



Inventory Workgroup Recommendations to Expedite the Completion of Vegetation, Soils, and Geology Inventories

FY2016-FY2020

Natural Resource Report NPS/NRSS/IMD/NRR—2017/1556



ON THE COVER

Clockwise from top left: Aspen (*Populus tremuloides*) forest, Wrangell-St. Elias NP; soil scientist collecting data in Yukon-Charley Rivers National Preserve; biological science technician collecting vegetation data in a Sawgrass prairie, Everglades National Park; Skagit Gneiss near Mt. Prophet, North Cascades National Park.

NPS photos

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Executive Summary

The National Park Service Inventory & Monitoring (I&M) Division (IMD) provides guidance, funding, and technical assistance for parks to complete a set of basic natural resource inventories. This report provides recommendations for products and funding commitments to complete vegetation, soils, and geology inventories within the five-year period from FY2016 to FY2020. The report was prepared by the Inventory Workgroup, based on their experience and input gathered through a survey of I&M networks, conversations with Inventory Program staff, and parks. Cost estimates represent best available figures as of the close of FY2015. Overviews of the Vegetation Mapping Inventory (VMI), Soil Resources Inventory (SRI), and Geologic Resources Inventory (GRI) are provided, as are brief descriptions of their status and ongoing challenges. Recommendations for expediting each inventory are provided with specific actions to take for expediting the inventory. These recommendations have been presented to the Inventory & Monitoring Division Leadership Team for their consideration.

Status of the Vegetation, Soils, and Geologic Inventories

At the close of FY2015, 197 (72%) of the 275 inventory projects within the VMI were completed, 75 (27%) were in progress or planning stages, and 3 (1%) inventory projects had not been started. Figures for the SRI show that 230 (85%) of the 270 I&M parks had received a soil survey, 16 (6%) were in progress or planning stages, and 24 (9%) inventory projects had not been started. At the end of FY2015 the GRI included 148 (55%) “complete” parks, 121 (45%) “in-progress” parks, and 1 (<0.01%) park “not started.” Figure A highlights these categories of progress for each inventory, and Figure B shows a timeline projection and anticipated yearly funding required to bring the VMI, SRI, and GRI inventories to completion between FY2016 and FY2020.

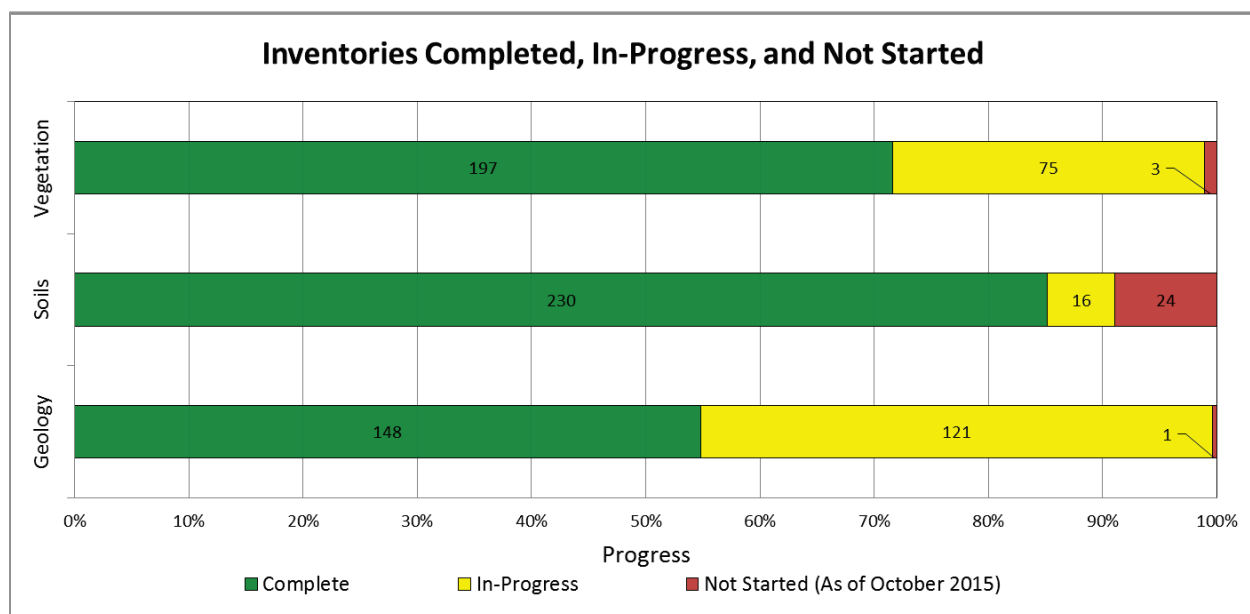


Figure A. Vegetation, soils, and geologic inventories status: completed, in-progress, and not started.

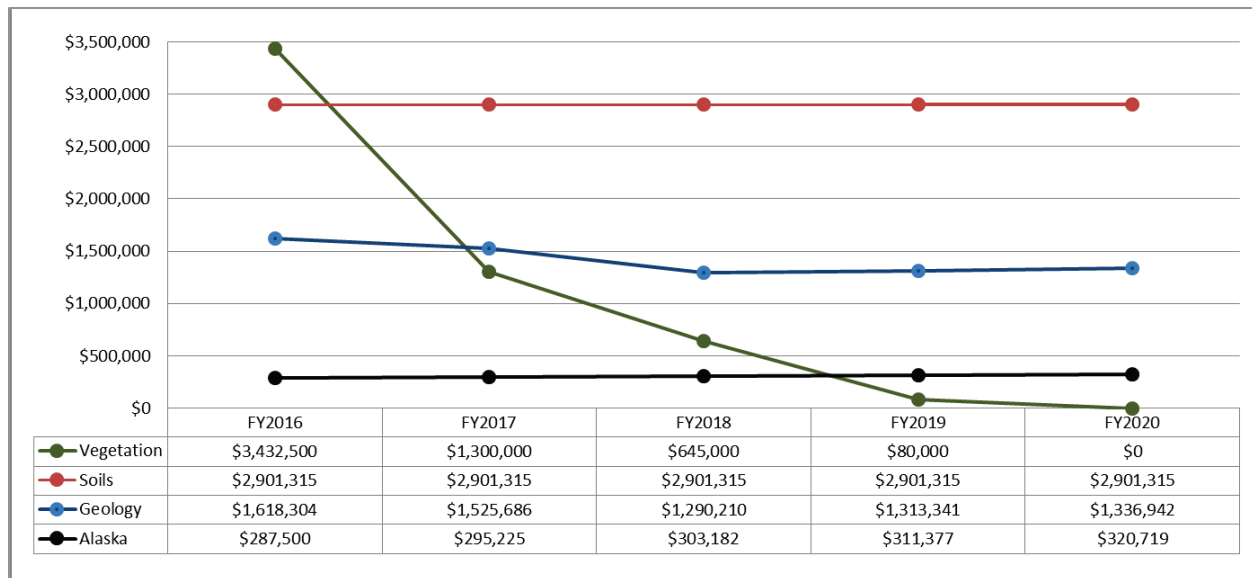


Figure B. Estimate of time and funding required to complete the VMI, SRI, and GRI by FY2020.

Cross-cutting Themes Common to All Three Inventories

Brief narratives and recommendations for six themes that are cross-cutting to expediting the inventories are also presented. The themes include (1) inventory program management; (2) completing all in-progress inventories; (3) reducing mapping resolution, area, and creating modified products; (4) expedited inventories in Alaska; (5) the use of standard when expediting inventories; and (6) importance of communication. Table A provides a summary of specific recommended actions by park and inventory.

1. When qualified lead roles and skilled staff are available to oversee implementation of inventory projects the projects have a higher chance of reaching the completion stage.

Recommendation: Evaluate vacant positions related to the VMI, SRI, and GRI to identify programmatic deficits, and rehire/re-staff key position/duties.

2. Inventories currently in progress are considered necessary and it is important to complete all their related products and deliverables.

Recommendation: Continue projects that are in progress and scheduled for completion by FY2020. Provide support to projects in need of administrative actions (e.g., establishment of a new interagency agreements, facilitated re-scoping, etc.) and provide additional funding, if needed, to ensure completion by FY2020.

3. All three inventory programs have projects that could benefit from modified or hybrid approaches.

Recommendation: Where limited resources, funding, or time will not allow standard inventory approaches to be used, work with the park, network, and/or cooperators to determine less-expensive and faster hybrid methods for producing all or part of an inventory.

4. Many recommendations identified in this report have successfully been applied to Alaska vegetation and soil inventories, and they have helped to expedite inventory completions.

Recommendation: Continue on-going support for the Alaska Regional Inventory Program. Use Alaska Inventory staff experience in implementing hybrid approaches for the VMI and SRI, where possible and appropriate.

5. Standards vary across the three inventories, but the use of standards does not.

Recommendation: Continue to use established, standard methodologies for remaining inventories, where possible. If methods require adjustment, ensure new standards are established to ensure quality of end products for similar projects (e.g., Standard Tiered Mapping Scales, Similar Report Outline and Content, Defined Product Lists, etc.).

6. When communication is working well, inventories make progress faster.

Recommendation: Continue to manage park and program expectations at all levels. Consider establishing internal and/or external liaison roles to facilitate communications and stakeholder engagement between project leads, network managers, park staff, contract officers, key officials, subject matter experts, etc.

Table A. Summary of recommendations.

Inventory Category	Inventory Types	Park	Recommended Action
Vegetation (7 parks)	Inventories recommended for facilitation	ORPI, YELL	Project leads, VMI and parks revisit scoping and study plans. For ORPI the study plan needs to address current safety-related access issues and outline/develop a collaboration with adjacent federal agency staff to leverage existing mapping products. YELL study plan needs to be agreed upon by all stakeholders to ensure park specific concerns are met.
	Inventories on track for 2019 completion	GUIS, BITH, NIOB, MNRR, DEVA	Continue projects as planned. Adjust project goals contingent on funding.
Soils (40 parks)	Inventories that are in-progress and have no known obstacles impeding progress.	GLAC, VOYA, WHSA, MORA, CAVE, FOBU, SUCR, WACA, WUPA, LAKE, GLBA, KATM	Continue the status quo. Planned project funding should continue to support completion with no modifications.
	Inventories that are in-progress and require new Interagency Agreements to complete inventory.	SEKI, OLYM, MOJA, ZION	Establish new Interagency Agreements with NRCS to support completion without modification.
	Inventories that have NRCS cost estimates under \$500,000, which have not started and are expected to take less than four years to complete.	BICA, YELL, BLCA, BRCA, CEBR, CURE, GRSA, CHIR, GRPO, SHEN, BISC, DTRO	NRCS-led inventory. Place into production schedule and fully fund as soon as possible.
	Outstanding Inventories that have NRCS cost estimates >\$500K, are not started, and are recommended for a modified/hybrid approach because they are large, expensive, expected to take more than four years, or have special concerns (i.e., no soil pits allowed).	DEVA, BICY, EVER, TICA, APPA, NATR, TONT, GICL, PETR, TUZI, ELMA, PECO	Non-NRCS-led inventory. Work with park, network, and NRCS/Cooperators to determine less-expensive and faster hybrid method for producing all or part of the inventory.

Table A (continued). Summary of recommendations.

Inventory Category	Inventory Types	Park	Recommended Action
Geology (122 parks)	Inventories that require scoping	APPA	GRI should convene a scoping meeting
	Inventories that require geology map	CAKR, YUCH, SITK, SACN, BUFF, MNRR, NIOB, UPDE, PETE, APPA, CHIS, BISO, CHCH, LIRI, NATR, VICK	Complete the 16 remaining map projects. Continue support for mapping 14 projects with plans, and the 2 parks with no formal mapping plan.
	Inventories that require GRI reports	ALAG, AZRU, BELA, BIBE, BLRI, BOHA, BUFF, CAKR, CHIS, COLO, CRMO, DEVA, FOPO, GAAR, GLBA, GLCA, GOGA, GRCA, JOTR, KATM, KEFJ, KOVA, LACL, LAKE, MOJA, MUWO, NOAT, NOCA, OLYM, OZAR, PINN, PORE, REDW, SAMO, SEKI, WRST, YELL, YUCH	Produce Tier 1 Reports (38)
		AMIS, APPA, BISO, BITH, BLUE, CACH, CUVA, GARI, GRPO, INDU, KLGO, LARO, LEWI, LIRI, MNRR, NATR, NERI, NIOB, OBRI, ORPI, PIRO, SACN, SLBE, UPDE, VICK	Produce Tier 2 Reports (25)
		AMME, BIHO, CAGR, CHAT, CHCH, COWP, EFMO, FODA, FODO, FOLS, FOVA, GWCA, HEHO, HOBE, HUTR, JOMU, KEMO, LIBO, MIMA, MISS, MOCA, NEPE, NISI, OCMU, PERI, PETE, PETR, PIPE, RICH, ROVA, SAAN, SAGA, SAPU, SARA, SHIL, SITK, TAPR, TONT, TUZI, WABA, WICR	Produce Tier 3 Reports (41)
		BISC, CABR, CACO, CALO, CANA, CASA, CUIS, FIIS, FOCA, FOFR, FOMA, FOPU, FOSU, GATE, GUIS, JELA, SAHI, TIMU	Produce Coastal Reports (18)

Table A (continued). Summary of recommendations.

Inventory Category	Inventory Types	Park	Recommended Action
Geology (122 parks) (continued)	Inventories that require GRI reports (continued)	KATM, ALAG, BLUE, GARI, NERI, CAKR, NOAT, KOVA, GAAR, GOGA, FOPO, MUWO, FOSU, CHPI	Evaluate options to combine into Multi-Park Reports

Recommendations Specific to each of the Inventories

Objectives for addressing challenges of each inventory are addressed below. Table A summarizes the actions recommended to achieve these objectives.

Vegetation Mapping Inventory

Several challenges hamper progress of the Vegetation Mapping Inventory (VMI). Objectives for remedying these challenges are presented below.

Objective 2.1: Develop new data standard thresholds based on size and complexity of a particular inventory, or based on projects that are past their initial completion dates.

Objective 2.2: Provide skilled leadership within networks where deficits exist.

Objective 2.3: Continue managing park and program expectations.

Soil Resources Inventory

It must be emphasized that program coordination and oversight is vital to the success and completion of the Soil Resources Inventory (SRI); without it, progress will continue to be hampered. Therefore, the following four objectives should be considered for the SRI:

Objective 3.1: Re-establish full-time management, coordination, and oversight of the NPS Soil Resources Inventory Program.

Objective 3.2: Reduce time, labor, and costs of soils inventories.

Objective 3.3: Improve communications and working relations between NPS and Natural Resources Conservation Service (NRCS) personnel.

Objective 3.4: Match the size of parks with the appropriate amount of soils data needed to inform management decisions.

Geologic Resources Inventory

Objectives of the Geologic Resources Inventory (GRI) are as follows:

Objective 4.1: Complete GRI Scoping.

Objective 4.2: Complete GRI Maps.

Objective 4.3: Complete GRI Reports.

Vision Statement, NPS Inventory & Monitoring Program

The Inventory & Monitoring Program will chart the course and provide the leadership and information resources needed by the National Park Service to preserve and protect the natural resources placed under its trust by the American people.

Through its accomplishments, the program will enhance the National Park Service's stature as an international leader in natural resource management and stewardship.

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Acronyms and Abbreviations

AA	Accuracy Assessment
AKRO	Alaska Regional Office
FGDC	Federal Geographic Data Committee
GIS	Geographic Information System
GPRA	Government Performance and Results Act
GRD	Geologic Resources Division
GRI	Geologic Resources Inventory
I&M	Inventory & Monitoring
IMD	Inventory & Monitoring Division
IMIWG	I&M Inventory Work Group
IRMA	Integrated Resource Management Applications
NASIS	National Soil Information System
NCE	No Cost Extension
NCSS	National Cooperative Soil Survey
NPS	National Park Service
NRCS	Natural Resource Conservation Service
NRSS	Natural Resources Stewardship and Science
NVCS	National Vegetation Classification Standard
SOP	Standard Operating Procedure
SRI	Soil Resource Inventory Program
SSURGO	Soil Survey Geographic Database
USDA	United States Department of Agriculture
USGS	United States Geological Survey
VMI	Vegetation Mapping Inventory
WASO	Washington Office of the National Park Service
WRD	Water Resources Division

Definition of Key Terms

Basic Inventory: Any of the 12 natural resource inventories specified in Appendix A of NPS-75, Natural Resources Inventory and Monitoring Guideline (NPS 1992): 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 Inventory, Species Lists, and Species Occurrence and Distribution. The data sets and other products from the initial phase of these 12 basic inventories provide the minimal set of natural resource information needed by managers and planners to effectively manage and protect park resources. The need for this particular set of inventories was common across all parks in the NPS that contain significant natural resources.

Continuing Inventory (needs that continue beyond the basic inventories): Additional inventories are high-priority basic inventories that were either (1) deferred until after the initial phase when improved technology, taxonomy, and knowledge would make it more cost-effective to undertake the inventory, or (2) identified by some parks as a high-priority need, 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, fossils, and wetlands.

GPRA Complete: The term “GPRA” refers to the Government Performance and Results Act of 1993. A park inventory will be considered to be “GPRA Complete” when the minimal set of products have been developed and delivered to the park (see Initial Phase Complete).

Initial Phase of Twelve Basic Inventories: The “initial” phase for the 12 basic inventories as described in NPS-75 (NPS 1992) was to develop and deliver the minimal set (or basic inventories) of natural resource information that all I&M parks had in common, and that could be developed efficiently based on the knowledge and technologies available in 1992. 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).

Initial Phase Complete: Experience showed that certain minimum products described in NPS-75 (NPS 1992), such as a “digital map,” were not useful to parks without certain additional supporting products. A park inventory is “Initial Phase Complete” when the minimum supporting products deemed necessary for park managers and planners to effectively use and interpret the digital map have been delivered to the park. The minimum supporting products include an explanatory report, FGDC-compliant metadata, and database or geodatabase files.

Official Inventory & Monitoring Park (or I&M Park): Any of the 270 NPS units listed in Appendix A that were identified by the regional offices and the I&M Program in FY2000 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.

Recurring Inventory: Basic inventories that need to be repeated or updated at future intervals because of changes in resource status, but not necessarily part of monitoring, *per se*. Recurring inventories continue to provide useful and reliable information to parks over time or as conditions change. An example would be the need to update the vegetation map for a park approximately every 10-20 years as the vegetation maps would be outdated by then.

Chapter 1. Introduction

Purpose and Need for Natural Resource Inventories

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 the status and trends of park resources 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, 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 (GAO 1997). The primary purpose of natural resource inventories specifically is to document the presence of resources in parks and to assess and document their current condition and knowledge of natural resources in the parks. Inventories allow comparison of existing conditions to a set of reference conditions (or to the desired state of particular park resources), establish a solid baseline for making scientifically sound management decisions, and inform the design of long-term monitoring plans that track the health of key park resources. Beyond informing management, inventories foster education and stimulate the public's innate fascination with the natural world in the parks. More than ever, parks serve as natural laboratories for scientists, important refuges of biodiversity, and tranquil oases for visitors. Natural resource inventories provide data to place park resources into a broader ecological context wherein assessment of resources, such as species rarity and biodiversity at various scales can be made, thereby highlighting the critical role that parks play in conserving natural resources.

Legal and Policy Requirements for Inventories

The fundamental purpose of the National Park System, established by the Organic Act of 1916 and reaffirmed by the General Authorities Act of 1970, as amended, begins with a mandate to conserve park resources and values. The National Parks Omnibus Management Act of 1998 established the framework for fully integrating natural resource monitoring and other science activities into the management processes of the National Park System. The Act charges the Secretary of the Interior to

...continually improve the ability of the National Park Service to provide state-of-the-art management, protection, and interpretation of and research on the resources of the National Park System," and to "assure the full and proper utilization of the results of scientific studies for park management decisions." The Act also requires the Secretary of the Interior to develop a program of "inventory and monitoring of National Park System resources to establish baseline information and to provide information on the long-term trends in the condition of National Park System resources" (16 U.S.C. §5934).

Congress reinforced the message of the National Parks Omnibus Management Act of 1998 in the text of the FY2000 Appropriations Committee report when it described its intent and expectations for the funding increases provided to the NPS Inventory & Monitoring (I&M) Program:

The Committee applauds the Service for recognizing that the preservation of the diverse natural elements and the great scenic beauty of America's national parks and other units should be as high a priority in the Service as providing visitor services. A major part of protecting those resources is knowing what they are, where they are, how they interact with their environment and what condition they are in. This involves a serious commitment from the leadership of the National Park Service to insist that the superintendents carry out a systematic, consistent, professional inventory and monitoring program, along with other scientific activities, that is regularly updated to ensure that the Service makes sound resource decisions based on sound scientific data.

NPS Management Policies (2006) reinforce the legal requirement for park managers to use scientific and technical data and information about the condition of natural resources in their park as a basis for park management and planning:

The Service will also strive to ensure that park resources and values are passed on to future generations in a condition that is as good as, or better than, the conditions that exist today...

and

Decision makers and planners will use the best available scientific and technical information and scholarly analysis to identify appropriate management actions for protection and use of park resources.

