



Data Quality Standards for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs

Natural Resource Report NPS/MOJN/NRR—2018/1819



ON THE COVER

Photograph of NPS biologist sampling desert spring water quality at Grapevine Spring (AZ)

Photograph courtesy of the National Park Service

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Mark Lehman, Sarah Wright, Jennifer Bailard

National Park Service
Mojave Desert Network Inventory and Monitoring Program
601 Nevada Highway
Boulder City, Nevada 89005

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Contents

	Page
Tables.....	iv
Abstract.....	v
Protocol Overview	1
Protocol Activities and Modules	1
Sampling Design	3
Data Quality Objectives.....	4
Literature Cited	10

Tables

	Page
Table 1. Protocol activity matrix for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs.	2
Table 2. Activity-level sample design matrix for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs.	3
Table 3. Data Quality Values (DQVs) for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs.	4
Table 4. Measurement Quality Objectives for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs.	6
Table 5. Taxonomic standards to be used for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs.	8
Table 6. Data Protection standards for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs.	9

Abstract

The purpose of this report is to document the standards, used by the Mojave Desert Network (MOJN) for activities related to the collection, processing, storage, analysis, and publication of monitoring data as described in Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs (Moret, 2018). The policies and procedures documented in this quality-assurance plan for these activities complement the quality-assurance plans for other monitoring activities conducted by the Mojave Desert Network and supplement the National Inventory & Monitoring Division Quality Management Plan. The plan also serves as a guide for all Mojave Desert Network personnel who are involved in protocol/program activities and as a resource for identifying memoranda, publications, and other literature that describe associated techniques and requirements in more detail.

Protocol Overview

The mission of the National Park Service (NPS) is “to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations” (NPS 1999). To uphold this goal, the Director of the NPS approved the Natural Resource Challenge to encourage national park units to focus on the preservation of the nation’s natural heritage through science, natural resource inventories, and expanded resource monitoring (NPS 1999). Through the Challenge, 270 parks in the national park system were organized into 32 inventory and monitoring networks. The Mojave Desert Network (MOJN) includes nine units of the National Park system: Castle Mountains National Monument (CAMO), Death Valley National Park (DEVA), Great Basin National Park (GRBA), Joshua Tree National Park (JOTR), Lake Mead National Recreation Area (LAKE), Manzanar National Historic Site (MANZ), Mojave National Preserve (MOJA), Grand Canyon-Parashant National Monument (PARA), and Tule Springs Fossil Beds National Monument (TUSK). Collectively, these parks comprise 3.3 million hectares or 9.7 percent of the total land area managed by NPS.

The MOJN Inventory and Monitoring Program (I&M) has identified 20 priority park vital signs, or indicators of ecosystem health, which represent a broad suite of ecological phenomena operating across multiple temporal and spatial scales. This protocol addresses four of these vital signs (Surface Water Dynamics, Surface Water Chemistry, Vegetation Change, and Invasive/Exotic Plants) in a statistical sample of the spring population in the five large desert parks (DEVA, JOTR, LAKE, MOJA, and PARA). Monitoring of high priority springs chosen by park managers (the MOJN I&M Water Quality and Quantity Monitoring at Selected Large Springs protocol, Moret et al. 2016) and monitoring of streams and lakes (the MOJN I&M Streams and Lakes protocol, Caudill et al. 2012) are addressed in a separate set of protocols. The data collected for this protocol will be used to monitor the following measurable (quantitative) objectives:

- Determine the status and trends of water availability (flow condition, discharge, and surface water dimensions) at a subsample of springs in each of the five monitored parks.
- Determine the status and trends of water quality (temperature, pH, dissolved oxygen, and specific conductance) at a subsample of springs in each of the five monitored parks.

Additional qualitative site condition information will be collected at springs including dominant vegetation, invasive plants, disturbance, and repeat photographs.

Water quality measurements and observations of spring vegetation and site condition will be made at the time the site is visited. A subset of springs will be equipped with humidity sensors to provide a continuous record of the presence and absence of water.

Protocol Activities and Modules

Data are collected or derived as a part of Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs (Moret, 2018) in four different activities or modules (Table 1).

