APPENDIX 3.2
Air Quality

Monthly Climate Summaries for Selected Climate Stations Near Fort Wainwright and Fort Greely (Western Regional Climate Center 1998).

Eielson Field, Alaska
Period of Record Monthly Climatic Summary
Period of Record: September 2, 1949 to June 30, 1997

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Max. Temperature (°F)	-2.3	6.4	23.2	41.3	58.2	68.9	70.6	65.6	53.9	31.5	10.2	-0.2	35.7
Average Min. Temperature (°F)	-18.5	-14.7	-2.9	19.7	37.2	48.0	51.1	46.2	35.0	16.6	-5.1	-15.8	16.5
Average Temperature (°F)	-10.5	-4.2	10.2	29.7	47.4	58.0	60.9	55.9	44.7	23.8	1.3	-7.8	25.8
Average Total Precipitation (in.)	0.70	0.52	0.50	0.32	0.71	1.73	2.38	2.23	1.35	0.95	0.78	0.71	12.9
Average Total Snowfall (in.)	11.7	8.9	7.7	4.2	0.9	0.0	0.0	0.0	2.3	12.4	15.4	12.8	76.4
Average Snow Depth (in.)	14	17	18	7	0	0	0	0	0	2	8	12	6

Big Delta FAA/AMOS AP, Alaska
Period of Record Monthly Climatic Summary
Period of Record: February 1, 1937 to June 30, 1997

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average Max. Temperature (°F)	3.6	11.7	23.9	40.9	57.2	67.1	69.5	64.6	52.5	31.9	13.5	4.8	36.8
Average Min. Temperature (°F)	-11.1	-5.9	1.6	20.3	36.8	47.1	50.4	45.5	35.3	18.0	-0.8	-9.6	19.0
Average Temperature (°F)	-4.0	2.2	13.5	30.4	46.8	56.8	60.2	55.4	44.4	24.5	5.5	-1.6	27.8
Average Total Precipitation (in.)	0.34	0.35	0.27	0.25	0.88	2.37	2.65	1.91	1.13	0.65	0.51	0.41	11.71
Average Total Snowfall (in.)	5.5	5.4	4.4	2.9	0.6	0.0	0.0	0.0	1.8	9.1	8.6	6.2	44.5
Average Snow Depth (in.)	8	10	9	4	0	0	0	0	0	2	5	6	4

Air Quality - Clean Air Act

The Clean Air Act (CAA), passed in 1963 and subsequently amended, is the primary federal statute regulating the emission of air pollutants within the United States. The intent of the CAA is to protect and enhance the quality of the Nation's air, public health, and welfare. In general, the CAA delegates responsibility to state and local governments to prevent and control air pollution. The CAA directs the U. S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards, (NAAQS). These standards limit the maximum concentration levels of pollutants in the outdoor air. Air pollutants are categorized as either primary or secondary. Primary air quality standards are established to protect human health; secondary standards are established to prevent negative effects on animals, plants, structures, and materials and to protect public welfare. EPA has established NAAQS for six atmospheric criteria pollutants: ozone (O_3), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), particulate matter 10-microns or less in size (PM_{10}), and lead (Pb). These pollutants were chosen because they can injure health, harm the environment, and cause property damage. The NAAQS for these pollutants are depicted in the following table.

National Ambient Air Quality Standards (NAAQS). Standards other than those for O_3 and PM_{10} are not to be exceeded more than once a year. For O_3 and PM_{10}, compliance is determined by the number of days on which the respective standard is exceeded. The 3-year running average of the number of exceedances is not to be more than 1.0 (40 CFR 50, 51; 18 AAC 50).

Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	PSD Class I Increments	PSD Class II Increments
Ozone (O_3)	Daily Maximum Hourly Average	235 $\mu g/m^3$	235 $\mu g/m^3$	-	-
Carbon Monoxide (CO)	1-hour Average 8-hour Average	40 mg/m^3 10 mg/m^3	- -	- -	- -
Sulfur Dioxide (SO_2)	3-hour Maximum 24-hour Maximum Annual Arithmetic Mean	- 365 $\mu g/m^3$ 80 $\mu g/m^3$	1,300 $\mu g/m^3$ - -	25 $\mu g/m^3$ 5 $\mu g/m^3$ 2 $\mu g/m^3$	512 $\mu g/m^3$ 91 $\mu g/m^3$ 20 $\mu g/m^3$
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	100 $\mu g/m^3$	100 $\mu g/m^3$	2.5 $\mu g/m^3$	2.5 $\mu g/m^3$
Particulate Matter of 10 Microns or Less (PM_{10})	24-hour Average Annual Arithmetic Mean	150 $\mu g/m^3$ 50 $\mu g/m^3$	150 $\mu g/m^3$ 50 $\mu g/m^3$	8 $\mu g/m^3$ 4 $\mu g/m^3$	30 $\mu g/m^3$ 17 $\mu g/m^3$
Lead (Pb)	Annual Quarterly Average	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	-	-

At the federal level, NAAQS standards are applied in two ways. Primary standards, such as sulfur dioxide, particulate matter, and nitrogen oxides are emitted from an identifiable source. Secondary pollutants are formed in the atmosphere by chemical reactions involving primary pollutants. This is illustrated by ozone, which is formed by photochemical reactions involving NO_2 and intense, short-wavelength, radiant energy from the sun. The following table lists the principle primary and secondary pollutants in the United States and their sources. These pollutants are found in areas of concentrated human population. Special regulatory requirements are set by the CAA for areas with air quality failing to meet the limitations set by the NAAQS. These areas are considered "nonattainment" for a particular pollutant when any standard is not met for more than three times (on separate days) at any point during a three calendar year period. Areas that are currently meeting the established air quality standards are considered to be "in attainment". Additionally, areas can be considered "unclassified" if there are insufficient data to determine its status and are usually considered to be in compliance with NAAQS.

Sources of Pollutant Emissions. In the United States, the principle primary and secondary air pollutants are particulate matter, sulfur dioxide, carbon monoxide, nitrogen oxides, hydrocarbons, lead, and ozone (USAF 1995).

	Natural	Domestic	Commercial	Agricultural	Industrial	Transportation-related
Particulate matter	X	X		X	X	X
Gases (ozone)	X					
Sulfur oxides (SO_x)		X			X	X
Carbon monoxide (CO)		X			X	X
Nitrogen oxides (NO_x)		X		X	X	X
Hydrocarbons			X		X	X
Lead					X	X
Chlorines			X			
Hydrogen sulfide					X	
Carbon dioxide (CO_2)		X				

Areas having air quality levels meeting the established standards are also known as PSD areas. The Prevention of Significant Deterioration (PSD) program was established to control and regulate the air quality of areas that met or exceed the NAAQS. The U.S. EPA is required to design and implement a program that prevents unlimited industrial growth from degrading air quality where the NAAQS are to be met. This program includes the classification of areas into three categories to establish the amount of protection needed to prevent future air pollution. Class I areas were designated to protect wilderness, national parks, and other areas by maintaining pristine air quality in those areas with more stringent air quality standards. New or modified emission sources may use up to approximately 10 percent of the NAAQS. Four PSD Class I areas have been designated within the state of Alaska: Denali National Park, Tuxedni National Wilderness Area, Bering Sea (St. Matthews Island) National Wilderness Area, and Simeonof National Wilderness Area. PSD Class I areas are also protected against visibility degradation. Poor visibility includes degradation of contrast and visual range and increases in air coloration. These conditions are a result of the interactions between fine particulate matter, sulfur dioxide, and humidity and development of ice fog.

Class II areas include all other areas not in the Class I category and those designated as being in attainment of the NAAQS or unclassifiable due to lack of information or data. Fort Wainwright Yukon Training Area and Fort Greely are Class II areas. There are no Class III designations in Alaska. Thus, all areas not classified as Class I are Class II. This designation allows for a larger amount of air quality degradation. The table *National Ambient Air Quality Standards (NAAQS)* lists the increments allowed within areas designated as PSD Class I and PSD Class II.

Each state is required to prepare a State Implementation Plan (SIP) to fulfill the overall goals of the Clean Air Act. The purpose of the SIP is to provide for the implementation, maintenance, and enforcement of each NAAQS. States may choose to implement standards that are more stringent than those at the national level, but not less. A more stringent standard is typically set when an area is experiencing very poor air quality. Commonly, states will set emission standards coinciding with or replacing NAAQS simply for measurement and enforcement ease. Emissions from stationary sources such as power plants and other industrial facilities, and mobile sources, such as vehicles, are regulated. Stationary source facilities are typically required to obtain state permits for operation, modification, and construction. These facilities may also be subject to performance testing and emissions monitoring to ensure compliance with the emissions standards. States typically enforce annual vehicle emissions testing by a permit program to regulate vehicle emissions.

Summary of Major Sources of Air Pollution Located on Fort Wainwright Cantonment Area (U.S. Army Center for Health Promotion and Preventive Medicine 1997a). These sources were identified as part of the Title V operating permit required by the Alaska Air Quality Control Regulations, 18 AAC 50.335.

Group ID Number	Equipment Description Manufacturer/Model/Serial No.	Installed On	Modified On	Rated Capacity
EU01	Central Power Plant Boilers, Wickes and Garret & Shafer	1953, 1949	--	230 mmBtu/hr 154 mmBtu/hr
EU02	3 Aboveground Storage Tanks with Tanker Truck Loading	1995	--	13,000 gallons each
EU03	Standby Diesel Generator Plant	1949-1950	--	3@500 kW 2@1000 kW
EU04	Aerospace Activity	--	--	--
EU05	Sanitary Landfill	1962	--	--
EU06	Clear Creek Landfill	1984	--	--
EU07	Remediation Sites	1995 and 1996	--	--
EU08	Firefighter Training/Prescribed Burning	--	--	--
EU09	Ozone Depleting Substances	--	--	--
EU10	Fugitive Dust	--	--	--

Summary of *Potential* Emissions from Major Sources Located on Fort Wainwright Cantonment Area Including Regulated and Hazardous Air Contaminants (U.S. Army Center for Health Promotion and Preventive Medicine 1997a). All values are reported in tons per year unless specified.

Group ID Number	Unit Description	NO_x	SO_2	CO	PM	VOC
EU01	Central Power Plant Boilers	2352	1310	2388	1152.07	8.4
EU02	Aboveground Storage Tank with Tanker Truck Loading	0.00	0.00	0.00	0.00	7.12
EU03	Standby Diesel Generator Plant	0.00	0.00	0.00	0.00	0.00
EU04	Aerospace Activity	0.00	0.00	0.00	0.17	8.78
EU05	Sanitary Landfill	0.00	0.00	0.00	0.00	7.97
EU06	Clear Creek Landfill	0.00	0.00	0.00	0.00	0.80
EU07	Remediation Sites	0.00	0.00	0.00	0.00	1
EU08[2]	Firefighter Training/Prescribed Burning	400.16	0.00	17781.60	1648.68	0.76
EU09	Ozone Depleting Substances	0.00	0.00	0.00	0.00	0.00
EU10[2]	Fugitive Dust	0.00	0.00	0.00	50.01	0.00
TOTAL[3]		**2352.00**	**1310.00**	**2388.00**	**1152.24**	**33.07**

[2] Fugitive emissions source

[3] Total does not include fugitive emissions (for applicability purposes) based on the definition of potential to emit in 18 AAC 210(b).

Summary of *Assessable* Emissions from Major Sources Located on Fort Wainwright Cantonment Area Including Regulated and Hazardous Air Contaminants (U.S. Army Center for Health Promotion and Preventive Medicine 1997a). All values are reported in tons per year unless specified.

Group ID Number	Unit Description	NO_x	SO_2	CO	PM	VOC
EU01	Central Power Plant Boilers	1188.90	644.80	283.2	489.94	4.25
EU02	Aboveground Storage Tank with Tanker Truck Loading	0.00	0.00	0.00	0.00	2.33
EU03	Standby Diesel Generator Plant	0.00	0.00	0.00	0.00	0.00
EU04	Aerospace Activity	0.00	0.00	0.00	0.04	2.08
EU05	Sanitary Landfill	0.00	0.00	0.00	0.00	7.07
EU06	Clear Creek Landfill	0.00	0.00	0.00	0.00	0.80
EU07	Remediation Sites	0.00	0.00	0.00	0.00	16.47
EU08	Firefighter Training/Prescribed Burning	200.08	0.00	8890.80	824.34	0.38
EU09	Ozone Depleting Substances	0.00	0.00	0.00	0.00	0.00
EU10	Fugitive Dust	0.00	0.00	0.00	13.32	0.00
Insignificant Sources - Emission Rate Basis	Miscellaneous Sources	1.12	0.09	1.41	0.23	2.78
Insignificant Sources - Size Basis	Miscellaneous Sources	0.88	0.59	0.23	0.08	0.08
TOTAL[3]		**1390.98**	**645.48**	**9175.64**	**1327.95**	**36.24**

[3] Total does not include fugitive emissions (for applicability purposes) based on the definition of potential to emit in 18 AAC 210(b).

Emissions List of All Regulated Contaminants Emitted from Major Sources Located on Fort Wainwright Cantonment Area (U.S. Army Center for Health Promotion and Preventive Medicine 1997a).

Precursor or Contaminant With Ambient Air Quality Standards:		
Nitrogen Dioxide Sulfur Oxides Carbon Monoxide	PM_{10} Lead VOC (ozone precursors)	
New Source Performance Standards (NSPS) -Contaminants:		
VOC		
National Emission Standards for Hazardous Air Pollutants (NESHAPs) - Pre-1990:		
asbestos		
National Emission Standards for Hazardous Air Pollutants (NESHAPS) - Post-1990, MACT Standards:		
ethyl benzene methylene chloride toluene 1,1,2,2-tetrachloroethane 1,2-dichloroethane carbon disulfide chloroethane mercury methyl isobutyl ketone cobalt hydrogen fluoride hydrogen chloride vinyl chloride	cumene chloroform benzene hexane naphthalene xylenes (o,m,p) 1,1-dichloroethane 1,2-dichloropropane carbon tetrachloride dichloromethane methyl ethyl ketone perchloroethylene phenol	formaldehyde 1,1,1-trichloroethane chlorobenzene arsenic cadmium acrylonitrile 1,1-dichloroethene carbonyl sulfide chromium trichloroethylene lead styrene hexamethylene-1,6-diisocyanate
Ozone-Depleting Substances (CAA 602):		
CFC-12 HCFC-22 R-502	Halon-1301 Halon-1211	
Hazardous Air Pollutant (HAP):		

Emissions List of All Regulated Contaminants Emitted from Major Sources Located on Fort Wainwright Cantonment Area (U.S. Army Center for Health Promotion and Preventive Medicine 1997a).

cumene	chloroform	arsenic
styrene	benzene	formaldehyde
toluene	ethyl benzene	1,1,1-trichloroethane
1,1,2,2-tetrachloroethane	methylene chloride	chlorobenzene
1,2-dichloroethane	1,1-dichloroethane	hexane
carbon disulfide	1,2-dichloropropane	naphthalene
carbonyl sulfide	carbon tetrachloride	xylenes (o,m,p)
chloroethane	mercury	1,1-dichloroethene
ethyl benzene	cadmium	acrylonitrile
methyl isobutyl ketone	chromium	carbonyl disulfide
vinyl chloride	perchloroethylene	dichloromethane
lead	cobalt	methyl ethyl ketone
hexamethylene-1,6-diisocyanate	hydrogen fluoride	trichloroethylene
	hydrogen chloride	phenol
Air Contaminants Regulated Under Accidental Release Prevention:		
propane	chlorine	

Summary of Major Sources of Air Pollution Located on Fort Greely (U.S. Army Center for Health Promotion and Preventive Medicine 1997b). These sources were identified as part of the Title V operating permit required by the Alaska Air Quality Control Regulations, 18 AAC 50.335.

Group ID Number	Equipment Description Manufacturer/Model/Serial No.	Installed On	Modified On	Rated Capacity
EU01	2 Industrial Boilers, English Tube, Serial Nos. 92-193-A & 92-193-B	1993	--	57.9 mmBtu
EU02	Industrial Boilers, Erie City Iron Works, Serial No. 94268	1954	--	67.3 mm Btu
EU03	Generator, Standby, Enterprise, Model No. DSQ316, Serial No. 54033	1953	--	1000 kW
EU04	Generator, Standby, Enterprise, Model No. DSQ316, Serial No. 54032	1953	--	1000 kW
EU05	Generator, Standby, Enterprise, Model No. DSQ316, Serial No. 54031	1953	--	1000 kW
EU06	Generator, Standby, Enterprise, Model No. DSQ38, Serial No. 59019	1962	--	1250 kW
EU07	Generator, Standby, Enterprise, Model No. DSQ38, Serial No. 59020	1962	--	1250 kW
EU08	3 Generators, Primary, Caterpillar, Model No. CAT3306B, Serial Nos. PC-3785273, PC-3785272, XC-3785275	1991	--	125 kW
EU09	Open Burn Pit, Municipal Refuse 12 feet wide x 30 feet long x 12 feet deep	--	--	--
EU10	Storage Tank, Aboveground, Horizonal, Diesel Fuel Arctic, Bldg. 2035	1994	--	20,000 gallons
EU11	2 Storage Tanks, Underground, Horizontal, Diesel Fuel Arctic, Bldg. 606	1992	--	35,000 gallons
EU12	Storage Tanks, Underground, Horizontal, Diesel Fuel Arctic, Bldg. 2019	1993	--	30,000 gallons
EU13	Storage Tanks, Underground, Horizontal, Diesel Fuel Arctic, Bldg. 1928	1989	--	15,000 gallons
EU14	Storage Tank, Aboveground, Horizontal with Tanker Truck Loading, Jet Fuel (JP4) Bldg. 110	1994	--	20,000 gallons

Summary of Major Sources of Air Pollution Located on Fort Greely (U.S. Army Center for Health Promotion and Preventive Medicine 1997b). These sources were identified as part of the Title V operating permit required by the Alaska Air Quality Control Regulations, 18 AAC 50.335.

Group ID Number	Equipment Description Manufacturer/Model/Serial No.	Installed On	Modified On	Rated Capacity
EU15	Storage Tank, Aboveground, Vertical Fixed Roof, Diesel Fuel Arctic, Bldg. 618	1954	1995	630,000 gallons
EU16	Firefighter training/Prescribed burning	--	--	--
EU17	Ozone Depleting Substances	--	--	--
EU18	Fugitive Dust	--	--	--
EU19	Municipal Landfill	--	--	--

Summary of *Potential* Emissions from Major Sources Located on Fort Greely Including Regulated and Hazardous Air Contaminants (U.S. Army Center for Health Promotion and Preventive Medicine 1997b). All values are reported in tons per year unless specified. AST = Aboveground Storage Tank. UST = Underground Storage Tank. DFA = Diesel Fuel Arctic.

Group ID Number	Unit Description	NO_x	SO_2	CO	PM	VOC
EU01	2 Industrial Boilers, 57.9 mmBtu	81.96	174.60	20.50	4.10	0.82
EU02	Industrial Boiler, 67.3 mmBtu	47.64	101.47	11.91	2.38	0.48
EU03	Generator, 1000 kW	151.37	15.31	34.69	2.83	4.05
EU04	Generator, 1000 kW	151.37	15.31	34.69	2.83	4.05
EU05	Generator, 1000 kW	151.37	15.31	34.69	2.83	4.05
EU06	Generator, 1250 kW	185.54	18.76	42.52	3.47	4.96
EU07	Generator, 1250 kW	185.54	18.76	42.52	3.47	4.96
EU08	3 Generators, 125 kW	91.65	6.06	19.75	6.50	7.42
EU09	Open Burn Pit	122.67	4.09	347.55	65.42	122.67
EU10	AST, 20,000 gal, DFA	0.00	0.00	0.00	0.00	<0.01
EU11	2 UST, 35,000 gal, DFA	0.00	0.00	0.00	0.00	0.18
EU12	UST, 30,000 gal, DFA	0.00	0.00	0.00	0.00	<0.01
EU13	UST, 15,000 gal, DFA	0.00	0.00	0.00	0.00	<0.01
EU14	UST, 20,000 gal, JP4	0.00	0.00	0.00	0.00	1.83
EU15	AST, 630,000 gal, DFA	0.00	0.00	0.00	0.00	0.07
EU16[1]	Firefighter Training/ Prescribed Burning	160.00	NA	7457.95	659.20	NA
EU17	Ozone Depleting Substances	0.00	0.00	0.00	0.00	0.00
EU18[1]	Fugitive Dust	0.00	0.00	0.00	6.21	0.00
EU19	Municipal Landfill	0.00	0.00	0.00	0.00	1.04
TOTAL[2]		**1169.11**	**369.67**	**588.82**	**93.83**	**156.61**

[1] Fugitive emissions source

[2] Total does not include fugitive emissions (for applicability purposes) based on the definition of potential to emit in 18 AAC 210(b).

Summary of *Assessable* Emissions from Major Sources Located on Fort Greely Including Regulated and Hazardous Air Contaminants (U.S. Army Center for Health Promotion and Preventive Medicine 1997b). All values are reported in tons per year unless specified. AST = Aboveground Storage Tank. UST = Underground Storage Tank. DFA = Diesel Fuel Arctic.

Group ID Number	Unit Description	NO_x	SO_2	CO	PM	VOC
EU01	2 Industrial Boilers, 57.9 mmBtu	12.20	6.93	3.05	0.62	0.12
EU02	Industrial Boiler, 67.3 mmBtu	6.10	3.47	1.53	0.31	0.06
EU03	Generator, 1000 kW	2.09	0.06	0.56	0.04	0.06
EU04	Generator, 1000 kW	2.09	0.06	0.56	0.04	0.06
EU05	Generator, 1000 kW	2.09	0.06	0.56	0.04	0.06
EU06	Generator, 1250 kW	2.61	0.07	0.69	0.05	0.07
EU07	Generator, 1250 kW	2.61	0.07	0.69	0.05	0.07
EU08	3 Generators, 125 kW	15.94	1.05	3.44	1.12	1.30
EU09	Open Burn Pit	7.08	1.18	100.35	18.89	35.42
EU10	AST, 20,000 gal, DFA	0	0	0	0	<0.01
EU11	2 UST, 35,000 gal, DFA	0	0	0	0	0.02
EU12	UST, 30,000 gal, DFA	0	0	0	0	<0.01
EU13	UST, 15,000 gal, DFA	0	0	0	0	<0.01
EU14	UST, 20,000 gal, JP4	0	0	0	0	0.50
EU15	AST, 630,000 gal, DFA	0	0	0	0	0.06
EU16	Firefighter Training/ Prescribed Burning	80.00	NA	3555.20	329.60	NA
EU17	Ozone Depleting Substances	0.00	0.00	0.00	0.00	0.00
EU18	Fugitive Dust	0.00	0.00	0.00	1.56	0.00
EU19	Municipal Landfill	0.00	0.00	0.00	0.00	0.40
Insignificant Sources Emission Rate Basis	Miscellaneous Sources	2.89	1.01	0.71	0.50	2.77
Insignificant Sources Size Basis	Miscellaneous Sources	0.77	0.49	0.22	0.13	0.16

Summary of *Assessable* Emissions from Major Sources Located on Fort Greely Including Regulated and Hazardous Air Contaminants (U.S. Army Center for Health Promotion and Preventive Medicine 1997b). All values are reported in tons per year unless specified. AST = Aboveground Storage Tank. UST = Underground Storage Tank. DFA = Diesel Fuel Arctic.

Group ID Number	Unit Description	NO_x	SO_2	CO	PM	VOC
TOTAL		136.47	14.45	3667.56	352.95	41.16

Emissions List of All Regulated Contaminants Emitted from Major Sources Located on Fort Greely (U.S. Army Center for Health Promotion and Preventive Medicine 1997b).

Precursor or Contaminant With Ambient Air Quality Standards:		
Nitrogen Dioxide Sulfur Oxides Carbon Monoxide	PM_{10} Lead VOC (ozone precursors)	
New Source Performance Standards (NSPS) - Contaminants:		
VOC	Particulate Matter	
National Emission Standards for Hazardous Air Pollutants (NESHAPs) - Pre-1990:		
asbestos		
National Emission Standards for Hazardous Air Pollutants (NESHAPS) - Post-1990, MACT Standards:		
acetaldehyde 1,3-butadiene polycyclic organic matter ethyl benzene methylene chloride toluene 1,1,2,2-tetrachloroethane 1,2-dichloroethane carbon disulfide chloroethane mercury methyl isobutyl ketone vinyl chloride polyaromatic	acrolein chloroform benzene hexane naphthalene xylenes (o,m,p) 1,1-dichloroethane 1,2-dichloropropane carbon tetrachloride dichloromethane methyl ethyl ketone perchloroethylene nickel hydrocarbons	formaldehyde 1,1,-trichloroethane chlorobenzene arsenic beryllium cadmium 1,1-dichloroethene acrylonitrile carbonyl sulfide chromium manganese trichloroethylene lead
Ozone-Depleting Substances (CAA 602):		
CFC-12 HCFC-22	R-502 Halon-1301	
Hazardous Air Pollutant (HAP):		
acetaldehyde 1,3-butadiene polycyclic organic matter cumene styrene toluene 1,1,2,2-tetrachloroethane 1,2-dichloroethene carbon disulfide chloroethane ethyl benzene methyl isobutyl ketone vinyl chloride	acrolein chloroform benzene ethyl benzene methylene chloride 1,2,4-trichlorobenzene 1,1-dichloroethane 1,2-dichloropropane carbon tetrachloride chloroform mercury perchloroethylene	formaldehyde 1,1,1-trichloroethane chlorobenzene hexane naphthalene xylenes (o,m,p) 1,1-dichloroethene acrylonitrile carbonyl disulfide dichloromethane methyl ethyl ketone trichloroethylene

Emissions List of All Regulated Contaminants Emitted from Major Sources Located on Fort Greely (U.S. Army Center for Health Promotion and Preventive Medicine 1997b).

