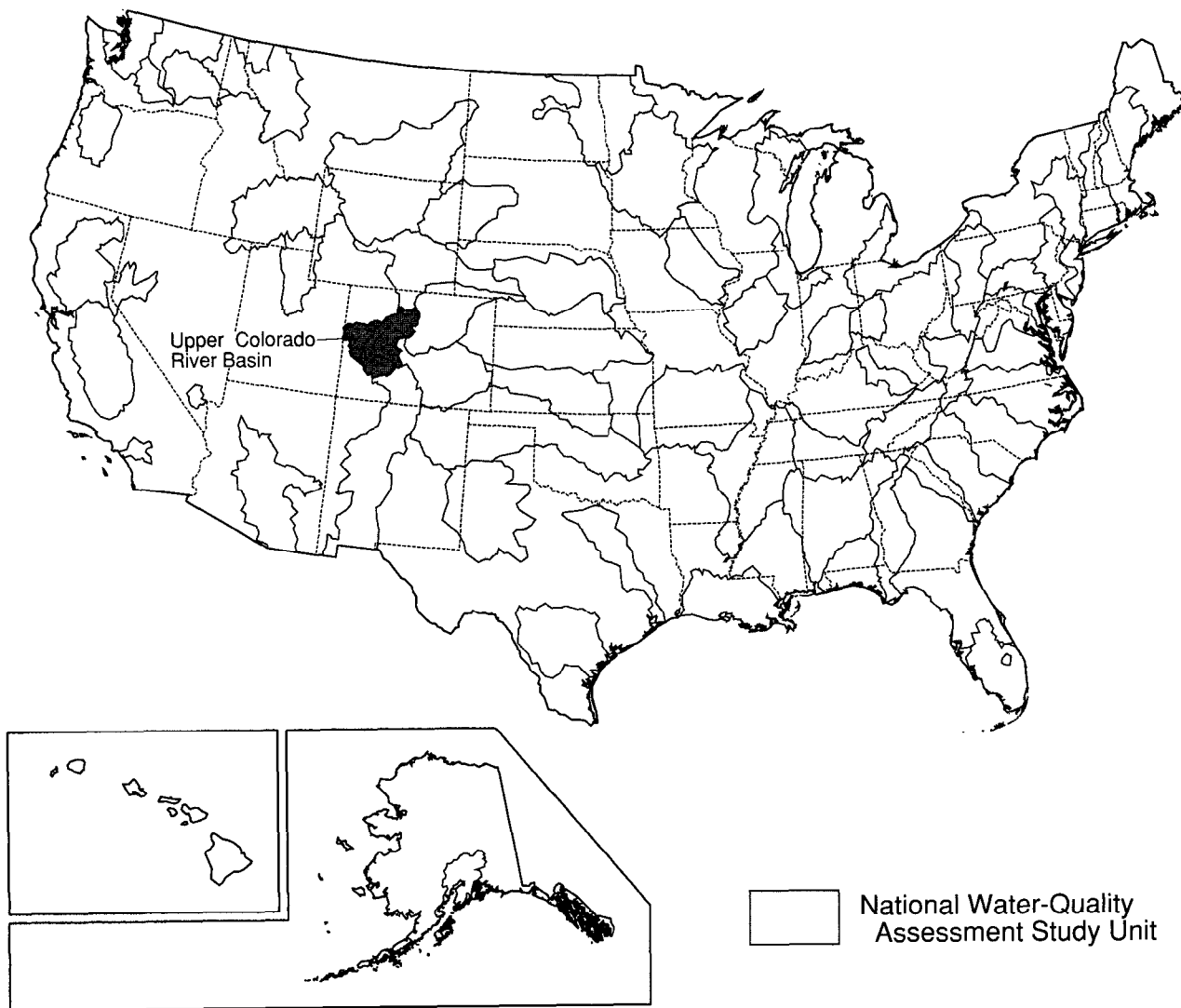


# NITROGEN AND PHOSPHORUS DATA FOR SURFACE WATER IN THE UPPER COLORADO RIVER BASIN, COLORADO, 1980-94

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U.S. GEOLOGICAL SURVEY  
Open-File Report 97-233



NATIONAL WATER-QUALITY ASSESSMENT PROGRAM

# Nitrogen and Phosphorus Data for Surface Water in the Upper Colorado River Basin, Colorado, 1980–94

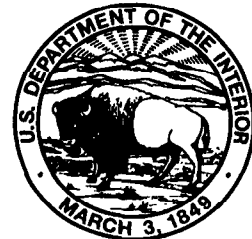
By Kirby H. Wynn and Norman E. Spahr

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U.S. GEOLOGICAL SURVEY

Open-File Report 97–233

Denver, Colorado  
1997



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### [Data-Set Diskette in Pocket]

## CONVERSION FACTORS AND VERTICAL DATUM

|  | Multiply | By    | To obtain              |
|--|----------|-------|------------------------|
| cubic foot per second (ft <sup>3</sup> /s) |          | 0.028 | cubic meter per second |
| mile (mi)                                  |          | 1.609 | kilometer              |

Degree Celsius (°C) may be converted to degree Fahrenheit (°F) by using the following equation:

$$^{\circ}\text{F} = (1.8 \times ^{\circ}\text{C}) + 32$$

# Nitrogen and Phosphorus Data for Surface Water in the Upper Colorado River Basin, Colorado, 1980–94

By Kirby H. Wynn and Norman E. Spahr

## Abstract

This report documents, summarizes, and provides on 3.5-in. diskette the surface-water data collected from January 1980 through August 1994 for nitrogen and phosphorus in the Upper Colorado River Basin from the Colorado-Utah State line to the Continental Divide. Ancillary data for parameters, such as water temperature, streamflow, specific conductance, dissolved oxygen, pH, and alkalinity, also are compiled, if available. Data were retrieved from the U.S. Geological Survey National Water Information System and the U.S. Environmental Protection Agency STORET (STORage and RETrieval) system. The water-quality data are presented for sites having five or more nutrient analyses that reflect ambient stream conditions. The compiled data base contains 4,927 samples from 123 sites. The median sample period of record for individual sites is 2.5 years, and the seventy-fifth percentile is about 12 years. Sixteen sites have only five samples each. The median number of samples per site is 14 samples, whereas the seventy-fifth percentile is 65 samples. The compiled data set was used in the design of a basinwide sampling network that incorporates sites that lack historic surface-water-quality data.

## INTRODUCTION

The Upper Colorado River Basin (UCOL) is 1 of 59 U.S. Geological Survey (USGS) National Water-Quality Assessment (NAWQA) study units. The UCOL study began in October 1993 (Driver,

1994). A major part of each NAWQA study is retrospective analysis of existing water-quality data. The four goals of the retrospective analysis are:

1. Develop an improved conceptual model of spatial and temporal patterns of concentrations and loads within the study unit;
2. Guide additional data collection;
3. Contribute data to the National Synthesis Program of NAWQA; and
4. Document findings for future NAWQA work.