Table 1. Protocol activity matrix for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs (Moret, 2018).

Category	Activity Number	Activity	Description
Site Recon, Establishment, and Maintenance	1	Site Acceptance	Assessment of the ability to monitor this site during this field season and as part of the long-term monitoring panel
Field Observations	2	Site Classification and Condition	Spring classification, evidence of wildlife presence, and assessment of natural and anthropogenic disturbance (SOP 4, SOP 10)
	3	Water Availability	Flow condition; channel dimensions and characteristics (SOP 5)
	4	Spring Vegetation	Life form, dominant species, and presence of mistletoe (SOP 8)
	5	Invasive Plants	Species and location of invasive plants (SOP 9)
Sensor Data	6	Core Water Quality Parameters	Collection of discrete measurements of the four “core” water quality parameters (pH, dissolved oxygen, specific conductance, and temperature) using a handheld multi-probe (SOP 7).
	7	Continuous Humidity & Temperature	Collection of continuous temperature and humidity data using iButton humidity sensors as proxy for presence of water (SOP 6)
	8	Photographs	Repeat site photos, photos of dominant plant species within each life form category, and photos of all invasive plant species. GPS coordinates of repeat site photopoints are always recorded; GPS coordinates of invasive plants are recorded if the plant is outside the buffer zone. Repeat site photos primarily used to assist with relocation of humidity sensors. Vegetation photos used to confirm field crew plant ID (SOP 11)
Quality Control Data	9	Water Quality data correction/qualification	Calibration of specific conductance, dissolved oxygen, and pH. Qualification based on post-calibration data.

Sampling Design

Information regarding the sampling design is provided in Table 2.

Table 2. Activity-level sample design matrix for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs (Moret, 2018).

Category	Activity Number	Activity	Sampling Design	Revisit Design
Field Observations	2	Site Classification and Condition	Probability ¹	Rotating Panels ²
	3	Water Availability	Probability ¹	Rotating Panels ²
	4	Spring Vegetation	Probability ¹	Rotating Panels ²
	5	Invasive Plants	Probability ¹	Rotating Panels ²
Sensor Data	6	Core Water Quality Parameters	Probability ¹	Rotating Panels ²
	7	Continuous Humidity & Temperature	Probability ¹	Continuous ³
	8	Photographs	Probability ¹	Rotating Panels ²

¹ GRTS-based sample of all locations w/in park. Black Canyon springs in LAKE have separate GRTS draw due to accessibility uncertainty.

² [(1-0), (1-2)] 60 annual sites, 188 triennial sites.

³ 4 hour interval.

Data Quality Objectives

Data quality values and standards for implementation are provided in Table 3 through 6.

Table 3. Data Quality Values (DQVs) for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs (Moret, 2018).

Category	Data Quality Value	Definition	Protocol Considerations
Intrinsic Data Quality	Accuracy	Measurements reflect the true value of the parameter being observed. This applies to measures (length, width, position) or classes (species, types, or categories). Includes components of precision and bias.	Accuracy of class data is achieved by training field crew personnel in all standard operating procedures and basic plant identification at the beginning of each field season as well as by using expert resources, such as botanists, when available. The accuracy of water quality data is ensured by adhering to Water Resources Division (WRD) standards (unpublished) for instrument specifications, staff training, and by following USGS methods (Wagner et al. 2006) for calibration and measurement in the field
	Representativeness	Measurements represent conditions at the time of sampling. Combined with accuracy, leads to repeatable data collection.	Representativeness was achieved by doing a GRTS draw for each park from a sample frame of all representative springs excluding those included in the MOJN Selected Large Springs protocol, heavily used recreational springs, and those periodically inundated by water released from the Hoover Dam.
Contextual Data Quality	Comparability	The degree to which data can be compared among sample locations, data sources, or periods of time.	Data comparability is ensured through time, even when sensors, instruments, and staff change occur by following the guidelines laid out in SOP 1 for staff training and field methods. Comparability is further enhanced by employing USGS guidelines for calibration frequency and field methodology (SOP 7).
	Timeliness / Currency	How recent the data need to be to be considered valid for their intended use. Data represents conditions and/or is available and in a format for use at the appropriate time in the decision-making process.	Certification of data occurs on an annual basis. Where certified data cannot be provided for resource management decisions in a timely manner, requirements for provisional use of data are defined and documented prior to data dissemination and use.

