National Park Service
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Natural Resource Stewardship and Science

Water Quality in the Northern Colorado Plateau Network

Water Years 2013–2015

Natural Resource Report NPS/NCPN/NRR—2016/1332



ON THE COVER

Water-quality monitoring equipment and tools in use at Capitol Reef National Park. NPS photo.

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Natural Resource Report NPS/NCPN/NRR—2016/1332

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Contents

Figures v
Tables vii
Acronyms, Abbreviations, and Codes ix
Executive Summary xi
Acknowledgements xiii

1 Introduction 1
1.1 Background 1
1.2 Program justification 1
1.3 Long-term monitoring objectives 1
1.4 Management outcomes 3
1.5 Report scope and objectives 3

2 Methods 5
2.1 Target population 5
2.2 Laboratory and field methods 5
2.3 Partnerships 5
2.4 Data quality 6
2.5 Understanding water quality data and standards 6
2.6 Site-specific standards and triennial reviews 7

3 Results 9
3.1 Arches National Park 9
3.2 Black Canyon of the Gunnison National Park 14
3.3 Bryce Canyon National Park 18
3.4 Canyonlands National Park 21
3.5 Capitol Reef National Park 25
3.6 Curecanti National Recreation Area 30
3.7 Dinosaur National Monument 37
3.8 Golden Spike National Historic Site 40
3.9 Hovenweep National Monument 41
3.10 Natural Bridges National Monument 44
3.11 Timpanogos Cave National Monument 45
3.12 Zion National Park 47

4 Literature Cited 53

Appendix A. Water Quality Sites Reported, Water Years 2013–2015. 55

Figures

Figure A. Percentage of use evaluations that exceeded standards, and the causes of exceedances at selected sites sampled in NCPN park units as percentages of all samples, October 1, 2012–September 30, 2015. xi

Figure B. Sources of water quality standard violations, as percentages of samples with an exceedance in NCPN park units, October 1, 2012 to September 30, 2015. xi

Figure 1-1. Park units of the Northern Colorado Plateau Network 2

Figure 3-1. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Arches NP, October 1, 2012–September 30, 2015. 9

Figure 3-2. Sources of water-quality standard violations, as percentages of samples with an exceedance at Arches NP, October 1, 2012–September 30, 2015. 9

Figure 3-3. Water-quality monitoring locations in and near Arches National Park 10

Figure 3-4. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Black Canyon of the Gunnison NP, October 1, 2012–September 30, 2015. 14

Figure 3-5. Sources of water quality standard violations, as percentages of samples with an exceedance at Black Canyon of the Gunnison NP, October 1, 2012–September 30, 2015. 14

Figure 3-6. Water-quality monitoring locations in Black Canyon of the Gunnison National Park 15

Figure 3-7. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Bryce Canyon NP, October 1, 2012–September 30, 2015. 18

Figure 3-8. Sources of water-quality standard violations, as percentages of samples with an exceedance at Bryce Canyon NP, October 1, 2012–September 30, 2015. 18

Figure 3-9. Water-quality monitoring locations in Bryce Canyon National Park 19

Figure 3-10. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Canyonlands NP, October 1, 2012–September 30, 2015..... 21

Figure 3-11. Sources of water quality standard violations, as percentages of samples with an exceedance at Canyonlands NP, October 1, 2012–September 30, 2015. 21

Figure 3-12. Water-quality monitoring locations in and near Canyonlands National Park..... 22

Figure 3-13. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Capitol Reef NP, October 1, 2012–September 30, 2015. 25

Figure 3-14. Sources of water quality standard violations, as percentages of samples with an exceedance at Capitol Reef NP, October 1, 2012–September 30, 2015. 25

Figure 3-15. Water-quality monitoring locations in and near Capitol Reef National Park 26

Figure 16a. Oak Creek before cattle trailing through the canyon, September 7, 2013 28

Figure 16b. Oak Creek after cattle trailing though the canyon, October 25, 2013 28

Figure 3-17. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Curecanti NRA, October 1, 2012–September 30, 2015..... 30

Figure 3-18. Sources of water quality standard violations, as percentages of samples with an exceedance at Curecanti NRA, October 1, 2012–September 30, 2015. 30

Figure 3-19. Water-quality monitoring locations in and near Curecanti National Recreation Area 31

Figure 3-20. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Dinosaur NM, October 1, 2012–September 30, 2015. 37

Figures, cont.

Figure 3-21. Sources of water-quality standard violations, as percentages of samples with an exceedance at Dinosaur NM, October 1, 2012–September 30, 2015. 37

Figure 3-22. Water-quality monitoring locations in and near Dinosaur National Monument..... 38

Figure 3-23. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Hovenweep NM, October 1, 2012–September 30, 2015. 41

Figure 3-24. Sources of water-quality standard violations, as percentages of samples with an exceedance at Hovenweep NM, October 1, 2012–September 30, 2015. 41

Figure 3-25. Water-quality monitoring locations in Hovenweep National Monument..... 42

Figure 3-26. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Timpanogos Cave NM, October 1, 2012–September 30, 2015. 45

Figure 3-27. Water quality monitoring locations in Timpanogos Cave National Monument 46

Figure 3-28. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Zion NP, October 1, 2012–September 30, 2015..... 47

Figure 3-29. Sources of water quality standard violations, as percentages of samples with an exceedance at Zion NP, October 1, 2012–September 30, 2015. 47

Figure 3-30. Water-quality monitoring locations in and near Zion National Park..... 48

Figure 3-31. North Creek pH levels compared with temperature, October 1, 2012–September 30, 2015 51

Tables

Table 3-1. Exceedances of surface water quality standards for sites sampled in or near Arches NP, October 1, 2012–September 30, 2015. 12

Table 3-2. Exceedances of surface water quality standards for sites sampled in or near Black Canyon of the Gunnison NP, October 1, 2012–September 30, 2015. 15

Table 3-3. Exceedances of surface water quality standards for sites sampled in or near Bryce Canyon NP, October 1, 2012–September 30, 2015. 20

Table 3-4. Exceedances of surface water quality standards for sites sampled in or near Canyonlands NP, October 1, 2012–September 30, 2015. 23

Table 3-5. Exceedances of surface water quality standards for sites sampled in or near Capitol Reef NP, October 1, 2012–September 30, 2015. 27

Table 3-6. Exceedances of surface water quality standards for sites sampled in or near Curecanti NRA, October 1, 2012–September 30, 2015. 32

Table 3-7. Exceedances of surface water quality standards for sites sampled in or near Dinosaur NM, October 1, 2012–September 30, 2015. 38

Table 3-8. Exceedances of surface water quality standards for sites sampled in or near Hovenweep NM, October 1, 2012–September 30, 2015. 42

Table 3-9. Exceedances of surface water quality standards for sites sampled in or near Zion NP, October 1, 2012–September 30, 2015. 49

Acronyms, Abbreviations, and Codes

Park acronyms	
ARCH	Arches National Park
BLCA	Black Canyon of the Gunnison National Park
BRCA	Bryce Canyon National Park
CANY	Canyonlands National Park
CARE	Capitol Reef National Park
CURE	Curecanti National Recreation Area
DINO	Dinosaur National Monument
GOSP	Golden Spike National Historic Site
HOVE	Hovenweep National Monument
NABR	Natural Bridges National Monument
TICA	Timpanogos Cave National Monument
ZION	Zion National Park
General acronyms and abbreviations	
303(d)	Section 303(d) of Clean Water Act, requiring a reporting of waters not meeting criteria
AB	above
BL	below
BLM-WSA	Bureau of Land Management Wilderness Study Area
BNDRY	boundary
cfs	cubic feet per second
cfu	colony-forming units
ck	creek
CNFL	confluence
CNTY	county
CO	Colorado
CWA	Clean Water Act
DO	dissolved oxygen
E. coli	*Escherichia coli* bacteria
EPA	U.S. Environmental Protection Agency
GPRA	Government Performance and Results Act
HWY	highway
mg/L	milligrams per liter
MPN	most probable number
NPS	National Park Service
NCPN	Northern Colorado Plateau Network
NM	national monument
NP	national park
NR	near
NRA	national recreation area
NWQL	National Water Quality Laboratory
ONRW	Outstanding Natural Resource Waters
OHV	off-highway vehicle
SEUG	Southeast Utah Group (includes ARCH, CANY, HOVE, and NABR)
SOP	standard operating procedure
TDS	total dissolved solids

Acronyms, Abbreviations, and Codes, cont.

TMDL	total maximum daily load
µg/L	micrograms per liter
UT	Utah
UDWQ	Utah Division of Water Quality
UDEQ	Utah Department of Environmental Quality
USGS	U.S. Geological Survey
Type of standard	
AC	acute
CH	chronic
Colorado Designated Use Codes	
AG	Agriculture
ALCW1	Aquatic-life cold-water class 1
ALCW2	Aquatic-life cold-water class 2
ALWW1	Aquatic-life warm-water class 1
ALWW2	Aquatic-life warm-water class 2
DWS	Drinking-water supply
RecE	Existing primary-contact recreation
RecU	Undetermined-use recreation
Res	Reservoir-specific aquatic life standards
Standards for assessed Colorado stream segments within Colorado park units	
LC3	Lower Colorado River basin segment 3 aquatic-life standard
LG1	Lower Gunnison River basin segment 1 aquatic-life standard
LG4c	Lower Gunnison River basin segment 4c aquatic-life standard
LYG2	Lower Yampa/Lower Green River basin segment 2 aquatic-life standard
LYG19a	Lower Yampa/Lower Green River basin segment 19a aquatic-life standard
UG14	Upper Gunnison River basin segment 14 aquatic-life standard
UG26	Upper Gunnison River basin segment 26 aquatic-life standard
UG29b	Upper Gunnison River basin segment 29b aquatic-life standard
Utah Designated Use Codes	
1C	Drinking-water supply
2A	Primary-contact recreation
2B	Secondary-contact recreation
3A	Cold-water game fish
3B	Warm-water game fish
3C	Non-game fish
3D	Waterfowl
4	Agricultural use
NoCrk	Zion National Park North Creek TDS standard

Executive Summary

Water-quality monitoring in National Park Service units of the Northern Colorado Plateau Network (NCPN) is made possible through partnerships between the National Park Service Inventory & Monitoring Division, individual park units, the U.S. Geological Survey, and the State of Utah's Division of Water Quality. This report evaluates data from site visits made at 60 different locations on NCPN streams and rivers in or near 10 NCPN park units between October 1, 2012 and September 30, 2015. Data are compared to state water-quality standards for the purpose of providing information to park managers about potential water-quality problems. The National Park Service does not determine the regulatory status of surface waters; state water-quality agencies determine whether waters comply with the Clean Water Act.

Evaluation of water-quality parameters relative to state water-quality standards indicated that 17,434 (96.7%) of the 18,034 total designated beneficial-use evaluations completed for the period covered in this report met state water-quality standards (Figure A).

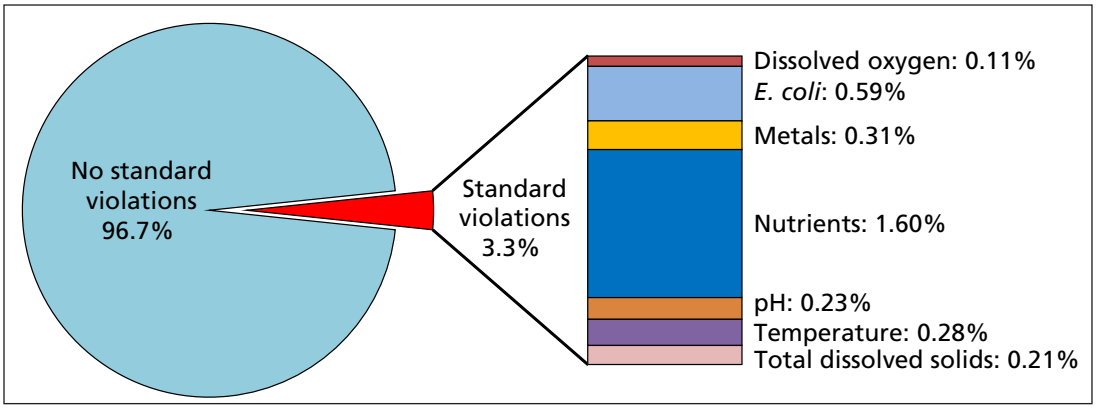


Figure A. Percentage of use evaluations that exceeded standards, and the causes of exceedances at selected sites sampled in NCPN park units as percentages of all samples, October 1, 2012–September 30, 2015.

While some exceedances were recurring and may have been caused by human activities in the watersheds, many were due to naturally occurring conditions characteristic of the geographic setting. The most common exceedances or indications of impairment, in order of abundance, were due to elevated nutrients, elevated bacteria (*E. coli*), elevated trace metals, elevated temperature, elevated pH, elevated total dissolved solids, and low dissolved oxygen (Figure B).

Two sites in particular are worthy of management concern from a human-health perspective because of continued *E. coli* exceedances: North Fork of the Virgin River at Zion National Park and Red Rock Canyon at Black Canyon of the Gunnison National Park. At North Fork of the Virgin River, efforts are still ongoing with the State of Utah to remedy bacterial contamination due to flood irrigation of pastures grazed by cattle. At Red Rock Canyon, cooperation with the State of Colorado may be needed to determine the source of bacteria and in order to resolve the contamination issue. Additional investigations are warranted to document potential sources of *E. coli* at Beaver Creek, Blue Creek, and the Cimarron River at Curecanti National Recreation Area. Lastly, iron in the Yampa River at Dinosaur National Monument warrants further study to determine if anthropogenic sources are contributing to iron exceedances.

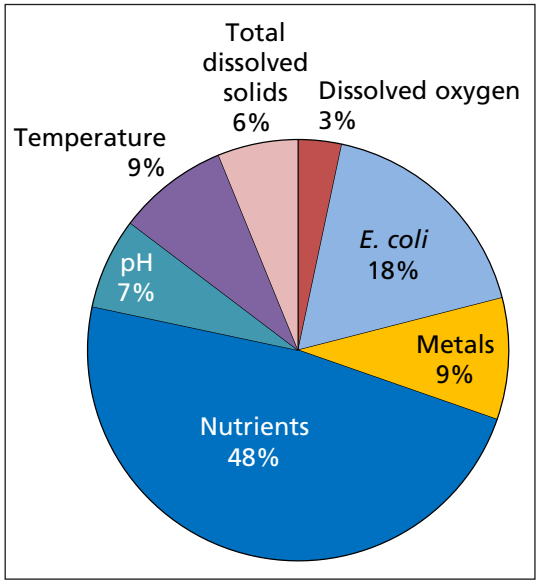


Figure B. Sources of water quality standard violations, as percentages of samples with an exceedance in NCPN park units, October 1, 2012– September 30, 2015.

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1 Introduction

1.1 Background

The Northern Colorado Plateau Network (NCPN) consists of 16 park units in Utah, Colorado, Arizona, and Wyoming (Figure 1-1). The water-dependent ecosystems in these unique landscapes are protected by the National Park Service (NPS) Organic Act, NPS Management Policies (NPS 2006), and the Clean Water Act (CWA). Through comprehensive scoping processes, water quality and quantity were identified as vital signs that should be monitored by the network (O'Dell et al. 2005).

Under authority of the U.S. Environmental Protection Agency (EPA), U.S. states have developed a regulatory system under the CWA that provides for specific concentrations or measures for water-quality constituents that protect a class of uses. The protected uses vary by state, but generally include irrigated agriculture, domestic water supply, cold-water aquatic life, warm-water aquatic life, water-based recreation, and livestock watering.

1.2 Program justification

In order to mitigate past impacts and future threats to park water resources, park managers need objective information on status and trends in surface-water quality and quantity. Section 4.3.6 of NPS Management Policies (NPS 2006) establishes expectations for park managers regarding water resources:

The pollution of surface waters and groundwaters by both point and nonpoint sources can impair the natural functioning of aquatic and terrestrial ecosystems and diminish the utility of park waters for visitor use and enjoyment. The Service will determine the quality of park surface and groundwater resources and avoid, whenever possible, the pollution of park waters by human activities occurring within and outside the parks. The Service will

a) work with appropriate governmental bodies to obtain the highest possible standards available under the Clean Water Act for the protection for park waters;

b) take all necessary actions to maintain or restore the quality of surface waters and groundwaters within the parks consistent with the Clean Water Act and all other applicable Federal, State, and local laws and regulations; and

c) enter into agreements with other agencies and governing bodies, as appropriate, to secure their cooperation in maintaining or restoring the quality of park water resources.

1.3 Long-term monitoring objectives

Measurable objectives of this long-term monitoring program focus on status and trends in water quality parameters, and include the following:

a) Establish range and variability of water-quality parameters under base flow conditions as they vary seasonally using descriptive statistics.
b) Determine status and trends in selected water-quality parameters as a function of flow, season, and climatic conditions, using trend-analysis techniques.
c) Compare water quality data against state criteria for acute and chronic exceedance.
d) Analyze long-term data for designation as Outstanding National Resource Waters (ONRW).
e) Determine point and nonpoint sources of pollution within watersheds via association with ancillary data or knowledge of land-management practices or activities in the watersheds.

Northern Colorado Plateau Network
Utah, Colorado, Arizona, and Wyoming

National Park Service
U.S. Department of the Interior

Water Quality Monitoring Sites, 2013–2015

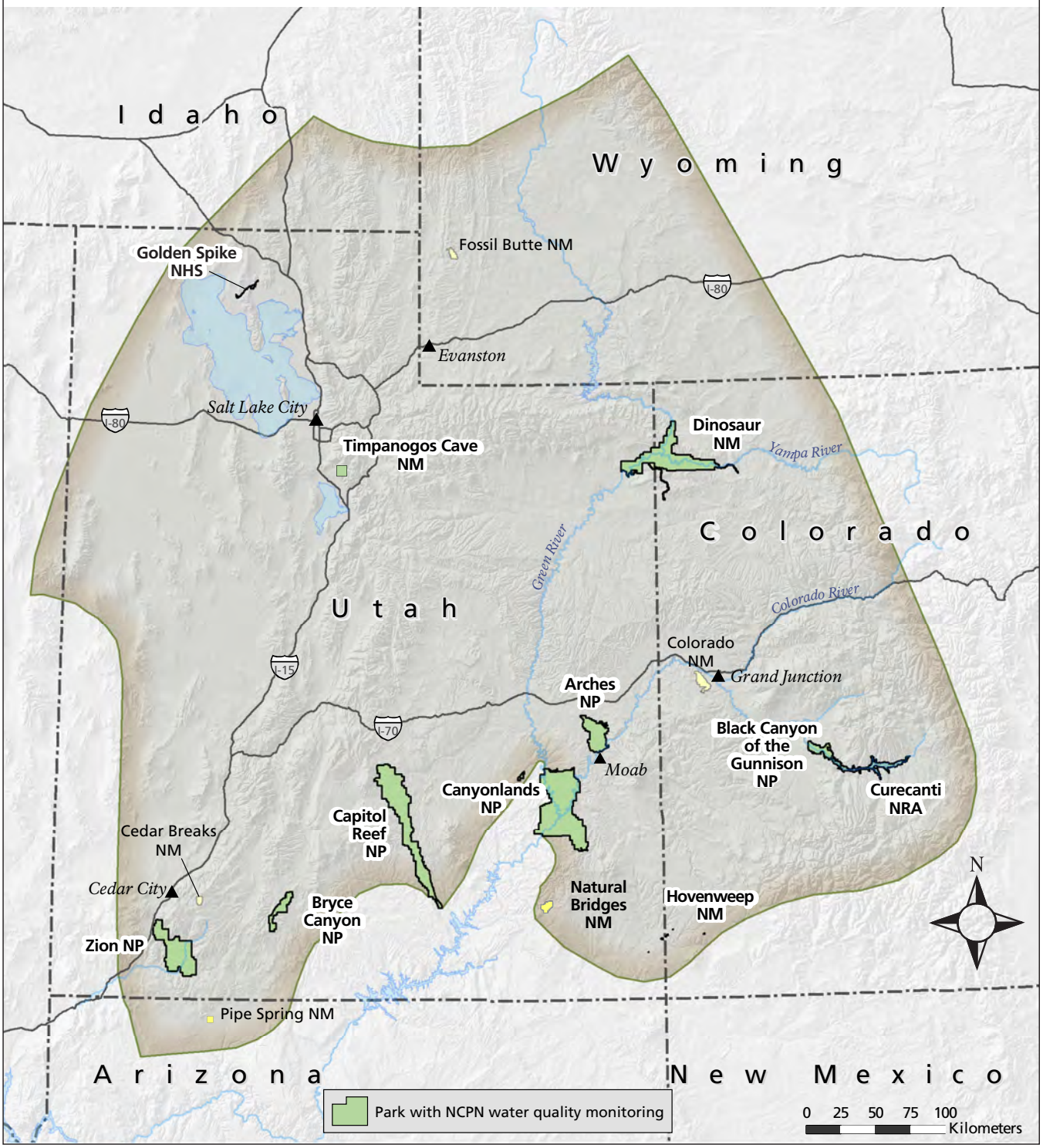


Figure 1-1. Park units of the Northern Colorado Plateau Network. Parks where the NCPN monitors water quality are highlighted.

1.4 Management outcomes

The knowledge gained by achieving the measurable objectives of this monitoring will be used to evaluate and report on the condition of water bodies in NCPN park units. Additionally, it can be used to inform park managers about water resources in order to:

a) Maintain waters that vary within their natural chemical and biological ranges and meet applicable federal and state water-quality criteria.