The UCOL study-unit team has done a retrospective analysis of available surface-water data for nitrogen and phosphorus, which are essential nutrients for plant and animal growth. Results of nutrient retrospective analysis have guided the design of the UCOL surface-water-quality sampling network. Many of the selected sampling sites lack historic water-quality data (Spahr and others, 1996), and one of the priorities of network design was to select some sites without current or historic water-quality monitoring to expand the spatial extent of available data.

## Purpose and Scope

This report documents, summarizes, and provides on 3.5-in. diskette the surface-water nutrient data that were collected from January 1980 through August 1994. Interpretive analyses of the data are in Spahr and Wynn (1997). Ancillary data for parameters, such as water temperature, streamflow, specific conductance, dissolved oxygen, pH, and alkalinity, also are included on the data diskette, if available, but are not summarized in this report. The compiled data base contains 4,927 samples from 123 sites.

## Description of Study Unit

The UCOL study unit (fig. 1) consists of the Colorado River and its tributaries that drain the mountains of central and western Colorado. The major tributaries to the Colorado River within the study unit are the Blue, Eagle, Roaring Fork, and Gunnison Rivers. The Colorado River, the largest river within the study-unit basin, flows southwest for about 230 mi from its headwaters in the mountains of central Colorado to the Colorado-Utah State line.

Land use is the major factor affecting nutrient loading within the study unit. Areas that have a rapidly developing infrastructure to support recreational activities within the Fraser and Eagle River Basins and agricultural areas within the Grand Valley and lower Gunnison River Basin are most associated with elevated nutrient loading (Spahr and Wynn, 1997). The study unit is primarily rural and has a population of 234,000 people (Bureau of Census, 1990). More than a quarter of the population resides in the immediate vicinity of Grand Junction, Colo. Although not accounted for in Bureau of Census figures, tourism attracts a large influx of people to the basin during summer and winter (Driver, 1994). An extensive analysis of the environmental setting of the UCOL study unit, including land use, physiography, climate, ecoregion, and hydrologic characteristics, is presented in Apodaca and others (1996).

## NITROGEN AND PHOSPHORUS DATA

### Sources

Data used in the surface-water nutrient analyses were obtained from two sources: (1) The USGS National Water Information System (NWIS) (Maddy and others, 1990), and (2) the U.S. Environmental Protection Agency (USEPA) STORET (STORage and RETrieval) system. The STORET system is used as a repository for water-quality data by many agencies. The following agencies provided data for this report: USGS; Colorado Department of Public Health and Environment; U.S. Department of Agriculture, Forest Service; and Denver Board of Water Commissioners.

### Retrieval

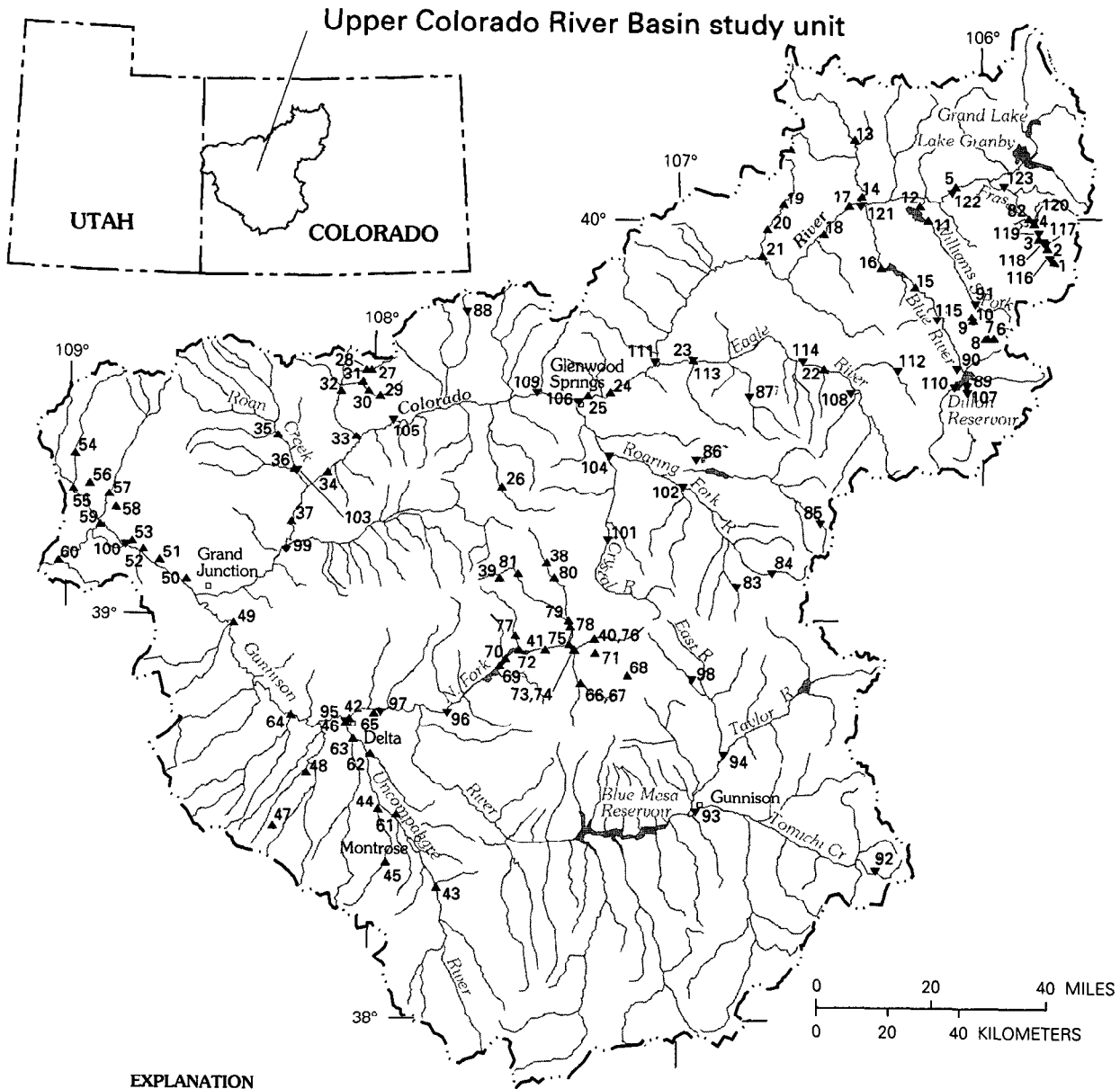
Water-quality data for January 1, 1980, through August 31, 1994, were retrieved for sites within the UCOL study unit. Only records containing data for concentrations of nitrate, ammonia, total nitrogen, total phosphorus, orthophosphate, or a related constituent were retained. Effort was made to exclude sample sites that do not reflect ambient stream conditions; therefore, data collected at point sources are not included in this report. In December 1994, STORET records for sites were retrieved. Updates or changes made to data in the STORET system after December 1994 are not included in this report.

### Screening

Many sites and samples were excluded from the final data set if definitive corrections for erroneous location information, site type, or nutrient data values were not possible. In some instances, data entry errors were discovered and then corrected after verifying data values with the agency that collected the data. The data set was compiled to determine water-quality patterns on a regional scale; therefore, some sites were retained that have only generalized latitude and longitude values. These sites are identifiable by latitude and longitude values that end in "00." Other sites that had comparatively large errors in latitude and longitude or did not represent ambient surface-water conditions were excluded. Additional screening of sites based on quantity of data was performed during data compilation.