Section 4.2.1 of NPS Management Policies (NPS 2006) specifies that the NPS will:

- *identify, acquire, and interpret needed inventory, monitoring, and research, including applicable traditional knowledge, to obtain information and data that will help park managers accomplish park management objectives provided for in law and planning documents;*
- *define, assemble, and synthesize comprehensive baseline inventory data describing the natural resources under NPS stewardship, and identify the processes that influence those resources;*
- *use qualitative and quantitative techniques to monitor key aspects of resources and processes at regular intervals;*
- *analyze the resulting information to detect or predict changes (including interrelationships with visitor carrying capacities) that may require management intervention and provide reference points for comparison with other environments and time frames; and*
- *use the resulting information to maintain—and where necessary restore—the integrity of natural systems.*

Long-term I&M Programmatic Goals

To comply with legal requirements, fully implement NPS policy, and guide resource management activities, the I&M Division established the following five long-term programmatic goals (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 National Park Service 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 National Park Service planning, management, and decision making.
5. Share National Park Service accomplishments and information with other natural resource organizations and form partnerships for attaining common goals and objectives.

Program and Budget History

The I&M program provides guidance, funding, and technical assistance for parks to complete a set of twelve basic natural resource inventories: 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 Inventory, Species Lists, and Species Occurrence and Distribution. When the I&M program was funded by the Natural Resources Challenge, the target number of inventories was 2,767. At the end of FY2015, over 90% are complete, with only vegetation, soils, and geology inventories remaining uncompleted.

The design and implementation of the I&M Program during the first ten years of 1992-2001 were structured around recommendations provided by the Hester Task Force. This task force, established by Associate Director for Natural Resources Dr. Eugene Hester in 1989, was charged with developing a strategic program for inventorying and monitoring of natural resources that would meet the needs of park managers for the science-based decision making and resource protection.

The strategy and recommendations developed by the Hester Task Force were described in the report NPS-75, Natural Resources Inventory and Monitoring Guideline (NPS 1992). For the first ten years of the I&M Program, NPS-75 (NPS 1992) outlined a three-phase approach for biological, chemical, and geophysical resource inventory and monitoring, in which Phase I was Inventory, Phase II Monitoring, and Phase III Integration. Phase I described the initial work to develop and deliver a set of basic natural resource inventories that were common to all park units containing significant natural resources. Inventories were expected to be completed in about ten years at the planned funding level of \$26.6 million by the year 2000. Additional inventories (e.g., those that were not common to all of the parks, or that could not be undertaken efficiently at the time because of insufficient knowledge or technology; or considered continuing inventories) were to be deferred to a later phase of programmatic implementation, or completed using funding from other sources. All inventories were

to be completed in Phase I. Phase II of the recommended program focused on the establishment of a network of 10-12 prototype monitoring programs from which the NPS could gain experience and expertise in park-wide monitoring of ecological “vital signs.” Phase III involved the analysis, synthesis, and modeling of I&M data and the development of decision support systems to assist park managers and planners with management decision making.

A Strategic Plan for Natural Resource Inventories, FY2008-FY2012 was published (NPS 2009) that described actions to address inventory needs for the next five-year period while acknowledging products for some of the larger, more difficult to access parks (e.g., Alaska parks) may require an even longer period. The plan addressed three major areas (1) completion of the initial phase of the 12 service-wide inventories, (2) funding for any continuing and recurring inventories, and (3) operation and maintenance activities such as data management and decision support systems. During that period significant progress was made toward completion of the 12 service-wide Inventories such that only geology, soils, and vegetation inventories, which are spatially derived and require map and GIS products for completion, had outstanding products. In addition, I&M gained experience from implementing a small number of the continuing and recurring inventories recommended as part of the FY2008-FY2012 Inventory Strategic Plan.

The budget strategies documented in the Natural Resource Challenge (NPS 1999) assumed that additional funding from park base accounts, project funds, partnerships with the USGS and other agencies, and the interagency fire program would allow inventories to be completed more quickly. In contrast, parks have lost natural resource positions and funding, and have not been able to contribute as much as was initially planned. There have been some instances where partnerships with other land management agencies or organizations have been successful. In general, however, partner agencies have also had budget shortfalls that reduce their ability to work with the NPS to meet common needs.

Special considerations for Alaska parks were also made within the NPS I&M Program, because it was not financially or logistically feasible to complete those inventories using the same approaches, standards, and products as in the other 49 states. As a result, a more generalized, cost effective, and expedited inventory strategy was established for Alaska that was funded separately. To accommodate this approach, both vegetation and soil inventories for Alaska parks have been managed through the Alaska Regional I&M Inventory Program, which operates in parallel with the National Vegetation Mapping Inventory (VMI) and Soil Resources Inventory (SRI) Programs, while geologic inventories for Alaska have been managed through the National Geologic Resources Inventory Program (GRI).

The I&M Program continues to deliver an impressive number of high-quality data sets and other inventory products to the 270 parks within the I&M networks each year. However, because of budget shortfalls and increased costs, the delivery of the initially defined inventory data sets and products to the current list of 270 parks are projected to take at least another five to six years at FY2015 funding levels, and possibly longer.

Purpose of this Report

In February 2014, I&M Leadership began incorporating newly released employee survey results into recommendations and actions for improving program performance. One of the first steps was the

formation of an I&M Inventories Work Group (IMIWG) to develop recommendations for expediting the three remaining Phase I inventories of vegetation, soils and geology, with a caveat that they be completed by FY2020, if possible. An eight-member work group was formed that conducted interviews with all three inventory coordinators, and solicited input from regional I&M program managers, network program managers, and parks. Findings and recommendations of the IMIWG were presented to I&M Leadership, NPS staff were briefed as part of an I&M webinar series, and a Natural Resources Report (this report) was written to provide a strategy for expediting inventory progress.

The inventory completion strategy and recommendations that follow identify proposed products and funding estimates of the vegetation, soils, and geologic inventories for the five-year period of FY2016-FY2020. Status of each inventory program at the close of FY2015 is provided, as well as an approach to expedite the inventories within this timeframe. In the absence of increased funding, it is recognized new approaches and methods may be required to increase efficiency of data collection and project management, while still providing useful products for park managers. In some cases, recommendations do not reflect current operations, standards, or procedures of the existing inventory programs. However, viability of these recommendations have been reviewed by members of the I&M leadership, networks, and inventory programs. Chapters 2-4 focus on the individual vegetation, soils, and geology inventories and include program overviews, current inventory products and deliverables, challenges faced by each inventory, and possible ways to address challenges and expedite inventory completion. Chapter 5 presents challenges and recommendations that are cross-cutting among all three inventories, and recommends prioritized actions that form a strategy for completing the vegetation, soils, and geologic inventories by FY2020.

Chapter 2. Vegetation Mapping Inventory

Vegetation Mapping Inventory Overview

The objectives of the vegetation mapping inventory (VMI) are to classify and map vegetation as ecological community types in more than 270 NPS I&M units. The NPS VMI follows well-established procedures that are compatible with other state and federal agencies and scientific organizations. Primary data used for classification efforts are vegetation plot data that have been collected from or near each park. Data used for mapping efforts include remotely sensed imagery, supplemented by ancillary field physiognomic and taxonomic data used for formal or informal modeling. Final products include digital spatial databases (maps) of the vegetation, descriptions of classified vegetation, and quality control data that assess both the thematic and spatial accuracy of the map products. Stringent quality control procedures ensure reliability of the vegetation data and encourage the use of resulting maps, reports, and databases at multiple scales. The VMI makes an important contribution to science and conservation because the inventory represents one of the first times in the history of United States land management that vast acreages are being mapped and described using a unified vegetation classification and mapping standard (NPS 2009).

The VMI uses the National Vegetation Classification Standard (NVCS, <http://usnvc.org/>), which is a Federal Geographic Data Committee (FGDC) standard that allows federal agencies to produce uniform statistics about vegetation resources across the nation. Each VMI project contributes to the development of the NVCS by making available datasets and classified descriptions of the inventory. In many cases this leads to an expansion of range for described NVC types. While this external “push” of data is not an officially supported (i.e., funded) part of the VMI, it allows a summarizing effort to update “global” NVC descriptions, which provides potential use in the monitoring and multi-park landscape analysis framework.

Operating in parallel with the VMI, and funded separately, the Alaska Regional Inventory Program manages vegetation mapping efforts for Alaska parks. The program uses a modified VMI approach because large park size and challenging logistics are cost and time prohibitive (the 16 Alaska parks contain two-thirds of the total acreage in the National Park System). The Program uses a variety of contractors and cooperators to assist with developing basic vegetation products that conform to the VMI standards, however, products often have coarser thematic and spatial resolution than national standards and do not include accuracy assessments. All sixteen Alaska vegetation inventory projects have been completed, however, several activities are ongoing to culminate and archive these first generation inventories.

All vegetation inventories within the NPS collect information on species as well as plant communities, providing managers with a range of products and data sources that can aid activities such as conserving biodiversity, managing insect or non-native plant outbreaks, and locating and protecting rare species. VMI data products have also proven invaluable in understanding wildfire potential, evaluating landscape-level changes and planning for prescribed burns or for restoration activities. More broadly, these inventories are intended to provide point-in-time baseline data that can

be updated or recreated, and ultimately serve as a reference against which to compare vegetative change over time.

Vegetation Mapping Inventory Products and Deliverables

The VMI has established 12 steps to capture “best management practices” and key lessons learned from developing, delivering, and using the vegetation maps and associated datasets and products. Formalized in 2010, these steps are outlined in the “12-Step Guidance for NPS Vegetation Inventories” white paper available on-line at:

http://science.nature.nps.gov/im/inventory/veg/docs/Veg_Inv_12step_Guidance_v1.1.pdf

The twelve steps are:

1. Review existing data and “best practices” to develop a brief proposal (1-5 pages) to develop a park or network Vegetation Mapping Inventory Study Plan.
2. Conduct planning and scoping activities to gather the detailed information needed to develop the study plan. [Note: this is a vital step.]
3. Develop and submit a detailed study plan for approval of funding.
4. Collect field plot data (for the ecological classification; PLOTs database).¹
5. Develop vegetation classification, vegetation type descriptions, and field key.¹
6. Develop mapping model (calibration).
7. Acquire and prepare imagery.¹
8. Analyze and classify imagery (draft map).¹
9. Prepare GIS project.
10. Validate thematic accuracy of map products.
11. Conduct a formal accuracy assessment (AA).
12. Deliver final reports, final map in a GIS database, and required products.

All final deliverables are reviewed for completeness by the VMI prior to acceptance and dissemination to the parks and public. Sensitive data is restricted and has digital back-up in IRMA for access and use by NPS and collaborators with non-disclosure agreements in place (ref RM50B).

Additionally, the program has defined *national standards* for all park vegetation classification and mapping projects (excluding Alaska). These include a minimum mapping unit (MMU) of 0.5 ha (1.24 ac); horizontal positional accuracy that meets National Map Accuracy Standards at the 1:24,000 scale; FGDC metadata standards; and an 60% Association or 80% Alliance thematic accuracy at the 90% confidence level (more information is available at <http://science.nature.nps.gov/im/inventory/veg/guidance.cfm>).

¹ Steps produce independently stand-alone products, which are useful even if the later products are not available.

Products required for a vegetation inventory to be considered complete include:

- A full report published in the NPS Natural Resource Publication Management Series. The report must include: vegetation descriptions, vegetation dichotomous key, map class descriptions, photos of map classes, photo-interpretation key, and the AA methods and results.
- Vegetation plot data: PLOTs database containing plot data, plot metadata, and field photos.
- Spatial data (preferably geodatabase format): polygons, plot locations, photo points, and AA plot locations.
- Aerial or satellite imagery of the study area; adjusted or color-balanced.
- Final digital vegetation map graphic.
- Accuracy assessment (AA) data and analysis (excluding Alaska)

Status of the Vegetation Mapping Inventory

Vegetation Mapping Inventory Progress

Vegetation Mapping Inventory status was provided by VMI staff, and by parks and networks through a survey (Appendix B) conducted by the IMIWG to determine the condition of VMI projects. At the close of FY2015, 197 (72%) of the 275 inventory projects within the VMI were completed, 75 (27%) were in progress or planning stages, and 3 (1%) inventory projects had not been started. Only one inventory is not planned, Yucca House National Monument, which is an un-excavated, 34-acre archaeological site. Figure 1 illustrates overall Vegetation Inventory Program progress, including Alaska inventories, and Table 1 provides Region and Network breakdowns for these three categories of progress.

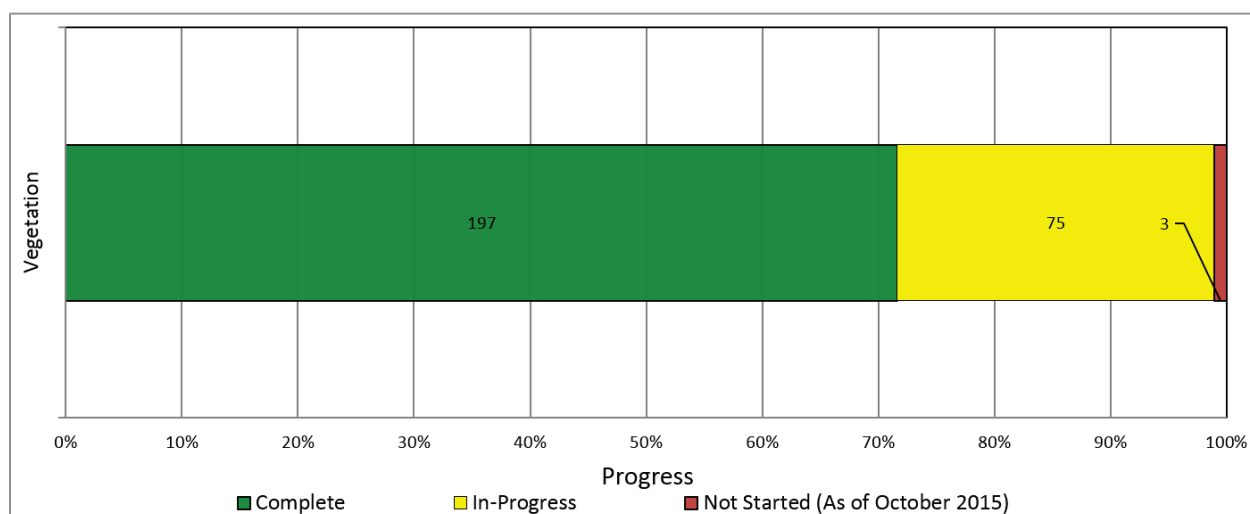


Figure 1. Vegetation inventories completed, in progress, and not started.

Table 1. Vegetation inventories progress summarized by region and network.

Region	Network	Completed	In Progress	Not Started	Totals
Alaska	Arctic	5	0	0	5
	Central Alaska	3	0	0	3
	Southeast Alaska	3	0	0	3
	Southwest Alaska	5	0	0	5
	Regional Total	16	0	0	16
Intermountain Region	Chihuahuan Desert	2	5	0	7
	Greater Yellowstone	1	1	1	3
	Northern Colorado Plateau	16	0	0	16
	Northern Great Plains	2	0	0	2
	Rocky Mountain	6	0	0	6
	Sonoran Desert	2	8	1	11
	Southern Colorado Plateau	16	3	0	19
	Southern Plains	11	0	0	11
	Regional Total	56	17	2	75
Midwest Region	Great Lakes	9	0	0	9
	Heartland	15	0	0	15
	Northern Great Plains	9	2	0	11
	Regional Total	33	2	0	35
National Capital Region	National Capital	1	10	0	11

Table 1 (continued). Vegetation inventories progress summarized by region and network.

Region	Network	Completed	In Progress	Not Started	Totals
Northeast Region	Eastern Rivers and Mountains	9	0	0	9
	Mid-Atlantic	10	0	0	10
	Northeast Coastal and Barrier	7	1	0	8
	Northeast Temperate	8	3	0	11
	Regional Total	34	4	0	38
Pacific West Region	Klamath	2	4	0	6
	Mediterranean Coast	0	3	0	3
	Mojave Desert	3	4	0	7
	North Coast and Cascades	3	4	0	7
	Pacific Islands	9	0	0	9
	San Francisco Bay	6	0	0	6
	Sierra Nevada	2	1	0	3
	Upper Columbia Basin	9	0	0	9
	Regional Total	34	16	0	50
Southeast Region	Appalachian Highlands	1	3	0	4
	Cumberland/Piedmont	14	0	0	14
	Gulf Coast	2	5	1	8
	South Florida/Caribbean	4	3	0	7
	Southeast Coast	2	15	0	17
	Regional Total	23	26	1	50
Grand Total		197	75	3	275

Estimate of Time and Funding Required to Complete the VMI

Projected timeline and funding requirements to complete remaining VMI projects was estimated in the VMI Program's Annual Administrative Report for FY2014. These figures represent the best available projections for future projects at the close of FY2015. Figure 2 shows a timeline projection and anticipated yearly funding required to bring 273 of the initial 275 inventories to completion between FY2016 and FY2020. Estimates for YELL and ORPI were not available. Although project funding requirements decrease over time, oversight and management will still be needed to publish final products and reports through web services, and archive source materials, etc., which will entail additional funding not reflected in this graph.



Figure 2. Estimate of time and funding required to complete the VMI by FY2020.

Challenges of the Vegetation Mapping Inventory

Over the course of producing VMI datasets and products, several challenges have been identified that, if improved, could help speed their completion. This section highlights three such challenges and provides recommendations to address them.

Size and Complexity of Parks

Mapping vegetation over large areas (i.e., parks ranging from 10 to 10⁶ km²) across a variety of terrain types can be hampered by the inability of technology and analytical methods to produce automated maps at the detail needed to address specific park management questions. For instance, while not the primary goal of the initial inventory approach, applications regarding changes in riparian plant communities or changes in forest composition over time and post-disturbance are examples of desired uses of VMI products. Study areas that can provide data to inform such uses often are covered by complex forms of vegetation, or are composed of different successional stages, which can result in unresolvable spectral responses within base imagery being used for mapping. When this occurs, mapping efforts become challenging, especially at landscape scales. Higher resolution imagery and further analysis may render greater detail and accuracy but it comes at a greater cost of resources, staff and time. Even with the best resolution imagery, certain landscapes prove too difficult to accurately classify certain vegetation types. As a result, when technological and analytical methods are unable to provide desired outcomes, or they become too costly or time

consuming to implement, adjustments to the mapping plan may be required to more appropriately align park size and complexity with inventory goals and objectives.

Several steps may be taken to help keep projects moving forward. These steps include (1) adjusting mapping resolution, coverage, or completeness; (2) adjusting the total area mapped or mapping only selected high-priority areas; and (3) reducing accuracy, level of classification, or completeness of products. In situations where funding or time are not available to complete the map as originally planned, discussions between VMI, park, network, and regional staff may take place to modify the resolution, coverage or completeness, and scaling of maps commensurate with park needs. In some cases, facilitated re-scoping meetings may be required to re-align achievable project goals and objectives with management needs, given current available resources. Where mapping has not yet started, projects can also be initiated at a coarser thematic scale, with a finer-scaled effort still feasible later should funds become available. Another reasonable option for adjustment is to reduce the target area(s) or overall coverage of the map project. In these instances, specific geographic areas or specific vegetation types (or formations such as the grasslands or shrubland habitats) could be identified as “higher priority” or of greater importance by the project team. These higher-priority designations may be based on park-specific management issues (rare plants, areas particularly sensitive to climate change, threatened or endangered species, invasive species, habitat types, visitor use priorities, fire use, or management priorities) or focused on the areas least known or least studied (backcountry wilderness, new land additions), or based on other criteria. Reducing the overall size of the project area also may provide cost savings in some stages of the project, and reduce the length of the project. Additionally, projects could also continue the current practice of using the tiered NVC concepts to adjust the level of map detail. This solution might require the use of the existing alternative standards that do not require 80% accuracy at the alliance/association level, but rather 60% accuracy at the association level or 80% accuracy at the alliance level. If modifications must be made to accommodate available resources (time, funding, staffing, technology), it is advisable to combine approaches where compromises are made in multiple areas, such as accepting fewer vegetation classes in order to have complete coverage, or mapping multiple areas at different scales (tiered resolution approach) based on management needs and priorities. In short, where current processes do not provide desired results, or they become limited by funding, or time (i.e., when project completion dates have exceeded initial expectations), establishing new thresholds for data standards and products based on park size and complexity can help speed up vegetation mapping efforts.

Project Staffing

The nature of vegetation mapping is such that project staff should have a level of expertise, experience, and training to complement the effort. Projects require capable personnel that are familiar with botany and the flora of the region, remote sensing technologies, vegetation classification systems, project coordination, supervisory duties, and field logistics, to name a few skills. Unfortunately, staff turnover and attrition have contributed to prolonged implementation and delivery of remote sensing and field-based product. Changes in staffing have also led to delays and inconsistency in completing the inventories. When the key VMI vegetation ecologist retired, the vacant position left a gap in institutional knowledge, expertise in vegetation mapping, and botanical

and classification awareness. This position provided critical assistance in developing and reviewing vegetation classifications and data quality, assistance for which there is still a need today, especially within networks and parks where classifications are being developed. Contributing to the staffing challenge is also the loss of institutional knowledge when term positions end, which require extensive training to overcome programmatic and technical learning curves when and if the positions are back-filled. In short, inventory progress experiences setbacks when there is a lack of dedicated resources to manage projects within parks, networks, and the VMI Program, as well as when key staff positions experience prolonged vacancies, high turnover rates, or attrition.

