Public-data File 90-15

STREAMFLOW, SEDIMENT LOAD, AND WATER QUALITY STUDY OF HOSEANNA CREEK BASIN NEAR HEALY, ALASKA: 1989 PROGRESS REPORT AND 1986-1989 DATA SUMMARY

BY

Scott R. Ray

Alaska Division of
Geological and Geophysical Surveys

April 1990

THIS REPORT HAS NOT BEEN REVIEWED FOR TECHNICAL CONTENT (EXCEPT AS NOTED IN TEXT) OR FOR CONFORMITY TO THE EDITORIAL STANDARDS OF DGGS.

794 University Avenue, Suite 200
Fairbanks, Alaska 99709-3645

EXECUTIVE SUMMARY

From 1986 through 1989, the Alaska Division of Geological and Geophysical Surveys investigators measured precipitation, measured discharge, and collected surface and ground water samples in the Hoseanna Creek basin near Healy, Alaska. The purpose of the study is two-fold. The first is to quantify the ambient water-quality and sediment transport conditions and establish baseline levels. The second is to measure, if any, the effects of the Poker Flat mine ground water on Hoseanna Creek. To this end, some 1700 water-quality and sediment samples have been collected.

The summer sediment load has increased each year of the study, with load of 100300 tons at Bridge 3 on Hoseanna Creek in 1989. The large seasonal load in 1989 was due to a few large storm events which did not occur in the same frequency or magnitude in the previous years. Sediment rating curves have been established at nine sites with number of samples used in the rating equations (n) ranging from 22 at Runaway Creek to 520 at Hoseanna Creek at Bridge 3. The low r^2 values for the sediment rating equations on small streams may reflect local mass wasting events where mixing is not as thorough.

Surface water samples for water quality analysis were collected seven times during the study at sites located on Hoseanna Creek at Bridge 3 (above mining) and at Bridge 1 (below mining). Generally, no appreciable difference was found in the field-determined parameters or between the ionic constituents, however there may be a trend toward increasing sodium and chloride percentages.

Ground water samples for water quality analysis were collected from five wells in or nearby the Poker Flat mine. The major ion concentrations varied widely among the wells. Classification of the wells remained constant, with the exception of one well which did have a large change in the water chemistry.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

This report discusses sediment, streamflow, and water quality data collected during the 1986 - 1989 summer field seasons (with some emphasis on the 1989 season) by Alaska Division of Geological and Geophysical Surveys (DGGS) investigators in Hoseanna Creek basin.

Hoseanna Creek flows west into the Nenana River approximately three miles north of Healy, Alaska. The total basin area is approximately 48 mi^2. Hoseanna Creek appears on USGS topographic maps as Lignite Creek, but is referred to as Hoseanna Creek by Usibelli Coal Mine and DGGS (see Ray and Maurer, 1989).

The lithologies of the basin (see Wabrhaftig, 1987; Wilbur and Clark, 1987; Wahrhaftig, et al., 1969) produce mass wasting, which contributes to high sediment loads in some of the streams in the basin. The purpose of this study is to estimate the discharge and quantify the sediment yield of selected basins above mining influence.

In 1986, five sites were chosen to represent different geologic aspects of the basin: Sanderson Creek (above mining), North Hoseanna Creek (unmined), Popovitch Creek (unmined), Frances Creek (future mining), and Hoseanna Creek at Bridge 3 (main channel, above mining)(Mack, 1987). Results of the 19% season indicated that most of the sediment moves during high flow events, and that future field seasons should concentrate effort on measuring such events. Mack (1987) also concluded that the only way to obtain reliable data from the small sediment-laden streams was with a Parshall flume. The design of this flume prevents sediment from clogging the path of water flow, a problem which occurs with weirs or H-flumes. Parshall flumes were installed at Frances and Popovitch Creeks. Samples taken during high flow events by automated samplers were combined with grab samples taken at all flow stages to develop sediment rating equations. The equations were used to predict total suspended sediment (TSS) from discharge data in order to estimate daily and seasonal sediment loads for the various sites.

In an attempt to establish background data from the upper Hoseanna basin in 1987, a non-automated sampling site was added on Hoseanna Creek above its confluence with North Hoseanna Creek.

During the winter of 1988, Usibelli Coal Mine completed a haul road to Gold Run Pass, which now allows easy access to the upper basin sites. The site on Hoseanna Creek above North Hoseanna Creek was moved to the newly installed Bridge 6, which is about one-half mile downstream of North Hoseanna Creek. The bridge site is ideal for developing stage-discharge relationships. Automated equipment was placed at this site in late-July.

Two additional sites were added in 1988: Two Bull and Louise Creeks. Grab samples were collected and discharge measured throughout the season at these sites. Automated equipment began operation at these sites in August.

Additional changes were made during the 1989 sampling season. Sanderson, North Hoseanna, Popovitch, and Frances Creeks were all dropped from the study, while only one site was added to the study: Runaway Creek. Aufeis was a problem at Runaway Creek. The large amounts of ice made it impossible to install the H flume (previously used on Iron Creek). It was not possible to establish a stage-discharge relationship on the natural channel since the channel was constantly changing due to the melting ice. Ice was still a problem in late-June. The large storm on June 24-26 washed away the H flume from its resting place on the banks of Hoseanna Creek near Iron Creek. The flume was never found. Because of this, no continuous record of discharge or sediment load was collected at this site.

During the 1989 season, two Isco samplers were used at Bridge 3. One of the samplers was water-level actuated (same as previous seasons), During spring break-up, this Isco sampled throughout the day on intervals ranging from one to six hours. The other Isco was set as a composite sampler. Samples were taken by this Isco four times a day: 0300, 0900, 1500, and 2100 hours. The samples were collected in the same bottle for that day, giving an approximate daily average sediment sample.

Figure 1 shows the study location with each subbasin and sampling site indicated. Table 1 gives the basin characteristics of each sampling site.

Surface water quality sampling has been conducted in the study since 1987. Two sampling sites on **Hoseanna** Creek, Bridge 3 (above mining) and Bridge 1 (below mining), are used to quantify the effect of the Poker **Flat** mine on water chemistry. The sites were sampled once during the 1989 field season and analyzed for major ions and trace elements. Four additional sites (all on Runaway Creek) were sampled during the 1989 season.

Water quality samples were also collected during the 1989 summer season from three shallow wells (one upgradient of mine disturbance and two in the disturbed spoils). These wells were sampled at the same tune as the surface water quality samples. The samples were analyzed for major ions and trace elements. One additional well was drilled and sampled this season. The well is Runaway Ridge and was sampled once in November.

Table 1. Basin characteristics of sampling sites (after Mack, 1988).

Site	Area (mi^2)	Percent of total basin area	Principle Lithology
Sanderson	5.1	11.6	Schist
North Hoseanna	3.1	7.2	Coal Group
Hoseanna @ Brd 6	20.8	47.5	Mixed
Popovitch	4.1	9.3	Nenana Gravel, Coal Group
Louise	1.6	3.6	Nenana Gravel, Coal Group
Frances	1.7	3.9	Nenana Gravel, Coal Group
Hoseanna @ Brd 3	43.8	100.0	Mixed
Runaway	0.9	----	Coal Group, Schist
Two Bull	0.9	----	Nenana Gravel, Coal Group

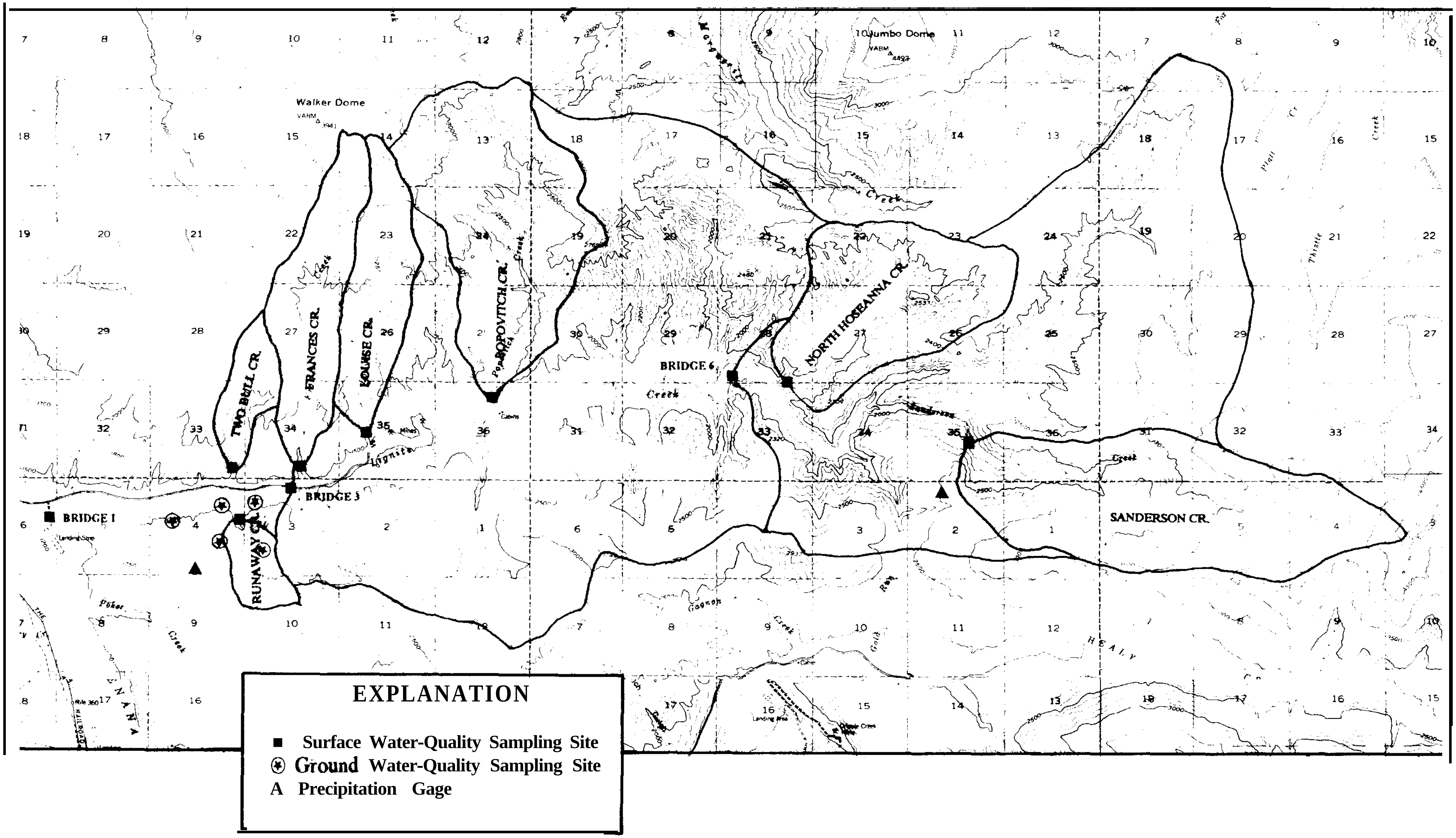


Figure 1. Hoseanna Creek Basin

METHODS

PRECIPITATION

The precipitation data for the basin is gathered in two locations. DGGS operates a Wyoming gage with a datapod recording device at Gold Run Pass (see Mack (1988) for location and construction specifications). Readings are taken every 30 minutes, with changes as small as twelve one-hundredths of an inch recorded. The other reporting station is operated by Usibelli Coal Mine personnel and is located at Poker Flat mine. The precipitation gage operated by UCM was moved approximately 2000 feet southwest of its original placement prior to the 1989 season. The gage has been replaced by a standard eight inch tipping-bucket gage connected to a datapod recording device. The resolution of this precipitation gage is 0.01 inches. The tipping-bucket canister does not have any type of wind protection device.

DISCHARGE

Stream velocities used in the calculation of discharge were measured with a Marsh-McBirney model 201 digital flow-meter. However during the high flow events in June, a type AA current meter suspended from a bridge crane was used. Velocities were measured at six-tenths depth, with sufficient number of sections such that no one section contained over ten percent of the total flow. If the depth was greater than 2.5 feet, measurements were made at two-tenths and eight-tenths depth. The average of the two readings was interpreted as the mean velocity. Discharge was calculated using the standard midpoint method (US Dept. of Interior, 1981). At Louise, Frances and Popovitch Creeks, discharge was estimated using the standard equations for Parshall flumes (US Dept. of Interior, 1981).

A continuous stage record was recorded at each site using Omnidata DP320 stream stage recorders with pressure transducers (except at Runaway Creek). The small, battery operated device can measure water levels from 0 to 10 feet in intervals of one-hundredth of a foot. The data are stored on EPROM microchips, which are then read by a computer at the lab.

Discharge rating curves were calculated for each site using the discharge-stage data. High flow events which were not directly measured were estimated using the indirect slope-area method (Dalrymple and Benson, 1984). The rating equations were then used to convert the continuous stage record into a continuous discharge record.

SEDIMENT RATING EQUATIONS

Sediment rating equations were calculated at each site to estimate sediment concentrations from discharge data. Leopold and Maddock (1953) found that equations of the form:

$$TSS = aQ^b$$

where TSS = total suspended solids (mg/l)
Q = discharge (cfs)
a,b = numerical constants

adequately approximate the relationship. Using the TSS data from the grab and automated samples, these equations were developed as linear log-log plots (log TSS = a + b log Q). Using the actual and estimated sediment concentrations and the continuous discharge data, we calculated the daily sediment load. Whenever possible, the actual values (automated or grab) were used in the calculation. The daily loads were then added to estimate the season load. The daily loads for the 1989 season from Bridge 3 were calculated from the daily composite samples (except when TSS values were available from the level-actuated isco).

WATER QUALITY

To ensure consistency of data between the different field seasons, the same water quality sampling and analytical methods were used during the 1987,1988 and 1989 field seasons (see also Mack, 1988). The following methods for surface water, ground water, and laboratory analysis are from Ray and Maurer (1989):

Surface Water

Surface water for chemical analyses was obtained and composited from Hoseanna Creek at locations shown on Figure 1 with a hand-held depth-integrating suspended-sediment sampler and a chum splitter, according to the methods of the US. Department of the Interior (1977). Samples collected from the splitter at each site were: filtered, for determining dissolved major anions; unfiltered, for determining suspended solids; and filtered and acidified, for determining dissolved trace metals and major cations. Water for major ion and dissolved trace-metal analyses was immediately pumped through 0.45 micron membrane filters. All acidified samples were collected in pre-acid-washed bottles, and acidified with Ultrex-grade nitric acid, to a concentration of 1.5 ml acid per liter sample.

Water temperature, dissolved oxygen, and specific conductance of surface water samples were measured in situ with a digital 4041 Hydrolab. An Beckman digital pH meter was used to measure pH on a cornposited sample. Alkalinity was measured electrometrically on a composited sample with an Beckman pH meter and a Hach digital titrator, according to the methods of the U.S. Environmental Protection Agency (1983). Settleable solids were determined in the field with Imhoff Cones according to the methods of the American Public Health Association, and others (1985).

Ground Water

Ground water samples were obtained from wells shown in Figure 1. Water levels in all wells were measured prior to pumping with a Johnson Watermark electric water-depth indicator, "Well Wizard" equipment was used to purge and sample all wells. The submersible bladder pump and tubing are composed of non-metallic materials. Water temperature, pH, and specific conductance were measured at regular intervals with a digital 4041 Hydrolab during well purging. After at least one well casing volume was removed from the well, sampling commenced when specific conductance fluctuated less than 10 percent. Water samples were obtained according to the methods of Scalf and others (1981). Water was collected in a churn splitter at the well head. Water temperature, pH, specific conductance and alkalinity were determined in the field using the same instrumentation and methods described for surface water samples. Samples for chemical constituent analysis were also treated and preserved in the same manner as surface water samples. Two additional samples were collected at each site: filtered, for determining nutrients, and unfiltered and acidified, for determining total iron. The sample for determining nutrients was kept on ice and placed in a freezer within one hour of collection.

Laboratory Analysis

Water quality analyses for surface water and ground water were conducted in the DGGS hydrology laboratory located in the Water Research Center on the University of Alaska Fairbanks (UAF) campus. Some trace metal analyses were also performed with the generous help and use of equipment of the UAF Forest Soils Laboratory. Laboratory procedures used to analyze surface water are described in Mack (1988). Analytical methods and detection limits for surface water and ground water constituents are shown in Appendix E. The laboratory is a participant in EPA analytical quality assurance studies, and has participated in the USGS Standard Reference Water Sample Quality Assurance program since 1980. For all analyses calibrations were performed using in-house analytical standards and blanks, and were monitored and verified by running previously analyzed USGS Standard Reference Water Samples along with the water samples collected for this study.

RESULTS

PRECIPITATION

The precipitation total at Gold Run Pass for the period of May 1 to September 30, 1989 was 14.24 inches. The total for the same period at Poker **Flat** was 10.06 inches, Table 2 gives the monthly precipitation for the **two** gages for the period of 1986-1989. The daily precipitation (1989 season) for both Gold Run Pass and Poker Flat is reported in Appendix A.

The average precipitation total at Poker Flat for the period of May - September (1979-1989) is 12.44 inches (Wilbur, 1989). The precipitation total at Poker Flat this year was approximately 19% below the average calculated by Wilbur (1989). As was the same in previous years, the precipitation was greater at the Gold Run Pass site (approximately 42% greater this year).

Table 2. Monthly precipitation for Gold Run Pam (GRP) and Poker Flat (PF). All values in inches.

Site	MAY	JUN	JUL	AUG	SEP	Total
GRP 1986	----	----	----	----	----	-----
PF 1986	1.62	2.43	4.30	3.37	1.79	13.51
GRP 1987	0.12	1.08	2.52	3.24	4.32	11.28
PF 1987	0.23	2.17	3.74	2.10	1.16	9.40
GRP 1988	2.16	5.88	4.92	2.52	1.56	17.04
PF 1988	2.15	4.25	4.20	1.87	1.43	13.90
GRP 1989	0.96	6.20	1.32	4.92	0.84	14.24
PF 1989	0.49	3.90	1.25	3.11	1.31	10.06
Avg GRP (87-89)	1.08	4.39	2.92	3.56	2.24	14.19
Avg PF (87-89)	0.96	3.44	3.06	2.36	1.30	11.12
Avg PF (79-89)	0.84	3.25	3.77	3.03	1.55	12.44

DISCHARGE

1989

Continuous discharge records were made at Bridge 3, Bridge 6, Louise Creek, and Two Bull Creek (Appendix B). As stated in the introduction, continuous discharge was not recorded at Runaway Creek.

The datapods for continuous stage measurements were placed at Bridge 3 and Bridge 6 on May 25th. No major problems were experienced at Bridge 6, although the pressure transducer was moved to different locations on the bridge a couple of times. However, many problems were experienced at Bridge 3. It was difficult to establish a good stage-discharge relationship due to the many channel changes (both natural and manmade). The datapod pressure transducer was "silted-in" three times.

The flume on Louise creek was removed from Frances creek on June 7, however due to the high flow from the storm on the sixth, it was impossible to put the flume in place. The flume was placed into operation on June 13. The datapod was also started on that day. No major problems were experienced at this site. However the late-June storm did over-top the sandbags leading to the flume. This did not cause any problems with the datapod recording stage.

The pressure transducer and datapod for Two Bull Creek was also installed on June 13. The site established this year was approximately 100 feet downstream of the previous site. This site proved better than the previous site, however a flume would still be the best way to obtain flow data on this creek.

1986-1989

Table 3 summarizes the peak and season flows for the study sites with continuous records. Bridge 3 on Hoseanna Creek has the best record of all the study sites, due mainly to a concentrated effort at this site. It is also the only site which has been monitored in each of the study years. Both Sanderson Creek and Bridge 6 on Hoseanna Creek have good records, although not as long. Runaway Creek has the worst record due to it size and lack of flow-controlling structure (flume).

The peak and seasonal flows have generally increased for all the sites since the study began (excluding 1986). The peak flow in 1989 on **Hoseanna** Creek at Bridge 3 was 62 percent than in 1988 and 167 percent higher than 1987. The remaining sites probably experienced similar increases in flow, although the smaller basin sites may have experienced much greater increases. For example, the flume at Popovitch is capable of passing approximately 50 cfs, however the event in late-June, 1989 appeared to surpass this amount. Although no direct measurement was made, water was flowing in and around the flume. The previous peak flow on Popovitch Creek was 3.5 cfs in 1988.

Table 3. Flow data for 1987-1989 field seasons. AN values in cfs.

Site	Peak Flow 87	88	89	Season Average 87	88	89
Sanderson	150	225	----	6.98	8.23	----
North Hoseanna	10	13.2	----	----	2.72	----
Hoseanna Brd 6	150	550	----	----	18.9	25.9
Popovitch	0.90	3.53	----	----	0.50	----
Louise	----	----	11.0	----	----	0.20
Frances	1.53	3.30	----	0.13	0.17	----
Hoseanna Brd 3	449	740	1200	35.9	42.6	52.6
Runaway	----	----	7.9	----	----	0.17
Two Bull	----	----	6.3	----	----	0.18

SEDIMENT LOAD

1989

The quality of the regression equations varied at the different sites with the r^2 values ranging from 0.53 to 0.85. The number of samples collected at each site has increases from previous years resulting in improved goodness-of-tit regressions. Table 4 gives the coefficients (a,b), r^2 value, and number of samples used to generate the equation (n). Appendix C gives the daily sediment loads.

Table 4. Coefficients, r^2 value, and number of samples used (n) for the sediment rating equations. The equations are of the form: $TSS = aQ^b$.

Site	a	b	r^2	n
Hoseanna @ Brd 6	22.8	1.20	0.69	162
Louise	7820	1.24	0.73	102
low-flow	28400	2.11	0.84	14
Hoseanna @ Brd 3	6.16	1.26	0.85	258
grab & isco*	28.9	1.01	0.72	125
Runaway	1630	1.34	0.56	22
Two Bull	13700	1.24	0.53	41

* Does not include composite samples

Hoseanna Creek at Bridge 6

Figure 2 shows the plot of TSS versus discharge for this site. The r^2 value is 0.69. One might *expect* a higher r^2 value looking at the plot since most of the data points do match with the regression equation line. However, there is a group of data above the line which statistically lowers the r^2 value. This data group is from the August 5th storm. Since there were no high-flow events in July, there was plenty of sediment available for transport. This results in higher TSS values for a given flow.

Louise

Figure 3 shows the plot of TSS versus discharge for this site. The r^2 value is 0.73. Since the regression line does not fit the data at lower flows, another regression equation was calculated using the 14 grab samples at lower flows. The resulting equation was applied to low-flow values of 0.20 cfs or less for the calculation of sediment load.

Hoseanna Creek at Bridge 3

Figure 4 shows the plot of TSS versus discharge for this site. The r^2 value is 0.85. Although the r^2 value is quite good, a curved regression equation might fit the data better. Since this equation was

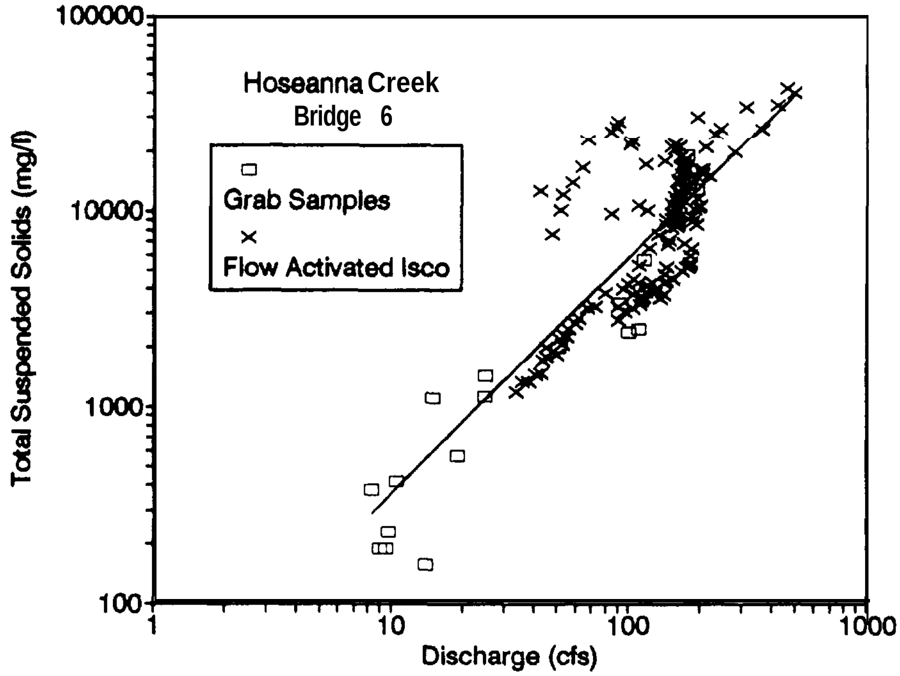


Figure 2. TSS versus discharge for Hoseanna Creek at Bridge 6 (1989 data). r^2 value equals 0.69.

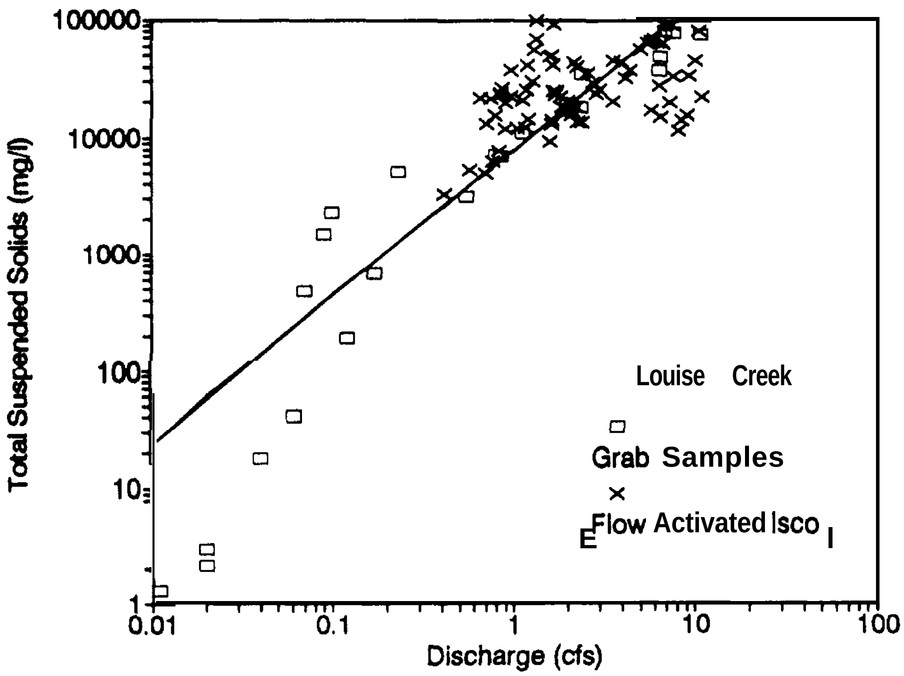


Figure 3. TSS versus discharge for Louise Creek (1989 data). r^2 value equals 0.73.

not used to calculate the sediment load, no other equations were calculated to compensate for the **overestimation of sediment** load at low flows.

Two Bull Creek

Fiie 5 shows the plot of TSS versus discharge for this site. The r^2 value is 0.53. This is the lowest r^2 value of the five sites in the study this year. This low value is due primarily to the large scatter of TSS values at low flows.

Runaway Creek

Fiie 6 shows the plot of TSS versus discharge for this site. The r^2 value is 0.56. This equation was derived from grab sample data only. The sediment load data was estimated from the flow data from Runaway Creek and the flow records from Louise and Two Bull Creeks.

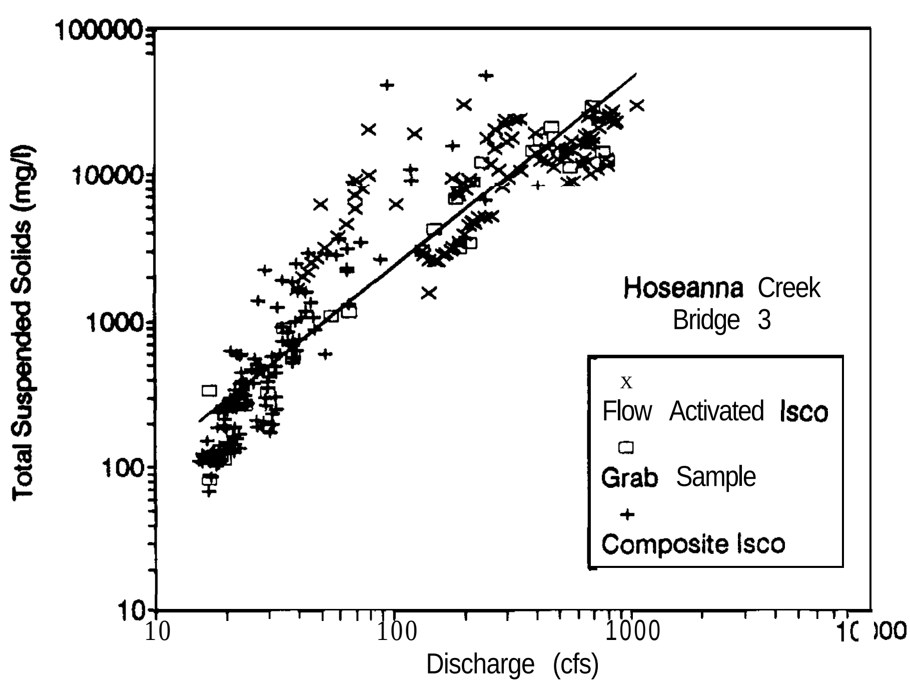
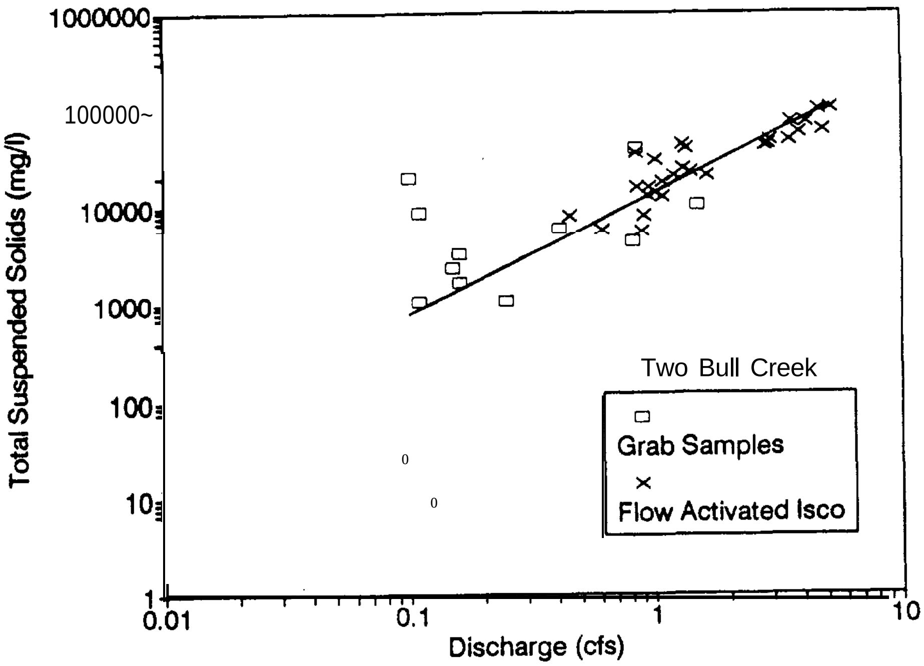


Figure 4. TSS versus discharge for Hoseanna Creek at Bridge 3 (1989 data). r^2 value equals 0.85.



