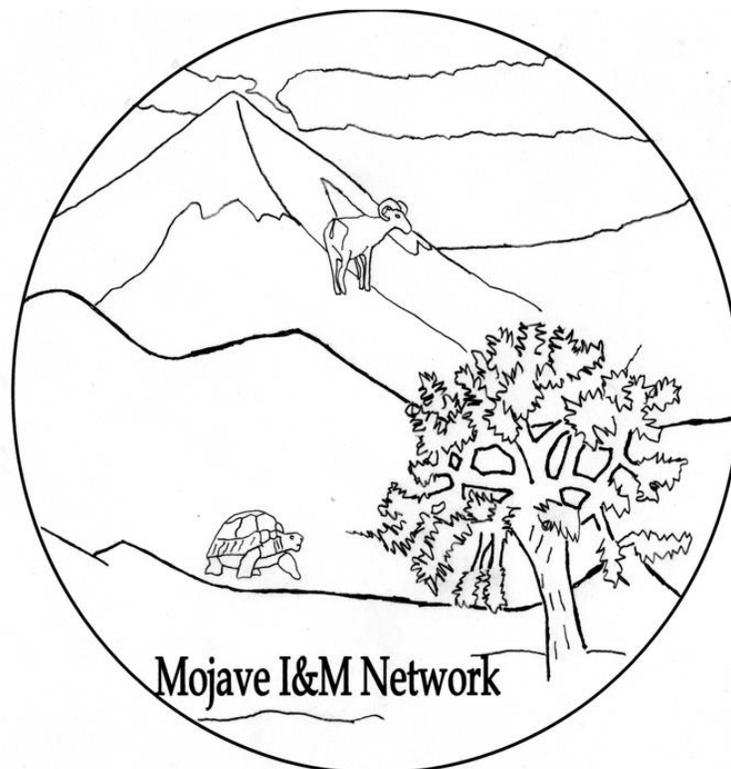




Mojave Inventory and Monitoring Network

Data and Information Management Plan



Version*: 4.1

Status: Draft

Revision Date: July 1, 2010

Author: Robert E. Truitt

Abstract: This document describes the general framework for managing all data and information within the Mojave Network I&M Program

Suggested Citation: Mojave Network. 2008. Data and Information Management Plan for the Mojave Network. Mojave Inventory and Monitoring Network – National Park Service. Boulder City, Nevada. [<http://science.nature.nps.gov/im/units/mojn/index.cfm>], Boulder City, Nevada. 47 pg. plus appendices.

*Available at: http://science.nature.nps.gov/im/units/MOJN/datamgmt/datamgmt_main.cfm

Topic(s):

data, information, management, guidelines, specifications

Theme Keywords:

data management, information management, project management, natural resource information, ecological monitoring

Placename Keywords:

Arizona/California/Nevada/Utah State, Mojave/Great Basin Deserts, Mojave Network

Acronyms:

DIMP - Data and Information Management Plan

DEVA - Death Valley National Park

GRBA - Great Basin National Park

I&M - Inventory & Monitoring Program of the National Park Service

JOTR - Joshua Tree National Park

LAKE - Lake Mead National Recreation Area

MANZ - Manzanar National Historic Site

MOJA - Mojave National Preserve

MOJN - Mojave Inventory and Monitoring Network

PARA – Grand Canyon-Parashant National Monument

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Acknowledgments

Many people have contributed to the production of this plan. The overall plan outline and components of all chapters were developed by the Inventory and Monitoring Program Data Management Planning Workgroup. The authors wish to thank all subsequent plan workgroups that contributed their thoughts and materials generously and without concern for credit. The collaboration of network data managers has been a highlight of producing this plan, and sets a precedent for cooperation in the data management tasks we all face in the upcoming years.

The authors thank the national-level Inventory and Monitoring Program data management team, who have provided the vision and created the tools that are essential to our work. In particular, Lisa Nelson, Danelle Malget, Chris Dietrich, Willene Hendon, Joe Gregson, Wendy Schumacher, Mark Wotawa, Simon Kingston, and Alison Loar have all provided outstanding technical support, and have been patient and open-minded to our questions and suggestions.

Special thanks must be extended by the authors to Margaret Beer and John Gross for their words of wisdom, knowledgeable council, and copious patience.

Thanks and acknowledgment of the National Science Foundation's LTER (Long-Term Ecological Research) Program, one of the first to integrate data and information management.

This plan would not have been what it is without the combined collaboration and tireless work of the network's data mining team, the Lake Mead NRA GIS staff, and the effort initiated by Craig Palmer (UNLV), the first MOJN Data Manager.

Finally, we want to thank Steve Fancy for his unwavering commitment to data management in the National Park Service.

Change History for this Document

Version #	Date	Revised By	Changes	Justification
1.1	6/30/10	R.E. Truitt	draft	
0.2				
0.3				
0.4	8/23/10	R.E. Truitt	Modified and included digital photo sections in several chapters	Reduction of IMS SOP
0.5	8/23/10	R.E. Truitt	Additions from Archive SOP	

This table reflects changes to this document. Version numbers will be incremented by one (e.g., Version 1.3 to Version 2.0) each time there is a significant change in the process and/or changes are made that affect the interpretation of the data. Version numbers will be incremented after the decimal (e.g., Version 1.6 to Version 1.7...1.10....1.21) when there are changes to grammar, spelling, or formatting, or minor modifications in the process that do not affect the interpretation of the data.

Executive Summary

I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood, and I—
I took the one less travelled by,
And that has made all the difference.



The road not taken (Robert Frost, 1916)

Data management has been adopted traditionally through attrition (Brunt et al., 2002). With the implementation of the Natural Resource Challenge and the subsequent Inventory and Monitoring Program (I&M), the National Park Service has instituted a process to mitigate that tradition. A cornerstone of the Inventory and Monitoring Program is the strong emphasis placed on data management. All I&M networks, including the Mojave Inventory and Monitoring Network (MOJN), expect to invest at least thirty percent of their available resources in data management. The data and information management plan (this document) is one element in the network's effort to fulfill the goal of high-quality data and information management; fully integrated into the Inventory and Monitoring program.

This plan is not limited to facts or data contained in the tables, fields, and values that make up a dataset. Its larger purpose is to describe the process for generating, preserving, documenting, and transmitting the context that helps data become information and makes it valuable and interpretable. As such, this plan covers both data—commonly defined as “facts or pieces of information” in scientific or academic literature—and information, defined variously as “knowledge communicated or received concerning a particular fact or circumstance” to “computer data at any stage of processing, as input, output, storage, or transmission” (Merriam-Webster 2006). In other words, this plan is not just concerned with the management of data and facts; it also intends to ensure that facts become information (e.g., interpretation of the data via analyses), which in turn translates into knowledge that we apply to manage the NPS lands that we are entrusted with as stewards. Therefore, it addresses pieces of information, the processing and preservation of those pieces, and the communication of knowledge derived from those pieces (Figure 1).

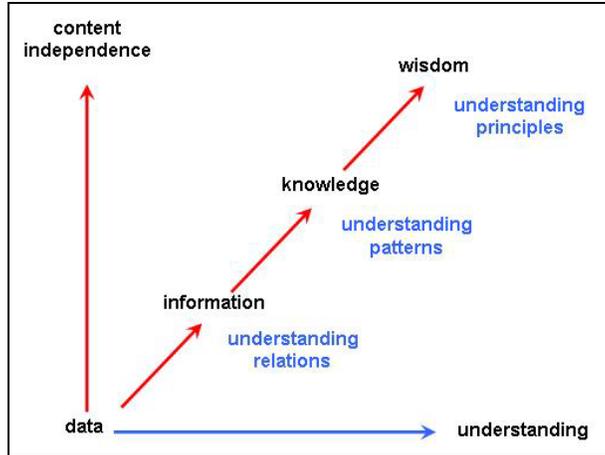


Figure 1. Understanding Data (Bellinger, 2004)

The central mission of the NPS Inventory and Monitoring Program is to provide timely and usable scientific information about the status and trends of park resources to park managers. To meet this challenge, we need a data and information management system that can effectively produce, maintain and distribute the products (knowledge) of scientific work done in our parks. Information is the common currency among the activities and staff involved in natural resource management in the National Park Service (NPS).

National Park Service Mission
The National Park Service preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education and inspiration of this and future generations...

Good data management is the means by which a thorough understanding of the value of scientific data and information about our natural resources can become a part of our National Park Service heritage. Management of data and information refers to the framework by which data are acquired, maintained, and made available. Data management is not an end unto itself, but instead is the means of maximizing the quality and utility of our natural resource information. A robust system for data management is particularly important for long-term programs where the lifespan of a dataset will span the careers of several scientists. Seen in this way, it becomes obvious that data management is vital to the success of any long-term monitoring initiative.

The overarching goal of the Mojave I&M Network data management system is to provide timely and usable scientific information about the status and trends of park resources to park managers. The success of our program hinges upon our ability to produce, manage and deliver this information, and the subsequent knowledge derived, to its intended audience. Our strategy for achieving this goal can be summarized as follows: ensure the quality, interpretability, security, longevity and availability of our natural resource data. In implementing a data and information management system we will strive for the following:

- Confidence in the security and availability of natural resource data and related information
- Easy access to most information, and appropriate safeguards for sensitive information

- Awareness of the intended use and limitations of each dataset
- Infrastructure and documentation that encourages data exploration
- Compatibility of datasets for exploration and analysis at larger scales and across disciplines
- Implementation of standards and procedures that facilitate information management, and that reinforce good habits among staff at all levels of project implementation – project leaders, technicians, and volunteer data collectors
- A proper balance between the standards needed to ensure quality and usability, and the flexibility to meet specific needs and encourage innovation
- A natural resource culture which views data not as a commodity but as the lifeblood of our work

This plan outlines how we intend to implement and maintain a system that will serve the data and information management needs of our Inventory and Monitoring Program. This plan reflects our commitment to establishing and maintaining a robust system for data management to ensure the availability and usability of high-quality natural resource information.

This plan and supporting standard operating procedure (SOPs) describes how our Network will:

- support Inventory and Monitoring Program objectives
- acquire and process data
- assure data and information quality
- document, analyze, summarize, and disseminate data and information
- maintain nationally developed data management systems
- maintain, store, and archive data

To monitor park health, across a group of parks consistently, using better information management practices to provide managers the ability to make scientific based management decisions.

The goal of the Mojave Network's data management program is to maintain, in perpetuity, the ecological data, information, and knowledge that result from the network's resource inventory and monitoring work. This plan is to describe the resources and processes required to ensure the following standards for data acquired or managed by MOJN:

- *Accuracy*: The quality of the data collected and managed by the I&M Program is paramount. Analyses performed to detect ecological trends or patterns require data with minimal error and bias. Inconsistent or poor-quality data can limit the detectability of subtle changes in ecosystem patterns and processes, lead to incorrect interpretations and conclusions, and could greatly compromise the credibility and success of the I&M Program. To ensure that MOJN produces and maintains data of the highest possible quality, procedures are established to identify and minimize errors at each stage of the data lifecycle.
- *Security*: Digital and hard-copy data must be maintained in environments that protect against loss, either due to electronic failure or to poor storage conditions. MOJN digital data are stored in multiple formats on a secure server, and are part of an integrated backup routine that includes rotation to off-site storage locations. In addition, MOJN is working with NPS museum curators and archivists to ensure that related project materials such as field notes, data forms, specimens, photographs, and reports are properly cataloged, stored, and managed in archival conditions.
- *Longevity*: Countless datasets have become unusable over time either because the format is outdated (e.g., punchcards), or because metadata is insufficient to determine the data's collection methods, scope and intent, quality assurance procedures, or format. While proper storage conditions, backups, and migration of datasets to current platforms and software standards are basic components of data longevity, comprehensive data documentation is equally important. MOJN uses a suite of metadata tools to ensure that datasets are consistently documented, and in formats that conform to current federal standards.
- *Usability*: One of the most important responsibilities of the Inventory and Monitoring Program is to ensure that data collected, developed, or assembled by MOJN staff and cooperators are made available for decision-making, research, and education. Providing well-documented data in a timely manner to park managers is especially important to the success of the program. MOJN must ensure that:
 - data can be easily found and obtained
 - data are subjected to full quality control before release
 - data are accompanied by complete metadata
 - sensitive data are identified and protected from unauthorized access and distribution

The MOJN's main mechanism for distribution of the network's inventory and monitoring data will be the World Wide Web, which will allow data and information to reach a broad community of users. As part of the NPS I&M Program, web-based applications and repositories have been developed to store a variety of park natural resource information (Table 1).

Table 1. Data that are provided on the MOJN and national I&M websites.

Web Application Name	Data available at site
NPSpecies	Database of plant and animal species known or suspected to occur on NPS park units and as a species keyword search for reference materials
NPS NRInfo	Portal to a variety of NPS information sources; will include NPSpecies and References links.
References	Park and network -related metadata and selected datasets (spatial and non-spatial) and bibliography of park-related natural resource information
NPStoret	Database for water quality assessment
MOJN Websites	Through the use of the network’s inter- and intra-net web sites and the use of MS SharePoint, reports, summaries, outreach materials, as well as other monitoring data and information for MOJN projects and tools for data; data downloads; database templates will be made available (MOJN Home Page)

The Mojave Network’s information acquires its real value when it reaches those who can apply it (Figure 1). If these web portals do not meet a specific user’s requirements, MOJN data management staff will work with users on an individual basis to ensure receipt of the desired information in the requested format.

Data Management Plan Model

Network data management plans have been written as an iterative process. Each of the networks has been placed into one of four groups, each group submitting their plans in a subsequent year. As each group of network data managers has submitted a draft plan, the groups have worked to identify and synthesize the salient elements of a complete plan. The first group of network data managers worked collaboratively to develop a plan, 1-2 data managers working on each identified chapter of the plan. The second and third groups of data mangers built off the initial work to fill gaps, revise materials and build a sound set of chapters, ultimately developing a plan model that is comprehensive. Unfortunately the resulting network plans are large (therefore discouraging for others to read and implement) and redundant (each network plan discusses the legal mandates, policies, and general data stewardship guidelines)

The last group of data mangers have designed and written their plans around a new data management plan model. Instead of each network plan containing the same redundant materials (adding to its length) and necessitating that each network update its plan based upon new national guidance and legal mandates, the new model proposed:

- To produce a national level data management plan guidance document that maintains the overarching documentation (what and why concerning data/information stewardship) and legal mandates into plan that is easily referenced in the development of a network data management plan.