To address the staffing challenge, it is recommended that skilled leadership be provided within networks where deficits exist so inventories may be produced more effectively. Two actions could accomplish this objective. First, it is recommended that an evaluation of currently vacant positions related to the VMI effort take place so that deficient areas can be identified and brought back on track. This action should also revisit renewing the role of network vegetation mapping coordinators. If re-instated, qualified leads could oversee implementation of vegetation mapping projects within networks and help direct projects through to fruition in coordination with the VMI Program. The term of the position and level of effort required in these roles may vary depending on the status of the map(s). However, since the position requires a great deal of effort and expertise, adequate time and travel must be allocated for project-specific training, if re-instated.

Secondly, the VMI vegetation ecologist position should be re-hired, or re-staffed. The VMI program currently lacks a dedicated staff member with a vegetation ecology background and a deep understanding of NVCS who can provide assistance in developing or reviewing classification products. With inventories nearing completion, this may be best filled by a term position or by funding short-term details (one or two pay periods) to allow current network or park staff to assist others in specific phases of the work.

Managing Park and Program Expectations

Ensuring networks, parks, and the VMI Program are in agreement over the terms of the detailed study plan (steps 2 and 3) is also a challenge. Generating vegetation data and map products is an iterative process, one that is contingent upon funding and staffing. Staying within budget and timeline often requires revisiting project expectations, and balancing park needs alongside available VMI funding and resources. Overall costs and benefits of producing map products must be considered, because no one mapping approach can effectively and efficiently be applied to an extensive range of parks that are of inconsistent size and complexity. The technology and tools selected must fit the needs of the location and park. Given the expense and time required to complete vegetation mapping projects, parks should also carefully consider the level of detail needed in their mapping products to address management objectives for today, as well as in the future. In short, if parks, networks, and VMI staff are not in agreement regarding expectations, goals, objectives, and methods being employed, it becomes difficult to build consensus and achieve buy-in for moving forward with projects. This is a scenario capable of causing delays and inefficiencies throughout the inventory process.

Managing expectations of stakeholders is critical to ensure networks, parks, and the VMI Program are in alignment regarding work to be performed, particularly for the remaining vegetation mapping projects. Ongoing efforts should continue to provide support to all projects. For projects that are well underway, and have no known obstacles impeding progress, project management should maintain the status quo. In this context, “well underway” is defined as projects having developed mapping models (step 6) or are beyond this step, which means they have begun mapping work. For these projects it is assumed the VMI Program, networks, and parks have sustainable implementation strategies in place and the maps/products will be delivered as expected. Specifically, this would include all inventory projects that are currently in progress and are anticipated to be completed on schedule and within the next four years. For situations where projects have taken an unreasonable amount of time to reach their current stage, or have inherent difficulties due to size, safety, politics, budgets, or some combination thereof, VMI and network efforts should be reinforced with IMD Leadership as needed to facilitate project completions. These projects should have IMD leadership facilitation made available to them to assist in revising plans, identifying staffing needs, supporting technical needs, and facilitating any other project management needs such as final product development. In all cases, discussions regarding possible trade-offs to accomplish goals should be held in collaboration with the park, VMI, and network, in order to build consensus and buy-in throughout the process. Current practices to reinforce study plan expectations and negotiated alterations of the projects should also continue, as should ensuring parks, networks, and VMI staff are in agreement regarding expectations, goals, objectives, and methods being employed.

Recommended Actions to Expedite Completion of the Vegetation Mapping Inventory

Most of the seventy-eight vegetation inventories that have not yet been completed are relatively small projects with estimated completion dates within the next four years, before the FY2020 inventory completion target. Of the inventories either not started or in progress, seven parks had not begun mapping (step 6) at the close of FY2015 and have forecasted completion dates in 2019, or 2020. Each of these seven projects has had a delayed start either because funding was not available, logistical or safety constraints that prevented field work from occurring, or in one case due to hurricane damage (BITH). These seven inventories are listed in Table 2 and are presented as projects that if accelerated could help expedite completion of the overall VMI. Five projects (DEVA, BITH, MNRR, NIOB, GUIS) have skilled project coordinators and cooperators in place and are otherwise well positioned to achieve completion by 2019. ORPI and YELL have evolving teams and project support from VMI and networks, but they will require additional levels of support and project management to ensure a 2020 completion.

Table 2. Seven parks that have not begun mapping activities (step 6). As of September 30, 2015, these projects were either in the scoping/pre-planning phase (step 2), developing a study plan (step 3), or were developing the classification (step 5).

Park Code	Step Completed	Estimated Year of Completion	Acreage
DEVA	5	2019	3,401,045
BITH	3	2019	88,817
MNRR	3	2019	69,039
NIOB	3	2019	27,115
ORPI	2	2020	330,690
YELL	2	2020	2,200,683
GUIS	1	2019	120,482

Actions to Address VMI Challenges

As previously mentioned, several challenges hamper progress of the VMI. Based on the narrative above which describes these challenges, several actions are listed below that could achieve desired objectives for remedying these challenges. It is anticipated these actions will principally be applied on the remaining seven projects that are identified for project acceleration, but where appropriate, some actions may be applied to other ongoing projects, if necessary.

Objective 2.1: Develop new data standard thresholds based on size and complexity of a particular inventory, or based on project completion dates that greatly exceed initial expectations.

Action 2.1.1: Continue the current practice to adjust mapping resolution, coverage, or completeness to match available funds and resources.

Action 2.1.2: Adjust the total area mapped or map only selected high-priority areas.

Action 2.1.3: Reduce accuracy, level of classification, or completeness of products (e.g. 60% accuracy at the association level or 80% accuracy at the alliance level).

Objective 2.2: Provide skilled leadership within networks where deficits exist.

Action 2.2.1: Evaluate vacant positions or fund new key network positions.

Action 2.2.2: Rehire / re-staff key VMI vegetation ecologist position / duties.

Objective 2.3: Continue managing park and program expectations.

Action 2.3.1: Continue to provide support to all projects in progress and being planned.

Action 2.3.2: Facilitate ORPI and YELL completion.

Project-specific Actions

Below are actions specific to the remaining seventy-eight outstanding vegetation mapping projects, that if taken could accelerate completion of the overall VMI.

Projects “Well Underway” and On Schedule (68 parks)

Continue the status quo for the majority of park projects that are already well underway and have no known obstacles impeding progress. This includes 68 of the 75 outstanding projects, based on current expected completion dates. Project funding should continue as planned to support completion with no modifications to study plans.

GUIS, BITH, NIOB, MNRR, DEVA

These five projects have experienced coordinators and cooperators in place and are otherwise well positioned to be successful in achieving completion by 2019. However, because these projects have not yet started mapping (step 6), they have the most room for potential study plan modification, that is, making changes to what will be mapped and to what resolution. It is recommended to continue projects as planned, however adjustments to project goals could be made contingent on available funding.

ORPI

This project has taken an excessive amount of time to reach its current stage, as it has inherent difficulties due to size, safety, politics, or some combination thereof. ORPI has significant obstacles in terms of access and safety due to long-standing illegal border activities. The project provides another example where the resolution of mapping will likely be reduced over large swaths of land and more detailed efforts will be given to selected areas. This approach may not only be more efficient, but is likely the only way a mapping project will be completed within the next several years given current funding prospects. Heavy reliance on remotely sensed data with little to no field verification in some areas should be expected, would still produce a useful product even if the map units are at a coarser level than is achievable elsewhere. Options to reduce the thematic resolution of the mapping effort do not necessarily mean that the taxonomic classification effort need be reduced or that this is recommended. Because the project has completed classification at the association level, the map can be created such that multiple finer-scaled community types are contained within each map unit. The network and park have a plan in place, and they are working on safety and fieldwork trade-offs for a mostly remote-sensing solution.

Because ORPI is a new-start case, scoping is essential to determine the scale and resolution criteria. Scoping and planning documents could be adjusted in terms of thematic resolution to meet the current available resources, however, this effort should be carefully customized to best meet and complement current management issues at the parks. Additionally, the IMD should develop a review procedure for ORPI to guide and validate a process for completion. IMD leadership facilitation should be made available to assist in revising plans, identifying staffing needs, supporting technical needs, and facilitating any other project management needs such as final product development.

YELL

Adjusting the total area mapped, or mapping only selected high-priority areas presents is a potential cost reduction for the YELL project. Since 2014, a six-zone map concept has been discussed, and it currently awaits park leadership support. Alternatives have also been prepared by YELL and network staff and a “two zone trial” project has been accepted by VMI/IMD leadership. However, YELL has limited housing at this time, and the park liaison has been instructed not to hire a vegetation crew until the issue is resolved, which places the project on an uncertain timeline.

This project should have IMD leadership facilitation made available to assist in revising plans, identifying staffing needs, supporting technical needs, and facilitating any other project management needs such as final product development. The IMD should develop a review process for YELL to guide and validate the process for completion. A process should be implemented to facilitate discussion of park needs (i.e., fine resolution, multi-temporal) and VMI limitations (i.e., funds and resources). When the YELL housing issue is resolved, and field crews can be accommodated by the park, development a park and network based mapping alternative and action plan may continue forward. Once developed, the plan should be approved by the VMI and IMD leadership, and park-based liaison/lead.

Summary

The Vegetation Mapping Inventory (VMI) Program provides valuable information about vegetation within parks. This information is intended to provide a point-in-time baseline that can be updated or recreated, and it can serve as a reference against which to compare vegetative change over time. The VMI utilizes a standardized 12-step process for collecting, processing, and distributing its products. By implementing these steps the program at the close FY2015 had completed 197 (72%) of the 275 inventory projects, with the remaining 78 projects targeted for completion by 2020, or sooner. It is estimated that completion of the VMI will cost an additional \$5.5 million. Several challenges that impede progress of the VMI have been identified, and recommendations to remedy them include altering mapping methods, addressing staffing issues, and managing stakeholder expectations. Seven key projects are described which could benefit from these recommendations, and if applied could accelerate their progress towards completion. Table 3 highlights the seven projects and the recommended actions. By implementing these recommendations it is expected the VMI will be able to achieve completion by the target year of 2020.

Table 3. Recommended actions to expedite seven selected VMI inventories.

Description	Park	Recommended Action
Inventories recommended for facilitation	ORPI, YELL	Project leads, VMI and parks revisit scoping and study plans. For ORPI the study plan needs to address current safety-related access issues and outline/ develop a collaboration with adjacent federal agency staff to leverage existing mapping products. YELL study plan needs to be agreed upon by all parties to ensure park specific concerns are met.
Inventories on track for 2019 completion	GUIS, BITH, NIOB, MNRR, DEVA	Continue projects as planned. Adjust project goals contingent on funding.

Chapter 3. Soil Resources Inventory

Soil Resources Inventory Overview

The Soil Resources Inventory (SRI) Program provides basic information needed to manage soil sustainability and to protect water quality, wetlands, vegetation communities, and wildlife habitats. Soil resource inventories also provide managers with the ability to predict the behavior of a soil under a variety of circumstances and alternative uses—its potential erosion hazard, sensitivity to disturbances such as wildfires, potential for groundwater contamination, suitability for control of exotic plant species and establishment of native communities, and potential for preservation of cultural sites and landscapes. The inventory provides parks with information regarding potential uses and limitations of each kind of soil type. SRI products can be used for park interpretive programs, general management plans, and resource stewardship strategies, as well as to identify emerging soil resource management needs, and to serve as baseline information on soil resources for the I&M Program.

To complete soil resource inventories for the 270 I&M parks with significant natural resources, the SRI Program primarily works with the Natural Resource Conservation Service (NRCS) in the Department of Agriculture (USDA) and with other members of the National Cooperative Soil Survey (NCSS). The NCSS is a nation-wide partnership of federal, regional, state, and local agencies and institutions. This partnership works together to cooperatively investigate, inventory, document, classify, and interpret soils and to disseminate, publish, and promote the use of information about the soils of the United States and its trust territories. The activities of the NCSS are carried out on national, regional, and state levels. The NPS is a member of this group, and the SRI Coordinator has historically served as the agency's representative.

Operating in parallel and funded separately from the SRI, the Alaska Regional Inventory Program uses a hybrid approach to documenting soil resources inventories, because large park size and challenging logistics in Alaska are cost and time prohibitive. The Program takes advantage of two methodologies—NRCS Soil Surveys using published standards and procedures of the NCSS, and contractor-performed Ecological Landscape Surveys (ELS) mapping projects. As of the end of FY2015, all sixteen Alaska Soil Inventory projects had been completely funded, with the final two projects in-progress expected to be completed by 2018.

Soil Resources Inventory Products and Deliverables

It has been common practice for the NPS to work with the NRCS for providing park managers with basic information about soil resources, as well as more detailed information for potentially high-use or developed areas in the park (e.g., visitor centers, campgrounds, trails, access roads, etc.). Such surveys provide an orderly, on-the-ground, scientific assessment of soil resources present in NPS units. Soil resources inventories describe the locations and extent of soils; data about the physical, chemical, and biological properties of those soils; information pertaining to the use and management of soils; and information and education products such as a soil survey manuscript, fact sheets, and image galleries. The information provides sufficient detail for application by park managers, planners, engineers, scientists, and researchers to specific areas of concern.

General products of the Soil Resources Inventory include:

1. Geospatial soils data meeting Soil Survey Geographic (SSURGO) standards;
2. Soil attributes, properties, and interpretations exported from the National Soil Information System (NASIS) in a Microsoft Access format;
3. Soil survey manuscript in both hardcopy and digital format;
4. Metadata following the FGDC Soil Geographic Data Standard.

A hybrid to the SRI approach has been developed for soils inventories in Alaska, because it is currently too time consuming and cost prohibitive to exclusively use NRCS methods and products. This hybrid approach uses contracts with environmental consulting firms to produce soil inventories in parallel with those produced by the NRCS to increase inventory production rates. While inventories for Alaska parks provide the same general products (i.e., geospatial data, soil database, manuscript, and metadata), they do not always follow NCSS standards. In general, contractor-provided products are more customized, and may not be derived following NCSS field sampling and documentation requirements, and they do not use NCSS data formats and schemas (e.g., raster datasets instead of vector datasets). Additionally, due to the large areas being mapped, Alaska inventories are often more generalized in both scale and thematic resolution compared to those commonly produced for conterminous lower-48 parks, regardless of which cooperator provides products.

Optional products are sometimes provided by the SRI Program, depending upon the needs and requests of the specific park being mapped. These products have included:

1. A park-specific soil survey report, computer generated from the existing data contained in the National Soil Information System (NASIS) database.
2. Digitally finished soil maps on an orthophoto base, at 1:24,000 or 1:12,000 scale, on either a full-quad or quarter-quad format.
3. USDA Ecological Site Descriptions (ESD) in a park-specific report linked to the USDA Plants Database as well as the USDA Ecological Site Information System (ESIS) database.
4. Soil profile and soil landscape images in a digital format, with corresponding geospatial locations.
5. Raster geospatial maps.
6. Soil laboratory analyses for selected soil profiles within the park, with corresponding geospatial locations

Status of the Soil Resources Inventory

Soil Resources Inventory Progress

As of December 2015, 230 (85%) of the 270 I&M parks had received a soil survey, 16 (6%) were in progress or planning stages, and 24 (9%) inventory projects had not been started. Figure 3 illustrates overall Soil Resources Inventory Program progress, including Alaska inventories, and Table 4 provides Region and Network breakdowns for each of these three categories of completeness.

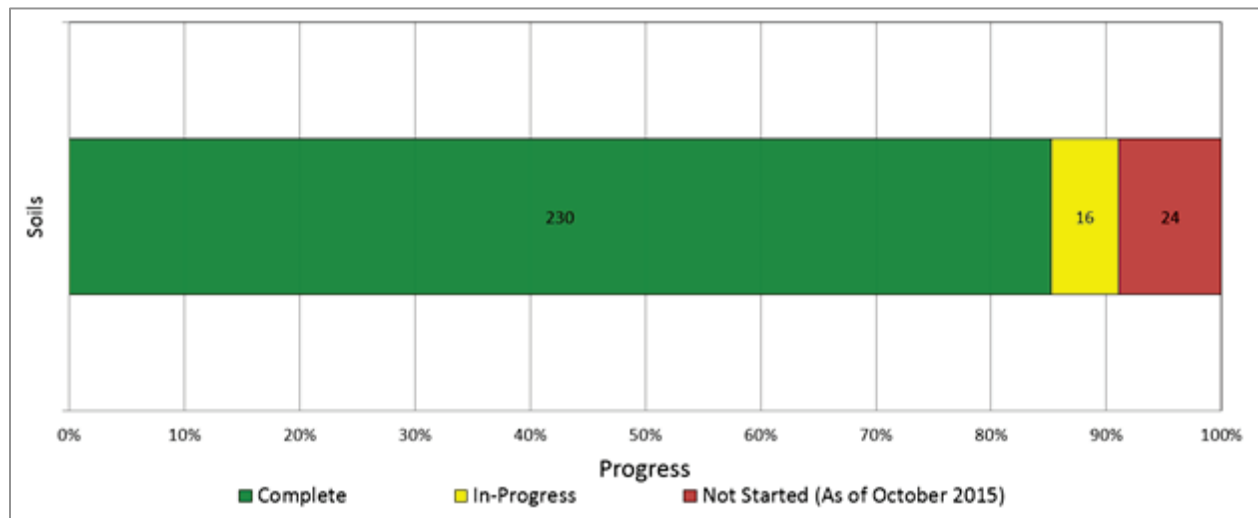


Figure 3. Soil resources inventories completed, in progress, and not started.

Table 4. Soil resource inventories progress summarized by region and network.

Region	Network	Completed	In Progress	Not Started	Totals
Alaska	Arctic	5	0	0	5
	Central Alaska	3	0	0	3
	Southeast Alaska	2	1	0	3
	Southwest Alaska	4	1	0	5
	Regional Total	49	7	15	71
Intermountain Region	Chihuahuan Desert	4	1	0	5
	Greater Yellowstone	1	0	2	3
	Northern Colorado Plateau	9	2	5	16
	Northern Great Plains	2	0	0	2
	Rocky Mountain	4	1	1	6
	Sonoran	7	0	4	11
	Southern Colorado Plateau	14	3	2	19
	Southern Plains	8	0	1	9
	Regional Total	49	7	15	71
Midwest Region	Great Lakes	7	1	1	9
	Heartland	15	0	0	15
	Northern Great Plains	11	0	0	11
	Southern Plains	1	0	0	1
	Regional Total	34	1	1	36

Table 4 (continued). Soil resource inventories progress summarized by region and network.

Region	Network	Completed	In Progress	Not Started	Totals
National Capital Region	National Capital	11	0	0	11
Northeast Region	Great Lakes	7	1	1	9
	Heartland	15	0	0	15
	Northern Great Plains	11	0	0	11
	Southern Plains	1	0	0	1
	Regional Total	36	0	2	38
Pacific West Region	Klamath	6	0	0	6
	Mediterranean Coast	3	0	0	3
	Mojave Desert	3	2	1	6
	North Coast and Cascades	5	2	0	7
	Pacific Island	9	0	0	9
	San Francisco Bay Area	6	0	0	6
	Sierra Nevada	2	1	0	3
	Upper Columbia Basin	8	0	0	8
	Regional Total	42	5	1	48
Southeast Region	Appalachian Highlands	4	0	0	4
	Cumberland/Piedmont	14	1	0	15
	Gulf Coast	7	0	1	8
	South Florida/Caribbean	2	0	4	6

Table 4 (continued). Soil resource inventories progress summarized by region and network.

Region	Network	Completed	In Progress	Not Started	Totals
Southeast Region (continued)	Southeast Coast	17	0	0	17
	Regional Total	44	1	5	50
Grand Total		230	16	24	270

Estimate of Time and Funding Required to Complete the SRI

In 2014, the SRI acting program lead conducted a survey of NRCS regional managers to estimate costs and timeframes for completing soil resources inventories for the remaining 24 park units. While no information was provided to determine NRCS's staffing capacity, or if they could begin projects soon enough to meet the FY2020 inventory completion target, estimated time required to complete the inventories ranged from zero months to 10 years, and cost figures were equally widespread ranging from no funding needed to more than \$5 million. Table 5 provides details for this information, broken down by network and park.

Table 5. 2014 NRCS estimates for completing soil surveys in 24 remaining park units.

Network	Park Unit	Projected Cost	Projected Timeframe (years)
Greater Yellowstone Network	Bighorn Canyon NRA (BICA)	\$50,000	0.50
	Yellowstone NP (YELL)	\$320,000	3.00
Northern Colorado Plateau Network	Black Canyon of the Gunnison NP (BLCA)	\$106,000	1.00
	Bryce Canyon NP (BRCA)	\$341,692	2.00
	Cedar Breaks NM (CEBR)	\$91,409	0.80
	Curecanti NRA (CURE)	\$0	0.00
	Timpanogos Cave NM (TICA)	— ^a	— ^a
Rocky Mountain Network	Great Sand Dunes NP (GRSA)	\$100,000	1.00
Sonoran Desert Network	Chiricahua NM (CHIR)	\$149,552	1.00
	Gila Cliff Dwellings NM (GICL)	— ^b	— ^a
	Tonto NM (TONT)	\$0	0
	Tuzigoot NM (TUZI)	\$0	0
Southern Colorado Plateau Network	El Malpais NM (ELMA)	\$601,510	3.00
	Petrified Forest NP (PETR)	\$601,966	3.00
Southern Plains Network	Pecos NM (PECO)	\$110,000	1.00
Great Lakes Network	Grand Portage NM (GRPO)	\$10,000	0.50
Mid-Atlantic Network	Shenandoah NP (SHEN)	\$489,850	1.25
Northeast Temperate Network	Appalachian Trail (APPA)	— ^a	— ^a
Mojave Desert Network	Death Valley NP (DEVA)	\$3,394,417	10.00
Gulf Coast Network	Natchez Trace Parkway (NATR)	— ^a	— ^a

^a No estimate given.

