How Inventory Data are Used	Project Planning, Design, and Implementation	- Base cartographic data are routinely-used data sources as a part of most planning efforts and scientific analyses conducted by NPS. - Data are used to assist with day-to-day decisions with regard to where to site management actions.
	Reporting	Need to increase efficiency and clarity through standardization in routinely-used cartographic data sources and presentation of similar information service-wide.
Considerations to Maximize Utility	Timeliness	There's a needs backlog so getting some of this information is high-priority, particularly for data that impact legal, policy, or real-estate decisions.
	Accuracy	- Scale of data layer must match intended/required use. This might not be standard Service- or even park-wide (nor does it need to be). - Base Cartographic data must be citable, authoritative, and of known quality. - Base Cartographic data must meet current (and evolving) service-wide mapping standards.
	Audience	Base cartographic data should be publicly available unless protected under existing statutes.
	Other Associated Data Important for Context and Use	<u>Management areas</u>: routinely-used, frequently-amended areas of interest that are linked to one or more documents/plans that provide information related to use, values, goals, desired outcomes, etc. Because NPS is constantly adding areas of interest and because these areas are used to frame analysis of other data, Management Areas is treated as a separate inventory. <u>Hazards</u>: Also geospatial and mappable data, but includes only a subset of features or elements within base cartographic data. Hazards also include information derived from monitoring efforts and other scientific analyses. <u>Citable Science</u>: Discrete research or management projects that occur at the park scale also in some cases provide geospatial data that are relevant for cartographic purposes or further geospatial analysis. In most cases the high-value information will be aggregated into one or more of the other inventories (such as species observations), or do not meet the "routinely-used" criterion for base cartographic data. This includes items such as model outputs.

Table 17 (continued). Core base cartographic inventory information needs, description of how information is used, and considerations for ensuring maximum utility of information based on scoping sessions with NPS staff.

Category	Subcategory	Description
Considerations to Maximize Utility (continued)	Opportunities	- Partnering with planning and the NEPA/EA process to acquire base cartographic data through projects, studies, or assessments (fill information gaps using contracts that include data products as ancillary deliverables that NPS can reuse for future planning efforts). - Data can be managed by NPS, or available and referenced by NPS. NPS does not need to own/store/manage copies.
	Challenges	- Storage capacity, bandwidth and accessibility due to large volume and size of available data. - Distribution and communication of updates of dynamic data sets. - Identifying and designating authoritative versions of NPS-created base cartographic data where multiple copies currently exist.

IMD Priorities and Commitments

IMD will contribute to this inventory

1. To the greatest extent possible, IMD will rely on and leverage the NPS GIS program to manage and support base cartographic needs of NPS units and programs, including data management and delivery.
2. IMD will ensure that any base cartographic products developed as a part of inventory and monitoring activities are made available via official NPS GIS repositories for reuse. IMD will not fund projects for the sole purpose of creating or managing new base cartographic data.

IMD will endeavor to have Network and Central Office representation on the GIS Council so that needs identified through our program are incorporated into the GIS Council work plan.

Chapter 4. Program Administration

The administrative requirements and general planning and implementation process for the Inventories 2.0 program are presented below. Specific criteria for identifying, selecting, and managing new inventory studies will be developed in early FY 2019. The overall Inventories 2.0 planning process is designed to establish scientific criteria for inventories where IMD is taking a leadership role, and map out short- and long-term inventory needs, while allowing for flexibility to change priorities as management priorities change and the body of inventory data grows.

Inventory Program Requirements

General Priorities and Sideboards

The purpose of the inventory program is to provide information necessary to support resource management, planning, or operations that is currently unavailable. The IMD Leadership Team has identified the following sideboards for implementation of the Inventories 2.0 program to ensure the program meets this purpose.

- Prior to initiating a new inventory study a review of existing inventory information and knowledge gaps is necessary and explicit park needs of the data to support resource management, planning, or operations must be demonstrated.
- All I&M parks are eligible for funding to support new inventory studies (see Appendix A for the complete list). Non-I&M parks established before 2000 may be eligible for funding pending approval of the project by the IMD Leadership Team. Inventories 2.0 funding cannot be spent to collect new data in parks established in 2000 or later, that are not currently served by an I&M network. Data from other sources may still be aggregated and delivered to these parks, however.
- IMD will phase in implementation of IMD-led inventories during the first five years of program implementation. This will allow IMD to focus near-term efforts on meeting needs identified by the greatest number of parks (Species) while conducting necessary scoping to further refine needs for Vegetation Community Mapping and Surficial Geology/Soils Mapping inventories.
 - During next two years, inventory efforts will be focused on implementing the Species inventory, beginning with foundational work in advance of field data collection efforts to be funded in 2020.
 - Additional scoping to identify suitable methods and minimum product specifications for Vegetation Community and Surficial Geology/Soils mapping will be conducted in 2018-2019. These two inventories will be phased in based on findings from scoping and progress toward closing out existing (1.0) inventory efforts.
- Inventories 2.0 funding will not be used to fund programs or initiatives already funded or committed to by other programs, divisions, or agencies. We will endeavor to partner with these entities when possible and appropriate to meet inventory needs identified in this plan, and to ensure IMD-created inventory (and monitoring) data are available to support other programs.

- Data and other products resulting from new IMD-funded inventory studies must be managed by IMD, by another NPS program, or by an approved third-party acting under contractual authority and oversight by IMD/NPS. This does not preclude sharing data with third parties or use of third-party tools or data distribution systems. At a minimum IMD commits to make inventory data available to others via the Data Store as well as data and/or map services.
- To the extent possible, IMD management of inventory data will use the data management infrastructure used for managing monitoring data. This includes a commitment to leverage data, tools, systems, and expertise where it already exists.
- “Tools” is defined broadly to include anything that NPS or public stakeholders may use to acquire, aggregate, discover, disseminate, analyze, interpret, or integrate inventory data into park resource management and planning.
- IMD will build modular needs-driven tools or processes that can be easily maintained, scaled, shared, and leveraged, rather than building and maintaining large data management applications designed to meet all inventory needs. Any tools or applications will be designed to allow for integration and reuse among inventories and across programs. Any tools, applications, or investments will be designed to be useable by the greatest number of parks possible, including I&M, non-I&M, and new parks, wherever such design does not incur additional costs attributable to new parks.
- Because of IMD’s explicit mandate to integrate I&M data with planning, wherever practicable, IMD commits to work with NPS Planning to ensure map and data services are integrated into NPS Atlas projects for each park or other planning tools as they are developed over time.

Data Management Requirements

Prior to funding studies that involve data collection, specifications, methods, and standards will be developed and fully documented to ensure that resultant products can be integrated/aggregated with other inventory data. At a minimum, this will include:

1. Defining required elements for data collection
2. Developing templates or standards for data reporting or other study deliverables
3. Defining metadata requirements to maximize discoverability, accessibility, and re-use of inventory data for secondary purposes.
4. Identifying or creating repositories for submission of final products
5. Developing standard workflows for accepting, reviewing, assimilating, and making inventory data available for use by parks, programs, and the public.

All inventory studies must adhere to data management requirements.

To the greatest extent possible, IMD will leverage the Data Store and IMD’s next-generation data management solution to support long-term inventory & monitoring data management needs.

Any scientific and data management efforts where the IMD Central Office plays a contributing role—with networks or other NPS programs—will be designed such that resultant work can contribute to one or more inventories. Science and data management efforts will be designed such that they help to achieve long-term inventory goals. In the short term, this includes

1. Designing data management tools to manage monitoring stations used as a part of the IMD Environmental Settings Protocol (climate stations, hydrologic stations, and areas of interest) in a manner that is scalable to potentially include other monitoring station types.
2. Designing and deploying features of IMDs next-generation long-term data management solution that allow for disseminating study results and extracting inventory data from well-documented data sets.
3. Implementing network data management support projects in a manner that allows for discovery and use of inventory-relevant data such as monitoring stations, sampling frames, areas of interest, species observations, assessment points, etc.

Inventories 2.0 Implementation

Implementation of the Inventories 2.0 process has three broad steps. First, peer-reviewed inventory science plans will be developed for all inventories where IMD takes a leadership role, to ensure that means for collecting, organizing, and integrating data result in scientifically-credible bases for support of park management and operations. Second, inventory study plans will be developed on a cyclical basis to prioritize, fund, and implement new projects designed to improve park and service-wide inventory information. Third—and concurrent with development of science plans and the first study implementation plan—we have identified several action items to ensure that the staffing, data management systems, and planning processes are in place before collecting and receiving data from new inventory studies.

Inventory Science Plans

An inventory science plan will be developed for each of the three inventories to be led by IMD. These plans will be based on guidance in use by IMD for development of protocols (Oakley et al. 2003, DeVivo *In Review*) and will include inventory objectives, a summary of methods and designs for data collection/acquisition, quality assurance information, data management, data analysis and reporting, and records management. Science plans will include operational components as well, including budget and staffing details, and standard operating procedures to guide the inventory's overall implementation. Inventory science plans will be peer reviewed prior to finalization, though it is expected that some species field studies will be funded prior to (or concurrent with) review and approval of the species inventory science plan.