Fieure 5. TSS versus discharze for Two Bull Creek (1989 data). r^2 value eauals 0.53.

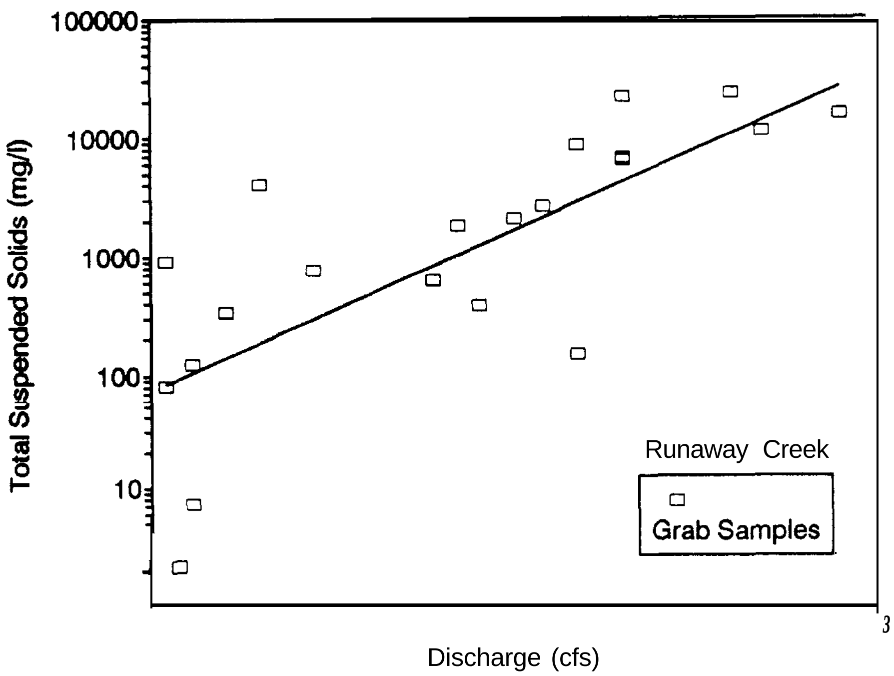


Figure 6. TSS versus discharge for Runaway Creek (1989 data). r^2 value equals 0.56.

Spring Runoff

Prior to the 1989 season, little data existed from spring runoff period. What few samples had been taken indicated that the spring runoff could contribute a significant portion of the annual sediment load. During the 1989 season, sediment samples were collected at Hoseanna Creek at Bridge 3 using both composite and automated-interval samples. Although the discharge was not recorded due to the aufeis in the channel, loads were estimated using 90 percent of the flow at Bridge 1 (estimated by the USGS). The flows and loads are found in the appendices.

During the spring runoff, the flow changes throughout the day due to snowmelt. The flow is at the lowest during the morning hours (6:00-9:00 A.M.) slowly increasing all day, reaching peak discharge during the late evening (9:00 P.M.). The TSS values also follow this sinusoidal pattern of low values in the morning and high values in the evening. Figure 7 shows the diurnal variation of TSS during the spring runoff. The high peak of TSS on May 8 was caused by a storm event.

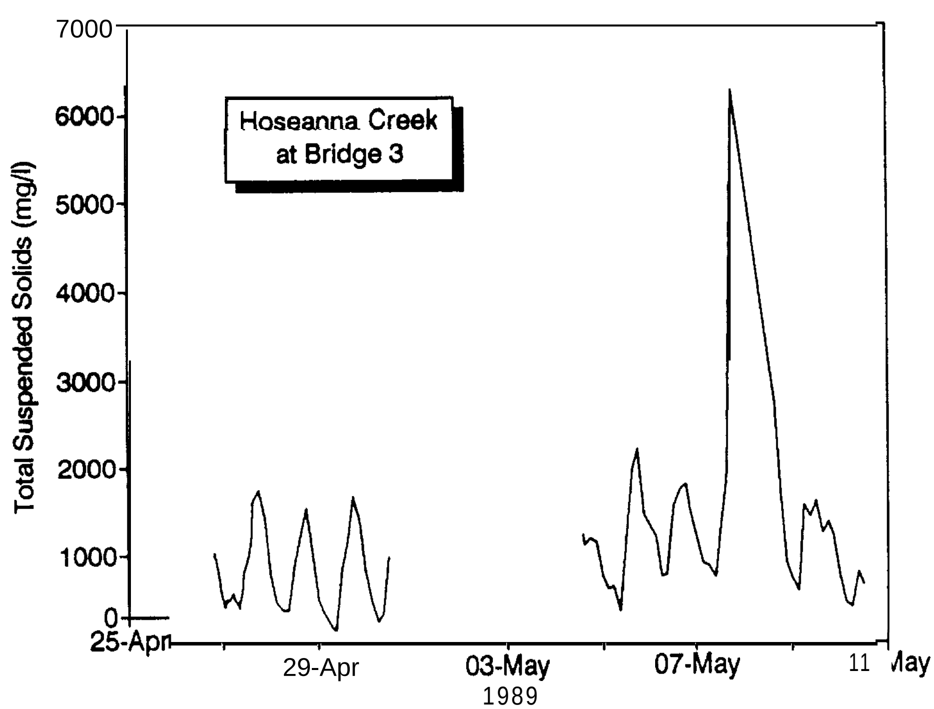


Figure 7. The diurnal variation of TSS during the spring runoff, 1989.

1986-1989

Table 5 summarizes the results of the sediment regression equations for 1986-1989 (see Appendix D for raw data used). Most of the sites have regression coefficients which are similar from year to year. The notable exceptions are North Hoseanna, Louise, and Two Bull Creeks. Both coefficients for Louise Creek changed, however the 1988 data was considered poor since the site did not have a flume. The 1989 data is much better (since the installation of the flume), and is probably a more accurate representation of the natural processes occurring. The coefficients for Two Bull and North Hoseanna Creeks are also different for the two years of record. It is unclear which year is more accurate, as neither site had a flow-controlling structure. The sites with the most consistent data were the large, stable channel sites, indicating the need for flumes on the smaller creeks. Figures 8-16 plot all the data collected for each site since the study began.

Table 5. Coefficients, r^2 value, and number of samples used (n) for the sediment rating equations for the 19861989 seasons. The equations are of the form: $TSS = aQ^b$.

Site	a	b	r^2	n
Sanderson (1987)	1.93	1.88	0.73	63
1988	2.39	1.97	0.86	108
1986-1988	3.33 425	1.82	0.72	173
North Hoseanna (1987)	164	1.10	0.65	21
1988		2.04	0.47	70
1986-1988	393	1.40	0.46	93
Hoseanna @ Brd 6 (1988)	1.41	1.83	0.72	50
1989	22.8	1.20	0.69	162
1988-1989	8.18	1.41	0.75	212
Popovitch (1987)	730	4.38	0.65	24
1988	2730	4.69	0.59	21
1986-1988	1340	4.50	0.57	52
Louise (1988)	95000	2.27	0.75	14
1989	7820	1.24	0.73	102
1988-1989	8620 7260	1.21	0.72	116
Frances (1987)	16400	1.47	0.28	32
1988		1.91	0.55	60
1986-1988	13300	1.86	0.48	98

Table 5 (continued)

Site	a	b	r^2	n
Hoseanna @ Brd 3 (1987)	1.81	1.56	0.71	113
1988	2.82	1.26	0.74	127
1989	6.16		0.85	259
1986-1989	5.10	136	0.77	520
Runaway (1989)	1630	1.34	0.56	22
Two Bull (1988)	186000	3.37	0.74	13
1989	13700	1.24	0.53	41
1988-1989	13500	1.51	0.62	54

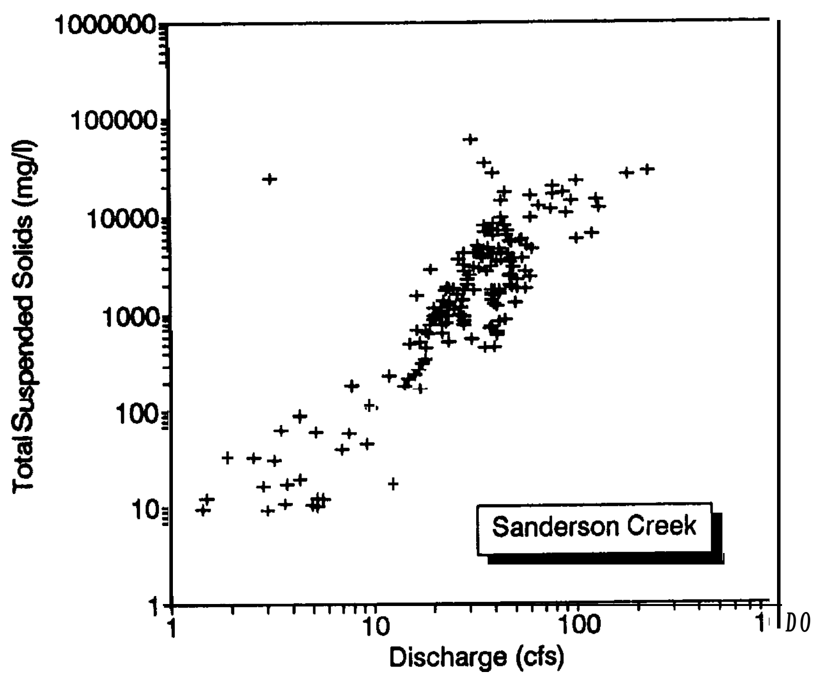


Figure 8. TSS versus discharge for Sanderson Creek (1986-1988). r^2 value = 0.72, n = 173.

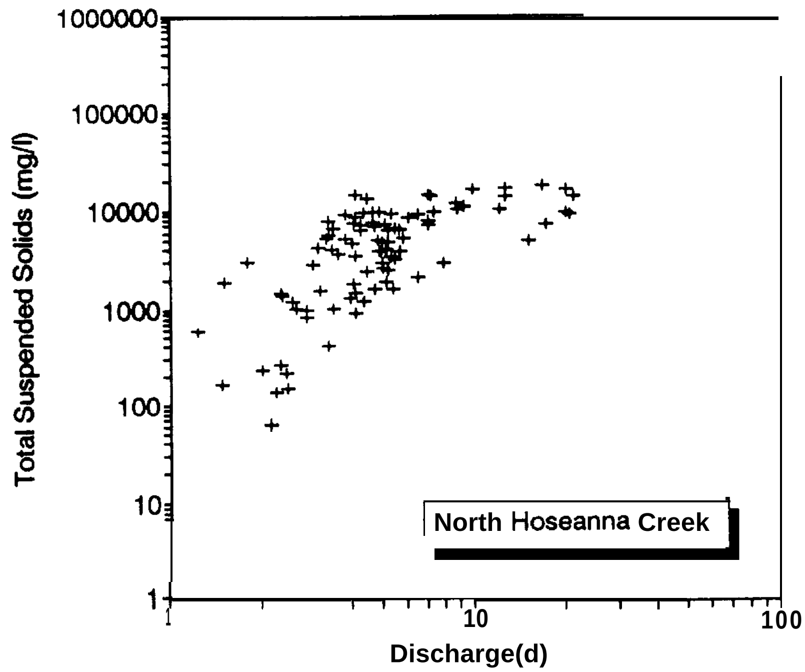


Figure 9. TSS versus discharge for North Hoseanna Creek (19861988). r^2 value = 0.46, n = 93.

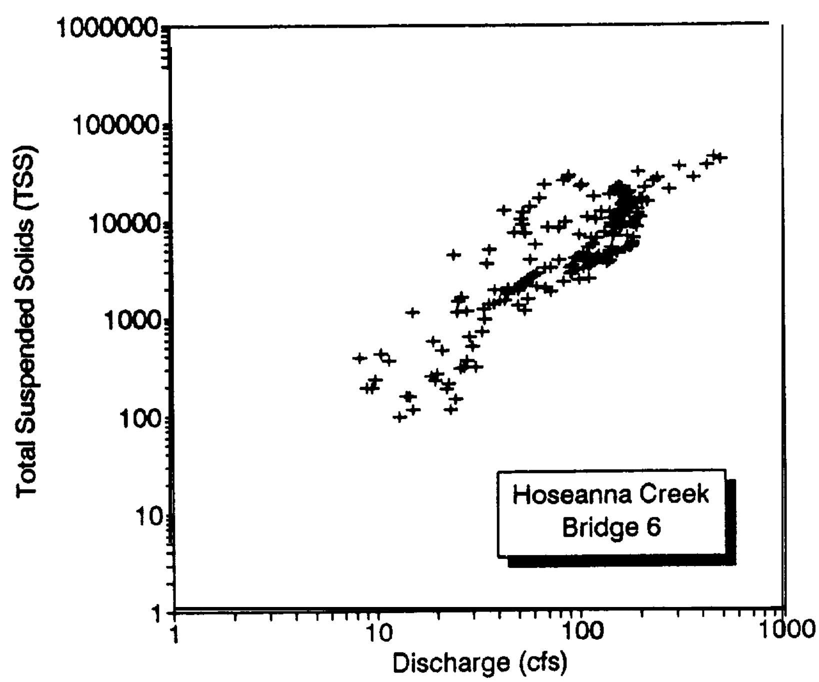


Figure 10. TSS versus discharge for Hoseanna Creek at Bridge 6 (1988-1989). r^2 value = 0.75, n = 212.

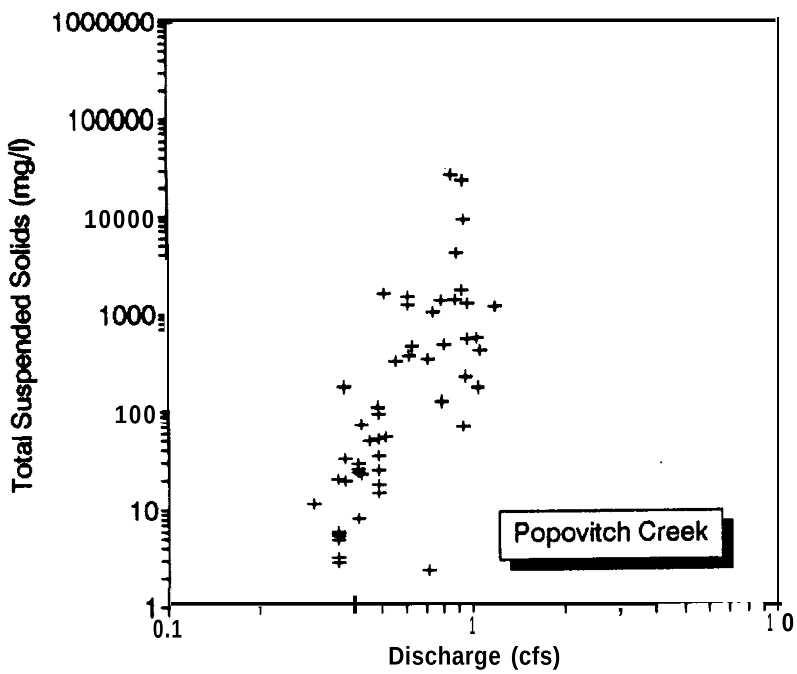


Figure 11. TSS versus discharge for Popovitch Creek (1986-1988). r^2 value = 0.57, n = 52.

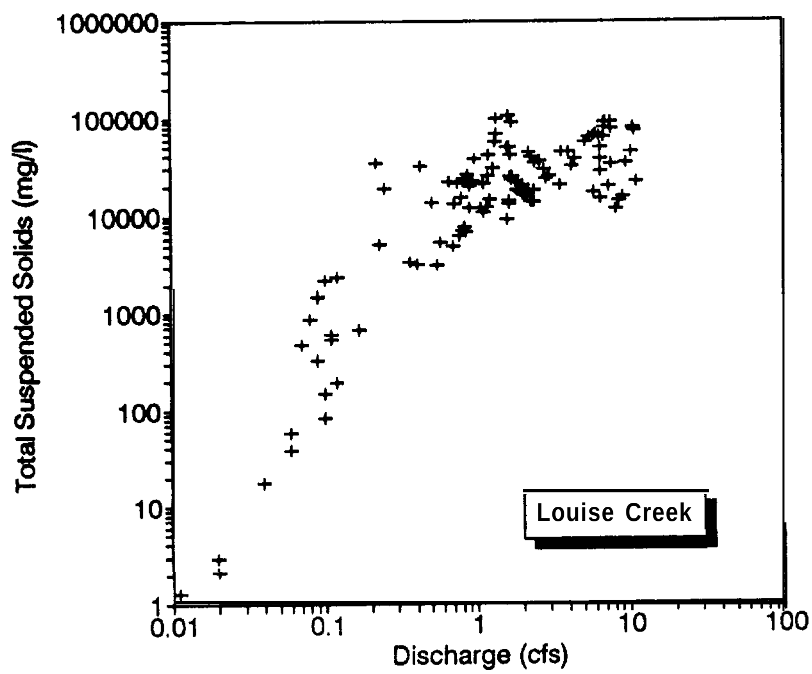


Figure 12. TSS versus discharge for Louise Creek (1988-1989). r^2 value = 0.72, n = 116.

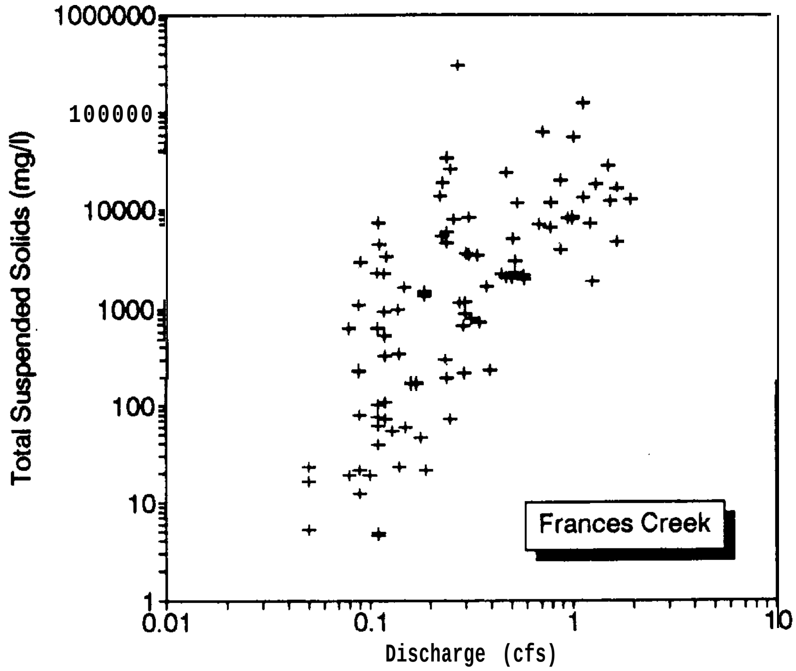


Figure 13. TSS versus discharge for Frances Creek (19861988). r^2 value = 0.48, n = 98.

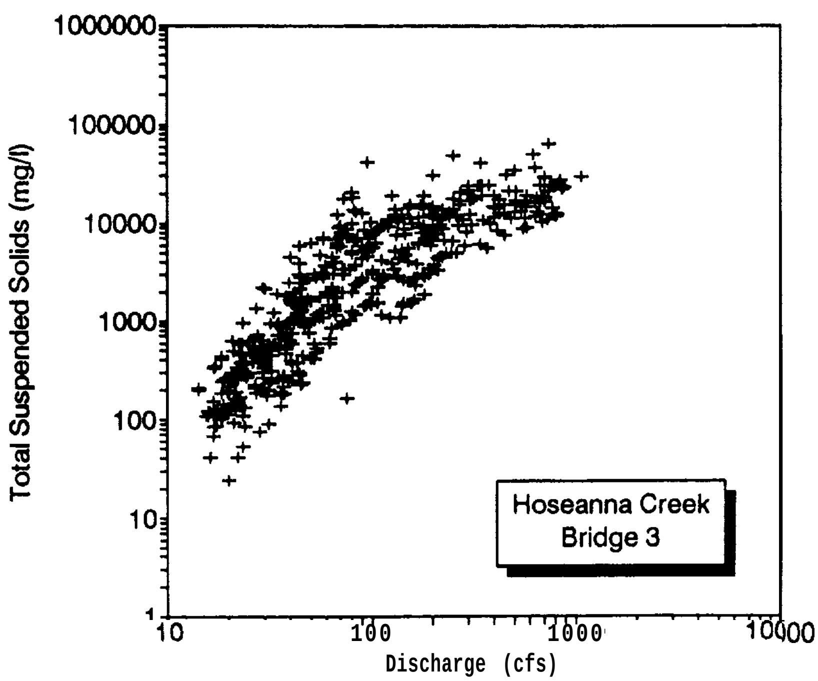


Figure 14. TSS versus discharge for Hoseanna Creek at Bridge 3 (1986-1989). r^2 value = 0.77, n = 520.

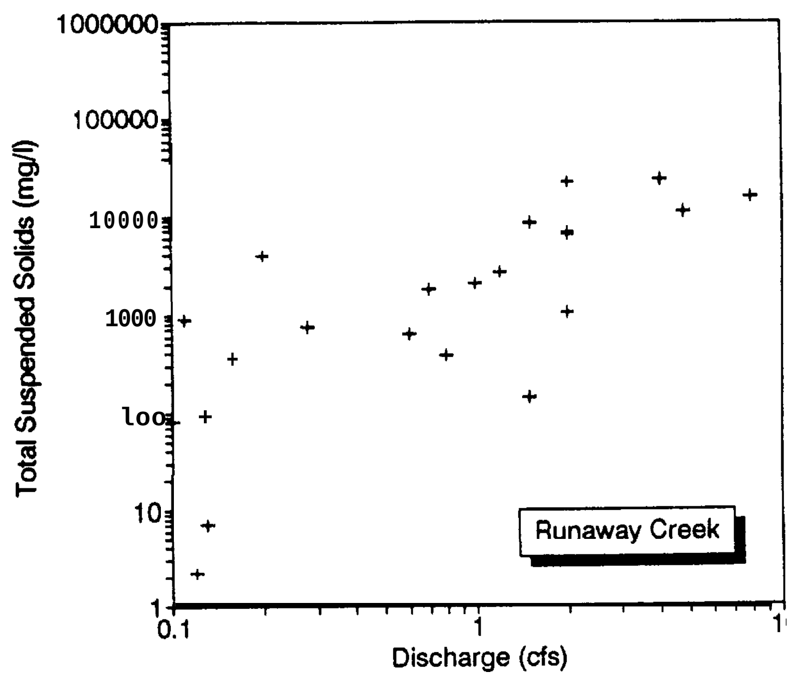


Figure 15. TSS versus discharge for Runaway Creek (1989). r^2 value = 0.56, n = 22.

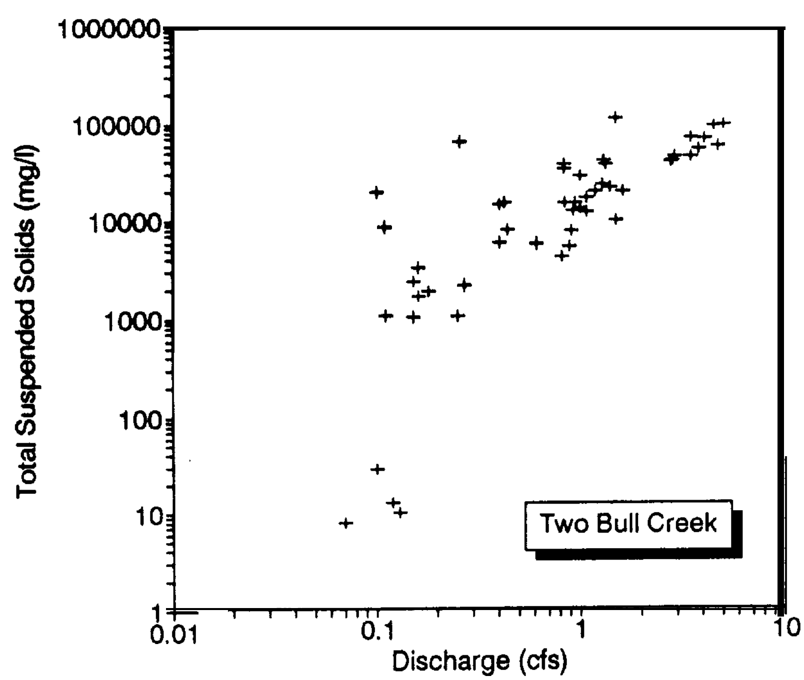


Figure 16. TSS versus discharge for Two Bull Creek (1988-1989). r^2 value = 0.62, n = 54.

WATER QUALITY

Surface Water

Surface water-quality samples were collected at two sites on Hoseanna Creek since 1987. Seven samples were collected at Bridge 3 (above Poker Flat mining); three during 1987, three during 1988, and one in 1989. Seven samples were also collected from Bridge 1 (below Poker Flat mining) over the same period of time. The results of the analyses from these samples are found in Appendix F. Samples *were* collected during non-storm runoff periods, generally at low-flows. Discharge for the samples ranged from 46.2 cfs at Bridge 1 on May 23, 1988 to 19.7 cfs at Bridge 3 on September 21, 1989.

Field-determined parameters were similar between sites for a given sampling day. Water temperature and dissolved oxygen did vary between the sites due to the lag in sampling time. The stream water would warm during the day, resulting in differences in water temperature and dissolved oxygen values between sites. The average pH for the two sites was about 7.3 (slightly basic). The average conductivity was 558 umhos/cm at Bridge 1 and 520 umhos/cm at Bridge 3.

Table 6 gives the average ionic composition for each site expressed as percentages (based on meq/l). Both calcium and potassium percentages have remained nearly constant over the three years

Table 6. Average percentages of the major ion composition (in meq/l) at Hoseanna Creek for 1987-1989.

	Bridge 3			Bridge 1		
	1987	1988	1989	1987	1988	1989
Calcium	37	37	37	38	36	37
Magnesium	44	51	3.5	43	49	29
Sodium	16	11	26	16.	14	32
Potassium	3	1	2	3	1	2
Bicarbonate	56	47	50	56	46	50
Sulfate	34	31	32	29	29	31
Chloride	10	22	18	12	25	19
Nitrate	C1	<1	<1	3	<1	<1

for both sites at 37 percent and 2 percent respectively.

Both magnesium **and** sodium percentages have fluctuated, with a high sodium percentage and low magnesium percentage in 1989. Magnesium had been the dominant cation in 1987 and 1988, but in 1989 the distribution among calcium, magnesium, and sodium is nearly equal. Bicarbonate has been the dominant anion each year with percentages of about 50 percent. The bicarbonate percentages did fluctuate some each year. The sulfate percentages did not fluctuate, but remained steady at about 30 percent. The chloride percentages also fluctuated, with values averaging slightly below 20 percent. The nitrate percentages are generally less than one percent.

Figure 17 is a Piper diagram showing all the samples collected for Bridge 1 and Bridge 3. The Piper diagram was plotted using HC-Gram (McIntosh, 1987). The cation portion of the diagram shows that calcium percentages have remained constant (linear trend of symbols), while the anion portion of the diagram shows that the sulfate percentages have remained nearly constant.

The trace metal and element concentration were similar between sites and among dates (Appendix F). Arsenic, beryllium, cadmium, copper, lead were all below the detection limit. Two samples at Bridge 3 in 1987 had zinc concentrations which were slightly greater than the detection limit of 0.02 **mg/l.** Manganese was the only constituent to exceed the secondary maximum contaminant concentration (0.05 **mg/l)** for Alaska public drinking water supplies (Alaska Department of Environmental Conservation, 1982). The mean value of manganese concentrations for the study period was 0.34 **mg/l** at Bridge 3 and 0.28 **mg/l** at Bridge 1. No other constituent exceeded the Alaska **Drinking** water standards (Table 7).

The physical parameters studied were similar between the two sites. Little difference in color was found as the mean values were 36 and 37 PCU at Bridge 3 and Bridge 1, respectively. Turbidity at Bridge 3 ranged from 30 to 600 NTU with a mean value of 185. Turbidity at Bridge 1 ranged from 36 to 700 NTU with a mean value of **220.** Variations total suspended solids are discussed in previous sections. The total suspended solids (TSS) ranged from 84.2 to 1970 **mg/l** at Bridge 3 with a mean value of 650. The TSS ranged from 78.6 to 1850 **mg/l** at Bridge 1 with a mean value of 800. Settleable

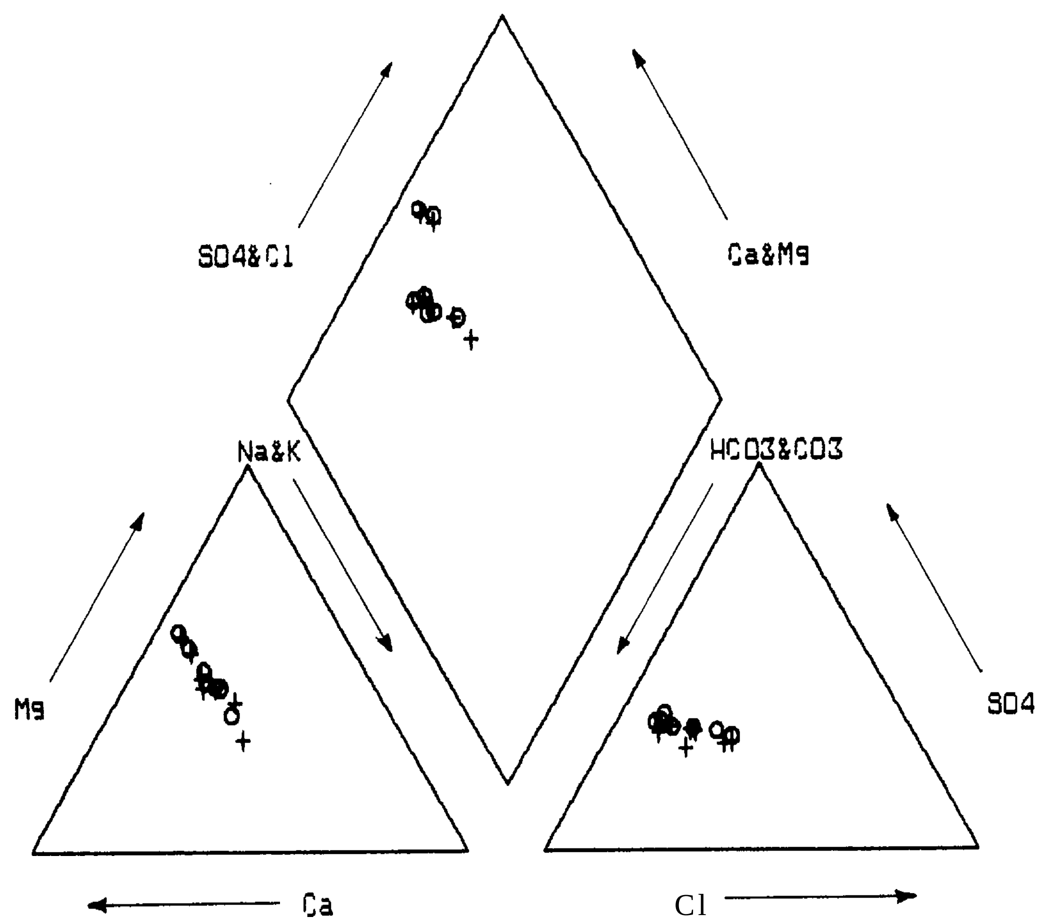


Figure 17. Piper diagram for the surface water sites. The + (plus) indicates samples collected at Bridge 1. The o (circle) indicates samples collected at Bridge 3.

solids were ***generally*** very low, usually a trace or **slightly** above. The maximum settleable solid volume measured was 2.0 ml/l at Bridge 3 in 1987.

