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Water and Sediment Quality in the Yukon River and its Tributaries Between Atlin, British Columbia, Canada, and Eagle, Alaska, USA, 2004

Edited by Douglas R. Halm and Mark M. Dornblaser

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Conversion Factors

Multiply	By	To Obtain
	Length	
kilometer (km)	0.6214	mile
meter (m)	3.281	foot
centimeter (cm)	0.394	inch
millimeter (mm)	0.03937	inch
micrometer (μm)	0.00003937	inch
nanometer (nm)	0.00000003937	inch
	Area	
square kilometer (km^2)	0.3861	square mile
square meter (m^2)	10.76	square foot
	Volume	
liter (L)	0.2642	gallon
milliliter (ml)	0.03382	ounce, fluid
microliter (μl)	0.00003382	ounce, fluid
	Mass	
gram (g)	0.03527	ounce, avoirdupois
milligram (mg)	0.00003527	ounce, avoirdupois
microgram (μg)	0.00000003527	ounce, avoirdupois
	Flow	
cubic meters per second (m^3/sec)	35.31	cubic foot per second (ft^3/sec)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

°F= (1.8×°C) +32

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

°C= (°F-32)/1.8

Vertical coordinate information is referenced to the "North American Vertical Datum of 1988 (NAVD 88)"

Horizontal coordinate information is referenced to the "North American Datum of 1983 (NAD 83)"

Altitude, as used in this report, refers to distance above the vertical datum.

Abbreviations

The following terms are also used in this report:

ADCP Acoustic Doppler Current Profiler

AES Artic Environmental Strategy

$CaCO_3$ Calcium Carbonate

CH_4 Methane

CO_2	Carbon Dioxide
DIAND	Department of Indian Affairs and Northern Development
DIC	Dissolved Inorganic Carbon
DOC	Dissolved Organic Carbon
E	Estimate
EC	Environment Canada
EDI	Equal Discharge Increment
Hg	Mercury
L	Liter
m^3/s	cubic meters per second
MDL	Method Detection Limit
mg/L	milligrams per liter
mm	millimeter
NAD	North American Datum
NASQAN	National Stream Quality Accounting Network
nm	nanometer
ppm	parts per million by volume
QA	Quality Assurance
QC	Quality Control
RPD	Relative Percent Difference
SUVA	Specific Ultraviolet Absorbance
TU	Tritium Units
µg/L	micrograms per Liter
µmol/L	micromoles per Liter
µS/cm	micro Siemens per centimeter
USGS	U.S. Geological Survey
WSC	Water Survey Canada
YT	Yukon Territory

Water and Sediment Quality in the Yukon River and its Tributaries, Between Atlin, British Columbia, Canada and Eagle, Alaska, USA, 2004

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Abstract

The Yukon River basin is the fourth largest watershed in North America at 855,300 square kilometers (km^2). Approximately 126,000 people live within the basin and depend on the Yukon River and its tributaries for drinking water, commerce, subsistence and recreational fish and game resources.

Climate warming in the Arctic and Sub arctic regions encompassing the Yukon basin has recently become a concern because of possible far-reaching effects on the ecosystem. Large amounts of carbon and nutrients are stored in permafrost and have potential for release in response to this warming. These changes in carbon and nutrient cycling may result in changes in stream chemistry and productivity, including salmon populations, and ultimately changes in the chemistry and productivity of the Bearing Sea.

To address these concerns, the U.S. Geological Survey (USGS) conducted a 5-year comprehensive water-quality study of the Yukon River and its major tributaries starting in 2000. The study included frequent water-quality sampling at a fixed site network as well as intensive sampling along the Yukon River and its major tributaries.

This report contains observations of water and sediment quantity and quality of the Yukon River and its tributaries in Canada during 2004. Chemical, biological, physical, and discharge data are presented for the reach of river between Atlin, British Columbia, Canada, and Eagle, Alaska, USA.

Introduction

The Yukon River basin covers 855,300 km^2 in British Columbia and Yukon Territory, Canada, and Alaska, USA (fig. 1). The basin includes 20 ecoregions and is of prime importance to the ecology of the Bering Sea, contributing most of its fresh-water runoff, sediment load, and dissolved solutes (Lisitsysn, 1969).

Figure 1. Location of the Yukon River Basin in Canada and Alaska, USA.

The Yukon basin is located approximately between 60 and 68 degrees north. Much of the Yukon River basin is underlain by continuous or discontinuous permafrost. Air temperature records from 1961 to 1990 show a warming trend of about 0.75 °C (degrees Celsius) per decade at these latitudes (Chapman and Walsh, 1993). This warming is expected to affect permafrost depth and distribution, glacial runoff, and biogeochemical fluxes within and from the basin. Because the effect of this warming is unclear, the USGS National Stream Quality Accounting Network (NASQAN) began a 5-year study of the basin in 2000. The main objective of this study was to develop a baseline characterization of water quality in the Yukon basin that will serve as a benchmark for future studies of the river and its tributaries.

Intensive Sampling

In 2001, a plan was developed to sample along the entire length of the Yukon River, including its major tributaries. The river was divided into three study sections. The middle section of the river was sampled in 2002, the lower river section was sampled in 2003 (see, Dornblaser and Halm, 2006), and the upper section of the river within British Colombia and the Yukon Territory, Canada, was sampled in 2004. The 5-year study sections were undertaken by the USGS Central Region National Research Program with the aid of the USGS Field Headquarters in Fairbanks, Alaska. The 2004 study section of the upper Yukon River was accomplished with the collaboration of the Water Survey Canada (WSC) in Whitehorse, Yukon Territory, and Environment Canada (EC) out of Vancouver, British Colombia.

The 1,800-km Canadian reach of the Yukon River was sampled twice in 2004: once in June near peak flow conditions and again from late August to early September during a lower flow regime. Figure 2 shows the study watersheds and sampling sites along the main stem and tributaries. Table 1 references the locations of the sampling sites on figure 2 and provides location, drainage area, and elevation. Three boats were outfitted to conduct discharge with acoustic Doppler current profiler (ADCP) and water-quality sampling by the equal discharge interval (EDI) method (U.S. Geological Survey 1997-1999).

Samples were collected at four main-stem locations, all major tributaries, and below the mixing zone of the major tributaries for a small number of water-quality characteristics. A mobile lab followed the sampling crews down river so that samples could be processed in a timely manner. Sampling was conducted for a broad range of characteristic, including sediment concentration and mineralogy, major ions, nutrients, dissolved and sediment associated trace elements, mercury, biological indicators, various forms of organic carbon, dissolved carbon gases, and stable isotopes. In conjunction with the intensive sampling, NASQAN sampled five Yukon River basin fixed stations within Alaska approximately seven times a year from 2001 through 2004 (Schuster, 2003, 2005a, 2005b, 2006).

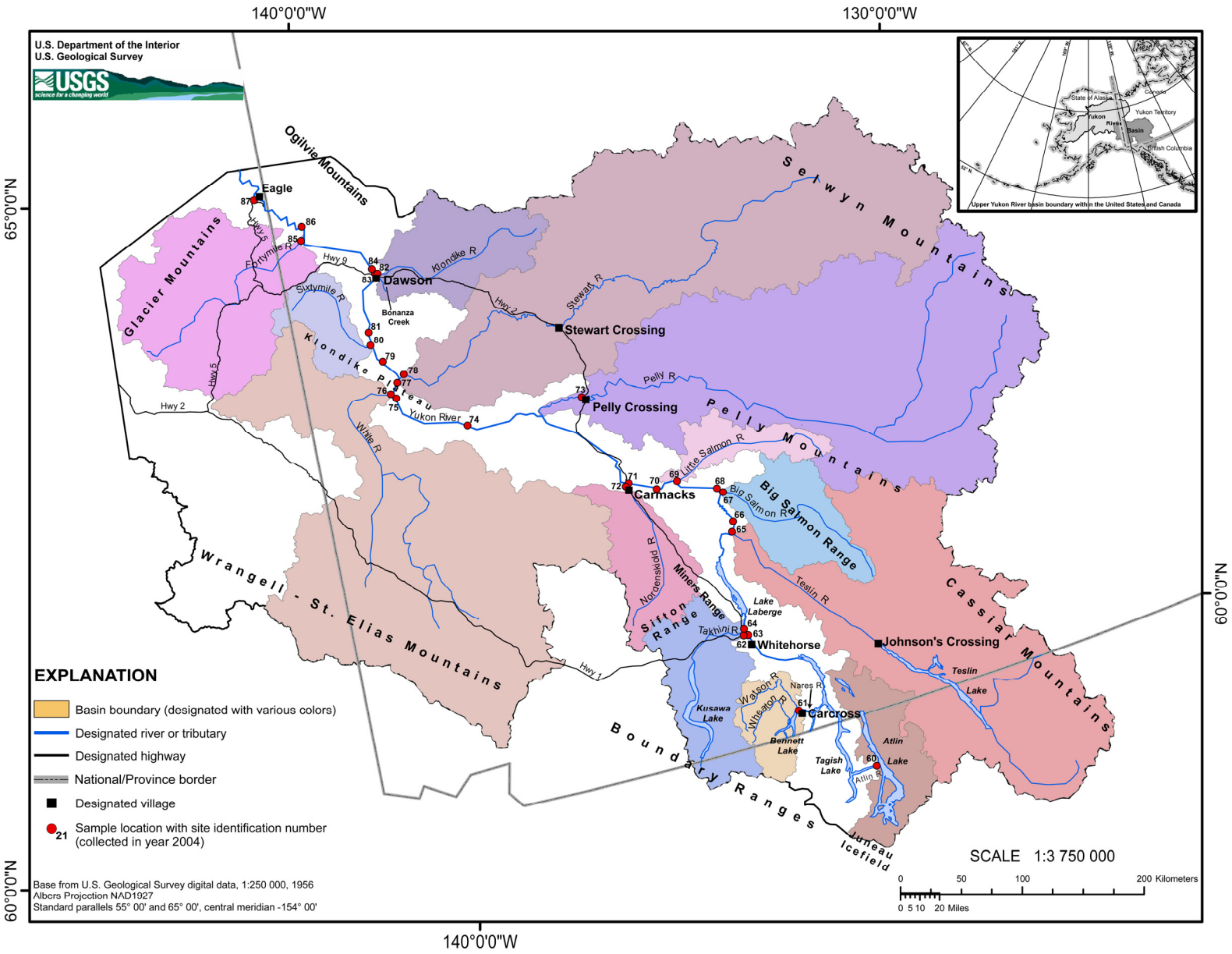

Figure 2. Study watersheds and sampling sites.

Table 1. Summary of site characteristics with station numbers.

[NAD 83, North American Datum of 1983; km^2, square kilometers; m, meters; NA, not applicable; --, not available]

Identification number on figure 2	Site name	U.S. Geological Survey station sumber	Water survey Canada station number	Latitude (NAD 83)	Longitude (NAD 83)	Drainage area (km^2)	Elevation (m)
61	Nares River	600954134422900	09AA004	60° 09' 50.7"	134° 42' 26.0"	3,535	660
60	Atlin River	15304600	09AA007	59° 36' 01.6"	133° 48' 53.4"	6,812	664
62	Yukon River above Takhini River	605008135104100	09AB001	60° 50' 18.9"	135° 10' 55.3"	19,971	641
63	Takhini River	15305050	09AC001	60° 50' 26.0"	135° 11' 42.1"	6,993	636
65	Teslin River	613417134540000	09AF001	61° 34' 11.4"	134° 53' 60.0"	35,014	601
67	Big Salmon River	15305300	09AG001	61° 52' 57.8"	134° 54' 23.7"	6,760	575
69	Little Salmon River	620322135395300	NA	62° 03' 25.4"	135° 39' 55.9"	3,626	552
71	Yukon River at Carmacks	15305350	09AH001	62° 06' 40.9"	136° 16' 01.0"	81,843	532
72	Nordenskiold River	15305352	09AH004	62° 06' 12.6"	136° 18' 17.2"	6,371	530
73	Pelly River	15305420	09BC001	62° 49' 42.7"	136° 34' 11.3"	48,951	464
75	Yukon River above White River	15305450	09CD001	63° 08' 21.5"	139° 32' 20.6"	149,960	374
76	White River	631020139395400	NA	63° 10' 19.9"	139° 39' 56.1"	48,000	373
78	Stewart River	15305650	09DD033	63° 18' 13.4"	139° 19' 53.5"	51,023	362
80	Sixtymile River	633327139463400	09EB004	63° 33' 51.5"	139° 45' 48.1"	3,719	342
82	Klondike River above Bonanza Creek	15305698	09EA003	64° 02' 42.0"	139° 24' 08.5"	7,796	319
83	Klondike River below Bonanza Creek	640305139260900	NA	64° 03' 14.7"	139° 26' 27.4"	8,044	316
85	Fortymile River	15355000	09EC002	64° 25' 32.6"	140° 32' 31.1"	16,602	288
87	Yukon River at Eagle, Alaska	15356000	09ED001	64° 47' 22.3"	141° 11' 52.2"	293,963	258
	Main stem grab sites						
64	Yukon River below Takhini River	NA	NA	60° 51' 24.0"	135° 11' 10.5"	--	630
66	Yukon River below Teslin River	NA	NA	61° 38' 32.4"	134° 50' 25.5"	--	599
68	Yukon River below Big Salmon River	NA	NA	61° 54' 53.9"	134° 55' 57.6"	--	572
70	Yukon River below Little Salmon River	NA	NA	62° 01' 29.0"	135° 50' 50.3"	--	550
74	Yukon River below Pelly River	NA	NA	62° 49' 43.1"	138° 30' 44.9"	--	401
77	Yukon River below White River	NA	NA	63° 17' 10.4"	139° 26' 07.2"	--	365
79	Yukon River below Stewart River	NA	NA	63° 25' 45.3"	139° 37' 28.6"	--	354
81	Yukon River below Sixtymile River	NA	NA	63° 39' 36.6"	139° 45' 01.7"	--	344
84	Yukon River below Klondike River	NA	NA	64° 06' 53.7"	139° 28' 02.8"	--	317
86	Yukon River below Fortymile River	NA	NA	64° 31' 26.7"	140° 29' 04.8"	--	286

Purpose and Scope

This report summarizes water and sediment quality of the Yukon River and its tributaries in British Columbia and Yukon Territory, Canada, and Eagle, Alaska, USA. Environmental and flow characteristics also are described. The purpose of this summary is (1) to provide current information on the water quantity and water quality characteristics of the Yukon River and its major tributaries and (2) to provide baseline information needed for future studies in the Yukon River basin.

Acknowledgments

The USGS National Stream Quality Accounting Network (NASQAN) and the Central Region National Research Program would like to thank the USGS Alaska Science Center in Anchorage and the USGS Water Resource Office in Fairbanks Alaska. This work would not have been possible without their field expertise and continuous logistical support. Additional thanks go to Ank Webbers and Amy Dawson of the USGS, Boulder, Colorado for their geographic-information-systems contributions.
Thank you to Beverly McNaughton and Andrea Ryan of Environment Canada (EC), Vancouver, British Colombia, for their work in coordinating USGS and EC efforts, Bob Truelson of the Yukon Department of Environment, Whitehorse, Yukon Territory, and Blair Thorson, Scott Palfreyman, Wade Hanna, Patrick Maltais, and Brian Forsyth of Water Survey Canada (WSC), Whitehorse, Yukon Territory, for the use of their facilities and their field assistance.

Historical Background of Canadian Water Quantity and Quality Programs in the Yukon River Basin

A Brief History of Hydrometric Monitoring Stations in the Yukon River Basin

By Blair Thorson and Lynne Campo
Water Survey Canada, Whitehorse, Yukon Territory, Canada.

There have been 83 hydrometric monitoring stations operated within the Yukon River basin. The oldest hydrometric station is the Yukon River at Whitehorse, which has records going back to 1902. This site was operated for navigational purposes of the steamship traffic between Whitehorse and the Klondike gold fields. The Yukon and White Pass railway maintained these records from 1902 to 1940. In 1944, hydrometric stations were established on Teslin Lake at Teslin and the Teslin River near Teslin during the construction of the Alaskan highway and were maintained by the U.S. Public Roads Administration.

Between 1945 and 1950 hydrometric stations were established on the Yukon River at Dawson, the Mayo River near Mayo, the Takhini River near Whitehorse, the Stewart River at Mayo, and Bennet Lake near Carcross. In 1950, a road to Atlin Lake was completed and four southern lake hydrometric stations were established.

The 1950s saw the use of fixed wing aircraft for the construction and operation of hydrometric stations. Fixed wing aircraft enabled 25 stations to be added between 1951 and 1956. In the 1960s eight more hydrometric stations were added as the network expanded north. This expansion included two stations on the Porcupine River and two new stations on the Stewart River. The 1970s brought 13 more stations to the network and by 1995 there were 80 stations operating in the Yukon River Basin. Funding for WSC was cut in 1995 and of the 80 stations in operation in 1995, only 37 remained after this funding reduction.

Records for all hydrometric monitoring stations were originally processed and maintained at the regional level in Vancouver, British Columbia. Records presently are processed and maintained at the local level in Whitehorse, Yukon Territory. Today,

hydrometric information for any station in Canada can be accessed on the web at www.wsc.ec.gc.ca.

A Brief History of Environment Canada's Water-Quality Monitoring Program in the Yukon River Basin

By Andrea Ryan, Environment Canada, Vancouver, British Columbia, Canada

In the 1970s, an intergovernmental study was commissioned by the governments of Canada, the Yukon Territory, and British Columbia, in response to a surge of resource-development proposals in the Yukon. It was determined that there was insufficient information to assess the impacts of these potential developments on the resource base in the Territory. One key component–information on baseline water quality–was missing altogether. Little water-quality work had been carried out in the Yukon Territory between 1970 and 1980. Water-quality data during this early period were collected infrequently on a site-specific basis for assessment of environmental impacts and effectiveness of pollution control methods. The Yukon River Basin Study (1980-1984) focused on a number of areas, including water quality and hydrology. The study included the initiation of 21 monitoring stations that were operated for one year to provide a basin-wide assessment of water quality. Six key stations (three on the Yukon River, and one each on the Liard, Teslin, and Wheaton Rivers) continued after the Yukon River Basin Study was completed. This network formed the basis for a longer-term federal water-quality monitoring network in the Yukon, which was operated by Environment Canada in partnership with the Department of Indian Affairs and Northern Development (DIAND).

The ongoing stations in the territory were sampled routinely (monthly, every 2 weeks, or weekly) for a range of water-quality variables, and continued into the 1990s. In 1991, the Canadian federal government launched a 6-year program known as the Arctic Environmental Strategy (AES) to promote sustainable development in Canada's north. A key component of the strategy was water, which allowed for expansion of the existing monitoring network, in addition to other water-quality programs. Another component of AES, the Northern Contaminants Program, targeted concerns about human exposure to

elevated levels of contaminants in fish and wildlife. At the height of AES, a total of 38 routine water-quality monitoring stations were being jointly operated in the Yukon by Environment Canada and DIAND. Funding for the AES program ended in 1997 and this, coupled with the DIAND's desire to focus more on issue-related monitoring, led to the reduction of the federal network in the Yukon to four stations.

These four stations continued for the next decade, at which time a new Environment Canada initiative, the Canadian Environmental Sustainability Indicators initiative, was launched. Funding is being provided under this program to expand the water-quality monitoring network in Canada, particularly in areas that are underrepresented, like the Yukon Territory. Four new stations were added to the federal network in the Yukon in 2006. The addition of three more stations is anticipated in 2007, eventually bringing the total to11 stations. All of these new stations will be operated in partnership with the Yukon Territorial Government (Yukon Environment). Environment Canada and Yukon Environment are negotiating a joint Federal/Yukon Territory Water Quality Monitoring Agreement that would encompass all of these stations, provide some support for their continued operation into the future, and serve as a framework for potential growth of the Yukon monitoring network.

All of the current stations are sampled on a routine basis (in most cases monthly or every 2 weeks) for a range of water-quality variables, including trace metals, nutrients, major ions, and bacteriology. These data are used for a range of purposes, including reporting on status and trends in water quality, detecting emerging issues, formulating water-quality guidelines and objectives, and environmental impact assessments. Water-quality sampling also has been conducted on a more infrequent basis at these stations for mercury and trace organic compounds. All of the information on current and historic stations can be accessed at Environment Canada's Water Quality Website, at www.waterquality.ec.gc.ca. The data collected can be accessed and downloaded in several different formats, or viewed graphically on-line.

Site Descriptions and Hydrology

Sites for intensive sampling were initially determined by drainage-basin size. Other determining factors included heavily mined areas such as the Klondike River and the Fortymile River, possible large sources of dissolved and particulate carbon, glacial terrain drainage, subsistence use, and logistics.

All of the main-stem sites and 11 of the 13 sampled tributaries have or have had gaging stations. Many of the basins have or had mining for major metal commodities, with some coal, oil, and gas extraction. For an environmental and hydrologic overview of the Yukon basin, see Brabets and others (2000). Hydrologic information and site descriptions were compiled from U.S. Geological Survey (2006c), (stream discharge), Natural Resources Canada (2006), (permafrost, ecozones, soils, rock ages and categories, and surface materials), Yukon Environment (2005), (snow pack), Environment Canada (2006), (water quality), Water Survey Canada (2006), (stream discharge), and Oregon Climate Service (2006) (precipitation).

Nares River

Figure 3. Nares River.

The Nares River (fig. 3) connects Bennet Lake to Tagish Lake at Carcross, Yukon Territory. The two largest tributaries to Bennet Lake are the Watson and Wheaton rivers, both draining the Boundary Range. The Nares River basin is mostly snowmelt fed with some glacial input. Water Survey Canada has a lake elevation gage on Bennet Lake (fig 4), but does not have a stream gage on the Nares River. Environment Canada had a water-quality monitoring station on the Watson River from March 1993 to September 1996 and on the Wheaton River from May 1989 to September 1996. Discharge at the time of sampling was 96 m^3/s in June and 71 m^3/s in August.

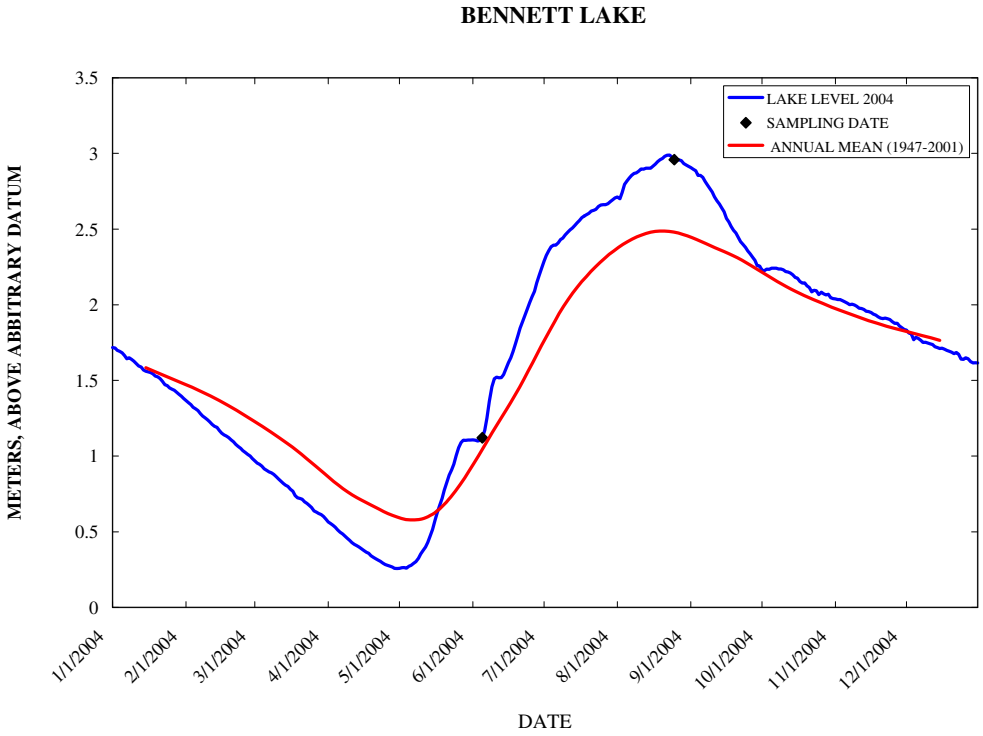

Figure 4. Bennett Lake water level and sampling dates.

Precipitation in the basin ranges from 250 mm in the valleys to 2,000 mm at the upper reaches in the Boundary Range. Snow pack in the basin in May 2004 was 111 to 130 percent of normal based on records for the period 1971 to 2000. Permafrost within the basin is sporadic-discontinuous (10-50 percent coverage) with low ice content. The basin lies within the Boreal Cordillera ecozone, which includes the Yukon Southern Lakes, Yukon Stikine Highlands, Boreal Mountains and Plateaus, and a small area in the Northern Coastal Mountains ecoregions. Rock ages in these ecoregions include Mesozoic-Cenozoic and Paleozoic. Major rock categories are intrusive with some sedimentary and volcanic. Surficial materials are alpine complexes with smaller areas of till blanket and till veneer. Soils are dominantly Eutric Brunisols.

Atlin River

Figure 5. Atlin River.

In this study, the Atlin River, (fig. 5) is considered the headwaters of the Yukon River. It is a short river of about 4 kilometers between Atlin Lake and Tagish Lake. The Atlin River drains the Boundary Range and is largely influenced by glacier melt from the Juneau Icefield.

WSC has operated a stream-gaging station near the outflow of Atlin Lake since 1950. Mean annual discharge for the period of record (1950-2001) is 95.7 m^3/s with recorded extremes of 310 m^3/s occurring on September 14, 1981 and 17.6 m^3/s on May 9, 1956. Discharge at the time of sampling was 65 m^3/s in June and 306 m^3/s in August (fig. 6).

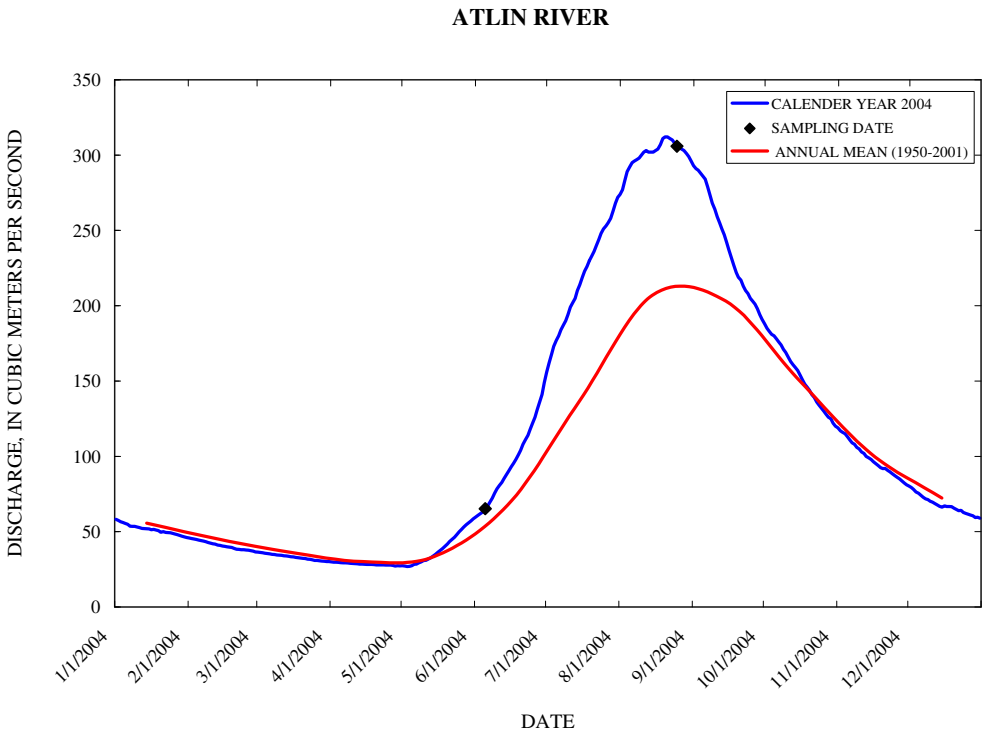

Figure 6. Hydrograph and sampling dates, Atlin River.

Precipitation in the basin ranges from 300 mm in the valleys to 7,000 mm on the Juneau Icefield. Snowpack in May 2004 was 91 to 110 percent of normal for the eastern side of the basin and 111 to 130 percent for the western side of the basin, based on records from 1971 to 2000. Permafrost within the basin is sporadic-discontinuous (10-50 percent coverage) with generally low ice content. The basin lies within the Boreal Cordillera ecozone that includes Boreal Mountains and Plateaus, Yukon Stikine Highlands, and Northern Coastal Mountains ecoregions. Rock ages in these ecoregions include Paleozoic-Mesozoic and Precambrian-Paleozoic with major rock categories of sedimentary, volcanic, and intrusive. Surficial materials include alpine complexes, till blankets, and till veneer. Soils are dominantly Eutric Brunisols.

Yukon River above Takhini River

Figure 7. Yukon River above Takhini River.

The Yukon River above the Takhini River sampling site (table 1, fig. 7) was chosen to incorporate the headwaters of the Yukon River, including the previously described Atlin and Nares River basins, and drains an area of about 20,000 km^2. The Yukon River at this site is glacially influenced, with the greatest flows usually occurring in August.

WSC has operated a stream-gaging station approximately 19 km upstream in Whitehorse since 1943 and EC has operated a water-quality monitoring station south of Whitehorse at Marsh Lake dam since 1980. Mean annual discharge in Whitehorse (1943-2001) is 242 m^3/s with extremes of 646 m^3/s on August 9, 1953 and 32.6 m^3/s on May 21, 1964. Discharge at the time of sampling was 264 m^3/s in June and 572 m^3/s in August (fig. 8).

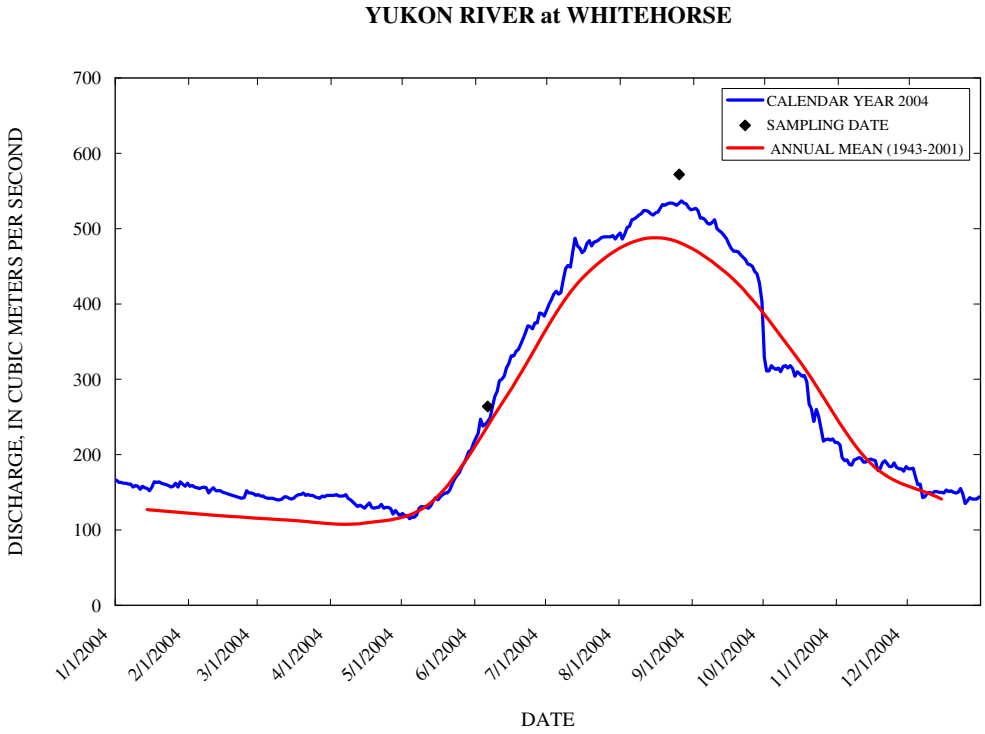

Figure 8. Hydrograph and sampling dates, Yukon River at Whitehorse, Yukon Territory.

Precipitation in the Yukon River headwaters basin ranges from 250 mm in the valleys to 7,000 mm on the Juneau Icefield. Snowpack in May 2004 was 91 to 110 percent for the southern parts of the basin and 111 to 130 percent for the Whitehorse area for the period of record from 1971 to 2000. Permafrost within the basin is sporadic-discontinuous (10-50 percent coverage). The basin is within the Boreal Cordillera ecozone and includes the Yukon Southern Lakes, Yukon Stikine Highlands, and the Boreal Mountains and Plateaus ecoregions. Basin characteristics for this site are a composite of those described for the Nares and Atlin basins.

Takhini River

Figure 9. Takhini River.

The Takhini River (fig. 9) originates in the Boundary Range and has a moderate glacial influence. The 6,993- km^2 basin includes the 75-km-long, glacier-fed Kusawa Lake. WSC has operated a stream-gaging station on the Takhini River since 1948. Mean annual discharge for the period of record (1948-2001) is 62.3 m^3/s with recorded extremes of 487 m^3/s on September 2, 1949 and 4.33 m^3/s on February 19, 1951. Discharge at the time of sampling was 91 m^3/s in June and 130 m^3/s in August (fig. 10). EC operated a water-quality monitoring station at this site from 1992 through 1996.

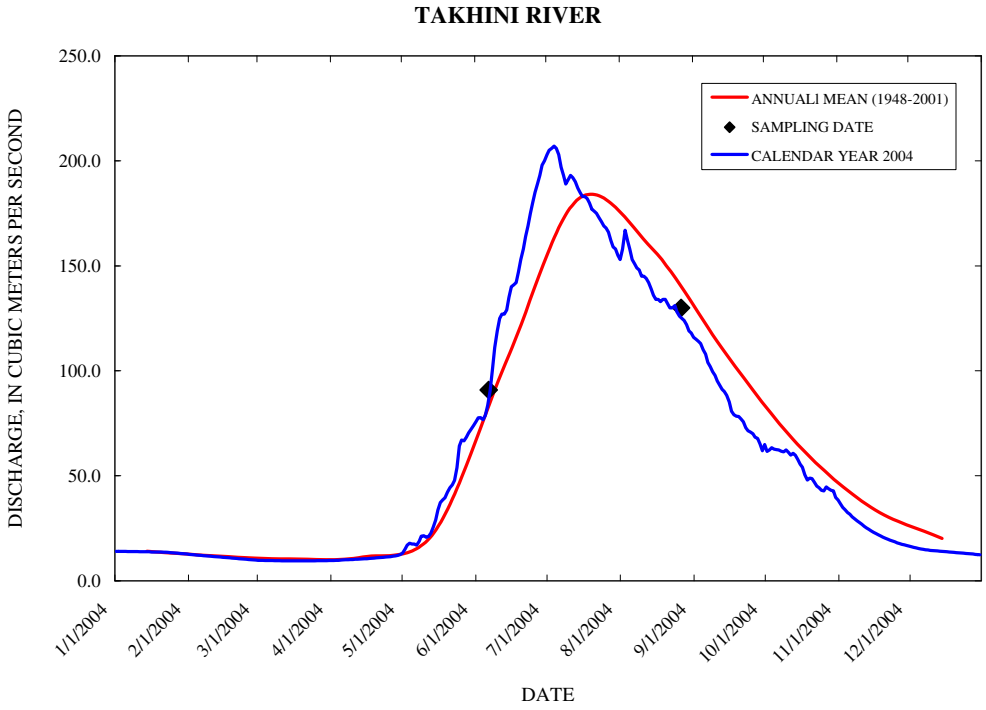

Figure 10. Hydrograph and sampling dates, Takhini River.

Precipitation within the basin ranges from 250 mm in the valleys to 2,000 mm along the Boundary Range. Snowpack in May 2004 was 111 to 131 percent of normal in the southern areas of the basin and 131 to 150 percent in the northern areas of the basin based on records from 1971 to 2000. Permafrost within the basin is sporadic-discontinuous (10-50 percent coverage) for most of the basin with a small area in the isolated patches (0-10 percent coverage) category. The basin lies within the Boreal Cordillera ecozone, which includes the Yukon Southern Lakes, Yukon Stikine Highlands, and a small area of the Northern Coastal Mountains ecoregions. Rock ages in the basin are largely Cenozoic with some in the Mesozoic. Major rock categories are intrusive and sedimentary-volcanic. Surficial material in the lower valleys is mostly fine-grained glaciolacustrine with other areas in the till blanket, till veneer, and alpine complex categories. Soils are primarily Eutric Brunisols with some Podzolic and scattered Cryosolic great groups.

Teslin River

Figure 11. Teslin River.

The Teslin River (fig. 11) originates in the Cassiar and Big Salmon Mountains and is influenced primarily by snowmelt. The 35,014 km^2 basin includes the 120-km-long Teslin Lake.

WSC operated a stream-gaging station near the confluence of the Teslin River with the Yukon River from 1956 to 1973. EC sampled near the confluence October 28, 1992 and operated a water-quality monitoring site at Johnson's Crossing from 1982 to 1994. Mean annual discharge for the period of record (1955-1973) is 331 m^3/s with recorded extremes of 1,860 m^3/s on June 8, 1962 and 50.5 m^3/s on March 1, 1972. Discharge at the time of sampling was 1,073 m^3/s in June and 252 m^3/s in August (fig.12).

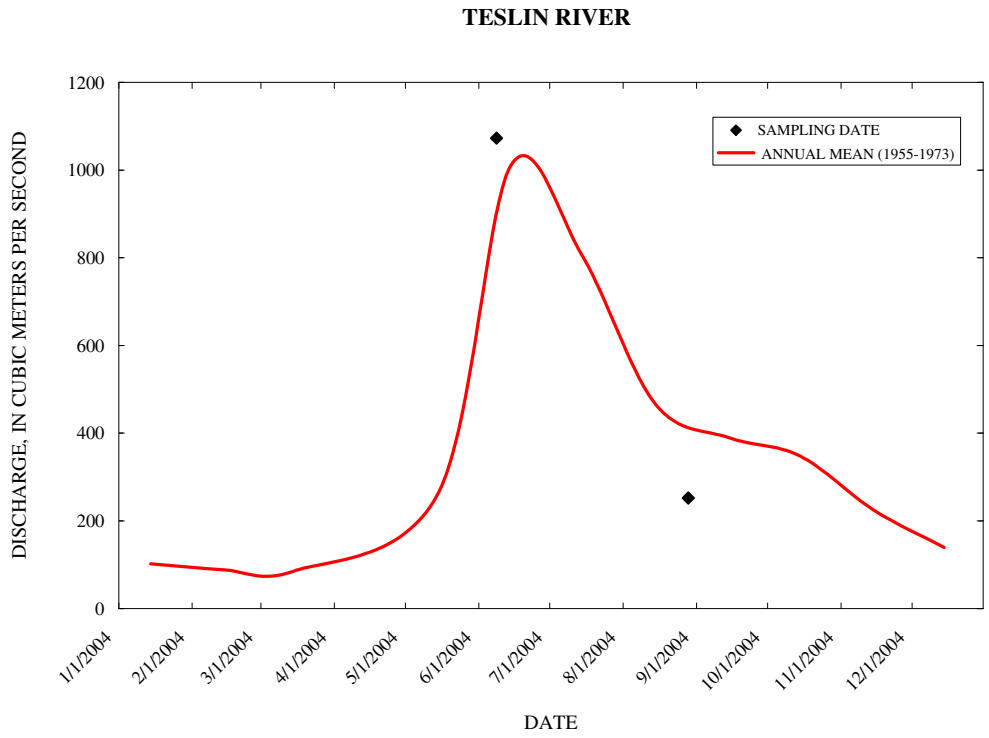

Figure 12. Hydrograph and sampling dates, Teslin River.

Precipitation within the basin ranges from 250 mm in the valleys to 1,200 mm in the Cassiar Mountains. Snowpack in the basin in May 2004 was 91 to 110 percent of normal in the south to 131 to 150 percent of normal in the north, based on records from 1971 to 2000. Permafrost within the basin is sporadic-discontinuous (10-50 percent coverage) with low ice content.

The basin lies within the Boreal Cordillera ecozone, which includes the Southern Yukon Lakes, Pelly Mountains, and the Boreal Mountains and Plateaus ecoregions. Rock ages include Mesozoic-Cenozoic, Paleozoic-Mesozoic, Paleozoic, and some Precambrian-Mesozoic ages. Major rock categories are sedimentary, sedimentary and volcanic, and small areas of intrusive. Surficial materials are mostly till veneers and till blankets with less coverage of coarse-grained glaciolacustrine and glaciofluvial complexes. Soils in the basin are predominantly Dystric and Eutric Brunisols with scattered Turbic Cryosolic.

Big Salmon River

Figure 13. Big Salmon River.

The Big Salmon River (fig. 13) originates in the Big Salmon Range and drains parts of the Pelly Mountains. The 6,760-km^2 basin is snowmelt dominated. WSC operated a stream gage near the confluence with the Yukon River from 1953 to 1996. Mean annual discharge for this period of record is 67.6 m^3/s with recorded extremes of 685 m^3/s on June 23, 1965 and 11.0 m^3/s on April 2, 1972. Discharge at time of sampling was 524 m^3/s in June and 58 m^3/s in August (fig. 14).

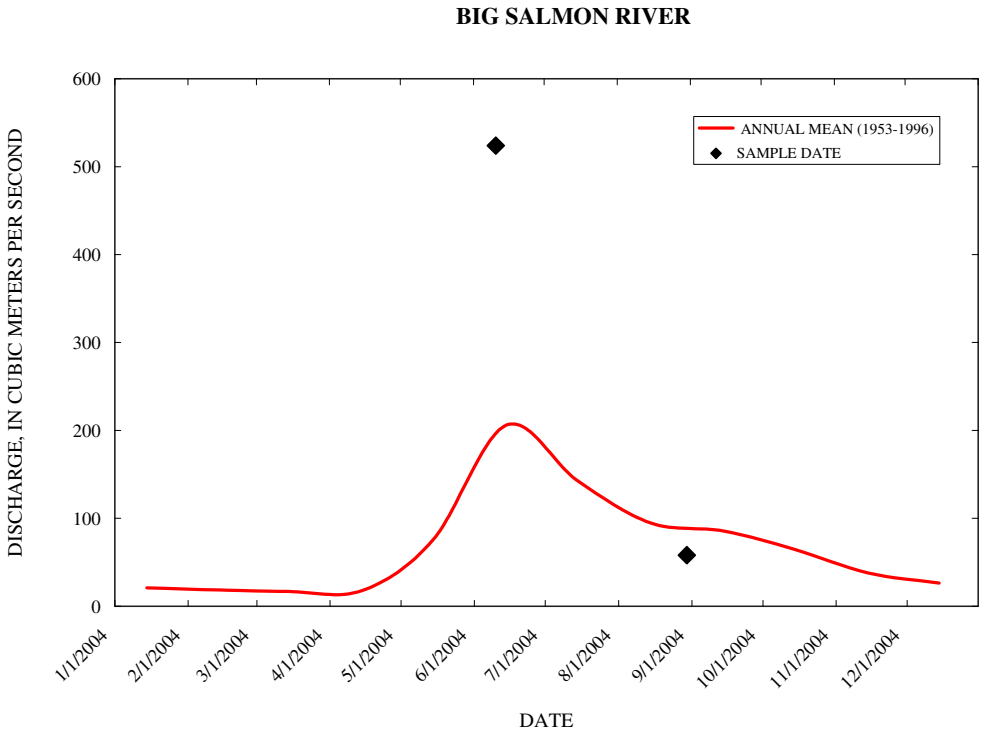

Figure 14. Hydrograph and sampling dates, Big Salmon River.

Precipitation within the basin ranges from 250 mm in the valleys to 800 mm along the Big Salmon Range. Snowpack in May 2004 ranged from 131 to 150 percent of normal based on records from 1971 to 2000. Permafrost within the basin is sporadic-discontinuous (10-50 percent coverage) with high ice content associated with fine-textured valley deposits.

The basin lies within the Boreal Cordillera ecozone and includes the Pelly Mountains and the Yukon Plateau Central ecoregions. Rock ages in the basin are predominantly Mesozoic and Paleozoic with rock categories of sedimentary, volcanic, and intrusive. Surficial materials are till blanket, glaciofluvial complex, and alpine complex. Dystric and Eutric Brunisols are co-dominant in the basin with Turbic Cryosolic soils in the alpine areas.

Little Salmon River

Figure 15. Little Salmon River.

The Little Salmon River (fig. 15) drains the Pelly Mountains and is a snowmelt-dominated basin of about 3,626 km^2. There are no present or historic stream-gage records. Discharge at time of sampling was 86 m^3/s in June and 15 m^3/s in August.

Precipitation within the basin ranges from 250 mm in the valleys to 800 mm in the Pelly Mountains. Snowpack in May 2004 was 131 to 150 percent of normal based on records from 1971 to 2000. Permafrost within the basin is sporadic discontinuous (10-50 percent coverage) with generally low ice content except for high ice content in the fine-textured valley deposits.

Little Salmon River lies within the Boreal Cordillera ecozone and includes the Yukon Plateau-Central and Pelly Mountains ecoregions. The basin is composed of Mesozoic and Paleozoic strata with rock categories of sedimentary and volcanic. Surficial material is predominantly till blanket and veneer with some alpine complexes. Soil great groups are predominantly Dystric and Eutric Brunisols with some Turbic Cryosolic soils.

Yukon River at Carmacks, Yukon Territory

Figure 16. Yukon River at Carmacks, Yukon Territory.

The Yukon River at Carmacks, YT. (table 1, fig. 16) sampling site was chosen because it is a historic WSC stream-gaging station and EC water-quality monitoring site. WSC operated a stream gage at this site from1951 to 1995. EC sampled at this site from 1980 to 1996. Mean annual discharge for the period of record (1951-1995) is 756 m^3/s. Extremes recorded over this period were 2,890 m^3/s on June 23, 1964 and June 23, 1992 and 136 m^3/s on March 15, 1952. Discharge at the time of sampling was 1,993 m^3/s in June and 1,022 m^3/s in August (fig. 17). Basin characteristics for this site are a composite of the previously discussed basins.

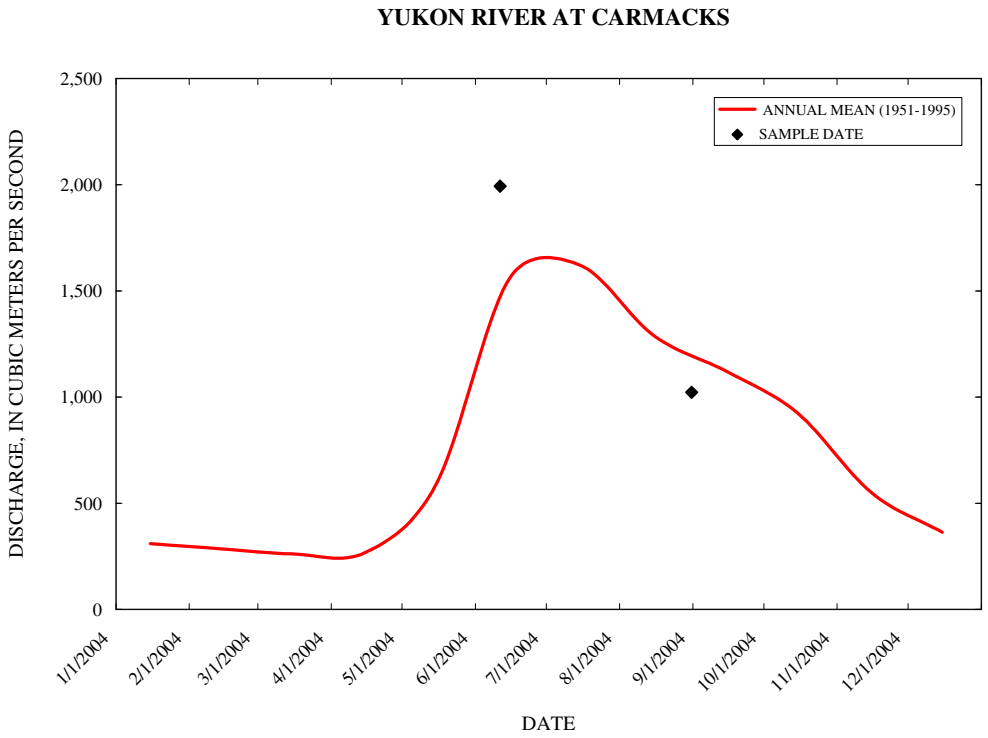

Figure 17. Hydrograph and sampling dates, Yukon River at Carmacks, Yukon Territory.

Nordenskiold River

Figure 18. Nordenskiold River.

The Nordenskiold River (table 1, fig 18) is a snowmelt-dominated river with a basin area of about 6,371 km^2. The river drains the Sifton range and parts of the Miners range. WSC has operated a stream gage, approximately 8 km upstream from sampling site 72 at the confluence with the Yukon River since 1982. Mean annual discharge for the period of record (1982-2001) is 15.4 m^3/s. Extremes for this period of record are 98 m^3/s on May 27, 1985 and 1.19 m^3/s on January 16, 1999. Discharge at time of sampling was 36 m^3/s in June and 7 m^3/s in August (fig. 19).

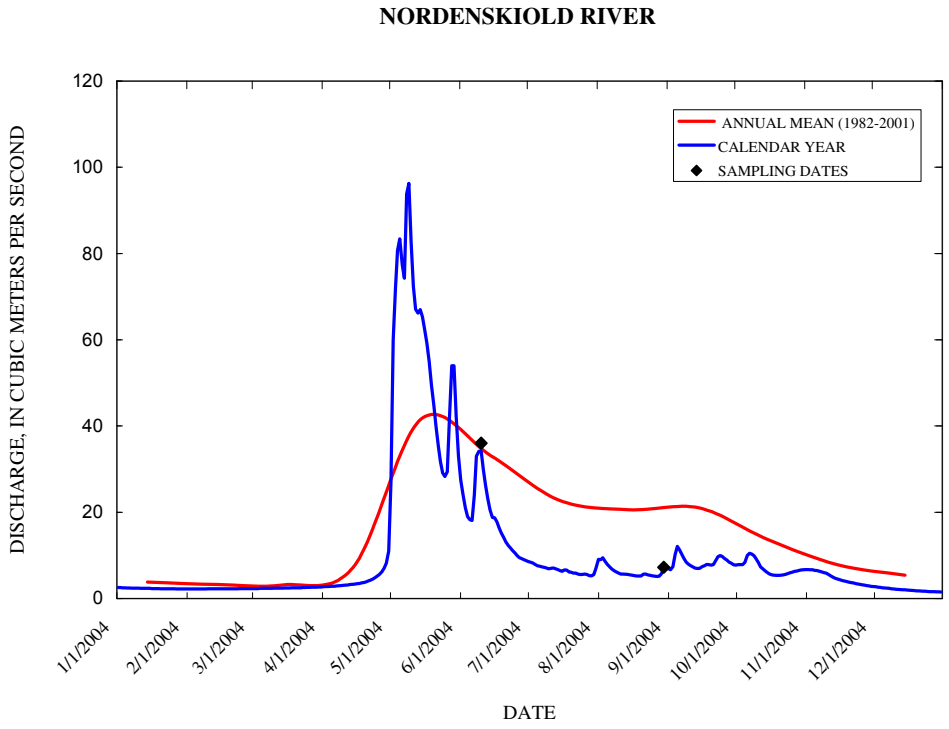

Figure 19. Hydrograph and sampling dates, Nordenskiold River.

Precipitation within the basin ranges from 250 mm in the valleys to 500 mm along the Miners Range. Snow pack in May 2004 was 131 to 150 percent of normal based on records from 1971 to 2000. Permafrost within the basin is sporadic-discontinuous (10 to 50 percent coverage) in the southern part of the basin and extensive-discontinuous (50 to 90 percent coverage) for the rest of the basin. Permafrost ice content is generally low except in fine-textured valley deposits where it is high.

The basin lies within the Boreal Cordillera ecozone and includes the Yukon Plateau Central and the Yukon Southern Lakes ecoregions. Rock ages are Mesozoic and Paleozoic with rock categories of mostly volcanic and intrusive. Soils are Eutric Brunisols, and some Turbic Cryosols.

Pelly River

Figure 20. Pelly River.

The Pelly River (fig. 20) is one of the larger river basins sampled (48,951 km^2), is snowmelt fed, and drains the Pelly and Selwyn Mountains. EC operated a water-quality monitoring station at Pelly Crossing from August 1992 to September 1996. WSC has operated a stream gage at Pelly Crossing since 1951. Mean annual discharge for the period of record (1951-2001) is 391 m^3/s. Extremes for the period of record are 4,160 m^3/s on June 11, 1964 and 28.0 m^3/s on February 26, 1982. Discharge at the time of sampling was 1,829 m^3/s in June and 199 m^3/s in September (fig. 21).

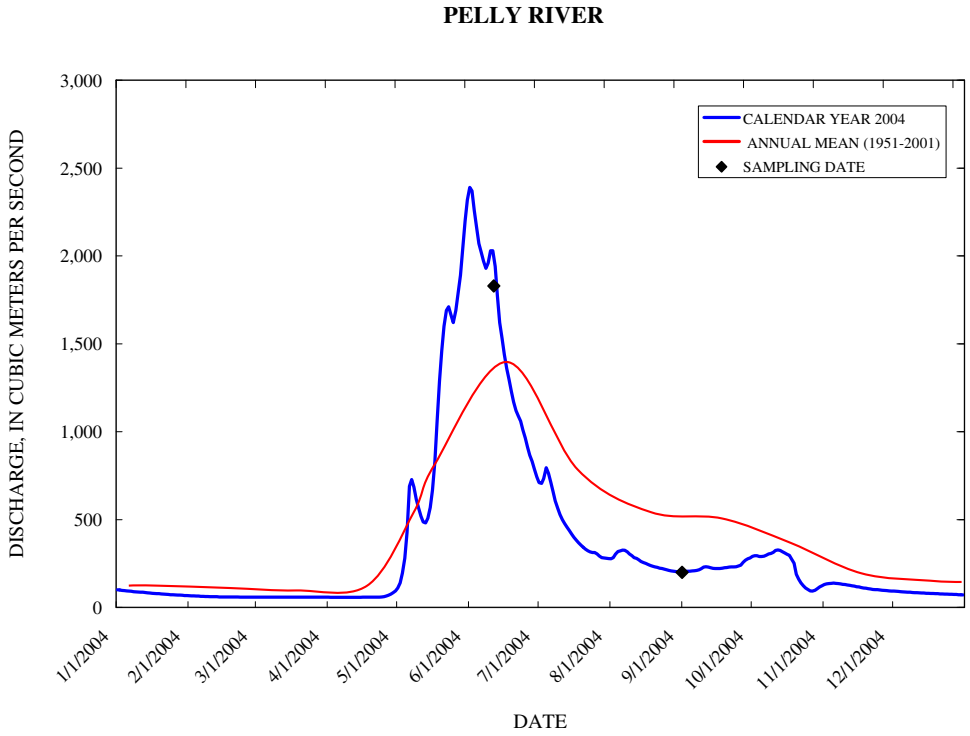

Figure 21. Hydrograph and sampling dates, Pelly River.

Precipitation in the basin ranges from 250 mm in the valleys to 1,200 mm in the Pelly and Selwyn Mountains. Snowpack in May 2004 was mostly in the 131 to 150 percent range with some of the upper reaches in the 111 to 130 percent range. Permafrost within the basin is mostly extensive-discontinuous (50 to 90 percent coverage) with some of the basin in sporadic-discontinuous (10 to 50 percent coverage).