Inventory Study Plan Development

Study plans will be three-year implementation plans, with the flexibility of modifying planned work for the second and third years based on a review of needs, priorities, and appropriations (Table 18). This cycle is intended to reduce annual planning workloads, allow for multi-year analysis of inventory data to identify knowledge gaps or strategic focus areas, and develop funding priorities for future inventory studies. To the greatest extent possible, IMD will strive to use surplus funds during any fiscal year to fund out-year studies. Plans submitted in years two and three of each funding cycle

are expected to be simplified modifications based on available funding, changes in priorities, and projects funded to date. Each three-year plan will also be designed to ensure equitable distribution of studies servicewide.

Table 18. Inventories 2.0 planning and study implementation cycle.

Category	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025
Planning	Cycle 1 Implemen- tation Plan	Cycle 1 Modifica- tion	Cycle 1 Modifica- tion	Cycle2 Implemen- tation Plan	Cycle 2 Modifica- tion	Cycle 2 Modifica- tion	–
Implementation	–	Cycle 1 Year 1	Cycle 1 Year 2	Cycle 1 Year 3	Cycle 2 Year 1	Cycle 2 Year 2	Cycle 2 Year 3

Planning Process

Identification of Inventory Study Needs. In the first spring of each three-year planning cycle, inventory program staff (see below) collate existing documented study needs and solicit additional or new needs from parks. Information needs identified in approved park planning documents (foundation documents, resource stewardship strategies, and others as appropriate), and projects submitted through the Servicewide combined call process will serve as the primary sources of documented needs. IMD inventory staff will solicit additional needs directly from parks and through IMD networks on an annual basis.

Inventory staff will work with parks and networks to refine inventory study needs, including study descriptions, evaluation of existing available data and suitability, explanations of how new data are intended to further science-based decision making, study cost, and target implementation and completion dates. Each study will also be screened for eligibility based on the type of inventory, work to be done, park(s) where the project is to be implemented, cost, duration, and adherence to inventory program requirements. Servicewide study needs will be managed by IMD as a catalog of long-term inventory needs.

Prioritization of Inventory Studies. Proposed studies will be prioritized at the national level based on a combination of park-driven science needs, analyses of existing data identify knowledge gaps or strategic focus areas (see discussion of Inventories Science Applications Manager position below), and potential for “bundling” projects of similar scope, need, and geography. Priorities will be developed based on input from parks, networks, regions, and other subject-matter experts as appropriate. Project priorities are expected to change over time, and may be updated each year based on one or more of the following:

1. Changes in park needs based on published or revised management plans, stewardship strategies, other park-, network-, and regional-level planning documents, and emerging project and compliance needs. Note that this may result in the addition of new needs in the second and third year of each planning cycle.
2. Findings from other inventory & monitoring efforts

3. Changes in the quality and availability of existing data, which may vary as new non-inventory data become available through other NPS programs and external data providers.
4. Changes in park boundaries that may warrant expansions or updates to prior inventory studies.
5. Additions or changes to the types, parks, or studies considered eligible for Inventory 2.0 expenditures.
6. Changes in the amount of funding (upward or downward) from anticipated funding levels.

The criteria and process for prioritizing study needs has not yet been determined, but will be developed by the Inventory 2.0 Program Manager in 2019 (see description of job duties below). Prioritization of studies should occur in late summer/early fall of each year.

Study Plan Development and Approval. Study plans will be submitted to the IMDLT for review and approval in the late fall/early winter of the fiscal year. The three-year study plans will include a summary of each proposed study, costs, and implementation/completion schedule, and will include any data management, analysis, reporting, or integration projects required to fully implement inventories. The IMDLT will review and approve the work plan and subsequent annual modifications no later than the end of January of each fiscal year.

Other Preparations for Inventories 2.0 Implementation

Several projects have been identified to be initiated during the first two years of the Inventories 2.0 program. These projects are designed to modularly complement one another, and in most cases will be developed iteratively to add functionality as others are concurrently developed. Many will continue refinement or expand capabilities beyond the initial two-year window as new data sources are identified, and new uses of inventory data emerge. Production, maintenance, and integration of these modules/efforts with NPS operations will be conducted by Central Office data management staff as a part of the Inventory 2.0 program, and will focus primarily on the Species Inventory during the first two years of program implementation.

Program Administration

Project Management and Planning

Staffing: During the first two years of program implementation, IMD will hire the program management lead to ensure that the position responsible for developing annual work plans is on board in sufficient time to develop the 2020 work plan (the first year with planned funding for park inventory studies). In FY2019, the position may be filled on a temporary basis through detail or lateral assignments to refine the planning process, including development of templates and means for soliciting and reviewing proposed studies, a template for the annual work plan, and any tools needed to track the status, costs, and completion of inventory studies.

Establishing Study Selection Criteria: Prior to solicitation of new inventory study needs, criteria for evaluating inventory studies must be developed and communicated broadly. In addition to meeting the requirements outlined above to ensure scientific need and relevance, IMD will select projects in a manner that is transparent and equitable.

Inventory Study Plan Development: After the establishment of study criteria and filling of key staffing positions, inventory study needs will be solicited and prioritized to develop the initial inventory study plan.

Update IMD Inventories Web Presence: The IMD Inventories website will be updated to reflect priorities for Inventories 2.0. For inventories where IMD takes a leadership role, the NPS Content Management System will include resources for accessing inventory data and information about conducting, reviewing, and submitting data from new inventory studies.

Scoping

Vegetation, Surficial Geology, and Soils Mapping Methods Scoping: In 2019 and 2020, IMD and GRD will conduct additional scoping related to the Vegetation Community Mapping (2018) and Surficial Geology/Soils Mapping (2019) Inventories to refine NPS inventory needs, determine specific uses of inventory data, identify cost-effective methods for acquiring those data, and develop minimum project specifications. Scoping will also include an evaluation of 1.0 inventories to identify key lessons learned and potential improvements to incorporate into the 2.0 efforts.

Data Management

Brief descriptions of the scope and intent of projects planned during the first two years of program implementation are provided below. Additional foundational modules related to Vegetation Mapping and Surficial Geology/Soils Mapping inventories may also be added following the methods scoping to be conducted in 2018 and 2019, but have not yet been defined. Note that the following studies do not need to be completed prior to funding new studies. However, work during the first two years will focus on developing the ability to inform selection of new inventory studies with an expectation that those tools will be expanded to meet the analysis and reporting needs identified by parks and programs.

Projects to prepare for new inventory data fall into one of six categories:

1. **Data Repositories:** Service-enabled data “containers” designed to house authoritative versions of data not currently managed as a part of existing NPS programs or projects. Repositories may house data as single observations or discrete data sets. The IMD Data Store will be used as the default data repository for all data to be published as discrete data sets.
2. **Aggregators and Harvesters:** Tools designed to acquire, normalize, and in some cases transform data from multiple data sources or repositories so they can be used to drive data dissemination, decision support, or other reporting and analysis tools designed to inform park management. Aggregators only consume data from service-enabled data sources (such as Inventory Data Repositories); harvesters extract and collate specific data elements across records or data sets within a repository.
3. **Data Collection:** Tools to facilitate collection of new inventory data and integration of those data into the inventory framework. Data collection tools publish data to existing or to-be-built data repositories.
4. **Reference Modules:** Lookup lists or reference libraries designed to add value, information, or relevance to inventory data collected through any of the ten inventories.

5. **Data Dissemination:** Data dissemination modules consume data from aggregators and push data to warehouses or other locations in a manner optimized for specific uses. Includes data and map services designed to offer persistent locations from which inventory data can be accessed.
6. **Decision Support & Park Integration:** Tools to visualize, report, or synthesize inventory data in a manner tailored to specific uses of information by NPS staff in support of science, planning, or operations.

All projects described below will be conducted in coordination with IMD's long-term data management planning efforts and/or IMD guidance and best practices for data management.

Data Repository & Database Development

NPS Ad-hoc Observation Evidence Repository: Repository of basic species observation data, intended to house incidental observations made by NPS personnel. Will include mechanisms for evaluating/qualifying identifications based on observer, ancillary evidence (photos, description), etc. Module will be a replacement/upgrade to functionality currently within NPSpecies, and will allow for inclusion of observations from park personnel to be included in species lists, distribution maps, or other evidence-based reports.

Vegetation Community Plots Data Repository: Repository to store vegetation plot data collected in establishment or re-surveying of vegetation communities used for class definition and description. Only includes data collected and managed by the Vegetation Mapping Inventory (versions 1.0 and 2.0). Repository will serve as a servicewide reference library of vegetation classification definitions as well as a source of species observation data to be included in the Species 2.0 inventory.