- To produce a new network level data management plan that is more applicable (how and when concerning data/information stewardship), easily understood, and does not require the lengthy background documentation and legal mandates.

This plan is written using this new model. For information concerning the national guidance and legal mandates refer to the draft national plan (National Park Service 2008). The network's implementation of that material is contained in this document and the supporting documentation (management sections and SOPs).

This plan is written as both a standalone document and as a support document for the network's Vital Signs Monitoring Plan (Chung-MacCoubrey et al. 2007), for the management of data and subsequently produced information and knowledge. The plan by itself would be too daunting of a tome to be used or applied (as seen by the plans already developed by the preceding 26 I&M networks) by anyone other than the authors. Hence the plan is only a condensed or abbreviated link between the national data management plan guidance document (National Park Service 2008) and the more technically oriented and applicable supporting documentation (management sections and standard operating procedures), that are appended to the plan (Figure 2). The supporting documentation are the dynamic guidance that will provide users (park and network staff, cooperators, and others) with the practical know-how to be applied for any particular data and/or information management procedure. The supporting documentation is composed of standard operating procedures (SOPs) that have been arranged into categories of related procedures (i.e. management sections) as illustrated in Figure 2. The national guidance document contains the legal mandates and over-arching justifications, the network plan is the connection between the national guidance and the network level management sections and SOPs.

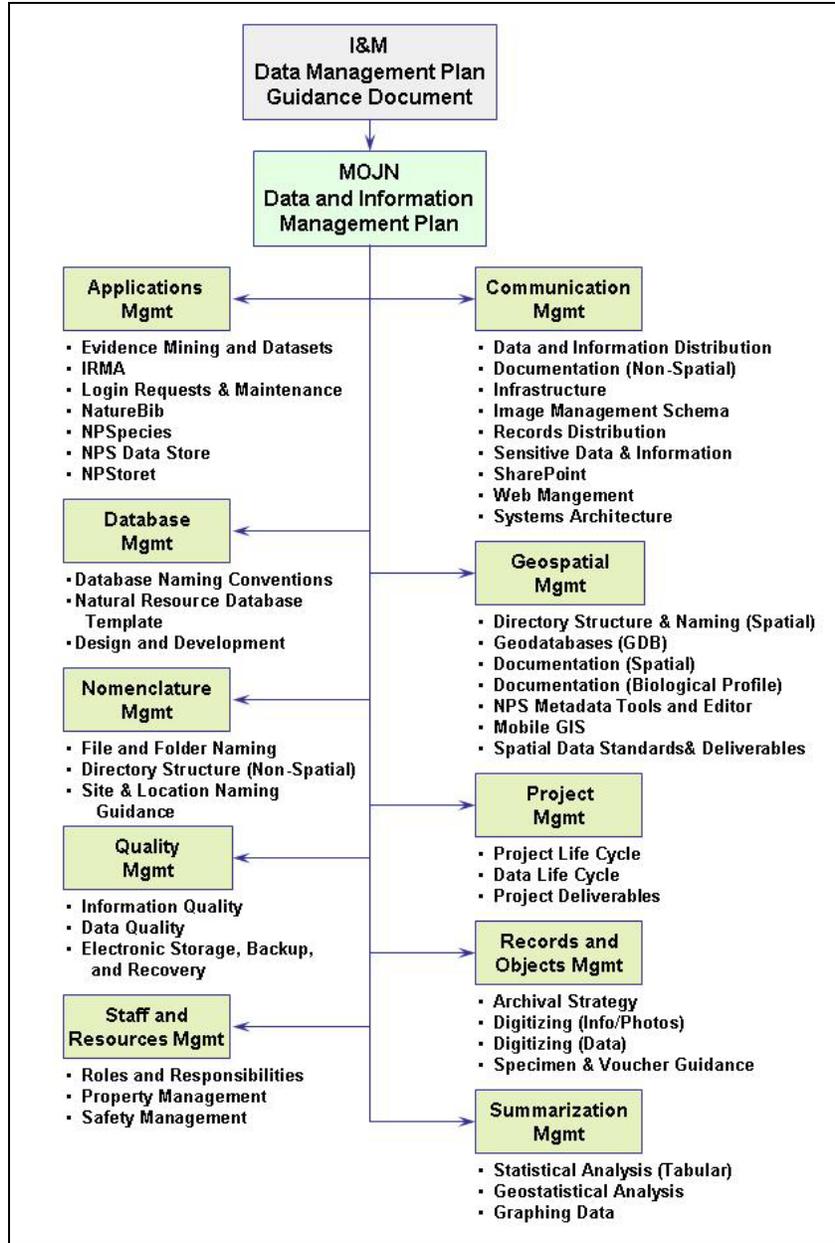


Figure 2. Data and Information Management Plan Flowchart

Data Management Roles and Responsibilities

Data management is collaborative work that involves many persons with a broad range of expertise and abilities. All network staff has a role in data stewardship, and project datasets and products reflect all who have contributed. Table 2 lists data-related roles and primary responsibilities, from field-based data collection, to final distribution and archiving. The fundamental role of the network data manager is to coordinate these tasks.

Table 2. Roles and responsibilities related to network data management.

Role	Primary responsibilities related to data management
Project leader	Direct operations, including data management requirements, for network projects
Project crew leader	Supervise crew; communicate regularly with data manager and project leader
Project crew member	Collect, record, perform data entry, verify data; organize field forms, photos, other related materials
Resource specialist	Evaluate validity and utility of project data; document, analyze, publish data and associated information products
GIS specialist	Oversee GPS data collection; manage spatial data; prepare maps; perform spatial analyses
IT specialist	Apply database and programming skills to network projects; maintain information systems to support data management
Quantitative ecologist	Determine project objectives and sample design; perform and document data analysis and synthesis; prepare reports
Network data manager	Ensure program data and information are organized, useful, compliant, safe, and available
Network coordinator	Coordinate and oversee all network activities
Park or regional curator	Ensure project results (documents, specimens, photographs, etc.) are cataloged and accessioned into NPS or other repositories
I&M data manager (national level)	Provide service-wide database support and services; provide data management coordination among networks
End users (managers, scientists, interpreters, public)	Inform and direct the scope of science information needs; interpret information and use to direct or support decisions

Data Sources and Priorities

There are multiple sources of significant data related to natural resources in the MOJN parks. The types of work that may generate these data include:

- inventories
- monitoring
- protocol development pilot studies
- special-focus studies performed by internal staff, contractors, or cooperators
- external research projects
- studies performed by other agencies on park or adjacent lands

Prioritizing data management efforts in a sea of unmanaged data

- Highest priority is to produce and curate high-quality, well-documented data originating with the Inventory and Monitoring Program
- As time and resources permit, assist with data management for current projects, legacy data, and data originating outside the Inventory and Monitoring Program that complement program objectives
- In addition, help ensure good data management practices for park-based natural resource projects that are just beginning to be developed and implemented

- resource impact evaluations related to park planning and compliance
- resource management and restoration work.

Because the I&M Program focuses on natural resource inventories and long-term monitoring, MOJN's first data management priority is the data and information that results from these efforts. However, the standards, procedures, and approaches to data management developed by MOJN are being applied to other natural resource data sources.

For example, all natural resource parks need a basic suite of resource inventory data in order to manage their resources and support a successful monitoring program. The national Inventory and Monitoring Program has determined that a minimum of 12 inventory datasets, including both biotic and abiotic components, will be acquired by all parks. MOJN is working with individual parks and national NPS programs to acquire and standardize these basic resource datasets, and make them widely available. The datasets are:

- Natural resource bibliography
- Documented species list of vertebrates and vascular plants
- Species distribution and status of vertebrates and vascular plants
- Vegetation map
- Base cartographic data
- Soils map
- Geology map
- Water body location and classification
- Water quality data
- Location of air quality monitoring stations
- Air quality data
- Weather data

A summary of the status of these datasets for network parks is presented in Appendix J (Status of the 12 natural resource inventories, Mojave Network).

Data Management and the Project Lifecycle

Inventory and monitoring projects are typically divided into five broad stages: initiation, planning, execution, monitoring and control, and closure (Figure 3). During all stages data management staff collaborate closely with project leaders and participants.

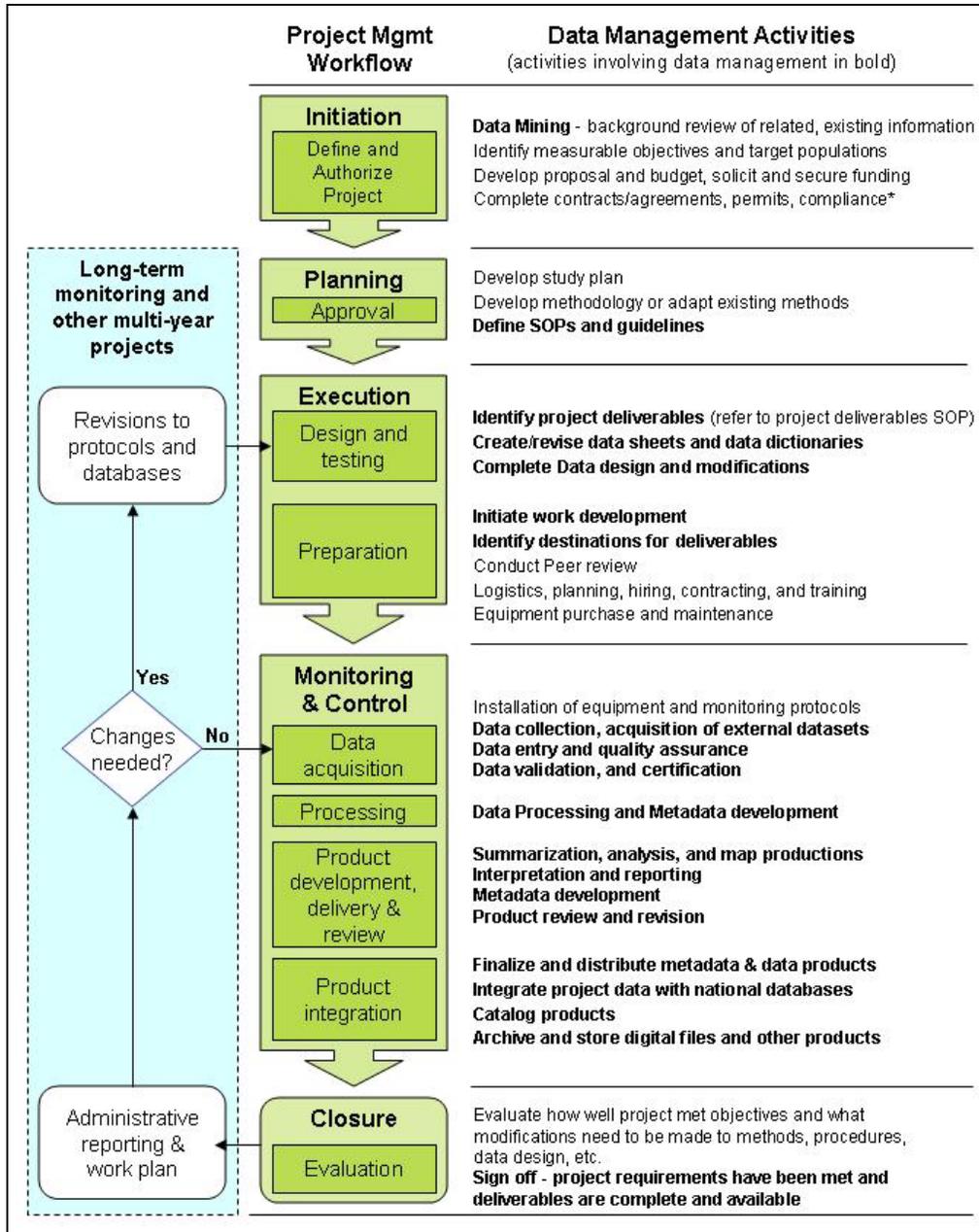


Figure 3. Project Workflow and Data Management activities

Specific data management procedures corresponding to these stages are described in the chapters of this plan. Building upon the data management framework presented in chapters 1 through 5, Chapter 6 is devoted to data acquisition, processing, and reporting, and Chapter 7 provides a framework for verifying and validating data that are collected and entered into databases. Dataset documentation is the subject of Chapter 8, data ownership and sharing is presented in Chapter 9, and data dissemination, including issues such as compliance with the Freedom of Information Act (FOIA), are addressed in Chapter 10. Chapters 11 and 12 provide a framework for the long-term maintenance, storage, and security of MOJN data.

Water Quality Data

The water quality component of the Natural Resource Challenge requires that networks archive all water quality data collected as part of the monitoring program in a STORET (STORage and RETrieval, EPA 2006) database maintained by the NPS Water Resources Division (WRD, [NPSTORET home page](#)). MOJN will be developing a MS-Access database that consolidates available water quality data collected in and near the 7 MOJN park units. Associated with this database are water quality standards assessment tools that allow comparisons of historical and current data with applicable state standards. MOJN will maintain this database and integrate new data collected so it can serve as an ongoing tool for the network's long-term water quality monitoring and analysis needs.

On an annual basis MOJN will compile and format new water quality data from MOJN H₂O into an electronic data deliverable (EDD) that is compatible with WRD-STORET. WRD will ensure that content is transferred to the Environmental Protection Agency's STORET database (Figure 4).

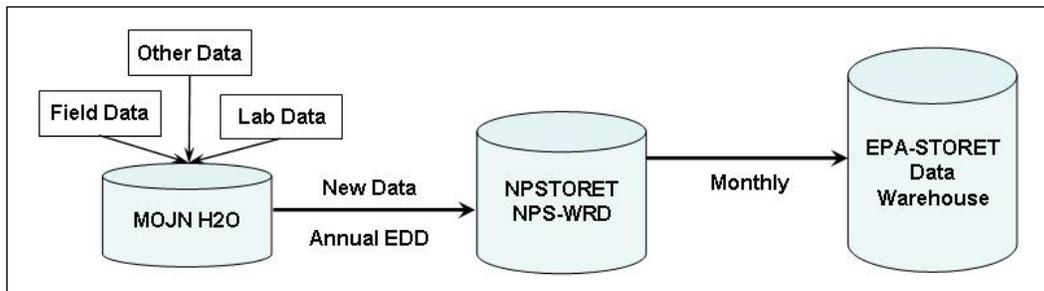


Figure 4. Simplified Data Flow Diagram for Water Quality Data

Data Management Plan Maintenance

The MOJN approach is to maintain a Data and Information Management Plan that is useful to a broad audience, and that can provide guidance on data management practices at a number of different levels. MOJN will keep the plan simple, flexible, and evolving, and include data users in the decision-making process whenever possible.

