# SODIUM AND CHLORIDE DATA FROM SELECTED STREAMS IN THE LASSEN AREA, NORTH-CENTRAL CALIFORNIA, AND THEIR RELATION TO THERMAL-FLUID DISCHARGE FROM THE LASSEN HYDROTHERMAL SYSTEM

By K.M Paulson and S.E. Ingebritsen

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## CONVERSION FACTORS

Conversion factors for terms used in this report are listed below:

| Multiply | By | To obtain |
|---|---|---|
| meter (m) | 3.281 | feet (ft) |
| kilogram (kg) | 0.4536 | pounds (lb) |
| kilojoule (kJ) | 238.9 | calorie (cal) |
| milliwatt per square meter ($mW/m^2$) | 0.02389 | heat-flow units (hfu) (1 hfu = 1 $\mu cal/cm^2 \cdot s$) |
| milligram per liter (mg/L) | $6.243x10^{-5}$ | pounds per cubic foot ($lb/ft^3$). |
| liter per second (L/s) | 0.03532 | cubic feet per second ($ft^3/s$) |

For conversion of degrees Celsius (°C) to degrees Fahrenheit (°F), use the formula $°F = 9/5°C + 32$.

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Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Sea Level Datum of 1929."

# SODIUM AND CHLORIDE DATA FROM SELECTED STREAMS IN THE LASSEN AREA, NORTH-CENTRAL CALIFORNIA, AND THEIR RELATION TO THERMAL-FLUID DISCHARGE FROM THE LASSEN HYDROTHERMAL SYSTEM

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## ABSTRACT

**The Lassen hydrothermal system in north-central California is characterized by phase separation in a zone of upflow of two-phase fluid, with steam rising to discharge at relatively high elevations (1,800 to 2,500 m) and high-chloride liquid flowing laterally to discharge at lower elevations (about 1,500 m). A previous study identified about 20 kilograms per second of liquid discharge. Subsequent numerical simulations that assumed 20 kilograms per second of flow through the system resulted in less than 2 kilograms per second of steam discharge at high elevations. Recently, total steam discharge was estimated to be about 40 kilograms per second. This indicates that conditions within the Lassen hydrothermal system may be substantially different from those assumed in the numerical simulations. One possibility is that high-chloride thermal water is entering local streams at unknown points and that the total liquid discharge is much greater than that identified previously. This possibility was investigated by sampling streams at 116**

**sites in the Lassen area. A number of samples were chloride-enriched relative to a "background" sodium:chloride ratio established by nonthermal waters from the Cascade Range. However, many of the chloride-enriched samples were from streams at lower elevations that have flowed over Upper Cretaceous marine rocks that crop out as high as 760 m above sea level. Assuming that the relatively high-chloride streams in the lower-elevation (western) part of the study area are receiving all or most of their chloride enrichment from Upper Cretaceous marine rocks exposed locally, we did not identify any major high-chloride discharge to add to the previously measured 20 kilograms per second. The large streams that constitute the northern and southern boundaries of the study area--the Pit River and the North Fork of the Feather River--are slightly chloride-enriched compared with most streams in the study area. We estimate that the Pit River contains less than 6 kilograms per second and the North Fork of the Feather River contains less than 12 kilograms per second of Lassen-equivalent thermal water. The mass ratio of liquid outflow to steam upflow for the Lassen hydrothermal system thus appears to be less than 1:1.**

## INTRODUCTION

Phase separation in a zone of upflow of two-phase fluid is a common characteristic of two-phase hydrothermal systems in areas of moderate to great topographic relief. Steam rises to discharge at high elevations and relatively high-chloride liquid flows laterally to discharge at low elevations. In the Lassen area of north-central California, fumaroles and steam-heated acid-sulfate springs occur at elevations of 1,800 to 2,500 m within Lassen Volcanic National Park (LVNP), and high-chloride hot springs occur at elevations of approximately 1,500 m, south of the Park boundary (fig. 1a). Although the steam-heated features and high-chloride springs are widely separated, they are assumed to be connected to and fed by a single hydrothermal system at depth (Ingebritsen and Sorey, 1985).

The Lassen area is at the southern end of the Cascade Range, which here comprises a broad ridge of Late Pliocene to Holocene volcanic rocks (Muffler and others, 1982). The regional basement probably consists of Mesozoic granitic and metamorphic rocks. It is overlain by Upper Cretaceous to Eocene marine rocks and by a widespread series of Late Pliocene lahars, tuffs, and tuff breccias. The Quaternary to Holocene rocks are primarily pyroxene andesite flows and pyroclastics with minor basaltic and silicic flows and pyroclastics (Muffler and others, 1982). The thickness of the Late Pliocene to Holocene volcanic sequence in the vicinity of LVNP is unknown.

## Background

Ingebritsen and Sorey (1985) did numerical simulations of heat and fluid flow in the Lassen hydrothermal system. Their conceptual model of the system involved three basic components: (1) Recharge of meteoric water in the general vicinity of Lassen Peak; (2) addition of heat to this fluid by conduction from a

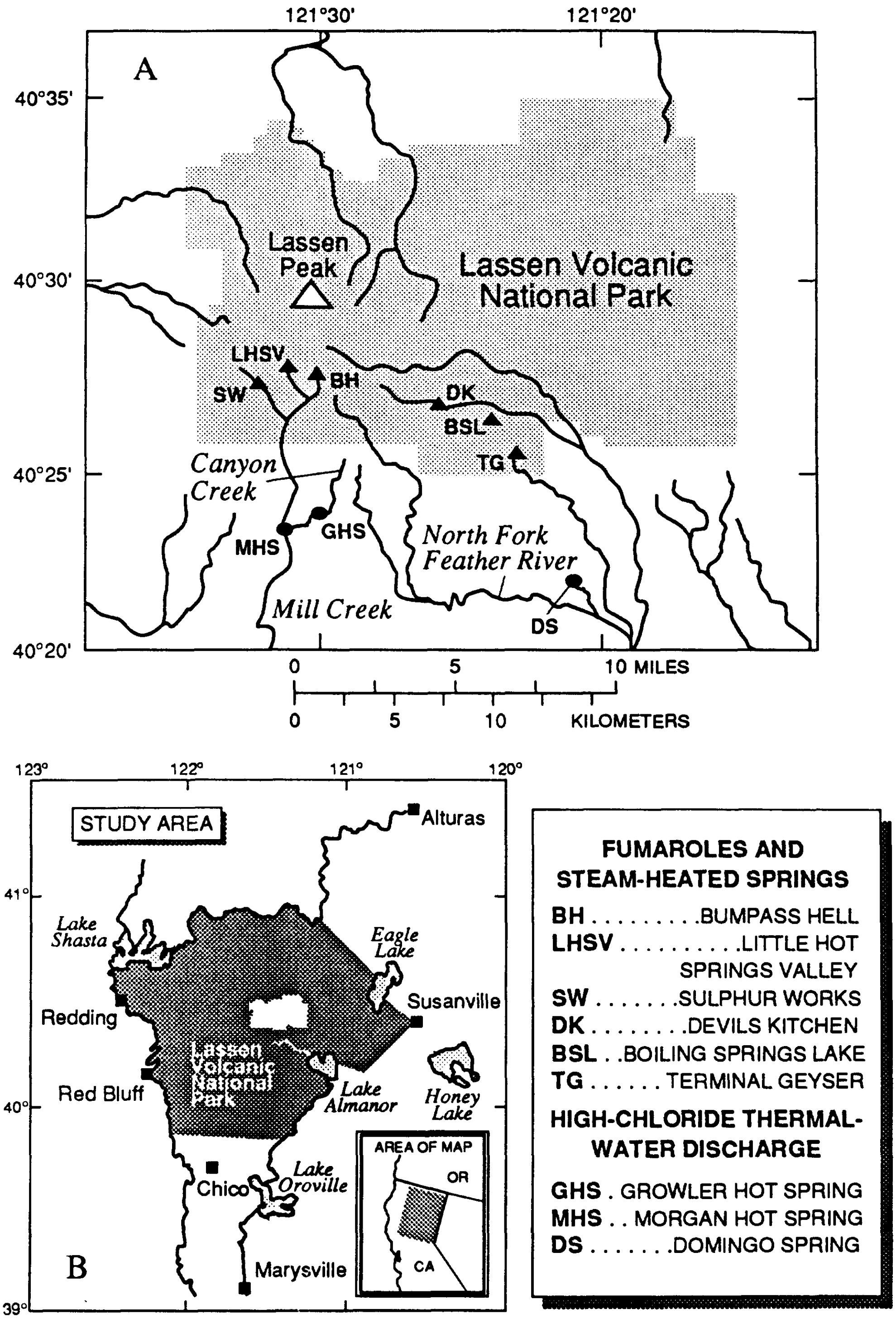


**Figure 1** **(A)** Areas of thermal-fluid discharge and major streams in the Lassen region. **(B)** Location of the study area and of Lassen Volcanic National Park (LVNP) in north-central California.

residual silicic magma chamber; and (3) upwelling of high-enthalpy fluid in a central upflow zone beneath Bumpass Hell, with lateral outflow to the south and southeast feeding high-chloride springs at lower elevations (fig. 1a). In their model, steam is generated by nearly adiabatic decompression of the rising high-enthalpy fluid.