### Compilation

The NWIS and STORET data were combined into a single data set for analysis after screening for errors. The parameter codes for the STORET data were converted, as necessary, to their NWIS equivalents before merging the two data sets into a single data base. All the NWIS parameter codes and their definitions in the order that they appear on the data diskette provided with this report are listed in table 1. Additional parameters created during data compilation or analysis are included in table 1 and on the data diskette.



**EXPLANATION**

**SAMPLING SITES**

[Number designates map reference number ("mapno" parameter in table 1 and table 2)]

- ▲ Data from U.S. Geological Survey National Water Information System
- ▼ Data from U.S. Environmental Protection Agency STORage and RETrieval System

**Figure 1.** Location of study unit and sampling sites for nutrient data collection.

**Table 1.** Parameter codes for data compiled on data-set diskette

[mg/L, milligrams per liter;  $\mu\text{S}/\text{cm}$ , microsiemens per centimeter at 25 degrees Celsius; N, nitrogen;  $\text{NH}_4$ , ammonium ion;  $\text{NO}_3$ , nitrate; P, phosphorus;  $\text{PO}_4$ , phosphate;  $^\circ\text{C}$ , degrees Celsius;  $\text{ft}^3/\text{s}$ , cubic feet per second;  $\text{CaCO}_3$ , calcium carbonate]

| Parameter | Definition   |
|-----------|--|
| mapno     | Map reference number   |
| staid     | Site identification number   |
| lat       | Latitude, degrees  |
| lon       | Longitude, degrees   |
| date      | Sample date  |
| time      | Sample time  |
| name      | Site name  |
| nitrate   | Nitrate, as N (mg/L); computed <sup>1</sup>  |
| ammon     | Ammonia, as N (mg/L); computed <sup>1</sup>  |
| totaln    | Total nitrogen, as N (mg/L); computed <sup>1</sup>   |
| phos      | Total phosphorus, as P (mg/L); computed <sup>1</sup>   |
| ortho     | Orthophosphate, as P (mg/L); computed <sup>1</sup>   |
| p00608    | Nitrogen, ammonia, dissolved (mg/L as N)   |
| p71846    | Nitrogen, ammonia, dissolved (mg/L as $\text{NH}_4$ )  |
| p00610    | Nitrogen, ammonia, total (mg/L as N)   |
| p71845    | Nitrogen, ammonia, total (mg/L as $\text{NH}_4$ )  |
| p00613    | Nitrogen, nitrite, dissolved (mg/L as N)   |
| p71856    | Nitrogen, nitrite, dissolved (mg/L as $\text{NO}_2$ )  |
| p00615    | Nitrogen, nitrite, total (mg/L as N)   |
| p00631    | Nitrogen, nitrite plus nitrate, dissolved (mg/L as N)  |
| p00630    | Nitrogen, nitrite plus nitrate, total (mg/L as N)  |
| p00618    | Nitrogen, nitrate, dissolved (mg/L as N)   |
| p71851    | Nitrogen, nitrate, dissolved (mg/L as $\text{NO}_3$ )  |
| p00620    | Nitrogen, nitrate, total (mg/L as N)   |
| p00600    | Nitrogen, total (mg/L as N)  |
| p71887    | Nitrogen, total (mg/L as $\text{NO}_3$ )   |
| p00625    | Nitrogen, ammonia plus organic, total (mg/L as N)  |
| p00671    | Phosphorus, orthophosphate, dissolved (mg/L as P)  |
| p00660    | Phosphate, ortho, dissolved (mg/L as $\text{PO}_4$ )   |
| p70507    | Phosphorus, orthophosphate, total (mg/L as P)  |
| p00650    | Phosphate, total (mg/L as $\text{PO}_4$ )  |
| p00665    | Phosphorus, total (mg/L as P)  |
| p71886    | Phosphorus, total (mg/L as $\text{PO}_4$ )   |
| p00666    | Phosphorus, dissolved (mg/L as P)  |
| temp      | Water temperature ( $^\circ\text{C}$ )   |
| p00060    | Discharge ( $\text{ft}^3/\text{s}$ )   |
| p00061    | Discharge, instantaneous ( $\text{ft}^3/\text{s}$ )  |
| sc        | Specific conductance ( $\mu\text{S}/\text{cm}$ )   |
| labsc     | Specific conductance, laboratory ( $\mu\text{S}/\text{cm}$ )                                 |
| do        | Oxygen, dissolved, field (mg/L)  |
| ph        | pH, water, whole, field, standard units  |
| labph     | pH, water, whole, laboratory, standard units   |
| p00410    | Alkalinity, water, whole, total, fixed endpoint titration, field (mg/L as $\text{CaCO}_3$ )  |
| p90410    | Alkalinity, titration to pH 4.5, laboratory (mg/L as $\text{CaCO}_3$ )                       |
| p39086    | Alkalinity, water, dissolved, total, incremental titration, field (mg/L as $\text{CaCO}_3$ ) |
| yr        | Year sample collected  |
| mo        | Month sample collected   |
| day       | Day sample collected   |
| agency    | Agency collecting sample   |

<sup>1</sup>Value computed from a related parameter field using method of Mueller and others (1995, p. 7).

Because many agencies collected the data for different purposes, nutrient parameters are reported in numerous ways. Nutrient parameters were combined to reduce the total number from 20 to a more manageable 5 for data-analysis purposes. Procedures described by Mueller and others (1995, p. 7) for combining nutrient parameters were followed. The combined nutrient parameters summarized in this report, included on the data diskette with other nutrient and ancillary data, and used in interpretive work by Spahr and Wynn (1997) are:

- Nitrate as nitrogen (hereinafter referred to as nitrate).
- Ammonia as nitrogen (hereinafter referred to as ammonia).
- Total nitrogen as nitrogen (hereinafter referred to as total nitrogen).
- Total phosphorus as phosphorus (hereinafter referred to as total phosphorus).
- Orthophosphate as phosphorus (hereinafter referred to as orthophosphate).

The data set was screened to include only sites that had a minimum of five observations for at least one of the five nutrients listed above. The resulting data set contains 4,927 samples at 123 sites located within the UCOL study unit. The locations of these 123 sites are shown in figure 1. The sites labeled with map reference numbers 1 through 82 are from the USGS NWIS data base, and the remaining 41 sites are from the USEPA STORET data base. Map reference number, site number, and site name for each of the 123 sites that met data-screening criteria are listed in table 2. The data set presented here was used for analysis of the spatial distribution, relation to land use, and temporal trends of nutrient concentrations in surface waters of the UCOL study unit. However, because of especially restrictive data requirements, temporal trend analysis was possible for fewer than 10 percent of the sites for each of the five combined nutrient parameters.

## DATA-SET SUMMARY

The selected set of 123 sampling sites for analyzing surface-water quality has widely varying sampling periods. The sample-collection dates range

from January 7, 1980, to August 29, 1994. The median sample period of record for individual sites is only 2.5 years, whereas the seventy-fifth percentile is about 12 years. The distribution of sampling dates for the USGS NWIS (map reference numbers 1–82) and USEPA STORET (map reference numbers 83–123) sites where nutrient data were collected are shown in figure 2.