The document has undergone an initial prescribed review process that included both an internal network review (i.e., by members of the technical committee and network staff), and a service-wide review that involved the regional data/GIS coordinator, data management staff from the WASO I&M Program, and other network data managers.

MOJN will update the plan to ensure that it reflects accurately the network's current standards and practices. Recommendations for changes can be forwarded to the network data manager by any interested party or user of network inventory and monitoring data (e.g., park resource managers, project leaders, technicians, superintendents, external users). These recommendations will be discussed by data management and network staff and actions decided upon. Simple changes can be made immediately in the document, while substantive changes will be made during version updates.

The most current version of the plan is available on the MOJN website (<http://science.nature.nps.gov/im/units/mojn/index.cfm>).

1. Introduction

Reliable data and information are essential to managing the national parks, and collecting natural resource information is the first step toward understanding national-park ecosystems. When collected using rigorous methods, maintained through sound management practices, and transmitted to park managers in a useable format, that information can also form the basis for sound management decisions.

Preserving information requires the establishment and maintenance of reliable data and information management practices. Without planning, data are easily corrupted, misplaced, or misunderstood, and information can be quickly lost through staff turnover, lack of effective communication, and changes in hardware, software, and data archive formats.

The knowledge to make science based resource management decisions is sometimes misunderstood from the perspective of knowledge management, what does it involve? The American Productivity and Quality Center (O'Dell et al. 1998) provides that:

"Knowledge Management is a conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that will improve organizational performance."

The Gartner Group (Bair 1998) articulates a more defined concept of knowledge management as: *"...a discipline that promotes an integrated and collaborative approach to the process of information asset creation, capture, organization, access and use. Information assets include databases, documents, and most importantly, the uncaptured, tacit expertise and experience resident in individual workers."*

1.1. Objectives

The goals of our data and information management system are to ensure the quality, interpretability, security, longevity, and availability of ecological data and related information resulting from resource inventory and monitoring efforts.

Quality. The MOJN will take measures during all phases (project development, data acquisition, data handling, summary and analysis, reporting, and archiving) to guarantee the quality of the data. These measures will reflect current best practices and meet rigorous scientific standards.

Interpretability. A dataset is only useful if it can be readily understood and appropriately interpreted in the context of its original scope and intent. Data taken out of context can lead to misinterpretation, misunderstanding, and poor management decisions. Similarly, datasets that are obscure, complex, or poorly documented can be easily misused. Sufficient documentation (metadata) will accompany each dataset (and all reports and summaries derived from it) to ensure that users will have an informed appreciation of the dataset's applicability and limitations.

Security. The MOJN will maintain and archive datasets in an environment that provides appropriate levels of access. The network's data-management system will take advantage of existing systems for network security and systems backup, and augment these with specific measures aimed at ensuring the long-term security and integrity of the data.

Longevity. The longevity of a dataset is reliant on thorough documentation (metadata). Longevity is also realized through continued use, which requires that the data be maintained in an accessible and interpretable format.

Availability. Natural resource information can inform decisions only if it is available to managers at the right times and in appropriate forms. The MOJN will ensure that the products of inventory and monitoring efforts are created, documented, and maintained in a manner that is transparent to the potential users of these products.

The objectives that support these goals are as follows:

- To acquire and/or generate the data that the MOJN needs to achieve its goals;
- To compile that data into sets (information) and ensure its accuracy and logical consistency;
- To provide the documentation critical to maintaining the long-term interpretability of the acquired and compiled information;
- To determine the sensitivity level of the information;
- To properly archive the information;
- To properly catalogue the information and report it to the network parks and the public; and
- To provide information to the appropriate audiences in the correct format.

1.2. Scope

This plan applies to the Mojave Inventory and Monitoring Network (MOJN), one of 32 NPS networks nationwide, which connect seven park units: Death Valley National Park (DEVA), Joshua Tree National Park (JOTR), Great Basin National Park (GRBA), Lake Mead National Recreation Area (LAKE), Manzanar National Historic Site (MANZ), Mojave National Preserve (MOJA), and Parashant National Monument (PARA). The core network staff is located in Boulder City, Nevada (LAKE) with other network staff duty stationed across the Pacific West Region (Table 3). While the Internet and other modern telecommunication technologies have greatly facilitated contact between the multiple entities of the network, direct personal communication remains critical in establishing common goals, locating and resolving misunderstandings, and setting priorities. Figure 5 shows the physical relationship of the network office, the seven parks, roads, and geographic barriers that affect geographic connectivity among the network entities.

Table 3. MOJN Staff and duty station

Network Staff	Number of Staff	Duty Station
Network Coordinator	1	LAKE
Network Data Manager	1	LAKE
Data Mining Team	1	DEVA
Data Mining Team	1	MOJA
Data Mining Team	2	JOTR
Administrative Assist.	1	PWR CESU (Seattle)

The primary audience for this plan includes developers and users of network information. Developers include network staff, park professional staff, other NPS staff, and external collaborators. Users include network park managers and staff from all divisions, network staff, Region managers and staff, Washington Area Service Office (WASO) managers and staff, and the public.

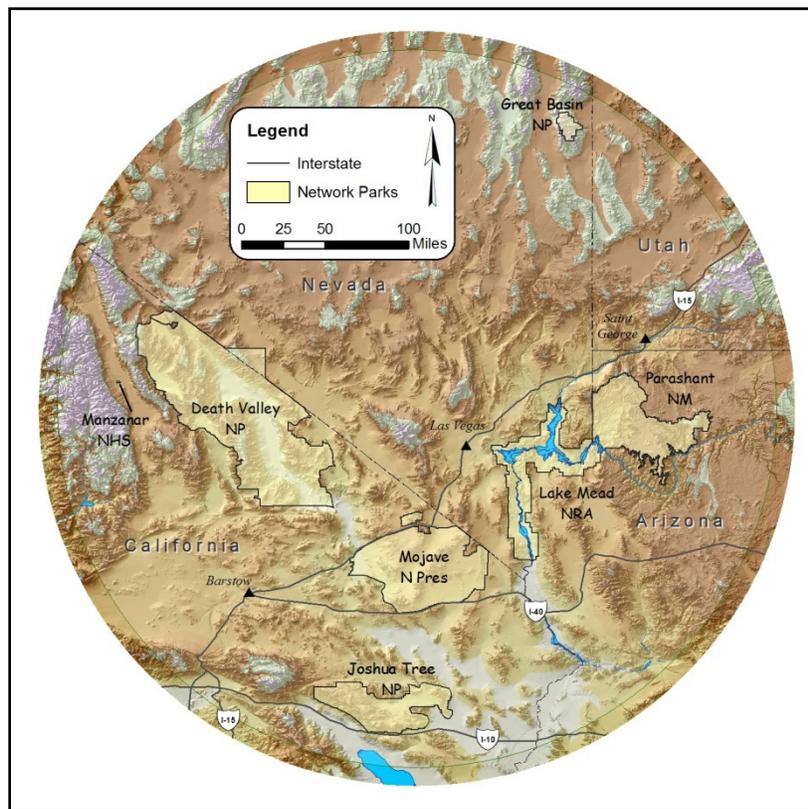


Figure 5. Location of Mojave Network Relative to Each of the Network Parks

While this document is about data and information management and is intended is to address all data and the derived information from that data either directly collected by or funded by the MOJN. Hence this plan incorporates both tabular and spatial datasets and their associated

informational derivatives. This plan therefore includes both the network’s data and geographical information system (GIS) management plans into one seamless overarching document.

1.3. Purpose

Preserving knowledge requires the establishment and maintenance of reliable data and information management practices. Without planning, data are easily corrupted, misplaced, or misunderstood, and information can be quickly lost through staff turnover, lack of effective communication, and changes in hardware, software, and data archive formats (Figure 6). Any good set of facts, whether collected last week or 20 years ago, must also provide enough information about itself to ensure its preservation and meaningful use (Figure 7).

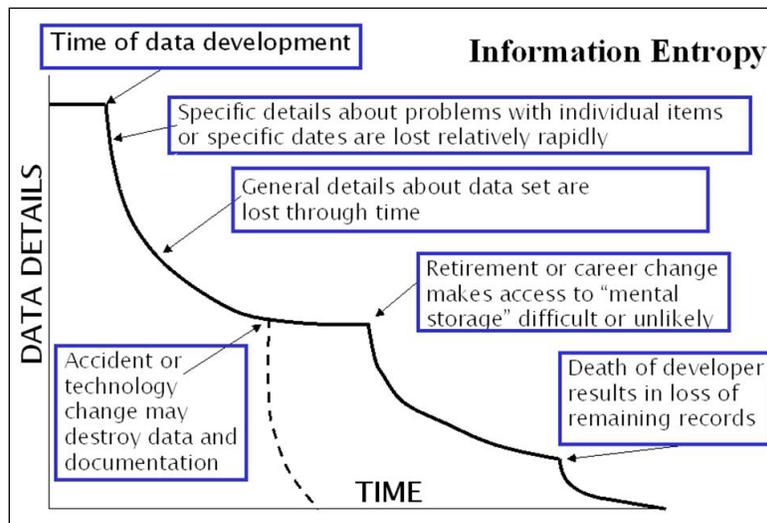


Figure 6. Information Entropy - without sound management practices (Michener 2000).

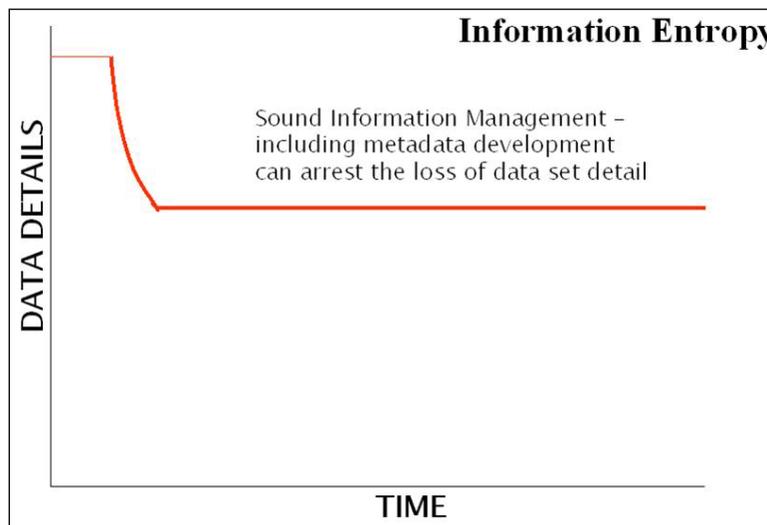


Figure 7. Information Entropy - with sound management practices.

1.4. Supporting Documentation

This document, the MOJN Data and Information Plan, is written as both a standalone document and as a support document for the network's Vital Signs Monitoring Plan (chapter 6 in Chung-MacCoubrey et al. 2008), for the management of data, the information derived, and the knowledge gained. This document by itself would be too daunting of a tome to be used or applied (as witnessed by the plans already developed by the preceding 26 I&M networks) by anyone other than the authors. Hence this plan is only a condensed or abbreviated link between the national data management plan guidance document (National Park Service 2008) and the more technically oriented and applicable supporting documentation (i.e. management sections and standard operating procedures), that are appended to this plan (Figure 8). The supporting documentation are the dynamic guidance and specifications that will provide users (e.g. park and network staff, cooperators, and others) with the practical know-how to be applied for any particular data and/or information management procedure.

The materials necessary for the MOJN's data and information management to be comprehensive is composed of three components: 1) a national level data management plan that provides guidance, policy references, and the bases for good data management practices; 2) the technical documentation on how the network will apply any particular data management activity or task; and 3) a network stand alone data and information management plan that connects both of the first two components. Figure 8 depicts the relationship of the two higher level documents and their primary subject matter.

The supporting documentation is composed of standard operating procedures (SOPs) that have been arranged into categories of related procedures (i.e. management sections). The management sections were used to organize similar SOPs into natural groupings. Each of the management groups has a central theme used to organize the SOPs into and may seem arbitrary at first:

- *Applications Management*: consolidates all of the SOPs that address any national level applications, tools, or on-line logins required during routine of network activities of managing data management.
- *Communications Management*: unites all of the SOPs that are centered on the communication of data and information including web development and maintenance, sensitive data, image management, distribution specifications, etc. All hardware and software involved in communicating data and information to the appropriate NPS staff and cooperators are also included in this management section.
- *Database Management*: brings together all SOPs associated with tabular database design, development, and deployment, as well as standardized database naming conventions employed by the network. There is limited relationship to particular summarization SOPs also where general summaries and basic statistics are automated into a database; these are addressed on a case-by-case basis.
- *Geospatial Management*: combines those SOPs that are uniquely relevant to spatial datasets and information. There exists some blending of SOPs with other management sections, such as the embedding of a MS Access database into a Geodatabase for greater functionality. Any spatial analysis or modeling has been merged with tabular data

summary processes and activities into its own summarization management section (see section below).

- *Nomenclature Management*: ties together those SOPs related to the naming of files and folders and how there are arranged (i.e. directory structures) and access privileges to them. Since spatial data are uniquely organized, that SOP is included in the geospatial management section.
- *Project Management*: Since each vital sign monitoring protocol is unique and typically involves different staff and resources, each is considered its own unique project, separate from the network's I&M program which provides oversight for all associated projects. Therefore a set of SOPs have been developed to address project and data management as they relate to the activities involved, the role of staff, and scheduling and tracking a project and associated deliverables.
- *Quality Management*: quality assurance and control are important at all levels of data and information management. Included with data and information quality is the capacity to maintain and protect the quality of files and folders over time, hence the network SOP storage, backup, and recovery is also included in this management section. Quality management is also integrated into all SOPs to the degree necessary to identify specific QA/QC requirements to perform each SOP.
- *Records and Objects Management*: consolidates all of the SOPs related to records (e.g. documents, field data sheets) and objects, objects being all voucher specimens and associated records that are under the purview of the network. Archiving of documents and curation of specimens is addressed under this management section.
- *Staff and Resources Management*: to apply the network's vital signs monitoring program protocols have to be implemented, that requires staff, time, funding, and equipment. This also requires that all aspects of the program are accomplished safely, providing for the integrity of the equipment to the best of our ability, and the identification of those responsible. This management section therefore unites together all SOPs directly related to the resources, staffing responsibilities, and safety at all levels. Staff and resources management is also integrated into all SOPs to the degree necessary to identify the staff and resource needs required to perform each SOP.
- *Summarization Management*: summarization or the manipulation of data to extract salient information and trends has been consolidated in its own management section. Examples of these SOPs are statistical analyses that are not automated into a database but where data are extracted and used in a separate, specifically designed application for advanced data analysis, modeling, and graphing techniques.

A number of the SOPs and/or management sections will be applicable to more than one chapter of this plan. Therefore each chapter has a final sub-chapter on supporting documentation listing all applicable management sections and SOPs relevant to the subject matter and a complete list of SOPs are listed in Table 4. All SOPs with their development status and timetable for completion of the draft documents are available in Table 8 (page 31).

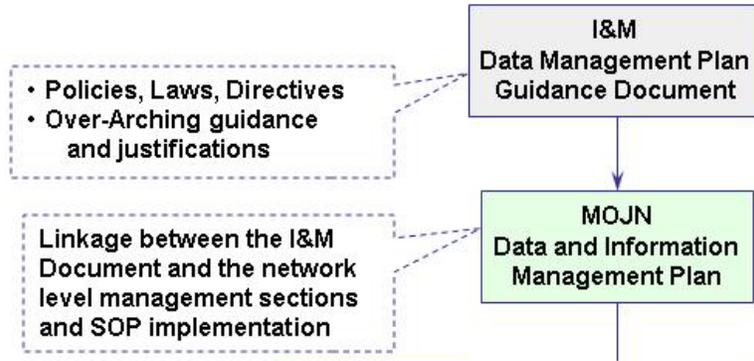


Figure 8. Higher Level Management Plan Content

Table 4. MOJN Management Sections and associated SOPs.

Applications Management	Nomenclature Management
Login Requests and Maintenance	Protocol Naming Conventions
Evidence Mining and Datasets	Directory Structure Non-Spatial
NRInfo	Site and Location Naming Guidance
References	Project Management
NPSpecies	Project Life Cycle and Workflow
NPStoret	Data Life Cycle and Workflow
	Project Deliverables
Communications Management	Project Scheduling and Tracking
Data and Information Distribution	Quality Management
Records Distribution	Data Quality
Documentation Non-Spatial	Information Quality
Image Management Schema	Electronic Storage, Backup, and Recovery
Sensitive Data and Information	Records and Objects Management
MOJN Infrastructure	Archival Strategy
MOJN Systems Architecture	Digitizing Information and Photos
Network SharePoint	Digitizing (Data)
Web Management	Specimen and Voucher Guidance
Database Management	Staff and Resources Management
Database Naming Conventions	Roles and Responsibilities
Natural Resources Database Template	Property Guidance
Database Design and Development	Safety Guidance
Geospatial Management	Summarization Management
Spatial Data Standards and Deliverables	Graphing Data
Directory Structure Spatial	Statistical Analysis (Tabular)
Geodatabases (GDB)	Geospatial Statistics
Documentation (Spatial)	
Biological Data Profile	
NPS Metadata Tools and Editor	
Mobile GIS	
Digitizing (Maps)	

2. Infrastructure and System Architecture

Modern information management infrastructure and system architecture represent the foundation of network data and information management systems. *Infrastructure* refers to the system of computers, servers, I/O devices, and global positioning system devices that are functionally or directly linked through computer networking services (in lay terms “the hardware”). *System architecture* refers to the applications, database systems, repositories, and software tools that make up the framework of our data and information management enterprise (in lay terms “the software”).

2.1. Objectives

- Ensure staff has appropriate access to electronic files that are secure and protected from accidental and malicious loss.
- Simplify GIS software installation and management, and expedite access and retrieval of GIS data using automation tools.
- Identify and implement appropriate collaborative technologies and tools that enhance networking and communications at both an intra- and inter-agency level.
- Develop a collective long-term strategy towards identifying and developing a content management system and intranet portal for storing, managing, searching, and disseminating electronic files.

2.2. Scope

The staff of the MOJN is located across the network parks and region as shown in Table 4. This creates a logistically challenging environment within which to develop and maintain comprehensive and united network infrastructure and systems architecture. The network relies upon the M&M IT Network (the combined Mojave and Mediterranean Networks’ park IT staff) and the individual parks and regional IT support where staff is located to provide computer IT needs. Network staff is required to comply with all federal, department, and agency IT requirements as outlined in the national Data Management Plan guidance document (National Park Service 2008). A comprehensive explanation and presentation of the MOJN’s infrastructure and system architecture is in the network supporting documentation (see section 2.3).

Table 5. MOJN Staff duty stations

Number of Staff	Duty Station
2	LAKE
1	DEVA
1	MOJA
2	JOTR
1	PWR CESU (Seattle)

Data and information management is an important component of the Inventory and Monitoring program (I&M). The national data management plan guidance document (National Park Service 2008) outlines the policies and standards by which national level applications and tools (e.g. NRInfo NPSpecies, References, and NPStoret) need to be implemented and why. Chapter 2 provides information on the systems architecture and the use of the I&M tools and applications as repositories for data and information. Chapter 9 addresses ownership and sensitive of data and information and chapter 10 discusses the use of the I&M tools and applications for their

dissemination. To achieve an integrated data and information management system, three of the national-level data management applications (NRInfo NPSpecies, and References) use distributed application architecture with both desktop and internet-accessible (master) components.

Figure 9 provides a visual representation of the MOJN services, in an operational and functional context. The network’s operational requirements are inextricably linked to our infrastructure, without reliance upon the technological hardware we would have to resort to paper, file cabinets, and typewriters to implement a monitoring program. There exists a strong link however between our software requirements and their requirement for an infrastructure to be functional. The system architecture provides the interface with and graphic interpretation of the data in its numerous iterations that is stored within the hardware (i.e. infrastructure). Imbedded within the operational requirements is the capability to store, backup, and recover electronic data and information that is functionally deployed through applications (i.e. software). The network is then linked through a series of local area networks (LAN) or network of devices, the ultimate desire is deployment through enterprise architecture accessible by all stakeholders with the appropriate levels of privileges and securities.

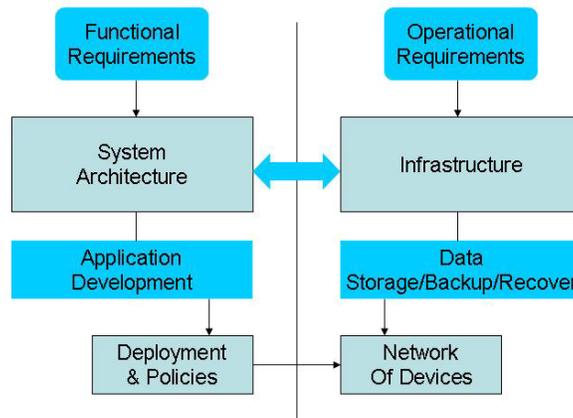


Figure 9. Functional and Operational Requirements (modified from Maarten and Burner 2002).

2.3. Software

MOJN software is stored in two places. The network tries to maintain all software primarily in digital format in the property folder at: M:\MOJN_ALL\Property\Software. The licenses and any maintenance agreements for our software are also stored under the appropriate software folder.

Licenses

Table 6. Software and licenses held by MOJN

Software Title	License Quantity
Adobe	
Acrobat Pro 9	8
InDesign CS3	1
Photoshop CS2	1

Macromedia	1
CommonTime	1
DirectoryCompare	8
DirectoryPrinter	8
Extensis	
Client/Server	3
Server	1
NetPublish	1
MS Project	1
SmartFTP	1
MS Visio	2
SQL Server 2005	1
WinRar	1
WinZip	10

2.3.1. Maintenance Agreements

The only software we currently maintain an annual service agreement on is Extensis. We have a standing agreement with Extensis through 2012 to pay \$2,000 annually. This annual cost covers technical assistance and software upgrades.

2.4. Supporting Documentation

Application and communication management are the primary sections with SOPs relevant to the network infrastructure and system architecture. How park and network staff will apply and utilize the I&M tools and applications. How the network develops and maintains its infrastructure and systems architecture. How the network will maintain its web sites and dissemination of data and information products. What the roles are of network staff and their responsibilities, relative the oversight of network property.

2.4.1. Management Sections and Recommended SOPs

A. Applications Management

- a. Login Requests and Maintenance SOP
- b. NRInfo NPSpecies SOP
- c. NRInfo References SOP

B. Communications Management

- a. MOJN Infrastructure SOP
- b. MOJN Systems Architecture SOP
- c. Network SharePoint SOP
- d. Web Management SOP

- e. Sensitive Data and Information SOP
 - f. Image Management SOP
- C. Staff and Resources Management
- a. Roles and Responsibilities SOP
 - b. Property Guidance SOP

3. Project Development and Data Management Workflow

The objective of this chapter is to illustrate the data and information management tasks that are associated with each stage of a project. By describing the progressive stages of a project and the life cycle of the associated data, we can clearly define the overall objectives and specific steps of the data management process. Addressing the data and information management needs throughout the project lifecycle will allow network staff to effectively manage the staffing resources needed to produce, maintain, and deliver high quality data and information.

The MOJN conceptual model of project management is illustrated in Figure 10. The Natural Resource Challenge (NRC) and the subsequent I&M Program are the initiator/sponsor of the network model for inventory and monitoring. The MOJN has developed the Data and Information Management Plan based upon the guidance from; the I&M Program (NPS-75), the overarching national data management guidance document (National Park Service 2008), the network's stakeholders (i.e. technical committee, board of directors), the vital signs scoping, and identified network oversight groups (e.g. Data/GIS work group, Water work group). This guides the identification of protocols and standard operating procedures (SOPs) to be designed, developed, and implemented (executed for field and laboratory data collection), as well as the operational requirements necessary. An annual project is brought to a close with the synthesis and reporting on data acquisition and processing, and as project deliverables are completed, integrated, and archived into the preceding years.

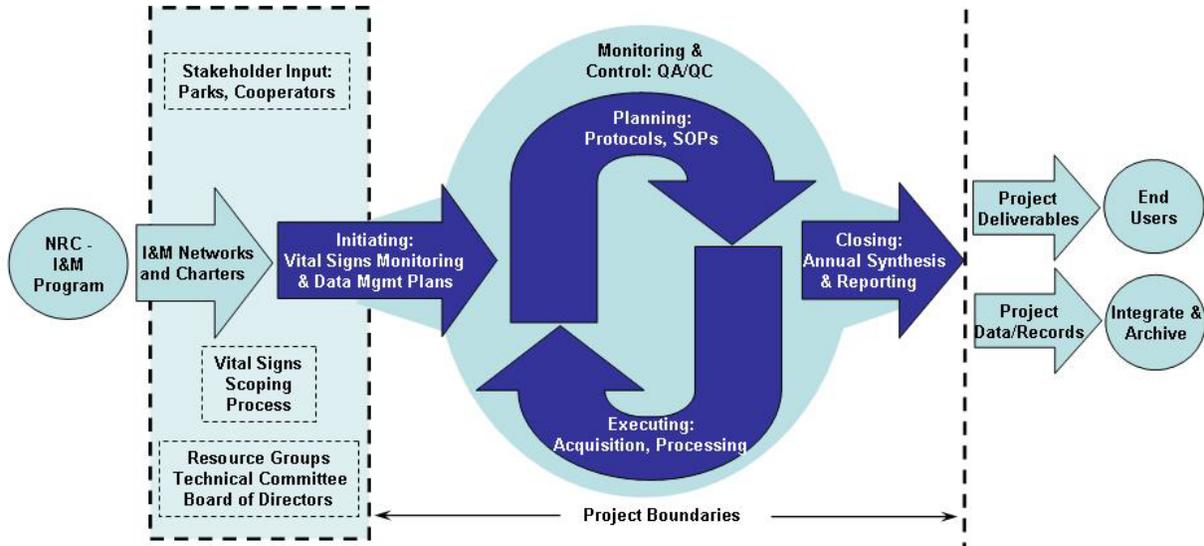


Figure 10. Conceptual Model of MOJN Project Management.

3.1. Objectives

- Illustrate the project management workflow and its relevant data management activities
- Describe the progressive stages of a project and the resulting data life cycle
- Define the specific steps of the data management process

3.2. Scope

Figure 3 in the executive summary displays the project life cycle and workflow as related to the MOJN and associated data management activities. This project life cycle deviates slightly from the one in chapter 3 of the I&M data management guidance document (National Park Service 2008) and needs to be referred to for all MOJN projects. A Project is divided into five knowledge groups recognized by the Project Management Institute (PMI, www.pmi.org); initiation, planning, execution, monitoring and control, and closing. Each knowledge area has a series of nine process areas associated with it (incorporated into the network's SOP template structure); the MOJN has adopted this project management structure and strives to incorporate our data and information management activities into it.

To maintain our network's data and information management in a PMI context that a "project is unique and temporary", we chose to identify each year or season of data and information derived from the vital signs monitoring protocols as a project, and each annual project is then one component of the network's overall vital signs monitoring program. All other data and information not protocol related will be differentiated between short- (<3 years) and long-term (>3 years, however with a finite scheduled completion date). Long-term projects have an increased need to adhere to and maintain standards for an extended period of time. Maintaining standardization from year-to-year will be necessary when comparing data over an extended

period of time (decades for long term monitoring). To ensure the development of high quality scientific information, data management must be an integral component in all aspects of project development. The following is a short description of the five knowledge areas:

Initiate. This is when many of the preliminary decisions are made regarding project definition, scope, and authorization. In addition, the proposal has been accepted, funding secured, so that the permits, and compliance are addressed in this phase. Primary responsibility rests with project leaders and program administrators. Specific data management activities can include the mining for existing datasets and data relevant to the project (both NPS and non-NPS). Final authorization is then received to proceed with the project.