^b No dollar value provided, done with ELMA.

Table 5 (continued). 2014 NRCS estimates for completing soil surveys in 24 remaining park units.

Network	Park Unit	Projected Cost	Projected Timeframe (years)
South Florida/Caribbean Network	Big Cyprus N Preserve (BICY)	\$2,535,798	6.00
	Biscayne NP (BISC)	\$231,107	0.50
	Dry Tortugas NP (DRT0)	\$34,590	— ^a
	Everglades NP (EVER)	\$5,338,686	10.00

^a No estimate given.

^b No dollar value provided, done with ELMA.

Based on the NRCS estimates above, \$14.5 million will be needed to complete the 24 non-started soil resources inventories (forecasted figures for ongoing inventories were not available at the close of FY2015). If such funding became available and was divided equally across targeted inventory completion years (2016-2020), \$2.9 million per year would be required to complete the SRI by 2020, if projects began immediately. However, because project start dates are unknown, this funding scenario (Figure 4) illustrates a hypothetical yearly budget requirement if projects were aligned with flat funding.

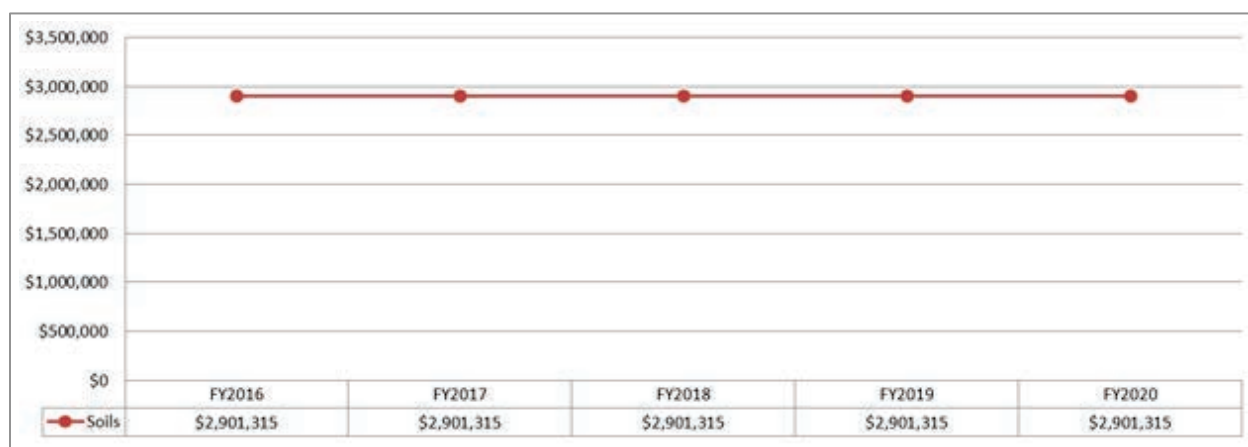


Figure 4. Estimate of funding required to complete the soil resources inventory by 2020. Estimates were not available for on-going inventories, or APPA, TICA, and NATR.

Challenges of the Soil Resources Inventory

Several challenges currently hinder progress toward completing the SRIs, among them (1) the current vacancy for the SRI Program Coordinator position; (2) the amount of time and funding required to conduct detailed soils inventories; (3) organizational complexities related to the interagency partnership with the NRCS; and (4) on-going concern about the level of detail and number of products required to make soils inventories useful for park management activities.

Staffing

At the close of calendar year 2013, the SRI Program Coordinator retired, leaving a vacancy in the most crucial position for guiding the direction and progress of the SRI program. Day-to-day management and operations of the SRI Program has been delegated as collateral duty to an acting role within the Geologic Resources Division (GRD). While this acting role may be able to accomplish some of the administrative workload previously performed by the SRI Coordinator, a large amount of knowledge regarding soil science, applicable authorities, methods, NPS guidelines, and applications of soils inventories to NPS management has been lost. Because soils expertise in the NPS is not as prevalent as other resources (e.g., vegetation or geology), this vacancy leaves the NPS with a knowledge shortfall in the area of soil science. Additionally, formal and informal collaborative relations with counterparts in the NRCS and other agencies that facilitated the ability to shepherd projects through a complex system of regulatory and environmental concerns have also been lost. The net effect amounts to administrative slowdowns and the loss of historical program knowledge that is needed to guide planning efforts for future inventories. As a result, only on-going inventories are being worked on now, and all plans for new soils inventory starts have been indefinitely suspended.

A dedicated program manager with soils program expertise is necessary in order to finish the sixteen on-going inventories, and to complete the twenty-four inventories which currently have no start dates. Backfilling the Soil Inventory Program Coordinator position should be the first and foremost action taken to complete the SRI. This would allow a dedicated full-time staff member to manage all aspects related to the SRI, and it would relieve the workload on GRD personnel currently assigned to these duties. This action would also re-establish planning activities for new projects that are currently suspended. If re-hiring a permanent SRI Program Coordinator is not feasible, a detail or multi-year term “SRI Sunset Position” occupied by an NRCS staff member or NPS employees with similar credentials should be considered for the SRI Program Coordinator role. This would allow the SRI to be completed without a long-term personnel commitment, and it would re-establish continuity of understanding for NRCS procedures and protocols necessary for managing soil resources projects on behalf of the NPS.

Two other scenarios worth consideration may facilitate completion of the inventory if rehiring or filling the SRI Program Coordinator role is not possible. The first includes delegating oversight and funding to the twelve networks that currently lack soil inventories. I&M networks could conduct their own inventories using cooperators and methods of their choosing (i.e., inter-agency agreements with NRCS, contracts with environmental consulting firms, etc.). While this is worthy of consideration, several regional program managers expressed hesitation over this option, citing most networks lack soil scientists and expertise to accomplish the additional tasks of managing soil inventories. The second option could utilize soil inventory experience of the Alaska Region Inventory Program for coordination and management of remaining inventories. The Alaska Region currently has a program manager, and an established working relationship with the NRCS and environmental consulting firms that produce similar products, and the program expects to complete its final two soil inventories by 2018, allowing capacity for taking on new projects before the 2020 inventory completion target.

Time and Expense

Soil inventories are time and labor intensive, and the amount of logistical and administrative support needed is extensive and expensive. It can take several years and millions of dollars to describe the different soil types and ecological sites for a single park; the larger the park, the more costly and time consuming the process. For instance, to meet stringent documentation requirements of NRCS and NCSS protocols, soil scientists often dig hundreds of soil pits within a park over the course of multiple field seasons. To get to the sample locations, they hike and use other modes of transportation ranging from cars and trucks, to off-road vehicles, boats, fixed-wing airplanes, and helicopters, among others. Digging holes in national parks using mechanical tools also creates issues that must be addressed when mapping culturally sensitive areas, areas with endangered species, and Wilderness, all of which involve compliance processes that are time consuming to navigate and add expense to the project. It is not uncommon to have park archaeologists accompany soils crews to oversee field operations in such cases, or for park compliance staff salaries being charged to soil inventory projects. When compared to other inventories, soils projects are among the most time consuming and expensive.

Reducing time, labor, and costs of soils inventories offers several advantages that can expedite completion of the SRI by 2020. Perhaps the simplest solution to reducing time and expense of the SRI would be to finish the list of sixteen soils inventories currently in progress, then pronounce the goals of the soils inventory have been met, leaving the remaining twenty-four inventories unfinished. This would reduce overall Inventory Program costs and free up funding and resources for other I&M programs. Four less extreme and more favorable options stated by I&M staff include (1) eliminating parks from the “to-be-done” list that do not have significant natural resources, (2) excluding inventories for parks that will not allow soil pits to be dug, (3) eliminating inventories where park management feels soil information is not needed for their operations, and (4) by not conducting inventories for parks that cannot be completed within the 2016-2020 inventory completion window. Streamlining inventories is another way to reduce time and expenses of inventories. This could be accomplished through the reduction in mapping resolution, or only mapping focus areas where there are high levels of management concerns, and/or reducing the suite of products delivered for each inventory. For instance, map and geospatial products could be produced without an accompanying report. Cost savings and a shortening of timelines may also be obtained through the parallel use of contractor and NRCS soil crews, providing funding allows it, or by forgoing national standards and relaxing sampling requirements imposed by NCSS, particularly for large inventories. Finally, use of automated methods such as computer supervised classification and modifying data formats (i.e., raster vs. vector) can also help reduce overall time and expense for producing soil inventories.

NRCS Organizational Restructuring

During the past several years, the NRCS has undergone organizational restructuring of several core business functions, which has made it difficult to maintain effective working relations between NPS personnel and their counterparts at NRCS. New regional and state soil scientist roles have been created, key personnel and officials for ongoing projects and agreements have changed, and in several cases it has become unclear who within NRCS should be contacted regarding establishment and administration of SRI task orders, interagency agreements, and invoicing. In time, as the

organization stabilizes and new relationships are established, these challenges are expected to moderate. For the moment, however, conducting business with NRCS has many hurdles to overcome².

Improving communications and working relations between NPS and NRCS personnel will help address the challenge of working with NRCS through its reorganization. One way to help achieve this objective would be to establish a liaison role through an agreement with NRCS. An NRCS liaison could help NPS staff communicate with NRCS project leads, contract officers, state soil scientists, and key officials. Having an “inside person” within NRCS to act as a point of contact can improve communications and improve efficiencies of project management while the NRCS settles into its new organizational structure.

Matching Project Complexity with Park Size

Matching the size of parks with the appropriate amount of soils information needed for management decisions has also been a challenge for soils inventories. NRCS provides a tiered approach for soil surveys that allows the production of standardized and consistent products. Tiers, or soil mapping orders, provide different levels of mapping detail that are mostly based on land use patterns. For instance, more remote, less populated, and expansive Alaska parks are usually mapped at courser soil orders (Order 3 or 4) compared to less remote and more populated conterminous 48 parks (Order 2). The process relies on published standards and procedures of the National Cooperative Soil Survey (NCSS), and each order of mapping intensity has inherent constraints in terms of the overall cost, field time, and product usefulness. Unfortunately, when higher detailed mapping orders are used to document soils in large parks it becomes a challenge to produce cost effective and timely inventories due to these standards. While higher detail is useful, not all management decisions require it, and lower intensity mapping may be adequate for the questions being asked. Additionally, the number and types of products being produced for soils inventories should also be commensurate with the project size and complexities. Sometimes SRI product deliverables have included not only the basic four data products (i.e., geospatial data, soil database, manuscript, and metadata), but they have also included customized products such as web-based maps, specialized SQL queries of NRCS databases, derivative GIS products, and custom reports, all of which demand programmatic funding and place pressures on limited timelines for completing the SRI. In brief, when evaluating the requirements for soils inventories, the size of the park, level of mapping detail, and the number of product deliverables must be weighed against the availability of resources (i.e., staff, time, funding), and the management decisions for which the data will support. This challenge has resulted in adjustments to project

² There are significant administrative issues impacting the completion of soil resources inventories for the 24 remaining park units without a survey. Serious issues at NRCS, including extensive reorganization and key retirements, chaotic billing practices, and likely new reduced-resolution national mapping standards, have impeded progress on the completion of the those parks with surveys in progress. Post-FY2015 revisions to the Interagency Agreement process by the NPS Washington Contracting Office have radically altered how the SRI provides funding to the NRCS for park soil surveys. The SRI team continues to await guidance on these revisions; new agreements and funds to complete surveys in these remaining parks are likely going to be required.

schedules and budgets, and in recent years it has become particularly more difficult as availability of staff and funding levels have declined within the SRI.

To improve productivity of the SRI so completion of the inventory can be achieved faster, it is important to match the size of parks with the appropriate amount of soils data needed to inform management decisions. Due to recent fiscal and timing constraints of the inventory, one important objective should be to reduce the overall time and expense of producing soil resources inventories. One way to achieve this is by establishing new inventory thresholds based on size of parks, where soil inventory products vary by park size. For instance, categories for mapping levels could be set according to newly created park size categories as follows: Category 1 = 0- 50,000 acres, Category 2 = 50,000-250,000 acres, and Category 3 = >250,000 acres. Each category of park could be mapped at standard scales (i.e., 1:12,000, 1:24,000, 1:63,360, 1:250,000, etc.) and levels of thematic detail could be founded on NRCS soil mapping orders, such that smaller parks have more detailed mapping (Order 1), and larger parks have more generalized mapping (Order 3). Finally, consideration should be given to modified soil inventories that include using pre-existing NRCS soil surveys, or adjusting inventories that are estimated to take longer than four years to complete, or using contractors instead of NRCS staff, or combining soil inventory efforts with vegetation inventories, etc. All of these options can improve productivity of the SRI.

Recommended Actions to Expedite Completion of the Soil Resources Inventory

At the close of FY2015, a total of forty SRI projects were either in progress or had not been started; sixteen were in progress, and twenty-four had not been started. To reach completion by 2020 the SRI will need to be expedited in some manner, and this will require addressing some or all of the challenges listed in the previous section. Below are several objectives and related actions to take that draw from the discussion above, and from discussions with I&M leadership³ that if executed can speed progress of the remaining projects and expedite completion of the overall SRI.

Actions to Address SRI Challenges

It must be emphasized that program coordination and oversight is vital to the success and completion of the SRI; without it, progress will continue to be hampered. Once full-time program management (Objective 1) has been restored, the succeeding objectives and actions below should be implemented.

Objective 3.1: Re-establish full-time management, coordination, and oversight of the NPS Soil Resources Inventory Program. [Choose one (1) action.]

³ In February 2015, the IMIWG presented preliminary findings and recommendations to the I&M division leadership team (IMDLT). At the time, the IMDLT made several decisions regarding the SRI including the following (1) the IMDLT supported hiring a soil coordinator within GRD; (2) soil inventories in progress and fully funded should continue toward completion; (3) the interim SRI coordinator should work with regional program managers, network managers, and park staff to review the status of the soil inventories at the remaining parks and identify proposed next steps that reduce costs and timeframe for completion; (4) large parks (above 250,000 acres) will use a modified approach comparable to the approach used in large Alaska parks; (5) parks that do not want an invasive approach could use a modified approach with more limited mapping or be excluded from the mapping.

Action 3.1.1: Re-hire a full-time permanent Soil Inventory Program Coordinator.

Action 3.1.2: Create a detail or multi-year term “Inventory Sunset” Coordinator role to be occupied by an NPS employee or NRCS staff member with similar credentials.

Action 3.1.3: Delegate management oversight and funding directly to the networks for each remaining soil resources inventory.

Action 3.1.4: Utilize Alaska Region Inventory Program for coordination and management of inventories, when possible.

Objective 3.2: Reduce time, labor, and costs of soils inventories. [Choose one (1), or a combination of the following actions.]

Action 3.2.1: Finish soils inventories that are in progress, pronounce the goals of the soils inventory have been met,

Action 3.2.2: Streamline inventories to reduce costs and decrease time, using responses from the program manager survey conducted by the inventory workgroup (Appendix B) to eliminate inventories for parks that do not need them, or that will not allow digging of soils pits in the park.

Action 3.2.3: Implement a hybrid method of conducting soils inventories that incorporates NRCS and contractor supported projects operating in parallel. This may speed completion and reduce time, but it may not reduce costs.

Objective 3.3: Improve communications and working relations between NPS and NRCS personnel.

Action 3.3.1: Establish an NRCS liaison role through an agreement with NRCS to help NPS staff communicate with NRCS project leads, contract officers, state soil scientists, and key officials.

Objective 3.4: Match the size of parks with the appropriate amount of soils data needed to inform management decisions. [Choose one (1), or a combination of the following actions.]

Action 3.4.1: Establish new data standard thresholds based on park size. Modify mapping methods and soil inventory products so the detail of soil data provided to parks varies with park size, i.e. parks greater than 250,000 acres would receive coarsest resolution products.

Action 3.4.2: Reduce the costs and expedite soil inventory timelines by modifying how inventories are conducted. Investigate alternate approaches to conduct modified soil inventories. Options could include using existing NRCS soil surveys, reducing resolution and generalizing mapping for large parks, modifying inventories that are estimated by NRCS to take longer than four years to complete, using contractors instead of NRCS, combining soil inventories with vegetation inventories, etc.

Project-specific Actions

All totaled, 40 of the original 270 soil resource inventories are outstanding and in need of completion. Divided into four subcategories of inventories there are (1) inventories that are currently in progress and have no known obstacles impeding their completion by the 2020 target date, (2) in-progress inventories that need administrative actions to establish new interagency agreements with the NRCS, (3) inventories that are outstanding and currently have no plans for their completion, but if funded and started could be accomplished by 2020, and (4) inventories that are outstanding and currently have no plans for their completion, but if funded with more than \$500,000 and started probably would *not* be completed by 2020, and therefore are in need of modification to expedite their completion. Table 6 provides park listings organized by these categories. To bring the SRI to completion, these actions are suggested.

Table 6. Summary of recommended actions to complete the remaining forty soil resources inventory.

Description	Park	Recommended Action
Inventories that are in-progress and have no known obstacles impeding progress.	GLAC, VOYA, WHSA, MORA, CAVE, FOBU, SUCR, WACA, WUPA, LAKE, GLBA, KATM	Continue the status quo. Planned project funding should continue to support completion with no modifications.
Inventories that are in-progress and require new Interagency Agreements to complete inventory.	SEKI, OLYM, MOJA, ZION	Establish new Interagency Agreements with NRCS to support completion without modification.
Outstanding Inventories that have NRCS cost estimates under \$500,000, which have not started and are expected to take less than four years to complete.	BICA, YELL, BLCA, BRCA, CEBR, CURE, GRSA, CHIR, GRPO, SHEN, BISC, DTRO	NRCS-led inventory. Place into production schedule and fully fund as soon as possible.
Outstanding Inventories that have NRCS cost estimates >\$500K, are not started, and are recommended for a modified/hybrid approach because they are large, expensive, expected to take more than four years, or have special concerns (i.e., no soil pits allowed).	DEVA, BICY, EVER, TICA, APPA, NATR, TONT, GICL, PETR, TUZI, ELMA, PECO	Non-NRCS-led inventory. Work with park, network, and NRCS/Cooperators to determine less-expensive and faster hybrid method for producing all or part of the inventory.

Summary

The Soil Resources Inventory Program provides valuable information about soils within parks. The Program provides basic information needed to manage soil sustainability and to protect water quality, wetlands, vegetation communities, and wildlife habitats. To complete soil resource inventories for the 270 I&M parks with significant natural resources, the SRI Program primarily works with the Natural Resource Conservation Service (NRCS) and follows standards set by the National Cooperative Soil Survey (NCSS). By implementing these standards the program at the close of FY2015 had completed 230 (85%) of the 270 I&M parks chosen for soil surveys, 16 (6%) projects were in progress or planning stages, and 24 (9%) inventory projects had not been started. If funding were to continue, and allocated equally across target completion years (2016-2020), \$2.9 million per

year would be required to complete the SRI by FY2020. Several challenges that impede progress of the SRI have been identified, and recommendations to remedy them have been suggested. Actions to take for addressing the remaining forty SRI projects have also been provided, which if applied could expedite completion of the overall SRI by 2020.

Chapter 4. Geologic Resources Inventory

Geologic Resources Inventory Overview

The primary objective of the Geologic Resources Inventory (GRI) is to provide a relevant geologic map and an issues-focused report to each NPS unit, and to ensure the map is digitized into a Geographic Information System (GIS). The maps include bedrock, surficial, and/or geomorphic information, which have much different management applications. The report is an important deliverable for each NPS unit to make resource management connections to the map data. These products are critical information for resource managers at national parks because they provide information on habitat, geologic hazards, mineral resources, natural history, soils, scenic resources, landforms, cultural resources, and water chemistry, among others.

Since its inception, the GRI has been administered as a collaborative effort between the National Park Service and Colorado State University (CSU) Department of Geosciences. National Park Service staff include full-time and term federal positions in Denver (GRD), and remotely in Anchorage, Alaska (AKRO) and Baton Rouge, Louisiana. CSU Department of Geosciences staff include research associates on campus (Fort Collins) and working remotely (Fort Collins, Colorado; Bigfork, Montana; Anchorage, Alaska; Vancouver, British Columbia). CSU student interns are hired by the GRI team. An NPS Inventory program administrator/manager handles the bulk of the administrative, contracting, and planning tasks and a CSU Research Associate handles administrative responsibilities for intern positions. Each of the three components of the GRI—scoping, maps/GIS, and reports—have an individual in a lead or point-of-contact role that coordinates scoping meetings, identifies existing map coverages, and oversees and coordinates the production of the GRI map and report products. The entire team meets once annually to discuss progress and planning, and resolve any internal issues. Team-wide conference calls are conducted on a quarterly (more or less) basis.