Table 7. Mean values of selected water quality constituents from Hoseanna Creek sites (1987-1989) and respective Alaska Water Quality Standards. Mean values based on seven samples. All values in mg/l unless otherwise noted.

	Bridge 3	Bridge 1	Alaska Water Quality Standard[1]
Field Determination			
pI-I	7.34	7.30	6.0-8.5
Dissolved oxygen	13.0	11.0	> 4.0
Specific Conductance (umhos/cm)	520	558	---
Cations			
Calcium	35.9	37.1	---
Magnesium	27.0	26.1	---
Sodium	17.1	18.7	250
Potassium	3.8	4.0	---
Anions			
Alkalinity	143.1	146.5	---
Sulfate	72.7	69.1	250
Chloride	29.0	33.5	250
Nitrate	0.41	3.54	10
Trace Elements			
Arsenic	< 0.004	< 0.004	0.05
Barium	0.082	0.105	1.0
Cadmium	co.01	<0.01	0.01
Chromium	< 0.002	co.002	0.05
Iron (dissolved)[2]	0.04	0.04	0.3
Manganese	0.34	0.28	0.05
Lead	co.03	<0.03	0.05
zinc	< 0.02	< 0.02	5.0
Lab Determinations			
Color (pcu)	36	37	75
Total Suspended Sediment	650	800	--- [3]
Turbidity (NTU)	185	220	--- [4]
Acidity	5.0	4.0	---
Total Dissolved Solids	282	290	500

[1] Alaska Water Quality Standards are based on the following freshwater use: Water supply - drinking, culinary and food processing (ADEC, 1987).

[2] The mean is estimated by assigning values to "less than" values, assuming a uniform distribution of data between 0 mg/l and the detection limit.

[3] No increase above natural conditions.

[4] Ten percent above natural conditions.

Ground Water

The location of seven ground water monitoring wells are given in Table 8. Detailed descriptions of the GAWM wells and installations are given by Golder Associates (1987). Description and installation of the MW-1 well is given by Shannon and Wilson Inc. (1990). GAWM-1A, GAWM-1B, and GAWM-1C are located upgradient of the Poker Flat mine and penetrate coal seam #4, the interburden layer between the coal seams, and coal seam #3, respectively, of the unmined Suntrana Formation (Golder Associates, 1987). MW-1 is located east of the Poker Flat mine on Runaway Ridge. The well penetrates coal seam #3 (Shannon and Wilson Inc., 1990).

Table 9 gives the initial depth-to-water, volume and pumping rates for the ground water monitoring wells, During first sampling in 1988, additional pumping of the wells was conducted since the wells were not developed at the time of installation (Ray and Maurer, 1989). Subsequent sampling only pumped sufficient water to meet the sampling requirement (constant conductivity after a minimum of three casing volumes are evacuated).

Due to problems with the wells, no samples were obtained in 1988 from monitoring well GAWM-1A or GAWM-1B, although one sample was collected from well GAWM-1C (Ray and Maurer, 1989). During the spring and summer of 1989, buckling of the surface in the vicinity of these wells (caused by the shifting weight of a nearby spoils pile) has rendered these wells useless for any further sampling.

Table 8. Coordinates for ground water monitoring wells at Usibelli Coal Mine.

Well Name	Longitude	Latitude
GAMW-1A	148°-55'-29.8	63°-53'-50.4"
GAMW-1B,1C	148°-55'-27.2"	63°-53'-51.2
GAMW-3	148°-54'-42.5	63°-54'-26.6"
GAMW-4	148°-55'-33.9"	63°-54'-26.9"
GAMW-5	1480-w-57.2"	63°-54'-18.9"
MW-1	148°-54'-46.3	63°-54'-02.3"

Table 9. Initial water level readings and purging protocol for ground water monitoring wells at Usibelli Coal Mine.

Well Name	Date	Initial[1] Depth to Water (ft)	Calc Casing Volume (gal)	Volume Pumped (gal)	Pumping Rate (gal/hr)	Comments
GAMW-3	9-15-87	***26.86***	---	---	---	
	5-23-88	***25.97***	1.5	1.4	---	2
	5-24-88	***27.69***	1.2	8.0	---	3
	7-18-88	***27.59***	1.3	4.1	5.0	
	9-07-88	28.04	1.2	8.0	6.4	
	9-20-89	27.82	1.2	5.5	5.7	
GAMW-4	9-15-87	7.68	---	---	---	
	5-24-88	7.96	3.6	6.8	---	4
	5-25-88	8.28	3.6	17.0	12.7	
	7-18-88	8.74	3.5	14.7	9.8	
	9-07-88	8.62	3.6	12.0	13.1	
	9-20-89	9.26	3.4	10.5	13.7	
GAMW-5	9-15-87	72.22	---	---	---	
	5-25-88	71.84	3.9	7.0	2.3	
	7-18-88	82.70	2.3	5.3	1.3	
	7-19-88	-----	---	---	1.1	5
	9-07-88	82.87	2.2	---	---	6
	9-21-89	81.95	2.4	22.0	1.0	7
GAMW-1C	9-15-87	221.61	mm-	---	---	
	11-23-87	222.03	--m	---	---	
	7-20-88	224.16	20.2	27.5	3.1	
GAMW-1B	9-15-87	210.87	---	---	---	
	11-W-87	192.58	---	---	---	
	7-19-88	197.04	---	---	---	
GAMW-1A	9-15-87	153.73	---	---	---	
	7-21-88	157.51	---	---	---	
M-w-1	U-07-89	44.80	54.8	180	79	

Comments:

1. All measurements are from top of PVC casing.
2. Irregular pumping rate due to low water yield and pump failure.
3. Irregular pumping rate due to low water yield.
4. Irregular pumping rate due to ice in well.
5. Pumped well from 2330 hrs, 7-18-88 to 1040 hrs, 7-19-88 due to very low water yield.
6. Pumped well from 1755 hrs, 9-7-88 to 1053 hrs, 9-8-88 due to very low water yield.
7. Pumped well from 1022 hrs, 9-21-89 to 0845 hrs, 9-22-89 due to very low water yield.

MW-1 was sampled once in November, 1989 during the well development and pump test conducted by the drilling contractor. The results of the water-quaky analyses from this well, the one samples from GAWM-1C, and the four samples each from GAWM-3, GAWM-4, and GAWM-5 are found in Appendix F.

The field-determined parameters varied considerably among the sites, with little variance between dates. The specific conductance range from 315 umhos/cm at MW-1 on November, 1989 to 7841 umhos/cm at GAWM-5 on July, 1988. The specific conductance at GAWMJ varied the most between dates, with values ranging from 3193 to 7841 umhos/cm. The alkalinity (average) was 180 mg/l at MW-1, 24X mg/l at GAWM-4,358 mg/l at GAWM-3, 596 mg/l at GAWM-5, and 1680 mg/l at GAWM-1C. The alkalinity at GAWM-1C may be underestimated because the water was effervescent (Ray and Maurer, 1989). The average pH for all the wells were below 7.0, ranging from 6.17 at GAWM-3 to 6.95 at MW-1. The water temperatures were generally less than 4°C.

Table 10 gives the major ion average percentages (based on meq/l) for the ground water samples. As indicated by the variation in the specific conductance, the composition also varies widely among the sites. The waters were classified following the 1988 sampling as sodium bicarbonate-chloride (GAWM-3), cakium-potassium, bicarbonate (GAWM-4), sodium chloride (GAWM-5), and sodium bicarbonate (GAWM-1C). After the 1989 sampling, GAWM-3 and GAWMJ remain in their respective classifications. However GAWM-4 has changed from calcium-potassium bicarbonate to sodium bicarbonate. The MW-1 well is classified as calcium bicarbonate. Figure 18 is a Piper diagram showing the distribution of ground water samples collected.

The wells which have been sampled for two seasons (GAWM-3, GAWM-4, GAWMJ) show little change in the average anion percentages. GAWM-3 and GAWMJ had some minor variations in the average cation percentages. However GAWM-4 had significant changes in the percentages. In 1988, the dominant cation was calcium (43 percent) with sodium the least abundant (seven percent). In 1989, however, the dominant cation was sodium *(77 percent)* with each of the other cations at approximately seven to eight percent.

Table 10. Average percentages of the major ion composition (in meq/l) of ground water monitoring wells at Usibelli Coal Mine (1988-1989).

	GAMW-3		GAMW-4		GAMW-5		GAMW-1C	MW-1
	1988	1989	1988	1989	198.8	1989	1988	1989
Calcium	21	17	43	8	19	22	7	54
Magnesium	16	15	20	7	18	12	13	20
sodium	59	62	7	77	62	64	76	25
Potassium	4	6	30	8	1	2	4	1
Bicarbonate	47	48	87	87	20	22	86	99
Chloride	42	40	2	2	78	75	13	c 1
Sulfate	11	12	10	10	2	3	1	1
Fluoride	<1	c l	1	1	c l	c l	c l	c l

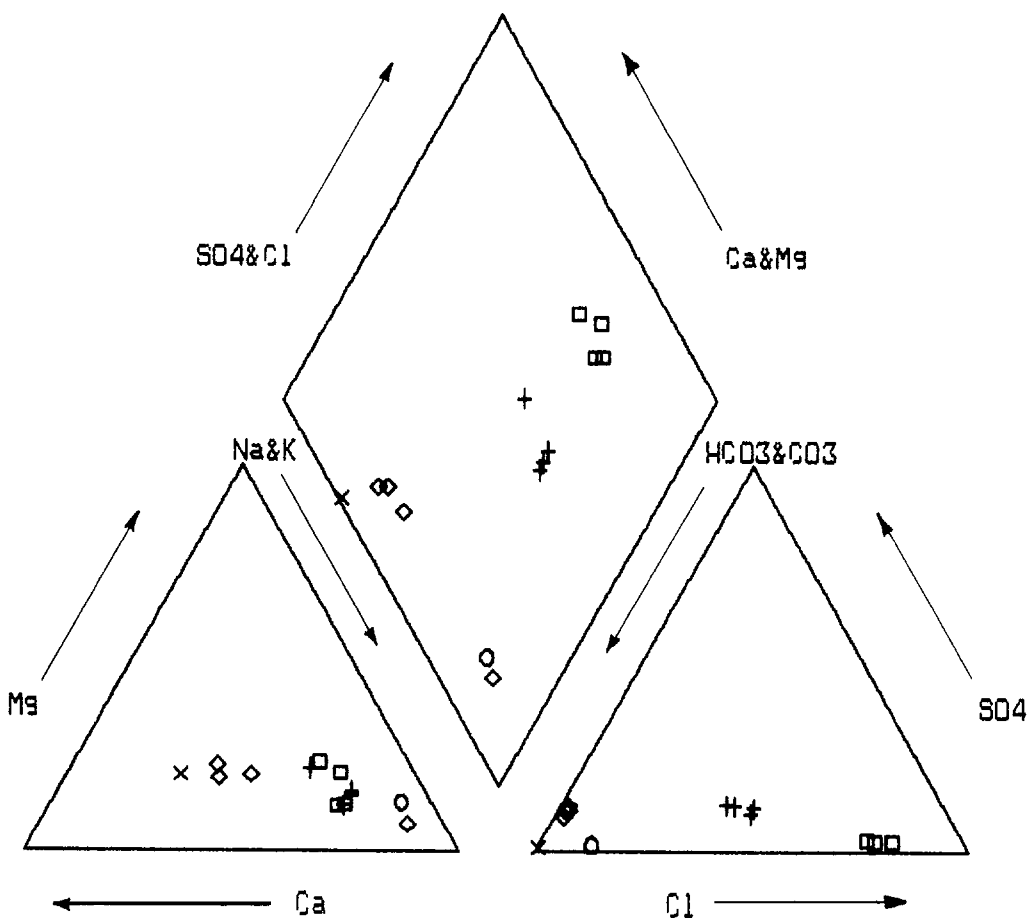


Figure 18. Piper diagram for the ground water sites. The sites are represented as follows: GAWM-3 (+), GAWM-4 (diamond), GAWM-5 (square), GAMW-1C (circle), and MW-1 (X).

Table 11 gives the mean values for the field-determined parameter and trace metal concentrations. The constituents which exceeded the Alaska Drinking Water Standards (ADEC, 1982) were barium at GAWM-5 (all dates in 1988), cadmium at GAWM-4 (twice in 1988), lead at GAWM-3 and GAWM-5 (all dates), dissolved iron and manganese at all wells (all dates), fluoride at GAWM-5 (all dates), and total dissolved solids at GAWM-1C, GAWM-3, and GAWM-5 (all dates). No nitrate was detected in 1988 in any of the wells, *however* in 1989 all wells sampled did have measurable nitrate. GAWM-1C was the only well with measurable orthophosphate (1988).

Table 11 Mean values of selected water quality constituents from the ground water monitoring wells and respective Alaska Drinking Water Standards (ADWS). Mean values based on four samples, except for wells GAMW-1C and MW-1 (single sampies). All values are in mg/l unless otherwise noted.

Analyte	GAMW-3	GAMW-4	GAMW-5	GAMW-1C	MW-1	ADWS
Trace Elements						
Arsenic	< 0.004	0.0051	0.008	CO.004	< 0.004	0.05
Aluminum	0.278	0.183	0.265	0.294	0.049	---
Barium	0.291	0.256	1.19	0.245	0.317	1.0
Beryllium	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	---
Cadmium	< 0.001	0.015[1]	0.001[2]	< 0.001	< 0.001	0.01
Copper	0.101	0.21	0.04'	co.01	< 0.01	1.0
Chromium	0.002	< 0.001	0.004	0.002	co.001	0.05
Iron (total)	39.0	11.9	54.1	0.35	4.70	---
Iron (dissolved)	28.6	7.84	41.2	0.28	4.16	0.03
Manganese	1.18	0.62	8.23	0.12	1.24	0.05
Nickel	< 0.05	co.05	< 0.05	< 0.05	< 0.05	0.05
Lead	0.103	< 0.03	0.191	0.05	< 0.03	0.05
Zinc	0.14	< 0.02	0.24	< 0.02	0.03	5.0
Anions						
Fluoride	0.654	1.14	5.02	0.59	0.49	2.4
Nitrate	0.37	0.12	0.59	< 0.02	0.30	10.0
Phosphate	< 0.05	< 0.05	c 0.05	5.35	co.05	---
Field Determinations						
Water Temperature (°C)	2.6	1.7	3.6	3.8	3.3	---
PI-I	4.2	6.6	6.2	6.7	6.95	6.5-8.5
Specific Conductance (umhos/cm)	1537	448	6176	3318	315	---
Alkalinity	358	205	5%	1680	180	---

Table 11 (continued).

Analyte	GAMW-3	GAMW-4	GAMW-5	GAMW-1C	MW-1	ADWS
Lab Determinations						
Total Dissolved Solids	901	296	3435	2271	219	500
Acidity	164	66.9	259	71.4	43.6	---

[1] The mean is estimated by assigning the detection limit value to the "less than" value.

[2] The mean is estimated by assigning values to "less than" values, assuming a uniform distribution of data between zero mg/l and the detection limit.

DISCUSSION

The precipitation at Gold Run Pass has exceeded the total at Poker Flat each year of the study (by an average of 28 percent). The precipitation total for 1987 and 1988 at Gold Run Pass exceeded the total at Poker Flat by 20 percent and 23 percent, respectively. However, in 1989 Gold Run Pass received 42 percent more precipitation than Poker Flat. Certainly some of this discrepancy is real, resulting from heavier showers further in the basin. However, some may be due to the inability of the Poker Flat gage to accurately measure the rainfall because of wind. The Gold Run Pass gage has a "Wyoming" wind shield around it to protect the gage orifice from the wind. The Poker Flat gage does not have such a device. The previous Poker Flat gage site was better protected from the wind than the present site. If this is true, than the present site may not be recording the actual rainfall due to the wind blowing across the opening of the gage.

The data continues to show that the events which produce the large flow events (resulting in high sediment loads) are the large cyclonic storms from the Gulf of Alaska or Bering Sea (Ray and Maurer, 1989). These moisture-laden storms are accompanied by low-level west-southwesterly winds and are capable of dropping more than two inches of rain in 24 hours to 48 hours.

The average seasonal runoff at Bridge 3 has increased each year. Table 12 shows the average flow (cfs), total runoff (inches), total precipitation (inches), and the runoff to precipitation ratio for Bridge 3 for June through September.

Table 12. Average flow (cfs), total runoff (inches), total precipitation at Gold Run Pass (inches), and runoff to precipitation ratio for Bridge 3 for June through September.

Site	Average Flow	Runoff	Precipitation	Ratio
1987	37.1	3.84	11.16	.344
1988	40.7	4.22	14.88	.284
1989	53.6	5.55	13.28	.418

The average runoff-to-precipitation ratio for the three years is approximately 0.35. The variance among the values is due to variation in temperature, wind, and the frequency of the rainfall events. The 1989 season had the highest runoff ratio, but not the highest precipitation. This was primarily due to the month of June. Numerous heavy rains during the month maintained high soil moisture conditions, increasing the runoff. This weather pattern in June also produced the highest peak flows recorded during the study period. Although not all the creeks were measured, each creek certainly would have recorded its highest flow of the study period during June, 1989.

The increase in flow each year resulted in an increase in the total sediment load each year. Table 13 shows the load for each site sampled from 1987-1989. The loads are for the period of discharge record.

Table 13. Sediment load estimates (for the period of discharge record) and basin distribu tion for 1987- 1989.

Site	1987	1988	1989
Sanderson	5600	7570	----
North Hoseanna	7500	1020	----
Hoseanna @ Brd 6	----	2606	41900
Popovitch	60	88	----
Louise	ewe-	---e	1236
Frances	45	401	----
Hoseanna @ Brd 3	40000	59200	100300
Two Bull	----	----	554

The data from Hoseanna Creek at Bridge 3 shows the importance of large storms in determining the total seasonal load. The average flow in 1989 was 47 and 23 percent greater than 1987 and 1988, respectively. However the sediment load was 151 and 69 percent greater, respectively. The percent increase in sediment load was approximately three times the percent increase in flow. During the 1987 season there were no events greater than 500 cfs. During the 1988 season one event exceeded 500 cfs and one event was approximately 500 cfs. However during the 1898 season three events exceeded 500 cfs with one of the events exceeding 1000 cfs. This shows the importance of large storm events in determining the seasonal sediment load.

The spring runoff is a significant contributor to the annual sediment load. Prior to the 1989 season, little data existed from spring runoff. The 1989 spring runoff was sampled, indicating the importance of the period. The load calculated for the month of May using the composite TSS samples from Bridge 3 and the estimated flow from Bridge 1 (90 percent of Bridge 1 flow was used) was 16,000 tons. This is greater than the loads of July, August, September and October combined. The month of May had only one small storm with most of the precipitation falling as snow in the higher elevations.

As discussed by Ray and Maurer (1989), the majority of sediment transported during a season occurs over a relatively short period of time. Table 14 shows the percentage of sediient transported in discrete, short periods of time. For most sites, over 50 percent of the seasonal sediment load was transported in two to three days. Louise Creek had 91 percent of the total load transported in three days, with 99 percent in 10 days. The average transported in the 10 days was approximately 84 percent. A note of interest is that the percentages for 1988 and 1989 for Hoseanna Creek at Bridge 3 were nearly identical.

As discussed by Ray and Maurer (1989) the statistical quality of the sediment rating equations is a function of the physical parameters of the basin. The larger streams have higher r^2 values than the smaller creeks. This is due to small mass wasting events which supply pulses of sediment to the smaller streams. This creates a large variation in the sediment concentration for that discharge. This results in a lower r^2 value for that stream. This is not as great of a factor on the large streams due to the wider channels and higher flows diluting the pulses.

Another factor which lowers the r^2 value of the rating equations is the seasonal variation of sediment available for transport. Ray and Maurer (1989) compared the sediment load for two similar storms in 1988, one in June and one in July. The June storm induced a much higher sediment load that did the July storm, primarily due to more sediment available for transport in June.

Table 14. The percentage of seasonal sediment load in short durations.

Site	DAYS 1	2	3	5	10
Sanderson (1988)	26	48	62	77	88
North Hoseanna (1988)	17	29	40	47	60
Hoseanna @ Brd 6 (1988)	55	62	68	71	82
1989	37	49	59	74	87
Popovitch (1988)	27	36	44	53	67
Louise (1989)	52	86	91	95	99
Frances (1988)	27	41	52	71	93
Hoseanna @ Brd 3 (1988)	44	55	65	78	87
1989	42	56	63	78	91
Two Bull (1989)	58	64	69	77	87
AVERAGE	39	53	61	72	84

WATER QUALITY

Surface Water

The surface water-quality sampling since 1987 have been conducted at flows ranging from 19.7 to 46.2 cfs. The seasonal average flows at Bridge 3 ranged from 36 cfs in 1987 to 52 cfs in 1989. The samples were taken during non-storm periods, which represent average to low-flow conditions. One of the main purposes of the surface water quality study is to determine the effect of Poker Flat mine on the water quality of Hoseanna Creek. The most likely influence of the Poker Flat mine is from ground water input from the spoils. If samples were taken during storm runoff, any effects of the mine would probably be diluted by the large volume of surface runoff. To measure the maximum influence from the mine, samples should be taken at low-flow conditions when surface runoff is low and the ground water contribution is high.

Another complicating factor in determining changes in the stream chemistry is that even during low-flow periods when there is little or no surface runoff, the concentration of dissolved constituents is a function of the discharge (Ray, 1988). As the flow decreases, the total dissolved concentration increases. This factor can be seen in Figure 19, which plots TDS versus discharge for Hoseanna Creek at Bridge 3. As shown, the TDS increases as the discharge decreases. This makes it difficult to determine the influence of the mine on the water chemistry from the samples collected due to the variations in flow. The best samples for comparison are those collected in September each year. The flow conditions were nearly the same (baseflow with little surface runoff). The magnitude of flows ranged from 19.7 to 26.4 cfs at Bridge 3 to 22.9 to 35.5 cfs at Bridge 1.

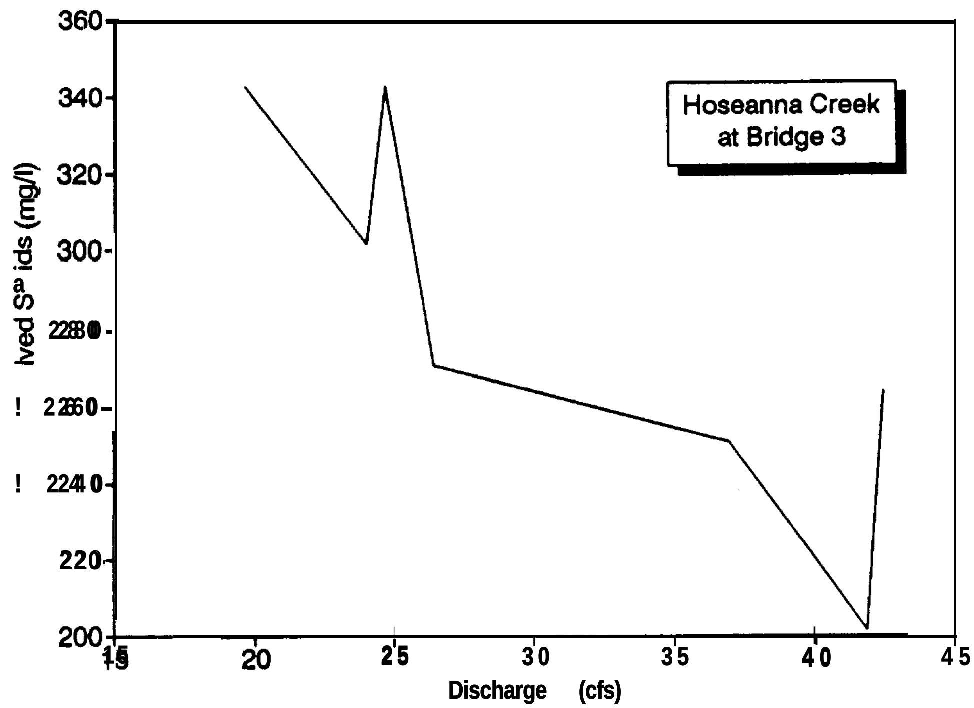


Figure 19. Total dissolved solids (mg/l) versus discharge (cfs) for Hoseanna Creek at Bridge 3.

Figure 20 is a Piper diagram showing the three September samples collected for both Bridge 1 and Bridge 3. There is a trend toward increasing sodium and potassium percentages and decreasing magnesium percentages from 1987 to 1989. The trend is present for both Bridge 1 and Bridge 3. If

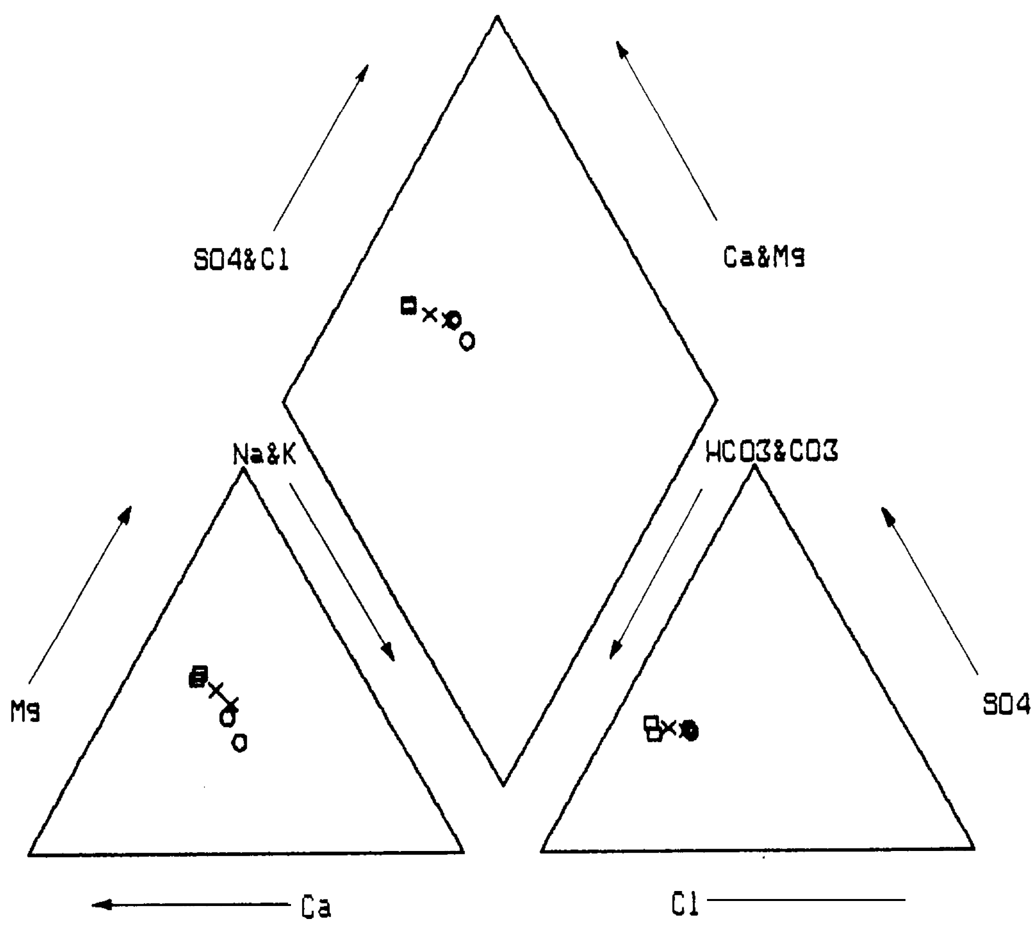


Figure 20. Piper diagram for the September surface water samples. The symbols represent 1987 (squares), 1988 (X), and 1989 (circles).

Bridge 1 had been the only site to exhibit this trend, then the conclusion might be that the ground water from the spoils (high in sodium, potassium, and chloride) was indeed having an impact on the surface water chemistry. However, since both sites have increased, it may only be a function of the flow (flow decreased from 1987 to 1989). The percentage of chloride shows a similar trend among the anions (Figure 20).

Using the conservation of mass, it is possible to estimate the sodium concentration in the ground water necessary to mix with the water in Hoseanna Creek at Bridge 3 to produce the concentration at Bridge 1. Conservation of mass is stated in this case as:

$$Q_1C_1 = Q_3C_3 + Q_{gw}C_{gw}$$

where: Q_x is the discharge at Bridge 1, Bridge 3, and ground water

C_x is the sodium concentration at the respective sites.

It is therefore possible to solve for C_{gw}, to see if any changes occur over time. Table 15 gives the results of this calculation. As shown by the asterisks, the flow at Bridge 3 is often greater than the flow at Bridge 1 due to the porous nature of the stream channel above Bridge 1 at low-flows. This loss of channel flow complicates the analysis. The estimated concentration of the ground water increases with time, and is much greater in September 1988 and 1989 than in September 1987. This suggests that the ground water from the mine spoils is supplying more sodium ions to the surface water. However this is not conclusive due to the loss or potential loss of flow from Bridge 3 to Bridge 1. A better location for the downstream site on Hoseanna Creek may be at Bridge 2. This location should be influenced by the mine, however, the site would probably not have the loss of flow that occurs at Bridge 1.

The concentration of nitrate at Bridge 1 on June 8, 1987 was significantly higher than any other nitrate concentration recorded during the study. This high concentration may have been the result of an areal fertilizer application near the stream prior to sampling (Ray and Maurer, 1989).

Ground Water

The purpose of the ground water monitoring program is to monitor the ground water quality of the disturbed and undisturbed formations associated with the Poker Flat mine and to estimate, if any,

Table 15. Estimation of C_{gw} for Hoseanna Creek

Date	Q_1C_1 (grams/sec)	Q_3C_3 (grams/sec)	Q_1C_1-Q_3C_3 (grams/sec)	C_{gw} (mg/l)
08 JUN 87	15.05	17.28	-2.23	****
03 AUG 87	13.55	15.36	-1.81	****
14 SEP 87	14.78	10.99	3.79	14.7
23 MAY 88	8.87	6.76	2.11	19.6
19 JUL 88	8.73	8.25	0.48	****
08 SEP 88	23.10	15.77	7.33	108
20 SEP 89	29.76	19.69	10.07	111

**** Indicates that the flow at Bridge 3 was greater than the flow at Bridge 1

the impact of the ground water on the waters of Hoseanna Creek. GAWM-3, GAWM-1C, and MW-1 are wells in undisturbed soils, and are used as control wells. Wells GAWM-4 and GAWM-5 are wells in the disturbed spoils. Changes in the concentrations or anomalous values in these wells *may* be reflected in the chemistry of the surface waters.