It is important to determine the similarity of sampling frequency and period of record before attempting to compare data values between sites. Sites 11 and 12 on the Williams Fork and sites 15 and 16 on the Blue River were sampled for short, but concurrent, time intervals and would, therefore, be good sites for comparing water quality between the two rivers. However, comparison of the data for these four sites with data from site 63 on Dry Creek, near Delta, Colo., would be misleading because data for site 63 were collected several years later. Sites 49 and 60 were appropriate choices for determining water-quality trends, in part, because they each have many samples collected over a 14.5-year period.

The number of samples and the number of samples collected for each of the five combined nutrient parameters (nitrate, ammonia, total nitrogen, total phosphorus, and orthophosphate) are listed, by site, in table 3. The total number of samples for the whole data set and for each of the five combined nutrient parameters is listed in the last row of table 3. None of the sites have data for all five nutrients for each and every sample. Therefore, for a given site, the number of samples in column 2 of table 3 usually is greater than the number of samples collected for nitrate, ammonia, total nitrogen, total phosphorus, or orthophosphate. Site 22 is typical: the number of samples is 76 but there are only 50 nitrate, 1 ammonia, 0 total nitrogen, 0 total phosphorus, and 69 orthophosphate samples. The number of samples per site is variable. Because sites retained must have at least five samples for one of the combined nutrients, the minimum number of samples listed in table 3 is five. Sixteen of the sites (about 13 percent) have only 5 samples. The median number of samples per site is 14 samples, whereas the seventy-fifth percentile is 65 samples. Site 100, Colorado River near Loma, has the most samples (263), collected from 1980 to 1992.

**Table 2. Site identification numbers and site names for map reference numbers in figure 1**

[Map reference number is the parameter "mapno" in table 1 and on data diskette; site identification number is the parameter "staid" in table 1 and on data diskette; site name is the parameter "name" in table 1 and on data diskette]

| Map reference number | Site identification number | Site name  |
|----------------------|----------------------------|--|
| 1                    | 09023750                   | Fraser River below Buck Creek at Winter Park, CO                   |
| 2                    | 09025010                   | Fraser River below Vasquez Creek at Winter Park, CO                |
| 3                    | 09027010                   | Fraser River below St. Louis Creek at Fraser, CO                   |
| 4                    | 09027100                   | Fraser River at Tabernash, CO                                      |
| 5                    | 09034500                   | Colorado River at Hot Sulphur Springs, CO                          |
| 6                    | 09035830                   | South Fork Williams Fork near Ptarmigan Pass, CO                   |
| 7                    | 09035840                   | South Fork Williams Fork above tributary near Ptarmigan Pass, CO   |
| 8                    | 09035850                   | South Fork Williams Fork above Short Creek near Ptarmigan Pass, CO |
| 9                    | 09035870                   | South Fork Williams Fork below Short Creek near Ptarmigan Pass, CO |
| 10                   | 09035880                   | South Fork Williams Fork below Old Baldy Mountain near Leal, CO    |
| 11                   | 09037500                   | Williams Fork near Parshall, CO                                    |
| 12                   | 09038500                   | Williams Fork below Williams Fork Reservoir, CO                    |
| 13                   | 09041090                   | Muddy Creek above Antelope Creek near Kremmling, CO                |
| 14                   | 09041500                   | Muddy Creek at Kremmling, CO                                       |
| 15                   | 09053500                   | Blue River above Green Mountain Reservoir, CO                      |
| 16                   | 09057500                   | Blue River below Green Mountain Reservoir, CO                      |
| 17                   | 09058000                   | Colorado River near Kremmling, CO                                  |
| 18                   | 09058030                   | Colorado River near Radium, CO                                     |
| 19                   | 09060500                   | Rock Creek near Toponas, CO  |
| 20                   | 09060550                   | Rock Creek at Crater, CO   |
| 21                   | 09060770                   | Rock Creek at McCoy, CO  |
| 22                   | 09067000                   | Beaver Creek at Avon, CO   |
| 23                   | 09069000                   | Eagle River at Gypsum, CO  |
| 24                   | 09071100                   | Colorado River near Glenwood Springs, CO                           |
| 25                   | 09071750                   | Colorado River above Glenwood Springs, CO                          |
| 26                   | 09089500                   | West Divide Creek near Raven, CO                                   |
| 27                   | 09092830                   | Northwater Creek near Anvil Points, CO                             |
| 28                   | 09092850                   | East Middle Fork Parachute Creek near Rio Blanco, CO               |
| 29                   | 09092960                   | East Fork Parachute Creek near Anvil Points, CO                    |
| 30                   | 09092970                   | East Fork Parachute Creek near Rulison, CO                         |
| 31                   | 09092980                   | Ben Good Creek near Rulison, CO                                    |
| 32                   | 09093000                   | Parachute Creek near Parachute, CO                                 |
| 33                   | 09093500                   | Parachute Creek at Parachute, CO                                   |
| 34                   | 09093700                   | Colorado River near De Beque, CO                                   |
| 35                   | 09095000                   | Roan Creek near De Beque, CO                                       |
| 36                   | 09095400                   | Dry Fork near De Beque, CO   |
| 37                   | 09095500                   | Colorado River near Cameo, CO                                      |
| 38                   | 09129800                   | Clear Fork near Ragged Mountain, CO                                |
| 39                   | 09131100                   | Cow Creek near Paonia, CO  |
| 40                   | 09132050                   | Anthracite Creek near Somerset, CO                                 |
| 41                   | 09132500                   | North Fork Gunnison River near Somerset, CO                        |

**Table 2.** Site identification numbers and site names for map reference numbers in figure 1—Continued

[Map reference number is the parameter "mapno" in table 1 and on data diskette; site identification number is the parameter "staid" in table 1 and on data diskette; site name is the parameter "name" in table 1 and on data diskette]