Plan. During this phase, details are worked out regarding how data will be acquired, processed, analyzed, reported, and made available to others (development or modification of existing SOPs). The project leader is responsible for the development and testing of the project methodology, or modifying existing methods to meet project objectives. It is critical that the project leader and the data manager work together throughout this phase. This dialogue will help to build and reinforce good data management throughout the project, especially during the crucial stages of data acquisition, processing, and retrieval. By beginning collaborative development as soon after project authorization as possible, data integrity and quality can be assured most easily. This is especially true as timelines for deliverables are finalized (in the execution area below). It is recommended that all contracts, agreements, and permits include standard language that describes the formats, specifications, and timelines for project deliverables (this can be accomplished by referencing the appropriate SOPs). Another important part of this collaboration is the development of the data model (i.e., database structure) and data dictionary, where the specifics of database implementation and the parameters that will be collected are defined in detail. Devoting adequate attention to this aspect of the project is possibly the single most important part of assuring the quality, integrity and usability of the resulting data. Once the project methods, protocols and SOPs have been developed, documented, and approved, a project can move into the execution phase.

Execute. During the project execution phase, data containers are developed, a complete list of deliverables identified, field crews hired, training accomplished, and logistics finalized. Data sheets, data dictionaries, databases, and/or geodatabases are designed, developed, tested, and modified for use. Obtain the necessary equipment for the protocol, test and integrate the equipment as needed. The project deliverables identified have their formats and destinations established. Field staff is trained in the use and operation of mobile GIS, data loggers, and other technologies/software used for field data collection.

Monitoring and Control. This phase is where the data are acquired, processed, error-checked and documented. This is also when products such as reports, maps, geospatial themes, and other products are developed and delivered. The project leader oversees all aspects of implementation; from logistics planning to data acquisition, report preparation, and final delivery. Throughout this phase, data-management staff functions primarily as facilitators, providing training and support for database applications, use of GIS and GPS hardware/software, and other data processing applications; facilitation of data

summarization, validation, and analysis; and assistance with the technical aspects of documentation (i.e. metadata) and product development.

Close. Upon project closure, records are updated to reflect the status of the project and its associated deliverables in a network project-tracking application. For monitoring protocols, careful documentation of all changes is required. Changes to methods, SOPs, and other procedures are maintained in a tracking table associated with each document. Major revisions may require additional peer review. During this phase, data products, reports, and other deliverables are integrated into national and network databases, metadata records are finalized and posted in clearinghouses, and products are distributed or otherwise made available to their intended audience. Another aspect of integration is merging data from a working database to a master database maintained on the network server. This occurs only after the annual working dataset has been certified for quality by the project leader. Certain projects may also have additional integration needs, such as when working jointly with other agencies for a common database.

3.3. Supporting Documentation

The Project Management section is the primary source of network technical guidance and implementation regarding this chapter, however other management section SOPs apply on a case-by-case bases, see subsection 3.3.1 for further information.

3.3.1. Management Sections and Recommended SOPs

A. Project Management

- a. Project Life Cycle and Workflow SOP
- b. Data Life Cycle and Workflow SOP
- c. Project Deliverables SOP
- d. Project Scheduling and Tracking SOP
- e. Season Closeout

B. Geospatial Management

- a. Spatial Data Standards and Deliverables SOP
- b. Documentation Spatial SOP
- c. Directory Structure SOP

C. Nomenclature Management

- a. Protocol Naming Conventions SOP
- b. Directory Structure Non-Spatial SOP

D. Quality Management

- a. Data Quality SOP
- b. Information Quality SOP
- E. Communication Management
 - a. Documentation Non-Spatial SOP
- F. Staff and Resources Management
 - a. Roles and Responsibilities SOP

4. Data Management Roles and Responsibilities

Data management is about people and organizations as much as it is about information technology, database theory, and applications. Data stewardship is the assignment and acceptance of responsibility for the oversight of management aspects of information. For park and network resource programs to work effectively, everyone within the program, and all those in collaboration with it, must take responsibility for the production, analysis, management, and/or end use of the data collected and information produced by the program. In order to meet the data management goals and standards developed by the I&M program (National Park Service 2008) and its constituents, program staff must understand what their roles and responsibilities are in this process.

4.1. Objectives

- Clearly define roles associated with functions
- Establish data ownership throughout all phases of a project
- Instill data accountability

4.2. Scope

This chapter is relevant to everyone within the MOJN I&M Program, and all those in collaboration with it, that have data stewardship responsibilities for the production, analysis, management, and/or end use of data and information produced by the program. Most of the roles and responsibility guidance is well documented in the national data management plan guidance document (National Park Service 2008) however the MOJN does have a SOP related to the roles and responsibilities of data stewardship (see the next section). Figure 11 displays the network staff and their inter-relationships. There is a number of staff scheduled to be hired or potentially hired over time (they are depicted in by the bounding dotted line).

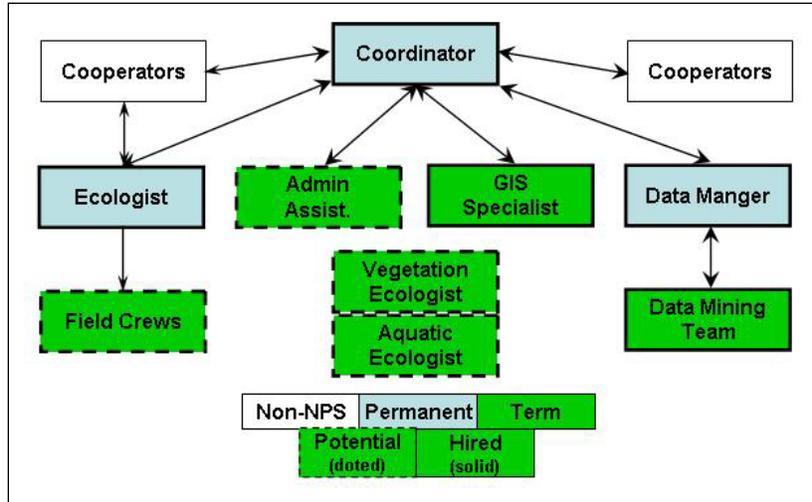


Figure 11. MOJN Staffing chart, existing staff in solid lines and potential staff dotted.

4.3. Supporting Documentation

The Staff and Resource Management section is the primary source of network information regarding this chapter; however other management section SOPs apply, see subsection 4.3.1 for further information. Staff roles and responsibilities are also incorporated into individual SOPs.

4.3.1. Management Sections and Recommended SOPs

- A. Staff and Resources
 - a. Roles and Responsibilities SOP
- B. Project Management
 - a. Project Life Cycle and Workflow SOP
- C. Communications
 - a. Data and Information Distribution SOP

5. Databases

The adoption of sound database design principles that will help facilitate interpretability, ensure integrity, and promote compatibility of natural resources data collected in the parks. Deming’s third point, in his 14 tenets on management (Deming 1986), states that quality should be built in and not inspected for afterwards, and the network will integrate quality assurances into database design and development to the maximum extent possible.

5.1. Objectives

- To clearly articulate sound database design and development practices for the MOJN
- To develop all MOJN databases compliant with the NRDT

5.2. Scope

The national data management plan guidance document (National Park Service 2008) provides overarching information on the guidance and policies for database use by the network. All network staff and cooperators that have responsibility for the design, development, modification, and/or maintenance of network databases that are for the MOJN I&M vital signs monitoring protocol data collection will follow the guidance and other supporting documentation listed below. The MOJN has integrated fully with the Natural Resources Database Template (NRDT) for the implementation of all network level database design and development and will attempt to integrate its use in legacy datasets where possible. The next section identifies the supporting documentation concerning the execution of database implementation in the MOJN Vital Signs Monitoring.

5.3. Supporting Documentation

The database management is the primary section with SOPs important to database design, development, and implementation, see the subsection 5.3.1 for further information, however other management section SOPs apply as they have components relevant to the design, development and maintenance of databases.

5.3.1. Management Sections and Recommended SOPs

- A. Database Management
 - a. Database Naming Conventions SOP
 - b. Natural Resources Database Template SOP
- B. Applications Management
 - a. NRInfo NPSpecies SOP
 - b. NRInfo References SOP
 - c. Evidence Mining and Datasets SOP
- C. Staff and Resource Management
 - a. Roles and Responsibilities SOP
- D. Project Management
 - a. Project Deliverables SOP
- E. Communications Management

- a. Documentation Non-Spatial SOP

F. Quality Management

- a. Data Quality SOP

6. Acquisition, Processing, and Reporting

Large, multi-scale natural resources programs increasingly rely on data and information gathered from multiple sources. This chapter describes the general steps involved with acquiring, processing, and reporting data to meet standards established by the I&M program, although these standards could apply broadly to any of the programs covered by this plan. Guidelines for the acquisition and processing of physical objects (photographs, voucher specimens) which are often collected as part of resource management, inventory and monitoring, and other research projects are covered in chapter 11 of this plan. Instructions specific to particular projects must be developed and included with the protocols for those projects.

6.1. Objectives

- Acquire, through a variety of sources, data and information needed by MOJN Park managers to properly manage and maintain the natural resources of their parks.
- Acquire data and information needed to understand broad-scale changes in the environment that impact ecosystems on a regional or national level in cooperation with NPS and collaborative monitoring efforts.

6.2. Scope

This chapter is relevant to everyone within the program, and all those in collaboration with it, that have responsibility for the acquisition, processing, and/or end use of programmatic and non-programmatic data and information, as judged applicable to the program.

Administrative records derived from the MOJN I&M program must follow the Director's Order 19 (NPS 2001a) that provides general guidance and in particular Appendix B (NPS 2001b) detailing the types of records required to be maintained and for how long.

- Natural resources records (Section N). Records and reports are considered permanent if they pertain to plant and animal life, the management of natural resources and their areas, research programs and partnerships, geologic features, pollution and environmental quality, weather and climate, pest and weed control, or soil.
- Fiscal records (Section F). Most fiscal records, including budgeting and payroll, are considered temporary and are to be purged after three years.
- Personnel records (Section P). Records related to employees, including performance and work schedules are considered temporary and to be purged between two and three years.

- Property (Section S). Property and office supply records are temporary and are removed after three years.

Appendix A of the I&M Guidelines document (Natural Resources Inventory and Monitoring, NPS-75) specifies the types of park-specific information to be acquired and managed, either directly or indirectly, by the network:

- Legacy datasets and reports;
- Species information;
- Digital vegetation maps;
- Digital cartographic data;
- Digital soils maps;
- Digital geology maps;
- Water resources inventories;
- Water chemistry and flow information;
- Regional air quality monitoring stations, pollution sources, and data; and
- Precipitation and meteorological data.

The guidelines that apply to information acquired from other sources state that the network will only acquire and manage information that:

- Directly or indirectly supports the defined vital signs and/or facilitates the inventorying of natural resources at or around the network parks;
- Either has basic documentation that identifies the meaning of the information, its source and quality (metadata), or those elements can be documented. The information source can be another document, individual, or agency, as long as it is possible to refer back to this source. Information may be unpublished or incomplete as long as its meaning is defined, its source is identified, and some measure of its quality (its reliability) can be assigned;
- Is one of the following information formats: book, report, gray literature, periodical, journal article, NPS reference material, dataset, or map; and
- Is not a voucher specimen collected at a network park, that is, the network will not house, manage, or curate specimens.

6.3. Digital Photographic Images

6.3.1. Acquisition

TIFF photos may use a lossless or lossy data compression; the former retains the exact original data through photo copies and processing. The more common lossy data compression, typical of .jpg photos, approximates the original data and will lead to degradation in the photo over time. TIFF lossless is the preferred format for all digital photographic image acquisition (i.e taken with any type of camera).

At the time of photo acquisition, a photo log field datasheet should be completed to track and describe the photos. A sample photo log is provided in Appendix 1. Photo Log. The purpose of the photo log is to track each photo, differentiate between the types of photos, and to facilitate properly organizing and naming the photos.

6.3.2. Editing

Editing of photos occurs in a software program outside of Extensis; however, the file can be opened and edited with the photo editing software from within Extensis. Numerous freeware programs can be used as long as the software is DOI approved, such as [Google Picasa](#). Windows OS also includes basic editing tools as well through Office Picture Manager (Windows XP and Vista) or Windows Live Photo Gallery (Windows 7), the latter of which may not be available for installation on DOI computers. The network has one license for Adobe Photoshop.

Editing of all photos occurs in the queue folders and may include:

1. Rotating
2. Cropping
3. Adjusting the brightness and or contrast
4. Red-eye removal
5. Color balance adjustments
6. Adjust the resolution (lower resolution *only*), in which case the original resolution file is retained with the reduced resolution file and **has the letters “LowRes” in the file name**

Edited photos are saved with the same file name as in the working file unless extensive alterations were applied such as reduced resolution for web or email purpose. The four remaining types of edit tasks listed above do not qualify as extensive alterations.

6.3.3. Archiving

All photos are located on the Network shared drive which is routinely backed-up and archived according to NPS Office of Information and Operations policy and standards. Project photos are provided on a DVD or CD with reports or posted on the internet for greater access by the intended audience. Additional archive methods will include dissemination to NPS NRInfo Reference application (<http://inp2300fcsmaca1/ReferenceDomain.mvc/Welcome>) and potentially NPS Focus (<http://focus.inside.nps.gov/>).

6.3.4. Digital Photo Naming Standards

General guidelines for renaming photos and the specifics are listed in Table 3:

- No spaces in the file name, use an underscore between words
- Generally less than 30 characters
- Include the park unit code (Table 4)
- File names of protocol data photos must include the 5 characters or less protocol code
- Large quantities of photos in a collection (same subject) may use identical file names followed by a differentiating number

Species vouchers are a unique data collection and therefore their naming convention is designed to include the accession number associated with the research permit for tracking purposes. The accession number is also included in the metadata, as is the catalog number once the number is received.

6.4. Supporting Documentation

A number of management sections and their associated SOPs apply to acquisition, processing and reporting. Spatial and tabular data collection, analysis and synthesis of data to information (e.g. posters, newsletters, presentations, graphs) and the subsequent reporting on the status and trends of park ecosystem health are included.