Air Contaminants Regulated Under Accidental Release Prevention:	
propane	chlorine

Carbon Monoxide Emissions From Mobile Sources for Fairbanks Military Bases

1990 Base year mobile sources:

1. On road (roadway)- Eielson contribution

    1990 roadway emissions= 86.77 tons/day (TPD)

    Prorate Eielson contribution based on 1990 Vehicle Miles Traveled (VMT) estimates(1)

        Eielson on base VMT = 20,175

        Total VMT = 1,446,484

    Eielson on-base emissions = 20,175 / 1,446,686 (86.77) = 1.21 TPD

2. Off road (off Highway)(2)- Military contribution

    -Snowmachines / ATV - Ft. Wainwright(0.03) + Ft. Eielson(0.22) = 0.25 TPD

    - Refuse / Snow removal - Ft. Wainwright(0.06) + Ft. Eielson(0.07) = 0.13 TPD

    - Home snowblower (not broken out by military usage) = 0

    - Agricultural equipment, RV's, lawn and garden equipment, and construction = 0 equipment assumed to have no wintertime emissions in Fairbanks

Total Military Emissions = 0.38 TPD

3. Aircraft(2) - Military contribution

    -Fairbanks International Airport military contribution = 0.11TPD

    -Ft. Wainwright = 0.87 TPD

    -Eielson Air Force Base = 1.36TPD

Total Military Emissions = 2.34TPD

4. Railroad - not broken out for military = 0

NOTES

* On-road emission values for Eielson are prorated based on available VMT estimates. Ft. Wainwright VMT estimates were not available, so the Ft. Wainwright contribution is not included in the 1.21 TPD emissions estimate.

* See the following tables for total point, area and mobile source emissions for 1990, 1995, and 2000. These are from the Alaska State Air Quality Control Plan.

Footnotes

(1) 2/28/92 letter from Kelly McMullen (App III.C.3 of Alaska State Air Quality Control Plan)

(2) "Fairbanks 1990 Base Year Emissions Inventory" prepared by Sierra Research 12/29/93 (App III.C.3 of Alaska State Air Quality Control Plan)

Daily Wintertime Carbon Monoxide Emissions for Fairbanks, Alaska (1990 Base Year). Percentages may not add up due to rounding.

Source Category	Tons / Day	Percent of Total Daily
Roadway	86.77	78.0
Off Highway	1.62	1.5
Aircraft	3.76	3.4
Railroad	0.02	0.0
TOTAL MOBILE	**92.17**	**82.9**
Fuel Oil Combustion	0.58	0.5
Coal Combustion	0.56	0.5
Propane Combustion	0.01	0.0
Wood Combustion	11.74	10.6
Industrial Equipment	<0.01	0.0
Solid Waste Incineration	<0.01	0.0
Open Burning/Structural Fires	0.11	0.1
TOTAL AREA SOURCES	**13.00**	**11.7**
MAPCO Petroleum	0.18	0.2
Eielson Air Force Base	1.38	1.2
Fort Wainwright	1.59	1.4
Golden Valley Electric Association/Fairbanks	0.58	0.5
Golden Valley Electric Association/Fairbanks	0.19	0.2
University of Alaska/Fairbanks	0.40	0.4
Petro-Star	0.01	0.0
Fairbanks Municipal Utilities System (FMUS)	1.21	1.1
Alyeska Pump Station No. 8	0.52	0.5
TOTAL POINT SOURCES	**6.06**	**5.4**
TOTAL EMISSIONS	**111.23**	**100.0**

Daily Wintertime Carbon Monoxide Emissions for Fairbanks, Alaska (1995 Projected Year). Percentages may not add up due to rounding. Roadway emissions are based on assumed I/M program effectiveness of 85% of MOBILES test-only credits.

Source Category	Tons / Day	Percent of Total Daily
Roadway	63.64"	72.2
Off Highway	1.62	1.8
Aircraft	3.76	4.3
Railroad	0.2	0.0
TOTAL MOBILE	**69.04**	**78.4**
Fuel Oil Combustion	0.58	0.7
Coal Combustion	0.56	0.6
Propane Combustion	0.01	0.0
Wood Combustion	11.74	13.3
Industrial Equipment	<0.01	0.0
Solid Waste Incineration	<0.01	0.0
Open Burning/Structural Fires	0.11	0.1
TOTAL AREA SOURCES	**13.00**	**14.8**
MAPCO Petroleum	0.18	0.2
Eielson Air Force Base	1.38	1.6
Fort Wainwright	1.59	1.8
Golden Valley Electric Association/Fairbanks	0.58	0.7
Golden Valley Electric Association/Fairbanks	0.19	0.2
University of Alaska/Fairbanks	0.40	0.5
Petro-Star	0.01	0.0
Fairbanks Municipal Utilities System (FMUS)	1.21	1.4
Alyeska Pump Station No. 8	0.52	0.6
TOTAL POINT SOURCES	**6.06**	**6.9**
TOTAL EMISSIONS	**88.10**	**100.0**

Daily Wintertime Carbon Monoxide Emissions for Fairbanks, Alaska (2000 Projected year). Percentages may not add up due to rounding. Roadway emissions are based on an assumed I/M program effectiveness of 85% of MOBILES test-only credits.

Source Category	Tons / Day	Percent of Total Daily
Roadway	47.70"	66.1
Off Highway	1.62	2.2
Aircraft	3.76	5.2
Railroad	0.02	0.0
TOTAL MOBILE	**53.10**	**73.6**
Fuel Oil Combustion	0.58	0.8
Coal Combustion	0.56	0.8
Propane Combustion	0.01	0.0
Wood Combustion	11.74	16.3
Industrial Equipment	<0.01	0.0
Solid Waste Incineration	<0.01	0.0
Open Burning/Structural Fires	0.11	0.2
TOTAL AREA SOURCES	**13.00**	**18.0**
MAPCO Petroleum	0.18	0.2
Eielson Air Force Base	1.38	1.9
Fort Wainwright	1.59	2.2
Golden Valley Electric Association/Fairbanks	0.58	0.8
Golden Valley Electric Association/Fairbanks	0.19	0.3
University of Alaska/Fairbanks	0.40	0.6
Petro-Star	0.01	0.0
Fairbanks Municipal Utilities System (FMUS)	1.21	1.7
Alyeska Pump Station No. 8	0.52	0.7
TOTAL POINT SOURCES	**6.06**	**8.4**
TOTAL EMISSIONS	**72.16**	**100.0**

APPENDIX 3.4
Selected Geologic Terms
and
Geologic Time Scale

Selected Geologic Terms Used in Chapters 3.4 and 3.5

(Simplified Definitions for Practical Use)

epicenter . . . . . a point on the surface of the earth which is directly above an earthquake's point of origin

geothermal . . . . heat from natural processes that occur within the earth

granitic . . . . a type of crystalline rock characterized by specific minerals such as quartz, feldspar, and mica

igneous . . . . . . a category of rocks which have formed by solidifying from a molten state (includes volcanic rocks)

intrusive . . . . . . a rock body (such as a pluton) which forms when molten material migrates into an existing rock body and solidifies without reaching the surface

lode . . . . mineral deposit occurring in solid rock

loess . . . . windblown silt

metamorphic . . a category of rocks which have been chemically, physically, and/or structurally altered from their original state

moraine . . . . . . rock and soil debris carried and deposited by a glacier

outwash . . . . . . sediments (mostly sand and gravel) deposited by meltwater from a glacier

placer . . . . unconsolidated material (gravel, sand, etc.) containing particles of valuable minerals

plate . . . . a major block of the earth's crust

pluton . . . . a rock body formed when molten material (magma) intrudes other rocks and cools to a solid mass without reaching the surface

porphyry . . . . . . crystalline rock in which certain minerals are conspicuously larger than the main mass

riprap . . . . coarse, blocky rock material used for fill and slope protection

sedimentary . . . a category of rocks made from solidified gravel, sand, silt, or clay; transported by water, air, or gravity

sulfide . . . . a mineral that is composed of sulfur combined with other elements such as iron, lead, zinc. Many ores consist of sulfide minerals.

terrane . . . . a collection of rocks that share a geologic history and have often traveled far from where they originated

volcanic . . . . . . rock that forms when molten material reaches the earth's surface before solidifying

volcanogenic . . originating from a volcanic process

The Geologic Time Scale

Source: U.S. Geological Survey Web Site. URL: http://geology.er.usgs.gov/paleo/geotime.shtml
Last modified: June 1998

Cenozoic Era . . . . 66 million years ago - present

Quaternary Period . . . . . 2 million years ago - present

Holocene Epoch . . . . 8,000 years ago - present
Pleistocene Epoch . . 2 million - 8,000 years ago

Tertiary Period . . . . 66 - 2 million years ago

Pliocene Epoch . . . . 5 - 2 million years ago
Miocene Epoch . . . . 24 - 5 million years ago
Oligocene Epoch . . . 37 - 24 million years ago
Eocene Epoch . . . . . 58 - 37 million years ago
Paleocene Epoch . . . 66 - 58 million years ago

Mesozoic Era . . . . 250 - 66 million years ago

Cretaceous Period . . . . . 135 - 66 million years ago
Jurassic Period . . . . 205 - 135 million years ago
Triassic Period . . . . 250 - 205 million years ago

Paleozoic Era . . . . 570 - 250 million years ago

Permian Period . . . . 290 - 250 million years ago
Carboniferous Period . . . 365 - 290 million years ago
Pennsylvanian Period . . 310 - 290 million years ago
Mississippian Period . . . 365 - 310 million years ago
Devonian Period . . . . . . 400 - 365 million years ago
Silurian Period . . . . 425 - 400 million years ago
Ordovician Period . . . . . 500 - 425 million years ago
Cambrian Period . . . . . . 570 - 500 million years ago

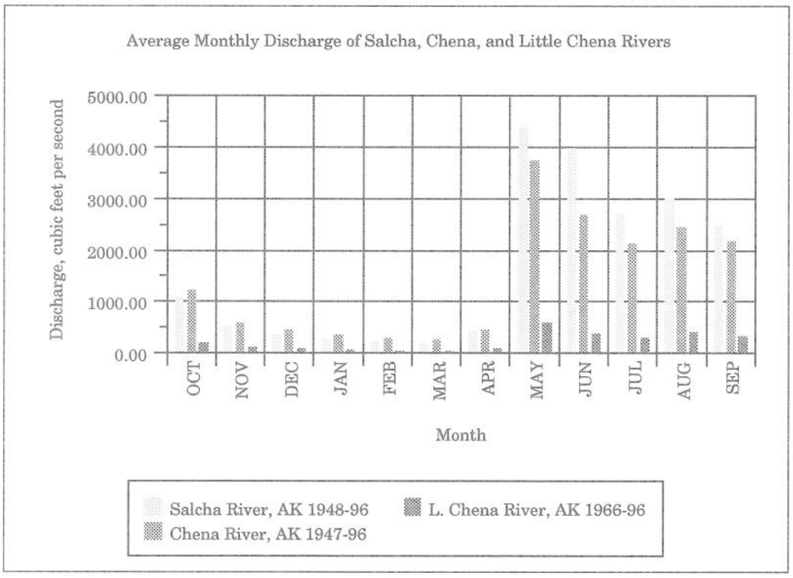
Precambrian . . . . Formation of Earth to 570 million years ago

APPENDIX 3.8
Surface Water

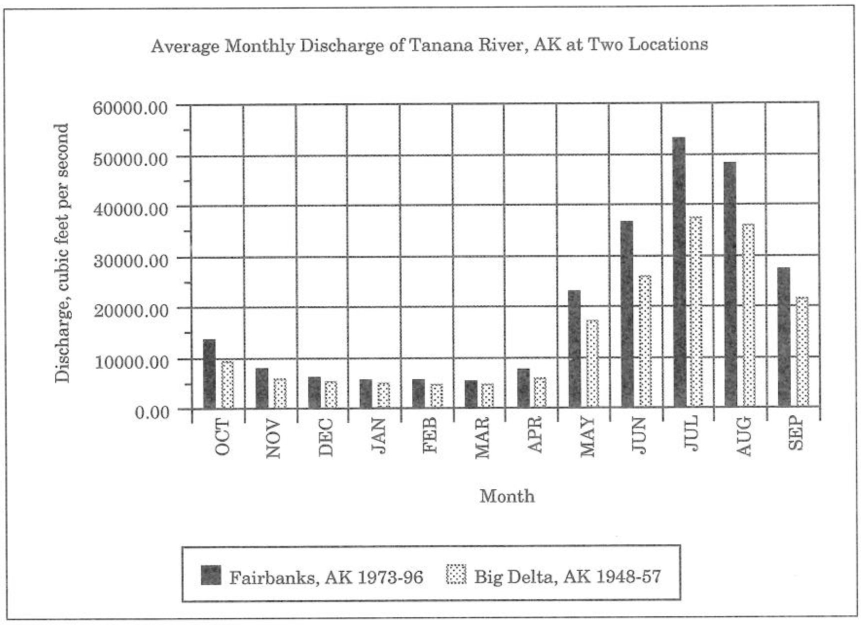
Appendix 3.8.A
Streamflow

General Description of Tanana River Basin

Fort Wainwright Yukon Training Area and Fort Greely West and East Training Areas are within the Tanana River drainage basin. The Tanana River basin covers approximately 44,500 square miles, with 576 square miles of its headwaters in Canada. Sources of flow for the Tanana River include the glaciers and slopes of the Wrangell, Mentasta and Nutzotin Mountains. The Tanana River eventually empties into the larger Yukon River. The average streamflow of the Tanana River near its mouth is estimated as 37,000 cfs (cubic feet per second). Approximately 85% of this discharge originates in the Alaska Range; approximately 50% of this discharge originating in the Alaska Range is contributed by four tributaries from the south side: the Kantishna, Nenana, Nebesna, and Delta rivers (Anderson 1970). The remaining 15% of Tanana basin discharge originates in the Yukon-Tanana Upland. The four main tributaries are the Salcha, Tolovana, Chena, and Goodpaster rivers (Anderson 1970).



The average low flow, 31 cfs, and high flow, 588 cfs, of the Little Chena River near Fairbanks occurs in March and May, respectively. The average yearly discharge for the Little Chena River is 213 cfs. A peak discharge of 17,000 cfs occurred on August 13, 1967. Similarly, an average low flow of 260 cfs and an average high flow of 3,731 cfs occurred in March and May for the Chena River at Fairbanks. The average discharge for the Chena River is 1,394 cfs. A peak discharge of 74,400 cfs occurred on August 15, 1967. The Salcha River, which is the largest river of the three, has an average yearly discharge of 1,630 cfs. Low and high flows of 193 cfs and 4,404 cfs occurred in March and May. The highest discharge value recorded for the Salcha River was 97,000 cfs, which occurred on August 14, 1967 (United States Geological Survey 1998).



Average low flows of 4,716 cfs at Big Delta and 5,371 cfs at Fairbanks occurred in March. Highest average discharges of 37,408 and 53,089 cfs were recorded in July at Big Delta and Fairbanks, respectively. The yearly average discharge for the Tanana River between Big Delta and Fairbanks is approximately 17,500 cfs. The highest peak flow of 62,800 cfs recorded at the Big Delta station occurred on July 29, 1949. The highest peak flow of 125,000 cfs occurred on August 16, 1967 at the Fairbanks station (United States Geological Survey 1998).

Appendix 3.8.B
Floodplains

Federal Emergency Management Agency's National Flood Insurance Program

The National Flood Insurance Program (NFIP) was delegated by the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This program requires the Fairbanks North Star Borough (FNSB), of which Fort Wainwright is a part, to periodically revise and update its Flood Insurance Study/Flood Insurance Rate Map. This information is used by FNSB to update existing floodplain regulations and to promote sound land use and floodplain development. Each flood insurance study provides 100-year flood elevations and delineations of the 100 and 500-year floodplain boundaries and 100-year floodway values to assist communities in developing floodplain management measures.

Figure 3.8.c illustrates the 100-year, 500-year, and outside of the 500-year floodplain boundaries for the areas surrounding Fort Wainwright Yukon Training Area. The one percent annual chance (100-year) flood is considered the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is used to identify additional areas of flood risk. Zone A is considered a special flood hazard area and is inundated by the 100-year flood. However, no base flood elevations were determined. Zone X is considered a moderate flood hazard area and is within the 500-year floodplain. This zone also includes areas where the 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile occur and areas protected by levees from the 100-year flood. Zone XO includes areas determined to be outside of the 500-year floodplain (Federal Emergency Management Agency 1982a).

The upper northwest portion of Fort Wainwright Yukon Training Area relies on the Chena River Lakes Flood Control Project for flood protection. The Flood Control Project consists of an earthfill dam across the Chena River, a 12-foot levee along the north bank of the Tanana River and various drainage ditches. Stream flow is not impeded under normal conditions. When flooding occurs, water will be temporarily detained until the flood threat passes; if this holding area is filled, a spillway will take the excess into the Tanana River (Nakata Planning Group 1987).

A Flood Insurance Study was completed for the incorporated areas of the City of Delta Junction, Southeast Fairbanks Division, Alaska. The Delta River and Jarvis Creek were studied in detail even though they were not within the corporate limits of the community. The main flood-related problems within Delta Junction have been erosion along the Delta River and flooding from Jarvis Creek (Federal Emergency Management Agency 1982b).

The east bank of the Delta River is higher than the west bank. As a result, the low west bank, as well as the large floodplain, creates very low probabilities of overbank flooding to the east (Nelson 1995). The principle risk to local communities is not from river flooding, but from lateral erosion of the east bank of the Delta River. Numerous groins and bank-protection structures have been installed to prevent bank erosion. According to studies performed by the Alaska District U.S. Army Corps of Engineers, the 500-year flood would not flood the communities on the east side of the Delta River (Federal Emergency Management Agency 1982).

Jarvis Creek has historical problems with overflow into an old channel, located approximately 14 miles above the confluence of Jarvis Creek and the Delta River that runs through Delta Junction. The U.S. Army placed a barrier at the overflow location after the flood of 1967, and since then, flooding along this old channel has not occurred (Federal Emergency Management Agency 1982). In addition, flooding from Jarvis Creek may occur due to ice jams.

Appendix 3.8.C
Water Quality Criteria

Water Quality Criteria for Fresh Water Uses as Set by the State of Alaska in 18 AAC 70.

(1) FRESH WATER USES	FECAL COLIFORM BACTERIA (FC) (See note 1)	DISSOLVED GAS	PH (Variation of pH for waters naturally outside the specified range must be towards the range)	TURBIDITY (not applicable to groundwater)	TEMPERATURE
(A)Water Supply (I) drinking, culinary, and food processing	Based on minimum of 5 samples taken in a 30-day period, the mean may not exceed 20 FC/100 ml, and not more than 10% of the samples may exceed 40 FC/100 ml. For groundwater, the FC concentration must be less than 1 FC/100 ul, using the fecal coliform Membrane Filter Technique, or less than 3 FC/100 ml, using he fecal coliform most probable number (MPN) technique.	Dissolved Oxygen (D.O.) must be greater than or equal to 4 mg/l (this does not apply to lakes or reservoirs in which supplies are taken from below the thermocline, or to groundwater).	May not be less than 6.0 or greater than 8.5. May not vary more than 0.5 pH unit from natural conditions.	May not exceed 5 nephelometric turbidity units (NTU) above natural conditions when the natural turbidity is 50 NTU or less, and may not have more than 10% increase in turbidity when the natural turbidity is more than 50 NTU, not to exceed a maximum increase of 25 NTU.	May not exceed 15 C.
(A)Water Supply (Ii) agriculture including irrigation and stock watering	For products normally cooked and for dairy sanitation of pasteurized products, the mean, based on a minimum of 5 samples taken in a 30-day period, may not exceed 200 FC/100 ml, and not more than 10% of the samples may exceed 400 FC/ml. For products not normally cooked and for dairly sanitation of unpasteurized products, the criteria for drinking water supply (1)(A)(i), apply.	D.O. must be greater than 3 mg/l in surface waters.	May not be less than 5.0 or greater than 9.0; for dairy sanitation, pH may not be less than 6.8 or greater than 8.5.	May not cause detrimental effects on indicated use.	May not exceed 30 C.

Water Quality Criteria for Fresh Water Uses as Set by the State of Alaska in 18 AAC 70.

(1) FRESH WATER USES	**FECAL COLIFORM BACTERIA (FC) (See note 1)**	**DISSOLVED GAS**	**PH (Variation of pH for waters naturally outside the specified range must be towards the range)**	**TURBIDITY (not applicable to groundwater)**	**TEMPERATURE**
(A)Water Supply (Iii) aquiculture	For products normally cooked, the mean, based on a minimum of 5 samples taken in a 30-day period, may not exceed 200 FC/100 ml and not more than 10% of the samples may exceed 400 FC/100 ml. For products not normally cooked, the criteria for drinking water supply, (1)(A)(i) apply.	D.O. must be greater than 7 mg/l in surface waters. The concentration of D.O. may not exceed 110% of saturation at any point of sample collectiion.	May not be less than 6.5 or greater than 8.5. May not vary more than 0,5 pH unit from natural conditions.	May not exceed 25 NTU above natural conditions. For all lake waters, may not exceed 5 NTU above natural conditions.	May not exceed 20 C at any time. The following maximum temperatures may not be exceeded, where applicable: Migration routes 15 C Spawning areas 13 C Rearing areas 15 C Egg & fry incubation 13C
(A)Water Supply (Iv) industrial	Where worker contact is present, the mean, based on a minimum of 5 samples taken in a 30-day period, may not exceed 200 FC/100 ml, and not more than 10% of the samples may exceed 400 FC/100 ml.	May not cause detrimental effects on established water supply treatment levels.	May not be less than 5.0 or greater than 9.0.	May not cause detrimental effects on established water supply treatment levels.	May not exceed 25 C.
(B)Water Recreation (I) contact recreation	Based on a minimum of 5 samples taken in a 30-day period, the mean may not exceed 100 FC/100 ml, and not more than one sample, or more than 10% of the samples if there are more than 10 samples, may exceed 200 FC/100 ml.	D.O. must be greater than or equal to 4 mg/l.	May not be less than 6.5 or greater than 8.5. May not vary more than 0.5 pH unit from natural conditions. If the natural condition is outside this range, substances may not be added that cause an increase in the buffering capacity of the water.	May not exceed 5 NTU above natural conditions when the natural turbidity is 50 NTU or less, and may not have more than 10% increase in turbidity when the natural turbidity is more than 50 NTU, not to exceed a maximum increase of 15 NTU. May not exceed 5 NTU above natural turbidity for all lake waters.	Same as (1)(A)(ii).

Water Quality Criteria for Fresh Water Uses as Set by the State of Alaska in 18 AAC 70.

(1) FRESH WATER USES	FECAL COLIFORM BACTERIA (FC) (See note 1)	DISSOLVED GAS	PH (Variation of pH for waters naturally outside the specified range must be towards the range)	TURBIDITY (not applicable to groundwater)	TEMPERATURE
(B) Water Recreation (ii) secondary recreation	Based on a minimum of 5 samples taken in a 30-day period, the mean may not exceed 200 FC/100 ml, and not more than 10% of the total samples may exceed 400 FC/100 ml.	Same as (1)(B)(i).	Same as (1)(A)(iv).	May not exceed 10 NTU above natural conditions when the natural turbidity is 50 NTU or less, and may not have more than 20% increase in turbidity when the natural turbidity is more than 50 NTU, not to exceed a maximum increase of 15 NTU. May not exceed 5 NTU above natural turbidity for all lake waters.	Not applicable.
(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	Not applicable.	D.O. must be greater than 7 mg/l in water used by anadromous and resident fish. In no case may D.O. be less than 5 mg/l to a depth of 20 cm in the interstitial waters of gravel used by anadromous or resident fish for spawning. For waters not used for anadromous or resident fish, D.O. must be greater than or equal to 5 mg/l. In no case may D.O. be greater than 17 mg/l. The concentration of D.O. may not exceed 110% of saturation at any point of sample collection.	May not be less than 6.5 or greater than 9.0. May not vary more than 0.5 pH unit from natural conditions.	Same as (1)(A)(iii).	Same as (1)(A)(iii).

