



Hydrologic Benchmark Network Stations in the West-Central U.S. 1963-95 (USGS Circular 1173-C)

Abstract and Map Index	List of all HBN Stations	Introduction to Circular	Analytical Methods
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Swiftcurrent Creek at Many Glacier, Montana (05014500)

This report details one of the approximately 50 stations in the Hydrologic Benchmark Network (HBN) described in the four-volume U.S. Geological Survey Circular 1173. The suggested citation for the information on this page is:

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All of the tables and figures are numbered as they appear in each circular. Use the navigation bar above to view the abstract, introduction and methods for the entire circular, as well as a map and list of all of the HBN sites. Use the table of contents below to view the information on this particular station.

Table of Contents
1. Site Characteristics and Land Use
2. Historical Water Quality Data and Time-Series Trends
3. Synoptic Water Quality Data
4. References and Appendices

Site Characteristics and Land Use

The Swiftcurrent Creek HBN Basin lies within the Northern Rocky Mountain physiographic province (Fenneman, 1946) in northern Montana ([Figure 10. Map showing study area in the Swiftcurrent Creek Basin and photograph of the Grinnell Creek Basin](#)). The HBN station is at the outlet of Swiftcurrent Lake in Glacier National Park, about 18 km southwest of Babb, Mont., at a latitude of 48°47'57" and a longitude of 113°39'21".

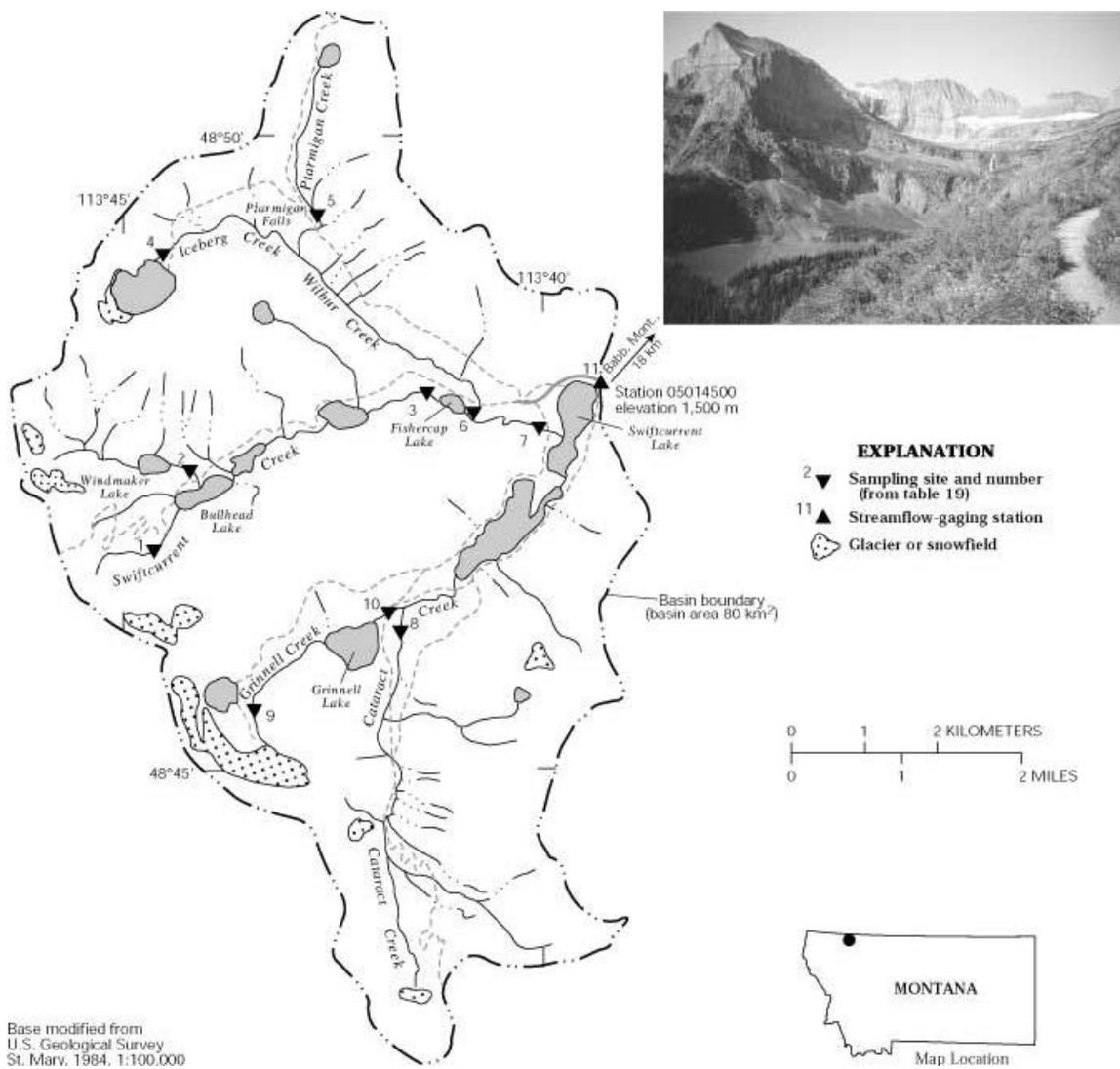


Figure 10. Map showing study area in the Swiftcurrent Creek Basin and photograph of the Grinnell Creek Basin