The cation percentages in GAWM-3 and GAWM-5 remained constant during the sampling (Table 10) and plot in the same vicinity on the Piper Diagram (Figure 18). Although the total dissolved solids (TDS) remained constant for the two wells, the TDS is much higher in GAWM-5 than in GAWM-3. The anion percentages for the two wells also remained constant for the sampling period. However the dominant anion in GAWM-5 is chloride, where as in GAWM-3 bicarbonate and chloride percentages are approximately equal.

Wells MW-1 and GAWM-1C were only sampled one time each. Both wells a characterized by high alkalinity percentages (99 and 86 percent, respectively). The water sample from GAWM-1C was visibly effervescent, presumably due to the release of carbon dioxide (Ray and Maurer, 1989). Although both these wells are in coal seam #3, the cation percentages of the waters were quite different. GAWM-1C was dominated by sodium, while MW-1 was dominated by calcium (Table 10).

The most significant changes in the water chemistry occurred at GAWM-4. Although the anion percentages remained the same from 1988 to 1989, the cation percentages changed considerably (TDS remained constant). In 1988, the dominant cation was calcium at 43 percent. However in 1989, the dominant cation was sodium at 77 percent. The water chemistry of the well in 1988 was termed "unusual" by Ray and Maurer (1989) since potassium concentrations do not normally exceed the sodium concentrations unless both are less than 5 mg/l (Hem, 1985). The average concentration of potassium and sodium in 1988 was 49.6 and 7.0 mg/l, respectively. However in 1989, the potassium and sodium concentrations were 13.4 and 75.3 mg/l, respectively. The 1989 GAWM-4 data plots on a Piper diagram in the same region as the other ground water wells (Figure 18). A possible explanation for this change in chemistry may be due to the cracked concrete well casing. During the initial sampling of well GAWM-4, it was noted that the well casing was cracked. It is hypothesized that during the 1988 summer season, this crack in the casing may have allowed surface water infiltration. The high potassium concentration was derived from fertilizers applied to the spoils. However sometime between the last 1988 sampling and the 1989 sampling, the well became "sealed" (possibly due to freeze-thaw action). This cut-off the surface water input, allowing the sample to reflect the "true" nature of the ground water.

The effects of fertilizer spraying may be showing up in the other ground water wells. The potassium concentration in well GAWM-5 rose from an average in 1988 of 12.4 mg/l to 52.1 mg/l in 1989. There has been a steady rise in the potassium concentration at GAWM-3 (undisturbed), but the change has not been as great. The area of well GAWM-3 may receive some over spray of fertilizer. Another indicator is the presence of nitrate in all the GAWM well sampled in 1989. In 1988, well GAWM-4 had one sample which had a small concentration of nitrate.

CONCLUSIONS

1. Large cyclonic storms are responsible for most of the sediment transport, while the isolated convective storms result in minor sediment production.

2. A large portion of the seasonal sediment load occurs during the first major flood event of the season (may coincide with break-up).

3. The runoff prior to break-up carries a significant sediment load which is important factor in the annual sediment load.

4. Most of the seasonal sediment load is transported over a relative few days during high-flow events.

5. Rating equations have a limited accuracy, in that they are power functions.

6. Good sediment rating equations (high r^2 values) are difficult to obtain for small creeks due to mass wasting events.

7. Some streams are better suited for the establishment of good rating equations (also noted by Wilbur, 1989).

8. Hysteresis results in additional variance in the calculation of the sediment rating equations.

9. The available sediment for transport decreases through the summer, resulting in additional variance in the calculation of the sediment rating equations.

10. There appears to be a trend toward increasing sodium and chloride in Hoseanna Creek at both Bridge 1 and Bridge 3. The trend may be more evident at Bridge 1.

11. The best time to sample the surface water is during the late-fall or even late-winter when the surface runoff is at a minimum.

12. The water type classification for the five ground water monitoring wells is significantly different.

13. Little change in the water chemistry has occurred in GAWM-3 and GAW-5. What changes have taken place may be due to fertilization the of the spoils.

14. The water chemistry of GAW-4 in 1988 may have been influenced by surface water runoff down the well casing.

REFERENCES CITED

Alaska Department of Environmental Conservation, 1982, Drinking Water Regulations: Title 18, Chapter 80 of the Alaska Administrative Code, Register 83, 1982, Juneau, Alaska, 20 p.

Alaska Department of Environmental Conservation, 1987, Water Quality Regulations: Title 18, Chapter 70 of the Alaska Administrative Code, 1987, Juneau, Alaska, 18 p.

American Public Health Association, Water Works Association, and Water Pollution Control Federation, 1985, Standard Methods for the examination of water and wastewater (16th ed.): American Public Health Association, Washington, D.C., 1268 p.

Dahymple, Tate and MA. Benson, 1984, Measurement of peak discharge by the slope-area method: Techniques of Water-Resources Investigations of the United States Geological Survey, Book 3, Chapter A2, Washington, D.C., U.S. Government Printing Office, 12 p.

Golder Associates, 1987, Groundwater monitoring well installation field investigation: Unpublished report submitted to Usibelli Coal Mine, Inc., August 1987, 26 p.

Hem, J.D., 1985, Study and Interpretation of the Chemical Characteristics of Natural Water, 3rd ed., U.S. Geological Survey, Water-Supply Paper 2254,263 p.

Leopold, L.B., and Thomas Maddock Jr., 1953, The hydraulic geometry of stream channels and some physiographic implications: U.S. Geological Survey Professional Paper 252, Washington, DC., U.S. Government Printing Office, 57 p.

Mack, Stephen F., 1987, Streamflow and sediment study of **Hoseanna** Creek near Healy, Alaska: 1986 progress report, Alaska Division of Geological and Geophysical Surveys Public-data File Report **87-4, 13** p.

Mack, Stephen F., 1988, Streamflow and sediment study of **Hoseanna** Creek near Healy, Alaska: 1987 progress report, Alaska Division of Geological and Geophysical Surveys Public-data File Report **88-9, 58** p.

McIntosh, Gary E., 1987, HC-Gram; **Hydrochemical** Graphic Representation Analysis Methods, Version 1.42

Ray, Scott R., 1988, **Physical and** chemical characteristics of headwater streams at Caribou-Poker Creeks Research Watershed, University of Alaska Fairbanks (unpublished thesis), 172 pp.

Ray, Scott R. and Mary **Maurer,** 1989, Streamflow, sediment load, and water-quality study of **Hoseanna** Creek basin near Healy, Alaska: 1988 progress report, Alaska Division of Geological and Geophysical Surveys Public-data File Report **88-10, 62** p.

Shannon and Wilson Inc., 1990, Groundwater monitoring well installation field investigation: Unpublished report submitted to **Usibelli** Coal Mine, Inc., (in press).

Skougstad, M.W., **Fishman,** M.J., Friedman, L.C., Erdmann, D.E., and Duncan, S.S., 1979, Methods for determination of inorganic substances in water and **fluvial** sediments: U.S. Geological Survey, Techniques of Water-Resources Investigation, Book 5, Chapter Al, 626 p.

Scalf, R., **McNabb,** J.F., **Dunlap,** WJ., Cosby, R.L., and Fryberger, J., 1981, Manual of ground-water sampling procedures: National Water **Well** Association and U.S. Environmental Protection **Agency, 93 p.**

U.S. Department of Interior, 1977, National handbook of recommended methods for water-data acquisition: Geological Survey Office of Water Data Coordination, 3 volumes.

U.S. Department of Interior, 1981, Water measurement manual, U.S. Bureau of Reclamation, U.S. Government Printing Office, 329 p.

U.S. Environmental Protection Agency, 1983, Methods for chemical analysis of water and wastes: U.S. Environmental Protection Agency, **EPA-600/4-79-020.**

Wahrhaftig, Clyde, JA. Wolfe, E.B. Leopold, and MA. Lanphere, **1969,** The Coal-Bearing Group in the Nenana **Coal** Field, Alaska, Geological Survey **Bulletin** 1274-D, Washington, D.C., U.S. Government Printing Office, **30** p.

Wahrhaftig, Clyde, 1987, The Cenozoic section at Suntrana, Alaska, Contributions for Geological Society of America DNAG Centennial Guide, **Cordilleran** Section, vol. 1.

Wilbur, S., and T. Clark, 1987, Relations among Iithology, sediment production, and drainage density for **Hoseanna** Creek basin near Healy, Alaska, **in:** Huntsinger, R.G. ed., Water quality in the great land, Alaska's **challenge,** Proceedings, American Water Resources Association, Water Research Center, IWR 109, p. **203-213.**

Wilbur, S., 1989, Predicting sediment concentrations for small subarctic creeks in the Hoseanna Creek Basin, in Proceedings, International Conference on Mining in the Arctic, University of Alaska Fairbanks, July 1989.

APPENDIX A

Gold Run Pass

Daily Precipitation - 1989 (in)

	MAY	JUN	JUL	AUG	SEP	OCT
1			0.12	0.36		
2				0.12		
3				0.48		
4				0.72		
5		0.48		1.68		
6		2.04				
7	0.12					
8	0.24					
9	0.12					
10	0.24					
11	0.12					
12						
13				0.36		
14				0.12	0.24	
15			0.12			
16	0.12		0.12			
17						
18		0.72				
19						
20				0.72		
21			0.12	0.36	0.12	
22						
23		0.12				
24		0.96	0.12			
25		1.56				
26			0.48		0.48	
27		0.24	0.24			
28		0.12				
29						
30						
31						
Total	0.96	6.20	1.32	4.92	0.84	

Season Total = 14.24

Poker Flat

Daily Precipitation - 1989 (in)

	MAY	JUN	JUL	AUG	SEP	OCT
1			0.11	0.34		
2				0.11		
3				0.31	0.01	
4		0.01		0.43		
5		0.34		0.96	0.01	
6		1.47			0.02	
7	0.04				0.01	
8	0.15					
9	0.06					
10	0.15					
11	0.04		0.01		0.01	
12						
13				0.18	0.05	
14		0.03		0.02	0.28	
15	0.01		0.10			
16	0.04		0.08			
17						
18		0.51				
19			0.06	0.64	0.04	
20					0.04	
21			0.07	0.02	0.12	
22						
23		0.03				
24		0.68	0.07			
25		0.40	0.02		0.04	
26			0.44		0.64	
27		0.31	0.28			
28		0.12				
29				0.10		
30			0.01			
31						
Total	0.49	3.90	1.25	3.11	1.31	

Season Total = 10.06

APPENDIXB

Hoseanna Creek at Bridge 3

Daily Average Discharge - 1989 (cfs)

	MAY	JUN	JUL	AUG	SEP	OCT
1	81*	40.2	59.7	20.7	22.1	19.8
2	90*	37.9	46.7	22.3	18.7	19.2
3	72*	38.3	39.5	29.1	17.8	19.6
4	63*	40.1	36.8	38.1	18.1	18.6
5	72*	250	34.3	350	17.6	
6	90*	495	27.5	88.8	16.7	
7	135*	192	25.9	51.9	16.8	
8	180*	65.2	23.7	38.1	16.1	
9	90*	43.3	23.2	29.8	16.0	
10	45*	38.9	21.8	24.1	15.4	
11	36*	36.3	21.2	22.2	16.2	
12	32*	34.8	21.4	24.5	15.8	
13	27*	33.7	23.0	29.5	17.4	
14	27*	31.9	22.8	34.6	22.9	
15	32*	31.2	21.7	32.3	28.4	
16	36*	30.0	27.3	29.0	18.4	
17	40*	29.4	33.1	26.9	18.3	
18	45*	44.5	23.1	27.2	17.6	
19	54*	37.8	24.2	32.4	20.3	
20	63*	32.2	23.5	31.8	20.9	
21	72*	31.5	22.3	31.2	19.7	
22	63*	31.3	20.3	30.2	17.3	
23	54*	30.6	19.6	26.3	17.2	
24	53*	121	20.1	23.7	15.8	
25	64.5	800	19.7	22.1	16.8	
26	63.9	440	25.9	22.7	39.3	
27	63.9	350	34.4	22.7	26.7	
28	73.6	220	20.9	21.6	23.2	
29	58.0	150	19.4	28.7	21.4	
30	53.0	66.3	18.6	27.1	20.6	
31	45.4		18.9	21.8		
AVE	60.3	128	26.5	40.7	19.6	19.3

Season Average = 52.6 cfs

Hoseanna Creek at Bridge 6

Daily Average Discharge - 1989 (cfs)

	MAY	JUN	JUL	AUG	SEP
1		28.4	22.9	9.74	11.1
2		26.9	18.2	10.5	9.44
3		27.8	15.6	13.7	9.04
4		32.3	14.8	17.9	9.23
5		133	14.0	116	9.00
6		157	11.5	41.7	8.60
7		116	11.0	24.3	8.66
8		74.6	10.2	17.9	8.31
9		57.5	10.2	14.0	8.30
10		42.9	9.75	11.4	8.03
11		28.0	9.65	10.5	8.48
12		27.8	9.96	11.6	8.31
13		24.9	10.9	19.6	9.23
14		22.7	10.8	22.3	12.1
15		21.4	10.3	15.4	15.2
16		19.3	12.9	13.8	9.86
17		19.4	15.7	12.9	9.82
18		34.2	10.9	13.1	9.50
19		22.0	11.4	15.6	11.0
20		17.6	11.1	20.8	11.4
21		15.7	10.6	19.7	10.8
22		15.1	9.58	14.6	9.50
23		13.9	9.24	12.8	9.50
24		77.3	9.50	11.5	8.79
25	57.1	234	9.27	10.8	9.35
26	52.4	138	12.2	11.2	20.8
27	50.4	112	16.2	11.2	13.0
28	60.4	81.9	9.87	10.7	
29	50.9	42.6	9.12	14.3	
30	51.2	25.0	8.73	13.5	
31	36.3		8.89	10.9	
AVE	51.2	56.3	11.8	18.5	10.2

Season Average = 25.9 cfs

APPENDIX B (cont)

Louise Creek

Daily Average Discharge - 1989 (cfs)

	JUN	JUL	AUG	SEP	OCT
1		0.64	0.05	0.03	0.03
2		0.38	0.04	0.03	0.03
3		0.30	0.07	0.03	0.03
4		0.24	0.19	0.03	0.03
5		0.21	0.74	0.03	
6	3.26	0.16	0.17	0.02	
7	0.85	0.11	0.12	0.03	
8		0.09	0.09	0.03	
9		0.07	0.07	0.03	
10		0.08	0.07	0.03	
11		0.08	0.05	0.02	
12		0.06	0.05	0.02	
13	0.19	0.05	0.08	0.03	
14	0.21	0.05	0.06	0.05	
15	0.17	0.05	0.05	0.03	
16	0.13	0.05	0.05	0.02	
17	0.13	0.04	0.05	0.03	
18	0.48	0.04	0.07	0.02	
19	0.19	0.04	0.10	0.03	
20	0.17	0.04	0.08	0.03	
21	0.15	0.04	0.07	0.03	
22	0.12	0.04	0.05	0.02	
23	0.12	0.03	0.05	0.02	
24	0.73	0.03	0.04	0.03	
25	4.58	0.03	0.04	0.03	
26	1.55	0.06	0.04	0.14	
27	1.06	0.07	0.04	0.04	
28	1.03	0.05	0.04	0.03	
29	0.73	0.05	0.04	0.02	
30	0.54	0.04	0.03	0.04	
31		0.04	0.03		
AVE	0.82	0.11	0.09	0.03	0.03

Season Average = 0.20 cfs

APPENDIX B **(cont)**

Two **Bull** Creek

Daily Average Discharge • 1989 (cfs)

	JUN	JUL	AUG	SEP	OCT
1		0.36	0.11	0.12	0.11
2		0.13	0.17	0.11	0.12
3		0.13	0.20	0.15	0.12
4		0.12	0.26	0.18	0.13
5		0.12	0.54	0.15	
6		0.13	0.17	0.15	
7		0.10	0.17	0.16	
8		0.11	0.16	0.15	
9		0.11	0.15	0.15	
10		0.12	0.14	0.14	
11		0.10	0.13	0.12	
12		0.09	0.12	0.12	
13	0.14	0.11	0.16	0.12	
14	0.14	0.12	0.14	0.15	
15	0.24	OS.5	0.13	0.14	
16	0.19	0.14	0.11	0.14	
17	0.19	0.14	0.10	0.13	
18	0.78	0.13	0.09	0.13	
19	0.17	0.12	0.17	0.12	
20	0.33.	0.11	0.13	0.13	
21	0.16	0.12	0.10	0.16	
22	0.06	0.11	0.11	0.14	
23	0.08	0.10	0.10	0.13	
24	0.27	0.11	0.10	0.12	
25	3.12	0.12	0.09	0.11	
26	0.46	0.13	0.09	0.18	
27	0.27	0.17	0.10	0.10	
28	0.81	OS3	0.10	0.11	
29	0.14	0.12	0.15	0.12	
30	0.07	0.10	0.10	0.11	
31		0.09	0.12		
AVE	0.42	0.13	0.15	0.13	0.12

Season Average = 0.18 cfs

APPENDIX C

Hoseanna Creek at Bridge 3

Daily Sediment Load - 1989 (tons)

	MAY	JUN	JUL	AUG	SEP	OCT
1	284*	171	180	16.7	9.4	11.4
2	403*	57.7	133	35.4	7.1	5.8
3	264*	77.0	67.4	174	5.6	6.9
4	459*	176	69.1	368	5.4	5.2
5	204*	6700	85.1	7510	6.2	
6	286'	13300	37.6	628	6.9	
7	488*	1790	26.3	83.0	4.9	
8	942*	225	23.9	53.2	5.2	
9	418*	135	23.5	31.4	5.1	
10	137*	105	19.9	17.2	4.6	
11	59*	83.3	16.2	17.6	5.1	
12	40*	68.0	14.7	18.2	5.3	
13	32*	54.5	20.0	118	4.0	
14	197*	43.0	35.6	110	23.3	
15	357*	48.5	11.1	39.0	36.1	
16	300*	28.7	100	23.6	9.3	
17	472*	21.4	111	15.2	5.0	
18	1750*	1020	28.2	13.8	5.5	
19	297*	69.7	25.0	22.1	8.0	
20	651*	26.7	24.5	183	8.2	
21	4540*	20.1	18.6	82.3	6.5	
22	166*	16.7	13.4	34.3	5.8	
23	86*	14.2	10.0	39.5	5.0	
24	215*	7810	10.0	19.9	4.5	
25	534	42500	10.3	15.3	3.1	
26	369	6510	33.0	10.4	261	
27	391	2720	176	8.2	36.8	
28	675	972	35.0	7.3	36.9	
29	435	569	14.0	16.1	9.4	
30	405	256	12.0	33.4	15.0	
31	162		12.7	8.4		
Total	16000	85600	1400	9750	554	29.3

Season Total = 100300 tons (does not include estimated loads)

Hoseanna Creek at Bridge 6

Daily Sediment Load • 1989 (tons)

	MAY	JUN	JUL	AUG	SEP
1		97.6	60.6	9.24	6.82
2		46.1	36.6	10.9	5.60
3		41.6	26.2	19.6	4.20
4		130	23.3	285	3.95
5		1870	20.7	4210	4.80
6		5140	13.2	180	5.20
7		800	12.0	69.5	4.10
8		151	10.3	29.0	3.80
9		76	10.2	20.6	3.91
10		61	9.3	13.0	4.06
11		51.6	9.1	10.9	3.95
12		48.9	9.7	13.5	4.21
13		40.2	11.8	43.4	3.54
14		32.6	11.7	57.5	15.0
15		35.5	8.2	25.2	24.5
16		21.6	17.3	20.0	7.40
17		18.6	26.3	12.5	4.95
18		458	11.9	10.3	3.58
19		55.6	13.1	17.5	6.41
20		22.4	12.3	49.3	5.94
21		14.6	11.0	43.5	5.03
22		13.5	8.92	22.6	4.21
23		11.2	8.24	16.8	3.65
24		3410	8.74	13.4	3.45
25	456	15300	8.29	11.7	2.21
26	285	2900	15.2	8.17	49.1
27	310	1800	28.4	6.51	17.5
28	465	624	9.51	4.42	
29	353	238	8.01	11.3	
30	357	73.8	7.27	19.0	
31	142		7.56	6.10	
Total	2370	33600	475	5260	204

Season total = 41900 tons

APPENDIX C (cont)

Louise Creek

Daily Sediment Load - 1989 (tons)

	JUN	JUL	AUG	SEP	OCT
1		7.76	0.01	0.00	0.00
2		2.41	0.00	0.00	0.00
3		1.38	0.02	0.00	0.00
4		0.89	0.43	0.00	0.00
5		0.57	10.7	0.00	
6	423	0.27	0.31	0.00	
7	12.1	0.07	0.11	0.00	
8		0.05	0.05	0.00	
9		0.02	0.02	0.00	
10		0.03	0.02	0.00	
11		0.03	0.01	0.00	
12		0.01	0.01	0.00	
13	0.44	0.01	0.03	0.00	
14	0.57	0.01	0.01	0.01	
15	0.33	0.01	0.01	0.00	
16	0.14	0.01	0.01	0.00	
17	0.14	0.00	0.01	0.00	
18	4.07	0.00	0.02	0.00	
19	0.43	0.00	0.05	0.00	
20	0.30	0.00	0.03	0.00	
21	0.21	0.00	0.02	0.00	
22	0.11	0.00	0.01	0.00	
23	0.11	0.00	0.01	0.00	
24	10.4	0.00	0.00	0.00	
25	643	0.00	0.00	0.00	
26	56.0	0.01	0.00	0.18	
27	23.9	0.02	0.00	0.00	
28	22.6	0.01	0.00	0.00	
29	10.3	0.01	0.00	0.04	
30	5.30	0.00	0.00	0.00	
31		0.00	0.00		
Total	1210	13.6	11.9	0.23	0.01

Season Total = 1236 **tons**

APPENDIX C (cont)

Two Bull Creek

Daily Sediment Load - 1989 (tons)

	JUN	JUL	AUG	SEP	OCT
1		8.71	0.24	0.10	0.01
2		2.61	0.70	0.08	0.01
3		2.24	1.01	0.07	0.01
4		2.01	7.15	0.06	0.00
5		1.83	35.2	0.05	
6		1.77	0.72	0.04	
7		1.68	0.75	0.03	
8		1.51	0.60	0.02	
9		1.34	0.53	0.02	
10		1.16	0.45	0.01	
11		0.95	0.38	0.01	
12		0.81	0.32	0.01	
13	2.62	0.72	0.61	0.01	
14	2.31	0.64	0.45	0.01	
15	3.62	0.53	0.38	0.01	
16	3.14	0.45	0.26	0.01	
17	2.64	0.45	0.21	0.01	
18	20.9	0.38	0.17	0.01	
19	3.61	0.32	0.73	0.01	
20	2.76	0.26	0.40	0.01	
21	2.27	0.32	0.22	0.01	
22	1.83	0.26	0.26	0.01	
23	1.44	0.21	0.21	0.01	
24	24.6	0.26	0.21	0.01	
25	322	0.32	0.17	0.01	
26	21.3	0.41	0.17	0.76	
27	7.5	0.70	0.16	0.21	
28	23.3	0.38	0.15	0.13	
29	13.6	0.32	0.14	0.08	
30	5.23	0.21	0.12	0.03	
31		0.17	0.11		
Total	465	34.0	53.2	1.80	0.03

Season Total = 554 tons

APPENDIXD

AU data collected since study began

Units: **Turb** (Turbidity) - NTU
TSS (Total Suspended Solids) - **mg/l**

Type: g - grab sample
i - automated **isco** sample
c - automated composite sample

Location	Date	The	Turb	TSS	Q	T
Hos BRD 1	08-Jun-87	1715	700	1850	36.4	g
Hos BRD 1	03-Aug-87	1600	100	198	31.7	g
Hos BRD 1	14-Sep-87	1625	180	625	35.5	g
Hos BRD 1	23-May-88	1800	440	2360		g
Hos BRD 1	Z-May-88	815	750	3990		g
Hos BRD 1	26-May-88	815	560	5560		g
Hos BRD 1	Ol-Jun-88	1925	940	4040		g
Hos BRD 1	02-Jun-88	800	970	3450		g
Hos BRD 1	14-Jun-88	2010	1500	1860		g
Hos BRD 1	15-Jun-88	720	640	1310		g
Hos BRD 1	15-Jun-88	1805	1700	3620		g
Hos BRD 1	16-Jun-88	1700	2700	9880		g
Hos BRD 1	30-Jun-88	1840	210	652		g
Hos BRD 1	19-Jul-88	1410	38	85		g
Hos BRD 1	19-Jul-88	1455	37	252		g
Hos BRD 1	21-Jul-88	820	1500	5990		g
Hos BRD 1	21-Jul-88	1235	1300	6420		g
Hos BRD 1	22-Jul-88	1510	1300	5000		g
Hos BRD 1	29-Jul-88	1745	140	289		g
Hos BRD 1	10-Aug-88	1830	49	498		g
Hos BRD 1	12-Aug-88	1530	3300	11700		g
Hos BRD 1	23-Aug-88	1515	5.4	40		g
Hos BRD 1	08-Sep-88	1305	36	80		g
Hos BRD 1	08-Sep-88	1315	31	60		g
Hos BRD 1	18-Apr-89	1730	170	314		g
Hos BRD 1	27-Apr-89	1854	510	1233		g
Hos BRD 1	28-Apr-89	1000	240	705		g
Hos BRD 1	28-Apr-89	1450	480	1496		g
Hos BRD 1	28-Apr-89	730	230	570		g
Hos BRD 1	05-May-89	1510	300	1150		g
Hos BRD 1	21-Sep-89	1140	54	234		g
Hos BRD 3	13-Aug-86	1700		50.2		g
Hos BRD 3	14-Aug-86			1490		i
Hos BRD 3	14-Aug-86	1200		573	32.6	g
Hos BRD 3	15-Aug-86			1240		i
Hos BRD 3	16- Aug-86			698		i
Hos BRD 3	17-Aug-86			538		i

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	18-Aug-86			7150		i
Hos BRD 3	19-Aug-86			3030		i
Hos BRD 3	20-Aug-86			14800		i
Hos BRD 3	21-Aug-86			1200		i
Hos BRD 3	26-Aug-86	1900		1100	57.6	g
Hos BRD 3	27-Aug-86			1720		i
Hos BRD 3	28-Aug-86			1350		i
Hos BRD 3	29-Aug-86			1080		i
Hos BRD 3	30-Aug-86			1370		i
Hos BRD 3	Ol-Sep-86			653		i
Hos BRD 3	02-Sep-86			573		i
Hos BRD 3	03-Sep-86			676		i
Hos BRD 3	04-Sep-86			427		i
Hos BRD 3	04-Sep-86	1500		373	29.4	g
Hos BRD 3	05-Sep-86			372	29.8	i
Hos BRD 3	OS-Sep-86	1810		330	29.6	g
Hos BRD 3	06-Sep-86			546	28.6	i
Hos BRD 3	07-Sep-86			425	27.1	i
Hos BRD 3	08-Sep-86			391	40.5	i
Hos BRD 3	09-Sep-86				57.1	
Hos BRD 3	10-Sep-86			1620	46.7	i
Hos BRD 3	10-Sep-86	1830		1040	44.9	g
Hos BRD 3	11-Sep-86			1250	45.2	i
Hos BRD 3	12-Sep-86				43.8	
Hos BRD 3	13-Sep-86			600	40.8	i
Hos BRD 3	14-Sep-86			465	37.9	i
Hos BRD 3	15-Sep-86				35.6	
Hos BRD 3	16-Sep-86				38.8	
Hos BRD 3	17-Sep-86			1680	40.5	i
Hos BRD 3	18-Sep-86			931	41.9	i
Hos BRD 3	19-Sep-86			640	37.5	i
Hos BRD 3	20-Sep-86				38.4	
Hos BRD 3	21-Sep-86				42.9	
Hos BRD 3	22-Sep-86			1010	40.1	i
Hos BRD 3	22-Sep-86	1700		370	40.8	g
Hos BRD 3	23-Sep-86			661	38.2	i
Hos BRD 3	24-Sep-86	1024		214	36.9	g
Hos BRD 3	13-Oct-86	1810		2990	114	g
Hos BRD 3	21-May-87	1642		28.3		g
Hos BRD 3	31-May-87	1715	4700	19200	346	i
Hos BRD 3	31-May-87	1845	7400	24400	377	i
Hos BRD 3	31-May-87	2015	6700	40700	342	i
Hos BRD 3	31-May-87	2145	5100	16900	273	i
Hos BRD 3	31-May-87	2315	4500	12400	193	i
Hos BRD 3	01-Jun-87	45	3300	9980	158	i
Hos BRD 3	Ol-Jun-87	215	2500	8870	173	i
Hos BRD 3	Ol-Jun-87	345	2300	6700	227	i

APPENDIX D (cont)