| Map reference number | Site identification number | Site name   |
|----------------------|----------------------------|---|
| 42                   | 09144250                   | Gunnison River at Delta, CO                               |
| 43                   | 09147500                   | Uncompahgre River at Colona, CO                           |
| 44                   | 09149400                   | Spring Creek near Beaver Hill, CO                         |
| 45                   | 09149420                   | Spring Creek near Montrose, CO                            |
| 46                   | 09149500                   | Uncompahgre River at Delta, CO                            |
| 47                   | 09149900                   | Potter Creek near Columbine Pass, CO                      |
| 48                   | 09149910                   | Potter Creek near Olathe, CO                              |
| 49                   | 09152500                   | Gunnison River near Grand Junction, CO                    |
| 50                   | 09152650                   | Leach Creek at Durham, CO                                 |
| 51                   | 09152900                   | Adobe Creek near Fruita, CO                               |
| 52                   | 09153270                   | Big Salt Wash at Fruita, CO                               |
| 53                   | 09153300                   | Reed Wash near Loma, CO                                   |
| 54                   | 09153330                   | West Salt Creek near Carbonera, CO                        |
| 55                   | 09153400                   | West Salt Creek near Mack, CO                             |
| 56                   | 09160500                   | Badger Wash Observation Res 12 near Mack, CO              |
| 57                   | 09163310                   | East Salt Creek near Mack, CO                             |
| 58                   | 09163340                   | Mack Wash near Mack, CO                                   |
| 59                   | 09163490                   | Salt Creek near Mack, CO                                  |
| 60                   | 09163500                   | Colorado River near Colorado-Utah State line              |
| 61                   | 383041107544201            | Cedar Creek near mouth                                    |
| 62                   | 383946107595301            | Loutsenhizer Arroyo near mouth                            |
| 63                   | 384202108032001            | Dry Creek at mouth, near Delta, CO                        |
| 64                   | 384527108152701            | Gunnison River above Escalante Creek, near Delta, CO      |
| 65                   | 384551107591901            | Unnamed drainage at Highway 92, near Read, CO             |
| 66                   | 385033107190300            | Upper Coal Creek near Somerset, CO                        |
| 67                   | 385037107190300            | Cliff Creek near Somerset, CO                             |
| 68                   | 385146107094700            | Ruby Anthracite Creek near Kebler Pass, CO                |
| 69                   | 385308107345100            | North Fork Gunnison River above Paonia, CO                |
| 70                   | 385414107334000            | Terror Creek near Paonia, CO                              |
| 71                   | 385506107161400            | Grouse Spring Creek near Marcelling Mountain, CO          |
| 72                   | 385532107310400            | Lower Hubbard Creek near Bowie, CO                        |
| 73                   | 385534107201900            | Lower Coal Creek near Somerset, CO                        |
| 74                   | 385538107202400            | Lower Anthracite Creek near Somerset, CO                  |
| 75                   | 385626107212000            | Muddy Creek below Paonia Reservoir, CO                    |
| 76                   | 385712107162600            | Upper Anthracite Creek near Somerset, CO                  |
| 77                   | 385741107315100            | Upper Hubbard Creek near Bowie, CO                        |
| 78                   | 385903107210800            | Muddy Creek above Paonia Reservoir, CO                    |
| 79                   | 390000107212700            | Lower West Muddy Creek near Paonia Reservoir, CO          |
| 80                   | 390620107241900            | East Muddy Creek near Ragged Mountain, CO                 |
| 81                   | 390658107312500            | West Muddy Creek near West Muddy Creek Ranger Station, CO |
| 82                   | 400009105504600            | Fraser River below Crooked Creek at Tabernash, CO         |

**Table 2. Site identification numbers and site names for map reference numbers in figure 1—Continued**

[Map reference number is the parameter "mapno" in table 1 and on data diskette; site identification number is the parameter "staid" in table 1 and on data diskette; site name is the parameter "name" in table 1 and on data diskette]

| Map reference number | Site identification number | Site name                                      |
|----------------------|----------------------------|--|
| 183                  | FS021547A020001            | Lower Castle Creek SI 9 80                     |
| 84                   | FS021545A030001            | Lower Lincoln Creek SI 8 76                    |
| 85                   | FS021541S040002            | Marten Creek SI 8                              |
| 86                   | FS021543S020001            | Lower Taylor Creek SI 7 99                     |
| 87                   | FS021535E010001            | Lower Brush Creek SI 14 71.5                   |
| 88                   | FS021563R010001            | Three Forks Creek SI 4 94                      |
| 89                   | 002102                     | So Plat Dillon Res Blue R @ Res                |
| 90                   | 2501                       | Straight Creek at Res near Dillon, CO          |
| 91                   | 003106                     | Williams Fork No 8 at Sugarloaf CMPGD          |
| 92                   | 000149                     | Indian Creek near Sargents                     |
| 93                   | 000059                     | Tomichi Creek at Gunnison                      |
| 94                   | 000078                     | East River at confl. with Taylor               |
| 95                   | 000055                     | Uncompahgre River at Delta                     |
| 96                   | 000100                     | N Fk of Gunnison below Hotchkiss               |
| 97                   | 000056                     | Gunnison River near Delta                      |
| 98                   | 000151                     | Slate River below Crested Butte                |
| 99                   | 000048                     | Colorado River near Cameo                      |
| 100                  | 000050                     | Colorado River near Loma                       |
| 101                  | 000145                     | Crystal River at Redstone                      |
| 102                  | 000144                     | Roaring Fork River below Aspen                 |
| 103                  | 000148                     | Roan Creek near De Beque                       |
| 104                  | 000146                     | Crystal River near mouth                       |
| 105                  | 000147                     | Colorado River at Rulison                      |
| 106                  | 000053                     | Roaring Fork at mouth                          |
| 107                  | 000115                     | Blue River above Dillon Reservoir              |
| 108                  | 000118                     | Cross Creek Ar con. with Eagle                 |
| 109                  | 000047                     | Colorado River at New Castle                   |
| 110                  | 000141                     | Ten Mile Creek at Frisco                       |
| 111                  | 000046                     | Colorado River near Dotsero                    |
| 112                  | 000074                     | Gore Creek at mouth                            |
| 113                  | 000052                     | Eagle River at Gypsum                          |
| 114                  | 000076                     | Eagle River at town of Edwards                 |
| 115                  | 000098                     | Blue River below Dillon Reservoir              |
| 116                  | 000FR3                     | Fraser River at USGS Gauge                     |
| 117                  | 000FR4                     | Fraser above Grand WWTP                        |
| 118                  | 000FR6                     | Fraser below Grand WWTP                        |
| 119                  | 000FR7                     | Fraser River above Fraser WWTP                 |
| 120                  | 00FR10                     | Fraser near Tabernsh                           |
| 121                  | 000099                     | Blue River near confluence with Colorado River |
| 122                  | 000045                     | Colorado River near Hot Sulfur Springs         |
| 123                  | 000139                     | Fraser River near Granby                       |

<sup>1</sup>The site names for map reference numbers 83–123 are spelled as they appear in the U.S. Environmental Protection Agency's STORET (STORage and RETrieval) system.