Geologic Resources Inventory Products and Deliverables

To meet their objectives, the GRI team undertakes three tasks for each I&M park (1) conduct a scoping meeting and provide a summary document, (2) provide digital geologic map data in a GIS format, and (3) provide a GRI report. These products are designed and written for non-geoscientists.

The initial GRI product is a scoping meeting at each park, where park staff can identify issues and sources of data. In addition to GRI staff, scoping includes park scientists and managers, geologists from federal and state agencies, and academic institutions. Together, the scoping team evaluates the extent and quality of existing geologic maps and park-specific geologic resource management issues. One result of a scoping session may be the need for the GRI to fund new mapping in parks that lack or have inadequate map coverage. Discussions at the scoping meeting determine the map deliverable and provide the basis for the subsequent report.

The primary product of the GRI is a geologic map in digital form (geospatial data) produced at a scale appropriate to the park that could be any one of several variants or a combination thereof:

Geologic - geologic maps that depict both bedrock and surficial deposits. However, the surficial deposits are typically grouped together under broad descriptions with limited detail.

Bedrock - geologic maps that depict bedrock and little to no surficial deposits.

Surficial - geologic maps that depict the surficial geology with limited bedrock unit descriptions, often simply described as “bedrock” on the map.

Geomorphic - geologic maps that depict a park’s geomorphology. For the GRI, these are mainly used for coastal park units or for identifying geologic hazards; it may be very similar to a surficial geology map or a landform map.

The GRI team does not conduct original geologic mapping. However, the team digitizes paper maps and compiles and converts digital data to conform to the GRI GIS data model. Geologic maps are obtained from existing USGS, state, or academic sources where such maps are of adequate scale and extent. For parks with inadequate or non-existent map coverage, GRI utilizes contracts or cooperative agreements with state geologic surveys, academic institutions, the private sector, and Interagency Agreements with the USGS. A limited number (4) of landform maps—as supplemental products to delivered geologic maps—have also been funded by GRI and conducted through networks by NPS staff.

The most recent GRI GIS maps include the following products as part of the deliverable:

1. A GIS readme file (PDF format) that describes the GRI data formats, naming conventions, extraction instructions, use constraints, and contact information
2. Data in ESRI© geodatabase GIS format
3. Layer files with feature symbology
4. Federal Geographic Data Committee (FGDC)-compliant metadata
5. An ancillary map information document (PDF format) that contains information captured from source maps such as map unit descriptions, geologic unit correlation tables, legends, cross-sections, and figures
6. An ESRI© map document (MXD format) that displays the GRI GIS data
7. A version of the data viewable in Google Earth© (KMZ format)

The final product of the GRI is the park-specific report. Reports for a particular park are based upon that park’s map product(s); therefore, reports cannot be started until maps are complete. The reports are a “resource manager’s guide” to park geology. Most parks lack staff with a geoscience background. Therefore reports identify geologic resource management issues and summarize the unit’s geologic history, processes, and features. The report provides a very useful product for a number of park management activities, including development of foundation statements, general management plans, research, resource management, visitor safety, interpretation, and maintenance. Geologic map data, a bibliography, a list of additional sources of information, and a summary of laws, policies, and NPS regulations relevant to geologic resources are also included in each report. Reports are written by NPS staff at GRD and AKRO, and by Colorado State University Research Associates.

Status of the Geologic Resources Inventory

Geologic Resources Inventory Progress

At the end of FY2015, the Geologic Resources Inventory (GRI) included 148 (55%) “complete” parks, 121 (45%) “in progress” parks, and 1 (<0.01%) park “not started” (Figure 5). In order to be considered “complete” both a report and map must be delivered to the park. An inventory “in progress” may fall into one of two possible scenarios: (1) the map is complete but a report has not yet been completed; (2) a map is not yet complete but it is in progress or has been funded. Inventories “not started” are those where a map is not yet complete and is not in progress, and it has not been funded. Table 7 provides region and network totals of the GRI inventories for each of these categories of completeness.

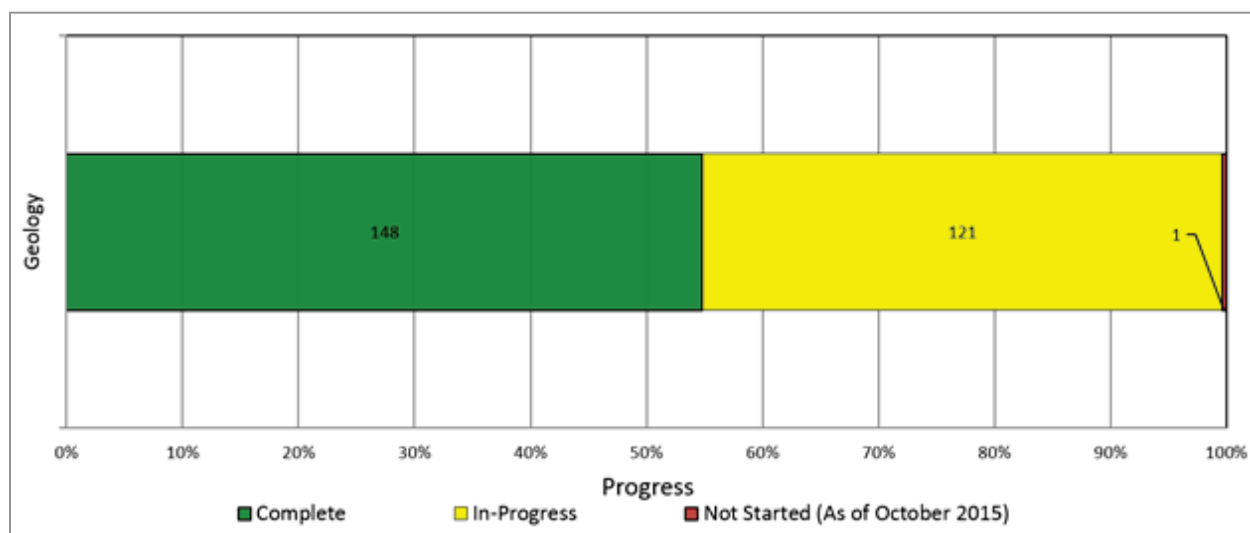


Figure 5. Geologic resources inventories completed, in progress, and not started.

Table 7. Geologic resources inventories progress summarized by region and network.

Region	Network	Completed	In Progress	Not Started	Totals
Alaska	Arctic	0	5	0	5
	Central Alaska	1	2	0	3
	Southeast Alaska	0	3	0	3
	Southwest Alaska	1	4	0	5
	Regional Total	2	14	0	16
Intermountain Region	Chihuahuan Desert	3	3	0	6
	Greater Yellowstone	2	1	0	3
	Northern Colorado Plateau	16	0	0	16
	Northern Great Plains	2	0	0	2
	Rocky Mountain	6	0	0	6
	Sonoran	6	5	0	11
	Southern Colorado Plateau	12	7	0	19
	Southern Plains	8	2	0	10
	Regional Total	55	18	0	73
Midwest Region	Great Lakes	3	6	0	9
	Heartland	4	11	0	15
	Northern Great Plains	9	2	0	11
	Regional Total	16	19	0	35
National Capital Region	National Capital	11	0	0	11

Table 7 (continued). Geologic resources inventories progress summarized by region and network.

Region	Network	Completed	In Progress	Not Started	Totals
Northeast Region	Eastern Rivers and Mountains	5	4	0	9
	Mid-Atlantic	8	2	0	10
	NE Coastal and Barrier	3	5	0	8
	Northeast Temperate	5	5	1	11
	Regional Total	21	16	1	38
Pacific West Region	Klamath	5	1	0	6
	Mediterranean Coast	0	3	0	3
	Mojave Desert	2	4	0	6
	North Coast and Cascades	3	4	0	7
	Pacific Islands	8	1	0	9
	San Francisco Bay	0	6	0	6
	Sierra Nevada	2	1	0	3
	Upper Columbia Basin	4	4	0	8
	Regional Total	24	24	0	48
Southeast Region	Appalachian Highlands	1	3	0	4
	Cumberland/Piedmont	8	6	0	14
	Gulf Coast	2	6	0	8
	South Florida/Caribbean	5	1	0	6
	Southeast Coast	3	14	0	17
	Regional Total	19	30	0	49
Grand Total		148	121	1	270

Progress for the three primary GRI tasks at the end of FY2015 were as follows:

- Scoping has occurred at 269 of 270 I&M parks (99.7%). Only the 2,184 mile-long Appalachian National Scenic Trail (APPA) remained to be scoped.
- Geologic maps of some kind have been delivered to 254 I&M parks (94.10%). Of the remaining parks, NPS funds have been committed by contract or agreement to complete geologic maps at 15 of the remaining by 2018. (Table 9). The final park, APPA, needs scoping to determine the most feasible GRI product to deliver.
- Reports have been written for and delivered to 148 of 270 NPS units (54.8%). An additional 14 reports were in progress. The remaining 108 parks have been assigned to tiers and new completion dates have been projected through FY2020.

Estimate of Time and Funding Required to Complete the GRI

The graph below is (Figure 6) is a projection of yearly outlays to deliver GRI products to 120 of the remaining 122 remaining parks by the FY2020 target completion date. Figures for APPA and NATR were not available. Refer to Appendix C for more detailed yearly cost projections provided by the GRI which highlights expected expenditures for salaries, new mapping, and report writing.

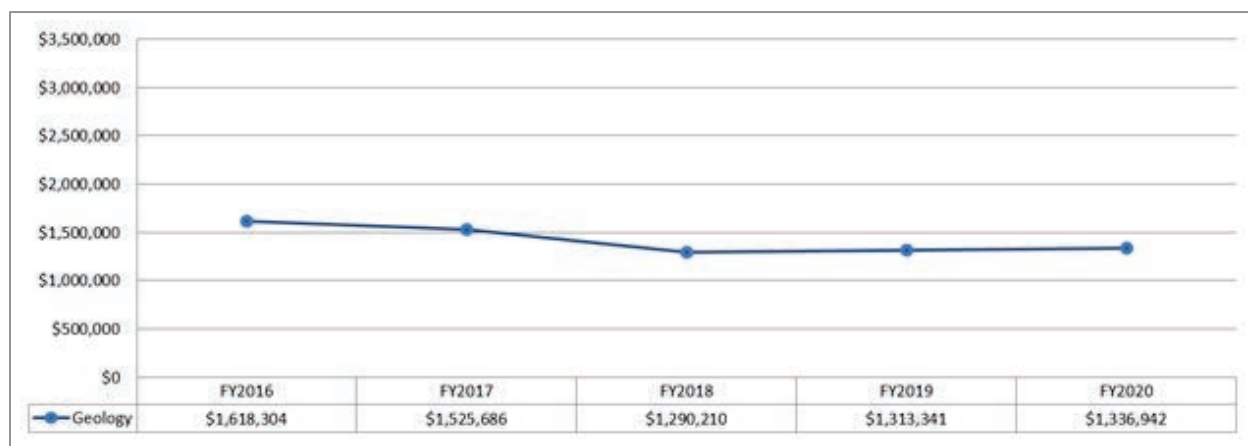


Figure 6. Estimate of time and funding required to complete the GRI by FY2020.

Challenges of the Geologic Resources Inventory

Challenges of completing the GRI are presented below and grouped by three product and deliverable themes, which include (1) conducting scoping meetings and working with cooperators, (2) providing digital geologic map data in a GIS format, and (3) providing GRI reports.

Project Scoping and External Party Collaboration

GRI scoping meetings are the first opportunity to listen to and collaborate with parks, and to capture input for developing products. Scoping meetings require collaborating with the parks and subject matter experts, and meeting scheduling often revolves around the availability of park staff and geologic experts that usually work for other agencies. For parks with multiple agency interest, convening such a meeting can be a challenge. For instance, efforts to hold an APPA scoping meeting

began in FY2012, and the actual meeting was scheduled for FY2016. Once all parties have met, and the scoping efforts are completed, GRI can move forward with the developed plan. Until then, it is difficult for projects to progress.

Regardless of the GRI product, completion and delivery of final products are dependent upon external parties at many levels. Source material used by the GRI team can be derived from USGS, state geologic survey, or academic mapping organizations. On the front end of map production, where existing mapping is inadequate, outdated, or non-existent, new mapping may require funding and contracting actions with mapping agencies. Geologic reports, which are generated in-house, require external reviews. All require time and dependencies that influence the GRI process flow and schedule. If problems are encountered, production delays of the inventory can occur.

Over time, the GRI has worked to improve and leverage relationships with collaborators that influence their workflows. Besides providing a written plan as an output from the scoping process, the GRI also works with parks up front and frequently to ensure products being created will be accessible and relevant to park needs. There has been an increased collaboration with GRD program leads and other NPS staff during the writing phase of reports to limit subsequent review time, and “backup” reviewers of products are identified to ensure reviews get done in a timely manner. Collaborating more with the Map Team to reduce revisions of GIS data while reports are being written has also improved performance, and so has obtaining early releases of map products from cooperators, before they are published, which gives staff a jump start on creating GRI specific map products and reports. By taking advantage of these methods, the GRI has been able to effectively scope out park needs and work with cooperators to produce high-quality geologic data sets, maps, and reports that are relevant to parks.

Managing GIS Map Products

GRI map products have evolved over time to keep up with technology and to provide park staff with easy access to geologic data. Because the GRI relies on a multitude of source agencies to produce map data, GIS products delivered to the GRI have varied in quality, and followed different development conventions. Over the years multiple geospatial data formats have also been developed and surpassed, which has required the GRI to keep up to date with the latest GIS and mapping technologies. While doing so has required time and resources, not addressing this evolving technology challenge would have resulted in GRI products and deliverables becoming obsolete or unusable.

In order to standardize what parks receive from the GRI, and to ensure consistency between GRI products, the GRI staff developed a robust and flexible data model which can be implemented for a variety of geologic features and map types (coastal, geomorphology, bedrock, surficial, hazards, etc.). The data model has been refined over time to better communicate geologic map data (e.g., adding fields such as FGDC symbology, altering fields, adding new data layers). It has also been optimized so it is concise and efficient, and leverages new software and data storage functionality (migration from older formats, utilization of topology for quality control, etc.). The development of a GRI-specific data model was critical to ensure that data from a wide variety of source agencies are presented consistently in GRI products. GRI GIS data are now produced in up-to-date formats with

compatibility for online map viewers and map services. Google Earth[®] compatible versions of data are also provided so that non-GIS specialists can interact with the data. In short, by keeping current with technology, GIS map products delivered by the GRI continue to be accessible and usable by parks and other end-users.

Providing GRI Reports

Producing relevant and useful reports has been an evolving challenge for the GRI. As originally envisioned in the mid-1990s, the GRI would deliver to each park a digital version of a geologic map, without an accompanying report. Reports were developed a few years after the GRI started delivering map products because the vast majority of parks did not have geoscientists on staff and they did not have the expertise to incorporate the information on geologic maps into resource management. Parks requested help using the maps, and the GRI reports were developed to provide some of that guidance. Today, parks are offered the opportunity to review reports, and the content of what goes into a report has changed dramatically based on park and GRD input. For instance, GRI now produces high quality posters showing the data over shaded relief or other imagery because parks requested hard copies to display and view the GIS data. As the GRI reports became more descriptive, the included maps, called layouts, also became ever more complex. Today, layouts are included each report, and the evolving challenge continues to ensure reports stay relevant and useful.

In 2015, in response to an Inventory and Monitoring Division (IMD) request to accelerate report production, the GRI made several adjustments to the way they produce reports. Now the GRI offers a series of 4 report tiers, each containing differing levels of geologic information. Tier 1 reports follow a standard similar to what the team had delivered in recent years. Tier 3 reports are updated and illustrated versions of existing scoping meeting summaries. Tier 2 reports are something in between Tiers 2 and 3, focusing on specific management, policy, and regulatory issues. Coastal park reports, the fourth category, emphasize recently completed and forthcoming coastal resource management guidance. There are also reports that cover multiple park units, for instance when parks are geographically adjacent to one another. By providing these modified reports, more parks receive deliverables, and production rates can increase.

Recommendations to Expedite Completion of the Geologic Resources Inventory

This section offers recommendations to address challenges of GRI described above. In general, all scoping should be completed, and geology maps where work has begun and contractual agreements are in place (Table 8) should also be finished. Because reports are the only documents that identify geologic resource management issues, the new tiered approach and modified report content should be used to accelerate report production for all remaining reports.

Table 8. Actions required to complete GRI map products for remaining 16 parks.

Region	Network	Parks	Action	Required Funding
Alaska Region	Arctic	CAKR	New IA with USGSa	Annual ASC
	Central Alaska	YUCH	New IA with USGSa	Annual ASC
	Southeast Alaska	SITK	New IA with USGSa	Annual ASC
Midwest Region	Great Lakes	SACN	Mod to CA in FY 16	\$50k
	Heartland	BUFF	NCE with USGS in FY16b	No
	Northern Great Plains	MNRR	New CA with Nebraska Survey to complete west half of park	\$100K in FY16; estimated \$50K in FY17
	Northern Great Plains	NIOB	NCE with USGS in FY16b	No
Northeast Region	Eastern Rivers and Mountains	UPDE	Mod to CA in FY17	\$105k in FY17
	Mid-Atlantic	PETE	New contract in FY16	\$80k
	Northeast Temperate	APPA	None at this time	\$7,000 in travel funds during FY16, unknown beyond that
Pacific West Region	Mediterranean Coast	CHIS	NCE in FY16	No
Southeast Region	Appalachian Highlands	BISO	None	No
	Cumberland/Piedmont	CHCH	None	No
	Cumberland/Piedmont	LIRI	Mod to CA in FY16	\$82.5k in FY 16
	Gulf Coast	NATR	Mod to CA in FY 16	\$20k in FY16, beyond that undetermined
	Gulf Coast	VICK	None	No

^aPart of annual IA with Alaska Science Center (ASC)

^bBuffalo and Niobrara USGS mapping projects on same IA, both with receive NCE (No Cost Extension)

Actions to Address GRI Challenges

The following objectives and actions are recommended for expediting the GRI:

Objective 4.1: Complete GRI Scoping.

Action 4.1.1: GRI staff should convene a scoping meeting for APPA and develop a mapping plan.

Objective 4.2: Complete GRI Maps.

Action 4.2.1: Complete the 16 remaining map projects. Support should continue for mapping of the 14 projects with plans, and the two parks with no formal mapping plan.

Objective 4.3: Complete GRI Reports.

Action 4.3.1: Follow a tiered approach to adapt report content and reviews to the geologic complexity and/or resource management needs of each park.

Action 4.3.2: Write more reports that cover multiple parks.

Action 4.3.3: Streamline the report writing and review process by engaging park geologists.

Project-specific Actions

GRI Project Scoping

Only one park remains to be scoped, Appalachian National Scenic Trail (APPA). Scoping APPA will complete the overall scoping effort for all GRI parks and provide a plan to move forward with one of the two parks that currently have no mapping plan. In addition to costs for GRI staff time, travel for NPS staff and geologists from USGS and potentially a dozen state surveys is estimated to be about \$7,000.

GIS Map Projects

Because the principal product of the GRI is a digital geologic map for each park, it is recommended that GRD complete ongoing projects for the remaining 16 parks. Mapping plans should be completed for APPA (scoping meeting will accomplish this task) and NATR. The cost of producing new map coverage for the 14 parks in progress is approximately \$500,000 plus between \$50,000 and \$100,000 for USGS Alaska Science Center support. While costs for APPA and NATR are not known, it is expected these should not exceed a few hundred thousand dollars for each park. The following table outlines actions and funding required to deliver maps to these 16 remaining parks. Note that these costs are for mapping only, and do not include GRI map team salary and support costs to convert data into GRI products. Total map team costs from FY2016 through FY2020 are estimated to be approximately \$2.8 million. Refer to Appendix C for more detail.

GRI Reports

At the end of FY2015, 148 reports were complete and 14 were in progress, leaving reports for 108 parks that had not been started. The cost of producing the remaining GRI reports by FY2020 is estimated to be about \$3.5 million, or roughly \$30,000 for each report. These figures include staff support in Denver for one report team lead, one report writer/editor, one writer in Alaska, dedicated to writing reports for Alaska parks, and one part time writer for coastal parks. This funding will also support three report writers that are CSU Research Associates (one of which is also an editor). Cost of completing reports for each park has not been determined because the time spent by team members involved at each stage of the writing, review, and production process varies widely. Individual authors concurrently work on as many as five reports in different stages of writing or review, and team-wide, there are commonly fifteen reports or more in progress.

It will be a challenge to keep to the report completion schedule moving along considering the number of parks and the large size and/or complex geology of many of the remaining parks (e.g., DEVA, GOGA, GRCA, YELL, and all the Alaska parks). In order to complete the remaining 122 reports by

FY2020, production rates will need to accelerate from what they had been from FY2005 through FY2015; maintaining the status quo for report content and time investment will not be possible to achieve this goal. Short of eliminating the reports, they could be shortened by focusing them on geologic resource management issues, and eliminating sections on geologic history, processes, and features where other publications already exist. Peer and park review is critical to the utility of the reports, therefore eliminating the review process is not recommended. Recommendations for accelerating report production are presented below, and include the following:

1. Reduce or eliminate portions of the review process.
2. Alter the report product.
3. Only produce a report for a subset of the remaining parks.
4. Write reports that cover multiple parks.
5. A combination of the above.