Location	Date	Tiie	Turb	TSS	Q	T
Hos BRD 3	Ol-Jun-87	515	1800	6140	338	i
Hos BRD 3	Ol-Jun-87	645	1600	5950	285	i
Hos BRD 3	Ol-Jun-87	815	1600	5510	369	i
Hos BRD 3	Ol-Jun-87	945	2200	7600	449	i
Hos BRD 3	Ol-Jun-87	1115	2500	9830	381	i
Hos BRD 3	01-Jun-87	1245	2800	12200	302	i
Hos BRD 3	01-Jun-87	1415	2700	12900	240	i
Hos BRD 3	Ol-Jun-87	1545	4400	14400	199	i
Hos BRD 3	Ol-Jun-87	1715	5100	15200	174	i
Hos BRD 3	Ol-Jun-87	1845	4200	14200	150	i
Hos BRD 3	Ol-Jun-87	2015	3600	13900	130	i
Hos BRD 3	Ol-Jun-87	2145	2400	9670	115	i
Hos BRD 3	Ol-Jun-87	2315	2300	8330	105	i
Hos BRD 3	02-Jun-87	45	2300	8560	92	i
Hos BRD 3	02-Jun-87	215	1800	7040	85	i
Hos BRD 3	02-Jun-87	345	2200	7080	97	i
Hos BRD 3	08-Jun-87	1534	2000	1770	56	g
Hos BRD 3	08-Jun-87	1555	600	1970	41.8	g
Hos BRD 3	09-Jun-87	1731	600	1480	40.8	g
Hos BRD 3	18-Jun-87	1827	450	953	34.7	g
Hos BRD 3	19-Jun-87	1705	400	932	31.9	g
Hos BRD 3	26-Jun-87	645	150	454	22.7	g
Hos BRD 3	30-Jun-87	1240	250	492	21.2	g
Hos BRD 3	01-Jul-87	1030	98	208	14.3	g
Hos BRD 3	Ol-Jul-87	1030	114	201	14.3	g
Hos BRD 3	03-Jul-87	1425	95	431	18.4	g
Hos BRD 3	06-Jul-87	1830	60	412	18.4	g
Hos BRD 3	09-Jul-87	930	31	348	17.1	g
Hos BRD 3	12-Jul-87	1530	110	955	23.4	g
Hos BRD 3	14-Jul-87	1845	400	2140	30.0	g
Hos BRD 3	15-Jul-87	820	2200	8850	75.2	g
Hos BRD 3	15-Jul-87	845	2800	7180	75.2	g
Hos BRD 3	15-Jul-87	1125	1700	4780	56.0	g
Hos BRD 3	19-Jul-87	1150	130	622	25.0	g
Hos BRD 3	20-Jul-87	1810	236	646	26.6	g
Hos BRD 3	20-Jul-87	1810	270	657	26.6	g
Hos BRD 3	21-Jul-87	1630	290	637	29.2	g
Hos BRD 3	23-Jul-87	1315	120	714	27.5	g
Hos BRD 3	24-Jul-87	1045	4500	13600	82.1	g
Hos BRD 3	27-Jul-87	945	130	492	30.0	g
Hos BRD 3	30-Jul-87	1100	5400	19000	180	g
Hos BRD 3	30-Jul-87	1330	3600	14300	180	g
Hos BRD 3	30-Jul-87	1750	2000	8680	144	i
Hos BRD 3	30-Jul-87	1850	2800	6230		i
Hos BRD 3	30-Jul-87	1950	2200	9530		i
Hos BRD 3	30-Jul-87	2050	2300	6800		i
Hos BRD 3	30-Jul-87	2150	1600	6230		i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	30-Jul-87	2250	1400	5270		i
Hos BRD 3	30-Jul-87	2350	2700	4850		i
Hos BRD 3	31-Jul-87	150	1800	4510		i
Hos BRD 3	31-Jul-87	250	1700	4680		i
Hos BRD 3	31-Jul-87	350	1700	4850		i
Hos BRD 3	31-Jul-87	450	1400	4110		i
Hos BRD 3	31-Jul-87	550	1400	3850		i
Hos BRD 3	31-Jul-87	650	1000	2780		i
Hos BRD 3	31-Jul-87	750	1100	2490		i
Hos BRD 3	31-Jul-87	850	1100	2300		i
Hos BRD 3	31-Jul-87	950	700	2090		i
Hos BRD 3	31-Jul-87	1050	650	2420		i
Hos BRD 3	31-Jul-87	1510	650	1540	107	g
Hos BRD 3	31-Jul-87	1515	600	1470	99.0	i
Hos BRD 3	31-Jul-87	1815	450	1250	80.0	i
Hos BRD 3	31-Jul-87	2115	500	166	75.0	i
Hos BRD 3	31-Jul-87	2450	2300	6100		i
Hos BRD 3	Ol-Aug-87	315	550	1350	65.0	i
Hos BRD 3	Ol-Aug-87	615	370	863	63.0	i
Hos BRD 3	01-Aug-87	915	340	678	62.0	i
Hos BRD 3	01-Aug-87	1215	300	589	62.0	i
Hos BRD 3	Ol-Aug-87	1515	260	529	54.0	i
Hos BRD 3	Ol-Aug-87	1815	240	482	53.0	i
Hos BRD 3	Ol-Aug-87	2115	230	446	46.0	i
Hos BRD 3	Ol-Aug-87	2415	500	979	73.0	i
Hos BRD 3	02-Aug-87	315	190	310	43.0	i
Hos BRD 3	02-Aug-87	615	170	2%	44.0	i
Hos BRD 3	02-Aug-87	915	160	283	44.0	i
Hos BRD 3	02-Aug-87	1215	150	235	46.0	i
Hos BRD 3	02-Aug-87	1515	150	247	41.0	i
Hos BRD 3	02-Aug-87	1815	120	243	39.0	i
Hos BRD 3	02-Aug-87	2115	140	182	36.0	i
Hos BRD 3	02-Aug-87	2415	190	378	43.0	i
Hos BRD 3	03-Aug-87	315	140	175	36.0	i
Hos BRD 3	03-Aug-87	615	110	179	36.0	i
Hos BRD 3	03-Aug-87	915	140	279	37.0	i
Hos BRD 3	03-Aug-87	1215	100	179	37.0	i
Hos BRD 3	03-Aug-87	1500	100	275	36.9	g
Hos BRD 3	03-Aug-87	2415	120	192	36.0	i
Hos BRD 3	04-Aug-87	1445		33.7		g
Hos BRD 3	10-Aug-87	1340	28	110	23.4	g
Hos BRD 3	13-Aug-87	1550	20	53	23.4	g
Hos BRD 3	18-Aug-87	1740	870	3040	44.0	g
Hos BRD 3	18-Aug-87	2215	2800	10200	98.0	i
Hos BRD 3	18-Aug-87	2345	3400	12400	131	g
Hos BRD 3	19-Aug-87	15	3600	11200	131	i
Hos BRD 3	19-Aug-87	215	2600	7480	132	i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	19-Aug-87	415	3600	11100	155	i
Hos BRD 3	19-Aug-87	615	3500	11800	220	i
Hos BRD 3	19-Aug-87	815	3300	11700	259	i
Hos BRD 3	19-Aug-87	950	2500	9710	216	g
Hos BRD 3	19-Aug-87	1015	2900	9010	210	i
Hos BRD 3	19-Aug-87	1215	1900	7230	187	i
Hos BRD 3	19-Aug-87	1415	1500	7870	176	i
Hos BRD 3	19-Aug-87	1615	1700	5580	150	i
Hos BRD 3	19-Aug-87	1645	900	4810	146	g
Hos BRD 3	19-Aug-87	1815	1300	4390	136	i
Hos BRD 3	19-Aug-87	2015	950	3380	128	i
Hos BRD 3	19-Aug-87	2215	800	2690	112	i
Hos BRD 3	20-Aug-87	15	900	2810	113	i
Hos BRD 3	20-Aug-87	215	850	2780	115	i
Hos BRD 3	20-Aug-87	415	950	2660	110	i
Hos BRD 3	20-Aug-87	615	750	2250	107	i
Hos BRD 3	20-Aug-87	815	650	1880	100	i
Hos BRD 3	20-Aug-87	1015	600	1570	97.0	i
Hos BRD 3	20-Aug-87	1215	550	1450	94.0	i
Hos BRD 3	20-Aug-87	1415	500	1410	92.0	i
Hos BRD 3	20-Aug-87	1615	450	1160	83.0	i
Hos BRD 3	20-Aug-87	1815	500	1010	78.0	i
Hos BRD 3	20-Aug-87	2015	400	916	71.0	i
Hos BRD 3	24-Aug-87	1750	42	90.4	31.2	g
Hos BRD 3	25-Aug-87	1350	41	74.3	28.3	i
Hos BRD 3	14-Sep-87	1438	120	378	26.4	i
Hos BRD 3	15-Sep-87	1630	450	1680	48.6	i
Hos BRD 3	12-Oct-87	1732	220	550	28.3	i
Hos BRD 3	13-Oct-87	945	27	41.7	16.1	i
Hos BRD 3	23-May-88	1545	340	1440	42.4	g
Hos BRD 3	26-May-88	930	280	1240	43.3	g
Hos BRD 3	26-May-88	930	240	1550	43.3	g
Hos BRD 3	31-May-88	0	8600	48900	620	i
Hos BRD 3	31-May-88	200	16000	63100	740	i
Hos BRD 3	31-May-88	400	13000	36400	630	i
Hos BRD 3	31-May-88	600	6300	19000	575	i
Hos BRD 3	31-May-88	800	5600	15700	510	i
Hos BRD 3	31-May-88	1000	4300	11500	400	i
Hos BRD 3	31-May-88	1200	3200	9450	265	i
Hos BRD 3	31-May-88	1400	2900	7790	210	i
Hos BRD 3	31-May-88	1600	2200	5880	195	i
Hos BRD 3	31-May-88	1800	2200	6130	170	i
Hos BRD 3	01-Jun-88	1715	780	3350	100	g
Hos BRD 3	02-Jun-88	930	900	2800	90.0	g
Hos BRD 3	02-Jun-88	1830	910	2510	87.0	g
Hos BRD 3	03-Jun-88	0	4600	12200	141	i
Hos BRD 3	03-Jun-88	200	4200	13800	220	i

APPENDIXD (cont)

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	03-Jun-88	400	4500	13800	250	i
Hos BRD 3	03-Jun-88	600	4700	13300	240	i
Hos BRD 3	03-Jun-88	800	4100	12000	210	i
Hos BRD 3	03-Jun-88	1000	8100	19900	295	i
Hos BRD 3	03-Jun-88	1200	4700	11400	200	i
Hos BRD 3	03-Jun-88	1400	2900	7740	145	i
Hos BRD 3	03-Jun-88	1600	4900	11300	170	i
Hos BRD 3	03-Jun-88	1800	4500	11500	130	i
Hos BRD 3	03-Jun-88	2000	5600	15100	155	i
Hos BRD 3	03-Jun-88	2200	4300	10300	135	i
Hos BRD 3	04-Jun-88	0	2600	6530	82.0	i
Hos BRD 3	04-Jun-88	200	4100	9130	110	i
Hos BRD 3	04-Jun-88	400	2700	5460	94.0	i
Hos BRD 3	04-Jun-88	600	1800	3770	83.0	i
Hos BRD 3	04-Jun-88	800	1900	3400	78.0	i
Hos BRD 3	04-Jun-88	1000	1200	3010	73.0	i
Hos BRD 3	04-Jun-88	1600	3300	6830	82.0	i
Hos BRD 3	14-Jun-88	1820	800	1710	45.2	g
Hos BRD 3	15-Jun-88	825	700	1430	45.0	g
Hos BRD 3	15-Jun-88	1750	2100	4530	40.0	g
Hos BRD 3	16-Jun-88	1545	2000	8150	70.8	g
Hos BRD 3	28-Jun-88	1130	1700	5100	93.0	i
Hos BRD 3	28-Jun-88	1130	1600	5420	93.0	i
Hos BRD 3	28-Jun-88	1225	1600	5210	130	i
Hos BRD 3	30-Jun-88	1710	270	757	40.5	g
Hos BRD 3	09-Jul-88	910	2600	8010	70.0	g
Hos BRD 3	09-Jul-88	9910	2700	7460	70.0	i
Hos BRD 3	10-Jul-88	1305	1400	3910	44.0	i
Hos BRD 3	10-Jul-88	1310	2000	5990	44.0	g
Hos BRD 3	10-Jul-88	1810	2700	6800	58.0	g
Hos BRD 3	10-Jul-88	1810	2600	7130	58.0	i
Hos BRD 3	11-Jul-88	1615	2500	5960	68.0	i
Hos BRD 3	Il-Jul-88	1615	1900	6270	68.0	g
Hos BRD 3	19-Jul-88	1004	45	291	24.7	g
Hos BRD 3	20-Jul-88	1009	17	41.5	22.0	g
Hos BRD 3	21-Jul-88	900	1200	3080	57.0	i
Hos BRD 3	21-Jul-88	905	1100	3130	57.0	g
Hos BRD 3	21-Jul-88	1030	960	3420	72.0	i
Hos BRD 3	21-Jul-88	1200	1400	5240	80.0	i
Hos BRD 3	21-Jul-88	1215	1500	5940	89.6	g
Hos BRD 3	21-Jul-88	1330	1700	5200	93.0	i
Hos BRD 3	21-Jul-88	1500	1200	4410	90.0	i
Hos BRD 3	21-Jul-88	1542	1200	4680	95.0	g
Hos BRD 3	21-Jul-88	1630	1500	5770	95.0	i
Hos BRD 3	21-Jul-88	1800	1900	5660	100	i
Hos BRD 3	21-Jul-88	1930	2000	4940	80.0	i
Hos BRD 3	21-Jul-88	2100	1100	2980	72.0	i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	21-Jul-88	2230	950	1990	66.0	i
Hos BRD 3	22-Jul-88	0	480	1460	61.0	i
Hos BRD 3	22-Jul-88	130	360	1180	54.0	i
Hos BRD 3	22-Jul-88	300	350	1010	52.0	i
Hos BRD 3	22-Jul-88	430	310	936	49.0	i
Hos BRD 3	22-Jul-88	600	250	756	49.0	i
Hos BRD 3	22-Jul-88	730	600	1610	50.0	i
Hos BRD 3	22-Jul-88	900	640	1870	61.0	i
Hos BRD 3	22-Jul-88	1400	1700	5320	96.0	g
Hos BRD 3	22-Jul-88	1730	1800	3860	165	i
Hos BRD 3	22-Jul-88	1900	3800	12200	205	i
Hos BRD 3	22-Jul-88	2030	6000	24000	340	i
Hos BRD 3	22-Jul-88	2200	6100	30700	460	i
Hos BRD 3	22-Jul-88	2330	5700	16800	510	i
Hos BRD 3	22-Jul-88	2340	5500	21100	510	g
Hos BRD 3	23-Jul-88	100	6900	33600	500	i
Hos BRD 3	23-Jul-88	530	3000	11000	215	i
Hos BRD 3	23-Jul-88	700	2800	6730	200	i
Hos BRD 3	23-Jul-88	755	2200	6540	185	8
Hos BRD 3	23-Jul-88	830	2500	6400	170	i
Hos BRD 3	23-Jul-88	1000	1800	5360	140	i
Hos BRD 3	23-Jul-88	1130	1500	3960	125	i
Hos BRD 3	23-Jul-88	1300	1300	4210	112	i
Hos BRD 3	23-Jul-88	1430	1300	3100	100	i
Hos BRD 3	23-Jul-88	1600	1100	2350	84.0	i
Hos BRD 3	23-Jul-88	1730	900	1990	80.0	i
Hos BRD 3	23-Jul-88	1900	1000	1990	72.0	i
Hos BRD 3	23-Jul-88	2030	820	1720	67.0	i
Hos BRD 3	23-Jul-88	2200	750	1450	65.0	i
Hos BRD 3	23-Jul-88	2330	970	2010	60.0	i
Hos BRD 3	24-Jul-88	100	640	1260	58.0	i
Hos BRD 3	24-Jul-88	230	760	1220	56.0	i
Hos BRD 3	24-Jul-88	400	630	1040	52.0	i
Hos BRD 3	25-Jul-88	1455	150	409	52.0	g
Hos BRD 3	29-Jul-88	1700	100	263	35.0	g
Hos BRD 3	10-Aug-88	1700	45	551	31.8	g
Hos BRD 3	12-Aug-88	100	910	2860	182	i
Hos BRD 3	12-Aug-88	230	750	2330	163	i
Hos BRD 3	12-Aug-88	400	640	1860	182	i
Hos BRD 3	12-Aug-88	530	660	1630	162	i
Hos BRD 3	12-Aug-88	700	460	1510	157	i
Hos BRD 3	12-Aug-88	830	490	1410	141	i
Hos BRD 3	12-Aug-88	1000	400	1090	137	i
Hos BRD 3	12-Aug-88	1130	410	1090	123	i
Hos BRD 3	12-Aug-88	1300	430	1140	112	i
Hos BRD 3	12-Aug-88	1300	1800	7730	100	i
Hos BRD 3	12-Aug-88	1425	4100	12600	90.0	g

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	12-Aug-88	1430	3200	12900	84.0	i
Hos BRD 3	12-Aug-88	1600	4900	18000	81.0	i
Hos BRD 3	12-Aug-88	1730	5000	17500	73.0	i
Hos BRD 3	12-Aug-88	1900	3100	12200	68.0	i
Hos BRD 3	12-Aug-88	2030	2400	6840	67.0	i
Hos BRD 3	12-Aug-88	2200	1700	5720	67.0	i
Hos BRD 3	12-Aug-88	2330	1400	4010	66.0	i
Hos BRD 3	14-Aug-88	1820	92	224	45.0	g
Hos BRD 3	16-Aug-88	1140	55	135	36.0	g
Hos BRD 3	23-Aug-88	1440	8.6	227	27.0	g
Hos BRD 3	29-Aug-88	1200	16	92.1	21.0	g
Hos BRD 3	08-Sep-88	1000	28	131	24.0	g
Hos BRD 3	08-Sep-88	1020	29	84.2	24.0	g
Hos BRD 3	29-Sep-88	1750	180	541	35.0	g
Hos BRD 3	07-Oct-88	915	18	24.1	20.0	g
Hos BRD 3	18-Apr-89	1715	600	1570		g
Hos BRD 3	27-Apr-89	1945	450	989		g
Hos BRD 3	27-Apr-89	2000	500	1040		i
Hos BRD 3	27-Apr-89	2100	450	881		i
Hos BRD 3	27-Apr-89	2200	450	770		i
Hos BRD 3	2%Apr-89	2300	400	621		i
Hos BRD 3	28-Apr-89	COMP	450	1150		i
Hos BRD 3	28-Apr-89	0	360	521		i
Hos BRD 3	28-Apr-89	100	320	422		i
Hos BRD 3	28-Apr-89	200	310	518		i
Hos BRD 3	28-Apr-89	300	300	501		i
Hos BRD 3	28-Apr-89	400	310	548		i
Hos BRD 3	28-Apr-89	500	310	583		i
Hos BRD 3	28-Apr-89	600	250	509		i
Hos BRD 3	28-Apr-89	700	230	477		i
Hos BRD 3	28-Apr-89	800	190	407		i
Hos BRD 3	28-Apr-89	800	230	456		i
Hos BRD 3	28-Apr-89	900	240	507		i
Hos BRD 3	28-Apr-89	1000	260	580		i
Hos BRD 3	28-Apr-89	1050	320	809		g
Hos BRD 3	28-Apr-89	1100	360	848		i
Hos BRD 3	28-Apr-89	1200	370	923		i
Hos BRD 3	28-Apr-89	1300	450	1000		i
Hos BRD 3	28-Apr-89	1400	500	1120		i
Hos BRD 3	28-Apr-89	1430	500	1250		g
Hos BRD 3	28-Apr-89	I.500	600	1620		i
Hos BRD 3	28-Apr-89	1800	750	1750		i
Hos BRD 3	28-Apr-89	2100	700	1410		i
Hos BRD 3	29-Apr-89	COMP	390	1220		i
Hos BRD 3	29-Apr-89	0	500	801		i
Hos BRD 3	29-Apr-89	300	320	479		i
Hos BRD 3	29-Apr-89	600	180	389		i

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	29-Apr-89	900	160	393		
Hos BRD 3	29-Apr-89	1200	290	904		i
Hos BRD 3	29-Apr-89	1500	450	1190		
Hos BRD 3	29-Apr-89	1800	550	1540		i
Hos BRD 3	29-Apr-89	2100	500	1060		i
Hos BRD 3	30-Apr-89	COMP	400	1010		i
Hos BRD 3	30-Apr-89	0	340	507		i
Hos BRD 3	30-Apr-89	300	240	354		i
Hos BRD 3	30-Apr-89	900	100	141		i
Hos BRD 3	30-Apr-89	1200	310	853		
Hos BRD 3	30-Apr-89	1500	400	1170		
Hos BRD 3	30-Apr-89	1800	650	1660		i
Hos BRD 3	30-Apr-89	2100	600	1400		i
Hos BRD 3	Ol-May-89	COMP	450	1300		
Hos BRD 3	01-May-89	0	450	841		i
Hos BRD 3	Ol-May-89	300	320	492		
Hos BRD 3	Ol-May-89	600	170	266		i
Hos BRD 3	01-May-89	900	140	340		i
Hos BRD 3	Ol-May-89	1200	310	979		
Hos BRD 3	02-May-89	COMP	450	1660		
Hos BRD 3	03-May-89	COMP	700	1360		i
Hos BRD 3	04-May-89	COMP	550	2700		i
Hos BRD 3	05-May-89	COMP	400	1050		
Hos BRD 3	05-May-89	1445	230	1210		g
Hos BRD 3	05-May-89	1500	370	1090		
Hos BRD 3	05-May-89	1800	450	1160		i
Hos BRD 3	05-May-89	2100	500	1120		
Hos BRD 3	06-May-89	COMP	370	1180		
Hos BRD 3	06-May-89	0	380	739		
Hos BRD 3	06-May-89	300	380	605		i
Hos BRD 3	06-May-89	600	250	631		
Hos BRD 3	06-May-89	900	130	357		
Hos BRD 3	06-May-89	1200	360	1140		i
Hos BRD 3	06-May-89	1500	600	1950		i
Hos BRD 3	06-May-89	1800	700	2200		
Hos BRD 3	06-May-89	2100	600	1430		i
Hos BRD 3	07-May-89	COMP	450	1340		
Hos BRD 3	07-May-89	300	450	1180		i
Hos BRD 3	07-May-89	600	250	740		i
Hos BRD 3	07-May-89	900	200	763		i
Hos BRD 3	07-May-89	1200	300	1530		
Hos BRD 3	07-May-89	1500	550	1720		
Hos BRD 3	07-May-89	1800	650	1780		i
Hos BRD 3	07-May-89	2100	850	1440		
Hos BRD 3	08-May-89	COMP	700	1940		
Hos BRD 3	08-May-89	0	600	1150		
Hos BRD 3	08-May-89	300	450	887		i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	OS-May-89	600	400	853		
Hos BRD 3	08-May-89	900	360	724		
Hos BRD 3	(N-May-89	1200	650	1300		i
Hos BRD 3	N-May-89	1430	750	1800		g
Hos BRD 3	08-May-89	1500	1100	1980		
Hos BRD 3	08-May-89	1800	1400	6250		
Hos BRD 3	09-May-89	COMP	650	1720		i
Hos BRD 3	09-May-89	1500	1000	2690		i
Hos BRD 3	09-May-89	1800	390	1770		
Hos BRD 3	09-May-89	2100	340	889		i
Hos BRD 3	lo-May-89	COMP	260	612		
Hos BRD 3	lo-May-89	0	220	706		i
Hos BRD 3	lo-May-89	300	140	572		
Hos BRD 3	lo-May-89	600	120	1530		
Hos BRD 3	lo-May-89	900	180	1400		i
Hos BRD 3	lo-May-89	1200	270	1580		i
Hos BRD 3	lo-May-89	1500	320	1210		i
Hos BRD 3	lo-May-89	1800	430	1340		
Hos BRD 3	lo-May-89	2100	490	1180		i
Hos BRD 3	11-May-89	COMP	310	1130		
Hos BRD 3	ll-May-89	0	320	735		
Hos BRD 3	11-May-89	300	210	439		
Hos BRD 3	ll-May-89	600	150	387		i
Hos BRD 3	11-May-89	900	140	784		i
Hos BRD 3	11-May-89	1200	170	631		
Hos BRD 3	12-May-89	COMP	180	463		
Hos BRD 3	14-May-89	COMP	looo	2710		
Hos BRD 3	15-May-89	COMP	1100	4130		
Hos BRD 3	16-May-89	COMP	800	3090		i
Hos BRD 3	17-May-89	COMP	750	4370		
Hos BRD 3	la-May-89	COMP	1200	14400		
Hos BRD 3	19-May-89	COMP	650	2040		
Hos BRD 3	20-May-89	COMP	750	3830		i
Hos BRD 3	21-May-89	COMP	1900	23400		i
Hos BRD 3	22-May-89	COMP	350	975		
Hos BRD 3	23-May-89	COMP	250	594		
Hos BRD 3	23-May-89	1140	150	417	50.0	g
Hos BRD 3	24-May-89	COMP	500	1500		
Hos BRD 3	25-May-89	COMP	800	3070	64.5	c
Hos BRD 3	25-May-89	1058	310	1080	55.4	8
Hos BRD 3	26-May-89	COMP	800	2140	63.9	c
Hos BRD 3	27-May-89	COMP	800	2270	64.0	c
Hos BRD 3	28-May-89	COMP	1200	3400	73.6	c
Hos BRD 3	29-May-89	COMP	120	2780	58.0	c
Hos BRD 3	30-May-89	COMP	900	2830	53.0	c
Hos BRD 3	31-May-89	COMP	500	1320	45.4	c
Hos BRD 3	01-Jun-89	COMP	650	1580	40.2	c

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	02-Jun-89	COMP	260	565	37.9	c
Hos BRD 3	03-Jun-89	COMP	340	745	38.3	c
Hos BRD 3	04-Jun-89	COMP	600	1630	40.1	c
Hos BRD 3	05-Jun-89	COMP	2400	8110	195	c
Hos BRD 3	05-Jun-89	500	2600	6190	104	i
Hos BRD 3	05-Jun-89	600	3100	7430	188	i
Hos BRD 3	05-Jun-89	700	3800	9480	180	i
Hos BRD 3	05-Jun-89	800	4600	17700	251	i
Hos BRD 3	05-Jun-89	900	5200	20400	272	i
Hos BRD 3	05-Jun-89	1000	5900	21700	298	i
Hos BRD 3	05-Jun-89	1100	6200	23600	330	i
Hos BRD 3	05-Jun-89	1200	6700	24000	347	i
Hos BRD 3	05-Jun-89	1300	5500	17800	318	i
Hos BRD 3	05-Jun-89	1400	5600	16900	304	i
Hos BRD 3	05-Jun-89	1500	3200	8060	291	i
Hos BRD 3	05-Jun-89	1600	2500	5070	261	i
Hos BRD 3	05-Jun-89	1700	2400	5030	246	i
Hos BRD 3	05-Jun-89	1800	2400	4970	231	i
Hos BRD 3	05-Jun-89	1900	2200	4650	220	i
Hos BRD 3	05-Jun-89	2000	2200	4640	217	i
Hos BRD 3	05-Jun-89	2100	2400	4530	221	i
Hos BRD 3	05-Jun-89	2200	2000	4420	210	i
Hos BRD 3	05-Jun-89	2300	1900	3780	201	i
Hos BRD 3	06-Jun-89	COMP	3000	8420	415	c
Hos BRD 3	06-Jun-89	0	1600	3390	191	i
Hos BRD 3	06-Jun-89	100	1600	2980	177	i
Hos BRD 3	06-Jun-89	200	1600	2800	162	i
Hos BRD 3	06-Jun-89	300	1200	2530	150	i
Hos BRD 3	06-Jun-89	400	450	1530	142	i
Hos BRD 3	06-Jun-89	940	7800	20900	470	g
Hos BRD 3	06-Jun-89	1000	5200	14800	543	i
Hos BRD 3	06-Jun-89	1100	4600	13000	648	i
Hos BRD 3	06-Jun-89	1120	4900	16600	670	g
Hos BRD 3	06-Jun-89	1200	4300	11800	635	i
Hos BRD 3	06-Jun-89	1300	4000	12200	668	i
Hos BRD 3	06-Jun-89	1330	3900	14300	773	g
Hos BRD 3	06-Jun-89	1400	4300	12700	795	i
Hos BRD 3	06-Jun-89	1450	4000	12400	804	g
Hos BRD 3	06-Jun-89	1500	4700	11600	800	i
Hos BRD 3	06-Jun-89	1600	3600	10900	730	i
Hos BRD 3	06-Jun-89	1700	3700	10100	688	i
Hos BRD 3	06-Jun-89	1800	3500	9000	579	i
Hos BRD 3	06-Jun-89	1826	3600	11200	564	g
Hos BRD 3	06-Jun-89	1900	3400	8760	549	i
Hos BRD 3	07-Jun-89	COMP	1600	3450	192	c
Hos BRD 3	07-Jun-89	845	1300	3320	210	g
Hos BRD 3	07-Jun-89	930	1400	3090	191	g

APPENDIX D **(cont)**

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	07-Jun-89	1030	1400	3110	179	i
Hos BRD 3	07-Jun-89	1130	1200	2840	168	i
Hos BRD 3	07-Jun-89	1230	1000	2550	155	i
Hos BRD 3	07-Jun-89	1330	1100	2590	142	i
Hos BRD 3	07-Jun-89	1430	1300	2780	135	i
Hos BRD 3	07-Jun-89	1505	1500	2960	134	g
Hos BRD 3	07-Jun-89	1530	1400	2960	133	i
Hos BRD 3	08-Jun-89	COMP	700	1280	65.2	c
Hos BRD 3	09-Jun-89	COMP	700	1160	43.3	c
Hos BRD 3	10-Jun-89	COMP	650	1000	38.9	c
Hos BRD 3	11-Jun-89	COMP	400	850	36.3	c
Hos BRD 3	12-Jun-89	COMP	350	725	34.8	c
Hos BRD 3	13-Jun-89	COMP	300	600	33.7	c
Hos BRD 3	13-Jun-89	1640	550	906	35.1	g
Hos BRD 3	14-Jun-89	COMP	340	499	31.9	c
Hos BRD 3	15-Jun-89	COMP	360	575	31.2	c
Hos BRD 3	16-Jun-89	COMP	220	354	30.0	c
Hos BRD 3	17-Jun-89	COMP	170	270	29.4	c
Hos BRD 3	18-Jun-89	COMP	1400	2870	44.5	c
Hos BRD 3	18-Jun-89	1030	2200	6170	50.0	i
Hos BRD 3	18-Jun-89	1130	3300	9450	70.0	i
Hos BRD 3	18-Jun-89	1230	3500	10000	80.0	i
Hos BRD 3	18-Jun-89	1330	3200	7830	75.0	i
Hos BRD 3	18-Jun-89	1430	2200	7150	70.0	i
Hos BRD 3	18-Jun-89	1530	2600	5800	70.0	i
Hos BRD 3	18-Jun-89	1630	1800	4500	64.0	i
Hos BRD 3	18-Jun-89	1730	1400	3720	59.0	i
Hos BRD 3	18-Jun-89	1830	1300	3110	52.0	i
Hos BRD 3	18-Jun-89	1930	1100	2660	48.0	i
Hos BRD 3	18-Jun-89	2030	950	2490	45.0	i
Hos BRD 3	18-Jun-89	2130	950	2150	44.0	i
Hos BRD 3	18-Jun-89	2230	950	1990	42.0	i
Hos BRD 3	18-Jun-89	2330	800	1650	40.0	i
Hos BRD 3	19-Jun-89	COMP	350	683	37.8	c
Hos BRD 3	20-Jun-89	COMP	190	307	32.2	c
Hos BRD 3	21-Jun-89	COMP	150	236	31.5	c
Hos BRD 3	22-Jun-89	COMP	120	197	31.3	c
Hos BRD 3	23-Jun-89	COMP	140	173	30.6	c
Hos BRD 3	23-Jun-89	1445	120	195	29.9	g
Hos BRD 3	24-Jun-89	COMP	2800	9190	121	c
Hos BRD 3	24-Jun-89	1420	6600	20200	80.0	i
Hos BRD 3	24-Jun-89	1620	9700	30100	200	i
Hos BRD 3	24-Jun-89	1720	6400	23400	300	i
Hos BRD 3	24-Jun-89	1820	6700	15300	270	i
Hos BRD 3	24-Jun-89	1920	4400	11900	260	i
Hos BRD 3	24-Jun-89	2005	4000	12100	240	g
Hos BRD 3	24-Jun-89	2020	3300	9310	210	i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	24-Jun-89	2120	3200	8750	200	i
Hos BRD 3	24-Jun-89	2120	3200	10800	280	i
Hos BRD 3	24-Jun-89	2220	3600	9530	310	i
Hos BRD 3	24-Jun-89	2320	4200	10600	350	i
Hos BRD 3	25-Jun-89	COMP	7900	24200	700	c
Hos BRD 3	25-Jun-89	5	4000	14600	395	g
Hos BRD 3	25-Jun-89	20	5600	14100	405	i
Hos BRD 3	25-Jun-89	105	4600	17300	420	g
Hos BRD 3	25-Jun-89	120	6200	15300	450	i
Hos BRD 3	25-Jun-89	220	7700	24500	673	i
Hos BRD 3	25-Jun-89	320	8300	23900	848	i
Hos BRD 3	25-Jun-89	420	9000	27400	840	i
Hos BRD 3	25-Jun-89	52-o	10200	29600	1070	i
Hos BRD 3	25-Jun-89	920	10700	28600	700	i
Hos BRD 3	25-Jun-89	930	8700	29200	700	g
Hos BRD 3	25-Jun-89	1020	8800	23400	744	i
Hos BRD 3	25-Jun-89	1045	8200	24200	770	g
Hos BRD 3	25-Jun-89	1120	8700	24300	813	i
Hos BRD 3	25-Jun-89	1220	7500	22200	860	i
Hos BRD 3	25-Jun-89	1230	6700	22900	875	i
Hos BRD 3	25-Jun-89	1300	6900	25600	830	i
Hos BRD 3	25-Jun-89	1400	6700	20700	740	i
Hos BRD 3	25-Jun-89	1500	5800	18100	650	i
Hos BRD 3	25-Jun-89	1600	5400	16700	565	i
Hos BRD 3	25-Jun-89	1700	4600	15300	500	i
Hos BRD 3	25-Jun-89	1800	4600	14800	540	i
Hos BRD 3	25-Jun-89	1900	5800	16100	660	i
Hos BRD 3	25-Jun-89	2000	6000	18000	700	i
Hos BRD 3	25-Jun-89	2100	6000	16300	700	i
Hos BRD 3	25-Jun-89	2200	5200	18700	680	i
Hos BRD 3	25-Jun-89	2300	6100	16200	630	i
Hos BRD 3	26-Jun-89	COMP	7900	47800	250	c
Hos BRD 3	26-Jun-89	0	6000	14700	570	i
Hos BRD 3	26-Jun-89	100	4400	13100	540	i
Hos BRD 3	26-Jun-89	200	4000	12800	500	i
Hos BRD 3	26-Jun-89	300	4500	11200	480	i
Hos BRD 3	26-Jun-89	400	4500	12400	450	i
Hos BRD 3	26-Jun-89	500	4200	12600	420	i
Hos BRD 3	26-Jun-89	600	5000	19200	400	i
Hos BRD 3	27-Jun-89	COMP	3400	15800	180	c
Hos BRD 3	27-Jun-89	1430	1500	4150	150	g
Hos BRD 3	28-Jun-89	COMP	2300	11000	120	c
Hos BRD 3	29-Jun-89	COMP	3900	41400	95.0	c
Hos BRD 3	30-Jun-89	COMP	1800	9020	69.0	c
Hos BRD 3	30-Jun-89	1030	400	1140	66.1	g
Hos BRD 3	01-Jul-89	COMP	950	3620	59.7	c
Hos BRD 3	02-Jul-89	COMP	340	1060	46.7	c