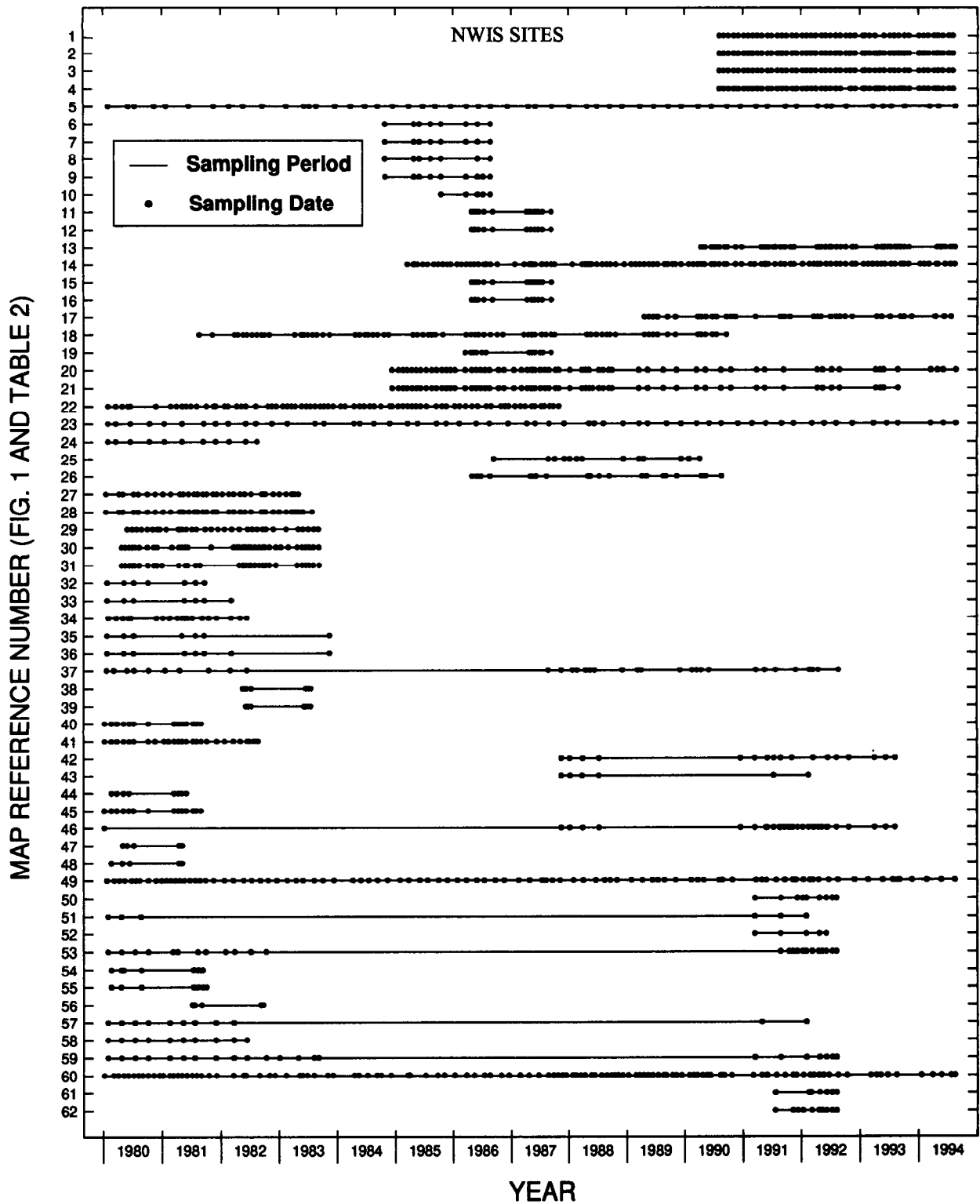
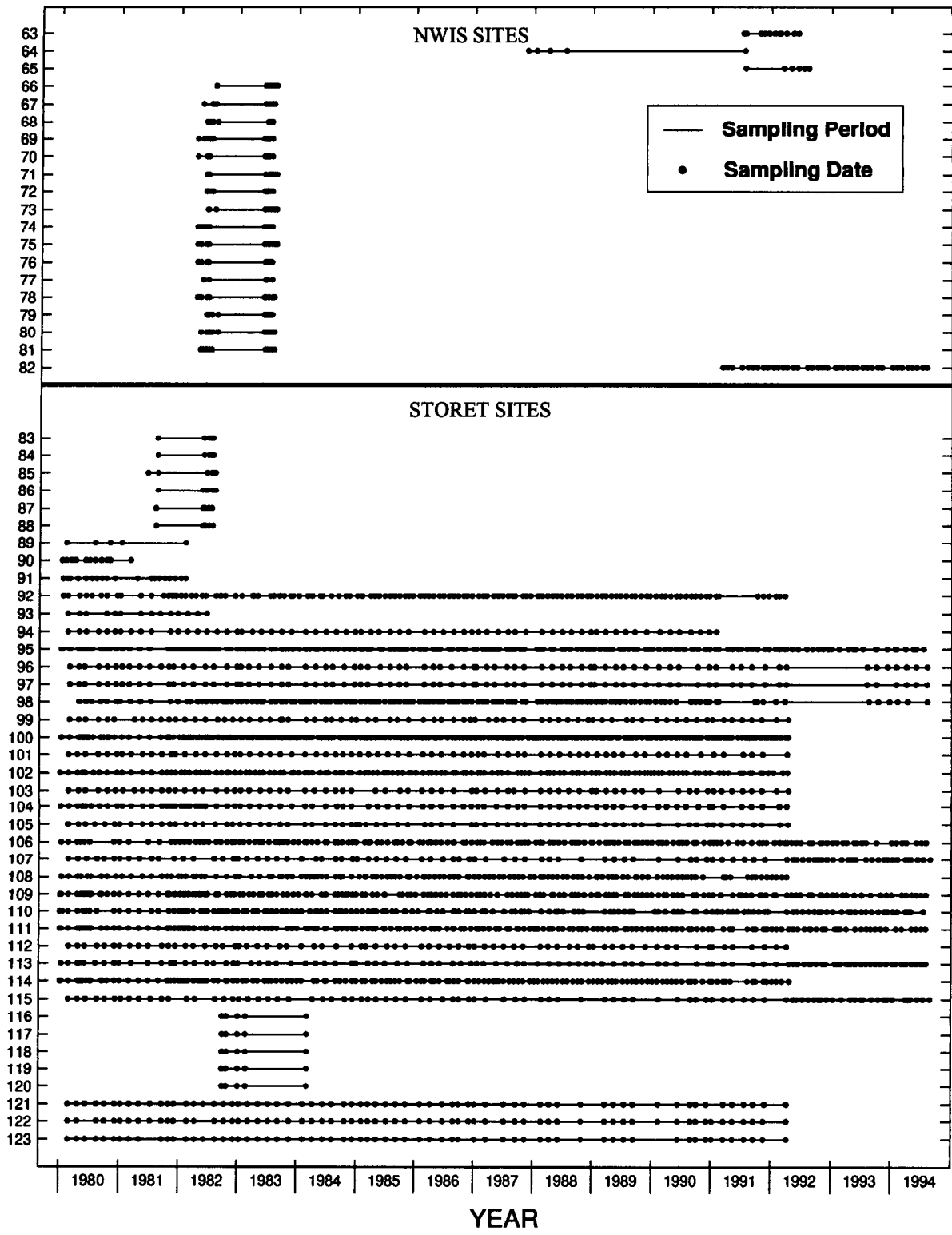


Figure 2. Distribution of sampling dates for National Water Information System (NWIS) and STOrage and RETrieval (STORET) surface-water sites for nutrient data collection.

MAP REFERENCE NUMBER (FIG. 1 AND TABLE 2)



**Figure 2.** Distribution of sampling dates for National Water Information System (NWIS) and STORage and RETrieval (STORET) surface-water sites for nutrient data collection—Continued.