Water Quality Criteria for Fresh Water Uses as Set by the State of Alaska in 18 AAC 70.

(1) FRESH WATER USES	DISSOLVED INORGANIC SUBSTANCES	SEDIMENT (Not applicable to groundwater)	TOXIC AND OTHER DELETERIOUS ORGANIC AND INORGANIC SUBSTANCES	COLOR	PETROLEUM HYDROCARBONS, OILS AND GREASE
(A)Water Supply (I) drinking, culinary, and food processing	Total dissolved solids (TDS) from all sources may not exceed 500 mg/l. Neither chlorides nor sulfates may exceed 200 mg/l.	No measurable increase in concentration of settleable solids above natural conditions, as measured by the volumetric Imhoff cone method (See note 13).	Substances may not exceed Alaska Drinking Water Standards (18 AAC 80) or where those standards do not exist, EPA Quality Criteria for Water (See note 5).	May not exceed 15 color units or the natural condition, whichever is greater.	May not cause a visible sheen upon the surface of the water. May not exceed concentrations that individually or in combination impart odor or taste as determined by organoleptic tests.
(A)Water Supply (Ii) agriculture including irrigation and stock watering	TDS may not exceed 1,000 mg/l. Sodium absorption ratio must be less than 2.5, sodium percentage less than 60%, residual carbonate less than 1.25 mg/l, and boron less than 0.3 mg/l (See note 6).	For sprinkler irrigation, water must be free of particles of 0.074 mm or coarser. For irrigation or water spreading, may not exceed 200 mg/l for an extended period of time.	Same as (1)(A)(i) where contact with a product destined for human consumption is present. Same as (1)(C) or Federal Water Pollution Control Administration, Water Quality Criteria (WQC/FWPCA), as applicable to substances for stockwaters; concentrations for irrigation waters may not exceed WQC/FWPCA or WQC 1972 (See notes 6 and 7).	Not applicable.	May not cause a visible sheen upon the surface of the water.

Water Quality Criteria for Fresh Water Uses as Set by the State of Alaska in 18 AAC 70.

(1) FRESH WATER USES	DISSOLVED INORGANIC SUBSTANCES	SEDIMENT (Not applicable to groundwater)	TOXIC AND OTHER DELETERIOUS ORGANIC AND INORGANIC SUBSTANCES	COLOR	PETROLEUM HYDROCARBONS, OILS AND GREASE
(A)Water Supply (iii) aquiculture	TDS may not exceed 1,500 mg/l, including natural conditions. Increase in TDS may not exceed one-third of the concentration of the natural condition of the water body.	No imposed loads that will interfere with established water supply treatment levels.	Same as (1)(C).	May not exceed 50 color units or the natural condition, whichever is greater.	Total aqueous hydrocarbons (TaqH) in the water column may not exceed 15 ug/l (See note 8). Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 ug/l (See note 8). There may be not concentrations of petroleum hydrocarbons, animal fats, or vegetable oils in shoreline or bottom sediments that cause deleterious effects to aquatic life. Surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration.
(A)Water Supply (iv) industrial	No amounts above natural conditions that can cause corrosion, scaling, or process problems.	Same as (1)(A)(iii).	Substances that pose hazards to worker contact may not be present.	May not cause detrimental effects on established water supply treatment levels.	May not make the water unfit or unsafe for the use.
(B)Water Recreation (i) contact recreation	Not applicable.	Same as (1)(A)(i).	Same as (1)(A)(i).	Same as (1)(A)(i).	May not cause a film, sheen, or discoloration on the surface or floor of the waterbody or adjoining shorelines. Surface waters must be virtually free from floating oils.
(B)Water Recreation (ii) secondary recreation	Not applicable.	May not pose hazards to incidental human contact or cause interference with the use.	Substances that pose hazards to incidental human contact may not be present.	May not interfere with or make the water unfit or unsafe for the use.	Same as (1)(B)(i).

Water Quality Criteria for Fresh Water Uses as Set by the State of Alaska in 18 AAC 70.

(1) FRESH WATER USES	DISSOLVED INORGANIC SUBSTANCES	SEDIMENT (Not applicable to groundwater)	TOXIC AND OTHER DELETERIOUS ORGANIC AND INORGANIC SUBSTANCES	COLOR	PETROLEUM HYDROCARBONS, OILS AND GREASE
(C) Growth and Propagation of Fish, Shellfish, Other Aquatic Life, and Wildlife	Same as (1)(A)(iii).	The percent accumulation of fine sediment in the range of 0.1 mm to 4.0 mm in the gravel bed of waters used by anadromous or resident fish for spawning may not be increased more than 5% by weight above natural conditions (as shown by grain size accumulation graph). In no case may the 0.1 mm to 4.0 mm fine sediment range in those gravel beds exceed a maximum of 30% by weight (as shown from grain size accumulation graph) (See notes 3 and 4). In all other surface waters no sediment loads (suspended or deposited) that can cause adverse effects on aquatic animal or plant life, their reproduction or habitat may be present.	Individual substances may not exceed criteria in EPA, Quality Criteria for Water (See note 5) or, if those criteria do not exist, may not exceed the Primary Maximum Contaminant Levels of the Alaska Drinking Water Standards (18 AAC 80). If those criteria are absent, or if the department finds that the criteria are not appropriate for sensitive resident Alaskan species, the department will, in its discretion, establish in regulation chronic and acute criteria to protect sensitive and biologically important life stages of resident Alaskan species, using methods approved by the EPA or alternate methods approved by the department. There may be no concentrations of toxic substances in water or in shoreline or bottom sediments, that, singly or in combination, cause, or reasonably can be expected to cause, toxic effects on aquatic life, except as authorized by this chapter. Substances may not be present in concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms, as determined by either bioassy or organoleptic tests (See note 5).	Color or apparent color may not reduce the depth of the compensation point for photosynthetic activity by more than 10% from the seasonally established norm for aquatic life. For all waters without a seasonally established norm for aquatic life, color or apparent color may not exceed 50 color units or the natural condition, whichever is greater.	Same as (1)(A)(iii).

Water Quality Criteria for Fresh Water Uses as Set by the State of Alaska in 18 AAC 70.

(1) FRESH WATER USES	DISSOLVED INORGANIC SUBSTANCES	SEDIMENT (Not applicable to groundwater)	TOXIC AND OTHER DELETERIOUS ORGANIC AND INORGANIC SUBSTANCES	COLOR	PETROLEUM HYDROCARBONS, OILS AND GREASE
(A)Water Supply (I) drinking, culinary, and food processing	Total dissolved solids (TDS) from all sources may not exceed 500 mg/l. Neither chlorides nor sulfates may exceed 200 mg/l.	No measurable increase in concentration of settleable solids above natural conditions, as measured by the volumetric Imhoff cone method (See note 13).	Substances may not exceed Alaska Drinking Water Standards (18 AAC 80) or where those standards do not exist, EPA Quality Criteria for Water (See note 5).	May not exceed 15 color units or the natural condition, whichever is greater.	May not cause a visible sheen upon the surface of the water. May not exceed concentrations that individually or in combination impart odor or taste as determined by organoleptic tests.
(A)Water Supply (Ii) agriculture including irrigation and stock watering	TDS may not exceed 1,000 mg/l. Sodium absorption ratio must be less than 2.5, sodium percentage less than 60%, residual carbonate less than 1.25 mg/l, and boron less than 0.3 mg/l (See note 6).	For sprinkler irrigation, water must be free of particles of 0.074 mm or coarser. For irrigation or water spreading, may not exceed 200 mg/l for an extended period of time.	Same as (1)(A)(i) where contact with a product destined for human consumption is present. Same as (1)(C) or Federal Water Pollution Control Administration, Water Quality Criteria (WQC/FWPCA), as applicable to substances for stockwaters; concentrations for irrigation waters may not exceed WQC/FWPCA or WQC 1972 (See notes 6 and 7).	Not applicable.	May not cause a visible sheen upon the surface of the water.

Notes to table:

1. Wherever cited in the section, fecal coliform bacteria must be determined by the membrane filter technique or most probable number procedure according to *Standard Methods for the Examination of Water and Wastewater*, 18th edition, 1992 or in accordance with other standards approved by the department and the United States Environmental Protection Agency (EPA).

2. Wherever cited in this chapter, dissolved oxygen (DO) concentrations in interstitial waters of gravel beds will be measured using the technique found in *Variations in the Dissolved Oxygen Content of Intragravel Water in Four Spawning Streams of Southeastern Alaska*, Special Scientific Report - Fisheries No. 402, February 1962, by William J. McNeil, available from the United States Department of the Interior. See note 14.

3. Wherever cited in this chapter, fine sediments must be sampled by the method described in *An Improved Technique for Freeze Sampling Streambed Sediments*, United States Department of Agriculture (USDA) Forest Service Research Note PNW-281, October 1976, by William J. Walkotten, available from the USDA Forest Service Pacific Northwest Forest and Range Experiment Station, P.O. Box 909, Juneau, AK 99802, or by the technique found in *Success of Pink Salmon Spawning Relative to Size of Spawning Bed Materials*, Special Scientific Report Fisheries No. 469, January 1964, by William J. McNeil and W.H. Ahnell, pages 1 through 3, available from the United States Fish and Wildlife Service. See note 14.

4. Wherever cited in this chapter, percent accumulation of fine sediments will be measured by the technique found in the *Manual on Test Sieving Methods*, Guidelines for Establishing Sieve Analysis Procedures, STP 447A, 1972 edition, available from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103. See note 14.

5. The term "EPA Quality Criteria for Water" includes *Quality Criteria for Water*, July 1976, United States Environmental Protection Agency, Washington, D.C. 20460, United States Government Printing Office: 1977 0-222-904, the Ambient Water Quality Criteria for the 64 toxic pollutants listed in the Federal Register, Vol. 45, No. 231, pg. 79318, November 1980, the Ambient Water Quality Document for 2, 3, 7, 8-tetrachlorodibenzopdioxin (TCDD) listed in the Federal Register, Vol. 49, No. 32, pg. 5831, February 1984, and the final ambient water quality criteria documents listed in the Federal Register, Vol. 50, No. 145, pg. 30784, July 1985. These documents may be seen at the department's Juneau office or may be purchased through the National Technical Information Service, United States Department of Commerce, Springfield, Virginia 22161.

6. *The Report of the Committee on Water Quality Criteria*, Federal Water Pollution Control Administration, Washington, D.C., April 1, 1968, available from the Superintendent of Documents, United States Government Printing Office,

Washington, D.C. See note 14.

7. Water Quality Criteria 1972, Environmental Studies Board of the National Academy of Sciences and the National Academy of Engineering, Washington, D.C., 1972, EPA-R3-73-033, March 1973, is available from the Superintendent of Documents, United States Government Printing Office, Washington, D.C. 20204 (Stock No. 5501-00520). See note 14.

8. Samples to determine concentrations of total aromatic hydrocarbons (TAH) and total aqueous hydrocarbons (TaqH) must be collected in marine and fresh waters below the surface and away from any observable sheen. Concentrations of TAqH must be determined and summed using a combination of: (A) EPA Method 602 (plus Xylenes) to quantify monoaromatic hydrocarbons and to measure TAH; and (B) EPA Method 610 to quantify polynuclear aromatic hydrocarbons. Use of an alternative method requires department approval. The EPA methods referred to in this note may be found in 40 CFR 136, Appendix A, as amended as of February 14, 1996, adopted by reference. They may be reviewed at the department or are available from the Office of Monitoring Systems and Quality Assurance, Office of Research and Development, United States Environmental Protection Agency, Washington, D.C. 20460.

9. Color is measured in color units on the platinum-cobalt scale according to *Standard Methods for the Examination of Waste and Wastewater*, 18th edition, 1992.

10. Wherever cited in this chapter, 10 CFR Part 20 means the *Standards for Protection Against Radiation* published in the *Code of Federal Regulations*, January 1, 1978. See note 14.

11. Wherever cited in this chapter, *National Bureau of Standards Handbook 69* means *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure*, United States Department of Commerce, National Bureau of Standards Handbook 69, June 5, 1959, available from the Superintendent of Documents, United States Government Printing Office, Washington, D.C. See note 14.

12. Wherever cited in this chapter, the *National Shellfish Sanitation Program, Manual of Operations, Part I, means Sanitation of Shellfish Growing Areas*, 1965 Revision, United States Department of Health, Education, and Welfare, Public Health Service Publication No. 33 Part I, available from the Superintendent of Documents, United States Government Printing Office, Washington, D.C. 20402. See note 14.

13. Volumetric measurements of settleable solids must be determined according to the following procedure: fill an Imhoff cone to the one-liter mark with thoroughly mixed sample; settle for 45 minutes; gently stir sides of cone with a rod or by spinning; settle 15 minutes longer, and record volume of settleable

matter in the cone as milliliters per liter; it the settled matter contains pockets of liquid between large settled particles, estimate volume of these and subtract from volume of settled matter.

14. The cited document is on file in the lieutenant governor's office and may be seen at the department office in Anchorage, Fairbanks, and Juneau.

Appendix 3.8.D
Water Quality Values

Surface Water Quality Values for the Salcha River Sampled Eight Miles Above Salchaket, AK (Earth Info, 1993). All values are reported as mg/l unless otherwise specified.

Date	6/14/71	8/9/71	10/13/71	4/7/75	7/23/75	9/19/75	3/15/76	8/6/76	9/29/76	MCL[3]
Discharge (cubic feet per second)	11,200	4,060	--	156	6,270	2,440	--	1,190	817	NS
Water temperature (°F)	48.2	49.1	34.7	33.8	39.2	44.6	32.0	61.7	41.0	NS
Dissolved oxygen	11.0	10.6	14.2	9.5	9.4	11.8	11.8	--	13.9	NS
pH (standard units)	7.4	7.7	7.1	6.9	6.6	7.5	7.0	7.5	7.3	6.5 (min) - 8.5 (max)[2]
Alkalinity	33	43	49	59	30	50	60	55	59	NS
Bicarbonate	40	53	60	72	37	61	73	67	72	NS
Specific conductance	87	115	145	--	88	131	150	115	122	NS
Nitrogen - Ammonia	--	--	--	0.01	0.01	0.25	0.02	--	--	NS
Nitrogen - Total	--	--	--	0.62	0.79	0.50	--	--	--	10 (as Nitrogen)[1]
Sodium	1.2	1.5	1.9	2.2	1.5	1.5	1.8	1.7	1.9	250[2]
Magnesium	3.1	4.3	5.0	5.9	3.7	4.5	6.1	5.2	5.4	NS
Calcium	12.0	16.0	16.0	20.0	11.0	16.0	20.0	20.0	19.0	NS
Potassium	0.8	0.9	1.5	1.3	0.7	0.9	1.0	1.0	1.0	NS
Iron	150	110	--	60	220	140	70	100	70	0.3[2]
Silica	5.4	6.9	7.7	7.5	7.4	7.6	7.9	6.4	6.5	NS
Dissolved solids	1600	789	--	40	1350	573	--	--	194	500[2]
Suspended sediment	--	--	--	2.0	64.0	3.0	--	10.0	2.0	NS
Suspended sediment	--	--	--	0.84	1080	20.0	--	32.0	4.4	NS

[1] - Primary MCL. [2] - Secondary MCL. [3] - Maximum Contaminant Levels - MCLs as set forth in Alaska Drinking Water Standards (18 AAC 80) . NS - No set standard.

Surface Water Quality Values for the Chena River at North Pole, AK for a Portion of the 1971 Water Year (Earth Info, 1993). All values are reported as mg/l unless otherwise specified.

	5/25/72	6/22/72	7/28/72	8/23/72	9/1/72	Maximum Contaminant Levels - MCLs as set forth in Alaska Drinking Water Standards (18 AAC 80)
Discharge (cubic feet per second)	5,300	1,540	--	1,100	1,130	NS
Water temperature (°F)	41.0	49.1	52.7	50.9	47.3	NS
Dissolved oxygen	10.9	9.3	10.2	10.2	10	NS
pH (standard units)	7.2	7.6	7.6	7.9	7.8	6.5 (minimum) - 8.5 (maximum)[2]
Alkalinity	31	54	58	61	64	NS
Bicarbonate	38	66	71	74	78	NS
Specific conductance	80	125	150	170	165	NS
Nitrogen - Ammonia	--	0	0.05	0.03	0.04	NS
Nitrogen - Nitrate	0.2	0.23	0.25	0.18	0.34	10 (as Nitrogen)[1]
Nitrogen - Total	0.33	0.12	0.09	0.07	0.1	10 (as Nitrogen)[1]
Phosphate - Ortho	0	0.03	0.03	0	0	NS
Sodium	1.0	1.6	1.6	1.6	1.7	250[2]
Magnesium	2.6	4.0	4.5	4.6	4.8	NS
Calcium	11.0	19.0	21.0	22.0	23.0	NS
Potassium	0.8	0.9	1.0	1.0	1.0	NS
Iron	90	460	490	200	220	0.3[2]
Silica	3.9	5.4	6.3	6.5	6.5	NS
Dissolved solids	687	--	--	270	293	500[2]
Suspended sediment	135	16	--	0.8	5	NS
BOD (Biological Oxygen Demand)	2.7	--	--	0	0.4	NS
COD (Chemical Oxygen Demand)	46	9	9	6	6	NS

[1] - Primary MCL. [2] - Secondary MCL. NS - No set standard.

Surface Water Quality Values for the Chena River at North Pole, AK for the 1972 Water Year (Earth Info, 1993). All values are reported as mg/l unless otherwise specified.

	10/26/72	11/17/72	12/6/72	2/9/73	3/22/73	4/18/73	5/10/73	7/19/73	9/29/73	MCL[3]
Discharge (cubic feet per second)	900	651	445	196	142	453	3,290	1,470	1,100	NS
Temperature (F)	32.9	32.9	32.9	32.0	32.0	32.0	36.5	49.1	37.4	NS
Dissolved oxygen	11.7	9.2	8.8	5.8	6.0	10.9	11.5	9.5	11.2	NS
pH (standard units)	7.5	7.4	7.2	7.2	6.9	--	7.2	7.0	7.4	6.5 (min) - 8.5 (max)[2]
Alkalinity	67	57	62	64	71	34	32	26	66	NS
Bicarbonate	82	80	81	78	87	42	39	32	80	NS
Specific conductance	160	170	170	171	190	200	100	150	160	NS
Nitrogen - Ammonia	<0.01	0.02	<0.01	0.01	--	--	0.04	0.03	<0.01	NS
Nitrogen - Nitrate	0.43	0.09	0.07	0.05	--	0.05	--	--	--	10 (as Nitrogen)[1]
Nitrogen - Total	2.5	0.4	0.03	0.06	--	--	0.1	0.13	0.15	10 (as Nitrogen)[1]
Phosphate - Ortho	0.03	--	--	--	0.03	--	0	0	0.06	NS
Sodium	1.6	1.9	1.8	1.8	1.9	1.8	1.2	1.7	--	250[2]
Magnesium	5.2	5.2	4.8	5.2	5.3	6.1	3.3	4.5	--	NS
Calcium	24.0	23.0	25.0	24.0	20.0	24.0	15.0	23.0	--	NS
Potassium	1.0	0.9	0.8	0.5	1.0	0.7	1.1	1.0	--	NS
Iron	280	390	--	290	320	260	--	210	--	0.3[2]
Silica	7.3	10.0	7.6	6.9	7.9	6.9	4.6	6.5	--	NS
Dissolved solids	245	172	118	52.4	38	127	542	373	--	500[2]
Biological Oxygen Demand	0.2	0.3	0.3	0.4	0.7	0.5	1.8	0.7	0.4	NS
Chemical Oxygen Demand	28	7	4.0	8.4	6.0	7.4	54	8.0	11.0	NS

[1] - Primary MCL. [2] - Secondary MCL. [3] - Maximum Contaminant Levels - MCLs as set forth in Alaska Drinking Water Standards (18 AAC 80). NS - No set standard.

Surface Water Quality Values for the Chena River at North Pole, AK for the 1973 Water Year (Earth Info 1993). All values are reported as mg/l unless otherwise specified.

	10/25/73	11/20/73	12/21/73	2/7/74	3/14/74	4/18/74	6/13/74	Maximum Contaminant Levels - MCLs as set forth in Alaska Drinking Water Standards (18 AAC 80)
Discharge (cubic feet per second)	275	350	214	97	55	85	753	NS
Water temperature (°F)	32.0	32.0	32.0	32.0	32.0	32.0	51.8	NS
Dissolved oxygen	10.0	8.1	7.0	6.2	6.3	11.6	10.7	NS
pH (standard units)	6.8	--	6.8	7.0	6.6	7.2	7.4	6.5 (min) - 8.5 (max)[2]
Alkalinity	68	--	66	65	63	51	52	NS
Bicarbonate	83	--	80	79	77	62	63	NS
Specific conductance	180	160	155	180	168	155	150	NS
Nitrogen - Ammonia	0.03	0.05	0.04	0.06	0.04	0.02	0.02	NS
Nitrogen - Total	0.23	0.21	0.44	0.48	0.25	0.26	0.41	10 (as Nitrogen)[1]
Phosphate - Ortho	0.12	0.06	0.06	0.03	0.03	0.03	0	NS
BOD (Biological Oxygen Demand)	0.5	0.7	0.6	0.8	0.4	0.9	0.4	NS
COD (Chemical Oxygen Demand)	3.0	7.0	5.0	8.0	6.0	8.0	11.0	NS

[1] - Primary MCL. [2] - Secondary MCL. NS - No set standard.

Water Quality Data Collected from Redmond Creek, Ninety-eight Creek, and McCoy Creek in 1974 and 1975 (adapted from U.S. Army Alaska, 1980).

Date	Stream	Water Temperature (°F)	Dissolved Oxygen (mg/l)	pH	Total Hardness (mg/l)	Color
12/23/74	Redmond Creek	33.8 - 35.6	1 - 3	--	--	--
12/7/75	Redmond Creek	32.0	0.8	6.4	84.0	--
6/18/75	Redmond Creek	53.6	10.0	6.5	85.5	reddish
	Ninety-eight Creek	55.4	11.0	8.0	85.5	reddish
	McCoy Creek	55.4	12.0	7.5	51.3	reddish
6/20/75	Redmond Creek	55.4	13.0	6.5	85.5	reddish
7/2/75	Ninety-eight Creek	59.0	10.0	7.5	85.5	reddish
	McCoy Creek	59.0	10.0	7.5	68.4	reddish
7/30/75	Redmond Creek	59.0	9.0	7.0	51.3	reddish
	Ninety-eight Creek	60.8	10.0	7.5	68.4	reddish
	McCoy Creek	57.2	11.0	7.5	48.2	reddish
9/17/75	Redmond Creek	48.2	12.0	7.0	68.4	reddish
	Ninety-eight Creek	48.2	13.0	8.0	68.4	reddish
	McCoy Creek	48.2	12.0	7.5	51.3	reddish

Surface Water Quality Values Collected Upstream for Selected Streams Located on Fort Greely (adapted from U.S. Army Environmental Hygiene Agency 1990). All values are reported as mg/l unless otherwise specified.

Parameter	Jarvis Creek	Delta River	100-Mile Creek	Delta Creek	Little Delta River	MCL[3]
Metals						
Aluminum	0.54	3.9	0.26	9.3	5.4	0.2[2]
Arsenic	0.006	0.005	0.005	0.007	0.005	0.05[1]
Barium	0.03	0.08	0.06	0.20	0.15	2.0[1]
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	0.0017	0.005[1]
Calcium	49.0	32.0	29.0	54.0	58.0	NS
Chromium	0.002	0.009	0.002	0.028	0.018	0.1[1]
Copper	<0.010	<0.010	<0.010	0.010	<0.010	1.0[2]
Iron	1.7	6.4	0.54	12.0	11.0	0.3[2]
Lead	<0.001	<0.001	<0.001	<0.001	<0.001	NS
Magnesium	22.0	12.0	7.7	15.0	17.0	NS
Manganese	0.06	0.14	0.04	0.24	0.20	0.05[2]
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.002[1]
Selenium	<0.001	<0.001	<0.001	<0.001	0.003	0.05[1]
Silver	<0.010	<0.010	<0.010	<0.010	<0.010	0.1[2]
Zinc	0.01	<0.01	<0.01	0.02	0.07	5.0[2]
Nonmetals						
Hardness	213.0	129.0	104.0	197.0	215.0	NS
Sulfates	120.0	49.0	37.0	120.0	140.0	250[2]
Conductivity	441.0	279.0	266.0	405.0	436.0	NS
pH SU	7.9	8.0	8.1	8.4	8.2	6.5 (min) - 8.5 (max)[2]
Temp. (°C)	5.9	5.6	3.4	0.4	1.6	NS
Diss. Oxygen	12.1	9.7	10.4	11.2	10.2	NS
NO2+NO3-N	<0.2	0.24	0.22	0.23	0.20	10 (as Nitrogen)[1]
NH3-N	<0.05	<0.05	<0.05	<0.05	<0.05	NS
PO4-P	0.10	0.46	0.12	0.22	0.42	NS
T-ALK	110.0	83.0	74.0	66.0	78.0	NS
TKN	0.34	0.39	0.39	0.92	0.31	NS

Surface Water Quality Values Collected Upstream for Selected Streams Located on Fort Greely (adapted from U.S. Army Environmental Hygiene Agency 1990). All values are reported as mg/l unless otherwise specified.