Vegetation Map Accuracy Assessment Repository: Repository for storing QA/QC information collected during accuracy assessment phases of Vegetation Community Mapping efforts. Includes location, predicted/mapped classification, and field-determined classification to be used to generate confusion matrices. Accuracy assessment data are collected at either the point or plot level; the repository also contains metadata about accuracy assessment sampling design. Repository will additionally serve as a source of species observation data to be included in the Species 2.0 inventory.

Data Aggregator Development

Observations Aggregator: Tool to pull observation data (taxon, identification system, date/time, location, and metadata) from multiple sources internal and external to NPS. Sources include any services-enabled data provider that makes species observation data available with associated information to evaluate data quality. Includes tools to handle or pre-process routine tasks such as de-duplication of observation data published to multiple repositories and geolocation of text-based location data. Serves as primary vehicle to acquire and process external data to be included in the Species 2.0 inventory.

Data Store Species Observation Harvester: Enhancement to the NPS Data Store (<https://irma.nps.gov/DataStore/>) to extract/harvest species observation/evidence data from data published to Data Store records. In the near-term, the scope of this project is limited to data sets

following the Darwin Core Archive standards established for Species 2.0 inventories (see Appendix F). This module includes a sub-project of publishing or versioning data from species inventories conducted under the Inventories 1.0 program in Darwin Core Archive format as described in Appendix F. Serves as primary vehicle to acquire and process internal data to be included in the Species 2.0 inventory, but may include data published to the Data Store from other programs within NPS.

Data Store Report Species Data Harvester: Tools to automatically extract/harvest and document species observation/evidence information from metadata associated with existing reports in Data Store. This will be particularly necessary for making evidence data from historical reports and publications available to the Species 2.0 inventory where supporting data sets are not available or are not sufficiently documented.

Data Acquisition Tools

Ad-Hoc Data Reporting Module: Mobile and/or desktop application for reporting/recording NPS observation data, including taxon, date, time, location, photo, and description. Module will be a replacement/upgrade to functionality currently within NPSpecies, and will serve as a vehicle for acquiring observation data from NPS staff.

Reference Modules

Taxonomic Resolution: Tools to reconcile, identify, or reduce errors within aggregated species observation data sets based on changes or differences in taxonomic concepts used for identification. Includes ability to indicate uncertainties in species occurrences where discrepancies cannot be resolved due to lack of documentation or changes that can only be verified with a specimen.

Natural History Characteristics: Characteristics about taxa useful for analysis, reporting, decision support, or integration with park management and operations. Module will be a replacement/upgrade to the species “crosswalk” functionality currently within NPSpecies. Designed to be augmented over time as needed and/or new categories or characteristics of interest are identified.

Protected Resources: Library of taxa, locations, and dissemination rules specific to each park. Information housed in the library to be initially “seeded” with federal and state T&E species and designated critical habitats; later augmented by protected data defined during call to parks in 2018, and any additions/changes identified in Quality Assurance Plans developed for vital signs monitoring protocols. Module also integrates with monitoring station and management area inventories. This module will be used to filter data presented in reports, maps, or other decision-support tools to ensure that only audience-appropriate information are made available.

Data Dissemination Tools

Species Inventory Data and Mapping Services: Module to stage aggregated and harvested species observation data in an optimized fashion for internal and external use. Data that are made available will fully consider audience-specific data protection requirements.

Decision Support & Park Integration Tools

Species List Generator: Web application that provides up-to-date species lists based on expected and observed data, with ability to group and query taxa by taxonomic hierarchy or characteristics included in the natural history characteristics library. Internal and external versions will be developed; internal version will be designed to provide current and relevant data to planning activities; external versions will be appropriately screened based on data quality and protection rules to be developed.

Species Evidence Snapshot: Designed to quickly inform new Species inventory studies and evaluate the need to collect new data based on currently-available data. Accessed via web-based tool that provides a map of observations included in the Species inventory, a description of data sources, and the ability to download data. First-generation versions will be park-wide in scale and only include publicly-available data sources, but will be augmented with more data sets over time, made audience-specific as data protection modules are developed, and ultimately allow for reporting at management-relevant scales other than park boundaries. Initial priority will be on developing information that can be used to identify data gaps and develop needs for Species 2.0 inventory studies.

Park Atlas Integration: Publication of species observation and range maps within the Park Atlas application developed/used by the NPS planning program (<https://insideparkatlas.nps.gov/Gallery/>).

Operations

Staffing

Implementing the Inventory 2.0 Program requires a combination of scientific and programmatic leadership, program management support, and data management support. The staffing plan below is designed to minimize administrative overhead, while ensuring that the administrative burden of the program is shouldered by IMD national office staff to minimize impacting parks, regions, or I&M networks with unanticipated inventory-related workload.

The staffing plan described below is based on the assumption that IMD will ultimately lead three inventories: Species, Vegetation Community Mapping, and Surficial Geology/Soils. The overall design is to have the Inventory 2.0 program co-led by a Program Manager who focuses on planning and executing inventory studies (across all IMD-led inventories), and a Science Applications Manager who focuses on 1) ensuring scientific rigor of studies, 2) developing scientific and technical means to manage and integrate inventory science into park operations, and 3) analyzes inventory data to identify strategic focus areas for future annual work plans. Both positions are supervised by the IMD Deputy Chief for Science and supported by project and data management staff with skills tailored to the inventories being implemented and the overall the project and data management workload (Figure 3). Staffing will be phased-in over time as Inventories 1.0 efforts wind down and workload shifts from 1.0 to 2.0 activities. In the near term, Inventories 2.0 activities will be conducted by other IMD science staff (staff associated with monitoring or Inventories 1.0 activities), IMD and NRSS IT staff (who manage the data management systems and applications used Division-wide), and Inventory staff managed by the Geologic Resources Division. Long-term, the Inventories 2.0 staffing plan is not expected to require any additional FTEs beyond those already included in

IMD financial plans, though the staffing plan may be amended as inventory-specific study plans are developed.

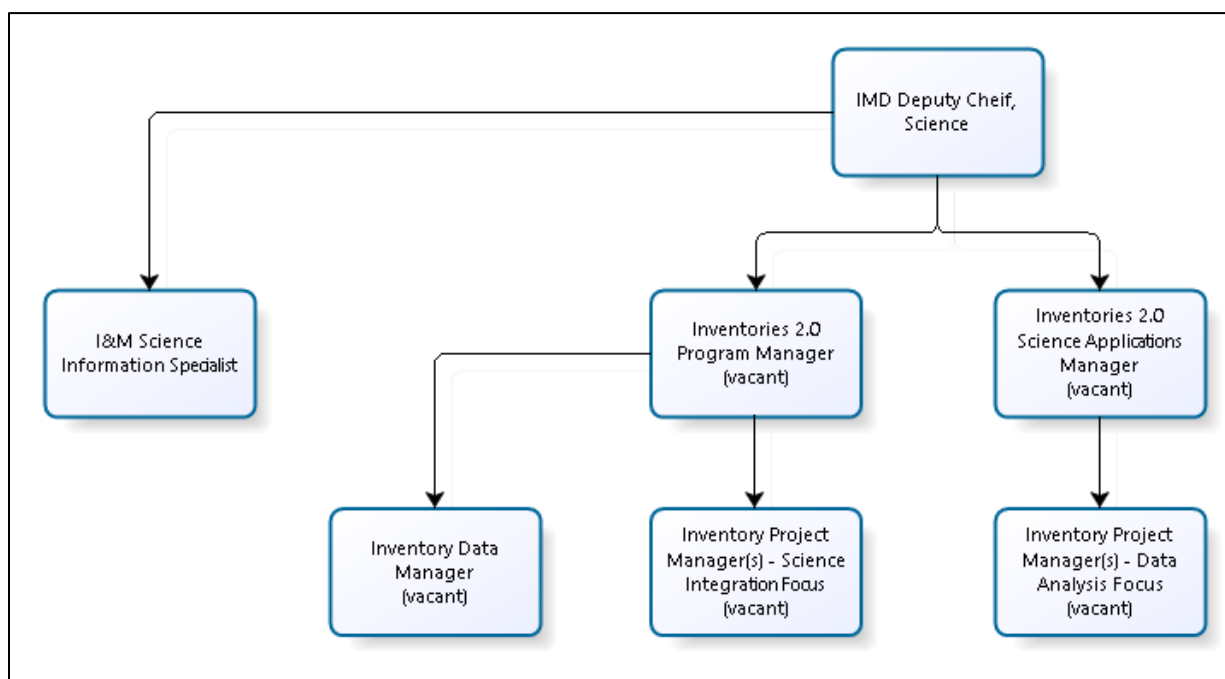


Figure 3. Organizational chart for Inventory 2.0 staff. Note that some positions may be shared/split with other IMD or NRSS positions.