   Justification: Waters that vary within their natural ranges can typically support healthy aquatic ecosystems and most beneficial uses.

b) Demonstrate and maintain high water quality where it exists.

   Justification: The antidegradation provision of the Clean Water Act specifies that high-quality waters will be maintained (EPA 2006, Section 303).

1.5 Report scope and objectives

This is the fourth report on activities and results of the NCPN water-quality monitoring program (Thoma et al. 2008; Van Grinsven et al. 2010; Hackbarth and Weissinger 2013). In total, these four reports provide information on water years 2005–2015.

This report focuses on sites monitored by NCPN staff and by cooperating staff and agencies working in and near NCPN parks. Although long-term data records exist for some of these sites, the period considered in this report is from October 1, 2012 through September 30, 2015 (water years 2013–2015).

The State of Utah is currently transitioning all of its water-quality data to a new database. For this reason, data from sites in Utah sampled by the state during this time period were not available for analysis. We have suspended reporting on sites sampled by the State of Utah until their data transition is complete.

The objectives of this report are to:

a) compare data to state water quality standards,

b) provide descriptive statistics for water quality data,

c) identify and characterize potential sources of water quality contamination, and

d) provide resource managers with pertinent information about these data.

2 Methods

2.1 Target population

The target population for NCPN water-quality monitoring is a subset of potential daytime water-quality measurements in perennial streams and rivers, selected through a judgmental or targeted process involving the participation of park resource managers, NCPN staff, U.S. Geological Survey (USGS) staff, and other water-quality specialists (O'Dell et al. 2005; Thoma et al. 2007).

Specific water sources were selected based on the following hierarchy:

a) **303(d)-listed waters,** where previous sampling indicated that one or more parameters regularly approached or exceeded criteria or recommended levels.
b) **Waters with demonstrated threat levels,** where an analysis of available data indicated that measured conditions regularly approached or exceeded criteria or recommended levels, but where the frequency of exceedance or the quality of the data did not support a 303(d) listing.
c) **Data gaps:** Waters identified as important, but where little or no water quality information existed.
d) **Waters of management concern,** where past sampling may not have indicated constituent values of concern, but where anthropogenic activities indicated that contamination was a significant threat.
e) **Other perennial waters** with no specific threat.

Perennial waters were preferentially selected over ephemeral or seasonal water sources because they support year-round aquatic ecological process and function and have established criteria that allow monitoring for CWA compliance. Sixty sites in or near 10 NCPN units were sampled between October 1, 2012 and September 30, 2015 (see Appendix A).

2.2 Laboratory and field methods

Approximately 30 parameters were measured for each site visit. The core parameters, or those measured in the field, included dissolved oxygen, pH, temperature, specific conductance, and flow. Other parameters, measured in the laboratory from samples collected in the field, fell into general categories of metals, nutrients, total dissolved solids, and bacteria.

Field methods used to collect data for this report are outlined in the NCPN Standard Operating Procedures (SOPs) for Water Quality (Thoma et al. 2007). Specifically, SOPs 3–11 outline the techniques for measurement of core parameters and sample collection and handling in the field.

Laboratory analytical methods are discussed in detail in SOPs 11–13 (Thoma et al. 2007). The NCPN ensures comparability of the laboratory data created by this monitoring program by using the USGS National Water Quality Laboratory (NWQL) methods for Colorado parks (SOP 12), and the EPA standard methods, or methods outlined in Standard Methods for Analysis of Water and Wastewater, for Utah parks (APHA, 1998; SOP 13). Details of the quality-control process for NWQL and the Utah Public Health Laboratory are provided in SOP 7, Appendices A and B (Thoma et al. 2007).

2.3 Partnerships

The NCPN water-quality monitoring program is a collaborative venture between the NCPN, Black Canyon of the Gunnison National Park (NP), Curecanti National Recreation Area (NRA), the Southeast Utah Group (SEUG), Timpanogos Cave National Monument (NM), the USGS, and the Utah Division of Water Quality (UDWQ). Personnel from the NCPN, SEUG, and Timpanogos Cave NM conduct field work and deliver samples to the Utah Public Health Laboratory according to a partnership agreement between the NPS and the UDWQ. Staff from Black Canyon of the Gunnison NP and Curecanti NRA conduct field work and have laboratory analysis conducted at the NWQL, in Lakewood, Colorado, via agreements with the USGS. Sites at Dinosaur NM are visited by USGS staff, who deliver samples to the NWQL for laboratory analysis. Other nearby sites (outside park boundaries) that are rou-

tinely monitored by the states of Colorado and Utah are also considered. Regardless of which entity performed the field work or laboratory analysis, the data were stewarded through the NPSTORET database v.1.86, which was used for this analysis.

2.4 Data quality

Samples collected by staff from the USGS, Black Canyon of the Gunnison NP, and Curecanti NRA are evaluated for data quality by those staff. Quality-control data for these sites are not available for this report. For sites sampled by NCPN and SEUG staff and analyzed by the Utah Public Health Laboratory, 12 field blanks were submitted between October 1, 2012 and September 30, 2015. No metals or dissolved solids were detected in any field blanks. Total phosphorus was detected in 4 of 12 field blanks, but the maximum concentration detected was 0.008 mg/L. Because the indicator of impairment for the State of Utah is 0.05 mg/L, evaluations of total phosphorus should not be affected by the low concentrations detected in some field blanks. Twenty-one replicate samples were submitted for major constituents and nutrients, and seven replicate samples were submitted for trace metals. The median replicate percent difference was 0.8% (interquartile range 0–3.1%, range 0–143%). For a more thorough discussion of data quality through water year 2013, see Weissinger (2016).

2.5 Understanding water quality data and standards

The sampling methodology used in the NCPN water-quality monitoring program has implications for data interpretation used for management. Monthly grab samples represent conditions at the point and time of sampling; they do not represent the condition of the entire water body, spatially or temporally. Samples are routinely collected several times per year in order to build a database that represents the range of conditions that occur, with a focus on base flow conditions. Thus, rare and short-term events are often not captured.

This report contains terminology that may not be readily understood by non-specialists. For clarification purposes, various terms and concepts that may cause confusion will be defined here. A water-quality standard refers to an individual parameter and its associated beneficial-use designation, in conjunction with a criterion, which is the numeric component against which a result is compared. For example, the standard for chronic selenium (parameter) for cold-water game fish (beneficial-use designation) is 4.6 µg/L (numeric criterion).

One site visit yields approximately 30 water-quality parameter measurements or results. Each result is then evaluated against a water-quality standard; this is referred to as a "use evaluation" in this report. Each beneficial-use designation may contain distinct criteria for one parameter, and each site may contain up to four distinct beneficial-use designations. Therefore, one parameter measurement from one site visit may result in multiple use evaluations.

Over the course of the study period, one site may have a different number of results for each parameter. For example, the NCPN may have visited one monitoring site 24 times during the period covered in this report; however, not all parameters may have been measured during each site visit. This is especially true for metals results. Laboratory analysis for metal concentrations is typically performed quarterly, whereas other parameters, such as nutrients and dissolved oxygen, are determined for each site visit.

2.5.1 Chronic and acute standards

For a single parameter, numeric criteria for water-quality standards address potential effects of both chronic exposure over an extended period of time (months) and acute exposure over a short period of time (hours or days). Permitted levels are much lower for chronic exposure than for acute exposure. Criteria for chronic exposure are not directly comparable to the results obtained from a one-time monthly grab sample. From a compliance standpoint, the acute instantaneous criteria afford the only direct comparison for such data. However, from a resource-conservation standpoint, instantaneous grab-sample data, when compared against more stringent chronic criteria, can provide a means of early warning and an indication of a problem

that may require more attention. Exceedances in this report, therefore, are meant to inform managers of potential problems, rather than conform to a regulatory definition.

For these reasons, parameter results were compared against the chronic standards to create the graphical and tabular data included in this report. Each exceedance was then re-evaluated against the less-stringent acute criteria. If a chronic exceedance also exceeded the acute standard, then documentation was provided in the results section for that individual site.

2.5.2 Phosphorus as an indication of impairment

The State of Utah does not have a water-quality standard for total phosphorus. Rather, the value of 0.05 mg/L is used as an indication of impairment meant to be considered with other parameters, such as dissolved oxygen. If low dissolved-oxygen concentrations were observed commensurate with elevated total-phosphorus concentrations (above 0.05 mg/L), then the collective results might indicate impairment due to eutrophication. Corroborating evidence may include other chemical parameters associated with eutrophication—such as elevated nutrient concentrations or low dissolved-oxygen concentrations—and bioassessments.

The State of Colorado has established interim values for total phosphorus that are scheduled to come into effect in 2022. For state regulatory purposes, total phosphorus is evaluated as an annual median value or average summer value, depending on the type of water body. For purposes of this report, any individual value that exceeds the designated total-phosphorus interim value is reported as an exceedance.

2.5.3 Rules for applying standards

When criteria for a parameter differ by designated beneficial use, or within a use class by aquatic-life stage, the more stringent standard is used as the basis for comparison in this report. Results that exceeded the more stringent standard (chronic standard) were then compared against the less stringent standard (acute standard). The goal is to provide advance warning of an impending problem before it becomes severe—not to meet regulatory definitions of impairment.

2.5.4 Frequency of exceedances for reporting

This report presents beneficial-use evaluation exceedances only if they occurred for more than 10% of results. This approach minimizes reporting of short-duration changes in water chemistry that may result from natural variability associated with weather events and may not be of management concern. It also follows the assessment guidelines used by the UDWQ in preparing their list of impaired water bodies.

Summary statistics displayed at the beginning of each results section refer to the number of use evaluations performed for all sites in or near that NPS unit. The term "evaluation" is used throughout this report in connection with exceedance analyses. Thus, tables and results sections for individual sites refer to "evaluations" instead of "site visits." The total number of evaluations is synonymous with the total number of site visits when an individual parameter is compared against an individual beneficial-use designation at one monitoring site.

2.5.5 Regulatory authority

The National Park Service does not have regulatory authority to establish water-quality standards or assign beneficial-use designations over waters in U.S. For that reason, this report compares water-quality data to designated beneficial-use criteria without stating whether a designated beneficial use was attained. Those designations are left to the states, in their triennial 305(b) reports to Congress. However, the NPS participates with states in collecting data used in the protection of water bodies under state jurisdiction. These assessments can provide early warning or evidence of evolving conditions.

2.6 Site-specific standards and triennial reviews

A triennial review process allows stakeholders to provide feedback about water-quality standards, criteria, and designated beneficial

uses. Through this process, the regulatory agencies may re-classify a water body's designated use or set standards appropriate for the use. This process is especially relevant where uses were not assigned, due either to a lack of use data or a situation in which natural conditions preclude a water body from meeting its designated beneficial use. For instance, a use-attainability analysis may indicate that a water body cannot achieve its beneficial designated use due to naturally elevated parameter concentrations that have been observed in that stream or stream segment. If the historical data record is not long enough or reasonable supporting evidence does not exist, then the state may choose not to change a water-quality standard, or reclassify a designated use during the triennial review, but may provide guidance on how to further investigate the particular issue.

Some NCPN water-quality monitoring sites may be suitable candidates for a use-attainability analysis and site-specific criteria, due to naturally elevated total phosphorus or total dissolved solids concentrations that may be derived from soil and bedrock weathering. If commensurate measurements, such as dissolved oxygen or nitrogen concentrations at a site, do not indicate that elevated total-phosphorus concentrations are causing eutrophication of the water body, then the water body may be considered for a different use classification or a water body-specific standard.

Results displayed in this report highlight and characterize such scenarios, but do not necessarily contain the breadth of supporting documentation required for submission to the triennial review process. Completion of a long-term trend-analysis report will significantly improve the NCPN's ability to determine which candidate sites and associated water-quality standards merit inclusion in a use-attainment assessment.

3 Results

3.1 Arches National Park

3.1.1 Water-quality summary

A total of 2,891 designated beneficial-use evaluations were completed for water-quality results obtained at six sites* in or near Arches NP between October 1, 2012 and September 30, 2015. Of those 2,891 evaluations, 89 (3.1%) exceeded water-quality standards or indications of impairment (Figure 3-1). Standards were exceeded for six constituent categories—most commonly, nutrients, total dissolved solids, and *E. coli* (Figure 3-2).

3.1.2 Reportable exceedances

The Colorado River near Cisco, Utah, did not have any exceedances based upon 100 evaluations. At this site, the only parameters tested were water temperature, fluorides, and total dissolved solids. The Dolores River near Cisco, Utah, did not have any exceedances based upon 75 evaluations. Only water temperature and total dissolved solids were tested at this site. The remaining four sites that were monitored in or around Arches NP had exceedances of water-quality standards or indications of impairment (Figure 3-3, Table 3-1). The following discussion focuses only on sites that had exceedances.

3.1.2.1 Colorado River near Colorado–Utah State Line

This site is located in the state of Colorado, and is thus subject to Colorado state water-quality standards. Total-phosphorus levels exceeded the aquatic-life warm-water class 1 interim standard for 47% of evaluations.

*In past years, nine sites were monitored. Three sites were dropped following a program reassessment by the SEUG Resource Stewardship and Science Division, in cooperation with the NCPN (Hackbarth and Weissinger 2013, 15).

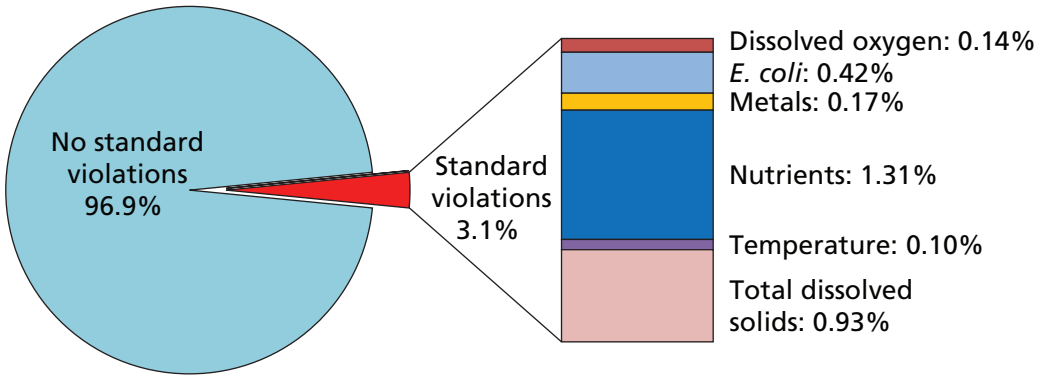


Figure 3-1. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Arches NP, October 1, 2012–September 30, 2015.

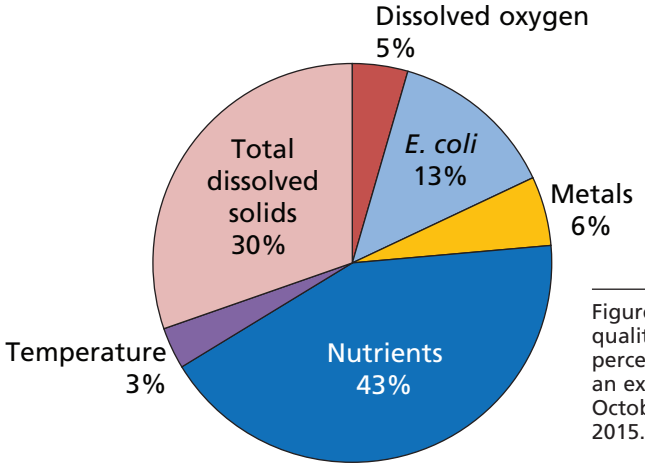


Figure 3-2. Sources of water-quality standard violations, as percentages of samples with an exceedance at Arches NP, October 1, 2012–September 30, 2015.

Arches National Park
Utah

National Park Service
U.S. Department of the Interior
Northern Colorado Plateau Network

Water Quality Monitoring Sites, 2013–2015

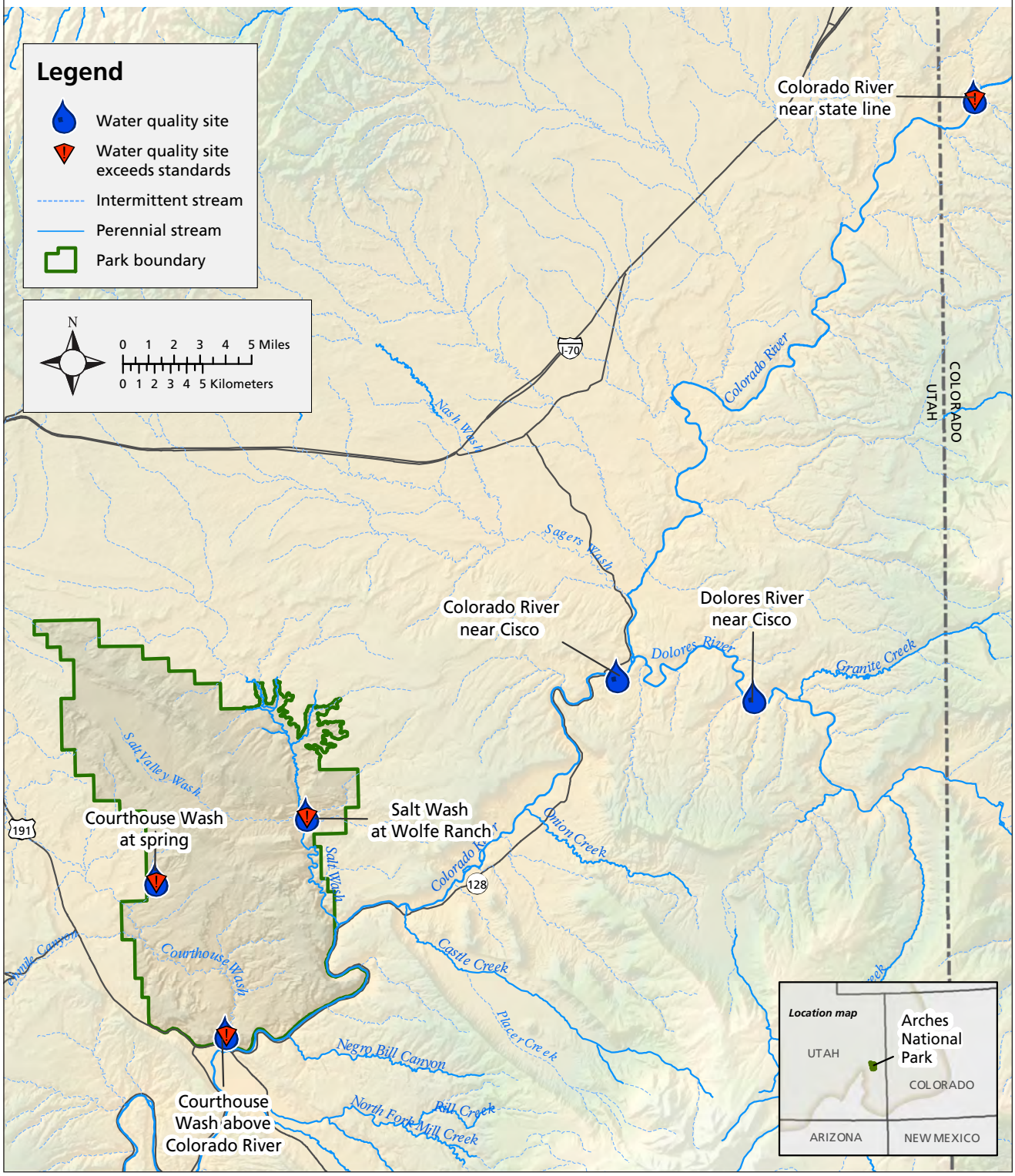


Figure 3-3. Water-quality monitoring locations in and near Arches National Park. Sites that exceeded standards for more than 10% of evaluations for one or more parameters are marked with a red symbol.

3.1.2.2 Courthouse Wash above Colorado River

Near its confluence with the Colorado River, Courthouse Wash exceeded the warm-water game-fish standard for water temperature for 10% of evaluations.

3.1.2.3 Salt Wash at Wolfe Ranch

This site had exceedances for dissolved oxygen (DO), *E. coli*, total dissolved solids, and total phosphorus. The chronic dissolved-oxygen standard (5.5 mg/L) for warm-water game fish was exceeded for 10% of evaluations, but the acute standard (3.0 mg/L) was never exceeded. *E.coli* concentrations exceeded the chronic (126 MPN) and acute (409 MPN) standards for primary-contact recreation for 24% and 12% of evaluations, respectively. *E. coli* concentrations exceeded the chronic (206 MPN) drinking-water supply standards for 24% of evaluations, but the acute standard (668 MPN) was never exceeded. Total dissolved solids exceeded the agricultural-use standard for 95% of evaluations. Total phosphorus exceeded the indication of impairment criteria for primary-contact recreation and warm-water game fish for 11% of evaluations.

3.1.2.4 Courthouse Wash at spring

This report marks the first set of evaluations for this site, which was initiated in October 2013. Previous monitoring near this location occurred downstream, but as the channel changed, sufficient surface water was no longer available for sampling downstream. This site had exceedances for copper, DO, *E. coli*, total phosphorus, and total dissolved solids. The standard for copper for warm-water game fish was exceeded for 17% of evaluations. Dissolved-oxygen levels exceeded the chronic standard for warm-water game fish for 10% of evaluations, and the acute standard was exceeded on one occasion. *E. coli* concentrations exceeded the chronic standard for primary-contact recreation for 11% of evaluations. Total dissolved solids exceeded the standard for agricultural use for 42% of evaluations. Total phosphorus exceeded the indication of impairment criteria for primary-contact recreation and warm-water game fish for 25% of evaluations.