Parameter	Jarvis Creek	Delta River	100-Mile Creek	Delta Creek	Little Delta River	MCL[3]
TOC	1.4	1.3	2.3	0.70	0.91	NS
Explosives						
HMX	<0.100	<0.100	<0.100	<0.100	<0.100	--
RDX	<0.030	<0.030	<0.030	<0.030	<0.030	--
TNT	<0.001	<0.001	<0.001	<0.001	<0.001	--
2,6-DNT	<0.001	<0.001	<0.001	<0.001	<0.001	--
2,4-DNT	<0.001	<0.001	<0.001	<0.001	<0.001	--
Tetryl	<0.010	<0.010	<0.010	<0.010	<0.010	--

[1] - Primary MCL. [2] - Secondary MCL. [3] - Maximum Contaminant Levels - MCLs as set forth in Alaska Drinking Water Standards (18 AAC 80). NS - No set standard.

Sediment Quality Sampled Upstream for Selected Streams Located on Fort Greely (adapted from U.S. Army Environmental Hygiene Agency 1990). All values are reported as mg/kg unless otherwise specified.

Parameter	Jarvis Creek	Delta River	100-Mile Creek	Delta Creek	Little Delta River
Metals					
Aluminum	1900.0	7900.0	6400.0	9600.0	8600.0
Arsenic	11.0	13.0	5.2	8.2	5.6
Barium	10.0	61.0	32.0	160.0	130.0
Cadmium	<0.25	<0.25	0.53	<0.25	0.47
Chromium	4.7	13	9.8	20	20
Copper	13.0	36.0	19.0	34.0	30.0
Iron	11000.0	19000.0	18000.0	17000.0	20000.0
Lead	3.5	4.6	7.4	2.4	3.4
Magnesium	2300.0	5400.0	5100.0	5700.0	7000.0
Manganese	220.0	320.0	340.0	240.0	350.0
Mercury	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	<0.50	<0.50	0.60	0.60	<0.50
Silver	<0.50	<0.50	<0.50	<0.50	<0.50
Zinc	18.0	40.0	56.0	42.0	52.0
Nonmetals					
Moisture %	20.4	19.6	17.4	15.5	19.9
NH3-N	120.0	140.0	<12.0	83.0	35.0
NO2+NO3-N	0.75	<0.75	0.97	<0.75	<0.75
PO4-P	280.0	460.0	280.0	280.0	290.0
TKN	120.0	140.0	140.0	830.	84.0
TOM %	0.66	0.62	0.62	<0.05	0.63
Explosives					
HMX	<0.001	<0.001	<0.001	<0.001	<0.001
RDX	<0.001	<0.001	<0.001	<0.001	<0.001
TNT	<0.001	<0.001	<0.001	<0.001	<0.001
2,6-DNT	<0.001	<0.001	<0.001	<0.001	<0.001
2,4-DNT	<0.001	<0.001	<0.001	<0.001	<0.001
Tetryl	<0.001	<0.001	<0.001	<0.001	<0.001

Surface Water Quality Values Collected Downstream for Selected Streams Located on Fort Greely (adapted from U.S. Army Environmental Hygiene Agency 1990). All values are reported as mg/l unless otherwise specified.

Parameter	Jarvis Creek	Delta River	100-Mile Creek	Delta Creek above 100-Mile Creek	Delta Creek	Little Delta River	MCL[3]
Metals							
Aluminum	0.84	7.9	5.5	7.8	10.0	5.9	0.2[2]
Arsenic	0.005	0.008	<0.005	0.008	0.005	<0.005	0.05[1]
Barium	0.03	0.11	0.09	0.19	0.22	0.18	2.0[1]
Cadmium	<0.0005	<0.0005	<0.0005	0.0009	<0.0005	<0.0005	0.005[1]
Calcium	49.0	31.0	16.0	49.0	42.0	54.0	NS
Chromium	0.002	0.0182	0.008	0.026	0.026	0.015	0.1[1]
Copper	<0.010	<0.010	<0.010	<0.010	0.03	<0.010	1.0[2]
Iron	2.4	12.0	9.5	11.0	14.0	11.0	0.3[2]
Lead	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	NS
Magnesium	22.0	12.0	4.2	13.0	12.0	15.0	NS
Manganese	0.006	0.24	0.16	0.22	0.24	0.20	0.05[2]
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.002[1]
Selenium	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.05[1]
Silver	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.1[2]
Zinc	0.01	0.02	0.01	0.03	0.03	0.03	5.0[2]
Nonmetals							
Hardness	213.0	129.0	57.0	176.0	154.0	197.0	NS
Sulfates	110.0	48.0	15.0	110.0	83.0	120.0	250[2]
Conductivity	437.0	256.0	126.0	390.0	311.0	404.0	NS
pH SU	8.2	8.2	8.4	8.4	8.3	8.3	6.5 (min) - 8.5 (max)[2]
Temp. (°C)	6.3	6.1	3.8	1.5	1.8	3.6	NS
Diss. Oxygen	12.0	10.2	14.0	13.6	19.5	10.9	NS
NO2+NO3-N	0.28	0.22	0.28	0.26	<0.20	0.26	10 (as Nitrogen)[1]
NH3-N	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	NS
PO4-P	0.13	0.52	0.28	0.35	0.22	0.34	NS
T-ALK	110.0	74.0	42.0	70.0	62.0	77.0	NS
TKN	0.39	0.42	1.0	0.78	0.98	0.70	NS

Surface Water Quality Values Collected Downstream for Selected Streams Located on Fort Greely (adapted from U.S. Army Environmental Hygiene Agency 1990). All values are reported as mg/l unless otherwise specified.

Parameter	Jarvis Creek	Delta River	100-Mile Creek	Delta Creek above 100-Mile Creek	Delta Creek	Little Delta River	MCL[3]
TOC	1.5	1.1	8.4	3.5	3.9	3.8	NS
Explosives							
HMX	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	--
RDX	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	--
TNT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--
2,6-DNT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--
2,4-DNT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	--
Tetryl	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	--

[1] - Primary MCL. [2] - Secondary MCL. [3] - Maximum Contaminant Levels - MCLs as set forth in Alaska Drinking Water Standards (18 AAC 80). NS - No set standard.

Sediment Quality Sampled Downstream for Selected Streams Located on Fort Greely (adapted from U.S. Army Environmental Hygiene Agency 1990). All values are reported as mg/kg unless otherwise specified.

Parameter	Jarvis Creek	Delta River	100-Mile Creek	Delta Creek above 100-Mile Creek	Delta Creek	Little Delta River
Metals						
Aluminum	1900.0	6600.0	6800.0	7800.0	8800.0	7000.0
Arsenic	9.4	4.5	3.8	4.2	4.0	4.8
Barium	14.0	56.0	71.0	120.0	150.0	140.0
Cadmium	<0.25	<0.25	0.39	<0.25	<0.25	0.35
Chromium	5.5	10	10	15	18	15
Copper	22.0	15.0	15.0	16.0	18.0	27.0
Iron	17000.0	12000.0	14000.0	13000.0	15000.0	16000.0
Lead	4.9	2.7	6.6	3.3	4.4	3.1
Magnesium	3000.0	3800.0	3600.0	5000.0	5300.0	5000.0
Manganese	320.0	220.0	290.0	250.0	260.0	270.0
Mercury	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Selenium	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver	<0.50	<0.50	<0.50	<0.50	<0.50	1.6
Zinc	27.0	21.0	39.0	34.0	35.0	37.0
Nonmetals						
Moisture %	22.7	21.6	22.2	18.8	21.3	20.2
NH3-N	72.0	<12.0	140.0	52.0	53.0	<12.0
NO2+NO3-N	0.91	<0.75	0.77	<0.75	<0.75	<0.75
PO4-P	300.0	290.0	270.0	230.0	280.0	280.0
TKN	72.0	110.0	140.0	120.0	120.0	120.0
TOM %	0.76	<0.05	0.69	<0.05	<0.05	0.61
Explosives						
HMX	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
RDX	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TNT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2,6-DNT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2,4-DNT	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tetryl	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Average Water and Sediment Chemistries Collected Upstream and Downstream of Fort Greely (adapted from U.S. Army Environmental Hygiene Agency 1990). Upstream = sample sites 1,3,5,7, and 10. Downstream = 2,4,6,9, and 11. Conductivity in umhos/cm.

	Water (mg/l)		Sediment (mg/kg)	
	Upstream	Downstream	Upstream	Downstream
Metals				
Aluminum	3.88	50.28	6880	6220
Arsenic	0.0056	0.0056	8.6	5.3
Barium	0.104	0.126	78.6	86.2
Cadmium	<0.0008	<0.0005	<0.35	<0.298
Calcium	44.4	38.4	--	--
Chromium	0.0118	0.0138	13.5	11.7
Copper	<0.010	<0.014	26.4	17.4
Iron	6.328	9.78	17000	14800
Lead	<0.001	<0.001	4.26	4.34
Magnesium	14.74	13.04	5100	4140
Manganese	0.1360	0.1800	394	272
Mercury	<0.0002	<0.0002	<0.10	<0.10
Selenium	<0.0014	<0.0012	<0.54	<0.50
Silver	<0.010	<0.010	<0.5	<0.72
Zinc	<0.024	<0.020	41.6	31.8
Nonmetals				
Hardness	171.6	150.0	--	--
Sulfates	93.2	75.2	--	--
Conductivity	365.4	306.8	--	--
NO2+NO3-N	0.218	0.248	<0.79	<0.786
NH3-N	<0.05	<0.05	78	57.8
PO4-P	0.264	0.298	319	284
T-Alk	82.2	72.4	--	--
TKN	0.474	0.698	113.4	112.4
TOC	1.322	3.74	--	--
TOM %	--	--	0.516	0.432
Explosives				
HMX	<0.1	<0.1	<0.01	<0.01
RDX	<0.03	<0.03	<0.001	<0.001

Average Water and Sediment Chemistries Collected Upstream and Downstream of Fort Greely (adapted from U.S. Army Environmental Hygiene Agency 1990). Upstream = sample sites 1,3,5,7, and 10. Downstream = 2,4,6,9, and 11. Conductivity in umhos/cm.

	Water (mg/l)		Sediment (mg/kg)	
	Upstream	Downstream	Upstream	Downstream
TNT	<0.001	<0.001	<0.001	<0.001
2,6-DNT	<0.001	<0.001	<0.001	<0.001
2,4-DNT	<0.001	<0.001	<0.001	<0.001
Tetryl	<0.010	<0.010	<0.001	<0.001

Surface Water Quality Values Collected on June 3, 1975 for North Twin, South Twin, and Mark Lakes Located on Fort Greely (Earth Info, 1991). All values are reported as mg/l unless otherwise specified.

	North Twin Lake	South Twin Lake	Mark Lake	Maximum Contaminant Levels - MCLs as set forth in Alaska Drinking Water Standards (18 AAC 80)
Depth (m)	2	2	2	NS
Temperature (°C)	12	12	11.5	NS
Alkalinity	31	43	37	NS
Bicarbonate	38	52	45	NS
Specific conductance	67	99	97	NS
Nitrogen - Ammonia	0.01	0.04	0.04	NS
Nitrogen - Nitrate	0.05	0.09	0.03	10 (as Nitrogen)[1]
Nitrogen - Nitrite	0.05	0.09	0.03	1 (as Nitrogen)[1]
Nitrogen - Total	0.41	0.69	0.80	10 (as Nitrogen)[1]
Phosphate - Ortho	0.03	0.03	0.06	NS
Sodium	1.3	1.2	0.8	250[2]
Magnesium	2.1	2.3	3.3	NS
Calcium	10.0	13.0	11.0	NS
Potassium	1.8	4.3	2.4	NS
Iron	40	60	110	0.3[2]
Silica	0.1	0.4	0.4	NS
Dissolved solids	0.09	0.09	0.09	500[2]

[1] - Primary MCL. [2] - Secondary MCL. NS - No set standard.

Surface Water Quality Values for Bolio Lake Located on Fort Greely (Earth Info, 1993). All values are reported as mg/l unless otherwise specified.

	7/10/74	8/10/74	6/3/75	9/10/86	Maximum Contaminant Levels - MCLs as set forth in Alaska Drinking Water Standards (18 AAC 80)
Depth (m)	--	0.5	2	8	NS
Temperature (°C)	16.5	19.0	13.5	--	NS
Dissolved oxygen	10.2	9.8	--	--	NS
pH	8.8	9.2	--	7.8	6.5 (minimum) - 8.5 (maximum)[2]
Alkalinity	41	44	40	41	NS
Bicarbonate	50	45	49	51	NS
Specific conductance	97	98	98	103	NS
Nitrogen - Ammonia	--	0.12	0.04	0.03	NS
Nitrogen - Nitrate	--	0.02	0.05	0.06	10 (as Nitrogen)[1]
Nitrogen - Nitrite	--	0.02	0.05	0.06	1 (as Nitrogen)[1]
Nitrogen - Total	--	1.1	0.72	--	10 (as Nitrogen)[1]
Phosphate - Ortho	--	--	0.03	--	NS
Sodium	--	--	1.3	1.0	250[2]
Magnesium	--	--	3.0	3.6	NS
Calcium	--	--	12.0	15.0	NS
Potassium	--	--	3.0	3.0	NS
Iron	--	--	220	170	0.3[2]
Silica	--	--	0.1	0.5	NS
Dissolved solids	--	--	0.11	--	500[2]
Fecal Coliform	--	0	--	10	NS

[1] - Primary MCL. [2] - Secondary MCL. NS - No set standard.

Surface Water Quality Values for the Delta River Above Jarvis Creek Near Fort Greely. Collected Water Year October 1985 to September 1986 (U.S. Geological Survey 1988).

YUKON ALASKA

640114145451800 - DELTA R AB JARVIS C NR FT GREELEY AK

WATER QUALITY DATA, WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986

DATE	TIME	SAMPLE LOCATION, CROSS SECTION (FT FM L BANK) (00009)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH (STANDARD UNITS) (00400)	TEMPERATURE WATER (DEG C) (00010)	BAROMETRIC PRESSURE (MM OF HG) (00025)	OXYGEN, DISSOLVED (MG/L) (00300)	OXYGEN, DISSOLVED (PERCENT SATURATION) (00301)
SEP								
09...	1845	115	212	8.00	6.5	735	11.6	97
09...	1846	210	213	8.00	6.0	735	--	--
09...	1847	270	213	8.00	6.0	735	11.6	97
09...	1848	310	213	8.10	6.0	735	11.6	97
09...	1849	350	213	8.10	6.0	735	11.5	96

DATE	TIME	STREAM WIDTH (FT) (00004)	STREAMFLOW, INSTANTANEOUS (CFS) (00061)	COLOR (PLATINUM-COBALT UNITS) (00080)	TURBIDITY (NTU) (00076)	OXYGEN DEMAND, CHEMICAL (HIGH LEVEL) (MG/L) (00340)	COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML) (31625)	STREPTOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)	HARDNESS (MG/L AS CACO3) (00900)	HARDNESS NONCARB WH WAT TOT FLD MG/L AS CACO3 (00902)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)
SEP												
09...	1900	420	3960	5	110	13	K2	K7	110	39	29	8.1

DATE	SODIUM, DISSOLVED (MG/L AS NA) (00930)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	ALKALINITY WH WAT TOTAL FIELD MG/L AS CACO3 (00410)	ALKALINITY, CARBONATE IT-FLD (MG/L - CACO3) (99430)	BICARBONATE IT-FLD (MG/L AS HCO3) (99440)	CARBONATE IT-FLD (MG/L AS CO3) (99445)	SULFATE DISSOLVED (MG/L AS SO4) (00945)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)
SEP												
09...	2.8	2.6	67	67	81	0	41	1.1	<0.10	4.0	130	<0.100

DATE	PHOSPHORUS, ORTHO, DISSOLVED (MG/L AS P) (00671)	ARSENIC TOTAL (UG/L AS AS) (01002)	ARSENIC TOTAL IN BOTTOM MATERIAL (UG/G AS AS) (01003)	BARIUM, TOTAL RECOVERABLE (UG/L AS BA) (01007)	BARIUM, RECOV. FM BOTTOM MATERIAL (UG/G AS BA) (01008)	CADMIUM TOTAL RECOVERABLE (UG/L AS CD) (01027)	CADMIUM RECOV. FM BOTTOM MATERIAL (UG/G AS CD) (01028)	CHROMIUM, TOTAL RECOVERABLE (UG/L AS CR) (01034)	CHROMIUM, RECOV. FM BOTTOM MATERIAL (UG/G) (01029)	COBALT, RECOV. FM BOTTOM MATERIAL (UG/G AS CO) (01038)	COPPER, TOTAL RECOVERABLE (UG/L AS CU) (01042)	COPPER, RECOV. FM BOTTOM MATERIAL (UG/G AS CU) (01043)
SEP												
09...	0.010	7	21	100	90	<1	<1	30	10	10	28	10

DATE	IRON, TOTAL RECOVERABLE (UG/L AS FE) (01045)	IRON, DISSOLVED (UG/L AS FE) (01046)	IRON, RECOV. FM BOTTOM MATERIAL (UG/G AS FE) (01170)	LEAD, TOTAL RECOVERABLE (UG/L AS PB) (01051)	LEAD, RECOV. FM BOTTOM MATERIAL (UG/G AS PB) (01052)	MANGANESE, TOTAL RECOVERABLE (UG/L AS MN) (01055)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MANGANESE, RECOV. FM BOTTOM MATERIAL (UG/G) (01053)	MERCURY TOTAL RECOVERABLE (UG/L AS HG) (71900)	MERCURY RECOV. FM BOTTOM MATERIAL (UG/G AS HG) (71921)	NICKEL, RECOV. FM BOTTOM MATERIAL (UG/G AS NI) (01068)
SEP											
09...	18000	24	6600	6	<10	340	5	280	<0.10	0.03	20

DATE	SILVER, TOTAL RECOVERABLE (UG/L AS AG) (01077)	ZINC, TOTAL RECOVERABLE (UG/L AS ZN) (01092)	ZINC, RECOV. FM BOTTOM MATERIAL (UG/G AS ZN) (01093)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. FALL DIAM. % FINER THAN .002 MM (70337)	SED. SUSP. FALL DIAM. % FINER THAN .004 MM (70338)	SED. SUSP. FALL DIAM. % FINER THAN .008 MM (70339)	SED. SUSP. FALL DIAM. % FINER THAN .016 MM (70340)	SED. SUSP. FALL DIAM. % FINER THAN .031 MM (70341)	SED. SUSP. FALL DIAM. % FINER THAN .062 MM (70342)
SEP											
09...	<1	60	40	1080	11500	8	11	15	21	26	36

DATE	SED. SUSP. FALL DIAM. % FINER THAN .125 MM (70343)	SED. SUSP. FALL DIAM. % FINER THAN .250 MM (70344)	SED. SUSP. FALL DIAM. % FINER THAN .500 MM (70345)	SED. SUSP. FALL DIAM. % FINER THAN 1.00 MM (70346)	GROSS ALPHA, DISSOLVED (UG/L AS U-NAT) (80030)	GROSS ALPHA, SUSP. TOTAL (UG/L AS U-NAT) (80040)	GROSS BETA, DISSOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137) (03516)	GROSS BETA, DISSOLVED (PCI/L AS SR/YT-90) (80050)	GROSS BETA, SUSP. TOTAL (PCI/L AS SR/YT-90) (80060)	TANNIN AND LIGNIN (MG/L) (32240)
SEP											
09...	52	85	99	100	0.8	8.4	2.9	7.7	2.3	6.6	<1.0

K NON-IDEAL COLONY COUNT

YUKON ALASKA--Continued

640114145451800 - DELTA R AB JARVIS C NR FT GREELEY AK--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986

DATE	TIME	DI-CHLORO-BROMO-METHANE TOTAL (UG/L) (32101)	CARBON-TETRA-CHLO-RIDE TOTAL (UG/L) (32102)	1,2-DI-CHLORO-ETHANE TOTAL (UG/L) (32103)	BROMO-FORM TOTAL (UG/L) (32104)	CHLORO-DI-BROMO-METHANE TOTAL (UG/L) (32105)	CHLORO-FORM TOTAL (UG/L) (32106)	TOLUENE TOTAL (UG/L) (34010)	BENZENE TOTAL (UG/L) (34030)	ACE-NAPHTH-YLENE TOTAL (UG/L) (34200)	ACE-NAPHTH-YLENE BOT.MAT (UG/KG) (34203)	ACE-NAPHTH-ENE TOTAL (UG/L) (34205)
SEP 09...	1900	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<5.0	<200	<5.0

DATE	ACE-NAPHTH-ENE BOT.MAT (UG/KG) (34208)	ANTHRA-CENE TOTAL (UG/L) (34220)	ANTHRA-CENE BOT.MAT (UG/KG) (34223)	BENZO B FLUOR-AN-THENE TOTAL (UG/L) (34230)	BENZO B FLUOR-AN-THENE BOT.MAT (UG/KG) (34233)	BENZO K FLUOR-AN-THENE TOTAL (UG/L) (34242)	BENZO K FLUOR-AN-THENE BOT.MAT (UG/KG) (34245)	BENZO-A-PYRENE TOTAL (UG/L) (34247)	BENZO-A-PYRENE BOT.MAT (UG/KG) (34250)	BIS 2-CHLORO-ETHYL ETHER TOTAL (UG/L) (34273)	BIS (2-CHLORO-ETHYL) ETHER BOT.MAT (UG/KG) (34276)	BIS (2-CHLORO-ETHOXY) METHANE TOTAL (UG/L) (34278)
SEP 09...	<200	<5.0	<200	<10.0	<400	<10.0	<400	<10.0	<400	<5.0	<200	<5.0

DATE	BIS (2-CHLORO-ETHOXY) METHANE BOT.MAT (UG/KG) (34281)	BIS (2-CHLORO-ISO-PROPYL) ETHER TOTAL (UG/L) (34283)	BIS (2-CHLORO-ISO-PROPYL) ETHER BOT.MAT (UG/KG) (34286)	N-BUTYL BENZYL PHTHAL-ATE TOTAL (UG/L) (34292)	N-BUTYL BENZYL PHTHAL-ATE BOT.MAT (UG/KG) (34295)	CHLORO-BENZENE TOTAL (UG/L) (34301)	CHLORO-ETHANE TOTAL (UG/L) (34311)	CHRY-SENE TOTAL (UG/L) (34320)	CHRY-SENE BOT.MAT (UG/KG) (34323)	DIETHYL PHTHAL-ATE TOTAL (UG/L) (34336)	DIETHYL PHTHAL-ATE BOT.MAT (UG/KG) (34339)	DI-METHYL PHTHAL-ATE TOTAL (UG/L) (34341)
SEP 09...	<200	<5.0	<200	<5.0	<200	<3.0	<3.0	<10.0	<400	<5.0	<200	<5.0

DATE	DI-METHYL PHTHAL-ATE BOT.MAT (UG/KG) (34344)	ETHYL-BENZENE TOTAL (UG/L) (34371)	FLUOR-ANTHENE TOTAL (UG/L) (34376)	FLUOR-ANTHENE BOT.MAT (UG/KG) (34379)	FLUOR-ENE TOTAL (UG/L) (34381)	FLUOR-ENE BOT.MAT (UG/L) (34384)	HEXA-CHLORO-CYCLO-PENT-ADIENE TOTAL (UG/L) (34386)	HEXA-CHLORO-CYCLO-PENT-ADIENE BOT.MAT (UG/KG) (34389)	HEXA-CHLORO-ETHANE TOTAL (UG/L) (34396)	HEXA-CHLORO-ETHANE BOT.MAT (UG/KG) (34399)	INDENO (1,2,3-CD) PYRENE TOTAL (UG/L) (34403)	INDENO (1,2,3-CD) PYRENE BOT.MAT (UG/KG) (34406)
SEP 09...	<200	<3.0	<5.0	<200	<5.0	<200	<5.0	<200	<5.0	<200	<10.0	<200