General Position Descriptions

Descriptions of positions are as follows:

Inventory 2.0 Program Manager (GS-12/13; 1 FTE): The primary duties of this position are to facilitate development of inventory study plans, annual work plans, and track, manage, and ensure the scientific rigor of approved and implemented inventory studies. This position requires the ability to regularly lead or facilitate multi-park planning efforts with a goal of identifying, justifying, and prioritizing inventory data collection and data management efforts into a national study implementation plan. The Program Management Lead works with the IMD Deputy Chief, the Inventory 2.0 Science Applications Lead, and other Inventory staff to identify and prioritize upcoming data management, analysis, and integration needs so as to ensure full implementation of inventories from data acquisition to integration. This position will supervise project management and data management staff.

Inventory 2.0 Science Applications Manager (GS-12/13; 1 FTE): The primary duties of the Science Applications Manager are to evaluate potential internal and external data sources for utility or suitability for NPS use, working with data management staff to incorporate suitable data into NPS inventories, and developing means to analyze, interpret, and deliver inventory data in a manner suitable for integration into NPS operations. In addition to supporting park-level inventory needs, the inventory Science Applications Lead is responsible for analyzing regional- and national-level

inventory data compiled from multiple sources, reporting significant findings, and recommending opportunities for focused inventory investments based on data gaps, NPS strategic conservation initiatives, and/or significant findings. The Science Applications Lead works with the IMD Deputy Chief, the Inventory 2.0 Program Manager, and other inventory staff to identify and prioritize upcoming data management, analysis, and integration needs so as to ensure full implementation of inventories from data acquisition to integration. This position will supervise project management and data analysis staff.

The Science Applications Lead is expected to have a) biometrics expertise sufficient to synthesize species observation and covariate data at multi-park to national-level scales to support NRSS “scaling up” priorities, b) ability to evaluate quality, completeness, and utility of data from external sources, and c) the ability to develop recommended specifications for collection of new data by IMD and partners. The incumbent should also possess knowledge of park resource management issues sufficient to lead the development of reference materials that link inventory data to management priorities, and expertise in either wildlife or vegetation taxonomy (this will be balanced and complemented by expertise of project management staff).

Inventory Project Managers (GS 9/11/12; 2 FTEs): Inventory project managers are responsible assisting the Program Management Lead with the management and tracking of park inventory studies (70% of job duties), as well as assisting the Science Applications Lead with studies or projects designed to analyze, interpret, and integrate inventory science into park operations (30%).

Project Management staff are expected to have excellent project management skills as well as secondary competencies that complement the technical expertise of other inventory staff in one or more of the following areas:

- Data Analyst expertise to support other IMD-led inventories. Sufficient statistical expertise to guide design of studies, including accuracy assessments for future Vegetation Community Mapping studies. Ability to evaluate quality, completeness, and utility of data from external sources, and develop recommended specifications for collection of new data by IMD and partners. Technical expertise in areas of remotely-sensed imagery acquisition and analysis, surficial geology, or soils ecology, and ability to adapt emerging technologies to meet inventory goals.
- Science Integration expertise to facilitate the use of scientific information using structured decision making, scenario planning, or other processes appropriate to support park planning efforts.

Inventory Data Managers (GS 9/11/12; 2 FTEs): Inventory Data Managers are responsible for three primary tasks: 1) review of data products from inventory studies, 2) transforming and integrating inventory data sets determined to be suitable for NPS use, and developing applications or workflows to manage inventory data from acquisition through dissemination. These positions will be phased in over the next 3-4 years given that new data collection efforts aren’t scheduled to be funded until FY 2020. In the short term, work focuses on the review and publication of Inventories 1.0 data, with a long-term shift toward managing and processing data from new inventory studies. In total, 3-4

data management staff are expected to be needed long-term, but these positions may be filled with contractor staff. Short-term needs may be met through discrete contractor-conducted projects.

IMD Science Information Specialist (GS-12; 0.5 FTE): Responsible for coordinating data dissemination and integration to ensure work is aligned with similar activities being undertaken with the national Environmental Settings protocol. Oversees “needs assessments” or functional analyses for development of applications designed to facilitate collection, visualization, or publication/dissemination of Inventory 2.0 data to parks and partners. May supervise or co-supervise one or more data management or contract support staff.

Budget

The overall allocation for inventories will be determined through IMD strategic planning efforts currently underway. However, IMD expects a minimum of \$3M per year to be allocated toward field inventory studies.

Accountability and Measures of Success

The Inventory Program Manager will annually report on project status, and how inventory data from prior studies have been used to support management. IMD will track the scientific value and impact, as well as administrative benchmarks resulting from the Inventories 2.0 program. Scientific value and impact will be based on the number of data sets and reports published and cited (the latter will require the ability to publish data with digital object identifiers), and the number of data sets incorporated into NPS decision-support systems. Because IMD has a specific goal to integrate with park planning, IMD will also endeavor to quantify the number of inventory data sets or reports cited or referenced in NPS planning documents. Administratively, IMD will track the number and distribution of funds allocated to Inventories 2.0, and deviations from planned costs or project timelines.

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Appendix A. Inventory & Monitoring Parks

All I&M parks (Table A-1) are eligible for funding to support new inventory studies. Non-I&M parks established before 2000 may be eligible for funding pending approval of the project by the IMD Leadership Team. Inventories 2.0 funding cannot be spent to collect new data in parks established in 2000 or later, that are not currently served by an I&M network.

Table A-1. I&M parks eligible for funding to support new inventory studies.

Region	Unit	Unit Name	Network
Alaska	ALAG	Alagnak Wild River	Southwest Alaska
	ANIA	Aniakchak National Monument and Preserve	Southwest Alaska
	BELA	Bering Land Bridge National Preserve	Arctic
	CAKR	Cape Krusenstern National Monument	Arctic
	DENA	Denali National Park and Preserve	Central Alaska
	GAAR	Gates of the Arctic National Park and Preserve	Arctic
	GLBA	Glacier Bay National Park and Preserve	Southeast Alaska
	KATM	Katmai National Park and Preserve	Southwest Alaska
	KEFJ	Kenai Fjords National Park	Southwest Alaska
	KLGO	Klondike Gold Rush National Historical Park	Southeast Alaska
	KOVA	Kobuk Valley National Park	Arctic
	LACL	Lake Clark National Park and Preserve	Southwest Alaska
	NOAT	Noatak National Preserve	Arctic
	SITK	Sitka National Historical Park	Southeast Alaska
	WRST	Wrangell-St. Elias National Park and Preserve	Central Alaska
	YUCH	Yukon-Charley Rivers National Preserve	Central Alaska
Intermountain	ALFL	Alibates Flint Quarries National Monument	Southern Plains
	AMIS	Amistad National Recreation Area	Chihuahuan Desert
	ARCH	Arches National Park	Northern Colorado Plateau
	AZRU	Aztec Ruins National Monument	Southern Colorado Plateau
	BAND	Bandelier National Monument	Southern Colorado Plateau
	BEOL	Bent's Old Fort National Historic Site	Southern Plains
	BIBE	Big Bend National Park	Chihuahuan Desert
	BICA	Bighorn Canyon National Recreation Area	Greater Yellowstone
	BITH	Big Thicket National Preserve	Gulf Coast
	BLCA	Black Canyon of the Gunnison National Park	Northern Colorado Plateau
	BRCA	Bryce Canyon National Park	Northern Colorado Plateau
	CACH	Canyon De Chelly National Monument	Southern Colorado Plateau
	CAGR	Casa Grande Ruins National Monument	Sonoran Desert

Table A-1 (continued). I&M parks eligible for funding to support new inventory studies.