Table 3 (continued). Data Quality Values (DQVs) for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs (Moret, 2018).

Category	Data Quality Value	Definition	Protocol Considerations
Contextual Data Quality (continued)	Completeness	All data/ measures required to evaluate accuracy and representativeness are present; incomplete data sets (either at a location, across sampling locations, or over time) lose utility or relevance. Data records contain values as planned across the period of record.	Road washouts or security concerns may occasionally prevent access to a site in a given year. Any site that is deemed permanently unsuitable for monitoring will be permanently replaced by the next site in the GRTS draw. Every effort will be made to achieve 100% completion of data collection at all visited sites. A high attrition rate is expected with the iButton sensors and the long-term efficacy of this technology will continue to be assessed.
Representational Data Quality	Consistent Representation	Use of standard definitions when describing data quality or resource quality based on data.	The Data Processing Level of all data will be tracked using the nomenclature described in “Certification Guidelines for Inventory and Monitoring Data Products” (2016). The protected status of data will be tracked using the nomenclature described in “Minimum Implementation Standards for Network Projects Version 1.1” (2016).
Data Accessibility	Secure	Access to data, products, and systems limited to appropriate audiences.	MOJN will identify and ensure that potentially protected data, including sensitive species location data, sensitive spring locations, and other data as protected by DO#66 are not released to the public. Protected data may be released in limited cases only with park Superintendent approval following park procedures. For protected data, MOJN will collaborate with parks to determine the appropriate method of redaction.

Table 4. Measurement Quality Objectives for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs (Moret, 2018).

Measure	Quality Indicator	Quality Objective
Site Acceptance	Location Accuracy	Sample location within +/- 10m of established waypoint.
	Location Range	All UTM locations associated with this protocol, regardless of UTM Zone, will fall in the following ranges Easting (X): >200,000 and <900,000 and Northing (Y): >3,500,000 and <4,350,000.
	Location Description Detail	Description provided with enough detail to relocate the site from a known location in the park such as an intersection or permanent, well-marked parking location without use of GPS equipment. Description includes permanent landmarks and does not rely on features that may be moved or destroyed by flood, fire, etc.
	Acceptance/Rejection Status	Enough detail provided in notes to confirm that acceptance/rejection determination was correct. Photos should be taken of rejected locations if it is safe to do so.
Site Classification and Condition	Spring Type Accuracy	Field crew reaches a consensus on spring type. Spring type is consistent across monitoring years.
	Consistent Spring Type ID	Spring type is determined using the “sphere of discharge” classifications described by Springer and Stevens (2009).
	Disturbance Accuracy	Field crew consensus on disturbance classes.
	Disturbance Range	Valid data values range from 0 to 4.
	Wildlife Accuracy	100% accuracy for broad category ID.
	Wildlife Taxonomic Resolution	Identified to one of the following broad categories: Mammal, Bird, Amphibian, Fish, Aquatic Invertebrate, Terrestrial Invertebrate, Other. More precise identifications are optional.
	Wildlife Completeness	Notable species recorded; not expected to be an exhaustive list.
Water Availability	Flow Condition	Field crew reaches consensus
	Measured Discharge Accuracy	At least five volumetric discharge measurements are collected. Measurements vary by at most 10% from the mean. Fill times are greater than 10 seconds. If the first five measurements do not meet these quality objectives, collect additional measurements until they agree.
	Estimated Discharge Accuracy	Field crew reaches consensus on estimated discharge and describes flow condition in detail. Precise to order of magnitude.
	Channel Length Accuracy	± 10% for channels <50m
	Channel Width Accuracy	± 10%
Spring Vegetation	Spring Vegetation Taxonomic Resolution	Identifications made to lifeform class; species level identifications are only recorded if they can be confidently identified, otherwise recorded as unknown.
	Spring Vegetation Identification Accuracy	95% accuracy for lifeform class. All species level identifications should include corroborating evidence such as photographs.