3.1.3 Discussion and management implications

Many of the water-quality exceedances in Arches NP are likely due to naturally occurring conditions, and resulted from the application of use designations that were intended to protect the Colorado River and its tributaries. Because many monitoring sites in Arches NP are low-flow, intermittent, or ephemeral tributaries to the Colorado River, the applicable use designations, specifically 3B (warm-water game fish), do not necessarily account for their biogeochemical nature.

Most of the monitoring sites in Arches NP are candidates for use-attainability assessments because of their geologic setting. The geologic conditions of small springs with large groundwater components, and predominantly intermittent streams that may episodically contribute naturally elevated constituent loads, distinguish them from other perennial tributaries to the Colorado River. After two decades of water-quality monitoring, the SEUG has reevaluated its site-selection criteria and moved toward monitoring sites with more specific resource threats.

3.1.3.1 Dissolved oxygen

Low dissolved-oxygen concentrations that exceed the warm-water game-fish standard are likely the result of two factors: hydrologic setting and summertime low-flow conditions. At the Salt Wash at Wolfe Ranch and Courthouse Wash at spring sites, the potential existence of stagnant or semi-stagnant pools caused by summertime low-flow conditions can cause depleted oxygen concentrations. In these pools, a lack of shade may increase temperature, decreasing oxygen solubility. Higher temperatures accelerate the rate of decomposition of organic matter, which is an oxygen-consuming biological activity, further depleting oxygen concentrations.

3.1.3.2 *E. coli*

The *E. coli* standards for primary-contact recreation and drinking-water supply were exceeded at Salt Wash. Possible sources of *E. coli* contamination could be wildlife, domestic animals, humans, or a combination thereof. During high-discharge events,

Table 3-1. Exceedances of surface water quality standards for sites sampled in or near Arches NP, October 1, 2012–September 30, 2015.

Site	Use code	Constituents	Numeric standard	Units	Total evaluations	% evaluations exceeded standards
Colorado River near Colorado–Utah State Line	ALWW1	Phosphorus, total	0.17	mg/L	51	47
Courthouse Wash above Colorado River	3B	Temperature, water	27	°C	21	10
Salt Wash at Wolfe Ranch	3B	Dissolved oxygen	5.5	mg/L	21	10
	2A	*E. coli*	126	MPN/100ml	17	24
	1C	*E. coli*	206	MPN/100ml	17	18
	2A	*E. coli*	409	MPN/100ml	17	12
	2A, 3B	Phosphorus, total	0.05	mg/L	18	11
	4	Total dissolved solids	1,200	mg/L	20	95
Courthouse Wash at spring	3B	Copper, dissolved	h-dep.	µg/L	6	17
	3B	Dissolved oxygen	5.5	mg/L	20	10
	2A	*E. coli*	126	MPN/100ml	18	11
	2A, 3B	Phosphorus, total	0.05	mg/L	16	25
	4	Total dissolved solids	1,200	mg/L	19	42

Use codes: ALWW1 = aquatic-life warm-water class 1 (CO standard); 2A = primary-contact recreation; 3B = warm-water game fish; 1C = drinking-water supply; 4 = agricultural use
h-dep. = hardness-dependent

runoff from the watershed contributes large amounts of sediment and organic material to streams. Fecal matter and its microbial components, such as *E. coli*, are carried into streams, along with silts and sands eroded during overland-flow events. *E. coli* readily binds to benthic and suspended sediment in surface-water bodies, and is able to survive for prolonged periods when attached to sediments (Sampson et al. 2006). The majority of *E. coli* exceedances at Salt Wash occurred after rain and overland-flow events. Because *E. coli* exceedances were infrequent and episodic storm events were related to the observed elevated *E. coli* concentrations, management concern is not warranted at this time.

3.1.3.3 Metals

One of six samples collected at the Courthouse Wash at spring site exceeded the standard for dissolved copper for warm-water game fish. The sample was collected following a recent rain event and also had high turbidity. Additional sampling is needed to determine whether copper is of management concern.

3.1.3.4 Nutrients

Natural sources of phosphorus likely occur within the Courthouse Wash and Salt Wash watersheds. However, accelerated weathering from grazing and off-highway vehicle (OHV) use upstream from the park boundary may contribute to the observed total -phosphorus levels. Elevated total-phosphorus concentrations in Courthouse Wash and Salt Wash are consistent with 16 years of data collected from 1990 to 2006 (Brown and Thoma 2012).

3.1.3.5 Temperature

Temperatures at Courthouse Wash above the Colorado River exceeded the warm-water game-fish standard of 27°C on two occasions. On July 13, 2015, the water temperature was 29.63°C, and on August 1, 2015, the temperature was 27.51°C. Water temperatures were measured in the afternoon, when air temperatures were also high. Low-flow conditions, combined with hot summer air temperatures, cause periodic surface-water temperature exceedances. Thus, these exceedances do not warrant immediate concern.

3.1.3.6 Total dissolved solids

As in past years, concentrations of total dissolved solids (TDS) at Salt Wash at Wolfe Ranch exceeded standards and likely have a geologic origin, as there are few human activities near Salt Wash that could contribute to such high TDS levels. Elevated TDS concentrations in surface water and groundwater are not uncommon in the Moab area, and result from the underground weathering of the near sub-surface salt dome (Baars and Doelling 1987; Chaffin 2002). Mineral-rich clay and shale deposits of the Morrison and Mancos formations exposed near the sample site may also contribute TDS to Salt Wash during overland-flow events. The results presented are consistent with over 10 years of sampling in Arches NP, as described by Schelz and Moran (2004), Van Grinsven and others (2010) and Hackbarth and Weissinger (2013). Elevated TDS concentrations in Courthouse Wash are most likely from the same sources as at Salt Wash.

The presence of salt-bearing geologic layers near the surface results in conditions that may be cause for exemption or re-classification of the TDS standard for Salt Wash. In fact, the UDWQ is reviewing water bodies across the state that may need to be re-classified as a result of natural conditions, such as salt-bearing geologic layers, that cause elevated TDS concentrations.

3.2 Black Canyon of the Gunnison National Park

3.2.1 Water-quality summary

A total of 354 designated beneficial-use evaluations were completed for water-quality results obtained at three sites in Black Canyon of the Gunnison NP between October 1, 2012 and September 30, 2015. Of those 354 evaluations, 22 (6.2%) exceeded water-quality standards or criteria (Figure 3-4). Water-quality standards were exceeded for four constituent categories: *E. coli*, metals, nutrients, and pH (Figure 3-5).

3.2.2 Reportable exceedances

The Gunnison River below the Gunnison Tunnel had no water-quality exceedances or indications of impairment, based upon 158 total evaluations. Two of the three sites sampled had exceedances of water-quality standards for the State of Colorado (Table 3-2, Figure 3-6). The following discussion focuses only on sites that had exceedances.

3.2.2.1 Red Rock Canyon at mouth near Montrose, Colorado

This site exceeded selenium standards for aquatic-life warm-water class 2. A total of two samples were collected at this site and both exceeded the acute (18.4 µg/L) and chronic (4.6 µg/L) aquatic-life warm-water class 2 standards.

3.2.2.2 Red Rock Canyon near the NPS boundary near Montrose, Colorado

This site had exceedances for pH, total phosphorus, selenium, and *E. coli*. One of five evaluations resulted in a pH exceedance for aquatic-life warm-water class 2 and the existing primary-contact recreation standard. Total-phosphorus levels exceeded the interim standard for aquatic-life warm-water class 2 for 40% of evaluations. Dissolved selenium concentrations exceeded the acute (18.4 µg/L) and chronic (4.6 µg/L) standards for

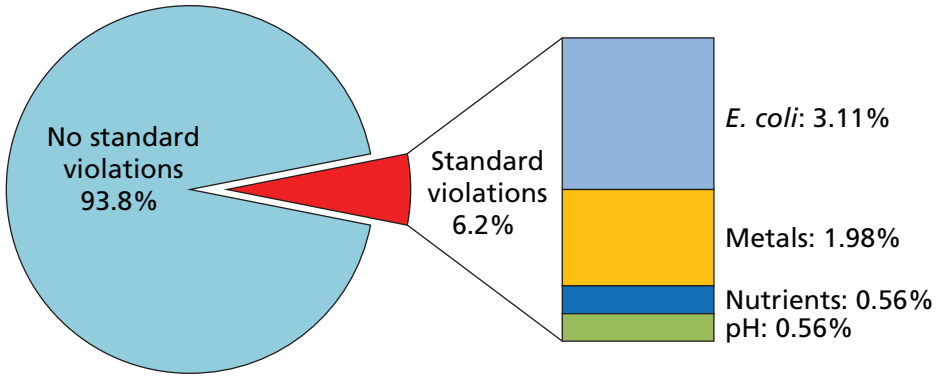


Figure 3-4. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Black Canyon of the Gunnison NP, October 1, 2012–September 30, 2015.

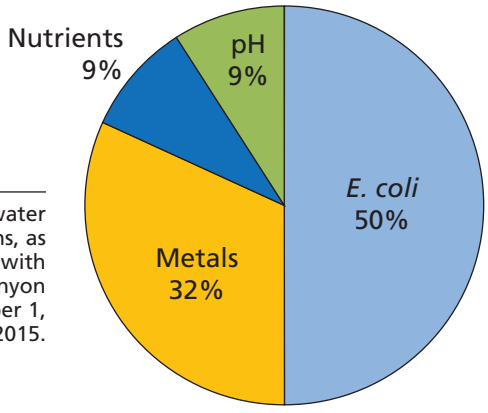


Figure 3-5. Sources of water quality standard violations, as percentages of samples with an exceedance at Black Canyon of the Gunnison NP, October 1, 2012–September 30, 2015.

Black Canyon of the Gunnison National Park
Colorado

National Park Service
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Northern Colorado Plateau Network

Water Quality Monitoring Sites, 2013–2015

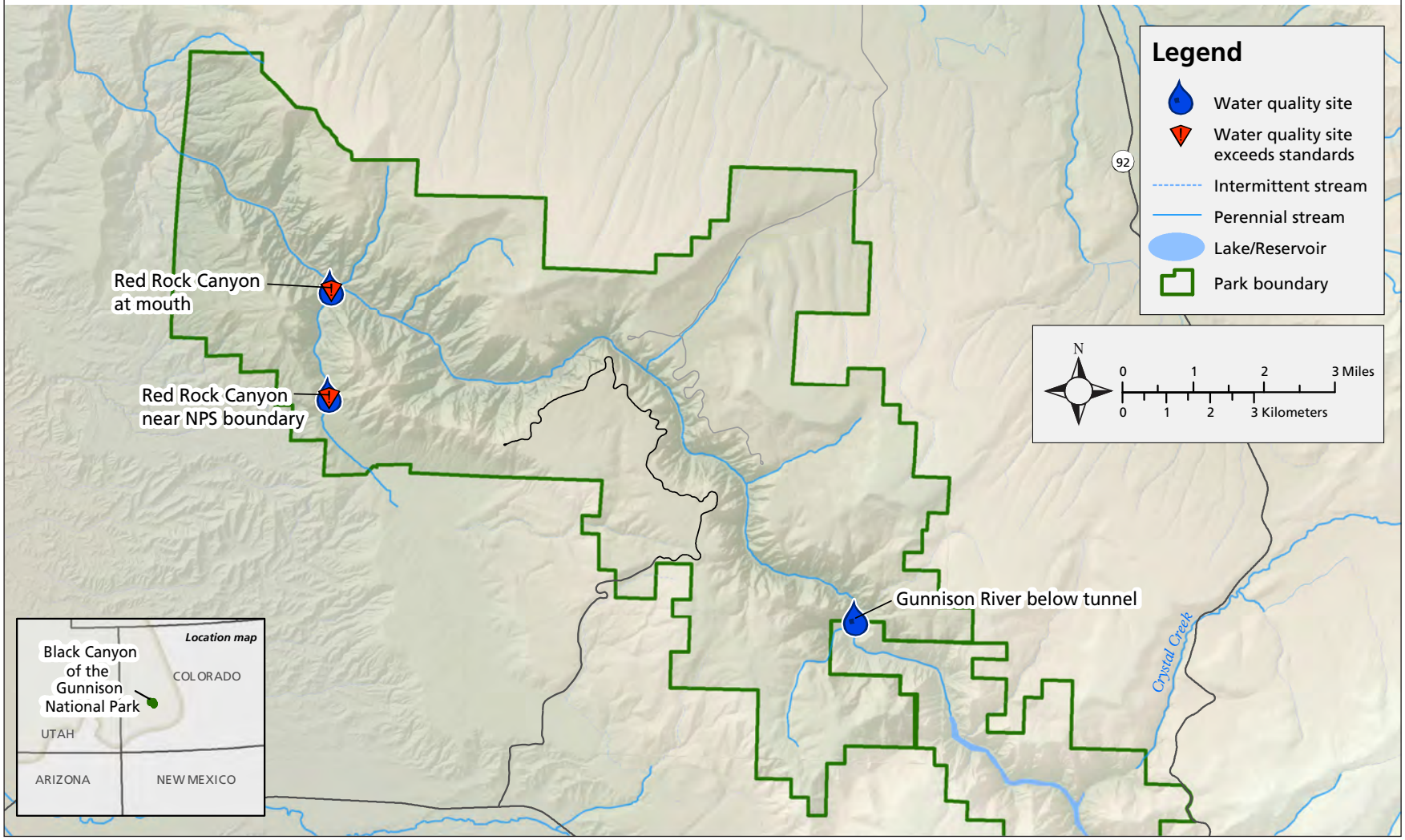


Figure 3-6. Water-quality monitoring locations in Black Canyon of the Gunnison National Park. Sites that exceeded standards for more than 10% of evaluations for one or more parameters are marked with a red symbol.

Table 3-2. Exceedances of surface water quality standards for sites sampled in or near Black Canyon of the Gunnison NP, October 1, 2012–September 30, 2015.

Site	Use code	Constituents	Numeric standard	Units	Total evaluations	% evaluations exceeded standards
Red Rock Canyon at mouth near Montrose, CO	ALWW2	Selenium, dissolved	4.6	µg/L	2	100
Red Rock Canyon near NPS boundary near Montrose, CO	ALWW2, RecE	pH	6.5	none	5	20
	ALWW2	Phosphorus, total	0.17	mg/L	5	40
	ALWW2	Selenium, dissolved	4.6	µg/L	5	100
	LG4c, RecE	*E. coli*	126	cfu/100ml	5	100
	DWS	*E. coli*	630	cfu/100ml	5	20

Use codes: ALWW2 = aquatic-life warm-water class 2; RecE = existing primary-contact recreation; LG4c = Lower Gunnison River basin segment 4c aquatic-life standard; DWS = drinking-water supply

aquatic-life warm-water class 2 for 100% of evaluations. *E. coli* levels exceeded the existing primary-contact recreation standard and the Lower Gunnison River basin aquatic-life standard for 100% of evaluations. One of five *E. coli* evaluations exceeded the standard for drinking-water supply.

3.2.3 Discussion and management implications

3.2.3.1 *E. coli*

E. coli standards were exceeded at Red Rock Canyon near the NPS boundary. A total of five samples were collected at this site and all exceeded the existing primary-contact recreation standard of 126 cfu/100ml. Possible sources of *E. coli* contamination could be wildlife, domestic animals, humans, or a combination thereof.

Consistent with previous years of sampling (Van Grinsven et al. 2010; Hackbarth and Weissinger 2013), the majority of *E. coli* exceedances in Black Canyon of the Gunnison NP occurred during average flow and clear water conditions. Because episodic storm events were not related to the observed *E. coli* exceedances, a continuous source may exist upstream. The majority of *E. coli* exceedances occurred during the summer months, when recreational activity in Red Rock Canyon is at its peak. Cooperation with the State of Colorado may be needed to determine the source or sources of bacteria in the area.

3.2.3.2 Metals

Natural weathering of the Mancos Shale deposit, present in Red Rock Canyon, generates elevated selenium and TDS levels in surface-water bodies. Accelerated erosion of the Mancos Shale deposit from land-use practices, such as irrigation and OHV recreation, are known to exacerbate selenium and TDS levels.

Selenium exceedances in Red Rock Canyon have been documented extensively, and the tributary was previously included on the 303(d) list of impaired waters in Colorado. In 2011, an assessment for total maximum daily load (TMDL) was completed for selenium for the Gunnison River and tributaries, including Red Rock Creek. The TMDL indicates that non-point sources in Red Rock Creek would need to be reduced by over 90% in order to meet selenium standards (CDPHE 2011). Although selenium weathers naturally from bedrock and soils in the Red Rock Creek drainage, statewide debate exists about the impact of irrigation on this weathering. The majority of Red Rock Creek's discharge is return flow from an upstream irrigation headgate. Downstream loading of selenium in the Gunnison River watershed has been decreasing for several decades (Henneberg 2016).

3.2.3.3 Nutrients

In June 2012, the Colorado Water Quality Control Commission adopted regulations to

address current and potential future nutrient pollution of Colorado surface waters. Interim numerical values for nutrients, including phosphorus, nitrogen, and chlorophyll a, were established at levels to protect designated uses of Colorado waters. These would initially be applied only to streams and lakes above dischargers and to protect municipal water supplies taken directly from lakes or reservoirs.

The interim standard for total phosphorus in Colorado's warm-water rivers and streams, scheduled to be implemented in 2022, is analyzed as an annual median value of 0.17 mg/L (CDPHE 2008). For purposes of this report, any individual total-phosphorus value for Colorado warm-water rivers or streams that exceeded 0.17 mg/L was included as an indicator of a potential problem. Two of five evaluations at Red Rock Canyon near the NPS boundary exceeded this value. Elevated total-phosphorus values in Red Rock Canyon are consistent with 10 years of data collected from 1996 to 2006 (Brown and Thoma 2012). Natural sources of phosphorus likely occur within Red Rock Canyon and the surrounding area. However, in conjunction with the high *E. coli* numbers noted above, it would be prudent to work with the State of Colorado to begin more intensive sampling of the area to determine if anthropogenic sources are contributing to phosphorus and coliform exceedances.

3.2.3.4 pH

Red Rock Canyon near the NPS boundary near Montrose, Colorado, had one low pH reading that resulted in exceedances for two standards: aquatic-life warm-water class 2 and existing primary-contact recreation. The low pH reading occurred when the stream was sampled during the afternoon in the summer. Measurements for pH taken later in the year were within range of pH standards, and management concern is not warranted at this time.

3.3 Bryce Canyon National Park

3.3.1 Water-quality summary

A total of 1,307 designated beneficial-use evaluations were completed for water-quality results obtained at four sites in Bryce Canyon NP between October 1, 2012 and September 30, 2015. Of those 1,307 evaluations, ten (0.8%) exceeded water-quality standards or criteria (Figure 3-7). Water-quality standards were exceeded for two constituent categories: pH and *E. coli* (Figure 3-8).

3.3.2 Reportable exceedances

Mossy Cave Spring did not have any water-quality exceedances based on 399 evaluations. Sheep Creek had one exceedance for *E. coli* in less than 10% of evaluations. The following discussion focuses only on sites that had exceedances for more than 10% of evaluations (Table 3-3, Figure 3-9).

3.3.2.1 Tropic Ditch

The only parameters measured at Tropic Ditch were pH, dissolved oxygen, temperature, and *E. coli*. This site exceeded the pH standard for secondary-contact recreation, non-game fish, and agricultural use for 10% of evaluations.

3.3.2.2 Yellow Creek

One sample at Yellow Creek exceeded the chronic secondary-contact recreation standard (206 MPN) for *E. coli*, but did not exceed the acute standard (668 MPN).

3.3.3 Discussion and management implications

3.3.3.1 *E. coli*

One of eight samples at Yellow Creek and one of 29 samples at Sheep Creek exceeded the chronic *E. coli* standard. It was noted on each of these visits that there were cow tracks

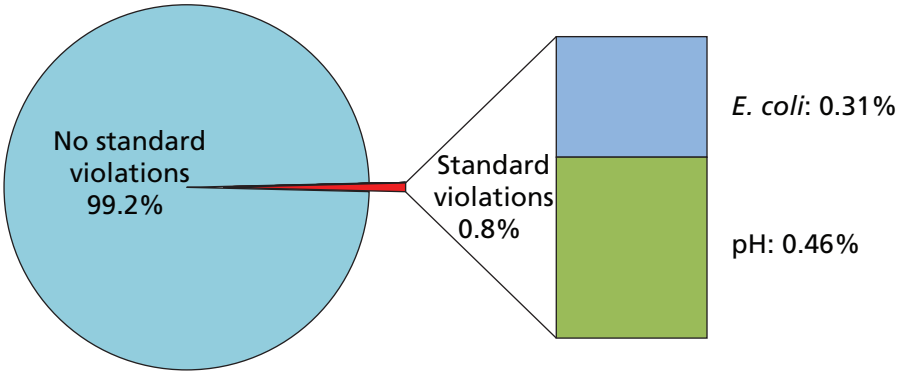


Figure 3-7. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Bryce Canyon NP, October 1, 2012–September 30, 2015.

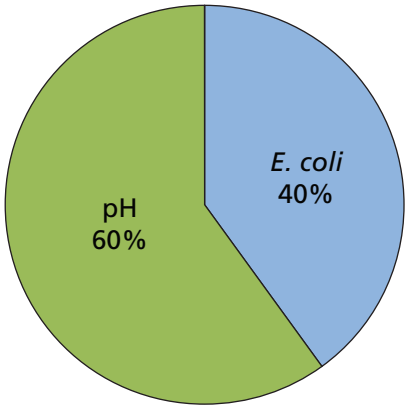


Figure 3-8. Sources of water-quality standard violations, as percentages of samples with an exceedance at Bryce Canyon NP, October 1, 2012–September 30, 2015.