The following actions incorporate one or more of the options suggested above.

Follow a Tiered Report Approach

Because the status quo of 10-15 reports per year will not accommodate the remaining 122 parks by FY2020, GRI should adjust content and/or review process to greatly accelerate report production based on the GRI's four established. Table 9 identifies park lists grouped by tier that could be used to expedite GRI report production.

Table 9. List of parks grouped by the type of GRI report (tier) that will be produced.

Tier	Parks
Tier 1	ALAG, AZRU, BELA, BIBE, BLRI, BOHA, BUFF, CAKR, CHIS, COLO, CRMO, DEVA, FOPO, GAAR, GLBA, GLCA, GOGA, GRCA, JOTR, KATM, KEFJ, KOVA, LACL, LAKE, MOJA, MUWO, NOAT, NOCA, OLYM, OZAR, PINN, PORE, REDW, SAMO, SEKI, WRST, YELL, YUCH
Tier 2	AMIS, APPA, BISO, BITH, BLUE, CACH, CUVA, GARI, GRPO, INDU, KLGO, LARO, LEWI, LIRI, MNRR, NATR, NERI, NIOB, OBRI, ORPI, PIRO, SACN, SLBE, UPDE, VICK
Tier 3	MME, BIHO, CAGR, CHAT, CHCH, COWP, EFMO, FODA, FODO, FOLS, FOVA, GWCA, HEHO, HOBE, HUTR, JOMU, KEMO, LIBO, MIMA, MISS, MOCA, NEPE, NISI, OCMU, PERI, PETE, PETR, PIPE, RICH, ROVA, SAAN, SAGA, SAPU, SARA, SHIL, SITK, TAPR, TONT, TUZI, WABA, WICR
Coastal	BISC, CABR, CACO, CALO, CANA, CASA, CUIS, FIIS, FOCA, FOFR, FOMA, FOPU, FOSU, GATE, GUIS, JELA, SAHI, TIMU

The 25 Tier 1 parks, plus the 14 already in progress, have significant geologic resources and should receive a detailed report similar to what the GRI currently produces, but with streamlined content. The 41 Tier 3 parks have less significant geologic resources, and should receive an abbreviated report. GRI also includes an intermediate Tier 2 which encompasses 25 parks. A fourth tier for the 18 coastal parks has also been created. Compared to “mainland” parks, coastal parks have different, and

in many cases, common, features, processes, and resource management issues. The NPS has also developed resource management guidance specifically for coastal parks.

Write More Reports that Cover Multiple Parks

Tier 2 reports should provide a review of geologic history, processes, and features, but at a network or sub-network scale. Sections of the reports could still focus on geologic issues relevant to each park. Combining parks will also more efficiently use reviewers' time by addressing multiple parks at once. This action has already been implemented by GRI in the past (e.g., single reports were completed for GRTE-JODR; LAMR-ALFL; and MONO-HAFE-CHOH) and makes the most sense when parks are adjacent or covered by one map, or at least similar maps by same source agency. In those instances, stratigraphic nomenclature and geologic descriptions should remain consistent among the parks, which will make it easier and practical to discuss them together. The 14 parks identified in Table 10 meet the above criteria and could easily be combined into five reports. GRI should combine additional parks when practical and appropriate.

Table 10. List of five multiple park reports for the GRI.

Description	Parks
Southwest Alaska Parks	KATM, ALAG
West Virginia River Parks	BLUE, GARI, NERI
Brooks Range (Alaska) Parks	CAKR, NOAT, KOVA, GAAR
San Francisco Bay Area Parks	GOGA, FOPO, MUWO
South Carolina Coastal Parks	FOSU, CHPI

Streamline the Report Writing and Review Process by Engaging Park Geologists

Although park geologists are uncommon in the NPS, GRI relies heavily on them to provide information and to review reports. In addition to having park geologists review reports, they should also be considered as potential report authors, too. This could result in reports that are better integrated into park plans and operations. NOCA has been suggested as a pilot park for this approach. The park has a permanent geologist with 25 years of experience and three physical science technicians with M.S. degrees in geology, as well as an outstanding summary of the park's geology (Tabor and Haugerud 1999). Other parks with geologists on staff that may be candidates to write GRI reports include BIBB, REDW, and YELL (if geologist positions are rehired). Such an effort would need to be carefully coordinated with park administration to ensure the park geologists have time to work on reports and follow GRI guidance, and have time to complete drafts in a timely manner. GRI staff would need to review and edit the reports, and external reviews would be necessary to satisfy the requirements of the NPS Natural Resource Report Series.

Summary

The Geologic Resources Inventory Program provides valuable information about geology within parks. The primary objective of the GRI is to provide a relevant geologic map and an issues-focused

report to each NPS unit, and to ensure the map is digitized into a Geographic Information System (GIS). Since its inception, the GRI has been administered as a collaborative effort between the National Park Service and Colorado State University (CSU) Department of Geosciences. To meet their objectives, the GRI team undertakes three tasks for each I&M park (1) conduct a scoping meeting and provide a summary document, (2) provide digital geologic map data in a GIS format, and (3) provide a GRI report. Scoping has occurred at 269 of 270 I&M parks (99.7%). Geologic maps have been delivered to 254 I&M parks (94.10%), and reports have been written for, and delivered to, 148 of 270 NPS units (54.8%). If funding were to continue for the GRI, it is estimated that approximately \$7,084,482 would be necessary to complete the inventory. Several challenges of the GRI have been identified, and recommendations to remedy them through several actions have been suggested. Should these actions be taken, it is expected the GRI would be expedited and completion of the overall GRI and its products could be achieved by 2020.

Chapter 5. Recommendations to Expedite Inventory Completion

In 2014, the NPS Inventory & Monitoring Division's (IMD) established the I&M Inventory Workgroup to evaluate the current status of the VMI, SRI, and the GRI. The workgroup was asked to evaluate and recommend potential avenues to help reduce the time and cost of these inventories so their completions might be expedited. The previous chapters have identified current status, challenges, and potential actions to move the remaining inventories forward. Table 11 below consolidates these recommendations into a single list to help identify recommendations that cut across all inventories. Following this summary is a discussion of several themes which are cross-cutting among all three inventories.

Table 11. Summary of recommendations to expedite the completion of vegetation, soils, and geology inventories.

Inventory Category	Inventory Types	Park	Recommended Action
Vegetation (7 parks)	Inventories recommended for facilitation	ORPI, YELL	Project leads, VMI and parks revisit scoping and study plans. For ORPI the study plan needs to address current safety-related access issues and outline/develop a collaboration with adjacent federal agency staff to leverage existing mapping products. YELL study plan needs to be agreed upon by all stakeholders to ensure park specific concerns are met.
	Inventories on track for 2019 completion	GUIS, BITH, NIOB, MNRR, DEVA	Continue projects as planned. Adjust project goals contingent on funding.
Soils (40 parks)	Inventories that are in-progress and have no known obstacles impeding progress.	GLAC, VOYA, WHSA, MORA, CAVE, FOBU, SUCR, WACA, WUPA, LAKE, GLBA, KATM	Continue the status quo. Planned project funding should continue to support completion with no modifications.
	Inventories that are in-progress and require new Interagency Agreements to complete inventory.	SEKI, OLYM, MOJA, ZION	Establish new Interagency Agreements with NRCS to support completion without modification.
	Inventories that have NRCS cost estimates under \$500,000, which have not started and are expected to take less than four years to complete.	BICA, YELL, BLCA, BRCA, CEBR, CURE, GRSA, CHIR, GRPO, SHEN, BISC, DTRO	NRCS-led inventory. Place into production schedule and fully fund as soon as possible.
	Outstanding Inventories that have NRCS cost estimates >\$500K, are not started, and are recommended for a modified/hybrid approach because they are large, expensive, expected to take more than four years, or have special concerns (i.e., no soil pits allowed).	DEVA, BICY, EVER, TICA, APPA, NATR, TONT, GICL, PETR, TUZI, ELMA, PECO	Non-NRCS-led inventory. Work with park, network, and NRCS/Cooperators to determine less-expensive and faster hybrid method for producing all or part of the inventory.

Table 11 (continued). Summary of recommendations to expedite the completion of vegetation, soils, and geology inventories.

Inventory Category	Inventory Types	Park	Recommended Action
Geology (122 parks)	Inventories that require scoping	APPA	GRI should convene a scoping meeting
	Inventories that require geology map	CAKR, YUCH, SITK, SACN, BUFF, MNRR, NIOB, UPDE, PETE, APPA, CHIS, BISO, CHCH, LIRI, NATR, VICK	Complete the 16 remaining map projects. Continue support for mapping 14 projects with plans, and the 2 parks with no formal mapping plan.
	Inventories that require GRI reports	ALAG, AZRU, BELA, BIBE, BLRI, BOHA, BUFF, CAKR, CHIS, COLO, CRMO, DEVA, FOPO, GAAR, GLBA, GLCA, GOGA, GRCA, JOTR, KATM, KEFJ, KOVA, LACL, LAKE, MOJA, MUWO, NOAT, NOCA, OLYM, OZAR, PINN, PORE, REDW, SAMO, SEKI, WRST, YELL, YUCH	Produce Tier 1 Reports (38)
		AMIS, APPA, BISO, BITH, BLUE, CACH, CUVA, GARI, GRPO, INDU, KLGO, LARO, LEWI, LIRI, MNRR, NATR, NERI, NIOB, OBRI, ORPI, PIRO, SACN, SLBE, UPDE, VICK	Produce Tier 2 Reports (25)
		AMME, BIHO, CAGR, CHAT, CHCH, COWP, EFMO, FODA, FODO, FOLS, FOVA, GWCA, HEHO, HOBE, HUTR, JOMU, KEMO, LIBO, MIMA, MISS, MOCA, NEPE, NISI, OCMU, PERI, PETE, PETR, PIPE, RICH, ROVA, SAAN, SAGA, SAPU, SARA, SHIL, SITK, TAPR, TONT, TUZI, WABA, WICR	Produce Tier 3 Reports (41)
		BISC, CABR, CACO, CALO, CANA, CASA, CUIS, FIIS, FOCA, FOFR, FOMA, FOPU, FOSU, GATE, GUIS, JELA, SAHI, TIMU	Produce Coastal Reports (18)

Table 11 (continued). Summary of recommendations to expedite the completion of vegetation, soils, and geology inventories.

Inventory Category	Inventory Types	Park	Recommended Action
Geology (122 parks) (continued)	Inventories that require GRI reports (continued)	KATM, ALAG, BLUE, GARI, NERI, CAKR, NOAT, KOVA, GAAR, GOGA, FOPO, MUWO, FOSU, CHPI	Evaluate options to combine into Multi-Park Reports

Cross-Cutting Themes Common to All Three Inventories

The foregoing discussions regarding methods to expedite completion of the VMI, SRI, and GRI all have several overlapping themes in common. Below are brief narratives for six of these themes that are cross-cutting with regards to expediting inventory completions. The themes include (1) inventory program management, (2) completing all in-progress inventories, (3) reducing mapping resolution, area, and creating modified products, (4) expedited inventories in Alaska, (5) the use of standard when expediting inventories, and (6) importance of communication.

Inventory Program Management is Essential

It must be emphasized that program coordination and oversight at many levels is vital to the success and completion of the Inventories; without it, progress is severely hampered. Not only should there be adequate leadership for decision making and program guidance, there also needs to be sufficient qualified and dedicated staff on-board for work to be performed. Two examples that illustrate this point include (1) critical leadership and direction within the SRI has been missing for over three years due to the Program Manager vacancy who's responsibilities have temporarily been assigned as "acting" collateral duties to staff within the GRI; and (2) a key VMI ecologist position, relied upon for providing critical assistance in developing and reviewing vegetation classifications and data quality, has not been backfilled. While addressing vacancies is an important issue, it is the management of each inventory as a program that has helped achieve the objectives of the I&M Inventory Program. Conducting inventories for 270 has been a monumental undertaking, and the achievements could not have come so far had each inventory been accomplished independently, without standards, or consistent processes that programs provide. When qualified lead roles and skilled staff are available to oversee implementation of inventory projects they can help direct projects through to fruition.

Recommendation: Evaluate vacant positions related to the VMI, SRI, and GRI to identify programmatic deficits, and rehire/re-staff key position/duties.

Complete Projects That Are In-Progress

Each of the three inventories has numerous ongoing projects that in some cases are fully funded and simply need more time to finish the ongoing work. Some inventories that are in progress may need additional time and also more funding. Other inventories may need time, funding, and administrative actions (e.g., establishment of a new inter-agency agreement, facilitated re-scoping to reach FY2020 completion, etc.). Regardless of the scenario, inventories currently in-progress are considered necessary and it is important to complete all related products and deliverables.

Recommendation: Continue projects that are in-progress and on target for completion by FY2020. Provide support to projects in need of administrative actions (e.g., establishment of a new interagency agreements, facilitated re-scoping, etc.) and provide additional funding, if needed, to ensure completion by FY2020.

Reduce Mapping Resolution, Area, and Modify Products to Complete Inventories

All three inventory programs have projects that could benefit from modified or hybrid approaches. Inventories may be scaled back in terms of mapping extent, resolution, level of classification, or

details in the final report to ensure park management is provided with useful products. At the same time, these hybrid approaches allow the I&M program to complete inventories in the most efficient manner possible. The use of such adjustments helps reduce project costs and allows larger areas to be inventoried in less time. While in some cases less detailed information is provided, product deliverables are still beneficial for resource management decisions, because they can be designed to be compatible with existing NPS standards and can help form a basis for more detailed or focused mapping in the future, if required.

Recommendation: Where limited resources, funding, or time will not allow standard inventory approaches to be used, work with park, network, and/or cooperators to determine less-expensive and faster hybrid methods for producing all or part of an inventory.

Expedited Vegetation and Soil Inventories in Alaska

For more than a decade, the Alaska Regional Inventory Program has worked in parallel with the VMI and SRI to provide Phase I Natural Resource Inventories for the I&M Program. Funded as a separate Inventory Program, the Alaska program has focused exclusively on producing inventories for the Alaska Region. The sixteen national park units in Alaska make up about two-thirds of the total land area in the National Park System, with ten parks exceeding one million acres. Because most parks in Alaska are large and remote, it was recognized that adjustments to the standard VMI and SRI approaches were needed to complete the inventories in a timely manner. Many recommendations identified in this report have successfully been applied to Alaska vegetation and soil inventories, and they have helped expedite inventory completions. Today, all sixteen Alaska vegetation inventories have been completed, and the last two soil inventories are in progress with completion dates in 2018. At the close of FY2015, all thirty-two Alaska vegetation and soil inventories were fully funded and no further project funds were required. Only basic operating expenses and salaries for two program staff will be necessary for the next several years (Figure 7) to culminate more than two decades of scientific vegetation and soil data collection and reporting for the Alaska Regional Inventory Program.

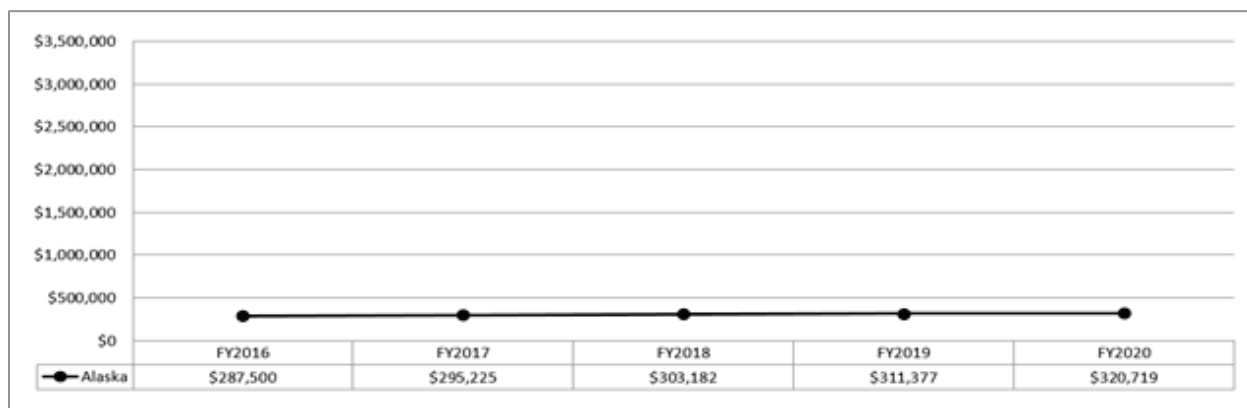


Figure 7. FY2016-FY2020 Alaska Regional Inventory Program funding requirements.

Recommendation: Continue on-going support for the Alaska Regional Inventory Program. Utilize Alaska Inventory staff experience for implementing hybrid approaches for the VMI and SRI, where possible and appropriate.

Standards Provide Consistent Products

Standards vary across the three inventories, but the use of standards does not. Even when inventories require modifications, standards for such adjustments are necessary to ensure consistency in quality and assurance. For instance, tiered approaches to mapping and creating reports have been implemented in all three inventories, as has using standardized classifications and data formats. Regardless of the inventory, use of standards is a basic prerequisite for ensuring useful and consistent end-products are created.

Recommendation: Continue to use established standard methodologies for remaining inventories, where possible. If methods require adjustment, ensure new standards are established to ensure quality of end-products for similar projects (e.g., Standard Tiered Mapping Scales, Similar Report Outline and Content, Defined Product Lists, etc.).

Effective Communication is Critical

Effective communication is critical at all levels of the VMI, SRI, and GRI, and it is essential to expediting completions of these inventories. Whether the activity involves scoping projects with park management and staff, subject matter experts at other agencies, and fellow NPS colleagues, being able to convey and receive accurate information with one another up front will ensure projects do not get derailed by misunderstandings or misperceptions downstream. Clear communication is also vital when conveying expectations to individuals, or stating requirements and capabilities of product to park staff, and when inventory issues span multiple levels of organizations (i.e., park, network, region, I&M division). Finally, when working with other agencies for reviewing data and reports, or when establishing new task orders, or when trying to resolve invoicing issues, effective communication is critical so information can flow in both directions. In short, when communication is working well, inventories are able to move forward faster.

Recommendation: Continue to manage park and program expectations at all levels. Consider establishing internal and/or external liaison roles to facilitate communications and stakeholder engagement between project leads, network managers, park staff, contract officers, key officials, subject matter experts, etc.

Conclusion

The recommendations described herein are based on significant discussions with both the Inventory Workgroup and Inventory leads. It is understood that the process for completing the VMI, SRI, and GRI has extended long after the established initial timeline. However, early estimates could not have begun to envision the complexities of some of the inventory projects, the delays that have been encountered due to staff turnover, modifications to improve deliverables, and the extensive areas being inventoried, without a “one size fits all” process. In hindsight, the NPS has benefitted tremendously from the multitude of lessons learned, gained a much better understanding of the resources evaluated through these processes, and can now feel confident that at the beginning of this

century, the NPS can manage its vegetation, soil, and geologic resources with a much improved understanding of what the status and spatial distribution of those resources are across the landscape of the NPS.

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Appendix A. Park List by Network

Figure A1 provides a map of the I&M networks, and Table A1 provides a list of all the parks within each network by region.

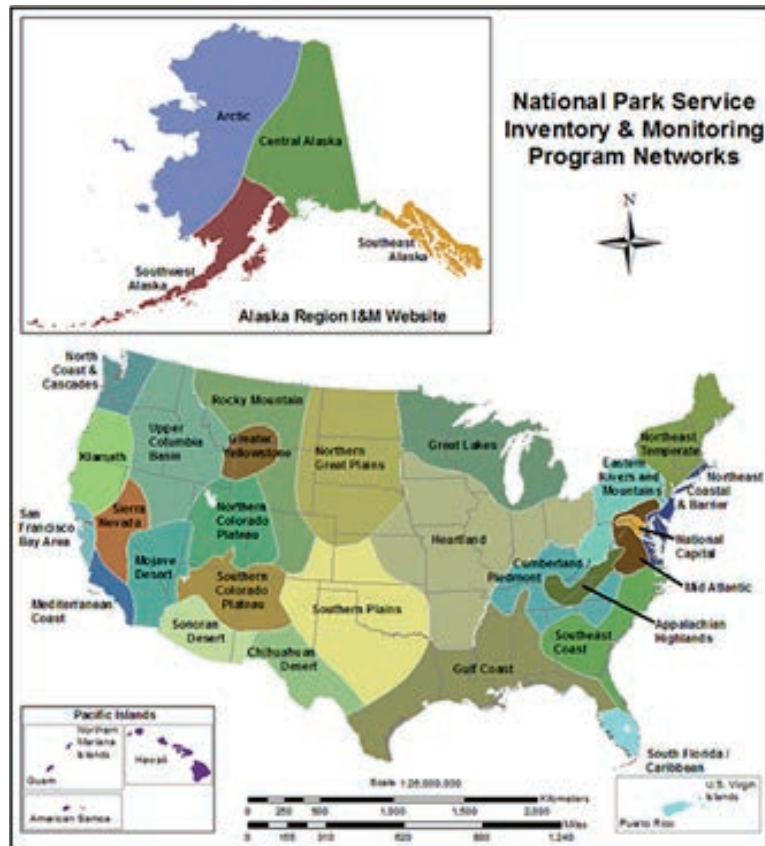


Figure A1. Map of the I&M networks.