Table 4 (continued). Measurement Quality Objectives for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs (Moret, 2018).

Measure	Quality Indicator	Quality Objective
Invasive Plants	Invasive Plants Taxonomic Resolution	Identifications made to the species level
	Invasive Plants Identification Accuracy	95% accuracy for visual observations
	Invasive Plants Identification Completeness	95% of observations made to species level
	Invasive Plants Distance accuracy	± 10m
Core Water Quality Parameters: pH	Units	standard pH units
	Accuracy	± 0.2 units
	Resolution	0.01 units
	Range	0 to 14 units
	Reporting	Report to one decimal place
	Calibration/Data Correction Criteria	± 0.2
Core Water Quality Parameters: Temperature	Units	degrees Celsius (°C)
	Accuracy	± 0.15°C
	Resolution	0.01°C
	Range	-5 to 50 °C
	Reporting	Report to one decimal place
	Calibration/Data Correction Criteria	± 0.2
Core Water Quality Parameters: Dissolved Oxygen	Units	milligrams per liter (mg/l)
	Accuracy	± 5%
	Resolution	± 5%
	Range	0 to 50 mg/l; 0 – 300 %
	Reporting	Report to one decimal place
	Calibration/Data Correction Criteria	± 0.3
Core Water Quality Parameters: Specific Conductance	Units	microsiemens per centimeter [$\mu\text{S}/\text{cm}$])
	Accuracy	0.5% within calibrated range
	Resolution	1 $\mu\text{S}/\text{cm}$
	Range	0 to 100,000 $\mu\text{S}/\text{cm}$
	Reporting	Report to whole number
	Calibration/Data Correction Criteria	± 5 or ± 3% of the measured value, which-ever is greater

Table 4 (continued). Measurement Quality Objectives for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs (Moret, 2018).

Measure	Quality Indicator	Quality Objective
Continuous Humidity & Temperature	Range	0 to 100% RH, -20 to +85 °C
	Accuracy	Device is being used outside manufacturer recommendations and should only be used to determine presence ($\geq 80\%$ RH)/absence ($< 80\%$ RH) of water. For this use, accuracy is 95% in a controlled environment.
	Resolution	0.001% RH, 0.001 °C
	Reporting	Report to one decimal place
Photographs	Image resolution	8 megapixel or greater
	Image format	JPEG w/ embedded EXIF metadata
	GPS accuracy	± 10 m

Table 5. Taxonomic standards to be used for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs (Moret, 2018).

Category	Activity Number	Activity	Standard to be Used	Reference / Authority
Collection of Observational Data	2	Wildlife	Scientific Publication	Integrated Taxonomic Information System (ITIS) (http://www.itis.gov)
	4	Spring Vegetation	Scientific Publication	The Jepson Desert Manual (2002)
	5	Invasive Plants	Scientific Publication	The Jepson Desert Manual (2002)
Reporting of Observational Data	2	Wildlife	Scientific Publication	Integrated Taxonomic Information System (ITIS) (http://www.itis.gov)
	4	Spring Vegetation	Scientific Publication	The Jepson Desert Manual (2002)
	5	Invasive Plants	Scientific Publication	The Jepson Desert Manual (2002)

Table 6. Data Protection standards for Springs in the Mojave Desert Network—Surface Water Monitoring at Desert Springs (Moret, 2018). With the exceptions noted, all data collected are to be made publicly available in a timely fashion.

Category	Type of Data	Level of Protection	Rules for Dissemination
Resource Data and Information	Federally listed T&E species locations	Legally Protected	Locations of observations reported at park centroid only.
Location Data and Information	Spring locations	Operationally protected	Provided to NPS personnel upon request. Shared outside NPS upon request and only with permission of park(s). Mapped only at coarse scale (1:100,000) in reports.
Personally Identifiable Information	Non-NPS Staff Information	Legally Protected	All but first name and last initial redacted from public release.

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1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525