Water Quality Monitoring Sites, 2013–2015

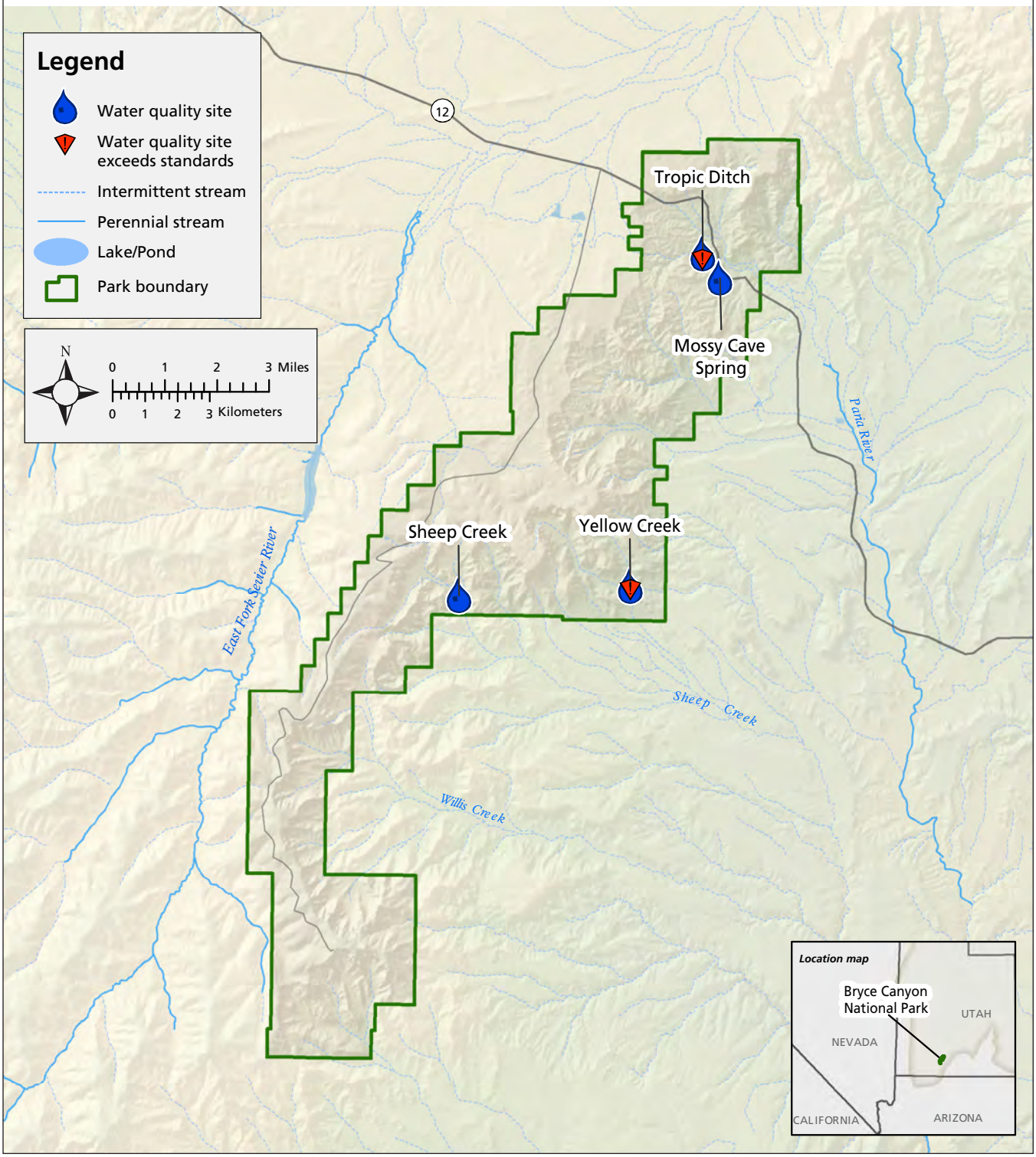


Figure 3-9. Water-quality monitoring locations in Bryce Canyon National Park. Sites that exceeded standards for more than 10% of evaluations for one or more parameters are marked with a red symbol.

Table 3-3. Exceedances of surface water quality standards for sites sampled in or near Bryce Canyon NP, October 1, 2012–September 30, 2015.

Site	Use code	Constituents	Numeric standard	Units	Total evaluations	% evaluations exceeded standards
Tropic Ditch	2B, 3C, 4	pH	9	none	20	10
Yellow Creek	2B	*E. coli*	206	MPN/100ml	8	13

Use codes: 2B = secondary-contact recreation; 3C = non-game fish; 4 = agricultural use

and fresh cow manure at the sites. The infrequent *E. coli* exceedances that occurred during the study period do not warrant concern from a human-health perspective. Possible sources of contamination include wildlife, human use, and trespass cattle, which have been an infrequent but reoccurring issue in Bryce Canyon NP. During monthly monitoring visits, signs of cattle trespass were observed in the park along the riparian corridors of Sheep and Yellow creeks. Potential physical and biological damage to the riparian corridor and degradation of water quality from cattle trespass is not being measured but may be a resource-management concern. There has been continued effort to maintain the boundary fences at Sheep Creek and Yellow Creek, but high water damages these fences during the summer monsoon season. The fence at Sheep Creek was repaired during this study period but there were still signs of cattle trespass.

3.3.3.2 pH

At Tropic Ditch, two of 20 samples had elevated pH readings that exceeded the standard for secondary-contact recreation, nongame fish, and agricultural use. A pH of 9.04 was recorded on August 5, 2014, and a pH of 9.01 was recorded on September 4, 2014. The geochemical components of watersheds throughout the Northern Colorado Plateau naturally cause the pH of surface water to be slightly basic. Measurements taken later in the year and in 2015 were within the acceptable pH range. There is no immediate management concern.

3.4 Canyonlands National Park

3.4.1 Water-quality summary

A total of 2,677 designated beneficial-use evaluations were completed for water-quality results obtained at seven sites in or near Canyonlands NP between October 1, 2012 and September 30, 2015. Of those 2,677 evaluations, 156 (5.8%) exceeded water-quality standards or criteria (Figure 3-10). Water-quality standards were exceeded for three constituent categories: nutrients, metals, and temperature (Figure 3-11).

3.4.2 Reportable exceedances

Green River at Green River, Utah, did not have any exceedances or indications of impairment based upon 96 total evaluations. The only parameters tested at this site were temperature, fluorides, and total dissolved solids. Green River at Ouray, Utah, exceeded the temperature standard for 7% of evaluations. All other sites had exceedances of water-quality standards for the State of Utah (Table 3-4, Figure 3-12). The following discussion focuses only on sites that had exceedances for more than 10% of evaluations.

3.4.2.1 Colorado River above the confluence with Green River

This site had exceedances for total phosphorus and selenium. Total phosphorus exceeded the indication of impairment criteria for primary-contact recreation and warm-water game fish for 85% of evaluations. Selenium concentrations exceeded the chronic standard for warm-water game fish for 25% of evaluations, but did not exceed the acute selenium standard (18.6 µg/L).

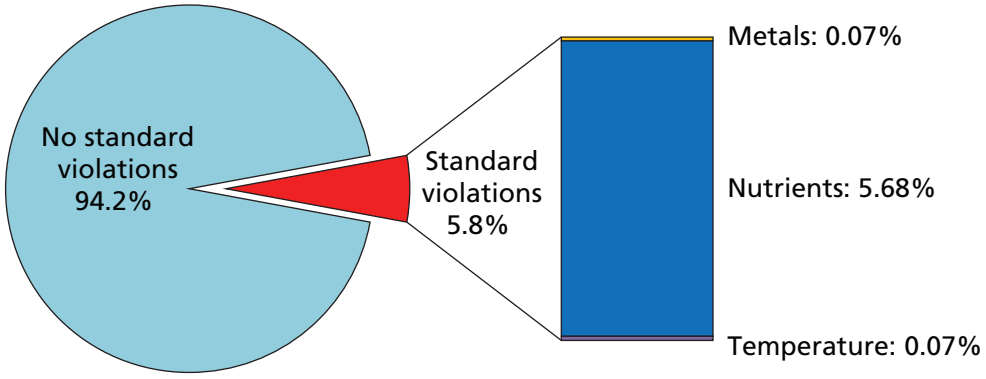


Figure 3-10. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Canyonlands NP, October 1, 2012–September 30, 2015.

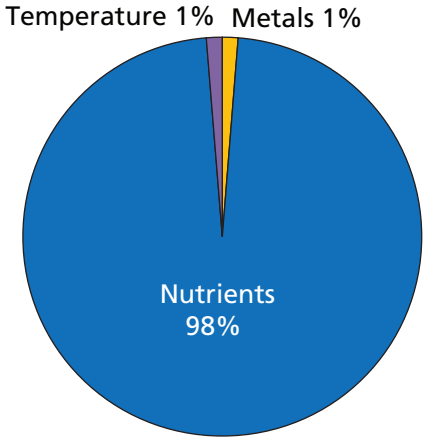


Figure 3-11. Sources of water quality standard violations, as percentages of samples with an exceedance at Canyonlands NP, October 1, 2012–September 30, 2015.

Canyonlands National Park
Utah

National Park Service
U.S. Department of the Interior
Northern Colorado Plateau Network

Water Quality Monitoring Sites, 2013–2015

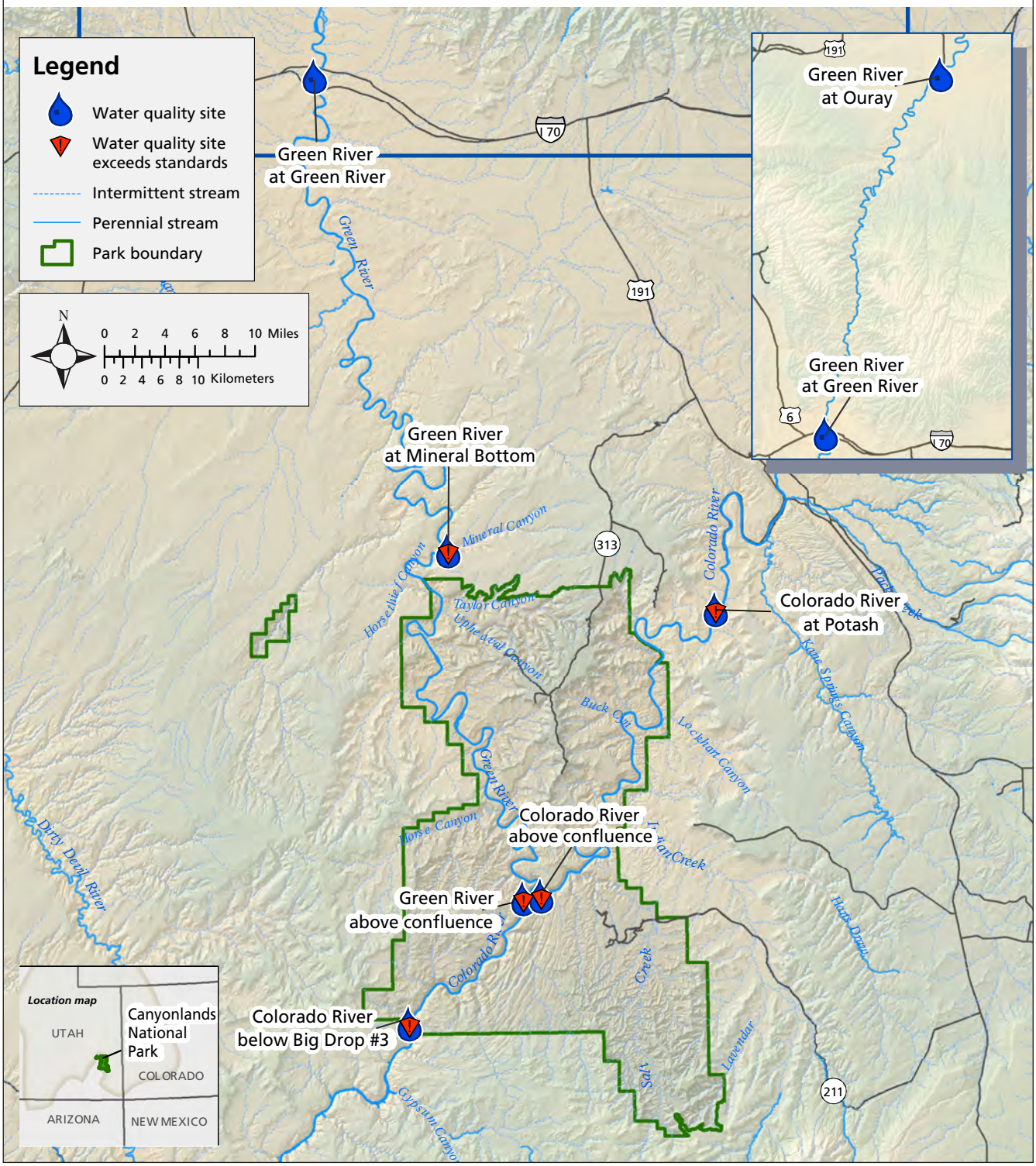


Figure 3-12. Water-quality monitoring locations in and near Canyonlands National Park. Sites that exceeded standards for more than 10% of evaluations for one or more parameters are marked with a red symbol.

Table 3-4. Exceedances of surface water quality standards for sites sampled in or near Canyonlands NP, October 1, 2012–September 30, 2015.

Site	Use code	Constituents	Numeric standard	Units	Total evaluations	% evaluations exceeded standards
Colorado River above confluence with Green River	2A, 3B	Phosphorus, total	0.05	mg/L	20	85
	3B	Selenium, dissolved	4.6	µg/L	4	25
Colorado River at Potash boat ramp	2A, 3B	Phosphorus, total	0.05	mg/L	20	90
	3B	Selenium, dissolved	4.6	µg/L	5	20
Colorado River below Big Drop #3 Rapids	2A, 3B	Phosphorus, total	0.05	mg/L	17	88
Green River above confluence with Colorado River	2A, 3B	Phosphorus, total	0.05	mg/L	19	100
Green River at Mineral Bottom	2A, 3B	Phosphorus, total	0.05	mg/L	7	100

Use codes: 2A = primary-contact recreation; 3B = warm-water game fish

3.4.2.2 Colorado River at Potash boat ramp

This site had exceedances for total phosphorus and selenium. Total phosphorus exceeded the indication of impairment criteria for primary-contact recreation and warm-water game fish for 90% of evaluations. Selenium concentrations exceeded the chronic standard for warm-water game fish for 20% of evaluations, but did not exceed the acute standard (18.6 µg/L).

3.4.2.3 Colorado River below Big Drop #3

This site exceeded the indication of impairment for total phosphorus for primary-contact recreation and warm-water game fish for 88% of evaluations.

3.4.2.4 Green River above confluence with Colorado River

This site exceeded the indication of impairment for total phosphorus for primary-contact recreation and warm-water game fish for 100% of evaluations.

3.4.2.5 Green River at Mineral Bottom

This site exceeded the indication of impairment for total phosphorus for primary-contact recreation and warm-water game fish for 100% of evaluations.

3.4.3 Discussion

3.4.3.1 Nutrients

Total-phosphorus exceedances in perennial and intermittent streams may result from rock weathering, airborne deposition, or soil erosion. Phosphorus comes in several forms, including a form sorbed to soil particles that may be transported to water bodies where dissolution can occur, resulting in bioavailable phosphorus. In the headwaters areas of Canyonlands NP stream basins, soil erosion on uplands may have been accelerated due to grazing, and may continue at an accelerated pace if soil-surface crusts have not stabilized despite the absence of grazing for many years (Reynolds et al. 2005). Although speculative, this scenario may have important management implications.

It is also possible that the phosphorus has a geologic origin and is naturally occurring at high levels due to weathering (Reynolds et al. 2001). Elevated total-phosphorus concentrations at sites in or near Canyonlands NP are consistent with 11–29 years of data (1977–2006), depending on the site (Brown and Thoma 2012). A better understanding of phosphorus source, transport, and biological effect in these watersheds would help determine potential management actions for restoration, including the possibility of reclassifying or providing site-specific classifications for water bodies based on natural conditions.

3.4.3.2 Metals

Erosion of the Mancos Shale formation causes naturally elevated selenium concentrations in surface-water bodies throughout the Northern Colorado Plateau. Water-qual-

ity monitoring sites located on the Colorado River are no exception, as a large contributing area of the watershed includes a Mancos Shale component. The Colorado River from its confluence with the Green River upstream to Moab was listed for selenium impairment on Utah's 303(d) list in 2006. Selenium impairment in Colorado contributes to the downstream impairment noted in Utah.

The sources of phosphorus and metals could be further investigated through evaluation of geologic formations and current and past human land-use practices in the watersheds. If a likely source or sources cannot be identified in the current literature or via additional internal investigation, the NPS could advance a regional study by partnering with academic institutions or the USGS. When park managers understand the source and mechanisms of pollutant transport to water bodies—and their potential biological impact—then management actions can be developed in cases where the pollutant source is anthropogenic. If the source is outside the park, then managers can advocate for the resource when opportunities arise. Additionally, when investigations of the source and cause determine that the pollutants are naturally occurring, the NPS can work with the state to reclassify water bodies or develop site-specific classifications to better reflect natural conditions.

3.5 Capitol Reef National Park

3.5.1 Water-quality summary

A total of 1,755 designated beneficial-use evaluations were completed for water-quality results obtained at six sites in or near Capitol Reef NP between October 1, 2012 and September 30, 2015. Of those 1,755 evaluations, 111 (6.3%) exceeded water-quality standards or criteria (Figure 3-13). Water-quality standards were exceeded for four constituent categories: *E. coli*, nutrients, temperature, and total dissolved solids (Figure 3-14).

3.5.2 Reportable exceedances

Temperature was the only water-quality parameter evaluated at the Fremont River near Bicknell site and there were no exceedances based upon 22 evaluations during this study period. The other five sites sampled had water-quality exceedances for the State of Utah (Table 3-5, Figure 3-15). The following discussion focuses only on sites that had exceedances.

3.5.2.1 Halls Creek below Narrows

This site exceeded the chronic standard for *E. coli* for secondary-contact recreation for 10% of evaluations. Water temperature exceeded the standard for warm-water game fish for 30% of evaluations.

3.5.2.2 Oak Creek above Sandy Ranch Dam

This site exceeded the chronic standard for *E. coli* for secondary-contact recreation for 31% of evaluations. Total phosphorus exceeded the indication of impairment for secondary-contact recreation for 38% of evaluations.

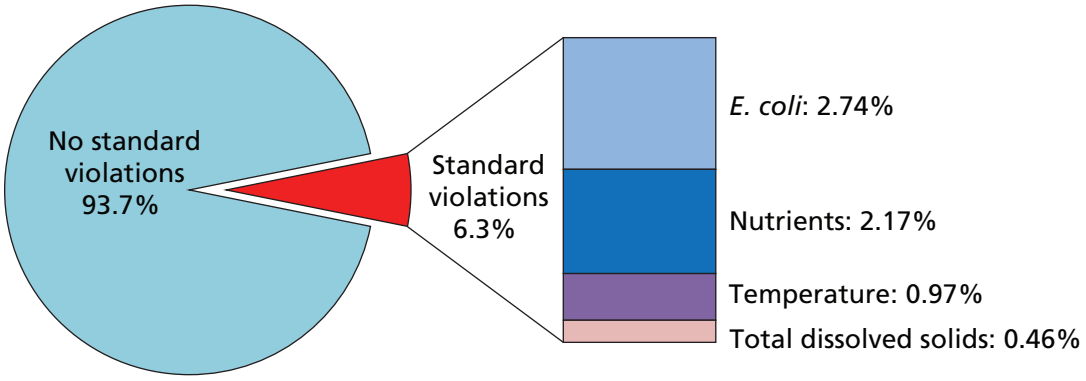


Figure 3-13. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Capitol Reef NP, October 1, 2012–September 30, 2015.

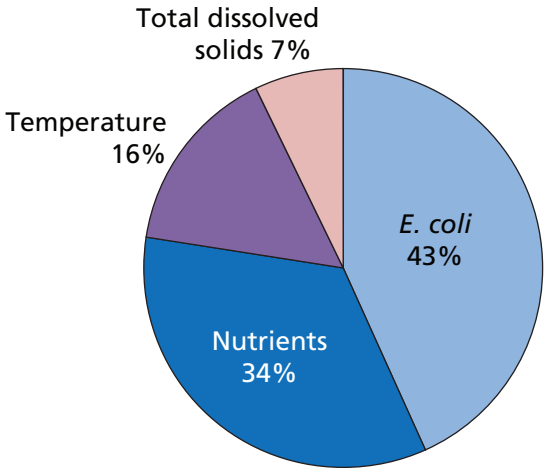


Figure 3-14. Sources of water quality standard violations, as percentages of samples with an exceedance at Capitol Reef NP, October 1, 2012–September 30, 2015.