Region	Unit	Unit Name	Network
Intermountain (continued)	CANY	Canyonlands National Park	Northern Colorado Plateau
	CARE	Capitol Reef National Park	Northern Colorado Plateau
	CAVE	Carlsbad Caverns National Park	Chihuahuan Desert
	CAVO	Capulin Volcano National Monument	Southern Plains
	CEBR	Cedar Breaks National Monument	Northern Colorado Plateau
	CHCU	Chaco Culture National Historical Park	Southern Colorado Plateau
	CHIC	Chickasaw National Recreation Area	Southern Plains
	CHIR	Chiricahua National Monument	Sonoran Desert
	COLM	Colorado Nation Monument	Northern Colorado Plateau
	CORO	Coronado National Memorial	Sonoran Desert
	CURE	Curecanti National Recreation Area	Northern Colorado Plateau
	DETO	Devils Tower National Monument	Northern Great Plains
	DINO	Dinosaur National Monument	Northern Colorado Plateau
	ELMA	El Malpais National Monument	Southern Colorado Plateau
	ELMO	El Morro National Monument	Southern Colorado Plateau
	FLFO	Florissant Fossil Beds National Monument	Rocky Mountain
	FOBO	Fort Bowie National Historic Site	Sonoran Desert
	FOBU	Fossil Butte National Monument	Northern Colorado Plateau
	FODA	Fort Davis National Historic Site	Chihuahuan Desert
	FOLA	Fort Laramie National Historic Site	Northern Great Plains
	FOUN	Fort Union National Monument	Southern Plains
	GICL	Gila Cliff Dwellings National Monument	Sonoran Desert
	GLAC	Glacier National Park	Rocky Mountain
	GLCA	Glen Canyon National Recreation Area	Southern Colorado Plateau
	GOSP	Golden Spike National Historic Site	Northern Colorado Plateau
	GRCA	Grand Canyon National Park	Southern Colorado Plateau
	GRKO	Grant-Kohrs Ranch National Historic Site	Rocky Mountain
	GRSA	Great Sand Dunes National Park	Rocky Mountain
	GRTE	Grand Teton National Park	Greater Yellowstone
	GUMO	Guadalupe Mountains National Park	Chihuahuan Desert
	HOVE	Hovenweep National Monument	Northern Colorado Plateau
	HUTR	Hubbell Trading Post National Historic Site	Southern Colorado Plateau
	LAMR	Lake Meredith National Recreation Area	Southern Plains
	LIBI	Little Bighorn Battlefield National Monument	Rocky Mountain
	LYJO	Lyndon B. Johnson National Historical Park	Southern Plains
	MEVE	Mesa Verde National Park	Southern Colorado Plateau

Table A-1 (continued). I&M parks eligible for funding to support new inventory studies.

Region	Unit	Unit Name	Network
Intermountain (continued)	MOCA	Montezuma Castle National Monument	Sonoran Desert
	NABR	Natural Bridges National Monument	Northern Colorado Plateau
	NAVA	Navajo National Monument	Southern Colorado Plateau
	ORPI	Organ Pipe Cactus National Monument	Sonoran Desert
	PAAL	Palo Alto Battlefield National Historic Site	Gulf Coast
	PAIS	Padre Island National Seashore	Gulf Coast
	PECO	Pecos National Historical Park	Southern Plains
	PEFO	Petrified Forest National Park	Southern Colorado Plateau
	PETR	Petroglyph National Monument	Southern Colorado Plateau
	PISP	Pipe Spring National Monument	Northern Colorado Plateau
	RABR	Rainbow Bridge National Monument	Southern Colorado Plateau
	ROMO	Rocky Mountain National Park	Rocky Mountain
	SAAN	San Antonio Missions National Historical Park	Gulf Coast
	SAGU	Saguaro National Park	Sonoran Desert
	SAND	Sand Creek Massacre National Historic Site	Southern Plains
	SAPU	Salinas Pueblo Missions National Monument	Southern Colorado Plateau
	SUCR	Sunset Crater Volcano National Monument	Southern Colorado Plateau
	TICA	Timpanogos Cave National Monument	Northern Colorado Plateau
	TONT	Tonto National Monument	Sonoran Desert
	TUMA	Tumacacori National Historical Park	Sonoran Desert
	TUZI	Tuzigoot National Monument	Sonoran Desert
	WABA	Washita Battlefield National Historic Site	Southern Plains
	WACA	Walnut Canyon National Monument	Southern Colorado Plateau
	WHSA	White Sands National Monument	Chihuahuan Desert
	WUPA	Wupatki National Monument	Southern Colorado Plateau
	YELL	Yellowstone National Park	Greater Yellowstone
	YUHO	Yucca House National Monument	Southern Colorado Plateau
	ZION	Zion National Park	Northern Colorado Plateau
Midwest	AGFO	Agate Fossil Beds National Monument	Northern Great Plains
	APIS	Apostle Islands National Lakeshore	Great Lakes
	ARPO	Arkansas Post National Memorial	Heartland
	BADL	Badlands National Park	Northern Great Plains
	BUFF	Buffalo National River	Heartland
	CUVA	Cuyahoga Valley National Park	Heartland
	EFMO	Effigy Mounds National Monument	Heartland
	FOLS	Fort Larned National Historic Site	Southern Plains

Table A-1 (continued). I&M parks eligible for funding to support new inventory studies.

Region	Unit	Unit Name	Network
Midwest (continued)	FOUS	Fort Union Trading Post National Historic Site	Northern Great Plains
	GRPO	Grand Portage National Monument	Great Lakes
	GWCA	George Washington Carver National Monument	Heartland
	HEHO	Herbert Hoover National Historic Site	Heartland
	HOCU	Hopewell Culture National Historic Site	Heartland
	HOME	Homestead National Monument of America	Heartland
	HOSP	Hot Springs National Park	Heartland
	INDU	Indiana Dunes National Lakeshore	Great Lakes
	ISRO	Isle Royale National Park	Great Lakes
	JECA	Jewel Cave National Monument	Northern Great Plains
	KNRI	Knife River Indian Villages National Historic Site	Northern Great Plains
	LIBO	Lincoln Boyhood National Memorial	Heartland
	MISS	Mississippi National River and Recreation Area	Great Lakes
	MNRR	Missouri National River and Recreation Area	Northern Great Plains
	MORU	Mount Rushmore National Memorial	Northern Great Plains
	NIOB	Niobrara National Scenic Riverway	Northern Great Plains
	OZAR	Ozark National Scenic Riverways	Heartland
	PERI	Pea Ridge National Military Park	Heartland
	PIPE	Pipestone National Monument	Heartland
	PIRO	Pictured Rocks National Lakeshore	Great Lakes
	SACN	Saint Croix National Scenic River	Great Lakes
	SCBL	Scotts Bluff National Monument	Northern Great Plains
	SLBE	Sleeping Bear Dunes National Lakeshore	Great Lakes
	TAPR	Tallgrass Prairie National Preserve	Heartland
	THRO	Theodore Roosevelt National Park	Northern Great Plains
	VOYA	Voyageurs National Park	Great Lakes
	WICA	Wind Cave National Park	Northern Great Plains
	WICR	Wilson's Creek National Battlefield	Heartland
National Capital	ANTI	Antietam National Battlefield	National Capital Region
	CATO	Catoctin Mountain Park	National Capital Region
	CHOH	Chesapeake and Ohio Canal National Historical Park	National Capital Region
	GWMP	George Washington Memorial Parkway	National Capital Region
	HAFE	Harpers Ferry National Historical Park	National Capital Region
	MANA	Manassas National Battlefield Park	National Capital Region
	MONO	Monocacy National Battlefield	National Capital Region

Table A-1 (continued). I&M parks eligible for funding to support new inventory studies.

Region	Unit	Unit Name	Network
National Capital (continued)	NACE	National Capital Parks-East	National Capital Region
	PRWI	Prince William Forest Park	National Capital Region
	ROCR	Rock Creek Park	National Capital Region
	WOTR	Wolf Trap National Park for the Performing Arts	National Capital Region
Northeast	ACAD	Acadia National Park	Northeast Temperate
	ALPO	Allegheny Portage Railroad National Historic Site	Eastern Rivers and Mountains
	APCO	Appomattox Court House National Historical Park	Mid-Atlantic
	APPA	Appalachian National Scenic Trail	Northeast Temperate
	ASIS	Assateague Island National Seashore	Northeast Coastal Barrier
	BLUE	Bluestone National Scenic River	Eastern Rivers and Mountains
	BOHA	Boston Harbor Islands National Recreation Area	Northeast Temperate
	BOWA	Booker T. Washington National Monument	Mid-Atlantic
	CACO	Cape Cod National Seashore	Northeast Coastal and Barrier
	COLO	Colonial National Historical Park	Northeast Coastal and Barrier
	DEWA	Delaware Water Gap National Recreation Area	Eastern Rivers and Mountains
	EISE	Eisenhower National Historic Site	Mid-Atlantic
	FIIS	Fire Island National Seashore	Northeast Coastal and Barrier
	FONE	Fort Necessity National Battlefield	Eastern Rivers and Mountains
	FRHI	Friendship Hill National Historic Site	Eastern Rivers and Mountains
	FRSP	Fredericksburg and Spotsylvania National Military Park	Mid-Atlantic
	GARI	Gauley River National Recreation Area	Eastern Rivers and Mountains
	GATE	Gateway National Recreation Area	Northeast Coastal and Barrier
	GETT	Gettysburg National Military Park	Mid-Atlantic
	GEWA	George Washington Birthplace National Monument	Northeast Coastal and Barrier
	HOFU	Hopewell Furnace National Historic Site	Mid-Atlantic
	JOFL	Johnstown Flood National Memorial	Eastern Rivers and Mountains
	MABI	Marsh-Billings-Rockefeller National Historical Park	Northeast Temperate

Table A-1 (continued). I&M parks eligible for funding to support new inventory studies.