Neutral-pH, sodium-chloride thermal waters in the Lassen area have much higher chloride ($Cl^-$) concentrations (2,200-2,300 mg/L; Thompson, 1983) than most of the nonthermal waters (less than 25 mg/L). High-chloride thermal water from the Lassen system discharges at Morgan and Growler Hot Springs, which flow into Mill and Canyon Creeks, respectively (fig. 1a). High-chloride thermal water also has been detected in an aquifer at depths near 550 m in a well drilled at Terminal Geyser (fig. 1a). Chloride concentrations at Domingo Spring (fig. 1a) are about two orders of magnitude higher than in nearby springs, and Thompson (1985) suggested that Domingo Spring may be the greatly diluted outlet for high-chloride water flowing under Terminal Geyser.

Sorey and Ingebritsen (1984) used a chloride-flux method to measure the discharge of high-chloride thermal water; the chloride flux was calculated as the product of stream flow and chloride concentration. They reported that the total discharge of thermal water along Mill and Canyon Creeks is about 17 kg/s. Chloride-flux calculations for Domingo Spring indicated a thermal component of about 2.7 kg/s. Sorey and Ingebritsen (1984) thus identified about 20 kg/s of high-chloride thermal-water discharge. Ingebritsen and Sorey (1985) used this value of mass inflow in their numerical simulations of the Lassen system, and suggested that steam discharge within LVNP might be at least an order of magnitude less than the mass flow of high-chloride water.

Subsequent measurements indicate that steam discharge within LVNP is actually much larger. Steam discharge from the Lassen hydrothermal system occurs at Bumpass Hell, Little Hot Springs Valley, Sulphur Works, Devils Kitchen, Boiling Springs Lake, and Terminal Geyser (fig. 1a). Sorey and Simpson (1991) determined steam discharge in each area by measuring the different components of heat flow at the surface, including advective heat loss in fumaroles and streams; evaporative, radiative, and conductive heat losses from water surfaces; and heat losses from bare ground. They inferred that the total steam discharge required to maintain the surface heat flow in all of these areas is about 40 kg/s.

Sorey and Simpson's (1991) steam-discharge estimates might be somewhat biased on the high side, because the measurements on which they were based were made during the summer and fall and in dry years (1986-1989). Decreased subsurface pressures associated with an abnormally low water table could induce boiling and increase steam upflow. The seasonal and annual variability in water-table elevation and steam upflow are unknown. However, evaporation from boiling pools is the dominant mode of heat discharge from the two largest steam-discharge areas, Bumpass Hell and Boiling Springs Lake (Sorey and Simpson, 1991), and pool areas and temperatures were not observed to vary substantially.

Numerical simulations assuming 20 kg/s of flow through the system generally resulted in near-steady-state steam-discharge values of less than 2 kg/s (Ingebritsen and Sorey, 1985; 1987; 1988). Sorey and Simpson's (1991) inferred steam-discharge value of 40 kg/s is much higher. A conservative calculation for phase separation in a steady-state system indicates that liquid discharge should be at least three times larger than the steam discharge (this value assumes that steam [about 2,800 kJ/kg] is generated by adiabatic decompression of liquid water from 300°C [1,350 kJ/kg] to 180°C [760 kJ/kg]). Assuming that the steam-discharge estimate of 40 kg/s is accurate, the adiabatic model predicts more than 120 kg/s of liquid discharge, or at least six times the observed value.

**Purpose and scope**

The purpose of this report is to examine whether thermal-liquid discharge from the Lassen hydrothermal system is substantially larger than 20 kg/s. This possibility was investigated by sampling the streams that drain the highlands in and around LVNP. The study area is bounded in part by the

Sacramento, Pit, and North Fork of the Feather Rivers, which capture much of the drainage from the Lassen area (fig. 1b).

The identified liquid discharge (20 kg/s) and inferred steam discharge (40 kg/s) values for the Lassen system are incompatible with the results from numerical simulation. One possible explanation for this inconsistency is that high-chloride thermal water is entering into the local drainages at unknown points, and therefore the measurements of liquid discharge are incomplete. If the high-chloride discharge is much larger (at least six times larger) than the total from Morgan and Growler Hot Springs and Domingo Springs (20 kg/s), then Ingebritsen and Sorey's (1985) conceptual model could be regarded as appropriate, despite their underestimate of the throughflow rate. If most of the high-chloride discharge comes from the three known sources, conditions within the Lassen system may be substantially different from those assumed in the numerical simulations.

Chloride was used as the indicator of a possible thermal component because it is present in high concentrations in the thermal waters and tends to be inert in solution. Other dissolved constituents characteristic of the sodium-chloride thermal waters (for example sodium, boron, ammonia, arsenic) are either present in lower concentrations, so that large dilutions decrease their concentrations to near-background levels, and/or behave less conservatively.

## Acknowledgments

We thank Rebecca Hamon for first drafts of the figures and for assistance in the field; Mark Huebner for stable-isotope determinations from our Tuscan Springs samples; W.C. Evans and T.S. Presser for use of their analytical laboratories and guidance in analytical techniques; and Hamon, M.L. Sorey, L.J.P. Muffler, R.O. Fournier, R.H. Mariner, J.M. Thompson and M.A. Clynne for helpful discussions.


## DATA COLLECTION AND SAMPLE ANALYSIS

Streams were sampled at 116 sites in the study area to identify sources of high-chloride water (fig. 2). Most of the sampling was done between late September and early October 1989, when the streams were near base-flow conditions. Because Morgan and Growler Hot Springs and Domingo Spring are at elevations of about 1,500 m, the major streams were sampled at locations near that elevation (fig. 2). Many of the major streams were sampled at several elevations. The data are summarized in table 1.

Chloride concentrations ranging from 0 to 10 mg/L were measured to an accuracy of ±0.1 mg/L. Two reagents [$FeNH_4(SO_4)_2 \cdot 12H_2O$ and $Hg(SCN)_2$] were added to the water sample, causing $Cl^-$ in the sample to form mercuric chloride ($HgCl_2$) and releasing thiocyanate (2 $SCN^-$), which combined with $Fe^{3+}$ to cause a color change. A spectrophotometer was used to measure the resulting absorption at 463 nanometers. Sodium ($Na^+$) concentrations ranging from 0 to 10 mg/L were determined to an accuracy of ±0.15