Location	Date	Tiie	Turb	TSS	Q	T
Hos BRD 3	03-Jul-89	COMP	280	633	39.5	c
Hos BRD 3	04-Jul-89	COMP	340	695	36.8	c
Hos BRD 3	05-Jul-89	COMP	400	919	34.3	c
Hos BRD 3	06-Jul-89	COMP	270	506	27.5	c
Hos BRD 3	07-Jul-89	COMP	230	377	25.9	c
Hos BRD 3	08-Jul-89	COMP	210	374	23.7	c
Hos BRD 3	09-Jul-89	COMP	190	375	23.2	c
Hos BRD 3	10-Jul-89	COMP	180	339	21.8	c
Hos BRD 3	11-Jul-89	COMP	180	283	21.2	c
Hos BRD 3	12-Jul-89	COMP	150	254	21.4	c
Hos BRD 3	13-Jul-89	COMP	180	322	23.0	c
Hos BRD 3	13-Jul-89	1230	240	363	23.4	g
Hos BRD 3	14-Jul-89	COMP	150	578	22.8	c
Hos BRD 3	15-Jul-89	COMP	130	189	21.7	c
Hos BRD 3	16-Jul-89	COMP	500	1360	27.3	c
Hos BRD 3	17-Jul-89	COMP	600	1240	33.1	c
Hos BRD 3	18-Jul-89	COMP	210	452	23.1	c
Hos BRD 3	19-Jul-89	COMP	190	384	24.2	c
Hos BRD 3	20-Jul-89	COMP	180	386	23.5	c
Hos BRD 3	21-Jul-89	COMP	170	310	22.3	c
Hos BRD 3	22-Jul-89	COMP	150	244	20.3	c
Hos BRD 3	23-Jul-89	COMP	110	189	19.6	c
Hos BRD 3	24-Jul-89	COMP	110	184	20.1	c
Hos BRD 3	25-Jul-89	COMP	110	193	19.7	c
Hos BRD 3	26-Jul-89	COMP	180	473	25.6	c
Hos BRD 3	27-Jul-89	COMP	750	1900	34.4	c
Hos BRD 3	28-Jul-89	COMP	290	619	20.9	c
Hos BRD 3	29-Jul-89	COMP	160	268	19.4	c
Hos BRD 3	30-Jul-89	COMP	150	241	18.6	c
Hos BRD 3	31-Jul-89	COMP	110	255	18.9	c
Hos BRD 3	01-Aug-89	COMP	150	300	20.7	c
Hos BRD 3	02-Aug-89	COMP	170	588	22.3	c
Hos BRD 3	02-Aug-89	1135	130	267	24.1	g
Hos BRD 3	03-Aug-89	COMP	1100	2220	29.1	c
Hos BRD 3	04-Aug-89	COMP	650	1820	38.1	c
Hos BRD 3	05-Aug-89	COMP	2400	6520	247	c
Hos BRD 3	05-Aug-89	300	9200	19000	125	i
Hos BRD 3	05-Aug-89	1300	3500	8720	220	i
Hos BRD 3	05-Aug-89	1305	2600	8830	220	g
Hos BRD 3	05-Aug-89	1400	3000	7750	205	i
Hos BRD 3	OS-Aug-89	1500	2900	6980	190	i
Hos BRD 3	OS-Aug-89	1520	3000	6710	185	g
Hos BRD 3	06-Aug-89	COMP	1100	2620	88.8	c
Hos BRD 3	07-Aug-89	COMP	370	594	51.9	c
Hos BRD 3	08-Aug-89	COMP	260	518	38.1	c
Hos BRD 3	08-Aug-89	1145	270	570	38.3	g
Hos BRD 3	09-Aug-89	COMP	210	391	29.8	c

APPENDIX D **(cont)**

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	10-Aug-89	COMP	150	264	24.1	c
Hos BRD 3	11-Aug-89	COMP	150	295	22.2	c
Hos BRD 3	12-Aug-89	COMP	150	275	24.5	c
Hos BRD 3	13-Aug-89	COMP	400	1060	41.4	c
Hos BRD 3	14-Aug-89	COMP	350	868	47.0	c
Hos BRD 3	15-Aug-89	COMP	200	448	32.3	c
Hos BRD 3	16-Aug-89	COMP	150	302	29.0	c
Hos BRD 3	17-Aug-89	COMP	110	210	26.9	c
Hos BRD 3	18-Aug-89	COMP	120	188	27.2	c
Hos BRD 3	19-Aug-89	COMP	130	252	32.4	c
Hos BRD 3	20-Aug-89	COMP	550	1570	43.3	c
Hos BRD 3	21-Aug-89	COMP	340	748	40.8	c
Hos BRD 3	22-Aug-89	COMP	140	421	30.2	c
Hos BRD 3	22-Aug-89	1140	170	329	29.8	g
Hos BRD 3	23-Aug-89	COMP	230	557	26.3	c
Hos BRD 3	24-Aug-89	COMP	130	312	23.7	c
Hos BRD 3	25-Aug-89	COMP	95	257	22.1	c
Hos BRD 3	26-Aug-89	COMP	80	169	22.7	c
Hos BRD 3	27-Aug-89	COMP	65	134	22.7	c
Hos BRD 3	28-Aug-89	COMP	60	126	21.6	c
Hos BRD 3	29-Aug-89	COMP	85	207	28.7	c
Hos BRD 3	30-Aug-89	COMP	150	446	27.1	c
Hos BRD 3	31-Aug-89	COMP	65	142	21.8	c
Hos BRD 3	Ol-Sep-89	COMP	70	158	22.1	c
Hos BRD 3	02-Sep-89	COMP	65	141	18.7	c
Hos BRD 3	03-Sep89	COMP	60	117	17.8	c
Hos BRD 3	04-Sep-89	COMP	60	110	18.1	c
Hos BRD 3	05-Sep-89	COMP	65	130	17.6	c
Hos BRD 3	06-Sep-89	COMP	85	152	16.7	c
Hos BRD 3	07-Sep-89	COMP	55	109	16.8	c
Hos BRD 3	08-Sep-89	COMP	65	120	16.1	c
Hos BRD 3	09-Sep-89	COMP	60	118	16.0	c
Hos BRD 3	10-Sep-89	COMP	55	110	15.4	c
Hos BRD 3	ll-Sep-89	COMP	55	118	16.2	c
Hos BRD 3	12-Sep-89	COMP	50	124	15.8	c
Hos BRD 3	12-Sep-89	1315	75	334	17.0	g
Hos BRD 3	13-Sep-89	COMP	50	84.5	17.4	c
Hos BRD 3	14-Sep-89	COMP	170	377	22.9	c
Hos BRD 3	15-Sep-89	COMP	230	471	28.4	c
Hos BRD 3	16-Sep-89	COMP	90	187	18.4	c
Hos BRD 3	17-Sep-89	COMP	65	102	18.3	c
Hos BRD 3	18-Sep-89	COMP	65	117	17.6	c
Hos BRD 3	19-Sep-89	COMP	75	147	20.3	c
Hos BRD 3	20-Sep-89	COMP	85	145	20.9	c
Hos BRD 3	21-Sep-89	COMP	70	123	19.7	c
Hos BRD 3	21-Sep-89	907	55	113	19.5	g
Hos BRD 3	22-Sep-89	COMP	75	125	17.3	c

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 3	22-Sep-89	1200	55	82.4	17.0	g
Hos BRD 3	23-Sep-89	COMP	60	107	17.2	c
Hos BRD 3	24-Sep-89	COMP	60	106	15.8	c
Hos BRD 3	25-Sep-89	COMP	50	67.5	16.8	c
Hos BRD 3	26-Sep-89	COMP	800	2460	39.3	c
Hos BRD 3	27-Sep-89	COMP	180	512	26.7	c
Hos BRD 3	28-Sep-89	COMP	110	589	23.2	c
Hos BRD 3	29-Sep-89	COMP	70	163	21.4	c
Hos BRD 3	30-Sep-89	COMP	110	270	20.6	c
Hos BRD 3	01-Oct-89	COMP	loo	214	19.8	c
Hos BRD 3	02-Oct-89	COMP	65	111	19.2	c
Hos BRD 3	03-Oct-89	COMP	80	131	19.6	c
Hos BRD 3	04-Oct-89	COMP	65	104	18.6	c
Hos BRD 3	04-Oct-89	1200	50	118	19.0	g
Hos BRD 6	26-May-88	1610	380	1610	26.2	g
Hos BRD 6	26-May-88	1610	340	1610	26.2	g
Hos BRD 6	01-Jun-88	1815	1100	5610	60.9	g
Hos BRD 6	02-Jun-88	1610	1000	3570	35.1	g
Hos BRD 6	14-Jun-88	1930	1700	5000	36.5	g
Hos BRD 6	15-Jun-88	1115	2100	4440	24.3	g
Hos BRD 6	16-Jun-88	1420	1600	8870	52.4	g
Hos BRD 6	30-Jun-88	1500	270	1150	27.7	g
Hos BRD 6	09-Jul-88	1025	980	3920	57.7	g
Hos BRD 6	20-Jul-88	1200	26	247	18.5	g
Hos BRD 6	21-Jul-88	1055	2000	7440	54.2	g
Hos BRD 6	21-Jul-88	1611	2400	8390	80.0	g
Hos BRD 6	22-Jul-88	1250	2700	8440	70.0	g
Hos BRD 6	23-Jul-88	45	5800	19700	150	g
Hos BRD 6	29-Jul-88	1200	170	628	28.9	i
Hos BRD 6	29-Jul-88	1445	150	501	30.0	g
Hos BRD 6	30-Jul-88	1200	200	703	33.2	i
Hos BRD 6	31-Jul-88	1200	110	308	27.2	i
Hos BRD 6	01-Aug-88	1200	78	207	22.6	i
Hos BRD 6	02-Aug-88	1200	120	354	27.8	i
Hos BRD 6	03-Aug-88	1200	230	936	34.4	i
Hos BRD 6	04-Aug-88	1200	91	308	30.8	i
Hos BRD 6	05-Aug-88	1200	54	145	24.6	i
Hos BRD 6	06-Aug-88	1200	53	114	23.2	i
Hos BRD 6	07-Aug-88	1200	83	187	22.1	i
Hos BRD 6	08-Aug-88	1200	590	1880	38.4	i
Hos BRD 6	10-Aug-88	1430	11	227	19.5	g
Hos BRD 6	10-Aug-88	1430	82	270	20.0	i
Hos BRD 6	12-Aug-88	800	3200	6960	100	i
Hos BRD 6	12-Aug-88	930	3600	12400	129	i
Hos BRD 6	12-Aug-88	1100	3700	10300	145	i
Hos BRD 6	12-Aug-88	1230	4400	11900	143	i

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 6	12-Aug-88	1400	2600	6580	116	i
Hos BRD 6	12-Aug-88	1530	1600	3870	108	i
Hos BRD 6	12-Aug-88	1615	1200	4240	100	g
Hos BRD 6	12-Aug-88	1700	1200	2970	93.0	i
Hos BRD 6	12-Aug-88	1830	780	2320	84.0	i
Hos BRD 6	12-Aug-88	2000	680	1820	73.0	i
Hos BRD 6	12-Aug-88	2130	700	1980	69.0	i
Hos BRD 6	12-Aug-88	2300	560	1940	68.0	i
Hos BRD 6	13-Aug-88	30	560	2060	62.0	i
Hos BRD 6	13-Aug-88	200	440	1510	56.0	i
Hos BRD 6	13-Aug-88	330	430	1140	54.0	i
Hos BRD 6	13-Aug-88	500	430	1310	50.0	i
Hos BRD 6	14-Aug-88	1855	89	301	26.0	g
Hos BRD 6	21-Aug-88	1735	25	113	15.0	g
Hos BRD 6	23-Aug-88	1350	11	96.9	13.0	g
Hos BRD 6	08-Sep-88	1401	25	154	14.6	g
Hos BRD 6	29-Sep-88	1440	29	357	11.6	g
Hos BRD 6	06-Oct-88	1600	31	450	21.0	g
Hos BRD 6	18-Apr-89	1615	120	1%		g
Hos BRD 6	27-Apr-89	2010	600	1480		g
Hos BRD 6	28-Apr-89	820	290	921		g
Hos BRD 6	28-Apr-89	1140	550	1480		g
Hos BRD 6	05-May-89	COMP	360	929		i
Hos BRD 6	05-May-89	1135	150	513		g
Hos BRD 6	06-May-89	COMP	330	933		i
Hos BRD 6	07-May-89	COMP	400	1160		i
Hos BRD 6	08-May-89	COMP	550	1410		i
Hos BRD 6	09-May-89	COMP	270	855		i
Hos BRD 6	lo-May-89	COMP	230	500		i
Hos BRD 6	11-May-89	COMP	180	362		i
Hos BRD 6	12-May-89	COMP	700	1670		i
Hos BRD 6	13-May-89	COMP	630	1400		i
Hos BRD 6	14-May-89	COMP	900	2360		i
Hos BRD 6	15-May-89	COMP	850	1860		i
Hos BRD 6	16-May-89	COMP	750	1610		i
Hos BRD 6	17-May-89	COMP	700	1660		i
Hos BRD 6	18-May-89	COMP	750	1700		i
Hos BRD 6	19-May-89	COMP	600	1710		i
Hos BRD 6	20-May-89	COMP	900	2640		i
Hos BRD 6	21-May-89	COMP	550	991		i
Hos BRD 6	23-May-89	COMP	320	1090		i
Hos BRD 6	23-May-89	1045	130	364		g
Hos BRD 6	24-May-89	COMP	600	2030		i
Hos BRD 6	25-May-89	COMP	500	2170		i
Hos BRD 6	25-May-89	1510	650	2000	51.0	g
Hos BRD 6	05-Jun-89	400	1200	3260	91.0	i
Hos BRD 6	05-Jun-89	500	1300	4300	143	i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 6	OS-Jun-89	600	2200	6910	173	i
Hos BRD 6	05-Jun-89	700	2700	10300	190	i
Hos BRD 6	05-Jun-89	800	2000	6470	185	i
Hos BRD 6	05-Jun-89	900	1500	5950	183	i
Hos BRD 6	05-Jun-89	1000	1500	5470	182	i
Hos BRD 6	05-Jun-89	1100	1300	5370	181	i
Hos BRD 6	05-Jun-89	1200	1500	5260	180	i
Hos BRD 6	05-Jun-89	1300	1200	5220	175	i
Hos BRD 6	05-Jun-89	1400	1900	4960	168	i
Hos BRD 6	05-Jun-89	1500	1300	4500	15.5	i
Hos BRD 6	05-Jun-89	1600	1300	4430	146	i
Hos BRD 6	05-Jun-89	1700	1300	4360	12.5	i
Hos BRD 6	05-Jun-89	1800	1200	4140	122	i
Hos BRD 6	05-Jun-89	1900	1200	3870	119	i
Hos BRD 6	05-Jun-89	2000	1300	3640	117	i
Hos BRD 6	05-Jun-89	2100	900	3530	115	i
Hos BRD 6	05-Jun-89	2200	950	3510	114	i
Hos BRD 6	05-Jun-89	2300	1100	3320	112	i
Hos BRD 6	06-Jun-89	0	950	3190	105	i
Hos BRD 6	06-Jun-89	100	950	3070	97.0	i
Hos BRD 6	06-Jun-89	200	1000	2780	91.0	i
Hos BRD 6	06-Jun-89	1045	3900	14200	180	g
Hos BRD 6	06- Jun-89	1230	3900	15100	218	i
Hos BRD 6	06-Jun-89	1330	3900	21200	212	i
Hos BRD 6	06-Jun-89	1430	3800	15600	206	i
Hos BRD 6	06-Jun-89	1530	4300	16400	206	i
Hos BRD 6	06-Jun-89	1630	3000	16400	199	i
Hos BRD 6	06-Jun-89	1730	3000	11600	195	i
Hos BRD 6	06-Jun-89	1830	2600	16200	173	i
Hos BRD 6	06-Jun-89	1930	2300	12300	169	i
Hos BRD 6	06-Jun-89	2030	2500	11000	166	i
Hos BRD 6	06-Jun-89	2130	2300	8850	163	i
Hos BRD 6	06-Jun-89	2230	2300	8610	162	i
Hos BRD 6	06-Jun-89	2330	2300	8860	158	i
Hos BRD 6	07-Jun-89	30	1900	8240	153	i
Hos BRD 6	07-Jun-89	130	1800	7140	148	i
Hos BRD 6	07-Jun-89	230	1700	5210	145	i
Hos BRD 6	07-Jun-89	330	1500	4800	143	i
Hos BRD 6	07-Jun-89	430	1400	4310	142	i
Hos BRD 6	07-Jun-89	530	1200	3770	141	i
Hos BRD 6	07-Jun-89	630	1200	3580	137	i
Hos BRD 6	07-Jun-89	730	1000	4050	133	i
Hos BRD 6	07-Jun-89	830	1000	3880	131	i
Hos BRD 6	07-Jun-89	930	850	3690	114	i
Hos BRD 6	07-Jun-89	1000	900	2510	111	g
Hos BRD 6	07-Jun-89	1030	950	4320	110	i
Hos BRD 6	07-Jun-89	1130	850	3750	106	i

APPENDIX D **(cont)**

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 6	07-Jun-89	1440	850	2400	100	g
Hos BRD 6	13-Jun-89	1445	900	1440	25.3	g
Hos BRD 6	18-Jun-89	900	2400	12000	53.0	i
Hos BRD 6	18-Jun-89	1000	4400	16800	64.0	i
Hos BRD 6	18-Jun-89	1100	3600	13900	58.0	i
Hos BRD 6	18-Jun-89	1200	2300	10100	52.0	i
Hos BRD 6	18-Jun-89	1300	3100	7590	48.0	i
Hos BRD 6	23-Jun-89	1200	100	158	14.0	i
Hos BRD 6	24-Jun-89	1200	3200	9710	85.6	i
Hos BRD 6	24-Jun-89	1300	4700	17300	118	i
Hos BRD 6	24-Jun-89	1400	6100	22100	158	i
Hos BRD 6	24-Jun-89	1500	5900	19100	165	i
Hos BRD 6	24-Jun-89	1600	4500	16800	169	i
Hos BRD 6	24-Jun-89	1700	3300	11600	165	i
Hos BRD 6	24-Jun-89	1800	2600	8890	163	i
Hos BRD 6	24-Jun-89	1900	2600	8350	160	i
Hos BRD 6	24-Jun-89	2000	2900	10400	156	i
Hos BRD 6	24-Jun-89	2040	3000	10400	157	g
Hos BRD 6	24-Jun-89	2100	3400	14500	165	i
Hos BRD 6	24-Jun-89	2200	3500	12900	173	i
Hos BRD 6	24-Jun-89	2300	3700	13600	175	i
Hos BRD 6	25-Jun-89	0	4800	18700	176	i
Hos BRD 6	25-Jun-89	40	5400	19300	177	g
Hos BRD 6	25-Jun-89	100	7300	30700	1%	i
Hos BRD 6	25-Jun-89	200	8700	25100	235	i
Hos BRD 6	25-Jun-89	300	10700	34700	313	i
Hos BRD 6	25-Jun-89	400	11600	43300	462	i
Hos BRD 6	25-Jun-89	500	10200	41100	496	i
Hos BRD 6	25-Jun-89	600	8600	35600	426	i
Hos BRD 6	25-Jun-89	700	6900	26600	367	i
Hos BRD 6	25-Jun-89	800	5100	20400	280	i
Hos BRD 6	25-Jun-89	900	4800	26900	244	i
Hos BRD 6	25-Jun-89	1000	4900	15400	188	i
Hos BRD 6	25-Jun-89	1010	4200	14800	183	g
Hos BRD 6	25- Jun-89	1100	4200	12100	166	i
Hos BRD 6	25-Jun-89	1150	4200	13000	194	g
Hos BRD 6	25-Jun-89	1200	4200	10600	198	i
Hos BRD 6	25-Jun-89	1300	3700	10700	200	i
Hos BRD 6	25-Jun-89	1400	3200	8640	193	i
Hos BRD 6	25-Jun-89	1500	3400	8880	186	i
Hos BRD 6	25-Jun-89	1600	3100	9220	180	i
Hos BRD 6	25-Jun-89	1700	5300	14600	177	i
Hos BRD 6	25-Jun-89	1800	7000	18500	174	i
Hos BRD 6	25-Jun-89	1900	7300	16900	173	i
Hos BRD 6	25-Jun-89	2000	8200	17600	170	i
Hos BRD 6	25-Jun-89	2100	6300	15500	167	i
Hos BRD 6	25-Jun-89	2200	5700	14500	163	i

Location	Date	Time	Turb	TSS	Q	T
Hos BRD 6	25-Jun-89	2300	4800	12700	160	i
Hos BRD 6	26-Jun-89	0	5300	11900	157	i
Hos BRD 6	26-Jun-89	100	4500	9800	155	i
Hos BRD 6	26-Jun-89	200	4200	10900	153	i
Hos BRD 6	26-Jun-89	300	3600	9320	162	i
Hos BRD 6	26-Jun-89	400	3900	8500	159	i
Hos BRD 6	26-Jun-89	500	2700	9080	156	i
Hos BRD 6	26-Jun-89	600	2700	9260	153	i
Hos BRD 6	26-Jun-89	700	3200	8640	145	i
Hos BRD 6	26-Jun-89	800	2600	9740	155	i
Hos BRD 6	26-Jun-89	900	2300	9870	157	i
Hos BRD 6	26-Jun-89	1000	2600	9110	145	i
Hos BRD 6	26-Jun-89	1100	2000	7570	134	i
Hos BRD 6	27-Jun-89	1215	1200	3390	93.0	g
Hos BRD 6	30-Jun-89	1250	340	1120	25.0	g
Hos BRD 6	13-Jul-89	1100	140	420	10.5	g
Hos BRD 6	02-Aug-89	1025	110	231	9.8	g
Hos BRD 6	04-Aug-89	2230	5500	12700	42.5	i
Hos BRD 6	04-Aug-89	2330	9600	23200	67.9	i
Hos BRD 6	OS-Aug-89	30	12400	27300	88.7	i
Hos BRD 6	05-Aug-89	130	8500	28800	90.0	i
Hos BRD 6	05-Aug-89	230	9100	25700	85.0	i
Hos BRD 6	05-Aug-89	330	9300	22900	104	i
Hos BRD 6	05-Aug-89	430	10000	21800	102	i
Hos BRD 6	05-Aug-89	530	8100	21700	153	i
Hos BRD 6	05-Aug-89	630	7700	20700	158	i
Hos BRD 6	05-Aug-89	730	6400	21500	164	i
Hos BRD 6	05-Aug-89	830	6100	18200	142	i
Hos BRD 6	05-Aug-89	930	5800	14200	164	i
Hos BRD 6	05-Aug-89	1030	4600	11400	160	i
Hos BRD 6	05-Aug-89	1130	3400	10100	121	i
Hos BRD 6	05-Aug-89	1230	3400	10700	110	i
Hos BRD 6	05-Aug-89	1330	2800	9430	186	i
Hos BRD 6	05-Aug-89	1430	2300	6850	147	i
Hos BRD 6	05-Aug-89	1530	2400	6480	123	i
Hos BRD 6	05-Aug-89	1620	1600	5700	117	g
Hos BRD 6	05-Aug-89	1630	2100	5300	111	i
Hos BRD 6	05-Aug-89	1730	1700	4510	105	i
Hos BRD 6	05-Aug-89	1830	1700	4240	100	i
Hos BRD 6	05-Aug-89	1930	1500	3990	96.0	i
Hos BRD 6	05-Aug-89	2030	1500	3800	80.0	i
Hos BRD 6	05-Aug-89	2130	1300	3240	73.0	i
Hos BRD 6	05-Aug-89	2230	1300	3210	68.0	i
Hos BRD 6	05-Aug-89	2330	1100	2840	62.0	i
Hos BRD 6	06-Aug-89	30	1200	2690	60.0	i
Hos BRD 6	06-Aug-89	130	1300	2490	56.0	i
Hos BRD 6	06-Aug-89	230	950	2260	55.0	i

APPENDIX D **(cont)**

Location	Date	T i e	Turb	TSS	Q	T
Hos BRD 6	06-Aug-89	330	1000	2320	54.0	i
Hos BRD 6	06-Aug-89	430	900	2090	53.0	i
Hos BRD 6	06-Aug-89	530	1000	2200	52.0	i
Hos BRD 6	06-Aug-89	630	750	1840	50.0	i
Hos BRD 6	06-Aug-89	730	900	1920	48.0	i
Hos BRD 6	06-Aug-89	830	850	1790	45.0	i
Hos BRD 6	06-Aug-89	930	950	2010	45.0	i
Hos BRD 6	06-Aug-89	1030	700	1710	44.0	i
Hos BRD 6	06-Aug-89	1130	600	1490	43.0	i
Hos BRD 6	06-Aug-89	1230	550	1470	41.0	i
Hos BRD 6	06-Aug-89	1330	600	1340	38.0	i
Hos BRD 6	06-Aug-89	1430	600	1340	36.0	i
Hos BRD 6	06-Aug-89	1530	550	1190	34.0	i
Hos BRD 6	08-Aug-89	1345	290	565	19.0	g
Hos BRD 6	22-Aug-89	1220	450	1110	15.0	g
Hos BRD 6	12-Sep-89	1400	29	384	8.3	g
Hos BRD 6	22-Sep-89	1230	80	191	9.5	g
Hos BRD 6	04-Oct-89	945	60	191	9.0	g
Frances	14-Aug-86	900			1.92	
Frances	15-Aug-86			2130		i
Frances	16-Aug-86			1730		i
Frances	17-Aug-86			285		i
Frances	18-Aug-86			679		i
Frances	19-Aug-86			1810		i
Frances	20-Aug-86			3160		i
Frances	22-Aug-86	1800		4130		g
Frances	23-Aug-86			2310		i
Frances	24-Aug-86			1050		i
Frances	25-Aug-86			480		i
Frances	26-Aug-86	1600			0.39	
Frances	26-Aug-86	1842		239	0.39	g
Frances	27-Aug-86			332		i
Frances	28-Aug-86			404		i
Frances	29-Aug-86			162		i
Frances	30-Aug-86			119		i
Frances	31-Aug-86			96.1		i
Frances	01-Sep-86			95.5		i
Frances	02-Sep-86			81.9		i
Frances	03-Sep-86			35.5		i
Frances	04-Sep-86			18.3		i
Frances	04-Sep-86	1415		171	0.17	g
Frances	05-Sep-86			52.4		i
Frances	05-Sep-86	1800		54.5	0.13	g
Frances	06-Sep-86			73.2		i
Frances	06-Sep-86			54.9		i
Frances	07-Sep-86	1640		45.8		g