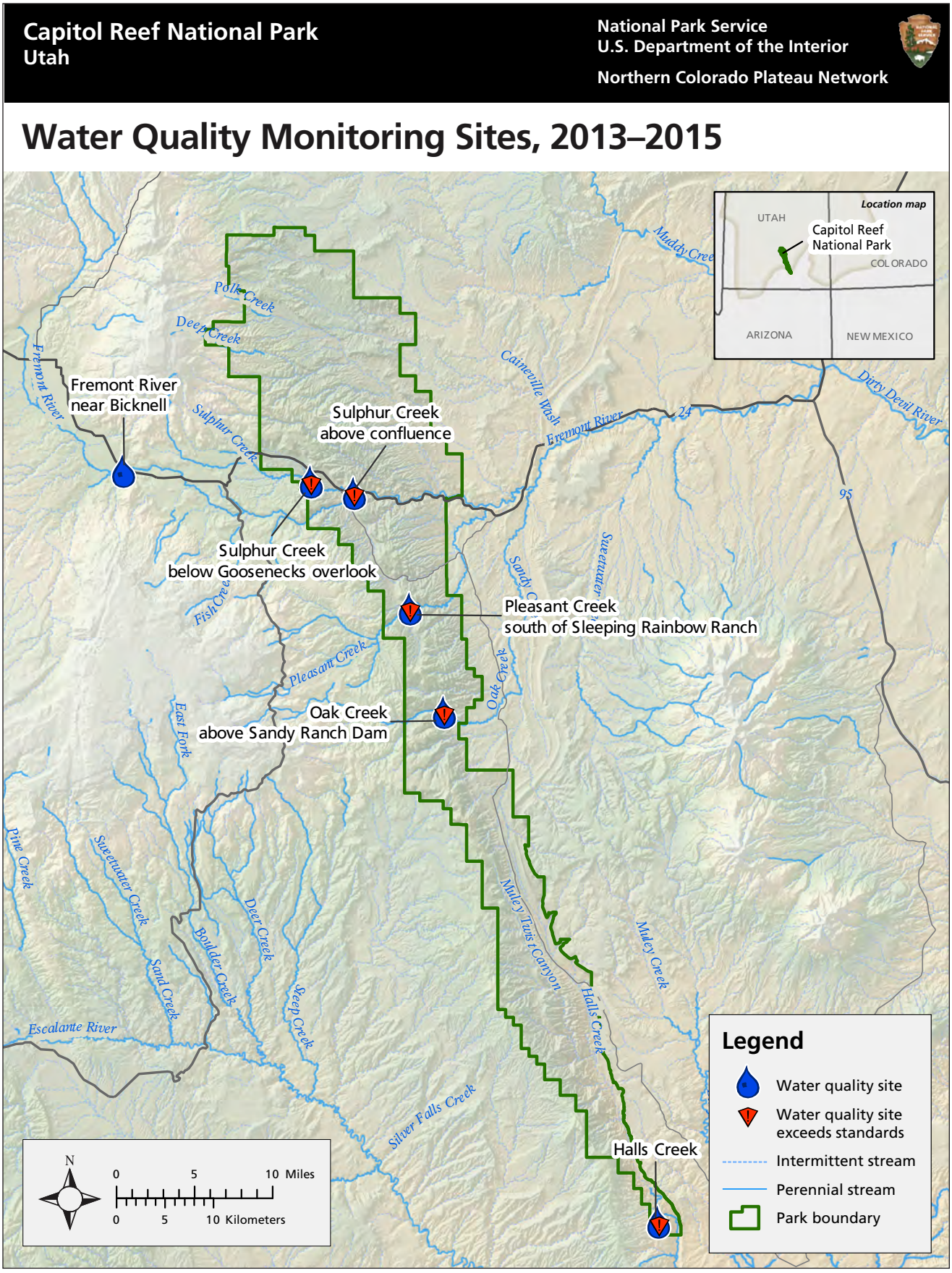


Figure 3-15. Water-quality monitoring locations in and near Capitol Reef National Park. Sites that exceeded standards for more than 10% of evaluations for one or more parameters are marked with a red symbol.

Table 3-5. Exceedances of surface water quality standards for sites sampled in or near Capitol Reef NP, October 1, 2012–September 30, 2015.

Site	Use code	Constituents	Numeric standard	Units	Total evaluations	% evaluations exceeded standards
Halls Creek below Narrows	2B	*E. coli*	206	MPN/100ml	10	10
	3B	Temperature, water	27	°C	10	30
Oak Creek above Sandy Ranch Dam	2B	*E. coli*	206	MPN/100ml	16	31
	2B	Phosphorus, total	0.05	mg/L	16	38
Pleasant Creek south of Sleeping Rainbow Ranch	1C, 2B	*E. coli*	206	MPN/100ml	19	21
	2B, 3A	Phosphorus, total	0.05	mg/L	19	42
	3A	Temperature, water	20	°C	20	20
Sulphur Creek above confluence with Fremont River	2A	*E. coli*	126	MPN/100ml	20	50
	1C	*E. coli*	206	MPN/100ml	20	40
	2A	*E. coli*	409	MPN/100ml	20	25
	1C	*E. coli*	668	MPN/100ml	20	10
	2A, 3A	Phosphorus, total	0.05	mg/L	19	26
	3A	Temperature, water	20	°C	20	30
	4	Total dissolved solids	1,200	mg/L	19	32
Sulphur Creek below road to Goosenecks Overlook	2A	*E. coli*	126	MPN/100ml	10	30
	1C	*E. coli*	206	MPN/100ml	10	20
	2A	*E. coli*	409	MPN/100ml	10	20
	2A, 3A	Phosphorus, total	0.05	mg/L	9	33
	3A	Temperature, water	20	°C	10	30
	4	Total dissolved solids	1,200	mg/L	8	25

Use codes: 2A = primary-contact recreation; 2B = secondary-contact recreation; 3A = cold-water game fish; 3B = warm-water game fish; 1C = drinking-water supply; 4 = agricultural use

3.5.2.3 Pleasant Creek south of Sleeping Rainbow Ranch

Pleasant Creek exceeded the standards for chronic drinking-water supply and secondary-contact recreation for *E. coli* for 21% of evaluations. The water-temperature standard for cold-water game fish was exceeded for 20% of evaluations. Total phosphorus exceeded the indication of impairment criteria for secondary-contact recreation and cold-water game fish for 42% of evaluations.

3.5.2.4 Sulphur Creek below road to Goosenecks Overlook

This site exceeded the chronic standard for *E. coli* for primary-contact recreation (126 MPN) for 50% of evaluations and drinking-water supply (206 MPN) for 40% of evaluations. The acute *E. coli* standard for primary-contact recreation (409 MPN) and drinking-water supply (668 MPN) was exceeded for 25% and 10% of evaluations, respectively. The water-temperature standard for cold-water game fish was exceeded for 30% of evaluations. Total phosphorus exceeded the indication of impairment criteria for primary-contact recreation and cold-water game fish for 26% of evaluations. Total dissolved solids exceeded the agricultural-use standard for 32% of evaluations.

3.5.2.5 Sulphur Creek above confluence with Fremont River

This site exceeded the chronic standard for *E. coli* for primary-contact recreation (126 MPN) for 30% of evaluations and drinking-water supply (206 MPN) for 20% of evaluations. The acute *E. coli* standard for primary-contact recreation (409 MPN) was exceeded for 20% of evaluations. The water-

temperature standard for cold-water game fish was exceeded for 30% of evaluations. Total phosphorus exceeded the indication of impairment criteria for primary-contact recreation and cold-water game fish for 33% of evaluations. Total dissolved solids exceeded the agricultural-use standard for 25% of evaluations.

3.5.3 Discussion and management implications

3.5.3.1 *E. coli*

Possible sources of *E. coli* contamination could be wildlife, domestic animals, humans, or a combination thereof. At Pleasant and Oak creeks, cattle are moved from lower pastures and up through the canyons to Boulder Mountain in May. The cattle are then trailed back through the canyon in September or October to return to lower elevations. Conditions after cattle trailing can cause damage to the riparian areas (Figure 16) and degrade water quality. Trespass cattle were noted outside of trailing times at Oak Creek. Also, cattle grazing occurs from early June through mid-October on U.S. Forest Service lands upstream of the park. Livestock are in the Oak Creek watershed for some or all of that time and could contribute to violations of water-quality standards.

During high-discharge events, runoff from the watershed contributes large amounts of sediment and organic material to streams. Fecal matter and its microbial components, such as *E. coli*, are carried into streams, along with silts and sands eroded during overland-flow events. *E. coli* readily binds to benthic and suspended sediment in surface water bodies, and is able to survive for prolonged periods when attached to sediments (Sampson et al. 2006). The majority of *E. coli* exceedances in Capitol Reef NP were associated with elevated turbidity and flow. The State of Utah has prioritized investigating *E. coli* exceedances in the Fremont River watershed by 2022.

3.5.3.2 Nutrients

Four sites within Capitol Reef NP exceeded the indication of impairment for total phosphorus. Rocks of volcanic origin are known to have naturally high levels of phosphorus (Brown and Thoma 2012) and are common in the upper watersheds of these streams, and a geologic source for these exceedances is likely. Anthropogenic activities, such as pasture irrigation, grazing, and OHV recreation, can accelerate erosion and transport of phosphorus (sorbed to sediment particles) to surface-water bodies. Further investigation is warranted to determine if the observed total-phosphorus concentrations are likely natural or anthropogenic in origin. If the observed total-phosphorus exceedances are strongly correlated with low dissolved-oxygen conditions, then management action could be war-



Figure 16a (left). Oak Creek before cattle trailing through the canyon, September 7, 2013 (looking downstream).



Figure 16b (right). Oak Creek after cattle trailing though the canyon, October 25, 2013 (looking downstream).

ranted. At these sites, elevated total-phosphorus concentrations did not coincide with low dissolved-oxygen concentrations, indicating a low likelihood of eutrophication.

3.5.3.3 Temperature

Elevated temperatures occurred at four sites within Capitol Reef National Park. Temperatures exceeded the State of Utah standard for cold-water game fish during the warmer summer months, usually from June through the beginning of September. Low-flow conditions, combined with hot summer air temperatures, cause periodic surface-water temperature exceedances at these sites.

3.5.3.4 Total dissolved solids

Both sites monitored on Sulphur Creek exceeded the agricultural-use standard for total dissolved solids. Sulphur Creek runs primarily through the Moenkopi Formation, which is known to contribute naturally high levels of dissolved solids (Doelling et al. 1989). Irrigation inflows and runoff from agricultural activities upstream from and within Capitol Reef NP are a possible anthropogenic source of elevated TDS levels.

3.6 Curecanti National Recreation Area

3.6.1 Water-quality summary

A total of 3,841 designated beneficial-use evaluations were completed for water-quality results obtained at 20 sites in and near Curecanti NRA between October 1, 2012 and September 30, 2015. Of those 3,841 evaluations, 104 (2.7%) exceeded water-quality standards or indications of impairment for the State of Colorado (Figure 3-17). Water-quality standards were exceeded for six constituent categories—most commonly, nutrients, metals, and temperature (Figure 3-18).

3.6.2 Reportable exceedances

Five sites in or near Curecanti NRA did not have exceedances. These included Curecanti Creek near Sapinero, Colorado (105 evaluations), Soap Creek above Chance Creek (193 evaluations), West Elk Creek below the U.S. Forest Service boundary (161 evaluations), Crystal Reservoir at Crystal Creek (56 evaluations), and Crystal Reservoir at Crystal Dam (56 evaluations). The Gunnison River at County Rd 32 below Gunnison, Colorado, had one exceedance that was in less than 10% of evaluations. All other sites sampled in Curecanti NRA had water-quality exceedances for the State of Colorado (Table 3-6, Figure 3-19). The following discussion focuses only on sites that had exceedances for more than 10% of evaluations.

3.6.2.1 Rivers and streams

Beaver Creek at Hwy 50 near Gunnison, Colorado. This site exceeded standards for *E. coli*, manganese, water temperature, and total phosphorus. One sample exceeded the chronic *E. coli* standard for undetermined-

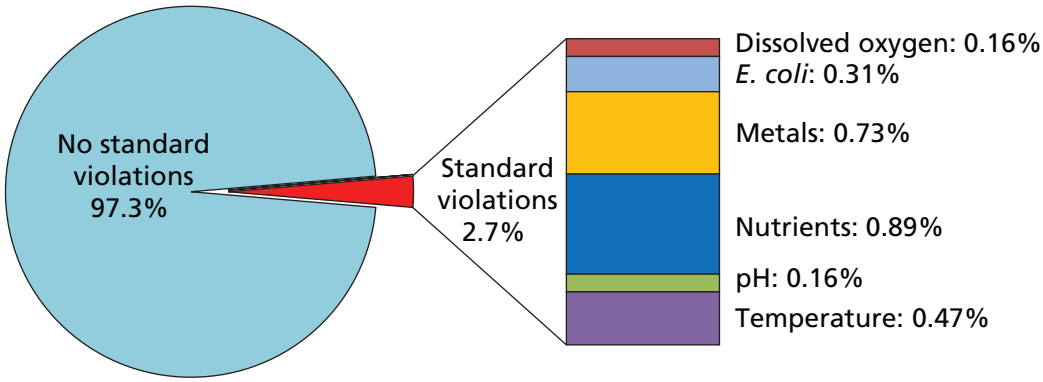


Figure 3-17. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Curecanti NRA, October 1, 2012–September 30, 2015.

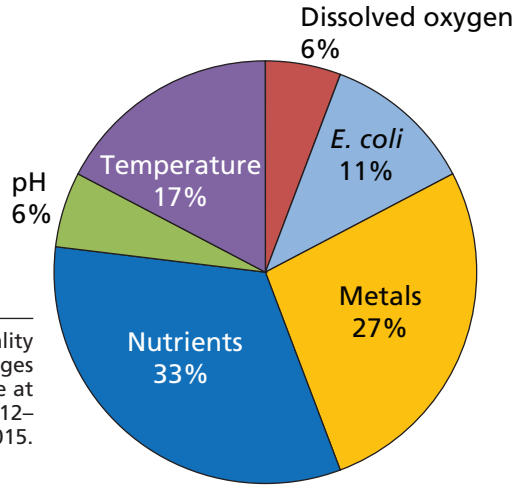


Figure 3-18. Sources of water quality standard violations, as percentages of samples with an exceedance at Curecanti NRA, October 1, 2012–September 30, 2015.

Water Quality Monitoring Sites, 2013–2015

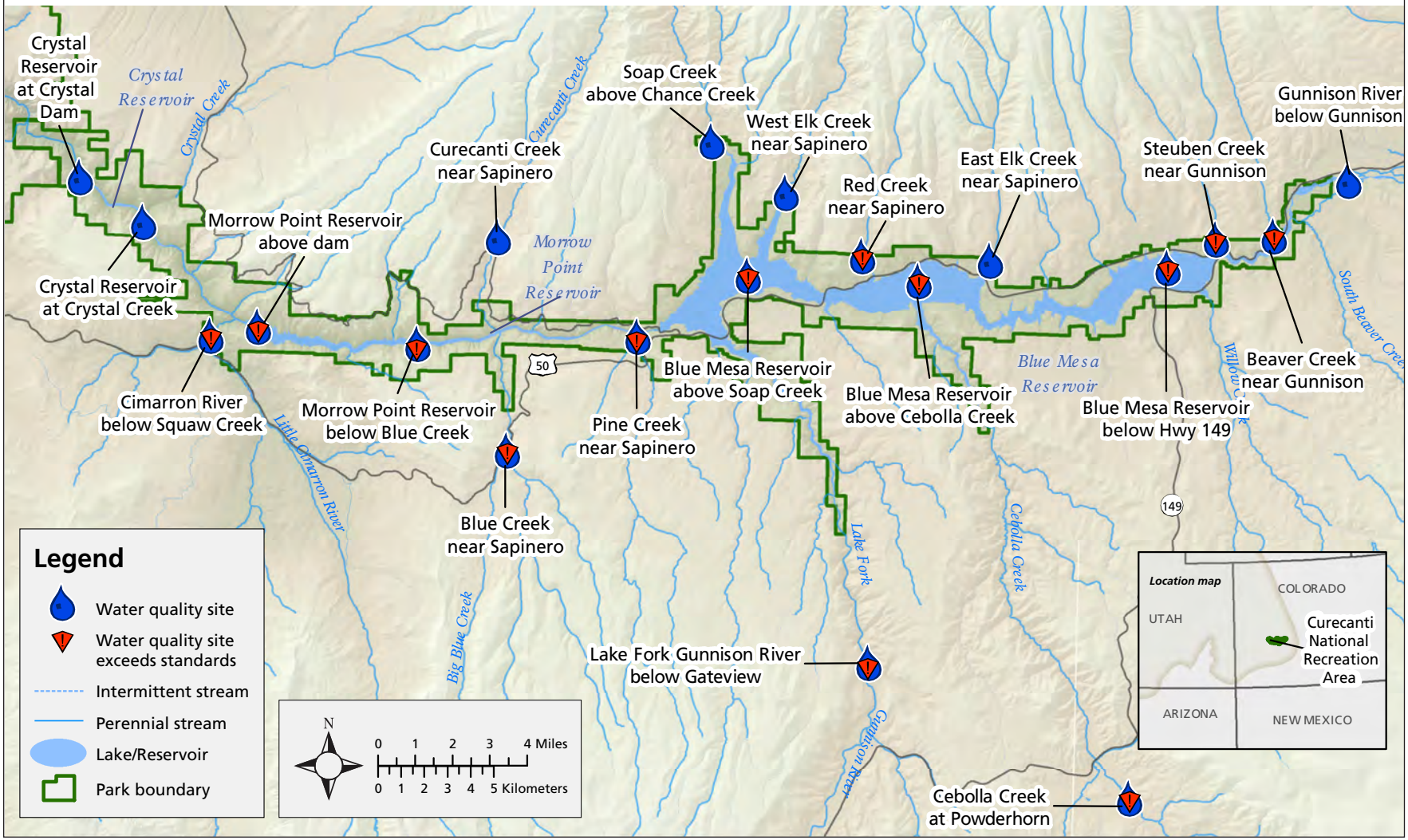


Figure 3-19. Water-quality monitoring locations in and near Curecanti National Recreation Area. Sites that exceeded standards for more than 10% of evaluations for one or more parameters are marked with a red symbol.

Table 3-6. Exceedances of surface water quality standards for sites sampled in or near Curecanti NRA, October 1, 2012–September 30, 2015.

Site	Use code	Constituents	Numeric standard	Units	Total evaluations	% evaluations exceeded standards
Beaver Creek at Hwy 50 near Gunnison, CO	RecU, UG26	*E. coli*	126	cfu/100ml	7	14
	DWS	Manganese, dissolved	50	µg/L	7	29
	ALCW1	Phosphorus, total	0.11	mg/L	7	29
	ALCW1	Temperature, water	date-dep.	°C	7	14
Blue Creek at Hwy 50 near Sapinero, CO	RecU, UG26	*E. coli*	126	cfu/100ml	6	33
Cebolla Creek at Powderhorn	ALCW1	Aluminum, dissolved	h-dep.	µg/L	12	25
	UG29b	Arsenic, total	0.02	µg/L	12	100
	DWS	Manganese, dissolved	50	µg/L	12	17
	ALCW1	Phosphorus, total	0.11	mg/L	12	17
Cimarron River below Squaw Creek near Cimarron, CO	RecU, UG26	*E. coli*	126	cfu/100ml	6	33
	ALCW1	Phosphorus, total	0.11	mg/L	7	57
	ALCW1	Temperature, water	date-dep.	°C	7	57
East Elk Creek near mouth near Sapinero, CO	DWS	Manganese, dissolved	50	µg/L	7	43
	ALCW1	Phosphorus, total	0.11	mg/L	7	71
	ALCW1	Temperature, water	date-dep.	°C	7	14
Lake Fork Gunnison River below Gateview, CO	ALCW1	Lead, dissolved	h-dep.	µg/L	7	14
Pine Creek at Hwy 50 near Sapinero, CO	ALCW1	Phosphorus, total	0.11	mg/L	7	43
	ALCW1	Temperature, water	date-dep.	°C	7	14
Red Creek near mouth near Sapinero, CO	ALCW1	Dissolved oxygen	7	mg/L	7	29
	DWS	Manganese, dissolved	50	µg/L	7	57
	ALCW1	Phosphorus, total	0.11	mg/L	7	100
	ALCW1	Temperature, water	date-dep.	°C	7	57
Steuben Creek near mouth near Gunnison, CO	ALCW1	Phosphorus, total	0.11	mg/L	7	14
Blue Mesa Reservoir above Cebolla Creek near Sapinero, CO	ALCW1	Dissolved oxygen	7	mg/L	7	14
	Res	Phosphorus, total	0.025	mg/L	7	29
	Res	Temperature, water	date-dep.	°C	7	29
Blue Mesa Reservoir above Soap Creek near Sapinero, CO	ALCW1	Dissolved oxygen	7	mg/L	7	29
	Res	Temperature, water	date-dep.	°C	7	29
Blue Mesa Reservoir below Hwy 149 near Gunnison, CO	ALCW1	Dissolved oxygen	7	mg/L	7	14
	ALCW1, DWS, RecE	pH	9	none	7	14
	Res	Phosphorus, total	0.025	mg/L	7	57
	Res	Temperature, water	date-dep.	°C	7	29
Morrow Point Reservoir above Morrow Point Dam near Cimarron, CO	ALCW1, DWS, RecE	pH	9	none	7	14
	Res	Phosphorus, total	0.025	mg/L	7	14

Table 3-6. Exceedances of surface water quality standards for sites sampled in or near Curecanti NRA, October 1, 2012–September 30, 2015, cont.