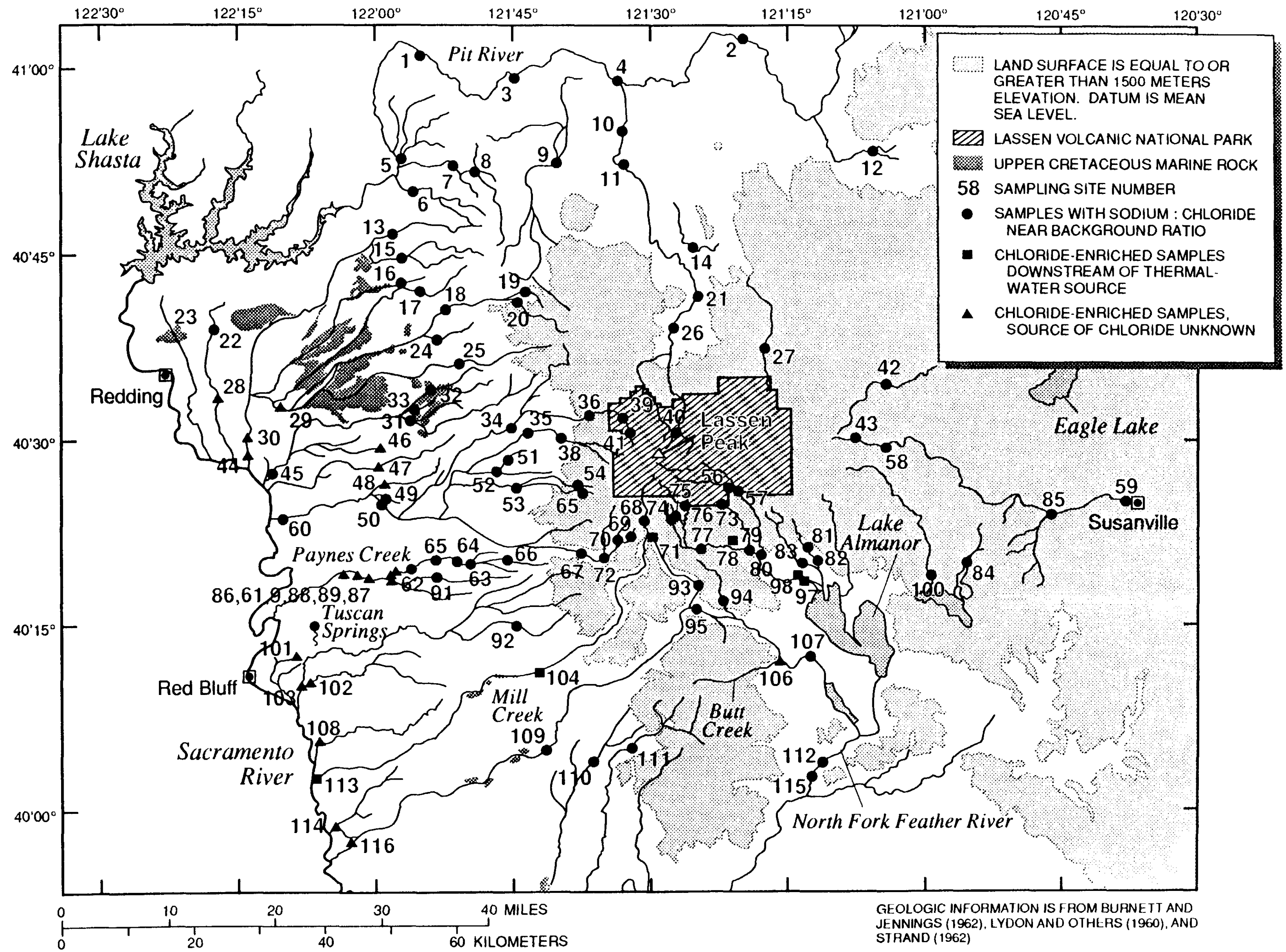


**Figure 2** Location of sample sites.

mg/L using an atomic absorption spectrophotometer.

## SODIUM AND CHLORIDE CONCENTRATIONS IN LASSEN-AREA STREAMS

Sodium and chloride concentrations in Lassen-area stream are generally low (<30 mg/L; see table 1). In figure 3 the sodium and chloride concentrations of the samples are compared with the sodium:chloride (Na:Cl) ratios of high-chloride waters from the Lassen hydrothermal system (about 0.62:1; Thompson, 1983) and with a "background" Na:Cl ratio (about 5.4:1) determined for nonthermal waters from the central Oregon Cascade Range. This background ratio (5.4:1) is obtained from a linear least-squares fit to the stream-chemistry data of Ingebritsen and others (1988). Most of the Lassen-area stream samples define the same ratio observed in the central Oregon Cascade Range, where streams traverse rocks of similar age and lithology. In figure 3 we identify samples that are obviously chloride-enriched with respect to the background ratio. These include samples from Mill Creek and Domingo Spring, where there are known thermal components, and other samples for which the source of the chloride is unknown.

The location map of figure 2 shows that some of the chloride-enriched samples are from streams at lower elevations that have passed over Upper Cretaceous marine rocks, which crop out at elevations as high as 760 m. Chloride may be released from these rocks by dissolution of intergranular salts and/or by mixing of circulating meteoric waters with high-chloride connate

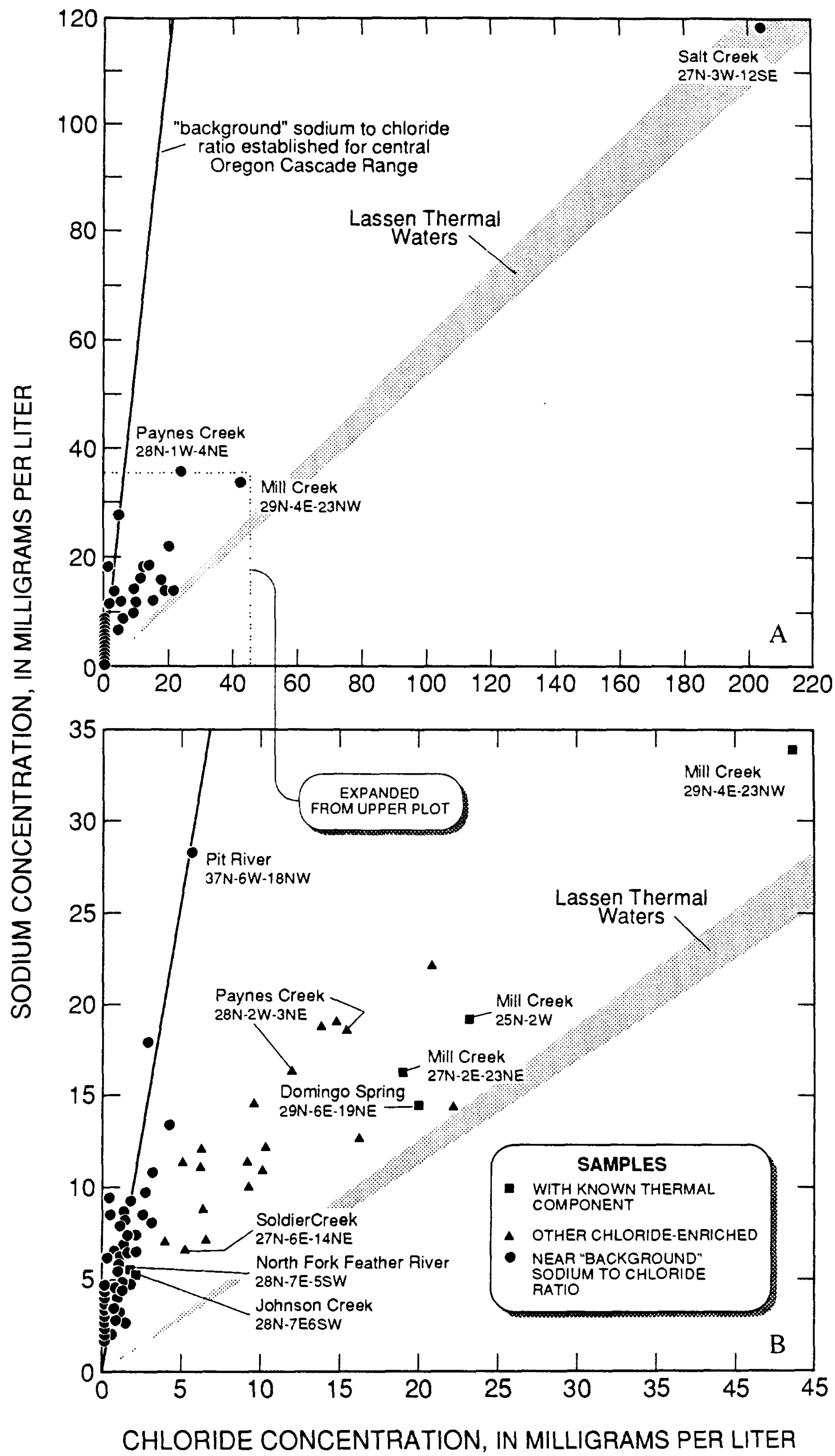


**Figure 3** Relation between sodium and chloride concentrations for samples from the Lassen region (table 1).

waters. The Upper Cretaceous marine rocks are probably more widespread than shown on figure 2. Relatively detailed mapping of part of the study area indicates that most of the streams west of LVNP encounter marine rocks at elevations ranging from 150 to 760 m (Harwood and Helley, 1987).

The relation between chloride concentration and elevation is shown in figure 4, which illustrates the possible effect of the Upper Cretaceous marine rocks on chloride concentrations at lower elevations. Most of the samples identified as being chloride-enriched on figure 3 (the Na:Cl plot) are from elevations of less than 760 m. These samples may have received their chloride enrichment locally from the Upper Cretaceous marine rocks.