6.4.1. Management Sections and Recommended SOPs

- A. Geospatial Management
 - a. Documentation Spatial SOP
 - b. Biological Data Profile SOP
 - c. Mobile GIS SOP
- B. Protocol Specific SOPs
 - a. Climate Data Acquisition
- C. Communications Management
 - a. Documentation Non-Spatial SOP
 - b. Data and Information Distribution SOP
 - c. Records Distribution SOP

- d. Image Management SOP
 - e. Sensitive Data and Information SOP
- D. Quality Management
- a. Data Quality SOP
 - b. Information Quality SOP
- E. Summarization Management (in development)
- a. Statistical Analysis (Tabular) SOP
 - b. Geostatistical Analysis SOP
 - c. Graphing Data SOP

7. Quality Assurance and Quality Control

Quality assurance (QA) can be defined as an integrated system of management activities involving initiation, planning, execution, monitoring & control, implementation, documentation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the consumer; quality control (QC) is a system of technical activities that measure the attributes and performance of a process, item, or service relative to defined standards (Palmer and Landis, 2002). While QA procedures maintain quality throughout all stages of data development, QC procedures monitor or evaluate the resulting data and derived information products. Quality must be built in at every opportunity, integrated instead of inspected for at the end of a project (Deming 1986). The primary reasons for data quality are to identify (Ravn and Høedholt, 2009):

- Trends in data quality
- Data quality issues before they impact critical processes
- Areas where process improvements are needed
- A structured and methodological approach to measuring and monitoring the quality of data should be part of a larger master data/information management strategy

7.1. Objectives

- Ensure natural resources projects produce high quality and credible data that can be confidently used by managers, researchers and the public
- Implement standard quality assurance and quality control procedures to meet the first objective

7.2. Scope

Quality management or the QA/QC of data and information is an element of every individual and activity that we perform either in a program or an operational perspective. The Bureau of Land Management (BLM) data life cycle (Figure 12) incorporates QA/QC into each process involved with the management of data (BLM 2006).

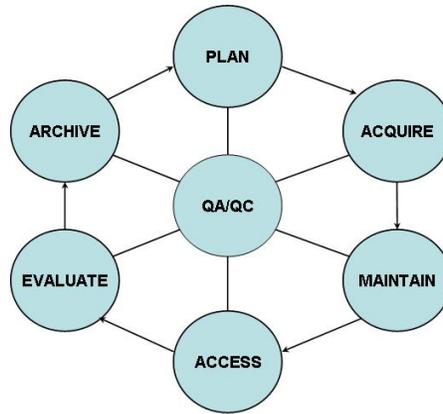


Figure 12. Data Life Cycle from a BLM perspective.

The I&M draft data management plan guidance documents (National Park Service 2008) provides the network with the guidelines, standards, and policies with respect to quality management (e.g. errors of commission and omission, verification/validation, instrument error, errors of logical consistency) from an NPS and DOI perspective. Figure 12 illustrates the common QA/QC activities involved with the networks monitoring, while Figure 13 represents the common elements (dimensions) to be considered in the quality of data.

Applying quality control to informational (e.g. written) materials is more difficult than applied to data. The network has instituted a set of procedures requiring all written material have two internal network reviews prior to external distribution or dissemination to parks or other stakeholders. The first is a technical review, that the material is both technically sound, correctly formatted, and spelling and grammar reviewed. The second internal review is by either the network coordinator or their identified agent for consistency with the network’s vision and is appropriate for external distribution.

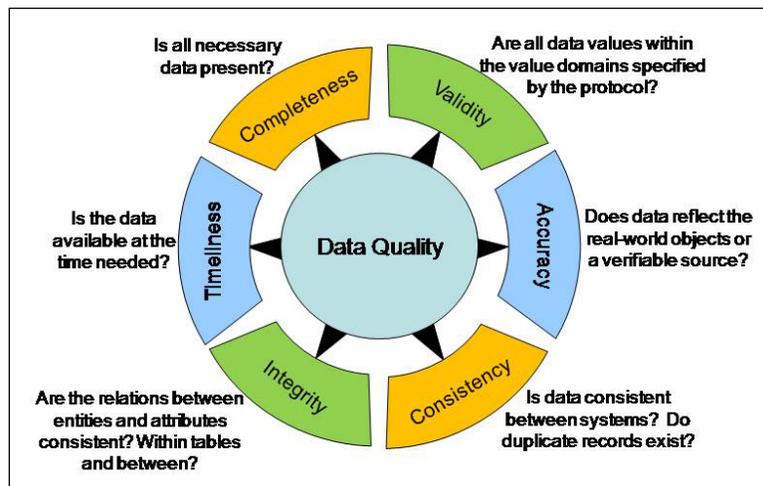


Figure 13. The Dimensions of Data Quality (Ravn and Høedholt, 2009).

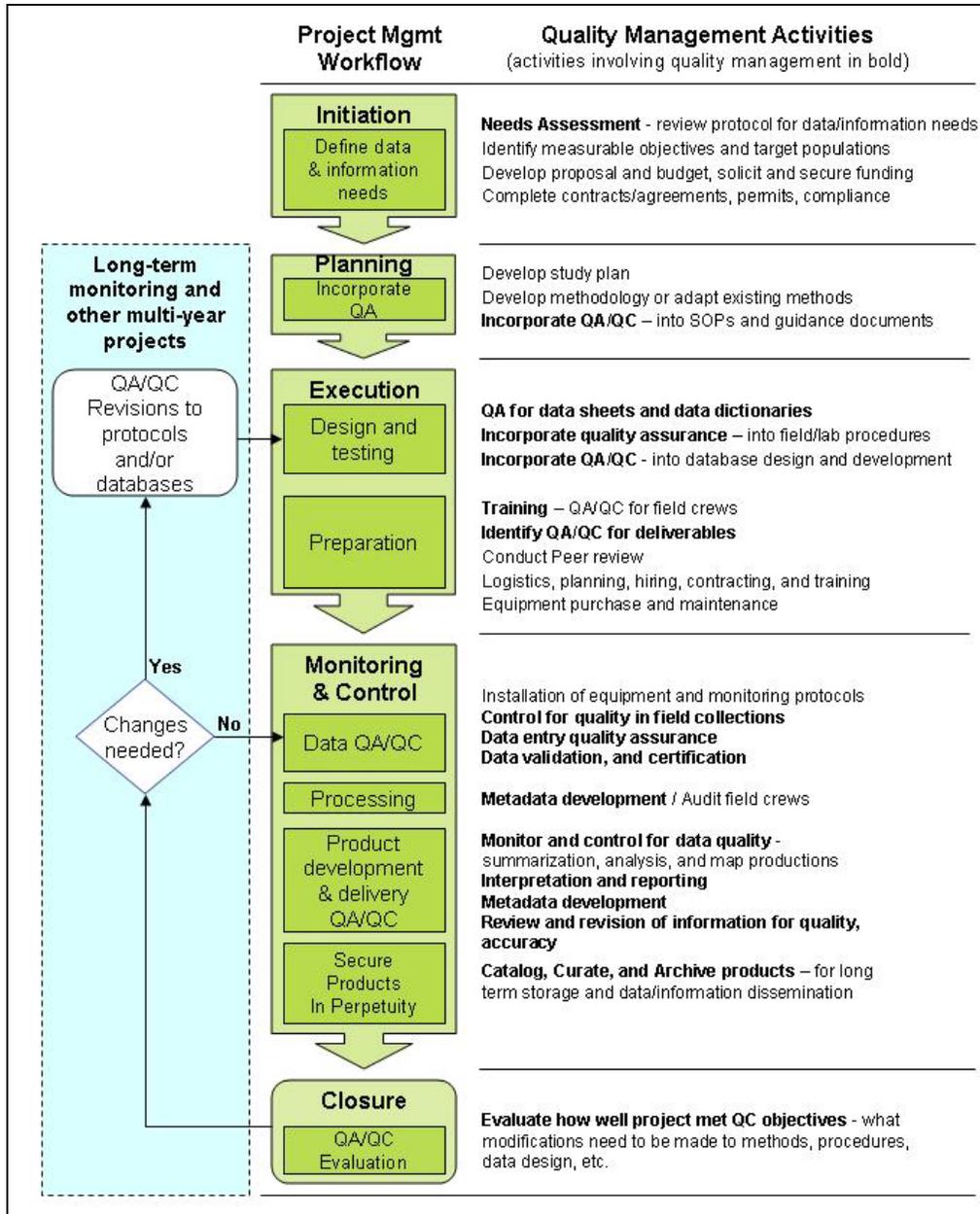


Figure 14. Project Workflow and Quality Management activities

7.3. Supporting Documentation

Quality management is integral to all steps in managing data and information (Figures 11) in a project (Figure 12), so it is challenging to provide one set of procedures that fulfill all needs. Therefore the guidance on quality management for data and information has been divided into different SOPs; one on Data Quality (MOJN-NPS, 2007X) and another on Information Quality (MOJN-NPS, 2007X). The Quality Management section applies as well as parts of other management sections; see the subsection 7.3.1 for further information. Each of the network’s SOPs provide for how MOJN will implement quality management into each stage of a project (Figure 13).



Figure 15. Quality is important in all aspects

7.3.1. Management Sections and Recommended SOPs

A. Quality Management

- a. Data Quality SOP
- b. Information Quality SOP
- c. Electronic Storage, Backup, and Recovery SOP

B. Project Management

- a. Project Deliverables SOP

C. Communications Management

- a. Documentation Non-Spatial SOP

D. Records and Objects Management

- a. Digitizing Information and Photos SOP

E. Geospatial Management

- a. Spatial Data Standards and Deliverables SOP
- b. Directory Structure Spatial SOP
- c. Documentation Spatial SOP

8. Dataset Documentation

Data developers often perceive data documentation or metadata creation as a tedious process whose benefits are realized only by those that later utilize or inherit their data. However

complete, robust metadata is increasingly used to manage in-house data resources, assess the utility of available data resources, instill data accountability, establish data liability, evaluate return on data investments, and provide a common language for both data contributors and consumers. Metadata help insure an organization's investment in data. As personnel change or time passes, information about data will be lost and the data may lose their value. Later workers may have little understanding of the content and uses for a dataset and may find that they can't trust the data. Complete metadata descriptions of the content and accuracy of a dataset will encourage appropriate use of the data. Such descriptions also may provide some protection for the producing organization if conflicts arise over the misuse of data.

8.1. Objectives

- Document all significant geographic and tabular datasets to MOJN standards described in this chapter.
- Maintain and leverage the investment made by NPS staff and cooperators in producing quality data.
- Aid the discovery of relevant data by NPS staff, collaborators, and the public.

8.2. Scope

The MOJN will adhere to all of the guidance, policies and standards that are enumerated within the I&M data management plan guidance document (National Park Service 2008). From project development through final delivery of information products, the Network data manger and project leaders will place a high priority on documenting the aims, quality, and meaning of data and information, and allow for the time this will take when scheduling.

To the fullest extent possible the MOJN will implement and use the NPS Metadata Tools and Editor (MTE) for the creation and revision of dataset related metadata. The MOJN will place all created metadata records on the NPS Data Store for long-term storage, dissemination, and discovery, the datasets themselves will only be stored locally for the near future.

8.3. Supporting Documentation

Documentation or “metadata” has to be incorporated into all deliverables. Programmatic deliverables as a result of the vital signs monitoring will have documentation incorporated into the development process to the extent applicable (see documentation SOPs for both spatial and non-spatial). Non-programmatic data that is reviewed and determined adequate, will be checked for associated documentation to be revised or documentation added prior to being incorporated into the program. The management section below and associated SOPs appropriate to the documentation of data and information are identified, as well as other pertinent SOPs.

8.3.1. Digital Image Metadata Standards

All MOJN images will be documented with appropriate metadata as outlined in the NPS Digital Photo Metadata Standards, version 1.00 (NPS Digital Photo Metadata Standards and Review Team 2006). Minimum metadata standards for MOJN are:

7. *Title* - who or what is in the photo, very descriptive

8. *Image Content Place* – where the photo was taken
9. *Image Date* – when the photo was taken
10. *NPS Unit Alpha Code* – Park unit code (Table 4)
11. *Access Constraints* – who may view the record/photo (e.g. public, staff only)
12. *Constraints Information* – explanation of restrictions, if any, on access/use of the photo or the metadata
13. *Contact Information* - how to contact NPS for further information

8.3.2. Extensis

Extensis is the preferred software package to extract, edit, embed, and, if needed, generate a companion (i.e. sidecar) Extensible Metadata Platform (XMP) metadata file. Extensis must be used to extract and create metadata for protocol data photos and special photos such as voucher photos. Extensis metadata is accessible through the catalog database in Extensis (see next section) as well as embedded in the photo file. Embedded metadata ensures that regardless of how the photo is transported or if it is renamed, the metadata will be retained with the photo. Embedded metadata is in the standard XMP tags, including Dublin Core elements, and EXIF standard and geospatial tags, and can also be aliased to other schemas such as IPTC metadata tags for readable across software platforms and packages. Features of Extensis cataloging and metadata creation are:

1. XMP, based on Dublin Core elements, and IPTC metadata elements editing
2. Ability to generate template metadata
3. Automatically apply metadata to photos moved into a ‘watched’ folder
4. Ability to generate master keyword lists for the metadata and catalogs, a quality control measure
5. Ability to generate pre-defined lists for metadata fields, a quality control measure
6. Embed metadata to the photo
7. Add and embed geospatial coordinates metadata
8. Catalog photos and PDFs in one or more catalogs

MOJN Photo Wizard will automatically generate sidecar custom XMP metadata during the file renaming process and it will embed the metadata in custom XMP tags.

8.3.3. Privacy and Sensitive Photo Information

For privacy and sensitive information, MOJN follows the policies and guidelines documented in NPS Focus Policy on Publishing Digital Resources to the Web (NPS Digital Library Program

2005) concerning intellectual property rights, privacy rights, and sensitive information content of all digital camera photos. The guidelines suggest:

1. *If the resource was NOT created by an NPS employee on work time*, refer to “Section I. Intellectual property rights: copyright and ownership of digital images, texts, drawings, etc.”
2. *If the resource shows the recognizable face of a living person who is not an NPS employee on work time*, refer to “Section II. Privacy rights: Digital images, etc. that display the recognizable face of a living person”
3. *If the resource reveals information that is considered “sensitive”*, refer to “Section III. Sensitive information: Digital images, texts, etc. that contain sensitive information” such as the locations of caves, wells, Indian burial grounds, archeological sites, endangered species, or specific features of buildings such as ventilation, etc.