**Table 3.** Number of samples collected per site and number of samples collected per site for each of the five combined nutrient parameters

[Map reference number is the parameter "mapno" in table 1 and data diskette]

| Map reference number | Number of samples | Combined nutrient parameters |                 |                        |                          |                        |
|----------------------|-------------------|------------------------------|-----------------|------------------------|--------------------------|------------------------|
|                      |                   | Nitrate samples              | Ammonia samples | Total nitrogen samples | Total phosphorus samples | Orthophosphate samples |
| 1                    | 47                | 45                           | 47              | 0                      | 0                        | 1                      |
| 2                    | 61                | 59                           | 61              | 0                      | 0                        | 2                      |
| 3                    | 48                | 47                           | 48              | 0                      | 0                        | 1                      |
| 4                    | 60                | 60                           | 60              | 0                      | 0                        | 1                      |
| 5                    | 58                | 24                           | 16              | 56                     | 57                       | 16                     |
| 6                    | 8                 | 8                            | 8               | 0                      | 0                        | 7                      |
| 7                    | 8                 | 8                            | 8               | 0                      | 0                        | 6                      |
| 8                    | 7                 | 7                            | 7               | 0                      | 0                        | 5                      |
| 9                    | 9                 | 8                            | 9               | 0                      | 0                        | 8                      |
| 10                   | 5                 | 4                            | 5               | 0                      | 0                        | 4                      |
| 11                   | 13                | 1                            | 13              | 11                     | 13                       | 13                     |
| 12                   | 12                | 5                            | 12              | 12                     | 12                       | 12                     |
| 13                   | 49                | 11                           | 49              | 47                     | 49                       | 49                     |
| 14                   | 118               | 56                           | 117             | 116                    | 117                      | 104                    |
| 15                   | 13                | 10                           | 13              | 13                     | 13                       | 13                     |
| 16                   | 12                | 11                           | 12              | 12                     | 12                       | 12                     |
| 17                   | 35                | 23                           | 35              | 33                     | 35                       | 35                     |
| 18                   | 69                | 21                           | 12              | 65                     | 68                       | 69                     |
| 19                   | 12                | 2                            | 12              | 12                     | 12                       | 12                     |
| 20                   | 64                | 28                           | 64              | 46                     | 56                       | 52                     |
| 21                   | 61                | 28                           | 61              | 51                     | 57                       | 49                     |
| 22                   | 76                | 50                           | 1               | 0                      | 0                        | 69                     |
| 23                   | 57                | 53                           | 15              | 55                     | 57                       | 16                     |
| 24                   | 14                | 8                            | 0               | 11                     | 14                       | 1                      |
| 25                   | 13                | 13                           | 0               | 0                      | 0                        | 0                      |
| 26                   | 20                | 2                            | 20              | 15                     | 20                       | 20                     |
| 27                   | 32                | 25                           | 0               | 0                      | 0                        | 30                     |
| 28                   | 33                | 26                           | 0               | 0                      | 0                        | 32                     |
| 29                   | 33                | 30                           | 0               | 0                      | 0                        | 31                     |
| 30                   | 37                | 28                           | 1               | 0                      | 0                        | 33                     |
| 31                   | 33                | 31                           | 0               | 0                      | 0                        | 28                     |
| 32                   | 7                 | 7                            | 0               | 7                      | 7                        | 1                      |
| 33                   | 7                 | 7                            | 1               | 6                      | 7                        | 1                      |
| 34                   | 19                | 19                           | 0               | 0                      | 0                        | 0                      |
| 35                   | 8                 | 8                            | 0               | 7                      | 7                        | 1                      |
| 36                   | 8                 | 7                            | 1               | 6                      | 7                        | 1                      |
| 37                   | 33                | 31                           | 3               | 9                      | 10                       | 3                      |
| 38                   | 6                 | 5                            | 0               | 0                      | 6                        | 0                      |
| 39                   | 7                 | 4                            | 0               | 0                      | 7                        | 0                      |
| 40                   | 14                | 12                           | 0               | 14                     | 14                       | 0                      |
| 41                   | 29                | 18                           | 8               | 24                     | 27                       | 0                      |
| 42                   | 17                | 17                           | 13              | 9                      | 9                        | 13                     |

**Table 3.** Number of samples collected per site and number of samples collected per site for each of the five combined nutrient parameters—Continued

[Map reference number is the parameter "mapno" in table 1 and data diskette]

| Map reference number | Number of samples | Combined nutrient parameters |                 |                        |                          |                        |
|----------------------|-------------------|------------------------------|-----------------|------------------------|--------------------------|------------------------|
|                      |                   | Nitrate samples              | Ammonia samples | Total nitrogen samples | Total phosphorus samples | Orthophosphate samples |
| 43                   | 6                 | 6                            | 1               | 0                      | 0                        | 1                      |
| 44                   | 8                 | 6                            | 0               | 8                      | 8                        | 0                      |
| 45                   | 14                | 14                           | 0               | 13                     | 13                       | 0                      |
| 46                   | 30                | 30                           | 13              | 9                      | 9                        | 14                     |
| 47                   | 5                 | 5                            | 0               | 0                      | 0                        | 0                      |
| 48                   | 5                 | 5                            | 0               | 0                      | 0                        | 0                      |
| 49                   | 97                | 97                           | 75              | 94                     | 94                       | 76                     |
| 50                   | 9                 | 9                            | 2               | 0                      | 0                        | 2                      |
| 51                   | 6                 | 6                            | 2               | 0                      | 0                        | 2                      |
| 52                   | 5                 | 5                            | 2               | 0                      | 0                        | 2                      |
| 53                   | 24                | 24                           | 2               | 0                      | 0                        | 1                      |
| 54                   | 20                | 20                           | 0               | 0                      | 0                        | 2                      |
| 55                   | 9                 | 9                            | 0               | 0                      | 0                        | 0                      |
| 56                   | 15                | 15                           | 0               | 0                      | 0                        | 2                      |
| 57                   | 11                | 10                           | 1               | 0                      | 0                        | 1                      |
| 58                   | 10                | 10                           | 0               | 0                      | 0                        | 0                      |
| 59                   | 22                | 22                           | 2               | 0                      | 0                        | 2                      |
| 60                   | 120               | 120                          | 79              | 97                     | 98                       | 79                     |
| 61                   | 7                 | 7                            | 1               | 0                      | 0                        | 1                      |
| 62                   | 10                | 10                           | 2               | 0                      | 0                        | 1                      |
| 63                   | 11                | 11                           | 2               | 0                      | 0                        | 2                      |
| 64                   | 5                 | 5                            | 1               | 0                      | 0                        | 1                      |
| 65                   | 6                 | 6                            | 1               | 0                      | 0                        | 1                      |
| 66                   | 7                 | 6                            | 0               | 0                      | 3                        | 0                      |
| 67                   | 8                 | 6                            | 0               | 0                      | 4                        | 0                      |
| 68                   | 7                 | 5                            | 0               | 0                      | 6                        | 0                      |
| 69                   | 10                | 9                            | 0               | 0                      | 7                        | 0                      |
| 70                   | 8                 | 7                            | 0               | 0                      | 7                        | 0                      |
| 71                   | 8                 | 7                            | 0               | 0                      | 5                        | 0                      |
| 72                   | 8                 | 6                            | 0               | 0                      | 7                        | 0                      |
| 73                   | 10                | 9                            | 0               | 0                      | 6                        | 0                      |
| 74                   | 10                | 10                           | 0               | 0                      | 6                        | 0                      |
| 75                   | 12                | 11                           | 0               | 0                      | 5                        | 0                      |
| 76                   | 9                 | 8                            | 0               | 0                      | 5                        | 0                      |
| 77                   | 5                 | 3                            | 0               | 0                      | 5                        | 0                      |
| 78                   | 10                | 10                           | 0               | 0                      | 5                        | 0                      |
| 79                   | 9                 | 6                            | 0               | 0                      | 8                        | 0                      |
| 80                   | 11                | 10                           | 0               | 0                      | 8                        | 0                      |
| 81                   | 10                | 7                            | 0               | 0                      | 8                        | 0                      |
| 82                   | 39                | 37                           | 39              | 0                      | 0                        | 0                      |
| 83                   | 5                 | 5                            | 0               | 0                      | 0                        | 4                      |
| 84                   | 5                 | 5                            | 0               | 0                      | 0                        | 3                      |