Thompson (1983; 1985) suggested that the high concentrations of sodium, chloride, boron, and ammonia in the high-chloride waters of Morgan and Growler Hot Springs are due to circulation through marine rocks at depth. Thus it may be difficult to distinguish between thermal-water input and more local effects of the Upper Cretaceous marine rocks. However, two lines of evidence indicate that the chloride increases in the western part of the study area may be caused by relatively local sources. First, three samples collected at low elevations south of Lake Shasta (table 1, 32N-4W-04 SW, 32N-4W-07 SW, and 31N-4W-11 NW) show the same chloride enrichment as other lower-elevation samples. These samples could not contain thermal waters from the

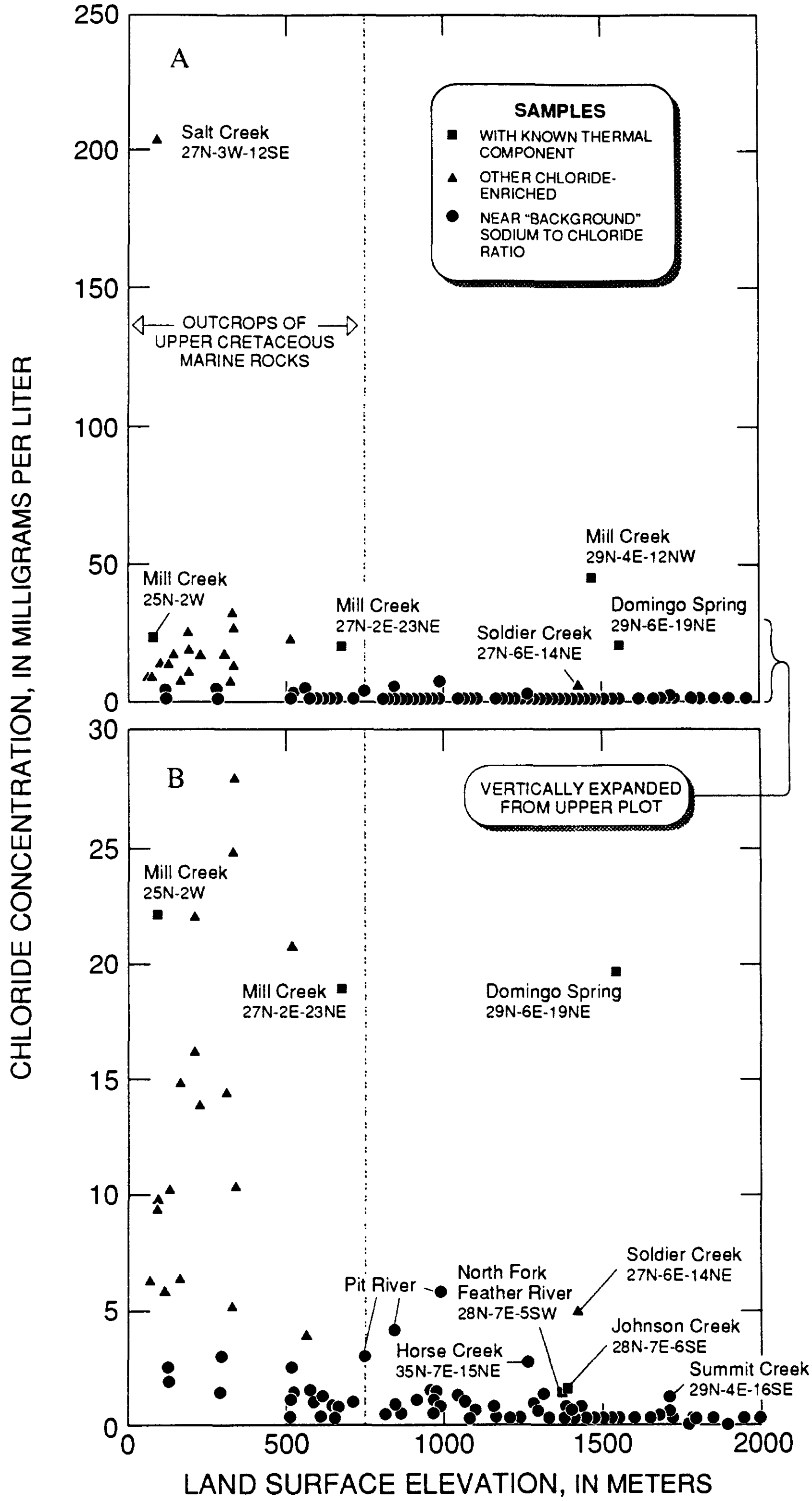


**Figure 4** Relation between chloride concentration and elevation for samples from the Lassen region.

Lassen system and probably acquired chloride from the marine rocks exposed nearby (fig. 2). Second, stable-isotope data indicate that the very saline (as much as 13,900 mg/L of chloride) sodium-chloride waters that discharge at Tuscan Springs (fig. 2), in the western part of the study area, are not related to the Lassen hydrothermal system ($\delta$D about -15 and -93 o/oo, respectively [Lassen data from Janik and others, 1983]).

Only one of the chloride-enriched samples identified on figure 3 (the Na:Cl plot) is from above 760 m. This sample is from Soldier Creek (table 1, 27N-6E-14 NE). We can conclude that the chloride flux in Soldier Creek is negligible because the chloride flux in Butt Creek (table 1, 27N-7E-16 NW) below its confluence with Soldier Creek is only about 600 mg Cl/s (0.6 mg Cl/L x 1,020 L/s). The average chloride concentration of high-chloride Lassen thermal water is about 2,250 mg/L (Thompson, 1983), so this chloride flux is equivalent to less than 0.3 kg/s of Lassen thermal water (600 mg Cl/s ÷ 2,250 mg Cl/L x 1 kg/L).

Several samples that were not identified as chloride-enriched on figure 3 (the Na:Cl plot) do show slightly higher chloride concentrations than samples from other streams at the same elevation. These include two samples from the Pit River and samples from Horse Creek, Summit Creek, Johnson Creek and the North Fork of the Feather River, all of which were obtained above 760 m (fig. 4). The chloride flux in the Pit River at 37N-1E-31 SW on 9/19/89 (table 1) was equivalent to approximately 5 kg/s of

Lassen thermal water. The maximum thermal components in Horse Creek (a tributary of the Pit River) and Summit Creek (table 1, 29N-4E-16 SE) are even smaller. Johnson Creek is a distributary of the North Fork of the Feather River, which receives the discharge from Domingo Spring. A set of samples obtained in September 1989 showed an increase in chloride concentration of 1.3 mg/L over a reach of the North Fork that brackets Domingo Spring (table 1, 29N-5E-22 SW to 28N-7E-05 SW). Additional sampling and discharge measurements in 1990 (table 1, 29N-5E-22 SW and 28N-6E-12 NW) indicate that the presumed thermal component must be small, approximately equal to the thermal component identified in Domingo Spring itself (less than 3 kg/s).

Paynes Creek (fig. 2) is one of the streams in the study area that shows chloride enrichment at relatively low elevations. A pair of samples obtained in September 1989 showed that Paynes Creek has "background" levels of sodium and chloride at 917 m elevation (table 1, 29N-2E-29 NE) and is chloride-enriched at 180 m elevation (28N-2W-03 NE). Another set of samples was collected along Paynes Creek in November 1989, in an effort to locate the point where chloride concentration increases. Figure 5 shows the 11 sampling sites as well as the relation between chloride concentration and elevation. Paynes Creek has relatively low chloride concentrations above 460 m and dramatically higher concentrations below 340 m elevation. Paynes Creek does not flow over any known exposures of the Upper Cretaceous marine rocks; however, at elevations lower than approximately 760 m all streams

