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Standard Operating Procedure #17: Data Analysis and Reporting, Version SCPN_WATER_QUALITY_ SOP17_20160901

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Standard Operating Procedure #17: Data Analysis and Reporting

Version SCPN_Water_Quality_SOP17_20160901				
Revision History Log				
Previous version number	Revision date	Section and paragraph	Change(s) made	Approved by

Only changes in this specific SOP will be logged here. Record the previous version number and date of revision; identify sections and paragraphs where changes were made, who approved the revision, and the new version number. More detailed descriptions of the changes made and the reason for the changes is provided at the end of this SOP.

This Standard Operating Procedure (SOP) describes the steps required to gather, prepare and summarize hydrologic data for Southern Colorado Plateau Network (SCPN) parks, and provides guidelines for preparing annual summary reports.

1 Core parameter data

1.1 Data preparation

Much of the core parameter data will exist as text files obtained from a multiparameter sonde after each field visit. The sonde records data for temperature, pH, specific conductance, and dissolved oxygen every 5 seconds, thus it is possible to record hundreds of readings for every site visit. When transferring data to the SCPN database and to NPSTORET, only a subset of these readings will be selected (SOP #14). The subset will consist of the seven measurements that were taken closest to the actual sampling time. The median value of these measure-

ments will be presented in the water quality data summary reports.

Turbidity measurements are obtained from at least three subsamples from a single sample (SOP #5); the median of these measurements is reported. Discharge measurements are taken with a current meter.

1.2 Streamflow gages

When available, discharge data from established streamflow gages can be used to supplement direct measurements of streamflow made by SCPN staff during water quality sample collection. Discharge data obtained from streamflow gages have a high degree of accuracy. In addition, streamflow gages provide a hydrograph documenting discharge for time periods before and after sample collection. Gages are typically constructed on rivers with base flows of about 1 cfs or greater.

The stream gage should be located near the

water quality sample site, without significant inflow or withdrawal of water occurring between the sample site and gage.

1.2.1 Accessing streamflow gage data

Real-time streamflow gage data from streamflow gages operated by the USGS can be accessed at:

Arizona, <http://waterdata.usgs.gov/az/nwis/current/?type=flow>

Colorado, http://waterdata.usgs.gov/co/nwis/current/?type=flow&group_key=huc_cd

New Mexico, <http://waterdata.usgs.gov/nm/nwis/current/?type=flow>

Utah, <http://waterdata.usgs.gov/ut/nwis/current/?type=flow>

When real-time streamflow gage data is not available, contact the agency responsible for the gage to obtain provisional data. Active streamflow gages on streams in or near SCPN parks are listed in Table 17-1.

1.3 Reporting significant figures

Data for temperature, pH, specific conductance, and dissolved oxygen will be reported according to the guidelines in Gibbs et al. 2012 (Table 17-2). Data for turbidity will be reported according to Anderson 2005. Reporting data for discharge depends on the precision of the flow meter used.

2 Water chemistry data

2.1 Reporting

Water chemistry data from the accredited laboratory conducting analysis of water quality samples for SCPN (at the time of this writing, the USGS National Water Quality Laboratory, NWQL) which includes trace metals, major ions, and nutrients, is formatted to contain the appropriate number of significant figures. Prior to including the data in reports, all quality control samples (such as blanks and replicates) must be evaluated to determine whether any stream data needs to

Table 17-1. Active streamflow gages on streams in or near SCPN parks.

Park	Stream	Streamflow Gaging Station Name	Streamflow Gaging Station Site ID	Agency	Contact Info
BAND	Rito de los Frijoles	Rito de los Frijoles at the HQ gaging station	08313350	USGS	New Mexico Water Science Center 5338 Montgomery Blvd., NE, Suite 400 Albuquerque, NM 87109-1311 Phone: (505) 830-7900 http://nm.water.usgs.gov/about/office.html
GLCA	Paria River	Paria River near Kanab, UT	09381800	USGS	USGS Grand Canyon Monitoring and Research Center 2255 North Gemini Drive (Mail Stop 9394) Flagstaff, AZ 86001 Phone: 928.556.7380 http://www.gcmrc.gov/
GLCA	Escalante River	Escalante River Near Escalante, UT	09337500	USGS	USGS Utah Water Science Center Field Office 2390 W Hwy 56, Suite #4 Cedar City, UT 84721 Phone: (435) 586-4543 http://ut.water.usgs.gov/
GRCA	Bright Angel Creek	Bright Angel Creek near Grand Canyon, AZ	09403000	USGS	USGS Grand Canyon Monitoring and Research Center (see GLCA Paria River above)
MEVE	Mancos River	Mancos River at Anitas Flat below Mancos, CO	09370600	USGS	USGS Durango Field Office 103 Sheppard Drive, Suite 110 Durango, CO 81303 Phone: (970) 247-4140 http://co.water.usgs.gov/
PEFO	Puerco River	Puerco River near Chambers, AZ	09396100	USGS	Arizona Water Science Center Flagstaff Field Office (see CACH above)

Table 17-2. Water quality core parameters and reporting conventions

Core parameter	Reporting convention
Temperature	Nearest 0.1°C
pH	Nearest 0.1
Specific conductance	Three significant figures to the nearest whole number
Dissolved oxygen	Nearest 0.1 mg/L; report ">20 mg/L" for a DO measurement that exceeds 20 mg/L
Turbidity	0-10, to the nearest 0.1 NTU
	10-100, to the nearest 1 NTU
	>100, to the nearest 10 NTU
	≥1000, to the nearest 50 NTU
Discharge	All flow meters, nearest 0.1 cfs
	Baski flume, use rating table

be flagged or omitted from the data summary report. Data acceptance criteria for blanks and replicates are detailed in SOP 10.