Swiftcurrent Creek at the HBN station drains 80 km² of rugged, mountainous terrain on the east side of the Rocky Mountains, entirely within Glacier National Park. Vertical rock exposures make for abrupt changes in basin topography; elevations range from 1,500 to 3,000 m. The ecoregion of the basin is classified as the Northern Rocky Mountain Forest-Steppe–Coniferous Forest–Alpine Meadow Province (Bailey, 1995). The vegetation in the Swiftcurrent Creek Basin changes with elevation. At lower elevations, forests of spruce and fir trees, aspen, and various shrubs cover the basin. At higher elevations, the vegetation grades into alpine tundra. The grass cover is sparse owing to the poorly developed soils and bare rock cover. Swiftcurrent Creek is tributary to the St. Mary River, which drains to the Saskatchewan River Basin.

Swiftcurrent Creek is a perennial, high-gradient mountain stream; several small glaciers near the Continental Divide form the headwaters of the stream. The basin has a snowmelt-dominated hydrograph; mean monthly discharges on Swiftcurrent Creek ranged from 0.75 m³/s in February to 14 m³/s in June (Shields and others, 1996). Average annual precipitation increases in the basin with increasing elevation. Average annual precipitation at the Many Glacier weather station is about 100 cm; higher elevations may receive closer to 200 cm. Precipitation falls predominantly in the form of snow. Average annual runoff is about 160 cm (Shields and others, 1996). The winters are cold and summers mild; mean monthly temperatures ranged from about -10.7°C in January to 14.8°C in July at the Many Glacier station during the period 1967–95 (National Climatic Data Center, 1996). Temperatures in the basin decrease with increasing elevation.

The Swiftcurrent HBN Basin drains a westward-dipping sequence of argillite, quartzite, and calcareous rocks of Precambrian age. The younger rocks in the sequence are exposed in the upper basin, whereas the older rocks are near the HBN station. The bedrock is very resistant to weathering and supplies little sediment to the stream. In the upper basin, Precambrian argillites are varicolored from dark green, gray, pink, to brick red. A series of greenish-gray mafic lava flow deposits lie in the upper basin, near the Continental Divide. Older, interbedded argillites, dolomites, stromatolitic limestones, and quartz arenites are present in the lower part of the basin (Earhart and others, 1990). Tectonic forces thrust sediments upward from west to east. The eastern limb of the Akamina Syncline is the predominant structural feature in the basin. Unconsolidated materials on slopes are composed of locally derived, unsorted, angular gravel-sized clasts in a matrix of unsorted sand, silt, and clay (Carrara, 1990). Unsorted, subrounded to subangular, bouldery rubble on the valley floor was deposited as ground moraine by alpine glaciers.

The Swiftcurrent Creek HBN Basin lies entirely within the boundaries of Glacier National Park. The access to the HBN station is by paved road. Just beyond the HBN station, park facilities are clustered along Swiftcurrent Lake. The rest of the basin, including Grinnell Lake, Bullhead Lake, and Iceberg Lake, is accessible only by hiking trail. Between December and April, the road to the station usually is impassable owing to snow and generally is closed at the Many Glacier park entrance. During this time, the HBN station is most accessible by skis, snowshoes, or mountain bike (N.A. Midtlyng, U.S. Geological Survey, oral commun., 1997). The basin is essentially undeveloped

except for park facilities, including a few hotels, campground, and ranger station, which are typically open from Memorial Day to Labor Day. The water supply for the facilities is withdrawn from the basin upstream from the HBN station; sewage disposal is downstream from the station. Recreational use of Glacier National Park is high. About 157,400 people used the park's backcountry during the summer season of 1988 (Coen, 1992). More than 95 percent of the backcountry users were day hikers. Other activities in the basin include fishing, backcountry camping, and some cross-country skiing. Several large lakes, which interrupt the steep stream gradients, lie in the basin. Wildlife is diverse and abundant in the park, including bighorn sheep, mountain goats, black and grizzly bear, whitetail and mule deer, moose, and wolves.