Region	Unit	Unit Name	Network
Northeast (continued)	MIMA	Minute Man National Historical Park	Northeast Temperate
	MORR	Morristown National Historical Park	Northeast Temperate
	NERI	New River Gorge National River	Eastern Rivers and Mountains
	PETE	Petersburg National Battlefield	Mid-Atlantic
	RICH	Richmond National Battlefield	Mid-Atlantic
	ROVA	Roosevelt-Vanderbilt Headquarters	Northeast Temperate
	SAGA	Saint-Gaudens National Historic Site	Northeast Temperate
	SAHI	Sagamore Hill National Historic Site	Northeast Temperate
	SAIR	Saugus Iron Works National Historic Site	Northeast Temperate
	SARA	Saratoga National Historical Park	Northeast Temperate
	SHEN	Shenandoah National Park	Mid-Atlantic
	THST	Thomas Stone National Historic Site	Northeast Coastal and Barrier
	UPDE	Upper Delaware National Scenic and Recreation River	Eastern Rivers and Mountains
	VAFO	Valley Forge National Historical Park	Mid-Atlantic
	WEFA	Weir Farm National Historic Site	Northeast Temperate
Pacific West	AMME	American Memorial Park	Pacific Islands
	BIHO	Big Hole National Battlefield	Upper Columbia Basin
	CABR	Cabrillo National Monument	Mediterranean Coast
	CHIS	Channel Islands National Park	Mediterranean Coast
	CIRO	City of Rocks National Preserve	Upper Columbia Basin
	CRLA	Crater Lake National Park	Klamath
	CRMO	Craters of the Moon National Monument	Upper Columbia Basin
	DEPO	Devils Postpile National Monument	Sierra Nevada
	DEVA	Death Valley National Park	Mojave Desert
	EBLA	Ebey's Landing National Historic Reserve	North Coast and Cascades
	FOPO	Fort Point National Historic Site	San Francisco Bay Area
	FOVA	Fort Vancouver National Historic Site	North Coast and Cascades
	GOGA	Golden Gate National Recreation Area	San Francisco Bay Area
	GRBA	Great Basin National Park	Mojave Desert
	HAFO	Hagerman Fossil Beds National Monument	Upper Columbia Basin
	HALE	Haleakala National Park	Pacific Islands
	HAVO	Hawaii Volcanoes National Park	Pacific Islands
	JODA	John Day Fossil Beds National Monument	Upper Columbia Basin
	JOMU	John Muir National Historic Site	San Francisco Bay Area

Table A-1 (continued). I&M parks eligible for funding to support new inventory studies.

Region	Unit	Unit Name	Network
Pacific West (continued)	JOTR	Joshua Tree National Park	Mojave Desert
	KAHO	Kaloko-Honokohau National Park	Pacific Islands
	KALA	Kalaupapa National Historical Park	Pacific Islands
	LABE	Lava Beds National Monument	Klamath
	LAKE	Lake Mead National Recreation Area	Mojave Desert
	LARO	Lake Roosevelt National Recreation Area	Upper Columbia Basin
	LAVO	Lassen Volcanic National Park	Klamath
	LEWI	Lewis and Clark National and State Historical Parks	North Coast and Cascades
	MANZ	Manzanar National Historic Site	Mojave Desert
	MOJA	Mojave National Preserve	Mojave Desert
	MORA	Mount Rainier National Park	North Coast and Cascades
	MUWO	Muir Woods National Monument	San Francisco Bay Area
	NEPE	Nez Perce National Historical Park	Upper Columbia Basin
	NOCA	North Cascades National Park	North Coast and Cascades
	NPSA	National Park of American Samoa	Pacific Islands
	OLYM	Olympic National Park	North Coast and Cascades
	ORCA	Oregon Caves National Monument	Klamath
	PINN	Pinnacles National Monument	San Francisco Bay Area
	PORE	Point Reyes National Seashore	San Francisco Bay Area
	PUHE	Puukohola Heiau National Historic Site	Pacific Islands
	PUHO	Pu'uhonua o Honaunau National Historical Park	Pacific Islands
	REDW	Redwood National and State Parks	Klamath
	SAJH	San Juan Island National Historical Park	North Coast and Cascades
	SAMO	Santa Monica Mountains National Recreation Area	Mediterranean Coast
	SEKI	Sequoia and Kings Canyon National Parks	Sierra Nevada
	WAPA	War in the Pacific National Historical Park	Pacific Islands
	WHIS	Whiskeytown National Recreation Area	Klamath
	WHMI	Whitman Mission National Historic Site	Upper Columbia Basin
	YOSE	Yosemite National Park	Sierra Nevada
Southeast	ABLI	Abraham Lincoln Birthplace National Historic Site	Cumberland Piedmont
	BICY	Big Cypress National Preserve	South Florida/Caribbean
	BISC	Biscayne National Park	South Florida/Caribbean
	BISO	Big South Fork National River and Recreation Area	Appalachian Highlands
	BLRI	Blue Ridge Parkway	Appalachian Highlands
	BUIS	Buck Island Reef National Monument	South Florida/Caribbean
	CAHA	Cape Hatteras National Seashore	Southeast Coast

Table A-1 (continued). I&M parks eligible for funding to support new inventory studies.

Region	Unit	Unit Name	Network
Southeast (continued)	CALO	Cape Lookout National Seashore	Southeast Coast
	CANA	Canaveral National Seashore	Southeast Coast
	CARL	Carl Sandburg Home National Historic Site	Cumberland Piedmont
	CASA	Castillo De San Marcos National Monument	Southeast Coast
	CHAT	Chattahoochee River National Recreation Area	Southeast Coast
	CHCH	Chickamauga and Chattanooga National Military Park	Cumberland Piedmont
	CONG	Congaree National Park	Southeast Coast
	COWP	Cowpens National Battlefield	Cumberland Piedmont
	CUGA	Cumberland Gap National Historical Park	Cumberland Piedmont
	CUIS	Cumberland Island National Seashore	Southeast Coast
	DRTO	Dry Tortugas National Park	South Florida/Caribbean
	EVER	Everglades National Park	South Florida/Caribbean
	FOCA	Fort Caroline National Memorial	Southeast Coast
	FODO	Fort Donelson National Battlefield	Cumberland Piedmont
	FOFR	Fort Frederica National Monument	Southeast Coast
	FOMA	Fort Matanzas National Monument	Southeast Coast
	FOPU	Fort Pulaski National Monument	Southeast Coast
	FOSU	Fort Sumter National Monument	Southeast Coast
	GRSM	Great Smoky Mountains National Park	Appalachian Highlands
	GUCO	Guilford Courthouse National Military Park	Cumberland Piedmont
	GUIS	Gulf Islands National Seashore	Gulf Coast
	HOBE	Horseshoe Bend National Military Park	Southeast Coast
	JELA	Jean Lafitte National Historical Park and Preserve	Gulf Coast
	KEMO	Kennesaw Mountain National Battlefield Park	Southeast Coast
	KIMO	Kings Mountain National Military Park	Cumberland Piedmont
	LIRI	Little River Canyon National Preserve	Cumberland Piedmont
	MACA	Mammoth Cave National Park	Cumberland Piedmont
	MOCR	Moore's Creek National Battlefield	Southeast Coast
	NATR	Natchez Trace National Parkway	Gulf Coast
	NISI	Ninety Six National Historic Site	Cumberland Piedmont
	OBED	Obed Wild and Scenic River	Appalachian Highlands
	OCMU	Ocmulgee National Monument	Southeast Coast
	RUCA	Russell Cave National Monument	Cumberland Piedmont
	SHIL	Shiloh National Military Park	Cumberland Piedmont
	TIMU	Timucuan Ecological and Historic Preserve	Southeast Coast

Table A-1 (continued). I&M parks eligible for funding to support new inventory studies.

Region	Unit	Unit Name	Network
Southeast (continued)	VICK	Vicksburg National Military Park	Gulf Coast
	VIIS	Virgin Islands National Park	South Florida/Caribbean

Appendix B. Candidate Natural Resource Inventories

The following candidate natural resource inventory types were defined based on IMD's review of project needs in park foundation documents completed as of June 2016.

For the purposes of the pre-workshop survey and the scoping workshop, a natural resource "inventory" was defined as either a) an account of park resources, including the presence, class, distribution, and normal variation of plants, animals, and abiotic components such as water, soils, landforms, and climate, or b) data about parks, management activities, and resource conditions that are required to effectively plan and manage natural resources. Inventories are designed to contribute to a statement of the condition of park resources, which is best described in relation to a standard condition such as the natural or unimpaired state. Inventories may involve both the compilation of existing information and the acquisition of new information. Inventories are implemented in two ways:

Static or Synoptic Assessments of conditions at a specific point in time that typically have a long period of utility without updating (or with minimal updates). Repeated synoptic studies can be used to assess changes in conditions.

Dynamic or Ongoing Inventories, where data are continually updated or appended based on data compiled from one or more credible sources.