Site	Use code	Constituents	Numeric standard	Units	Total evaluations	% evaluations exceeded standards
Morrow Point Reservoir below Blue Creek near Sapinero, CO	Res	Phosphorus, total	0.025	mg/L	7	43

Use codes: ALCW1 = aquatic-life cold-water class 1; RecE = existing primary-contact recreation; RecU = undetermined-use recreation; DWS = drinking-water supply; UG26 = Upper Gunnison River basin segment 26 aquatic-life standard; UG29b = Upper Gunnison River basin segment 29b aquatic-life standard; Res = reservoir-specific aquatic-life standard
date-dep. = date-dependent; h-dep. = hardness-dependent

use recreation and Upper Gunnison River segment-specific aquatic life. Manganese exceeded the drinking-water supply standard for 29% of evaluations. On one occasion, water temperature exceeded the aquatic-life cold-water class 1 standard. Total phosphorus exceeded the interim standard for aquatic-life cold-water class 1 for 29% of evaluations.

Blue Creek at Hwy 50 (near Sapinero). At this site, *E. coli* exceeded the undetermined-use recreation standard and the Upper Gunnison River segment-specific standard for 33% of evaluations.

Cebolla Creek at Powderhorn. This site exceeded standards for aluminum, arsenic, manganese, and total phosphorus. Aluminum exceeded the aquatic-life cold-water class 1 standard for 25% of evaluations. Arsenic exceeded the Upper Gunnison River segment-specific standard for 100% of evaluations. Manganese exceeded the drinking-water supply standard for 17% of evaluations. Total phosphorus exceeded the interim standard for aquatic-life cold-water class 1 for 17% of evaluations.

Cimarron River below Squaw Creek near Cimarron, Colorado. This site exceeded standards for *E. coli*, temperature, and total phosphorus. *E. coli* exceeded the undetermined-use recreation standard and the Upper Gunnison segment-specific standard for 33% of evaluations. Temperature exceeded the aquatic-life cold-water class 1 standard for 57% of evaluations. Total phosphorus exceeded the interim standard for aquatic-life cold-water class 1 for 57% of evaluations.

East Elk Creek near mouth near Sapinero, CO. This site exceeded standards for manganese, water temperature, and total phosphorus. Manganese exceeded the drinking-water supply standard for 43% of evaluations. There are no drinking-water supplies drawn from East Elk Creek within or outside Curecanti NRA. On one occasion, water temperature exceeded the aquatic-life cold-water class 1 standard. Total phosphorus exceeded the interim standard for aquatic-life cold-water class 1 for 71% of evaluations.

Lake Fork Gunnison River below Gateview, CO. At this site, one of seven samples exceeded the standard for lead for aquatic-life cold-water class 1.

Pine Creek at Hwy 50 near Sapinero, CO. This site exceeded standards for water temperature and total phosphorus. On one occasion, water temperature exceeded the aquatic-life cold-water class 1 standard. Total phosphorus exceeded the interim standard for aquatic-life cold-water class 1 for 43% of evaluations.

Red Creek near mouth near Sapinero, Colorado. At this site, exceedances were observed for dissolved oxygen, manganese, water temperature, and total phosphorus. Dissolved-oxygen concentrations failed to meet the standard for aquatic-life cold-water class 1 for 29% of evaluations. Dissolved-manganese concentrations exceeded the chronic standard for drinking-water supply for 57% of evaluations. There are no drinking-water supplies drawn from Red Creek within or outside Curecanti NRA. Water temperature exceeded the aquatic-life cold-water class 1

standard for 57% of evaluations. Total phosphorus exceeded the interim standard for aquatic-life cold-water class 1 for 100% of evaluations.

Steuben Creek near mouth near Gunnison, CO. At this site, total phosphorus exceeded the interim standard for aquatic-life cold-water class 1 for 14% of evaluations.

3.6.2.2 Reservoirs

Blue Mesa Reservoir above Cebolla Creek near Sapinero, Colorado. This site exceeded the standards for DO, temperature, and total phoshorus. Dissolved-oxygen concentrations failed to meet the standard for aquatic-life cold-water class 1 for 14% of evaluations. Water temperature exceeded the State of Colorado reservoir-specific standard for aquatic-life cold-water for 29% of evaluations. Total phosphorus exceeded the interim standard for aquatic-life cold-water in Colorado reservoirs for 29% of evaluations.

Blue Mesa Reservoir above Soap Creek near Sapinero, CO. This site exceeded the standards for DO and temperature. Dissolved-oxygen concentrations failed to meet the standard for aquatic-life cold-water class 1 for 29% of evaluations. Water temperature exceeded the State of Colorado reservoir-specific chronic standard for aquatic-life cold-water for 29% of evaluations.

Blue Mesa Reservoir below Hwy 149 near Gunnison, CO. This site exceeded the standards for DO, pH, temperature, and total phosphorus. Dissolved-oxygen concentrations failed to meet the standard for aquatic-life cold-water class 1 on one occasion. One of seven samples exceeded pH standards for aquatic-life cold-water class 1, drinking-water supply, and existing primary-contact recreation. Water temperature exceeded the State of Colorado reservoir-specific chronic standard for aquatic-life cold-water for 29% of evaluations. Total phosphorus exceeded the interim standard for aquatic-life cold-water in Colorado reservoirs for 57% of evaluations.

Morrow Point Reservoir above Morrow Point Dam near Cimarron, CO. This site exceeded the standards for pH and total phosphorus. One of seven samples exceeded pH standards for aquatic-life cold-water class 1, drinking-water supply, and existing primary-contact recreation. Total phosphorus exceeded the interim standard for aquatic-life cold-water in Colorado reservoirs for 14% of evaluations.

Morrow Point Reservoir below Blue Creek near Sapinero, CO. This site exceeded the interim standard for total phosphorus for aquatic-life cold-water in Colorado reservoirs for 43% of evaluations.

3.6.3 Discussion and management implications

Generally, water quality of all streams in Curecanti NRA is excellent, with occasional exceedances due to naturally occurring conditions in the watersheds. A monitoring record of more than 10 years supports the findings in this report. In 2012, many tributaries that drain into Curecanti NRA from the north were designated as Outstanding National Resource Waters, which recognizes the high quality of these waters and prevents any future point-source pollutant inputs.

3.6.3.1 Dissolved oxygen

Seasonal fluctuations in DO concentrations occur in all surface-water bodies. During the summer, low-flow conditions and elevated water temperatures reduce the amount of oxygen dissolved in surface water. Red Creek failed to meet the standard for aquatic-life cold-water class 1 spawning present (7.0 mg/L) on two occasions in the summer months, but levels were within limits for spawning absent (6.0 mg/L). Exceedances in Blue Mesa reservoir occurred most often in July, and never exceeded the spawning-absent standard. These low DO concentrations occurred when spawning was potentially present in streams and reservoirs, and DO exceedances and water temperature exceedances tended to co-occur. No fish kills or other impacts have been noted during episodes of low DO.

3.6.3.2 E. coli

E. coli standards were exceeded at Beaver Creek, Blue Creek, and Cimarron River. Possible sources of *E. coli* contamination could be wildlife, domestic animals, humans, or a combination thereof. During high-discharge

events, runoff from the watershed and re-suspension of bedrock material contribute large amounts of sediment and organic material to streams. Fecal matter and its microbial components, such as *E. coli,* are carried into nearby streams, along with silts and sands that are eroded and re-suspended during these events. *E. coli* readily binds to benthic and suspended sediment, and is able to survive for prolonged periods when attached to sediments (Sampson et al. 2006). In addition, *E. coli* concentrations have been shown to be positively correlated with turbidity levels (Smith et al. 2008). Therefore, elevated *E. coli* concentrations are more likely to occur during turbid, high-discharge events.

The majority of *E. coli* exceedances in Curecanti NRA occurred during higher flows, but when the water was clear. Additionally, the majority of *E. coli* exceedances occurred during the summer months, when recreational activity in the park is at its peak. Because the risk of primary contact is greatest at the same time as when the *E. coli* exceedances tend to occur, it is recommended that park resource staff warn visitors of potential bacterial contamination and increase the rate of sample collection if an exceedance is observed in the future.

3.6.3.3 Metals

The chronic manganese standard for drinking-water supply was exceeded at four sites. Exceedances do not raise significant concerns because these sites have no direct drinking-water intakes. The tributaries drain areas of public land (including the West Elk Wilderness) that are minimally impacted by human activities, and it is likely that the source of manganese is natural weathering. It should also be noted that the concentration of manganese in these and other water bodies did not exceed criteria for aquatic life, and that the drinking-water supply standard of 50 µg/L is for odor, color, and staining—not human health.

It may be possible to request exemptions or site-specific manganese criteria if sufficient evidence exists to make a strong case for naturally occurring conditions that exceed criteria, and no drinking-water source exists on the water bodies. Such a change would not improve water quality, but would make accounting for exceedances more straightforward, especially if these conditions are already recognized by the Colorado State Water Quality Control Commission.

Aluminum concentrations at Cebolla Creek exceeded the standard on three occasions. These exceedances occurred during high-flow conditions, when overland flow may have carried natural sources of aluminum into the creek. Total arsenic levels at Cebolla Creek exceeded the chronic Upper Gunnison River segment-specific standard (0.02 µg/L) for all samples tested during the study period. The 12 samples tested for arsenic had concentrations of 0.38–0.93 µg/L, which were well below the maximum contaminant level (10 µg/L) for drinking-water supply standards. Arsenic was not measured at other sites in Curecanti NRA, so it is unknown what levels of arsenic are found throughout the area. At Cebolla Creek, arsenic most likely entered the watershed from erosion of natural deposits.

3.6.3.4 Nutrients

In June 2012, the Colorado Water Quality Control Commission adopted regulations to address current and potential future nutrient pollution of Colorado surface waters. Interim numerical values for nutrients, including phosphorus, nitrogen, and chlorophyll a, were established at levels to protect designated uses of Colorado waters. These would initially be applied only to streams and lakes above dischargers and to protect municipal water supplies taken directly from lakes or reservoirs.

The total-phosphorus interim standard for Colorado cold-water rivers and streams, scheduled to be implemented in 2022, is analyzed as an annual median value of 0.11 mg/L (CDPHE 2008). For purposes of this report, any individual total-phosphorus value for Curecanti NRA rivers and streams that exceeded 0.11 mg/L was included as an indicator that there is a potential problem. As with rivers and streams, there is an adopted interim standard for Colorado cold-water lakes and reservoirs. The interim total-phosphorus value for Colorado cold-water lakes and reservoirs is analyzed as an average value of 0.025 mg/L for the summer months. Any individual total-phosphorus value for Cu-

recanti NRA reservoirs that exceeded 0.025 mg/L was included in this report. Elevated phosphorus levels reported here are consistent with decades of data from streams in and near Curecanti NRA (Brown and Thoma 2012). Rocks of volcanic origin, which commonly occur around the recreation area, are known to contain relatively high amounts of phosphorus. A recent trend analysis indicates that total phosphorus is not increasing or decreasing (Brown and Thoma 2012), and it is likely that elevated phosphorus is a naturally occurring phenomenon at Curecanti NRA.

3.6.3.5 pH

At one site on Blue Mesa Reservoir and one site on Morrow Point Reservoir, elevated pH levels were measured during July 2013. At each of these sites, pH values measured before and after these exceedances were within acceptable limits. Because these pH exceedances were infrequent, no immediate management concern is warranted.

3.6.3.6 Temperature

Elevated temperatures occurred at eight sites in Curecanti NRA. Temperatures exceeded the State of Colorado standard for aquatic-life cold-water at five stream and river sites and at three sites at Blue Mesa Reservoir. Most exceedances occurred during the warmer summer months, although there were also exceedances during the seasonal-transition month of May, when the standard drops from 17°C (streams) or 18.3°C (reservoirs) to 9.0°C. At stream and river sites, low-flow conditions, combined with hot summer air temperatures, cause periodic surface-water temperature exceedances. At sites on Blue Mesa Reservoir, summer air temperatures heat the water surface and result in water temperatures above the chronic standard for large reservoirs (18.3°C). Reservoir data are based on samples collected one meter below surface, but other temperature data not assessed here show typical cold-water refugia at depth. As climate change continues to warm higher-elevation areas more rapidly than lower-elevation areas, continued stream-temperature exceedances may threaten spawning habitat for fish. To reduce stress on game fish, managers at Yellowstone National Park have elected to close fisheries during periods of high water temperatures, a management option that may also be helpful for cold-water tributaries at Curecanti NRA.

3.7 Dinosaur National Monument

3.7.1 Water-quality summary

A total of 1,735 designated beneficial-use evaluations were completed for water-quality results obtained at five sites in or near Dinosaur NM between October 1, 2012 and September 30, 2015. Of those 1,735 evaluations, 24 (1.4%) exceeded water-quality standards or indications of impairment (Figure 3-20). Water-quality standards were exceeded for four constituent categories: metals, nutrients, temperature, and *E. coli.* (Figure 3-21).

3.7.2 Reportable exceedances

The Yampa River near Maybell, Colorado, did not have any water-quality exceedances based upon 270 total evaluations. The other sites had exceedances for the states of Colorado or Utah (Table 3-7, Figure 3-22). The following discussion focuses only on sites that had exceedances.

3.7.2.1 Green River above Gates of Lodore

Temperatures at this site exceeded the Lower Yampa/Green River segment-specific standard for 17% of evaluations. This standard supersedes and augments the aquatic-life cold-water class 1 standard and is date-dependent. The temperature standard is 18.3°C for April 1–October 31 and 9°C for November 1–March 31.

3.7.2.2 Green River near Jensen, UT

At this site, total-phosphorus concentrations exceeded the indication of impairment criteria for primary-contact recreation and warmwater game fish for 50% of evaluations.

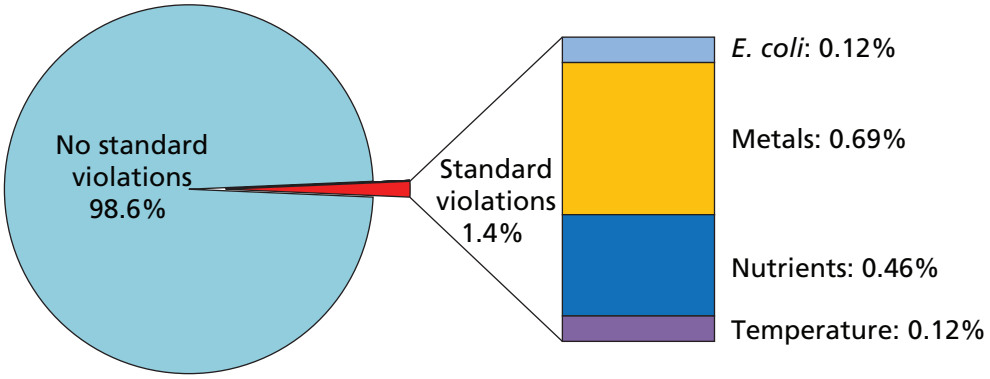


Figure 3-20. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Dinosaur NM, October 1, 2012–September 30, 2015.

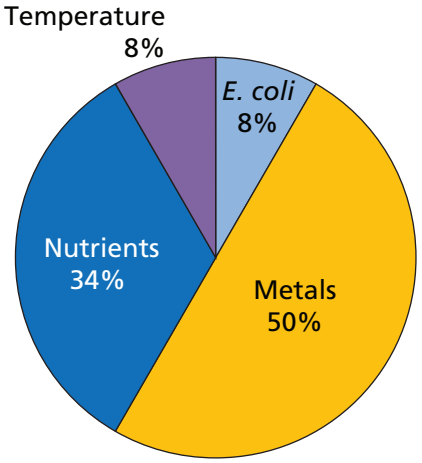


Figure 3-21. Sources of water-quality standard violations, as percentages of samples with an exceedance at Dinosaur NM, October 1, 2012–September 30, 2015.

Dinosaur National Monument
Colorado and Utah

National Park Service
U.S. Department of the Interior
Northern Colorado Plateau Network

Water Quality Monitoring Sites, 2013–2015

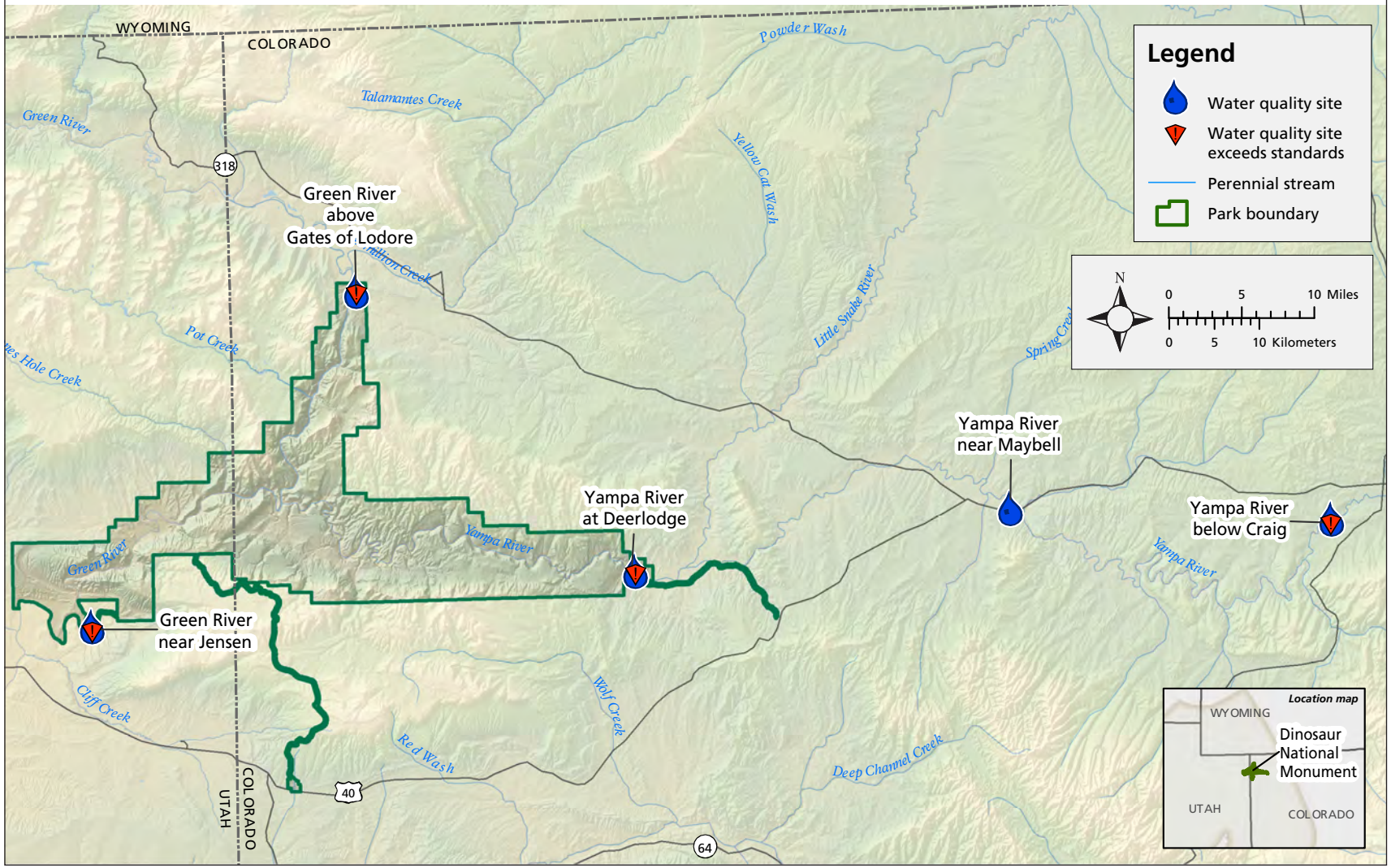


Figure 3-22. Water-quality monitoring locations in and near Dinosaur National Monument. Sites that exceeded standards for more than 10% of evaluations for one or more parameters are marked with a red symbol.

Table 3-7. Exceedances of surface water quality standards for sites sampled in or near Dinosaur NM, October 1, 2012–September 30, 2015.

Site	Use code	Constituents	Numeric standard	Units	Total evaluations	% evaluations exceeded standards
Green River above Gates of Lodore, CO	LYG19a	Temperature, water	date-dep.	°C	12	17
Green River near Jensen, UT	2A, 3B	Phosphorus, total	0.05	mg/L	4	50
Yampa River at Deerlodge Park, CO	ALWW1	Iron, total recoverable	1,000	µg/L	12	58
	ALWW1	Phosphorus, total	0.17	mg/L	16	19
Yampa River below Craig, CO	ALWW1	Iron, total recoverable	1,000	µg/L	12	25

Colorado use codes: ALWW1 = aquatic-life warm-water class 1; LYG19a = Lower Yampa/Green River basin segment 19a aquatic-life standard. Utah use codes: 2A = primary-contact recreation; 3B = warm-water game fish.
date-dep. = date-dependent

3.7.2.3 Yampa River at Deerlodge Park, Colorado

Total recoverable-iron concentrations exceeded the aquatic-life warm-water class 1 standard for 58% of evaluations. Total-phosphorus levels exceeded the aquatic-life warm-water class 1 interim standard for 19% of evaluations.

3.7.2.4 Yampa River below Craig, CO

This site exceeded the aquatic-life warm-water class 1 standard for total recoverable iron for 25% of evaluations.