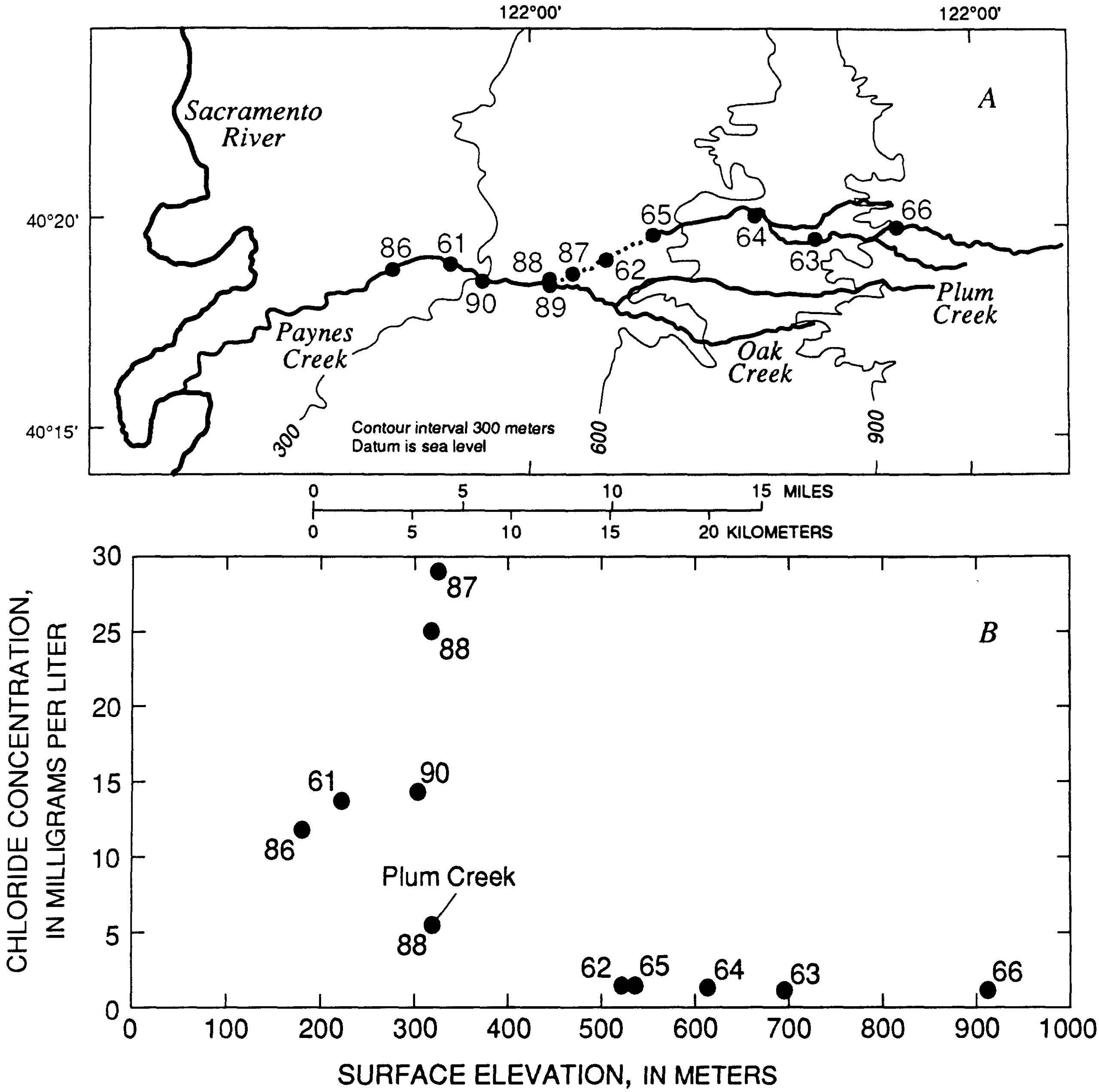


**Figure 5** (A) Location of sample sites along Paynes Creek. (B) Relation between chloride concentration and elevation for Paynes Creek samples.

have potentially received chloride-enriched water that has encountered marine rocks.

It appears that the relatively high-chloride streams in the western part of the study area receive all or most of their chloride enrichment from the Upper Cretaceous marine rocks exposed locally, because (1) three samples collected south of Lake Shasta exhibit the same level of chloride enrichment as the streams west of LVNP and (2) the sodium-chloride waters of Tuscan Springs, which may be representative of the lower-elevation chloride source, are isotopically distinct from the Lassen thermal waters.

## CHLORIDE-FLUX ESTIMATES FOR LARGE STREAMS THAT BOUND THE STUDY AREA

The streams that bound the study area to the north and south, the Pit River and the North Fork of the Feather River (fig. 1b), are large enough that they could contain substantial thermal components without appearing obviously chloride-enriched on the sodium-chloride plots of figure 3. The available data can be used to estimate the possible thermal components in these two streams.

As noted above, the chloride flux in the Pit River (37N-1E-31 SW) on 9/19/89 (10,400 mg Cl/s) was equivalent to less than 5 kg/s of Lassen thermal water. Three small hot springs north of the Pit River and upstream from our easternmost sample site (Little, Bassett, and Kellog Hot Springs) may contribute less than 1,000 mg Cl/s (Reed, 1975). Stable-isotope data indicate that these hot springs ($\delta$D about -116 o/oo [Reed, 1975]) are not related to the Lassen hydrothermal system ($\delta$D about -93 o/oo [Janik and others, 1983]). The chloride flux in the North Fork of the Feather River downstream from Lake Almanor (table 1, 26N-7E-34 SW) was also small in the autumn of 1989: 3,440 mg Cl/s, equivalent to less than 2 kg/s of Lassen thermal water.

The data from autumn of 1989 establish that the instantaneous chloride flux in the Pit River and the North Fork of the Feather River was small. However, late-season flow in these streams is highly regulated by dams and diversion, and we need to evaluate the possibility that the reconstructed average chloride flux is substantially larger. Although data regarding the temporal variation of chloride concentrations are lacking, the data obtained near base-flow conditions, when solute concentrations are relatively high, can be used to place approximate upper limits on the average chloride fluxes. Early-summer samples from the Pit River (37N-1E-31 SW) and the North Fork of the Feather River (25N-7E-05 SE, near the 26N-7E-34 SW site) have sustantially lower chloride concentrations than those obtained near base-flow conditions. Thus, by assuming that the base-flow data are representative, we presumably obtain choride-flux estimates that are biased on the high side.

The average discharge of the Pit River at 37N-1E-31 SW was 16,400 L/s in 1985-1988 (U.S. Geological Survey, 1987; 1988a; 1988b; 1989). Assuming that the base-flow chloride concentration in the 9/19/89 sample (table 1, 2.5 mg Cl/L) is an average value, and that all of the chloride is derived from Lassen-equivalent thermal water (about 2,250 mg Cl/L), the average thermal component could be as large as 18 kg/s. This value is unrealistically high, because (1) the average chloride concentration is less than that in the near base-flow sample and (2) the "background" (nonthermal) chloride flux is probably substantial. The background flux can be estimated using a two-component mixing model. If one component is assumed to have the Na:Cl ratio of the Lassen thermal waters (0.62:1) and the other to have the "background" Na:Cl ratio of 5.4:1 (fig. 3), the background chloride concentration is estimated to be 1.6 mg/L. The estimated thermal component is then reduced to about 6 kg/s ([2.5 - 1.6 mg Cl/L] x 16,400 L/s x 1 kg/L). This value probably still represents an upper limit, because it is based on the base-flow chloride concentration.

The average discharge of the North Fork of the Feather River below Lake Almanor at 26N-7E-34 SW was 33,000 L/s in 1985-1988 (U.S. Geological Survey, 1987; 1988a; 1988b; 1989). Here the assumptions that the 10/01/89 sample concentration is representative and that all of the chloride comes from Lassen thermal water indicate a maximum thermal component of 28 kg/s. The mixing-model approach indicates a smaller thermal component of about 12 kg/s. Of these totals about 3 kg/s can be attributed to the Domingo Spring area.

## CONCLUSIONS

The leakage of Lassen-equivalent thermal water into the Pit River and the North Fork of the Feather River is probably less than 20 kg/s. Additional sodium and chloride data would allow this estimate to be verified and refined. If diffuse discharge of high-chloride thermal water from the Lassen system amounts to less than 20 kg/s, the total discharge of high-chloride thermal water is less than 40 kg/s. The mass ratio of liquid outflow to steam upflow (about 40 kg/s) thus appears to be less than 1:1.

A simple model of adiabatic decompression suggests a ratio of liquid outflow to steam upflow of more than 3:1. Numerical simulations of the Lassen hydrothermal system led to liquid:steam discharge ratios on the order of 10:1. In the numerical simulations it was assumed that heat was supplied to the hydrothermal system by upflowing thermal water, with a relatively minor contribution from regional heat flow. Possible modifications to this model to allow much lower liquid:steam ratios might involve (1) recirculation and reheating of high-chloride water beneath the steam-discharge areas, which would allow for more boiling than an adiabatic process, and/or (2) long-term transient response to magmatic heat input or permeability changes.

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U.S. Geological Survey, 1989, Water data California water year 1988 Volume 4. Northern Great Valley basins and the Great Basin from Honey Lake basin to the Oregon state line: U.S. Geological Survey Water-Data Report CA-88-4, 289 p.