Table A1. List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Alaska	AKRO	Arctic	ARCN	Bering Land Bridge National Preserve	BELA
	AKRO	Arctic	ARCN	Cape Krusenstern National Monument	CAKR
	AKRO	Arctic	ARCN	Gates of the Arctic National Park and Preserve	GAAR
	AKRO	Arctic	ARCN	Kobuk Valley National Park	KOVA
	AKRO	Arctic	ARCN	Noatak National Preserve	NOAT
	AKRO	Central Alaska	CAKN	Denali National Park and Preserve	DENA
	AKRO	Central Alaska	CAKN	Wrangell-St. Elias National Park and Preserve	WRST
	AKRO	Central Alaska	CAKN	Yukon Charley Rivers National Preserve	YUCH
	AKRO	Southeast Alaska	SEAN	Glacier Bay National Park and Preserve	GLBA
	AKRO	Southeast Alaska	SEAN	Klondike Gold Rush National Historical Park	KLGO
	AKRO	Southeast Alaska	SEAN	Sitka National Historical Park	SITK
	AKRO	Southwest Alaska	SWAN	Alagnak Wild River	ALAG
	AKRO	Southwest Alaska	SWAN	Aniakchak National Monument and Preserve	ANIA
	AKRO	Southwest Alaska	SWAN	Katmai National Park and Preserve	KATM
	AKRO	Southwest Alaska	SWAN	Kenai Fjords National Park	KEFJ
	AKRO	Southwest Alaska	SWAN	Lake Clark National Park and Preserve	LACL
Intermountain	IMRO	Chihuahuan Desert	CHDN	Amistad National Recreation Area	AMIS
	IMRO	Chihuahuan Desert	CHDN	Big Bend National Park	BIBE
	IMRO	Chihuahuan Desert	CHDN	Carlsbad Caverns National Park	CAVE

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Intermountain	IMRO	Chihuahuan Desert	CHDN	Fort Davis National Historic Site	FODA
	IMRO	Chihuahuan Desert	CHDN	Guadalupe Mountains National Park	GUMO
	IMRO	Chihuahuan Desert	CHDN	Rio Grande Wild and Scenic River	RIGR
	IMRO	Chihuahuan Desert	CHDN	White Sands National Monument	WHSA
	IMRO	Greater Yellowstone	GRYN	Bighorn Canyon National Recreation Area	BICA
	IMRO	Greater Yellowstone	GRYN	Grand Teton National Park	GRTE
	IMRO	Greater Yellowstone	GRYN	John D. Rockefeller, Jr. Memorial Parkway	JODR
	IMRO	Northern Colorado Plateau	NCPN	Arches National Park	ARCH
	IMRO	Northern Colorado Plateau	NCPN	Black Canyon of the Gunnison National Park	BLCA
	IMRO	Northern Colorado Plateau	NCPN	Bryce Canyon National Park	BRCA
	IMRO	Northern Colorado Plateau	NCPN	Canyonlands National Park	CANY
	IMRO	Northern Colorado Plateau	NCPN	Capitol Reef National Park	CARE
	IMRO	Northern Colorado Plateau	NCPN	Cedar Breaks National Monument	CEBR
	IMRO	Northern Colorado Plateau	NCPN	Colorado National Monument	COLM
	IMRO	Northern Colorado Plateau	NCPN	Curecanti National Recreation Area	CURE
	IMRO	Northern Colorado Plateau	NCPN	Dinosaur National Monument	DINO
	IMRO	Northern Colorado Plateau	NCPN	Fossil Butte National Monument	FOBU
	IMRO	Northern Colorado Plateau	NCPN	Golden Spike National Historic Site	GOSP
	IMRO	Northern Colorado Plateau	NCPN	Hovenweep National Monument	HOVE

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Intermountain	IMRO	Northern Colorado Plateau	NCPN	Natural Bridges National Monument	NABR
	IMRO	Northern Colorado Plateau	NCPN	Pipe Spring National Monument	PISP
	IMRO	Northern Colorado Plateau	NCPN	Timpanogos Cave National Monument	TIMP
	IMRO	Northern Colorado Plateau	NCPN	Zion National Park	ZION
	IMRO	Rocky Mountain	ROMN	Florissant Fossil Beds National Monument	FLFO
	IMRO	Rocky Mountain	ROMN	Glacier National Park	GLAC
	IMRO	Rocky Mountain	ROMN	Grant-Kohrs Ranch National Historic Site	GRKO
	IMRO	Rocky Mountain	ROMN	Great Sand Dunes National Park and Preserve	GRSA
	IMRO	Rocky Mountain	ROMN	Little Bighorn Battlefield National Monument	LIBI
	IMRO	Sonoran Desert	SODN	Casa Grande Ruins National Monument	CAGR
	IMRO	Sonoran Desert	SODN	Chiracahua National Monument	CHIR
	IMRO	Sonoran Desert	SODN	Coronado National Memorial	CORO
	IMRO	Sonoran Desert	SODN	Fort Bowie National Historic Site	FOBO
	IMRO	Sonoran Desert	SODN	Gila Cliff Dwellings National Monument	GICL
	IMRO	Sonoran Desert	SODN	Montezuma Castle National Monument	MOCA
	IMRO	Sonoran Desert	SODN	Organ Pipe Cactus National Monument	ORPI
	IMRO	Sonoran Desert	SODN	Saguaro National Park	SAGU
	IMRO	Sonoran Desert	SODN	Tonto National Monument	TONT
	IMRO	Sonoran Desert	SODN	Tumacacori National Historical Park	TUMA

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Intermountain	IMRO	Sonoran Desert	SODN	Tuzigoot National Monument	TUZI
	IMRO	Southern Colorado Plateau	SCPN	Aztec Ruins National Monument	AZRU
	IMRO	Southern Colorado Plateau	SCPN	Bandelier National Monument	BAND
	IMRO	Southern Colorado Plateau	SCPN	Canyon de Chelly National Monument	CACH
	IMRO	Southern Colorado Plateau	SCPN	Chaco Culture National Historical Park	CHCU
	IMRO	Southern Colorado Plateau	SCPN	El Malpais National Monument	ELMA
	IMRO	Southern Colorado Plateau	SCPN	El Morro National Monument	ELMO
	IMRO	Southern Colorado Plateau	SCPN	Glen Canyon National Recreation Area	GLCA
	IMRO	Southern Colorado Plateau	SCPN	Grand Canyon National Park	GRCA
	IMRO	Southern Colorado Plateau	SCPN	Hubbell Trading Post National Historic Site	HUTR
	IMRO	Southern Colorado Plateau	SCPN	Mesa Verde National Park	MEVE
	IMRO	Southern Colorado Plateau	SCPN	Navajo National Monument	NAVA
	IMRO	Southern Colorado Plateau	SCPN	Petrified Forest National Park	PEFO
	IMRO	Southern Colorado Plateau	SCPN	Petroglyph National Monument	PETR
	IMRO	Southern Colorado Plateau	SCPN	Rainbow Bridge National Monument	RABR
	IMRO	Southern Colorado Plateau	SCPN	Salinas Pueblo Mission National Monument	SAPU
	IMRO	Southern Colorado Plateau	SCPN	Sunset Crater Volcano National Monument	SUCR
	IMRO	Southern Colorado Plateau	SCPN	Walnut Canyon National Monument	WACA
	IMRO	Southern Colorado Plateau	SCPN	Wupatki National Monument	WUPA

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Intermountain	IMRO	Southern Colorado Plateau	SCPN	Yucca House National Monument	YUHO
	IMRO	Southern Plains	SOPN	Alibates Flint Quarries National Monument	ALFL
	IMRO	Southern Plains	SOPN	Bent's Old Fort National Historic Site	BEOL
	IMRO	Southern Plains	SOPN	Capulin Volcano National Monument	CAVO
	IMRO	Southern Plains	SOPN	Chickasaw National Recreation Area	CHIC
	IMRO	Southern Plains	SOPN	Fort Larned National Historic Site	FOLS
	IMRO	Southern Plains	SOPN	Fort Union National Monument	FOUN
	IMRO	Southern Plains	SOPN	Lake Meredith National Recreation Area	LAMR
	IMRO	Southern Plains	SOPN	Lyndon B. Johnson National Historical Park	LYJO
	IMRO	Southern Plains	SOPN	Pecos National Historical Park	PECO
	IMRO	Southern Plains	SOPN	Sand Creek Massacre National Historic Site	SAND
	IMRO	Southern Plains	SOPN	Washita Battlefield National Historic Site	WABA
Midwest	MWRO	Great Lakes	GLKN	Apostle Islands National Lakeshore	APIS
	MWRO	Great Lakes	GLKN	Grand Portage National Monument	GRPO
	MWRO	Great Lakes	GLKN	Indiana Dunes National Lakeshore	INDU
	MWRO	Great Lakes	GLKN	Isle Royale National Park	ISRO
	MWRO	Great Lakes	GLKN	Mississippi National River and Recreation Area	MISS
	MWRO	Great Lakes	GLKN	Pictured Rocks National Lakeshore	PIRO
	MWRO	Great Lakes	GLKN	Saint Croix National Scenic River	SACN

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Midwest	MWRO	Great Lakes	GLKN	Sleeping Bear Dunes National Lakeshore	SLBE
	MWRO	Great Lakes	GLKN	Voyageurs National Park	VOYA
	MWRO	Heartland	HTLN	Arkansas Post National Memorial	ARPO
	MWRO	Heartland	HTLN	Buffalo National River	BUFF
	MWRO	Heartland	HTLN	Cuyahoga Valley National Park	CUVA
	MWRO	Heartland	HTLN	Effigy Mounds National Monument	EFMO
	MWRO	Heartland	HTLN	George Washington Carver National Monument	GWCA
	MWRO	Heartland	HTLN	Herbert Hoover National Historic Site	HEHO
	MWRO	Heartland	HTLN	Homestead National Monument of America	HOME
	MWRO	Heartland	HTLN	Hopewell Culture National Historical Park	HOCU
	MWRO	Heartland	HTLN	Hot Springs National Park	HOSP
	MWRO	Heartland	HTLN	Lincoln Boyhood National Memorial	LIBO
	MWRO	Heartland	HTLN	Ozark National Scenic Riverways	OZAR
	MWRO	Heartland	HTLN	Pea Ridge National Military Park	PERI
	MWRO	Heartland	HTLN	Pipestone National Monument	PIPE
	MWRO	Heartland	HTLN	Tallgrass Prairie National Preserve	TAPR
	MWRO	Heartland	HTLN	Wilson's Creek National Battlefield	WICR
	MWRO	Heartland	HTLN	Agate Fossil Beds National Monument	AGFO
	MWRO	Heartland	HTLN	Badlands National Park	BADL

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Midwest	MWRO	Heartland	HTLN	Devils Tower National Monument	DETO
	MWRO	Heartland	HTLN	Fort Laramie National Historic Site	FOLA
	MWRO	Heartland	HTLN	Fort Union Trading Post National Historic Site	FOUS
	MWRO	Heartland	HTLN	Jewel Cave National Monument	JECA
	MWRO	Heartland	HTLN	Knife River Indian Villages National Historic Site	KNRI
	MWRO	Heartland	HTLN	Missouri National Recreation River	MNRR
	MWRO	Heartland	HTLN	Mount Rushmore National Memorial	MORU
	MWRO	Heartland	HTLN	Niobrara National Scenic River	NIOB
	MWRO	Heartland	HTLN	Scotts Bluff National Monument	SCBL
	MWRO	Heartland	HTLN	Theodore Roosevelt National Park	THRO
	MWRO	Heartland	HTLN	Wind Cave National Park	WICA
National Capital	NCRO	National Capital Region	NCRN	Antietam National Battlefield	ANTI
	NCRO	National Capital Region	NCRN	Catoctin Mountain Park	CATO
	NCRO	National Capital Region	NCRN	Chesapeake and Ohio Canal National Historical Park	CHOH
	NCRO	National Capital Region	NCRN	George Washington Memorial Parkway	GWMP
	NCRO	National Capital Region	NCRN	Harpers Ferry National Historical Park	HAFE
	NCRO	National Capital Region	NCRN	Manassas National Battlefield Park	MANA
	NCRO	National Capital Region	NCRN	Monocacy National Battlefield	MONO
	NCRO	National Capital Region	NCRN	National Capital Parks East	NACE

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
National Capital	NCRO	National Capital Region	NCRN	Prince William Forest Park	PRWI
	NCRO	National Capital Region	NCRN	Rock Creek Park	ROCR
	NCRO	National Capital Region	NCRN	Wolf Trap Park for the Performing Arts	WOTR
Northeast	NERO	Eastern Rivers and Mountains	ERMN	Allegheny Portage Railroad National Historic Site	ALPO
	NERO	Eastern Rivers and Mountains	ERMN	Bluestone National Scenic River	VBUE
	NERO	Eastern Rivers and Mountains	ERMN	Delaware Water Gap National Recreation Area	DEWA
	NERO	Eastern Rivers and Mountains	ERMN	Fort Necessity National Battlefield	FONE
	NERO	Eastern Rivers and Mountains	ERMN	Friendship Hill National Historic Site	FRHI
	NERO	Eastern Rivers and Mountains	ERMN	Gauley River National Recreation Area	GARI
	NERO	Eastern Rivers and Mountains	ERMN	Johnstown Flood National Memorial	JOFL
	NERO	Eastern Rivers and Mountains	ERMN	New River Gorge National River	NERI
	NERO	Eastern Rivers and Mountains	ERMN	Upper Delaware Scenic and Recreational River	UPDE
	NERO	Mid-Atlantic	MIDN	Appomattox Court House National Historical Park	APCO
	NERO	Mid-Atlantic	MIDN	Booker T. Washington National Monument	BOWA
	NERO	Mid-Atlantic	MIDN	Eisenhower National Historic Site	EISE
	NERO	Mid-Atlantic	MIDN	Fredericksburg and Spotsylvania National Military Park	FRSP
	NERO	Mid-Atlantic	MIDN	Gettysburg National Military Park	GETT
	NERO	Mid-Atlantic	MIDN	Hopewell Furnace National Historic Site	HOFU
	NERO	Mid-Atlantic	MIDN	Petersburg National Battlefield	PETE

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Northeast	NERO	Mid-Atlantic	MIDN	Richmond National Battlefield Park	RICH
	NERO	Mid-Atlantic	MIDN	Shenandoah National Park	SHEN
	NERO	Mid-Atlantic	MIDN	Valley Forge National Historical Park	VAFO
	NERO	Northeast Coastal and Barrier Islands	NCBN	Assateague National Seashore	ASIS
	NERO	Northeast Coastal and Barrier Islands	NCBN	Cape Cod National Seashore	CACO
	NERO	Northeast Coastal and Barrier Islands	NCBN	Colonial National Historical Park	COLO
	NERO	Northeast Coastal and Barrier Islands	NCBN	Fire Island National Seashore	FIIS
	NERO	Northeast Coastal and Barrier Islands	NCBN	Gateway National Recreation Area	GATE
	NERO	Northeast Coastal and Barrier Islands	NCBN	George Washington Birthplace National Monument	GEWA
	NERO	Northeast Coastal and Barrier Islands	NCBN	Sagamore Hill National Historic Site	SAHI
	NERO	Northeast Coastal and Barrier Islands	NCBN	Thomas Stone National Historic Site	THST
	NERO	Northeast Temperate	NETN	Acadia National Park	ACAD
	NERO	Northeast Temperate	NETN	Appalachian National Scenic Trail	APPA
	NERO	Northeast Temperate	NETN	Boston Harbor Islands National Recreation Area	BOHA
	NERO	Northeast Temperate	NETN	Eleanor Roosevelt National Historic Site	ELRO
	NERO	Northeast Temperate	NETN	Home of Franklin D. Roosevelt National Historic Site	HOFR
	NERO	Northeast Temperate	NETN	Marsh-Billings-Rockefeller National Historical Park	MABI
	NERO	Northeast Temperate	NETN	Minute Man National Historical Park	MIMA
	NERO	Northeast Temperate	NETN	Morristown National Historical Park	MORR

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Northeast	NERO	Northeast Temperate	NETN	Roosevelt-Vanderbilt National Historic Sites	ROVA
	NERO	Northeast Temperate	NETN	Saint-Gaudens National Historic Site	SAGA
	NERO	Northeast Temperate	NETN	Saratoga National Historical Park	SARA
	NERO	Northeast Temperate	NETN	Saugus Iron Works National Historic Site	SAIR
	NERO	Northeast Temperate	NETN	Vanderbuilt Mansion National Historical Park	VAMA
	NERO	Northeast Temperate	NETN	Weir Farm National Historical Park	WEFA
Pacific West	PWRO	Klamath	KLMN	Crater Lake National Park	CRLA
	PWRO	Klamath	KLMN	Lassen Volcanic National Park	LAVO
	PWRO	Klamath	KLMN	Lava Beds National Park	LABE
	PWRO	Klamath	KLMN	Oregon Caves National Monument	ORCA
	PWRO	Klamath	KLMN	Redwood National	REDW
	PWRO	Klamath	KLMN	Whiskeytown National Recreation Area	WHIS
	PWRO	Mediterranean Coast	MEDN	Cabrillo National Monument	CABR
	PWRO	Mediterranean Coast	MEDN	Channel Islands National Park	CHIS
	PWRO	Mediterranean Coast	MEDN	Santa Monica Mountains National Recreation Area	SAMO
	PWRO	Mojave Desert	MOJN	Death Valley National Park	DEVA
	PWRO	Mojave Desert	MOJN	Great Basin National Park	GRBA
	PWRO	Mojave Desert	MOJN	Joshua Tree National Park	JOTR
	PWRO	Mojave Desert	MOJN	Lake Mead National Recreation Area	LAKE

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Pacific West	PWRO	Mojave Desert	MOJN	Manzanar National Historic Site	MANZ
	PWRO	Mojave Desert	MOJN	Mojave National Preserve	MOJA
	PWRO	Mojave Desert	MOJN	Grand Canyon-Parashant National Monument	PARA
	PWRO	North Coast and Cascades	NCCN	Ebey's Landing National Historical Reserve	EBLA
	PWRO	North Coast and Cascades	NCCN	Fort Vancouver National Historic Site	FOVA
	PWRO	North Coast and Cascades	NCCN	Lewis and Clark National Historical Park	LEWI
	PWRO	North Coast and Cascades	NCCN	Mount Rainier National Park	MORA
	PWRO	North Coast and Cascades	NCCN	North Cascades National Park	NOCA
	PWRO	North Coast and Cascades	NCCN	Olympic National Park	OLYM
	PWRO	North Coast and Cascades	NCCN	San Juan Island National Historical Park	SAJH
	PWRO	Pacific Islands	PACN	American Memorial Park	AMME
	PWRO	Pacific Islands	PACN	Haleakala National Park	HALE
	PWRO	Pacific Islands	PACN	Hawaii Volcanoes National Park	HAVO
	PWRO	Pacific Islands	PACN	Kalaupapa National Historical Park	KALA
	PWRO	Pacific Islands	PACN	Kaloko-Honokohau National Historical Park	KAHO
	PWRO	Pacific Islands	PACN	National Park of American Samoa	NPSA
	PWRO	Pacific Islands	PACN	Pu'uhonua o Honaunau National Historical Park	PUHO
	PWRO	Pacific Islands	PACN	Pu'ukohola Heiau National Historic Site	PUHE
	PWRO	Pacific Islands	PACN	War in the Pacific National Historical Park	WAPA

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Pacific West	PWRO	Pacific Islands	PACN	Ala Kahakai National Historic Trail	ALKA
	PWRO	San Francisco Bay Area	SFAN	Golden Gate National Recreation Area	GOGA
	PWRO	San Francisco Bay Area	SFAN	John Muir National Historic Site	JOMU
	PWRO	San Francisco Bay Area	SFAN	Muir Woods National Monument	MUWO
	PWRO	San Francisco Bay Area	SFAN	Pinnacles National Park	PINN
	PWRO	San Francisco Bay Area	SFAN	Point Reyes National Seashore	PORE
	PWRO	San Francisco Bay Area	SFAN	Eugene O'Neill National Historic Site	EUON
	PWRO	San Francisco Bay Area	SFAN	Fort Point National Historic Site	FOPO
	PWRO	San Francisco Bay Area	SFAN	The Presidio of San Francisco	PRSF
	PWRO	Sierra Nevada	SIEN	Devils Postpile National Monument	DEPO
	PWRO	Sierra Nevada	SIEN	Sequoia and Kings Canyon National Parks	SEKI
	PWRO	Sierra Nevada	SIEN	SIEN	YOSE
	PWRO	Upper Columbia Basin	UCBN	Big Hole National Battlefield	BIHO
	PWRO	Upper Columbia Basin	UCBN	City of Rocks National Reserve	CIRO
	PWRO	Upper Columbia Basin	UCBN	Craters of the Moon National Monument and Preserve	CRMO
	PWRO	Upper Columbia Basin	UCBN	Hagerman Fossil Beds National Monument	HAFO
	PWRO	Upper Columbia Basin	UCBN	John Day Fossil Beds National Monument	JODA
	PWRO	Upper Columbia Basin	UCBN	Lake Roosevelt National Recreation Area	LARO
	PWRO	Upper Columbia Basin	UCBN	Nez Perce National Historical Park	NEPE

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Pacific West	PWRO	Upper Columbia Basin	UCBN	Whitman Mission National Historic Site	WHMI
Southeast	SERO	Appalachian Highlands	APHN	Big South Fork National River and Recreation Area	BISO
	SERO	Appalachian Highlands	APHN	Blue Ridge Parkway	BLRI
	SERO	Appalachian Highlands	APHN	Great Smoky Mountains National Park	GRSM
	SERO	Appalachian Highlands	APHN	Obed Wild and Scenic River	OBED
	SERO	Cumberland/Piedmont	CUPN	Abraham Lincoln Birthplace National Historic Site	ABLI
	SERO	Cumberland/Piedmont	CUPN	Carl Sandburg Home National Historic Site	CARL
	SERO	Cumberland/Piedmont	CUPN	Cowpens National Battlefield	COWP
	SERO	Cumberland/Piedmont	CUPN	Chickamauga and Chattanooga National Military Park	CHCH
	SERO	Cumberland/Piedmont	CUPN	Cumberland Gap National Historical Park	CUGA
	SERO	Cumberland/Piedmont	CUPN	Fort Donelson National Battlefield	FODO
	SERO	Cumberland/Piedmont	CUPN	Guilford Courthouse National Military Park	GUCO
	SERO	Cumberland/Piedmont	CUPN	Kings Mountain National Military Park	KIMO
	SERO	Cumberland/Piedmont	CUPN	Little River Canyon National Preserve	LIRI
	SERO	Cumberland/Piedmont	CUPN	Mammoth Cave National Park	MACA
	SERO	Cumberland/Piedmont	CUPN	Ninety Six National Historic Site	NISI
	SERO	Cumberland/Piedmont	CUPN	Russell Cave National Monument	RUCA
	SERO	Cumberland/Piedmont	CUPN	Shiloh National Military Park	SHIL
	SERO	Cumberland/Piedmont	CUPN	Stones River National Battlefield	STRI

Table A1 (continued). List of parks by network and region.