3.7.3 Discussion and management implications

3.7.3.1 Metals

Elevated iron concentrations in the Yampa River have been well-documented (Roehm 2004; Harza 2002; Thoma et al. 2007). Naturally occurring mineralization of iron minerals is prevalent in the watershed. Elevated concentrations may also be a result of runoff from mining operations throughout the basin. Iron exceedances have been regularly observed in the past, are included in two State of Colorado watershed management plans, and are not unique to the lower portions of the Yampa River watershed. In 2010, the Yampa River from Elkhead Creek to its confluence with the Green River was added to Colorado's 303(d) list for iron exceedances. Total recoverable iron concentrations in the Yampa River at Deerlodge Park, Colorado, were consistently higher than concentrations observed upstream at Craig, Colorado, indicating that there is a source of iron located between these two sites.

3.7.3.2 Nutrients

Elevated total-phosphorus values are consistent with 27–33 years of data, and total-phosphorus concentrations have not increased or decreased at these sites (Brown and Thoma 2012). Naturally elevated phosphorus conditions are common throughout the Northern Colorado Plateau, and are suspected, in many cases, to be geologic in origin. Anthropogenic activities, such as logging, grazing, and OHV recreation, can accelerate erosion and transport of phosphorus (sorbed to sediment particles) to surface water bodies. Further investigation is warranted to determine if the observed total-phosphorus concentrations noted here are likely natural or anthropogenic in origin.

3.7.3.3 Temperature

Temperature exceedances observed at the Green River above Gates of Lodore were infrequent, and both exceedances occurred during the summer. Low-flow conditions, combined with hot summer air temperatures, cause periodic surface-water temperature exceedances.

3.8 Golden Spike National Historic Site

3.8.1 Water-quality summary

No data were reported for the single station located near Golden Spike National Historic Site between October 1, 2012 and September 30, 2015. This site, Blue Creek at County Road 504, is sampled by the State of Utah (see Section 1.5).

3.9 Hovenweep National Monument

3.9.1 Water-quality summary

A total of 347 designated beneficial-use evaluations were determined for water-quality results obtained at two sites in Hovenweep NM between October 1, 2012 and September 30, 2015. Of those 347 evaluations, 19 (5.5%) exceeded water-quality standards or indications of impairment (Figure 3-23). Water-quality standards were exceeded for three constituent categories: dissolved oxygen, nutrients, and total dissolved solids (Figure 3-24).

3.9.2 Reportable exceedances

Both sites sampled had water-quality exceedances for the State of Utah (Table 3-8, Figure 3-25).

3.9.2.1 Cajon Spring

At this site, DO concentrations failed to meet the chronic warm-water game-fish standard for the three times it was tested during this study period. Two of three visits also exceeded the acute warm-water game-fish standard (3.0 mg/L). Total phosphorus concentrations exceeded the indication of impairment for the primary-contact recreation and warm-water game-fish standards for 100% of evaluations. Cajon Spring is primarily a catchment basin for rain, and the Southeast Utah Group has removed it from the long-term monitoring program.

3.9.2.2 Square Tower Spring

Dissolved-oxygen concentrations failed to meet the chronic warm-water game-fish standard for 55% of evaluations; 18% of visits also exceeded the acute warm-water game-fish standard (3.0 mg/L). Total dissolved solids exceeded the agricultural-use standard for 25% of evaluations.

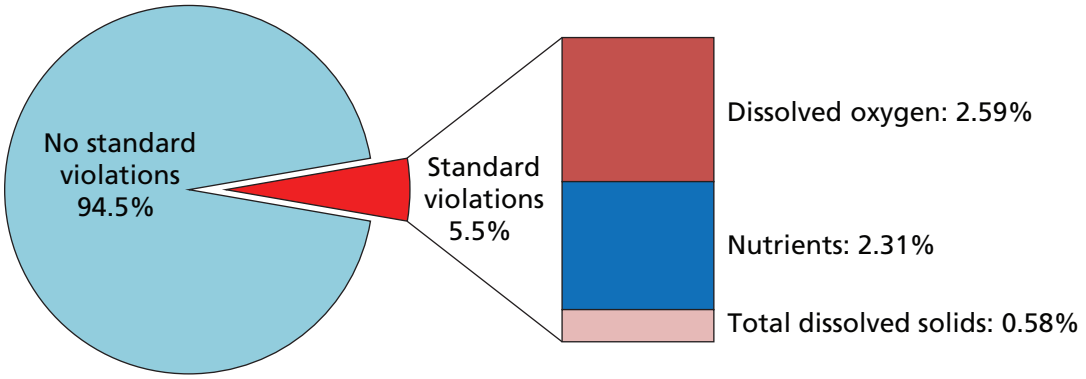


Figure 3-23. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Hovenweep NM, October 1, 2012–September 30, 2015.

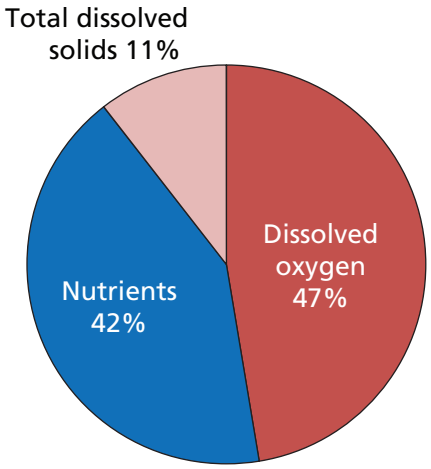


Figure 3-24. Sources of water-quality standard violations, as percentages of samples with an exceedance at Hovenweep NM, October 1, 2012–September 30, 2015.

Hovenweep National Monument
Colorado and Utah

National Park Service
U.S. Department of the Interior
Northern Colorado Plateau Network

Water Quality Monitoring Sites, 2013–2015

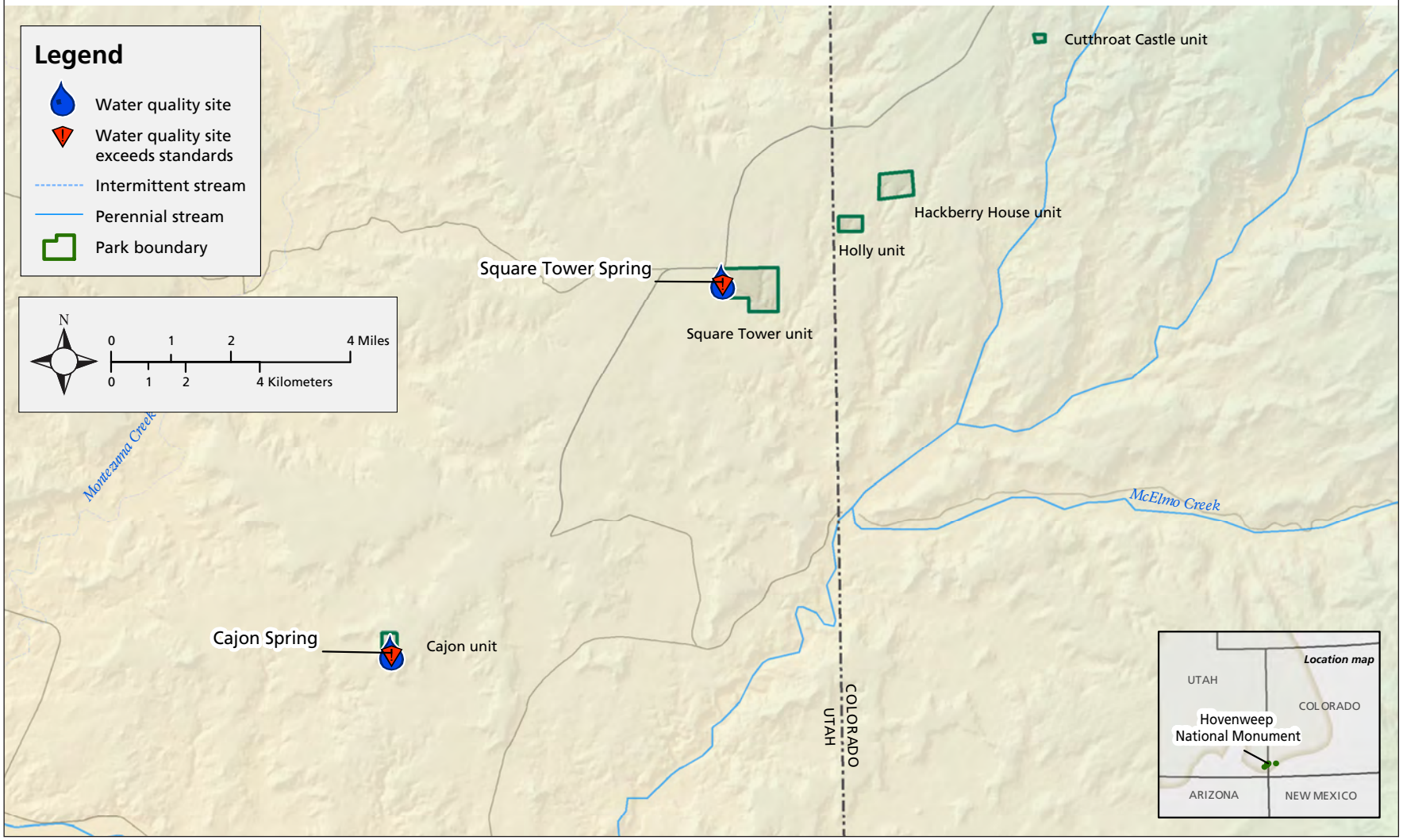


Figure 3-25. Water-quality monitoring locations in Hovenweep National Monument. Sites that exceeded standards for more than 10% of evaluations for one or more parameters are marked with a red symbol.

Table 3-8. Exceedances of surface water quality standards for sites sampled in or near Hovenweep NM, October 1, 2012–September 30, 2015.

Site	Use code	Constituents	Numeric standard	Units	Total evaluations	% evaluations exceeded standards
Cajon Spring	3B	Dissolved oxygen	5.5	mg/L	3	100
	2A, 3B	Phosphorus, total	0.05	mg/L	3	100
Square Tower Spring	3B	Dissolved oxygen	5.5	mg/L	11	55
	4	Total dissolved solids	1,200	mg/L	8	25

Use codes: 2A = primary-contact recreation; 3B = warm-water game fish; 4 = agricultural use

3.9.3 Discussion and management implications

Sites in Hovenweep NM are protected for warm-water aquatic life. However, the isolated nature of these water bodies differentiates them from others nearby. The aquatic-life standards for Square Tower and Cajon springs were intended to protect the segment of the San Juan River and its tributaries between Lake Powell and the Colorado–Utah state line. These standards are applicable by law; however, the ephemeral and intermittent nature of these water bodies significantly differentiates them from the San Juan River. In fact, there are no known breeding populations of fish within Square Tower or Cajon springs, and all water that enters the San Juan River from the park is derived from episodic or seasonal-driven events that likely do not reflect long-term water-quality conditions at these sites. Comparison of water-quality results against long-term trends observed within these systems will better detect the timing and occurrence of degradation (if present) than comparison of these systems against water-quality standards designed for large water bodies, such as the San Juan River.

3.9.3.1 Dissolved oxygen

Cajon Spring has little-to-no actual spring input and is largely or completely a rain-catchment pool. Surface-water influx during precipitation and/or snowmelt events causes DO concentrations to rise in the Cajon pool. After a rain event, the catchment, which is relatively deep, stagnates, and concurrent processes, such as elevated temperatures and increased microbial decomposition, cause DO concentrations to decrease.

In contrast, Square Tower Spring is a small, constant, spring-fed pool in the back of a protected alcove. The spring receives little direct influence from precipitation events. The oxygen-depleted groundwater discharged at this spring site is a natural phenomenon, and indicates that the water has been underground long enough to achieve complete or significant biological reduction of oxygen.

3.9.3.2 Nutrients

Naturally elevated phosphorus conditions are common throughout the Northern Colorado Plateau, and are suspected, in many cases, to be geologic in origin. Anthropogenic activities, such as pasture irrigation, grazing, and OHV recreation, can accelerate erosion and transport of phosphorus (sorbed to sediment particles) to surface water bodies. Cajon Spring is the only site likely to be affected by runoff events and has a history of more frequent and larger total-phosphorus exceedances than other sites at Hovenweep NM (Schelz and Moran 2006). Further investigation is warranted to determine if the observed total-phosphorus concentrations are natural or anthropogenic in origin.

3.9.3.3 Total dissolved solids

Square Tower Spring had two exceedances for total dissolved solids, consistent with the data history of this site (Schelz and Moran 2006). The spring is situated in a well-protected alcove, and no direct anthropogenic influences are suspected at the site. The overlying Dakota Sandstone, which serves as a shallow aquifer for the spring, can have variable amounts of clays and silts, which can contribute to dissolved solid concentrations in springs.

3.10 Natural Bridges National Monument

The sites at Natural Bridges National Monument were removed from the Southeast Utah Group long-term water-quality monitoring rotation after a reassessment of the monitoring program in 2012. This park will not be included in future reports unless circumstances change to warrant renewed monitoring. After 19 years of monitoring at these sites, water-quality data baselines are well-established. This baseline information will be valuable for comparison should threats arise in the future.

3.11 Timpanogos Cave National Monument

3.11.1 Water-quality summary

A total of 930 designated beneficial-use evaluations were completed for water-quality results obtained for two sites at Timpanogos Cave NM between October 1, 2012 and September 30, 2015. Two of those evaluations (0.2%) exceeded standards for metals (Figure 3-26). At Hidden Lake, one sample exceeded the selenium standard for cold-water game fish and agricultural use (8% of site visits). Hansen Cave Spring did not have any water-quality exceedances based upon 483 total evaluations (Figure 3-27).

3.11.2 Discussion and management implications

This is the first time that there has been an exceedance for metals at Timpanogos Cave. The single selenium exceedance at Hidden Lake was an unusually high concentration, at 150 µg/L, whereas other values for the study period were between 3.14 to 4.43 µg/L. Because of fire damage at the analytical laboratory, this sample was processed at a different lab, which could be a reason for the atypical result.

Continued water-quality monitoring is warranted for the purpose of long-term trend assessments. A trend assessment is likely a better method for evaluating condition than comparison against state water-quality standards protective of the American Fork River and its tributaries, and will provide early detection of degradation if it occurs.

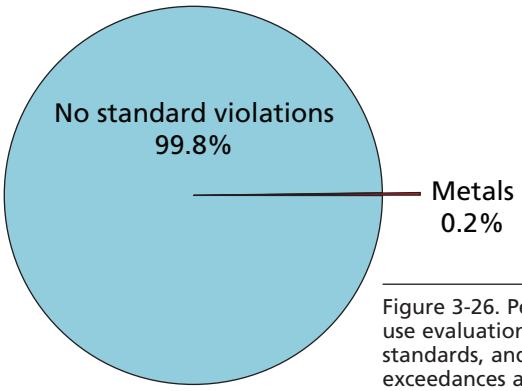


Figure 3-26. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Timpanogos Cave NM, October 1, 2012–September 30, 2015.

Timpanogos Cave National Monument
Utah

National Park Service
U.S. Department of the Interior
Northern Colorado Plateau Network

Water Quality Monitoring Sites, 2013–2015

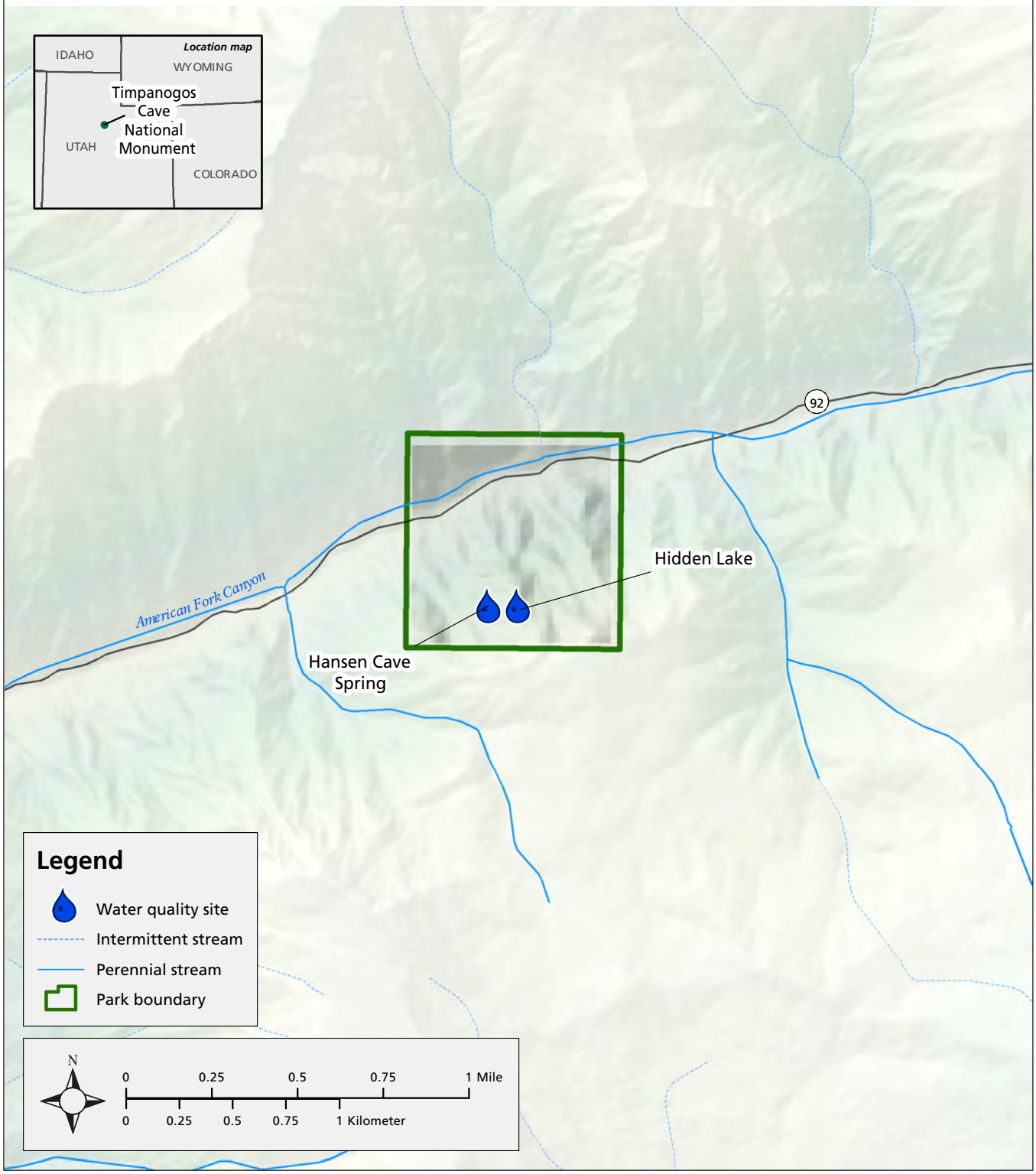


Figure 3-27. Water-quality monitoring locations in Timpanogos Cave National Monument.

3.12 Zion National Park

3.12.1 Water-quality summary

A total of 2,197 designated beneficial-use evaluations were completed for water-quality results obtained at five sites in and around Zion NP between October 1, 2012 and September 30, 2015. Of those 2,197 evaluations, 63 (2.9%) exceeded water-quality standards or indications of impairment (Figure 3-28). Water-quality standards were exceeded for five constituent categories—most commonly, pH, *E. coli*, temperature, and nutrients (Figure 3-29).

3.12.2 Reportable exceedances

Of the five sites evaluated for Zion NP, two did not have water-quality exceedances for the State of Utah: North Fork Virgin River near Springdale, Utah (7 total evaluations; water temperature only), and Virgin River near Virgin, Utah (119 total evaluations; water temperature and dissolved oxygen). Three of five sites sampled had exceedances (Table 3-9, Figure 3-30). The following discussion focuses only on sites that had exceedances.

3.12.2.1 La Verkin Creek at Lee Pass Trail

Total-phosphorus concentrations at this site, in the Kolob Canyons area of the park, exceeded the State of Utah indication of impairment for secondary-contact recreation and warm-water game fish for 14% of evaluations.

3.12.2.2 North Creek at planned gage in park

This site exceeded pH standards for drinking-water supply, secondary-contact recreation, non-game fish, and agricultural use for 23% of evaluations.

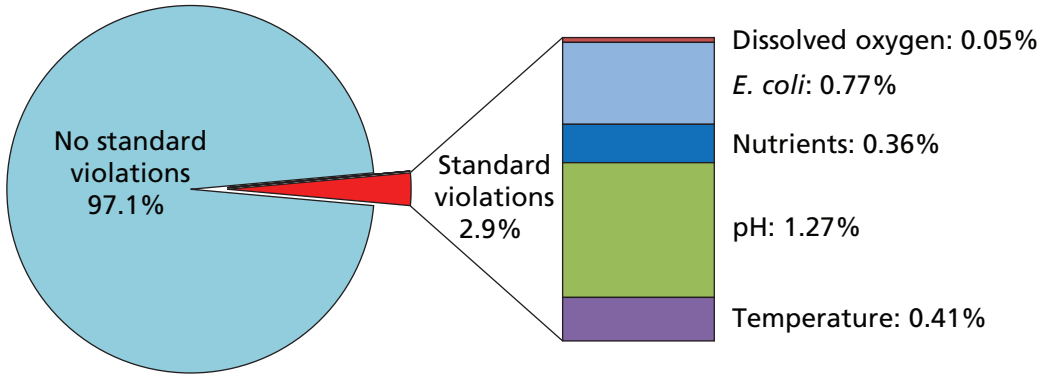


Figure 3-28. Percentage of use evaluations that exceeded standards, and the causes of exceedances as percentages of all samples, Zion NP, October 1, 2012–September 30, 2015.