Historical Water-Quality Data

Samples for chemical analyses have not been collected routinely at the Swiftcurrent Creek HBN station. The data set analyzed for this report includes 83 measurements of instantaneous discharge and 82 measurements of specific conductance for the period October 1963 to July 1994 (table 18). The entire period of record for discharge at the Swiftcurrent Creek HBN station is from 1959 to 1997. Median values and ranges of discharge and specific conductance are shown in table 18. Discharge ranged from 0.19 to 40 m³/s, with a median discharge of 3.1 m³/s. The range of specific conductance for the period was 70 to 131 mS/cm, with a median value of 104 mS/cm. Specific conductance can be used as an indicator of the dissolved solids (Hem, 1992, p. 165). Based on the range of specific-conductance values, dissolved solids generally are low at this site. Streams in basins with high annual runoff tend to have low dissolved-solids concentrations (Biesecker and Leifeste, 1975). Specific conductance had an inverse relation with discharge. The Spearman rank correlation coefficient was -0.674.

Table 18. Minimum, first quartile, median, third quartile, and maximum values of physical properties measured at Swiftcurrent Creek, Montana, 1964–94

[Discharge in cubic meters per second; specific conductance in microsiemens per centimeter at 25 degrees Celsius; n, number of measurements]

Parameter	Stream water					
	Minimum	First quartile	Median	Third quartile	Maximum	n
Discharge	0.19	1.4	3.1	8.2	40	83
Specific conductance, field	70	97	104	111	131	82

Synoptic Water-Quality Data

Results of a surface-water synoptic sampling conducted August 1–3, 1992, in the Swiftcurrent Creek Basin are presented in table 19, and locations of the sampling sites are shown in figure 10. Discharge at the HBN station (site 11) was $2.9 \text{ m}^3/\text{s}$ compared to the mean monthly discharge of $3.3 \text{ m}^3/\text{s}$ for the month of August (Shields and others, 1996). The water at the HBN station (site 11) was a calcium bicarbonate type. Bicarbonate was the primary contributor to alkalinity at this station. The sum of ions for the HBN station was $2,100 \text{ meq/L}$. The specific conductance was 102 mS/cm , compared to the median of 104 mS/cm for the period of record, 1964–94. Therefore, the synoptic sample should indicate typical water-quality composition at the HBN station. The dominant cation, calcium, contributed 67 percent of the total cation concentration in stream water; magnesium contributed 31 percent. Bicarbonate contributed 95 percent of the total anion concentration. The predominance of calcium and bicarbonate indicates that carbonate rocks in the basin contribute to the ion composition of the stream water. The weathering of dolomites and clay minerals in underlying argillites is a source for magnesium in the basin (Coen, 1992). Sulfate and chloride concentrations generally were low and were comparable to precipitation chemistry at NADP stations in Montana. The percent difference of cations and anions was about 1 percent, indicating that unmeasured ions do not substantially contribute to the ionic content of Swiftcurrent Creek. Nitrate concentrations in the samples were less than nitrate concentrations in precipitation chemistry for NADP stations in Montana, indicating atmospheric inputs probably account for the nitrate measured in the stream water.

The water at the remaining synoptic sites (sites 1–10) also is an alkaline, calcium bicarbonate type. The sum of ions in tributaries in the basin ranged from 940 meq/L in upper Grinnell Creek (site 9) to $3,300 \text{ meq/L}$ in Ptarmigan Creek (site 5). Water quality in the tributaries is a function of drainage size and underlying bedrock. The specific conductance in upper Grinnell Creek (49 mS/cm) was less than the minimum specific conductance (70 mS/cm) measured at the HBN station for the period of record, 1964–94. Site 1 and site 4 also had low specific conductance (75 and 84 mS/cm , respectively). The small drainage area and extensive exposures of resistant bedrock at these sites probably accounts for their low dissolved solids. The highest specific conductance was at site 5 on Ptarmigan Creek (175 mS/cm); that value exceeds the maximum specific conductance of 131 mS/cm measured at the HBN station for the period of record.

Table 19. Physical properties and major-ion concentrations in surface-water samples collected at sites in the Swiftcurrent Creek Basin, August 1—3, 1992

[Site locations shown in fig. 10; Q, discharge in cubic meters per second; SC, specific conductance in microsiemens per centimeter at 25 degrees Celsius; pH in standard units; Ca, calcium; Mg, magnesium; Na, sodium; K, potassium; Alk, alkalinity; SO₄, sulfate; Cl, chloride; NO₃, nitrate; SiO₂, silica; concentrations in microequivalents per liter, except silica is in micromoles per liter; --, not measured; <, less than; criteria used in selection of sampling sites: BG = bedrock geology, TRIB = major tributary, LU = land use]