Region	Region Unit Code	Network	Network Unit Code	Park	Park Unit Code
Southeast	SERO	Gulf Coast	GULN	Barataria Unit of Jean Lafitte National Historical Park and Preserve	JELA
	SERO	Gulf Coast	GULN	Big Thicket National Preserve	BITH
	SERO	Gulf Coast	GULN	Gulf Islands National Seashore	GUIS
	SERO	Gulf Coast	GULN	Natchez Trace Parkway	NATT
	SERO	Gulf Coast	GULN	Padre Island National Seashore	PAIS
	SERO	Gulf Coast	GULN	Palo Alto Battlefield National Historical Park	PAAL
	SERO	Gulf Coast	GULN	San Antonio Missions National Historical Park	SAAN
	SERO	Gulf Coast	GULN	Vicksburg National Military Park	VICK
	SERO	South Florida/Caribbean	SFCN	Big Cypress National Preserve	BICY
	SERO	South Florida/Caribbean	SFCN	Biscayne National Park	BISC
	SERO	South Florida/Caribbean	SFCN	Buck Island Reef National Monument	BUIS
	SERO	South Florida/Caribbean	SFCN	Dry Tortugas National Park	DRTO
	SERO	South Florida/Caribbean	SFCN	Everglades National Park	EVER
	SERO	South Florida/Caribbean	SFCN	Salt River Bay Historical Park and Ecological Preserve	SARI
	SERO	South Florida/Caribbean	SFCN	Virgin Islands National Park	VIIS
	SERO	Southeast Coast	SECN	Canaveral National Seashore	CANA
	SERO	Southeast Coast	SECN	Cape Hatteras National Seashore	CAHA
	SERO	Southeast Coast	SECN	Cape Lookout National Seashore	CALO

Appendix B. Inventory Survey Results

In October 2013, I&M conducted a program-wide survey of its approximately 400 staff to gather information that will help leadership make program adjustments that better position the program to achieve long-term success. As a result of this survey, workgroups were formed to address major issue areas, including the Inventory Workgroup that created this report.

The survey included three questions aimed at acquiring information to develop a strategy for future inventories beyond the basic 12 inventories. The results of the survey inform a long-term IMD strategy for funding remaining and future inventories beyond the basic twelve. Several possibilities exist including strategic inventories to update some of the basic twelve, expanding inventories to other high-priority resources, and using funds previously committed to inventories to enhance the monitoring capacity of the I&M program.

The three inventory questions were:

1. Considering the needs of parks and networks, what do you see as the highest priorities for future inventories?
2. If some funds were reallocated within the I&M program, what do you see as the highest priorities for funding? Some examples include expanded support to I&M networks in areas other than inventories, increase support for existing vital signs that are currently under funded, expand monitoring to include additional high priority vital signs, develop and implement an effectiveness monitoring component for the I&M program, etc.
3. Additional comments or ideas?

Results

The 32 I&M networks were unanimous in their view that a 13th national inventory is not a high priority for the program. Other responses included:

- Funding should be allocated to networks or parks for future inventories ($n=7$)
- Allocate inventory funds to monitoring ($n=7$)
- Allocations by competitive or grant process ($n=4$)
- Priority is to complete the basic 12 first ($n=3$)
- Need a 13th national inventory ($n=0$)

There were several priorities for new inventories identified by I&M networks, but in all cases these were recommended as being conducted at local or regional scales (not nationally):

- Invertebrates ($n=17$)
- Fungi/non-vascular plants ($n=14$)
- Repeat basic 12 ($n=9$)
- Amphibians ($n=5$)
- Marine/freshwater environments ($n=5$)

- Special-status species ($n=5$)
- Aquatic plants ($n=4$)
- Rare/endemic plants ($n=4$)
- Aquatic invasives ($n=3$)
- Exotic plants ($n=3$)
- Karst/caves ($n=3$)
- Animals ($n=2$)
- Birds ($n=2$)
- Contaminants/pollutants ($n=2$)
- Freshwater fish ($n=2$)
- Mesocarnivores ($n=2$)
- Small mammals ($n=2$)

Other responses highlighted more pressing priorities beyond new or additional inventories, including:

- Existing vital signs monitoring ($n=21$)
- Un- or under-funded ($n=9$)
- Add new protocols ($n=8$)
- Increase scope or scale ($n=5$)
- Fill staff vacancies ($n=3$)
- Include climate change effects ($n=3$)
- Effectiveness monitoring ($n=2$)
- Use monitoring data for research or predictive modeling ($n=2$)
- Science communication ($n=1$)

Inventory Workgroup Survey Results

In June 2014, a survey was conducted by the I&M inventory workgroup querying I&M regional and network program managers on their continued interest in outstanding vegetation and soils resources inventories, and their willingness to accept alternative products to what may have been promised during the original inventory scoping process. In order to evaluate and select the most appropriate inventory strategy, the inventory workgroup needed to weigh extended costs and value of completing current inventories with existing procedures against the very real issues of increased costs, reduced or flat budgets, continuing FTE constraints, and potentially changing priorities as time passes. With this in mind, the workgroup obtained responses to the following questions for each park in their region awaiting soils and vegetation products:

1. Would a modified, less-costly product be acceptable and still useful? Specific modifications would be determined later in consultation with parks.

2. Is the inventory needed and useful for the park? For the case of soils inventories, if the answer is yes, will the park allow digging of soils pits for data collection?
3. If the full inventory product is needed as currently described, are parks willing to take the risk that it may be difficult or infeasible to complete the inventory if funding becomes even more constrained?

Of the 12 networks surveyed, 24 parks had vegetation inventory projects either in progress or scheduled to begin soon (Table B1). Twelve units responded they are willing to discuss receiving a less costly product, although several also expressed hesitations due to not knowing exactly what that would mean. Of the 24 parks still in progress, only two park inventories were identified as potentially not needed or useful to the park (FOVA and CASA). Unfortunately, both of these units are quite small (20 to 200 acres) and could be mapped in a matter of months at a relatively low cost. Therefore, eliminating these from the inventory roster would provide no noteworthy savings to the program. All other parks responded positively, saying they needed the inventory and would find it useful.

Regarding soils inventories, two units (TONT and APPA) totaling approximately 235,491 acres reported not needing soil inventories. Six parks, totaling 129,523 acres, responded they would not allow soils pits to be dug in the park. Additionally, two units totaling 9,149,796 acres responded they are willing to discuss receiving a less costly soil inventory product. Based on these responses (Table B2), it was determined cost savings and reduced timelines could be achieved if parks not needing soils inventories and park that would not allow soil pits were removed from the list of remaining inventories. If modified soil inventories were conducted on respondent parks, reductions in inventory costs and timelines could also be obtained. These responses influenced the recommended options for expediting soils inventories presented in Chapter 3.

Table B1. Results of the inventory workgroup survey pertaining to the vegetation inventory. Responses to questions were Yes, No, Maybe, and No Response (–).

Network	Parks With Remaining Vegetation Inventories	Question #3: If parks feel they need the full inventory product as currently exists, are they willing to take the risk that it may be difficult or not feasible to complete the inventory if funding becomes even more constrained?		
		Question #1: Would a modified, less costly product be acceptable and still useful?	Question #2: Please indicate whether this inventory is needed and useful for the park?	
Greater Yellowstone	YELL	Yes	Yes	–
Gulf Coast	–	–	–	–
Sonoran Desert	ORPI	Yes	Yes	Yes
	SAGU	No	Yes	Yes
Southern Colorado Plateau	GLCA	No	Yes	Yes
Northern Great Plains	M–R	Yes	Yes	No
	NIOB	Yes	Yes	No
Northeast Temperate	APPA	No	Yes	Yes
Mediterranean Coast	CHIS	No	Yes	Yes
Mojave Desert	DEVA	Yes	Yes	No
	MOJA	Yes	Yes	No
North Coast and Cascades	EBLA	Yes	Yes	–
	FOVA	–	No	No
	NOCA	Yes	Yes	No

Table B1 (continued). Results of the inventory workgroup survey pertaining to the vegetation inventory. Responses to questions were Yes, No and No Response (–).

Network	Parks With Remaining Vegetation Inventories	Question #3: If parks feel they need the full inventory product as currently exists, are they willing to take the risk that it may be difficult or not feasible to complete the inventory if funding becomes even more constrained?		
		Question #1: Would a modified, less costly product be acceptable and still useful?	Question #2: Please indicate whether this inventory is needed and useful for the park?	
Gulf Coast	GUIS	Yes	Yes	–
	JELA	Yes	Yes	–
	BITH	Yes	Yes	–
South Florida/Caribbean	BICY	No	Yes	Yes
	EVER	No	Yes	Yes
Southeast Coast	CANA	No	Yes	Maybe
	CASA	Yes	No	Yes
	HOBE	Maybe	Yes	Maybe
	TIMU	No	Yes	Maybe

Table B2. Results of the inventory workgroup survey pertaining to the soils inventory. Responses to questions were Yes, No, and No Response (–).

Network	Parks With Remaining Vegetation Inventories	Question #1: Would a modified, less costly product be acceptable and still useful?	Question #2: Please indicate whether this inventory is needed and useful for the park?		Question #3: If parks feel they need the full inventory product as currently exists, are they willing to take the risk that it may be difficult or not feasible to complete the inventory if funding becomes even more constrained?
			Needed?	Soils Pits?	
Southwest Alaska	KATM	No	Yes	Yes	Yes
Chihuahuan Desert	CAVE	Yes	Yes	Yes	Yes
	WHSA	Yes	Yes	Yes	Yes
Greater Yellowstone	BICA	Yes	Yes	Yes	No
	YELL	Yes	Yes	Yes	No
Northern Colorado Plateau	ZION	Yes	Yes	Yes	Yes
	BLCA	Yes	Yes	Yes	Yes
	BRCA	Yes	Yes	Yes	Yes
	CEBR	Yes	Yes	Yes	Yes
	CURE	Yes	Yes	Yes	Yes
	FOBU	Yes	Yes	Yes	Yes
	TICA	Yes	Yes	Yes	Yes
Rocky Mountain	GLAC	–	–	–	–
	GRSA	–	–	–	–

Table B2 (continued). Results of the inventory workgroup survey pertaining to the soils inventory. Responses to questions were Yes, No, and No Response (–).

Network	Parks With Remaining Vegetation Inventories	Question #1: Would a modified, less costly product be acceptable and still useful?	Question #2: Please indicate whether this inventory is needed and useful for the park?		Question #3: If parks feel they need the full inventory product as currently exists, are they willing to take the risk that it may be difficult or not feasible to complete the inventory if funding becomes even more constrained?
			Needed?	Soils Pits?	
Sonoran Desert	CHIR	Yes	Yes	Yes	No
	GICL	Yes	Yes	No	No
	TONT	Yes	No	No	No
	TUZI	Yes	Yes	No	No
Southern Colorado Plateau	ELMA	Yes	Yes	No	No
	PEFO	Yes	Yes	Yes	No
	SUCR	Yes	Yes	Yes	No
	WACA	Yes	Yes	No	No
Southern Plains	PECO	Yes	Yes	No	No
Great Lakes	GRPO	No	Yes	Yes	No
	VOYA	No	Yes	–	No
Northeast Temperate	APPA	Yes	No	Yes	No
Mid-Atlantic	SHEN	No	Yes	Yes	Yes
Mojave Desert	DEVA	Yes	Yes	Yes	Yes
	LAKE	No	Yes	Yes	Yes

Table B2 (continued). Results of the inventory workgroup survey pertaining to the soils inventory. Responses to questions were Yes, No, and No Response (–).

Network	Parks With Remaining Vegetation Inventories	Question #1: Would a modified, less costly product be acceptable and still useful?	Question #2: Please indicate whether this inventory is needed and useful for the park?		Question #3: If parks feel they need the full inventory product as currently exists, are they willing to take the risk that it may be difficult or not feasible to complete the inventory if funding becomes even more constrained?
			Needed?	Soils Pits?	
Mojave Desert (continued)	MOJA	No	Yes	Yes	Yes
	PARA	Yes	Yes	Yes	Yes
North Coast and Cascades	OLYM	No	Yes	Yes	Yes
Sierra Nevada	SEKI	No	Yes	Yes	Yes
GULN	NATR	Yes	–	–	–
South Florida/Caribbean	BICY	No	Yes	Yes	Yes
	BISC	Yes	–	–	–
	DRTO	Yes	–	–	–
	EVER	No	Yes	Yes	Yes

Appendix C. GRI Status Updates and Cost Projections

Inventory and Monitoring Inventory Work Group (IMIWG)

Geologic Resources Inventory

Status Updates and Cost Projections

April 1, 2016

Summary

Through the end of fiscal year 2015, the Geologic Resources Inventory (GRI) had conducted scoping meetings in 269 of the 270 I&M parks, delivered map/GIS products to 254 parks, and completed a geologic report for 148 parks. Reports lag behind maps because a park's report cannot be started until a map is complete and delivered to the park.

The accompanying spreadsheet (GRI_IMIWG_2016-0330.xlsx) shows the IMIWG status, as well as the map and report status for each park. Overall, the GRI inventory status as of the end of FY2015 includes 148 "complete" parks, 121 "in progress" parks, and one "not started" park. "complete" indicates that both a report and map have been delivered to the park. "In progress" indicates one of two possible scenarios (1) map is complete but report has not yet been completed; (2) map is not yet complete but is in progress or has been funded. "Not started" indicates that the map is not yet complete and is not in progress and has not been funded.

Shown below is a summary table (Table C1) showing the projected costs to deliver GRI products to the remaining parks. A complete breakdown of salary costs and a product status and delivery timetable is provided in the accompanying spreadsheet.

Table C1. Projected cost by fiscal year to complete geologic resources inventory products.

Expense Category	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020
NPS+CSU Maps	\$511,211.50	\$585,499.43	\$553,175.08	\$562,595.21	\$572,190.21
NPS+CSU Reports	\$651,392.63	\$717,186.45	\$689,035.00	\$702,745.57	\$716,751.68
1/2 Report GIP	\$18,000.00	\$0.00	\$0.00	\$0.00	\$0.00
New Mapping	\$357,500.00	\$150,000.00	\$0.00	\$0.00	\$0.00
NPS Awards, Supplies, Equipment	\$40,000.00	\$40,000.00	\$40,000.00	\$40,000.00	\$40,000.00
NPS Travel	\$15,200.00	\$8,000.00	\$8,000.00	\$8,000.00	\$8,000.00
AK Science Center	\$25,000.00	\$25,000.00	\$0.00	\$0.00	\$0.00
Fiscal Year Total	\$1,618,304.13	\$1,525,685.88	\$1,290,210.08	\$1,313,340.78	\$1,336,941.89
Grand Total					\$7,084,482.75

Cost Projections, Explanations, and Assumptions

As requested by IMIWG, costs are broken down by the individual GRI product, either mapping or reports. NPS program manager and CSU PI costs are evenly divided between these two categories.

Salaries

- Salaries are based on FY2016 costs
- 2.5% step increase/COLA applied for Federal employees through 2020 as per the Inventory & Monitoring Division Work Plan model
- 1.5% pay increase applied for CSU RAs through 2020
- 50% [Coordinator's] salary through June, 2017
- GRD writer-editor (Port) salary will continue to be GRI funded at current grade, GRD agreed to pay the difference for grade increase.
- CSU costs for FY2016 only reflect 9-10 months of funding (through 12-31-2017) per request of WCO. Subsequent years reflect 12 month funding.
- Due to rounding, FY2016 cost projection does not exactly match FY2016 GRI Financial Plan.
- Full funding is shown for CSU GIS RAs through 2020 although their time will not be fully dedicated to completing this phase of the Inventory. In addition to completing maps for those 16 parks still needing some sort of GRI product (see below), these staff will also work on updating existing park maps (for instance, delivering a surficial map to a park that has already received a bedrock map) and maintaining the massive GRI GIS data set to ensure compatibility with new versions of ArcGIS, as well as NPS online map services and Google Earth. The CSU GIS RAs also support the report team by producing the posters included with each report and updating or correcting GRI GIS products based on input by report team members, report reviewers, and/or park staff. They will also be tasked with providing maps to any new park units (if approved by IMD) or possibly Soil Resources Inventory tasks.
- Similarly, [Mapping Coordinator's] salary (included in NPS map team) is also shown at 100% through FY2020, as per an agreement between IMD and GRD, although his time spent on this phase of the Inventory as mapping coordinator will diminish significantly through the five-year duration.

New Mapping

Since our original IMIWG projections in 2014, significant progress has been made on completing or taking steps to complete map/GIS deliveries to the remaining parks. Of the 16 parks still waiting on GRI map/GIS products, 14 of them have new mapping underway with completion dates ranging from 2016 to 2018. Eight of the 14 require no additional funding to complete. The cost projections to complete new mapping in the other 6 should be fairly accurate, agreements are in place for all of them and total costs already identified. Natchez Trace Trail and Parkway has mapping underway but not a final plan in place to complete it. Only the Appalachian Trail has no mapping plan, something which should be remedied after scoping there in May 2016. No cost projections for these two parks

are possible at this time. Also note that two parks which have already received GRI map products are listed as having dedicated funding for additional mapping in FY 2016; post Superstorm Sandy maps for Gateway National Recreation Area will be delivered this year and a surficial/glacial deposit map of Pictured Rocks National Lakeshore wrap up this summer as well.

USGS Alaska Science Center Costs

The GRI has provided funding to the USGS Alaska Science Center (ASC) for the past several years to cover salaries for their staff time dedicated to providing us with preliminary map data for Alaska park units. With the completion of the new USGS Alaska state geologic map in early FY2016, most of this data is now publically available. We show funding support for the ASC for costs already incurred in FY2016 and to complete detailed surficial mapping in Wrangell-Saint Elias National Park and Preserve in FY2017, after which no future funding is anticipated.

Travel Costs

NPS travel is shown to include significant costs associated with bringing a large number of people together for Appalachian Trail scoping in FY2016. Costs in subsequent years assume some conference and meeting attendance each year based roughly on historical averages. CSU costs are similarly projected but are built into the cooperative agreement and are wrapped into the map and report team costs on the table above.

Awards, Equipment, and Supplies

Costs for these categories for both the NPS and CSU are historical averages. The costs for CSU are built into the cooperative agreement and are wrapped into the map and report team costs on the table above.

Reports

In FY2016, the report team is revising its products to be able to complete reports for the remaining 122 parks by FY2020. The team developed a tiered approach so that not all parks will receive the same level of detail in their reports. The team also proposed combining parks into one report where geographic proximity and geologic similarity make that possible. Both the assigned report tiers and combined park reports are noted on the attached spreadsheet.

The funding and completion projections assume the current team remains intact through FY2020. The team now includes six authors with one focused on coastal reports and 1 dedicated to Alaska parks. FY2016 funding for an additional one-year Geoscientist-in-the-Park guest scientist position (costs and time shared 50/50 with GRD) to edit reports is included. This position will be advertised this spring and hopefully filled late summer or fall 2016. Because authors work simultaneously on as many as five parks, breaking out the costs by park is not possible. To provide some cost context, the average cost for each report works out to between \$28,000 and \$30,000 with wide variation depending on size of park, geologic complexity, and reviewer comments and needed revisions.

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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