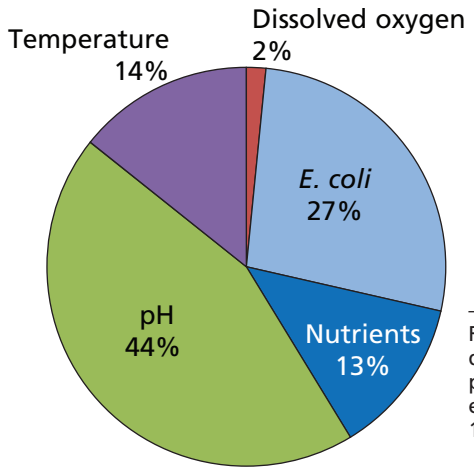


Figure 3-29. Sources of water quality standard violations, as percentages of samples with an exceedance at Zion NP, October 1, 2012–September 30, 2015.

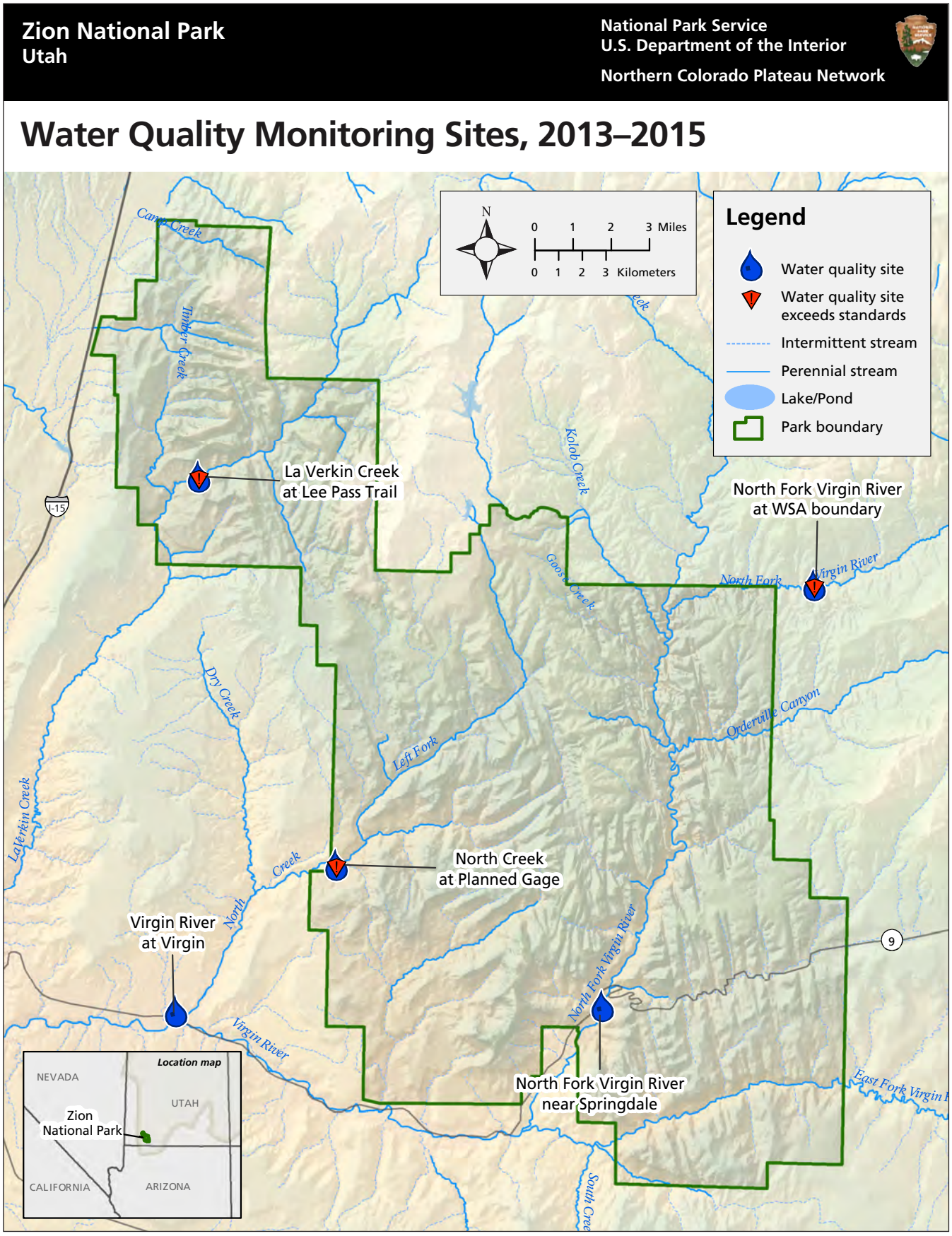


Figure 3-30. Water-quality monitoring locations in and near Zion National Park. Sites that exceeded standards for more than 10% of evaluations for one or more parameters are marked with a red symbol.

Table 3-9. Exceedances of surface water quality standards for sites sampled in or near Zion NP, October 1, 2012–September 30, 2015.

Site	Use code	Constituents	Numeric standard	Units	Total evaluations	% evaluations exceeded standards
La Verkin Creek at Lee Pass Trail	2B, 3B	Phosphorus, total	0.05	mg/L	28	14
North Creek at planned gage in park	1C, 2B, 3C, 4	pH	9	none	30	23
North Fork Virgin River at BLM–WSA boundary	2A	*E. coli*	126	MPN/100ml	27	26
	1C	*E. coli*	206	MPN/100ml	27	22
	3A	Temperature, water	20	°C	27	30

Use codes: 1C = drinking-water supply; 2A = primary-contact recreation; 2B = secondary-contact recreation; 3A = cold-water game fish; 3B = warm-water game fish; 3C = non-game fish; 4 = agricultural use

3.12.2.3 North Fork Virgin River at BLM–WSA boundary

This site exceeded the chronic *E. coli* standard for primary-contact recreation (126 MPN) for 26% of evaluations and drinking-water supply (206 MPN) for 22% of evaluations. A combination of livestock grazing and flood-irrigation practices have resulted in chronic impairment of the site and 303(d) listing in 2010 (Hackbarth and Weissinger 2013, 60). At this site, water temperatures exceeded the standard for cold-water game fish for 30% of site visits.

3.12.3 Discussion and management implications

3.12.3.1 *E. coli*

In summer months, *E. coli* contamination in the North Fork Virgin River upstream from the Narrows has been relatively consistent since the NCPN started monitoring efforts in 2006 (Van Grinsven et al. 2010; Hackbarth and Weissinger 2013). Zion NP staff noted exceedances above the Narrows in 2001 (D. Sharrow, ZION Hydrologist, pers. comm.). The North Fork of the Virgin River, from its confluence with Deep Creek to its headwaters, was added to Utah's 303(d) list of impaired waters because of *E. coli* contamination in 2010. Cooperative sampling between the State of Utah, the National Park Service, and the Bureau of Land Management continues to document chronic exceedances due to flood irrigation of riverside pastures grazed by livestock (Hackbarth and Weissinger 2013, 60).

The State of Utah continues to work with landowners and grazing permittees to improve water quality at this site. The large-scale irrigation improvement project proposed in 2013, that would have included both private and BLM land, has been put on hold indefinitely. The high cost (>$1 million), engineering concerns, and the concern over how well it would be managed all contributed to this decision.

In 2015, electric fences were installed around the pastures in an effort to rotate cattle off pastures as they were irrigated. Monitoring results show that initially, the grazing management may have been keeping *E. coli* concentrations below the standard—but by mid-August, concentrations downstream of irrigation and grazing exceeded the standard. Some of the issues with the project included lack of permittee support and participation, a short work season for the intern who helped manage and monitor the project, trespass cattle, and leaky canals that continually watered certain areas of pasture.

In May 2016, a control gate and flume were installed in one of the irrigation ditches in an attempt to limit the amount of water irrigating the pastures. Intensive monitoring will continue until the state removes this site from the 303(d) list of non-compliant waters.

At that time, the NCPN will resume regular monitoring and monitoring by the park and state may be reduced or cease.

3.12.3.2 Nutrients

Naturally elevated phosphorus conditions are common throughout the Northern Colorado Plateau, and are suspected, in many cases, to be caused by natural weathering of geologic strata containing phosphorus. Anthropogenic activities, such as pasture irrigation, grazing, and OHV recreation, can accelerate erosion and transport of phosphorus (sorbed to sediment particles) to surface water bodies. Further investigation is warranted to determine if the observed total-phosphorus concentrations are likely natural or anthropogenic in origin. If the observed total-phosphorus exceedances are strongly correlated with low DO conditions, then management action could be warranted.

High total-phosphorus concentrations at La Verkin Creek tend to occur during high-runoff events during the spring or after monsoonal storms in late summer. Consistent with previous reports, there is a correlation between stream turbidity and total phosphorus. Most of the time, when the stream is significantly turbid (>100 NTU), total-phosphorus concentrations exceed the indication of impairment for the State of Utah.

Upcoming trend analysis should evaluate this relationship to determine if soil erosion might be a significant factor in phosphorus loading at La Verkin Creek. Because DO concentrations remain within acceptable limits, it is unlikely that the observed total-phosphorus concentrations are causing eutrophication processes in La Verkin Creek that negatively impact aquatic ecological functions. Therefore, the observed total-phosphorus concentrations in La Verkin Creek do not currently warrant management concern.

3.12.3.3 pH

In 2006, a wildfire along the Right Fork of North Creek removed the vegetation cover that provided shade protection to the river corridor and erosion control within the watershed. The associated increase in solar energy and influx of nutrients sorbed to sediments that resulted from this disturbance most likely increased the rate of photosynthetic activity within North Creek, which causes a corresponding increase in pH. During warm summer months, pH levels still occasionally exceed applicable standards, as noted in previous reports (Van Grinsven et al. 2010; Hackbarth and Weissinger 2013; Figure 3-31).

The geochemical components of watersheds throughout the Northern Colorado Plateau and, more specifically, in North Creek, naturally cause the pH of surface water to be slightly basic. However, the above-normal rate of photosynthesis during the summer months in North Creek appears to cause alkalinization of water, resulting in periodic water-quality exceedances for pH.

3.12.3.4 Temperature

Temperature exceedances in the North Fork Virgin River at the BLM Wilderness Study Area boundary occurred during the hotter months of June through September, and exceeded the State of Utah standard for cold-water game fish. Low-flow conditions, in concert with hot summer air temperatures, cause periodic surface-water temperature exceedances during the summer months at this site. Downstream of this site, the North Fork Virgin River, from its confluence with the East Fork to Kolob Creek, was added to the state 303(d) list of impaired waters in 2010 for water-temperature exceedances. The State of Utah is considering whether the North Fork Virgin River might be more appropriately classified as a warm-water game fishery.

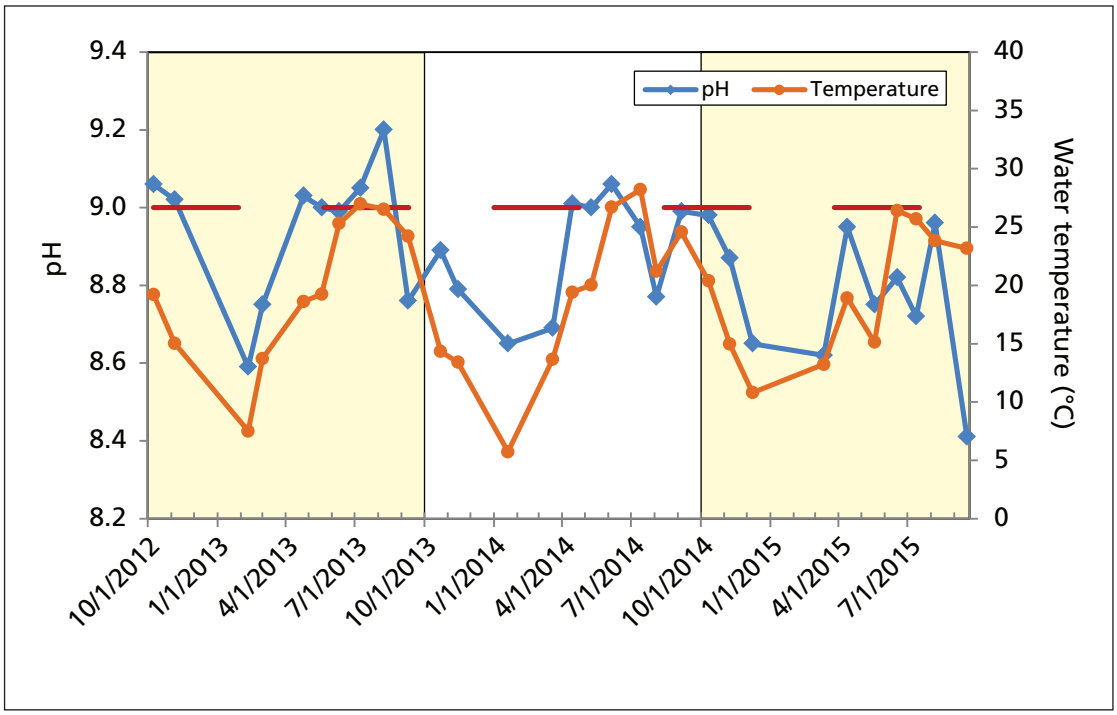


Figure 3-31. North Creek pH levels compared with temperature, October 1, 2012–September 30, 2015. Red-dashed line = State of Utah exceedance criteria for pH.

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Appendix A. Water Quality Sites Reported, Water Years 2013–2015.

Station ID	Station name	Latitude	Longitude	Designated beneficial uses
Arches National Park				
09180500	Colorado R nr Cisco, UT	38.811	-109.293	1C, 2A, 3B, 4
09163500	Colorado R nr Colorado-Utah state line	39.133	-109.027	Ag, ALWW1, RecE, LC3
5995240	Courthouse Wash .5 mi ab Colorado R at USGS CW-1	38.613	-109.579	1C, 2A, 3B, 4
5995246	Courthouse Wash at spring inside Arches NP west bndry	38.687	-109.653	1C, 2A, 3B, 4
09180000	Dolores R nr Cisco, UT	38.797	-109.195	2B, 3C, 4
5995220	Salt Wash at Wolfe Ranch rd xing SW-3	38.735	-109.519	1C, 2A, 3B, 4
Black Canyon of the Gunnison National Park				
09128000	Gunnison R bl Gunnison Tunnel, CO	38.529	-107.649	Ag, ALCW1, DWS, RecE, LG1
383537107471500	Red Rock Canyon at mouth nr Montrose, CO	38.594	-107.788	Ag, ALWW2, DWS, RecE, LG4c
383418107471401	Red Rock Canyon nr NPS boundary nr Montrose, CO	38.572	-107.788	Ag, ALWW2, DWS, RecE, LG4c
Bryce Canyon National Park				
4951915	Mossy Cave Spring NW of Tropic	37.665	-112.115	2B, 3C, 4
4951855	Sheep Ck bl Spring in Bryce Cyn NP	37.571	-112.201	2B, 3C, 4
N/A	Tropic Ditch	37.665	-112.115	2B, 3C, 4
4951857	Yellow Ck bl Spring in Bryce Cyn NP	37.574	-112.141	2B, 3C, 4
Canyonlands National Park				
4952400	Colorado R ab cnfl / Green R	38.193	-109.884	1C, 2A, 3B, 4
4952380	Colorado R bl Big Drop #3 rapids	38.071	-110.046	1C, 2A, 3B, 4
4956290	Colorado R at Potash Boat Ramp	38.467	-109.666	1C, 2A, 3B, 4
4930010	Green R ab cnfl / Colorado R	38.190	-109.889	1C, 2A, 3B, 4
4930150	Green R at Mineral Bottom	38.527	-109.993	1C, 2A, 3B, 4
09315000	Green R at Green R, UT	38.896	-110.151	1C, 2A, 3B, 4
09272400	Green R at Ouray, UT	40.085	-109.677	1C, 2A, 3B, 4
Capitol Reef National Park				
09330000	Fremont R nr Bicknell, UT	38.307	-111.517	1C, 2A, 3A, 4
4954812	Halls Ck bl Narrows	37.615	-110.892	2B, 3B, 4
4954795	Oak Creek above Sandy Ranch Dam	38.084	-111.140	2B, 3C, 4
4954780	Pleasant Ck S of Sleeping Rainbow Ranch	38.180	-111.181	1C, 2B, 3A
4954770	Sulphur Ck ab cnfl / Fremont R in picnic area	38.287	-111.247	1C, 2A, 3A, 4
4954775	Sulphur Ck bl road to Goosenecks Overlook	38.307	-111.315	1C, 2A, 3A, 4
Curecanti National Recreation Area				
382943107015300	Beaver Creek at HWY 50 nr Gunnison, CO	38.495	-107.032	Ag, ALCW1, DWS, RecU, UG26
382418107242600	Blue Creek at HWY 50 nr Sapinero, CO	38.405	-107.408	Ag, ALCW1, DWS, RecU, UG26
381633107054700	Cebolla Creek at Powderhorn, CO	38.276	-107.097	Ag, ALCW1, DWS, RecU, UG29b
09127000	Cimarron R bl Squaw Creek nr Cimarron, CO	38.446	-107.556	Ag, ALCW1, DWS, RecU, UG26
09125000	Curecanti Creek nr Sapinero, CO	38.488	-107.415	Ag, ALCW1, DWS, RecU, UG26
382900107101600	East Elk Creek nr mouth nr Sapinero, CO	38.483	-107.172	Ag, ALCW1, DWS, RecU, UG26
383103106594200	Gunnison R at Cnty Rd 32 bl Gunnison, CO	38.517	-106.996	Ag, ALCW1, DWS, RecE, UG14
381934107133500	Lake Fork Gunnison R bl Gateview, CO	38.326	-107.227	Ag, ALCW1, DWS, RecE, UG29b
382702107203900	Pine Creek at HWY 50 nr Sapinero, CO	38.451	-107.345	Ag, ALCW1, DWS, RecU, UG26
382902107140400	Red Creek nr mouth nr Sapinero, CO	38.484	-107.235	Ag, ALCW1, DWS, RecU, UG26

Appendix A. Water Quality Sites Reported, Water Years 2013–2015, cont.

Station ID	Station name	Latitude	Longitude	Designated beneficial uses
383137107183600	Soap Creek ab Chance Creek nr Sapinero, CO	38.527	-107.311	Ag, ALCW1, DWS, RecU, UG26
382937107033500	Steuben Creek nr mouth nr Gunnison, CO	38.494	-107.060	Ag, ALCW1, DWS, RecU, UG26
383028107162200	West Elk Creek bl forest boundary nr Sapinero, CO	38.508	-107.273	Ag, ALCW1, DWS, RecU, UG26
382829107122200	Blue Mesa Reservoir ab Cebolla Ck nr Sapinero, CO	38.475	-107.207	Ag, ALCW1, DWS, RecE, Res
382831107172600	Blue Mesa Reservoir ab Soap Ck nr Sapinero, CO	38.475	-107.291	Ag, ALCW1, DWS, RecE, Res
382856107050000	Blue Mesa Reservoir bl HWY 149 nr Gunnison, CO	38.482	-107.084	Ag, ALCW1, DWS, RecE, Res
382924107352300	Crystal Reservoir at Crystal Creek nr Cimarron, CO	38.490	-107.590	Ag, ALCW1, DWS, RecE, Res
383024107371800	Crystal Reservoir at Crystal Dam nr Cimarron, CO	38.507	-107.622	Ag, ALCW1, DWS, RecE, Res
382702107315400	Morrow Pt Reservoir ab Morrow Pt Dam nr Cimarron, CO	38.451	-107.532	Ag, ALCW1, DWS, RecE, Res
382644107271000	Morrow Pt Reservoir bl Blue Ck nr Sapinero, CO	38.446	-107.453	Ag, ALCW1, DWS, RecE, Res
Dinosaur National Monument				
404417108524900	Green R ab Gates Of Lodore, CO	40.738	-108.880	Ag, ALCW1, DWS, RecE, LYG19a
09261000	Green R nr Jensen, UT	40.409	-109.235	1C, 2A, 3B, 4
09260050	Yampa R at Deerlodge Park, CO	40.452	-108.525	Ag, ALWW1, DWS, RecE, LYG2
09247600	Yampa R bl Craig, CO	40.481	-107.614	Ag, ALWW1, DWS, RecE, LYG2
09251000	Yampa R nr Maybell, CO	40.503	-108.033	Ag, ALWW1, DWS, RecE, LYG2
Hovenweep National Monument				
5995710	Cajon Spring	37.297	-109.183	1C, 2A, 3B, 4
5995700	Square Tower Spring	37.386	-109.081	1C, 2A, 3B, 4
Timpanogos Cave National Monument				
4994970	Hansen Cave Spring in Timpanogos Cave	40.438	-111.711	2B, 3A, 4
N/A	Hidden Lake at Timpanogos Cave	40.438	-111.709	2B, 3A, 4
Zion National Park				
4950800	La Verkin Ck at Lee Pass Trail	37.407	-113.176	2B, 3B, 4
4950920	North Ck at planned gage in park	37.261	-113.106	1C, 2B, 3C, 4, NoCrk
4951265	North Fork Virgin R at WSA bndry	37.371	-112.882	1C, 2A, 3A, 4
09405500	North Fork Virgin R nr Springdale, UT	37.210	-112.979	1C, 2A, 3A, 4
09406000	Virgin R at Virgin, UT	37.204	-113.181	1C, 2B, 3C, 4

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

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U.S. Department of the Interior

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