8.3.4. Management Sections and Recommended SOPs

- A. Applications Management
 - a. Evidence Mining and Datasets SOP
 - b. NRInfo References SOP
- B. Communications Management
 - a. Documentation Non-Spatial SOP
- C. Geospatial Management
 - a. Documentation Spatial SOP
 - b. Biological Data Profile SOP
 - c. NPS Metadata Tools and Editor SOP
- D. Project Management
 - a. Project Deliverables SOP

9. Data Ownership and Sharing

Ownership and sensitivity are the two major factors in the determination in the sharing of data and/or information. This chapter outlines the approval for data and information distribution (sharing) to the National Park Service, cooperators, and the public. This applies to all datasets, models, analysis, graphs, presentations, and their release in any format (via the web based

internet or intranet, emailing electronic copies, providing printed materials, optical media, verbal descriptions, or any other form).

For the purposes of releasing data, the term *sharing* means releasing to an individual or entity upon request or as part of an agreement to do work that benefits the parks. The term *dissemination* (as well as *distribution*) includes releases to the public via publications or other standard routes of delivery such as the NPS NRInfo References. Chapter 10 provides detailed standards and guidelines for data dissemination. Guidelines for data sharing, including sensitive data procedures, are described in this chapter.

9.1. Objectives

- Establish clear guidelines for the ownership and sharing of natural resources data and information.

9.2. Scope

The network staff and cooperators will follow all applicable Freedom of Information Act (FOIA), Indian Sacred Sites (Executive Order No. 13007), National Parks Omnibus Management Act, National Historic Preservation Act, Federal Cave Resources Protection Act, Archaeological Resources Protection Act and all other pertinent guidance and policies (National Park Service 2008). Data and Information that is protected includes but is not limited to:

- Geological and geophysical information and data concerning wells;
- The nature and specific location of (a) endangered, threatened, rare, or commercially valuable species, (b) minerals or paleontological objects, or (c) objects of cultural patrimony;
- The nature and location of any archaeological resource for which the excavation or removal requires a permit or other permission; and
- The specific location of any significant caves.

Each cooperative or interagency agreement or contract will include a list of deliverables and products clearly defined within each agreement or contract (or have the appropriate network SOPs as attachments). This will include the details on formatting and media types that are required for final submission. Agreements and contracts will list all products expected to result from the project. These include, but are not limited to, field notebooks, photographs (hardcopy and digital), specimens, raw data, databases, and reports.

Data and information will be shared internally through Network channels, externally through online databases and repositories, and by special request as appropriate, and only after quality control procedures have been fully implemented.

9.3. Supporting Documentation

The communications management section has three particular SOPs that are primarily applicable to data sharing (data and information, and records distribution) and ownership (sensitive data and

information). A number of other SOPs relative to data ownership and sharing apply, as listed below. Data in this instance also applies to all photographs and digital images.

9.3.1. Management Sections and Recommended SOPs

- A. Communication Management
 - a. Data and Information Distribution SOP
 - b. Records Distribution SOP
 - c. Documentation Non-Spatial SOP
 - d. Sensitive Data and Information SOP
 - e. Web Management SOP
 - f. Image Management SOP
- B. Applications Management
 - a. NRInfo NPSpecies SOP
 - b. NRInfo References SOP
- C. Geospatial Management
 - a. Documentation Spatial SOP
- D. Staff and Resources Management
 - a. Roles and Responsibilities SOP
- E. Quality Management
 - a. Electronic Storage, Backup, and Recovery SOP

10. Data Dissemination

Under the terms of Freedom of Information Act (5 U.S.C. § 552), public agencies must make non-protected data and information (described in Chapter 9) available for inspection and copying in public reading rooms, the Internet, or via requests through a specified process. Providing well-documented data in a timely manner is one of the most important goals of the I&M program, and critical to the success of the program. This chapter describes the methods by which quality natural resource data and information collected by the Network are made available to park managers, researchers, educators, and the general public.

10.1. Objectives

- Ensure non-sensitive data are easily discoverable and obtainable.
- Ensure data that have not yet been subjected to full quality control are not released to the public, unless necessary in response to a FOIA request.
- Distribute data with complete and accurate metadata that clearly identify who collected the data, what data were collected, and where, when and how the data were collected.

10.2. Scope

This chapter applies to all internally collected data or MOJN I&M funded data collection and provides for the distribution of the data and any subsequent information materials. Internally collected data refers to all data collected by; MOJN I&M staff (permanent, term, temporary, interns, and/or volunteers), or park staff collecting data directly for a MOJN vital signs monitoring protocol or inventory. MOJN funded data collection refers to non-NPS personnel funded with MOJN I&M funds to collect data for a MOJN vital signs monitoring protocol or inventory.

Chapter 8 states that the project staff will, when appropriate, upload dataset to the NPS NRInfo. Chapter 11 provides that project staff will collaborate with the park identified curation staff with regards to all voucher specimens collected in conjunction with the network protocols. Informational products will be documented by the authors into the appropriate applications (e.g. NRInfo References) and images or photographs will be submitted to the network's image management schema for integration with the appropriate metadata.

The network is developing an Image Management Schema (IMS) to address documentation, storage and retrieval, and the dissemination of digital images created as a result of protocol implementation. This will be provided in an IMS SOP with completed. In conjunction with the network's IMS, the network is collaborating with the service-wide redesign of NPS Focus and will integrate the new procedures as they become available.

All reports, articles, and subsequent written materials developed from the network's vital sign monitoring will be recorded in NRInfo References according to the appropriate SOP. All written materials will also be made available through the appropriate web site based upon their ownership and sensitivity.

10.3. Supporting Documentation

There are a number of SOPs and management sections that contain guidance and specifications on how the MOJN will implement the dissemination/distribution of vital signs monitoring products (e.g. data, information, and reports). The communications management section contains a number of applicable SOPs (see subsection 10.3.1), however several other management sections contain SOPs that also apply.

10.3.1. Management Sections and Recommended SOPs

A. Communication Management

- a. Data and Information Distribution SOP
 - b. Records Distribution SOP
 - c. Sensitive Data and Information SOP
 - d. Documentation Non-Spatial SOP
 - e. Web Management SOP
 - f. Image Management SOP
- B. Applications Management
- a. NRInfo References SOP
 - b. NRInfo NPSpecies SOP
- C. Staff and Resources Management
- a. Roles and Responsibilities SOP
- D. Geospatial Management
- a. Documentation Spatial SOP
- E. Quality Management
- a. Electronic Storage, Backup, and Recovery SOP

11. Records Management and Object Curation

Documenting park resources and their management is an essential part of National Park Service administration. The potential for loss of data, documents, or objects can come from a variety of sources, including catastrophic events (e.g., fire, flood, and earthquake), user error, hardware failure, software failure or data corruption, theft, and intentional acts of vandalism.

This chapter also provides guidelines and standards for the curation of natural history specimens and other non-record objects. Such collections, and their associated records, are by definition museum objects, but have much in common with resource management records.

11.1. Objectives

- Adopt and implement robust standard file directory structure specifications.
- Where practical, maintain *mission critical* and *permanent* paper records in both hardcopy and electronic file format, and protect and preserve them indefinitely.
- Maintain datasets no more than two versions behind current software versions, or store in American Standard Code for Information Interchange (ASCII) format, complete with data and file documentation.
- Ensure information can be easily obtained, shared, and properly interpreted by a broad range of users.
- Ensure backup, storage, and recovery practices for electronic files equal or exceed the minimum standards established by the NPS Office of Chief Information Officer.
- Store all electronic files on servers in a networked environment using approved file-naming standards and file directory structures.
- Maintain all data, programmatic, and administrative electronic files indefinitely.

11.2. Scope

The responsibility for the preservation of park records begins with each employee and thorough implementation of effective best practices is crucial to ensuring long-term preservation and accessibility of park records. Network data management staff will collaborate with the park curation and archive staff to integrate our procedures with theirs. The network has a standalone version of the new ANCS+ rediscovery software that we populate our voucher data into and submit the records to the appropriate park curation staff for review and integration as they deem appropriate.

11.3. Archiving

An archive is a collection of data and documents assembled and stored for long term safe-keeping. Original data files, separate from archived data, may be maintained, stored, and accessed elsewhere on a regular basis.

A majority of the information is drawn from the Archival Strategy for Inventory Projects Records (Palmer and Heister 2005). Although Palmer and Heister (2005) address only inventory products, many of the standards are applicable to the products produced in conjunction with monitoring projects.

The MOJN archiving strategy incorporates records management standards from three sources:

1. NPS Director's Order 19: Records Management (2001) and, NPS Records Disposition Schedule (NPS-19, Appendix B, revised 5-2003)

- a. This publication provides direction for managing many types of materials. NPS 19 states that records of all natural and cultural resources and their management are considered mission-critical records. Mission-critical records are considered permanent records that will eventually become archival (Palmer and Heister 2005). NPS-19 also provides guidelines for managing natural resource related records and specifically addresses products associated with I&M projects.
2. Park Unit Standards
 - a. Each park unit has its own direction for managing museum collections as described in each collection facilities “Scope of Collection Statement”. All materials housed in a park collection facility are to be cataloged in Automated National Catalog System (ANCS+). Voucher specimen data cataloged in NPSpecies can be exported to ANCS+. See MOJN Data and Information Management (DM) *SOP NPSpecies*.
 - b. The NPS Museum Handbook provides the overarching guidance for managing museum collections including park records and archives (Palmer and Heister 2005).
3. Network Standards
 - a. The NPS Inventory & Monitoring program generated a Network guidance document for Data Management which includes a section on archiving standards and procedures (National Park Service 2008).

MOJN will adhere to these standards and manage data files according to the procedures presented in this document.

MOJN has adopted MS Access as its database standard and ESRI ArcGIS as its spatial data management standard. MOJN will remain current and compatible with NPS or national I&M version standards for these software programs. Due to the changing nature of computer software it is necessary that those digital data archives be periodically migrated to a more current software platform or version, e.g. Access 2003 to Access 2007. MOJN will maintain digital datasets within two versions of the current software platform (MOJN-NPS DIMP 2007)

All digital data acquired and derived are archived annually according to the procedures and standards in NPS National Data Management Plan (2008) and MOJN Data and Information Management Plan (MOJN-NPS 2007).

The archive files are organized and maintained in a consistent annual folder structure for easy access. The folder is compressed to a zip file, and stored on the Network drive that is backed-up according to Lake Mead IT procedures. The MOJN shared network drive is maintained by Lake Mead National Recreation Area IT department, which is responsible for proper back-up procedures, restoration in the case of system failure, and archive retrieval according to NPS policies.

MOJN has a digital archive folder on the N: drive for annual upload of project files/data. The network does not have a secure hard copy storage space at this time, so files are stored in file cabinets in the front mail room. Network offices must have designated storage space for all hard

copy records not being archived at a park. Adequate Network digital storage space must be available for housing the digital archive, especially digital photographs which require a large amount of digital storage space.

11.3.1. Types of Archiving Materials

There are two types of materials that the MOJN will be responsible for with regards to archiving:

- Hard Copy Records – printed hard copy such as field data sheets, reports, posters
- Digital Records – tabular and geospatial data, digital photographic images

Each of these is addressed in the Data Management SOP Archiving.

11.4. Image Management

11.4.1. Useful Image Management Links

Resource Information Management, Image Management library, available at:

<http://portal.nps.gov:46840/RIM/DIM/Library/Image%20Management/>

[I&M Guidance documents \(use with caution as many documents are not up to date\):](http://www1.nrintra.nps.gov/im/datamgmt/guidance/index.cfm#photo)

<http://www1.nrintra.nps.gov/im/datamgmt/guidance/index.cfm#photo>

The Digital Information Management (DIM) listserv:

This listserv is intended to provide a forum for NPS staff and cooperators to discuss information management issues and strategies. Subscribe to this listserv if you are responsible for managing metadata, digital images, digital documents and/or other digital content and are interested in connecting/communicating with other digital information managers. To subscribe to the DIM Listserv send an email to majordomo@webmail.itc.nps.gov with the following as the body of the message: **subscribe dim**. Instructions for sending messages to and unsubscribing from the listservs are included in the footer of each message received from the listservs.

Records Management:

<http://inside.nps.gov/regions/custommenu.cfm?lv=3&rgn=1306&id=9270>

[NPS Focus is a Digital Library and Research Station that offers one-stop searching gateway for NPS and related non-NPS databases, and a Service-wide digital image/resource management solution, available at:](http://npsfocus.nps.gov/)

<http://npsfocus.nps.gov/>

11.4.2. Image Management Workflow

. The workflow details the photo life cycle within a project, with the initial but critical step of establishing a framework for the photo workspace. (Figure 1) The framework provides the structure for processing and storing the digital photos. Common decision points are listed in Table 7 (SWAN and SEAN 2004).

Table 7. Potential decision points and the questions that this SOP attempts to address.

Action	Questions	
Download	Where? For how long? Folder naming standards?	
Review	With which software?	
Edit	Which software? Should you write over the master or make a copy?	
Rename	Manually or batch? Naming standards?	
Organize	Folders? How? Where? Most efficient method?	
Metadata	Which attributes should be documented? How is the documentation 'attached' to the photo?	
Catalog	How and with what software? How do I find photos?	
Data Photos	How are protocol data photos handled?	
Storage	On-line storage	Where? Managed by whom? For how long?
	Off-line storage	Where and when? When to delete?
Archiving	Where and when?	

The details are provided in the following section of this document. The overall general workflow is (Figure 1):

4. Download the photos to the Originals workspace where the digital photos will be archived in an unaltered format
5. Scan the field Photo log and place a version with original photo files
6. Run the digital photos in Originals through Photo Wizard and locate processed digital photos to the appropriate queue folders
 - a. Review the photos and discard duplicate, fuzzy or immaterial ones while using Photo Wizard
 - b. Determine if photos are data, library, special collections, or miscellaneous photos prior to moving to the queue folder
7. Edit photos, i.e. rotate, crop, etc. in the queue folder
8. Rename data photos
9. Relocate to the appropriate folders for long term storage
10. Add photos to Extensis catalog and generate metadata for data photos
11. Link data photos to the appropriate data in the Master database
12. When queue folders are empty, delete folders, typically during end-of-season closeout
13. Disseminate and archive photos

11.5. Supporting Documentation

The Records and Objects Management is the primary section that applies, however SOPs related to other management sections have limited applicability (e.g. image management), see the next subsection 11.3.1 for further information.