Site	Identification number	Q	SC	pH	Ca	Mg	Na	K	Alk	SO ₄	Cl	NO ₃	SiO ₂	Criteria
1	484649113443200	0.22	75	8.0	600	160	13	2.0	730	33	<0.3	4.3	20	BG
2	484717113440800	.23	106	8.3	800	260	13	3.3	1,000	29	<.3	.7	25	TRIB
3	484754113411700	--	107	8.2	750	300	17	2.8	1,000	21	37	.6	23	TRIB
4	484903113443500	.14	84	8.2	550	250	13	2.8	750	56	<.3	3.6	17	BG
5	484920113424000	.06	175	8.2	1,000	700	35	7.4	1,500	48	<.3	8.6	52	TRIB
6	484753113404500	.28	120	8.2	600	160	8.7	4.6	1,100	19	<.3	.7	20	TRIB
7	484739113395800	.94	110	8.3	750	330	22	3.3	1,000	35	<.3	1.9	28	LU
8	484604113414500	.064	125	8.2	800	410	17	4.1	1,200	23	<.3	8.6	37	TRIB
9	484528113432600	--	49	7.9	360	120	8.7	2.3	430	19	2.8	<.7	12	BG
10	484614113415500	1.5	114	8.2	550	240	13	2.8	800	38	<.3	3.6	22	TRIB
11	05014500	2.9	102	8.8	700	330	17	3.1	980	48	.3	<.7	27	--

References Cited

- Bailey, Robert G., 1995, Descriptions of the ecoregions of the United States: U.S. Department of Agriculture, Forest Service, Miscellaneous Publication 1391, 108 p.
- Biesecker, J.E., and Leifeste, D.K., 1975, Water quality of hydrologic benchmarks—An indicator of water quality in the natural environment: U.S. Geological Survey Circular 460-E, 21 p.
- Carrara, P.E., 1990, Surficial geologic map of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-D.
- Coen, Brenda, ed., 1992, Science in Glacier National Park: National Park Service Annual Report, 1991-92, 72 p.
- Earhart, R.L., Raup, O.B., Whipple, J.W., Ison, A.L., and Davis, G.A., 1990, Geologic maps, cross section, and photographs of the central part of Glacier National Park, Montana: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-B.
- Fenneman, N.M., 1946, Physical divisions of the United States: Washington, D.C., U.S. Geological Survey special map, scale 1:7,000,000.
- Hem, J.D., 1992, Study and interpretation of the chemical characteristics of natural water: U.S. Geological Survey Water-Supply Paper 2254, 263 p.
- National Climatic Data Center, 1996, Summary of the day, CD-ROM: Boulder, Colorado, EarthInfo Incorporated.
- Shields, R.R., White, M.K., Ladd, P.B., and Chambers, C.L., 1996, Water resources data, Montana, water year 1995: U.S. Geological Survey Water-Data Report MT-95-1, 521 p.

Appendix A. List of Map References

a. U.S. Geological Survey topographic maps:

- Ahern Pass, Montana (1:24,000), 1968
- Logan Pass, Montana (1:24,000), 1968
- Many Glacier, Montana (1:24,000), 1968, streamflow-gaging station
- Saint Mary, Montana-Alberta (1:100,000), 1981

b. Geologic maps:

- Alpha, T.R., and Nelson, W.H., 1990, Geologic sketches of Many Glacier, Hidden Lake Pass, Comeau Pass, and Bears Hump Viewpoint, Waterton-Glacier International Peace Park, Alberta, Canada, and Montana, United States: U.S. Geological Survey Miscellaneous Investigation Series Map I-1508-E.
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- James, H.L., 1982, Glacial features of the Upper Swiftcurrent Valley, Glacier National Park, Montana: Montana Bureau of Mines and Geology Geologic Map 27.
- Ross, C.P., 1959, Geology of Glacier National Park and the Flathead region, northwestern Montana: U.S. Geological Survey Professional Paper 296.

c. Soil surveys:

No soil survey available.

Appendix B. NWIS Site-Identification Numbers

Table B-1. NWIS site-identification numbers and site names for water-quality sampling sites.

Site	Identification Number	Site Name
1	484649113443200	SWIFTCURRENT CREEK ABOVE BULLHEAD LAKE
2	484717113440800	UNNAMED CREEK BELOW WINDMAKER LAKE
3	484754113411700	SWIFTCURRENT CREEK ABOVE FISHERCAP LAKE
4	484903113443500	ICEBERG CREEK
5	484920113424000	PTARMIGAN CREEK ABOVE FALLS
6	484753113404500	WILBUR CREEK ABOVE FISHERCAP LAKE
7	484739113395800	SWIFTCURRENT CREEK ABOVE SWIFTCURRENT LAKE
8	484604113414500	CATARACT CREEK
9	484528113432600	UPPER GRINNELL CREEK
10	484614113415500	GRINNELL CREEK BELOW GRINNELL LAKE
11	05014500	SWIFTCURRENT CREEK AT MANY GLACIER, MONTANA