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Office of Acid Deposition, Environmental Monitoring and Quality Assurance
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Research and Development

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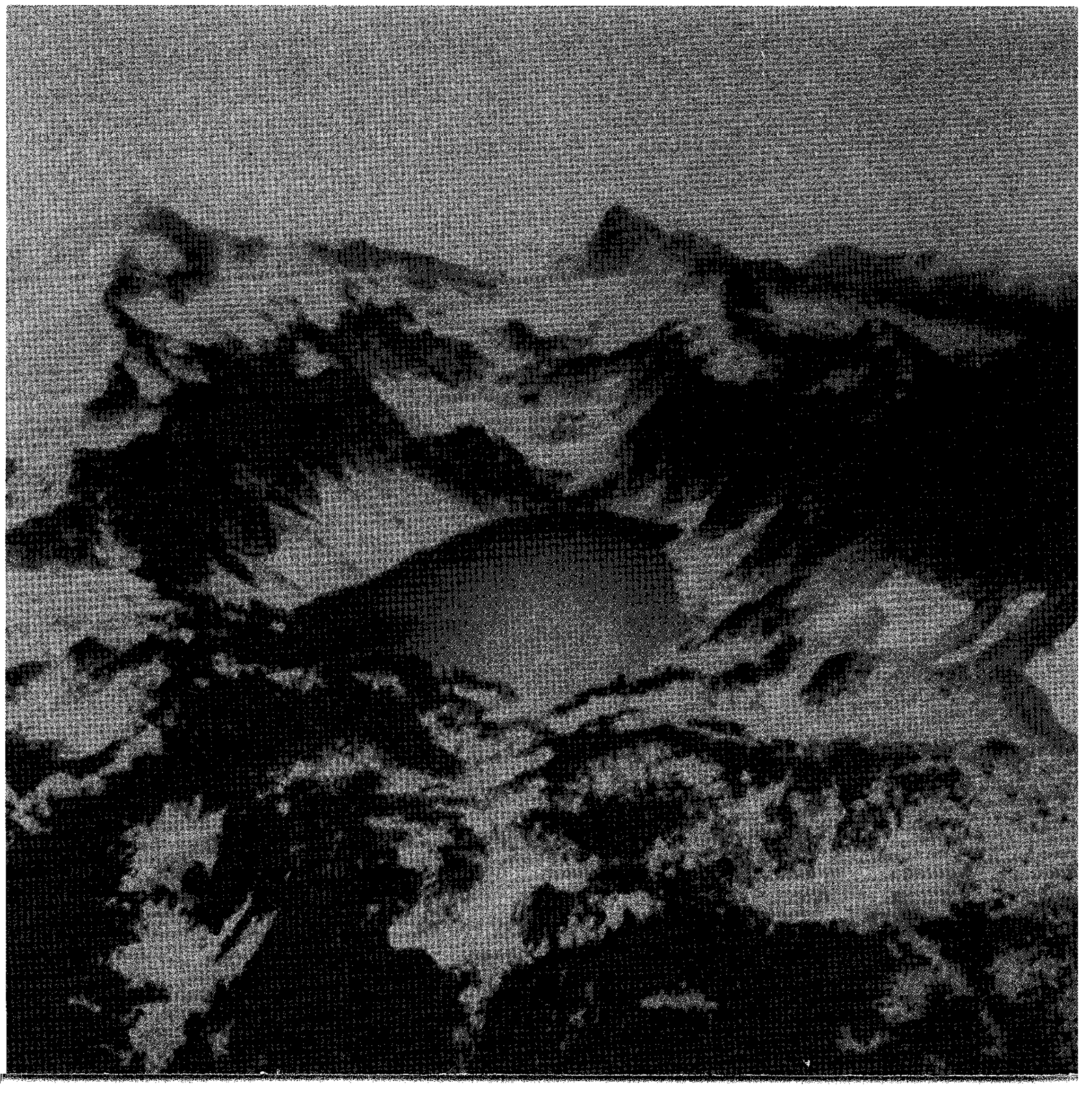
Western Lake Survey Phase I

Data Base



Aquatic Effects Research Program

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Western Lake Survey
Phase I

Data Base

A Contribution to the
National Acid Precipitation Assessment Program

U.S. Environmental Protection Agency
Acid Deposition and Atmospheric Research Division
Office of Acid Deposition, Environmental Monitoring, and Quality Assurance
Office of Research and Development
Washington, D.C. 20460

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NOTICE

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1.0 INTRODUCTION TO DOCUMENT AND EXPLANATION FOR ITS USE

The Western Lake Survey-Phase I (WLS-I) is a component of the National Surface Water Survey (NSWS), a project implemented by EPA as part of the Aquatic Effects Research Program (AERP) which is a major component of the National Acid Precipitation Assessment Program (NAPAP). For information about projects within the AERP, contact:

Dr. R. A. Linthurst, Director
Aquatic Effects Research Program
U. S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Mail Drop - 39
Research Triangle Park, NC 27711

The AERP includes several integrated studies which are conducted in areas believed to be potentially sensitive to change as a result of acidic deposition. The AERP addresses four major policy questions relating to the effects of acidic deposition on aquatic ecosystems: 1) the extent and magnitude of past change, 2) the change to be expected in the future under various rates of acidic deposition, 3) the maximum rates of deposition below which further change is not expected, and 4) the rate of change or recovery of aquatic ecosystems if deposition rates are decreased.

The NSWS is comprised of the Regional Stream Survey (RSS) and the National Lake Survey (NLS), the latter of which is subdivided into the Eastern Lake Survey (ELS) and the WLS. Each survey is conducted in two phases. Phase I activities provide information to determine the current status of lakes and streams. Phase II activities describe seasonal variation in regional surface water chemistry.

This data base package covers only the WLS-I. It is one of several products produced by the AERP Technical Information Project which has the goal of making AERP information and data available to state agencies and organizations involved in acidic deposition monitoring activities. Address inquires regarding the AERP Technical Information Project to:

Mr. R. E. Crowe, Technical Director, AERP Technical
Information Project
EPA/Environmental Monitoring Systems Laboratory-Las Vegas
P. O. Box 93478
Las Vegas, Nevada 89193-3478
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Included in this package are a computerized copy of the WLS-I data set and documentation necessary to make use of the data. There are three distributed WLS-I data sets: data set 3, the validated data set; data set 4, the final data set; and the PC data set, which is a subset of data set 4. Data sets 3 and 4 are distributed on magnetic tape, and the PC data set is distributed on a low-density diskette.

Documentation provided in the data base package includes information about the design and implementation of the WLS-I, a detailed description of the statistical design of the survey, and a summary of survey results (Sections 1-3). The data base dictionary and instructions on accessing the data are included as appendices.

Questions about the information in the data base, reading the data, or analysis of the data should be directed to:

Mr. J. M. Eilers, Technical Director
Western Lake Survey
Northrop Services, Inc.
200 S.W. 35th Street
Corvallis, OR 97333
(503) 757-4664

2.0 SURVEY DESCRIPTION

2.1 OVERVIEW

The NSWS was initiated by EPA when it became apparent that existing data could not be used quantitatively to assess the present chemical and biological status of surface waters in the United States. The results of the ELS-I are presented in detail in Linthurst et al. (1986), Overton et al. (1986), and Kanciruk et al. (1986). The WLS-I survey design, presented in Landers et al. (1987) and Eilers et al. (1987), is summarized here.

Phase I of the NSWS is designed to provide a geographically extensive data base of sufficient quality to estimate with known confidence the number of acidic and potentially sensitive lakes (lakes that have low acid-neutralizing capacity or ANC), identify their location, and describe their present chemical status from a broad-scale, regional perspective. Phase II of the NLS is designed to evaluate seasonal variability in lake chemistry. Lakes sampled in Phase I and Phase II will be used to frame a long-term monitoring program which will evaluate regional-scale, long-term trends in surface water chemistry that may be attributable to the effects of acidic deposition.

The WLS-I was conducted in the fall of 1985 in five high elevation areas in the western United States. The major areas surveyed included those containing the Sierra Nevada, the Cascade Range, and the Rocky Mountains. Because not all lakes in the western United States could be sampled, a statistical procedure for selecting a subset of lakes for sampling was developed. Lakes were selected using a stratified design with equal allocation of sample lakes to strata. Lakes were selected in each stratum by systematic sampling of an ordered list following a random start. The choice of a desired sample size of 50 target lakes per stratum was based on the judgement that this sample size would yield adequate precision for population estimates by stratum.

During the WLS-I, one sample per lake was collected during the fall turnover period from the apparent deepest part of the lake as an index to the essential characteristics of each lake. The fall turnover period was selected because lake water chemistry within any single lake was expected to be the most homogeneous during this season.

The population to be sampled was defined as lakes located in those areas of the western United States expected to contain an abundance of lakes with alkalinity $< 400\ \mu eq\ L^{-1}$. The boundaries of the western region (Figure 2-1) were derived from a national map of surface water alkalinity (Omernik and Powers 1983) and were considered to contain 95 to 99 percent of the lower alkalinity lakes in the western United States. Unlike the Northeast and Upper Midwest in the ELS-I (Linthurst et al. 1986), no subregions in the West were conterminous, because the low alkalinity areas of the West generally coincide with major mountain ranges.

Environmental data collection activities conducted or sponsored by EPA are based on a program which ensures that the resulting data are of known quality. The detailed quality assurance plan for the WLS-I (Silverstein et al. 1987) provides protocols for assessment of data quality in terms of precision, accuracy, completeness, and comparability. Standardized methods for sampling and analysis were developed, based upon the protocols used in the ELS-I (Morris et al. 1986; Kerfoot and Faber 1987).

The data collected during the WLS-I were used to address the key objectives of the Survey--identification of the numbers and locations of acidic lakes and lakes with low ANC, and quantification of the present chemical characteristics of the western lake resource. Because of the WLS-I lake selection design, the standardized protocols employed in data collection, and the quality assurance program, the data from the WLS-I can be used to compare the chemical status of (1) lakes sampled in the West to those sampled in the East during the ELS-I, (2) lakes sampled among the five subregions of the West, and (3) lakes sampled within specific subpopulations within subregions, such as wilderness lakes and nonwilderness lakes.

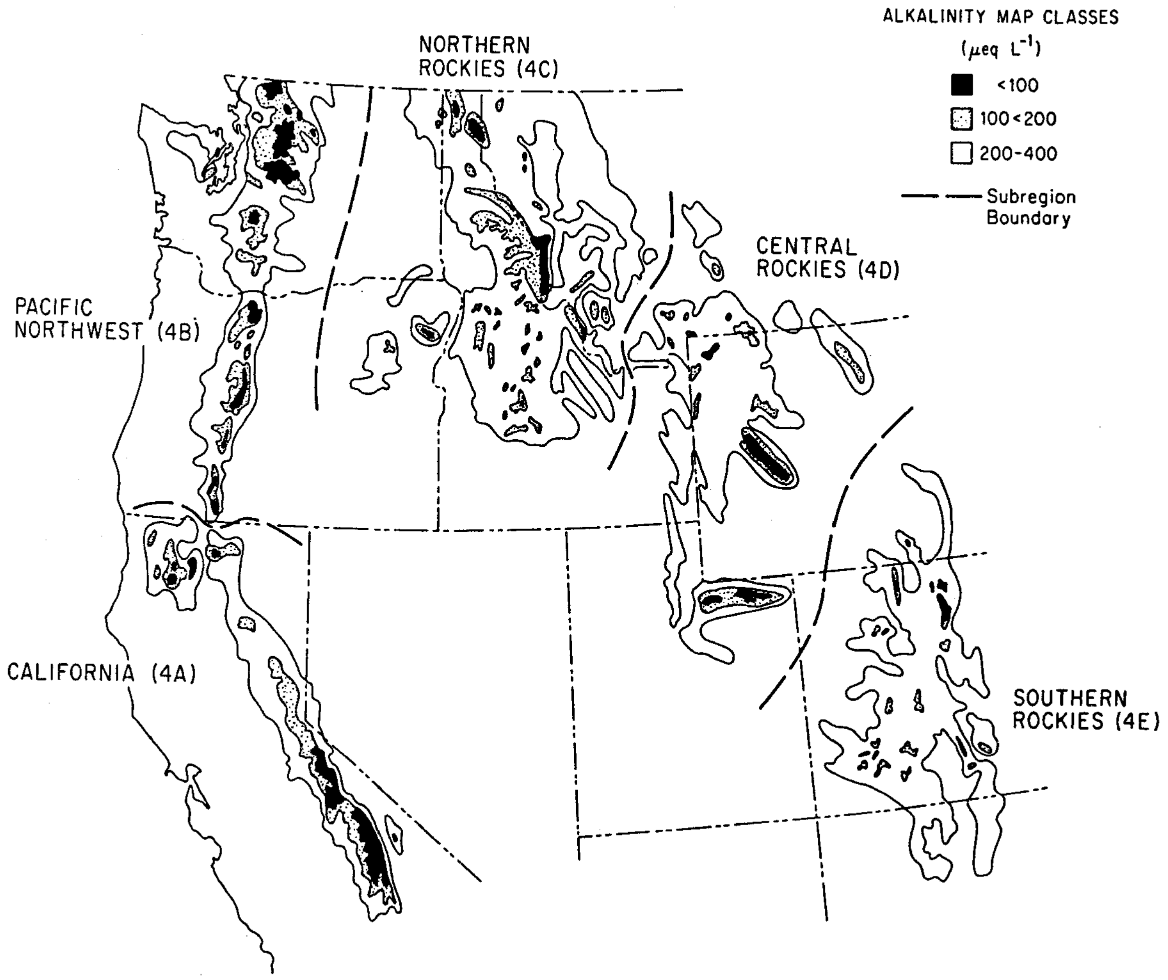

Figure 2-1. Subregions and alkalinity map classes in study areas of the Western Lake Survey - Phase I.

2.2 SURVEY DESIGN

2.2.1 Lake Selection

2.2.1.1 Probability Sample--The stratification factors used in lake selection were region, subregion, and alkalinity map class. The West was defined as one region (Region 4 in the National Lake Survey) with five subregions (4A through 4E). Descriptive names of subregions were assigned (Figure 2-1). Lakes representing each of the three alkalinity map classes (ANC < 100, 100-199, 200-400 μeq L^{-1} derived from Omernik and Griffith 1986, Figure 2-1) were found within each of the five subregions; thus, 15 strata were defined in the WLS-I.

Lakes were identified and listed using 1:100,000-scale United States Geological Survey (USGS) topographic maps in contrast of the ELS-I, in which 1:250,000-scale maps were used for lake selection. Use of 1:100,000-scale maps permitted lakes with a minimum size of approximately 1 hectare (ha) to be identified, as opposed to the approximately 4 ha minimum used in the ELS-I.

Strata boundaries were delineated, and all lakes on the maps were numbered in spatial order within each stratum. The final number of lakes identified in each stratum was the total number of lakes in the map population for the stratum. All population estimates for physical and chemical attributes computed in this study refer to the map population of lakes and do not necessarily represent conditions in lakes outside the area of coverage or in those not depicted on the USGS topographic maps used. For example, population estimates cannot be made for lakes smaller than 1 hectare.

Within each stratum, a systematic random sample of 50 lakes was drawn. Lake numbers were entered into a computer file in numberical order as labeled on the maps. In each stratum, the first lake was selected at random between lakes 1 and k (where k is the size of the map population divided by the desired sample size), and every kth lake was selected thereafter. This sample is a true probability sample, i.e., within each stratum, each lake had an equal probability of inclusion.

2.2.1.2 Identification of Non-target Lakes--"Non-target" lakes (Table 2-1) are those bodies of water that either were not the focus of the Survey's objectives or could not be sampled within the constraints of a synoptic survey. Non-target lakes were first identified in the probability sample by the examination of large-scale (1:24,000 or 1:62,500) USGS topographic maps. Categories of non-target lakes identified by examining these maps include:

1. No lake present: lakes initially identified on 1:100,000-scale maps that did not appear on more detailed, larger scale maps.

2. Flowing water: sites identified as lakes on 1:100,000-scale maps that appeared as points on a stream on larger scale maps. However, if the small-scale maps were more recent than the large-scale maps and the lake in question was known to be a new reservoir, the lake was not eliminated.

3. Urban/Industrial/Agricultural: lakes surrounded by or adjacent to intense urban, industrial, or agricultural land use including tailing ponds, water treatment lagoons, and fish hatcheries.

4. Wetlands: lakes identified on 1:100,000-scale maps that appeared as wetlands on larger scale maps.

5. Too small (< 1 ha): lakes identified on 1:100,000-scale maps that were smaller than approximately 1 ha when measured on larger scale maps. Because the resolution of most 1:100,000-scale maps was about 1 ha, this limit was established for consistency.

Following the elimination of non-target lakes by map examination, it was necessary to restore the number of selected lakes per stratum to 50. Also, in the event that field crews encountered non-target lakes, additional lakes were selected. These additional lakes were chosen from the computer file of lakes remaining after initial selection using the same procedure as for the original set of lakes, and were also evaluated on large-scale maps to eliminate non-target lakes.

The lakes that met the selection criteria after the map evaluation were provisionally designated as "target" lakes. This designation was refined further as a result of information obtained during or after field sampling. The categories and numbers of non-target lakes eliminated during or after sampling are given in Table 2-1. The definitions of these categories are as follows.

1. No lake present: sites visited that were found to be dry.

2. Flowing water: sites visited that were found to be streams.

3. High conductance: lakes visited that were found to have a measured conductance greater than 1500 $\mu S\ cm^{-1}$.

4. Urban / Industrial / Agricultural: lakes that were surrounded by or were adjacent to intense anthropogenic activities.

5. Too shallow: lakes that were too shallow (generally less than 0.75 m) to obtain clean (i.e., free of debris and sediment) sample.

6. Other: lakes that were inaccessible due to a permanent feature of the lake that prevented helicopters from landing safely (e.g., power lines).

Lakes were classified as "not visited" (Table 2-1) if the reason for not sampling was unrelated to a permanent feature of the lake. This category of lakes includes those that could not be visited because permission to sample was not obtained or weather conditions prohibited access. Lakes that were visited but were not sampled because they were frozen or were sampled, but were found during data validation to be the wrong lake, were also classified as not visited. The target or non-target status of this group of lakes could not be determined; thus, they represent incompleteness in the sample. For statistical analyses, it was assumed that lakes not visited were a random subsample of the original probability sample and thus had the same proportion of non-target lakes as the lakes that were visited. This asumptions appears valid because no systematic differences in lake area, watershed area, or elevation were found between frozen lakes and sampled lakes.

However, some differences were noted in the Central and Southern Rockies between the frozen lakes and the sampled lakes (Table 2-2). Frozen lakes were generally smaller and were located at higher elevations than were the sampled lakes. It is also probable that the frozen lakes were shallower than the sampled lakes, although no measurements of lake depth in the frozen lakes are available to confirm this assumption. Analyses indicate that ANC is inversely related to elevation in the Central Rockies (Landers et al. 1987). That frozen lakes in this subregion were generally located at elevations higher than those estimated from the sampled lakes for the target population suggests that the population estimates for the Central Rockies are not based on a random subsample. The degree to which the population estimates underestimate the number of

TABLE 2-1. NON-TARGET LAKES AND LAKES NOT VISITED OR NOT SAMPLED, WESTERN LAKE SURVEY - PHASE I

A. Probability sample lakes determined to be non-target from large-scale map examination

Categories	California 4A	Pacific Northwest 4B	Northern Rockies 4C	Central Rockies 4D	Southern Rockies 4E	Total
No Lake Present	7	0	1	1	1	10
Flowing Water	1	0	0	1	1	3
Urban/Industrial/ Agricultural	2	1	0	0	3	6
Wetlands	2	4	2	1	0	9
Too Small(< 1 ha)	14	24	7	18	3	66
Total	26	29	10	21	8	94

B. Non-target probability sample lakes determined during or after sampling

Categories	California 4A	Pacific Northwest 4B	Northern Rockies 4C	Central Rockies 4D	Southern Rockies 4E	Total
No Lake Present	7	2	5	6	2	22
Flowing Water	0	0	0	0	0	0
High Conductance	0	0	1	0	1	2
Urban/Industrial/ Agricultural	1	0	0	0	0	1
Too Shallow	10	15	18	14	13	70
Other	0	0	0	2	1	3
Total	18	17	24	22	17	98

C. Probability sample lakes that were not visited

Categories	California 4A	Pacific Northwest 4B	Northern Rockies 4C	Central Rockies 4D	Southern Rockies 4E	Total
No Access Permit	2	4	0	0	2	8
Bad Weather	0	1	0	1	0	2
Wrong Lake	0	0	1	0	0	1
Frozen	1	0	7	21	20	49
Total	3	5	8	22	22	60

TABLE 2-2. POPULATION ESTIMATES OF MEDIAN LAKE AREA AND MEDIAN ELEVATION FOR FROZEN LAKES AND SAMPLED LAKES IN CENTRAL ROCKIES (4D) AND SOUTHERN ROCKIES (4E), WESTERN LAKE SURVEY - PHASE I

	Target Lakes Visited (n***)		Lake Area (ha)		Elevation (m)	
Stratum	frozen	sampled	frozen	sampled	frozen	sampled
Central Rockies						
4D1	11	43	3.5	5.6	3338	3219
4D2	7	47	2.4	5.5	3042	3042
4D3	3	39	6.1	3.5	2865	2687
Southern Rockies						
4E1	14	46	2.6	3.0	3394	3307
4E2	5	52	2.6	3.3	3237	3456
4E3	1	41	1.7	3.5	3188	3147

low ANC lakes in the Central Rockies is difficult to assess. However, comparison of WLS-I results with previous surveys shows relatively close agreement (Eilers et al. 1987).

The population estimates for the number of low ANC lakes in the Southern Rockies are probably not affected to the degree that may have occurred in the Central Rockies. The difference in lake size between frozen and sampled lakes is smaller and there is no apparent relationship between lake ANC and lake elevation in Subregion 4E. However, with such a large proportion of the selected subsample unavailable for sampling in the Central and Southern Rockies, it is not possible to determine confidently the impact that frozen lakes had on the characterizations of the lake populations.

2.2.1.3. Special Interest Lakes--Other lakes, in addition to those chosen in the probability sample, were included in the WLS-I. Forty-two lakes that were not selected randomly and are or were the subjects of relevant research programs were selected as special interest lakes. Of these lakes, samples were collected from 32. All western lakes in the current EPA Long-Term Monitoring Program were selected as special interest lakes. Other special interest lakes were included based on recommendations from state and federal agencies. Data from these lakes were not used in computing population estimates, but individual lake results are shown in Volume II of the Western Lakes Report (Eilers et al. 1987).

2.2.1.4. Final Lake Lists and Maps--Lake names, identification (ID) numbers, geographical coordinates, wilderness area or park names, and map names were entered into computer files and were printed for field crews. If no name was printed on the map for a given lake, the entry in the file was "no name." Each lake was assigned a unique ID number coded for the stratum in which it occurred (e.g., 4A2-011 is the 11th lake selected in alkalinity map class 2 of Subregion A in Region 4). The latitude and longitude for each lake were measured with 11 point dividers to the nearest degree, minute, and second and were checked by visual examination and computer-generated overlays. Additionally, ID codes were printed on the topographic maps for use by field crews in locating the lakes.

2.2.2 Variables Selected for Analysis

A number of physical and chemical variables were measured in the WLS-I, 24 of which are shown in Table 2-3. The variables were selected on the basis of their importance in chemically characterizing lakes from a regional perspective, as well as for their biological importance.

TABLE 2-3. SUMMARY OF VARIABLES MEASURED IN THE WESTERN LAKE SURVEY - PHASE I[a]

Acid neutralizing capacity	Magnesium, dissolved
Aluminum, extractable	Manganese, dissolved
Aluminum, total	Nitrate, dissolved
Ammonium, dissolved	pH
Calcium, dissolved	Phosphorus, total
Carbon, dissolved inorganic	Potassium, dissolved
Carbon, dissolved organic	Secchi disk transparency
Chloride, dissolved	Silica, dissolved
Color, true	Sodium, dissolved
Conductance	Sulfate, dissolved
Fluoride, total dissolved	Temperature
Iron, dissolved	Turbidity

[a]The complete list of variables for the Survey is given in Eilers et al. (1987) and Kanciruk et al. (1986).

2.3 SURVEY IMPLEMENTATION

2.3.1 Base Site Operations

During the WLS-I sampling effort five base sites were established: Missoula and Bozeman, Montana; Aspen, Colorado; Carson City, Nevada; and Wenatchee, Washington. Each base site consisted of a mobile field laboratory, an area for storage and calibration of field equipment, one helicopter, and one fixed-wing aircraft. Approximately 25 personnel were responsible for collection and delivery of samples to each field laboratory staffed by a crew of five people. The field laboratories were responsible for sample tracking, sample preservation, and sample shipping by overnight courier to analytical laboratories. Additionally, the field laboratories analyzed samples collected in airtight sealed syringes for pH and dissolved inorganic carbon; two chemical variables which are especially prone to change.

2.3.2 Field Sampling Activities

Approximately six lakes per day were scheduled for sampling by each helicopter sampling crew. Ground crews sampled one or two lakes per day, depending on the distance they had to travel to reach each site. Upon approaching each lake, crews recorded watershed descriptions for the site and conducted on-site measurements of a few key chemical variables. Samples collected at each lake included those to be processed through the field laboratory for delivery to the analytical laboratories and the two samples collected in airtight sealed syringes. As part of a calibration study, helicopter crews collected 3 lake water samples (triplicates) and ground crews collected 2 lake water samples (duplicates) from each of 45 calibration study lakes (see Section 2.4.1).

2.3.3 Analytical Laboratory Operations

Laboratories analyzing WLS-I samples were contractually required to process samples within pre-established holding times according to standardized protocols (Kerfoot and Faber 1987). Data for each batch (an entire set of samples processed at one field laboratory on one day) were required to be submitted to the Quality Assurance group at the Environmental Monitoring Systems Laboratory (EMSL), Las Vegas, within 35 days of receiving the samples.

2.4 QUALITY ASSURANCE PROGRAM

An extensive quality assurance program was designed to standardize all sampling and analytical protocols and to ensure that the quality of the data could be determined. Field sampling methods and field laboratory activities are detailed in Bonoff and Groeger (1986), Morris et al. (1986), and Peck et al. (1985). Several types of quality assurance/quality control (QA/QC) samples were used to ensure that sampling and analytical methods were performed as specified in the QA plan. The results of QA sample analysis were used to evaluate the performance of field sampling methods and field and analytical laboratory procedures. The analysis of QC samples allowed field samplers and laboratory personnel to identify and quickly correct problems such as instrument malfunctions or reagent contamination.

2.4.1 Calibration Study

The necessity to access wilderness area lakes by ground rather than by helicopter required that field sampling methods used in the WLS-I be modified from those previously used in the ELS-I. To evaluate the differences between ground sampling and helicopter sampling, and the potential effect of these differences on data interpretation, 45 lakes located in wilderness areas were sampled using both protocols. This study was conducted primarily to determine if the data from samples collected by ground crews had to be "calibrated" or adjusted to ensure that they were comparable to data from samples collected by helicopter crews.

A statistical evaluation of the data collected by helicopter crews and ground crews revealed that no significant differences existed, consequently, data collected using both protocols were pooled for data analysis. A related study with these samples which evaluated the effects of various holding times revealed that the few instances of delay in sample delivery by the ground crews had no significant effect on the chemical variables measured.

2.4.2 Data Base Quality Assurance

Quality assurance of the WLS-I data base was accomplished through a series of steps designed to identify and eliminate errors and verify all questionable or unusual data. Data verification was a systematic process in which the raw data set was reviewed. The initial step involved a review of the field data forms to ensure that field QA/QC sample data were within previously established acceptance criteria. The results reported by the analytical laboratories were evaluated to ensure that the reports were complete, that laboratory QA/QC criteria were met, and that, if necessary, data were appropriately qualified.

The validation process for the WLS-I data base was designed to investigate potential errors in the chemical analyses that were not detected during verification. The data validation procedures provided a means of identifying questionable data, based on empirical evidence or statistical analyses, and a way to determine the most appropriate value for a water quality variable when it was measured in more than one way or when data substitution was necessary. Data substitution was necessary when values were missing from the data set.

2.4.3 Summary of QA/QC Results

The numerous quality assurance/quality control procedures that were implemented during the WLS-I are described in detail in Silverstein et al. (1986). Analysis of the QA/QC data revealed that the two analytical laboratories performed well; however, for a few variables there were systematic differences in the measurements reported. This relative laboratory bias has been evaluated and is discussed in more detail in Landers et al. (1987) and Silverstein et al. (1987).

3.0 STATISTICAL DESIGN APPLICATIONS AND RESTRICTIONS

3.1 EXTRAPOLATION FROM SAMPLE TO POPULATION

For statistical analyses, the probability sample was treated as a simple random sample within each stratum. The ordering of the lakes and the systematic selection process were designed to increase the precision over that which would have been obtained with a simple random sample; therefore, statements of precision for population estimates are probably conservative.

When population estimates from combined strata are required (e.g., when making subregional or regional estimates), expansion factors or weights (W) must be used because the sampling intensity varied among strata. These weights (the stratum target population size divided by the stratum sample size) vary considerably among strata; for example, a lake sampled in one stratum may represent three lakes, whereas each lake sampled in another stratum may represent 36 lakes.