11.5.1. Management Sections and Recommended SOPs

- A. Records and Object Management
 - a. Archiving SOP
 - b. Digitizing Information and Photographs SOP
 - c. Specimen and Voucher Guidance SOP
- B. Applications Management
 - a. Evidence Mining and Datasets SOP
 - b. NRInfo References SOP
- C. Communications Management
 - a. Documentation Non-Spatial SOP
 - b. Image Management Schema SOP
 - c. Web Management SOP
- D. Quality Management
 - a. Electronic Storage, Backup, and Recovery SOP
 - b. Archiving SOP
- E. Project Management
 - a. Project Deliverables SOP
- F. Geospatial Management
 - a. Mobile GIS SOP
 - b. Directory Structure Spatial SOP
- G. Nomenclature Management
 - a. Directory Structure SOP

12. Project Tracking and Documentation

Develop and implement a comprehensive and cohesive procedure for tracking I&M projects*, including project status, data, and the products of analysis to support program coordination and annual reporting, and to improve accountability for Network natural resource inventory and monitoring efforts and products.

* so as to maintain our network's data and information management program in a Project Management Institute context that a "project is unique and temporary", we chose to identify each year or season of data and information as project, and each annual project is then one component of the overall network's monitoring program.

12.1. Objectives

- Adopt and implement well organized standard project directory structure specifications
- Develop and implement a mechanism for tracking projects

12.2. Scope

All project electronic files must be well organized; the MOJN digital directory structure is organized at the project level, such that most or all digital files associated with a project are filed under a common root directory. Project file names will adhere to the naming conventions established for the network (see subsection 12.3.2). Physical objects acquired as part of a project will be stored according to specification in Chapter 11 and its appendices.

Project-specific protocol narratives and SOPs are the principle means by which I&M projects will be documented. Standards for these documents have been developed by the national I&M Program (National Park Service 2008) and are discussed for the MOJN in Chung-MacCoubrey et al. (2008). These documents must always accompany the distribution of monitoring data.

Project tracking has not been discussed by network staff at this juncture to come to a consensus as to what tracking software or database will be implemented. As the network progresses towards full implementation of the protocols these and other relevant subjects will be discussed and modes of execution identified. Several potential possibilities are MS Project or ThinkingRock. It will be necessary to address a number of considerations; how and what mechanisms for deployment, levels of access and privileges, ability and frequency of update, etc.

12.3. Supporting Documentation

The project management section and its related SOPs provide guidance and specifications for how the MOJN will implement project tracking and documentation. There are SOPs in other management sections are also applicable, see the next subsection 12.3.1 for further information.

12.3.1. Management Sections and Recommended SOPs

- A. Project Management
 - a. Project Scheduling and Tracking SOP
 - b. Project Life Cycle and Workflow SOP

- c. Data Life Cycle SOP
 - d. Project Deliverables SOP
- B. Nomenclature Management
- a. Protocol Naming Conventions SOP
 - b. Directory Structure Non-Spatial SOP
- C. Geospatial Management
- a. Directory Structure Spatial SOP

13. Implementation

The data management plans for each of the 32 I&M Networks are the first comprehensive documents of their kind in the NPS and contain practices that may be new to staff and cooperators. However, almost every requirement stems from federal law, Executive Orders, Director's Orders, or national I&M Program guidance. The DMP helps put these requirements into context, and provides operational guidance for achieving them.

13.1. Objectives

- Acceptance and understanding by all staff of targeted programs and their cooperators of the fundamentals of data and information management
- Improvement of data management practices by implementing standards, integration into field studies, and improved quality control practices
- Inclusion of data and information management consistent with the data management plan in all protocols developed

13.2. Scope

Full implementation of this plan by the MOJN I&M Program is expected to be achieved by 2010-11. Implementation at the broader park level is expected to be an ongoing process and will most likely occur in stages. Realistically, it will not be possible for all programs to fully adopt the practices and procedures recommended without an increase in current levels of funding and staff support. Currently, none of the network park resource divisions have a data manager on staff, although a number of park within the network have identified GIS staff that are recognized as the park level data management experts. Programs wishing to participate need to identify those areas that can be implemented given existing resources. For example, it is relatively easy for programs to begin implementing standards and guidelines for organizing and managing electronic files, including digital photos. Pragmatism should dictate prioritization and implementation. Critically important to successful implementation at the broader park level will be the active support of park resource management teams.

The network data manager will, on a case-by-case basis as requested by parks, provide assistance, guidance, and recommendations for the implementation of data and information. Otherwise various trainings and other educational opportunities will be provided to network and park staff on documentation, metadata, databases, applications (I&M tools), and other areas as requested.

13.3. Supporting Documentation

All of the management sections and their associated SOPS are written as guidance and specifications documents on how the MOJN will implement its data and information plan. However it would be to no benefit to simply list them all but to list those that are clearly applicable to the implementation of data and information management (see subsection 13.3.1).

13.3.1. Management Sections and Recommended SOPS

- A. Applications Management
 - a. NRInfo SOP
 - b. NRInfo References SOP
 - c. NRInfo NPSpecies SOP
 - d. Natural Resources Database Template SOP
 - e. Evidence Mining and Datasets SOP
- B. Communications Management
 - a. Documentation Non-Spatial SOP
 - b. Image Management SOP
- C. Geospatial Management
 - a. NPS Metadata Tools and Editor SOP
 - b. Documentation Spatial SOP
 - c. Biological Data Profile SOP

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15. Supporting Documentation

There are a number of standard operating procedures (SOPs) involved with data and information management for the MOJN. As stated in the introduction to this plan, the network plan is the link between the national guidance document and the SOPs or implementation steps to network data and information management (Figure 8). The network’s SOPs have been grouped into management sections (Figure 2), each management section containing SOPs of related subject matter. Table 4 provides a catalog of the management sections and their associated SOPs.

SOPs can be categorized into two general areas; specifications and guidance. Specifications are those which have to be followed for minimum data management and guidance are those that should be followed for a high-quality level of data management. Refer to Table 4 to find what management section or associated SOPs apply.

The MOJN has numerous individual SOPs on guidance, standards, and specifications related to the various tasks and activities associated with data and information management. To assist in the process of determining which SOP(s) are relevant, Figure 16 below provides a general overview of tasks and activities divided into three categories; organizational, data, and spatial.

Organizational tasks and activities generally fall into those general or “house-keeping” operational needs such as file and folder naming conventions, directory structures, computer hardware, property management, storage, backup, and archiving of data/records/information, etc... The data category concerns all aspects related to data, and in particular tabular data, such as field/laboratory collection, database design and development, quality control and assurance, statistical and graphic information for data. The spatial category is much the same as the data category except it is specific to GIS types of data and other related type activities. Each of these categories is further arranged into associated SOPs in figures 17-19.

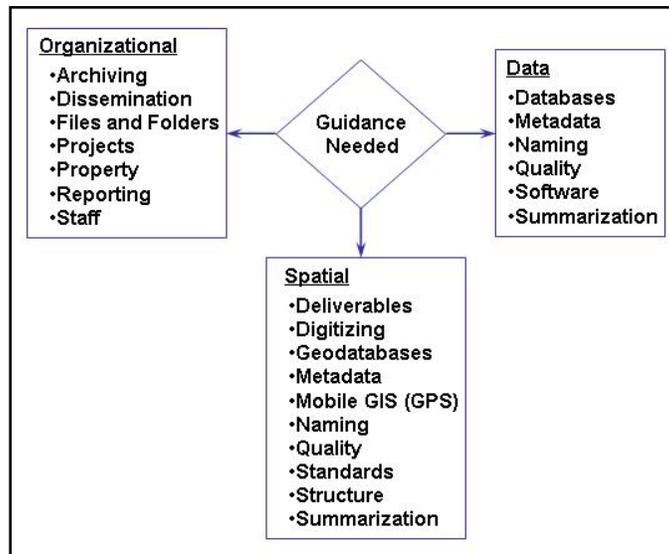


Figure 16. Guidance Assistance Decision Tree

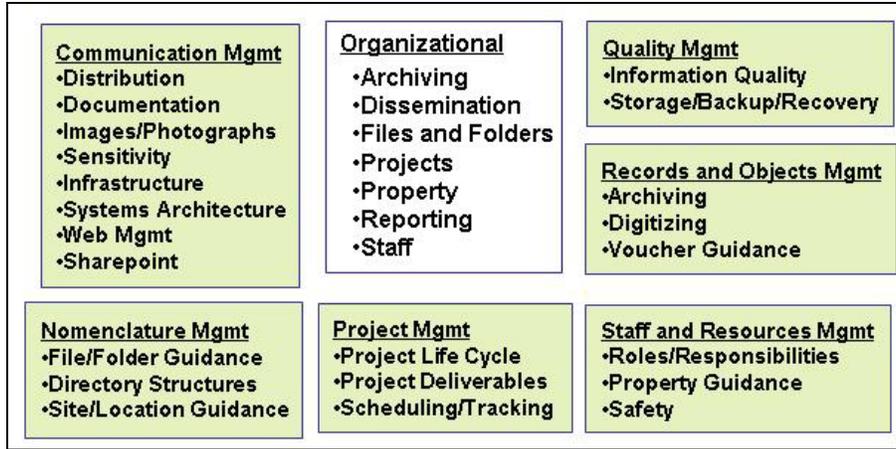


Figure 17. SOPs relevant to Organizational tasks and activities

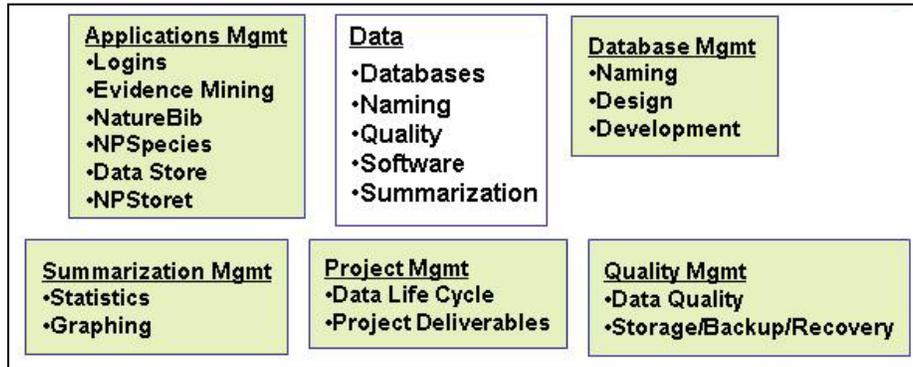


Figure 18. SOPs relevant to tabular data

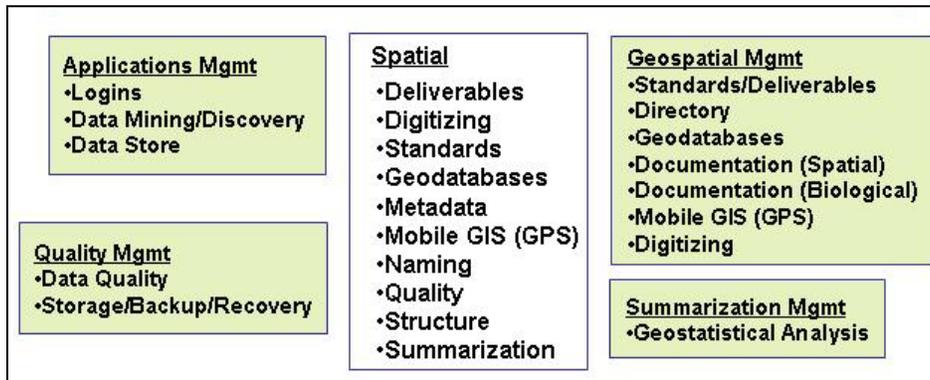


Figure 19. SOPs relevant to spatial data

Table 8. MOJN SOPs and their development status

Mgmt Section/SOPs	Development Status
Applications Management	
Login Requests and Maintenance	In Progress
Evidence Mining and Datasets	In Progress
NRInfo	Planned
References	In Progress
NPSpecies	In Progress
NPStoret	Planned
Using Extensis	In Progress
Communications Management	
Data and Information Distribution	In Progress
Records Distribution	In Progress
Documentation Non-Spatial	Complete
Image Management	Complete
Sensitive Data and Information	Planned
MOJN Infrastructure	In Progress
MOJN Systems Architecture	In Progress
Network SharePoint	Planned
Web Management	In Progress
Database Management	
Database Naming Conventions	Complete
Natural Resources Database Template	Planned
Geospatial Management	
Directory Structure Spatial	In Progress
Geodatabases (GDB)	Planned
Documentation Spatial	Complete
Biological Data Profile	Complete
NPS Metadata Tools and Editor	Complete
Mobile GIS	Planned
Digitizing (Maps)	Planned
Nomenclature Management	
Protocol Naming Conventions	Complete
Directory Structure Non-Spatial	Complete
Establishing a Marker	Complete
Project Management	
Project Life Cycle and Workflow	In Progress
Data Life Cycle and Workflow	In Progress
Project Deliverables	Complete
Project Scheduling and Tracking	Planned
Directory Structure Non-Spatial	Complete
Season Closeout	Complete

Mgmt Section/SOPs	Development Status
Quality Management	
Data Quality	Complete
Information Quality	Planned
Electronic Storage, Backup, and Recovery	In Progress
Data Management Best Practices	Complete
Records and Objects Management	
Archiving	Complete
Digitizing Information and Photographs	Complete
Digitizing (Data)	In Progress
Specimen and Voucher Guidance	Planned
Core Site Data	Complete
Photo Log	Complete
Staff and Resources Management	
Roles and Responsibilities	Planned
Property Guidance	In Progress
Safety Guidance	In Progress
Summarization Management	
Graphing Data	Planned
Statistical Analysis (Tabular)	Planned
Geospatial Statistics	Planned
Protocol Specific SOPs	
Climate Data Acquisition	Planned

Completed = ready for technical review

In Progress = draft document in progress

Planned = planned for but need to progress on other aspects first (i.e. protocol development)

Change History

Version	Date	Revised By	Change Description	Justification
4.0	20080912	R.E. Truitt	Original Draft	
4.1	20100630	J. Burke	Formatting, update SOPs and status list	Formatted and edited for review

This table reflects changes to this document. Version numbers will be incremented by one (e.g., Version 1.3 to Version 2.0) each time there is a significant change in the process and/or changes are made that affect the interpretation of the data. Version numbers will be incremented after the decimal (e.g., Version 1.6 to Version 1.7...1.10...1.21) when there are changes to grammar, spelling, or formatting, or minor modifications in the process that do not affect the interpretation of the data.