The basin lies largely within the Boreal Cordillera ecozone with the upper reaches in the Taiga Cordillera. Ecoregions include Yukon Plateau Central, Yukon Plateau North, and Selwyn Mountains. Rock ages are Mesozoic and Paleozoic. Rock categories include sedimentary and volcanic with some intrusive. Surficial materials are till blankets and veneers, alluvial deposits, and alpine complexes. Dystric and Eutric Brunisols are dominant in the basin with Static and Turbic Cryosols on upper elevations.

Yukon River above White River

Figure 22. Yukon River above White River.

The Yukon River above White River (fig. 22) was chosen as a main stem sampling site because of the WSC stream-gaging station established in 1956. This site has been sampled once by EC on February 15, 1993. This site also was chosen, as it is just upstream from the White River, which is a large, sediment-laden river that has a noticeable sediment influence on the Yukon River below the confluence. Mean annual discharge for the period of record (1956-2001) is 1,190 m^3/s. Extremes recorded were 5,560 m^3/s on June 22, 1992 and 227 m^3/s on March 29, 1959. Discharge at the time of sampling was 3,823 m^3/s in June and 1,257 m^3/s in September (fig. 23). Basin characteristics for this site are a composite of the previously discussed basins.

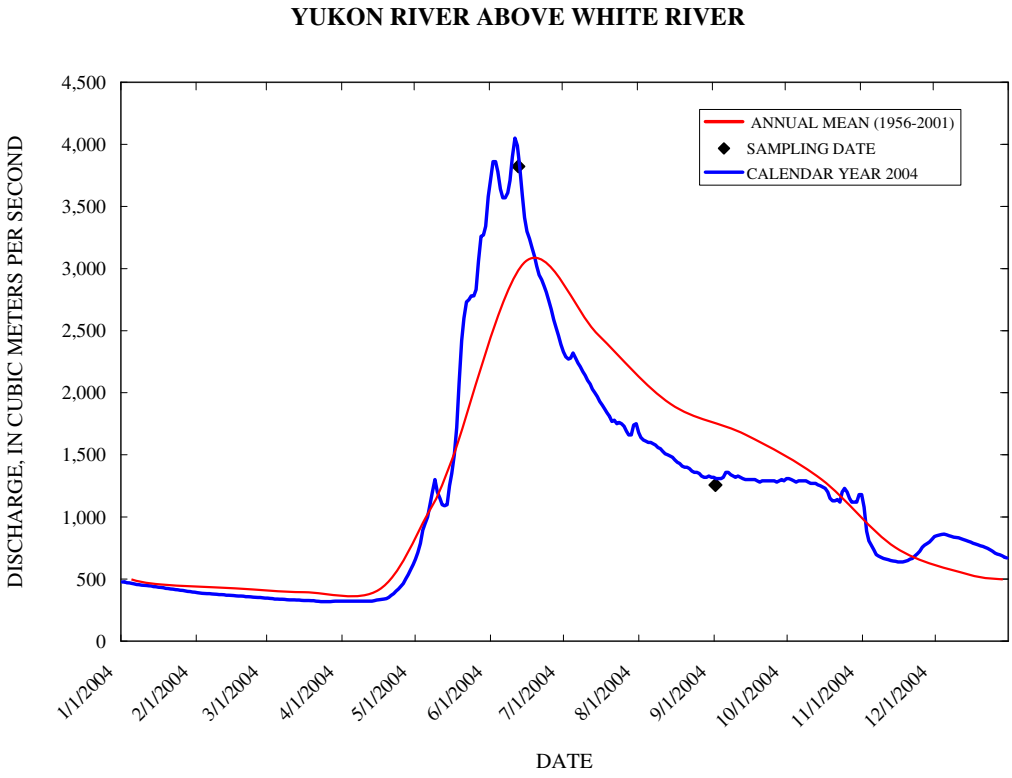

Figure 23. Hydrograph and sampling dates, Yukon River above White River.

White River

Figure 24. White River.

The White River (fig. 24) is a large glacier-fed river with a basin area of approximately 48,000 km^2. The White River originates in the Wrangell-St Elias Mountains and drains an area with icefields and many large valley glaciers. As a result, the White River has the highest median suspended-sediment concentrations of any of the Yukon River tributaries. WSC has operated a stream gage near its headwaters at the Alaska Highway since 1973. Discharge at the time of sampling was 971m^3/s in June and 742 m^3/s in September.

Precipitation in the basin ranges from 250 mm in the lower valleys to 12,000 mm on the icefields of the Wrangell-St Elias Mountains. Snowpack in May 2004 was 111 to 130 percent of normal for the northern half of the basin and 131 to 150 percent of normal for the southern half of the basin based on records from 1971 to 2000. Permafrost within the basin is mostly extensive-discontinuous (50 to 90 percent coverage) in the north and mountains and sporadic-discontinuous (10 to 50 percent coverage) in the south.

The basin lies mostly in the Boreal Cordillera ecozone with a small portion in the Pacific Maritime ecozone. These ecozones include the Klondike Plateau, St Elias Mountains, and the Ruby Ranges ecoregions. Rock ages are Mesozoic, Paleozoic, and Precambrian. Rock categories include volcanic, intrusive, sedimentary, and metamorphic. Surficial materials are icefields and valley glaciers, glaciofluvial plains, alpine complexes, and alluvial deposits. Soils are dominantly Eutric Brunisols with Turbic Cryosols associated with permafrost.

Stewart River

Figure 25. Stewart River.

The Stewart River (fig. 25) is a snowmelt-fed river originating in the Selwyn Mountains. Draining an area of 51,023 km^2, the Stewart River is the largest tributary of the Yukon River in the Yukon Territory. WSC has operated a stream gage just above the confluence with the Yukon River since 1963. Mean annual discharge for the period of record (1963-2001) is 468 m^3/s with extremes of 5,640 m^3/s on June 13, 1964 and 35.4 m^3/s on March 12, 1974. Discharge at the time of sampling was 1,580 m^3/s in June and 224 m^3/s in September (fig. 26). EC operated a water-quality monitoring station upstream at Stewart Crossing from August 1992 to September 1996.

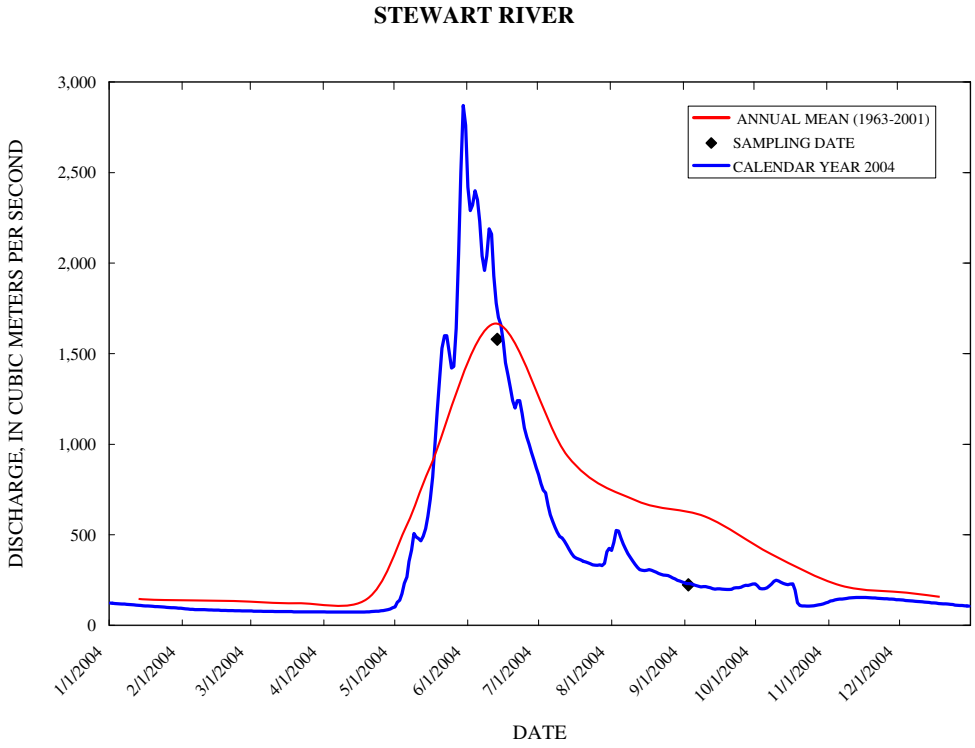

Figure 26. Hydrograph and sampling dates, Stewart River.

Precipitation for the basin ranges from 250 mm in the valleys to 1,200 mm over the higher elevations. Snowpack in May 2004 was 131 to 150 percent of normal for the western portions of the basin and 111 to 130 percent of normal in the east, based on records from 1971 to 2000. Permafrost with in the basin is mostly extensive-discontinuous (50 to 90 percent coverage) with low to moderate ice content.

The basin lies within the Boreal Cordillera ecozone, with the eastern parts of the basin in the Taiga Cordillera ecozone. Ecoregions include the Klondike Plateau, Yukon Plateau Central, and the Yukon Plateau North. Rock ages are Mesozoic, Paleozoic, and Precambrian. Rock categories are mostly sedimentary and intrusive. Surficial materials include till blankets and veneers, alluvial deposits, alpine complexes, and glaciofluvial plains. Eutric Brunisols, Turbic Cryosols, and pockets of Dystric Brunisols make up the soil great groups.

Sixtymile River

Figure 27. Sixtymile River.

The Sixtymile River (fig. 27) flows through an area of historic and active mining and is one of the smaller basins sampled (3,719 km^2). The river is snowmelt-fed from low mountains of the Klondike Plateau. WSC has operated a stream gage at this site since January 1996. Mean annual discharge for the period of record (1996-2004) is 15.2 m^3/s. Extremes in discharge since 1996 are 386 m^3/s on June 10, 1997 and 0.025 m^3/s on December 17, 1996. Discharge at the time of sampling was 22 m^3/s in June and 12 m^3/s in September (fig. 28).

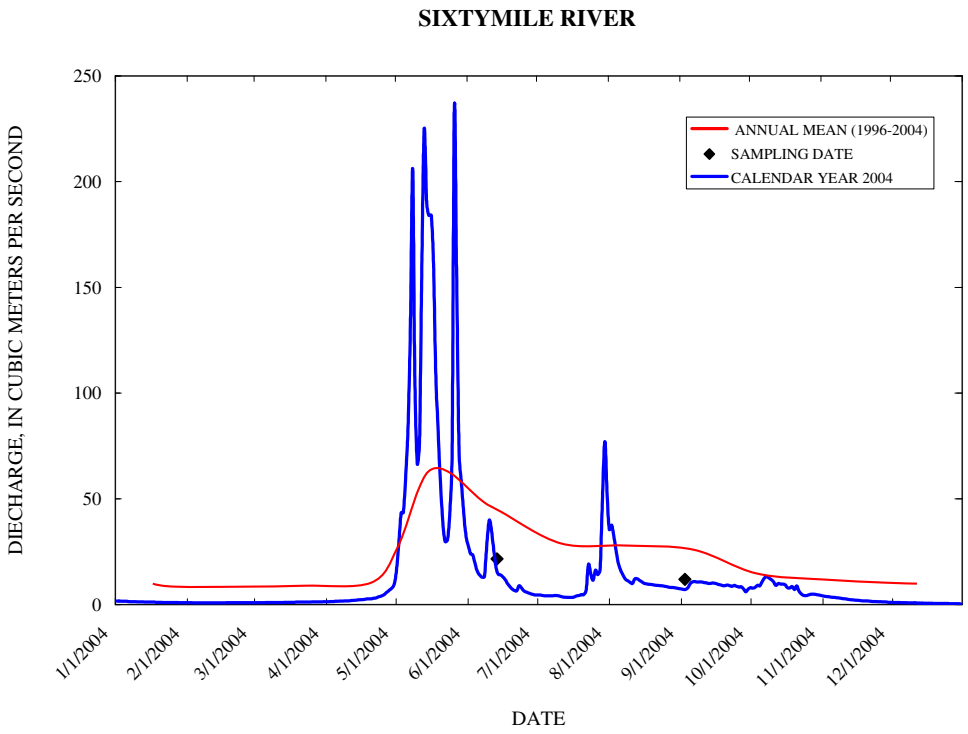

Figure 28. Hydrograph and sampling dates, Sixtymile River.

Precipitation in the basin ranges from 250 mm in the valleys to 600 mm in the mountains. Snowpack in May 2004 was 111 to 130 percent of normal based on records from 1971 to 2000. Permafrost within the basin is extensive-discontinuous (50 to 90 percent coverage) with moderate ice content.

The basin lies within the Boreal Cordillera ecozone and is in the Klondike Plateau ecoregion. Rock ages are predominantly Mesozoic and Paleozoic with some Cenozoic. Rock categories of the basin include sedimentary, volcanic, and intrusive. Surficial materials are mostly colluvial blocks and colluvial rubble with a small percentage of alpine complex. Turbic Cryosols and Eutric Brunisols are the major soil great groups with some Regosols on sandy floodplains.

Klondike River

Figure 29. Klondike River.

The Klondike River (fig. 29) is snowmelt-fed and drains the Ogilvie Mountains. The 8,044-km^2 basin has been extensively mined for gold since 1899. WSC has operated a stream gage on the Klondike River since 1965. Mean annual discharge for the period of record (1965-2000) is 63.9 m^3/s. Extremes in discharge for the period of record are 679 m^3/s on May 31, 1998 and 4.48 m^3/s on April 5, 1997. Discharge at the time of sampling was 188 m^3/s in June and 40 m^3/s in September (fig. 30). EC has had an active water-quality monitoring site near the confluence with the Yukon River since May 1993. Two sampling sites were chosen for the 2004 study (table 1): one above Bonanza Creek at the streamflow gage and one below Bonanza Creek to include this heavily mined basin.

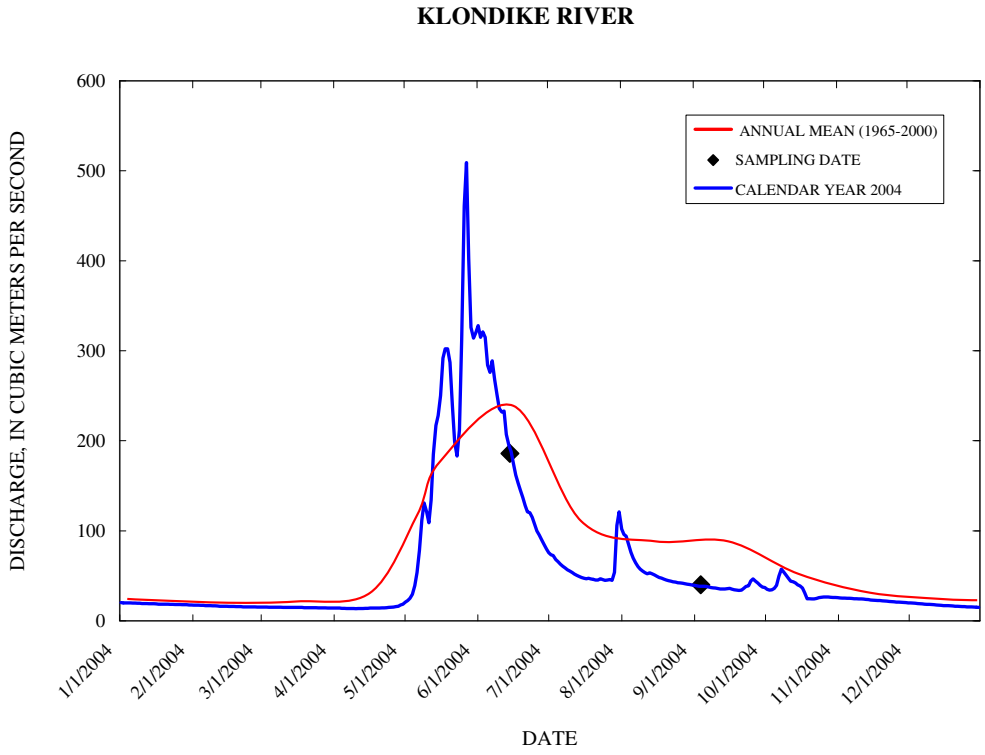

Figure 30. Hydrograph and sampling dates, Klondike River.

Precipitation in the basin ranges from 250 mm in the valleys to 800 mm in the mountains. Snowpack in May 2004 was 131 to150 percent of normal for most of the basin with a small area in the 111 to 130 percent of normal based on records from 1971 to 2000. Permafrost within the basin is extensive-discontinuous (50 to 90 percent coverage) with medium ice content.

The basin lies mostly within the Boreal Cordillera ecozone with the northern reaches in the Taiga Cordillera ecozone and includes the Klondike Plateau, Yukon Plateau-North, and the Mackenzie Mountains ecoregions. Rock ages are predominantly Cenozoic, Paleozoic, and Precambrian, and include sedimentary and intrusive rock categories. Surficial materials include colluvial blocks and rubble, till blankets, alluvial deposits, and some alpine complexes. Turbic Cryosols and Eutric Brunisols are the major soil great groups.

Fortymile River

Figure 31. Fortymile River.

The Fortymile River (fig. 31) drains a 16,602-km^2 basin and has been extensively mined. The Fortymile River is a snowmelt-fed river that has most of its drainage area in Alaska, USA, and drains the Glacier Mountains. WSC operated a stream gage near the confluence with the Yukon River from 1982 to 1996. The U.S. Geological Survey has discontinuous discharge records upstream from the US-Canadian border dating back to 1911 and water-quality data dating back to 1953 (U.S. Geological Survey 2006c). Mean annual streamflow from WSC's records is 75.6 m^3/s with streamflow extremes of 1,900 m^3/s on May 18, 1988 and 0.005 m^3/s on March 16, 1996. Discharge at the time of sampling was 99 m^3/s in June and 65 m^3/s in September (fig. 32).

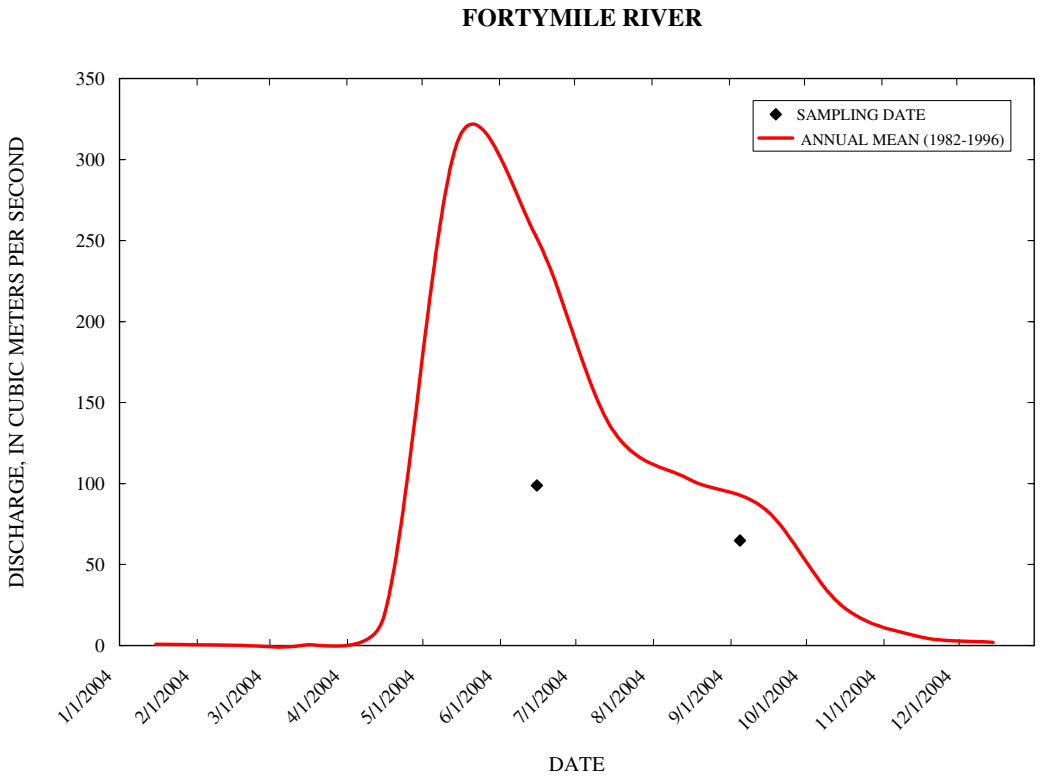

Figure 32. Hydrograph and sampling dates, Fortymile River.

Precipitation ranges from 250 mm to 800 mm. Snowpack in May 2004 was 111 to 130 percent of normal based on records from 1971 to 2000. Permafrost within the basin is extensive-discontinuous (50 – 90 percent coverage) with moderate ice content.

The basin lies within the Boreal Cordillera ecozone and is in the Klondike Plateau ecoregion. Rock ages are Mesozoic and Paleozoic with rock categories of mostly sedimentary and intrusive. Surface materials are predominantly colluvial blocks and rubble with some alpine complexes. Soils are Eutric Brunisols and Turbic Cryosols.

Yukon River at Eagle, Alaska, USA

Figure 33. Yukon River at Eagle, Alaska, USA.

The Yukon River at Eagle, Alaska, (fig. 33) is one of the fixed-site sampling stations of the USGS NASQANs 5-year study. The basin at this point encompasses approximately 294,000 km^2. The USGS has operated a stream gage at this site since 1950, and has water-quality data dating back to the same time period (U.S. Geological Survey 2006c). Mean annual streamflow (1950-2004) is approximately 2,400 m^3/s. A peak discharge of 14,923 m^3/s was recorded on May 30, 1957, and minimum discharge of approximately 198 m^3/s typically occurs in February or March. Discharge at the time of sampling was 5,804 m^3/s in June and 2,393 m^3/s in September (fig. 34).

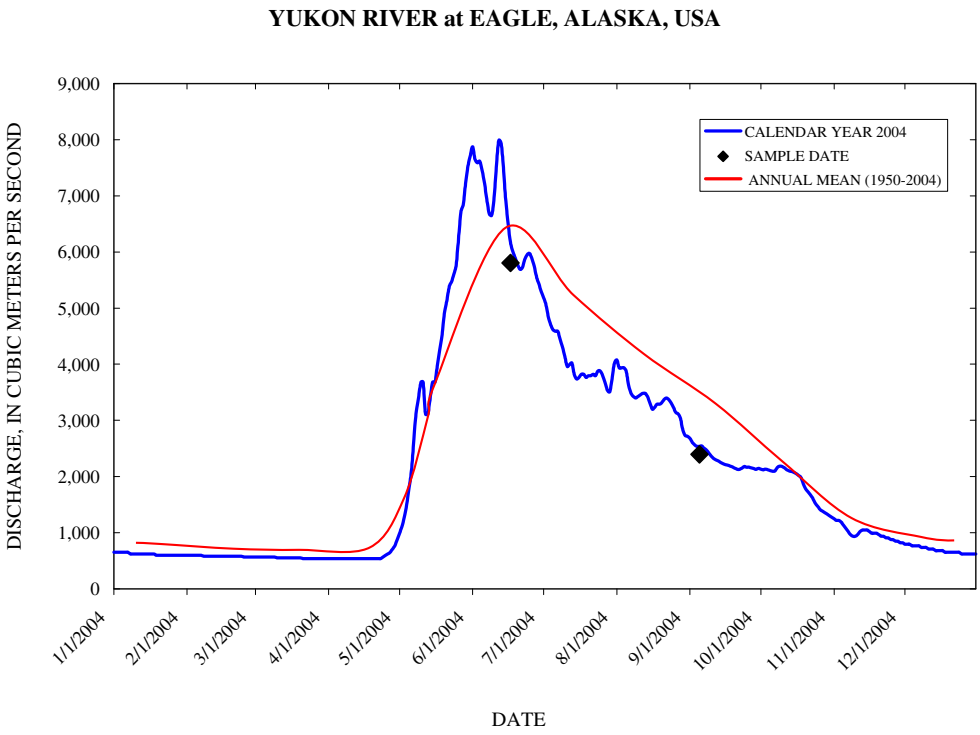

Figure 34. Hydrograph and sampling dates, Yukon River at Eagle, Alaska, USA.

Methods

Sample Collection and Processing

For a detailed description of sample collection and processing, see Schuster (2003). Standard USGS protocols, described by Edwards and Glysson (1988), were used for the collection of Equal Discharge Increment (EDI) samples at all major sites. A minimum of two-person field teams collected samples to reduce the chance of contamination of low-concentration analytes, following the protocols of Horowitz and others (2001). Samples were processed according to established USGS protocols (U. S Geological Survey, 1997-99). In addition to the main-stem sites chosen for full sampling, 10 main-stem sites were chosen for quick centroid surface grab samples (table 1). These sites were located below the confluence of tributaries with the Yukon River. Grab samples were analyzed for major ions, dissolved organic carbon (DOC), ultraviolet (UV) absorbance, and dissolved carbon gases.

Laboratory Analyses

For a complete description of laboratory analyses, see Schuster (2003). Major anions and cations, dissolved organic carbon, ultraviolet absorbance, specific ultraviolet absorbance (SUVA), dissolved organic carbon fractionation, dissolved carbon gases , nitrite, ammonium, phosphate and sediment mineralogy were analyzed at the USGS laboratories in Boulder, Colorado. Particulate carbon and particulate nitrogen were analyzed at the Chesapeake Bay Laboratories in Solomons, Maryland. Mercury was analyzed at the USGS Mercury Research Lab, Middleton, Wisconsin. The Cascades Volcano Observatory in Vancouver, Washington, analyzed total suspended-sediment concentrations and the percent fines (<0.063mm). Total suspended-sediment concentrations, as well as suspended-sediment chemistry, were analyzed at the USGS laboratories in Atlanta, Georgia. Tritium was analyzed at the USGS laboratories in Menlo Park, California. Deuterium and ^{18}O, as well as uranium isotopes, were analyzed at the USGS laboratories in Reston, Virginia. ^{13}C-DIC was analyzed at Florida State University, Tallahassee, Florida. Chlorophyll *a*, total dissolved nitrogen, total dissolved phosphorus, soluble reactive phosphorus, and particulate phosphorus were analyzed at the

University of Minnesota, Minneapolis. Isotopic composition of organic and inorganic carbon was analyzed at Yale University, New Haven, Connecticut. Data obtained from laboratory analysis are presented in tables 2 through 30.

Water and Sediment Quality and Water Discharge

Water Discharge and Field Water Quality

Discharge was measured by using an acoustic Doppler current profiler (ADCP) (Oberg and others, 2005). In streams too small to use the ADCP, a wading discharge measurement was conducted (Rantz and others, 1982). Water temperature, pH, dissolved oxygen, and specific conductance were measured at the sampling sites approximately 30 cm below the water surface by using a calibrated Hydrolab™ Minisonde water-quality multi-probe. Field alkalinity was determined by incremental titration (U. S. Geological Survey 1997-99).

Table 2. Water discharge and field water quality of water samples from the Yukon River and tributaries, June 2004.