This design permits strata to be combined when it is meaningful to do so. The flexibility of the design also allows estimates to be made for specific subpopulations, or subsets of lakes; however, unless the definition of the population of interest is clearly stated, conclusions based on the WLS-I data can be misleading.

3.2 ESTIMATING THE TARGET POPULATION SIZE AND ATTRIBUTES

The first steps in the statistical analysis of the data were to estimate the target population size in each stratum ($\hat{N}$; Figure 3-1) and to determine the stratum-specific weights needed for interstratum estimation. The target population size in each stratum was estimated in two units: number of lakes and lake area (in hectares).

The statistical frame is defined by the list of lakes identified by the map population. The map population consists of both target and non-target populations. Within each stratum, it is possible to estimate the size of the target population by multiplying the number of sampled lakes classified as target (n^{***}) by the stratum-specific weight (W). This weight is the inverse of the inclusion probability (P) of a target lake in the final sample, which is determined according to the following equation:

$$P = 1/W = (n^*/N^*)\, q \qquad (1)$$

where n^* = the size of the sample drawn from the map population

N^* = the size of the map population

q = the probability that a target lake in the drawn sample is actually visited; computed by dividing the actual number of lakes visited ($n^* - n_{nb} - n_o$) by the number of lakes intended to be visited ($n^* - n_{nb}$)

where n_{nb} = the number of non-target lakes in the original sample, as determined from the maps, and

n_o = the number of lakes not visited.

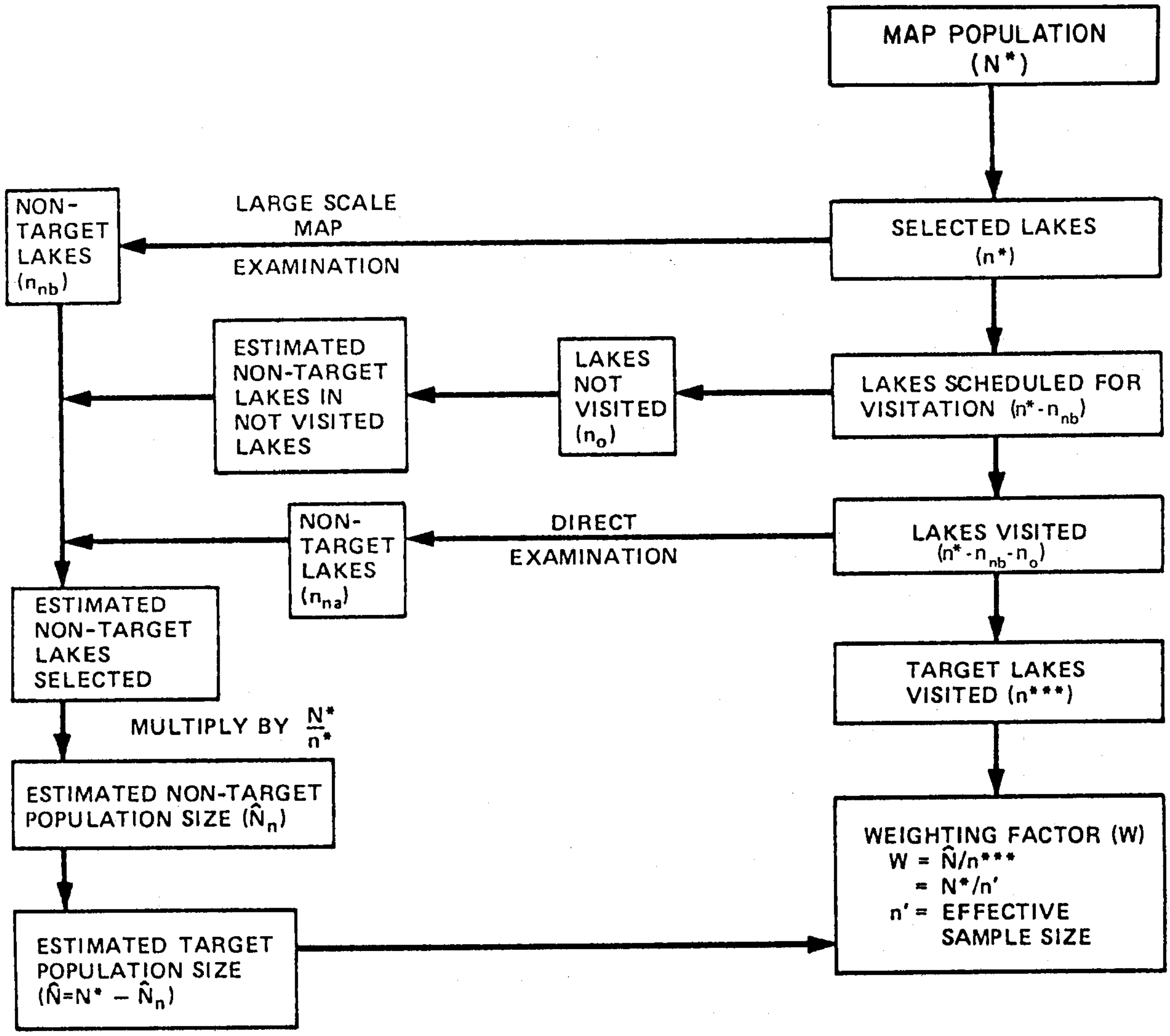

Figure 3-1. Procedures used to estimate the target population size, Western Lake Survey - Phase I.

Hence, P is the probability of obtaining a water sample from any target lake in the map population. Note that each lake within a stratum has the same value of P and hence the same W, but that lakes from different strata can have different weights depending on the values of n^*, N^*, or q. Within a stratum, the estimated number of target lakes in the map population is:

$$\hat{N} = W(n^{***}) \qquad (2)$$

An alternate expression for W is this ($\hat{N}/n^{***}$)

The use of equations 1 and 2 can be illustrated with the data from Stratum 4A1. A sample of 60 lakes (n^*) was selected from a map population of 1885 lakes . Three lakes in the sample were determined to be non-target lakes based on the examination of large-scale maps (n_{nb}), and one lake was not visited (n_o). Thus, the probability that a target lake in the sample from Stratum 4A1 was actually visited (q) is 56/57 = 0.982 and the probability of obtaining a water sample from any target lake in the map population (P) is 0.982 (60/1885) = 0.031. The value of W to be used in combining data from Stratum 4A1 with data from any other stratum is thus 1/0.031 = 31.978. Because 54 target lakes (n***) were sampled in Stratum 4A1, the estimated target population size ($\hat{N}$) for the stratum is (31.98)(54) = 1727 lakes.

The estimated target lake area in a stratum ($\hat{A}$) was calculated similarly by multiplying the total area of visited target lakes (ΣA) by the stratum weight:

$$\hat{A} = W(\Sigma A) \tag{3}$$

The variances of $\hat{N}$ and $\hat{A}$, for single strata, were estimated by:

$$\hat{V}(\hat{N}) = N^* [(N^* - n')/(n'-1)][n^{***}/n'][(n' - n^{***})/n'] \tag{4}$$

$$\hat{V}(\hat{A}) = N^* [(N^* - n')/(n'-1)][1/n'][\Sigma A^2 - (\Sigma A)^2/n'] \tag{5}$$

where n', the "effective sample size," is used in place of n* because of incomplete visitation (i.e., n' = qn*). The standard errors are calculated as the square roots of the variances.

For estimates of populations covering multiple strata, estimates and variances must be computed within strata and added or else computed with equations containing weights (see below). Any explicitly defined subset of the total population of target lakes in the West is a subpopulation. Subpopulations can be defined over any combination of strata. For example, for any given variable, each observed value of a variable, X, defines a subpopulation of lakes having a value x less than or equal to that value. Subpopulation definitions also can be based on geographic boundaries such as states or national parks. This procedure was used in identifying specific subpopulations in geomorphic units (Landers et al. 1987).

Estimates for subpopulations that are defined within single strata can be generated using formulae that are modifications of the equations given above (mathematically identical to the algorithms used in generating all the statistics for the Survey). To generate single stratum subpopulation equations from equations 2 through 5, each n*** is replaced by n_z and each Σ by Σ_z, where n_z is the number of sample lakes in the subpopulation z and Σ_z is the summation over the sample lakes in the subpopulation z.

For example, all 22 lakes (n_z) sampled in Rocky Mountain National Park are in Stratum 4E1, which has W = 3.261 (Section 4.1.2, Table 4-1). Thus, the estimated target population size ($\hat{N}$) for Rocky Mountain National Park is (3.261)(22) = 72 lakes. The 22 lakes have a combined area of 106.8 ha ($\Sigma_z A$); thus, the estimated area ($\hat{A}$) of the target population in Rocky Mountain National Park is (3.261)(106.8 ha) = 348.3 ha.

A useful generalization, appropriate for any subpopulation and any combination of strata, is that,

$$\hat{N} = \Sigma W, \text{ and } \hat{A} = \Sigma WA, \tag{6}$$

where summation is over the appropriate subset of sample lakes in the appropriate strata, and where the values of W are assigned according to the stratum in which the lake belongs.

The use of equation 6 can be illustrated with the data for population estimates of acid neutralizing capacity (ANC) by state. In Utah, 30 lakes were sampled. Eleven of these were in Stratum 4D1 with W = 18.356, 13 in Stratum 4D2 with W = 19.744, and 6 in Stratum 4D3 with W = 14.918). The estimated target population size ($\hat{N}$) for Utah is calculated by adding the product of n_z and W for each stratum, which is the same as 11(18.356) + 13(19.744) + 6(14.918) = 548 lakes. A subpopulation of the lakes in Utah can be defined by a particular value for ANC. Only one of the lakes sampled in Utah had an ANC value $\leq$ 50 μeq L^{-1}. This lake was in Stratum 4D2 with a weight of 19.744; thus, the estimated number of lakes in Utah with ANC $\leq$ 50 μeq L^{-1} is 20, and the estimated proportion is 20/548 = 0.04.

A further generalization, used in data analysis, leads to a similar formula for the estimated variance of any variable, X, over any subpopulation and combination of strata:

$$\text{Variance}(X) = \Sigma WX^2/\Sigma W - (\Sigma WX/\Sigma W)^2 \quad (7)$$

where the set of sample lakes in the summation defines the subpopulation of lakes for which the variance is estimated.

The weighting factors are extremely important. Estimating population parameters from sample data without accounting for weights can lead to erroneous calculations and incorrect interpretation. Examining relationships among variables with the expectation that these relationships are representative of the population should only be done within strata or by using weighting factors.

By a method equivalent to calculating subpopulation estimates (number or area of lakes with concentration less than or equal to x) and their associated upper confidence limits for all possible values of X, cumulative frequency distributions [F(x)] and cumulative areal distributions [G(x)] were calculated. At any value x, these curves represent the estimated number or area of lakes in the population having a value for that variable less than or equal to x, with the 95 percent upper confidence limit for that number. For some variables, interest is in the number of lakes with concentrations above a particular value (e.g., sulfate > 50 μeq L^{-1}), so the inverses of the cumulative frequency distributions [1-F(x)] and of the cumulative areal distributions [1-G(x)] were generated in a similar manner.

Quintiles and medians for these cumulative frequency and areal distributions were also calculated. The quintiles (Q_1 and Q_4) reflect the estimated values of x separating the distribution into five equal parts (i.e., the 4th quintile is the 80th percentile). The median is the estimated value of x such that half the lakes in the population are characterized by concentrations of the variable equal to or less than the value of x.

3.3 RESTRICTIONS

The use and interpretation of any data set are restricted by the design, the quality of the data obtained, and the sampling protocols. The map and target populations and the period of sampling are the primary design considerations influencing the proper interpretation of the WLS-I data.

Estimates of the number of lakes within an area are strongly affected by the map scale used to define the map population. Use of larger scale maps provides greater resolution and allows smaller lakes to be identified and included in the population under consideration. The map scale used to define the map population in the WLS-I was 1:100,000, which identified lakes as small as approximately 1 ha. Lakes identified from 1:24,000-scale maps can be as small as 0.1 ha. Some estimates of the number of lakes in portions of the West have been based on larger scale maps such as 1:62,500 or 1:25,000 (Turk and Adams 1983).

To illustrate the influence of map scale in estimating the total number of lakes, the number of lakes on 1:100,000-scale maps within several areas of interest were counted. The process was then repeated using larger scale maps covering the same area as the 1:100,000-scale maps. The results show that large-scale maps display more lakes.

Comparisons of the results of the WLS-I to those from other lake surveys in the West must be done with knowledge of the map scales used to prepare the population estimates. No direct conclusions can be drawn about the population of lakes less than 1 ha from WLS-I data. This restriction also applies to other categories of non-target lakes defined in the WLS-I.

The period of sampling restricts the conclusions of the WLS-I to the fall of 1985. The accuracy of extrapolating the fall index sample to other times of the year or to other years is not known. The degree to which short term, episodic events (e.g. spring snowmelt) affect the estimated chemical characteristics of western lake populations is not addressed.

3.4 DESIGN CONSIDERATIONS

3.4.1 Using Weights

The design of the WLS-I requires that the results be presented as population and/or subpopulation estimates whenever conclusions on combined strata are to be drawn. Expansion factors or weights (W) must be used when making combined strata estimates of attributes for the populations of lakes (Linthurst et al. 1986). These weights are defined, and the estimating equations are given, in Section 3.2.

Using Strata 4A1 and 4A2 illustrates the requirement that all unweighted estimates be made within strata and that means or other statistics involving more than one stratum be calculated with the appropriate stratum weights (Table 3-1). The correct way to estimate the total number of lakes in two strata below a reference value (in this example ANC $\leq$ 50 μeq L^{-1}) is to determine first the total number of lakes in the sample below the reference value in each stratum (n_c). The next step is to determine the proportion of lakes in the sample below the reference value for each stratum (n_c/n^{***}: 23/54 = 0.426 and 12/53 = 0.226). Next, multiply the proportion of sample lakes below the reference value in the stratum by the estimated number of lakes in the stratum population ($\hat{N}$), which results in $\hat{N}_c$, the estimated number of lakes in the stratum population below the reference value. Adding the $\hat{N}_c$ for each stratum (735.5 + 101.1) yields the combined stratum $\hat{N}_c$ (836.6). The same answer can be obtained by multiplying n_c by W for each stratum and summing the results.

The most accurate estimate for the overall proportion of lakes in the designated population below the reference value, therefore, is 836.6/2173 = 0.384 (Table 3-1). If the overall proportion of lakes below the reference value were computed as 35/107 = 0.327 (n_c/n^{***} for the sum of n_c and n^{***} for both strata), the answer would be biased. For example, there is an estimated total of 2173 lakes in Strata 4A1 and 4A2. Using the correct value of 0.384 as p_c, the estimated number of lakes with ANC $\leq$ 50 μeq L^{-1} would be 837. Using the incorrect p_c value of 0.327 (based on the combined n_c/n^{***}), the estimated number of lakes with ANC $\leq$ 50 μeq L^{-1} would be 711. Therefore, the number of lakes estimated to have ANC $\leq$ 50 μeq L^{-1} in both strata would be underestimated by 126 (837-711.)

A less clear issue associated with the design and weighting is related to examining relationships among variables. Unweighted analyses such as regressions or correlations should not be used unless the relationships between the variables are the same across strata. Unless the relationships are independent of alkalinity map class (and any factor associated with the alkalinity map class strata) unweighted estimates can be biased, as can unweighted means or medians and total numbers.

TABLE 3-1. USE OF WEIGHTS IN COMBINED STRATA ESTIMATION, WESTERN LAKE SURVEY - PHASE I

				ANC $\leq$ 50 μeq L^{-1}		
Stratum	$\hat{N}$	n***	W	n_c	p_c	$\hat{N}_c$
4A1	1727	54	31.978	23	0.426	735.5
4A2	446	53	8.422	12	0.226	101.1
Combined	2173	107		35	0.384	836.6

$\hat{N}$ = estimated number of lakes within an alkalinity map class stratum.
n*** = number of lakes from which samples were obtained.
W = weighting or expansion factor.
n_c = number of lakes in the probability sample with ANC $\leq$ 50 μeq L^{-1}, the reference value.
p_c = estimated proportion of lakes in the sample (for a stratum) or population (for combined strata) which has ANC $\leq$ 50 μeq L^{-1} (n_c / n***).
$\hat{N}_c$ = estimated number of lakes in the population which has ANC $\leq$50 μeq L^{-1}, the reference value.

In this report the estimated statistics for regression and correlation analyses and their associated standard errors are presented by stratum; thus, they are unweighted. Analyses which combine strata (e.g., on a subregional level) are weighted and, as for strata, the regression statistics are unbiased. However, the standard errors associated with these combined estimates are biased and, therefore, are not presented.

3.4.2 Evaluation of Alkalinity Map Classes

The third level of stratification for the design was alkalinity map class (Section 2.2.1). In order to evaluate the effectiveness of the stratification based on alkalinity map class, measured ANC values were compared to the ranges of alkalinity for each map class. For the design to be most efficient, the largest percentage of lakes with ANC < 100 μeq L^{-1} should be observed in Map Class 1, the largest percentage with ANC from 100-199 μeq L^{-1} should be observed in Map Class 2 and the largest percentage having ANC $\geq$ 200 μeq L^{-1} should be observed in Map Class 3. In general, the map classes used in lake selection were good estimates of the measured ANC, but the intermediate class (100-199 μeq L^{-1}) was less effectively classified by the maps than were the other two classes.

The maps also can be evaluated by examining the distribution of ANC within map classes. In all cases, Map Class 1 had lower quintile values than either Map Class 2 or 3. Map Class 3 had the highest quintile values of ANC. These results indicate that the map classes used in selection led to increased efficiency in the design.

4.0 SURVEY RESULTS

4.1 DESCRIPTION OF TARGET POPULATION

4.1.1 Number of Lakes Sampled

A total of 973 probability sample lakes was selected from the map population. Of those, 94 were classified as non-target by examination of large-scale maps, 98 were classified as non-target when visited, and 60 were not visited (Table 2-1). Data from water samples collected from 720 lakes were subsequently considered for use in making population estimates. One lake which was larger than 2000 ha was excluded from population estimates; thus, the number of lakes upon which population estimates are based is 719.

Of the 42 special interest lakes selected, 32 were sampled. The data collected from special interest lakes are presented in Volume II of the WLS report (Eilers et al. 1987). Because these lakes were not part of the random selection process, weighting factors do not apply in this case, and the representativeness of these lakes with respect to the chemical characteristics of the lake population as a whole is uncertain.

4.1.2 Description of Target Population and Sample

Table 4-1 gives the components of the population and sample by strata, subregions, and region. All estimates were made with the equations in Section 3.0 The weights provided in Table 4-1 are appropriate for all analyses in which weighting is necessary.

4.1.3 Distribution of Lakes

Of the 719 probability sample lakes, 455 were located in wilderness areas (Table 4-2). The largest numbers of probability sample lakes were sampled in the states of California (147), Colorado (132), and Washington (117). Only two lakes were sampled in Nevada and one in New Mexico (Table 4-3). Most of the special interest lakes sampled were located in Montana (8), Utah (7), and Wyoming (7). Based on the sample size of the probability sample lakes, and using the equations developed to extrapolate to the total number of target lakes, it is estimated that the number of lakes characterized by the WLS - I is 10,393 with a standard error of 219.4 (see Table 4-1).

4.2 ESTIMATED CHEMICAL CHARACTERISTICS

4.2.1 Comparison among Subregions

Five of the chemical variables measured during the WLS-I were selected for detailed analysis because of their direct relevance to the effects of acidic deposition on lake chemistry, as described below:

1. pH: In some lakes, continuous inputs of acids can result indecreases in pH and acid neutralizing capacity.

2. ANC: In other lakes, acid neutralizing capacity may decrease before substantial decreases in pH occur; therefore, losses in acid neutralizing capacity may serve as a better indicator of acidification than decreases in pH.

TABLE 4-1. DESCRIPTION OF THE TARGET POPULATION, SAMPLE AND WEIGHTING FACTORS EXCLUDING LAKES > 2000 ha, WESTERNR LAKE SURVEY - PHASE I

STR	N*	n*	n***	W	Ñ	SE(Ñ)	Â	SE(Â)
4A1	1885	60	54	31.978	1726.81	67.58	14256	2409
4A2	538	65	53	8.422	446.37	23.94	10822	3355
4A3[a]	383	72	42	5.416	227.47	20.34	10931	3296
4B1	695	70	59	9.929	585.81	28.87	7676	1566
4B2	724	70	53	10.700	567.10	34.78	9185	3469
4B3	781	70	47	11.766	553.00	42.01	51177	23022
4C1	343	60	53	6.246	331.04	7.85	1831	196
4C2	675	60	50	11.455	572.75	30.38	4136	794
4C3	2317	65	40	36.875	1475.00	139.79	30097	11284
4D1	885	60	43	18.356	789.31	38.89	9242	1877
4D2	1024	60	47	19.744	927.97	40.78	7726	1121
4D3	1061	75	39	14.918	581.80	60.90	12818	5324
4E1	150	60	46	3.261	150.01	0.00	711	65
4E2	261	63	52	4.526	235.35	9.1 1	1119	136
4E3	1784	63	41	29.834	1223.19	106.19	10123	2979
Subregion								
4A[a]	2806	197	149		2400.65	74.52	36009	5284
4B	2200	210	159		1705.91	61.71	68038	23335
4C	3335	185	143		2378.79	143.27	36065	11314
4D	2970	195	129		2299.08	82.98	29786	5756
4E	2195	186	139		1608.55	106.58	11953	2983
Region								
4[a]	13506	973	719		10392.98	219.39	181851	27248

STR = stratum.
N* = map population.
n* = number of lakes in the probability sample.
n*** = number of lakes sampled.
W = weight.
Ñ = estimated target population size.
SE(Ñ)= standard error of N.
Â = estimated area of target population.
SE(Â)= standard error of A.

[a]Lake Almanor (ID number = 4A3-017) is not included in these estimates. The estimates for the target population which included Lake Almanor are:
STR 4A3: Ñ = 232.89, SE(Ñ) = 20.22, Â = (65148), SE(Â) = 48927.
Subregion 4A: Ñ = 2406.07, SE(Ñ) = 74.52, Â = 90227, SE(Â) = 49101.
Region 4: Ñ = 10,398.40, SE(Ñ) = 219.38, Â = 236069, SE(Â) = 55906.

TABLE 4-2. NUMBER OF LAKES SAMPLED WITHIN EACH SUBREGION IN THE WEST (REGION 4) DURING THE WESTERN LAKE SURVEY - PHASE I

	Probability Sample Lakes		
Subregion	Wilderness	Non-Wilderness	Special Interest Lakes
California (4A)	97	52	2
Pacific Northwest (4B)	90	69	3
Northern Rockies (4C)	82	61	5
Central Rockies (4D)	96	33	19
Southern Rockies (4E)	90	49	3
Total	455	264	32

TABLE 4-3. NUMBER OF LAKES SAMPLED WITHIN EACH STATE IN THE WEST (REGION 4) DURING THE WESTERN LAKE SURVEY PHASE I

State	Probability Sample Lakes[a]	Special Interest Lakes
California	147	2
Colorado	132	3
Idaho	72	2
Montana	80	8
Nevada	2	0
New Mexico	1	0
Oregon	55	3
Utah	30	7
Washington	117	0
Wyoming	83	7
Total	719	32

[a] The number of probability sample lakes that were > 1 ha and ≤ 2000 ha.

3. Sulfate: Sulfate concentrations in lake water can become elevated as a result of sulfate deposition, one of the key components of acidic deposition.

4. Extractable Aluminum: Acidification of lakes can be accompanied by elevated concentrations of aluminum that can be toxic to aquatic organisms, particularly fish.

5. DOC: Dissolved organic carbon (DOC) in "colored" lakes is largely composed of organic acids of terrestrial origin. These compounds can serve as sources of hydrogen ion (i.e., acidity). Thus, some acidic lakes may be so because of the presence of organic acids and not necessarily because of acidic deposition.

A qualitative comparison of estimated cumulative frequency distributions reveals that many lakes in the West are characterized by low ANC (Figure 4-1). Acid neutralizing capacity in lakes in the California subregion (4A) was generally lower than in other subregions. The ANC values for the Northern Rockies (4C) and Southern Rockies (4E) were generally high relative to other subregions. A similar comparison for pH indicates that a very small percentage of lakes in the West had pH $\leq$ 6.0 (Figure 4-2).

A quantitative analysis of the characteristics of lakes in the five western subregions was made using the sample results and the statistical design of the Survey. Reference values for ANC (50 $\mu eq\ L^{-1}$ and 200 $\mu eq\ L^{-1}$) and pH (6.0) were selected to estimate the number and percentage of lakes in each subregion and in the West as a whole at or below these specific values. California had the largest number and percentage of lakes with ANC $\leq$ 50 $\mu eq\ L^{-1}$, followed by the Pacific Northwest, the Northern Rockies, the Central Rockies, and the Southern Rockies. Nearly 67 percent of the estimated 10,393 lakes in the western target population had ANC $\leq$ 200 $\mu eq\ L^{-1}$ and most of these (2078 lakes, 86.6%) were located in California. Only 103 lakes in the West were estimated to have pH $\leq$ 6.0; the highest percentage and largest number were estimated for the Pacific Northwest.

Three additional key chemical variables (Table 4-4) were also used to compare lakes in the five western subregions. An estimated 13.5 percent of the lakes in the West had sulfate concentrations equal to or exceeding 50 $\mu eq\ L^{-1}$. The estimated percentage of lakes in the Southern Rockies (33.7%) with sulfate $\geq$ 50 $\mu eq\ L^{-1}$ was nearly twice that observed in the Pacific Northwest, the subregion with the second highest percentage of lakes in this category.

The number of clearwater lakes (true color $\leq$ 30 platinum cobalt units) with extractable aluminum concentrations $\geq$ 50 $\mu g\ L^{-1}$ was extremely low in western lakes; only 16 of the estimated 10,393 lakes had extractable aluminum concentrations in this category. No lakes with extractable aluminum $\geq$ 50 $\mu g\ L^{-1}$ were sampled in the Rocky Mountain subregions. The highest percentages of lakes with dissolved organic carbon $\geq$ 6 mg L^{-1} were estimated for the Northern and Southern Rockies.

4.2.2 Comparison between Eastern and Western Lakes.

Median values, representing 50 percent of the lakes surveyed in the estimated target populations in the East and West, were compared by region and subregion for ANC, pH, and sulfate (Figure 4-3). The West had a lower estimated median ANC than did the Northeast, the Upper Midwest, and the Southern Blue Ridge. The median values for ANC in the Northeast and West (158 and 119 $\mu eq\ L^{-1}$, respectively) were less than one-half that estimated for the Upper Midwest (360 $\mu eq\ L^{-1}$). For all subregions surveyed, California had the lowest median ANC value (62.6 $\mu eq\ L^{-1}$), followed by Florida in the Southeast (83.5 $\mu eq\ L^{-1}$) and Northcentral Wisconsin in the Upper Midwest (93.9 μeq L^{-1}). Median pH values for all eastern subregions were above 6.5, and for all western subregions were near or above 7.0.

The clearest differences between eastern and western lakes for these three variables were observed for sulfate. All median values for western lakes were lower than those observed for any other subregion except the Southern Blue Ridge. The median value in the Southern Blue Ridge (31.8 μeq L^{-1}) was slightly less than that observed for the Southern Rockies (34.6 μeq L^{-1}), the highest estimated for the West. Median values of sulfate for all other eastern subregions were above 50 μeq L^{-1}.

4.2.3 Summary Observations

Some of the principal observations based on the results of Phase I of the Western and Eastern Lake Surveys (Landers et al. 1987 and Linthurst et al. 1986) are presented below. These conclusions are valid only for the areas surveyed within the four regions of the NLS--the Northeast, Upper Midwest, Southeast, and West. The conclusions are restricted further by the

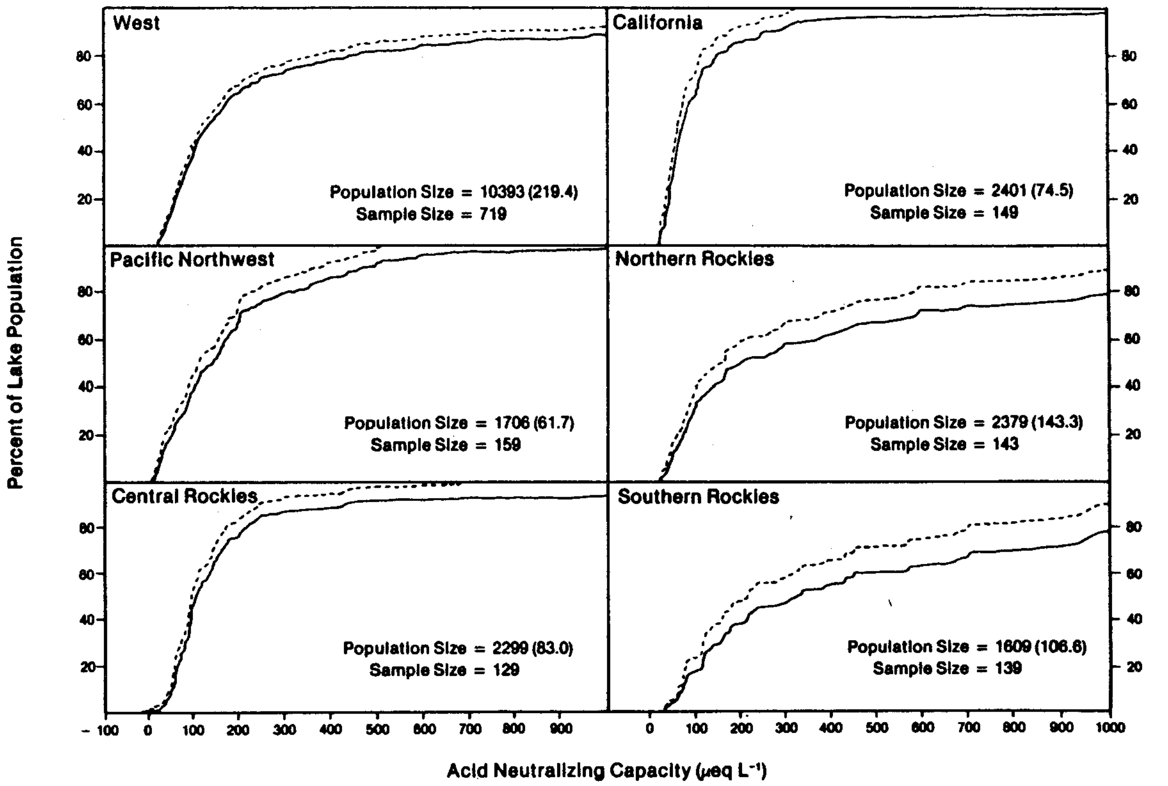

Figure 4-1. Cumulative frequency distributions for acid neutralizing capacity for the target populations of lakes in the western subregions sampled in fall, 1985 during Phase I of the Western Lake Survey. NOTE: The dashed line is the 95 percent upper confidence limit. Population size is estimated; standard errors of these estimates are shown in parentheses. These plots can be used to make qualitative comparisons among areas surveyed; e. g., the dots shown for California indicate that approximately 85 percent of the lakes have ANC $\leq$ 200 μeq L^{-1}. Data are from Landers et al. (1987) and Eilers et al. (1987).

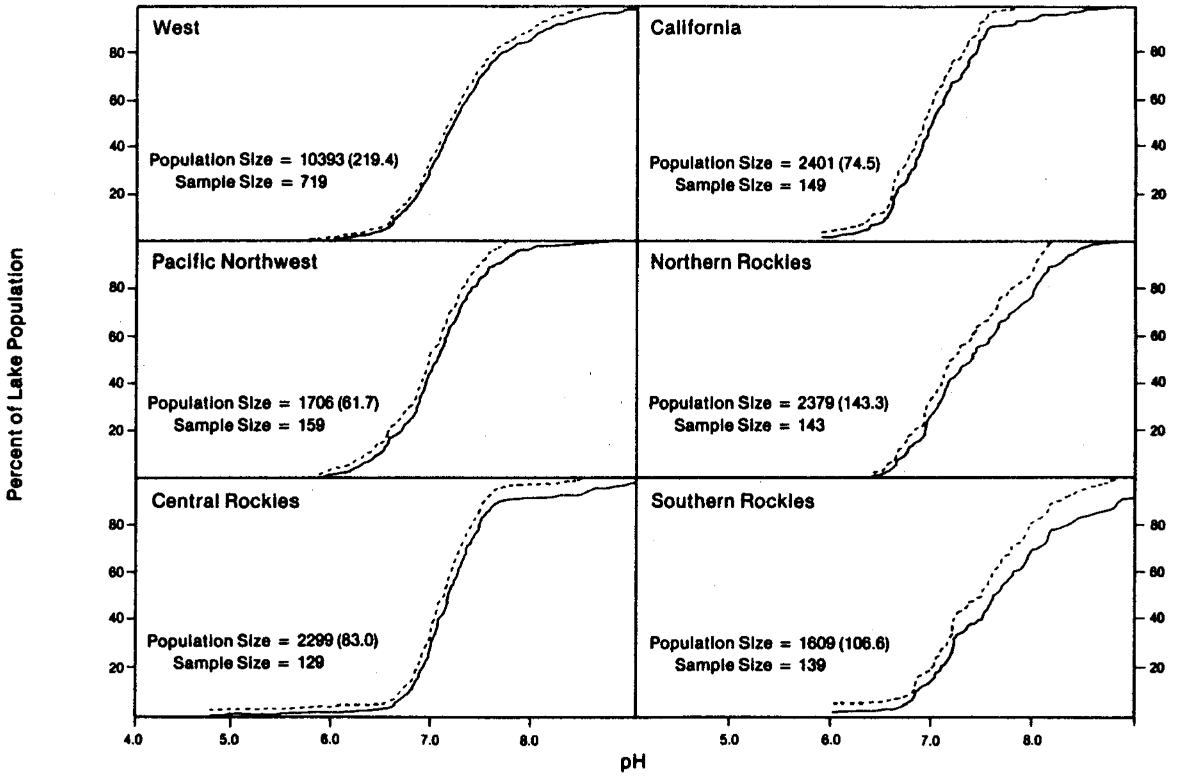

Figure 4-2. Cumulative frequency distributions for pH for the target populations of lakes in the western subregions sampled in fall, 1985 during Phase I of the Western Lake Survey. NOTE: The dashed line is the 95 percent upper confidence limit. Population size is estimated; standard errors of these estimates are shown in parentheses. These plots can be used to make qualitative comparisons among areas surveyed; e. g., the dots shown for the Southern Rockies indicate that approximately 14 percent of the lake have pH $\leq$ 7.0. Data are from Landers et al. (1987) and Eilers et al. (1987).

Survey design criteria, which define the lake populations, or subpopulations, of interest selected for sampling specifically to satisfy the objectives of the Survey. Extrapolation beyond the study area or to lakes not meeting the selection criteria is not possible without further analyses.

The following conclusions apply to the areas of the western United States sampled and covered by the design of the Western Lake Survey.

1. No lakes sampled in the West had ANC $\leq 0\ \mu eq\ L^{-1}$, with the exception of one lake associated with a hot spring.

TABLE 4-4. ESTIMATED NUMBER OF LAKES, AND NUMBER AND PERCENTAGE OF LAKES WITH SELECTED VALUES OF THREE KEY VARIABLES FROM PHASE I OF THE WESTERN LAKE SURVEY.[a,b] THE 95 PERCENT UPPER CONFIDENCE LIMITS (UCL) FOR LAKE NUMBER ARE SHOWN IN PARENTHESES[c].

Region/ Subregion	Population Size	Sulfate[e] Number(UCL)	%	Extractable Al[d,f] Number(UCL)	%	DOC[g] Number(UCL)	%
California (4A)	2401	187 (300)	7.8	5 (14)	0.2	71 (129)	3.0
Pacific NW (4B)	1706	292 (374)	17.1	11 (28)	0.6	45 (80)	2.7
N. Rockies (4C)	2379	256 (399)	10.7	0 (-)	0	196 (326)	8.2
Cen. Rockies (4D)	2299	128 (198)	5.6	0 (-)	0	93 (152)	4.0
S. Rockies (4E)	1609	543 (711)	33.7	0 (-)	0	158 (263)	9.8
West (4)	10,393	1405 (1676)	13.5	16 (35)	0.2	563 (753)	5.4

[a] >1 ha and < 2000 ha.
[b] Data are from Landers et al. (1987) and Eilers et al. (1987).
[c] Upper confidence limits for values of zero are undefined.
[d] Data are for "clearwater" lakes only, i.e., with true color values ≤ 30 platinum cobalt units.
[e] Estimated target for sulfate is $\geq 50\ \mu eq\ L^{-1}$
[f] Estimated target for extractable Al is $\geq 50\ \mu g\ L^{-1}$
[g] Estimated target for Dissolved Organic Carbon is $\geq 6\ mg\ L^{-1}$

2. Of the subregions sampled in the West, California had the largest number (880) and percentage (36.7%) of lakes with low ANC ($\leq 50\ \mu eq\ L^{-1}$); followed by the Pacific Northwest (332 lakes, 19.5%). The Southern Rockies had the lowest percentage and smallest number of lakes with low ANC (74 lakes, 4.6%).

3. Lakes in wilderness areas had much lower concentrations of ANC than lakes in nonwilderness areas (median values 91.4 $\mu eq\ L^{-1}$ and 282.7 $\mu eq\ L^{-1}$, respectively).

4. pH values were high in the West, where 99 percent of the lakes had values greater than 6.0. Median pH values for the subregions ranged from 6.94 in California to 7.60 in the Southern Rockies.

5. Median sulfate concentrations were extremely low throughout the West, ranging from 6.6 $\mu eq\ L^{-1}$ in California to 34.6 $\mu eq\ L^{-1}$ in the Southern Rockies. In comparison, median concentrations for lakes in the East were 115.4 $\mu eq\ L^{-1}$ for the Northeast, 57.1 $\mu eq\ L^{-1}$ for the Upper Midwest, 31.8 $\mu eq\ L^{-1}$ for the Southern Blue Ridge, and 93.7 $\mu eq\ L^{1}$ for Florida.

6. Extractable aluminum concentrations in clearwater lakes were very low throughout the West. Only 0.2 percent of the lakes in the West had extractable aluminum concentrations exceeding 50 $\mu g\ L^{-1}$ compared to 5.2 percent of the lakes in the Northeast, and 7.4 percent of the lakes in Florida. Lakes in the West were most similar to those for the Southern Blue Ridge, where no lakes exceeded this criterion.

7. Concentrations of DOC were also low throughout the West; only 5.4 percent of the lakes in the West had DOC values exceeding 6 mg L^{-1} whereas this criterion was exceeded for 26.4 percent of the lakes in the Northeast, 62.9 percent in the Upper Midwest, and 68.9 percent in Florida. DOC in the Southern Blue Ridge was similar to the West with 6.1 percent of the lakes having DOC $\geq$ 6 mg L^{-1}.

4.2.4 Additional Information

Results of the WLS-I are presented in much greater detail in the two volume report entitled Characteristics of Lakes in the Western United States (Landers et al. 1987; Eilers et al. 1987).

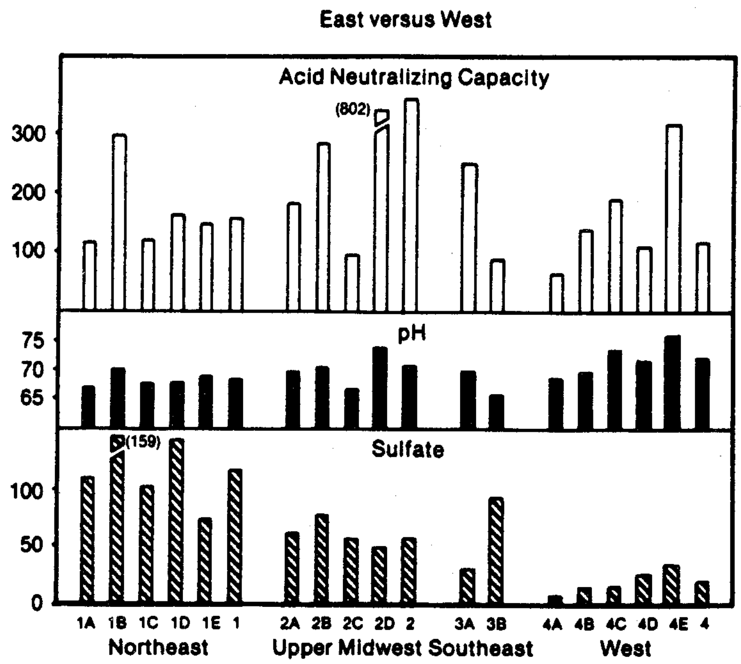

Figure 4-3. Median values for acid neutralizing capacity, pH, and sulfate by subregion for the Northeast, Upper Midwest, Southeast and West, for lakes in the target population surveyed during Phase I of the National Lake Survey. NOTE: ANC and sulfate are measured in $\mu eq\ L^{-1}$; pH is measured in pH units.

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APPENDIX A

DATA BASE DICTIONARY

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National Surface Water Survey: Western Lake Survey–Phase I, Data Base Dictionary

Paul Kanciruk
Merilyn Gentry
Raymond McCord
Les Hook
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Mary D. Best

Environmental Sciences Division
Publication No. 2838

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ENVIRONMENTAL SCIENCES DIVISION

NATIONAL SURFACE WATER SURVEY: WESTERN LAKE SURVEY-PHASE I, DATA BASE DICTIONARY

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ABSTRACT

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The Western Lake Survey-Phase I (WLS-I), conducted in the fall of 1985, was the second part of a U.S. Environmental Protection Agency field sampling effort known as the National Surface Water Survey. The WLS-I followed the Eastern Lake Survey-Phase I, which was conducted in the fall of 1984 and included the northeastern, southeastern, and upper midwestern regions of the United States (see "Related Documents"). Both surveys were designed to quantify synoptically the lake chemistry in areas of the United States where the majority of lakes were expected to exhibit low alkalinity. These surveys were conducted as part of the National Acid Precipitation Assessment Program.

The survey involved a three-month field effort in which 720 probability sample lakes and 32 special interest lakes in the western regions of the United States were sampled. The Environmental Sciences Division of the Oak Ridge National Laboratory designed and implemented data management and provided data analysis for the WLS-I.

This document provides the information necessary for researchers to accurately transfer the WLS-I data base to their own computer systems. As a data dictionary, this document also includes complete descriptions of the variables in the data base and of the data set formats.

Keywords: National Lake Survey; NSWS; Western Lake Survey; Water Quality; Acidic Deposition; Acid Rain; EPA; Research Data Management.

1. INTRODUCTION

This data dictionary describes the U.S. Environmental Protection Agency's (EPA's) Western Lake Survey-Phase I (WLS-I) data base. A description of the purpose, design, and results of the survey is contained in the two-volume report on the WLS-I (Landers et al. 1987; Eilers et al. 1987). Table 1 summarizes the information collected during the survey.

This dictionary does not report the results of the survey nor does it describe its purpose, design, or protocols. The purpose of the data base dictionary is to provide to data managers and programmers the information necessary to transfer accurately the WLS-I data to their own computer systems.

Table 1. Summary of information collected during the U.S. EPA Western Lake Survey-Phase I[a]

Geographic information		
Bedrock	Lake name	
County	Latitude	
Elevation	Longitude	
Geographic face	Presence of inlets/outlets	
Geomorphic unit	State	
Lake area	USGS map names	
Lake ID	Watershed area	
Collected on the lake		
Air temperature	Number of inlets/outlets	Watershed disturbances
Conductance	pH	Water temperature
Depth	Secchi disk transparency	
Measured in the field laboratory		
Color	Dissolved inorganic carbon	pH
Turbidity		
Measured in the analytical laboratory		
Acid neutralizing capacity	Dissolved organic carbon	Phosphorus
Acidity	Extractable aluminum	Potassium
Air-equilibrated pH	Fluoride	Silica
Ammonium	Initial titration pH	Sodium
Calcium	Iron	Sulfate
Chloride	Magnesium	Total aluminum
Conductance	Manganese	
Dissolved inorganic carbon	Nitrate	
Calculated or interpolated		
Anion deficit	Precipitation	
Bicarbonate ion	Runoff	
Calculated conductance	Sum of anions	
Carbonate ion	Sum of base cations	
Distance from ocean	Sum of cations	
Estimated hydraulic residence time	Sum of cations/sum of anions	
Lake volume	Watershed/lake area	
Organic anions		

[a]For a complete list and definition of variables, see Sects. 4 and 5. For a description of the survey purpose, design, and results, see the "Related Documents" listed on pp. vii and viii of this report.

2. DATA BASE DESIGN

The WLS-I data base was developed at the Oak Ridge National Laboratory (ORNL) on tandem IBM* 3033 mainframe computers using the SAS† statistical analysis software system. The data were entered into a series of relational (tabular) SAS files which, after extensive error checking and validation, were merged to create the data sets distributed for public use. A description of data base design and implementation is presented in Kanciruk, Olson, and McCord (1986).

Two working data sets (1 and 2) were used internally to verify and validate the WLS-I data base. These are not distributed. There are three distributed WLS-I data sets (Table 2): data set 3 (the validated data set), data set 4 (the final data set), and a subset of data set 4 [the personal computer (PC) data set, distributed on IBM PC format disks]. Data sets 3 and 4, which are distributed on magnetic tape in both SAS and card-image formats, contain similar sets of variables, but duplicate lake samples [collected for quality assurance (QA)] are identified separately only in data set 3. In data set 4 and the PC data set the duplicate samples were averaged, and only the average value is reported for each lake; additionally, some missing data were substituted with estimates based upon duplicate analyses (Eilers, Blick, and DeHaan, 1987). For example, if the analytical laboratory calcium value was missing, a calcium value determined from the split sample with the EPA Corvallis laboratory was substituted.

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*IBM is the registered trademark of International Business Machines Corporation, Boca Raton, Florida 33432.

†SAS is the registered trademark of SAS Institute Inc., Cary, North Carolina 27511.

Table 2. Characteristics of data sets 3 and 4 and the PC data set

Characteristic	Data set 3 (validated)	Data set 4 (final)	PC data set (final)
Format, media	SAS or card image, 9-track magtape	SAS or card image, 9-track magtape	Card image, IBM PC disks
Number of files	1	1	2
File names[a]	WLSI.SAS(DS3) (SAS format) WLSI.DS3C (Card format)	WLSI.SAS(DS4) (SAS format) WLSI.DS4C (Card format)	WLS-I.REG (Regular) WLS-I.SPC (Special)
Approximate size in MBytes	3.0	1.1	0.26 (total)
Number of observations	1106	752	752
Number of variables	277	159	47
Duplicate lake samples	Retained	Averaged	Averaged
Number of observations per lake	1 or 2	1	1
Tags present	Yes	No	No
Flags present	Yes	Yes	No
Missing data	Not substituted	Substituted when possible[b]	Substituted when possible[b]
Missing value representation[c]	-999 if numeric, space if character	-999 if numeric, space if character	-999 if numeric, space if character
Unique key	LAKE_ID with SAMCOD	LAKE_ID	LAKE_ID

[a]Magnetic tape files may or may not be named. PC data files are always named.
[b]Eilers, Blick, and DeHaan (1987).
[c]Missing value representation is for card-image files only. Standard SAS notation for missing values is used in the SAS files.

Data set 4 was used for analyzing and reporting results in Landers et al. (1987) and Eilers et al. (1987). Data set 3 is useful when the researcher desires unaveraged, unsubstituted data. In data set 3, LAKE_ID concatenated with SAMCOD is the unique record identifier. Data set 4 and the PC data set are easier to use for general analysis, with LAKE_ID the unique record identifier. The PC data set (two files - one for probability sample lakes and one for all special interest lakes) is smaller and duplicates information presented in some of the tables in Eilers et al. (1987).

3. DATA TAGS AND FLAGS

In addition to the WLS-I analytic and descriptive variables, some variables on the data sets were designated as "tags" or "flags." These data qualifiers provide additional information for an individual value. Tags were one-letter codes contained in a variable used to qualify data as the data were recorded on the field or laboratory data forms. For example, if a pH reading was not acceptable because the pH meter was slow to stabilize or was erratic and a second attempt was necessary, then the pH was recorded with a tag "B" to associate this information specifically with this variable. Tag variable names have the same names as the variables they qualify, but with the suffix "T." A list of tag codes is given in Table 3. Tags are provided only in data set 3 for historic purposes. Tags values were adjusted, if necessary, in data set 4 and the tags themselves deleted.

Flags are two-character codes (Table 4) that also qualify data. Flags were not entered by the observer conducting the measurement but were entered later during the data verification and validation process. For flag variable names, an "F" was appended to the name of the variable being qualified.

Both tags and flags can contain multiple, concatenated codes. Variables that are tags or flags are included in the list of variables presented in Sect. 4. The use of tags and flags during the WLS-I is described in Kanciruk, Olson, and McCord (1986). Analytical QA and validation procedures, including QA flagging, are provided in Silverstein et al. (1986, 1987) and Eilers, Blick, and DeHaan (1987).

Table 3. Tag[a] code definitions, U.S. EPA Western Lake Survey-Phase I

Tag code	Definition[b]
A	Instrument unstable.
B	Redone; first reading not acceptable.
C	Instruments and sampling gear not vertical in water column.
D	Slow stabilization.
E	HYDROLAB cable too short.
F	Results outside of criteria with consent of the quality assurance manager.
J	Results not available; insufficient sample volume shipped to the analytical laboratory from the field.
K	Results not available; entire aliquot not shipped.
L	Results not available due to interference.
M	Results not available; sample lost or destroyed by analytical laboratory.
N	Not required.
R	Results from reanalysis.
S	Contamination suspected.
T	Leaking container.
U	Results not required by procedure; unnecessary.
X	User-defined on the field form (defined in variable TAG_X).
Y	User-defined on the field form (defined in variable TAG_Y).
Z	User-defined on the field form (defined in variable TAG_Z).
<	Measurements taken at <0.75 m.

[a]Tags are included only in data set 3.
[b]For a description of the analytical quality assurance verification process, see Silverstein et al. (1986, 1987).

Table 4. Flag code definitions, U.S. EPA Western Lake Survey-Phase I

Flag code	Definition[a]
A0	Anion/cation percent ion balance difference was outside of criteria due to unknown cause.
A1	Anion/cation percent ion balance difference was outside of criteria due to nitrate contamination.
A2	Anion/cation percent ion balance difference was outside of criteria due to anion (other than nitrate) contamination.
A3	Anion/cation percent ion balance difference was outside of criteria due to cation contamination.
A4	Anion/cation percent ion balance difference was outside of criteria due to unmeasured organic protolytes (fits Oliver Model, Kerfoot and Faber 1986).
A5	Anion/cation percent ion balance difference was outside of criteria due to possible analytical error; anion concentration too high.
A6	Anion/cation percent ion balance difference was outside of criteria due to possible analytical error; cation concentration too low.
A7	Anion/cation percent ion balance difference was outside of criteria due to possible analytical error; anion concentration too low.
A8	Anion/cation percent ion balance difference was outside of criteria due to possible analytical error; cation concentration too high.
B0	External (field) blank was above expected criteria (for pH, DIC, DOC, conductance, alkalinity, and acidity determinations where the blank was above expected criteria).
B1	Internal (laboratory) blank was greater than twice the required detection limit (this flag used for pH, DIC, DOC, conductance, alkalinity, and acidity determinations where the blank was above expected criteria).

Table 4. (continued)

Flag code	Definition[a]
B2	External (field) blank was above expected criteria and contributed more than 20 percent to sample concentrations that were greater than ten times the required detection limit (flag not used for pH, DIC, DOC, acidity, or alkalinity determinations).
B3	Internal (laboratory) blank was more than twice the required detection limit and contributed more than 10 percent to the sample concentrations that were greater than ten times the required detection limit (flag not used for pH, DIC, DOC, acidity, or alkalinity determinations).
B4	Potential negative sample bias based on internal (laboratory) blank data.
B5	Potential negative sample bias based on external (field) blank data.
C0	Percent conductance difference was outside of criteria due to an unknown cause (possible analytical error; ion concentration too high).
C1	Percent conductance difference was outside of criteria due to possible analytical error; anion concentration too high.
C2	Percent conductance difference was outside of criteria due to anion contamination.
C3	Percent conductance difference was outside of criteria due to cation contamination.
C4	Percent conductance difference was outside of criteria due to unmeasured organic anions (fits Oliver Model, Kerfoot and Faber 1986).
C5	Percent conductance difference was outside of criteria due to possible analytical error in conductance measurement.
C6	Percent conductance difference was outside of criteria due to possible analytical error; anion concentration too low.
C7	Percent conductance difference was outside of criteria due to unmeasured protolyte anions (does not fit Oliver Model, Kerfoot and Faber 1986).

Table 4. (continued)

Flag code	Definition[a]
C8	Percent conductance difference was outside of criteria due to possible analytical error; cation concentration too low.
C9	Percent conductance difference was outside of criteria due to possible analytical error; cation concentration too high.
D0	External (field) duplicate precision exceeded the maximum expected percent relative standard deviation, but either the routine or the duplicate concentration was greater than ten times the required detection limit.
D2	External (field) duplicate precision exceeded the maximum expected percent relative standard deviation, and both the routine and the duplicate sample concentrations were greater than ten times the required detection limit.
D3	Internal (laboratory) duplicate precision exceeded the maximum required percent relative standard deviation, and both the routine and duplicate sample concentrations were greater than ten times the required detection limit.
F0	Percent conductance difference exceeded criteria when HYDROLAB conductance value was substituted.
F1	Protolyte analysis program indicated field pH problem when HYDROLAB pH value was substituted.
F2	Protolyte analysis program indicated unexplained field pH/DIC problem when HYDROLAB pH value was substituted.
H0	The maximum holding-time criteria were not met.
N5	Nitrate data obtained from analysis of aliquot 5.
P0	Field problem; station pH.
P1	Field problem; station DIC.
P2	Field problem; unexplained (pH or DIC).
P3	Laboratory problem; initial alkalinity pH.

Table 4. (continued)

Flag code	Definition[a]
P4	Laboratory problem; initial acidity pH.
P5	Laboratory problem; unexplained, initial pH (acidity or alkalinity).
P6	Laboratory problem; initial DIC.
P7	Laboratory problem; air-equilibrated pH or DIC.
P8	Laboratory problem; unexplained, initial pH or DIC.
P9	Laboratory problem; alkalinity determination.
U0	Known error based on relationships with other variables and/or impossible values; substitutions were made in data set 4.
U1	Data value is a substitution; original value was missing.
U2	Data value is a substitution; original value was considered to be in error.
V0	Data value represents the average from a duplicate split and measurement of the lake sample.
V1	Data value is from the duplicate lake sample and is not averaged because the regular sample had "W0" flag limitations.
W0	Data value has possible measurement error, based on relationships with other variables, has QA violations or is outside of QA criteria for acceptable data.
Z0	Original value was less than zero and has been replaced with zero.

[a]For a description of the analytical verification process and validation methods, see Silverstein et al. (1986, 1987) and Eilers, Blick, and DeHaan (1987).

4. LIST OF VARIABLES

Table 5, which lists the variables in data sets 3 or 4 or the PC data set, is alphabetized by variable name and provides variable type (numeric or character), length (in bytes, as structured in SAS), the SAS label, and the data set(s) in which the variable is found. Units of measure are defined in Sect. 5.

Variable labels are printed as they appear in the SAS data sets. To ensure accuracy, these lists are unedited file transfers from the mainframe computer. The use of all capital letters and "UEQ/L" for "µeq/l" and "US" for "µS/cm" are examples of some unavoidable constraints on the aesthetics of table presentation imposed by limitations of the mainframe computer character set.

To avoid confusion, programmers loading data into their local software systems should retain original variable names and labels when possible.

Table 5. List of variables, all data sets, U.S. EPA Western Lake Survey-Phase I

Variable name	Label[a]	Variable type	Variable length[b]	Variable present in data set[c] 3	4	PC
ACCO11	CO2 ACIDITY (UEQ/L)	NUM	8	Y	Y	.
ACCO11F	FLAG FOR ACCO11	CHAR	12	Y	Y	.
ACCO11T	TAG FOR ACCO11	CHAR	6	Y	.	.
AIRTMP	AIR TEMPERATURE (DEG C)	NUM	8	Y	Y	.
AIRTMPF	FLAG FOR AIRTMP	CHAR	12	Y	Y	.
ALEX11	EXTRACTABLE ALUMINUM (UG/L)	NUM	8	Y	Y	Y
ALEX11F	FLAG FOR ALEX11	CHAR	12	Y	Y	.
ALEX11T	TAG FOR ALEX11	CHAR	6	Y	.	.
ALKA11	ALKALINITY (UEQ/L)	NUM	8	Y	Y	Y
ALKA11F	FLAG FOR ALKA11	CHAR	12	Y	Y	.
ALKA11T	TAG FOR ALKA11	CHAR	6	Y	.	.
ALK_CLSS	ALKALINITY CLASS (1,2,3)	CHAR	1	Y	Y	.
ALTIM	ALTIMETER (FT)	NUM	8	Y	Y	.
ALTIMT	TAG FOR ALTIM	CHAR	6	Y	.	.
ALTL11	TOTAL ALUMINUM (UG/L)	NUM	8	Y	Y	Y
ALTL11F	FLAG FOR ALTL11	CHAR	12	Y	Y	.
ALTL11T	TAG FOR ALTL11	CHAR	6	Y	.	.
ANCAT	CATSUM/ANSUM	NUM	8	Y	Y	Y
ANDEF	CATSUM - ANSUM (UEQ/L)	NUM	8	Y	Y	.
ANSUM	SUM OF ANIONS (UEQ/L)	NUM	8	Y	Y	Y
ANSUMF	FLAG FOR ANSUM	CHAR	12	Y	Y	.
BAT_ID	BATCH ID	CHAR	6	Y	Y	.
BAT_IDT	TAG FOR BAT_ID	CHAR	6	Y	.	.
BEDROCK	NORTON BEDROCK CLASSIFICATION	CHAR	1	Y	Y	.
BNSTAR	POPULATION SIZE BY STRATA	NUM	8	Y	Y	Y
CA11	CALCIUM (MG/L)	NUM	8	Y	Y	.
CA11F	FLAG FOR CA11	CHAR	12	Y	Y	.
CA11T	TAG FOR CA11	CHAR	6	Y	.	.
CA16	CALCIUM (UEQ/L)	NUM	8	Y	Y	Y
CATSUM	SUM OF CATIONS (UEQ/L)	NUM	8	Y	Y	Y
CATSUMF	FLAG FOR CATSUM	CHAR	12	Y	Y	.
CL11	CHLORIDE (MG/L)	NUM	8	Y	Y	.
CL11F	FLAG FOR CL11	CHAR	12	Y	Y	.
CL11T	TAG FOR CL11	CHAR	6	Y	.	.
CL16	CHLORIDE (UEQ/L)	NUM	8	Y	Y	Y
CO316	CARBONATE ALKALINITY (UEQ/L)	NUM	8	Y	Y	.
CO316F	FLAG FOR CO316	CHAR	12	Y	Y	.
COLVAL	COLOR (PCU)	NUM	8	Y	Y	Y
COLVALF	FLAG FOR COLVAL	CHAR	12	.	Y	.
COLVALT	TAG FOR COLVAL	CHAR	6	Y	.	.
COMO1	COMMENT FROM FORM 1	CHAR	75	Y	.	.
COMMNT	COMMENT FROM FORM 2	CHAR	75	Y	.	.
CONCAL	CALCULATED SPECIFIC CONDUCTANCE (US/CM)	NUM	8	Y	Y	Y
CONCALF	FLAG FOR CONCAL	CHAR	14	Y	Y	.

Table 5. (continued)

Variable name	Label[a]	Variable type	Variable length[b]	Variable present in data set[c] 3	4	PC
COND11	CONDUCTANCE, ANALYTICAL LAB (US/CM)	NUM	8	Y	Y	Y
COND11F	FLAG FOR COND11	CHAR	12	Y	Y	.
COND11T	TAG FOR COND11	CHAR	6	Y	.	.
CONFI	FINAL CONDUCTANCE (US/CM)	NUM	8	Y	.	.
CONFIT	TAG FOR CONFI	CHAR	6	Y	.	.
CONIN	INITIAL CONDUCTANCE (US/CM)	NUM	8	Y	.	.
CONINT	TAG FOR CONIN	CHAR	6	Y	.	.
CONTOP	CONDUCTANCE AT SURFACE (1.5M) (US/CM)	NUM	8	Y	Y	.
CONTOPF	FLAG FOR CONTOP	CHAR	12	Y	Y	.
CONTOPT	TAG FOR CONTOP	CHAR	6	Y	.	.
CON_1	CONDUCTANCE AT 4 OR 5 M (US/CM)	NUM	8	Y	.	.
CON_10	CONDUCTANCE AT 50 M (US/CM)	NUM	8	Y	.	.
CON_1T	TAG FOR CON_1	CHAR	6	Y	.	.
CON_2	CONDUCTANCE AT 6 OR 10 M (US/CM)	NUM	8	Y	.	.
CON_2T	TAG FOR CON_2	CHAR	6	Y	.	.
CON_3	CONDUCTANCE AT 8 OR 15 M (US/CM)	NUM	8	Y	.	.
CON_3T	TAG FOR CON_3	CHAR	6	Y	.	.
CON_4	CONDUCTANCE AT 10 OR 20 M (US/CM)	NUM	8	Y	.	.
CON_4T	TAG FOR CON_4	CHAR	6	Y	.	.
CON_5	CONDUCTANCE AT 12 OR 25 M (US/CM)	NUM	8	Y	.	.
CON_5T	TAG FOR CON_5	CHAR	6	Y	.	.
CON_6	CONDUCTANCE AT 14 OR 30 M (US/CM)	NUM	8	Y	.	.
CON_60	CONDUCTANCE AT 0.60*SITE DEPTH (US/CM)	NUM	8	Y	Y	.
CON_60T	TAG FOR CON_60	CHAR	6	Y	.	.
CON_6T	TAG FOR CON_6	CHAR	6	Y	.	.
CON_7	CONDUCTANCE AT 16 OR 35 M (US/CM)	NUM	8	Y	.	.
CON_7T	TAG FOR CON_7	CHAR	6	Y	.	.
CON_8	CONDUCTANCE AT 18 OR 40 M (US/CM)	NUM	8	Y	.	.
CON_8T	TAG FOR CON_8	CHAR	6	Y	.	.
CON_9	CONDUCTANCE AT 20 OR 45 M (US/CM)	NUM	8	Y	.	.
CON_B	CONDUCTANCE AT BOTTOM-1.5M (US/CM)	NUM	8	Y	Y	.
CON_BT	TAG FOR CON_B	CHAR	6	Y	.	.
COUNTY	FIPS CODE (STATE, COUNTY)	CHAR	5	Y	Y	.
CRW_ID	CREW ID	CHAR	6	Y	Y	.
DATPRO	DATE PROCESSED, FORM 2	NUM	8	Y	.	.
DATSHP	DATE SHIPPED, FORM 2	NUM	8	Y	.	.
DATSMP	DATE SAMPLED (DDMMMYY), FORM 1	NUM	8	Y	Y	Y
DATTR	DATE RECEIVED AT TRAILER, FORM 1	NUM	8	Y	.	.
DICE11	EQUILIBRATED DIC, ANALYTICAL LAB (MG/L)	NUM	8	Y	Y	Y
DICE11F	FLAG FOR DICE11	CHAR	12	Y	Y	.
DICE11T	TAG FOR DICE11	CHAR	6	Y	.	.
DICI11	INITIAL DIC, ANALYTICAL LAB (MG/L)	NUM	8	Y	Y	.
DICI11F	FLAG FOR DICI11	CHAR	12	Y	Y	.
DICI11T	TAG FOR DICI11	CHAR	6	Y	.	.

Table 5. (continued)

Variable name	Label[a]	Variable type	Variable length[b]	Variable present in data set[c] 3	4	PC
DICQCS	DIC QCCS, FIELD LAB (MG/L)	NUM	8	Y	.	.
DICQCST	TAG FOR DICQCS	CHAR	6	Y	.	.
DICVAL	DIC, FIELD LAB (MG/L)	NUM	8	Y	Y	Y
DICVALF	FLAG FOR DICVAL	CHAR	12	Y	Y	.
DICVALT	TAG FOR DICVAL	CHAR	6	Y	.	.
DISM	DISTANCE FROM COAST (KM)	NUM	8	Y	Y	.
DOC11	DOC, ANALYTICAL LAB (MG/L)	NUM	8	Y	Y	Y
DOC11F	FLAG FOR DOC11	CHAR	12	Y	Y	.
DOC11T	TAG FOR DOC11	CHAR	6	Y	.	.
DP_60	DEPTH AT 0.6*SITE DEPTH (M)	NUM	8	Y	Y	.
DP_60T	TAG FOR DP_60	CHAR	6	Y	.	.
DP_B	DEPTH AT BOTTOM-1.5 M (M)	NUM	8	Y	Y	.
DP_BT	TAG FOR DP_B	CHAR	6	Y	.	.
DP_TOP	DEPTH AT SURFACE (1.5 M) (M)	NUM	8	Y	Y	.
DP_TOPT	TAG FOR DP_TOP	CHAR	6	Y	.	.
ELEV	LAKE ELEVATION (M)	NUM	8	Y	Y	Y
FACE	GEOMORPHIC SLOPE (E/W)	CHAR	1	Y	Y	.
FE11	IRON (UG/L)	NUM	8	Y	Y	.
FE11F	FLAG FOR FE11	CHAR	12	Y	Y	.
FE11T	TAG FOR FE11	CHAR	6	Y	.	.
FOREST	FOREST-NF PAR-NP NATREC-NRA	CHAR	30	Y	Y	.
FTL11	FLUORIDE (MG/L)	NUM	8	Y	Y	.
FTL11F	FLAG FOR FTL11	CHAR	12	Y	Y	.
FTL11T	TAG FOR FTL11	CHAR	6	Y	.	.
FTL16	FLUORIDE (UEQ/L)	NUM	8	Y	Y	Y
GMU	GEOMORPHIC UNIT	CHAR	6	Y	Y	.
H16	HYDRONIUM FROM PHAC (UEQ/L)	NUM	8	Y	Y	.
H16F	FLAG FOR H16	CHAR	12	Y	Y	.
HCO316	HCO3 (UEQ/L)	NUM	8	Y	Y	Y
HCO316F	FLAG FOR HCO316	CHAR	12	Y	Y	.
HELGR	H/HELICOPTER, G/GROUND TEAM	CHAR	1	Y	Y	.
HEL_ID	HELICOPTER ID	CHAR	9	Y	.	.
HYDROTYP	DRAINAGE, SEEPAGE, CLOSED, RESERVOIR	CHAR	9	Y	Y	Y
HYD_ID	HYDROLAB ID	CHAR	3	Y	.	.
INLETS	INLETS (#) (FORM 1)	NUM	8	Y	.	.
INLETST	TAG FOR INLETS	CHAR	6	Y	.	.
IN_OUT	PRESENCE/ABSENCE OF INLETS/OUTLETS	CHAR	6	Y	Y	.
K11	POTASSIUM (MG/L)	NUM	8	Y	Y	.
K11F	FLAG FOR K11	CHAR	12	Y	Y	.
K11T	TAG FOR K11	CHAR	6	Y	.	.
K16	POTASSIUM (UEQ/L)	NUM	8	Y	Y	Y
LABNAM	LABORATORY FOR ANALYSIS	CHAR	30	Y	Y	.
LAKENAME	LAKE NAME	CHAR	30	Y	Y	Y
LAKE_ID	LAKE IDENTIFICATION CODE	CHAR	7	Y	Y	Y
LAKE_SIZ	LAKE SURFACE AREA (HA)	NUM	8	Y	Y	Y

Table 5. (continued)

Variable name	Label[a]	Variable type	Variable length[b]	Variable present in data set[c] 3	4	PC
LAKE_VOL	CALCULATED LAKE VOLUME (10**6 CU M)	NUM	8	Y	Y	.
LAKVER	LOCATION VERIFIED BY, FORM 1	CHAR	25	Y	.	.
LAT	LATITUDE	CHAR	10	Y	Y	Y
LATINS	LORAN LATITUDE (DDMM.DM)	CHAR	10	Y	Y	.
LATINST	TAG FOR LATINS	CHAR	6	Y	.	.
LATMAP	MAP LATITUDE (DDMM.DM)	CHAR	10	Y	.	.
LATMAPT	TAG FOR LATMAP	CHAR	6	Y	.	.
LAT_DD	LATITUDE (DECIMAL DEGREES)	NUM	4	Y	Y	.
LNGINS	LORAN LONGITUDE (DDDMM.DM)	CHAR	10	Y	Y	.
LNGINST	TAG FOR LNGINS	CHAR	6	Y	.	.
LNGMAP	MAP LONGITUDE (DDDMM.DM)	CHAR	10	Y	.	.
LNGMAPT	TAG FOR LNGMAP	CHAR	6	Y	.	.
LONG	LONGITUDE	CHAR	11	Y	Y	Y
LONG_DD	LONGITUDE (DECIMAL DEGREES)	NUM	4	Y	Y	.
MAP_BIG	MAP NAME, 1:250,000 SCALE	CHAR	25	Y	Y	.
MAP_MED	MAP NAME, 1:100,000 SCALE	CHAR	60	Y	Y	.
MAP_SML	MAP NAME, 15 OR 7.5 QUAD	CHAR	40	Y	Y	.
MG11	MAGNESIUM (MG/L)	NUM	8	Y	Y	.
MG11F	FLAG FOR MG11	CHAR	12	Y	Y	.
MG11T	TAG FOR MG11	CHAR	6	Y	.	.
MG16	MAGNESIUM (UEQ/L)	NUM	8	Y	Y	Y
MN11	MANGANESE (UG/L)	NUM	8	Y	Y	Y
MN11F	FLAG FOR MN11	CHAR	12	Y	Y	.
MN11T	TAG FOR MN11	CHAR	6	Y	.	.
NA11	SODIUM (MG/L)	NUM	8	Y	Y	.
NA11F	FLAG FOR NA11	CHAR	12	Y	Y	.
NA11T	TAG FOR NA11	CHAR	6	Y	.	.
NA16	SODIUM (UEQ/L)	NUM	8	Y	Y	Y
NH411	AMMONIUM (MG/L)	NUM	8	Y	Y	.
NH411F	FLAG FOR NH411	CHAR	12	Y	Y	.
NH411T	TAG FOR NH411	CHAR	6	Y	.	.
NH416	AMMONIUM (UEQ/L)	NUM	8	Y	Y	Y
NO311	NITRATE (MG/L)	NUM	8	Y	Y	.
NO311F	FLAG FOR NO311	CHAR	12	Y	Y	.
NO311T	TAG FOR NO311	CHAR	6	Y	.	.
NO316	NITRATE (UEQ/L)	NUM	8	Y	Y	Y
NUM_IO	NUMBER OF INLETS/OUTLETS (MAP)	CHAR	5	Y	Y	.
ORGION	ORGANIC ANION (UEQ/L)	NUM	8	Y	Y	.
ORGIONF	FLAG FOR ORGION	CHAR	12	Y	Y	.
OUTLET	OUTLETS (#) (FORM 1)	NUM	8	Y	.	.
OUTLETT	TAG FOR OUTLET	CHAR	6	Y	.	.
PHAC11	PH, ACIDITY INITIAL	NUM	8	Y	Y	.
PHAC11F	FLAG FOR PHAC11	CHAR	12	Y	Y	.
PHAC11T	TAG FOR PHAC11	CHAR	6	Y	.	.
PHAL11	PH, ALKALINITY INITIAL	NUM	8	Y	Y	.

Table 5. (continued)

Variable name	Label[a]	Variable type	Variable length[b]	Variable present in data set[c] 3	4	PC
PHAL11F	FLAG FOR PHAL11	CHAR	12	Y	Y	.
PHAL11T	TAG FOR PHAL11	CHAR	6	Y	.	.
PHEQ11	PH, AIR EQUILIBRATED	NUM	8	Y	Y	Y
PHEQ11F	FLAG FOR PHEQ11	CHAR	12	Y	Y	.
PHEQ11T	TAG FOR PHEQ11	CHAR	6	Y	.	.
PHFI01	PH FINAL CALIBRATION	NUM	8	Y	.	.
PHFI01T	TAG FOR PHFI01	CHAR	6	Y	.	.
PHINO1	PH INITIAL CALIBRATION	NUM	8	Y	.	.
PHINO1T	TAG FOR PHINO1	CHAR	6	Y	.	.
PHSTQC	PH QCCS, FIELD LAB	NUM	8	Y	.	.
PHSTQCT	TAG FOR PHSTQC	CHAR	6	Y	.	.
PHSTVL	PH, FIELD VALUE	NUM	8	Y	Y	Y
PHSTVLF	FLAG FOR PHSTVL	CHAR	12	Y	Y	.
PHSTVLT	TAG FOR PHSTVL	CHAR	6	Y	.	.
PH_60	PH AT 0.60*SITE DEPTH	NUM	8	Y	Y	.
PH_60F	FLAG FOR PH_60	CHAR	12	Y	Y	.
PH_60T	TAG FOR PH_60	CHAR	6	Y	.	.
PH_B	PH AT BOTTOM-1.5M	NUM	8	Y	Y	.
PH_BF	FLAG FOR PH_B	CHAR	12	Y	Y	.
PH_BT	TAG FOR PH_B	CHAR	6	Y	.	.
PH_TOP	PH AT SURFACE (1.5M)	NUM	8	Y	Y	.
PH_TOPF	FLAG FOR PH_TOP	CHAR	12	Y	Y	.
PH_TOPT	TAG FOR PH_TOP	CHAR	6	Y	.	.
PRECIP	ANNUAL PRECIPITATION (M/YR)	NUM	8	Y	Y	.
PTL11	TOTAL PHOSPHORUS (UG/L)	NUM	8	Y	Y	Y
PTL11F	FLAG FOR PTL11	CHAR	12	Y	Y	.
PTL11T	TAG FOR PTL11	CHAR	6	Y	.	.
REGION	NSWS REGION	CHAR	1	Y	Y	.
REG_SPC	/REG/SPC/LTM	CHAR	12	Y	Y	Y
RT	RESIDENCE TIME (YR)	NUM	8	Y	Y	.
RUNIN	SURFACE WATER RUNOFF (INCHES)	NUM	8	Y	Y	.
SAMCOD	SAMPLE CODE	CHAR	9	Y	Y	.
SAM_ID	SAMPLE ID	CHAR	6	Y	Y	.
SAM_IDF	FLAG FOR SAM_ID	CHAR	12	Y	Y	.
SAM_IDT	TAG FOR SAM_ID	CHAR	6	Y	.	.
SECDIS	SECCHI DISAPPEARANCE DEPTH (M)	NUM	8	Y	Y	.
SECDIST	TAG FOR SECDIS	CHAR	6	Y	.	.
SECMEAN	SECCHI MEAN DEPTH (M)	NUM	8	Y	Y	Y
SECREA	SECCHI REAPPEARANCE DEPTH (M)	NUM	8	Y	Y	.
SECREAT	TAG FOR SECREA	CHAR	6	Y	.	.
SIO211	SILICA (MG/L)	NUM	8	Y	Y	Y
SIO211F	FLAG FOR SIO211	CHAR	12	Y	Y	.
SIO211T	TAG FOR SIO211	CHAR	6	Y	.	.
SITDPF	SITE DEPTH (FT)	NUM	8	Y	.	.
SITDPFT	TAG FOR SITDPF	CHAR	6	Y	.	.

Table 5. (continued)

Variable name	Label[a]	Variable type	Variable length[b]	Variable present in data set[c] 3	4	PC
SITDPM	SITE DEPTH (M)	NUM	8	Y	Y	Y
SITDPMT	TAG FOR SITDPM	CHAR	6	Y	.	.
SO411	SULFATE (MG/L)	NUM	8	Y	Y	.
SO411F	FLAG FOR SO411	CHAR	12	Y	Y	.
SO411T	TAG FOR SO411	CHAR	6	Y	.	.
SO416	SULFATE (UEQ/L)	NUM	8	Y	Y	Y
SOBC	SUM OF BASE CATIONS (UEQ/L)	NUM	8	Y	Y	.
SOBCF	FLAG FOR SOBC	CHAR	12	Y	Y	.
SPLCOD	SPLIT CODES	CHAR	4	Y	.	.
ST	STATE (TWO-LETTER ABBREVIATION)	CHAR	2	Y	Y	.
STA_ID	STATION ID	CHAR	6	Y	Y	.
STRAT	STRATIFICATON TYPE (MIXED, WEAK, STRONG)	CHAR	6	Y	Y	Y
STRATA	NSWS STRATA	CHAR	3	Y	Y	.
SUB_RGN	NSWS SUBREGION	CHAR	1	Y	Y	.
TAG_X	MEANING OF TAG X, FORM 1	CHAR	40	Y	.	.
TAG_X2	MEANING OF TAG X, FORM 2	CHAR	40	Y	.	.
TAG_Y	MEANING OF TAG Y, FORM 1	CHAR	20	Y	.	.
TAG_Y2	MEANING OF TAG Y, FORM 2	CHAR	25	Y	.	.
TAG_Z	MEANING OF TAG Z, FORM 1	CHAR	20	Y	.	.
TAG_Z2	MEANING OF TAG Z, FORM 2	CHAR	25	Y	.	.
TIMSMP	TIME SAMPLED (HH:MM), FORM 1	NUM	8	Y	Y	.
TIMTR	TIME RECEIVED AT TRAILER, FORM 1	NUM	8	Y	.	.
TMPDF1	TEMP DIFFERENCE TOP-BOTTOM (DEG C)	NUM	8	Y	Y	.
TMPDF1T	TAG FOR TMPDF1	CHAR	6	Y	.	.
TMPDF2	TEMP DIFFERENCE TOP-0.6*DEPTH (DEG C)	NUM	8	Y	Y	.
TMPDF2T	TAG FOR TMPDF2	CHAR	6	Y	.	.
TMPTOP	TEMPERATURE AT SURFACE (1.5M)	NUM	8	Y	Y	Y
TMPTOPT	TAG FOR TMPTOP	CHAR	6	Y	.	.
TMP_1	TEMPERATURE AT 4 OR 5 M (DEG C)	NUM	8	Y	.	.
TMP_10	TEMPERATURE AT 50 M (DEG C)	NUM	8	Y	.	.
TMP_1T	TAG FOR TMP_1	CHAR	6	Y	.	.
TMP_2	TEMPERATURE AT 6 OR 10 M (DEG C)	NUM	8	Y	.	.
TMP_2T	TAG FOR TMP_2	CHAR	6	Y	.	.
TMP_3	TEMPERATURE AT 8 OR 15 M (DEG C)	NUM	8	Y	.	.
TMP_4	TEMPERATURE AT 10 OR 20 M (DEG C)	NUM	8	Y	.	.
TMP_5	TEMPERATURE AT 12 OR 25 M (DEG C)	NUM	8	Y	.	.
TMP_6	TEMPERATURE AT 14 OR 30 M (DEG C)	NUM	8	Y	.	.
TMP_60	TEMPERATURE AT 0.6*SITE DEPTH (DEG C)	NUM	8	Y	Y	.
TMP_60T	TAG FOR TMP_60	CHAR	6	Y	.	.
TMP_7	TEMPERATURE AT 16 OR 35 M (DEG C)	NUM	8	Y	.	.
TMP_7T	TAG FOR TMP_7	CHAR	6	Y	.	.
TMP_8	TEMPERATURE AT 18 OR 40 M (DEG C)	NUM	8	Y	.	.
TMP_9	TEMPERATURE AT 20 OR 45 M (DEG C)	NUM	8	Y	.	.
TMP_B	TEMPERATURE AT BOTTOM-1.5 M (DEG C)	NUM	8	Y	Y	.
TMP_BT	TAG FOR TMP_B	CHAR	6	Y	.	.

Table 5. (continued)

Variable name	Label[a]	Variable type	Variable length[b]	Variable present in data set[c]		
				3	4	PC
TURQCS	TURBIDITY QCCS, FIELD LAB (NTU)	NUM	8	Y	.	.
TURVAL	TURBIDITY, FIELD LAB (NTU)	NUM	8	Y	Y	Y
TURVALF	FLAG FOR TURVAL	CHAR	12	.	Y	.
TURVALT	TAG FOR TURVAL	CHAR	6	Y	.	.
USFS	FOREST SERVICE REGION(APPROX)	CHAR	1	Y	Y	.
WALA	WATERSHED AREA / LAKE AREA	NUM	8	Y	Y	Y
WEIGHT1	POPULATION EXTRAPOLATION FACTOR	NUM	8	Y	Y	Y
WILDNA	USFS WILDERNESS NAME	CHAR	30	Y	Y	.
WSHED	WATERSHED AREA (HA)	NUM	8	Y	Y	Y
WS_DIS	D)WELL F)IRE L)OG M)INE R)OAD S)TOCK	CHAR	8	Y	Y	.
WS_OTH	OTHER DISTURBANCE	CHAR	25	Y	Y	.

[a]Labels are provided only in the SAS-formatted version of data sets 3 and 4. Labels are not provided in the PC data sets.

[b]Length for character fields is the integer field length.

[c]"Y" in the column indicates the variable is in the data set; "." indicates that the variable is not in the data set.

5. DEFINITION OF VARIABLES

Table 6 provides units of measure and extended definitions for variables contained in data sets 3 and 4 and the PC data set. Variable tags and flags are not included because their definitions would invariably be just "tag (or flag) for variable X." A complete description of data collected and WLS-I protocol is provided in Landers et al. (1987). In situ measurements are outlined in Kerfoot and Faber (1986) and Bonoff and Groeger (1986). EPA methods are from U.S. EPA (1983), and U.S. Geological Survey (USGS) methods are from Skougstad et al. (1979).

Conventions used in the computer-coded equations are:

+ represents addition,
- represents subtraction,
* represents multiplication,
** represents exponentiation,
/ represents division, and
() represents operational grouping.

Table 6. Definition of variables, U.S. EPA Western Lake Survey-Phase I

Name	Units	Definition
ACCO11	µeq/L	Carbon dioxide acidity (or base-neutralizing capacity) is the measured acidity in a sample due to dissolved CO_2, hydronium, and hydroxide. Determined in the analytical laboratory, using base titration and modified Gran analysis. Used in conjunction with alkalinity to refine alkalinity and acidity calculations.
AIRTMP	°C	Air temperature measured from the helicopter with a thermometer.
ALEX11	µg/L	Extractable aluminum is an estimate of labile monomeric aluminum (Al^{+3}). Aluminum in an unacidified, filtered sample was complexed with 8-hydroxyquinoline and extracted with methyl-isobutyl ketone (MIBK) in the field laboratory. The extract was analyzed in the analytical laboratory, using the method described in Kerfoot and Faber (1986).
ALK_CLSS		Alkalinity class, defined by an area's expected alkalinity. Classes are 1 = <100 µeq/L, 2 = 100 to 200 µeq/L, and 3 = >200 µeq/L.
ALKA11	µeq/L	Acid-neutralizing capacity is a measure of the amount of acid necessary to neutralize the bicarbonate, carbonate, alumino-hydroxy complexes, and other bases in a sample. Determined in the analytical laboratory in an unfiltered, unacidified aliquot, using acidimetric titration and modified Gran analysis (Kerfoot and Faber 1986; Kramer 1984).
ALTIM	ft	Altimeter reading (helicopter samples only).
ALTL11	µg/L	Total aluminum, measured in the analytical laboratory in an unfiltered, acidified (HNO_3) aliquot, using EPA method 202.2 [atomic absorption spectroscopy (AAS) and graphite furnace].

Table 6. (continued)

Name	Units	Definition
ANCAT		Ratio of measured cations to measured anions: ANCAT = CATSUM/ANSUM.
ANDEF	μeq/L	Anion deficit is the measured cations minus the measured anions: ANDEF = CATSUM - ANSUM.
ANSUM	μeq/L	Sum of major anion concentrations: ANSUM = CL16 + FTL16 + NO316 + HCO316 + CO316 + SO416.
BAT_ID		Batch identification number, lake and quality assurance samples processed and analyzed together on the same day and in the same field laboratory were given common batch numbers.
BEDROCK		Bedrock classification, describes the dominant bedrock class (Norton 1982) within the lake basin. Classes are ordered from one to five, in order of lowest to highest acid-neutratizing capacity: Class 1 = Low to no acid-neutralizing capacity (eg., granitic gneiss), Class 2 = Medium to low acid-neutralizing capacity (eg., sandstones, shales, etc.), Class 3 = High to medium acid-neutralizing capacity (eg., ultramafic rocks and glassy volcanic rocks), Class 4 = "Infinite" acid-neutralizing capacity capacity (eg., limestone), and Class 5 = Glacial debris obscuring bedrock.
BNSTAR		Number of lakes identified in a stratum (see STRATA) from the USGS 1:100,000 scale maps. Lakes to be sampled were randomly selected within strata to represent this frame population.
CA11	mg/L	Dissolved calcium, measured in the analytical laboratory in filtered, acidified (HNO_3) aliquot (EPA method 215.1, AAS, flame or ICPAES).
CA16	μeq/L	Dissolved calcium: CA16 = CA11*49.90 μeq/mg.
CATSUM	μeq/L	Summation of major cation concentrations: CATSUM = CA16 + MG16 + NA16 + K16 + NH416 + H16.
CL11	mg/L	Chloride ion, measured in the analytical laboratory in a filtered, unacidified aliquot (ASTM 1984; O'Dell et al. 1984; ion chromatographic method).

Table 6. (continued)

Name	Units	Definition
CL16	µeq/L	Chloride ion: CL16 = CL11*28.21 µeq/mg.
CO316	µeq/L	Carbonate, an estimate (Butler 1982) of $CO_3^{-2} = \frac{4.996 \times [\text{DIC mg/L}] \times K_1K_2}{[H^+]^2 + [H^+] \times K_1 + K_1K_2}$, which is coded as CO316 = 60009*(DICI11/12011)*ALPHA2*33.33, where ALPHA2 = K1*K2/ ((10**(-PHAC11))**2 + (10**-PHAC11)*K1 + K1*K2), where K1 = 4.3*10**-7, K2 = 5.61*10**-11.
COLVAL	PCU	True color (platinum cobalt units), measured in the field laboratory by first centrifuging the sample to remove particles, then using an HACH Model CO-1 Comparator (EPA method 110.2, modified).
COMMNT		Comment from field laboratory.
COM01		Comment from field sampling crew.
	Field specific conductance	
		The following measurements of conductance (CONTOP thru CONFI) were made with the HYDROLAB probe from the helicopter. These are not in alphabetical order but are ordered as usually measured. Measurements paralleled field temperature measurements.
CONTOP	µS/cm	Conductance at surface (usually 1.5 m below the surface).
CON_B	µS/cm	Conductance at SITDPM - 1.5 m.
CON_60	µS/cm	Conductance at 0.6*SITDPM. Measurement taken when TMPDF1 $\geq$ 4°C.

Table 6. (continued)

Name	Units	Definition
	Profile measurements	
		Specific conductance profile measurements were taken when TMPDF2 $\geq$ 4°C. Profile measurement depths were determined by maximum lake depth measured (SITDPM). If SITDPM $\leq$ 20 m, profile measurements were taken at 4 m and at 2-m increments to the bottom. If SITDPM > 20 m, the profile was taken at 5 m and at 5-m increments to a maximum depth of 50 m.
CON_1	µS/cm	Conductance at 4 m (SITDPM $\leq$ 20) or 5 m (SITDPM > 20).
CON_2	µS/cm	Conductance at 6 m (SITDPM $\leq$ 20) or 10 m (SITDPM > 20).
CON_3	µS/cm	Conductance at 8 m (SITDPM $\leq$ 20) or 15 m (SITDPM > 20).
CON_4	µS/cm	Conductance at 10 m (SITDPM $\leq$ 20) or 20 m (SITDPM > 20).
CON_5	µS/cm	Conductance at 12 m (SITDPM $\leq$ 20) or 25 m (SITDPM > 20).
CON_6	µS/cm	Conductance at 14 m (SITDPM $\leq$ 20) or 30 m (SITDPM > 20).
CON_7	µS/cm	Conductance at 16 m (SITDPM $\leq$ 20) or 35 m (SITDPM > 20).
CON_8	µS/cm	Conductance at 18 m (SITDPM $\leq$ 20) or 40 m (SITDPM > 20).
CON_9	µS/cm	Conductance at 20 m (SITDPM $\leq$ 20) or 45 m (SITDPM > 20).
CON_10	µS/cm	Conductance at 50 m.
CONIN	µS/cm	Initial conductance values, obtained from initial analysis of a 50-µS/cm QC check sample used to verify HYDROLAB calibration.

Table 6. (continued)

Name	Units	Definition
CONFI	µS/cm	Final conductance values, obtained from final analysis of a 50-µS/cm QC check sample used to verify HYDROLAB calibration (see CONIN).
CONCAL	µS/cm	Calculated conductance, sum of the products of ion concentration times equivalent conductance. The cations summed were Ca^{+2}, Mg^{+2}, Na^{+}, K^{+}, NH_4^{+}, and H^{+}. The anions summed were SO_4^{-2}, HCO_3^{-2}, Cl^{-}, NO_3^{-}, F^{-}, CO_3^{-2}, and OH^{-}. Coded as CONCAL = ((CA16*59.47) + (MG16*53.0) + (K16*73.48) + (NA16*50.08) + (NH416*73.5) + (H16*349.65) + (SO416*80.0) + (HCO316*44.5) + (CL16*76.31) + (NO316*71.42) + (F16*55.4) + (CO316*69.3) + (OH*198))/1000. This calculation converts µeq/L to µS/cm (Kerfoot and Faber 1986).
COND11	µS/cm	Specific conductance, measured in the analytical laboratory using a conductivity cell (EPA method 120.1).
COUNTY		Federal Information Processing Standard (FIPS 1979) state and county code.
CRW_ID		Lake sampling crew ID number.
DATPRO		Date samples were processed by the field laboratory. DDMMMYY format.
DATTR		Date sample was received by the field laboratory. DDMMMYY format.
DATSHP		Date samples were shipped from field laboratories to the analytical laboratories. DDMMMYY format.
DATSMP		Date lake was sampled. DDMMMYY format.

Table 6. (continued)

Name	Units	Definition
DICE11	mg/L	Air-equilibrated, dissolved inorganic carbon, measured in the analytical laboratory in an unfiltered, unacidified aliquot bubbled with 300-ppm CO_2, drawn into a syringe, filtered, and analyzed without exposure to the atmosphere (EPA method 415.2 modified, infrared spectrophotometric detector).
DICI11	mg/L	Dissolved inorganic carbon, measured in the analytical laboratory in an unfiltered, unacidified aliquot. The sample was drawn into a syringe, filtered, and analyzed without exposure to the atmosphere (EPA method 415.2 modified, infrared spectrophotometric detector).
DICQCS	mg/L	Dissolved inorganic carbon QC check sample (field laboratory). DIC was measured in the field laboratory on a 2.0-mg/L sodium carbonate solution using a detector. The check sample was measured before the first sample measurement and after every eight samples.
DICVAL	µg/L	Dissolved inorganic carbon, measured in the field laboratory on a sample drawn directly into a syringe from the Van Dorn water sampler, filtered, and analyzed without exposure to the atmosphere, using a DOHRMANN DC-80 carbon analyzer with infrared spectrophotometric detector (EPA method 415.2, modified).
DISM	km	Distance of the lake from the Pacific Ocean. A calculated variable for lakes within 150 km from the coast line (otherwise this value is missing).
DOC11	mg/L	Dissolved organic carbon, measured in the analytical laboratory in a filtered, acidified (H_2SO_4) aliquot (EPA method 415.2, infrared spectrophotometric detector).
DP_B	m	Depth at which bottom temperature and conductance were measured: DP_B = SITDPM - 1.5.
DP_CAT		Lake depth category, 4 (if SITDPM $\leq$ 20 m) or 5 (if SITDPM > 20 m).
DP_TOP	m	Depth of surface water sample, usually 1.5 m.

Table 6. (continued)

Name	Units	Definition
DP_60	m	Sixty percent of site depth: DP_60 = 0.6*SITDPM.
ELEV	m	Lake elevation, taken from USGS topographic maps.
FACE		Geomorphic slope (E/W), defines the east- or west-facing slope of the Cascade or Sierra Nevada mountain ranges, determined on the basis of topographic divide.
FE11	µg/L	Dissolved iron, measured in the analytical laboratory in a filtered, acidified (HNO_3) aliquot (EPA method 236.1, AAS, flame or ICPAES).
FOREST		Name of national forest, national park, or national recreation area in which lake is located.
FTL11	mg/L	Total dissolved fluoride, measured in the analytical laboratory in a filtered, unacidified aliquot, analyzed using an ion-selective electrode (ISE, EPA method 340.2, modified).
FTL16	µeq/L	Total dissolved fluoride: FTL16 = FTL11*52.64 µeq/mg.
GMU		Geomorphic unit, a physiographic area defined on the basis of topography and common geologic history (Snead 1980).
H16	µeq/L	Hydrogen ion concentration: H16 = 10**(-PHAC11)*10**6.
HCO316	µeq/L	Bicarbonate, an estimate (Butler 1982) of $HCO_3^- = \frac{5.080 \times [DIC\ mg/L] \times [H^+] \times K_1}{[H^+]^2 + [H^+] \times K_1 + K_1K_2}$, which is coded as HCO316 = 61017*(DICI11/12011)* ALPHA1*16.39, where ALPHA1 = ((10**(-PHAC11))*K1)/ ((10**(-PHAC11))**2 + (10**-PHAC11)*K1 + K1*K2), where K1 = 4.3*10**-7, K2 = 5.61*10**-11.

Table 6. (continued)

Name	Units	Definition
HELGR		Helicopter/Ground, designates whether sample was taken from a helicopter or by a ground crew: H = Helicopter; G = Ground.
HEL_ID		Helicopter identification number.
HYD_ID		Identification number for the HYDROLAB meter used for field measurements.
HYDROTYP		Hydrologic type, defined from geographic data (see IN_OUT). Classes are CLOSED (I/NO) DRAINAGE (I/O; or NI/O) RESERVOIR (RES) SEEPAGE (NI/NO)
INLETS		Number of lake inlets observed from the helicopter.
IN_OUT		Presence and/or absence of inlets and outlets, determined from USGS topographic maps: I/O = both, NI/O = outlets only, I/NO = inlets only; NI/NO = neither, and RES = Reservoir.
K11	mg/L	Dissolved potassium, measured in the analytical laboratory in a filtered, acidified (HNO_3) aliquot (EPA method 258.1, AAS, flame).
K16	µeq/L	Dissolved potassium: K16 = K11*25.57 µeq/mg.
LABNAM		Name of the analytical laboratory that performed the chemical analyses. The two laboratories were Versar, Inc. (VERSAR) and Environmental Monitoring and Services, Inc. (EMSI).
LAKE_ID		Seven-character unique identification code assigned to each lake. The first character represents the region (4); the second character, the subregion; the third character, the alkalinity map class; a dash; and the last three digits the assigned lake number. The first three characters also designate the stratum (see STRATA). LAKE_ID is unique for every record in data set 4 and the PC data set but is repeated in data set 3 for those lakes that were sampled twice for quality assurance purposes.

Table 6. (continued)

Name	Units	Definition
LAKE_SIZ	ha	Lake surface area, measured using an electronic planimeter on USGS topographic maps.
LAKE_VOL	$10^6 m^3$	Estimated lake volume: LAKE_VOL = ((LAKE_SIZ*10**4)*SITDPM*0.464)/10**6.
LAKENAME		Lake name taken from USGS topographic maps. When a number of small lakes were identified by only one name on the map, another qualifier, such as "southern," was added to the name to identify the lake. Where no name was listed, "(NO NAME)" was entered into the data base as the lake name.
LAKVER		Source of information by which field crew verified lake location.
LAT	deg	Latitude taken from the USGS topographic maps in DD-MM-SS (degrees-minutes-seconds) format.
LATINS		Latitude determined from LORAN-C guidance system (helicopter samples only).
LATMAP		Latitude recorded by the field crew.
LAT_DD	deg	Latitude expressed as degrees and decimal degrees in DD.DDDD format.
LNGINS		Longitude determined from LORAN-C guidance system (helicopter samples only).
LNGMAP		Longitude recorded by the field crew.
LONG	deg	Longitude read from the USGS topographic maps in DDD-MM-SS format.
LONG_DD	deg	Longitude expressed as degrees and decimal degrees in DDD.DDDD format.
MAP_BIG		Name of the 1:250,000-scale USGS topographic map on which the lake is located.
MAP_MED		Name of the 1:100,000-scale USGS topographic map on which the lake is located.

Table 6. (continued)

Name	Units	Definition
MAP_SML		Name of the 15- or 7.5-min scale USGS topographic map on which the lake is located.
MG11	mg/L	Dissolved magnesium, measured in the analytical laboratory in a filtered, acidified (HNO_3) aliquot (EPA method 242.1, AAS, flame or ICPAES).
MG16	µeq/L	Dissolved magnesium: MG16 = MG11*82.26 µeq/mg.
MN11	µg/L	Dissolved manganese, measured in the analytical laboratory in a filtered, acidified (HNO_3) aliquot (EPA method 243.1, AAS, flame or ICPAES).
NA11	mg/L	Dissolved sodium, measured in the analytical laboratory in a filtered, acidified (HNO_3) aliquot (EPA method 273.1, AAS, flame).
NA16	µeq/L	Dissolved sodium: NA16 = NA11*43.50 µeq/mg.
NH411	mg/L	Ammonium ion, measured in the analytical laboratory in a sample from the filtered, acidified (H_2SO_4) aliquot (EPA method 350.1, colorimetric, automated).
NH416	µeq/L	Ammonium ion: NH416 = NH411*55.44 µeq/mg.
NO311	mg/L	Nitrate ion, measured in the analytical laboratory in a filtered, unacidified aliquot (ASTM 1984; O'Dell et al. 1984; ion chromatography).
NO316	µeq/L	Nitrate ion: NO316 = NO311*16.13 µeq/mg.
NUM_IO		Number of inlets/outlets of a lake, determined from the map (MAP_SML) by the field crew.
ORGION	µeq/L	Estimate of the organic anion concentration (Oliver et al. 1983): ORGION = K*CT/(K + (10**(-PHAC11))), where K = 10**(-PK); CT = DOC11*10 and PK = 0.96 + 0.9*PHAC11 - 0.039*PHAC11**2.
OUTLET		Number of lake outlets observed from the helicopter.

Table 6. (continued)

Name	Units	Definition
	Field pH measurements	
		The following measurements were made from the helicopter with the HYDROLAB probe (PH_TOP through PHFI01). They are listed in the usual order of sampling. Measurements of pH paralleled field temperature measurements.
PH_TOP	pH	pH measurement at surface (usually 1.5 m below the surface).
PH_B	pH	pH at SITDPM - 1.5 m.
PH_60	pH	pH at 0.6*SITDPM.
PHIN01	pH	Initial measurement of a pH 3.91 QC check sample, used to calibrate the HYDROLAB.
PHFI01	pH	Final measurement of a pH 3.91 QC check sample, used to calibrate the HYDROLAB.
	Laboratory pH measurements	
PHAC11	pH	Initial pH from the acidity titration, measured in the analytical laboratory. A sample from an unfiltered, unacidified aliquot was placed into a CO_2-free titration vessel and stirred. The pH was measured with an electrode (without exposure to the atmosphere) before addition of base titrant.
PHAL11	pH	Initial pH from the alkalinity titration, measured in the analytical laboratory. A sample from the unfiltered, unacidified aliquot was placed into a titration vessel (not CO_2 free) and stirred. The pH was measured with an electrode before the first addition of acid titrant.
PHEQ11	pH	Air-equilibrated pH, measured in the analytical laboratory in an unfiltered, unacidified aliquot bubbled with 300-ppm CO_2 (EPA method 150.1, electrode).
PHSTQC	pH	Measurement of a pH 4.0 QC check sample, used by the field laboratory to calibrate closed-system pH measurements.

Table 6. (continued)

Name	Units	Definition
PHSTVL	pH	Closed-system pH, measured in the field laboratory using an ORION Model 611 meter and an ORION ROSS combination pH electrode on a syringe sample unexposed to the atmosphere (EPA method 150.1).
PRECIP	m	Annual precipitation, estimated from 30-year precipitation norm values (1931 - 1960) by overlaying the location of lakes on a contour map of normal annual total precipitation (USDC 1968) and assigning the lower value to each lake.
PTL11	µg/L	Total phosphorous, measured in the analytical laboratory in an unfiltered, acidified (H_2SO_4) aliquot, using either of two automated, colorimetric phosphomolybdate methods: for normal phosphorus levels, using a 15-mm absorption cell; for low levels, a preliminary method using a 50 mm absorption cell was employed (USGS method I-4600-78).
REGION		Region is a major area of the conterminous United States where a substantial number of lakes with alkalinity <400 µeq/L can be found. For the WLS-I there was one region, Region 4 (West).
REG_SPC		Reason for lake being sampled. This can be any combination of the following codes (the categories are not mutually exclusive): REG: part of the probability sample, SPC: special interest lake, and LTM: EPA long-term monitoring lake.
RT	yr	Estimated hydraulic residence time, defined as years required to replace the volume of the lake. Calculated only for drainage lakes and reservoirs (see HYDROTYP). $RT = \frac{LA \times \text{site depth}}{\text{runoff} \times (\text{watershed area} - LA) + (\text{precip} \times LA)}$, where LA = lake area. Coded as RT = ((LAKE_SIZ*10**4)*(SITDPM*0.464))/ (((RUNIN*2.54*10**-2)*((WSHED*10**4) - (LAKE_SIZ*10**4))) + ((LAKE_SIZ*10**4)*(PRECIP))).

Table 6. (continued)

Name	Units	Definition
RUNIN	in/yr	Surface water runoff interpolated from USGS map (Busby 1966).
SAM_ID		Identifies individual samples within a batch (see BAT_ID). In combination BAT_ID and SAM_ID are the unique sample identifiers.
SAMCOD		Sample code (consisting of up to three characters) indicating the type of sample. The first character can be one of the following: D = duplicate, R = routine, or T = triplicate. The second character can be one of the following: G = ground or H = helicopter. The third character can be one of the following: C = calibration lake or 2 = indicating a second sample and second visit.
SECDIS	m	Secchi disk disappearance depth.
SECMEAN	m	Mean of Secchi disk disappearance and reappearance depths. SECMEAN is set to SITDPM if the disk was visible on the lake bottom.
SECREA	m	Secchi disk reappearance depth.
SIO211	mg/L	Silica, measured in the analytical lab in an unfiltered aliquot (USGS method I-2700-78, colorimetric, molybdate blue, automated method).
SITDPF	ft	Sampling site depth, measured using a weighted line. Not necessarily maximum lake depth.
SITDPM	m	Sampling site depth, measured using a weighted line. Not necessarily maximum lake depth.
SO411	mg/L	Sulfate ion, measured in the analytical laboratory in a filtered, unacidified aliquot (ASTM 1984; O'Dell et al. 1984; ion chromatographic methods).

Table 6. (continued)

Name	Units	Definition
SO416	µeq/L	Sulfate ion: SO416 = SO411*20.82 µeq/mg.
SOBC	µeq/L	Sum of base cations: SOBC = NA16 + K16 + CA16 + MG16.
SPLCOD		Split code, indicates that duplicate sample aliquots were sent to cooperating analytical laboratories, where E = U.S. EPA Environmental Research Laboratory at Corvallis and L = U.S. EPA Environmental Monitoring Systems Laboratory at Las Vegas.
ST		State: standard two-character postal abbreviation.
STA_ID		Station ID of the field laboratory where lake samples were processed. STA_ID codes: 11 = Missoula, MT; 12 = Bozeman, MT; 13 = Aspen, CO; 14 = Wenatchee, WA; or 15 = Carson City, NV.
STRAT		Thermal stratification status: MIXED = Lakes where the difference between top temperature and bottom temperature (TMPDF1) was <4°C, WEAK = Lakes where the temperature difference between top and bottom (TMPDF1) was ≥4°C and the difference between top and the 60% depth temperature (TMPDF2) was <4°C, STRONG = Lakes with a temperature difference ≥4°C between the top temperature (TMPTOP) and the temperature at 60% of lake depth (TMP_60).
STRATA		Stratum, a subpopulation of lakes within a geographic area defined before sampling by the expected alkalinity of surface waters within a subregion and within a region.

Table 6. (continued)

Name	Units	Definition
SUB_RGN		Subregions are areas within each region that, based on historic data, are similar in water quality, physiography, vegetation, climate, and soil. All WLS-I lakes were within Region 4, the western United States. The five subregions in the WLS-I were A: California, B: Pacific Northwest, C: Northern Rockies, D: Central Rockies, and E: Southern Rockies.
TAG_X		Meaning of the user-defined tag "X" reported on the field form.
TAG_X2		Meaning of the user-defined tag "X" reported on the field laboratory form.
TAG_Y		Meaning of the user-defined tag "Y" reported on the field form.
TAG_Y2		Meaning of the user-defined tag "Y" reported on the field laboratory form.
TAG_Z		Meaning of the user-defined tag "Z" reported on the field form.
TAG_Z2		Meaning of the user-defined tag "Z" reported on the field laboratory form.
TIMSMP		Time lake was sampled in HH:MM format (24 H).
TIMTR		Time sample was received by the field lab in HH:MM format (24 H).
	<u>Field temperature measurement</u>	
		The following temperature measurements (TMPTOP to TMP_10) were made from the helicopter with the HYDROLAB probe. They are not in alphabetical order but are ordered as usually measured. Comparisons of top and bottom temperatures determined the need to conduct profile measurements.
TMPTOP	°C	Lake water temperature at surface (1.5 m).

Table 6. (continued)

Name	Units	Definition
TMP_B	°C	Temperature at SITDPM - 1.5 m.
TMPDF1	°C	Difference between top and bottom temperatures: TMPDF1 = TMPTOP - TMP_B.
TMP_60	°C	Temperature at 0.6*SITDPM. Measurement taken if TMPDF1 $\geq$ 4°C.
TMPDF2	°C	Difference between temperature at top and temperature at 0.6*SITDPM: TMPDF2 = TMPTOP - TMP_60.
	Profile measurements	
		Temperature profile measurements were taken when TMPDF2 $\geq$ 4°C. Profile measurement depths were determined by maximum lake depth measured (SITDPM). If SITDPM $\leq$ 20 m, profile measurements were taken at 4 m and at 2-m increments to the bottom. If SITDPM > 20 m, the profile was taken at 5 m and at 5-m increments to a maximum depth of 50 m.
TMP_1	°C	Temperature at 4 m (SITDPM $\leq$ 20) or at 5 m (SITDPM > 20).
TMP_2	°C	Temperature at 6 m (SITDPM $\leq$ 20) or at 10 m (SITDPM > 20).
TMP_3	°C	Temperature at 8 m (SITDPM $\leq$ 20) or at 15 m (SITDPM > 20).
TMP_4	°C	Temperature at 10 m (SITDPM $\leq$ 20) or at 20 m (SITDPM > 20).
TMP_5	°C	Temperature at 12 m (SITDPM $\leq$ 20) or at 25 m (SITDPM > 20).
TMP_6	°C	Temperature at 14 m (SITDPM $\leq$ 20) or at 30 m (SITDPM > 20).
TMP_7	°C	Temperature at 16 m (SITDPM $\leq$ 20) or at 35 m (SITDPM > 20).
TMP_8	°C	Temperature at 18 m (SITDPM $\leq$ 20) or at 40 m (SITDPM > 20).

Table 6. (continued)

Name	Units	Definition
TMP_9	°C	Temperature at 20 m (SITDPM $\leq$ 20) or at 45 m (SITDPM > 20).
TMP_10	°C	Temperature at 50 m.
TURQCS	NTU	Turbidity, measured by the field laboratory on a 5.0-NTU nephelometric turbidity QC check sample used to verify nephelometer calibration. Values for the check sample were recorded before and after eight sample measurements.
TURVAL	NTU	Turbidity, measured in the unfiltered sample in the field laboratory using a MONITEK model 21 nephelometer (EPA method 180.1).
USFS		United States Forest Service (USFS) region.
WALA		Ratio of watershed area to lake area. Watershed area includes lake area.
WEIGHT1		Stratum-specific population expansion factor (probability sample lakes only), equal to the inverse of a sample lake's inclusion probability.
WILDNA		USFS Wilderness Area name.
WSHED	ha	Watershed area, the geographic area from which surface water drains into a particular lake, determined using an electronic planimeter on USGS topographic maps. Lake area was included in watershed area.
WS_DIS		Disturbances of the natural environment in a watershed within 100 m of the shore, noted by field crew, where D = dwellings L = logging R = roads F = fire M = mining S = livestock.
WS_OTH		Disturbances of the natural environment in a watershed within 100 m of the shore, other than those described by WS_DIS, noted by field crew.

6. CARD-IMAGE FORMAT DEFINITION

WLS-I data sets 3 and 4 are provided as both SAS-formatted files and as card-image files. The PC data set is provided in card-image format only. The formats for the card-image files for all data sets are presented in Tables 7-9. Table 9 provides the card-image format used for both PC data set files. The two PC data set files -- WLS-I.REG and WLS-I.SPC--provide information for the probability sample lakes and the special interest lakes, respectively.

Most numeric variables were transferred to the card-image files for data sets 3 and 4 in 9.4 format (total length 9, including decimal point, with 4 decimals), regardless of their original formats (however, WSHED is in 9.2; LAKE_SIZ, WALA, and ALTIM are all in 9.3 format). The column "Dec" in Tables 7 and 8 indicates the original number of digits to the right of the decimal point in the SAS data sets. This value should be used as a part of the input format to prevent the generation of overly significant data on other computer systems.

Dates are in DDMMMYY format, and times are in HH:MM format (24-h clock) for all data sets.

The two comment variables in data set 3 (COMMNT and COMO1) were each split into two parts because of their lengths (becoming COMMNT1, COMMNT2, and COMO11, COMO12, respectively). Therefore, the card-image form of data set 3 has 279 (not 277) variables.

Note that missing numeric variables are represented as -999. These values must be removed before statistical analysis.

Table 7. Card-image format definition, data set 3, U.S. EPA Western Lake Survey-Phase I

Card No.[a]	Variable	Label	Variable type	Variable length[b]	Dec[c]	Column start	Column end	Card No.
1	HELGR	H/HELICOPTER, G/GROUND TEAM	CHAR	1		1	1	1
1	LAKE_ID	LAKE IDENTIFICATION CODE	CHAR	7		3	9	1
1	LATMAP	MAP LATITUDE (DDMM.DM)	CHAR	10		11	20	1
1	LATMAPT	TAG FOR LATMAP	CHAR	6		22	27	1
1	LNGMAP	MAP LONGITUDE (DDDMM.DM)	CHAR	10		29	38	1
1	LNGMAPT	TAG FOR LNGMAP	CHAR	6		40	45	1
1	LATINS	LORAN LATITUDE (DDMM.DM)	CHAR	10		47	56	1
1	LATINST	TAG FOR LATINS	CHAR	6		58	63	1
1	LNGINS	LORAN LONGITUDE (DDDMM.DM)	CHAR	10		65	74	1
2	LNGINST	TAG FOR LNGINS	CHAR	6		1	6	2
2	DATSMP	DATE SAMPLED (DDMMMYY), FORM 1	NUM	7		8	14	2
2	TIMSMP	TIME SAMPLED (HH:MM), FORM 1	NUM	5		16	20	2
2	HYD_ID	HYDROLAB ID	CHAR	3		22	24	2
2	PHINO1	PH INITIAL CALIBRATION	NUM	9.4	2	26	34	2
2	PHINO1T	TAG FOR PHINO1	CHAR	6		36	41	2
2	PHFIO1	PH FINAL CALIBRATION	NUM	9.4	2	43	51	2
2	PHFIO1T	TAG FOR PHFIO1	CHAR	6		53	58	2
2	CONIN	INITIAL CONDUCTANCE (US/CM)	NUM	9.4	0	60	68	2
2	CONINT	TAG FOR CONIN	CHAR	6		70	75	2
3	CONFI	FINAL CONDUCTANCE (US/CM)	NUM	9.4	0	1	9	3
3	CONFIT	TAG FOR CONFI	CHAR	6		11	16	3
3	ALTIM	ALTIMETER (FT)	NUM	9.3	0	18	26	3
3	ALTIMT	TAG FOR ALTIM	CHAR	6		28	33	3
3	WS_OTH	OTHER DISTURBANCE	CHAR	25		35	59	3
3	SITDPM	SITE DEPTH (M)	NUM	9.4	1	61	69	3
4	SITDPMT	TAG FOR SITDPM	CHAR	6		1	6	4
4	AIRTMP	AIR TEMPERATURE (DEG C)	NUM	9.4	0	8	16	4
4	AIRTMPF	FLAG FOR AIRTMP	CHAR	12		18	29	4
4	SITDPF	SITE DEPTH (FT)	NUM	9.4	0	31	39	4
4	SITDPFT	TAG FOR SITDPF	CHAR	6		41	46	4
4	SECDIS	SECCHI DISAPPEARANCE DEPTH (M)	NUM	9.4	1	48	56	4
4	SECDIST	TAG FOR SECDIS	CHAR	6		58	63	4
4	SECREA	SECCHI REAPPEARANCE DEPTH (M)	NUM	9.4	1	65	73	4
5	SECREAT	TAG FOR SECREA	CHAR	6		1	6	5
5	DP_TOP	DEPTH AT SURFACE (1.5 M) (M)	NUM	9.4	1	8	16	5
5	DP_TOPT	TAG FOR DP_TOP	CHAR	6		18	23	5
5	DP_B	DEPTH AT BOTTOM-1.5 M (M)	NUM	9.4	1	25	33	5
5	DP_BT	TAG FOR DP_B	CHAR	6		35	40	5
5	TMPTOP	TEMPERATURE AT SURFACE (1.5M)	NUM	9.4	1	42	50	5
5	TMPTOPT	TAG FOR TMPTOP	CHAR	6		52	57	5
5	TMP_B	TEMPERATURE AT BOTTOM-1.5 M (DEG C)	NUM	9.4	1	59	67	5
5	TMP_BT	TAG FOR TMP_B	CHAR	6		69	74	5

Table 7. (continued)

Card No.[a]	Variable	Label	Variable type	Variable length[b]	Dec[c]	Column start	Column end	Card No.
6	CONTOP	CONDUCTANCE AT SURFACE (1.5M) (US/CM)	NUM	9.4	0	1	9	6
6	CONTOPF	FLAG FOR CONTOP	CHAR	12		11	22	6
6	CONTOPT	TAG FOR CONTOP	CHAR	6		24	29	6
6	CON_B	CONDUCTANCE AT BOTTOM-1.5M (US/CM)	NUM	9.4	0	31	39	6
6	CON_BT	TAG FOR CON_B	CHAR	6		41	46	6
6	PH_TOP	PH AT SURFACE (1.5M)	NUM	9.4	2	48	56	6
6	PH_TOPF	FLAG FOR PH_TOP	CHAR	12		58	69	6
7	PH_TOPT	TAG FOR PH_TOP	CHAR	6		1	6	7
7	PH_B	PH AT BOTTOM-1.5M	NUM	9.4	2	8	16	7
7	PH_BT	TAG FOR PH_B	CHAR	6		18	23	7
7	TMPDF1	TEMP DIFFERENCE TOP-BOTTOM (DEG C)	NUM	9.4	1	25	33	7
7	TMPDF1T	TAG FOR TMPDF1	CHAR	6		35	40	7
7	DP_60	DEPTH AT 0.6*SITE DEPTH (M)	NUM	9.4	1	42	50	7
7	DP_60T	TAG FOR DP_60	CHAR	6		52	57	7
7	TMP_60	TEMPERATURE AT 0.6*SITE DEPTH (DEG C)	NUM	9.4	1	59	67	7
7	TMP_60T	TAG FOR TMP_60	CHAR	6		69	74	7
8	CON_60	CONDUCTANCE AT 0.60*SITE DEPTH (US/CM)	NUM	9.4	0	1	9	8
8	CON_60T	TAG FOR CON_60	CHAR	6		11	16	8
8	PH_60	PH AT 0.60*SITE DEPTH	NUM	9.4	2	18	26	8
8	PH_60T	TAG FOR PH_60	CHAR	6		28	33	8
8	TMPDF2	TEMP DIFFERENCE TOP-0.6*DEPTH (DEG C)	NUM	9.4	1	35	43	8
8	TMPDF2T	TAG FOR TMPDF2	CHAR	6		45	50	8
8	OUTLET	OUTLETS (#)	NUM	9.4	0	52	60	8
8	OUTLETT	TAG FOR OUTLET	CHAR	6		62	67	8
9	INLETS	INLETS (#)	NUM	9.4	0	1	9	9
9	INLETST	TAG FOR INLETS	CHAR	6		11	16	9
9	LAKVER	LOCATION VERIFIED BY, FORM 1	CHAR	25		18	42	9
9	TMP_1	TEMPERATURE AT 4 OR 5 M (DEG C)	NUM	9.4	1	44	52	9
9	TMP_1T	TAG FOR TMP_1	CHAR	6		54	59	9
9	TMP_2	TEMPERATURE AT 6 OR 10 M (DEG C)	NUM	9.4	1	61	69	9
10	TMP_2T	TAG FOR TMP_2	CHAR	6		1	6	10
10	TMP_3	TEMPERATURE AT 8 OR 15 M (DEG C)	NUM	9.4	1	8	16	10
10	TMP_4	TEMPERATURE AT 10 OR 20 M (DEG C)	NUM	9.4	1	18	26	10
10	TMP_5	TEMPERATURE AT 12 OR 25 M (DEG C)	NUM	9.4	1	28	36	10
10	TMP_6	TEMPERATURE AT 14 OR 30 M (DEG C)	NUM	9.4	1	38	46	10
10	TMP_7	TEMPERATURE AT 16 OR 35 M (DEG C)	NUM	9.4	1	48	56	10
10	TMP_7T	TAG FOR TMP_7	CHAR	6		58	63	10
10	TMP_8	TEMPERATURE AT 18 OR 40 M (DEG C)	NUM	9.4	1	65	73	10
11	TMP_9	TEMPERATURE AT 20 OR 45 M (DEG C)	NUM	9.4	1	1	9	11
11	TMP_10	TEMPERATURE AT 50 M (DEG C)	NUM	9.4	1	11	19	11
11	CON_1	CONDUCTANCE AT 4 OR 5 M (US/CM)	NUM	9.4	0	21	29	11
11	CON_1T	TAG FOR CON_1	CHAR	6		31	36	11
11	CON_2	CONDUCTANCE AT 6 OR 10 M (US/CM)	NUM	9.4	0	38	46	11
11	CON_2T	TAG FOR CON_2	CHAR	6		48	53	11
11	CON_3	CONDUCTANCE AT 8 OR 15 M (US/CM)	NUM	9.4	0	55	63	11
11	CON_3T	TAG FOR CON_3	CHAR	6		65	70	11

Table 7. (continued)

Card No.[a]	Variable	Label	Variable type	Variable length[b]	Dec[c]	Column start	Column end	Card No.
12	CON_4	CONDUCTANCE AT 10 OR 20 M (US/CM)	NUM	9.4	0	1	9	12
12	CON_4T	TAG FOR CON_4	CHAR	6		11	16	12
12	CON_5	CONDUCTANCE AT 12 OR 25 M (US/CM)	NUM	9.4	0	18	26	12
12	CON_5T	TAG FOR CON_5	CHAR	6		28	33	12
12	CON_6	CONDUCTANCE AT 14 OR 30 M (US/CM)	NUM	9.4	0	35	43	12
12	CON_6T	TAG FOR CON_6	CHAR	6		45	50	12
12	CON_7	CONDUCTANCE AT 16 OR 35 M (US/CM)	NUM	9.4	0	52	60	12
12	CON_7T	TAG FOR CON_7	CHAR	6		62	67	12
13	CON_8	CONDUCTANCE AT 18 OR 40 M (US/CM)	NUM	9.4	0	1	9	13
13	CON_8T	TAG FOR CON_8	CHAR	6		11	16	13
13	CON_9	CONDUCTANCE AT 20 OR 45 M (US/CM)	NUM	9.4	0	18	26	13
13	CON_10	CONDUCTANCE AT 50 M (US/CM)	NUM	9.4	0	28	36	13
14	TAG_X	MEANING OF TAG X, FORM 1	CHAR	40		1	40	14
14	TAG_Y	MEANING OF TAG Y, FORM 1	CHAR	20		42	61	14
15	TAG_Z	MEANING OF TAG Z, FORM 1	CHAR	20		1	20	15
15	BAT_ID	BATCH ID	CHAR	6		22	27	15
15	SAM_ID	SAMPLE ID	CHAR	6		29	34	15
15	DATTR	DATE RECEIVED AT TRAILER, FORM 1	NUM	7		36	42	15
15	TIMTR	TIME RECEIVED AT TRAILER, FORM 1	NUM	5		44	48	15
15	HEL_ID	HELICOPTER ID	CHAR	9		50	58	15
15	CRW_ID	CREW ID	CHAR	6		60	65	15
16	PH_BF	FLAG FOR PH_B	CHAR	12		1	12	16
16	PH_60F	FLAG FOR PH_60	CHAR	12		14	25	16
16	LAKE_SIZ	LAKE SURFACE AREA (HA)	NUM	9.3	1	27	35	16
16	LAKENAME	LAKE NAME	CHAR	30		37	66	16
16	ST	STATE (TWO-LETTER ABBREVIATION)	CHAR	2		68	69	16
17	WSHED	WATERSHED AREA (HA)	NUM	9.2	2	1	9	17
17	ELEV	LAKE ELEVATION (M)	NUM	9.4	1	11	19	17
17	IN_OUT	PRESENCE/ABSENCE OF INLETS/OUTLETS	CHAR	6		21	26	17
17	LAT_DD	LATITUDE (DECIMAL DEGREES)	NUM	9.4	4	28	36	17
17	LONG_DD	LONGITUDE (DECIMAL DEGREES)	NUM	9.4	4	38	46	17
17	REGION	NSWS REGION	CHAR	1		48	48	17
17	SUB_RGN	NSWS SUBREGION	CHAR	1		50	50	17
17	ALK_CLSS	ALKALINITY CLASS (1,2,3)	CHAR	1		52	52	17
18	MAP_BIG	MAP NAME, 1:250,000 SCALE	CHAR	25		1	25	18
18	MAP_SML	MAP NAME, 15 OR 7.5 QUAD	CHAR	40		27	66	18
19	LAT	LATITUDE	CHAR	10		1	10	19
19	LONG	LONGITUDE	CHAR	11		12	22	19
19	STRATA	NSWS STRATA	CHAR	3		24	26	19
19	COUNTY	FIPS CODE (STATE, COUNTY)	CHAR	5		28	32	19
19	USFS	FOREST SERVICE REGION(APPROX)	CHAR	1		34	34	19
19	WILDNA	USFS WILDERNESS NAME	CHAR	30		36	65	19
20	FOREST	FOREST-NF PAR-NP NATREC-NRA	CHAR	30		1	30	20
21	MAP_MED	MAP NAME, 1:100,000 SCALE	CHAR	60		1	60	21
21	NUM_IO	NUMBER OF INLETS/OUTLETS	CHAR	5		62	66	21
21	BAT_IDT	TAG FOR BAT_ID	CHAR	6		68	73	21

Table 7. (continued)

Card No.[a]	Variable	Label	Variable type	Variable length[b]	Dec[c]	Column start	Column end	Card No.
22	LABNAM	LABORATORY FOR ANALYSIS	CHAR	30		1	30	22
22	DATPRO	DATE PROCESSED, FORM 2	NUM	7		32	38	22
22	DATSHP	DATE SHIPPED, FORM 2	NUM	7		40	46	22
22	STA_ID	STATION ID	CHAR	6		48	53	22
22	SAM_IDF	FLAG FOR SAM_ID	CHAR	12		55	66	22
22	SAM_IDT	TAG FOR SAM_ID	CHAR	6		68	73	22
23	SAMCOD	SAMPLE CODE	CHAR	9		1	9	23
23	DICVAL	DIC, FIELD LAB (MG/L)	NUM	9.4	4	11	19	23
23	DICVALF	FLAG FOR DICVAL	CHAR	12		21	32	23
23	DICVALT	TAG FOR DICVAL	CHAR	6		34	39	23
23	DICQCS	DIC QCCS, FIELD LAB (MG/L)	NUM	9.4	3	41	49	23
23	DICQCST	TAG FOR DICQCS	CHAR	6		51	56	23
23	PHSTVL	PH, FIELD VALUE	NUM	9.4	2	58	66	23
24	PHSTVLF	FLAG FOR PHSTVL	CHAR	12		1	12	24
24	PHSTVLT	TAG FOR PHSTVL	CHAR	6		14	19	24
24	PHSTQC	PH QCCS, FIELD LAB	NUM	9.4	2	21	29	24
24	PHSTQCT	TAG FOR PHSTQC	CHAR	6		31	36	24
24	TURVAL	TURBIDITY, FIELD LAB (NTU)	NUM	9.4	1	38	46	24
24	TURVALT	TAG FOR TURVAL	CHAR	6		48	53	24
24	TURQCS	TURBIDITY QCCS, FIELD LAB (NTU)	NUM	9.4	1	55	63	24
24	COLVAL	COLOR (PCU)	NUM	9.4	0	65	73	24
25	COLVALT	TAG FOR COLVAL	CHAR	6		1	6	25
25	SPLCOD	SPLIT CODES	CHAR	4		8	11	25
25	TAG_X2	MEANING OF TAG X, FORM 2	CHAR	40		13	52	25
26	TAG_Y2	MEANING OF TAG Y, FORM 2	CHAR	25		1	25	26
26	TAG_Z2	MEANING OF TAG Z, FORM 2	CHAR	25		27	51	26
26	WS_DIS	D)WELL F)IRE L)OG M)INE R)OAD S)TOCK	CHAR	8		53	60	26
26	LAKE_VOL	CALCULATED LAKE VOLUME (10**6 CU M)	NUM	9.4	4	62	70	26
27	WALA	WATERSHED AREA / LAKE AREA	NUM	9.4	3	1	9	27
27	RUNIN	SURFACE WATER RUNOFF (INCHES)	NUM	9.4	1	11	19	27
27	DISM	DISTANCE FROM COAST (KM)	NUM	9.4	0	21	29	27
27	CONCALF	FLAG FOR CONCAL	CHAR	14		31	44	27
27	ANSUMF	FLAG FOR ANSUM	CHAR	12		46	57	27
27	CATSUMF	FLAG FOR CATSUM	CHAR	12		59	70	27
28	SOBCF	FLAG FOR SOBC	CHAR	12		1	12	28
28	ORGIONF	FLAG FOR ORGION	CHAR	12		14	25	28
28	ANSUM	SUM OF ANIONS (UEQ/L)	NUM	9.4	2	27	35	28
28	CATSUM	SUM OF CATIONS (UEQ/L)	NUM	9.4	2	37	45	28
28	SOBC	SUM OF BASE CATIONS (UEQ/L)	NUM	9.4	4	47	55	28
28	ORGION	ORGANIC ANION (UEQ/L)	NUM	9.4	4	57	65	28
28	ANDEF	CATSUM - ANSUM (UEQ/L)	NUM	9.4	4	67	75	28
29	HCO316	HCO3 (UEQ/L)	NUM	9.4	3	1	9	29
29	HCO316F	FLAG FOR HCO316	CHAR	12		11	22	29
29	CA16	CALCIUM (UEQ/L)	NUM	9.4	3	24	32	29
29	CO316	CARBONATE ALKALINITY (UEQ/L)	NUM	9.4	3	34	42	29
29	CO316F	FLAG FOR CO316	CHAR	12		44	55	29
29	CL16	CHLORIDE (UEQ/L)	NUM	9.4	3	57	65	29
29	MG16	MAGNESIUM (UEQ/L)	NUM	9.4	3	67	75	29

Table 7. (continued)

Card No.[a]	Variable	Label	Variable type	Variable length[b]	Dec[c]	Column start	Column end	Card No.
30	NO316	NITRATE (UEQ/L)	NUM	9.4	3	1	9	30
30	K16	POTASSIUM (UEQ/L)	NUM	9.4	3	11	19	30
30	NA16	SODIUM (UEQ/L)	NUM	9.4	3	21	29	30
30	SO416	SULFATE (UEQ/L)	NUM	9.4	3	31	39	30
30	FTL16	FLUORIDE (UEQ/L)	NUM	9.4	3	41	49	30
30	NH416	AMMONIUM (UEQ/L)	NUM	9.4	3	51	59	30
30	H16	HYDRONIUM FROM PHAC (UEQ/L)	NUM	9.4	3	61	69	30
31	H16F	FLAG FOR H16	CHAR	12		1	12	31
31	CA11	CALCIUM (MG/L)	NUM	9.4	3	14	22	31
31	CA11F	FLAG FOR CA11	CHAR	12		24	35	31
31	CA11T	TAG FOR CA11	CHAR	6		37	42	31
31	MG11	MAGNESIUM (MG/L)	NUM	9.4	3	44	52	31
31	MG11F	FLAG FOR MG11	CHAR	12		54	65	31
31	MG11T	TAG FOR MG11	CHAR	6		67	72	31
32	K11	POTASSIUM (MG/L)	NUM	9.4	3	1	9	32
32	K11F	FLAG FOR K11	CHAR	12		11	22	32
32	K11T	TAG FOR K11	CHAR	6		24	29	32
32	NA11	SODIUM (MG/L)	NUM	9.4	3	31	39	32
32	NA11F	FLAG FOR NA11	CHAR	12		41	52	32
32	NA11T	TAG FOR NA11	CHAR	6		54	59	32
32	MN11	MANGANESE (UG/L)	NUM	9.4	0	61	69	32
33	MN11F	FLAG FOR MN11	CHAR	12		1	12	33
33	MN11T	TAG FOR MN11	CHAR	6		14	19	33
33	FE11	IRON (UG/L)	NUM	9.4	0	21	29	33
33	FE11F	FLAG FOR FE11	CHAR	12		31	42	33
33	FE11T	TAG FOR FE11	CHAR	6		44	49	33
33	ALEX11	EXTRACTABLE ALUMINUM (UG/L)	NUM	9.4	1	51	59	33
33	ALEX11F	FLAG FOR ALEX11	CHAR	12		61	72	33
34	ALEX11T	TAG FOR ALEX11	CHAR	6		1	6	34
34	CL11	CHLORIDE (MG/L)	NUM	9.4	3	8	16	34
34	CL11F	FLAG FOR CL11	CHAR	12		18	29	34
34	CL11T	TAG FOR CL11	CHAR	6		31	36	34
34	SO411	SULFATE (MG/L)	NUM	9.4	3	38	46	34
34	SO411F	FLAG FOR SO411	CHAR	12		48	59	34
34	SO411T	TAG FOR SO411	CHAR	6		61	66	34
35	NO311	NITRATE (MG/L)	NUM	9.4	4	1	9	35
35	NO311F	FLAG FOR NO311	CHAR	12		11	22	35
35	NO311T	TAG FOR NO311	CHAR	6		24	29	35
35	SIO211	SILICA (MG/L)	NUM	9.4	3	31	39	35
35	SIO211F	FLAG FOR SIO211	CHAR	12		41	52	35
35	SIO211T	TAG FOR SIO211	CHAR	6		54	59	35
35	FTL11	FLUORIDE (MG/L)	NUM	9.4	4	61	69	35
36	FTL11F	FLAG FOR FTL11	CHAR	12		1	12	36
36	FTL11T	TAG FOR FTL11	CHAR	6		14	19	36
36	DOC11	DOC, ANALYTICAL LAB (MG/L)	NUM	9.4	2	21	29	36
36	DOC11F	FLAG FOR DOC11	CHAR	12		31	42	36
36	DOC11T	TAG FOR DOC11	CHAR	6		44	49	36
36	NH411	AMMONIUM (MG/L)	NUM	9.4	3	51	59	36
36	NH411F	FLAG FOR NH411	CHAR	12		61	72	36

Table 7. (continued)

Card No.[a]	Variable	Label	Variable type	Variable length[b]	Dec[c]	Column start	Column end	Card No.
37	NH411T	TAG FOR NH411	CHAR	6		1	6	37
37	PHEQ11	PH, AIR EQUILIBRATED	NUM	9.4	2	8	16	37
37	PHEQ11F	FLAG FOR PHEQ11	CHAR	12		18	29	37
37	PHEQ11T	TAG FOR PHEQ11	CHAR	6		31	36	37
37	PHAL11	PH, ALKALINITY INITIAL	NUM	9.4	2	38	46	37
37	PHAL11F	FLAG FOR PHAL11	CHAR	12		48	59	37
37	PHAL11T	TAG FOR PHAL11	CHAR	6		61	66	37
38	PHAC11	PH, ACIDITY INITIAL	NUM	9.4	2	1	9	38
38	PHAC11F	FLAG FOR PHAC11	CHAR	12		11	22	38
38	PHAC11T	TAG FOR PHAC11	CHAR	6		24	29	38
38	ACCO11	CO2 ACIDITY (UEQ/L)	NUM	9.4	2	31	39	38
38	ACCO11F	FLAG FOR ACCO11	CHAR	12		41	52	38
38	ACCO11T	TAG FOR ACCO11	CHAR	6		54	59	38
38	ALKA11	ALKALINITY (UEQ/L)	NUM	9.4	2	61	69	38
39	ALKA11F	FLAG FOR ALKA11	CHAR	12		1	12	39
39	ALKA11T	TAG FOR ALKA11	CHAR	6		14	19	39
39	COND11	CONDUCTANCE, ANALYTICAL LAB (US/CM)	NUM	9.4	1	21	29	39
39	COND11F	FLAG FOR COND11	CHAR	12		31	42	39
39	COND11T	TAG FOR COND11	CHAR	6		44	49	39
39	DICE11	EQUILIBRATED DIC, ANALYTICAL LAB (MG/L)	NUM	9.4	3	51	59	39
39	DICE11F	FLAG FOR DICE11	CHAR	12		61	72	39
40	DICE11T	TAG FOR DICE11	CHAR	6		1	6	40
40	DICI11	INITIAL DIC, ANALYTICAL LAB (MG/L)	NUM	9.4	3	8	16	40
40	DICI11F	FLAG FOR DICI11	CHAR	12		18	29	40
40	DICI11T	TAG FOR DICI11	CHAR	6		31	36	40
40	PTL11	TOTAL PHOSPHORUS (UG/L)	NUM	9.4	1	38	46	40
40	PTL11F	FLAG FOR PTL11	CHAR	12		48	59	40
40	PTL11T	TAG FOR PTL11	CHAR	6		61	66	40
41	ALTL11	TOTAL ALUMINUM (UG/L)	NUM	9.4	1	1	9	41
41	ALTL11F	FLAG FOR ALTL11	CHAR	12		11	22	41
41	ALTL11T	TAG FOR ALTL11	CHAR	6		24	29	41
41	CONCAL	CALCULATED SPECIFIC CONDUCTANCE (US/CM)	NUM	9.4	4	31	39	41
41	GMU	GEOMORPHIC UNIT	CHAR	6		41	46	41
41	FACE	GEOMORPHIC SLOPE (E/W)	CHAR	1		48	48	41
41	PRECIP	ANNUAL PRECIPITATION (M/YR)	NUM	9.4	3	50	58	41
41	RT	RESIDENCE TIME (YR)	NUM	9.4	4	60	68	41
42	REG_SPC	/REG/SPC/LTM	CHAR	12		1	12	42
42	BNSTAR	POPULATION SIZE BY STRATA	NUM	9.4	0	14	22	42
42	WEIGHT1	POPULATION EXTRAPOLATION FACTOR	NUM	9.4	4	24	32	42
42	HYDROTYP	DRAINAGE, SEEPAGE, CLOSED, RESERVOIR	CHAR	9		34	42	42
42	BEDROCK	NORTON BEDROCK CLASSIFICATION	CHAR	1		44	44	42
42	ANCAT	CATSUM/ANSUM	NUM	9.4	4	46	54	42
42	SECMEAN	SECCHI MEAN DEPTH (M)	NUM	9.4	2	56	64	42
42	STRAT	STRATIFICATON TYPE (MIXED, WEAK, STRONG)	CHAR	6		66	71	42
43	COM011	COMMENT FROM FORM 1 PT 1	CHAR	75		1	75	43
44	COM012	COMMENT FROM FORM 1 PT 2	CHAR	45		1	45	44
45	COMMNT1	COMMENT FROM FORM 2 PT 1	CHAR	75		1	75	45
46	COMMNT2	COMMENT FROM FORM 2 PT 2	CHAR	75		1	75	46

[a]Card No. is a variable on each record in columns 78–79.

[b]Length for CHAR (character) fields is the integer field length. The length for NUM (numeric) fields is in W.D format, where W = the total field length (decimal point included) and D = the number of decimal places. For example, 34.78 is in 5.2 format.

[c]Dec is the number of decimal places with which the original data were reported.

Table 8. Card-image format definition, data set 4, U.S. EPA Western Lake Survey-Phase I

Card No.[a]	Variable	Label	Variable type	Variable length[b]	Dec[c]	Column start	Column end	Card No.
1	HELGR	H/HELICOPTER, G/GROUND TEAM	CHAR	1		1	1	1
1	LAKE_ID	LAKE IDENTIFICATION CODE	CHAR	7		3	9	1
1	LATINS	LORAN LATITUDE (DDMM.DM)	CHAR	10		11	20	1
1	LNGINS	LORAN LONGITUDE (DDDMM.DM)	CHAR	10		22	31	1
1	DATSMP	DATE SAMPLED (DDMMMYY), FORM 1	NUM	7		33	39	1
1	TIMSMP	TIME SAMPLED (HH:MM), FORM 1	NUM	5		41	45	1
1	ALTIM	ALTIMETER (FT)	NUM	9.3	0	47	55	1
1	SITDPM	SITE DEPTH (M)	NUM	9.4	1	57	65	1
1	AIRTMP	AIR TEMPERATURE (DEG C)	NUM	9.4	0	67	75	1
2	AIRTMPF	FLAG FOR AIRTMP	CHAR	12		1	12	2
2	SECDIS	SECCHI DISAPPEARANCE DEPTH (M)	NUM	9.4	1	14	22	2
2	SECREA	SECCHI REAPPEARANCE DEPTH (M)	NUM	9.4	1	24	32	2
2	DP_TOP	DEPTH AT SURFACE (1.5 M) (M)	NUM	9.4	1	34	42	2
2	DP_B	DEPTH AT BOTTOM-1.5 M (M)	NUM	9.4	1	44	52	2
2	TMPTOP	TEMPERATURE AT SURFACE (1.5M)	NUM	9.4	1	54	62	2
2	TMP_B	TEMPERATURE AT BOTTOM-1.5 M (DEG C)	NUM	9.4	1	64	72	2
3	CONTOP	CONDUCTANCE AT SURFACE (1.5M) (US/CM)	NUM	9.4	0	1	9	3
3	CONTOPF	FLAG FOR CONTOP	CHAR	12		11	22	3
3	CON_B	CONDUCTANCE AT BOTTOM-1.5M (US/CM)	NUM	9.4	0	24	32	3
3	PH_TOP	PH AT SURFACE (1.5M)	NUM	9.4	2	34	42	3
3	PH_TOPF	FLAG FOR PH_TOP	CHAR	12		44	55	3
3	PH_B	PH AT BOTTOM-1.5M	NUM	9.4	2	57	65	3
3	TMPDF1	TEMP DIFFERENCE TOP-BOTTOM (DEG C)	NUM	9.4	1	67	75	3
4	DP_60	DEPTH AT 0.6*SITE DEPTH (M)	NUM	9.4	1	1	9	4
4	TMP_60	TEMPERATURE AT 0.6*SITE DEPTH (DEG C)	NUM	9.4	1	11	19	4
4	CON_60	CONDUCTANCE AT 0.60*SITE DEPTH (US/CM)	NUM	9.4	0	21	29	4
4	PH_60	PH AT 0.60*SITE DEPTH	NUM	9.4	2	31	39	4
4	TMPDF2	TEMP DIFFERENCE TOP-0.6*DEPTH (DEG C)	NUM	9.4	1	41	49	4
4	BAT_ID	BATCH ID	CHAR	6		51	56	4
4	SAM_ID	SAMPLE ID	CHAR	6		58	63	4
4	CRW_ID	CREW ID	CHAR	6		65	70	4
5	PH_BF	FLAG FOR PH_B	CHAR	12		1	12	5
5	PH_60F	FLAG FOR PH_60	CHAR	12		14	25	5
5	LAKE_SIZ	LAKE SURFACE AREA (HA)	NUM	9.3	1	27	35	5
5	LAKENAME	LAKE NAME	CHAR	30		37	66	5
5	ST	STATE (TWO-LETTER ABBREVIATION)	CHAR	2		68	69	5
6	WSHED	WATERSHED AREA (HA)	NUM	9.2	2	1	9	6
6	ELEV	LAKE ELEVATION (M)	NUM	9.4	1	11	19	6
6	IN_OUT	PRESENCE/ABSENCE OF INLETS/OUTLETS	CHAR	6		21	26	6
6	LAT_DD	LATITUDE (DECIMAL DEGREES)	NUM	9.4	4	28	36	6
6	LONG_DD	LONGITUDE (DECIMAL DEGREES)	NUM	9.4	4	38	46	6
6	REGION	NSWS REGION	CHAR	1		48	48	6
6	SUB_RGN	NSWS SUBREGION	CHAR	1		50	50	6
6	ALK_CLSS	ALKALINITY CLASS (1,2,3)	CHAR	1		52	52	6

Table 8. (continued)

Card No.[a]	Variable	Label	Variable type	Variable length[b]	Dec[c]	Column start	Column end	Card No.
7	MAP_BIG	MAP NAME, 1:250,000 SCALE	CHAR	25		1	25	7
7	MAP_SML	MAP NAME, 15 OR 7.5 QUAD	CHAR	40		27	66	7
8	LAT	LATITUDE	CHAR	10		1	10	8
8	LONG	LONGITUDE	CHAR	11		12	22	8
8	STRATA	NSWS STRATA	CHAR	3		24	26	8
8	COUNTY	FIPS CODE (STATE, COUNTY)	CHAR	5		28	32	8
8	USFS	FOREST SERVICE REGION (APPROX)	CHAR	1		34	34	8
8	WILDNA	USFS WILDERNESS NAME	CHAR	30		36	65	8
9	FOREST	FOREST-NF PAR-NP NATREC-NRA	CHAR	30		1	30	9
9	NUM_IO	NUMBER OF INLETS/OUTLETS	CHAR	5		32	36	9
9	LABNAM	LABORATORY FOR ANALYSIS	CHAR	30		38	67	9
10	SAM_IDF	FLAG FOR SAM_ID	CHAR	12		1	12	10
10	SAMCOD	SAMPLE CODE	CHAR	9		14	22	10
10	DICVAL	DIC, FIELD LAB (MG/L)	NUM	9.4	4	24	32	10
10	DICVALF	FLAG FOR DICVAL	CHAR	12		34	45	10
10	PHSTVL	PH, FIELD VALUE	NUM	9.4	2	47	55	10
10	PHSTVLF	FLAG FOR PHSTVL	CHAR	12		57	68	10
11	TURVAL	TURBIDITY, FIELD LAB (NTU)	NUM	9.4	1	1	9	11
11	COLVAL	COLOR (PCU)	NUM	9.4	0	11	19	11
11	LAKE_VOL	CALCULATED LAKE VOLUME (10**6 CU M)	NUM	9.4	4	21	29	11
11	WALA	WATERSHED AREA / LAKE AREA	NUM	9.4	3	31	39	11
11	RUNIN	SURFACE WATER RUNOFF (INCHES)	NUM	9.4	1	41	49	11
11	DISM	DISTANCE FROM COAST (KM)	NUM	9.4	0	51	59	11
11	CONCALF	FLAG FOR CONCAL	CHAR	14		61	74	11
12	ANSUMF	FLAG FOR ANSUM	CHAR	12		1	12	12
12	CATSUMF	FLAG FOR CATSUM	CHAR	12		14	25	12
12	SOBCF	FLAG FOR SOBC	CHAR	12		27	38	12
12	ORGIONF	FLAG FOR ORGION	CHAR	12		40	51	12
12	ANSUM	SUM OF ANIONS (UEQ/L)	NUM	9.4	2	53	61	12
12	CATSUM	SUM OF CATIONS (UEQ/L)	NUM	9.4	2	63	71	12
13	SOBC	SUM OF BASE CATIONS (UEQ/L)	NUM	9.4	4	1	9	13
13	ORGION	ORGANIC ANION (UEQ/L)	NUM	9.4	4	11	19	13
13	ANDEF	CATSUM - ANSUM (UEQ/L)	NUM	9.4	4	21	29	13
13	HCO316	HCO3 (UEQ/L)	NUM	9.4	3	31	39	13
13	HCO316F	FLAG FOR HCO316	CHAR	12		41	52	13
13	CA16	CALCIUM (UEQ/L)	NUM	9.4	3	54	62	13
13	CO316	CARBONATE ALKALINITY (UEQ/L)	NUM	9.4	3	64	72	13
14	CO316F	FLAG FOR CO316	CHAR	12		1	12	14
14	CL16	CHLORIDE (UEQ/L)	NUM	9.4	3	14	22	14
14	MG16	MAGNESIUM (UEQ/L)	NUM	9.4	3	24	32	14
14	NO316	NITRATE (UEQ/L)	NUM	9.4	3	34	42	14
14	K16	POTASSIUM (UEQ/L)	NUM	9.4	3	44	52	14
14	NA16	SODIUM (UEQ/L)	NUM	9.4	3	54	62	14
14	SO416	SULFATE (UEQ/L)	NUM	9.4	3	64	72	14
15	FTL16	FLUORIDE (UEQ/L)	NUM	9.4	3	1	9	15
15	NH416	AMMONIUM (UEQ/L)	NUM	9.4	3	11	19	15
15	H16	HYDRONIUM FROM PHAC (UEQ/L)	NUM	9.4	3	21	29	15
15	H16F	FLAG FOR H16	CHAR	12		31	42	15
15	CA11	CALCIUM (MG/L)	NUM	9.4	3	44	52	15

Table 8. (continued)

Card No.[a]	Variable	Label	Variable type	Variable length[b]	Dec[c]	Column start	Column end	Card No.
15	CA11F	FLAG FOR CA11	CHAR	12		54	65	15
15	MG11	MAGNESIUM (MG/L)	NUM	9.4	3	67	75	15
16	MG11F	FLAG FOR MG11	CHAR	12		1	12	16
16	K11	POTASSIUM (MG/L)	NUM	9.4	3	14	22	16
16	K11F	FLAG FOR K11	CHAR	12		24	35	16
16	NA11	SODIUM (MG/L)	NUM	9.4	3	37	45	16
16	NA11F	FLAG FOR NA11	CHAR	12		47	58	16
16	MN11	MANGANESE (UG/L)	NUM	9.4	0	60	68	16
17	MN11F	FLAG FOR MN11	CHAR	12		1	12	17
17	FE11	IRON (UG/L)	NUM	9.4	0	14	22	17
17	FE11F	FLAG FOR FE11	CHAR	12		24	35	17
17	ALEX11	EXTRACTABLE ALUMINUM (UG/L)	NUM	9.4	1	37	45	17
17	ALEX11F	FLAG FOR ALEX11	CHAR	12		47	58	17
17	CL11	CHLORIDE (MG/L)	NUM	9.4	3	60	68	17
18	CL11F	FLAG FOR CL11	CHAR	12		1	12	18
18	SO411	SULFATE (MG/L)	NUM	9.4	3	14	22	18
18	SO411F	FLAG FOR SO411	CHAR	12		24	35	18
18	NO311	NITRATE (MG/L)	NUM	9.4	4	37	45	18
18	NO311F	FLAG FOR NO311	CHAR	12		47	58	18
18	SIO211	SILICA (MG/L)	NUM	9.4	3	60	68	18
19	SIO211F	FLAG FOR SIO211	CHAR	12		1	12	19
19	FTL11	FLUORIDE (MG/L)	NUM	9.4	4	14	22	19
19	FTL11F	FLAG FOR FTL11	CHAR	12		24	35	19
19	DOC11	DOC, ANALYTICAL LAB (MG/L)	NUM	9.4	2	37	45	19
19	DOC11F	FLAG FOR DOC11	CHAR	12		47	58	19
19	NH411	AMMONIUM (MG/L)	NUM	9.4	3	60	68	19
20	NH411F	FLAG FOR NH411	CHAR	12		1	12	20
20	PHEQ11	PH, AIR EQUILIBRATED	NUM	9.4	2	14	22	20
20	PHEQ11F	FLAG FOR PHEQ11	CHAR	12		24	35	20
20	PHAL11	PH, ALKALINITY INITIAL	NUM	9.4	2	37	45	20
20	PHAL11F	FLAG FOR PHAL11	CHAR	12		47	58	20
20	PHAC11	PH, ACIDITY INITIAL	NUM	9.4	2	60	68	20
21	PHAC11F	FLAG FOR PHAC11	CHAR	12		1	12	21
21	ACCO11	CO2 ACIDITY (UEQ/L)	NUM	9.4	2	14	22	21
21	ACCO11F	FLAG FOR ACCO11	CHAR	12		24	35	21
21	ALKA11	ALKALINITY (UEQ/L)	NUM	9.4	2	37	45	21
21	ALKA11F	FLAG FOR ALKA11	CHAR	12		47	58	21
21	COND11	CONDUCTANCE, ANALYTICAL LAB (US/CM)	NUM	9.4	1	60	68	21
22	COND11F	FLAG FOR COND11	CHAR	12		1	12	22
22	DICE11	EQUILIBRATED DIC, ANALYTICAL LAB (MG/L)	NUM	9.4	3	14	22	22
22	DICE11F	FLAG FOR DICE11	CHAR	12		24	35	22
22	DICI11	INITIAL DIC, ANALYTICAL LAB (MG/L)	NUM	9.4	3	37	45	22
22	DICI11F	FLAG FOR DICI11	CHAR	12		47	58	22
22	PTL11	TOTAL PHOSPHORUS (UG/L)	NUM	9.4	1	60	68	22
23	PTL11F	FLAG FOR PTL11	CHAR	12		1	12	23
23	ALTL11	TOTAL ALUMINUM (UG/L)	NUM	9.4	1	14	22	23
23	ALTL11F	FLAG FOR ALTL11	CHAR	12		24	35	23

Table 8. (continued)

Card No.[a]	Variable	Label	Variable type	Variable length[b]	Dec[c]	Column start	Column end	Card No.
23	CONCAL	CALCULATED SPECIFIC CONDUCTANCE (US/CM)	NUM	9.4	4	37	45	23
23	GMU	GEOMORPHIC UNIT	CHAR	6		47	52	23
23	FACE	GEOMORPHIC SLOPE (E/W)	CHAR	1		54	54	23
23	PRECIP	ANNUAL PRECIPITATION (M/YR)	NUM	9.4	3	56	64	23
23	RT	RESIDENCE TIME (YR)	NUM	9.4	4	66	74	23
24	REG_SPC	/REG/SPC/LTM	CHAR	12		1	12	24
24	TURVALF	FLAG FOR TURVAL	CHAR	12		14	25	24
24	COLVALF	FLAG FOR COLVAL	CHAR	12		27	38	24
24	ANCAT	CATSUM/ANSUM	NUM	9.4	4	40	48	24
24	SECMEAN	SECCHI MEAN DEPTH (M)	NUM	9.4	2	50	58	24
24	BNSTAR	POPULATION SIZE BY STRATA	NUM	9.4	0	60	68	24
25	WEIGHT1	POPULATION EXTRAPOLATION FACTOR	NUM	9.4	4	1	9	25
25	HYDROTYP	DRAINAGE, SEEPAGE, CLOSED, RESERVOIR	CHAR	9		11	19	25
25	STRAT	STRATIFICATON TYPE (MIXED, WEAK, STRONG)	CHAR	6		21	26	25
25	BEDROCK	NORTON BEDROCK CLASSIFICATION	CHAR	1		28	28	25
25	MAP_MED	MAP NAME, 1:100,000 SCALE	CHAR	35		30	64	25
26	WS_OTH	OTHER DISTURBANCE	CHAR	25		1	25	26
26	WS_DIS	D)WELL F)IRE L)OG M)INE R)OAD S)TOCK	CHAR	8		27	34	26
26	STA_ID	STATION ID	CHAR	6		36	41	26

[a]Card No. is a variable on each record in columns 78 and 79.

[b]Length for CHAR (character) fields is the integer field length. The length for NUM (numeric) fields is in W.D format, where W = the total field length (decimal point included) and D = the number of decimal places. For example, 34.78 is in 5.2 format.

[c]Dec is the number of decimal places with which the original data were reported.

Table 9. Card-image format definition, PC data set, U.S. EPA Western Lake Survey-Phase I

Card No.[a]	Variable	Label	Variable type	Variable length[b]	Column start	Column end	Card No.
1	LAKE_ID	LAKE ID	CHAR	7	1	7	1
1	LAKENAME	LAKE NAME	CHAR	26	9	34	1
1	LAT	LATITUDE	CHAR	10	36	45	1
1	LONG	LONGITUDE	CHAR	11	46	57	1
1	ELEV	LAKE ELEVATION (M)	NUM	4.0	59	62	1
1	LAKE_SIZ	LAKE SURFACE AREA (HA)	NUM	7.1	64	70	1
1	WSHED	WATERSHED AREA (HA)	NUM	7.0	72	78	1
2	WALA	WATERSHED AREA/LAKE AREA	NUM	7.1	1	7	2
2	HYDROTYP	DRAINAGE, SEEPAGE, CLOSED, RESERVOIR	CHAR	9	9	17	2
2	TMPTOP	TEMPERATURE AT SURFACE	NUM	6.1	19	24	2
2	STRAT	STRATIFICATION (NONE, WEAK, STRONG)	CHAR	6	26	31	2
2	SITDPM	SITE DEPTH (M)	NUM	5.1	33	37	2
2	SECMEAN	SECCHI, MEAN DEPTH (M)	NUM	6.1	39	44	2
2	TURVAL	TURBIDITY, FIELD LAB (NTU)	NUM	5.1	46	50	2
2	COLVAL	COLOR (PCU)	NUM	4.0	52	55	2
2	FE11	IRON (UG/L)	NUM	6.1	57	62	2
2	ANSUM	SUM OF ANIONS (UEQ/L)	NUM	6.1	64	69	2
2	CATSUM	SUM OF CATIONS (UEQ/L)	NUM	6.1	71	76	2
3	ANCAT	CATSUM/ANSUM	NUM	4.2	1	4	3
3	PHEQ11	PH, AIR EQUILIBRATED	NUM	4.2	6	9	3
3	PHSTVL	PH, FIELD LAB	NUM	4.2	11	14	3
3	ALKA11	ALKALINITY (UEQ/L)	NUM	6.1	16	21	3
3	COND11	CONDUCTANCE, ANALYTICAL LAB (US/CM)	NUM	5.1	23	27	3
3	CONCAL	CALCULATED SPECIFIC CONDUCTANCE (US/CM)	NUM	5.1	29	33	3
3	DICE11	EQUIL DIC, ANALYTICAL LAB (MG/L)	NUM	5.2	35	39	3
3	DICVAL	DIC, FIELD LAB (MG/L)	NUM	5.2	41	45	3
3	DOC11	DOC, ANALYTICAL LAB (MG/L)	NUM	5.2	47	51	3
3	ALEX11	EXTRACTABLE ALUMINUM (UG/L)	NUM	5.1	53	57	3
3	ALTL11	TOTAL ALUMINUM (UG/L)	NUM	6.1	59	64	3
3	CA16	CALCIUM (UEQ/L)	NUM	6.1	66	71	3
3	MG16	MAGNESIUM (MG/L)	NUM	6.1	73	78	3
4	NA16	SODIUM (UEQ/L)	NUM	6.1	1	6	4
4	K16	POTASSIUM (UEQ/L)	NUM	5.1	8	12	4
4	NH416	AMMONIUM (UEQ/L)	NUM	4.1	14	17	4
4	SO416	SULFATE (UEQ/L)	NUM	6.1	19	24	4
4	HCO316	HCO3 (UEQ/L)	NUM	6.1	26	31	4
4	CL16	CHLORIDE (UEQ/L)	NUM	6.1	33	38	4
4	NO316	NITRATE (UEQ/L)	NUM	4.1	40	43	4
4	FTL16	FLUORIDE (UEQ/L)	NUM	5.1	45	49	4
4	PTL11	TOTAL PHOSPHORUS (UG/L)	NUM	5.1	51	55	4
4	SIO211	SILICA (MG/L)	NUM	6.2	57	62	4
4	REG_SPC	/REG/SPEC/LTM	CHAR	12	64	75	4
4	ST	STATE (TWO-LETTER ABBREV)	CHAR	2	77	78	4
5	MN11	MANGANESE (UG/L)	NUM	6.1	1	6	5
5	DATSMP	DATE SAMPLED, FORM 1	CHAR	7	8	14	5
5	WEIGHT1	POPULATION EXTRAPOLATION FACTOR	NUM	6.3	16	21	5
5	BNSTAR	POPULATION SIZE BY STRATA	NUM	4.0	23	26	5

[a]Card number is a variable on each 80-column record. For cards 1-4, it is in column 80 and in column 28 for card 5.

[b]Format for CHAR (character) fields is the integer field length. The length for NUM (numeric) fields is in W.D format where W = the total field length and D = the number of decimal places. For example, 34.78 is in 5.2 format.

7. DATA TRANSPORT VERIFICATION

The WLS-I data sets can be read as fully formatted SAS data sets or as card-image files (Sect. 6). Regardless, users should verify that the data have been transported correctly to their systems by generating some or all of the statistics presented in Tables 10-13. These statistics were generated using SAS (PROC MEANS) but can be duplicated in other statistical packages or languages. If the statistics generated by the user differ from those presented here, the data sets may have been corrupted in transport. Note that missing values in the card-image data sets, represented as -999, must be removed before generating the summary statistics to check data transport.

Tables 14-16 are card-image printouts of the first five lakes in data sets 3 and 4 and the PC data set (file WLS-I.REG). They can be used to check data formats for those using the card-image versions.

These statistics are presented only as a tool to ensure proper reading of the data sets. They are not to be construed as summarizing the WLS-I results.

Table 10. Characteristics of numeric variables, data set 3, U.S. EPA Western Lake Survey-Phase I

Variable	N	Mean	Standard deviation	Min	Max
ACC011	1105	25.29	32.92	-270.30	450.70
AIRTMP	1105	6.19	5.76	-17.00	23.00
ALEX11	1105	6.97	29.30	-6.00	723.80
ALKA11	1105	244.41	426.37	-24.00	4948.60
ALTIM	573	7332.98	2939.82	20.00	12800.00
ALTL11	1105	36.87	71.58	-2.30	1154.00
ANCAT	1104	1.16	0.15	0.70	2.76
ANDEF	1104	32.60	123.82	-639.79	2565.19
ANSUM	1104	274.11	541.96	14.62	7320.76
BNSTAR	1106	849.96	574.31	150.00	2317.00
CA11	1105	3.65	6.58	0.09	95.38
CA16	1105	182.03	328.57	4.29	4759.51
CATSUM	1105	306.61	565.84	18.04	6680.97
CL11	1104	0.44	3.21	0.01	74.22
CL16	1104	12.34	90.69	0.31	2093.66
CO316	1105	3.90	22.61	0.00	311.12
COLVAL	1104	8.69	9.50	0.00	110.00
CONCAL	1104	31.68	62.12	2.14	852.16
COND11	1105	29.64	51.96	1.60	695.00
CONFI	579	43.98	7.01	0.00	60.00
CONIN	579	47.39	6.62	30.00	64.00
CONTOP	564	35.16	64.18	-2.00	667.00
CON_1	21	36.48	58.01	1.00	206.00
CON_10	1	7.00	--	7.00	7.00
CON_2	21	36.19	57.91	1.00	206.00
CON_3	21	38.19	59.06	3.00	212.00
CON_4	21	43.29	65.36	3.00	225.00
CON_5	18	44.56	67.25	3.00	225.00
CON_6	18	46.17	66.94	3.00	224.00
CON_60	33	35.06	52.63	3.00	225.00
CON_7	12	50.00	82.45	4.00	224.00
CON_8	10	51.80	90.38	4.00	223.00
CON_9	7	8.71	6.05	3.00	17.00
CON_B	474	34.95	66.95	-3.00	668.00
DICE11	1105	2.84	4.69	0.14	50.22
DICI11	1105	2.98	5.21	0.16	61.83
DICQCS	355	2.10	0.22	1.82	5.96
DICVAL	1103	3.17	5.82	0.20	88.67
DISM	346	71.68	38.42	1.00	149.00
DOC11	1105	1.72	1.68	0.05	16.72
DP_60	63	19.77	8.14	3.60	42.20
DP_B	944	11.91	10.30	0.30	53.40
DP_TOP	1096	1.50	0.00	1.50	1.50

Table 10. (continued)

Variable	N	Mean	Standard deviation	Min	Max
ELEV	1106	2405.99	843.87	10.67	3912.78
FE11	1105	31.61	68.24	-9.00	974.00
FTL11	1104	0.05	0.19	0.00	3.54
FTL16	1104	2.84	10.22	0.00	186.57
H16	1105	0.20	0.87	0.00	28.18
HCO316	1105	214.79	379.46	2.63	3732.72
INLETS	989	1.22	1.58	0.00	25.00
K11	1105	0.37	0.97	0.03	20.00
K16	1105	9.47	24.72	0.10	511.40
LAKE_SIZ	1106	34.53	357.27	1.00	10010.70
LAKE_VOL	1104	4.27	39.96	0.01	919.70
LAT_DD	1106	42.95	3.57	36.09	48.99
LONG_DD	1106	114.85	5.89	105.06	123.78
MG11	1105	0.81	1.84	0.02	17.88
MG16	1105	66.44	151.45	1.32	1471.14
MN11	1105	3.84	18.54	-49.00	227.00
NA11	1105	1.11	5.38	0.02	124.50
NA16	1105	48.47	234.09	1.00	5415.75
NH411	1105	0.00	0.03	-0.08	0.29
NH416	1105	0.00	1.45	-4.60	15.91
NO311	1104	0.10	0.21	-0.01	2.67
NO316	1104	1.53	3.39	-0.22	43.05
ORGION	1105	16.72	16.45	0.48	167.02
OUTLET	1063	0.90	0.37	0.00	3.00
PHAC11	1105	7.01	0.54	4.55	9.59
PHAL11	1105	7.01	0.54	4.60	9.61
PHEQ11	1104	7.27	0.50	4.06	9.05
PHFI01	579	3.94	0.08	3.77	4.26
PHINO1	579	3.95	0.08	3.73	4.34
PHSTQC	388	4.06	0.02	4.00	4.10
PHSTVL	1103	7.19	0.60	4.79	9.83
PH_60	34	6.67	0.52	5.95	7.77
PH_B	471	7.04	0.79	4.50	9.69
PH_TOP	1093	6.71	0.85	4.48	10.52
PRECIP	1103	1.04	0.61	0.20	3.25
PTL11	1105	8.08	14.71	-3.00	188.10
RT	880	0.74	1.41	0.00	18.69
RUNIN	1106	27.22	23.35	0.20	120.00
SECDIS	1096	6.21	4.06	0.30	28.50
SECMEAN	1096	6.08	3.99	0.25	27.75
SECREA	687	6.48	4.25	0.20	27.00
SIO211	1104	3.71	6.64	-0.05	114.05
SITDPF	569	41.85	44.38	3.00	360.00
SITDPM	1104	12.42	12.53	0.50	109.70

Table 10. (continued)

Variable	N	Mean	Standard deviation	Min	Max
SO411	1104	1.86	8.02	0.00	142.17
SO416	1104	38.64	166.91	0.08	2960.02
SOBC	1105	306.41	565.25	17.40	6668.25
TMPDF1	945	0.88	1.78	-20.60	8.80
TMPDF2	60	4.63	3.29	0.00	20.30
TMPTOP	1103	7.57	2.70	0.30	20.10
TMP_1	37	10.56	1.08	8.20	12.90
TMP_10	1	4.70	--	4.70	4.70
TMP_2	37	8.68	2.30	4.80	12.60
TMP_3	38	6.65	2.28	3.70	11.30
TMP_4	38	5.65	2.63	3.60	18.70
TMP_5	31	5.48	2.99	3.60	20.00
TMP_6	28	5.53	4.43	3.60	27.40
TMP_60	62	6.55	3.42	3.60	26.50
TMP_7	13	4.78	0.73	4.10	6.30
TMP_8	11	4.69	0.59	4.00	5.70
TMP_9	7	4.64	0.62	4.00	5.50
TMP_B	945	6.77	2.51	0.30	27.40
TURQCS	319	4.78	0.13	4.50	5.30
TURVAL	1104	0.76	1.86	0.00	30.00
WALA	1106	55.44	177.86	1.27	3332.45
WEIGHT1	1106	14.10	9.60	3.26	36.87
WSHED	1106	1354.44	11997.97	5.18	291592.56

Table 11. Characteristics of numeric variables, data set 4, U.S. EPA Western Lake Survey-Phase I

Variable	N	Mean	Standard deviation	Min	Max
ACC011	752	25.23	32.49	-270.30	380.80
AIRTMP	751	6.08	5.82	-17.00	23.00
ALEX11	752	6.41	25.05	0.00	658.95
ALKA11	752	260.55	443.71	-24.00	4948.60
ALTIM	435	7364.45	2961.86	20.00	12800.00
ALTL11	752	37.82	69.49	0.70	1119.00
ANCAT	752	1.16	0.13	0.78	2.15
ANDEF	752	33.31	66.45	-337.10	736.36
ANSUM	752	287.24	527.67	14.62	6967.79
BNSTAR	752	868.75	586.52	150.00	2317.00
CA11	752	3.80	6.39	0.09	95.30
CA16	752	189.81	319.10	4.32	4755.57
CATSUM	752	320.55	550.44	18.38	6696.22
CL11	752	0.43	2.82	0.02	72.73
CL16	752	12.24	79.67	0.65	2051.77
CO316	752	4.28	23.57	0.00	311.12
COLVAL	752	9.19	10.11	0.00	110.00
CONCAL	752	33.00	59.77	2.17	834.43
COND11	752	30.85	49.86	1.60	676.00
CONTOP	427	35.04	59.01	-2.00	667.00
CON_60	20	36.60	50.02	4.00	225.00
CON_B	356	33.73	60.82	-3.00	668.00
DICE11	752	3.04	4.93	0.14	50.22
DICI11	752	3.15	5.25	0.31	61.83
DICVAL	752	3.30	5.57	0.27	86.72
DISM	238	73.26	39.37	1.00	149.00
DOC11	752	1.83	1.83	0.06	16.72
DP_60	39	19.67	8.23	3.60	42.20
DP_B	636	11.87	10.31	1.50	53.40
DP_TOP	745	1.50	0.00	1.50	1.50
ELEV	752	2394.50	855.84	10.67	3912.78
FE11	752	35.40	75.97	0.00	974.00
FTL11	752	0.06	0.19	0.00	3.45
FTL16	752	2.90	10.09	0.00	181.61
H16	752	0.20	1.04	0.00	28.18
HCO316	752	229.44	394.42	2.63	3732.72
K11	752	0.38	0.90	0.03	19.65
K16	752	9.72	23.00	0.64	502.45
LAKE_SIZ	752	43.62	429.33	1.00	10010.70
LAKE_VOL	750	5.03	45.14	0.01	919.70
LAT_DD	752	42.88	3.60	36.09	48.99
LONG_DD	752	114.82	5.92	105.06	123.78

Table 11. (continued)

Variable	N	Mean	Standard deviation	Min	Max
MG11	752	0.86	1.86	0.02	17.88
MG16	752	70.71	152.75	1.81	1471.14
MN11	752	7.38	17.06	0.00	212.00
NA11	752	1.14	4.92	0.02	124.50
NA16	752	49.73	213.99	1.00	5415.75
NH411	752	0.01	0.02	0.00	0.26
NH416	752	0.38	1.15	0.00	14.61
NO311	752	0.10	0.22	0.00	2.67
NO316	752	1.66	3.59	0.00	43.05
ORGION	752	17.81	17.97	0.58	167.02
PHAC11	752	7.03	0.55	4.55	9.56
PHAL11	752	7.03	0.55	4.60	9.61
PHEQ11	752	7.29	0.50	4.65	9.05
PHSTVL	752	7.20	0.61	4.79	9.81
PH_60	21	6.78	0.56	5.95	7.77
PH_B	355	7.06	0.80	4.50	9.69
PH_TOP	752	6.80	0.87	4.48	10.52
PRECIP	750	1.03	0.60	0.20	3.25
PTL11	752	8.44	15.43	0.00	188.10
RT	602	0.76	1.42	0.00	18.69
RUNIN	752	26.40	22.43	0.20	120.00
SECDIS	748	6.07	4.03	0.30	28.50
SECMEAN	748	5.94	3.96	0.25	27.75
SECREA	476	6.21	4.20	0.20	27.00
SIO211	752	3.82	6.77	0.04	114.05
SITDPM	750	12.37	12.78	0.50	109.70
SO411	752	1.76	7.02	0.01	139.72
SO416	752	36.71	146.08	0.23	2909.06
SOBC	752	319.97	549.97	17.40	6682.94
TMPDF1	637	0.82	1.78	-20.60	8.80
TMPDF2	37	4.45	3.71	0.00	20.30
TMPTOP	750	7.52	2.76	0.30	20.10
TMP_60	38	7.03	4.03	3.60	26.50
TMP_B	637	6.77	2.59	0.30	27.40
TURVAL	752	0.81	1.89	0.00	30.00
WALA	752	59.86	200.84	1.27	3332.45
WEIGHT1	752	14.39	9.79	3.26	36.87
WSHED	752	1701.14	14336.26	5.18	291592.56

Table 12. Characteristics of numeric variables, PC data set, file WLS-I.REG, U.S. EPA Western Lake Survey-Phase I

Variable	N	Mean	Standard deviation	Min	Max
ALEX11	720	6.56	25.58	0.00	658.95
ALKA11	720	265.37	450.95	-24.00	4948.60
ALTL11	720	38.42	70.85	0.70	1119.00
ANCAT	720	1.16	0.13	0.85	2.15
ANSUM	720	292.20	536.67	14.62	6967.79
BNSTAR	720	873.12	595.86	150.00	2317.00
CA16	720	193.62	324.67	4.32	4755.57
CATSUM	720	325.97	559.65	18.38	6696.22
CL16	720	12.13	80.68	0.65	2051.77
COLVAL	720	9.23	10.24	0.00	110.00
CONCAL	720	33.55	60.79	2.17	834.43
COND11	720	31.33	50.66	1.60	676.00
DICE11	720	3.09	5.01	0.14	50.22
DICVAL	720	3.37	5.67	0.27	86.72
DOC11	720	1.85	1.87	0.06	16.72
ELEV	720	2381.52	862.82	10.67	3885.33
FE11	720	35.88	77.26	0.00	974.00
FTL16	720	2.98	10.31	0.00	181.61
HCO316	720	233.80	400.89	2.63	3732.72
K16	720	9.77	23.40	0.64	502.45
LAKE_SIZ	720	33.01	382.17	1.00	10010.70
MG16	720	71.59	155.06	1.81	1471.14
MN11	720	7.52	17.39	0.00	212.00
NA16	720	50.40	218.11	1.00	5415.75
NH416	720	0.38	1.15	0.00	14.61
NO316	720	1.66	3.54	0.00	43.05
PHEQ11	720	7.30	0.50	4.65	9.05
PHSTVL	720	7.20	0.61	4.79	9.82
PTL11	720	8.39	15.64	0.00	188.10
SECMEAN	717	5.95	3.98	0.25	27.75
SIO211	720	3.88	6.88	0.04	114.05
SITDPM	720	12.16	12.10	0.50	93.90
SO416	720	37.20	149.07	0.23	2909.06
TMPTOP	719	7.55	2.77	0.30	20.10
TURVAL	720	0.82	1.92	0.00	30.00
WALA	720	61.01	205.06	2.59	3332.45
WEIGHT1	720	14.44	9.94	3.26	36.88
WSHED	720	1694.16	14615.34	5.18	291592.56

Table 13. Characteristics of numeric variables, PC data set, file WLS-I.SPC, U.S. EPA Western Lake Survey-Phase I

Variable	N	Mean	Standard deviation	Min	Max
ALEX11	32	3.09	2.73	0.00	9.40
ALKA11	32	152.19	200.79	23.20	1100.00
ALTL11	32	24.30	18.97	3.50	74.80
ANCAT	32	1.16	0.14	0.78	1.42
ANSUM	32	175.54	228.04	29.19	1022.71
BNSTAR	32	770.53	297.94	150.00	1061.00
CA16	32	104.02	118.31	10.48	675.80
CATSUM	32	198.52	244.02	32.87	1146.13
CL16	32	14.73	52.71	0.75	302.55
COLVAL	32	8.20	6.45	0.00	25.00
CONCAL	32	20.59	25.84	3.67	118.99
COND11	32	19.86	23.95	3.40	112.00
DICE11	32	1.80	2.22	0.41	12.35
DICVAL	32	1.93	2.18	0.46	12.00
DOC11	32	1.40	0.73	0.24	4.28
ELEV	32	2692.52	630.33	1423.60	3912.78
FE11	32	24.52	35.39	0.00	162.50
FTL16	32	1.17	1.16	0.19	4.89
HCO316	32	131.41	175.36	16.35	967.24
K16	32	8.67	10.48	1.53	50.09
LAKE_SIZ	32	282.30	1008.23	1.00	5396.70
MG16	32	50.78	84.51	4.94	423.97
MN11	32	4.05	5.25	0.00	20.00
NA16	32	34.60	75.66	5.57	445.66
NH416	32	0.31	1.26	0.00	7.10
NO316	32	1.78	4.53	0.00	21.36
PHEQ11	32	7.20	0.31	6.68	8.21
PHSTVL	32	7.22	0.51	6.36	8.73
PTL11	32	9.50	9.50	0.00	41.40
SECMEAN	31	5.87	3.65	1.65	15.25
SIO211	32	2.57	3.60	0.16	19.04
SITDPM	30	17.48	23.69	2.40	109.70
SO416	32	25.73	37.55	1.39	221.94
TMPTOP	31	6.77	2.57	2.70	12.00
TURVAL	32	0.70	1.05	0.10	5.85
WALA	32	34.00	34.67	1.27	132.04
WEIGHT1	32	13.21	5.40	3.26	19.74
WSHED	32	1858.24	4972.87	23.31	26570.69

Table 14. Card-image listing (first five lakes), data set 3, U.S. EPA Western Lake Survey-Phase I

```
H 4A1-001 0383167             1194658             0383182             1194657
      03OCT85 13:28 HMM    3.9100            4.0300              44.0000
  37.0000          8250.000                                       2.7000
        15.0000                    9.0000            1.2000            1.0000
         1.5000 <        -999.0000             9.9000        -999.0000
  20.0000                      -999.0000           8.7000
X      -999.0000        -999.0000        -999.0000        -999.0000
-999.0000       -999.0000       -999.0000          1.0000
-999.0000       TOPO/LORAN              -999.0000         -999.0000
      -999.0000 -999.0000 -999.0000 -999.0000 -999.0000        -999.0000
-999.0000 -999.0000 -999.0000        -999.0000       -999.0000
-999.0000       -999.0000       -999.0000       -999.0000
-999.0000       -999.0000 -999.0000
PH RANGE 8.67-8.72
                   1512   06     03OCT85 15:30 N90016    5754
                          1.700 NOBLE LAKE                            CA
    10.36 2702.0433 NI/O    38.5278  119.7764 4 A 1
WALKER LAKE            7.5' EBBETTS PASS
38-31'40"N 119-46'35"W 4A1 06003 4 ZZZ NOT IN USFS WILDERNESS ZZZ
TOIYABE NF
SMITH VALLEY                                                   0/1
EMSI                           03OCT85 04OCT85 15
RH           3.3770                  -999.0000         8.5100
                    4.0400            2.5000        -999.0000  35.0000
      E
                                                                 0.0210
   6.0900   20.0000 -999.0000 D3           D3           D3
            D3             267.8200  337.6300  336.9278   64.0323   69.8070
 259.8460 D3             118.4130    0.3120 D3             4.0060  115.9870
   0.8230   33.6250   68.9040    0.9580    1.8790    0.6100    0.0900
D3             2.3730                        1.4100
   1.3150                        1.5840                       21.0000
                   401.0000                         2.2000
         0.1420                        0.0460 WO
   0.0510                        9.2180                        0.0357
                    6.5400                          0.0110
         7.5100                        7.0600 D3
   7.0300 D3                     55.8000                      317.5000
                    33.8000                         3.5700
         3.8000                        72.3000
  43.9000                       31.3171 SIERRA E    1.0160    0.3476
/REG        1885.0000   31.9780 DRAINAGE  3    1.2607     1.1000 MIXED
```

Table 14. (continued)

```
G 4A1-003 0381382           1193885
      16OCT85  7:30 T03 -999.0000        -999.0000        -999.0000
-999.0000      -999.000                                   15.2000
        0.0000            -999.0000          4.3000          4.0000
        1.5000         13.7000         5.0000         5.0000
-999.0000                 -999.0000          6.2000 WO
X      -999.0000        0.0000        -999.0000        -999.0000
-999.0000      -999.0000      -999.0000         1.0000
   1.0000      USDAFS EMIGRANT WILD. MAP -999.0000       -999.0000
      -999.0000 -999.0000 -999.0000 -999.0000 -999.0000       -999.0000
-999.0000 -999.0000 -999.0000       -999.0000       -999.0000
-999.0000      -999.0000      -999.0000      -999.0000
-999.0000      -999.0000 -999.0000
DUPLICATE PH 6.2
                  1522   05     16OCT85 21:45          0004
WO          WO               4.100 LOST LAKE                   CA
    93.24 2964.3184 NI/O     38.2303  119.6475 4 A 1
WALKER LAKE                15' TOWER PEAK
38-13'49"N 119-38'51"W 4A1 06109 5 EMIGRANT WILDERNESS
STANISLAUS NF
WALKER LAKE                                               0/1
EMSI                            16OCT85 17OCT85 15
RG           1.8870                    -999.0000        7.4200
                     4.0500            0.8000        -999.0000    0.0000
      EL
                                                            0.2890
  22.7400   40.0000 -999.0000 D2           D2          D2
            B5D2           154.6500  166.9300  166.9454    7.2111   12.2811
 145.3140 D2            127.0450    0.4000 D2              1.3260   17.6040
   0.0000    1.7640   20.5320    7.2040    0.4050   -0.0550    0.0400
D2             2.5460                        0.2140
   0.0690                        0.4720                          -6.0000
B5                   13.0000                          1.5000
         0.0470                          0.3460
   0.0000                        0.3060                         0.0077
                     0.7300 B5                        -0.0010
         7.2600 D2                        7.3600 D2
   7.3900 D2                     20.8000 B0                      164.9000
B0                   16.9000                          1.9840
         1.9130 B0                       12.6000
  17.0000                        16.8503 SIERRA W    1.0160    0.3052
/REG         1885.0000   31.9780 DRAINAGE  3     1.0794    4.1500 MIXED
```

Table 14. (continued)

```
G 4A1-003 0381382            1193885
      16OCT85  7:30 T03 -999.0000         -999.0000          -999.0000
-999.0000       -999.000                                   15.2000
        0.0000           -999.0000          4.3000          4.0000
        1.5000        13.7000         5.0000          5.0000
-999.0000                -999.0000         6.2000 WO
X     -999.0000        0.0000        -999.0000       -999.0000
-999.0000     -999.0000      -999.0000       1.0000
  1.0000       USDAFS EMIGRANT WILD. MAP -999.0000        -999.0000
      -999.0000 -999.0000 -999.0000 -999.0000 -999.0000        -999.0000
-999.0000 -999.0000 -999.0000       -999.0000       -999.0000
-999.0000     -999.0000      -999.0000       -999.0000
-999.0000     -999.0000 -999.0000
DUPLICATE PH 6.2
                  1522   09     16OCT85 21:45          0004
WO         WO           4.100 LOST LAKE                        CA
   93.24 2964.3184 NI/O     38.2303  119.6475 4 A 1
WALKER LAKE             15' TOWER PEAK
38-13'49"N 119-38'51"W 4A1 06109 5 EMIGRANT WILDERNESS
STANISLAUS NF
BRIDGEPORT                                              0/1
EMSI                         16OCT85 17OCT85 15
DG         1.8900                   1.8190         7.3800
                  4.0500          0.8000         4.7000     0.0000
      EL
                                                        0.2890
  22.7400   40.0000 -999.0000 D2              D2          D2
            B5D2         146.8100  169.4400  169.3490    5.2919   22.6221
 136.8800 D2          129.6400    0.1760 D2             1.4950   17.7680
  0.0810    1.7130   20.2280    7.7870    0.3950    0.0000    0.0900
D2           2.5980                    0.2160
  0.0670                   0.4650                        0.0000
B5                19.0000                     1.5000
        0.0530                    0.3740
  0.0050                   0.3200                        0.0075
                  0.5400 B5                   0.0000
        7.4400 D2                 7.1200 D2
  7.0600 D2                33.2000 B0                   163.5000
B0                17.3000                     1.9740
        1.9780 B0                 2.4000
 16.1000                   16.6898 SIERRA W    1.0160    0.3052
/REG        1885.0000   31.9780 DRAINAGE  3    1.1541    4.1500 MIXED
```

Table 14. (continued)

```
G 4A1-004 0381065          1194827
      11OCT85 11:30 T91 -999.0000        -999.0000        -999.0000
-999.0000      -999.000                                    3.5000
        8.0000           -999.0000         3.5000 X      -999.0000
        1.5000         2.0000        7.0000          6.8000
-999.0000                -999.0000         5.5000 WO
      -999.0000        0.2000       -999.0000      -999.0000
-999.0000     -999.0000      -999.0000        1.0000
  2.0000      PINECREST 7.5 QUAD       -999.0000        -999.0000
      -999.0000 -999.0000 -999.0000 -999.0000 -999.0000        -999.0000
-999.0000 -999.0000 -999.0000        -999.0000       -999.0000
-999.0000     -999.0000      -999.0000      -999.0000
-999.0000     -999.0000 -999.0000
SECCHI VISIBLE ON BOTTOM
                   1518   12     11OCT85 21:10          0006
WO         WO             4.100 LEOPOLD LAKE                    CA
   36.26 2695.9439 NI/O    38.1775  119.8044 4 A 1
WALKER LAKE              15' PINECREST
38-10'39"N 119-48'16"W 4A1 06109 5 EMIGRANT WILDERNESS
STANISLAUS NF
BRIDGEPORT                                                0/1
EMSI                          11OCT85 12OCT85 15                T
RG          0.3640                     2.0590         6.2500
                 -999.0000             0.2000       -999.0000   0.0000
      EL
                                                          0.0670
  8.8400   20.0000 -999.0000 B2D2          B2D2        D2
D2          D2            24.2000   28.5300   25.5594   13.7928   4.3391
 11.5800               9.0320   0.0020              3.4980   3.8660
  1.5320    3.2220   9.4400   7.1830   0.4000   2.1620   0.8100
            0.1810                     0.0470
  0.1260                     0.2170 D2                    4.0000
                   18.0000                      4.5000
      0.1240 D2NO                  0.3450
  0.0950 B2D2NO              1.0980                       0.0076
                   1.4900 D2NO                  0.0390
      6.4200                       6.1200
  6.0900                    34.5000 BO                   16.4000
                   3.8000                       0.4510
      0.4020                       2.2000
 32.4000                     3.3823 SIERRA W   1.2192   0.3121
/REG        1885.0000   31.9780 DRAINAGE  3    1.1789   3.5000 MIXED
CT/5C; DUPLICATE SCHEDULED, BUT NOT TAKEN
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Table 14. (continued)

```
G 4A1-005 0380788              1194397
      16OCT85  8:30 T85 -999.0000        -999.0000        -999.0000
-999.0000        -999.000        SNOW & ICE                1.5000
        10.0000             -999.0000          1.5000 X       -999.0000
         1.5000 <       -999.0000         7.0000        -999.0000
-999.0000                -999.0000          5.5000 WO
Y      -999.0000        -999.0000        -999.0000        -999.0000
-999.0000        -999.0000        -999.0000          0.0000
  0.0000         USFS AIR PHOTOS; MAPS      -999.0000        -999.0000
      -999.0000 -999.0000 -999.0000 -999.0000 -999.0000        -999.0000
-999.0000 -999.0000 -999.0000        -999.0000        -999.0000
-999.0000        -999.0000        -999.0000        -999.0000
-999.0000        -999.0000 -999.0000
SECCHI ON BOTTOM--DEPTH ESTIMATED        DUPLICATE PH 5.5
                     1522   07      16OCT85 21:45          0001
WO           WO          2.000 (NO NAME)                      CA
   31.08 2549.5578 NI/NO    38.1314  119.7328 4 A 1
WALKER LAKE                 15' TOWER PEAK
38-07'53"N 119-43'58"W 4A1 06109 5 EMIGRANT WILDERNESS
STANISLAUS NF
BRIDGEPORT                                                 0/0
EMSI                              16OCT85 17OCT85 15
DG            0.5690                     -999.0000         5.7600
              Q      -999.0000           0.3000         4.7000    0.0000
     EL
                                                              0.0140
  15.5400   20.0000 -999.0000 D2              D2            D2
              B5D2          29.6100   34.7000   32.3545   21.6334    5.0911
  11.9000 D2               12.8740   0.0010 D2               7.0530    5.5940
   1.1940    3.7080   10.1790    9.0980    0.3630    0.8320    1.5100
D2              0.2580                         0.0680
  0.1450                         0.2340                          7.0000
B5                     38.0000                        12.6000
          0.2500                         0.4370
  0.0740                         1.2990                          0.0069
                      2.4100 B5                       0.0150
          6.2300 D2                     5.8400 D2
  5.8200 D2                     53.0000 B0                      14.1000
B0                     3.9000                         0.3680
          0.6460 B0                     3.0000
  55.9000                        4.3345 SIERRA W    1.2192 -999.0000
/REG           1885.0000   31.9780 SEEPAGE   1    1.1719    1.5000 MIXED
SAMPLE TAKEN FROM ROCK OUTCROP; VAN DORN HAND HELD, HAND TRIGGERED; ENTIRE
SAMP TAKEN @ <.75M; SHALLOW AREAS WERE FROZEN
```

Table 15. Card-image listing (first five lakes), data set 4, U.S. EPA Western Lake Survey-Phase I

```
H 4A1-001 0383182     1194657    03OCT85 13:28  8250.000    2.7000   15.0000
                1.2000     1.0000     1.5000 -999.0000    9.9000 -999.0000
  20.0000                -999.0000    8.7000               -999.0000 -999.0000
-999.0000 -999.0000 -999.0000 -999.0000 -999.0000 1512   06      5754
                                  1.700 NOBLE LAKE                     CA
    10.36 2702.0433 NI/O      38.5278  119.7764 4 A 1
WALKER LAKE                 7.5' EBBETTS PASS
38-31'40"N 119-46'35"W 4A1 06003 4 ZZZ NOT IN USFS WILDERNESS ZZZ
TOIYABE NF                       0/1    EMSI
             RH             3.3770                  8.5100
   2.5000   35.0000    0.0210     6.0900   20.0000 -999.0000 D3WO
D3WO         D3                          D3            267.8200  337.6300
 336.9278   64.0323   69.8070  259.8460 D3              118.4130    0.3120
D3               4.0060  115.9870    0.8230   33.6250   68.9040    0.9580
   1.8790    0.6100    0.0900 D3                2.3730                1.4100
                1.3150                1.5840                21.0000
              401.0000                2.2000                 0.1420
                0.0460 WO             0.0510                 9.2180
                0.0357                6.5400                 0.0110
                7.5100                7.0600 D3              7.0300
D3             55.8000              317.5000                33.8000
                3.5700                3.8000                72.3000
               43.9000               31.3171 SIERRA E    1.0160    0.3476
/REG                                     1.2606      1.1000 1885.0000
  31.9780 DRAINAGE  MIXED  3 SMITH VALLEY
                                15
```

Table 15. (continued)

```
G 4A1-003                    16OCT85  7:30  -999.000   15.2000    0.0000   1
              4.3000    4.0000    1.5000   13.7000    5.0000    5.0000     2
-999.0000           -999.0000    6.2000 WO           -999.0000    0.0000   3
-999.0000 -999.0000 -999.0000 -999.0000 -999.0000 1522   05      0004      4
                          4.100 LOST LAKE                      CA          5
   93.24 2964.3184 NI/O     38.2303  119.6475 4 A 1                        6
WALKER LAKE              15' TOWER PEAK                                    7
38-13'49"N 119-38'51"W 4A1 06109 5 EMIGRANT WILDERNESS                     8
STANISLAUS NF                  0/1   EMSI                                  9
            RG           1.8885 VO              7.4000 VO                  10
  0.8000    0.0000    0.2890   22.7400   40.0000 -999.0000 D2VOZO          11
D2VO        D2VOZO        VO           B5D2VO         151.7700  168.2100   12
 168.1472   6.2506   16.4321  142.1610 D2VO          128.3430    0.2680    13
D2VO          1.4110   17.6860    0.0400    1.7390   20.3800    7.4950     14
  0.4000    0.0000    0.0600 D2VO               2.5720 VO             0.2150  15
VO            0.0680 VO               0.4685 VO              0.0000        16
B5VOZO       16.0000 VO               1.5000 VO              0.0500        17
VO            0.3600 VO               0.0025 VO              0.3130        18
VO            0.0076 VO               0.6350 B5VO            0.0000        19
VOZO          7.3500 D2VO             7.2400 D2VO            7.2250        20
D2VO         27.0000 BOVO           164.2000 BOVO           17.1000        21
VO            1.9790 VO               1.9455 BOVO            7.5000        22
VO           16.5500 VO              16.8163 SIERRA W    1.0160    0.3052  23
/REG         VO          VO             1.1083    4.1500 1885.0000         24
  31.9780 DRAINAGE  MIXED  3 BRIDGEPORT                                    25
                                15                                         26
```

Table 15. (continued)

```
G 4A1-004                              11OCT85 11:30  -999.000    3.5000    8.0000   1
               3.5000 -999.0000    1.5000    2.0000    7.0000    6.8000   2
-999.0000            -999.0000    5.5000 WO            -999.0000    0.2000   3
-999.0000 -999.0000 -999.0000 -999.0000 -999.0000 1518    12      0006            4
                                  4.100 LEOPOLD LAKE                  CA          5
    36.26 2695.9439 NI/O      38.1775  119.8044 4 A 1                             6
WALKER LAKE              15' PINECREST                                            7
38-10'39"N 119-48'16"W 4A1 06109 5 EMIGRANT WILDERNESS                            8
STANISLAUS NF                 0/1    EMSI                                         9
            RG           0.3640                  6.2500                          10
   0.2000    0.0000    0.0670    8.8400   20.0000 -999.0000 B2D2                 11
B2D2         D2           D2           D2             24.2000   28.5300         12
  25.5594   13.7928    4.3391   11.5800                9.0320    0.0020         13
               3.4980    3.8660    1.5320    3.2220    9.4400    7.1830       14
   0.4000    2.1620    0.8100                0.1810                0.0470      15
               0.1260                0.2170 D2            4.0000              16
              18.0000                4.5000               0.1240              17
D2NO           0.3450                0.0950 B2D2NO        1.0980              18
               0.0076                1.4900 D2NO          0.0390              19
               6.4200                6.1200               6.0900              20
              34.5000 BO            16.4000               3.8000              21
               0.4510                0.4020               2.2000              22
              32.4000                3.3823 SIERRA W    1.2192    0.3121      23
/REG                                    1.1793    3.5000 1885.0000            24
  31.9780 DRAINAGE  MIXED  3 BRIDGEPORT                                       25
                                  15                                          26
```

Table 15. (continued)

```
G 4A1-005                      16OCT85  8:30  -999.000    1.5000   10.0000   1
               1.5000 -999.0000    1.5000 -999.0000    7.0000 -999.0000     2
-999.0000            -999.0000    5.5000 WO            -999.0000 -999.0000   3
-999.0000 -999.0000 -999.0000 -999.0000 -999.0000 1522   08      0001        4
                             2.000 (NO NAME)                  CA             5
   31.08 2549.5578 NI/NO    38.1314  119.7328 4 A 1                          6
WALKER LAKE               15' TOWER PEAK                                     7
38-07'53"N 119-43'58"W 4A1 06109 5 EMIGRANT WILDERNESS                       8
STANISLAUS NF                  0/0   EMSI                                    9
             RG           0.6275 VO               5.8450 VO                 10
   0.3000    0.0000    0.0140    15.5400    20.0000 -999.0000 D2VO          11
D2VO         D2VO         VO            B5D2VO          29.9200   34.6100   12
  32.2449   21.6192    4.6849   11.7940 D2VO            12.7490    0.0010   13
D2VO            7.2220    5.5530    1.2340    3.7200   10.2230    9.3070    14
   0.3660    0.8320    1.5300 D2VO              0.2555 VO               0.0675 15
VO              0.1455 VO              0.2350 VO              6.0000        16
B5VO           32.5000 VO             11.0500 VO              0.2560        17
VO              0.4470 VO              0.0765 VO              1.3040        18
VO              0.0069 VO              2.4100 B5VO            0.0150        19
VO              6.2350 D2VO            5.8400 D2VO            5.8150        20
D2VO           53.6500 B0VO           14.5000 B0VO            4.0000        21
VO              0.3785 VO              0.6460 B0V1            2.8500        22
VO             56.8000 VO              4.3629 SIERRA W    1.2192 -999.0000  23
/REG         VO           VO              1.1566    1.5000 1885.0000        24
  31.9780 SEEPAGE   MIXED   1 BRIDGEPORT                                    25
SNOW & ICE                          15                                      26
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Table 15. (continued)

```
H 4A1-006 0380529    1194235    03OCT85 11:19  8290.000    18.6000    16.0000   1
               11.7000   11.0000    1.5000   17.1000   11.9000   11.6000      2
  2.0000                 3.0000    6.2400                6.2200    0.3000     3
-999.0000 -999.0000 -999.0000 -999.0000 -999.0000 1512   08     5754          4
                              3.600 (NO NAME)                      CA         5
    33.67 2720.3416 NI/O      38.0867  119.7053 4 A 1                         6
WALKER LAKE                15' TOWER PEAK                                     7
38-05'12"N 119-42'19"W 4A1 06109 5 ZZZ NOT IN USFS WILDERNESS ZZZ             8
YOSEMITE NP                     0/1   EMSI                                    9
             RH            0.3015 VO              6.3150 VO                  10
  0.2500     0.0000     0.3110     9.3500   20.0000 -999.0000 D3VOZO         11
D3VO         D3VOZO        VO            D3VO           19.5600   21.2000    12
 20.5681     5.9851     1.6414    11.7600 D3VO            9.4310    0.0020   13
D3VO            1.9750     2.7970     0.8390     2.2500     6.0900    4.6740 14
  0.3080     0.0000     0.6300 D3VO              0.1890 VO              0.0340 15
VO              0.0880 VO                0.1400 VO              12.0000      16
VO              4.5000 VO                2.0000 VO               0.0700      17
VO              0.2245 VO                0.0520 VO               0.7450      18
VO              0.0058 VO                0.6400 VO               0.0000      19
VOZO            6.3100 VO                6.1700 D3VO             6.2000      20
D3VO           26.5500 VO               15.6000 VO               2.6000      21
VO              0.4310 VO                0.3485 VO               0.0000      22
VOZO           21.0500 VO                2.5248 SIERRA W    1.2192    1.5800 23
/REG         VO            VO               1.0839   11.3500 1885.0000       24
 31.9780 DRAINAGE  MIXED  1 BRIDGEPORT                                       25
                                    15                                       26
```

Table 16. Card-image listing (first five lakes), PC data set, file WLS-I.REG, U.S. EPA Western Lake Survey-Phase I

```
4A1-001 NOBLE LAKE                 38-31'40"N 119-46'35"W 2702    1.7      10 1
   6.1 DRAINAGE     9.9 MIXED    2.7    1.1   2.5   35  401.0  267.8  337.6  2
1.26 7.51 8.51  317.5  33.8  31.3  3.57  3.38  6.54  2.2    43.9  118.4  116.0 3
  68.9  33.6  0.6    1.0  259.8    4.0  0.8   1.9  72.3   9.22 REGULAR      CA 4
  21.0 03OCT85 31.978 1885 5
4A1-003 LOST LAKE                  38-13'49"N 119-38'51"W 2964    4.1      93 1
   22.7 DRAINAGE    5.0 MIXED   15.2    4.1   0.8    0   16.0  151.8  168.2  2
1.11 7.35 7.40  164.2  17.1  16.8  1.98  1.89  0.63  1.5    16.5  128.3   17.7 3
  20.4   1.7  0.0    7.5  142.2    1.4  0.0   0.4   7.5   0.31 REGULAR      CA 4
   0.0 16OCT85 31.978 1885 5
4A1-004 LEOPOLD LAKE               38-10'39"N 119-48'16"W 2696    4.1      36 1
    8.8 DRAINAGE    7.0 MIXED    3.5    3.5   0.2    0   18.0   24.2   28.5  2
1.18 6.42 6.25   16.4   3.8   3.4  0.45  0.36  1.49  4.5    32.4    9.0    3.9 3
   9.4   3.2  2.2    7.2   11.6    3.5  1.5   0.4   2.2   1.10 REGULAR      CA 4
   4.0 11OCT85 31.978 1885 5
4A1-005 (NO NAME)                  38-07'53"N 119-43'58"W 2550    2.0      31 1
   15.5 SEEPAGE     7.0 MIXED    1.5    1.5   0.3    0   32.5   29.9   34.6  2
1.16 6.23 5.84   14.5   4.0   4.4  0.38  0.63  2.41 11.0    56.8   12.7    5.6 3
  10.2   3.7  0.8    9.3   11.8    7.2  1.2   0.4   2.8   1.30 REGULAR      CA 4
   6.0 16OCT85 31.978 1885 5
4A1-006 (NO NAME)                  38-05'12"N 119-42'19"W 2720    3.6      34 1
    9.3 DRAINAGE   11.9 MIXED   18.6   11.3   0.2    0    4.5   19.6   21.2  2
1.08 6.31 6.31   15.6   2.6   2.5  0.43  0.30  0.64  2.0    21.0    9.4    2.8 3
   6.1   2.2  0.0    4.7   11.8    2.0  0.8   0.3   0.0   0.74 REGULAR      CA 4
  12.0 03OCT85 31.978 1885 5
```

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APPENDIX B

DATA BASE FORMAT DOCUMENTATION

Format Documentation for U.S. EPA NSWS
Western Lake Survey - Phase I
PC Data Set

The U.S. EPA NSWS Western Lake Survey-Phase I data as reported in EPA report number EPA-600/3-86-054A have been formatted into fixed records with a maximum length of 80 columns. The data in this format are stored on one 360Kb double-sided, double-density 5 1/4" diskette using PC-DOS version 3.1. The data and format are reported in the files as described below. The data files have an identical format.

FILE DOCUMENTATION

Description	Filename	File Size (bytes)	Number of Lakes
Regular lakes	WLS-I.REG	257,758	720
Special lakes	WLS-I.SPC	11,454	32

PARAMETER AND FORMAT DOCUMENTATION

		Format Attributes			
Parameter	Units	Type	Width*	Record Number**	Start - End Column
Lake ID	(none)	Char	7	1	1 - 7
Lake name	(none)	Char	26	1	9 - 34
Latitude	(dd-mm'ss"N)	Char	10	1	36 - 45
Longitude	(dd-mm'ss"W)	Char	11	1	46 - 57
Lake elevation	(meters)	Num	4.0	1	59 - 62
Lake size	(ha)	Num	7.1	1	64 - 70
Watershed area	(ha)	Num	7.0	1	72 - 78
Record number	(none)	Num	1.0	1	80 - 80

*Width for character fields represents the field width expressed as an integer. The width for numeric fields is in W.D. format where W = the total field width and D = the number of decimal places.

**Record number is a variable on each 80-column record. For records 1-4, it is in column 80 and in column 28 for record 5.

Parameter	Units	Type	Width*	Record Number	Start End Column
		Format Attributes			
Watershed/lake area	(none)	num	7.1	2	1 - 7
Hydrologic type	(none)	char	9	2	9 - 17
Surface temperature	(deg C)	num	6.1	2	19 - 24
Stratification	(char)	char	6	2	26 - 31
Site depth	(m)	num	5.1	2	33 - 37
Secchi depth	(m)	num	6.1	2	39 - 44
Turbidity	(NTU)	num	5.1	2	46 - 50
Color	(PCU)	num	4.0	2	52 - 55
Iron	(μg/L)	num	6.1	2	57 - 62
Sum anions	(μeg/L)	num	6.1	2	64 - 69
Sum cations	(μeg/L)	num	6.1	2	71 - 76
Record number	(none)	num	1.0	2	80 - 80
Cations/anions	(none)	num	4.2	3	1 - 4
Equilibrated pH	(pH)	num	4.2	3	6 - 9
Closed pH	(pH)	num	4.2	3	11 - 14
Alkalinity	(μeg/L)	num	6.1	3	16 - 21
Meas. conductivity	(μS/cm)	num	5.1	3	23 - 27
Cal. conductivity	(μS/cm)	num	5.1	3	29 - 33
Equilibrated DIC	(mg/L)	num	5.2	3	35 - 39
Closed DIC	(mg/L)	num	5.2	3	41 - 45
DOC	(mg/L)	num	5.2	3	47 - 51
Extractable Al	(μg/L)	num	5.1	3	53 - 57
Total aluminum	(μg/L)	num	6.1	3	59 - 64
Calcium	(μeq/L)	num	6.1	3	66 - 71
Magnesium	(mg/L)	num	6.1	3	73 - 78
Record number	(none)	num	1.0	3	80 - 80
Sodium	(μeq/L)	num	6.1	4	1 - 6
Potassium	(μeq/L)	num	5.1	4	8 - 12
Ammonium	(μeq/L)	num	4.1	4	14 - 17
Sulfate	(μeq/L)	num	6.1	4	19 - 24
$HC0_3$	(μeq/L)	num	6.1	4	26 - 31
Chloride	(μeq/L)	num	6.1	4	33 - 38
Nitrate	(μeq/L)	num	4.1	4	40 - 43
Flouride	(μeq/L)	num	5.1	4	45 - 49
Total phosphorus	(μg/L)	num	5.1	4	51 - 55
Silica	(mg/L)	num	6.2	4	57 - 62
Sample type	(none)	char	12	4	64 - 75
State	(none)	char	2	4	77 - 78
Record	(none)	num	1.0	4	80 - 80
Manganese	(μg/L)	num	6.1	5	1 - 6
Date sampled	(ddmmmyy)	char	7	5	8 - 14
Population factor	(none)	num	6.3	5	16 - 21
Strata population	(N)	num	4.0	5	23 - 26
Record number	(none)	num	1.0	5	28 - 28

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