Table 1.--Sodium and chloride data for selected streams in the general vicinity of Lassen Volcanic National Park

[Dashes indicate absence of data. Values followed by "(e)" are approximate. Sites are ordered by township, range, section, and quarter section (T-R-Sec. 1/4). Elevation is reported in both feet and meters (ft/m) above sea level. Date is month, day, year (mo/da/yr) of sample collection. Specific electrical conductance is reported in microseimens per centimeter at 25 degrees Celsius (uS/cm). Sodium and chloride values are reported in milligrams per liter (mg/L). Comments include discharge measurements and estimates, reported in liters per second (L/s), and stream temperatures, reported in degrees Celsius (°C). The numbers in parentheses following the discharge measurements identify U.S. Geological Survey streamflow-gaging stations.]

| Site Number | T-R-Sec. 1/4 | Name | Longitude -----(° ' | Latitude ")----- | Elevation (ft/m) | Date (mo/da/yr) | Time (hr:mn) | Specific Conductance (uS/cm) | Sodium --(mg/L) | Cloride --(mg/L)-- | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 37N-1E-31 SW | PIT RIVER | 121 54 32 | 41 01 14 | 1680/ 512 | 9/19/89 | 10:15 | 140 | 9.7 | 2.5 | 4,160 L/s (11364200) |
| | | | | | | 6/25/90 | 20:00 | - | 8.6 | 1.9 | 3,890 L/s, 20°C |
| 2. | 37N-6E-18 NW | DO. | 121 19 49 | 41 02 44 | 3235/ 986 | 9/18/89 | 16:05 | 225 | 28.2 | 5.7 | |
| 3. | 36N-2E-10 NW | DO. | 121 44 15 | 40 59 40 | 2440/ 744 | 9/19/89 | 12:45 | 155 | 10.9 | 3.0 | |
| 4. | 36N-4E-17 NW | DO. | 121 32 46 | 40 58 50 | 2760/ 841 | 9/18/89 | 15:20 | 124 | 13.4 | 4.1 | |
| 5. | 35N-1W-14 NW | ROARING CREEK | 121 56 47 | 40 53 34 | 1660/ 506 | 9/19/89 | 9:15 | 105 | 3.2 | .4 | 280-370 L/s (11364200) |
| 6. | 35N-1W-36 SW | MONTGOMERY CREEK | 121 55 23 | 40 50 29 | 2140/ 652 | 9/21/89 | 5:25 | 104 | 4.0 | .4 | |
| 7. | 35N-1E-22 SW | HATCHET CREEK | 121 51 27 | 40 52 15 | 3600/1097 | 9/19/89 | 7:45 | 80 | 3.3 | .6 | |
| 8. | 35N-1E-25 NW | LITTLE HATCHET CR. | 121 49 00 | 40 51 54 | 3830/1167 | 9/19/89 | 7:15 | 62 | 2.1 | .4 | |
| 9. | 35N-3E-20 NW | BURNEY CREEK | 121 39 42 | 40 52 56 | 3125/ 953 | 9/18/89 | 19:50 | 100 | 4.8 | 1.5 | |
| 10. | 35N-4E-05 SW | RISING RIVER | 121 33 02 | 40 55 10 | 3180/ 969 | 9/18/89 | 13:55 | 124 | 7.0 | 1.1 | |
| 11. | 35N-4E-29 NW | HAT CREEK | 121 32 57 | 40 52 09 | 3210/ 978 | 9/18/89 | 13:15 | 148 | 8.9 | 1.4 | |
| 12. | 35N-7E-15 NE | HORSE CREEK | 121 10 13 | 40 53 51 | 4150/1265 | 9/18/89 | 18:25 | 230 | 18.0 | 2.7 | |
| 13. | 34N-1W-22 SE | CEDAR CREEK | 121 57 07 | 40 47 08 | 1940/ 591 | 9/21/89 | 7:05 | 80 | 3.5 | .5 | |
| 14. | 34N-5E-33 SE | LOST CREEK | 121 25 20 | 40 45 30 | 3800/1158 | 9/18/89 | 12:20 | 114 | 5.0 | .8 | |
| 15. | 33N-1W-02 NW | LITTLE COW CREEK | 121 56 35 | 40 44 56 | 1980/ 604 | 9/21/89 | 7:45 | 101 | 4.8 | .4 | |
| 16. | 33N-1W-14 SW | OAK RUN CREEK | 121 56 40 | 40 42 49 | 2650/ 808 | 9/21/89 | 9:10 | 71 | 4.0 | .6 | |
| 17. | 33N-1W-24 NE | CLOVER CREEK | 121 55 06 | 40 42 08 | 2680/ 817 | 9/21/89 | 10:00 | 74 | 3.6 | .4 | |
| 18. | 33N-1E-30 SE | OLD COW CREEK | 121 52 13 | 40 40 47 | 2820/ 860 | 9/21/89 | 10:45 | 107 | 4.5 | .5 | |
| 19. | 33N-2E-23 SW | DO. | 121 44 18 | 40 41 17 | 4840/1475 | 9/20/89 | 18:20 | 79 | 3.1 | .3 | |
| 20. | 33N-2E-27 SW | OLD COW CREEK TRIB. | 121 44 42 | 40 41 12 | 4750/1448 | 9/20/89 | 17:35 | 65 | 2.3 | .4 | |
| 21. | 33N-5E-28 SE | HAT CREEK | 121 25 25 | 40 41 12 | 4320/1317 | 9/18/89 | 10:30 | 155 | 8.9 | 1.3 | 71 L/s (1355500) |
| 22. | 32N-4W-04 SW | W. FK. STILLWATER CR. | 121 19 50 | 40 39 19 | 630/ 192 | 11/03/89 | 15:05 | - | 14.0 | 22.2 | |
| 23. | 32N-4W-07 SW | CHURN CREEK | 122 22 00 | 40 38 21 | 650/ 198 | 11/03/89 | 15:40 | - | 12.5 | 16.2 | |

Table 1.--Sodium and chloride data for selected streams (continued)

| Site Number | T-R-Sec. 1/4 | Name | Longitude -----(° ' ")----- | Latitude | Elevation (ft/m) | Date (mo/da/yr) | Time (hr:mn) | Specific Conductance (uS/cm) | Sodium --(mg/L)-- | Chloride | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24. | 32N-1E-17 NW | OLD COW CREEK TRIB. | 121 53 05 | 40 37 55 | 2320/ 707 | 9/21/89 | 11:40 | 130 | 4.5 | 1.0 | |
| 25. | 32N-1E-22 SW | SOUTH COW CREEK | 121 51 12 | 40 36 25 | 2640/ 805 | 9/21/89 | 12:35 | 106 | 4.3 | .5 | |
| 26. | 32N-5E-07 NW | HAT CREEK | 121 27 33 | 40 39 05 | 4550/1386 | 9/18/89 | 10:55 | 155 | 8.9 | 1.2 | |
| 27. | 32N-6E-22 SW | BUTTE CREEK | 121 17 50 | 40 36 50 | 5590/1704 | 9/19/89 | 14:50 | 75 | 3.8 | .4 | |
| 28. | 31N-4W-11 NW | STILLWATER CREEK | 121 17 13 | 40 33 33 | 4900/1494 | 11/03/89 | 14:15 | - | 7.6 | 6.3 | |
| 29. | 31N-3W-14 NW | COW CREEK | 122 10 27 | 40 32 43 | 500/ 152 | 9/29/89 | 14:25 | - | 8.9 | 6.2 | |
| 30. | 31N-3W-32 NW | DO. | 122 13 55 | 40 30 00 | 390/ 119 | 9/29/89 | 13:40 | - | 10.1 | 9.1 | 97 L/s (11374000) |
| 31. | 31N-1W-24 NW | SOUTH FK. BEAR CREEK | 121 55 48 | 40 32 00 | 2155/ 657 | 9/21/89 | 14:55 | 146 | 4.5 | .7 | |
| 32. | 31N-1E-05 SE | NORTH FK. BEAR CREEK | 121 52 45 | 40 34 10 | 2110/ 643 | 9/21/89 | 13:30 | 144 | 6.5 | .8 | |
| 33. | 31N-1E-07 SW | SNOW CREEK | 121 54 39 | 40 33 04 | 1920/ 585 | 9/21/89 | 14:05 | 180 | 7.9 | 1.0 | |
| 34. | 31N-2E-21 SE | N. FK. BATTLE CREEK | 121 45 04 | 40 31 03 | 3960/1207 | 9/20/89 | 11:40 | 84 | 4.4 | .4 | |
| 35. | 31N-2E-27 NE | BAILEY CREEK | 121 43 37 | 40 30 39 | 4060/1237 | 9/20/89 | 12:05 | 66 | 3.4 | .4 | |
| 36. | 31N-3E-13 SW | MANZANITA CREEK | 121 35 38 | 40 32 01 | 5500/1676 | 11/03/89 | 13:10 | - | 3.8 | .4 | |
| 37. | 31N-3E-19 SE | UNNAMED SPRING | 121 40 33 | 40 31 08 | 4540/1384 | 9/19/89 | 17:30 | 65 | 3.3 | .9 | |
| 38. | 31N-3E-32 NE | BAILEY CREEK | 121 39 25 | 40 29 59 | 4680/1481 | 9/19/89 | 16:35 | 63 | 3.5 | .2 | |
| 39. | 31N-4E-17 SW | MANZANITA CREEK | 121 33 15 | 40 31 56 | 6100/1859 | 11/03/89 | - | - | 4.4 | .3 | |
| 40. | 31N-4E-25 NE | WEST FORK HAT CREEK | 121 27 54 | 40 30 33 | 6420/1957 | 9/21/89 | 17:45 | 120 | 4.8 | .4 | |
| 41. | 31N-4E-29 NE | MANZANITA CREEK | 121 32 21 | 40 30 41 | 6590/2009 | 11/03/89 | - | - | 3.8 | .4 | |
| 42. | 31N-8E-04 SE | PINE CREEK | 121 04 29 | 40 34 26 | 5630/1716 | 9/18/89 | 8:50 | 69 | 3.1 | .5 | |
| 43. | 31N-8E-31 SW | SUSAN RIVER | 121 07 52 | 40 30 09 | 6250/1905 | 9/22/89 | 12:00 | 63 | 2.6 | .1 | |
| 44. | 30N-3W-08 NE | COW CREEK | 122 13 38 | 40 28 36 | 370/ 113 | 9/24/89 | 17:25 | - | 10.7 | 10.0 | |
| 45. | 30N-3W-15 SW | BEAR CREEK | 122 11 46 | 40 26 55 | 380/ 116 | 9/24/89 | 16:55 | - | 7.5 | 1.9 | |
| 46. | 30N-1W-05 NE | LACK CREEK | 121 59 52 | 40 29 27 | 1675/ 510 | 9/20/89 | 9:30 | 205 | 22.1 | 20.8 | |
| 47. | 30N-1W-08 SW | ASH CREEK | 122 00 08 | 40 28 03 | 1835/ 559 | 9/20/89 | 9:10 | 140 | 7.0 | 3.8 | ~1 L/s (e) |
| 48. | 30N-1W-21 SW | BALDWIN CREEK | 121 59 04 | 40 26 20 | 1060/ 323 | 9/20/89 | 8:15 | 205 | 12.2 | 10.2 | |
| 49. | 30N-1W-28 SW | BATTLE CREEK | 121 59 11 | 40 25 28 | 910/ 277 | 9/20/89 | 7:40 | 142 | 7.3 | 1.4 | |
| 50. | 30N-1W-33 SE | S. FK. BATTLE CREEK | 121 58 44 | 40 24 21 | 920/ 280 | 9/20/89 | 6:50 | 139 | 8.2 | 3.0 | 210 L/s (11376460) |
| 51. | 30N-2E-10 NW | CANYON CREEK | 121 45 32 | 40 28 31 | 3480/1061 | 9/20/89 | 13:40 | 125 | 5.2 | 1.0 | |
| 52. | 30N-2E-17 NE | ROCK CREEK | 121 46 53 | 40 27 32 | 3160/ 963 | 9/20/89 | 14:25 | 76 | 4.0 | .5 | |
| 53. | 30N-2E-26 NE | DIGGER CREEK | 121 44 00 | 40 26 08 | 3515/1071 | 9/20/89 | 15:25 | 61 | 3.9 | .3 | |
| 54. | 30N-3E-22 SE | DO. | 121 37 48 | 40 26 17 | 5480/1670 | 10/01/89 | 12:30 | - | 2.4 | .2 | |
| 55. | 30N-3E-26 SW | S. FK. DIGGER CREEK | 121 37 43 | 40 25 41 | 5680/1731 | 10/01/89 | 12:00 | - | 3.1 | .2 | |