[°C, degrees Celsius; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter; m^3/s, cubic meters per second; --, not available; $CaCO_3$, calcium carbonate]

Site	Date	Discharge (m^3/s)	Water temperature (°C)	pH	Dissolved oxygen (mg/L)	Specific conductance (µS/cm)	Alkalinity (mg/L as $CaCO_3$)
Nares River	6/5/2004	96	5.7	7.2	12.0	39	29
Atlin River	6/6/2004	65	4.7	7.7	12.2	99	41
Yukon River above Takhini River	6/7/2004	264	13.0	7.8	10.1	96	41
Takhini River	6/7/2004	91	12.5	7.7	10.0	59	24
Yukon River below Takhini River	6/7/2004	--	--	--	--	--	--
Teslin River	6/9/2004	1,073	9.0	7.7	10.8	139	65
Yukon River below Teslin River	6/9/2004	--	--	--	--	--	--
Big Salmon River	6/10/2004	524	6.6	7.7	11.5	89	39
Yukon River below Big Salmon River	6/10/2004	--	--	--	--	--	--
Little Salmon River	6/10/2004	86	8.6	7.9	10.8	242	101
Yukon River below Little Salmon River	6/10/2004	--	--	--	--	--	--
Yukon River at Carmacks	6/11/2004	1,993	9.8	7.8	11.0	128	55
Nordenskiold River	6/11/2004	36	10.5	7.8	10.7	165	77
Pelly River	6/12/2004	1,829	11.8	7.7	10.2	187	57
Yukon River below Pelly River	6/12/2004	--	--	--	--	--	--
Yukon River above White River	6/13/2004	3,823	12.2	8.0	10.1	149	59
White River	6/13/2004	971	13.3	8.1	10.3	222	87
Yukon River below White River	6/14/2004	--	--	--	--	--	--
Stewart River	6/14/2004	1,580	12.4	7.9	9.6	234	65
Yukon River below Stewart River	6/14/2004	--	--	--	--	--	--
Sixtymile River	6/14/2004	22	14.0	7.6	10.5	202	57
Yukon River below Sixtymile River	6/14/2004	--	--	--	--	--	--
Klondike River above Bonanza Creek	6/15/2004	188	9.0	7.6	--	198	59
Klondike River below Bonanza Creek	6/15/2004	186	9.6	7.6	12.3	199	59
Yukon River below Klondike River	6/16/2004	--	--	--	--	--	--
Fortymile River	6/16/2004	99	15.0	7.5	9.7	134	38
Yukon River below Fortymile River	6/16/2004	--	--	--	--	--	--
Yukon River at Eagle, Alaska	6/17/2004	5,805	15.0	8.0	10.1	205	67

Table 3. Water discharge and field water quality of water samples from the Yukon River and tributaries, August/September 2004.

[°C, degrees Celsius; mg/L, milligrams per liter; µS/cm, microsiemens per centimeter; m^3/s, cubic meters per second; --, not available; $CaCO_3$, calcium carbonate]

Site	Date	Discharge (m^3/s)	Water temperature (°C)	pH	Dissolved oxygen (mg/L)	Specific conductance (µS/cm)	Alkalinity (mg/L as $CaCO_3$)
Nares River	8/25/2004	71	13.0	7.7	9.7	63	--
Atlin River	8/26/2004	306	14.1	7.8	10.0	100	34
Yukon River above Takhini River	8/27/2004	572	15.4	7.8	9.8	65	30
Takhini River	8/27/2004	130	13.2	7.4	9.4	32	15
Yukon River below Takhini River	8/27/2004	--	--	--	--	--	--
Teslin River	8/29/2004	252	13.4	8.0	10.0	157	59
Yukon River below Teslin River	8/29/2004	--	--	--	--	--	--
Big Salmon River	8/30/2004	58	8.6	8.1	10.8	164	77
Yukon River below Big Salmon River	8/30/2004	--	--	--	--	--	--
Little Salmon River	8/30/2004	15	12.9	8.4	10.9	203	98
Yukon River below Little Salmon River	8/30/2004	--	--	--	--	--	--
Yukon River at Carmacks	8/31/2004	1,022	13.5	7.8	9.8	98	44
Nordenskiold River	8/31/2004	7	10.1	8.0	11.3	224	103
Pelly River	9/1/2004	199	11.1	8.0	10.5	332	97
Yukon River below Pelly River	9/1/2004	--	--	--	--	--	--
Yukon River above White River	9/2/2004	1,257	12.7	8.0	10.2	158	55
White River	9/2/2004	742	10.4	8.0	11.6	308	87
Yukon River below White River	9/2/2004	--	--	--	--	--	--
Stewart River	9/3/2004	224	10.7	8.1	10.9	340	89
Yukon River below Stewart River	9/3/2004	--	--	--	--	--	--
Sixtymile River	9/3/2004	12	8.4	7.7	11.8	245	70
Yukon River below Sixtymile River	9/3/2004	--	--	--	--	--	--
Klondike River above Bonanza Creek	9/4/2004	38	7.9	7.8	12.4	290	74
Klondike River below Bonanza Creek	9/4/2004	40	8.0	7.7	11.6	291	73
Yukon River below Klondike River	9/5/2004	--	--	--	--	--	--
Fortymile River	9/5/2004	65	7.1	7.7	11.9	218	53
Yukon River below Fortymile River	9/5/2004	--	--	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	2,393	9.3	7.8	--	225	74

Suspended Sediment

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A description of sample processing for suspended sediment concentration can be found in Guy (1969).

Table 4. Suspended sediment in water samples from the Yukon River and tributaries, June 2004.

[mg/L, milligrams per liter; mm, millimeters; --, not available; <, less than]

Site	Date	Suspended[1] sediment (mg/L)	Suspended sediment (percent < 0.063 mm)
Nares River	6/5/2004	--	--
Atlin River	6/6/2004	--	--
Yukon River above Takhini River	6/7/2004	13	62
Takhini River	6/7/2004	67	86
Yukon River below Takhini River	6/7/2004	--	--
Teslin River	6/9/2004	66	78
Yukon River below Teslin River	6/9/2004	--	--
Big Salmon River	6/10/2004	346	70
Yukon River below Big Salmon River	6/10/2004	--	--
Little Salmon River	6/10/2004	41	78
Yukon River below Little Salmon River	6/10/2004	--	--
Nordenskiold River	6/11/2004	36	84
Yukon River at Carmacks	6/11/2004	128	74
Pelly River	6/12/2004	208	80
Yukon River below Pelly River	6/12/2004	--	--
Yukon River above White River	6/13/2004	218	65
White River	6/13/2004	1,750	67
Yukon River below White River	6/14/2004	--	--
Sixtymile River	6/14/2004	--	--
Yukon River below Sixtymile River	6/14/2004	--	--
Stewart River	6/14/2004	106	83
Yukon River below Stewart River	6/14/2004	--	--
Klondike River above Bonanza Creek	6/15/2004	--	--
Klondike River below Bonanza Creek	6/15/2004	16	44
Yukon River below Klondike River	6/16/2004	--	--
Fortymile River	6/16/2004	1	33
Yukon River below Fortymile River	6/16/2004	--	--
Yukon River at Eagle, Alaska	6/17/2004	383	53

[1] Sediment sample taken from 1-L bottle from churn splitter.

Table 5. Suspended sediment in water samples from the Yukon River and tributaries, August/September 2004.

[mg/L, milligrams per liter; mm, millimeters; --, not available; <, less than]

Site	Date	Suspended[1] sediment (mg/L)	Suspended sediment (percent < 0.063 mm)
Nares River	8/25/2004	--	--
Atlin River	8/26/2004	--	--
Yukon River above Takhini River	8/27/2004	11	59
Takhini River	8/27/2004	34	79
Yukon River below Takhini River	8/27/2004	--	--
Teslin River	8/29/2004	7	77
Yukon River below Teslin River	8/29/2004	--	--
Big Salmon River	8/30/2004	7	70
Yukon River below Big Salmon River	8/30/2004	--	--
Little Salmon River	8/30/2004	3	45
Yukon River below Little Salmon River	8/30/2004	--	--
Nordenskiold River	8/31/2004	10	77
Yukon River at Carmacks	8/31/2004	6	65
Pelly River	9/1/2004	9	91
Yukon River below Pelly River	9/1/2004	--	--
Yukon River above White River	9/2/2004	8	50
White River	9/2/2004	1,040	61
Sixtymile River	9/3/2004	6	65
Yukon River below Sixtymile River	9/3/2004	--	--
Stewart River	9/3/2004	15	89
Yukon River below Stewart River	9/3/2004	--	--
Klondike River above Bonanza Creek	9/4/2004	--	--
Klondike River below Bonanza Creek	9/4/2004	7	72
Yukon River below Klondike River	9/5/2004	--	--
Fortymile River	9/5/2004	19	81
Yukon River below Fortymile River	9/5/2004	--	--
Yukon River at Eagle, Alaska	9/6/2004	314	72

[1] Sediment sample taken from 1-L bottle from churn splitter

Particulate Carbon and Particulate Nitrogen

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A description of sample collection and processing of samples for particulate carbon and particulate nitrogen concentrations is given in Schuster (2003).

Table 6. Particulate carbon and particulate nitrogen in water samples from the Yukon River and tributaries, June 2004.

[mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Total particulate carbon (mg/L)	Particulate inorganic carbon (mg/L)	Particulate organic carbon (mg/L)	Total particulate nitrogen (mg/L)
Nares River	6/5/2004	0.15	--	--	0.01
Atlin River	6/6/2004	1.59	--	--	0.03
Yukon River above Takhini River	6/7/2004	0.41	--	--	0.04
Takhini River	6/7/2004	0.70	<0.08	0.67	0.05
Yukon River below Takhini River	6/7/2004	--	--	--	--
Teslin River	6/9/2004	0.97	<0.08	0.94	0.07
Yukon River below Teslin River	6/9/2004	--	--	--	--
Big Salmon River	6/10/2004	5.20	0.44	4.76	0.01
Yukon River below Big Salmon River	6/10/2004	--	--	--	--
Little Salmon River	6/10/2004	1.62	--	--	0.10
Yukon River below Little Salmon River	6/10/2004	--	--	--	--
Yukon River at Carmacks	6/11/2004	2.20	0.14	2.07	0.19
Nordenskiold River	6/11/2004	1.19	--	--	0.09
Pelly River	6/12/2004	4.80	0.18	4.62	0.28
Yukon River below Pelly River	6/12/2004	--	--	--	--
Yukon River above White River	6/13/2004	3.22	0.14	3.08	0.13
White River	6/13/2004	27.90	15.20	12.70	0.58
Yukon River below White River	6/14/2004	--	--	--	--
Stewart River	6/14/2004	2.51	<0.08	2.49	0.15
Yukon River below Stewart River	6/14/2004	--	--	--	--
Sixtymile River	6/14/2004	0.68	--	--	0.04
Yukon River below Sixtymile River	6/14/2004	--	--	--	--
Klondike River above Bonanza Creek	6/15/2004	0.65	--	--	0.05
Klondike River below Bonanza Creek	6/15/2004	0.58	--	--	0.04
Yukon River below Klondike River	6/16/2004	--	--	--	--
Fortymile River	6/16/2004	0.35	--	--	0.02
Yukon River below Fortymile River	6/16/2004	--	--	--	--
Yukon River at Eagle, Alaska	6/17/2004	3.88	1.00	2.88	0.14

Table 7. Particulate carbon and particulate nitrogen in water samples from the Yukon River and tributaries, August/September 2004.

[mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Total particulate carbon (mg/L)	Particulate inorganic carbon (mg/L)	Particulate organic carbon (mg/L)	Total particulate nitrogen (mg/L)
Nares River	8/25/2004	0.13	--	--	0.01
Atlin River	8/26/2004	0.15	--	--	0.01
Yukon River above Takhini River	8/27/2004	0.17	--	--	0.02
Takhini River	8/27/2004	0.40	<0.08	0.37	0.03
Yukon River below Takhini River	8/27/2004	--	--	--	--
Teslin River	8/29/2004	0.27	<0.08	0.27	0.03
Yukon River below Teslin River	8/29/2004	--	--	--	--
Big Salmon River	8/30/2004	0.33	<0.08	0.33	0.30
Yukon River below Big Salmon River	8/30/2004	--	--	--	--
Little Salmon River	8/30/2004	0.20	--	--	0.02
Yukon River below Little Salmon River	8/30/2004	--	--	--	--
Yukon River at Carmacks	8/31/2004	0.26	<0.08	0.26	0.02
Nordenskiold River	8/31/2004	0.46	--	--	0.03
Pelly River	9/1/2004	0.34	<0.08	0.30	0.02
Yukon River below Pelly River	9/1/2004	--	--	--	--
Yukon River above White River	9/2/2004	0.30	<0.08	0.29	0.02
White River	9/2/2004	14.60	7.33	7.27	0.25
Yukon River below White River	9/2/2004	--	--	--	--
Stewart River	9/3/2004	0.27	<0.08	0.25	0.02
Yukon River below Stewart River	9/3/2004	--	--	--	--
Sixtymile River	9/3/2004	0.22	--	--	0.02
Yukon River below Sixtymile River	9/3/2004	--	--	--	--
Klondike River above Bonanza Creek	9/4/2004	0.14	--	--	0.02
Klondike River below Bonanza Creek	9/4/2004	0.14	--	--	0.01
Yukon River below Klondike River	9/5/2004	--	--	--	--
Fortymile River	9/5/2004	1.15	--	--	0.09
Yukon River below Fortymile River	9/5/2004	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	6.21	2.20	4.01	0.13

Suspended Sediment Chemistry

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A description of sample collection and processing of samples for suspended sediment chemistry is given in Schuster (2003).

Table 8. Suspended sediment chemistry of water samples from the Yukon River and tributaries, 2004

[mg/L, milligrams per liter; ppm, parts per million; <, less than; --, not available; %, percent]

Site	Date	Suspended[1] Sediment (mg/L)	Silver (ppm)	Copper (ppm)	Lead (ppm)	Zinc (ppm)	Cadmium (ppm)	Chromium (ppm)	Cobalt (ppm)	Nickle (ppm)	Barium (ppm)
Yukon River at Carmacks	6/11/2004	150	<0.5	35	89	110	0.4	130	14	78	1,100
Pelly River	6/12/2004	213	0.6	61	62	320	2.3	120	14	98	810
Yukon River above White River	6/13/2004	203	<0.5	37	70	200	1.4	120	13	79	1,800
White River	6/13/2004	1,799	<0.5	35	18	98	0.3	99	16	55	720
Yukon River at Carmacks	8/31/2004	7	<3.0	35	91	120	<0.6	86	10	93	700
Pelly River	9/1/2004	6	4.6	38	75	180	1.5	150	<6	90	860
Yukon River above White River	9/2/2004	6	7.3	56	170	250	1.5	370	16	220	1,100
White River	9/2/2004	1,059	<0.5	37	11	88	0.2	86	15	48	610

Site	Date	Vanadium (ppm)	Lithium (ppm)	Beryllium (ppm)	Molybdenum (ppm)	Phosphorus (ppm)	Strontium (ppm)	Arsenic (ppm)	Antimony (ppm)	Selenium (ppm)	Mercury (ppm)
Yukon River at Carmacks	6/11/2004	120	29	1.8	5	1,000	250	9.9	1.5	0.6	0.07
Pelly River	6/12/2004	200	36	1.9	6	1,400	160	18	2.9	1.6	0.12
Yukon River above White River	6/13/2004	160	30	1.7	5	1,100	200	14	2.2	1.1	0.10
White River	6/13/2004	120	21	1.4	2	1,000	360	10	1.6	0.3	0.08
Yukon River at Carmacks	8/31/2004	68	16	0.8	16	640	630	8.2	1.4	1.1	--
Pelly River	9/1/2004	56	17	0.6	12	480	620	7.2	1.4	2.6	--
Yukon River above White River	9/2/2004	110	21	1.3	30	1,100	390	10	2.0	0.3	0.02
White River	9/2/2004	120	20	1.2	2	930	390	11	1.4	1.3	--

Site	Date	Thallium (ppm)	Uranium (ppm)	Iron (%)	Manganese (ppm)	Aluminum (%)	Titanium (%)	Total Organic Carbon (%)	Total Carbon (%)	Total Nitrogen (%)
Yukon River at Carmacks	6/11/2004	<50	<50	3.6	800	6.7	0.39	1.6	1.7	0.16
Pelly River	6/12/2004	<50	<50	3.6	950	6.3	0.38	1.9	2.6	0.21
Yukon River above White River	6/13/2004	<50	<50	3.3	830	6.2	0.37	1.5	2.3	0.06
White River	6/13/2004	<50	<50	4.3	800	7.2	0.50	0.5	1.7	0.17
Yukon River at Carmacks	8/31/2004	<300	<300	2.2	610	3.4	0.24	--	--	--
Pelly River	9/1/2004	<300	<300	1.5	560	1.9	0.13	--	--	--
Yukon River above White River	9/2/2004	<50	<50	4.2	740	6.7	0.48	0.5	2.5	0.03
White River	9/2/2004	<350	<350	3.1	940	4.6	0.32	--	--	--

[1] 15-L sediment sample taken directly from depth integrating sampler.

Tritium

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A description of processing of samples for tritium concentration is given in Thatcher and others (1977).

Table 9. Tritium in water samples from the Yukon River and tributaries, June 2004.

[TU, tritium units; --, not available]

Site	Date	Tritium (TU)	±1 sigma uncertainty
Nares River	6/5/2004	5.5	0.5
Atlin River	6/6/2004	8.0	0.5
Yukon River above Takhini River	6/7/2004	7.2	0.7
Takhini River	6/7/2004	7.5	0.5
Yukon River below Takhini River	6/7/2004	--	--
Teslin River	6/9/2004	8.8	0.6
Yukon River below Teslin River	6/9/2004	--	--
Big Salmon River	6/10/2004	10.2	0.6
Yukon River below Big Salmon River	6/10/2004	--	--
Little Salmon River	6/10/2004	16.6	0.7
Yukon River below Little Salmon River	6/10/2004	--	--
Yukon River at Carmacks	6/11/2004	9.0	0.6
Nordenskiold River	6/11/2004	11.8	0.6
Pelly River	6/12/2004	9.0	0.6
Yukon River below Pelly River	6/12/2004	--	--
Yukon River above White River	6/13/2004	9.3	0.6
White River	6/13/2004	10.5	0.6
Yukon River below White River	6/14/2004	--	--
Stewart River	6/14/2004	10.3	0.6
Yukon River below Stewart River	6/14/2004	--	--
Sixtymile River	6/14/2004	11.2	0.7
Yukon River below Sixtymile River	6/14/2004	--	--
Klondike River above Bonanza Creek	6/15/2004	10.2	0.6
Klondike River below Bonanza Creek	6/15/2004	10.0	0.6
Yukon River below Klondike River	6/16/2004	--	--
Fortymile River	6/16/2004	11.4	0.6
Yukon River below Fortymile River	6/16/2004	--	--
Yukon River at Eagle, Alaska	6/17/2004	9.8	0.6

Table 10. Tritium in water samples from the Yukon River and tributaries, August/September 2004.

[TU, tritium units; --, not available]

Site	Date	Tritium (TU)	±1 sigma uncertainty
Nares River	8/25/2004	5.5	0.6
Atlin River	8/26/2004	8.2	0.6
Yukon River above Takhini River	8/27/2004	6.9	0.6
Takhini River	8/27/2004	6.0	0.7
Yukon River below Takhini River	8/27/2004	--	--
Teslin River	8/29/2004	7.7	0.6
Yukon River below Teslin River	8/29/2004	--	--
Big Salmon River	8/30/2004	11.2	0.6
Yukon River below Big Salmon River	8/30/2004	--	--
Little Salmon River	8/30/2004	12.1	0.8
Yukon River below Little Salmon River	8/30/2004	--	--
Yukon River at Carmacks	8/31/2004	8.5	0.5
Nordenskiold River	8/31/2004	12.9	0.8
Pelly River	9/1/2004	10.9	0.7
Yukon River below Pelly River	9/1/2004	--	--
Yukon River above White River	9/2/2004	6.8	0.8
White River	9/2/2004	9.5	0.6
Yukon River below White River	9/2/2004	--	--
Stewart River	9/3/2004	10.5	0.6
Yukon River below Stewart River	9/3/2004	--	--
Sixtymile River	9/3/2004	11.6	0.6
Yukon River below Sixtymile River	9/3/2004	--	--
Klondike River above Bonanza Creek	9/4/2004	8.4	0.6
Klondike River below Bonanza Creek	9/4/2004	11.1	0.6
Yukon River below Klondike River	9/5/2004	--	--
Fortymile River	9/5/2004	12.0	0.8
Yukon River below Fortymile River	9/5/2004	--	--
Yukon River at Eagle, Alaska	9/6/2004	8.8	0.6

Major Cations and Dissolved Trace Elements

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A description of sample collection and processing of samples for major cations and trace elements is given in Schuster (2003).

Table 11. Major cations and dissolved trace elements in water samples from the Yukon River and tributaries, June 2004.

[µg/L , micrograms per liter; mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Aluminum (µg/L)	Arsenic (µg/L)	Boron (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Bismuth (µg/L)	Calcium (mg/L)	Cadmium (µg/L)	Cerium (µg/L)	Cobalt (µg/L)
Nares River	6/5/2004	4.5	0.23	0.7	15	<0.01	0.015	10	0.028	0.0078	0.026
Atlin River	6/6/2004	12	0.25	1.9	32	<0.01	0.003	14	0.009	0.0025	0.018
Yukon River above Takhini River	6/7/2004	21	0.42	1.7	25	<0.01	0.003	14	0.004	0.0170	0.034
Takhini River	6/7/2004	26	0.19	< 0.6	14	<0.01	0.004	9	0.004	0.0375	0.034
Yukon River below Takhini River	6/7/2004	--	--	--	--	--	--	--	--	--	--
Teslin River	6/9/2004	23	0.40	3.1	30	<0.01	0.004	19	0.009	0.0653	0.124
Yukon River below Teslin River	6/9/2004	--	--	--	--	--	--	--	--	--	--
Big Salmon River	6/10/2004	35	0.45	<0.6	18	<0.01	0.007	14	0.019	0.4681	0.079
Yukon River below Big Salmon River	6/10/2004	--	--	--	--	--	--	--	--	--	--
Little Salmon River	6/10/2004	8.8	0.38	1.9	66	<0.01	< 0.003	33	0.007	0.0206	0.108
Yukon River below Little Salmon River	6/10/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Carmacks	6/11/2004	47	0.42	1.5	28	<0.01	0.004	18	0.009	0.1443	0.119
Nordenskiold River	6/11/2004	37	0.64	5.4	32	<0.01	0.004	22	0.004	0.1546	0.076
Pelly River	6/12/2004	69	0.61	2.2	47	<0.01	0.005	24	0.046	0.1426	0.154
Yukon River below Pelly River	6/12/2004	--	--	--	--	--	--	--	--	--	--
Yukon River above White River	6/13/2004	40	0.49	3.0	38	<0.01	0.004	22	0.026	0.0849	0.052
White River	6/13/2004	36	0.69	31	31	<0.01	0.005	30	0.006	0.0862	0.100
Yukon River below White River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Stewart River	6/14/2004	49	0.49	2.5	47	<0.01	0.003	29	0.043	0.0741	0.125
Yukon River below Stewart River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Sixtymile River	6/14/2004	48	0.56	2.9	42	0.02	0.005	22	0.015	0.3984	1.310
Yukon River below Sixtymile River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Klondike River below Bonanza Creek	6/15/2004	9.0	0.53	4.0	40	<0.01	< 0.003	26	0.017	0.0189	0.052
Klondike River above Bonanza Creek	6/15/2004	8.9	0.55	4.3	42	<0.01	< 0.003	26	0.016	0.0243	0.052
Yukon River below Klondike River	6/16/2004	--	--	--	--	--	--	--	--	--	--
Fortymile River	6/16/2004	77	0.46	3.0	29	0.029	0.010	17	0.012	0.4098	0.092
Yukon River below Fortymile River	6/16/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	6/17/2004	62	0.54	10	41	<0.03	0.003	27	0.021	0.0838	0.136

Table 11. Major cations and dissolved trace elements in water samples from the Yukon River and tributaries, June 2004 – cont.

[µg/L, micrograms per liter; mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Chromium (µg/L)	Cesium (µg/L)	Copper (µg/L)	Dysprosium (µg/L)	Erbium (µg/L)	Europium (µg/L)	Iron (µg/L)	Gallium (µg/L)	Gadolinium (µg/L)	Holmium (µg/L)
Nares River	6/5/2004	<0.2	<0.02	0.25	0.0029	0.002	< 0.0007	5	0.006	0.0027	0.0005
Atlin River	6/6/2004	<0.2	<0.02	0.23	<0.001	< 0.001	< 0.0007	6	0.024	< 0.0008	<0.0003
Yukon River above Takhini River	6/7/2004	<0.2	< 0.02	0.39	0.0023	0.001	< 0.0007	32	0.016	0.0023	0.0005
Takhini River	6/7/2004	<0.2	<0.02	0.39	0.0052	0.003	0.0014	39	0.012	0.0050	0.0011
Yukon River below Takhini River	6/7/2004	--	--	--	--	--	--	--	--	--	--
Teslin River	6/9/2004	<0.2	<0.02	0.83	0.0114	0.007	0.0034	63	0.007	0.011	0.0025
Yukon River below Teslin River	6/9/2004	--	--	--	--	--	--	--	--	--	--
Big Salmon River	6/10/2004	<0.2	<0.02	1.3	0.0425	0.027	0.013	108	0.016	0.049	0.0091
Yukon River below Big Salmon River	6/10/2004	--	--	--	--	--	--	--	--	--	--
Little Salmon River	6/10/2004	<0.2	<0.02	1.4	0.0038	0.003	0.0019	31	0.004	0.0037	0.0008
Yukon River below Little Salmon River	6/10/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Carmacks	6/11/2004	<0.2	<0.02	1.0	0.0163	0.011	0.0052	91	0.015	0.018	0.0031
Nordenskiold River	6/11/2004	<0.2	<0.02	2.1	0.0314	0.022	0.0097	141	0.008	0.035	0.0061
Pelly River	6/12/2004	< 0.2	<0.02	1.8	0.0177	0.011	0.0084	183	0.020	0.023	0.0036
Yukon River below Pelly River	6/12/2004	--	--	--	--	--	--	--	--	--	--
Yukon River above White River	6/13/2004	<0.2	<0.02	1.5	0.0141	0.008	0.0038	84	0.014	0.014	0.0027
White River	6/13/2004	<0.2	<0.02	3.0	0.0175	0.012	0.0036	67	0.042	0.017	0.0034
Yukon River below White River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Stewart River	6/14/2004	<0.2	<0.02	1.3	0.0100	0.005	0.0051	92	0.015	0.013	0.0017
Yukon River below Stewart River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Sixtymile River	6/14/2004	0.2	<0.02	2.9	0.0702	0.042	0.014	190	0.012	0.076	0.0143
Yukon River below Sixtymile River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Klondike River below Bonanza Creek	6/15/2004	<0.2	<0.02	0.79	0.0047	0.002	0.0021	32	0.004	0.0052	0.0009
Klondike River above Bonanza Creek	6/15/2004	<0.2	<0.02	0.78	0.0048	0.003	0.0022	32	0.003	0.0055	0.0010
Yukon River below Klondike River	6/16/2004	--	--	--	--	--	--	--	--	--	--
Fortymile River	6/16/2004	0.6	<0.02	3.4	0.0820	0.049	0.018	257	0.010	0.088	0.0166
Yukon River below Fortymile River	6/16/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	6/17/2004	<0.3	<0.02	1.6	0.0106	0.007	0.0049	98	--	0.013	0.0023

Table 11. Major cations and dissolved trace elements in water samples from the Yukon River and tributaries, June 2004 – cont.