APPENDIX D **(cont)**

Location	Date	Time	Turb	TSS	Q	T
Frances	08-Sep-86			264		i
Frances	09-Sep-86			1180		i
Frances	10-Sep-86			188		i
Frances	10-Sep-86	1840		109		g
Frances	11-Sep86			139		i
Frances	12-Sep-86			249		i
Frances	13-Sep-86			69.9		i
Frances	14-Sep-86			37.5		i
Frances	14-Sep-86	1310		48.1		g
Frances	15-Sep-86			92.1		i
Frances	16-Sep-86			220		i
Frances	17-Sep-86			118		i
Frances	18-Sep-86			250		i
Frances	19-Sep-86			130		i
Frances	20-Sep-86			229		i
Frances	21-Sep-86			273		i
Frances	22-Sep-86			96.4		i
Frances	22-Sep-86	1645		21.2	0.19	g
Frances	23-Sep-86			88.9		i
Frances	24-Sep-86	1000		46.1	0.18	g
Frances	13-Oct-86	1750		72.5	0.25	g
Frances	18-Jun-87	1815	550	1590	0.15	g
Frances	19-Jun-87	1700	950	2270	0.11	g
Frances	26-Jun-87	700	350	2910	0.09	g
Frances	30-Jun-87	1235	230	960	0.14	g
Frances	01-Jul-87	950	200	622	0.11	g
Frances	03-Jul-87	1415	80	617	0.08	g
Frances	06-Jul-87	1845	17	1060	0.09	g
Frances	09-Jul-87	940	11	239	0.09	g
Frances	12-Jul-87	1500	900	4350	0.11	g
Frances	14-Jul-87	1900	1500	7350	0.11	g
Frances	15-Jul-87	850	350	3350	0.12	g
Frances	19-Jul-87	1200	210	2220	0.12	g
Frances	20-Jul-87	1715	2500	7930	0.26	g
Frances	21-Jul-87	1625	45	323	0.12	g
Frances	23-Jul-87	1325	110	1400	0.19	g
Frances	27-Jul-87	955	16	102	0.11	g
Frances	30-Jul-87	740	1800	7910	0.99	g
Frances	31-Jul-87	1355	450	1210	0.28	g
Frances	03-Aug-87	1740	27	106	0.12	g
Frances	04-Aug-87	1436	23	72.9	0.12	g
Frances	10-Aug-87	1350	4.7	21.2	0.09	g
Frances	13-Aug-87	1600	5.5	12.2	0.09	g
Frances	18-Aug-87	1730	850	5110	0.51	g
Frances	18-Aug-87	1930	2400	8330	0.99	g
Frances	19-Aug-87	300	1700	7200	1.22	i
Frances	19-Aug-87	430	3000	12500	1.53	i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Frances	24-Aug-87	1724	14	59.3	0.15	g
Frances	25-Aug-87	1340	12	23.3	0.14	g
Frances	14-Sep-87	1440	120	300	0.24	g
Frances	15-Sep-87	1625	90	198	0.24	g
Frances	12-Oct-87	1705	12	4.9	0.11	g
Frances	13-Oct-87	1050	5.3	4.6	0.11	g
Frances	26-May-88	1120	240	1380	0.19	g
Frances	26-May-88	1120	350	1470	0.19	g
Frances	01-Jun-88	1430	1400	7100	0.69	g
Frances	01-Jun-88	1900	11000	56900	1.00	g
Frances	02-Jun-88	950	640	4740		g
Frances	14-Jun-88	1845	380	914	0.12	g
Frances	15-Jun-88	1300	170	534	0.12	g
Frances	16-Jun-88	1515	280	1290	0.19	g
Frances	30-Jun-88	1630	90	343	0.14	g
Frances	08-Jul-88	1720	1900	5910	0.24	g
Frances	10-Jul-88	1315	1600	4590	0.24	g
Frances	11-Jul-88	1620	5700	19100	1.31	g
Frances	17-Jul-88	1830	11	19.2	0.10	g
Frances	20-Jul-88	1110	24	39.8	0.11	g
Frances	21-Jul-88	615	12000	125000	1.11	i
Frances	21-Jul-88	640	5400	17200	1.66	g
Frances	21-Jul-88	745	1900	62000	0.71	i
Frances	21-Jul-88	830	1000	2230	0.57	i
Frances	21-Jul-88	915	880	11800	0.54	i
Frances	21-Jul-88	930	930	2050	0.58	g
Frances	21-Jul-88	1000	880	2100	0.50	i
Frances	21-Jul-88	1045	1300	24100	0.47	i
Frances	21-Jul-88	1130	940	2120	0.47	i
Frances	21-Jul-88	1135	910	2380	0.52	g
Frances	21-Jul-88	1430	1000	3450	0.31	i
Frances	21-Jul-88	1515	870	3530	0.30	i
Frances	21-Jul-88	1645	330	729	0.29	i
Frances	21-Jul-88	1730	270	298000	0.27	i
Frances	21-Jul-88	1815	270	26200	0.25	i
Frances	21-Jul-88	1900	210	33600	0.24	i
Frances	21-Jul-88	1945	190	19100	0.23	i
Frances	21-Jul-88	2030	190	14200	0.22	i
Frances	21-Jul-88	2200	130	5340	0.23	i
Frances	21-Jul-88	2245	130	8260	0.31	i
Frances	21-Jul-88	2330	120	219	0.29	i
Frances	22-Jul-88	1340	1100	3010	0.52	g
Frances	22-Jul-88	1630	1000	3360	0.34	i
Frances	22-Jul-88	1715	4200	12000	0.78	i
Frances	22-Jul-88	1800	4200	13600	1.11	i
Frances	22-Jul-88	1845	3600	8090	0.95	i
Frances	22-Jul-88	1930	1400	4080	0.87	i

APPENDIX D (cont)

Location	Date	Tiie	Turb	TSS	Q	T
Frances	22-Jul-88	2100	11000	27700	1.50	i
Frances	22-Jul-88	2145	5500	12800	1.93	i
Frances	22-Jul-88	2230	2800	4830	1.66	i
Frances	22-Jul-88	2315	1200	1970	1.24	i
Frances	23-Jul-88	0	1300	20600	0.88	i
Frances	23-Jul-88	45	1300	6590	0.78	i
Frances	23-Jul-88	345	620	2330	0.45	i
Frances	23-Jul-88	430	500	1740	0.38	i
Frances	23-Jul-88	515	380	782	0.35	i
Frances	23-Jul-88	600	360	852	0.32	i
Frances	23-Jul-88	645	330	942	0.30	i
Frances	23-Jul-88	730	460	1240	0.30	i
Frances	25-Jul-88	1505	38	173	0.16	g
Frances	29-Jul-88	1630	25	74.9	0.11	g
Frances	10-Aug-88	1610	15	60.6	0.11	g
Frances	16-Aug-88	1220	6.8	79	0.09	g
Frances	23-Aug-88	1430	5.6	16.4	0.05	g
Frances	29-Aug-88	1210	10	22.8	0.05	g
Frances	07-Sep-88	1540	7.6	5.2	0.05	g
Frances	29-Sep-88	1820	9.8	19.1	0.08	g
Frances	18-Apr-89	1655	1100	4070		g
Frances	28-Apr-89	1320	1600	6010		g
Hos ab N Hos.	13-Oct-86	1427		2100		g
Hos ab N Hos.	09-Jun-87	1546	270	656	15.0	g
Hos ab N Hos.	19-Jun-87	1240	95	765	9.6	g
Hos ab N Hos.	30-Jun-87	1550	32	390	6.6	g
Hos ab N Hos.	08-Jul-87	1700	50	537	6.3	g
Hos ab N Hos.	21-Jul-87	1125	320	928	17.0	g
Hos ab N Hos.	04-Aug-87	1150	85	214	16.2	g
Hos ab N Hos.	25-Aug-87	1035	240	249	17.7	g
Hos ab N Hos.	15-Sep-87	1122	70	141	12.6	g
Hos ab N Hos.	12-Oct-87	1550	280	1390		g
Hoseanna ab San	21-Jul-87	1245	240	1030	12.4	g
Hoseanna ab San	25-Aug-87	1145	24	793	9.4	g
Hoseanna ab San	13-Oct-86	1452		1740		g
Hoseanna ab San	21-Jul-87	1247	160	1030		g
Louise	15-Jun-88	1245	52	2450	0.12	g
Louise	16-Jun-88	1450	140	611	0.11	g
Louise	30-Jun-88	1600	19	156	0.10	g
Louise	08-Jul-88	1940	8000	19100	0.25	g
Louise	10-Jul-88	1325	11000	34000	0.22	g
Louise	21-Jul-88	650	11000	31800	0.43	g
Louise	21-Jul-88	930	910	3440	0.36	g
Louise	22-Jul-88	1100	27000	106000	1.62	g

APPENDIX D **(cont)**

Location	Date	Time	Turb	TSS	Q	T
Louise	22-Jul-88	1310	4400	13400	0.51	g
Louise	29-Jul-88	1600	31	533	0.11	g
Louise	10-Aug-88	1545	75	879	0.08	g
Louise	23-Aug-88	1415	8.7	332	0.09	g
Louise	29-Aug-88	1225	6.4	86.1	0.10	g
Louise	07-Sep-88	1600	7.8	59.4	0.06	g
Louise	18-Apr-89	1644	500	1370		g
Louise	27-Apr-89	2000	2400	7670		g
Louise	28-Apr-89	835	800	3320		g
Louise	28-Apr-89	1130	2300	10100		g
Louise	28-Apr-89	1300	2100	7230		g
Louise	05-May-89	COMP	1200	4950		i
Louise	05-May-89	1200	600	2890		g
Louise	06-May-89	COMP	600	1910		i
Louise	07-May-89	COMP	650	1980		i
Louise	08-May-89	COMP	2400	9780		i
Louise	ll-May-89	COMP	1900	7070		i
Louise	U-May-89	1110	350	2250	0.10	g
Louise	25-May-89	1540	550	5110	0.23	g
Louise	06-Jun-89	1015	17100	80300	6.9	i
Louise	06-Jun-89	1015	18800	89300	6.9	g
Louise	06-Jun-89	1100	19400	91000	7.5	i
Louise	06-Jun-89	1145	17200	63600	6.8	i
Louise	06-Jun-89	1230	13700	91600	7.0	i
Louise	06-Jun-89	1250	14100	65400	6.4	g
Louise	06-Jun-89	1315	13800	69500	6.0	i
Louise	06-Jun-89	1400	11400	65600	5.8	i
Louise	06-Jun-89	1445	6700	63500	5.5	i
Louise	06-Jun-89	1530	10700	56400	5.1	i
Louise	06-Jun-89	1615	7500	37600	4.4	i
Louise	06-Jun-89	1700	6400	44700	3.6	i
Louise	06-Jun-89	1745	5900	25500	3.0	i
Louise	06-Jun-89	1800	6700	29500	2.8	i
Louise	06-Jun-89	2000	5500	34400	2.4	g
Louise	06-Jun-89	2130	5100	18200	2.2	g
Louise	07-Jun-89	1040	2100	6900	0.85	g
Louise	07-Jun-89	1400	2500	7100	0.80	g
Louise	13-Jun-89	1330	180	694	0.17	g
Louise	23-Jun-89	1345	65	193	0.12	g
Louise	24-Jun-89	2015	3800	16600	2.0	g
Louise	24-Jun-89	2015	5700	19800	2.0	i
Louise	24-Jun-89	2045	3900	13800	2.3	i
Louise	24-Jun-89	2110	4500	18100	2.4	g
Louise	24-Jun-89	2115	4700	13800	2.4	i
Louise	24-Jun-89	2145	5600	15900	2.1	i
Louise	24-Jun-89	2215	8100	24600	1.7	i
Louise	24-Jun-89	2245	7900	25ooo	1.7	i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Louise	24-Jun-89	2315	11500	35500	2.6	i
Louise	24-Jun-89	2345	17400	43900	4.0	i
Louise	25-Jun-89	27	10800	48800	6.5	g
Louise	25-Jun-89	100	9200	37600	6.5	g
Louise	25-Jun-89	115	13100	27900	6.4	i
Louise	25-Jun-89	415	14100	39600	2.3	i
Louise	25-Jun-89	515	8000	90700	1.7	i
Louise	25-Jun-89	545	6200	41300	1.7	i
Louise	25-Jun-89	615	5600	22900	1.7	i
Louise	25- Jun-89	645	5400	14300	1.7	i
Louise	25-Jun-89	715	6200	13200	1.6	i
Louise	25-Jun-89	745	5400	9280	1.6	i
Louise	25-Jun-89	1030	11100	33000	7.7	i
Louise	25-Jun-89	1030	16500	78000	7.7	g
Louise	25-Jun-89	1130	8500	33700	9.5	i
Louise	25-Jun-89	1200	5000	80300	10.6	i
Louise	25-Jun-89	1215	17800	74300	10.8	g
Louise	25-Jun-89	1230	9800	22200	11.0	i
Louise	25-Jun-89	1300	16100	44600	10.2	i
Louise	25-Jun-89	1330	8900	15600	9.1	i
Louise	25-Jun-89	1400	8900	14200	8.6	i
Louise	25-Jun-89	1430	7100	11700	8.2	i
Louise	25-Jun-89	1530	8500	19900	7.3	i
Louise	25-Jun-89	1600	11300	15000	6.5	i
Louise	25-Jun-89	1630	9300	17200	5.8	i
Louise	25-Jun-89	1700	12100	32000	4.2	i
Louise	25-Jun-89	1730	11200	20500	3.6	i
Louise	25-Jun-89	1800	10000	23700	2.9	i
Louise	25-Jun-89	1930	8600	16700	2.1	i
Louise	25-Jun-89	2000	9700	17000	2.1	i
Louise	25-Jun-89	2030	10300	20500	2.0	i
Louise	25-Jun-89	2100	9700	17800	1.9	i
Louise	25-Jun-89	2130	9500	18200	1.8	i
Louise	25-Jun-89	2200	9900	22200	1.8	i
Louise	27-Jun-89	1315	3500	10900	1.1	g
Louise	30-Jun-89	1200	1000	3130	0.55	g
Louise	Ol-Jul-89	100	7500	21500	0.75	i
Louise	01-Jul-89	130	12700	48700	1.6	i
Louise	Ol-Jul-89	200	6300	22500	0.96	i
Louise	Ol-Jul-89	230	4400	11900	0.90	i
Louise	Ol-Jul-89	300	2300	7710	0.83	i
Louise	01-Jul-89	330	1700	6280	0.77	i
Louise	Ol-Jul-89	400	1700	4920	0.70	i
Louise	13-Jul-89	1245	17	40.5	0.06	g
Louise	02-Aug-89	1050	16	18.2	0.04	g
Louise	04-Aug-89	2130	4400	19800	0.90	i
Louise	04-Aug-89	2215	20600	99700	1.4	i

Location	Date	Time	Turb	TSS	Q	T
Louise	04-Aug-89	2300	20900	56500	1.3	i
Louise	04-Aug-89	2345	4300	41300	1.2	i
Louise	05-Aug-89	30	3700	20900	1.1	i
Louise	05-Aug-89	115	3900	25600	1.2	i
Louise	OS-Aug-89	200	14200	68700	1.4	i
Louise	05-Aug-89	245	10300	49900	1.6	i
Louise	05-Aug-89	330	9000	43600	2.2	i
Louise	05-Aug-89	415	5200	30000	1.3	i
Louise	05-Aug-89	500	3500	14500	1.2	i
Louise	05-Aug-89	545	3200	12400	1.2	i
Louise	05-Aug-89	630	2500	12100	1.1	i
Louise	OS-Aug-89	715	3600	37300	0.97	i
Louise	05-Aug-89	800	3300	26200	0.87	i
Louise	OS-Aug-89	845	3400	23600	0.86	i
Louise	05-Aug-89	930	3600	23300	0.84	i
Louise	05-Aug-89	1015	2700	15400	0.79	i
Louise	05-Aug-89	1100	2500	13200	0.71	i
Louise	05-Aug-89	1145	2300	21900	0.66	i
Louise	05-Aug-89	1315	1000	5330	0.57	i
Louise	05-Aug-89	1545	850	3240	0.41	g
Louise	08-Aug-89	1320	160	1490	0.09	g
Louise	22-Aug-89	1200	30	480	0.07	g
Louise	12-Sep-89	1345	4.2	1.28	0.01	g
Louise	22-Sep-89	1210	3.4	2.94	0.02	g
Louise	04-Oct-89	1015	3.7	2.13	0.02	g
N Hoseanna	13-Aug-86	1307			5.8	
N Hoseanna	14-Aug-86			3170		i
N Hoseanna	15-Aug-86			1480		i
N Hoseanna	16-Aug-86			1860		i
N Hoseanna	17-Aug-86			2470		i
N Hoseanna	18-Aug-86			1500		i
N Hoseanna	19-Aug-86			6300		i
N Hoseanna	20-Aug-86			6050		i
N Hoseanna	21-Aug-86			26800		i
N Hoseanna	22-Aug-86			20700		i
N Hoseanna	23-Aug-86			7100		i
N Hoseanna	24-Aug-86			9080		i
N Hoseanna	25-Aug-86			8340		i
N Hoseanna	26-Aug-86			5770		i
N Hoseanna	27-Aug-86			2208		i
N Hoseanna	05-Sep-86	1500		986	2.8	g
N Hoseanna	08-Sep-86			13200		i
N Hoseanna	09-Sep-86			6220		i
N Hoseanna	10-Sep-86			3530		i
N Hoseanna	ll-Sep-86			3450		i
N Hoseanna	12-Sep-86			1410		i

Location	Date	Time	Turb	TSS	Q	T
N Hoseama	13-Sep-86			1190		i
N Hoseanna	14-Sep-86			880		i
N Hoseanna	15-Sep-86			2800		i
N Hoseanna	16-Sep-86			3550		i
N Hoseanna	17-Sep-86			4450		i
N Hoseama	18-Sep-86			6610		i
N Hoseanna	19-Sep-86			4410		i
N Hoseanna	20-Sep-86			2460		i
N Hoseanna	22-Sep-86			1790		i
N Hoseanna	23-Sep-86			306		i
N Hoseanna	13-Oct-86	1400		2960	7.9	g
N Hoseanna	09-Jun-87	1600	1200	7200	5.1	g
N Hoseama	19-Jun-87	1245	450	2840	2.9	g
N Hoseanna	19-Jun-87	1420	600	3450	4.1	g
N Hoseanna	30-Jun-87	1622	200	3030	1.8	g
N Hoseanna	08-Jul-87	1640	130	1920	1.5	g
N Hoseama	21-Jul-87	1145	120	1200	2.5	g
N Hoseanna	04-Aug-87	1215	70	1460	2.3	g
N Hoseanna	10-Aug-87	1530	26	163	1.5	g
N Hoseanna	13-Aug-87	1725	12	581	1.2	g
N Hoseanna	18-Aug-87	1625	260	1450	4.1	g
N Hoseanna	19-Aug-87	245	3200	17800	16.6	i
N Hoseama	19-Aug-87	415	2800	16100	19.9	i
N Hoseanna	19-Aug-87	545	2700	13400	21.1	i
N Hoseanna	19-Aug-87	715	2000	9060	20.5	i
N Hoseanna	19-Aug-87	845	2100	9340	19.9	i
N Hoseanna	19-Aug-87	1015	1400	7190	17.1	i
N Hoseanna	19-Aug-87	1145	1200	4910	15.0	i
N Hoseama	21-Aug-87	1200	160	1010	3.4	g
N Hoseanna	25-Aug-87	1105	50	1400	2.3	g
N Hoseanna	15-Sep-87	1155	17	136	2.2	g
N Hoseanna	12-Oct-87	1556	65	473		g
N Hoseanna	Ol-Jun-88	1630	1100	7830	7.0	g
N Hoseanna	02-Jun-88	1600	530	7090	7.0	g
N Hoseanna	14-Jun-88	1945	400	2090	6.5	g
N Hoseanna	15-Jun-88	1000	260	1020	2.6	g
N Hoseanna	16-Jun-88	1400	570	2410	4.4	g
N Hoseanna	30-Jun-88	1400	440	4220	3.0	i
N Hoseanna	30-Jun-88	1430	110	4230	3.0	g
N Hoseanna	08-Jul-88	2350	1100	6850	4.7	i
N Hoseanna	09-Jul-88	20	3700	9460	4.3	i
N Hoseanna	09-Jul-88	150	2200	9020	3.8	i
N Hoseanna	09-Jul-88	450	1400	7610	4.6	i
N Hoseanna	09-Jul-88	620	2400	9120	5.3	i
N Hoseanna	09-Jul-88	750	1600	6200	5.2	i
N Hoseanna	09-Jul-88	920	1300	4760	5.0	i
N Hoseanna	09-Jul-88	1040	750	4000	5.1	g

APPENDIX D (cont)

Locatioı	Date	Tim	Turb			
N Hoseanna	09-Jul-88	1050	880	3880	4.9	i
N Hoseanna	09-Jul-88	1220	860	2960	5.0	i
N Hoseanna	09-Jul-88	1350	750	2620	5.0	i
N Hoseanna	09-Jul-88	1520	620	2490	5.2	i
N Hoseanna	09-Jul-88	1650	2100	8400	6.0	i
N Hoseanna	09-Jul-88	1820	4500	14000	7.2	i
N Hoseanna	09-Jul-88	1950	3600	14300	7.0	i
N Hoseanna	09-Jul-88	2120	2100	8970	6.5	i
N Hoseanna	09-Jul-88	2250	1500	6540	5.5	i
N Hoseanna	10-Jul-88	20	1200	4830	5.2	i
N Hoseanna	10-Jul-88	150	1100	5010	4.8	i
N Hoseanna	10-Jul-88	620	430	1800	4.0	i
N Hoseanna	10-Jul-88	1915	260	1300	3.9	g
N Hoseanna	20-Jul-88	1300	22	232	2.0	g
N Hoseanna	21-Jul-88	1015	490	3830	4.9	g
N Hoseanna	21-Jul-88	1730	1400	6260	4.2	i
N Hoseanna	21-Jul-88	1900	990	4700	4.0	i
N Hoseanna	21-Jul-88	2030	860	5170	3.8	i
N Hoseanna	21-Jul-88	2200	770	3680	3.6	i
N Hoseanna	21-Jul-88	2330	840	4050	3.4	i
N Hoseanna	22-Jul-88	100	960	5610	3.3	i
N Hoseanna	22-Jul-88	230	1100	5300	3.3	i
N Hoseanna	22-Jul-88	400	1300	7750	3.3	i
N Hoseanna	22-Jul-88	530	1100	6490	3.4	i
N Hoseanna	22-Jul-88	700	1000	7360	4.0	i
N Hoseanna	22-Jul-88	830	1400	14200	4.1	i
N Hoseanna	22-Jul-88	1000	1100	8640	4.1	i
N Hoseanna	22-Jul-88	1130	1500	7090	4.2	i
N Hoseanna	22-Jul-88	1235	560	3400	5.3	g
N Hoseanna	22-Jul-88	1300	2000	13000	4.4	i
N Hoseanna	22-Jul-88	1430	1800	9580	4.6	i
N Hoseanna	22-Jul-88	1600	1800	9730	4.9	i
N Hoseanna	22-Jul-88	1730	2200	9590	7.4	i
N Hoseanna	22-Jul-88	1900	1700	10200	8.8	i
N Hoseanna	22-Jul-88	2030	2100	16200	9.9	i
N Hoseanna	22-Jul-88	2200	2300	16600	12.6	i
N Hoseanna	22-Jul-88	2330	2100	13700	12.6	i
N Hoseanna	23-Jul-88	100	2000	10200	12.0	i
N Hoseanna	23-Jul-88	230	2100	11000	9.2	i
N Hoseanna	23-Jul-88	400	2200	11600	8.7	i
N Hoseanna	25-Jul-88	1540	90	1580	3.1	g
N Hoseanna	29-Jul-88	1300	86	405	3.3	g
N Hoseanna	10-Aug-88	1330	11	148	2.4	g
N Hoseanna	12-Aug-88	930	1300	6320	5.6	i
N Hoseanna	12-Aug-88	1100	1300	5200	5.9	i
N Hoseanna	12-Aug-88	1230	930	3800	5.7	i
N Hoseanna	12-Aug-88	1400	660	3250	5.5	i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
N Hoseama	12-Aug-88	1530	600	1920	5.1	i
N Hoseanna	12-Aug-88	1645	420	1620	5.4	g
N Hoseanna	12-Aug-88	1700	450	1600	4.7	i
N Hoseanna	12-Aug-88	1830	310	1190	4.3	i
N Hoseanna	12-Aug-88	2000	280	917	4.1	i
N Hoseanna	14-Aug-88	1920	23	842	2.8	g
N Hoseama	21-Aug-88	1705	8	212	2.4	g
N Hoseanna	23-Aug-88	1335	7.2	260	2.3	g
N Hoseanna	08-Sep-88	1430	6.6	63.4	2.2	g
N Hoseama	29-Sep-88	1410	9.4	96		g
N Hoseanna	06-Oct-88	1440	8	20		g
Popovitch	12-Aug-86	1655			0.33	
Popovitch	14-Aug-86	1230		178		g
Popovitch	14-Aug-86	1315		624		g
Popovitch	04-Sep-86	1400		169	1.1	g
Popovitch	05-Sep-86	1740		221	0.96	g
Popovitch	06-Sep-86				0.96	
Popovitch	07-Sep-86	1510		1640	0.93	g
Popovitch	08-Sep-86				1.4	
Popovitch	09-Sep-86				1.1	
Popovitch	10-Sep-86	1910		8830	0.95	g
Popovitch	11-Sep-86				0.91	
Popovitch	12-Sep-86				0.89	
Popovitch	13-Sep-86			24800	0.86	i
Popovitch	14-Sep-86				0.87	
Popovitch	15-Sep-86				0.78	
Popovitch	16-Sep-86				0.93	
Popovitch	17-Sep-86				0.72	
Popovitch	18-Sep-86				0.78	
Popovitch	19-Sep-86				0.70	
Popovitch	20-Sep-86				0.78	
Popovitch	21-Sep-86				0.69	
Popovitch	22-Sep-86	1630		66.5	0.93	g
Popovitch	22-Sep-86	1845		17000		g
Popovitch	23-Sep-86				0.62	
Popovitch	24-Sep-86	925			0.70	
Popovitch	26-Sep-86			340		i
Popovitch	26-Sep-86			1250		i
Popovitch	26-Sep-86				7780	i
Popovitch	26-Sep-86	1240		2120		g
Popovitch	26-Sep-86	1530			2.1	
Popovitch	13-Oct-86	1730		540	1.1	g
Popovitch	18-Jun-87	1540	32	407	1.1	g
Popovitch	19-Jun-87	1608	13	522	0.98	g
Popovitch	26-Jun-87	730	5.9	110	0.49	g
Popovitch	30-Jun-87	1150	2	4.8	0.36	g

APPENDIX D **(cont)**

Location	Date	Time	Turb	TSS	Q	T
Popovitch	03-Jul-87	1400	1.2	2.8	0.36	g
Popovitch	06-Jul-87	1930	1	5.3	0.36	g
Popovitch	08-Jul-87	945	0.5	3.2	0.36	g
Popovitch	10-Jul-87	1610	12.5	429	0.64	g
Popovitch	14-Jul-87	1915	1	5.6	0.36	g
Popovitch	19-Jul-87	1230	2.9	28.3	0.42	g
Popovitch	20-Jul-87	1630	26	329	0.72	g
Popovitch	21-Jul-87	1540	2.7	8	0.42	g
Popovitch	23-Jul-87	1330	1.4	14.2	0.49	g
Popovitch	27-Jul-87	1010	1.6	5.8	0.36	g
Popovitch	30-Jul-87	940	220	1300	0.80	g
Popovitch	31-Jul-87	1320	6.6	313	0.56	g
Popovitch	03-Aug-87	1720	2.1	23.2	0.42	g
Popovitch	04-Aug-87	1405	2.1	25	0.42	g
Popovitch	13-Aug-87	1625	2.9	19.9	0.36	g
Popovitch	18-Aug-87	1710	270	1330	0.89	g
Popovitch	19-Aug-87	1010	140	1190	0.98	g
Popovitch	25-Aug-87	1330	0.9	11.1	0.30	g
Popovitch	15-Sep-87	1355	19	119	0.80	g
Popovitch	12-Oct-87	1643	0.6	2.3	0.72	g
Popovitch	26-May-88	1245	34	1180	0.62	g
Popovitch	26-May-88	1245	26	1430	0.62	g
Popovitch	01-Jun-88	1500	1100	4040	0.89	g
Popovitch	02-Jun-88	1100	44	471	0.82	g
Popovitch	14-Jun-88	1915	9.5	69.6	0.43	g
Popovitch	15-Jun-88	1140	8.8	88.8	0.49	g
Popovitch	16-Jun-88	1440	8.8	34	0.49	g
Popovitch	30-Jun-88	1530	4.1	19.1	0.38	g
Popovitch	08-Jul-88	1955	24	173	0.38	g
Popovitch	10-Jul-88	1340	260	1510	0.52	g
Popovitch	10-Jul-88	1800	360	1120	1.2	g
Popovitch	20-Jul-88	1140	6.1	31.4	0.38	g
Popovitch	21-Jul-88	950	36	355	0.62	g
Popovitch	22-Jul-88	1130	11000	22200	0.93	g
Popovitch	22-Jul-88	1304	330	1000	0.75	g
Popovitch	29-Jul-88	1515	3.9	22	0.43	g
Popovitch	10-Aug-88	1450	1.8	17.1	0.49	g
Popovitch	14-Aug-88	1935	5.2	48.3	0.46	g
Popovitch	23-Aug-88	1400	1.1	49.6	0.49	g
Popovitch	29-Aug-88	1230	8.3	24.1	0.49	g
Popovitch	08-Sep-88	1330	11	52.2	0.52	g
Runaway	28-Apr-89	1345	240	1030	2.0	g
Runaway	05-May-89	1400	18	127		g
Runaway	08-May-89	1345	75	373	0.80	g
Runaway	23-May-89	1215	40	143	1.5	g
Runaway	25-May-89	1625	95	618	0.60	g