**Table 3.** Number of samples collected per site and number of samples collected per site for each of the five combined nutrient parameters—Continued

[Map reference number is the parameter "mapno" in table 1 and data diskette]

| Map reference number | Number of samples | Combined nutrient parameters |                 |                        |                          |                        |
|----------------------|-------------------|------------------------------|-----------------|------------------------|--------------------------|------------------------|
|                      |                   | Nitrate samples              | Ammonia samples | Total nitrogen samples | Total phosphorus samples | Orthophosphate samples |
| 85                   | 6                 | 6                            | 0               | 0                      | 0                        | 3                      |
| 86                   | 7                 | 6                            | 0               | 0                      | 0                        | 5                      |
| 87                   | 5                 | 5                            | 0               | 0                      | 0                        | 3                      |
| 88                   | 5                 | 5                            | 0               | 0                      | 0                        | 3                      |
| 89                   | 5                 | 5                            | 0               | 0                      | 4                        | 0                      |
| 90                   | 11                | 11                           | 0               | 0                      | 9                        | 0                      |
| 91                   | 19                | 15                           | 0               | 0                      | 17                       | 0                      |
| 92                   | 124               | 14                           | 112             | 11                     | 117                      | 1                      |
| 93                   | 14                | 2                            | 5               | 0                      | 14                       | 0                      |
| 94                   | 67                | 4                            | 56              | 5                      | 66                       | 0                      |
| 95                   | 174               | 105                          | 154             | 86                     | 154                      | 0                      |
| 96                   | 80                | 42                           | 69              | 36                     | 79                       | 0                      |
| 97                   | 78                | 3                            | 68              | 5                      | 77                       | 0                      |
| 98                   | 129               | 6                            | 116             | 8                      | 121                      | 0                      |
| 99                   | 75                | 4                            | 65              | 14                     | 74                       | 0                      |
| 100                  | 263               | 78                           | 242             | 62                     | 235                      | 0                      |
| 101                  | 72                | 3                            | 60              | 7                      | 72                       | 0                      |
| 102                  | 137               | 12                           | 123             | 8                      | 127                      | 0                      |
| 103                  | 71                | 58                           | 60              | 53                     | 70                       | 0                      |
| 104                  | 80                | 6                            | 66              | 1                      | 75                       | 0                      |
| 105                  | 75                | 3                            | 63              | 11                     | 73                       | 0                      |
| 106                  | 159               | 6                            | 133             | 5                      | 149                      | 0                      |
| 107                  | 92                | 5                            | 68              | 2                      | 91                       | 0                      |
| 108                  | 128               | 6                            | 113             | 3                      | 124                      | 0                      |
| 109                  | 174               | 8                            | 141             | 4                      | 154                      | 0                      |
| 110                  | 146               | 34                           | 118             | 22                     | 137                      | 0                      |
| 111                  | 175               | 10                           | 141             | 6                      | 156                      | 0                      |
| 112                  | 73                | 35                           | 61              | 33                     | 71                       | 0                      |
| 113                  | 102               | 29                           | 75              | 21                     | 99                       | 0                      |
| 114                  | 150               | 32                           | 131             | 28                     | 134                      | 0                      |
| 115                  | 90                | 5                            | 65              | 6                      | 90                       | 0                      |
| 116                  | 5                 | 2                            | 5               | 3                      | 0                        | 0                      |
| 117                  | 5                 | 3                            | 5               | 3                      | 0                        | 0                      |
| 118                  | 5                 | 2                            | 5               | 4                      | 0                        | 0                      |
| 119                  | 5                 | 2                            | 5               | 2                      | 0                        | 0                      |
| 120                  | 5                 | 4                            | 5               | 2                      | 0                        | 0                      |
| 121                  | 67                | 5                            | 56              | 4                      | 66                       | 0                      |
| 122                  | 66                | 3                            | 56              | 9                      | 65                       | 0                      |
| 123                  | 65                | 6                            | 55              | 8                      | 65                       | 0                      |
| <b>Total</b>         | <b>4,927</b>      | <b>2,076</b>                 | <b>3,454</b>    | <b>1,330</b>           | <b>3,795</b>             | <b>963</b>             |

## DESCRIPTION OF DATA-SET DISKETTE

The MSDOS format 3.5-in. diskette inside the back cover pocket contains the compiled nutrient and ancillary data set in an ASCII text file named ucol.txt. The diskette contains 76 tab-delimited parameter fields, including remark fields, for the 49 parameters listed in table 1. The data are arranged as one line per unique sample date and time for each site. The data set is sorted sequentially by map reference number, date, and time.

The first line of the file contains the parameter field names in the same order as listed in table 1. The second line of the file defines the type (n = numeric, s = character string, d = date) and width of each parameter field. Data values begin on line 3 of ucol.txt. Water-quality constituents that have a laboratory reporting limit have a separate character field for remark (data censoring) codes. These remark fields are positioned to the left of their associated constituent. All remark fields have the same name as their associated constituent, except the first letter of the remark field is an "r." For example, the remark fields for the nitrate and p00600 parameter fields are rnitrate and r00600, respectively. Constituent concentrations reported as above or below a laboratory reporting limit or undetected are considered censored values and have a ">," "<," or "U" in their remark field. A ">" in the remark field indicates that the actual value is known to be greater than the value in the parameter field for that constituent. A "<" in the remark field indicates the actual value is known to be less than the value in the parameter field for that constituent, whereas a "U" in the remark field indicates the material was specifically analyzed for, but was undetected (Maddy and others, 1990, p. 2–14). There are several methods for determining the concentration of a given constituent in water; therefore, several different laboratory reporting limits may be present for a single constituent.

To load the data set into a spread sheet or other software package, insert the file as ASCII text, tab-delimited data. For best results, if possible, be sure to

import the parameter field for the site identification number (staid, table 1) as character text to preserve the leading zeros for site identification numbers.

An ASCII text version of table 1 is included on the data diskette. The file is named table1.txt and is provided so table 1 can be printed out and easily referenced while working with the nutrient data set.

The data set also is available for retrieval on the World Wide Web at: [http://webserver.cr.usgs.gov/nawqa/ucol/ucol\\_home.html](http://webserver.cr.usgs.gov/nawqa/ucol/ucol_home.html)

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