DATE	ISO-PHORONE TOTAL (UG/L) (34408)	ISO-PHORONE BOT.MAT (UG/KG) (34411)	METHYL-BROMIDE TOTAL (UG/L) (34413)	METHYL-CHLO-RIDE TOTAL (UG/L) (34418)	METHYL-ENE CHLO-RIDE TOTAL (UG/L) (34423)	N-NITRO-SODI-N-PROPYL-AMINE TOTAL (UG/L) (34428)	N-NITRO-SODI-N-PROPYL-AMINE BOT.MAT (UG/KG) (34431)	N-NITRO-SODI-PHENY-LAMINE TOTAL (UG/L) (34433)	N-NITRO-SODI-PHENY-LAMINE BOT.MAT (UG/KG) (34436)	N-NITRO-SODI-METHY-LAMINE TOTAL (UG/L) (34438)	N-NITRO-SODI-METHY-LAMINE BOT.MAT (UG/KG) (34441)	NAPHTH-ALENE BOT.MAT (UG/KG) (34445)
SEP 09...	<5.0	<200	<3.0	<3.0	<3.0	<5.0	<200	<5.0	<200	<5.0	<200	<200

DATE	NITRO-BENZENE TOTAL (UG/L) (34447)	NITRO-BENZENE BOT.MAT (UG/KG) (34450)	PARA-CHLORO-META CRESOL TOTAL (UG/L) (34452)	PARA-CHLORO-META CRESOL BOT.MAT (UG/KG) (34455)	PHENAN-THRENE TOTAL (UG/L) (34461)	PHENAN-THRENE BOT.MAT (UG/KG) (34464)	PYRENE TOTAL (UG/L) (34469)	PYRENE BOT.MAT (UG/KG) (34472)	TETRA-CHLORO-ETHYL-ENE TOTAL (UG/L) (34475)	TRI-CHLORO-FLUORO-METHANE TOTAL (UG/L) (34488)	1,1-DI-CHLORO-ETHANE TOTAL (UG/L) (34496)	1,1-DI-CHLORO-ETHYL-ENE TOTAL (UG/L) (34501)
SEP 09...	<5.0	<200	<5.0	<600	<5.0	<200	<5.0	<200	<3.0	<3.0	<3.0	<3.0

DATE	1,1,1-TRI-CHLORO-ETHANE TOTAL (UG/L) (34506)	1,1,2-TRI-CHLORO-ETHANE TOTAL (UG/L) (34511)	1,1,2,2 TETRA-CHLORO-ETHANE TOTAL (UG/L) (34516)	BENZOGH I PERYL ENE1,12 -BENZOP ERYLENE TOTAL (UG/L) (34521)	BENZOGH I PERYL ENE1,12 -BENZOP ERYLENE BOT.MAT (UG/KG) (34524)	BENZO A ANTHRAC ENE1,2-BENZANT HRACENE TOTAL (UG/L) (34526)	BENZO A ANTHRAC ENE1,2-BENZANT HRACENE BOT.MAT (UG/KG) (34529)	1,2-DI-CHLORO-BENZENE TOTAL (UG/L) (34536)	1,2-DI-CHLORO-BENZENE BOT.MAT (UG/KG) (34539)	1,2-DI-CHLORO-PROPANE TOTAL (UG/L) (34541)	1,2-TRANSDI CHLORO-ETHYL-ENE TOTAL (UG/L) (34546)	1,2,4-TRI-CHLORO-BENZENE TOTAL (UG/L) (34551)
SEP 09...	<3.0	<3.0	<3.0	<10.0	<400	<10.0	<200	<3.0	<200	<3.0	<3.0	<5.0

DATE	1,2,4-TRI-CHLORO-BENZENE BOT.MAT (UG/KG) (34554)	1,2,5,6 -DIBENZ -ANTHRA -CENE TOTAL (UG/L) (34556)	1,2,5,6 -DIBENZ -ANTHRA -CENE BOT.MAT (UG/KG) (34559)	1,3-DI-CHLORO-PROPANE TOTAL (UG/L) (34561)	1,3-DI-CHLORO-BENZENE TOTAL (UG/L) (34566)	1,3-DI-CHLORO-BENZENE BOT.MAT (UG/KG) (34569)	1,4-DI-CHLORO-BENZENE TOTAL (UG/L) (34571)	1,4-DI-CHLORO-BENZENE BOT.MAT (UG/KG) (34574)	2-CHLORO-ETHYL-VINYL-ETHER TOTAL (UG/L) (34576)	2-CHLORO-NAPH-THALENE TOTAL (UG/L) (34581)	2-CHLORO-NAPH-THALENE BOT.MAT (UG/KG) (34584)	2-CHLORO-PHENOL TOTAL (UG/L) (34586)
SEP 09...	<200	<10.0	<400	<3.0	<3.0	<200	<3.0	<200	<3.0	<5.0	<200	<6.0

YUKON ALASKA--Continued

640114145451800 - DELTA R AB JARVIS C NR FT GREELEY AK--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986

DATE	2-CHLORO-PHENOL BOT.MAT (UG/KG) (34589)	2-NITRO-PHENOL TOTAL (UG/L) (34591)	2-NITRO-PHENOL BOT.MAT (UG/KG) (34594)	DI-N-OCTYL PHTHAL-ATE TOTAL (UG/L) (34596)	DI-N-OCTYL PHTHAL-ATE BOT.MAT (UG/KG) (34599)	2,4-DI-CHLORO-PHENOL TOTAL (UG/L) (34601)	2,4-DI-CHLORO-PHENOL BOT.MAT (UG/KG) (34604)	2,4-DI-METHYL-PHENOL TOTAL (UG/L) (34606)	2,4-DP, IN BOTTOM MAT. (UG/KG) (34609)	2,4-DI-NITRO-TOLUENE TOTAL (UG/L) (34611)	2,4-DI-NITRO-TOLUENE BOT.MAT (UG/KG) (34614)	2,4,-DI-NITRO-PHENOL TOTAL (UG/L) (34616)
SEP 09...	<200	<6.0	<200	<10.0	<400	<6.0	<200	<6.0	<200	<5.0	<200	<20.0

DATE	2,4-DI-NITRO-PHENOL BOT.MAT (UG/KG) (34619)	2,4,6-TRI-CHLORO-PHENOL TOTAL (UG/L) (34621)	2,4,6-TRI-CHLORO-PHENOL BOT.MAT (UG/KG) (34624)	2,6-DI-NITRO-TOLUENE TOTAL (UG/L) (34626)	2,6-DI-NITRO-TOLUENE BOT.MAT (UG/KG) (34629)	4-BROMO-PHENYL PHENYL ETHER TOTAL (UG/L) (34636)	4-BROMO-PHENYL PHENYL ETHER BOT.MAT (UG/KG) (34639)	4-CHLORO-PHENYL PHENYL ETHER TOTAL (UG/L) (34641)	4-NITRO-PHENOL TOTAL (UG/L) (34646)	4-NITRO-PHENOL BOT.MAT (UG/KG) (34649)	4,6-DINITRO-ORTHO-CRESOL TOTAL (UG/L) (34657)	4,6-DINITRO-ORTHO-CRESOL BOT.MAT (UG/KG) (34660)
SEP 09...	<600	<5.0	<600	<5.0	<200	<5.0	<200	<200	<30.0	<600	<30.0	<600

DATE	DI-CHLORO-DI-FLUORO-METHANE TOTAL (UG/L) (34668)	PHENOL (C6H-5OH) TOTAL (UG/L) (34694)	PHENOL (C6H-5OH) BOT.MAT (UG/KG) (34695)	NAPHTH-ALENE TOTAL (UG/L) (34696)	TRANS-1,3-DI-CHLORO-PROPENE TOTAL (UG/L) (34699)	CIS 1,3-DI-CHLORO-PROPENE TOTAL (UG/L) (34704)	DI-SYSTON TOTAL (UG/L) (39011)	PHORATE OTAL (UG/L) (39023)	PENTA-CHLORO-PHENOL TOTAL (UG/L) (39032)	PER-THANE TOTAL (UG/L) (39034)	PENTA-CHLORO-PHENOL BOT.MAT (UG/KG) (39061)	1,2-DIBROMO ETHYL-ENE TOTAL (UG/L) (39082)
SEP 09...	<3.0	<6.0	<200	<5.0	<3.0	<3.0	<0.01	<0.01	<30.0	<0.1	<600	<3.0

DATE	BIS(2-ETHYL HEXYL) PHTHAL-ATE TOTAL (UG/L) (39100)	BIS(2-ETHYL HEXYL) PHTHAL-ATE BOT.MAT (UG/KG((39102)	DI-N-BUTYL PHTHAL-ATE TOTAL (UG/L) (39110)	DI-N-BUTYL PHTHAL-ATE BOT.MAT (UG/KG) (39112)	VINYL CHLO-RIDE TOTAL (UG/L) (39175)	TRI-CHLORO-ETHYL-ENE TOTAL (UG/L) (39180)	NAPH-THA-LENES, POLY-CHLOR. TOTAL (UG/L) (39250)	ALDRIN, TOTAL (UG/L) (39330)	LINDANE TOTAL (UG/L) (39340)	CHLOR-DANE, TOTAL (UG/L) (39350)	DDD, TOTAL (UG/L) (39360)	DDE, TOTAL (UG/L) (39365)
SEP 09...	<5.0	<200	<5.0	<200	<3.0	<3.0	<0.10	<0.010	<0.010	<0.1	<0.010	<0.010

DATE	DDT, TOTAL (UG/L) (39370)	DI-ELDRIN TOTAL (UG/L) (39380)	ENDO-SULFAN, TOTAL (UG/L) (39388)	ENDRIN, TOTAL (UG/L) (39390)	ETHION, TOTAL (UG/L) (39398)	TOX-APHENE, TOTAL (UG/L) (39400)	HEPTA-CHLOR, TOTAL (UG/L) (39410)	HEPTA-CHLOR EPOXIDE TOTAL (UG/L) (39420)	METH-OXY-CHLOR, TOTAL (UG/L) (39480)	PCB, TOTAL (UG/L) (39516)	MALA-THION, TOTAL (UG/L) (39530)	PARA-THION, TOTAL (UG/L) (39540)
SEP 09...	<0.010	<0.010	<0.010	<0.010	<0.01	<1	<0.010	<0.010	<0.01	<0.1	<0.01	<0.01

DATE	DI-AZINON, TOTAL (UG/L) (39570)	METHYL PARA-THION, TOTAL (UG/L) (39600)	HEXA-CHLORO-BENZENE TOTAL (UG/L) (39700)	HEXA-CHLORO-BENZENE TOT. IN BOTTOM MATL. (UG/KG) (39701)	HEXA-CHLORO-BUT-ADIENE TOTAL (UG/L) (39702)	HEXA-CHLORO-BUT-ADIENE BOT.MAT (UG/KG) (39705)	MIREX, TOTAL (UG/L) (39755)	TOTAL TRI-THION (UG/L) (39786)	METHYL TRI-THION, TOTAL (UG/L) (39790)	STYRENE TOTAL (UG/L) (77128)	TNT TOTAL (UG/L) (81360)	RDX TOTAL (UG/L) (81364)
SEP 09...	<0.01	<0.01	<5.0	<200	<5.0	<200	<0.01	<0.01	<0.01	<3.0	<2.0	<2.0

Surface Water Quality Values for Bolio Lake Near Delta Junction. Collected Water Year October 1985 to September 1986 (U.S. Geological Survey 1988).

YUKON ALASKA

635342145503000 - BOLIO LK NR DELTA JUNCTION AK

WATER QUALITY DATA, WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986

DATE	TIME	SAMPLING DEPTH (FEET) (00003)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH (STANDARD UNITS) (00400)	TEMPERATURE WATER (DEG C) (00010)	BAROMETRIC PRESSURE (MM OF HG) (00025)	OXYGEN, DISSOLVED (MG/L) (00300)	OXYGEN, DISSOLVED (PERCENT SATURATION) (00301)
SEP								
10...	1115	0.50	100	7.60	10.5	735	9.6	89
10...	1117	2.00	99	7.60	10.5	735	9.4	87
10...	1119	3.00	99	7.60	10.0	735	9.4	87
10...	1121	4.50	99	7.60	10.0	735	9.3	86
10...	1123	6.00	99	7.60	10.0	735	9.2	85
10...	1125	7.50	99	7.60	10.0	735	9.2	85
10...	1127	9.00	99	7.60	10.0	735	9.3	86
10...	1129	10.5	98	7.60	10.0	735	9.3	85
10...	1131	12.0	98	7.70	10.0	735	9.2	85
10...	1133	12.8	99	7.70	10.0	735	9.2	85

DATE	TIME	SAMPLING DEPTH (FEET) (00003)	COLOR (PLATINUM-COBALT UNITS) (00080)	TURBIDITY (NTU) (00076)	OXYGEN DEMAND, CHEMICAL (HIGH LEVEL) (MG/L) (00340)	COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML) (31625)	STREPTOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)	HARDNESS (MG/L AS CACO3) (00900)	HARDNESS NONCARB WH WAT TOT FLD MG/L AS CACO3 (00902)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)
SEP											
10...	1200	8.00	30	1.1	44	K10	<1	52	10	15	3.6

DATE	SODIUM, DISSOLVED (MG/L AS NA) (00930)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	ALKALINITY WH WAT TOTAL FIELD MG/L AS CACO3 (00410)	ALKALINITY WH WAT TOTAL LAB MG/L AS CACO3 (00417)	ALKALINITY, CARBONATE IT-FLD (MG/L - CACO3) (99430)	BICARBONATE IT-FLD (MG/L AS HCO3) (99440)	CARBONATE IT-FLD (MG/L AS CO3) (99445)	SULFATE DISSOLVED (MG/L AS SO4) (00945)	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)
SEP											
10...	1.0	3.0	41	44	42	51	0	9.2	0.90	<0.10	0.5

DATE	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N) (00630)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N) (00608)	NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L AS N) (00625)	NITROGEN, TOTAL (MG/L AS N) (00600)	PHOSPHORUS, TOTAL (MG/L AS P) (00665)	PHOSPHORUS, ORTHO, DISSOLVED (MG/L AS P) (00671)	ARSENIC TOTAL (UG/L AS AS) (01002)	ARSENIC TOTAL IN BOTTOM MATERIAL (UG/G AS AS) (01003)	BARIUM, TOTAL RECOVERABLE (UG/L AS BA) (01007)
SEP											
10...	59	0.058	0.064	0.034	0.80	0.86	0.016	0.004	1	8	<100

DATE	BARIUM, RECOV. FM BOTTOM MATERIAL (UG/G AS BA) (01008)	CADMIUM TOTAL RECOVERABLE (UG/L AS CD) (01027)	CADMIUM RECOV. FM BOTTOM MATERIAL (UG/G AS CD) (01028)	CHROMIUM, RECOV. FM BOTTOM MATERIAL (UG/G) (01029)	COBALT, RECOV. FM BOTTOM MATERIAL (UG/G AS CO) (01038)	COPPER, TOTAL RECOVERABLE (UG/L AS CU) (01042)	COPPER, RECOV. FM BOTTOM MATERIAL (UG/G AS CU) (01043)	IRON, TOTAL RECOVERABLE (UG/L AS FE) (01045)	IRON, DISSOLVED (UG/L AS FE) (01046)	IRON, RECOV. FM BOTTOM MATERIAL (UG/G AS FE) (01170)
SEP										
10...	70	<1	1	10	20	7	3	240	170	7600

DATE	LEAD, TOTAL RECOVERABLE (UG/L AS PB) (01051)	LEAD, RECOV. FM BOTTOM MATERIAL (UG/G AS PB) (01052)	MANGANESE, TOTAL RECOVERABLE (UG/L AS MN) (01055)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MANGANESE, RECOV. FM BOTTOM MATERIAL (UG/G) (01053)	MERCURY TOTAL RECOVERABLE (UG/L AS HG) (71900)	MERCURY RECOV. FM BOTTOM MATERIAL (UG/G AS HG) (71921)	NICKEL, RECOV. FM BOTTOM MATERIAL (UG/G AS NI) (01068)	SILVER, TOTAL RECOVERABLE (UG/L AS AG) (01077)	ZINC, TOTAL RECOVERABLE (UG/L AS ZN) (01092)
SEP										
10...	<5	10	20	9	140	<0.10	0.34	20	1	10

K NON-IDEAL COLONY COUNT

YUKON ALASKA--Continued

635342145503000 - BOLIO LK NR DELTA JUNCTION AK--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986

DATE	ZINC, RECOV. FM BOT-TOM MA-TERIAL (UG/G AS ZN) (01093)	GROSS ALPHA, DIS-SOLVED (UG/L AS U-NAT) (80030)	GROSS ALPHA, SUSP. TOTAL (UG/L AS U-NAT) (80040)	GROSS BETA, DIS-SOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137) (03516)	GROSS BETA, DIS-SOLVED (PCI/L AS SR/ YT-90) (80050)	GROSS BETA, SUSP. TOTAL (PCI/L AS SR/ YT-90) (80060)	TANNIN AND LIGNIN (MG/L) (32240)	CHLOR-A PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70953)	CHLOR-B PHYTO-PLANK-TON CHROMO FLUOROM (UG/L) (70954)
SEP 10...	80	< 0.4	< 0.4	4.3	< 0.4	3.7	< 0.4	1.1	5.40	0.300

DATE	TIME	DI-CHLORO-BROMO-METHANE TOTAL (UG/L) (32101)	CARBON-TETRA-CHLO-RIDE TOTAL (UG/L) (32102)	1,2-DI-CHLORO-ETHANE TOTAL (UG/L) (32103)	BROMO-FORM TOTAL (UG/L) (32104)	CHLORO-DI-BROMO-METHANE TOTAL (UG/L) (32105)	CHLORO-FORM TOTAL (UG/L) (32106)	TOLUENE TOTAL (UG/L) (34010)	BENZENE TOTAL (UG/L) (34030)	ACE-NAPHTH-YLENE TOTAL (UG/L) (34200)	ACE-NAPHTH-YLENE BOT.MAT (UG/KG) (34203)	ACE-NAPHTH-ENE TOTAL (UG/L) (34205)
SEP 10...	1200	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 5.0	< 200	< 5.0

DATE	ACE-NAPHTH-ENE BOT.MAT (UG/KG) (34208)	ANTHRA-CENE TOTAL (UG/L) (34220)	ANTHRA-CENE BOT.MAT (UG/KG) (34223)	BENZO B FLUOR-AN-THENE TOTAL (UG/L) (34230)	BENZO B FLUOR-AN-THENE BOT.MAT (UG/KG) (34233)	BENZO K FLUOR-AN-THENE TOTAL (UG/L) (34242)	BENZO K FLUOR-AN-THENE BOT.MAT (UG/KG) (34245)	BENZO-A-PYRENE TOTAL (UG/L) (34247)	BENZO-A-PYRENE BOT.MAT (UG/KG) (34250)	BIS 2-CHLORO-ETHYL ETHER TOTAL (UG/L) (34273)	BIS (2-CHLORO-ETHYL) ETHER BOT.MAT (UG/KG) (34276)	BIS (2-CHLORO-ETHOXY) METHANE TOTAL (UG/L) (34278)
SEP 10...	< 200	< 5.0	< 200	< 10.0	< 400	< 10.0	< 400	< 10.0	< 400	< 5.0	< 200	< 5.0

DATE	BIS (2-CHLORO-ETHOXY) METHANE BOT.MAT (UG/KG) (34281)	BIS (2-CHLORO-ISO-PROPYL) ETHER TOTAL (UG/L) (34283)	BIS (2-CHLORO-ISO-PROPYL) ETHER BOT.MAT (UG/KG) (34286)	N-BUTYL BENZYL PHTHAL-ATE TOTAL (UG/L) (34292)	N-BUTYL BENZYL PHTHAL-ATE BOT.MAT (UG/KG) (34295)	CHLORO-BENZENE TOTAL (UG/L) (34301)	CHLORO-ETHANE TOTAL (UG/L) (34311)	CHRY-SENE TOTAL (UG/L) (34320)	CHRY-SENE BOT.MAT (UG/KG) (34323)	DIETHYL PHTHAL-ATE TOTAL (UG/L) (34336)	DIETHYL PHTHAL-ATE BOT.MAT (UG/KG) (34339)	DI-METHYL PHTHAL-ATE TOTAL (UG/L) (34341)
SEP 10...	< 200	< 5.0	< 200	< 5.0	< 200	< 3.0	< 3.0	< 10.0	< 400	< 5.0	< 200	< 5.0

DATE	DI-METHYL PHTHAL-ATE BOT.MAT (UG/KG) (34344)	ETHYL-BENZENE TOTAL (UG/L) (34371)	FLUOR-ANTHENE TOTAL (UG/L) (34376)	FLUOR-ANTHENE BOT.MAT (UG/KG) (34379)	FLUOR-ENE TOTAL (UG/L) (34381)	FLUOR-ENE BOT.MAT (UG/L) (34384)	HEXA-CHLORO-CYCLO-PENT-ADIENE TOTAL (UG/L) (34386)	HEXA-CHLORO-CYCLO-PENT-ADIENE BOT.MAT (UG/KG) (34389)	HEXA-CHLORO-ETHANE TOTAL (UG/L) (34396)	HEXA-CHLORO-ETHANE BOT.MAT (UG/KG) (34399)	INDENO (1,2,3-CD) PYRENE TOTAL (UG/L) (34403)	INDENO (1,2,3-CD) PYRENE BOT.MAT (UG/KG) (34406)
SEP 10...	< 200	< 3.0	< 5.0	< 200	< 5.0	< 200	< 5.0	< 200	< 5.0	< 200	< 10.0	< 200

DATE	ISO-PHORONE TOTAL (UG/L) (34408)	ISO-PHORONE BOT.MAT (UG/KG) (34411)	METHYL-BROMIDE TOTAL (UG/L) (34413)	METHYL-CHLO-RIDE TOTAL (UG/L) (34418)	METHYL-ENE CHLO-RIDE TOTAL (UG/L) (34423)	N-NITRO-SODI-N-PROPYL-AMINE TOTAL (UG/L) (34428)	N-NITRO-SODI-N-PROPYL-AMINE BOT.MAT (UG/KG) (34431)	N-NITRO-SODI-PHENY-LAMINE TOTAL (UG/L) (34433)	N-NITRO-SODI-PHENY-LAMINE BOT.MAT (UG/KG) (34436)	N-NITRO-SODI-METHY-LAMINE TOTAL (UG/L) (34438)	N-NITRO-SODI-METHY-LAMINE BOT.MAT (UG/KG) (34441)	NAPHTH-ALENE BOT.MAT (UG/KG) (34445)
SEP 10...	< 5.0	< 200	< 3.0	< 3.0	< 3.0	< 5.0	< 200	< 5.0	< 200	< 5.0	< 200	< 200

DATE	NITRO-BENZENE TOTAL (UG/L) (34447)	NITRO-BENZENE BOT.MAT (UG/KG) (34450)	PARA-CHLORO-META CRESOL TOTAL (UG/L) (34452)	PARA-CHLORO-META CRESOL BOT.MAT (UG/KG) (34455)	PHENAN-THRENE TOTAL (UG/L) (34461)	PHENAN-THRENE BOT.MAT (UG/KG) (34464)	PYRENE TOTAL (UG/L) (34469)	PYRENE BOT.MAT (UG/KG) (34472)	TETRA-CHLORO-ETHYL-ENE TOTAL (UG/L) (34475)	TRI-CHLORO-FLUORO-METHANE TOTAL (UG/L) (34488)	1,1-DI-CHLORO-ETHANE TOTAL (UG/L) (34496)	1,1-DI-CHLORO-ETHYL-ENE TOTAL (UG/L) (34501)
SEP 10...	< 5.0	< 200	< 5.0	< 600	< 5.0	< 200	< 5.0	< 200	< 3.0	< 3.0	< 3.0	< 3.0

YUKON ALASKA--Continued

635342145503000 - BOLIO LK NR DELTA JUNCTION AK--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1985 TO SEPTEMBER 1986

DATE	1,1,1-TRI-CHLORO-ETHANE TOTAL (UG/L) (34506)	1,1,2-TRI-CHLORO-ETHANE TOTAL (UG/L) (34511)	1,1,2,2 TETRA-CHLORO-ETHANE TOTAL (UG/L) (34516)	BENZOGH I PERYL ENE1,12 -BENZOP ERYLENE TOTAL (UG/L) (34521)	BENZOGH I PERYL ENE1,12 -BENZOP ERYLENE BOT.MAT (UG/KG) (34524)	BENZO A ANTHRAC ENE1,2- BENZANT HRACENE TOTAL (UG/L) (34526)	BENZO A ANTHRAC ENE1,2- BENZANT HRACENE BOT.MAT (UG/KG) (34529)	1,2-DI-CHLORO-BENZENE TOTAL (UG/L) (34536)	1,2-DI-CHLORO-BENZENE BOT.MAT (UG/KG) (34539)	1,2-DI-CHLORO-PROPANE TOTAL (UG/L) (34541)	1,2-TRANSDI CHLORO-ETHYL-ENE TOTAL (UG/L) (34546)	1,2,4-TRI-CHLORO-BENZENE TOTAL (UG/L) (34551)
SEP 10...	< 3.0	< 3.0	< 3.0	< 10.0	< 400	< 10.0	< 200	< 3.0	< 200	< 3.0	< 3.0	< 5.0