[µg/L , micrograms per liter; mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Potassium (mg/L)	Lanthanum (µg/L)	Lithium (µg/L)	Lutetium (µg/L)	Magnesium (mg/L)	Manganese (µg/L)	Molybdenum (µg/L)	Sodium (mg/L)	Neodymium (µg/L)	Nickel (µg/L)
Nares River	6/5/2004	0.45	0.0105	0.51	0.0002	1.2	1.00	2.0	0.96	0.009	1.7
Atlin River	6/6/2004	0.61	0.0032	0.63	<0.0002	2.7	0.17	1.1	0.75	0.003	0.52
Yukon River above Takhini River	6/7/2004	0.64	0.0100	0.55	0.0002	2.5	1.25	1.5	0.92	0.004	0.49
Takhini River	6/7/2004	0.78	0.0259	0.73	0.0005	1.1	2.06	1.6	1.09	0.026	0.29
Yukon River below Takhini River	6/7/2004	--	--	--	--	--	--	--	--	--	--
Teslin River	6/9/2004	0.64	0.0503	0.81	0.0012	5.1	1.9	0.78	1.2	0.051	0.96
Yukon River below Teslin River	6/9/2004	--	--	--	--	--	--	--	--	--	--
Big Salmon River	6/10/2004	1.1	0.2565	1.00	0.0038	2.7	12	0.71	0.69	0.262	1.0
Yukon River below Big Salmon River	6/10/2004	--	--	--	--	--	--	--	--	--	--
Little Salmon River	6/10/2004	0.84	0.0143	1.52	0.0006	9.0	5.0	0.89	1.7	0.014	0.97
Yukon River below Little Salmon River	6/10/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Carmacks	6/11/2004	0.77	0.0853	0.87	0.0015	4.4	4.6	0.88	1.1	0.085	0.97
Nordenskiold River	6/11/2004	1.1	0.1320	1.33	0.0035	5.8	6.2	0.87	3.5	0.139	1.3
Pelly River	6/12/2004	0.72	0.0794	2.22	0.0014	7.4	8.9	0.93	0.98	0.088	3.3
Yukon River below Pelly River	6/12/2004	--	--	--	--	--	--	--	--	--	--
Yukon River above White River	6/13/2004	0.75	0.0516	1.48	0.0012	5.9	2.8	1.0	1.1	0.053	1.8
White River	6/13/2004	2.3	0.0456	5.17	0.0019	8.0	3.7	1.9	4.4	0.056	1.4
Yukon River below White River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Stewart River	6/14/2004	0.52	0.0423	2.64	0.0007	9.5	5.9	0.58	1.1	0.046	2.3
Yukon River below Stewart River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Sixtymile River	6/14/2004	1.0	0.2725	3.56	0.0064	8.9	21	0.65	3.7	0.313	2.4
Yukon River below Sixtymile River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Klondike River below Bonanza Creek	6/15/2004	0.42	0.0130	2.08	0.0003	7.3	8.3	0.39	1.5	0.016	1.3
Klondike River above Bonanza Creek	6/15/2004	0.40	0.0139	2.02	0.0005	7.2	7.6	0.40	1.4	0.019	1.2
Yukon River below Klondike River	6/16/2004	--	--	--	--	--	--	--	--	--	--
Fortymile River	6/16/2004	0.79	0.3252	3.54	0.0077	5.6	3.7	0.41	3.0	0.377	2.1
Yukon River below Fortymile River	6/16/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	6/17/2004	0.97	0.0471	2.30	0.0010	7.7	3.5	0.99	1.7	0.049	1.4

Table 11. Major cations and dissolved trace elements in water samples from the Yukon River and tributaries, June 2004 – cont.

[µg/L , micrograms per liter; mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Phosphorus (µg/L)	Lead (µg/L)	Praseodymium (µg/L)	Rubidium (µg/L)	Rhenium (µg/L)	Sulfur (mg/L)	Antimony (µg/L)	Selenium (µg/L)	Silica (mg/L)	Samarium (µg/L)
Nares River	6/5/2004	<10	0.012	0.0021	0.61	0.0008	2.4	0.071	<0.1	3.5	0.002
Atlin River	6/6/2004	<10	<0.005	0.0005	0.71	0.0011	2.3	0.144	<0.1	1.8	<0.001
Yukon River above Takhini River	6/7/2004	<10	0.018	0.0022	0.78	0.0012	2.4	0.094	<0.1	2.8	0.002
Takhini River	6/7/2004	<10	0.020	0.0059	0.69	<0.0005	1.2	0.022	<0.1	3.9	0.006
Yukon River below Takhini River	6/7/2004	--	--	--	--	--	--	--	--	--	--
Teslin River	6/9/2004	<10	0.027	0.012	0.62	0.0012	3.2	0.069	0.17	6.6	0.011
Yukon River below Teslin River	6/9/2004	--	--	--	--	--	--	--	--	--	--
Big Salmon River	6/10/2004	<10	0.068	0.067	1.0	0.0014	2.4	0.073	0.16	5.2	0.053
Yukon River below Big Salmon River	6/10/2004	--	--	--	--	--	--	--	--	--	--
Little Salmon River	6/10/2004	<10	0.024	0.0033	0.56	0.0023	7.6	0.100	0.27	7.2	0.004
Yukon River below Little Salmon River	6/10/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Carmacks	6/11/2004	<10	0.059	0.021	0.82	0.0015	3.2	0.081	0.18	6.0	0.018
Nordenskiold River	6/11/2004	<10	0.038	0.033	0.71	0.0022	3.2	0.054	<0.1	9.9	0.031
Pelly River	6/12/2004	<10	0.17	0.021	0.50	0.0040	12	0.243	0.67	5.6	0.020
Yukon River below Pelly River	6/12/2004	--	--	--	--	--	--	--	--	--	--
Yukon River above White River	6/13/2004	<10	0.074	0.013	0.60	0.0023	7.4	0.161	0.41	5.9	0.013
White River	6/13/2004	<10	0.025	0.012	2.2	0.0042	13	0.317	0.35	7.1	0.015
Yukon River below White River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Stewart River	6/14/2004	<10	0.099	0.010	0.39	0.0031	18	0.170	0.53	4.2	0.010
Yukon River below Stewart River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Sixtymile River	6/14/2004	<10	0.083	0.075	0.84	0.0050	14	0.171	<0.1	8.7	0.073
Yukon River below Sixtymile River	6/14/2004	--	--	--	--	--	--	--	--	--	--
Klondike River below Bonanza Creek	6/15/2004	<10	0.026	0.0034	0.24	0.0023	15	0.150	0.40	5.5	0.004
Klondike River above Bonanza Creek	6/15/2004	<10	0.018	0.0035	0.24	0.0017	14	0.152	0.42	5.5	0.005
Yukon River below Klondike River	6/16/2004	--	--	--	--	--	--	--	--	--	--
Fortymile River	6/16/2004	<10	0.038	0.087	0.93	0.0024	8.6	0.110	0.18	8.5	0.086
Yukon River below Fortymile River	6/16/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	6/17/2004	<7	0.080	0.012	1.1	0.0028	12	0.197	0.45	5.9	0.011

Table 11. Major cations and dissolved trace elements in water samples from the Yukon River and tributaries, June 2004 – cont.

[µg/L , micrograms per liter; mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Strontium (µg/L)	Terbium (µg/L)	Tellurium (µg/L)	Thorium (µg/L)	Thallium (µg/L)	Thulium (µg/L)	Uranium (µg/L)	Vanadium (µg/L)	Thungsten (µg/L)
Nares River	6/5/2004	67	0.0004	0.006	0.032	0.009	0.0002	0.84	0.07	0.010
Atlin River	6/6/2004	69	<0.0003	<0.005	0.014	< 0.005	<0.0001	0.55	0.16	0.019
Yukon River above Takhini River	6/7/2004	74	0.0004	<0.005	0.015	< 0.005	0.0001	0.67	0.20	0.021
Takhini River	6/7/2004	41	0.0007	<0.005	0.037	0.006	0.0004	0.44	0.31	0.010
Yukon River below Takhini River	6/7/2004	--	--	--	--	--	--	--	--	--
Teslin River	6/9/2004	75	0.0018	0.005	0.044	< 0.005	0.0011	0.79	0.25	0.010
Yukon River below Teslin River	6/9/2004	--	--	--	--	--	--	--	--	--
Big Salmon River	6/10/2004	49	0.0076	<0.005	0.20	< 0.005	0.0036	0.77	0.44	0.020
Yukon River below Big Salmon River	6/10/2004	--	--	--	--	--	--	--	--	--
Little Salmon River	6/10/2004	122	0.0006	<0.005	0.020	< 0.005	0.0004	1.2	0.24	0.005
Yukon River below Little Salmon River	6/10/2004	--	--	--	--	--	--	--	--	--
Yukon River at Carmacks	6/11/2004	74	0.0027	<0.005	0.076	< 0.005	0.0014	0.79	0.37	0.013
Nordenskiold River	6/11/2004	167	0.0048	<0.005	0.059	< 0.005	0.0033	0.47	0.67	0.004
Pelly River	6/12/2004	111	0.0033	<.005	0.061	< 0.005	0.0014	0.67	0.57	0.004
Yukon River below Pelly River	6/12/2004	--	--	--	--	--	--	--	--	--
Yukon River above White River	6/13/2004	93	0.0023	<0.005	0.052	< 0.005	0.0010	0.75	0.45	0.063
White River	6/13/2004	147	0.0026	0.006	0.070	0.007	0.0016	0.89	0.65	0.020
Yukon River below White River	6/14/2004	--	--	--	--	--	--	--	--	--
Stewart River	6/14/2004	139	0.0018	<0.005	0.038	< 0.005	0.0007	0.66	0.29	0.006
Yukon River below Stewart River	6/14/2004	--	--	--	--	--	--	--	--	--
Sixtymile River	6/14/2004	163	0.012	<0.005	0.17	< 0.005	0.0059	1.5	0.61	0.014
Yukon River below Sixtymile River	6/14/2004	--	--	--	--	--	--	--	--	--
Klondike River below Bonanza Creek	6/15/2004	154	0.0006	<0.005	0.030	< 0.005	0.0004	0.37	0.17	<0.002
Klondike River above Bonanza Creek	6/15/2004	152	0.0008	<0.005	0.023	< 0.005	0.0004	0.35	0.16	<0.002
Yukon River below Klondike River	6/16/2004	--	--	--	--	--	--	--	--	--
Fortymile River	6/16/2004	105	0.013	<0.007	0.26	0.014	0.0070	0.62	0.68	0.006
Yukon River below Fortymile River	6/16/2004	--	--	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	6/17/2004	122	0.0021	< 0.01	0.063	0.004	0.0010	0.80	0.5	0.010

Table 11. Major cations and dissolved trace elements water samples from the Yukon River and tributaries, June 2004 – cont.

[µg/L , micrograms per liter; mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Yttrium (µg/L)	Ytterbium (µg/L)	Zinc (µg/L)	Zirconium (µg/L)
Nares River	6/5/2004	0.024	0.002	0.76	0.06
Atlin River	6/6/2004	0.007	<0.001	0.31	0.05
Yukon River above Takhini River	6/7/2004	0.016	<0.001	0.23	0.03
Takhini River	6/7/2004	0.036	0.004	0.19	0.05
Yukon River below Takhini River	6/7/2004	--	--	--	--
Teslin River	6/9/2004	0.082	0.007	0.25	0.10
Yukon River below Teslin River	6/9/2004	--	--	--	--
Big Salmon River	6/10/2004	0.267	0.024	2.6	0.14
Yukon River below Big Salmon River	6/10/2004	--	--	--	--
Little Salmon River	6/10/2004	0.033	0.002	1.4	0.11
Yukon River below Little Salmon River	6/10/2004	--	--	--	--
Yukon River at Carmacks	6/11/2004	0.113	0.009	0.43	0.10
Nordenskiold River	6/11/2004	0.228	0.021	0.62	0.36
Pelly River	6/12/2004	0.122	0.009	2.9	0.15
Yukon River below Pelly River	6/12/2004	--	--	--	--
Yukon River above White River	6/13/2004	0.093	0.007	1.2	0.10
White River	6/13/2004	0.121	0.012	1.0	0.31
Yukon River below White River	6/14/2004	--	--	--	--
Stewart River	6/14/2004	0.064	0.004	2.5	0.08
Yukon River below Stewart River	6/14/2004	--	--	--	--
Sixtymile River	6/14/2004	0.466	0.042	2.3	0.76
Yukon River below Sixtymile River	6/14/2004	--	--	--	--
Klondike River below Bonanza Creek	6/15/2004	0.035	0.003	1.5	0.07
Klondike River above Bonanza Creek	6/15/2004	0.036	0.003	1.4	0.07
Yukon River below Klondike River	6/16/2004	--	--	--	--
Fortymile River	6/16/2004	0.523	0.046	1.7	1.41
Yukon River below Fortymile River	6/16/2004	--	--	--	--
Yukon River at Eagle, Alaska	6/17/2004	0.073	0.006	1.3	0.17

Table 12. Major cations and dissolved trace elements in water samples from the Yukon River and tributaries, August/September 2004.

[µg/L , micrograms per liter; mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Aluminum (µg/L)	Arsenic (µg/L)	Boron (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Bismuth (µg/L)	Calcium (mg/L)	Cadmium (µg/L)	Cerium (µg/L)	Cobalt (µg/L)
Nares River	8/25/2004	12	0.27	3.3	15	<0.006	0.004	9.7	0.006	0.0167	0.009
Atlin River	8/26/2004	13	0.28	2.6	34	<0.006	0.009	14	0.003	0.0029	0.010
Yukon River above Takhini River	8/27/2004	8	0.41	1.3	24	<0.006	0.008	12	0.004	0.0075	0.014
Takhini River	8/27/2004	32	0.14	< 0.6	13	<0.006	0.003	6.3	0.002	0.0396	0.029
Yukon River below Takhini River	8/27/2004	--	--	--	--	--	--	--	--	--	--
Teslin River	8/29/2004	4.7	0.45	2.7	33	<0.006	0.006	21	0.010	0.0116	0.055
Yukon River below Teslin River	8/29/2004	--	--	--	--	--	--	--	--	--	--
Big Salmon River	8/30/2004	3.2	0.37	4.2	35	<0.006	0.013	31	0.011	0.0086	0.188
Yukon River below Big Salmon River	8/30/2004	--	--	--	--	--	--	--	--	--	--
Little Salmon River	8/30/2004	2.3	0.56	2.4	79	<0.006	0.003	35	0.004	0.0052	0.033
Yukon River below Little Salmon River	8/30/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Carmacks	8/31/2004	8.4	0.40	1.8	28	<0.006	0.003	16	0.006	0.0077	0.021
Nordenskiold River	8/31/2004	5.0	0.86	12	44	<0.006	0.009	33	0.012	0.0250	0.241
Pelly River	9/1/2004	7.7	0.45	3.4	76	<0.006	0.003	43	0.033	0.0047	0.036
Yukon River below Pelly River	9/1/2004	--	--	--	--	--	--	--	--	--	--
Yukon River above White river	9/2/2004	11	0.39	4.6	37	<0.006	0.003	21	0.012	0.0080	0.140
White River	9/2/2004	46	0.58	37	35	<0.006	0.008	35	0.028	0.0421	1.770
Yukon River below White River	9/2/2004	--	--	--	--	--	--	--	--	--	--
Stewart River	9/3/2004	15	0.53	7.3	65	<0.006	0.002	43	0.042	0.0109	0.132
Yukon River below Stewart River	9/3/2004	--	--	--	--	--	--	--	--	--	--
Sixtymile River	9/3/2004	18	0.78	3.5	53	0.010	0.007	28	0.015	0.1611	0.306
Yukon River below Sixtymile River	9/3/2004	--	--	--	--	--	--	--	--	--	--
Klondike River above Bonanza Creek	9/4/2004	0.89	0.46	5.1	61	0.007	< 0.001	38	0.027	0.0005	0.305
Klondike River below Bonanza Creek	9/4/2004	2.3	0.41	5.2	63	<0.006	0.003	38	0.023	0.0053	0.159
Yukon River below Klondike River	9/5/2004	--	--	--	--	--	--	--	--	--	--
Fortymile River	9/5/2004	52	0.49	3.2	39	0.030	0.011	25	0.013	0.2799	0.179
Yukon River below Fortymile River	9/5/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	65	0.51	14	40	<0.03	0.002	29	0.021	0.0624	0.491

Table 12. Major cations and dissolved trace elements in water samples from the Yukon River and tributaries, August/September 2004 – cont.

[µg/L, micrograms per liter; mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Chromium (µg/L)	Cesium (µg/L)	Copper (µg/L)	Dysprosium (µg/L)	Erbium (µg/L)	Europium (µg/L)	Iron (µg/L)	Gallium (µg/L)	Gadolinium (µg/L)	Holmium (µg/L)
Nares River	8/25/2004	0.3	<0.02	0.27	0.0044	0.0025	0.0010	11	0.009	0.0050	0.0010
Atlin River	8/26/2004	0.3	<0.02	0.21	0.0007	< 0.0006	0.0006	<3	0.024	<0.0007	0.0003
Yukon River above Takhini River	8/27/2004	<0.2	<0.02	0.28	0.0012	< 0.0006	0.0006	11	0.016	0.0012	0.0003
Takhini River	8/27/2004	<0.2	<0.02	0.30	0.0047	0.0029	0.0009	40	0.013	0.0052	0.0010
Yukon River below Takhini River	8/27/2004	--	--	--	--	--	--	--	--	--	--
Teslin River	8/29/2004	<0.2	<0.02	0.67	0.0031	0.0019	0.0008	15	0.003	0.0029	0.0007
Yukon River below Teslin River	8/29/2004	--	--	--	--	--	--	--	--	--	--
Big Salmon River	8/30/2004	<0.2	<0.02	0.42	0.0017	0.0012	0.0007	18	0.004	0.0015	0.0004
Yukon River below Big Salmon River	8/30/2004	--	--	--	--	--	--	--	--	--	--
Little Salmon River	8/30/2004	<0.2	<0.02	0.60	0.0021	0.0015	0.0024	17	0.005	0.0014	0.0004
Yukon River below Little Salmon River	8/30/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Carmacks	8/31/2004	<0.2	<0.02	0.41	0.0015	0.0011	0.0007	8	0.011	0.0015	0.0003
Nordenskiold River	8/31/2004	<0.2	<0.02	1.3	0.0091	0.0062	0.0024	71	0.004	0.0080	0.0022
Pelly River	9/1/2004	<0.2	<0.02	0.77	0.0013	0.0011	0.0022	7	0.005	0.0016	0.0004
Yukon River below Pelly River	9/1/2004	--	--	--	--	--	--	--	--	--	--
Yukon River above White river	9/2/2004	<0.2	<0.02	0.45	0.0020	0.0011	0.0004	12	0.008	0.0018	0.0004
White River	9/2/2004	<0.2	<0.02	0.67	0.0046	0.0025	0.0010	59	0.040	0.0045	0.0009
Yukon River below White River	9/2/2004	--	--	--	--	--	--	--	--	--	--
Stewart River	9/3/2004	0.2	<0.02	0.69	0.0024	0.0020	0.0012	11	0.007	0.0032	0.0007
Yukon River below Stewart River	9/3/2004	--	--	--	--	--	--	--	--	--	--
Sixtymile River	9/3/2004	0.3	<0.02	1.7	0.0383	0.024	0.0068	120	0.007	0.038	0.0080
Yukon River below Sixtymile River	9/3/2004	--	--	--	--	--	--	--	--	--	--
Klondike River above Bonanza Creek	9/4/2004	<0.2	<0.02	0.53	0.0011	< 0.0006	0.0005	<3	0.003	<0.0007	0.0002
Klondike River below Bonanza Creek	9/4/2004	<0.2	<0.02	0.57	0.0026	0.0021	0.0017	8	0.004	0.0019	0.0006
Yukon River below Klondike River	9/5/2004	--	--	--	--	--	--	--	--	--	--
Fortymile River	9/5/2004	0.5	<0.02	2.6	0.0593	0.037	0.013	217	0.010	0.059	0.0118
Yukon River below Fortymile River	9/5/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	<0.3	<0.02	0.85	0.0061	0.004	0.0027	94	--	0.008	0.0013

Table 12. Major cations and dissolved trace elements in water samples from the Yukon River and tributaries, August/September 2004 – cont.

[µg/L , micrograms per liter; mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Potassium (mg/L)	Lanthanum (µg/L)	Lithium (µg/L)	Lutetium (µg/L)	Magnesium (mg/L)	Manganese (µg/L)	Molybdenum (µg/L)	Sodium (mg/L)	Neodymium (µg/L)	Nickel (µg/L)
Nares River	8/25/2004	0.45	0.0163	0.51	0.0004	1.2	0.73	2.1	0.92	0.016	0.32
Atlin River	8/26/2004	0.67	0.0024	0.65	< 0.0002	2.8	0.22	1.2	0.86	0.003	0.28
Yukon River above Takhini River	8/27/2004	0.67	0.0047	0.52	0.0003	2.1	1.1	1.5	0.79	0.004	0.18
Takhini River	8/27/2004	0.70	0.0248	0.62	0.0003	0.8	1.9	1.5	0.86	0.025	0.30
Yukon River below Takhini River	8/27/2004	--	--	--	--	--	--	--	--	--	--
Teslin River	8/29/2004	0.61	0.0107	0.86	0.0004	5.7	0.38	0.94	1.4	0.011	0.61
Yukon River below Teslin River	8/29/2004	--	--	--	--	--	--	--	--	--	--
Big Salmon River	8/30/2004	1.0	0.0081	1.81	0.0002	6.9	2.4	1.4	1.5	0.008	0.45
Yukon River below Big Salmon River	8/30/2004	--	--	--	--	--	--	--	--	--	--
Little Salmon River	8/30/2004	0.93	0.0046	1.65	0.0002	9.7	2.6	0.93	2.0	0.005	0.38
Yukon River below Little Salmon River	8/30/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Carmacks	8/31/2004	0.72	0.0065	0.76	0.0003	3.5	0.45	1.4	1.1	0.006	0.29
Nordenskiold River	8/31/2004	1.7	0.0228	2.14	0.0014	9.4	6.9	1.3	6.0	0.027	0.70
Pelly River	9/1/2004	0.91	0.0041	3.84	0.0002	14	1.7	1.3	2.1	0.004	1.5
Yukon River below Pelly River	9/1/2004	--	--	--	--	--	--	--	--	--	--
Yukon River above White river	9/2/2004	0.75	0.0070	1.29	0.0002	5.3	0.58	1.4	1.4	0.006	0.52
White River	9/2/2004	2.5	0.0210	5.56	0.0005	9.3	5.7	2.3	4.3	0.021	1.6
Yukon River below White River	9/2/2004	--	--	--	--	--	--	--	--	--	--
Stewart River	9/3/2004	0.68	0.0077	4.11	0.0004	14	3.4	0.80	2.1	0.008	1.7
Yukon River below Stewart River	9/3/2004	--	--	--	--	--	--	--	--	--	--
Sixtymile River	9/3/2004	1.2	0.1028	4.16	0.0045	11	37	0.92	4.9	0.125	1.6
Yukon River below Sixtymile River	9/3/2004	--	--	--	--	--	--	--	--	--	--
Klondike River above Bonanza Creek	9/4/2004	0.56	0.0009	2.44	0.0002	11	5.7	0.67	2.2	<0.001	0.44
Klondike River below Bonanza Creek	9/4/2004	0.58	0.0044	2.49	0.0004	11	14	0.56	2.2	0.006	0.80
Yukon River below Klondike River	9/5/2004	--	--	--	--	--	--	--	--	--	--
Fortymile River	9/5/2004	1.0	0.1921	4.26	0.0062	8.7	11	0.45	4.1	0.235	2.4
Yukon River below Fortymile River	9/5/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	1.4	0.0316	2.84	0.0006	7.9	3.2	1.5	2.6	0.037	1.2

Table 12. Major cations and dissolved trace elements in water samples from the Yukon River and tributaries, August/September 2004 – cont.

[µg/L, micrograms per liter; mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Phosphorus (µg/L)	Lead (µg/L)	Praseodymium (µg/L)	Rubidium (µg/L)	Rhenium (µg/L)	Sulfur (mg/L)	Antimony (µg/L)	Selenium (µg/L)	Silica (mg/L)	Samarium (µg/L)
Nares River	8/25/2004	<10	0.014	0.0038	0.65	0.0010	2.3	0.074	0.09	3.4	0.005
Atlin River	8/26/2004	<10	0.016	0.0005	0.75	0.0011	2.5	0.156	0.21	1.8	<0.001
Yukon River above Takhini River	8/27/2004	<10	0.017	0.0010	0.83	0.0009	2.4	0.104	0.15	2.4	0.001
Takhini River	8/27/2004	<10	0.028	0.0062	0.87	<0.0005	1.00	0.020	<0.05	3.7	0.006
Yukon River below Takhini River	8/27/2004	--	--	--	--	--	--	--	--	--	--
Teslin River	8/29/2004	<10	0.024	0.0024	0.66	0.0012	3.8	0.071	0.17	6.8	0.003
Yukon River below Teslin River	8/29/2004	--	--	--	--	--	--	--	--	--	--
Big Salmon River	8/30/2004	<10	0.012	0.0018	0.93	0.0038	6.5	0.126	0.24	7.0	0.002
Yukon River below Big Salmon River	8/30/2004	--	--	--	--	--	--	--	--	--	--
Little Salmon River	8/30/2004	<10	0.011	0.0010	0.63	0.0030	7.3	0.097	0.21	6.7	0.001
Yukon River below Little Salmon River	8/30/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Carmacks	8/31/2004	<10	0.013	0.0014	0.78	0.0014	3.0	0.085	0.15	4.2	0.001
Nordenskiold River	8/31/2004	<10	0.028	0.0060	0.92	0.0036	4.8	0.083	0.14	12	0.006
Pelly River	9/1/2004	<10	0.009	0.0007	0.59	0.0055	22	0.179	0.63	6.0	<0.001
Yukon River below Pelly River	9/1/2004	--	--	--	--	--	--	--	--	--	--
Yukon River above White river	9/2/2004	<10	0.014	0.0016	0.73	0.0019	6.2	0.111	0.19	4.6	0.002
White River	9/2/2004	<10	0.024	0.0049	2.3	0.0055	18	0.486	0.48	5.7	0.005
Yukon River below White River	9/2/2004	--	--	--	--	--	--	--	--	--	--
Stewart River	9/3/2004	<10	0.019	0.0019	0.59	0.0038	26	0.160	0.53	4.6	0.002
Yukon River below Stewart River	9/3/2004	--	--	--	--	--	--	--	--	--	--
Sixtymile River	9/3/2004	<10	0.028	0.029	0.86	0.0049	17	0.144	0.16	10	0.032
Yukon River below Sixtymile River	9/3/2004	--	--	--	--	--	--	--	--	--	--
Klondike River above Bonanza Creek	9/4/2004	<10	<0.004	<0.0002	0.33	0.0033	23	0.229	0.57	5.9	<0.001
Klondike River below Bonanza Creek	9/4/2004	<10	0.011	0.0010	0.33	0.0033	22	0.193	0.50	5.7	0.002
Yukon River below Klondike River	9/5/2004	--	--	--	--	--	--	--	--	--	--
Fortymile River	9/5/2004	<10	0.027	0.055	1.1	0.0036	15	0.135	0.17	10	0.058
Yukon River below Fortymile River	9/5/2004	--	--	--	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	<7	0.031	0.0085	1.5	0.0041	13	0.275	0.33	5.5	0.007

Table 12. Major cations and dissolved trace elements in water samples from the Yukon River and tributaries, August/September 2004 – cont.