Inventories About Natural Resources

Species Occurrence and Distribution: Completion, update, or expansion of baseline species inventories. Expanded to include all taxa, including those inventoried under initial inventory plans plus invertebrates, non-vascular plants, invasives, or other species of management concern. Includes the ability to generate species lists for parks or management areas based on current and available data.

Natural Resource Hazards: Location, type, and condition of natural resources that pose a significant risk to visitor safety or the condition of other resources (either natural or cultural). Can include things such as potential rock-falls, high-potential erosional areas, avalanche zones, etc.

Species Range and Habitat Maps: Areas of potential species occurrences based on observed data, published literature, and/or modeled relationships between occurrence data and physical, chemical, or biological environmental covariates in terrestrial and aquatic environments. Includes mapping of benthic marine, lake, and riverine habitats.

Night Skies and Lightscape: Baseline assessment of status and threats to dark night skies.

Vegetation Communities and Fire Fuels Mapping: Completion, update, or expansion of baseline Vegetation Mapping Inventory. Can include mapping to finer spatial resolution and/or updates, expansions, or crosswalks to new vegetation classification systems.

Soundscape: Baseline assessment of status and threats to natural soundscape.

Significant Natural Resource Features: Specific locations, characteristics, and documented significance of notable natural resource features within parks.

Soils Maps: Completion, update, or expansion of baseline soils mapping inventory. Can include mapping to finer spatial resolution and/or updates, expansions, or crosswalks to different soil classifications systems.

Paleontological and Fossil Resources: Completion, update, or expansion of baseline paleontological inventories conducted by GRD.

Water Body Locations and Classification: Completion, update, or expansion of baseline water body location and classification inventory where not available dynamically from USGS or other data providers. Includes State-designated beneficial uses, 303(d) impairment status, and State-determined restoration measures for impaired water bodies. Expanded to include location, extent, and condition of groundwater resources, including aquifers, springs, and fresh- and salt-water levels.

Bedrock Geology: Completion, update, or expansion of baseline geologic resource mapping inventory. Can include mapping to finer spatial resolution and/or updates or expansions.

Surficial Geology: Surficial geologic/geomorphic map of recent deposits within parks.

Inventories Needed to Effectively Manage Natural Resources

Ownership, Designations, and Rights: Location and level of confidence in boundaries of park management units, legal designations, or ownership rights. May include associated documentation, including designating statutes, management plans, etc. Not limited to park boundaries; includes (and defines) areas surrounding parks that serve as areas of interest/analysis when managing natural resources.

Management Treatment Areas: Locations of areas within parks and adjacent lands where specific management treatments are applied to the landscape to achieve a desired resource condition, visitor experience, or NPS mission goal. Includes both designated management areas (i.e., grazing lands or cultural landscapes) and management application sites (prescribed fire or exotic plant control locations).

Base Cartographic Information: General GIS layers needed for routine cartographic or planning activities available in formats for use with commercial and open source GIS software. Includes all of the “static” layers included in the original baseline inventories and others (such as the locations of dams, culverts, or others).

Disturbed and Restorable Lands Mapping: Locations of areas within parks and adjacent lands where natural or anthropogenic disturbances have occurred, and where resource management activities may occur to achieve a desired resource condition, visitor experience, or NPS mission goal.

LiDAR: Repository of Light Detection and Ranging data sets to be used for analysis and development of management-relevant derivative products.

Resource Extraction Sites: Locations of sites where natural resources are extracted from parks, such as mining caves, oil/natural gas drilling sites, or water supply wells. Includes sites outside of park boundaries that have a potential impact to park resources. Potentially includes extraction history and permitted uses.

Watershed Characteristics: Descriptive factors of drainage basins for watersheds supplying or contained within NPS units such as flood zones, basic basin characteristics (elevation change or other morphological measures), and other data used by engineers, land managers, biologists, and many others to help guide decisions in their everyday work.

Imagery: Repository of historical digitized aerial and satellite imagery to be used for analysis and development of management-relevant derivative products.

Monitoring Station Locations: Location of monitoring stations in use (or historically in use by) NPS and partners where environmental data are collected, including what data are being collected, periods of record, and information on where and how to obtain the data.

Climate and Climate-sensitive Features: Historical climate data from stations in and around parks (note that the needs for this should be met by IMD's climate monitoring protocols). Extent and condition of climate-sensitive landforms such as glaciers, ice cover, etc.

Research Catalog: List of prioritized natural resource scientific studies needed to address key information gaps, areas of uncertainty, or to meet mission goals. Includes future needs as well as past efforts.

Scientific Literature: Reports and findings significant to informing natural resource planning decisions. Includes studies performed or funded by NPS and external literature of subject-matter relevance.

Contaminant Sources: Locations, status, and type of point-sources of biological, chemical, or physical contaminants.

Models and Forecasts: Archive or repository of products that model the relationship between inventory and/or monitoring data to answer one or more research questions in a manner that may be relevant to informing park resource management and planning.

Resource Management Thresholds: Specific assessment points (numerical thresholds or qualitative categories) used for interpreting environmental inventory and monitoring data. Includes ecological thresholds, critical loads, regulatory or policy limits/standards, management

thresholds, desired future conditions, range of natural variation, and thresholds of potential concern².

Studies, Projects, or Analyses that need NR Inventory Data

Viewshed Delineation or Analysis: Identification and mapping of high-value viewsheds that should be considered for scenic conservation efforts.

Ecosystem Services Studies. Economic, aesthetic, or other valuations of park landscapes to understand how and where the public values NPS resources.

Wilderness Character Baseline Assessment: Assessment of the combination of biophysical, experiential, and symbolic ideals that distinguish wilderness from other lands, including measures of the degree to which lands are in a natural, untrammelled, and undeveloped state.

Condition Assessments, Impact Assessments, and Vulnerability Assessments. Assessments and studies in and of themselves are not inventories, though there may be inventory data used in their completion.

Natural Resource Studies that are Not Inventories

Ecological or Environmental Monitoring: Data needs from short- or long-term monitoring studies are not considered inventories for the purposes of this scoping process. However, data from monitoring efforts may contribute relevant information to inventories (i.e., including observations from species monitoring efforts in a species inventory), and inventory data may be necessary to interpret findings from monitoring.

Land use and cover maps: IMD is monitoring this at multiple levels through either network-managed monitoring protocols or the national *Environmental Setting* monitoring protocol.

Research: Studies or projects that do not fit into categories of inventory or monitoring; usually performed to answer specific questions about natural resources and/or their relationship to one or more other factor in the environment. Like monitoring data, results from research projects may contribute relevant information to inventories, and inventory data may be necessary to interpret findings from research studies.

² Categories from Bennetts, R. E., J. E. Gross, K. Cahill, C. McIntyre, B. B. Bingham, A. Hubbard, L. Cameron, and S. L. Carter. 2007. Linking monitoring to management and planning: Assessment points as a generalized approach. *The George Wright Forum* 24:59-77.

Appendix C. Pre-Workshop Inventory 2.0 Survey and Results

Pre-workshop needs assessment reports are available as an Adobe PDF [here](#). The file contains the blank survey form and responses. The responses are “raw” and contain many duplicate submissions. Data were cleaned prior to analysis and use. Graphical summaries provided by Google Forms did not reproduce well and are not included in the file; significant findings based on cleaned data are summarized in the Inventories 2.0 plan.

Appendix D. Pre-Workshop Needs Assessment Reports

Pre-workshop needs assessment reports are available as an Adobe Digital Portfolio [here](#). Pre-workshop reports were tailored to workshop participants and are sorted into three groups:

Park scoping workshop reports: Survey results are grouped by IMD network. Each report includes findings from park foundation reports completed as of June 2016, and responses from all park staff within a given network’s parks.

IMD scoping workshop reports: Survey results are grouped by IMD region. Each report includes findings from all regional park foundation reports completed as of June 2016, and responses from all IMD staff within a given region’s networks.

Regional Office workshop reports: Survey results are grouped by NPS region. Each report includes findings from all regional park foundation reports completed as of June 2016, and responses from all regional office staff within a given region.

No national-level pre-workshop reports were completed; park, IMD, and regional office reports were made available to all national-level scoping participants.

Appendix E. Scoping Workshop Reports and Materials

Scoping workshop reports are available as an Adobe Digital Portfolio [here](#). Workshop reports and associated materials include:

Scoping Workshop Background Materials: Guidance, templates, and background materials for meeting facilitators and participants to ensure consistent format and results of scoping workshops. Participants were also provided meeting-specific reports from pre-workshop needs assessments (see Appendix D).

Scoping Workshop Reports: Completed templates for meeting summaries, case studies, and any additional files provided by meeting facilitators. For meetings conducted using MeetingSphere, the final meeting report is provided, which includes case studies discussed during the meetings.

Collated Inventory-Specific Comments: For each of the ten inventories, two files were generated. The first (the “rough” version) contains all comments across all reports, case studies, and MeetingSphere discussions without editing. A “synthesis” version for each inventory is also included that distills the rough comments into a standard format.