DATE	1,2,4-TRI-CHLORO-BENZENE BOT.MAT (UG/KG) (34554)	1,2,5,6 -DIBENZ -ANTHRA -CENE TOTAL (UG/L) (34556)	1,2,5,6 -DIBENZ -ANTHRA -CENE BOT.MAT (UG/KG) (34559)	1,3-DI-CHLORO-PROPANE TOTAL (UG/L) (34561)	1,3-DI-CHLORO-BENZENE TOTAL (UG/L) (34566)	1,3-DI-CHLORO-BENZENE BOT.MAT (UG/KG) (34569)	1,4-DI-CHLORO-BENZENE TOTAL (UG/L) (34571)	1,4-DI-CHLORO-BENZENE BOT.MAT (UG/KG) (34574)	2-CHLORO-ETHYL-VINYL-ETHER TOTAL (UG/L) (34576)	2-CHLORO-NAPH-THALENE TOTAL (UG/L) (34581)	2-CHLORO-NAPH-THALENE BOT.MAT (UG/KG) (34584)	2-CHLORO-PHENOL TOTAL (UG/L) (34586)
SEP 10...	< 200	< 10.0	< 400	< 3.0	< 3.0	< 200	< 3.0	< 200	< 3.0	< 5.0	< 200	< 6.0

DATE	2-CHLORO-PHENOL BOT.MAT (UG/KG) (34589)	2-NITRO-PHENOL TOTAL (UG/L) (34591)	2-NITRO-PHENOL BOT.MAT (UG/KG) (34594)	DI-N-OCTYL PHTHAL-ATE TOTAL (UG/L) (34596)	DI-N-OCTYL PHTHAL-ATE BOT.MAT (UG/KG) (34599)	2,4-DI-CHLORO-PHENOL TOTAL (UG/L) (34601)	2,4-DI-CHLORO-PHENOL BOT.MAT (UG/KG) (34604)	2,4-DI-METHYL-PHENOL TOTAL (UG/L) (34606)	2,4-DP, IN BOTTOM MAT. (UG/KG) (34609)	2,4-DI-NITRO-TOLUENE TOTAL (UG/L) (34611)	2,4-DI-NITRO-TOLUENE BOT.MAT (UG/KG) (34614)	2,4,-DI-NITRO-PHENOL TOTAL (UG/L) (34616)
SEP 10...	< 200	< 6.0	< 200	< 10.0	< 400	< 6.0	< 200	< 6.0	< 200	< 5.0	< 200	< 20.0

DATE	2,4-DI-NITRO-PHENOL BOT.MAT (UG/KG) (34619)	2,4,6-TRI-CHLORO-PHENOL TOTAL (UG/L) (34621)	2,4,6-TRI-CHLORO-PHENOL BOT.MAT (UG/KG) (34624)	2,6-DI-NITRO-TOLUENE TOTAL (UG/L) (34626)	2,6-DI-NITRO-TOLUENE BOT.MAT (UG/KG) (34629)	4-BROMO-PHENYL PHENYL ETHER TOTAL (UG/L) (34636)	4-BROMO-PHENYL PHENYL ETHER BOT.MAT (UG/KG) (34639)	4-CHLORO-PHENYL PHENYL ETHER TOTAL (UG/L) (34641)	4-NITRO-PHENOL TOTAL (UG/L) (34646)	4-NITRO-PHENOL BOT.MAT (UG/KG) (34649)	4,6-DINITRO -ORTHO-CRESOL TOTAL (UG/L) (34657)	4,6-DINITRO -ORTHO-CRESOL BOT.MAT (UG/KG) (34660)
SEP 10...	< 600	< 5.0	< 600	< 5.0	< 200	< 5.0	< 200	< 200	< 30.0	< 600	< 30.0	< 600

DATE	DI-CHLORO-DI-FLUORO-METHANE TOTAL (UG/L) (34668)	PHENOL (C6H-5OH) TOTAL (UG/L) (34694)	PHENOL (C6H-5OH) BOT.MAT (UG/KG) (34695)	NAPHTH-ALENE TOTAL (UG/L) (34696)	TRANS-1,3-DI-CHLORO-PROPENE TOTAL (UG/L) (34699)	CIS 1,3-DI-CHLORO-PROPENE TOTAL (UG/L) (34704)	PENTA-CHLORO-PHENOL TOTAL (UG/L) (39032)	PER-THANE TOTAL (UG/L) (39034)	PENTA-CHLORO-PHENOL BOT.MAT (UG/KG) (39061)	1,2-DIBROMO ETHYL-ENE TOTAL (UG/L) (39082)	BIS(2-ETHYL HEXYL) PHTHAL-ATE TOTAL (UG/L) (39100)	BIS(2-ETHYL HEXYL) PHTHAL-ATE BOT.MAT (UG/KG((39102)
SEP 10...	< 3.0	< 6.0	< 200	< 5.0	< 3.0	< 3.0	< 30.0	< 0.1	< 600	< 3.0	< 5.0	< 200

DATE	DI-N-BUTYL PHTHAL-ATE TOTAL (UG/L) (39110)	DI-N-BUTYL PHTHAL-ATE BOT.MAT (UG/KG) (39112)	VINYL CHLO-RIDE TOTAL (UG/L) (39175)	TRI-CHLORO-ETHYL-ENE TOTAL (UG/L) (39180)	NAPH-THA-LENES, POLY-CHLOR. TOTAL (UG/L) (39250)	ALDRIN, TOTAL (UG/L) (39330)	LINDANE TOTAL (UG/L) (39340)	CHLOR-DANE, TOTAL (UG/L) (39350)	DDD, TOTAL (UG/L) (39360)	DDE, TOTAL (UG/L) (39365)	DDT, TOTAL (UG/L) (39370)	DI-ELDRIN TOTAL (UG/L) (39380)
SEP 10...	< 5.0	< 200	< 3.0	< 3.0	< 0.10	< 0.010	< 0.010	< 0.1	< 0.010	< 0.010	< 0.010	< 0.010

DATE	ENDO-SULFAN, TOTAL (UG/L) (39388)	ENDRIN, TOTAL (UG/L) (39390)	ETHION, TOTAL (UG/L) (39398)	TOX-APHENE, TOTAL (UG/L) (39400)	HEPTA-CHLOR, TOTAL (UG/L) (39410)	HEPTA-CHLOR EPOXIDE TOTAL (UG/L) (39420)	METH-OXY-CHLOR, TOTAL (UG/L) (39480)	PCB, TOTAL (UG/L) (39516)	MALA-THION, TOTAL (UG/L) (39530)	PARA-THION, TOTAL (UG/L) (39540)	DI-AZINON, TOTAL (UG/L) (39570)
SEP 10...	< 0.010	< 0.010	< 0.01	< 1	< 0.010	< 0.010	< 0.01	< 0.1	< 0.01	< 0.01	< 0.01

DATE	METHYL PARA-THION, TOTAL (UG/L) (39600)	HEXA-CHLORO-BENZENE TOTAL (UG/L) (39700)	HEXA-CHLORO-BENZENE TOT. IN BOTTOM MATL. (UG/KG) (39701)	HEXA-CHLORO-BUT-ADIENE TOTAL (UG/L) (39702)	HEXA-CHLORO-BUT-ADIENE BOT.MAT (UG/KG) (39705)	MIREX, TOTAL (UG/L) (39755)	TOTAL TRI-THION (UG/L) (39786)	METHYL TRI-THION, TOTAL (UG/L) (39790)	STYRENE TOTAL (UG/L) (77128)	TNT TOTAL (UG/L) (81360)	RDX TOTAL (UG/L) (81364)
SEP 10...	< 0.01	< 5.0	< 200	< 5.0	< 200	< 0.01	< 0.01	< 0.01	< 3.0	< 2.0	< 2.0

Primary Maximum Contaminant Levels (MCLs) for Inorganic Chemical Contaminants for a Public Water System (Alaska Drinking Water Standards (18 AAC 80)). MCL refers to the maximum permissible level of a contaminant in water that is delivered to any user of a public water system.

Parameter	Maximum Contaminant Level (mg/l)
Antimony	0.006
Arsenic	0.05
Asbestos	7 Million Fibers/liter
Barium	2
Beryllium	0.004
Cadmium	0.005
Chromium	0.1
Cyanide (as free cyanide)	0.2
Fluoride	4.0
Mercury	0.002
Nickel	0.1
Nitrate	10 (as Nitrogen)
Nitrite	1 (as Nitrogen)
Total Nitrate and Nitrite	10 (as Nitrogen)
Selenium	0.05
Thallium	0.002

Secondary Maximum Contaminant Levels (MCLs) for a Public Water System (Alaska Drinking Water Standards (18 AAC 80).

Parameter	Maximum Contaminant Level (mg/l)
Aluminum	0.2
Chloride	250
Color	15 color units
Copper	1.0
Corrosivity	Noncorrosive
Fluoride	2.0
Foaming Agents	0.5
Iron	0.3
Manganese	0.05
Odor	3 threshold odor number
pH	6.5 (minimum) - 8.5 (maximum)
Silver	0.1
Sodium	250
Sulfate	250
Total Dissolved Solids	500
Zinc	5

Available Water Quality Data for Streams In or Near the Withdrawal Areas As Collected By the U.S. Geological Survey.

	Water Quality Records By Year		
Stream	**Chemical**	**Sediment**	**Biological**
Delta River at Black Rapids	1949; 1951-53; 1955-58; 1974-75	None	1975
Delta River above Jarvis Creek near Fort Greely	1986	1986	1986
Jarvis Creek near Delta Junction	1949; 1951; 1953-56; 1974-75; 1978-79	1955	1974-75
Delta River near Big Delta	1955-58; 1966; 1975; 1978-79	None	1975
Little Gerstle River near Big Delta	1949; 1951-53; 1955-58	None	None
Gerstle River near Big Delta	1949; 1951-58; 1966; 1978-79	None	None
Tanana River 18 miles above Gerstle River near Delta Junction	1978-79	None	None
Tanana River at Big Delta	1948-52; 1953; 1955-58; 1971; 1975; 1978-79	None	None
Chena River Site 1 near North Pole	1973	None	1973
Chena River Site 2 near North Pole	1973	None	1973
Chena River Site 3 near North Pole	1973	None	1973
Chena River Site 4 near North Pole	1973	None	1973
Chena River Site 5 near North Pole	1973	None	1973
Chena River Site 6 near North Pole	1973	None	1973
Chena River Site 7 near North Pole	1972-73	None	1973
Chena River Site 8 near North Pole	1973	None	1973
Chena River Site 9 near North Pole	1973	None	1973
Chena River Site 10 near North Pole	1973	None	1973
Chena River Site 11 near North Pole	1973	None	1973
Chena River Site 12 near North Pole	1973	None	1973
Chena River Near North Pole	1972-75	1972-75	1973
Chena River below Mullen Slough near Eielson AFB	1973	None	1973
Little Chena River near Fairbanks	1961-62; 1967-68; 1971-74; 1979	1962; 1967-68; 1972-74	1973

Available Water Quality Data for Streams In or Near the Withdrawal Areas As Collected By the U.S. Geological Survey.

	Water Quality Records By Year		
Stream	Chemical	Sediment	Biological
Chena River above Chena Slough near Fairbanks	1971-72	None	1971
Chena River near Fairbanks	1970-71	None	1970-71
Salcha River near Salchaket	1948-58; 1967-68; 1970-72; 1974-76	1963; 1967-68; 1970-72; 1974-76	None
Little Salcha River near Salchaket	1951-53; 1955-56	None	None
Tanana River at Fairbanks	1974-76	1975; 1977-82	None
Chena River at Fort Wainwright	1958-60	None	None
Chena River at Fairbanks	1948-52; 1953; 1954-58; 1963-64; 1967-72; 1974-76; 1983-84	1954-56; 1962-71; 1972	None

Significance of Water Quality Parameters Measured at Fort Wainwright Yukon Training Area and Fort Greely West and East Training Areas

Chemical Analysis

PH is one of the primary indicators used for evaluation of surface water quality. Most aquatic biota are sensitive to pH variations. Fish kills and reduction and change of other species result when the pH is altered outside their tolerance limit. Most of the aquatic species prefer a pH near neutral but can withstand a pH in the range of about 6 to 8.5 (Novotny and Olem 1994).

Water quality investigations and toxicity studies indicate that the dissolved oxygen content is the most important parameter for protecting fish and aquatic biota. The level of protection can be classified into three groups. The first level of oxygen concentration would just permit the fish to live (prevention of fish kills). The second level would permit the fish or aquatic organisms to be active to a specified degree. The third level would allow the organisms to live, grow, and reproduce in a given area. Typically, fish kills occur when fish are exposed for a certain period of time (a few hours) to dissolved oxygen concentrations of less than 3 milligrams per liter (mg/l). Present standards provide, however, the third level of protection (Krenkel and Novotny 1980 *in* Novotny and Olem 1994).

For the general well-being of trout, salmon, and associated cold-water biota, the dissolved oxygen concentration should not be below 6.5 mg/l. Under extreme conditions, the concentration may range between 5 mg/l and 6 mg/l (second level of protection), provided that all other water quality parameters are within acceptable ranges (Novotny and Olem 1994).

Samples collected from the Chena River (Appendix 3.8.A) indicate that biological oxygen demand (BOD) and chemical oxygen demand (COD) would also be expected to be low in streams of Fort Wainwright Yukon Training Area. Most BOD values are below 1.0 mg/l and COD values range from 3 mg/l to 46 mg/l. These parameters are important to the assessment of the strength of domestic and industrial wastes discharged into natural water courses. BOD and COD also play an important role in the dissolved oxygen balance of streams (Novotny and Olem 1994).

Phosphate may be the limiting organic nutrient for phytoplankton (photosynthetic organisms of small size that drift on the water) production (U.S. Dept. of Interior and U.S. Dept. of Defense 1994a and 1994b). A study of biological data from the Chena River suggests that primary and secondary production are low (McCoy 1974). This is reflected by the presence of a large and diverse number of groups of aquatic insects and other benthic invertebrates that are typical of streams high in dissolved oxygen and low in productivity (the overall rate of organic matter production of a body of water). The most abundant benthic invertebrates are *Chironomidae* (midges), *Plecoptera* (stoneflies), *Ephemeroptera* (mayflies), *Tricoptera* (caddis flies), *Simuliidae* (blackflies); Aquatic *Acari* (water mites) were common but less abundant components of the benthic fauna (McCoy 1974). Benthic invertebrates are important to the study of effects of pollution on a water body. Their occurrence and abundance reflects the biochemical-ecological status of the body of water (Novotny and Olem 1994).

Sediment Analysis

The effects of excessive sediment loading on receiving waters include the deterioration or destruction of aquatic habitat, deterioration of aesthetic value, and accumulation of bottom deposits that inhibit normal biological life. Sediment can destroy spawning areas and food sources, as well as directly harming fish, and other aquatic wildlife. Nutrients carried by the sediment can stimulate algal growths and, consequently, accelerate the process of eutrophication. Eutrophication refers to the natural and artificial addition of nutrients to bodies of water and to the effect of these added nutrients on water quality (Rohlich 1969 *in* Novotny and Olem 1994).

Sediment can be considered a major pollutant of bodies of water. Futhermore, sediment, especially its fine fractions, is a primary carrier of other pollutants such as organic components, metals, ammonium ions, phosphates, and many organic toxic compounds (Novotny and Olem 1994).

Appendix 3.8.E
Ice Bridge Permits

Permits from State of Alaska for Construction of Ice Bridges on Fort Wainwright and Fort Greely. Construction and use of the sites will occur during the months of November through March of each year.

Permit Name and Responsible Agency	Agency Permit Reference Number	Department of Army Reference Number	Valid Term
Fish Habitat Permit - Title 16 - State of Alaska Department of Fish and Game	FG94-III-0213	DACA85-9-95-19	10/20/94 - 3/30/99
Land Use Permit - State of Alaska Department of Natural Resources Division of Land	LAS 19277	DACA85-9-95-20	11/15/94 - 3/15/99
Fairbanks North Star Borough Land Use Permit - Division of Land Management	UA 91-012	DACA85-9-96-11	12/1/95 - 3/15/00
Temporary Water Use Permit - State of Alaska Department of Natural Resources Division of Mining and Water	LAS 13965 Amended	DACA85-9-93-13 Amendment #1	12/24/97 - 12/24/02

APPENDIX 3.9
Groundwater

Groundwater Quality at Fort Wainwright (Anderson 1970). All analyses were for dissolved constituents and are reported in milligrams per liter, except where noted.

	G-14 Eielson Air Force Base	G-15 Main Post Fort Wainwright	G-16 Between Chena River and Chena Hot Springs Road	Maximum Contaminant Levels - MCLs (18 AAC 80)
	9/7/65	5/2/62	9/27/66	11/10/94
Major aquifer	gravel	gravel	weathered bedrock	NS
Well depth	115.0	105.0	200.0	NS
Silica	28.0	19.0	35.0	NS
Iron	7.11	12.0	25.0	0.3[2]
Calcium	38.0	61.0	83.0	NS
Magnesium	9.7	11.0	30.0	NS
Sodium	7.5	5.2	15.0	250[2]
Potassium	0.8	3.4	2.6	NS
Bicarbonate	166.0	229.0	484.0	NS
Sulfate	15.0	19.0	0.0	250[2]
Chloride	4.6	3.5	0.0	250[2]
Fluoride	0.1	0.0	0.4	4[1]
Nitrate	0.0	0.3	0.2	10[2]
Dissolved Solids	135.0	197.0	429.0	500[2]
Carbonate hardness (CaCO3)	135.0	188.0	332.0	NS
Noncarbonate hardness (CaCO3)	0.0	9.0	--	NS
Specific conductance	290.0	382.0	649.0	NS
pH	7.5	7.4	7.8	6.5-8.5
Color	15.0	5.0	10.0	NS

[1] - Primary MCL. [2] - Secondary MCL. NS - No set standard.

Groundwater Quality Data for Selected Well Sites Near Fort Greely East Training Area (Anderson, 1970). All analyses were for dissolved constituents and are reported in milligrams per liter, except where noted.

	G-10 Donnelly Flats Air Force Base	G-11 U.S. Army Black Rapids Training Area	G-12 Fort Greely	G-13 Near Delta Junction	Maximum Contaminant Levels - MCLs as set forth in Alaska Drinking Water Standards (18 AAC 80)
	7/21/65	2/20/61	9/29/48	7/26/51	11/10/94
Specific conductance (micromhos per centimeter at 25°C)	377.0	312.0	313.0	248.0	NS
pH (standards units)	8.0	7.5	--	7.1	6.5-8.5[2]
Hardness (total)	197.0	154.0	156.0	116.0	NS
Hardness (noncarbonate)	25.0	52.0	36.0	--	NS
Calcium	46.0	35.0	46.0	31.0	NS
Magnesium	20.0	16.0	10.0	9.4	NS
Sodium	5.1	3.2	4.4	7.4	250[2]
Potassium	1.9	2.3	--	--	NS
Bicarbonate	210.0	124.0	146.0	112.0	NS
Sulfate	31.0	59.0	36.0	33.0	250[2]
Chloride	5.3	2.5	2.8	3.5	250[2]
Fluoride	0.3	0.2	0.1	--	4[1]
Silica	11.0	4.3	10.0	13.0	NS
Nitrate as N	1.3	0.0	4.8	0.9	10[2]
Iron	0.02	0.02	0.04	--	0.3[2]
Major Aquifer	sandy-gravel	sandy-gravel	sandy-gravel	bedrock	NS
Well depth (feet)	102.0	110.0	198.0	230.0	NS

Groundwater Quality Data for Selected Well Sites Near Fort Greely East Training Area (Anderson, 1970). All analyses were for dissolved constituents and are reported in milligrams per liter, except where noted.

	G-10 Donnelly Flats Air Force Base	G-11 U.S. Army Black Rapids Training Area	G-12 Fort Greely	G-13 Near Delta Junction	Maximum Contaminant Levels - MCLs as set forth in Alaska Drinking Water Standards (18 AAC 80)
	7/21/65	**2/20/61**	**9/29/48**	**7/26/51**	**11/10/94**
Dissolved solids (residue on evaporation at 180°C)	225.0	184.0	186.0	153.0	500[2]

[1] - Primary MCL. [2] - Secondary MCL. NS - No set standard.

APPENDIX 3.10
Wetlands

Areal Extent and Individual Wetland Types Identified by the USFWS Within the Fort Wainwright Yukon Training Area. A majority of the wetlands found within the Fort Wainwright Yukon Training Area are located along interior stream corridors and the Chena River-French-Moose Creek floodplain area.

NWI SYMBOL	DEFINITION					% OF MAPPED AREA
	System	Sub system	Class	Subclass	Water Regime	
L1UBH	Lacustrine	Limnetic	unconsolidated bottom	--	permanently flooded	<1%
L2AB3H	Lacustrine	Littoral	aquatic bed	rooted vascular	permanently flooded	<1%
P(FO/SS)4B	Palustrine	--	forested/scrub-shrub	needle-leaved evergreen	saturated	<1%
P(SS/EM)1B	Palustrine	--	scrub-shrub/emergent	broad-leaved deciduous/ persistent	saturated	<1%
P(SS/EM)1C	Palustrine	--	scrub-shrub/emergent	broad-leaved deciduous/ persistent	seasonally flooded	<1%
PAB3H	Palustrine	--	aquatic bed	rooted vascular	permanently flooded	<1%
PEM1C	Palustrine	--	emergent	persistent	seasonally flooded	<1%
PEM1F	Palustrine	--	emergent	persistent	semi-permanently flooded	<1%
PFO1A	Palustrine	--	forested	broad-leaved deciduous	temporarily flooded	<1%
PFO4/1B	Palustrine	--	forested	needle-leaved evergreen/ broad-leaved deciduous	saturated	1%
PFO4/2B	Palustrine	--	forested	needle-leaved evergreen/ needle-leaved deciduous	saturated	<1%
PFO4B	Palustrine	--	forested	needle-leaved evergreen	saturated	2%
PSS1/4B	Palustrine	--	scrub-shrub	broad-leaved deciduous/ needle-leaved evergreen	saturated	<1%
PSS1A	Palustrine	--	scrub-shrub	broad-leaved deciduous	temporarily flooded	<1%
PSS1B	Palustrine	--	scrub-shrub	broad-leaved deciduous	saturated	6%

Areal Extent and Individual Wetland Types Identified by the USFWS Within the Fort Wainwright Yukon Training Area. A majority of the wetlands found within the Fort Wainwright Yukon Training Area are located along interior stream corridors and the Chena River-French-Moose Creek floodplain area.

NWI SYMBOL	DEFINITION					% OF MAPPED AREA
	System	Sub system	Class	Subclass	Water Regime	
PSS4/1B	Palustrine	--	scrub-shrub	needle-leaved evergreen/ broad-leaved deciduous	saturated	<0.1%
PSS4/2B	Palustrine	--	scrub-shrub	needle-leaved evergreen/ needle-leaved deciduous	saturated	6%
PSS4B	Palustrine	--	scrub-shrub	needle-leaved evergreen	saturated	6%
PUBH	Palustrine	--	unconsolidated bottom	--	semi-permanently flooded	<1%
R5UBH	Riverine	unknown perennial	unconsolidated bottom	--	`permanently flooded	<1%
U	Upland					72%
NO NWI DATA						5%

Areal Extent and Individual Wetland Types Identified by the USFWS at Fort Greely. Even though a majority of the impact area, 54%, was not inventoried, it is likely that wetlands are dominant throughout the Lakes impact area.

NWI SYMBOL	DEFINITION					% OF MAPPED AREA
	System	Sub system	Class	Subclass	Water Regime	
L1UBH	Lacustrine	Limnetic	unconsolidated bottom	--	permanently flooded	<1%
L2AB3H	Lacustrine	Littoral	aquatic bed	rooted vascular	permanently flooded	<1%
L2USC	Lacustrine	Littoral	unconsolidated shore	--	seasonally flooded	<1%
P(SS/EM)1A	Palustrine	--	scrub-shrub/emergent	broad-leaved deciduous/ persistent	temporarily flooded	1%
P(SS/EM)1B	Palustrine	--	scrub-shrub/emergent	broad-leaved deciduous/ persistent	saturated	3%
P(SS/EM)1C	Palustrine	--	scrub-shrub/emergent	broad-leaved deciduous/ persistent	seasonally flooded	1%
PAB3H	Palustrine	--	aquatic bed	rooted vascular	permanently flooded	<1%
PAB4H	Palustrine	--	aquatic bed	floating-leaved vascular	permanently flooded	<1%
PEM1B	Palustrine	--	emergent	persistent	saturated	<1%
PEM1C	Palustrine	--	emergent	persistent	seasonally flooded	<1%
PEM1F	Palustrine	--	emergent	persistent	semi-permanently flooded	<1%
PEM1H	Palustrine	--	emergent	persistent	permanently flooded	<1%
PFO1A	Palustrine	--	forested	broad-leaved deciduous	temporarily flooded	<1%
PFO2B	Palustrine	--	forested	needle-leaved deciduous	saturated	<1%
PFO4/1A	Palustrine	--	forested	needle-leaved evergreen/ broad-leaved deciduous	temporarily flooded	<1%
PFO4/1B	Palustrine	--	forested	needle-leaved evergreen/ broad-leaved deciduous	saturated	1%

Areal Extent and Individual Wetland Types Identified by the USFWS at Fort Greely. Even though a majority of the impact area, 54%, was not inventoried, it is likely that wetlands are dominant throughout the Lakes impact area.