[µg/L , micrograms per liter; mg/L, milligrams per liter; --, not available; <, less than]

Site	Date	Strontium (µg/L)	Terbium (µg/L)	Tellurium (µg/L)	Thorium (µg/L)	Thallium (µg/L)	Thulium (µg/L)	Uranium (µg/L)	Vanadium (µg/L)	Thungsten (µg/L)
Nares River	8/25/2004	67	0.0008	<0.007	0.051	0.003	0.0004	0.86	0.09	0.010
Atlin River	8/26/2004	72	<0.0002	<0.007	0.065	0.003	<0.0002	0.57	0.23	0.021
Yukon River above Takhini River	8/27/2004	69	0.0002	<0.007	0.035	0.005	<0.0002	0.59	0.22	0.019
Takhini River	8/27/2004	32	0.0007	<0.007	0.052	0.004	0.0003	0.23	0.22	0.008
Yukon River below Takhini River	8/27/2004	--	--	--	--	--	--	--	--	--
Teslin River	8/29/2004	89	0.0004	<0.007	0.030	0.004	0.0003	0.66	0.23	0.015
Yukon River below Teslin River	8/29/2004	--	--	--	--	--	--	--	--	--
Big Salmon River	8/30/2004	114	0.0004	<0.007	0.030	0.013	0.0002	2.3	0.16	0.019
Yukon River below Big Salmon River	8/30/2004	--	--	--	--	--	--	--	--	--
Little Salmon River	8/30/2004	141	0.0003	<0.007	0.019	<0.003	0.0003	1.3	0.13	0.006
Yukon River below Little Salmon River	8/30/2004	--	--	--	--	--	--	--	--	--
Yukon River at Carmacks	8/31/2004	81	0.0003	<0.007	0.015	0.004	<0.0002	0.71	0.24	0.014
Nordenskiold River	8/31/2004	271	0.0014	<0.007	0.048	0.011	0.0010	0.76	0.77	0.002
Pelly River	9/1/2004	200	<0.0002	<0.007	0.020	0.008	0.0002	1.4	0.19	0.003
Yukon River below Pelly River	9/1/2004	--	--	--	--	--	--	--	--	--
Yukon River above White river	9/2/2004	105	0.0003	<0.007	0.019	0.004	<0.0002	0.84	0.21	0.010
White River	9/2/2004	180	0.0006	<0.007	0.023	0.009	0.0005	1.0	0.52	0.017
Yukon River below White River	9/2/2004	--	--	--	--	--	--	--	--	--
Stewart River	9/3/2004	214	0.0003	<0.007	0.020	0.006	0.0002	1.1	0.17	0.010
Yukon River below Stewart River	9/3/2004	--	--	--	--	--	--	--	--	--
Sixtymile River	9/3/2004	225	0.0058	<0.007	0.13	0.008	0.0036	2.1	0.55	0.021
Yukon River below Sixtymile River	9/3/2004	--	--	--	--	--	--	--	--	--
Klondike River above Bonanza Creek	9/4/2004	217	<0.0002	<0.007	<0.003	<0.003	<0.0002	0.53	0.11	0.039
Klondike River below Bonanza Creek	9/4/2004	217	0.0004	<0.007	0.020	0.006	0.0002	0.76	0.16	0.002
Yukon River below Klondike River	9/5/2004	--	--	--	--	--	--	--	--	--
Fortymile River	9/5/2004	145	0.010	0.007	0.25	0.005	0.0053	0.73	0.64	0.010
Yukon River below Fortymile River	9/5/2004	--	--	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	147	0.0012	<0.01	0.038	0.006	0.0006	0.92	0.5	0.014

Table 12. Major cations and dissolved trace elements in water samples from the Yukon River and tributaries, August/September 2004 – cont.

[µg/L , micrograms per liter; mg/L, milligrams per liter; --, not available]

Site	Date	Yttrium (µg/L)	Ytterbium (µg/L)	Zinc (µg/L)	Zirconium (µg/L)
Nares River	8/25/2004	0.037	0.0030	1.4	0.08
Atlin River	8/26/2004	0.005	0.0005	1.1	0.11
Yukon River above Takhini River	8/27/2004	0.008	0.0007	1.3	0.05
Takhini River	8/27/2004	0.032	0.0036	1.0	0.05
Yukon River below Takhini River	8/27/2004	--	--	--	--
Teslin River	8/29/2004	0.026	0.0024	1.6	0.13
Yukon River below Teslin River	8/29/2004	--	--	--	--
Big Salmon River	8/30/2004	0.017	0.0012	1.3	0.03
Yukon River below Big Salmon River	8/30/2004	--	--	--	--
Little Salmon River	8/30/2004	0.017	0.0015	1.1	0.05
Yukon River below Little Salmon River	8/30/2004	--	--	--	--
Yukon River at Carmacks	8/31/2004	0.014	0.0011	1.5	0.04
Nordenskiold River	8/31/2004	0.071	0.0074	2.0	0.25
Pelly River	9/1/2004	0.020	0.0013	1.7	0.05
Yukon River below Pelly River	9/1/2004	--	--	--	--
Yukon River above White river	9/2/2004	0.017	0.0010	1.5	0.04
White River	9/2/2004	0.028	0.0027	7.7	0.13
Yukon River below White River	9/2/2004	--	--	--	--
Stewart River	9/3/2004	0.025	0.0017	2.0	0.08
Yukon River below Stewart River	9/3/2004	--	--	--	--
Sixtymile River	9/3/2004	0.255	0.027	2.2	0.64
Yukon River below Sixtymile River	9/3/2004	--	--	--	--
Klondike River above Bonanza Creek	9/4/2004	0.009	0.0008	0.9	0.09
Klondike River below Bonanza Creek	9/4/2004	0.018	0.0018	1.5	0.07
Yukon River below Klondike River	9/5/2004	--	--	--	--
Fortymile River	9/5/2004	0.403	0.038	2.2	1.63
Yukon River below Fortymile River	9/5/2004	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	0.041	0.004	2.7	0.15

Anions

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A description of processing of samples for chloride, sulfate, and nitrate can be found in Fishman and Friedman (1989). For a description of laboratory alkalinity analyses see U.S. Geological Survey (1997-99).

Table 13. Anions and laboratory alkalinity in water samples from the Yukon River and tributaries, June 2004.

[mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; E, estimate; --, not available; <, less than]

Site	Date	Chloride (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)	Lab alkalinity (mg/L as $CaCO_3$)
Nares River	6/5/2004	0.24	0.12	5.5	27
Atlin River	6/6/2004	0.13	0.02E	5.5	44
Yukon River above Takhini River	6/7/2004	0.22	<0.01	5.7	45
Takhini River	6/7/2004	0.23	0.04E	2.9	27
Yukon River below Takhini River	6/7/2004	0.1	<0.01	4.7	37
Teslin River	6/9/2004	0.06E	0.04E	7.5	64
Yukon River below Teslin River	6/9/2004	0.03E	0.04E	7.2	61
Big Salmon River	6/10/2004	0.04E	0.02E	5.6	41
Yukon River below Big Salmon River	6/10/2004	0.03E	0.03E	6.2	48
Little Salmon River	6/10/2004	0.28	0.29	18.8	104
Yukon River below Little Salmon River	6/10/2004	0.18	0.04E	7.1	56
Yukon River at Carmacks	6/11/2004	0.04E	0.03E	7.5	57
Nordenskiold River	6/11/2004	0.54	<0.01	7.3	74
Pelly River	6/12/2004	0.06E	0.04E	30.4	63
Yukon River below Pelly River	6/12/2004	0.05E	0.06E	12.1	61
Yukon River above White River	6/13/2004	0.05E	0.04E	18.2	61
White River	6/13/2004	1.64	0.20	33.0	85
Yukon River below White River	6/14/2004	0.52	0.09E	21.4	69
Stewart River	6/14/2004	0.15	0.25	48.3	66
Yukon River below Stewart River	6/14/2004	0.05E	0.08E	21.2	66
Sixtymile River	6/14/2004	0.05E	0.09E	37.8	60
Yukon River below Sixtymile River	6/14/2004	0.66	0.14	31.3	--
Klondike River above Bonanza Creek	6/15/2004	0.18	0.23	38.7	60
Klondike River below Bonanza Creek	6/15/2004	0.05E	0.24	39.7	61
Yukon River below Klondike River	6/16/2004	0.06E	0.15	31.4	70
Fortymile River	6/16/2004	0.59	<0.01	22.1	43
Yukon River below Fortymile River	6/16/2004	0.41	0.15	30.9	70
Yukon River at Eagle, Alaska	6/17/2004	0.45	0.03	29.9	--

Table 14. Anions and laboratory alkalinity in water samples from the Yukon River and tributaries, August/September 2004.

[mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; E, estimate; --, not available; <, less than]

Site	Date	Chloride (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)	Lab alkalinity (mg/L as $CaCO_3$)
Nares River	8/25/2004	0.2	0.13	5.5	26
Atlin River	8/26/2004	0.13	<0.01	5.9	44
Yukon River above Takhini River	8/27/2004	0.16	<0.01	5.7	36
Takhini River	8/27/2004	0.18	0.11	2.6	19
Yukon River below Takhini River	8/27/2004	0.16	<0.01	4.9	32
Teslin River	8/29/2004	0.06E	<0.01	9.1	70
Yukon River below Teslin River	8/29/2004	0.23	<0.01	6.6	48
Big Salmon River	8/30/2004	0.08E	<0.01	16.3	92
Yukon River below Big Salmon River	8/30/2004	0.16	<0.01	6.9	49
Little Salmon River	8/30/2004	0.46	<0.01	18.7	116
Yukon River below Little Salmon River	8/30/2004	0.2	<0.01	6.9	--
Nordenskiold River	8/31/2004	0.79	<0.01	11.9	122
Yukon River at Carmacks	8/31/2004	0.17	<0.01	7.1	51
Pelly River	9/1/2004	0.1	<0.01	58.3	113
Yukon River below Pelly River	9/1/2004	0.06E	<0.01	14.3	62
Yukon River above White River	9/2/2004	0.09E	<0.01	15.6	64
White River	9/2/2004	1.99	0.23	53.5	109
Yukon River below White River	9/2/2004	1.99	0.23	53.5	109
Stewart River	9/3/2004	0.09	0.07E	67.3	105
Yukon River below Stewart River	9/3/2004	0.88	0.10	32.9	79
Sixtymile River	9/3/2004	0.55	<0.01	42.6	79
Yukon River below Sixtymile River	9/4/2004	0.75	0.09E	34.3	80
Klondike River above Bonanza Creek	9/3/2004	0.39	0.14	58.2	86
Klondike River below Bonanza Creek	9/4/2004	0.37	0.14	59.0	81
Yukon River below Klondike River	9/5/2004	0.91	0.11	34.3	79
Fortymile River	9/5/2004	1.17	0.22	41.1	63
Yukon River below Fortymile River	9/5/2004	0.79	0.11	35.6	72
Yukon River at Eagle, Alaska	9/6/2004	0.92	0.02	35.0	--

Deuterium and Oxygen Isotopes

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A description of sample processing for deuterium (^{2}H) can be found in Coplen and others (1991), and a description of sample processing for oxygen isotope (^{18}O) analysis can be found in Epstein and Mayeda (1953).

Table 15. Deuterium (δ^2H) and oxygen isotopes ($\delta^{18}O$) in water samples from the Yukon River and tributaries, June 2004.

[^2H, deuterium; ^{18}O, oxygen isotope; δ, delta; --, not available]

Site	Date	δ^2H (per mil)	$\delta^{18}O$ (per mil)
Nares River	6/5/2004	-142.5	-18.69
Atlin River	6/6/2004	-142.7	-18.40
Yukon River above Takhini River	6/7/2004	-143.8	-18.55
Takhini River	6/7/2004	--	--
Yukon River below Takhini River	6/7/2004	--	--
Teslin River	6/9/2004	157.5	-20.18
Yukon River below Teslin River	6/9/2004	--	--
Big Salmon River	6/10/2004	-162.8	-21.36
Yukon River below Big Salmon River	6/10/2004	--	--
Little Salmon River	6/10/2004	-161.1	-20.38
Yukon River below Little Salmon River	6/10/2004	--	--
Yukon River at Carmacks	6/11/2004	-156.4	-20.24
Nordenskiold River	6/11/2004	-160.6	-20.26
Pelly River	6/12/2004	-168.1	-21.66
Yukon River below Pelly River	6/12/2004	--	--
Yukon River above White River	6/13/2004	-163.5	-20.89
White River	6/13/2004	-180.2	-23.29
Yukon River below White River	6/14/2004	--	--
Stewart River	6/14/2004	-171.0	-22.16
Yukon River below Stewart River	6/14/2004	--	--
Sixtymile River	6/14/2004	-172.1	-21.99
Yukon River below Sixtymile River	6/14/2004	--	--
Klondike River above Bonanza Creek	6/15/2004	--	--
Klondike River below Bonanza Creek	6/15/2004	-170.6	-21.84
Yukon River below Klondike River	6/15/2004	--	--
Fortymile River	6/16/2004	-171.5	-21.90
Yukon River below Fortymile River	6/16/2004	--	--
Yukon River at Eagle, Alaska	6/17/2004	-166.1	-21.42

Table 16. Deuterium (δ^2H) and oxygen isotopes ($\delta^{18}O$) in water samples from the Yukon River and tributaries, August/September 2004.

[^2H, deuterium; ^{18}O, oxygen isotope; δ, delta; --, not available]

Site	Date	δ^2H (per mil)	$\delta^{18}O$ (per mil)
Nares River	8/25/2004	-143.5	-18.78
Atlin River	8/26/2004	-142.4	-18.36
Yukon River above Takhini River	8/27/2004	-147.2	-19.03
Takhini River	8/27/2004	-142.1	-18.33
Yukon River below Takhini River	8/27/2004	--	--
Teslin River	8/29/2004	-153.7	-19.61
Yukon River below Teslin River	8/29/2004	--	--
Big Salmon River	8/30/2004	-161.2	-20.65
Yukon River below Big Salmon River	8/30/2004	--	--
Little Salmon River	8/30/2004	-161.0	-20.28
Yukon River below Little Salmon River	8/30/2004	--	--
Yukon River at Carmacks	8/31/2004	-147.5	-18.92
Nordenskiold River	8/31/2004	-161.2	-20.15
Pelly River	9/1/2004	-163.5	-20.79
Yukon River below Pelly River	9/1/2004	--	--
Yukon River above White River	9/2/2004	-150.0	-19.20
White River	9/2/2004	-180.1	-23.24
Yukon River below White River	9/2/2004	--	--
Stewart River	9/3/2004	-166.5	-21.38
Yukon River below Stewart River	9/3/2004	--	--
Sixtymile River	9/3/2004	-166.9	-21.24
Yukon River below Sixtymile River	9/3/2004	--	--
Klondike River above Bonanza Creek	9/4/2004	--	--
Klondike River below Bonanza Creek	9/5/2004	-167.2	-21.56
Yukon River below Klondike River	9/5/2004	--	--
Fortymile River	9/5/2004	-164.0	-20.98
Yukon River below Fortymile River	9/5/2004	--	--
Yukon River at Eagle, Alaska	9/6/2004	-162.7	-20.84

Chlorophyll *a*

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A description of sample processing for chlorophyll *a* analysis can be found in Welschmeyer (1994).

Table 17. Chlorophyll *a* in water samples from the Yukon River and tributaries, June 2004.

[µg/L, micrograms per liter; --, not available]

Site	Date	Chlorophyll *a* (µg/L)
Nares River	6/5/2004	0.37
Atlin River	6/6/2004	0.52
Yukon River above Takhini River	6/7/2004	0.58
Takhini River	6/7/2004	1.15
Yukon River below Takhini River	6/7/2004	--
Teslin River	6/9/2004	2.56
Yukon River below Teslin River	6/9/2004	--
Big Salmon River	6/10/2004	1.48
Yukon River below Big Salmon River	6/10/2004	--
Little Salmon River	6/10/2004	0.73
Yukon River below Little Salmon River	6/10/2004	--
Yukon River at Carmacks	6/11/2004	2.24
Nordenskiold River at mouth	6/11/2004	1.37
Pelly River	6/12/2004	0.76
Yukon River below Pelly River	6/12/2004	--
Yukon River above White River	6/13/2004	1.42
White River	6/13/2004	1.15
Yukon River below White River	6/14/2004	--
Stewart River	6/14/2004	0.35
Yukon River below Stewart River	6/14/2004	--
Sixtymile River	6/14/2004	0.22
Yukon River below Sixtymile River	6/14/2004	--
Klondike River above Bonanza Creek	6/15/2004	0.24
Klondike River below Bonanza Creek	6/15/2004	0.29
Yukon River below Klondike River	6/16/2004	--
Fortymile River	6/16/2004	0.35
Yukon River below Fortymile River	6/16/2004	--
Yukon River at Eagle, Alaska	6/17/2004	1.01

Table 18. Chlorophyll *a* in water samples from the Yukon River and tributaries, August/September 2004.

[µg/L, micrograms per liter; --, not available]

Site	Date	Chlorophyll *a* (µg/L)
Nares River	8/25/2004	0.50
Atlin River	8/26/2004	0.20
Yukon River above Takhini River	8/27/2004	0.48
Takhini River	8/27/2004	0.63
Yukon River below Takhini River	8/29/2004	--
Teslin River	8/29/2004	1.36
Yukon River below Teslin River	8/30/2004	--
Big Salmon River	8/30/2004	0.52
Yukon River below Big Salmon River	8/30/2004	--
Little Salmon River	8/30/2004	0.84
Yukon River at Carmacks	8/31/2004	0.86
Nordenskiold River	8/31/2004	0.88
Pelly River	9/1/2004	0.35
Yukon River below Pelly River	9/2/2004	--
Yukon River above White River	9/2/2004	0.89
White River	9/2/2004	0.52
Yukon River below White River	9/3/2004	--
Stewart River	9/3/2004	0.66
Yukon River below Stewart River	9/3/2004	--
Sixtymile River	9/3/2004	0.82
Yukon River below Sixtymile River	9/4/2004	--
Klondike River above Bonanza Creek	9/4/2004	0.64
Klondike River below Bonanza Creek	9/4/2004	0.60
Yukon River below Klondike River	9/5/2004	--
Fortymile River	9/5/2004	3.48
Yukon River below Fortymile River	9/5/2004	--
Yukon River at Eagle, Alaska	9/6/2004	0.64

Dissolved Organic Carbon and Fractionation

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A description of sample collection and processing of samples for dissolved organic carbon, ultraviolet absorbance spectroscopy, specific ultraviolet absorbance (SUVA), and dissolved organic carbon fractionation analyses is given in Schuster (2003).

Table 19. Dissolved organic carbon and fractionation of water samples from the Yukon River and tributaries, June 2004.

[mg C/L, milligrams carbon per liter; nm, nanometer wavelength; SUVA, specific ultra violet absorbance; (L/mg C/m), liters per milligram carbon per one meter path length; %, percent; --, not available]

Site	Date	Dissolved organic carbon (mg C/L)	Ultraviolet absorbance @ 254nm	SUVA (L/mg C/m)	Hydrophobic acid SUVA (L/mg C/m)	Hydrophobic acid (%)	Hydrophobic organic matter SUVA (L/mg C/m)	Hydrophobic organic matter (%)	Transphylic acid SUVA (L/mg C/m)	Transphylic acid (%)
Nares River	6/5/2004	1.1	0.020	1.8	2.8	41	--	--	--	--
Atlin River	6/6/2004	0.8	0.009	1.1	1.9	27	--	--	--	--
Yukon River above Takhini River	6/7/2004	1.4	0.024	1.7	2.4	33	--	--	--	--
Takhini River	6/7/2004	1.4	0.029	2.1	2.9	37	--	--	--	--
Yukon River below Takhini River	6/7/2004	--	--	--	--	--	--	--	--	--
Teslin River	6/9/2004	4.2	0.129	3.1	3.9	43	2.0	14	4.5	15
Yukon River below Teslin River	6/9/2004	--	--	--	--	--	--	--	--	--
Big Salmon River	6/10/2004	6.1	0.231	3.8	4.6	50	1.9	16	3.7	16
Yukon River below Big Salmon River	6/10/2004	--	--	--	--	--	--	--	--	--
Little Salmon River	6/10/2004	3.9	0.104	2.7	3.5	39	1.3	19	2.5	18
Yukon River below Little Salmon River	6/10/2004	4.8	0.147	3.1	--	--	--	--	--	--
Nordenskiold River	6/11/2004	13.4	0.474	3.5	4.1	49	1.9	15	3.6	17
Yukon River at Carmacks	6/11/2004	4.5	0.134	3.0	4.1	44	1.8	15	2.8	16
Pelly River	6/12/2004	5.1	0.155	3.1	4.2	46	3.5	15	2.7	17
Yukon River below Pelly River	6/13/2004	5.1	0.145	2.8	--	--	--	--	--	--
Yukon River above White River	6/13/2004	4.9	0.158	3.2	4.0	51	4.2	20	2.6	16
White River	6/13/2004	7.1	0.223	3.1	4.0	53	2.0	18	2.8	17
Yukon River Below White River	6/14/2004	4.7	0.154	3.3	--	--	--	--	--	--
Stewart River	6/14/2004	3.2	0.089	2.8	3.7	45	--	20	2.5	19
Yukon River below Stewart River	6/14/2004	4.8	0.176	3.7	--	--	--	--	--	--
Sixtymile River	6/14/2004	13.1	0.437	3.3	4.1	56	3.9	15	2.8	20
Yukon River below Sixtymile River	6/14/2004	4.3	0.134	3.1	--	--	--	--	--	--
Klondike River above Bonanza Creek	6/15/2004	2.8	0.072	2.6	3.7	44	2.1	17	2.5	18
Klondike River below Bonanza Creek	6/15/2004	2.7	0.073	2.7	3.7	47	2.0	20	2.7	18
Yukon River below Klondike River	6/16/2004	4.1	0.133	3.3	--	--	--	--	--	--
Fortymile River	6/16/2004	20.6	0.734	3.6	4.3	55	2.3	15	2.7	16
Yukon River below Fortymile River	6/16/2004	4.5	0.136	3.1	--	--	--	--	--	--
Yukon River at Eagle, Alaska	6/17/2004	4.1	0.124	3.0	3.7	48	1.3	20	2.5	18

Table 20. Dissolved organic carbon and fractionation of water samples from the Yukon River and tributaries, August/September 2004.

[mg C/L, milligrams carbon per liter; nm, nanometer wavelength; SUVA, specific ultra violate absorbance; (L/mg C/m), liters per milligram carbon per one meter path length; %, percent; --, not available]

Site	Date	Dissolved organic carbon (mg C/L)	Ultraviolet absorbance @ 254nm	SUVA (L/mg C/m)	Hydrophobic acid SUVA (L/mg C/m)	Hydrophobic acid (%)	Hydrophobic organic matter SUVA (L/mg C/m)	Hydrophobic organic matter (%)	Transphylic acid SUVA (L/mg C/m)	Transphylic acid (%)
Nares River	8/24/2004	1.3	0.022	1.7	2.7	52	--	--	--	--
Atlin River	8/25/2004	1.1	0.009	0.9	2.0	31	--	--	--	--
Yukon River above Takhini River	8/27/2004	1.1	0.016	1.5	2.2	39	--	--	--	--
Takhini River	8/26/2004	1.0	0.022	2.1	2.7	39	--	--	--	--
Yukon River below Takhini River	8/26/2004	--	--	--	--	--	--	--	--	--
Teslin River	8/30/2004	3.3	0.077	2.4	3.2	43	1.7	26	1.9	18
Yukon River below Teslin River	8/29/2004	1.8	0.035	1.9	--	--	--	--	--	--
Little Salmon River	8/30/2004	3.2	0.073	2.3	3.2	41	1.2	24	2.1	19
Yukon River below Little Salmon River	8/30/2004	1.9	0.034	1.7	--	--	--	--	--	--
Big Salmon River	8/29/2004	1.8	0.032	1.8	2.6	39	1.3	31	2.0	21
Yukon River below Big Salmon River	8/30/2004	2.1	0.030	1.4	--	--	--	--	--	--
Yukon River at Carmacks	8/31/2004	2.0	0.039	2.0	2.8	41	1.2	25	1.9	19
Nordenskiold River	8/31/2004	6.9	0.183	2.7	3.3	48	2.4	16	2.5	18
Pelly River	9/1/2004	2.5	0.052	2.1	2.8	39	1.2	25	2.0	17
Yukon River below Pelly River	9/1/2004	--	--	--	--	--	--	--	--	--
White River	9/2/2004	1.7	0.035	2.0	3.0	42	--	--	--	--
Yukon River below White River	9/2/2004	--	--	--	--	--	--	--	--	--
Stewart River	9/3/2004	2.4	0.050	2.1	2.9	43	--	--	--	--
Yukon River below Stewart River	9/3/2004	2.1	0.041	2.0	--	--	--	--	--	--
Sixtymile River	9/2/2004	11.3	0.332	3.0	3.5	53	1.9	16	2.6	15
Yukon River below Sixtymile River	9/3/2004	2.1	0.041	1.9	--	--	--	--	--	--
Klondike River above Bonanza Creek	9/3/2004	2.1	0.042	2.1	2.7	37	--	--	--	--
Klondike River below Bonanza Creek	9/4/2004	2.2	0.043	2.0	2.9	38	--	--	--	--
Yukon River below Klondike River	9/5/2004	2.4	0.045	1.9	--	--	--	--	--	--
Fortymile River	9/5/2004	15.7	0.521	3.3	3.9	54	1.9	16	2.8	19
Yukon River below Fortymile River	9/5/2004	2.6	0.067	2.6	--	--	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	2.4	0.057	2.3	3.2	41	--	--	--	--

Dissolved Carbon Gases and Carbon Isotopes

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A description of sample collection and processing of samples for carbon dioxide (CO_2), methane (CH_4), and dissolved inorganic carbon (DIC) is given in Schuster (2003). A description for the processing of samples for carbon isotopes (^{13}C-DIC) can be found in Chasar and others (2000). Equations for temperature and altitude correction of P_{CO2} and P_{CH4} can be found in Plummer and Busenberg (1982).

Table 21. Dissolved carbon gases and carbon isotopes in water samples from the Yukon River and tributaries, June 2004.

[CO_2, carbon dioxide; µmol/L, micromoles per liter; P_{CO2}, partial pressure of CO_2; ppm, parts per million; CH_4, methane; P_{CH4}, partial pressure of CH_4; DIC, dissolved inorganic carbon; Corrected, adjusted for temperature and altitude; --, not available]

Site	Date	CO_2 (µmol/L)	Corrected P_{CO2} (ppm)	CH_4 (µmol/L)	Corrected P_{CH4} (ppm)	DIC (µmol/L)	^{13}C-DIC (per mil)
Nares River	6/5/2004	5.8	85	0.09	2.1	612	-2.62
Atlin River	6/6/2004	21.5	303	0.1	2.2	1,011	-1.3
Yukon River above Takhini River	6/7/2004	13.4	255	0.26	5.7	976	-2.91
Takhini River	6/7/2004	2.9	54	0.08	1.9	613	-4.42
Yukon River below Takhini River	6/7/2004	9.2	180	0.23	5.2	808	-3.47
Teslin River	6/9/2004	43.7	731	0.13	3	1,485	-7.52
Yukon River below Teslin River	6/9/2004	31.7	541	0.12	2.6	1,555	-6.54
Big Salmon River	6/10/2004	36.9	566	0.18	4	848	-7.72
Yukon River below Big Salmon River	6/10/2004	21.3	340	0.17	3.8	1,124	-7.17
Little Salmon River	6/10/2004	53.6	887	0.15	3.4	2,392	-6.74
Yukon River below Little Salmon River	6/10/2004	44.2	749	0.13	2.9	1,332	-6.48
Nordenskiold River	6/11/2004	62.3	1,105	0.18	4	1,718	-8.02
Yukon River at Carmacks	6/11/2004	31.3	543	0.13	2.9	1,329	-6.54
Pelly River	6/12/2004	20.5	382	0.12	2.6	1,443	-7.51
Yukon River below Pelly River	6/12/2004	18.5	355	0.12	2.7	1,439	-6.5
Yukon River above White River	6/13/2004	23.4	446	0.13	3	1,390	-6.73
White River	6/13/2004	39.7	782	0.12	2.6	1,874	-3.74
Yukon River below White River	6/14/2004	25.6	511	0.11	2.5	1,540	-6.09
Sixtymile River	6/14/2004	56.8	1,156	0.22	5.1	1,263	-7.09
Yukon River below Sixtymile River	6/14/2004	36.3	732	0.11	2.5	1,506	-6.29
Stewart River	6/14/2004	39.1	757	0.1	2.4	1,544	-6.45
Yukon River below Stewart River	6/14/2004	24.4	481	0.07	1.7	1,506	-6.58
Klondike River above Bonanza Creek	6/15/2004	--	--	--	--	--	--
Klondike River below Bonanza Creek	6/15/2004	39.4	694	0.13	2.9	1,369	-7.64
Yukon River below Klondike River	6/16/2004	25.6	523	0.09	2.1	1,629	-6.49
Fortymile River	6/16/2004	79.9	1,692	0.18	4.2	962	-7.32
Yukon River below Fortymile River	6/16/2004	39.6	852	0.11	2.6	1,626	-6.12
Yukon River at Eagle, Alaska	6/17/2004	30.3	645	0.1	2.1	1,620	-6.33

Table 22. Dissolved carbon gases and carbon isotopes in water samples from the Yukon River and tributaries, August/September 2004.