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	c?	T
Runaway	06-Jun-89	1140	1900	15300	7.9	g
Runaway	06-Jun-89	1430	1900	11000	4.8	g
Runaway	06-Jun-89	1840	1400	6390	2.0	g
Runaway	07-Jun-89	915	350	2040	1.0	g
Runaway	07-Jun-89	1635	400	1810	0.70	g
Runaway	13-Jun-89	1730	1100	4070	0.20	g
Runaway	24-Jun-89	2240	6900	21700	2.0	g
Runaway	25-Jun-89	115	7400	23200	4.0	g
Runaway	25-Jun-89	1110	2500	8470	1.5	g
Runaway	30-Jun-89	1400	23	765	0.28	g
Runaway	13-Jul-89	1330	4.4	2.19	0.12	g
Runaway	05-Aug-89	1250	600	6610	2.0	g
Runaway	05-Aug-89	1700	320	2610	1.2	g
Runaway	08-Aug-89	1546	60	338	0.16	g
Runaway	22-Aug-89	1035	70	920	0.11	g
Runaway	12-Sep-89	1205	6.6	81.1	0.10	g
Runaway	03-Oct-89	1150	3.6	7.26	0.13	g
Runaway	04-Oct-89	1230	6.2	122	0.13	g
Sanderson	13-Aug-86	1030			5.1	
Sanderson	05-Sep-86	1045		16.8	2.9	g
Sanderson	23-Sep-86	1740		59.5	7.6	g
Sanderson	23-Sep-86	1800			37.6	
Sanderson	09-Jun-87	1155	11	9.28	3.0	g
Sanderson	19- Jun-87	1045	20	12.1	1.5	g
Sanderson	30-Jun-87	1800	30	9.4	1.5	g
Sanderson	14-Jul-87	2150	12000	33900	35.4	i
Sanderson	14-Jul-87	2320	13000	59300	30.5	i
Sanderson	15-Jul-87	50	4000	15900	60.0	i
Sanderson	15-Jul-87	350	1800	3010	49.0	i
Sanderson	15-Jul-87	1225	170	692	16.4	g
Sanderson	21-Jul-87	1005	23	60.4	5.2	g
Sanderson	24-Jul-87	450	1000	4200	31.4	i
Sanderson	24-Jul-87	620	2400	7970	44.0	i
Sanderson	24-Jul-87	750	4100	8260	39.0	i
Sanderson	24-Jul-87	920	1200	5400	48.0	i
Sanderson	24-Jul-87	1050	1300	4150	46.4	i
Sanderson	24-Jul-87	1220	850	4100	38.0	i
Sanderson	24-Jul-87	1350	850	1760	38.5	i
Sanderson	24-Jul-87	1520	600	1760	40.0	i
Sanderson	24-Jul-87	1650	400	1400	38.5	i
Sanderson	24-Jul-87	1820	360	972	23.5	i
Sanderson	24-Jul-87	1950	400	857	28.0	i
Sanderson	24-Jul-87	2120	360	783	27.7	i
Sanderson	24-Jul-87	2250	260	931	28.0	i
Sanderson	25-Jul-87	20	850	3120	38.0	i
Sanderson	25-Jul-87	150	650	2260	29.0	i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Sanderson	25-Jul-87	320	550	1870	48.8	i
Sanderson	25-Jul-87	450	550	1810	51.3	i
Sanderson	25-Jul-87	620	550	1820	56.6	i
Sanderson	25-Jul-87	750	500	1290	50.0	i
Sanderson	25-Jul-87	920	400	1260	39.6	i
Sanderson	25-Jul-87	1050	300	877	44.7	i
Sanderson	25-Jul-87	1220	230	725	37.4	i
Sanderson	25-Jul-87	1350	210	548	30.5	i
Sanderson	25-Jul-87	1520	210	525	23.5	i
Sanderson	04-Aug-87	1015	14	12.2	5.4	g
Sanderson	18-Aug-87	1920	450	1560	38.5	i
Sanderson	18-Aug-87	2050	1700	5790	53.9	i
Sanderson	18-Aug-87	2220	1000	5520	47.0	i
Sanderson	18-Aug-87	2350	650	3580	42.8	i
Sanderson	19-Aug-87	120	390	1600	41.8	i
Sanderson	19-Aug-87	250	340	1770	41.8	i
Sanderson	19-Aug-87	420	400	4710	41.8	i
Sanderson	19-Aug-87	550	950	4710	60.7	i
Sanderson	19-Aug-87	720	650	2380	59.3	i
Sanderson	19-Aug-87	850	750	5630	52.6	i
Sanderson	19-Aug-87	1020	550	1960	47.6	i
Sanderson	19-Aug-87	1150	370	3390	47.6	i
Sanderson	19-Aug-87	1320	400	2570	47.6	i
Sanderson	19-Aug-87	1450	320	2720	56.4	i
Sanderson	19-Aug-87	1620	280	1770	38.5	i
Sanderson	19-Aug-87	1750	170	1540	39.6	i
Sanderson	19-Aug-87	1920	180	760	38.0	i
Sanderson	19-Aug-87	2050	130	613	41.0	i
Sanderson	19-Aug-87	2220	250	835	41.9	i
Sanderson	19-Aug-87	2350	200	1200	40.7	i
Sanderson	20-Aug-87	120	220	1600	38.5	i
Sanderson	20-Aug-87	250	170	648	41.0	i
Sanderson	20-Aug-87	420	140	456	35.4	i
Sanderson	20-Aug-87	550	140	467	39.6	i
Sanderson	21-Aug-87	1750	8.6	16.1	12.7	g
Sanderson	25-Aug-87	945	16	10.4	5.3	g
Sanderson	29-Aug-87	2220	400	2720	36.4	g
Sanderson	15-Sep-87	1000	23	10.7	3.7	g
Sanderson	12-Oct-87	1435	85	64.1	3.5	g
Sanderson	26-May-88	1455	25	192	7.8	g
Sanderson	02-Jun-88	1520	30	170	17.0	g
Sanderson	15-Jun-88	1630	llooo	26500	38.9	g
Sanderson	16-Jun-88	1830	460	1510	16.4	g
Sanderson	23-Jun-88	500	3300	9680	42.7	i
Sanderson	23-Jun-88	650	4000	7120	41.2	i
Sanderson	23-Jun-88	800	2100	4200	42.7	i
Sanderson	23-Jun-88	950	1300	3110	38.2	i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Sanderson	23-Jun-88	1100	1400	3790	34.8	i
Sanderson	23-Jun-88	1250	600	1740	31.3	i
Sanderson	23-Jun-88	1400	550	1380	27.4	i
Sanderson	23-Jun-88	1550	620	1180	26.8	i
Sanderson	23-Jun-88	1700	390	977	26.5	i
Sanderson	23-Jun-88	1850	450	949	21.6	i
Sanderson	23-Jun-88	2000	670	1820	23.8	i
Sanderson	23-Jun-88	2150	1300	3630	26.2	i
Sanderson	23-Jun-88	2300	850	3200	28.0	i
Sanderson	24-Jun-88	50	900	1790	24.7	i
Sanderson	24-Jun-88	200	490	1330	23.8	i
Sanderson	24-Jun-88	350	420	1050	21.5	i
Sanderson	24-Jun-88	500	350	1030	21.0	i
Sanderson	24-Jun-88	650	410	954	21.9	i
Sanderson	24-Jun-88	800	400	1000	20.4	i
Sanderson	24-Jun-88	950	490	1140	19.8	i
Sanderson	24-Jun-88	1100	510	1230	23.8	i
Sanderson	24-Jun-88	1250	620	1730	23.0	i
Sanderson	24-Jun-88	1400	510	1110	25.0	i
Sanderson	24-Jun-88	1550	470	1340	22.1	i
Sanderson	30-Jun-88	1025	24	40.2	7.0	i
Sanderson	30-Jun-88	1030	13	45.2	9.3	g
Sanderson	17-Jul-88	1540	15	17.6	3.8	g
Sanderson	21-Jul-88	1320	1100	4730	36.7	i
Sanderson	21-Jul-88	1420	3100	14100	42.5	i
Sanderson	21-Jul-88	1520	2100	7320	37.1	i
Sanderson	21-Jul-88	1620	1000	4180	32.8	i
Sanderson	21-Jul-88	1720	860	2960	33.1	i
Sanderson	21-Jul-88	1820	420	2010	29.1	i
Sanderson	21-Jul-88	1920	340	1780	27.8	i
Sanderson	21-Jul-88	2020	220	809	22.8	i
Sanderson	21-Jul-88	2120	160	926	20.3	i
Sanderson	21-Jul-88	2220	170	616	18.5	i
Sanderson	21-Jul-88	2320	110	452	18.2	i
Sanderson	22-Jul-88	20	110	351	18.0	i
Sanderson	22-Jul-88	120	87	316	17.3	i
Sanderson	22-Jul-88	220	98	269	16.7	i
Sanderson	22-Jul-88	320	73	238	15.9	i
Sanderson	22-Jul-88	420	74	217	14.9	i
Sanderson	22-Jul-88	520	72	179	14.3	i
Sanderson	22-Jul-88	620	150	501	15.1	i
Sanderson	22-Jul-88	720	160	879	19.6	i
Sanderson	22-Jul-88	820	700	2730	28.1	i
Sanderson	22-Jul-88	920	380	1550	26.1	i
Sanderson	22-Jul-88	1020	230	774	21.9	i
Sanderson	22-Jul-88	1200	210	639	21.8	i
Sanderson	22-Jul-88	1300	450	1720	28.1	i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Sanderson	22-Jul-88	1400	2100	6290	39.0	i
Sanderson	22-Jul-88	1500	1200	3820	34.0	i
Sanderson	22-Jul-88	1600	680	3010	31.3	i
Sanderson	22-Jul-88	1700	400	2510	30.0	i
Sanderson	22-Jul-88	1800	980	7060	46.0	i
Sanderson	22-Jul-88	1900	5400	17400	87.0	i
Sanderson	22-Jul-88	2000	6100	22600	100	i
Sanderson	22-Jul-88	2100	3200	14200	95.0	i
Sanderson	22-Jul-88	2200	3200	14500	125	i
Sanderson	22-Jul-88	2300	6300	27800	225	i
Sanderson	23-Jul-88	0	4800	26000	180	i
Sanderson	23-Jul-88	100	1900	12000	130	i
Sanderson	23-Jul-88	200	1400	6530	120	i
Sanderson	23-Jul-88	300	1100	5750	100	i
Sanderson	23-Jul-88	400	990	10600	90.0	i
Sanderson	23-Jul-88	500	910	11600	75.0	i
Sanderson	23-Jul-88	600	780	9720	60.0	i
Sanderson	23-Jul-88	700	560	5060	57.0	i
Sanderson	23-Jul-88	800	520	3770	49.0	i
Sanderson	23-Jul-88	900	490	2410	47.0	i
Sanderson	23-Jul-88	1000	460	6410	45.1	i
Sanderson	25-Jul-88	1615	25	91.5	4.4	g
Sanderson	29-Jul-88	1110	5.9	10.6	5.0	g
Sanderson	08-Aug-88	1155	860	2890	19.3	i
Sanderson	08-Aug-88	1255	1300	4600	33.4	i
Sanderson	08-Aug-88	1355	1100	4270	27.8	i
Sanderson	08-Aug-88	1455	730	1870	23.2	i
Sanderson	08-Aug-88	1555	460	1160	21.6	i
Sanderson	08-Aug-88	1655	360	939	21.5	i
Sanderson	08-Aug-88	1755	400	975	19.8	i
Sanderson	08-Aug-88	1855	320	770	19.1	i
Sanderson	08-Aug-88	1955	300	648	18.2	i
Sanderson	08-Aug-88	2055	230	523	16.9	i
Sanderson	09-Aug-88	355	%	231	12.0	i
Sanderson	09-Aug-88	1055	61	107	9.7	i
Sanderson	10-Aug-88	1110	9.1	12	5.7	g
Sanderson	12-Aug-88	430	1300	6950	35.4	i
Sanderson	12-Aug-88	530	950	4160	39.0	i
Sanderson	12-Aug-88	630	910	7960	35.1	i
Sanderson	12-Aug-88	730	540	4970	32.7	i
Sanderson	12-Aug-88	830	900	3430	41.0	i
Sanderson	12-Aug-88	1030	4600	20000	76.8	i
Sanderson	12-Aug-88	1130	2800	16500	76.8	i
Sanderson	12-Aug-88	1230	1700	12.500	65.8	i
Sanderson	12-Aug-88	1330	1100	3720	54.5	i
Sanderson	12-Aug-88	1430	1100	2230	51.3	i
Sanderson	12-Aug-88	1530	640	3710	48.0	i

APPENDIX D (cont)

Location	Date	Time	Turb	TSS	Q	T
Sanderson	12-Aug-88	1630	600	17400	44.9	i
Sanderson	21-Aug-88	1430	18	24200	3.1	g
Sanderson	23-Aug-88	1230	21	19.6	4.4	g
Sanderson	03-Sep-88	1500	27	31.8	2.6	g
Sanderson	08-Sep-88	1530	25	30.4	3.3	g
Sanderson	29-Sep-88	1205	31	30.7	1.9	g
Sanderson	06-Oct-88	1300	7.8	6.3		g
Sanderson b mining	21-Jul-87	1235	330	1050	5.5	g
Sanderson b mining	25-Aug-87	1135	110	162	6.2	g
Slime	28-Apr-89	1400	5200	26100		g
Slime	05-May-89	1320	400	1780		g
Two Bull	15-Jun-88	1350	330	1900	0.18	g
Two Bull	16-Jun-88	1405	410	2270	0.27	g
Two Bull	30-Jun-88	1820	190	1030	0.15	g
Two Bull	08-Jul-88	1655	22000	66000	0.26	g
Two Bull	11-Jul-88	1550	36000	113000	1.5	g
Two Bull	21-Jul-88	845	2100	14600	0.41	g
Two Bull	22-Jul-88	1505	2300	15300	0.43	g
Two Bull	29-Jul-88	1730	4.8	523	0.20	g
Two Bull	10-Aug-88	1730	22	229	0.16	g
Two Bull	16-Aug-88	1105	12	534	0.18	g
Two Bull	23-Aug-88	1500	5.3	247	0.14	g
Two Bull	07-Sep-88	1235	4.8	12.4	0.12	g
Two Bull	29-Sep-88	1035	2.8	7.5	0.07	g
Two Bull	23-May-89	1230	240	1300		g
Two Bull	25-May-89	1610	850	6060	0.41	g
Two Bull	07-Jun-89	1630	2400	10300	1.5	g
Two Bull	13-Jun-89	1815	2400	8830	0.11	g
Two Bull	23-Jun-89	1115	550	3340	0.16	g
Two Bull	24-Jun-89	2200	7000	38600	0.84	i
Two Bull	24-Jun-89	2200	7500	35200	0.84	g
Two Bull	24-Jun-89	2230	8100	38400	1.4	i
Two Bull	24-Jun-89	2300	7500	42800	1.3	i
Two Bull	24-Jun-89	2330	7600	41100	2.8	i
Two Bull	25-Jun-89	0	9300	72000	3.6	i
Two Bull	25-Jun-89	30	20500	99400	5.2	i
Two Bull	25-Jun-89	100	11600	59000	4.8	i
Two Bull	25-Jun-89	130	11200	55800	3.9	i
Two Bull	25-Jun-89	200	8000	47000	3.0	i
Two Bull	25-Jun-89	230	9000	95400	4.6	i
Two Bull	25-Jun-89	300	9500	71100	4.1	i
Two Bull	25-Jun-89	330	9400	46100	3.5	i
Two Bull	25-Jun-89	400	9100	42700	2.9	i
Two Bull	30-Jun-89	1400	2900	19400	0.10	g

APPENDIX D (cont)

Location	Date	Tiie	Turb	TSS	Q	T
Two Bull	13-Jul-89	1310	650	2360	0.15	g
Two Bull	02-Aug-89	1205	39	1100	0.25	g
Two Bull	04-Aug-89	2045	1700	8170	0.45	i
Two Bull	04-Aug-89	2115	1800	5820	0.61	i
Two Bull	04-Aug-89	2145	3500	15500	0.85	i
Two Bull	04-Aug-89	2215	4500	17600	1.1	i
Two Bull	04-Aug-89	2245	5400	20600	1.2	i
Two Bull	04-Aug-89	2315	2700	13900	1.0	i
Two Bull	04-Aug-89	2345	2900	13000	0.93	i
Two Bull	05-Aug-89	15	3700	15500	0.95	i
Two Bull	05-Aug-89	45	1600	5660	0.89	i
Two Bull	05-Aug-89	115	1900	8210	0.91	i
Two Bull	05-Aug-89	145	7800	29300	1.0	i
Two Bull	OS-Aug-89	215	2600	12700	1.1	i
Two Bull	05-Aug-89	245	6400	24500	1.3	i
Two Bull	05-Aug-89	315	4500	20300	1.6	i
Two Bull	05-Aug-89	345	5500	22500	1.4	i
Two Bull	05-Aug-89	1645	800	4470	0.82	g
Two Bull	08-Aug-89	1420	210	1690	0.16	g
Two Bull	22-Aug-89	1015	110	1060	0.11	g
Two Bull	12-Sep-89	1150	4.4	27.5	0.10	g
Two Bull	04-Oct-89	1100	2.9	9.65	0.13	g

APPENDIX E

GROUNDWATER

Constituents	Method	Detection limit (ppm)
Major ions		
Alkalinity	Electrometric titration (in field)	0.6
F	DIONEX ion chromatography	0.01
Cl	DIONEX ion chromatography	0.01
NO_3	DIONEX ion chromatography	0.02
PO_4	Persulfate digestion of filtered sample then phosphomolydate colorimetry using Technicon Autoanalyzer	0.05
SO_4	DIONEX ion chromatography	0.01
Na	Flame atomic absorption spectrophotometry	0.1
K	Flame AA	0.01
Ca	Direct Current Plasma Emission spectrophotometry (DCP)	0.001
Mg	DCP	0.001
Trace metals		
As	AA, hydride	0.004
Al	DCP	0.002
Ba	DCP	0.001
Be	DCP	1.0
Cd	DCP	0.001
Cu	DCP	0.01
Cr	DCP	0.001
Fe dissolved	0.1um filter, DCP	0.03
Fe total	unfiltered, HCl digestion, DCP	0.03
Mn	DCP	0.005
Ni	DCP	0.05
Pb	DCP	0.03
Zn	DCP	0.02
Other determinations		
Total dissolved solids	calculated for analytical data	
pH	pH meter (field)	0.1 pH unit
Specific conductance	conductivity meter (field)	
Acidity	Electrometric titration (field)	0.1 ppm $CaCO_3$

APPENDIX E (coat)

SURFACE WATER

Constituents	Method	Detection limit (ppm)
Major ions		
Alkalinity	Electrometric titration (in field)	0.6
Cl	DIONEX ion chromatography	0.01
NO_3	DIONEX ion chromatography	0.02
SO_4	DIONEX ion chromatography	0.01
Na	Flame atomic absorption spectrophotometry	0.1
K	Flame AA	0.01
Ca	DCP	0.001
Mg	DCP	0.001
Trace metals		
As	AA, hydride	0.004
Ba	DCP	0.001
Cd	DCP	0.001
Cu	DCP	0.01
Cr	DCP	0.001
Fe	DCP	0.03
Mn	DCP	0.005
Pb	DCP	0.03
Zn	DCP	0.02
Other determinations		
Total dissolved solids	calculated for analytical data	
pH	pH meter (field)	0.1 pH unit
Specific conductance	conductivity meter (field)	
Acidity	Electrometric titration (field)	0.1 ppm $CaCO_3$
Temperature	Meter (field)	
Dissolved oxygen	Meter (field)	
Color	spectrophotometer (lab)	1 PCU
Settleable solids	Imhoff cone (field)	0.1 ml/l
Total suspended solids	Filtration (lab)	1 mg/l
Turbidity	Turner turbidimeter	0.1 NTU

APPENDIX F

SITE	DATE	TIME	Tw	pH	Acidity	DO	% SAT	Color	TSS	TURB	SS	Q
HOSEANNA B1	08 JUN 87	1708	13.3	6.70	3.50	10.5	100	20	1850	700	1.4	36.4
	03 AUG 87	1630	16.5	6.79	4.60	9.5	100	25	198	100	0.1	31.7
	14 SEP 87	1540	4.1	7.56	7.90	14.4	100	30	625	180	0.5	35.5
	23 MAY 88	1840		7.24	4.25	10.6	96	80	2360	444	1.3	46.2
	19 JUL 88	1500	2x::	7.32	2.19	8.3	95	30	253	38	0.1	23.0
	08 SEP 88	1230	5.9	7.84	2.50	12.9	100	30	78.6	36	Tr	26.4
	21 SEP 89	1110	4.0	7.65	2.72	14.0	100	45	234	54	Tr	22.9
HOSEANNA B3	08 JUN 87	1510	13.1	6.68	6.10	10.7	100	15	1970	600	2.0	41.8
	03 AUC 87	1515	15.6	6.85	5.70	10.0	100	40	275	95	Tr	36.9
	14 SEP 87	1400	2.0	7.36	8.10	15.4	100	25	378	120	Tr	26.4
	23 HAY 88	1620	8.6	7.19	5.90	12.4	100	70	1440	342	0.8	42.4
	19 JUL 88	1010	12.2	7.76	2.75	14.1	100	30	292	45	0.8	24.7
	08 SEP 88	1000	3.0	7.92	2.32	14.0	100	20	84.2	30	Tr	24.0
	21 SEP 89	0825	2.8	7.65	4.08	14.5	100	55	113	55	Tr	19.7
GAMW 1C	20 JUL 88	1805	3.8	6.71	71.4							
GAMW 3	24 MAY 88	1650	2.4	6.40	66.6							
	18 JUL 88	1450	3.9	6.15	147							
	07 SEP 88	1415	1.5	5.96	278							
	20 SEP 89	1432	1.1	6.15	163							
GAMW 4	25 HAY 88	1000	1.2	6.70	32.5							
	18 JUL 88	1700	1.9	6.95	56.3							
	07 SEP 88	1650	1.9	6.35	83.3							
	20 SEP 89	1802	1.8	6.10	95.3							
GAMW 5	25 MAY 88	1710	4.9	6.30	129							
	19 JUL 88	1200	3.7	6.24	224							
	08 SEP 88	1100	2.3	6.36	302							
	21 SEP 89	1840	3.9	6.02	332							
	22 SEP 89	0925	3.4	6.04	381							
MW-1	07 NOV 89	1337	3.3	6.95	43.6							

All units are mg/l except:

Yater Temp (Tw) - °C
pH - pH units

Color - PCU
Turbidity - NTU
Settleable Solids (SS) - ml/l
Discharge (Q) - cfs

Conductivity - umhos/cm at 25 °C
Alkalinity - mg/l as $CaCO_3$

APPENDIX F (cont)

SITE	DATE	Cond	TDS	Ca	Mg	Na	K	ALK	F	CL	NO3	SO4	PO4
HOSEANNA Bl	08 JUN 87	456	223	25.3	17.8	14.6	3.99	103	0.157	14.1	21.6	47.2	<0.05
	03 AUG 87	583	255	33.9	22.1	15.1	5.08	120	0.1%	20.6	0.26	67.2	<0.05
	14 SEP 87	631	276	36.0	25.5	14.7	5.14	140	0.202	19.1	0.20	69.5	<0.05
	23 MAY 88	459	270	36.3	32.6	6.78	1.03	106	0.633	47.0	0.21	61.6	<0.05
	19 JUL 88	571	345	45.9	38.5	13.4	3.45	129	0.799	62.3	0.27	79.7	co.05
	08 SEP 88	570	308	36.2	24.9	30.9	4.58	130	0.808	32.2	1.41	76.2	<0.05
	21 SEP 89	638	350	46.0	21.6	45.9	5.50	139	0.784	38.6	0.85	82.4	<0.05
HOSEANNA B3	08 JUN 87	441	201	25.6	18.2	14.6	3.80	94	0.094	12.2	0.23	53.0	so.05
	03 AUG 87	554	250	31.6	22.3	14.7	4.68	116	0.171	15.3	0.09	71.4	so.05
	14 SEP 87	582	270	34.7	26.5	14.7	4.70	133	0.159	14.9	0.05	72.8	<0.05
	23 MAY 88	433	263	36.7	33.7	5.63	0.97	100	0.561	38.5	0.26	65.9	<0.05
	19 JUL 88	516	343	44.8	38.4	11.8	3.22	125	0.745	60.6	0.26	82.9	<0.05
	08 SEP 88	532	301	35.4	25.6	23.2	3.99	139	0.791	24.5	1.16	77.4	<0.05
	21 SEP 89	580	343	42.5	24.9	35.3	4.90	141	0.761	36.8	0.82	85.4	<0.05
GAMW 1C	20 JUL 88	3318	2271	52.2	57.1	661	64.4	1680	0.588	171	<0.02	24.1	5.35
GAMW 3	24 MAY 88	1562	919	64.8	35.9	164	19.3	346	0.798	248	<0.02	85.4	<0.05
	18 JUL 88	1538	903	55.6	18.6	195	20.5	354	0.811	245	<0.02	71.7	<0.05
	07 SEP 88	1645	870	45.9	22.4	187	27.6	373	0.835	201	<0.02	86.9	co.05
	20 SEP 89	1400	911	49.8	26.7	208	34.4	358	0.171	212	1.46	83.4	so.05
GAMW 4	25 MAY 88	415	275	35.8	9.06	5.62	45.1	186	1.01	3.85	0.06	21.3	<0.05
	18 JUL 88	504	324	42.8	12.9	8.56	47.9	230	1.43	3.84	co.02	21.8	<0.05
	07 SEP 88	445	294	30.6	9.51	6.73	55.8	204	1.18	3.54	so.02	25.9	<0.05
	20 SEP 89	425	291	7.30	3.52	75.3	13.4	199	0.93	3.89	0.42	21.5	co.05
GAMW 5	25 MAY 88	4013	3146	190	133	792	10.5	454	4.39	1570	so.02	61.7	so.05
	19 JUL 88	7841	3717	283	193	893	15.6	645	6.23	1730	<0.02	72.0	<0.05
	08 SEP 88	6905	3551	251	89.6	956	11.2	638	6.10	1680	<0.02	63.1	<0.05
	21 SEP 89	3193	1759	182	58.9	360	29.7	532	2.84	680	2.12	81.0	<0.05
	22 SEP 89	5945	3325	245	78.6	806	52.1	646	3.37	1540	2.36	68.8	co.05
MU-1	07 NOV 89	315	219	39.1	8.57	20.7	1.90	180	0.49	0.38	0.30	0.87	co.05

APPENDIX F (cont)

ALL units are mg/l

SITE	DATE	AL	As	B	Be	Be	cd	co	Cr
HOSEANNA B1	08 JUN 87	0.057	<0.004	0.14	0.098	<1.0	<0.001	<0.01	<0.002
	03 AUG 87	0.057	co.004	0.19	0.117	<1.0	<0.001	<0.01	<0.002
	14 SEP 87	0.050	<0.004	0.19	0.116	<1.0	<0.001	<0.01	<0.002
	23 NAY 88	0.058	<0.004	0.13	0.110	<1.0	<0.001	0.009	<0.002
	19 JUL 88	0.061	<0.004	0.15	0.107	<1.0	<0.001	0.010	0.003
	08 SEP 88	0.057	<0.004	0.17	0.099	<1.0	co.001	0.011	0.002
	20 SEP 89	0.054	<0.004	0.16	0.087	<1.0	<0.001	0.005	<0.002
HOSEANNA B3	08 JUN 87	0.055	<0.004	0.13	0.089	<1.0	<0.001	<0.01	<0.002
	03 AUG 87	0.066	<0.004	0.17	0.096	<1.0	<0.001	<0.01	<0.002
	14 SEP 87	0.055	<0.004	0.19	0.094	<1.0	<0.001	<0.01	<0.002
	23 MAY 88	0.057	co.004	0.12	0.091	<1.0	<0.001	0.012	<0.001
	19 JUL 88	0.059	<0.004	0.14	0.076	<1.0	<0.001	0.011	0.002
	08 SEP 88	0.059	<0.004	0.16	0.064	<1.0	co.001	0.012	0.005
	20 SEP 89	0.059	<0.004	0.15	0.067	<1.0	<0.001	0.007	<0.002
GAMW 1C	20 JUL 88	0.294	<0.004	<0.01	0.245	<1.0	<0.001	0.023	0.002
GAMW 3	24 NAY 88	0.287	<0.004	1.71	0.404	<1.0	<0.001	0.027	0.004
	18 JUL 88	0.276	0.004	1.53	0.398	4.0	<0.001	0.041	0.003
	07 SEP 88	0.290	so.004	2.82	0.242	<1.0	0.002	0.040	0.003
	20 SEP 89	0.260	<0.004	2.26	0.121	<1.0	<0.001	0.024	<0.001
GAMW 4	25 MAY 88	0.175	0.009	0.45	0.420	<1.0	0.017	0.009	<0.001
	18 JUL 88	0.211	<0.004	0.50	0.355	<1.0	<0.001	<0.001	<0.001
	07 SEP 88	0.191	0.016	0.29	0.135	<1.0	0.042	0.002	<0.001
	20 SEP 89	0.154	co.004	0.38	0.114	<1.0	0.003	<0.001	<0.001
GAMW 5	25 MAY 88	0.271	0.010	1.53	1.37	<1.0	<0.001	0.412	0.004
	19 JUL 88	0.252	0.005	1.41	1.13	4.0	<0.001	0.267	0.005
	08 SEP 88	0.261	0.013	2.90	1.32	<1.0	0.005	0.345	0.001
	21 SEP 89	0.226	0.007	1.29	0.571	<1.0	<0.001	0.254	0.003
	22 SEP 89	0.278	0.006	2.60	0.943	<1.0	<0.001	0.326	0.006
MU-1	07 NOV 89	0.049	so.004	0.05	0.317	<1.0	<0.001	co.001	<0.001

APPENDIX F (cont)

SITE	DATE	cu	Fe (T)	Fe (D)	Mn	MO	Ni	Pb	Si	Zn
HOSEANNA B1	08 JUN 87	co.01		0.09	0.20	0.021		<0.03	1.92	co.02
	03 AUG 87	co.01		<0.03	0.24	0.022		<0.03	2.31	<0.02
	14 SEP 87	co.01		so.03	0.32	0.023		<0.03	2.24	so.02
	23 M Y 88	<0.01		0.08	0.47	0.019		so.03	5.52	co.02
	19 JUL 88	<0.01		0.04	0.41	0.020		<0.03	6.12	<0.02
	08 SEP 88	so.01		<0.03	0.36	0.022		<0.03	5.43	<0.02
	20 SEP 89	so.01		<0.03	0.40	0.029		<0.03	6.28	co.02
HOSEANNA B3	08 JUN 87	so.01		0.08	0.23	0.018		x0.03	1.91	co.02
	03 AUG 87	<0.01		<0.07	0.26	0.018		<0.03	2.29	0.025
	14 SEP 87	<0.01			0.33	0.023		<0.03	1.72	0.035
	23 MAY 88	go.01		0.07	0.41	0.019		so.03	5.54	<0.02
	19 JUL 88	co.01		co.03	0.39	0.022		<0.03	6.24	<0.02
	08 SEP 88	<0.01		<0.03	0.38	0.020		so.03	5.43	<0.02
	20 SEP 89	<0.01		so.03	0.39	0.025		<0.03	6.06	<0.02
GAMW 1C	20 JUL 88	<0.01	0.35	0.28	0.12	0.032	co.05	0.05	6.79	co.02
GAMW 3	24 MAY 88	0.13	47.2	39.2	1.23	0.026	<0.05	0.109	8.98	0.21
	18 JUL 88	0.15	43.4	31.9	1.19	0.041	co.05	0.111	5.34	0.23
	07 SEP 88	<0.01	36.1	18.0	1.26	0.028	<0.05	0.108	7.89	0.10
	20 SEP 89	<0.01	29.5	25.1	1.01	0.028	co.05	0.085	8.07	so.02
GAMW 4	25 MAY 88	0.01	12.7	8.45	0.66	0.012	<0.05	<0.03	9.34	<0.02
	18 JUL 88	0.02	12.1	7.12	0.78	0.017	co.05	<0.03	11.2	<0.02
	07 SEP 88	0.81	7.75	3.78	0.58	0.013	so.05	so.03	8.57	<0.02
	20 SEP 89	<0.01	14.8	12.0	0.47	<0.01	<0.05	<0.03	7.65	<0.02
GAHU 5	25 MAY 88	0.13	57.7	45.8	10.9	0.143	<0.05	0.175	10.4	0.30
	19 JUL 88	0.02	59.2	46.1	7.32	0.124	co.05	0.168	12.4	0.34
	08 SEP 88	so.01	42.8	22.7	8.30	0.112	co.05	0.209	10.2	0.20
	21 SEP 89	co.01	41.2	34.0	3.91	0.121	so.05	0.198	8.95	0.04
	22 SEP 89	<0.01	56.9	50.0	6.39	0.142	so.05	0.213	9.08	0.13
MU-1	07 NOV 89	<0.01	4.70	4.16	1.24	0.022	co.05	so.03	11.4	0.03

NOTE:
Fe (T) = Total Iron
Fe (D) = Dissolved Iron