NWI SYMBOL	DEFINITION					% OF MAPPED AREA
	System	Sub system	Class	Subclass	Water Regime	
PFO4/2B	Palustrine	--	forested	needle-leaved evergreen/ needle-leaved deciduous	saturated	<1%
PFO4B	Palustrine	--	forested	needle-leaved evergreen	saturated	5%
PSS1/4B	Palustrine	--	scrub-shrub	broad-leaved deciduous/ needle-leaved evergreen	saturated	<1%
PSS1A	Palustrine	--	scrub-shrub	broad-leaved deciduous	temporarily flooded	<1%
PSS1B	Palustrine	--	scrub-shrub	broad-leaved deciduous	saturated	5%
PSS2B	Palustrine	--	scrub-shrub	needle-leaved deciduous	saturated	<1%
PSS4/1B	Palustrine	--	scrub-shrub	needle-leaved evergreen/ broad-leaved deciduous	saturated	1%
PSS4B	Palustrine	--	scrub-shrub	needle-leaved evergreen	saturated	3%
PUBH	Palustrine	--	unconsolidated bottom	--	semi-permanently flooded	<1%
R5OWH	Riverine	unknown perennial	open water/unknown bottom	--	permanently flooded	<1%
R5UBH	Riverine	unknown perennial	unconsolidated bottom	--	permanently flooded	1%
R5USC	Riverine	unknown perennial	unconsolidated shore	--	seasonally flooded	2%
U	Upland					21%
NO NWI DATA						54%

A Description of the Hierarchial Wetland System Used by the U.S. Fish and Wildlife Service (Cowardian et al. 1979). Only three systems, palustrine, lacustrine, and riverine, out of five were identified in the Fort Wainwright Yukon Training Area and Fort Greely withdrawal area with a majority of wetlands in the area classified as palustrine.

Class	Definition	Description	Sub class	Definition	Plant/Animal species
Lacustrine - Nontidal and tidal-freshwater wetlands within an intermittently to permanently flooded lake or reservoir larger than 20 acres and (or) deeper than 6.6 feet. Vegetation, when present, is predominantly nonpersistent emergent plants and (or) floating plants.					
unconsolidated bottom	Includes all wetlands and deepwater habitats with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30%.	Characterized by the lack of large stable surfaces for plant and animal attachment. They are usually found in areas with low energy and may be very unstable. There is usually a high correlation between the nature of the substrate and the number of species and individuals.			macroalgae, Macoma and the amphipod Melita; polychaete worm Chaetopterus
aquatic bed	Includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of water for most of the growing season.	Represents a diverse group of plant communities that requires surface water for optimum growth and reproduction. They develop in areas with relatively permanent water or under conditions of repeated flooding.	rooted vascular	Rooted vascular plants occur at all depths within the photic zone, typically in areas where there is little water movement.	Pondweeds, horned pondweed (Zannichellia palustris), ditch grasses (Ruppia), wild celery, and waterweed (Elodea), riverweed (Postostemum ceratophyllum)
unconsolidated shore	Includes all wetland habitats that have three characteristics: (1) unconsolidated substrates with less than 75% areal cover of stones, boulders, or bedrock; (2) less than 30% areal cover of vegetation other than pioneering plants; and (3) seasonally flooded.	Characterized by substrates lacking vegetation except for pioneering plants. Erosion and deposition by waves and currents produce beaches, bars, and flats and are found adjacent to unconsolidated bottoms. The particle size of the substrate and the water regime determine types of plant and animal communities present.			
Palustrine - Nontidal and tidal-freshwater wetlands within intermittently to permanently flooded open-water bodies of less than 20 acres in which water is less than 6.6 feet deep. Vegetation is predominantly trees; shrubs; persistent or nonpersistent emergent, erect, rooted herbaceous plants; mosses and lichens; or submersed and floating plants.					

A Description of the Hierarchial Wetland System Used by the U.S. Fish and Wildlife Service (Cowardian et al. 1979). Only three systems, palustrine, lacustrine, and riverine, out of five were identified in the Fort Wainwright Yukon Training Area and Fort Greely withdrawal area with a majority of wetlands in the area classified as palustrine.

Class	Definition	Description	Sub class	Definition	Plant/Animal species
scrub-shrub	Includes areas dominated by woody vegetation less than 6 m tall. The species include true shrubs, young trees, and trees or shrubs that are small or stunted.	May represent a successional stage leading to a forested wetland or may be stable communities.	broad-leaved deciduous	Wetlands where trees and shrubs are predominantly deciduous and broad-leaved.	alders (Alnus spp.), willows (Salix spp.), buttonbush (Cephalanthus occedentalis), red osier dogwood (Cornus stolonifera), honeycup (Zenobia pulverulenta), spirea (Spiraea douglasii), bog birch (Betula pumila), and yound red maple (Acer rubrum) or black spruce (Picea mariana).
			needle-leaved evergreen	young or stunted trees	black spruce or pond pine (Pinus serotina)
			needle-leaved deciduous	Wetlands where trees and shrubs are predominantly young or stunted deciduous and needle-leaved	tamarack or bald cypress (Taxodium distichum)
emergent	Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens, which is present for most of the growing season. They are dominated by perennial plants.	Appearance remains constant in areas with stable climatic conditions. They are also known as marsh, meadow, fen, prairie pothole, and slough.	persistent	Dominated by species that normally remain standing at least until the beginning of the next growing season.	grasslike plants such ascattails Itypha spp.), bulrushes (Scirpus spp.), saw grass (Cladium jamaicense), sedges (Carex spp.); and true grasses such as reed (Phragmites australis), manna grasses (Glyceria spp.), slough grass(Beckmannia syzigachne), and whitetop (Scolochloa festucacea)

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Class	Definition	Description	Sub class	Definition	Plant/Animal species
aquatic bed	Includes wetlands and deepwater habitats dominated by plants that grow principally on or below the surface of water for most of the growing season.	Represents a diverse group of plant communities that requires surface water for optimum growth and reproduction. They develop in areas with relatively permanent water or under conditions of repeated flooding.	rooted vascular	Rooted vascular plants occur at all depths within the photic zone, typically in areas where there is little water movement.	Pondweeds, horned pondweed (Zannichellia palustris), ditch grasses (Ruppia), wild celery, and waterweed (Elodea), riverweed (Postostemum ceratophyllum)
			floating-leaved vascular	Plants float freely either in the water or on its surface. Surface plants are found primarily in protected portions of slow-flowing rivers.	Surface plants include: duckweeds (Lemncl, Spirodela), water lettuce (Pistia stratiotes), water hyacinth (Eichhornia crassipes), water nut (Trapa natans), water ferns (Salvinia spp.), and mosquito ferns (Azolla). Below-surface plants include: bladderworts (Utricularia), coontails (Ceratophyllum), and watermeals (Wolffia)
forested	Characterized by woody vegetation that is 6 m tall or taller.	They normally possess an overstory or trees, an understory of young trees or shrubs, and a herbaceous layer.	broad-leaved deciduous	Generally occur on mineral soils or highly decomposed organic soils.	
			needle-leaved evergreen		Black spruce on organic soils, Northern white cedar (Thuja occidentalis) on more nutrient poor soils.
			needle-leaved deciduous	Organic soils	Tamarack is characteristic of the Boreal Forest Region.
unconsolidated bottom	Includes all wetlands and deepwater habitats with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30%.	Characterized by the lack of large stable surfaces for plant and animal attachment. They are usually found in areas with low energy and may be very unstable. There is usually a high correlation between the nature of the substrate and the number of species and individuals.			macroalgae, Macoma and the amphipod Melita; polychaete worm Chaetopterus

A Description of the Hierarchial Wetland System Used by the U.S. Fish and Wildlife Service (Cowardian et al. 1979). Only three systems, palustrine, lacustrine, and riverine, out of five were identified in the Fort Wainwright Yukon Training Area and Fort Greely withdrawal area with a majority of wetlands in the area classified as palustrine.

Class	Definition	Description	Sub class	Definition	Plant/Animal species
Riverine - Nontidal and tidal-freshwater wetlands within a channel. Vegetation, when present, is same as in the Lacustrine System.					
open water/ unknown bottom					
unconsoli dated bottom	Includes all wetlands and deepwater haitats with at least 25% cover of particles smaller than stones, and a vegetative cover less than 30%.	Characterized by the lack of large stable surfaces for plant and animal attachment. They are usually found in areas with low energy and may be very unstable. There is usually a high correlation between the nature of the substrate and the number of species and individuals.		Substrate type is largely determined by current velocity, and plants and animals exhibit a high degree of morphologic and behavioral adaption to flowing water.	macroalgae, Macoma and the amphipod Melita; polychaete worm Chaetopterus
unconsoli dated shore	Includes all wetland habitats that have three characteristics: (1) unconsolidated substrates with less than 75% areal cover of stones, boulders, or bedrock; (2) less than 30% areal cover of vegetation other than pioneering plants; and (3) seasonally flooded.	Characterized by substrates lacking vegetation except for pioneering plants. Erosion and deposition by waves and currents produce beaches, bars, and flats and are found adjacent to unconsolidated bottoms. The particle size of the substrate and the water regime determine types of plant and animal communities present.			

General Wetland Description

In general, land areas falling into one the following five categories are considered wetlands:

> (1) areas with hydrophytes and hydric soils, such as those commonly known as marshes, swamps, and bogs;
>
> (2) areas without hydrophytes but with hydric soils, such as flats where drastic fluctuation in water level, wave action, turbidity, or high concentration of salts may prevent the growth of hydrophytes;
>
> (3) areas with hydrophytes but nonhydric soils, such as margins of impoundments or excavations where hydrophytes have become established but hydric soils have not yet developed;
>
> (4) areas without soils but with hydrophytes such as the seaweed-covered portion of rocky shores; and
>
> (5) wetlands without soil and without hydrophytes, such as gravel beaches or rocky shores without vegetation (Cowardian et al. 1979).

Wetlands on the withdrawal areas of Fort Wainwright and Fort Greely are considered ombrotrophic bogs with hydrophytes and hydric soils which develop in areas whose principle supply of water is from the atmosphere. Bogs exist in most areas of Alaska because annual precipitation exceeds calculated annual evapotranspiration. In the Interior region, the water balance is controlled by the combination of low evapotranspiration rates and the presence of low permeability permafrost, which allows the development of wetlands under semiarid (less than 10 inches of precipitation per year) conditions.

Hydrologic Role of Alaskan Wetlands

Many Alaskan wetlands are affected by permafrost, due to its strong influence on infiltration rates. In discontinuous permafrost regions, whether a slope faces away from or toward the sun can determine the presence or absence of permafrost and thus influence the location and distribution of wetlands.

Wetlands underlain by permafrost play an important role in the local hydrologic regime of the withdrawal areas. Wetlands influence the general hydrologic response of a watershed by affecting the relationship between the amount of incoming precipitation, the amount of storm runoff generated and its associated peak; the amount of time between precipitation inputs and the greatest amount of storm discharge, known as lag time; and the amount of time until normal baseflow conditions are reestablished, known as recession time.

Spring snowmelt and its associated runoff is the single most important hydrologic event occurring in interior Alaska watersheds. During this time, wetlands have limited flood control or water storage functions due to several factors. Permafrost underlying wetlands at a shallow depth can limit storage capacity and promote rapid runoff. Also, wetland peats retain a large portion of the water released by thawing of seasonally frozen upper soils. As a result, there is little excess storage capacity for water entering the wetland from other sources. Due to the fact that wetland soils tend to have a large ice content during snowmelt, they probably do not contribute significantly either to flood storage or to groundwater recharge. Thus, peak flows are typically higher in permafrost dominated catchments. However, wetlands also help to relatively reduce peak flows, even when the soils are frozen. Water is detained behind hummocks (elevated areas composed of moss and grasses) and within depressions, and the velocity is slowed by vegetation.

Generally speaking, lag times for arctic and subarctic wetland catchments tend to be much shorter than those of their temperate counterparts. Because of the shallowness of the thawed layer, potential storage capacity of rainfall is quickly reached when permafrost is present, even when peat deposits are deep.

Longer recession times are associated with Alaskan wetlands due to the combination of storage and slow release by peats with high water retention capabilities and low evapotranspiration rates. However, during snowmelt runoff the ability of wetlands to attenuate streamflow is small.

The contribution of water from wetlands on the withdrawal areas to groundwater recharge is slight. Since the climate within continuous and discontinuous permafrost regions of Alaska is typically arid, summer precipitation is usually balanced by summer evapotranspiration. As a result, groundwater recharge would likely occur during spring snowmelt. However, due to the poor infiltration rates of underlying permafrost, recharge would likely not occur in wetland areas. In regions of discontinuous permafrost, recharge primarily occurs in locations free of permafrost with little or no contribution from wetlands.

Wetlands also play an important role in erosion control by decreasing wind and water velocities near the ground and by holding soil particles together with the roots of wetland vegetation. On the withdrawal area, wetlands provide insulation for underlying permafrost by preventing warming and eventual thawing of ice-rich soils. Wetlands bordering floodplains aid in erosion control in a limited capacity by removing suspended sediment from floodwaters. Wetland vegetation in these areas help to stabilize the riverbank, preventing streambank collapse and the widening and deepening of channels. Removal of wetland vegetation increases local erosive forces and creates large depressions in the land surface, known as thermokarst. This is caused by the thawing of permafrost and subsequent settling of the land.

The water chemistry of wetlands is primarily the result of geologic setting, water balance, quality of inflowing water, type of soils and vegetation, and human activity within or near the wetland (Fretwell et al. 1996). In areas where wetland water quality reflects the contents of its direct water source, whether it be surface flow, precipitation, or groundwater, an accumulation of waterborne constituents may result. Wetlands can filter out or transform these constituents through a variety of biological and chemical processes depending upon the wetland's substrate, water, vegetation, and microbial populations. Overall, wetlands can maintain good quality water and improve degraded water.

Federal Protection of Wetlands

Modification of wetlands is controlled by the Federal government through Section 404 of the Clean Water Act. The Section 404 program was created as a result of the 1972 amendments to the Federal Water Pollution Control Act to control the discharge of dredged and fill materials into water of the United States. Specifically, this section prohibits a person from discharging or placing dredged or fill materials into navigable waters, which includes wetlands, without a permit. Dredged material is material that is excavated or dredged from the waters of the United States. Fill material is any material used for the primary purpose of replacing an aquatic area with dry land or of elevating the bottom of a body of water. Section 404 permits are required for a variety of projects such as channel construction and maintenance, fills to create dry land for development sites near water, and water-control projects such as dams and levees. The United States Army Corps of Engineers (USACE) and the Environmental Protection Agency (EPA) oversee the permitting program under Section 404. Section 404(c) gives the EPA power to veto any permits it deems harmful to surrounding resources.

In reviewing permit applications, the USACE must consider four basic questions relating to the guidelines set forth in the Section 404 program:

(1) Is the proposed discharge the least damaging practical alternative?

(2) Does the proposed discharge comply with other environmental standards or regulations?

(3) Will the proposed discharge significantly degrade wetlands?

(4) Have all the appropriate and practical steps been taken to minimize potential harm to the wetlands? (Fretwell et al. 1996)

In general, the USACE tries to balance the benefits an activity may provide against the costs it may incur. The permitting process requires the participation of other Federal agencies, state agencies, and the general public through various information collecting techniques. In addition, the cumulative effects of a dredge and fill project are taken into consideration when reviewing a permit application. As a result, a wetland mitigation plan is often required of the permit applicant.

Not all dredge and fill activities require a Section 404 permit. Exempted practices include farming activities; maintenance or reconstruction of dams, breakwaters, and other similar structures; operation of farm ponds or irrigation and drainage ditches; construction of temporary sediment basins; construction of farm roads, forest roads, or roads for mining; and activities under a state approved nonpoint source management program (CWA 404(f)(1); 22 U.S.C.A. 1344(f)(1)). The following table lists various wetland alterations. Unregulated methods include wetland drainage, the lowering of groundwater levels in areas adjacent to wetlands, permanent flooding of existing wetlands, deposition of material that is not specifically defined as dredged and fill material by the Clean Water Act, and wetland vegetation removal (Office of Technology Assessment 1984 in Fretwell et al. 1996).

Methods of Altering Wetlands. Not all methods of altering wetlands are regulated by Section 404. Unregulated methods include wetland drainage, the lowering of groundwater levels in areas adjacent to wetlands, permanent flooding of existing wetlands, deposition of material that is not specifically defined as dredged and fill material by the Clean Water Act, and wetland vegetation removal (Office of Technology Assessment 1984 in Fretwell et al. 1996).

Physical	
Filling	adding any material to raise the bottom level of wetland or to replace the wetland with dry land
Draining	removing the water from a wetland by ditching, tiling, pumping, and so forth
Excavating	dredging and removing soil and vegetation from a wetland
Diverting water away	preventing the flow of water into a wetland by removing water upstream, lowering lake levels, or lowering groundwater tables
Clearing	removing vegetation by burning, digging, application of herbicide, scraping, mowing, or otherwise cutting
Flooding	raising water levels, either behind dams, by pumping, or otherwise channeling water into a wetland
Diverting or withholding sediment	trapping sediment by constructing dams, channels, or other types of projects, thereby inhibiting wetland regeneration in natural deposition areas such as deltas
Shading	placing pile-supported platforms or bridges over wetlands, causing vegetation to die because of a lack of adequate sunlight
Conducting activities in adjacent areas	disrupting the interactions between wetlands and adjacent land areas, or incidentally affecting wetlands through activities at adjoining sites
Chemical	
Changing nutrient levels	increasing or decreasing nutrient levels within the local water and or soil system, forcing wetland plant community changes

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Introducing toxics	adding toxic compounds to a wetland either intentionally (for example, herbicide treatment to reduce vegetation) or unintentionally, adversely affecting wetland plants and animals
Biological	
Grazing	consumption and compaction of vegetation by domestic or wild animals
Disrupting natural populations	reducing populations of existing species, introducing exotic species, or otherwise disturbing resident organisms

In addition to Section 404 of the Clean Water Act, wetlands are also safeguarded under Executive Order 11990, *Protection of Wetlands.* The purpose of this legislation, which was signed by President Carter in 1977, was to ensure protection and proper management of floodplains and wetlands by Federal agencies. The Executive Order requires Federal agencies to consider the direct and indirect adverse effects of their activities on floodplains and wetlands. This is done through the NEPA process by identifying wetland conflicts with regard to planned actions and review of projects and activities involving wetlands.

APPENDIX 3.11
Vegetation

Checklist of collected vascular plants arranged by family from Fort Wainwright Military Installation, Alaska, 1995 and two plants found on Fort Greely not in the list. (*)

Adiantaceae
Cryptogramma stelleri (S. Gmelin) Prantl

Adoxaceae
Adoxa moschatellina l.

Alismataceae
Alisma triviale Pursh
Sagittaria cuneata e. Sheldon

Apiaceae
*Bupleurum americanum**
Diduta bulbifera l.
Cicuta virosa l.
Cnidium cnidiifolium (Turcz.) Schischkin
Podustera macounii (J. Coulter & Rose) Mathias & Constance
Sium suave Walter

Apocynaceae
Apocynum androsaemifolium l.

Araceae
Calla palustris l.

Aspleniaceae
Athyrium filix-femina (L.) Roth
Cystopteris fragilis (L.) Bernh.
Dryopteris fragrans (L.) Schott
Gymnocarpium dryopteris (L.) Newman
Gymnocarpium robertianum (Hoffm.) Newman
Woodsia ilvensis (L.) R. Br.

Asteraceae
Achellea borealis Bong.
Achillea millefolium l.
Achillea sibirica ledeb.
Antennaria friesiana (Trautv.) Ekman
Antennaria pulcherrima (Hook.) E. Greene
Antennaria rosea (D. C. Eaton) E. Greene
Anthemis cotula l.
Arnica alpina (L.) Olin ssp. Attenuata (E. Greene) Maguire
Arnica angustifolia M. Vahl

Arnica griscomii Fern. ssp. Frigida (C. Meyer ex Iljin) S. J. Wolf
Artemisia alaskana Rydb.
Artemisisa arctica Less.
Artemisia frigida Willd.
Artemisia furcata m. Bieb.
Artemisia laciniata Willd.
Artemisiatilesii ledeb. ssp. ELATIOR (Torr. & A. Gray) Hulten
Aster junciformis Rydb.
Aster sibiricus l.
Bidens cernua l.
Chrysanthemum leucanthemum l.
Cirsium arvense (L.) Scop.
Conyza canadensis (L.) Cronq.
Crepis elegansHook.
Crepis tectorum L.
Erigeron acris l.
Erigeron caespitosus Nutt.
Erigeron compositus Pursh
Erigeron elatus e. Greene
Erigeron glabellus Nutt.
Erigeron lonchophyllus Hook.
Gaillardia pulchella Foug.
Gnaphalium uliginosum l.
Matricaria matricarioides (Less.) Porter
Petasites frigidus (L.) Franchet
Petasites nivalis e. Greene
Petasites sagittatus (Banks) A. Gray
Rubeckia hirta l.
Saussurea angustifolia (Willd.) DC.
Senecia atropurpureus(Ledeb.) B. Fedtsch.
Senecia atropurpureus (R. Br.) DC.
Senecio llugens Richardson
Senecio pauciflorus Pursh
Senecio tundricola Tolm.
Senecio vulgaris l.
Solidago canedensis l.
Solidago decumbens e. Greene
Solidago multiradiata Aiton
Sonchus arvensis l.
Sonchus asper (L.) Hill
Taraxacum ceratophorum (Ledeb.) DC.
Taraxacum officinale g. Weber
Tripleurospermum inodorum (L.) Schultz-Bip.

Balsaminaceae
Impatiens noli-tangere l.

Betulaceae

Alnus tenuifolia Nutt.
Alnus viridis ssp.crispa (Aiton) A. Loeve & D. Loeve
Betula glandulosa Michaux
Betula hybrids
Betula nana l.
Betula papyrifera Marshall

Boraginaceae

Lappula myosotis Moench
Mertensia paniculata (Aiton) G. Don
Plagiobothrys cognatus (E. Greene) I. M. Johnston

Brassicaceae

Arabis divaricarpa Nelson
Arabis hirsuta (L.) Scop.
Aragis holboellii Hornem.
Arabis lyrata l.
Barbarea orthoceras Ledeb.
Brassica rapa l.
Capsella bursa-pastoris (L.) Medikus
Cardamine pratensis l. ssp. Angustifolia (Hook.) O. E. Schulz
Descurainia sophia (L.) Prantl
Descurainia sophioides (Fischer) O. Schulz
Draba fladnizensis Wulfen
Draba glabella Pursh
Draba nemorosa l.
Erysimum cheiranthoides l. ssp. Cheiranthoides
Erysimum inconspicuum (S. Watson) Macmillan
Halimolobus mollis (Hook.) Rollins
Hesperis matronalis l.
Lepisium densiflorum Schrader
Hesperis matronalis l.
Parrya nudicaulis (L.) Regel
Rorippa barbareaefolia (DC.) Kitigawa
Rorippa curvisiliqua (Hook.) Besser
Rorippa palustris (L.) Besser ssp. HISPIDA (Desv.) Jonsell
Rorippa pulustris (L.) Besser ssp. PALUSTRIS
Thlaspi arvense l.

Callitrichaceae

Callitriche verna l. emend. Kutz.

Campanulaceae

Campanula lasiocarpa Cham.
Campanula uniflora l.

Caprifoliaceae

Linnaea borealis l.
Viburnum edule (Michaux) Raf.

Caryophyllaceae

Dianthus barbatus l.
Gastrolychnis affinis (Vahl) Tolm. & Kozhanch.
Gastrolychnis ostenfeldii (A. Pors.) V. V. Petrovsky
Minuartia arctica (Steven) Asch. & Graebner
Minuartia yukonensis Hulten
Moehringia lateriflora (L.) Fenzl
Silene williamsii Britton
Spergularia rubra (L.) J. S. Presl & C. Presl
Stellaria borealis Bigelow ssp. BOREALIS
Stellaria calycantha (Ledeb.) Bong.
Stellaria crassifolia Ehrh.
Stellaria laeta Richardson
Stellaria longifolia Muhlenb. ex Willd.
Stellaria longipes Goldie
Stellaria media (L.) Villars
Wilhelmsia physodes (Fischer) Mcneill

Ceratophyllaceae

Ceratophyllum demersum l.