[CO_2, carbon dioxide; µmol/L, micromoles per liter; P_{CO2}, partial pressure of CO_2; ppm, parts per million; CH_4, methane; P_{CH4}, partial pressure of CH_4; DIC, dissolved inorganic carbon; Corrected, adjusted for temperature and altitude; --, not available]

Site	Date	CO_2 (µmol/L)	Corrected P_{CO2} (ppm)	CH_4 (µmol/L)	Corrected P_{CH4} (ppm)	DIC (µmol/L)	^{13}C-DIC (per mil)
Nares River	8/25/2004	10.6	203	0.14	3.2	605	-2.14
Atlin River	8/26/2004	15.8	312	0.1	2.3	1,068	-1.09
Yukon River above Takhini River	8/27/2004	19.2	397	0.37	8.4	878	-1.86
Takhini River	8/27/2004	13	250	0.17	3.8	486	-4.1
Yukon River below Takhini River	8/27/2004	6.1	126	0.31	7	632	-1.94
Teslin River	8/29/2004	34.2	664	0.15	3.5	1,744	-6.3
Yukon River below Teslin River	8/29/2004	12.1	239	0.14	3.2	1,147	-3.86
Big Salmon River	8/30/2004	37.2	618	0.12	2.8	2,215	-7.33
Yukon River below Big Salmon River	8/30/2004	13.8	268	0.16	3.6	1,169	-4.73
Little Salmon River	8/30/2004	43.8	830	0.19	4.3	2,757	-6.38
Yukon River below Little Salmon River	8/30/2004	26.3	522	0.13	2.9	1,159	-4.18
Nordenskiold River	8/31/2004	54	942	0.18	4	2,787	-7.82
Yukon River at Carmacks	8/31/2004	28.9	574	0.16	3.5	1,197	-4.39
Pelly River	9/1/2004	56.5	1,039	0.14	3.3	2,736	-6.61
Yukon River below Pelly River	9/1/2004	26	514	0.14	3.1	1,399	-4.83
Yukon River above White River	9/2/2004	36.9	722	0.14	3.2	1,467	-5.01
White River	9/2/2004	47.4	855	0.19	4.3	2,261	-3.45
Sixtymile River	9/3/2004	76.5	1,295	0.34	7.5	1,861	-6.79
Yukon River below Sixtymile River	9/3/2004	--	--	--	--	1,560	-4.38
Stewart River	9/3/2004	56	1,022	0.16	3.6	2,468	-6.33
Yukon River below Stewart River	9/3/2004	23.1	426	0.15	3.3	1,899	-5.21
Klondike River above Bonanza Creek	9/4/2004	--	--	--	--	--	--
Klondike River below Bonanza Creek	9/4/2004	62.6	1,046	0.13	2.8	2,008	-7.66
Yukon River below Klondike River	9/5/2004	37.9	675	0.14	3.1	1,612	-4.31
Fortymile River	9/5/2004	80.3	1,309	0.17	3.9	1,506	-4.89
Yukon River below Fortymile River	9/5/2004	39.9	718	0.15	3.3	1,860	-4.39
Yukon River at Eagle, Alaska	9/6/2004	53.5	981	0.12	2.8	1,834	-4.39

Mercury

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A description of sample collection and processing of samples for filtered methyl mercury, filtered total mercury, particulate methyl mercury, and particulate total mercury is given in Schuster (2003).

Table 23. Mercury in water samples from the Yukon River and tributaries, June 2004.

[Hg, mercury; ng/L, nanograms per liter; <, less than; --, not available]

Site	Date	Filtered methyl-Hg (ng/L)	Filtered total-Hg (ng/L)	Particulate methyl-Hg (ng/L)	Particulate total-Hg (ng/L)
Nares River	6/5/2004	<0.04	0.35	<0.02	<0.12
Atlin River	6/6/2004	<0.04	2.05	<0.01	<0.06
Yukon River above Takhini River	6/7/2004	<0.04	0.30	<0.01	0.36
Takhini River	6/7/2004	<0.04	0.53	<0.04	2.77
Yukon River below Takhini River	6/7/2004	--	--	--	--
Teslin River	6/9/2004	<0.04	1.24	0.02	3.95
Yukon River below Teslin River	6/9/2004	--	--	--	--
Big Salmon River	6/10/2004	<0.04	2.55	0.07	12.20
Yukon River below Big Salmon River	6/10/2004	--	--	--	--
Little Salmon River	6/10/2004	<0.04	0.63	<0.04	2.15
Yukon River below Little Salmon River	6/10/2004	--	--	--	--
Nordenskiold River	6/11/2004	0.09	3.64	0.02	2.18
Yukon River at Carmacks	6/11/2004	<0.04	2.64	<0.04	6.00
Pelly River	6/12/2004	<0.04	3.94	<0.04	8.93
Yukon River below Pelly River	6/12/2004	--	--	--	--
Yukon River above White River	6/13/2004	<0.04	3.01	0.01	15.51
White River	6/13/2004	<0.04	1.94	<0.05	26.30
Yukon River below White River	6/14/2004	--	--	--	--
Stewart River	6/14/2004	<0.04	2.67	<0.04	16.17
Yukon River below Stewart River	6/14/2004	--	--	--	--
Sixtymile River	6/14/2004	0.07	3.63	<0.04	0.74
Yukon River below Sixtymile River	6/14/2004	--	--	--	--
Klondike River above Bonanza Creek	6/15/2004	<0.04	1.50	0.01	1.82
Klondike River below Bonanza Creek	6/15/2004	<0.04	1.75	0.02	1.91
Yukon River below Klondike River	6/16/2004	--	--	--	--
Fortymile River	6/16/2004	0.11	4.54	<0.01	0.27
Yukon River below Fortymile River	6/16/2004	--	--	--	--
Yukon River at Eagle, Alaska	6/17/2004	<0.04	2.20	<0.04	20.84

Table 24. Mercury in water samples from the Yukon River and tributaries, August/September 2004.

[Hg, mercury; ng/L, nanograms per liter; <, less than; --, not available]

Site	Date	Filtered methyl-Hg (ng/L)	Filtered total-Hg (ng/L)	Particulate methyl-Hg (ng/L)	Particulate total-Hg (ng/L)
Nares River	8/25/2004	<0.04	0.27	<0.01	0.07
Atlin River	8/26/2004	<0.04	0.37	<0.01	0.08
Yukon River above Takhini River	8/27/2004	<0.04	6.35	<0.01	0.45
Takhini River	8/27/2004	<0.04	0.54	<0.01	1.02
Yukon River below Takhini River	8/27/2004	--	--	--	--
Teslin River	8/29/2004	<0.04	0.72	<0.01	0.40
Yukon River below Teslin River	8/29/2004	--	--	--	--
Big Salmon River	8/30/2004	<0.04	0.44	<0.01	0.29
Yukon River below Big Salmon River	8/30/2004	--	--	--	--
Little Salmon River	8/30/2004	<0.04	0.62	<0.01	0.19
Yukon River below Little Salmon River	8/30/2004	--	--	--	--
Nordenskiold River	8/31/2004	0.04	1.18	<0.01	0.45
Yukon River at Carmacks	8/31/2004	<0.04	0.41	<0.01	0.57
Pelly River	9/1/2004	<0.04	0.87	<0.01	0.85
Yukon River below Pelly River	9/1/2004	--	--	--	--
Yukon River above White River	9/2/2004	<0.04	0.39	<0.01	0.79
White River	9/2/2004	<0.04	0.70	<0.06	22.00
Yukon River below White River	9/2/2004	--	--	--	--
Stewart River	9/3/2004	<0.04	0.88	<0.01	0.76
Yukon River below Stewart River	9/3/2004	--	--	--	--
Sixtymile River	9/3/2004	0.05	1.35	<0.01	0.12
Yukon River below Sixtymile River	9/3/2004	--	--	--	--
Klondike River above Bonanza Creek	9/4/2004	<0.04	0.98	<0.01	0.12
Klondike River below Bonanza Creek	9/4/2004	<0.04	0.89	<0.01	0.25
Yukon River below Klondike River	9/5/2004	--	--	--	--
Fortymile River	9/5/2004	<0.04	0.89	<0.01	0.25
Yukon River below Fortymile River	9/5/2004	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	<0.04	0.67	<0.03	8.22

Uranium

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A description of sample collection and processing of samples for uranium concentrations and uranium activity ratio is given in Schuster (2003).

Table 25. Uranium and ^{234}Uranium/^{238}Uranium activity ratios of water samples from the Yukon River and tributaries, June 2004.

[µg/L, micrograms per liter; --, not available]

Site	Date	Uranium (µg/L)	^{234}Uranium/^{238}Uranium activity ratio
Nares River	6/5/2004	0.90	1.141
Atlin River	6/6/2004	0.57	1.173
Yukon River above Takhini River	6/7/2004	0.70	1.136
Takhini River	6/7/2004	0.46	1.202
Yukon River below Takhini River	6/7/2004	--	--
Teslin River	6/9/2004	0.84	1.287
Yukon River below Teslin River	6/9/2004	--	--
Big Salmon River	6/10/2004	0.83	1.122
Yukon River below Big Salmon River	6/10/2004	--	--
Little Salmon River	6/10/2004	1.33	1.477
Yukon River below Little Salmon River	6/10/2004	--	--
Yukon River at Carmacks	6/11/2004	0.82	1.218
Nordenskiold River	6/11/2004	0.48	1.626
Pelly River	6/12/2004	0.67	1.427
Yukon River below Pelly River	6/12/2004	--	--
Yukon River above White River	6/13/2004	0.78	1.282
White River	6/13/2004	0.90	1.494
Yukon River below White River	6/14/2004	--	--
Stewart River	6/14/2004	0.66	1.394
Yukon River below Stewart River	6/14/2004	--	--
Sixtymile River	6/14/2004	1.56	1.517
Yukon River below Sixtymile River	6/14/2004	--	--
Klondike River above Bonanza Creek	6/15/2004	0.37	1.700
Klondike River below Bonanza Creek	6/15/2004	0.39	1.751
Yukon River below Klondike River	6/16/2004	--	--
Fortymile River	6/16/2004	0.66	1.653
Yukon River below Fortymile River	6/16/2004	--	--
Yukon River at Eagle, Alaska	6/17/2004	0.89	1.376

Table 26. Uranium and ^{234}Uranium/^{238}Uranium activity ratios of water samples from the Yukon River and tributaries, August/September 2004.

[µg/L, micrograms per liter; --, not available]

Site	Date	Uranium (µg/L)	^{234}Uranium/^{238}Uranium activity ratio
Nares River	8/25/2004	0.91	1.146
Atlin River	8/26/2004	0.61	1.170
Yukon River above Takhini River	8/27/2004	0.65	1.142
Takhini River	8/27/2004	0.24	1.176
Yukon River below Takhini River	8/27/2004	--	--
Teslin River	8/29/2004	0.72	1.327
Yukon River below Teslin River	8/29/2004	--	--
Big Salmon River	8/30/2004	2.44	1.263
Yukon River below Big Salmon River	8/30/2004	--	--
Little Salmon River	8/30/2004	1.39	1.487
Yukon River below Little Salmon River	8/30/2004	--	--
Yukon River at Carmacks	8/31/2004	0.77	1.245
Nordenskiold River	8/31/2004	--	--
Pelly River	9/1/2004	1.49	1.458
Yukon River below Pelly River	9/1/2004	--	--
Yukon River above White River	9/2/2004	0.94	1.320
White River	9/2/2004	1.23	1.347
Yukon River below White River	9/2/2004	--	--
Stewart River	9/3/2004	1.12	1.433
Yukon River below Stewart River	9/3/2004	--	--
Sixtymile River	9/3/2004	2.21	1.531
Yukon River below Sixtymile River	9/3/2004	--	--
Klondike River above Bonanza Creek	9/4/2004	0.79	1.714
Klondike River below Bonanza Creek	9/4/2004	0.82	1.753
Yukon River below Klondike River	9/5/2004	--	--
Fortymile River	9/5/2004	0.84	1.732
Yukon River below Fortymile River	9/5/2004	--	--
Yukon River at Eagle, Alaska	9/6/2004	1.06	1.362

Nutrients

Howard E. Taylor[1] and Jacques Finlay[2]

[1]U.S. Geological Survey, Boulder, Colorado, and [2]University of Minnesota

A description of processing of samples for nitrate, ammonium, and phosphate is found in Antweiler and others (1996). A description of processing of samples for total dissolved nitrate and total dissolved phosphorus is found in Valderrama (1981). A description of processing of samples for soluble reactive phosphorus is found in Eaton and others (1995). A description of processing of samples for particulate phosphorus is found in Strickland and Parsons (1972).

Table 27. Nutrients in water samples from the Yukon River and tributaries, June 2004.

[µg/L, micrograms per liter; mg N/L, milligrams nitrogen per liter; mg P/L, milligrams phosphorus per liter; <, less than; --, not available]

Site	Date	Total dissolved nitrogen (µg/L)	Total dissolved phosphorus (µg/L)	Soluble reactive phosphorus (µg/L)	Particulate phosphorus (µg/L)	Nitrite (mg N/L)	Ammonium (mg N/L)	Phosphate (mg P/L)
Nares River	6/5/2004	103.93	19.20	1.42	1.43	< 0.001	< 0.008	< 0.02
Atlin River	6/6/2004	47.04	15.86	1.11	2.29	< 0.001	< 0.008	< 0.02
Yukon River above Takhini River	6/7/2004	57.07	15.82	1.60	7.58	0.001	< 0.008	< 0.02
Takhini River	6/7/2004	--	14.88	1.38	60.70	< 0.001	< 0.008	< 0.02
Yukon River below Takhini River	6/7/2004	--	--	--	--	--	--	--
Teslin River	6/9/2004	123.90	16.98	1.60	70.45	< 0.001	< 0.008	< 0.02
Yukon River below Teslin River	6/9/2004	--	--	--	--	--	--	--
Big Salmon River	6/10/2004	148.10	20.32	2.48	271.61	< 0.001	< 0.008	< 0.02
Yukon River below Big Salmon River	6/10/2004	--	--	--	--	--	--	--
Little Salmon River	6/10/2004	183.30	24.54	1.42	18.64	< 0.001	< 0.008	< 0.02
Yukon River below Little Salmon River	6/10/2004	64.29	--	--	--	--	--	--
Yukon River at Carmacks	6/11/2004	125.90	13.10	1.85	125.20	< 0.001	< 0.008	< 0.02
Nordenskiold River	6/11/2004	346.40	18.51	1.80	34.33	0.001	< 0.008	< 0.02
Pelly River	6/12/2004	146.90	19.09	3.57	248.42	< 0.001	< 0.008	< 0.02
Yukon River below Pelly River	6/12/2004	--	--	--	--	--	--	--
Yukon River above White River	6/13/2004	129.80	12.46	3.76	168.23	< 0.001	< 0.008	< 0.02
White River	6/13/2004	200.20	14.88	2.13	1318.57	< 0.001	< 0.008	< 0.02
Yukon River below White River	6/14/2004	--	--	--	--	--	--	--
Stewart River	6/14/2004	141.20	23.38	3.56	129.56	< 0.001	< 0.008	< 0.02
Yukon River below Stewart River	6/14/2004	--	--	--	--	--	--	--
Sixtymile River	6/14/2004	348.30	20.98	1.78	6.28	0.002	< 0.008	< 0.02
Yukon River below Sixtymile River	6/14/2004	--	--	--	--	--	--	--
Klondike River above Bonanza Creek	6/15/2004	120.20	22.10	1.64	4.50	< 0.001	< 0.008	< 0.02
Klondike River below Bonanza Creek	6/15/2004	142.60	26.47	1.72	9.82	< 0.001	< 0.008	< 0.02
Yukon River below Klondike River	6/16/2004	--	--	--	--	--	--	--
Fortymile River	6/16/2004	425.35	24.72	1.67	2.54	0.002	< 0.008	< 0.02
Yukon River below Fortymile River	6/16/2004	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	6/17/2004	133.80	20.52	2.25	239.26	< 0.001	< 0.008	< 0.02

Table 28. Nutrients in water samples from the Yukon River and tributaries, August/September 2004.

[µg/L, micrograms per liter; mg N/L, milligrams nitrogen per liter; mg P/L, milligrams phosphorus per liter; <, less than; --, not available]

Site	Date	Total dissolved nitrogen (µg/L)	Total dissolved phosphorus (µg/L)	Soluble reactive phosphorus (µg/L)	Particulate phosphorus (µg/L)	Nitrite (mg N/L)	Ammonium (mg N/L)	Phosphate (mg P/L)
Nares River	8/25/2004	110.80	6.32	5.32	3.51	< 0.001	< 0.008	< 0.02
Atlin River	8/26/2004	42.21	7.07	2.69	2.10	< 0.001	< 0.008	< 0.02
Yukon River above Takhini River	8/27/2004	66.03	5.81	5.60	7.39	< 0.001	< 0.008	< 0.02
Takhini River	8/27/2004	83.62	7.51	2.96	33.78	< 0.001	< 0.008	< 0.02
Yukon River below Takhini River	8/29/2004	--	--	--	--	--	--	--
Teslin River	8/29/2004	102.60	9.90	3.46	6.69	< 0.001	< 0.008	< 0.02
Yukon River below Teslin River	8/30/2004	--	--	--	--	--	--	--
Big Salmon River	8/30/2004	70.99	11.47	3.31	4.10	< 0.001	< 0.008	< 0.02
Yukon River below Big Salmon River	8/30/2004	--	--	--	--	--	--	--
Little Salmon River	8/30/2004	122.90	6.23	4.08	4.04	< 0.001	0.010	< 0.02
Yukon River below Little Salmon River	8/30/2004	--	--	--	--	--	--	--
Yukon River at Carmacks	8/31/2004	111.20	16.04	3.97	6.41	< 0.001	< 0.008	< 0.02
Nordenskiold River	8/31/2004	211.70	8.48	2.31	6.72	0.001	< 0.008	< 0.02
Pelly River	9/1/2004	96.94	5.60	4.02	6.80	< 0.001	< 0.008	< 0.02
Yukon River below Pelly River	9/2/2004	--	--	--	--	--	--	--
Yukon River above White River	9/2/2004	93.13	6.28	1.86	4.86	< 0.001	< 0.008	< 0.02
White River	9/2/2004	111.00	6.24	3.24	659.58	< 0.001	< 0.008	< 0.02
Yukon River below White River	9/3/2004	--	--	--	--	--	--	--
Stewart River	9/3/2004	97.49	6.20	2.47	4.73	< 0.001	< 0.008	< 0.02
Yukon River below Stewart River	9/3/2004	--	--	--	--	--	--	--
Sixtymile River	9/3/2004	303.00	8.61	3.21	3.73	< 0.001	< 0.008	< 0.02
Yukon River below Sixtymile River	9/4/2004	--	--	--	--	--	--	--
Klondike River above Bonanza Creek	9/4/2004	104.60	6.70	3.68	1.40	< 0.001	< 0.008	< 0.02
Klondike River below Bonanza Creek	9/4/2004	135.00	6.64	2.08	1.73	< 0.001	< 0.008	< 0.02
Yukon River below Klondike River	9/5/2004	--	--	--	--	--	--	--
Fortymile River	9/5/2004	452.80	11.33	5.53	16.16	< 0.001	< 0.008	< 0.02
Yukon River below Fortymile River	9/5/2004	--	--	--	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	113.80	7.27	3.10	325.23	< 0.001	< 0.008	< 0.02

Carbon Isotope Composition of Dissolved Organic and Inorganic Carbon

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A description of sample collection and processing of samples for carbon isotope composition and apparent age is given in Raymond and Hopkinson (2003). Samples for carbon isotope composition were collected during August / September 2004 only.

Table 29. Carbon isotope composition of dissolved organic and inorganic carbon in water samples from the Yukon River and tributaries, August/September 2004.

[C, carbon; DOC, dissolved organic carbon; DIC, dissolved inorganic carbon; --, not available]

Site	Date	^{13}C-DOC (per mil)	^{14}C-DOC Fraction modern	^{14}C-DOC Apparent age before present (years)	^{13}C-DIC (per mil)	^{14}C-DIC Fraction modern	^{14}C-DIC Apparent age before present (years)
Nares River	8/25/2004	-25.91	0.78	1,972	-2.51	1.00	--
Atlin River	8/26/2004	-27.45	0.55	4,800	-1.59	0.99	22
Yukon River above Takhini River	8/27/2004	-25.82	0.82	1,545	-1.99	1.00	--
Takhini River	8/27/2004	--	--	--	--	--	--
Yukon River below Takhini River	8/27/2004	--	--	--	--	--	--
Teslin River	8/29/2004	--	--	--	--	--	--
Yukon River below Teslin River	8/29/2004	--	--	--	--	--	--
Big Salmon River	8/30/2004	-26.02	0.90	805	-7.8	0.81	1,734
Yukon River below Big Salmon River	8/30/2004	--	--	--	--	--	--
Little Salmon River	8/30/2004	--	--	--	--	--	--
Yukon River below Little Salmon River	8/30/2004	--	--	--	--	--	--
Yukon River at Carmacks	8/31/2004	--	--	--	--	--	--
Nordenskiold River	8/31/2004	--	--	--	--	--	--
Pelly River	9/1/2004	-26.33	0.91	799	-7.13	0.76	2,195
Yukon River below Pelly River	9/1/2004	--	--	--	--	--	--
Yukon River above White River	9/2/2004	-26.05	0.88	1,676	-5.23	0.89	955
White River	9/2/2004	-27.84	0.90	806	-3.51	0.60	4,099
Yukon River below White River	9/2/2004	--	--	--	--	--	--
Stewart River	9/3/2004	-20.83	0.92	704	-6.59	0.75	39
Yukon River below Stewart River	9/3/2004	-20.75	0.93	603	--	--	--
Sixtymile River	9/3/2004	--	--	--	-7.27	0.83	1,510
Yukon River below Sixtymile River	9/3/2004	--	--	--	--	--	--
Klondike River above Bonanza Creek	9/4/2004	--	--	--	--	--	--
Klondike River below Bonanza Creek	9/4/2004	--	--	--	-8.26	0.77	2,059
Yukon River below Klondike River	9/5/2004	--	--	--	--	--	--
Fortymile River	9/5/2004	-27.47	1.01	post-nuclear era	-5.14	0.79	1,910
Yukon River below Fortymile River	9/5/2004	--	--	--	--	--	--
Yukon River at Eagle, Alaska	9/6/2004	-24.10	0.94	478	-5.12	0.75	2,274

Sediment Mineralogy

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A description of sample collection and processing of samples for quantitative X-ray mineralogical analysis is given in Schuster (2003).

Table 30. Sediment mineralogy of water samples from the Yukon River and tributaries, 2004

Site	Yukon River at Eagle	Yukon River at Eagle	White River	White River
Date	6/17/2004	9/6/2004	6/13/2004	9/2/2004
MINERALS: Non-Clays	Percent by weight	Percent by weight	Percent by weight	Percent by weight
Quartz	28.3	18.4	15.0	16.9
ordered Microcline feldspar	0.4	1.0	1.4	0.8
intermediate Microcline feldspar	5.7	5.3	5.3	4.8
Sanidine feldspar	0.2	0.7	0.3	0.0
Orthoclase feldspar	0.0	0.0	0.0	0.0
Anorthoclase feldspar	15.7	18.0	20.8	19.6
Albite feldspar (Cleavelandite)	6.8	7.0	7.5	7.8
Oligoclase feldspar (Norway)	1.2	1.3	0.1	1.2
Andesine feldspar	0.2	0.0	0.0	0.0
Labradorite feldspar	5.6	6.5	8.0	8.7
Bytownite feldspar	2.3	4.4	3.9	3.0
Anorthite feldspar	0.9	0.1	0.0	0.0
Calcite	6.3	10.4	10.3	11.2
Mg-calcite	0.2	0.3	0.2	0.5
Dolomite	2.9	3.6	3.4	3.8
Amphibole (ferrotschermakite)	0.9	1.3	1.5	1.7
Pyroxene (diopside)	0.3	1.1	1.3	1.6
Magnetite	0.0	0.0	0.0	0.0
Hematite	0.4	0.4	0.4	0.4
Goethite	0.1	0.2	0.0	0.0
Maghemite	0.9	1.3	1.0	1.3
Apatite	0.1	0.5	0.6	0.3
Total: non-clays	79.4	81.8	81.1	83.5
MINERALS: Clays				
disordered Kaolinite	1.2	0.9	1.1	0.6
Ferruginous smectite	6.9	8.0	7.7	7.2
1Md illite (+ dioct mica & smectite)	6.6	3.9	3.7	4.4
Chlorite CCa-1	1.9	2.4	2.7	1.8
Chlorite CCa-3	0.0	0.0	0.0	0.0
Chlorite CMM	2.5	2.7	1.9	2.3
Chlorite CO	0.0	0.0	0.0	0.3
Mg-Chlorite (A)	0.0	1.6	1.4	1.4
Muscovite (2M1)	5.4	5.4	5.0	2.8
Total: clays	24.5	24.9	23.5	20.7

Quality Assurance and Quality Control

Quality assurance (QA) and quality control (QC) procedures were an integral part of the study to ensure accuracy, precision, and completeness of the data. QA was achieved by adhering to standard USGS protocols (Edwards and Glysson, 1988) and detailed protocols for the collection and processing of environmental samples from the Yukon River basin specifically (USGS, 2006a, b). QA also required the collection of QC samples for the testing of field and laboratory methodologies.

QC samples included sequential replicates and process blanks. Sequential replicate samples are used to identify and quantify possible bias and variability introduced from the field equipment preparation, sample collection, and field processing. Process blanks are used to identify and document any systematic contamination induced from cleaning and preparation of the sampling and processing equipment and the handling of samples by field personnel.

Relative percent differences (RPDs) are used to describe variability found in replicate samples (table 31) and were computed with the follow equation:

$$\mathrm{RPD} = \left[\frac{C1 - C2}{(C1 + C2)/2} \right] \times 100$$

where

$C1$ is the concentration for aliquot 1, and

$C2$ is the concentration for aliquot 2.

Table 32, statistics for relative percent differences, indicates that the highest RPD of 169.5 occurred in the mercury sample analysis category. An arbitrarily defined RPD bracket of 0-15 contains 17 percent of mercury sample analyses and had the lowest percent of samples within the RPD bracket. All other analysis categories contain a larger percent of samples in the 0-15 RPD bracket with uranium and ^{234}uranium/^{238}uranium activity ratios, tritium, and deuterium and oxygen isotopes at 100 percent. The results indicate that confidence in reported concentrations is highest for uranium and

^{234}uranium/^{238}uranium activity ratios, tritium, and deuterium and oxygen isotopes and somewhat lower for other analyses.

Process blanks (table 33) were obtained by processing a volume, similar to an environmental sample, of inorganic and organic free water, with the same procedures and equipment used during sample processing. Concerns should be raised when the minimum concentration of a sample constituent is lower than the maximum concentration detected in the field equipment blank. Concentrations of constituents detected in the process blanks, with a few exceptions, were all at or near detection levels and generally were much lower than the concentrations in the environmental samples.

Table 31. Relative percent difference (RPD) for replicate samples.

Particulate carbon and particulate nitrogen in water samples from the Yukon River and tributaries.

[mg/L, milligrams per liter; --, not available]

Site	Date	Total particulate carbon (mg/L)	Total particulate nitrogen (mg/L)
Yukon River above Takhini River	6/7/2004	0.45	0.05
Yukon River above Takhini River	6/7/2004	0.37	0.04
RPD		19.5	20.0
Yukon River above Takhini River	8/27/2004	0.19	0.02
Yukon River above Takhini River	8/27/2004	0.16	0.02
RPD		17.1	0.0

Tritium in water samples from the Yukon River and tributaries.

[TU, tritium units]

Site	Date	Tritium (TU)
Yukon River above Takhini River	6/7/2004	7.1
Yukon River above Takhini River	6/7/2004	7.2
RPD		1.4

Table 31. Relative percent difference (RPD) for replicate samples-cont.

Major cations and dissolved trace elements in water samples from the Yukon River and tributaries.

[µg/L, micrograms per liter; mg/L, milligrams per liter; nc, not calculated; <, less than]

Site	Date	Aluminum (µg/L)	Arsenic (µg/L)	Boron (µg/L)	Barium (µg/L)	Beryllium (µg/L)	Bismuth (µg/L)
Yukon River above Takhini River	6/7/2004	6.1	0.41	1.5	24	< 0.01	0.003
Yukon River above Takhini River	6/7/2004	35	0.42	1.8	25	< 0.01	< 0.003
RPD		140.6	2.4	18.2	4.1	nc	nc
Yukon River above Takhini River	8/27/2004	8.2	0.42	1.3	25	< 0.006	0.010
Yukon River above Takhini River	8/27/2004	7.8	0.39	1.3	23	< 0.006	0.006
RPD		5.0	7.4	0.0	8.3	nc	50

Site	Date	Calcium (mg/L)	Cadmium (µg/L)	Cerium (µg/L)	Cobalt (µg/L)	Chromium (µg/L)	Cesium (µg/L)
Yukon River above Takhini River	6/7/2004	14	0.004	0.0064	0.015	< 0.2	< 0.02
Yukon River above Takhini River	6/7/2004	14	0.004	0.028	0.052	< 0.2	< 0.02
RPD		0.0	0.0	125.6	110.5	nc	nc
Yukon River above Takhini River	8/27/2004	12	0.004	0.0083	0.011	< 0.2	< 0.02
Yukon River above Takhini River	8/27/2004	12	< 0.002	0.0067	0.017	< 0.2	< 0.02
RPD		0.0	nc	21.3	42.8	nc	nc

Site	Date	Copper (µg/L)	Dysprosium (µg/L)	Erbium (µg/L)	Europium (µg/L)	Iron (µg/L)	Gallium (µg/L)
Yukon River above Takhini River	6/7/2004	0.35	< 0.001	< 0.001	< 0.0007	10	0.012
Yukon River above Takhini River	6/7/2004	0.42	0.0023	0.001	< 0.0007	54	0.020
RPD		18.2	nc	nc	nc	137.5	50.0
Yukon River above Takhini River	8/27/2004	0.29	0.0012	< 0.0006	0.0006	12	0.017
Yukon River above Takhini River	8/27/2004	0.27	0.0011	0.0009	< 0.0002	9	0.014
RPD		7.1	8.7	nc	nc	28.6	19.3

Table 31. Relative percent difference (RPD) for replicate samples-cont.

Major cations and dissolved trace elements in water samples from the Yukon River and tributaries-cont.

[µg/L , micrograms per liter; mg/L, milligrams per liter; nc, not calculated; <, less than]

Site	Date	Gadolinium (µg/L)	Holmium (µg/L)	Potassium (mg/L)	Lanthanum (µg/L)	Lithium (µg/L)	Lutetium (µg/L)
Yukon River above Takhini River	6/7/2004	0.0013	< 0.0003	0.65	0.0047	0.54	< 0.0002
Yukon River above Takhini River	6/7/2004	0.0033	0.0005	0.63	0.016	0.55	0.0002
RPD		87.0	nc	3.1	109.2	1.8	nc
Yukon River above Takhini River	8/27/2004	0.0015	0.0003	0.67	0.0049	0.52	0.0003
Yukon River above Takhini River	8/27/2004	0.0008	0.0002	0.66	0.0044	0.53	< 0.0002
RPD		60.9	40	1.5	10.7	1.9	nc

Site	Date	Magnesium (mg/L)	Manganese (µg/L)	Molybdenum (µg/L)	Sodium (µg/L)	Neodymium (µg/L)	Nickel (µg/L)
Yukon River above Takhini River	6/7/2004	2.5	1.2	1.5	0.92	0.004	0.43
Yukon River above Takhini River	6/7/2004	2.5	2.3	1.5	0.93	0.016	0.55
RPD		0.0	62.9	0.0	1.1	120	24.5
Yukon River above Takhini River	8/27/2004	2.1	1.1	1.5	0.79	0.0045	0.18
Yukon River above Takhini River	8/27/2004	2.1	1.1	1.5	0.79	0.0043	0.18
RPD		0.0	0.0	0.0	0.0	4.5	0.0

Site	Date	Phosphorus (µg/L)	Lead (µg/L)	Praseodymium (µg/L)	Rubidium (µg/L)	Rhenium (µg/L)	Sulfur (mg/L)
Yukon River above Takhini River	6/7/2004	< 10	0.015	0.0008	0.76	0.0012	2.4
Yukon River above Takhini River	6/7/2004	< 10	0.020	0.0035	0.80	0.0012	2.4
RPD		nc	28.6	125.6	5.1	0.0	0.0
Yukon River above Takhini River	8/27/2004	< 10	0.022	0.0010	0.83	0.0009	2.4
Yukon River above Takhini River	8/27/2004	< 10	0.012	0.0010	0.83	0.0010	2.4
RPD		nc	58.8	0.0	0.0	10.5	0.0

Table 31. Relative percent difference (RPD) for replicate samples-cont

Major cations and dissolved trace elements in water samples from the Yukon River and tributaries-cont.

[µg/L, micrograms per liter; mg/L, milligrams per liter; nc, not calculated; <, less than]

Site	Date	Antimony (µg/L)	Selenium (µg/L)	Silica (µg/L)	Samarium (µg/L)	Strontium (µg/L)	Terbium (µg/L)
Yukon River above Takhini River	6/7/2004	0.093	< 0.1	2.8	< 0.001	74	< 0.0003
Yukon River above Takhini River	6/7/2004	0.094	< 0.1	2.9	0.003	73	0.0005
RPD		1.1	nc	3.5	nc	1.4	nc
Yukon River above Takhini River	8/27/2004	0.10	0.16	2.4	0.001	69	< 0.0002
Yukon River above Takhini River	8/27/2004	0.11	0.13	2.4	0.001	69	0.0002
RPD		9.5	20.7	0.0	0.0	0.0	nc

Site	Date	Tellurium (µg/L)	Thorium (µg/L)	Thallium (µg/L)	Thulium (µg/L)	Uranium (µg/L)	Vanadium (µg/L)
Yukon River above Takhini River	6/7/2004	< 0.005	0.013	< 0.005	< 0.0001	0.67	0.17
Yukon River above Takhini River	6/7/2004	< 0.005	0.016	< 0.005	0.0002	0.68	0.22
RPD		nc	20.7	nc	nc	1.5	25.6
Yukon River above Takhini River	8/27/2004	< 0.007	0.042	0.004	< 0.0002	0.61	0.23
Yukon River above Takhini River	8/27/2004	< 0.007	0.028	0.006	< 0.0002	0.57	0.20
RPD		nc	31.1	40.0	nc	6.8	13.9

Site	Date	Thungsten (µg/L)	Yttrium (µg/L)	Ytterbium (µg/L)	Zinc (µg/L)	Zirconium (µg/L)
Yukon River above Takhini River	6/7/2004	0.016	0.0094	< 0.001	0.26	0.031
Yukon River above Takhini River	6/7/2004	0.026	0.018	< 0.001	0.21	0.026
RPD		47.6	62.8	nc	21.3	17.5
Yukon River above Takhini River	8/27/2004	0.020	0.0085	0.0008	1.6	0.043
Yukon River above Takhini River	8/27/2004	0.018	0.0075	0.0005	1.0	0.051
RPD		10.5	12.5	46.1	46.2	17.0

Table 31. Relative percent difference (RPD) for replicate samples-cont

Anions in water samples from the Yukon River and tributaries.

[mg/L, milligrams per liter; <, less than; nc, not calculated]

Site	Date	Chloride (mg/L)	Nitrate (mg/L)	Sulfate (mg/L)
Yukon River above Takhini River	6/7/2004	0.17	<0.01	5.65
Yukon River above Takhini River	6/7/2004	0.22	<0.01	5.74
RPD		25.5	nc	1.5
Yukon River above Takhini River	8/27/2004	0.16	<0.01	5.68
Yukon River above Takhini River	8/27/2004	0.16	<0.01	5.69
RPD		0.0	nc	0.2

Deuterium and oxygen isotopes in water samples from the Yukon River and tributaries.

[^{2}H, deuterium; ^{18}O, oxygen isotope; δ, delta]

Site	Date	δ^{2}H (per mil)	δ^{18}O (per mil)
Yukon River above Takhini River	6/7/2004	-143.7	-18.61
Yukon River above Takhini River	6/7/2004	-143.9	-18.48
RPD		0.1	0.7
Yukon River above Takhini River	8/27/2004	-142.3	-18.32
Yukon River above Takhini River	8/27/2004	-141.9	-18.34
RPD		0.3	0.1

Chlorophyll *a* in water samples from the Yukon River and tributaries.

[µg/L, micrograms per liter; --, not available]

Site	Date	Chlorophyll *a* (ug/L)
Yukon River above Takhini River	6/7/2004	0.41
Yukon River above Takhini River	6/7/2004	0.58
RPD		33.7
Yukon River above Takhini River	8/27/2004	0.48
Yukon River above Takhini River	8/27/2004	0.47
RPD		2.1

Table 31. Relative percent difference (RPD) for replicate samples-cont.

Dissolved organic carbon and fractionation of water samples from the Yukon River and tributaries.

[mg C/L, milligrams carbon per liter; nm, nanometer wavelength; SUVA, specific ultra violet absorbance; (L/mg C/m), liters per milligram carbon per one meter path length; %, percent;]

Site	Date	Dissolved organic carbon (mg C/L)	Ultraviolet absorbance at 254 nm	Whole water SUVA (L/mg C/m)	Hydrophobic acid SUVA (L/mg C/m)	Hydrophobic acid (percent)
Yukon River above Takhini River	6/7/2004	1.4	0.024	1.7	2.4	33.0
Yukon River above Takhini River	6/7/2004	1.4	0.023	1.7	2.8	30.0
RPD		0.0	4.3	0.0	15.4	9.5
Yukon River above Takhini River	8/27/2004	1.1	0.016	1.5	2.2	39.0
Yukon River above Takhini River	8/27/2004	1.2	0.017	1.4	2.3	34.0
RPD		8.7	6.1	6.9	4.4	13.7

Dissolved carbon gasses and carbon isotopes in water samples from the Yukon River and tributaries.

[CO_2, carbon dioxide; µmol/L, micromoles per liter; ppm, parts per million; CH_4, methane; DIC, dissolved inorganic carbon; Corrected, adjusted for temperature and altitude]

Site	Date	CO_2 (µ moles/L)	Corrected P_{CO2} (ppm)	CH_4 (µ mol/L)	Corrected P_{CH4} (ppm)	DIC (µ mol/L)	^{13}C-DIC (per mil)
Yukon River above Takhini River	6/7/2004	15.9	303	0.25	5.5	970	-2.78
Yukon River above Takhini River	6/7/2004	10.9	207	0.26	5.9	982	-3.03
RPD		37.3	37.6	3.9	7.0	1.2	8.6
Yukon River above Takhini River	8/27/2004	20.3	420	0.39	8.9	854	-1.97
Yukon River above Takhini River	8/27/2004	18.1	374	0.34	7.8	901	-1.74
RPD		11.5	11.6	13.7	13.2	5.4	12.4
White River	6/13/2004	35.2	692	0.12	2.8	1885	-3.56
White River	6/13/2004	44.3	871	0.11	2.4	1862	-3.92
RPD		22.9	22.9	8.7	15.4	1.2	9.6

Table 31. Relative percent difference (RPD) for replicate samples-cont.

Mercury concentrations in water samples from the Yukon River and tributaries.

[Hg, mercury; ng/L, nanograms per liter; <, less than; nc, not calculated]

Site	Date	Filtered methyl-Hg (ng/L)	Filtered total-Hg (ng/L)	Particulate methyl-Hg (ng/L)	Particulate total-Hg (ng/L)
Yukon River above Takhini River	6/7/2004	<0.04	0.30	<0.01	0.36
Yukon River above Takhini River	6/7/2004	<0.04	1.87	<0.01	0.29
RPD		nc	144.7	nc	21.5
Yukon River above Takhini River	8/27/2004	<0.04	6.35	<0.01	0.45
Yukon River above Takhini River	8/27/2004	<0.04	0.34	<0.01	0.47
RPD		nc	169.5	nc	4.3
White River	6/13/2004	<0.04	0.70	<0.06	22.00
White River	6/13/2004	<0.04	0.58	<0.07	12.30
RPD		nc	18.7	nc	56.6

Uranium and ^{234}Uranium/^{238}Uranium activity ratios of water samples from the Yukon River and tributaries.

[µg/L, micrograms per liter]

Site	Date	Uranium (µg/L)	^{234}Uranium/^{238}Uranium activity ratio
Yukon River above Takhini River	6/7/2004	0.70	1.154
Yukon River above Takhini River	6/7/2004	0.70	1.118
RPD		0.0	3.2
Yukon River above Takhini River	8/27/2004	0.65	1.150
Yukon River above Takhini River	8/27/2004	0.65	1.134
RPD		0.0	1.4

Table 31. Relative percent difference (RPD) for replicate samples-cont.

Nutrients in water samples from the Yukon River and tributaries.

[µg/L, micrograms per liter; mg N/L, milligrams nitrogen per liter; mg P/L, milligrams phosphorus per liter; <, less than; nc, not calculated]

Site	Date	Total dissolved nitrogen (µg/L)	Total dissolved phosphorus (µg/L)	Soluble reactive phosphorus (µg/L)	Particulate phosphorus (µg/L)	Nitrate (mg N/L)	Ammonium (mg N/L)	Phosphate (mg P/L)
Yukon River above Takhini River	6/7/2004	0.04	--	0.05	7.71	0.001	< 0.008	< 0.02
Yukon River above Takhini River	6/7/2004	0.06	15.82	0.05	7.58	< 0.001	< 0.008	< 0.02
RPD		40.0	nc	0.0	1.7	nc	nc	nc
Yukon River above Takhini River	8/27/2004	0.07	5.81	0.18	7.39	< 0.001	< 0.008	< 0.02
Yukon River above Takhini River	8/27/2004	0.08	6.76	0.08	6.40	< 0.001	< 0.008	< 0.02
RPD		13.3	15.1	76.9	14.4	nc	nc	nc

Table 31. Relative percent difference (RPD) for replicate samples-cont.

Carbon isotope composition of dissolved organic and inorganic carbon in water samples from the Yukon River and tributaries.

[DOC, dissolved organic carbon; DIC, dissolved inorganic carbon; --, not available]

Site	Date	^{13}C-DOC (per mil)	^{14}C-DOC Fraction modern	^{14}C-DOC Apparent age before present	^{13}C-DIC (per mil)	^{14}C-DIC Fraction modern	^{14}C-DIC Apparent age before present (years)
Yukon River above Takhini River	8/27/2004	-25.75	0.8	1772	--	--	--
Yukon River above Takhini River	8/27/2004	-25.89	0.85	1319	--	--	--
RPD		5.4	5.3	29.3	--	--	--
					--	--	--
Stewart River	9/3/2004	-23.66	0.94	543	-6.76	0.75	39
Stewart River	9/3/2004	-18	0.9	865	-6.42	0.76	39
RPD		27.2	4	45.7	5.2	0.3	0
Yukon River above White River	9/2/2004	--	--	--	-5.76	0.89	933
Yukon River above White River	9/2/2004	--	--	--	-5.29	0.89	977
RPD		--	--	--	8.5	0	4.6

Table 32. Statistics for relative percent difference in replicate samples.

.[Q25, 25th percentile; Q75, 75th percentile; Bracket, percentage of samples ≥ 0.0 and ≤ 15 relative percent difference; N, number of samples; nc, not calculated]

Analysis category	Mean	Q25	Q75	Minimum	Maximum	Bracket	N
Particulate carbon and particulate nitrogen	14.2	12.8	19.6	0.0	20.0	25	4
Tritium	nc	nc	nc	1.4	1.4	100	1
Major cations and dissolved trace elements	25.9	1.1	37.8	0.0	140.6	56	78
Anions	6.8	0.15	7.5	0.0	25.5	75	4
Deuterium and oxygen isotopes	0.3	0.1	0.4	0.1	0.7	100	4
Chlorophyll *a*	17.9	10.0	25.8	2.1	33.7	50	2
Dissolved organic carbon and fractionation	6.9	4.3	9.3	0.0	15.4	90	10
Dissolved carbon gasses and carbon isotopes	13.6	7.4	15.0	1.2	37.6	72	18
Mercury	69.2	18.7	122.7	4.3	169.5	17	6
Uranium and ^{234}Uranium/^{238}Uranium activity ratios	1.2	0.0	1.9	0.0	3.2	100	4
Nutrients	23.1	7.5	27.6	0.0	76.5	57	7
Carbon isotope composition of disolved organic and inorganic carbon	11.3	3.1	13.2	0.0	45.7	75	12

Table 33. Concentrations in process blank samples.

Particulate carbon.

[mg/L, milligrams per liter; MDL, method detection limit; <, less than]

Date	Total particulate carbon (mg/L)	MDL (mg/L)
6/4/2004	0.151	0.08
6/15/2004	0.260	0.08
8/24/2004	<0.08	0.08
9/6/2004	0.148	0.08

Table 33. Concentrations in process blank samples-cont.

Major cations and dissolved trace elements.

[µg/L, micrograms per liter; mg/L, milligrams per liter; <, less than; MDL, method detection limit]

Date	Aluminum (µg/L)	MDL (µg/L)	Arsenic (µg/L)	MDL (µg/L)	Boron (µg/L)	MDL (µg/L)	Barium (µg/L)	MDL (µg/L)
6/15/2004	0.94	0.01	0.06	0.02	< 0.6	0.6	0.071	0.006
8/24/2004	1.6	0.01	0.03	0.02	4.9	0.6	0.13	0.006
9/6/2004	2.7	0.01	0.03	0.02	0.7	0.6	0.053	0.006

Date	Beryllium (µg/L)	MDL (µg/L)	Bismuth (µg/L)	MDL (µg/L)	Calcium (mg/L)	MDL (mg/L)	Cadmium (µg/L)	MDL (µg/L)
6/15/2004	< 0.006	0.006	0.014	0.001	0.026	0.010	< 0.002	0.002
8/24/2004	< 0.006	0.006	0.008	0.001	0.039	0.010	0.005	0.002
9/6/2004	< 0.006	0.006	0.005	0.001	0.035	0.010	0.014	0.002

Date	Cerium (µg/L)	MDL (µg/L)	Cobalt (µg/L)	MDL (µg/L)	Chromium (µg/L)	MDL (µg/L)	Cesium (µg/L)	MDL (µg/L)
6/15/2004	0.0010	0.0002	0.43	0.003	< 0.2	0.2	< 0.02	0.02
8/24/2004	0.0011	0.0002	0.11	0.003	< 0.2	0.2	< 0.02	0.02
9/6/2004	0.0032	0.0002	0.11	0.003	< 0.2	0.2	< 0.02	0.02

Date	Copper (µg/L)	MDL (µg/L)	Dysprosium (µg/L)	MDL (µg/L)	Erbium (µg/L)	MDL (µg/L)	Europium (µg/L)	MDL (µg/L)
6/15/2004	0.06	0.02	< 0.0004	0.0004	< 0.0006	0.0006	< 0.0002	0.0002
8/24/2004	0.07	0.02	< 0.0004	0.0004	< 0.0006	0.0006	< 0.0002	0.0002
9/6/2004	0.04	0.02	< 0.0004	0.0004	< 0.0006	0.0006	< 0.0002	0.0002

Date	Iron (µg/L)	MDL (µg/L)	Gallium (µg/L)	MDL (µg/L)	Gadolinium (µg/L)	MDL (µg/L)	Holmium (µg/L)	MDL (µg/L)
6/15/2004	3	1	< 0.001	0.001	< 0.0007	0.0007	< 0.0001	0.0001
8/24/2004	5	1	< 0.001	0.001	< 0.0007	0.0007	< 0.0001	0.0001
9/6/2004	6	1	0.002	0.001	< 0.0007	0.0007	< 0.0001	0.0001

Table 33. Concentrations in process blank samples-cont.

Major cations and dissolved trace elements-cont.

[µg/L, micrograms per liter; mg/L, milligrams per liter; <, less than; MDL, method detection limit]

Date	Potassium (mg/L)	MDL (mg/L)	Lanthanum (µg/L)	MDL (µg/L)	Lithium (µg/L)	MDL (µg/L)	Lutetium (µg/L)	MDL (µg/L)
6/15/2004	0.010	0.01	0.0006	0.0002	0.03	0.02	< 0.0002	0.0002
8/24/2004	< 0.01	0.01	0.0005	0.0002	< 0.02	0.02	< 0.0002	0.0002
9/6/2004	< 0.01	0.01	0.0014	0.0002	< 0.02	0.02	< 0.0002	0.0002

Date	Magnesium (mg/L)	MDL (mg/L)	Manganese (µg/L)	MDL (µg/L)	Molybdenum (µg/L)	MDL (µg/L)	Sodium (mg/L)	MDL (mg/L)
6/15/2004	0.006	0.0001	0.74	0.01	0.18	0.03	0.012	0.005
8/24/2004	0.011	0.0001	0.23	0.01	< 0.03	0.03	0.009	0.005
9/6/2004	0.005	0.0001	0.27	0.01	< 0.03	0.03	0.009	0.005

Date	Neodymium (µg/L)	MDL (µg/L)	Nickel (µg/L)	MDL (µg/L)	Phosphorus (µg/L)	MDL (µg/L)	Lead (µg/L)	MDL (µg/L)
6/15/2004	< 0.001	0.001	0.17	0.01	< 10	10	0.021	0.005
8/24/2004	< 0.001	0.001	0.058	0.01	< 10	10	0.037	0.005
9/6/2004	< 0.001	0.001	0.055	0.01	< 10	10	0.016	0.005

Date	Praseodymium (µg/L)	MDL (µg/L)	Rubidium (µg/L)	MDL (µg/L)	Rhenium (µg/L)	MDL (µg/L)	Sulfur (mg/L)	MDL (mg/L)
6/15/2004	< 0.0002	0.0002	0.0097	0.0010	< 0.0005	0.0005	< 0.02	0.02
8/24/2004	< 0.0002	0.0002	0.0065	0.0010	< 0.0005	0.0005	< 0.02	0.02
9/6/2004	0.0003	0.0002	0.011	0.0010	< 0.0005	0.0005	< 0.02	0.02

Date	Antimony (µg/L)	MDL (µg/L)	Selenium (µg/L)	MDL (µg/L)	Silica (mg/L)	MDL (mg/L)	Samarium (µg/L)	MDL (µg/L)
6/15/2004	0.028	0.002	0.07	0.05	< 0.03	0.03	< 0.001	0.001
8/24/2004	0.026	0.002	< 0.05	0.05	0.06	0.03	< 0.001	0.001
9/6/2004	0.045	0.002	< 0.05	0.05	0.07	0.03	< 0.001	0.001

Table 33. Concentrations in process blank samples-cont.

Major cations and dissolved trace elements-cont.

[µg/L, micrograms per liter; mg/L, milligrams per liter; <, less than; MDL, method detection limit]

Date	Strontium (µg/L)	MDL (µg/L)	Terbium (µg/L)	MDL (µg/L)	Tellurium (µg/L)	MDL (µg/L)	Thorium (µg/L)	MDL (µg/L)
6/15/2004	0.13	0.01	< 0.0002	0.0002	< 0.007	0.007	0.029	0.002
8/24/2004	0.02	0.01	< 0.0002	0.0002	< 0.007	0.007	0.021	0.002
9/6/2004	0.09	0.01	< 0.0002	0.0002	< 0.007	0.007	0.027	0.002

Date	Thallium (µg/L)	MDL (µg/L)	Thulium (µg/L)	MDL (µg/L)	Uranium (µg/L)	MDL (µg/L)	Vanadium (µg/L)	MDL (µg/L)
6/15/2004	0.024	0.003	< 0.0002	0.0002	0.004	0.001	0.10	0.07
8/24/2004	0.003	0.003	< 0.0002	0.0002	< 0.001	0.001	< 0.07	0.07
9/6/2004	< 0.003	0.003	< 0.0002	0.0002	< 0.001	0.001	< 0.07	0.07

Date	Tungsten (µg/L)	MDL (µg/L)	Yttrium (µg/L)	MDL (µg/L)	Ytterbium (µg/L)	MDL (µg/L)	Zinc (µg/L)	MDL (µg/L)
6/15/2004	< 0.002	0.002	0.0004	0.0002	< 0.0004	0.0004	1.2	0.01
8/24/2004	< 0.002	0.002	0.0004	0.0002	< 0.0004	0.0004	1.8	0.01
9/6/2004	< 0.002	0.002	0.0011	0.0002	< 0.0004	0.0004	3.6	0.01

Date	Zirconium (µg/L)	MDL (µg/L)
6/15/2004	0.038	0.005
8/24/2004	0.043	0.005
9/6/2004	0.018	0.005

Table 33. Concentrations in process blank samples-cont.

Anions.

[mg/l, milligrams per liter; E, estimate; MDL, method detection limit]

Date	Chloride (mg/L)	MDL (mg/L)	Nitrate (mg/L)	MDL (mg/L)	Sulfate (mg/L)	MDL (mg/L)
6/4/2004	<0.03	0.03	0.06E	0.01	0.67	0.03
6/15/2004	0.04E	0.03	<0.01	0.01	0.70	0.03
8/24/2004	<0.03	0.03	<0.01	0.01	<0.03	0.03
9/6/2004	<0.03	0.03	<0.01	0.01	<0.03	0.03

Dissolved organic carbon and fractionation.

[mg C/L, milligrams carbon per liter; nm, nanometer wavelength;
MDL, method detection limit]

Date	Dissolved organic carbon (mg C/L)	MDL (mg C/L)	Ultraviolet absorbance @ 254nm	MDL @ 254nm
6/4/2004	0.5	0.2	0.004	0.0001
6/15/2004	0.9	0.2	0.003	0.0001
8/24/2004	0.8	0.2	0.005	0.0001

Mercury.

[Hg, mercury; ng/L, nanograms per liter; <, less then; MDL, method detection limit]

Date	Filtered Methyl-Hg (ng/L)	MDL (ng/L)	Filtered Total-Hg (ng/L)	MDL (ng/L)	Particulate Methyl-Hg (ng/L)	MDL (ng/L)	Particulate Total-Hg (ng/L)	MDL (ng/L)
6/15/2004	<0.04	0.04	0.10	0.02	<0.04	0.04	<0.13	0.13
8/24/2004	<0.04	0.04	0.25	0.03	<0.01	0.01	<0.07	0.07
9/6/2004	<0.04	0.04	0.13	0.02	<0.01	0.01	<0.08	0.08

Uranium.

[ug/L, micrograms per liter; MDL, method detection limit;
<, less than]

Date	Uranium (µg/L)	MDL (µg/L)
6/4/2004	<0.001	0.001
6/15/2004	<0.001	0.001
8/24/2004	<0.001	0.001

Table 33. Concentrations in process blank samples-cont.

Nutrients.

[µg/L, micrograms per liter; mg N/L, milligrams nitrogen per liter; mg P/L, milligrams phosphorus per liter; <, less than; --, not available; MDL, method detection limit]

Date	Soluble reactive phosphorus (µg/L)	MDL (µg/L)	Total dissolved nitrogen (µg/L)	MDL (µg/L)	Nitrite (mg N/L)	MDL (mg N/L)	Ammonium (mg N/L)	MDL (mg N/L)	Phosphate (mg P/L)	MDL (mg P/L)
6/4/2004	<4.03	4.03	<60.0	60.0	--	--	--	--	--	--
6/15/2004	<4.03	4.03	<60.0	60.0	--	--	--	--	--	--
8/24/2004	--	--	--	--	< 0.001	0.001	< 0.008	0.008	< 0.02	0.02
9/6/2004	4.24	4.03	65.8	60.0	< 0.001	0.001	< 0.008	0.008	< 0.02	0.02

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