Table 1.--Sodium and chloride data for selected streams (continued)

| Site Number | T-R-Sec. 1/4 | Name | Longitude -----( ° ' | Latitude ")----- | Elevation (ft/m) | Date (mo/da/yr) | Time (hr:mn) | Specific Conductance (uS/cm) | Sodium --(mg/L) | Cloride --(mg/L)-- | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 56. | 30N-6E-30 NW | HOT SPRINGS CREEK | 121 21 36 | 40 25 54 | 5300/1615 | 9/30/89 | 9:30 | - | 6.4 | .2 | |
| 57. | 30N-6E-30 NE | KINGS CREEK | 121 21 04 | 40 25 59 | 5300/1615 | 9/30/89 | 10:30 | - | 2.6 | .2 | |
| 58. | 30N-8E-03 SW | SUSAN RIVER | 121 04 29 | 40 29 24 | 5870/1789 | 9/22/89 | 12:50 | 63 | 2.3 | .2 | |
| 59. | 30N-12E-31 NE | DO. | 120 40 14 | 40 25 02 | 4235/1291 | 9/22/89 | 10:15 | 173 | 6.3 | .9 | 33 L/s (10356500) |
| 60. | 29N-3W-02 SW | BATTLE CREEK | 122 10 38 | 40 23 31 | 370/ 113 | 9/24/89 | 16:20 | - | 8.5 | 2.5 | |
| 61. | 29N-2W-36 SW | PAYNES CREEK | 122 02 30 | 40 19 12 | 725/ 221 | 11/03/89 | 17:10 | - | 18.6 | 13.8 | |
| 62. | 29N-1W-35 SW | DO. | 121 56 32 | 40 19 20 | 1710/ 521 | 11/03/89 | 13:00 | - | 5.2 | 1.4 | <1 L/s (e) |
| 63. | 29N-1E-26 SW | DO. | 121 49 41 | 40 20 09 | 2280/ 695 | 11/03/89 | 8:50 | - | 8.2 | 1.2 | |
| 64. | 29N-1E-28 NE | DO. | 121 51 34 | 40 20 35 | 2010/ 613 | 11/03/89 | 10:10 | - | 8.7 | 1.3 | |
| 65. | 29N-1E-30 SE | DO. | 121 53 42 | 40 20 14 | 1880/ 573 | 11/03/89 | 11:20 | - | 7.8 | 1.4 | |
| 66. | 29N-2E-29 NE | DO. | 121 46 05 | 40 20 20 | 3010/ 917 | 9/23/89 | 14:55 | - | 6.5 | 1.1 | |
| | | | | | | 11/03/89 | 7:00 | - | 5.0 | 1.1 | |
| 67. | 29N-3E-28 NW | S. FK. BATTLE CREEK | 121 39 49 | 40 21 04 | 4260/1298 | 9/23/89 | 13:55 | - | 3.0 | .6 | |
| 68. | 29N-4E-11 NW | MILL CREEK | 121 30 47 | 40 23 29 | 5060/1542 | 10/01/89 | 10:40 | - | 9.6 | .3 | |
| 69. | 29N-4E-16 SE | SUMMIT CREEK | 121 32 17 | 40 22 04 | 5640/1719 | 9/23/89 | 10:35 | - | 2.7 | 1.2 | ~2 L/s (e) |
| | | | | | | 6/25/90 | 11:20 | - | 2.1 | .8 | 5 L/s, 10 °C |
| 70. | 29N-4E-20 NW | NANNY CREEK | 121 33 44 | 40 21 55 | 5110/1558 | 9/23/89 | 11:20 | - | 2.9 | .3 | |
| 71. | 29N-4E-23 NW | MILL CREEK | 121 30 20 | 40 21 46 | 4830/1472 | 9/23/89 | 9:35 | 301 | 33.6 | 44.0 | |
| 72. | 29N-4E-30 NW | MARTIN CREEK | 121 35 24 | 40 20 58 | 4920/1500 | 9/23/89 | 13:30 | - | 2.9 | .3 | |
| 73. | 29N-5E-01 NE | WILLOW CREEK | 121 22 12 | 40 24 34 | 5500/1676 | 9/30/89 | 11:40 | - | 4.0 | .2 | |
| 74. | 29N-5E-06 SW | SOUTH ARM RICE CREEK | 121 28 27 | 40 23 42 | 5920/1804 | 10/01/89 | 9:30 | - | 8.6 | .4 | |
| 75. | 29N-5E-07 NE | BUNCHGRASS CREEK | 121 27 35 | 40 23 30 | 5850/1783 | 10/01/89 | 9:00 | - | 2.8 | .2 | <5 L/s (e) |
| 76. | 29N-5E-08 NE | NORTH ARM RICE CREEK | 121 26 37 | 40 23 34 | 5880/1792 | 10/01/89 | 8:30 | - | 4.5 | .2 | |
| 77. | 29N-5E-22 SW | N. FK. FEATHER RIVER | 121 25 06 | 40 21 10 | 5440/1658 | 9/23/89 | 8:45 | 67 | 4.8 | .2 | |
| | | | | | | 5/17/90 | 12:45 | 58 | 3.6 | .2 | 800 L/s |
| 78. | 29N-6E-19 NE | DOMINGO SPRING | 121 20 44 | 40 21 39 | 5110/1558 | 9/30/89 | 13:40 | - | 14.4 | 19.8 | |
| 79. | 29N-6E-21 SW | WILLOW CREEK | 121 19 28 | 40 20 36 | 4970/1515 | 9/23/89 | 8:05 | 86 | 3.8 | .3 | |
| 80. | 29N-6E-27 SW | WARNER CREEK | 121 18 13 | 40 20 30 | 4860/1481 | 9/22/89 | 16:45 | 80 | 4.8 | .2 | |
| 81. | 29N-7E-19 NE | LAST CHANCE CR. TRIB. | 121 13 30 | 40 21 12 | 4860/1481 | 9/22/89 | 15:30 | 76 | 3.1 | .1 | |
| 82. | 29N-7E-28 SW | MUD CREEK | 121 12 24 | 40 20 22 | 4515/1376 | 9/22/89 | 15:00 | 91 | 3.6 | .2 | ~1-2 L/s (e) |
| 83. | 29N-7E-31 NE | BENNER CREEK | 121 14 10 | 40 19 50 | 4560/1390 | 9/22/89 | 16:05 | 57 | 3.5 | .2 | |
| 84. | 29N-9E-35 SE | GOODRICH CREEK | 120 55 49 | 40 19 46 | 5095/1553 | 6/25/90 | 16:50 | - | 3.7 | .6 | 24 °C |