2.2 Comparing data against water quality criteria

Most water quality criteria for trace metals are based on water hardness, which will need to be calculated prior to comparing results against water quality criteria. Water hardness is calculated by converting calcium and magnesium concentrations into milliequivalents per liter, adding them together, and multiplying the result by 50. The result is a value for hardness in terms of an equivalent concentration of calcium carbonate (Hem 1989).

SCPN will evaluate its monitoring results against the applicable water quality standards at each site, as defined by the relevant state or tribe. Because SCPN water samples are analyzed for dissolved parameters, only water criteria that apply to dissolved parameters will be used. The only exception will be if sample results exceed criteria that are expressed in terms of the total concentration of the analyte. In this case, the water quality exceedances will be reported. It is impractical to list all the water quality criteria that are applicable to each analyte in the data summary reports. Instead, only the most stringent criterion will be listed.

Numeric criteria for aquatic life water quality standards address potential effects of both chronic exposure to a parameter over an

extended period of time (months), and acute exposure over a short period of time (hours or days). The SCPN sampling regime is best suited to evaluate acute criteria because these criteria typically apply to a single sample. However, from a resource conservation standpoint, grab sample data can be compared to the more stringent chronic criteria to detect a problem that may require more attention. Therefore, SCPN will identify chronic exceedances in the annual reports.

2.3 Piper plots

To characterize water type by the proportions of major ions present, SCPN will construct Piper plots for each sample site using averages for major ions analyzed throughout the year. The ions used in constructing a piper plot will be calcium, magnesium, sodium, potassium, chloride, sulfate, and carbonate/bicarbonate. Concentrations for all ions but carbonate/bicarbonate will be obtained from the NWQL results. Concentrations of carbonate/bicarbonate are calculated from alkalinity (or acid neutralizing capacity); note that this assumes that carbonate/bicarbonates are the primary determinates of alkalinity, which is true for almost all natural waters (Hem 1989). At the pH values typical of SCPN parks, alkalinity is nearly entirely in the form of bicarbonate; very little carbonate is present. SCPN has a spreadsheet to calculate bicarbonate from alkalinity based on Hem 1989.

3 Bacteria data

Bacteria data are reported as whole numbers only, with up to two significant figures. If data are to be averaged together, geometric means will be used. This is because the amount of bacteria in streams tends to fluctuate widely. Geometric means dampen very high results so that they do not skew the overall mean.

4 Data summary reports

For each year that sampling occurs, reports will be produced to document monitoring activities that occurred and summarize all water quality data collected at each park. Water quality monitoring reports for network parks can be found on the SCPN website: <http://science.nature.nps.gov/im/units/scpn/publications.cfm?tab=2>

Data summary reports consist of the following main sections:

1. Introduction. This section includes the background, purpose, and objectives of the monitoring effort, park- or site-specific objectives, and report-specific objectives. Descriptions of stream and monitoring sites as well as a description of management concerns for aquatic resources in the park are included. New and ongoing park management activities with the potential to impact water quality, stream habitat, or macroinvertebrate communities at the monitoring site should be noted here.
2. Methods. This section includes a summary of monitoring activities conducted on each stream during the current year, including the types of samples and other data that were collected and how the data are to be used in the report. Field and laboratory methods are summarized briefly with reference to the protocol for more detail.
3. Results. This section summarizes water quality monitoring data in graphical and/or tabular form. Data from previous years are included to provide a frame of reference for the present year's data. Documentation of antecedent hydrologic, climatic, and/or watershed condi-

tions (if available) that may influence this year's data should also be included in this section.

4. Quality assurance / Quality control. This section summarizes basic quality assurance and quality control steps that were taken to ensure the quality of the data. Any data that fail to meet the quality control objectives in SOP #10 are discussed here.
5. Summary. This section contains a brief data summary, such as ranges of results, findings of interest, and exceedances of water quality criteria.
6. Literature cited
7. Appendices. The appendices contain detailed monitoring site information, all monitoring results, and a list of abbreviations

5 Trend reports

Trend reports, based on comprehensive statistical analyses of long-term water quality data, will be prepared at approximately 5- to 10-year intervals. The main objectives of trend reports, as described in Thomas et al. (2006), are to (1) report patterns and trends in condition of resources being monitored, (2) report new characteristics of resources and (3) correlations among related vital signs and environmental drivers/stressors, (3) report the degree of change that can be detected by the current level of sampling, and (4) provide interpretation of monitoring data in a park and regional context.

8 Revision history

Provide the following information for each revision made to SOP #17.

New version:

SCPN_WATER_QUALITY_SOP17_YYYYMMDD

Date:

Author:

Sections affected:

Changes & reasons: