WATER QUALITY STATUS REPORT ● REPORT NO. 60

IMPACT OF GEOTHERMAL WATERS ON SELECTED STREAMS IN SOUTHERN IDAHO

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ABSTRACT

Four drainage areas were studied in Southern Idaho to determine the impact of geothermal discharges on area streams. Geothermal discharges were found to be high in fluorides and their discharge resulted in stream fluoride concentrations which exceeded acceptable limits. Acceptable limits were set at 1 and 1.5 mg/l fluoride to protect the water for stock watering and cold water biota respectively. The three streams which no longer have capacity to receive additional geothermal waters include; (1) Warm Springs Creek near Ketchum, (2) Mud Creek near Buhl, and (3) Salmon Falls Creek near Castleford.

ACKNOWLEDGEMENTS

Thanks to Russ Renk who prepared the draft report and gathered data. Also to Gary Burkett who assisted in sampling. A special thanks to Teresa Armstrong who provided proof reading and typing of the report.

INTRODUCTION

Background

The development of geothermal water resources in southern Idaho has become increasingly popular as the cost of energy has increased. This development includes the heating of industrial buildings, apartment complexes, schools, homes, pools, greenhouses, as well as the development of power generation, fish rearing facilities, and the developed process heat for industries.

In general, the development of the geothermal resources results in a geothermal wastewater which after use must be disposed. This disposal is usually into one of Idaho's streams. The capacity of the receiving stream to handle these geothermal discharges is limited. The limit is based on the water quality criteria for the stream.

Purpose of Study

The purpose of this study was to:

1) Evaluate current status of selected streams to determine the present impact of geothermal discharges.

2) Determine what future capacity remains in these streams to receive geothermal waters.

3) Determine if the receiving stream is at or near capacity to handle the discharge of geothermal water based on limits of 1 mg/l fluoride for stock water protection and 1.5 mg/l fluoride for protection of cold water biota.

General Impacts of Geothermal Waters

The two principal pollutants associated with geothermal waters are; (1) temperature and (2) fluoride ions. While these are the main concern, other contaminants may be present in any given geothermal water. These include hydrogen sulfide, heavy metals, and high salt levels. In general, the geothermal waters in this area were examined and found to be free of high salts, heavy metals, and hydrogen sulfide. The only exception to this was in the Ketchum area where hydrogen sulfide concentrations measured around 5 mg/l in some geothermal waters. For the purposes of this study, only the two most significant parameters, temperature and fluoride ion levels, were examined.

Temperature

All streams studied are protected for Cold Water Biota and Salmonid Spawning under the Idaho Water Quality Standards and Wastewater Treatment Requirements. The maximum water temperatures are limited to 22° C (71.6° F) during the non-spawning season and 13° C (55.4° F) during the spawning season. In addition, the Big Wood River, as a designated special resource water, is not allowed a detectable increase in the ambient water temperature as a result of a discharge.

Fluoride

In addition to protection for Cold Water Biota, all streams studied were also protected for agricultural water supply which includes crop irrigation and livestock watering. The recommended limit established for irrigation and livestock use is set at 1.0 mg/l (EPA, 1973, and McKee, et al, 1963). The recommended limit set for Cold Water Biota is set at 1.5 mg/l (McKee, et al, 1963). The toxic effects of fluorides on fish, including carp and rainbow trout, have been established (Neuhold, 1960 and 1962) as well as its effects on livestock (Suttie, 1973 and Shupe, 1970).

Quality assurance tests for the recovery of fluorides has been identified to be extremely poor (20.7%) for field samples (Clark, 1985). There is the possibility that fluoride concentrations are underestimated and therefore are actually higher than reported.

The Big Wood River, as a special resource water, is protected from an increase in ambient fluoride concentrations.

METHODS AND MATERIALS

All water samples consisted of discrete grab samples. Because the fluoride ion is well dissolved and the streams well mixed, depth integrated cross composite sampling was not necessary. The water samples were placed in plastic one liter cubitainers, then iced and sent to the Idaho Department of Health and Welfare, Bureau of Laboratories where they were analyzed according to the U.S. Environmental Protection Agency Methods for Chemical Analysis of Water and Wastes.

The samples were analyzed for total fluoride, (mg/l), Storet *00951. (*) Some samples were also analyzed for calcium, total dissolved solids, and heavy metals. The water samples taken for heavy metal analysis were preserved with nitric acid in accordance with the IDHW-DOE Technical Procedures Manual.

Temperature and dissolved oxygen measurements were made in the field using a Yellow Springs Instrument's dissolved oxygen meter, Model 54. The dissolved oxygen meter was calibrated using the iodometric-oxide method, air calibration, and a Class A thermometer. The pH was also field measured using a Model 404 Orion pH meter. Standard solutions were used to calibrate the instrument.

Flow measurements were made using a Marsh and McBirney Model 201 portable water current meter.

Sampling Stations

The four major drainage areas studied were the Big Wood River near Ketchum, Mud Creek near Buhl, Salmon Falls Creek near Castleford, and the Snake River from Twin Falls to Bliss. A listing of the specific sampling stations for each drainage is included in Table 1.

Frequency

The four drainage areas impacted by geothermal discharges were monitored over a period of one year for fluoride and temperature. The streams were sampled four times during the year, once during each season.

*There are a variety of ways to analyze and report ions - the Storet number uniquely identifies the method and unit.

RESULTS

Fluoride

Big Wood River Drainage - Blaine County, Idaho

Two tributaries to the Big Wood River were studied along with their impact on the Big Wood River. The two tributaries were Warm Springs Creek and Deer Creek. Both tributaries have development geothermal water discharging to them and the potential for additional geothermal use development.

Warm Springs Creek has several natural hot springs that feed into it. The one closest to town, Guyer Hot Springs, flows 2 to 3 cfs and is largely captured and channelled through Ketchum to heat homes (see Figure 1). The water discharges into Bald Mountain Hot Springs swimming pool in Ketchum and then into Trail Creek. The fluoride content of this hot water is about 16 mg/l (see Appendix A for chemical analysis data).

Table 2 below shows the fluoride concentration in Warm Springs Creek to be at or near the protected limit of 1 to 1.5 mg/l fluoride. This usually occurs during the late fall and winter when the stream flows are low. Appendix B indicates measured flows as low as 12.5 cfs and flows as low as 5 cfs during drought conditions. The stream is not recommended as a disposal site for additional thermal waters except during periods of high flow; that is, in the spring and summer.

Deer Creek also receives geothermal waters. One of the main developed springs is at Clarendon (see Figure 2). The fluoride level of the spring water is 15.6 mg/l (see Appendix A for chemical data). Table 2 shows the stream, at present, is not at a critical level. Table 2 also shows the Big Wood River to have a significant increase in the fluoride level as it passes through Ketchum; that is, from station FB-3 to FB-4 (see Figure 3 for locations).

Table 1. Description and Locations of Sampling Stations Used in Geothermal Impact Study

	STATION *	DESCRIPTION	LATITUDE/LONGITUDE	RIVER MILE	ELEVATION	STORET *
1	FB-3	Big Wood River .5 miles above Warm Springs Creek above Ketchum	43° 41' 17"/114° 22' 20"	324.3/571.4/97.4	5,800'	2060190
2	FB-4	Big Wood River 2 miles below Ketchum	43° 39' 20"/114° 20' 55"	324.3/571.4/94.4	5,706'	2060191
3	FB-5	Big Wood River .5 miles below East Fork of Big Wood River	43° 35' 47"/114° 20' 45"	324.3/571.4/90.6	5,500'	2060192
4	FB-8	Big Wood River at Hailey USGS Station (151062) (13139510)	43° 30' 55"/114° 19' 15"	324.3/571.4/84.9	5,318'	2060002
5	FB-9	Big Wood River at Hwy 68 USGS Station (151168) (13141000)	43° 19' 40"/114° 19' 10"	324.3/571.4/69.3	4,800'	2060001
6	FB-1	Warm Springs Creek 3.5 miles above Mouth	43° 40' 55"/114° 25' 07"	324.3/571.4/96.8/2.4	5,860'	2060198
7	FB-2	Warm Springs Creek 1 mile above Mouth	43° 41' 25"/114° 23' 50"	324.3/571.4/103.5/1.4	5,840'	2060199
8	FB-6	Deer Creek 4 miles above Mouth at Clarendon Hot Springs	43° 33' 22"/114° 24' 45"	324.3/571.4/87.5/4.2	5,632'	2060200
9	FB-7	Deer Creek 1 mile above Mouth	43° 33' 35"/114° 20' 55"	324.3/571.4/87.5/0.7	5,440'	2060201
10	FM-1	Mud Creek at Melon Valley Road	42° 38' 15"/114° 47' 10"	324.3/591.7/2.9	3,200'	2060207

Table 1. Description and Locations of Sampling Stations Used in Geothermal Impact Study

	STATION *	DESCRIPTION	LATITUDE/LONGITUDE	RIVER MILE	ELEVATION	STORET *
11	FM-3	Mud Creek 1 mile above Mounth (13094700)	42° 39' 35"/114° 47' 15"	324.3/591.7/1.0	2,960'	2060055
12	FM-2	EF Mud Creek at Melon Valley Road below Buhl	42° 37' 55"/114° 47' 20"	324.3/591.7/2.4/0.3	3,200'	2060053
13	FSF-1	Salmon Falls Creek at Balanced Rock Road	42° 32' 38"/114° 56' 55"	324.3/586.5/16.7	3,400'	2040082
14	FSF-2	Salmon Falls Creek 2 miles above Mouth at Old Hwy 30 Bridge	42° 41' 15"/114° 51' 20"	324.3/586.5/2.8	3,120'	151057
15	FS-1	Snake River at Canyon Springs Golf Course in Twin Falls	42° 36' 25"/114° 28' 30"	324.3/610.5	3,130'	2060225
16	FS-2	Snake River below Rock Creek near Jerome	42° 38' 00"/114° 33' 35"	324.3/605.3	2,990'	2060226
17	FS-3	Snake River 5 miles North of Buhl at Bridge	42° 40' 10"/114° 45' 30"	324.3/594.6	2,935	2060227
18	FS-4	Snake River at Hwy 30 Bridge near Hagerman at Gridley Br. (13134500)	42° 45' 25"/114° 52' 30"	324.3/583.1	2,900'	2060228
19	FS-5	Snake River South of Bliss at Shoestring Road Bridge	42° 55' 00"/114° 57' 55"	324.3/565.7	2,675'	2060229

Table 2. Stream Fluoride Concentrations at Selected Stations in Idaho in 1984 and 1985, in mg/l.

	STATION #	DESCRIPTION	1/16	1/25	1/30	4/23	4/25	8/21	8/22	11/28	12/13	7/8/85
1	FB-3	Big Wood River .5 miles above Warm Springs Creek above Ketchum	.26			<.01		.21		.24		
2	FB-4	Big Wood River 2 miles below Ketchum	.52			<.01		.35		.59		
3	FB-5	Big Wood River .5 miles below East Fork of Big Wood River	.44			.02		.34		.54		
4	FB-8	Big Wood River at Hailey USGS Station (151062) (13139510)	.45			<.01		.38		.43		
5	FB-9	Big Wood River at Hwy 68 USGS Station (151168) (13141000)	.38			<.01		.36		.41		
6	FB-1	Warm Springs Creek 3.5 miles above Mouth	.78			<.01		.59		.69		
7	FB-2	Warm Springs Creek 1 mile above Mouth	1.04			.02		.90		1.48		
8	FB-6	Deer Creek 4 miles above Mouth at Clarendon Hot Springs	.41			<.01		.35		.43		
9	FB-7	Deer Creek 1 mile above Mouth	.48			<.01		.41		.35		
10	FM-1	Mud Creek at Melon Valley Road			1.31		.90		.90	1.01		

Table 2. Stream Fluoride Concentrations at Selected Stations in Idaho in 1984 and 1985, in mg/l.

	STATION *	DESCRIPTION	1/16	1/25	1/30	4/23	4/25	8/21	8/22	11/28	12/13	7/8/85
11	FM-3	Mud Creek 1 mile above Mouth (13094700)					.91		1.07	1.11		
12	FM-2	East Fork Mud Creek at Melon Valley Road below Buhl			1.01		1.24		1.23		.94	
13	FSF-1	Salmon Falls Creek at Balanced Rock Road			.74		.13		.59		.64	
14	FSF-2	Salmon Falls Creek 2 miles above Mouth at Old Highway 30 Bridge			1.00		.55		1.07		1.07	
15	FS-1	Snake River at Canyon Springs Golf Course in Twin Falls		.68			.77		.63		.75	.60
16	FS-2	Snake River below Rock Creek near Jerome		.71			.76		.60		.78	.63
17	FS-3	Snake River 5 miles North of Buhl at Bridge		.80			.76		.66		.84	.60
18	FS-4	Snake River at Highway 30 Bridge near Hagerman at Gridley Bridge (13134500)			.76		.75		.67		.80	.63
19	FS-5	Snake River South of Bliss at Shoestring Road Bridge			.70		.65		.69		.65	.64

The discharge from Deer Creek into the Big Wood River has no identified impact on the fluoride level in the river. This data is shown in Table 2 and measured between Stations FB-5 and FB-8 (see Figure 4 and 4a for locations of stations). There are no significant geothermal discharges noted between Stations FB-8 and FB-9 on the lower Big Wood River and the fluoride levels tend to drop a little between these stations (see Figures 4 and 5 for station locations).

Salmon Falls Creek Drainage - Twin Falls County, Idaho

A number of geothermal wells have been drilled along Salmon Falls Creek and their water discharged into the creek to later be picked up and used for irrigation by pumps. One such well is at sampling site FSF-1. The discharge only travels a few hundred feet before hitting the pump intakes. The discharged geothermal water and creek water mix and the fluorides are carried down past the pump intakes with the remaining stream flow. Because this area is water short the stream flows can drop to very low levels in the summer (see Appendix B). The Salmon Falls Creek Dam has only filled once in 70 years and is mainly used for irrigation supply. Salmon Falls Creek is used to deliver some of this stored irrigation water.

Table 2 indicates that Salmon Falls Creek is at or near the fluoride limit of 1 to 1.5 mg/l most of the year. It is therefore not recommended for increased geothermal loadings. Figure 7 and 7a shows the locations of sampling sites FSF-1 and FSF-2.

Mud Creek Drainage - Twin Falls County, Idaho

Mud Creek receives geothermal water from several wells. Two of these wells were developed by Wayne Skeem to increase flow for his hydroelectric plant on Mud Creek. The total flow from these two wells is about 7 cfs with a fluoride concentration of about 2.3 mg/l (see Appendix A for fluoride analysis).

Table 2 indicates that Mud Creek and all its tributaries to be at or near the fluoride limit of 1 to 1.5 mg/l all year round and therefore it should not receive any additional geothermal discharges. The locations of the three sampling stations are shown in Figure 6.

Snake River Drainage - Twin Falls, Jerome, and Gooding Counties, Idaho (Twin Falls to Bliss)

The Snake River receives geothermal discharges from a number of sources. In the Twin Falls area (near site FS-1, Figure 8) several large geothermal wells are developed. The Canyon Springs Golf Course, Royal Catfish, and College of Southern Idaho wells have a total output of over 25 cfs with a fluoride concentration of about 15 mg/l. Because of mixing in the river the high fluorides only effect the bank areas before the flow from Rock Creek enters (see Figure 9 for location of Rock Creek).

Again, near Buhl and Bliss additional geothermal flows enter the Snake River from private homes, Leo Ray's catfish farm, numerous greenhouses, and public hot pools (Banburys and Sligars). Because of the large flows in the river at this point, however, Table 2 shows that fluoride levels are not a problem in the main Snake River. The geothermal water in the Buhl/Bliss area have fluoride levels generally less than 3 mg/l (see Appendix A, Kanaka Rapids for typical fluoride data). Figures 10 and 11 show the locations of these lower sampling sites on the Snake River.

Temperature

Since all the streams are protected for Cold Water Biota and Salmonid Spawning the temperatures must comply with the following:

1) Be protected to 13° C (55.4° F) for Coho and Mountain Whitefish (egg development) for the months of January and February.

2) Be protected to 13° C (55.4° F) for Dolly Varden, Mountain Whitefish, Coho, Brook Trout, Brown Trout, and Rainbow Trout (spawning) for the months October, November and December.

3) Be protected to 13° C (55.4° F) for Rainbow Trout (spawning) for the months of March, April, and May.

4) Be protected to 22° C (71.6° F) for fish growth for the months of June, July, August, and September.

The above table indicates that the streams should not exceed 13° C (55.4° F) from October through May since this is the spawning and egg development period for salmonid, and the stream not exceed 22° C (71.6° F) during the remainder of the year (June through September) since this is the salmonid growing period.

Appendix B indicates that none of the streams temperatures exceeded these values during the study. It should be noted, however, that during hot, low flow conditions some streams may be effected. Of particular concern would be the Snake River, Salmon Falls Creek, and Mud Creek. The temperature of the geothermal water ranged from 32° C (89.6° F) to 60° C (140° F).

CONCLUSIONS

1) Geothermal discharges have increased fluoride levels in some streams to the maximum recommended limit of 1 to 1.5 mg/l. These limits appear to be as follows:

   a) Mud Creek has continually high fluoride levels all year, no additional discharges should be allowed which increase ambient fluoride.

   b) Warm Springs Creek and Salmon Falls Creek have high fluoride levels from summer through winter. No additional discharges except during the period of high spring flows should be allowed.

   c) Deer Creek: New discharges should not be allowed which increase fluoride levels in the Big Wood River.

   d) Big Wood River: No discharges should be allowed which would increase the fluoride in the river.

   e) Snake River: Additional discharges may be allowed. The river upstream of Rock Creek may be limited during times of low flows.

2) Temperature does not appear to be a limiting factor. However, additional monitoring needs to be done during the hot summer and when stream flows are low.

RECOMMENDATONS

1) Discharges of geothermal waters should be limited and controlled to insure that beneficial uses of area streams are protected.

2) The Idaho Department of Water Resources and the U. S. Environmental Protection Agency should take action to control the development and future discharge to area streams which need protection.

3) Additional monitoring is needed during the hot summers to determine the impact geothermal discharges have on the receiving streams.

4) Additional monitoring is needed to determine what effects fluoride has on Cold Water Biota in area streams. A bioassay study to determine the impact of geothermal discharges on area streams is recommended.

SUMMARY

Geothermal discharges which are high in fluorides are impacting South Central Idaho streams. No additional geothermal discharges should be allowed on a year round basis to the following streams:

1) Mud Creek near Buhl, Idaho.

2) Warm Springs Creek near Ketchum, Idaho.

3) Salmon Falls Creek near Castleford, Idaho.

Other area streams have a limited ability to accept geothermal discharge water. All geothermal discharges should be permitted through the U. S. Environmental Protection Agency on a case by case basis to control these types of discharges.

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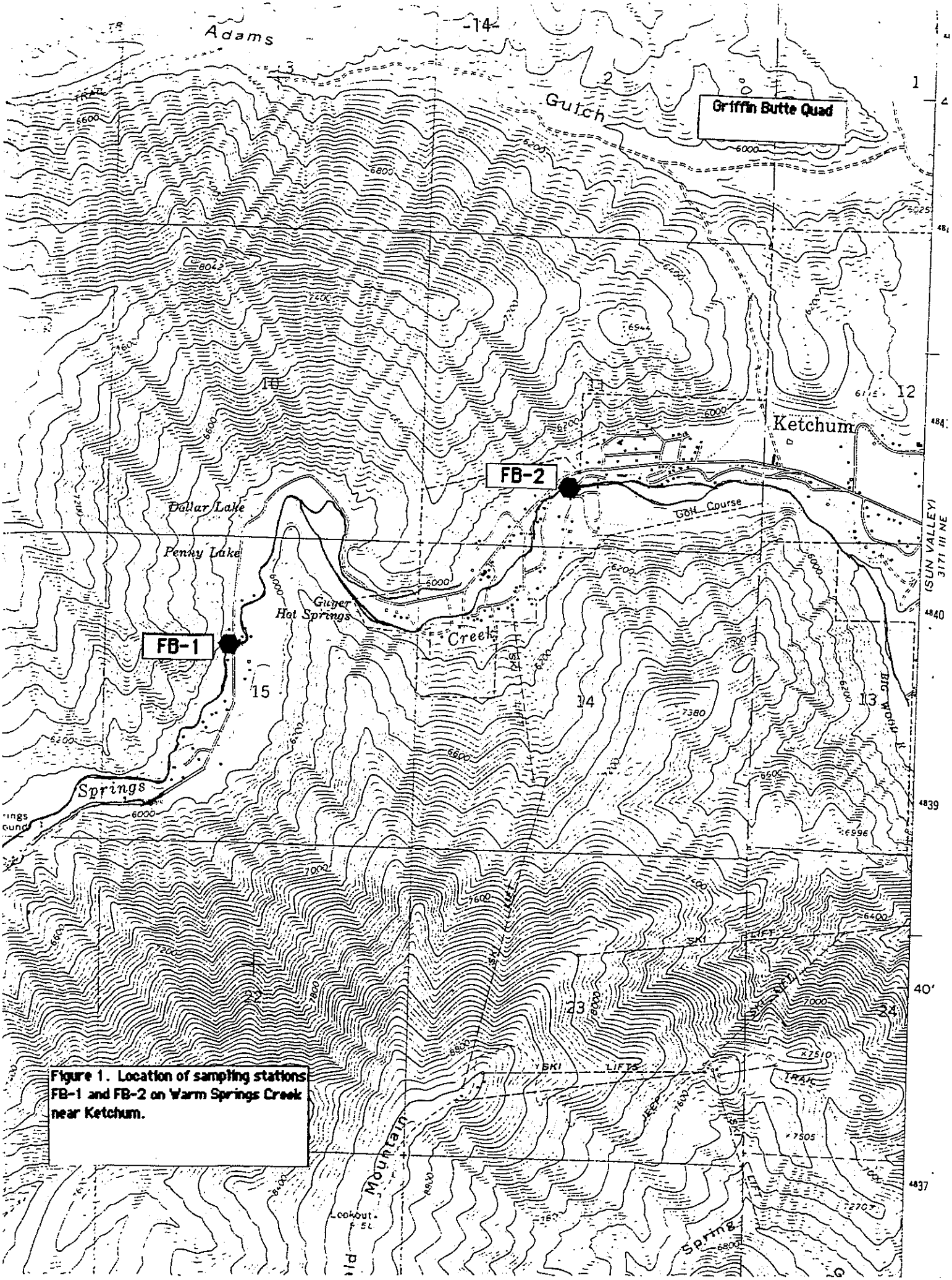

Figure 1. Location of sampling stations FB-1 and FB-2 on Warm Springs Creek near Ketchum.

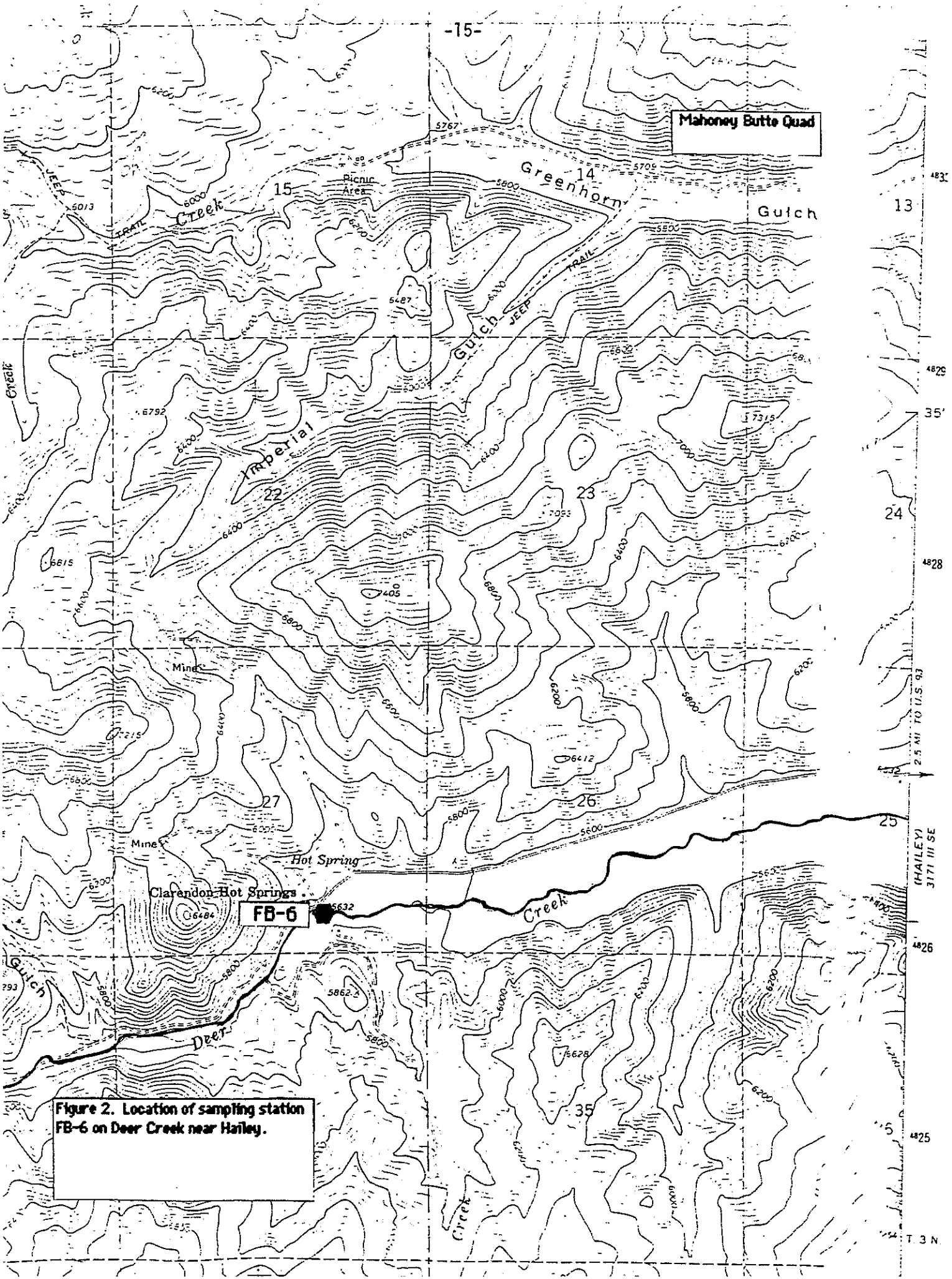

Figure 2. Location of sampling station FB-6 on Deer Creek near Hailey.

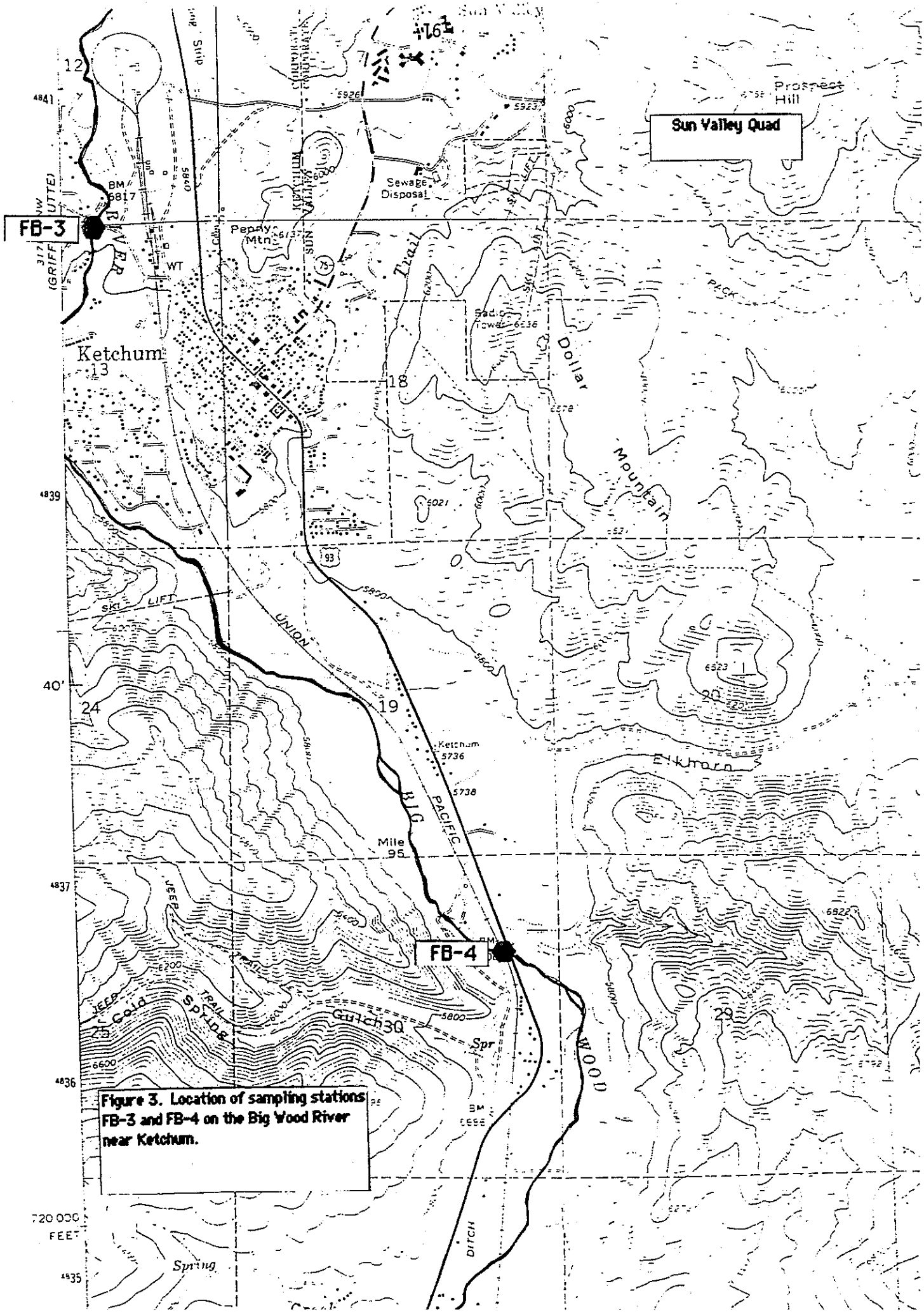

Figure 3. Location of sampling stations FB-3 and FB-4 on the Big Wood River near Ketchum.

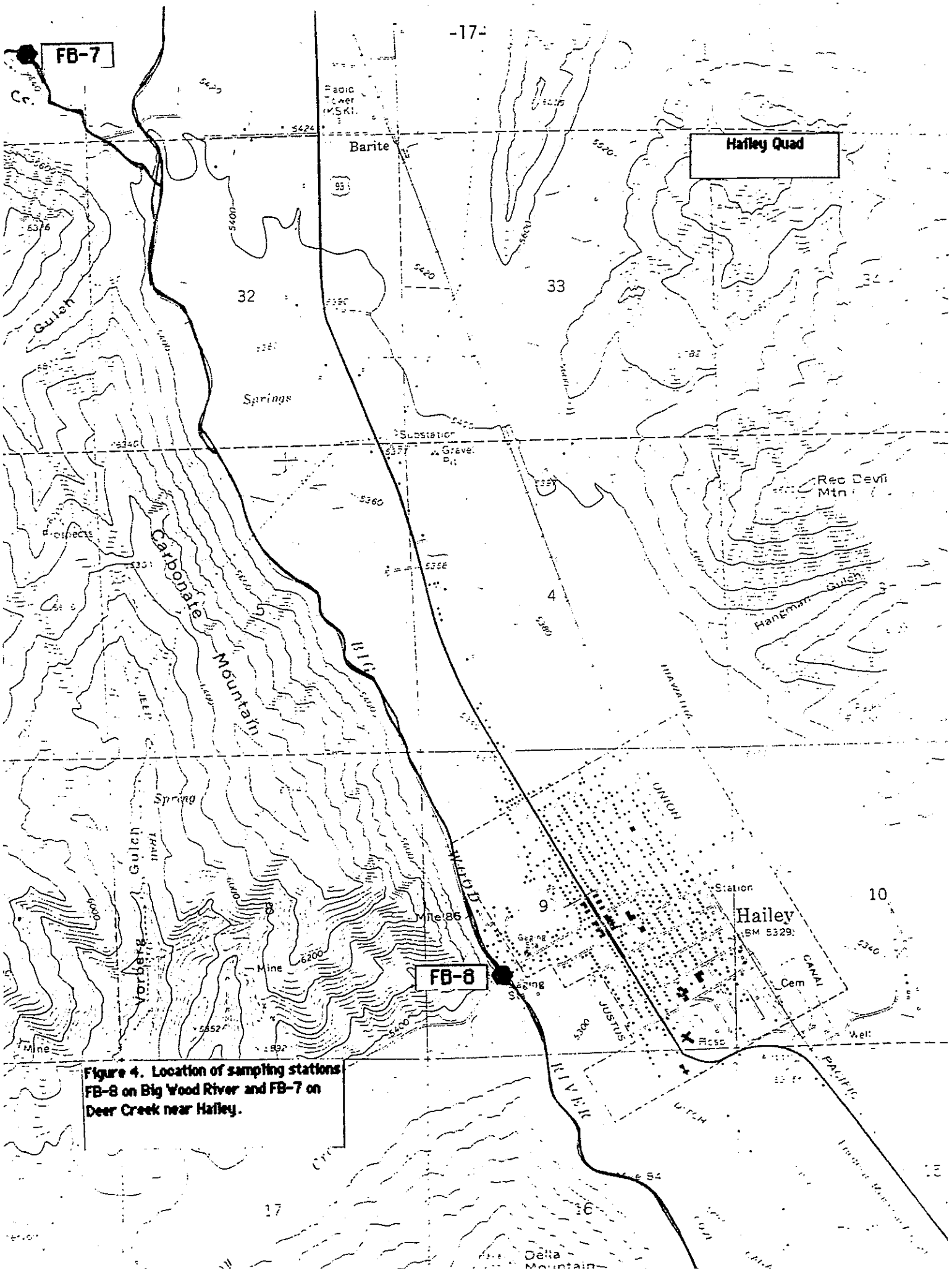

Figure 4. Location of sampling stations FB-8 on Big Wood River and FB-7 on Deer Creek near Hailey.

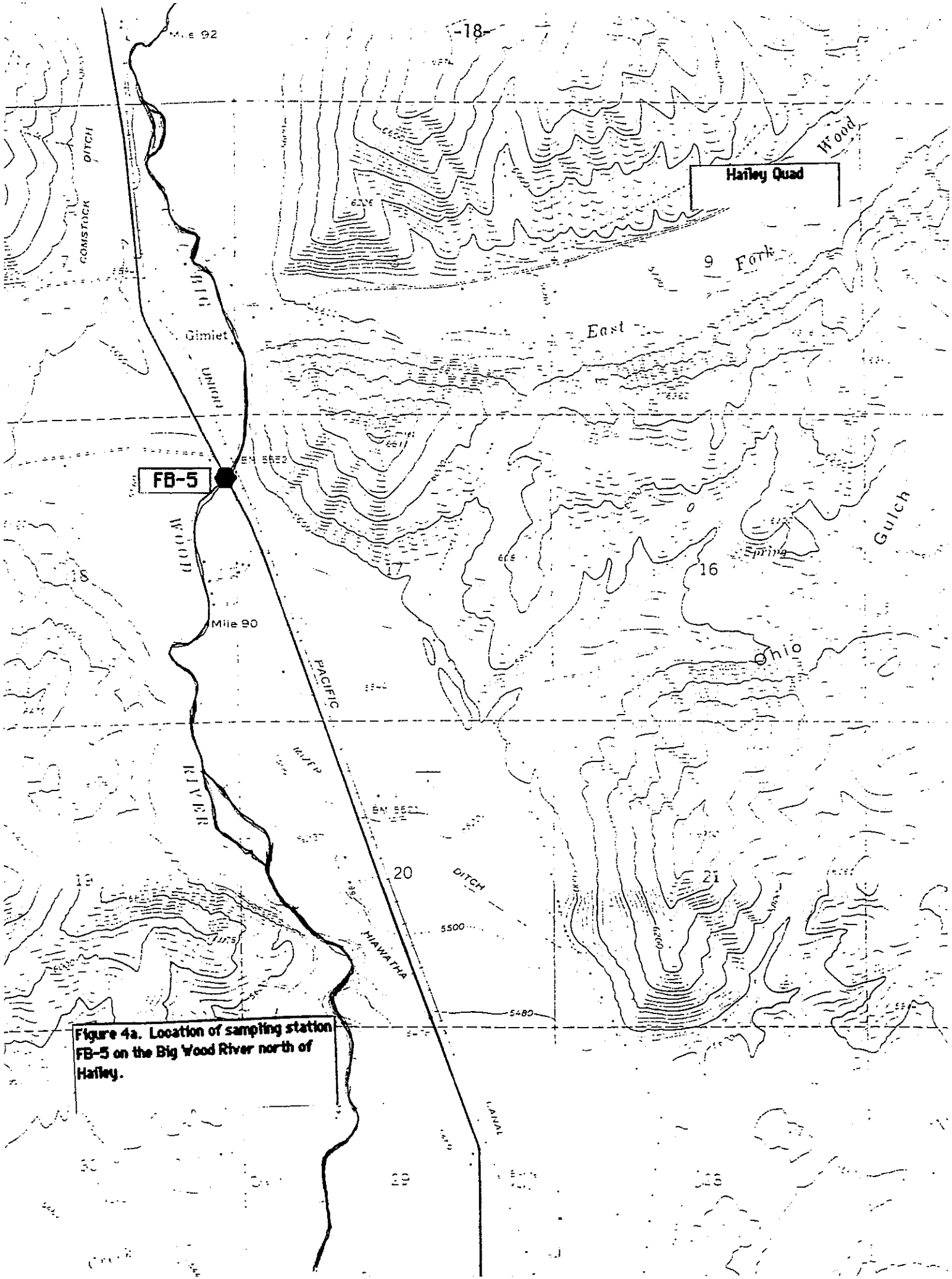

Figure 4a. Location of sampling station FB-5 on the Big Wood River north of Hailey.

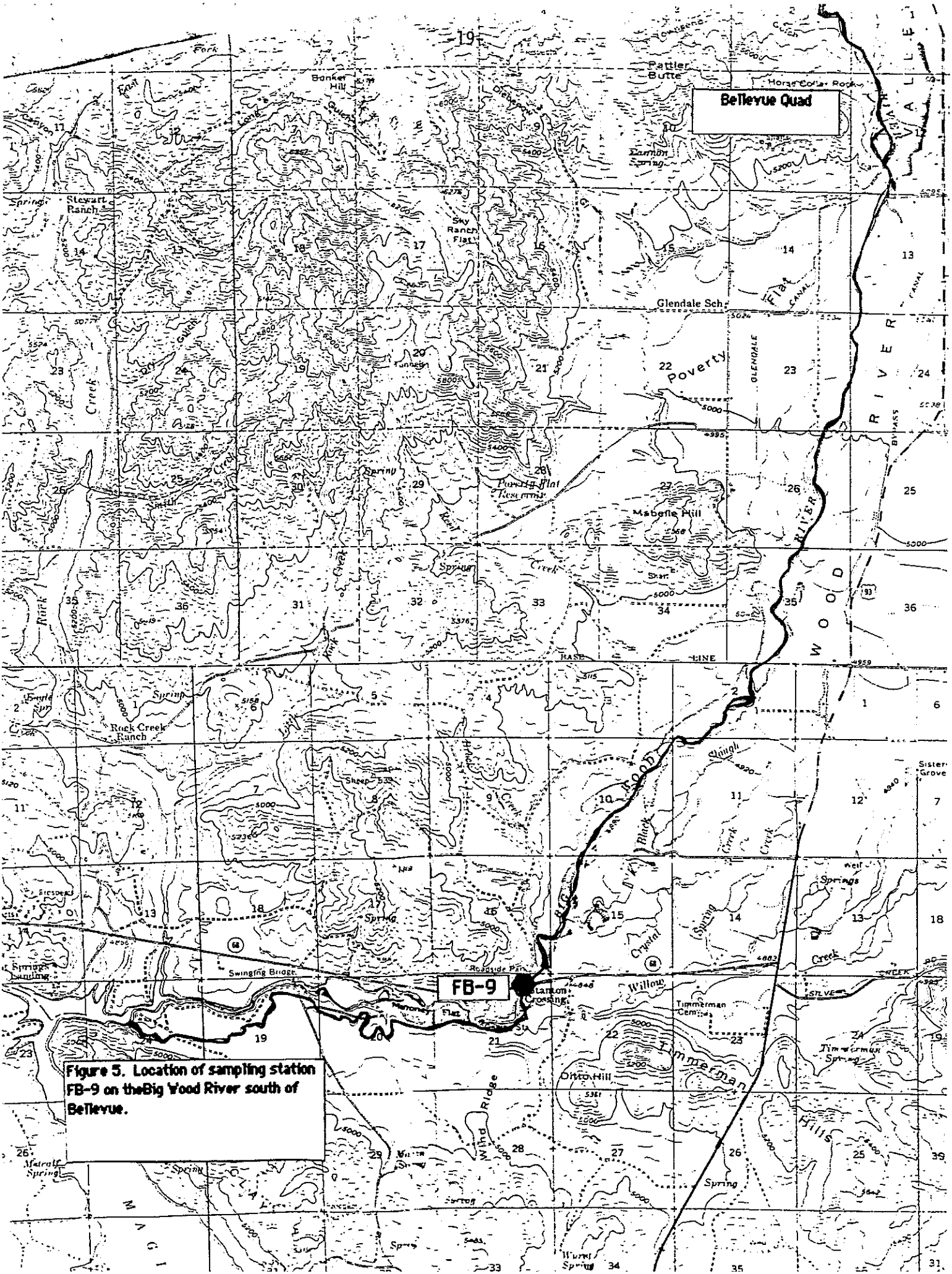

Figure 5. Location of sampling station FB-9 on theBig Wood River south of Bellevue.

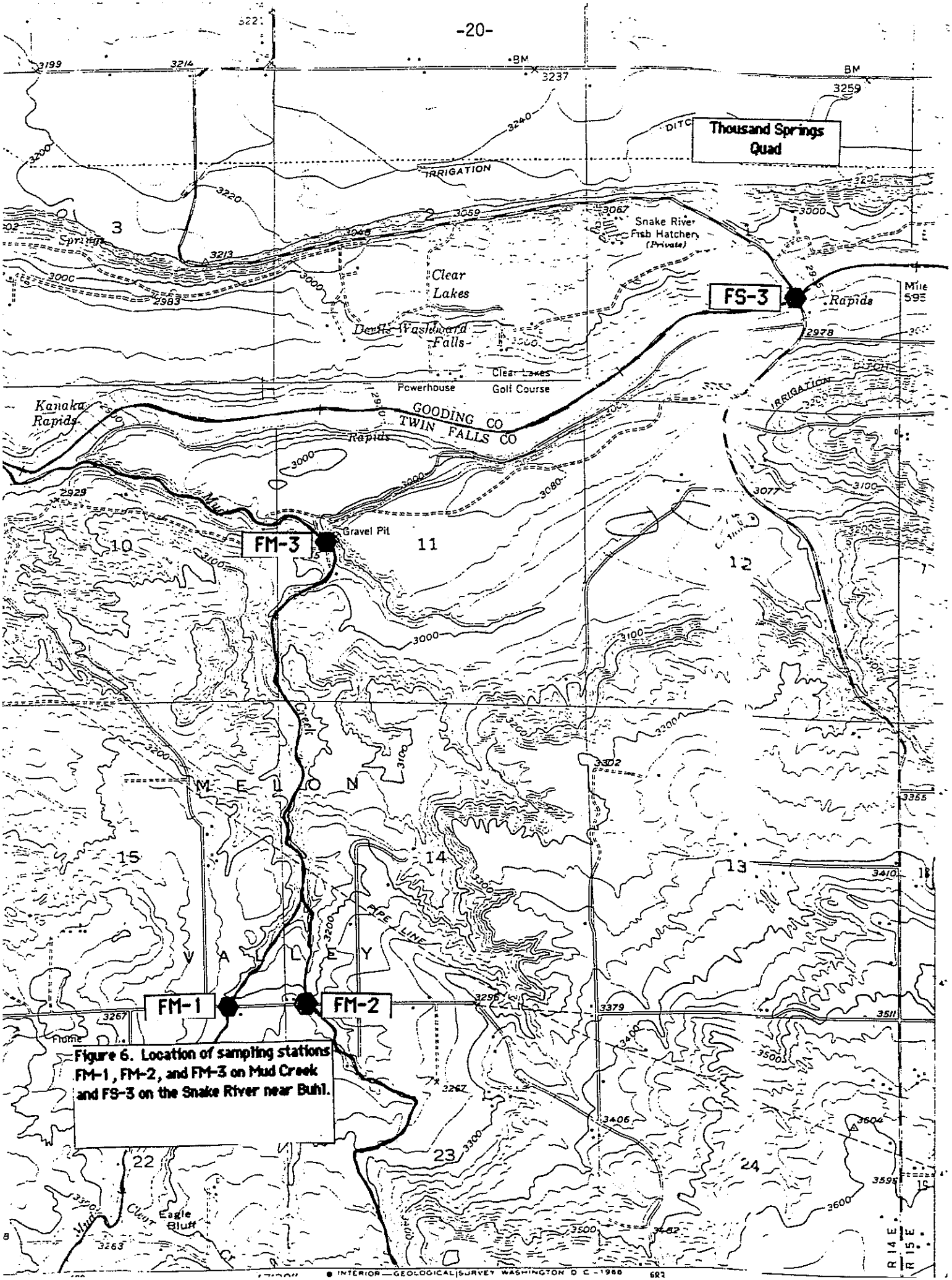

Figure 6. Location of sampling stations FM-1, FM-2, and FM-3 on Mud Creek and FS-3 on the Snake River near Buhl.

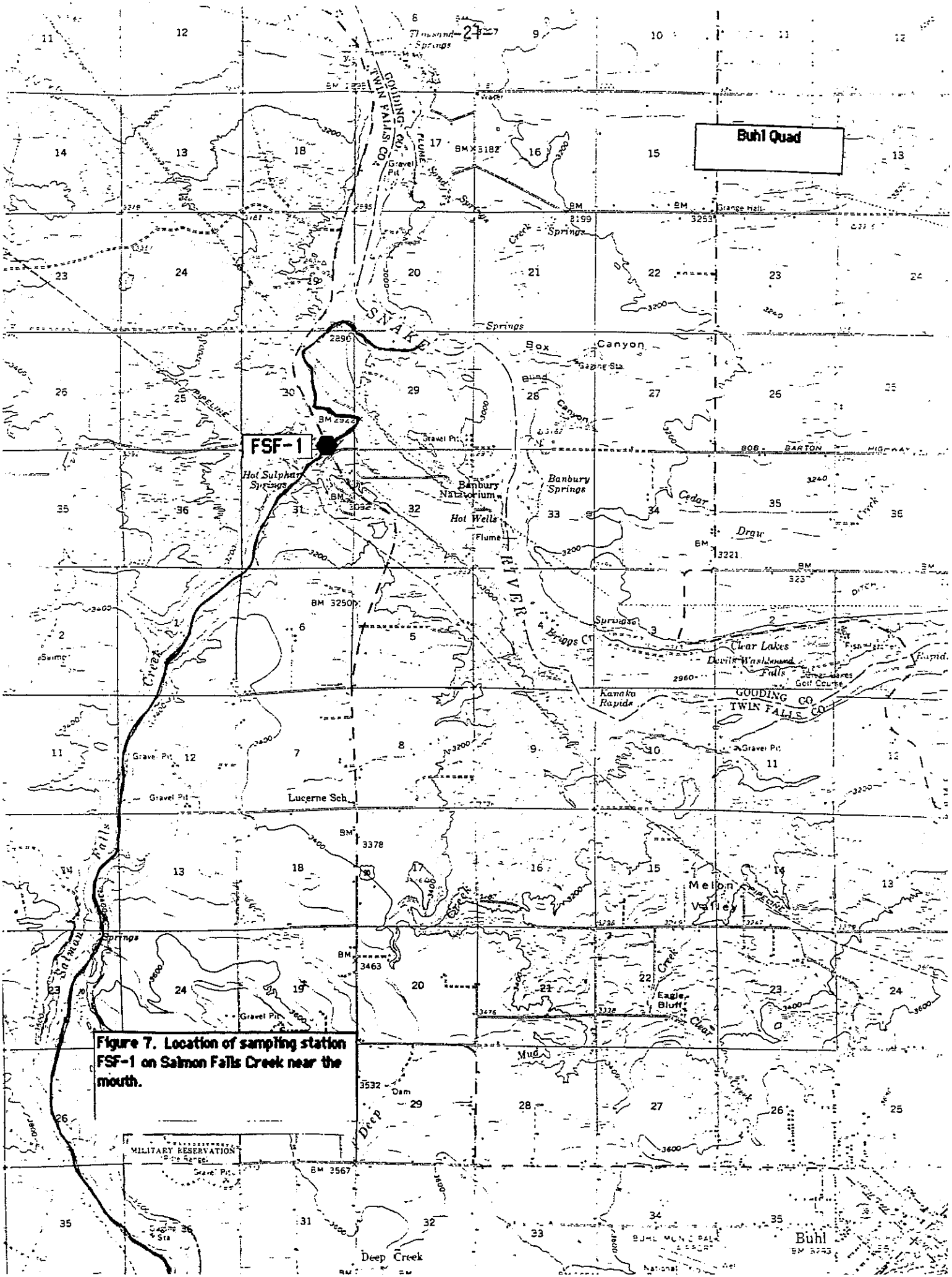

Figure 7. Location of sampling station FSF-1 on Salmon Falls Creek near the mouth.

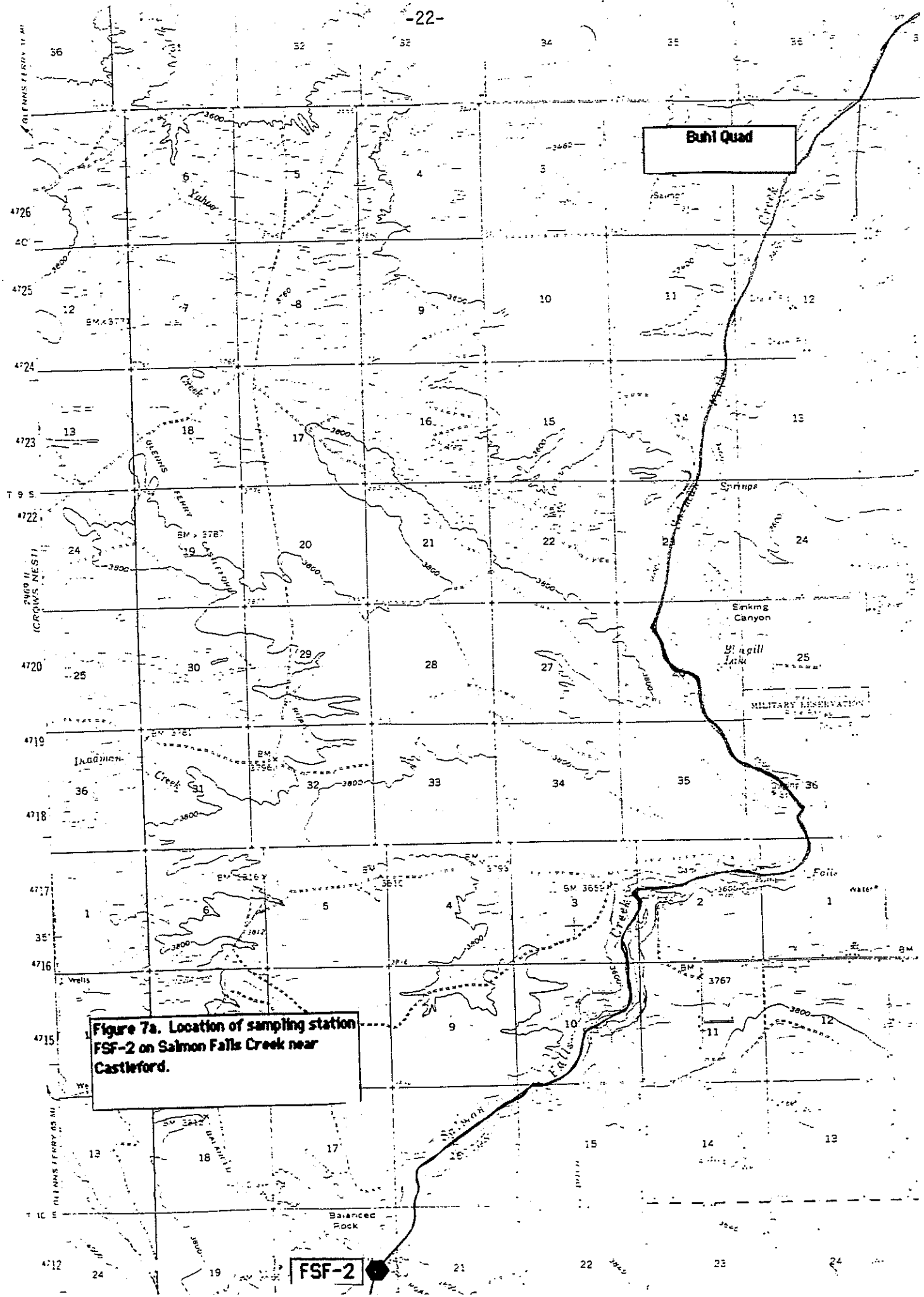

Figure 7a. Location of sampling station FSF-2 on Salmon Falls Creek near Castleford.

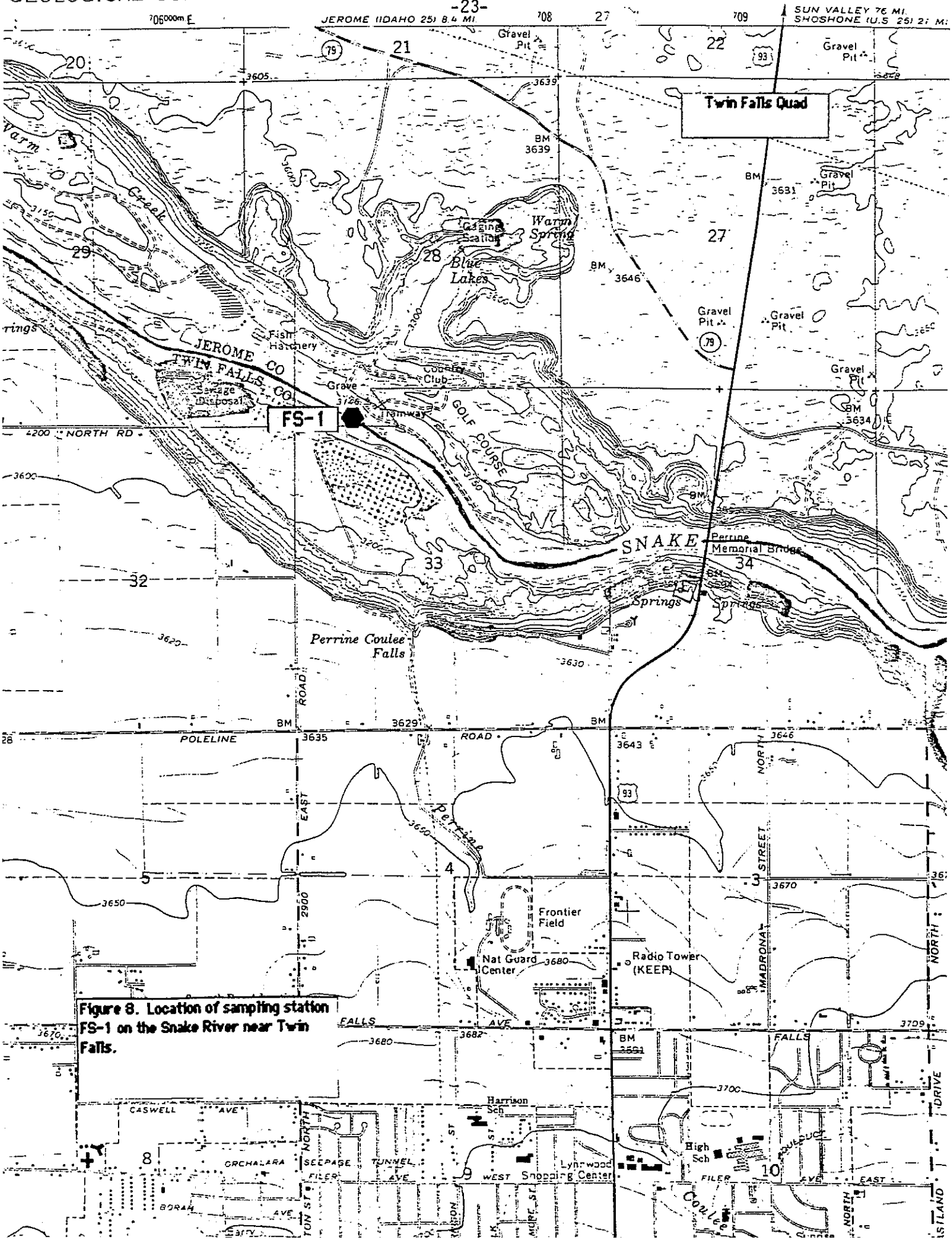

Figure 8. Location of sampling station FS-1 on the Snake River near Twin Falls.

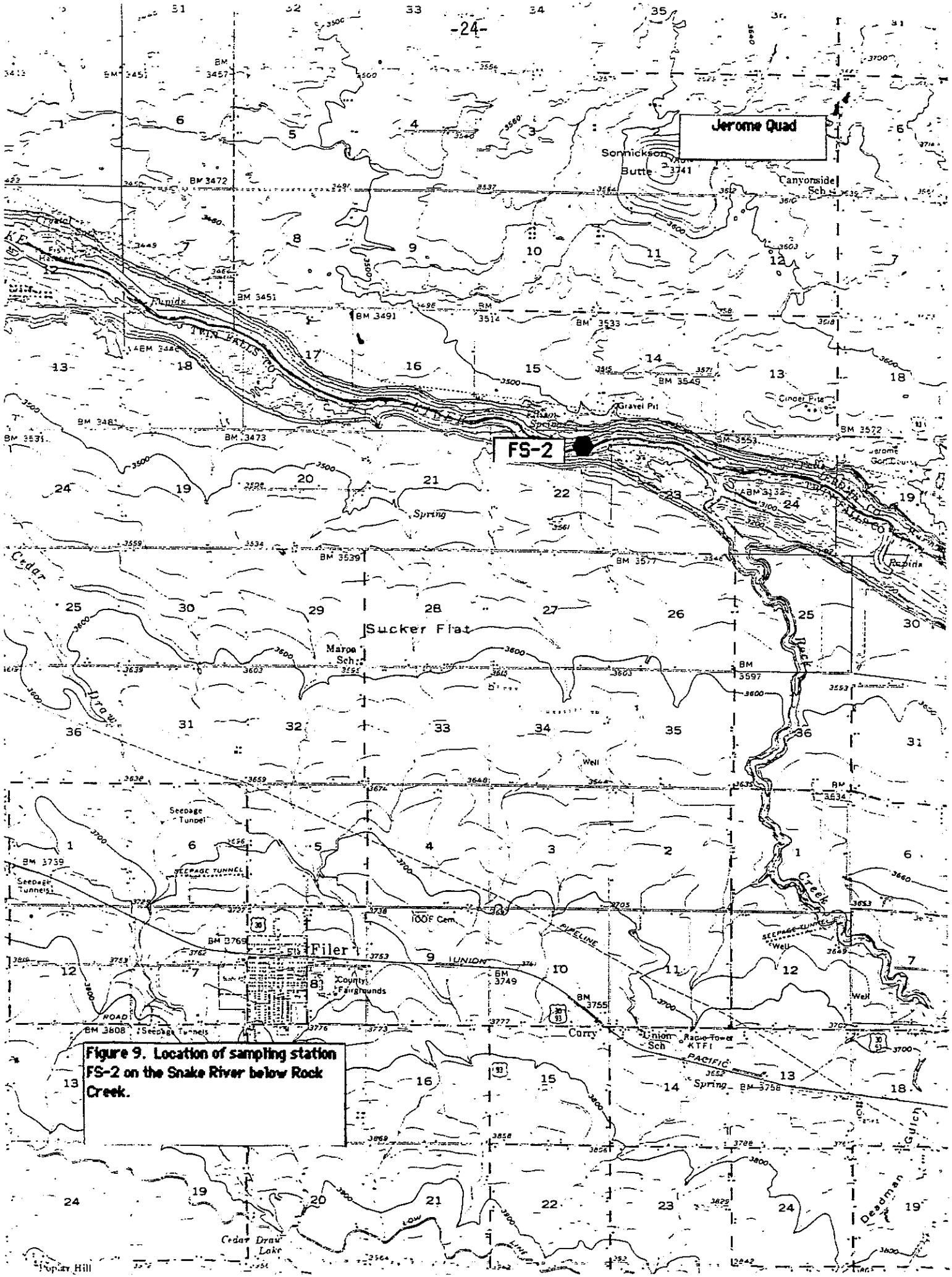

Figure 9. Location of sampling station FS-2 on the Snake River below Rock Creek.

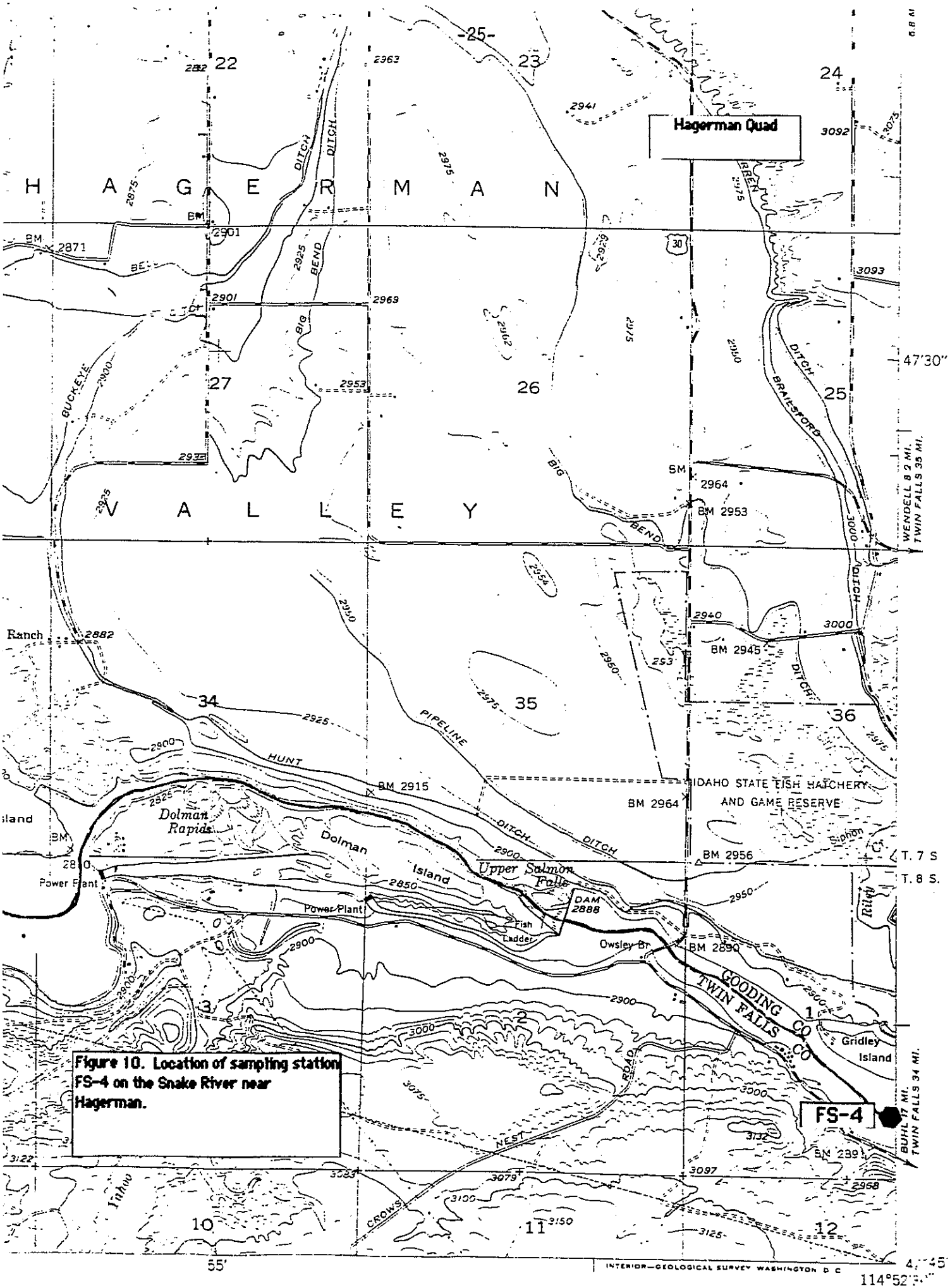

Figure 10. Location of sampling station FS-4 on the Snake River near Hagerman.

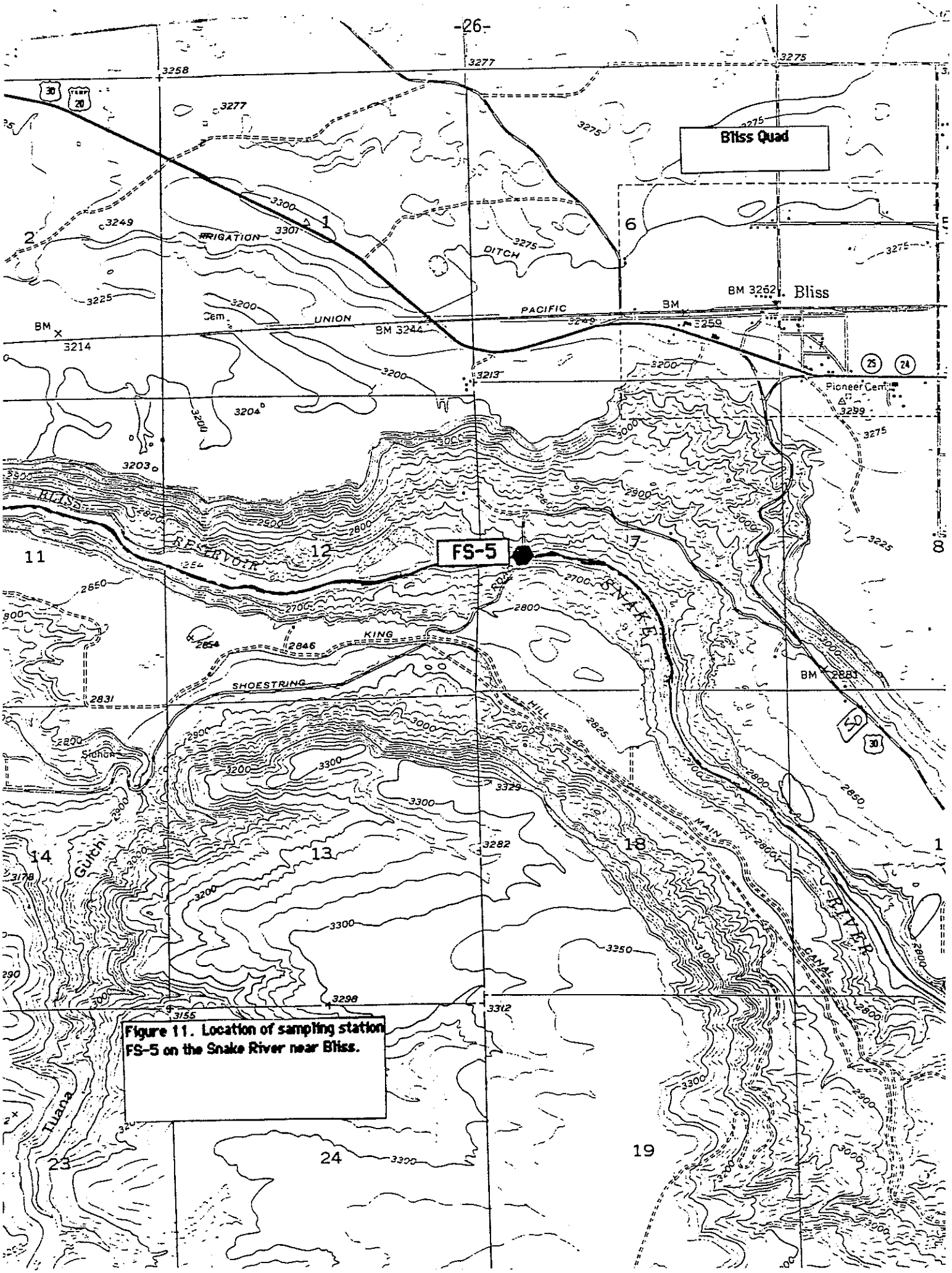

Figure 11. Location of sampling station FS-5 on the Snake River near Bliss.

APPENDIX A

FLUORIDE ANALYSIS - GEOTHERMAL SPRINGS/WELLS

SOURCE	DATE SAMPLED	FLUORIDES MG/L
Guyer Hot Springs	1/16/84	16.2
Guyer Hot Springs	4/4/85	16.7
Clarendon Hot Springs	1/16/84	15.6
Skeem Well	10/12/82	2.14
Skeem Well #2	8/5/83	2.40
Skeem Well #3	8/5/83	2.45
Kanaka Rapids Ranch	7/17/81	2.58

APPENDIX B

Complete printout of data, including flows, temperature, oxygen levels, and chemical analysis on all monitoring stations

BIG WOOD RIVER .5 MILES ABOVE WARM SPRINGS CREEK ABOVE KETCHUM

INITIAL DATE	84/01/16	84/04/23	84/08/21	84/11/28
WATER TEMP. (CENT.)	0	7.5		0.2
WATER TEMP. (FAHN.)	32	45.5		32.4
STREAM FLOW (INST-CFS)	250		200	155
CONDUCTIVITY AT 25C (MICROMHO)	222			
DO (MG/L)	12.1	10.8		14.8
DO (SATURATION %)	102.6	112.3		125.5
pH (SU)	8.1	7.5	8.2	8.4
CALCIUM (CA-TOT - MG/L)		25.6	31.2	31
FLUORIDE (F, TOTAL - MG/L)	0.26	0.01	0.21	0.24
ARSENIC (AS,TOT - UG/L)	10			
RESIDUE (DISS-180 C - MG/L)		112	130	123

STATION FB-3

BIG WOOD RIVER 2 MILES BELOW KETCHUM

INITIAL DATE	84/01/16	84/04/23	84/08/21	84/11/28
WATER TEMP. (CENT.)	0.3	8.2		1.3
WATER TEMP. (FAHN.)	32.5	46.8		34.3
STREAM FLOW (INST-CFS)	250		220	175
CONDUCTIVITY AT 25C (MICROMHO)	273			
DO (MG/L)	12.6	10.6		14.8
DO (SATURATION %)	106.4	109.9		128.5
pH (SU)	8.1	7.6	8.3	8.3
CALCIUM (CA-TOT - MG/L)		27.2	36	34
FLUORIDE (F, TOTAL - MG/L)	0.52	0.01	0.35	0.59
ARSENIC (AS,TOT - UG/L)	10			
RESIDUE (DISS-180 C - MG/L)		125	149	151

STATION FB-4

BIG WOOD RIVER .5 MILES BELOW EAST FORK BIG WOOD RIVER

INITIAL DATE	84/01/16	84/04/23	84/06/21	84/11/28
WATER TEMP. (CENT.)	0	8.8		0.1
WATER TEMP. (FAHN.)	32	47.8		32.2
STREAM FLOW (INST-CFS)	350		200	200
CONDUCTIVITY AT 25C (MICROMHO)	303			
DO (MG/L)	12.2	10.6		15.9
DO (SATURATION %)	102.3	111.8		133.3
pH (SU)	8	7.7	8.3	8.3
CALCIUM (CA-TOT - MG/L)		28.8	35.2	38
FLUORIDE (F, TOTAL - MG/L)	0.44	0.02	0.34	0.54
ARSENIC (AS,TOT - UG/L)	10			
RESIDUE (DISS-180 C - MG/L)		143	159	161

STATION FB-5

BIG WOOD RIVER AT HAILEY USGS STATION

INITIAL DATE	84/01/16	84/04/23	84/08/21	84/11/28
WATER TEMP. (CENT.)	0	5.8		0.9
WATER TEMP. (FAHN.)	32	42.4		33.6
STREAM FLOW (INST-CFS)	450		175	225
CONDUCTIVITY AT 25 C (MICROMHO)	302			
DO (MG/L)	12	11.1		14.2
DO (SATURATION %)	99.8	107.9		121.5
pH (SU)	7.8	7.5	8.1	8.4
CALCIUM (CA-TOT - MG/L)		32.8	40	40
FLUORIDE (F, TOTAL - MG/L)	0.45	0.01	0.38	0.43
ARSENIC (AS,TOT - UG/L)	10			
RESIDUE (DISS-180 C - MG/L)		152	166	166

STATION FB-8

BIG WOOD RIVER AT HIGHWAY 68 USGS STATION

INITIAL DATE	84/01/16	84/04/23	84/08/21	84/11/28
WATER TEMP. (CENT.)	0	6.8		0.1
WATER TEMP. (FAHN.)	32	44.2		32.2
STREAM FLOW (INST-CFS)	400		125	275
TURB. TRBIDMTR (HACH FTU)	0.3			
CONDUCTIVITY AT 25C (MICROMHO)	311			
DO (MG/L)	12	10.1		14.2
DO (SATURATION %)	98.7	99.4		116.8
COD-LOW LEVEL (MG/L)	3.2			
pH (SU)	8	7.5	8	8.2
LAB pH (SU)	8.1			
T. ALKALINITY CACO3 (MG/L)	142			
NH3+NH4 - N TOTAL (MG/L)	0.081			
UN-IONZD NH3-NH3 (MG/L)	0.001			
TOTAL KJELDAHL N (MG/L)	0.13			
NO2 & NO3 N-TOTAL (MG/L)	0.208			
PHOS-TOT (MG/L - P)	0.03			
PHOS-TOT HYDRO (MG/L - P)	0.02			
TOT HARD CACO3 (MG/L)	160			
CALCIUM (CA-TOT - MG/L)	46	35.2	44.8	44
MAGNESIUM (MG,TOT - MG/L)	10			
SODIUM (NA,TOT - MG/L)	4.6			
POTASSIUM (K,TOT - MG/L)	1			
CHLORIDE (TOTAL - MG/L)	2.8			
SULFATE (SO4-TOT - MG/L)	20			
FLUORIDE (F,TOTAL - MG/L)	0.38	0.01	0.36	0.41
SILICA (TOTAL - MG/L)	14			
ARSENIC (AS,TOT - UG/L)	10			
BORON (B,TOT - UG/L)	130			
CADMIUM (CD, DISS - UG/L)	1			
CADMIUM (CD, TOT - UG/L)	1			
CHROMIUM (HEX-VAL - UG/L)	50			
CHROMIUM (CR,TOT - UG/L)	50			
COPPER, (CU, DISS - UG/L)	10			
COPPER (CO,TOT - UG/L)	10			
IRON (FE,TOT - UG/L)	10			
LEAD (PB,TO - T UG/L)	50			
MANGANESE (MN - UG/L)	10			
SILVER (AG,TOT - UG/L)	1			
ZINC (ZN,TOT - UG/L)	4			
RESIDUE (DISSS-180 C - UG/L)		160	175	177
PHOS-T ORTHO (MG/L)	0.003			
MERCURY (HG,TOTAL - UG/L)	0.5			

STATION FB-9

WARM SPRINGS CREEK 3.5 MILES ABOVE MOUTH

INITIAL DATE	84/01/16	84/04/23	84/08/21	84/11/28
WATER TEMP. (CENT.)	0.2	8.5		1.5
WATER TEMP. (FAHN.)	32.4	47.3		34.7
STREAM FLOW (INST-CFS)	50	250	25	24
CONDUCTIVITY AT 25C (MICROMHO)	220			
DO (MG/L)	11.4	11.8		13.8
DO (SATURATION %)	97.2	126.7		124.5
pH (SU)	8	7.5	8.2	8.3
CALCIUM (CA-TOT - MG/L)		19.2	29.6	30
FLUORIDE (F,TOTAL - MG/L)	0.76	0.01	0.59	0.69
ARSENIC (AS,TOT - UG/L)	10			
RESIDUE (DISS-180 C - MG/L)		107	139	134

STATION FB-1

WARM SPRINGS CREEK 1 MILE ABOVE MOUTH

INITIAL DATE	84/01/16	84/04/23	84/06/21	84/11/26
WATER TEMP. (CENT.)	1.5	9.2		3.1
WATER TEMP. (FAHN.)	34.7	48.6		37.6
STREAM FLOW (INST-CFS)	50	300	57	12.5
CONDUCTIVITY AT 25C (MICROMHO)	236			
DO (MG/L)	11.4	10.4		13.6
DO (SATURATION %)	102.5	111.2		125
pH (SU)	8.1	7.5	8.4	8.3
CALCIUM (CA-TOTAL - MG/L)		20.8	30.4	29
FLUORIDE (F,TOTAL - MG/L)	1.04	0.02	0.9	1.46
ARSENIC (AS,TOT - UG/L)	10			
RESIDUE (DISS-180 C - MG/L)		110	148	142

STATION FB-2

DEER CREEK 4 MILES ABOVE MOUTH AT CLARENDON HOT SPRINGS

INITIAL DATE	84/01/16	84/04/23	84/08/21	84/11/28
WATER TEMP. (CENT.)	0	5.2		0
WATER TEMP. (FAHN.)	32	41.4		32
STREAM FLOW (INST-CFS)	25	50	16.5	3
CONDUCTIVITY AT 25C (MICROMHO)	275			
DO (MG/L)	11.4	10.6		12.2
DO (SATURATION %)	96	101.8		102.8
pH (SU)	7.9	7.4	8.6	8.1
CALCIUM (CA-TOT - MG/L)		33.6	44.8	44
FLUORIDE (F,TOTAL - MG/L)	0.41	0.01	0.35	0.43
ARSENIC (AS,TOT - UG/L)	10			
RESIDUE (DISS-180 C - MG/L)		142	173	168

STATION FB-6

DEER CREEK 1 MILE ABOVE MOUTH

INITIAL DATE	84/01/16	84/04/23	84/08/21	84/11/28
WATER TEMP. (CENT.)	0	7.5		2.5
WATER TEMP. (FAHN.)	32	45.5		36.5
STREAM FLOW (INST-CFS)	25	100	4.2	1.6
CONDUCTIVITY AT 25C (MICROMHO)	268			
DO (MG/L)	12.2	10.8		13.8
DO (SATURATION %)	102	110.8		124.8
pH (SU)	8	7.4	8.2	8.4
CALCIUM (CA-TOT - MG/L)		32.8	43.2	44
FLUORIDE (F,TOTAL - MG/L)	0.48	0.01	0.41	0.35
ARSENIC (AS,TOT - MG/L)	10			
RESIDUE (DISS-180 C - MG/L)		148	173	170

STATION FB-7

MUD CREEK AT MELON VALLEY ROAD

INITIAL DATE	84/01/30	84/04/25	84/08/22	84/12/13
WATER TEMP. (CENT.)	7.9	7.5	18.8	6.5
WATER TEMP. (FAHN.)	46.2	45.5	65.8	43.7
STREAM FLOW (INST-CFS)	30	20	30	25
CONDUCTIVITY AT 25C (MICROMHO)	1,068			
DO (MG/L)	10.5	12.2	8.8	10.6
DO (SATURATION %)	99.1	115.2	105.2	97.6
pH (SU)	7.9	8.1	8.4	8.2
CALCIUM (CA-TOT - MG/L)		76.8	83.2	90
FLUORIDE (F,TOTAL - MG/L)	1.31	0.9	0.9	1.01
ARSENIC (AS,TOT - UG/L)	0			
RESIDUE (DISS-180 C - MG/L)		530	537	609

STATION FM-1

MUD CREEK 1 MILE ABOVE MOUTH

INITIAL DATE	84/01/30	84/04/25	84/08/22	84/12/13
WATER TEMP. (CENT.)	9.3	8.5	19.8	7.3
WATER TEMP. (FAHN.)	48.7	47.3	67.6	45.1
STREAM FLOW (INST-CFS)	35	25	35	37
DO (MG/L)	10.2	10.8	8.4	10.8
DO (SATURATION %)	98	103.7	101.7	98.6
pH (SU)	8	8.2	8.6	8.2
CALCIUM (CA-DISS - MG/L)		60.8		
CALCIUM (CA-TOT - MG/L)			75.2	81
FLUORIDE (F-TOTAL - MG/L)		0.91	1.07	1.11
ARSENIC (AS-TOT - UG/L)	11			
RESIDUE (DISS-180 C - MG/L)		501	551	610

STATION FM-3

EAST FORK MUD CREEK AT MELON VALLEY ROAD BELOW BUHL

INITIAL DATE	84/01/30	84/04/25	84/08/22	84/12/13
WATER TEMP. (CENT.)	9	10.2	18.8	6.2
WATER TEMP. (FAHN.)	48.2	50.4	65.8	43.2
STREAM FLOW (INST-CFS)	1	0.5	3	0.5
CONDUCTIVITY AT 25C (MICROMHO)	824			
DO (MG/L)	9.8	11	8.3	9.8
DO (SATURATION %)	94.9	109.4	99.2	88.1
pH (SU)	7.8	8	8.1	8
CALCIUM (CA-TOT - MG/L)		96	101	106
FLUORIDE (F,TOTAL - MG/L)	1.01	1.24	1.23	0.94
ARSENIC (AS,TOT - UG/L)	18			
RESIDUE (DISS-180 C - MG/L)		699	716	784

STATION FM-2

SALMON FALLS CREEK AT BALANCED ROCK ROAD

INITIAL DATE	84/01/30	84/04/25	84/08/22	84/12/13
WATER TEMP. (CENT.)	5.9	6	19.2	3.5
WATER TEMP. (FAHN.)	42.6	42.8	66.6	38.3
STREAM FLOW (INST-CFS)	100		5	20
CONDUCTIVITY AT 25C (MICROMHO)	604			
DO (MG/L)	11.6	11.2	9.1	12.1
DO (SATURATION %)	105	101.4	109.6	104.6
pH (SU)	7.4	8.3	8.4	8.3
CALCIUM (CA-TOT - MG/L)		28.8	48	51
FLUORIDE (F,TOTAL - MG/L)	0.74	0.13	0.59	0.64
ARSENIC (AS,TOT UG/L)	0			
RESIDUE (DISS-180 C - MG/L)		227	322	364

STATION FSF-1

SALMON FALLS CREEK 2 MILES ABOVE MOUTH AT OLD HIGHWAY 30 BRIDGE

INITIAL DATE	84/01/30	84/04/25	84/08/22	84/12/13
WATER TEMP. (CENT.)	7	6.5	18.5	5.9
WATER TEMP. (FAHN.)	44.6	43.7	65.3	42.6
STREAM FLOW (INST-CFS)	150		50	55
CONDUCTIVITY AT 25C (MICROMHO)	777			
DO (MG/L)	12.4	11.4	9.9	13.2
DO (SATURATION %)	112.9	103.8	117	117.4
pH (SU)	7.9	8.2	8.4	8.4
CALCIUM (CA-TOT - MG/L)		46.4	68	69
FLUORIDE (F,TOTAL - MG/L)	1	0.55	1.07	1.07
ARSENIC (AS,TOT - UG/L)	10			
RESIDUE (DISS-180 C - MG/L)		348	490	537

STATION FSF-2

SNAKE RIVER AT CANYON SPRINGS GOLF COURSE IN TWIN FALLS

INITIAL DATE	84/01/25	84/04/25	84/08/22	84/12/13
WATER TEMP. (CENT.)	1.2	7	18.4	0.5
WATER TEMP. (FAHN.)	34.2	44.6	65.1	32.9
STREAM FLOW (INST-CFS)	15,700		2,500	5,000
CONDUCTIVITY AT 25C (MICROMHO)	435			
DO (MG/L)	15.8	12.5	8.4	13.1
DO (SATURATION %)	124.7	114.8	99.1	103.4
pH (SU)	6.9	8.2	8.3	8.1
CALCIUM (CA-TOT - MG/L)		48	44.8	52
FLUORIDE (F,TOTAL - MG/L)	0.68	0.77	0.63	0.75
ARSENIC (AS,TOT - UG/L)	0			
RESIDUE (DISS-180 C - MG/L)		270	282	310

STATION FS-1

SNAKE RIVER BELOW ROCK CREEK NEAR JEROME

INITIAL DATE	84/01/25	84/04/25	84/06/22	84/12/13
WATER TEMP. (CENT.)	2	7	20	0.8
WATER TEMP. (FAHN.)	35.6	44.6	68	33.4
STREAM FLOW (INST-CFS)	16,000		2,800	5,500
CONDUCTIVITY AT 25C (MICROMHO)	439			
DO (MG/L)	15.1	12.4	8.6	13.2
DO (SATURATION %)	122	113.3	104.2	103.6
pH (SU)	7.6	8.2	8.2	8.2
CALCIUM (CA-TOT - MG/L)		46.4	51.2	54
FLUORIDE (F,TOTAL - MG/L)	0.71	0.76	0.6	0.78
ARSENIC (AS,TOT - UG/L)	0			
RESIDUE (DISS-180 C - MG/L)		271	312	320

STATION FS-2

SNAKE RIVER 5 MILES NORTH OF BUHL AT BRIDGE

INITIAL DATE	84/01/25	84/04/25	84/08/22	84/12/13
WATER TEMP. (CENT.)	7.1	7.5	19.5	3.3
WATER TEMP. (FAHN.)	44.8	45.5	67.1	37.9
STREAM FLOW (INST-CFS)	16,900		7,000	6,000
CONDUCTIVITY AT 25C (MICROMHO)	439			
DO (MG/L)	13.6	11.5	9.3	11.9
DO (SATURATION %)	124	107.5	112.5	98.1
pH (SU)	7.6	8.2	8.4	8.2
CALCIUM (CA-TOT - MG/L)		48.8	52	46
CHLORIDE (TOTAL - MG/L)	0			
FLUORIDE (F,TOTAL - MG/L)	0.8	0.76	0.66	0.84
ARSENIC (AS,TOT - MG/L)	0			
RESIDUE (DISS-180 C - MG/L)		275	337	354

STATION FS-3

SNAKE RIVER AT HIGHWAY 30 BRIDGE NEAR HAGERMAN AT GRIDLEY BRIDGE

INITIAL DATE	84/01/30	84/04/25	84/08/22	84/12/13
WATER TEMP. (CENT.)	2.8	7.5	19	6
WATER TEMP. (FAHN.)	37	45.5	66.2	42.8
STREAM FLOW (INST-CFS)	13,500		7,000	7,500
CONDUCTIVITY AT 25C (MICROMHO)	457			
DO (MG/L)	12	11	8.7	10.6
DO (SATURATION %)	98.8	102.7	102.9	94.2
pH (SU)	7.4	8.1	8.2	8.2
CALCIUM (CA-TOT - MG/L)		46.4	47.2	50
FLUORIDE (F,TOTAL - MG/L)	0.76	0.75	0.67	0.8
ARSENIC (AS,TOT - UG/L)	0			
RESIDUE (DISS-180 C - MG/L)		278	310	330

STATION FS-4

SNAKE RIVER SOUTH OF BLISS AT SHOESTRING ROAD BRIDGE

INITIAL DATE	84/01/30	84/04/25	84/08/22	84/12/13
WATER TEMP. (CENT.)	3.8	8.5	17.5	6.6
WATER TEMP. (FAHN.)	38.8	47.3	63.5	43.9
STREAM FLOW (INST-CFS)	14,000		7,000	8,200
CONDUCTIVITY AT 25C (MICROMHO)	433			
DO (MG/L)	12.5	11.5	8.8	10.5
DO (SATURATION %)	105.2	109.3	102.1	94.9
pH (SU)	7.4	8.3	8.2	8.1
CALCIUM (CA-TOT - MG/L)		46.4	45.6	49
FLUORIDE (F,TOTAL - MG/L)	0.7	0.65	0.69	0.65
ARSENIC (AS,TOT - UG/L)	0			
RESIDUE (DISS-180 C - MG/L)		247	295	303

STATION FS-5