Table 1.--Sodium and chloride data for selected streams (continued)

| Site Number | T-R-Sec. 1/4 | Name | Longitude -----(° ' ")----- | Latitude | Elevation (ft/m) | Date (mo/da/yr) | Time (hr:mn) | Specific Conductance (uS/cm) | Sodium --(mg/L)-- | Chloride | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 85. | 29N-11E-06 SE | SUSAN RIVER | 120 46 55 | 40 23 47 | 4555/1388 | 9/22/89 | 7:00 | 180 | 5.7 | .8 | |
| 86. | 28N-2W-03 NE | PAYNES CREEK | 122 04 13 | 40 18 53 | 590/ 180 | 9/24/89 | - | - | 18.5 | 14.8 | |
| | | | | | | 11/03/89 | - | - | 16.2 | 11.9 | |
| 87. | 28N-1W-04 NE | DO. | 121 58 14 | 40 18 47 | 1070/ 326 | 11/03/89 | 14:10 | - | - | 28. | <1 L/s (e) |
| 88. | 28N-1W-04 NE | DO. | 121 58 41 | 40 18 39 | 1060/ 323 | 11/03/89 | 15:20 | - | 36.0 | 25. | |
| 89. | 28N-1W-04 NE | PLUM CREEK | 121 58 37 | 40 18 38 | 1060/ 323 | 11/03/89 | 15:00 | - | 11.3 | 5.1 | |
| 90. | 28N-1W-06 NE | PAYNES CREEK | 122 00 58 | 40 18 40 | 990/ 301 | 11/03/89 | 16:10 | - | 18.8 | 14.4 | |
| 91. | 28N-1E-05 NW | PLUM CREEK | 121 53 35 | 40 18 47 | 1980/ 604 | 9/23/89 | 15:45 | - | 9.3 | 1.5 | |
| 92. | 28N-2E-28 NW | S. FK. ANTELOPE CR. | 121 45 22 | 40 15 05 | 2780/ 847 | 10/01/89 | 9:35 | 68 | 4.3 | .8 | 9.0°C |
| 93. | 28N-5E-09 NE | GURNSEY CREEK | 121 25 32 | 40 18 28 | 4700/1433 | 9/29/89 | 16:35 | - | 4.9 | .8 | |
| 94. | 28N-5E-13 SW | LOST CREEK | 121 22 33 | 40 16 58 | 5030/1533 | 9/30/89 | 18:35 | 27 | 3.6 | .3 | 8.8°C |
| 95. | 28N-5E-21 SW | GURNSEY CREEK | 121 25 54 | 40 16 15 | 4553/1388 | 9/29/89 | 17:05 | - | 5.5 | .8 | |
| 96. | 28N-6E-12 NE | N. FK. FEATHER RIVER | 121 15 48 | 40 18 12 | 4590/1400 | 5/17/90 | 9:45 | 84 | 5.0 | 1.4 | 4,200 L/s |
| 97. | 28N-7E-05 SW | DO. | 121 13 39 | 40 18 38 | 4520/1378 | 9/23/89 | 7:00 | 81 | 5.5 | 1.5 | |
| 98. | 28N-7E-06 SE | JOHNSON CREEK | 121 14 08 | 40 18 48 | 4550/1387 | 9/22/89 | 17:30 | 91 | 5.5 | 1.6 | |
| 99. | 28N-9E-03 NW | GOODRICH CREEK TRIB. | 120 57 24 | 40 19 02 | 5100/1554 | 9/22/89 | 6:45 | 105 | 3.4 | .2 | |
| 100. | 28N-9E-05 SW | ROBBERS CREEK | 121 00 09 | 40 18 53 | 5115/1559 | 9/22/89 | 13:35 | 100 | 2.9 | .4 | ~3 L/s (e) |
| 101. | 27N-3W-12 SE | SALT CREEK | 122 08 57 | 40 12 04 | 300/ 91 | 9/24/89 | 12:55 | - | 118 | 204 | ~3 L/s (e) |
| 102. | 27N-2W | LITTLE ANTELOPE CR. | 122 07 20 | 40 10 15 | 290/ 88 | 9/24/89 | 8:55 | - | 14.4 | 9.4 | |
| 103. | 27N-2W | ANTELOPE CREEK | 122 08 07 | 40 10 02 | 275/ 84 | 9/24/89 | 8:15 | - | 11.3 | 9.2 | |
| 104. | 27N-2E-23 NE | MILL CREEK | 121 42 37 | 40 11 01 | 2160/ 658 | 10/01/89 | 10:30 | 128 | 16.0 | 19.0 | 9.7°C |
| 105. | 27N-4E-29 NW | DEER CREEK | 121 33 18 | 40 10 22 | 3226/ 983 | 9/30/89 | 14:05 | 80 | 5.4 | .7 | 11°C |
| 106. | 27N-6E-14 NE | SOLDIER CREEK | 121 16 25 | 40 12 12 | 4680/1426 | 9/30/89 | 10:45 | 53 | 6.6 | 5.1 | 8.6°C |
| 107. | 27N-7E-16 NW | BUTT CREEK | 121 12 31 | 40 12 06 | 4630/1411 | 9/30/89 | 9:50 | 84 | 4.4 | .6 | 6.0°C |
| | | | | | | 6/25/90 | 12:40 | - | 4.5 | .6 | 1,020 L/s, 14°C |
| 108. | 26N-2W | DYE CREEK | 122 05 58 | 40 05 25 | 240/ 73 | 3/28/90 | - | - | 10.2 | 10.5 | 16°C |
| 109. | 26N-2E-36 NW | DEER CREEK | 121 42 13 | 40 04 13 | 1660/ 506 | 10/01/89 | 12:25 | 88 | 6.6 | 1.1 | 12°C |
| 110. | 26N-3E-35 SW | BIG CHICO CREEK | 121 36 15 | 40 03 49 | 3440/1049 | 9/30/89 | 13:15 | 113 | 6.2 | 1.2 | 7.8°C |
| 111. | 26N-4E-29 NW | BUTTE CREEK | 121 32 58 | 40 04 45 | 4360/1329 | 9/30/89 | 12:40 | 75 | 3.7 | .3 | 3.9°C |
| 112. | 26N-7E-34 SW | N. FK. FEATHER RIVER | 121 12 02 | 40 03 26 | 2700/ 823 | 10/01/89 | 19:35 | - | 6.5 | 1.9 | 1,810 L/s (11401112) |
| 113. | 25N-2W | MILL CREEK | 122 05 56 | 40 02 34 | 245/ 75 | 9/24/89 | 10:00 | - | 19.2 | 22.9 | 2,970 L/s (11381500) |
| | | | | | | 3/28/90 | - | - | 11.6 | 12.9 | 7,000 L/s, 14°C |

Table 1.--Sodium and chloride data for selected streams (continued)

| Site Number | T-R-Sec. 1/4 | Name | Longitude -----(° ' | Latitude ")----- | Elevation (ft/m) | Date (mo/da/yr) | Time (hr:mn) | Specific Conductance (uS/cm) | Sodium --(mg/L)-- | Cloride --(mg/L)-- | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 114. | 25N-2W | TOOMES CREEK | 122 04 29 | 39 58 30 | 185/ 56 | 9/24/89 | 11:40 | - | 11.2 | 6.0 | |
| 115. | 25N-7E-05 NE | N. FK. FEATHER RIVER | 121 12 58 | 40 02 49 | 2470/ 753 | 6/25/90 | 15:10 | - | 5.7 | 1.3 | 4,010 L/s(11401112),20°C |
| 116. | 24N-2W | DEER CR. | 122 03 08 | 39 56 49 | 205/ 62 | 9/24/89 | 11:55 | - | 11.9 | 6.1 | |