Appendix F. Draft Minimum Specifications for Species Inventory Studies

Data Products

Data products must be submitted in Simple Darwin Core Archive (DwCA) format. The primary reason for obtaining NPS project data in DwCA is so that park and network staff can easily leverage additional non-NPS data to supplement the NPS data, as those external data are available using the Darwin Core Standard (DwC). This also allows NPS users to employ the growing set of tools developed to work with DwC-compliant data. The ease of then publishing such data into the Global Biodiversity Information Facility (gbif) and other open repositories is tertiary, and will be subject to all rules governing sensitive data. See Wiczorek et al (2012), <https://www.gbif.org/darwin-core>, and <https://github.com/tdwg/dwc> for more information. From the gbif website:

The [Darwin Core Standard \(DwC\)](#) offers a stable, straightforward and flexible framework for compiling biodiversity data from varied and variable sources. Originally developed by the [Biodiversity Information Standards \(TDWG\) community](#), Darwin Core is [an evolving community-developed biodiversity data standard](#). It plays fundamental role in the sharing, use and reuse of open-access biodiversity data and today accounts for vast majority of the hundreds of millions of species occurrence records available through GBIF.org.

In practice, using Darwin Core revolves around a standard file format, the Darwin Core Archive. This compact package (a ZIP file) contains interconnected text files and enables data publishers to share their data using a common terminology. This standardization not only simplifies the process of publishing biodiversity data sets, it also makes it easy for users to discover, search, evaluate and compare data sets as they seek answers to today's data-intensive research and policy questions.

Darwin Core Archives are zip files that contain:

1. At least three core tables:
 - a. Taxon Core, which lists the circumscriptions (reference for usage) of the taxonomic names of species, typically coming from the same region or sharing common characteristics <https://tools.gbif.org/dwca-validator/extension.do?id=dwc:taxon>
 - b. Occurrence Core, which lists a set of times and locations at which particular species have been recorded. <https://tools.gbif.org/dwca-validator/extension.do?id=dwc:Occurrence>
 - c. Event Core, which lists field studies (including the protocols used, the sample size, and the location for each). <http://rs.tdwg.org/dwc/terms/index.htm#Event>
2. Two metadata tables:
 - a. Metadata.xml, which provides information about the data set itself
 - b. Meta.xml, which explains how files within the DwCA are organized

3. Optional “extension” files, that provide additional information about occurrence, taxon, or event data (such as Audubon Core for digital images of species in the field or plots).
 - a. Protected Data Extension, which identifies data records that warrant some level of data protection as defined in park-specific data protection standards (in development).

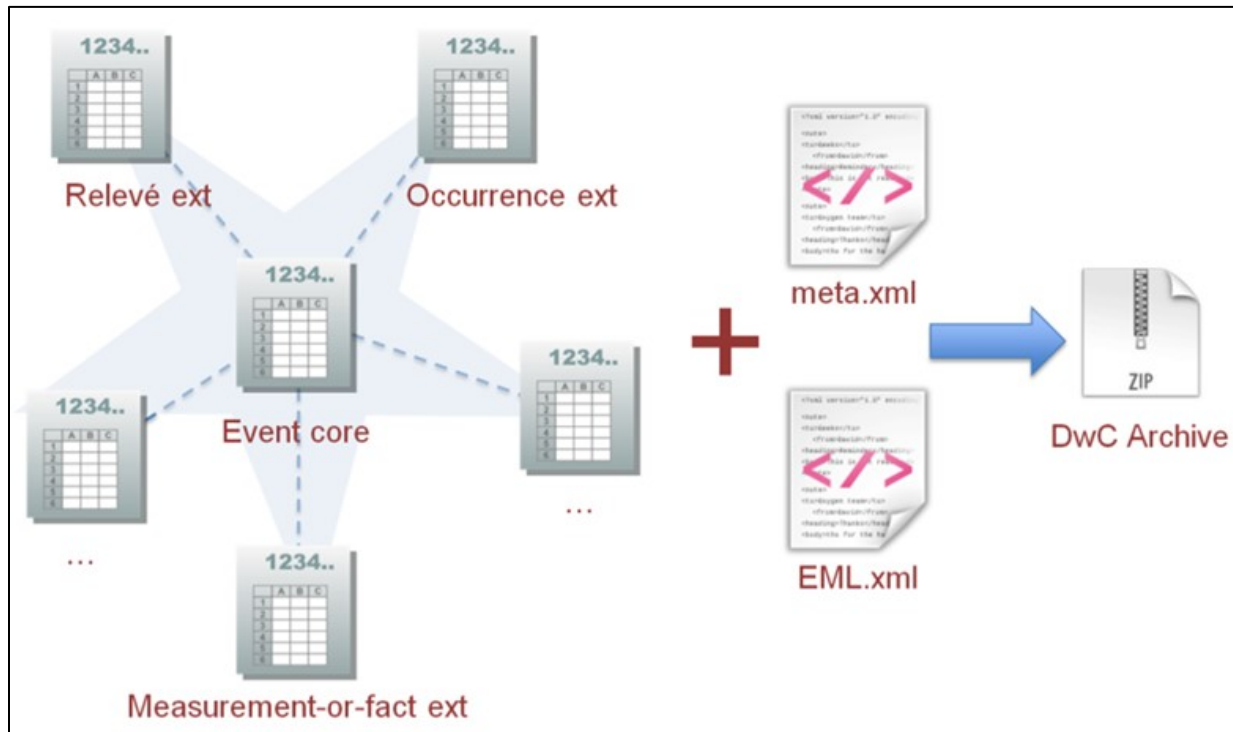


Figure F-1. Relationship between core files, extension files, and metadata files in a Darwin Core Archive (from Darwin Core Archives – How-to Guide; <https://github.com/gbif/ipt/wiki/DwCAHowToGuide>).

The variables and the metadata attributes in the above include a very small set of “required” or core attributes, plus blocks or modules of attributes that may or may not be applicable to a project. We ask that applicable modules of attributes be populated if they are likely to make the data more useful.

Many tools for biodiversity observations already produce data in these standards. Multiple sets of templates exist in formats from MS Excel spreadsheets to MS Access databases. Note that the data & metadata requirement are driven by compatibility with emerging standards. The primary reason is so that NPS users can more effectively leverage NPS data with external data to meet their needs. The secondary benefit is that we can more easily share (non-sensitive) NPS data with the broader scientific and natural resource management community.

Templates and recommended tools for reviewing and validating data will be made available on the IMD Inventories website prior to funding of new Species inventory studies.

Project Metadata Requirements

In addition to required fields, the project metadata file (metadata.xml) must contain the following information:

1. Target area
 - a. Boundary
 - b. Inclusion/exclusion by ownership, habitat, safety, accessibility, etc.
2. Target taxa
 - a. One or more circumscriptions at any level of taxonomic resolution (e.g.: vertebrates, herps would be Reptilia + Amphibia, bees, Agave shawii)
 - b. Any taxa specifically excluded from surveys based on rarity/commonness, conservation status, or other reason.
3. Broad search strategy:
 - a. roads, trails, searches in likely locations/habitats
 - b. discrete “plots” or sites? If so, how was the set of sites determined?
 - c. Exceptions to search strategies or sampling designs to avoid, minimize, or maximize likelihood of documenting target or non-target taxa.
4. Observation data frequency, resolution, or intensity
 - a. Rarely will every occurrence of target species be recorded.
 - b. One (or a quota) observation per species per park, per "area", per clump or population or stand for clumpy species?
 - c. Or finite set of “plots” with everything in a plot recorded, so absences can be inferred at the plot level.
5. Sensitive data handling
 - a. Whether the data set contains, does not contain, or might contain any data that are known to require protection from release and/or special consideration when being disseminated (such as fuzzing or degrading location information related to threatened or endangered species). Data sets that are known to contain protected data must include a protected data extension file with the DwCA.

Required Data Standards

For Species inventory products, the following standards must be followed:

- Location must be provided as latitude and longitude in decimal degrees with the WGS84 datum. Locations may be provided in additional coordinate systems (like UTM) but WGS84 latitude and longitude must be included. If additional coordinate systems are used, the datum and its realization plus relevant zone must be noted. Example: NAD83 (CORS2011) or NAD93(CORS96). Finally, be aware that longitudes are negative for all parks except AMME and WAPA.

Reports

All reports are to be published in the NPS Natural Resource Report series or other peer-reviewed venue.

Other Deliverables

To be determined prior to funding of new Species inventory studies.

Literature Cited

Wieczorek J, Bloom D, Guralnick R, Blum S, Döring M, et al. 2012.) Darwin Core: An Evolving Community-Developed Biodiversity Data Standard. PLoS ONE 7(1): e29715. Available online: <https://doi.org/10.1371/journal.pone.0029715>.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
U.S. Department of the Interior



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