Chenopodiaceae

Chenopodium album l.
Chenopodium capitatum (L.) Asch.
Chenopodium hybridum l.

Cornaceae

Cornus canadensis l.
Cornus canadensis_x_suecica l.
Swida stolonifera(Michx.) Rydb.

Cupressaceae

Juniperus communis l.

Cyperaceae

Carex aenea Fern.
Carex aquatilis Wahlenb.
Carex atherodes Sprengel
Carex bigelowii Torrey
Carex bonanzensis Britton
Carex brunnescens (Pers.) Poiret
Carex canescens l.
Carex capillaris l.

Carex capitata Sol.
Carex chordorrhiza Ehrh.
Carex concinna r. Br.
Carex crawfordii Fern.
Carex diandra Schrank
Carex disperma Dewey
Carex duriuscula c.e. Mey.
Carex eleusinoides Turcz.
Carex filifolia Nutt.
Carex garberiFern. ssp. bifaria(Fern.) Hulten
Carex krausei Boeckeler
Carex lasiocarpa Ehrh.
Carex leptalea Wahlenb.
Carex limosa l.
Carex magellanica Lam. ssp. irrigua (Wahlenb.) Hulten
Carex maritima Gunnerus
Carex media r. Br.
Carex microchaeta Holm ssp. Microchaeta
Carex microchaeta Holm ssp. nesophila (Holm) D. Murray
Carex obtusata Lilj.
Carex oederi Retz.
Carex peckii Howe
Carex phyllomanica w. Boott
Carex podocarpa r. Br.
Carex rossiiBoott
Carex rostrataStokes
Carex rotundata Wahlenb.
Carex rupestris All.
Carex saxatilis l.
Carex supina Willd. ssp. spaniocarpa (Steudel) Hulten
Carex tenuiflora Wahlenb.
Carex utriculata f. Boott
Carex vaginata Tausch
Eleocharis acicularis (L.) Roemer & Schultes
Eleocharis palustris (L.) Roemer & Schultes
Eriophorum angustifolium Honck. ssp. scabriusculum Hulten
Eriophorum gracile Koch
Eriophorum russeolum Fries
Eriophorum scheuchzeri Hoppe
Eriophorum vaginatum l.
Kobresia simpliciuscula (Wahlenb.) Mackenzie
Scirpus validus m. Presl
Scirpus validus m. Vahl
Trichophorum alpinum (L.) Pers.

Diapensiaceae
Diapensia lapponica l. ssp. obovata (F. Schmidt) Hulten

Droseraceae

Drosera anglica Hudson
Drosera rotundifolia l.

Elaeagnaceae

*Elaeagnus commutata**
Shepherdia canadensis (L.) Nutt.

Empetraceae

Empetrum hermaphroditum (Lange) Hagerup

Equisetaceae

Equisetum arvense l.
Equisetum fluviatile l. ampl. Ehrh.
Equisetum hiemale l.
Equisetum palustre l.
Equisetum pratense Ehrh.
Equisetum scirpoides Michaux
Equisetum silvaticum l.
Equisetum variegatum Schleicher

Ericaceae

Andromeda polifolia l.
Arctostaphylos uva-ursi (L.) Sprengel
Arctous alpina (L.) Niedenzu
Arctous rubra (Rehder & E. Wilson) Nakai
Cassiope tetragona (L.) D. Don ssp. tetragona
Chamaedaphne calyculata (L.) Moench
Ledum groenlandicum Oeder
Ledum palustre l. ssp. decumbens (Aiton) Hulten
Loiseleuria procumbens (L.) Desv.
Oxycoccus microcarpus Turcz. ex Rupr.
Vaccinium uliginosum l. ssp. alpinum (Bigelow) Hulten
Vaccinium vitis-idaea l.

Fabaceae

Astragalus adsurgens Pallas ssp. viciifolius (Hulten) Welsh
Astragalus alpinus l.
Astragalus bodinii e. Sheldon
Caragana arborescens Lam.
Hedysarum alpinum l. ssp. americanum (Michaux) B. Fedtsch.
Hedysarum mackenzii Richardson
Lupinus arcticus s. Watson
Medicago falcata l.
Medicago sativa l.
Melilotus albus Desrr.

Melilotus officinalis (L.) Lam.
Oxytropis deflexa (Pallas) dc. var. foliolosa(Hook.) Barneby
Oxytropis deflexa (Pallas) dc. var. sericea Torrey & A. Gray
Oxytropis tanenensis B. A. Yurtsev
Oxytropis varians (Rydb.) Schumann
Trifolium hybridum l.
Trifolium pratense l.
Trifolium repens l.
Vicia angustifolia (L.) Reichard
Vicia cracca l.

Fumariaceae
Corydalis aurea Willd.
Corydalis sempervirens (L.) Pers.

Gentianaceae
Gentiana glauca Pallas
Gentianella amarella (L.) Boerner
Gentianella propinqua (Richardson) J. M. Gillett
Gentianopsis detonsa (Rottb.) Malte ssp. yukonensis (J.M. Gillett) J.M. Gillett
Lomatogonium rotatum (L.) E. Fries
Menyanthes trifoliata l.

Geraniaceae
Eroduim cicutarium (L.) L'Her.
Geranium bicknellii Britton

Grossulariaceae
Ribes hudsonianum Richardson
Ribes lacustre (Pers.) Poiret
Ribes triste Pallas

Haloragaceae
Hippuris bulgaris l.
Myriophyllum sibiricum Kom.
Myriophyllum verticillatum l.

Hydrophyllaceae
Nemophila menziesii Hook. & Arn.

Iridaceae
Iris setosa Pallas

Juncaceae
Juncus alpinus Villars
Juncus arcticus Willd. ssp. alaskanus Hulten
Juncus arcticus Willd. ssp. ater (Rydb.) Hulten

Juncus bufonius l.
Juncus castaneus Smith ssp. castaneus
Juncus castaneus Smith ssp. leucochlamys (l. Zinserl.) Hulten
Juncus filiformis l.
Juncus stygius l.
Juncus triglumis l. ssp. albescens (Lange) Hulten
Luzula confusa Lindeb.
Luzula kjellmaniana Miyabe & Kudo
Luzula multiflora (Retz.) Lej.
Luzula parviflora (Ehrh.) Desv.
Luzula rufescens Fischer

Juncaginaceae
Triglochin maritimum l.
Triglochin palustris l.

Lamiaceae
Dracocephalum parviflorum Nutt.
Galeopsis bifida Boenn.
Lycopus uniflorus Michaux
Scutellaria galericulata l.
Stachys palustris l. ssp. pilosa (Nutt.) Epling

Lemnaceae
Lemna minor l.
Lemna trisulca l.

Lentibulariaceae
Pinguicula villosa l.
Utricularia intermedia Hayne
Utricularia minor l.
Utricularia vulgaris l.

Liliaceae
Tofieldia coccineaRichardson
Zygadenus elegans Pursh

Linaceae
Linum lewisii Pursh

Lycopodiaceae
Huperzia selago (L.) C. Martius
Lycopodium alpinum l.
Lycopodium annotinum l. ssp. annotinum
Lycopodium annotinum l. ssp. pungens (La Pyl.) Hulten
Lycopodium complanatum l.
Lycopodium obscurum l.

Myricaceae
Myrica gale l.

Nymphaceae
Nuphar polysepalum Engelm.
Nymphaea tetragona Georgi

Onagraceae
Circaea alpina l.
Epilobium angustifolium l.
Epilobium ciliatum Raf.
Epilobium ciliatum Raf. ssp. adenocaulon (Hausskn.) Hoch & Raven
Epilobium Hornemannii Reichb. ssp. hornemannii
Epilobium latifolium l.
Epilobium palustre l.

Ophioglossaceae
Botrychium lunaria (L.) Sw.

Orchidaceae
Calypso bulbosa (L.) Oakes
Corallorrhiza trifida Chatel.
Cypripedium guttatum Sw. ssp. guttatum
Cypripedium passerinum Richardson
Goodyera repens (L.) R. Br.
Hammarbya paludosa (L.) Kuntze
Listera borealis Morong
Platanthera hyperborea (L.) Lindley
Platanthera obtysata (Pursh) Lindley
Spiranthes romanzoffiana Cham.

Orobanchaceae
Boschniakia rossica (Cham. & Schldl.) B. Fedtsch.

Papaveraceae
Exchscholzia californica Cham.

Pinaceae
Larix laricina (Du Roi) K. Koch
Picea glauca (Moench) Voss
Picea mariana (Miller) Britton, Sterns, Pogg.

Plantaginaceae
Plantago major l. var. major

Poaceae
Agrostis scabra Willd.

Alopecurus aequalis Sobol.
Alopecurus alpinus Smith
Alopecurus pratensis l.
Arctagrostis latifolia (R. Br.) Griseb. var. Arundinacea (Trin.) Griseb.
Arctophila Fulva (Trin.) Andersson
Avena fatua l.
Becknannia erucaeformis (L.) Host
Bromopsis inermis (Leysser) Holub
Bromopsis pumpelliana (Scribner) Holub ssp. Pumpelliana
Calamagrostis canadensis (Michaux) P. Beauv.
Calamagrostis inexpansa a. Gray
Calamagrostis lapponica (Wahlenb.) Hartman F.
Calamagrostis neglecta (Ehrh.) Gaertner
Calamagrostis purpurascens r. Br.
Deschampsia cespitosa (L.) P. Beauv.
Elymus alaskanus (Scribner & Merr.) A. Loeve ssp. BOREALIS (Turcz.) A. Loeve & D. Loeve
Elymus macrourus (Turcz.) Tzvelev
Elymus subsecundus (Link) A. Loeve & D. Loeve
Elymus trachycaulus (Link) Gould ex Shinners
Elymus trachycaulus (Link) Gould ex Shinners ssp. Trachycaulus
Elymus trachycaulus (Link) Gould ex Shinners ssp. violaceus (Hornem.) A Loeve & D. Loeve
Elytrigia repens (L.) Nevski
Elytrigia spicata (Pursh) D. R. Dewey
Festuca altaica Trin.
Festuca brachyphylla Schultes & Schultes F.
Festuca lenensis Drobov
Festuca saximontana Rydb.
Glyceria borealis (Nash) Batch.
Glyceria maxima (Hartman F.) O. Holmb.
Glyceria pulchella (Nash) Schum.
Hierochloe alpina (Sw.) Roemer & Schultes
Hierochloe odorata (L.) P. Beauv.
Hordeum brachyantherum Nevski
Hordeum jubatum l.
Leymus innovatus (Beal) Pilger
Lolium multiflorum Lam.
Ohleum pratense l.
Poa alpina l.
Poa annua l.
Poa arctica r. Br.
Poa glauca m. Vahl
Poa palustris l.
Poa pratensis l.
Puccinellia borealis Swallen
Puccinellia t. Sorensen

Trisetum spicatum (L.) K. Richter

Polemoniaceae

Collomia linearis Nutt.
Polemonium acutiflorum Willd.

Polygonaceae

Bistorta plumosa (Small) E. Greene
Bistorta vivipara (L.) Gray
Polygonum alaskanum (Small) W. Wight
Polygonum amphibium l.
Polygonum aviculare l.
Polygonum convolvulus l.
Polygonum lapathifolium l.
Polygonum pennsylvanicum l. ssp. oneillii (Brenckle) Hulten
Rumex arcticus Trautv.
Rumex arcticus Greene
Rumex mexicanus Meissner
Rumex sibiricus Hulten

Polypodiaceae

Polypodium vulgare l. ssp. columbianum (Gilbert) Hulten

Potamogetonaceae

Potamogeton alpinus Balbis
Potamogeton epihydrus Raf.
Potamogeton filiformis Pers.
Potamogeton friesii Rupr.
Potamogeton gramineus l.
Potamogeton pectinatus l.
Potamogeton praelongus Wulfen
Potamogeton pusillus l. var. tenuissimus Mert. & Koch
Potamogeton richardsonii (A. Bennett) Rydb.
Potamogeton vaginatus Turcz.
Potamogeton zosteriformis Fernald

Primulaceae

Androsace septentrionalis l.
Dodecatheon pulchellum (Raf.) Merr. ssp. Pauciflorum (E. Greene)   Hulten
Lysimachia thyrsiflora l.
Primula incana m. e. Jones
Trientalis europaea l. ssp. arctica (Fischer) Hulten

Pyrolaceae

Moneses uniflora (L.) A. Gray
Orthilia secunda (L.) House
Orthilia secunda (L.) House ssp. Obtusata (Turcz.) Bocher

Pyrola asarifolia Michaux
Pyrola chlorantha Sw.
Pyrola grandiflora Radius

Ranunculaceae
Aconitum delphinifolium dc.
Actaea rubra (Aiton) Willd.
Anemone narcissiflora l. var. monantha dc.
Anemone parviflora Michaux
Anemone richardsonii Hook.
Aquilegia brevistyla Hook.
Caltha natans Pallas
Caltha palustris l.
Consolida ambiqua (L.) P. Bass & Heyw.
Delphinium glaucum s. Watson
Pulsatilla patens (L.) Miller
Ranunculus gmelinii dc.
Ranunculus lapponicus l. Rottb.
Ranunculus lapponicus l.
Ranunculus macounii Britton
Ranunculus pennsylvanicus l. f.
Ranunculus reptans l.
Ranunculus sceleratus l. ssp. multifidus (Nutt.) Hulten
Ranunculus trichophyllus Chaix
Rhalictrum sparsiflorum Turcz.

Rosaceae
Amelanchier alnifolia (Nutt.) Nutt.
Comarum palustre l.
Dryas drummondii Richardson
Dryas octopetala l. var. octopetala
Fragaria virginiana Duchesne
Geum perincisum Rydb.
Pentaphylloides floribunda (Pursh) A. Loeve
Potentila arguta Pursh
Potentilla egedii Wormsk.
Potentilla hookeriana Lehm.
Potentilla multifida l.
Potentilla norvegica l.
Potentilla pensylvanica l.
Potentilla uniflora Ledeb.
Potentilla virgulata Nelson
Rosa acicularis Lindley
Rosa woodsiiLindley
Rubus arcticus l. ssp. arcticus
Rubus chamaemorus l.
Rubus idaeus l.

Sanguisorba officinalis l.
Sorbus scopulina e. Greene
Spiraea stevenii (C. Schneider) Rydb.

Rubiaceae
Galium boreale l.
Galium brandegei a. Gray
Galium trifidum l. ssp. trifidum
Galium triflorum Michaux

Salicaceae
Populus balsamifera l. ssp. balsamifera
Populus tremuloides Michaux
Salix alaxensis (Andersson) Cov. var. longistylis (Rydb.) C. Schneider
Salix arbusculoides Andersson
Salix arctica Pallas
Salix bebbiana Sarg.
Salix brachycarpa Nutt.
Salix brachycarpa Nutt. ssp. niphoclada (Rydb.) Argus
Salix fuscescens Andersson
Salix glauca l.
Salix glauca l. var. acutifolia (Andersson) C. Schneider
Salix hastata l.
Salix rowlee
Salix lucida Muhl. ssp. lasiandra (Benth.) Argus
Salix myrtillifolia Andersson
Salix novae-angliae Andersson
Salixphlebophylla Andersson
Salix planifolia Pursh
Salix planifolia Pursh ssp. pulchra (Cham.) Argus
Salix pseudomonticola c. Ball
Salix scouleriana j. Barratt

Santalaceae
Geocaulon lividum (Richardson) Fern.

Saxifragaceae
Chrysosplenium tetrandrum (N. Lund) T. C. E. Fries
Parnassia palustris l.
Saxifraga cernua l.
Saxifraga nelsoniana d. Don
Saxifraga reflexa Hook.
Saxifraga tricuspidata Rottb.

Scrophulariaceae
Castilleja caudata (Pennell) Rebrist.
Castilleja elegans Malte

Euphrasia disjuncta Fern. & Wieg.
Linaria vulgaris Miller
Pedicularis capitata Adams
Pedicularis labradorica Wirs.
Pedicularis lanata Cham. & Schldl.
Pedicularis langsdorffii Fischer ex Steven
Pedicularis macrodonta Richardson
Rhinanthus minor l.
Synthyris minor l. Pennell
Veronica scutellata l.

Selaginellaceae
Selaginella sibirica (Milde) Hieron.

Sparganiaceae
Sparganium angustifolium Michaux
Sparganium hyperboreum Laest.
Sparganium minimum (Hartman F.) Fries

Typhaceae
Typha latifolia l.

Urticaceae
Urtica dioica l. ssp. gracilis (Aiton) Selander

Valerianaceae
Valeriana capitata Pallas

Violaceae
Viola biflora l.
Viola epipsila Ledeb.
Viola renifolia a. Gray
Viola tricolor l.

Checklist of collected cryptogams from Fort Wainwright Military Installation, Alaska, 1995.

LICHENS

Alectoria ochroleuca (Hoffm.) A.Massal.
Anamylopsora pulcherrima (Vain.) Timdal
Arctoparmelia separata (Th.Fr.) Hale
Asahinea chrysantha (Tuck.) W.L.Culb. & C.F.Culb.
Asahinea scholanderi (Llano) W.L.Culb. & C.F.Culb.

Bacidia
Baeomyces
Baeomyces rufus (Huds.) Rebent.
Brodoa oroarctica (Krog) Goward
Bryocaulon divergens (Ach.) Kèrnefelt
Bryoria lanestris (Ach.) Brodo & D.Hawksw.
Bryoria nitidula (Th.Fr.) Brodo & D.Hawksw.
Caloplaca
Candelariella
Cetraria
Cetraria aculeata (Schreb.) Fr.
Cetraria islandica (L.) Ach.
Cetraria laevigata Rass.
Cetraria muricata (Ach.) Eckfeldt
Cetraria nigricans Nyl.
Chaenotheca stemonea (Ach.) Mƒll.Arg.
Cladina
Cladina aberrans (Abbayes) Hale & W.L.Culb.
Cladina arbuscula (Wallr.) Hale & W.L.Culb.
Cladina rangiferina (L.) Nyl.
Cladina stellaris (Opiz) Brodo
Cladonia
Cladonia amaurocraea (FlÜrke) Schaer.
Cladonia borealis S.Stenroos
Cladonia cariosa (Ach.) Spreng.
Cladonia cenotea (Ach.) Schaer.
Cladonia coccifera (L.) Willd.
Cladonia cornuta (L.) Hoffm.
Cladonia cornuta (L.) Hoffm. subsp. cornuta
Cladonia crispata (Ach.) Flot.
Cladonia deformis (L.) Hoffm.
Cladonia fimbriata (L.) Fr.
Cladonia furcata (Huds.) Schrad.
Cladonia gracilis (L.) Willd.
Cladonia gracilis (L.) Willd. subsp. gracilis
Cladonia gracilis (L.) Willd. subsp. turbinata (Ach.) Ahti
Cladonia kanewskii Oksner
Cladonia phyllophora Ehrh. ex Hoffm.
Cladonia pleurota (FlÜrke) Schaer.
Cladonia pocillum (Ach.) Grognot
Cladonia scabriuscula (Delise) Nyl.
Cladonia singularis S.Hammer
Cladonia uncialis (L.) Weber ex F.H.Wigg.
Collema
Cornicularia
Dactylina
Dactylina arctica (Richardson) Nyl.

Dibaeis baeomyces (L.f.) Rambold & Hertel
Diploschistes
Endocarpon
Epilichen scabrosus (Ach.) Clem. ex Hafellner*
Flavocetraria cucullata (Bellardi) Kèrnefelt & Thell
Flavocetraria nivalis (L.) Kèrnefelt & Thell subsp. nivalis
Hypogymnia
Hypogymnia austerodes (Nyl.) Rèsènen
Hypogymnia physodes (L.) Nyl.
Hypogymnia subobscura (Vain.) Poelt
Icmadophila ericetorum (L.) Zahlbr.
Lasallia pensylvanica (Hoffm.) Llano
Lecanora
Lecidea
Leproplaca
Leptogium
Lobaria linita (Ach.) Rabenh.
Lobaria linita (Ach.) Rabenh. var. linita
Lobaria scrobiculata (Scop.) DC. in Lam. & DC.
Lopadium pezizoideum (Ach.) KÜrb.
Masonhalea richardsonii (Hook.) Kèrnefelt
Melanelia
Melanelia granulosa (Lynge) Essl.
Melanelia hepatizon (Ach.) Thell
Nephroma arcticum (L.) Torss.
Nephroma bellum (Spreng.) Tuck.
Nephroma expallidum (Nyl.) Nyl.
Nephroma parile (Ach.) Ach.
Nephroma resupinatum (L.) Ach.
Ochrolechia
Ochrolechia upsaliensis (L.) A.Massal.
Ophioparma lapponica (Rèsènen) Hafellner & R.W.Rogers
Pannaria pezizoides (Weber) Trevis.
Parmelia
Parmelia fraudans (Nyl.) Nyl.
Parmelia omphalodes (L.) Ach.
Parmelia panniformis (Nyl.) Vain.
Parmelia saxatilis (L.) Ach.
Parmelia sulcata Taylor
Parmeliella
Peltigera
Peltigera aphthosa (L.) Willd.
Peltigera canina (L.) Willd.
Peltigera collina (Ach.) Schrad.
Peltigera didactyla (With.) J.R.Laundon
Peltigera didactyla (With.) J.R.Laundon var. didactyla
Peltigera didactyla (With.) J.R.Laundon var. extenuata (Nyl. ex Vain.) Goffinet

& Hastings
Peltigera elisabethae Gyeln.
Peltigera lepidophora (Nyl. ex Vain.) Bitter
Peltigera leucophlebia (Nyl.) Gyeln.
Peltigera malacea (Ach.) Funck
Peltigera neckeri Hepp ex Mƒll.Arg.
Peltigera praetextata (FlÜrke ex Sommerf.) Zopf
Peltigera retifoveata Vitik.
Peltigera rufescens (Weiss) Humb.
Peltigera scabrosa Th.Fr.
Peltigera venosa (L.) Hoffm.
Pertusaria
Pertusaria subobducens Nyl.
Phaeophyscia
Phaeophyscia constipata (Norrl. & Nyl.) Moberg
Phaeophyscia kairamoi (Vain.) Moberg
Phaeophyscia sciastra (Ach.) Moberg
Phaeorrhiza nimbosa (Fr.) H.Mayrhofer & Poelt
Physcia
Physconia
Physconia isidiigera (Zahlbr.) Essl.
Physconia muscigena (Ach.) Poelt
Physconia perisidiosa (Erichsen) Moberg
Polychidium muscicola (Sw.) Gray
Psora
Psoroma hypnorum (Vahl) Gray
Psorula rufonigra (Tuck.) Gotth.Schneid.
Ramalina
Rhizocarpon
Rhizoplaca
Rhizoplaca chrysoleuca (Sm.) Zopf
Rinodina
Schadonia fecunda (Th.Fr.) Vezda & Poelt
Solorina crocea (L.) Ach.
Sphaerophorus fragilis (L.) Pers.
Sphaerophorus globosus (Huds.) Vain.
Sphaerophorus globosus (Huds.) Vain. var. globosus
Stereocaulon
Stereocaulon alpinum Laurer ex Funck
Stereocaulon coniophyllum I.M.Lamb
Stereocaulon glareosum (Savicz) H.Magn.
Stereocaulon paschale (L.) Hoffm.
Stereocaulon subcoralloides (Nyl.) Nyl.
Thamnolia
Thamnolia vermicularis (Sw.) Ach. ex Schaer.
Toninia
Tuckermannopsis americana (Spreng.) Hale

Umbilicaria
Umbilicaria deusta (L.) Baumg.
Umbilicaria vellea (L.) Ach.
Usnea
Vulpicida pinastri (Scop.) Mattson & M.J.Lai
Vulpicida tilesii (Ach.) Mattson & M.J.Lai
Xanthoparmelia
Xanthoria

HEPATICS

Aneura pinguis (L.) Dumort.
Asterella
Asterella saccata (Wahlenb.) A.Evans
Blepharostoma trichophyllum (L.) Dumort.
Calypogeia
Cephaloziella
Conocephalum conicum (L.) Underw.
Diplophyllum
Gymnomitrion
Lophozia
Marchantia
Marchantia aquatica (Nees) Burgeff
Marchantia polymorpha L.
Marsupella
Mylia
Pellia
Preissia
Preissia quadrata (Scop.) Nees
Ptilidium ciliare (L.) Hampe
Riccia fluitans L.
Ricciocarpos natans (L.) Corda
Tetralophozia setiformis (Ehrh.) Schljakov

MOSSES

Abietinella abietina (Hedw.) M.Fleisch.
Aloina brevirostris (Hook. & Grev.) Kindb.
Andreaea rupestris Hedw.
Andreaea rupestris Hedw. var. rupestris
Aongstroemia longipes (Sommerf.) Bruch & Schimp. in Bruch, Schimp. & W.Gƒmbel
Aulacomnium palustre (Hedw.) Schwègr.
Aulacomnium turgidum (Wahlenb.) Schwègr.
Barbula
Bartramia ithyphylla Brid.
Brachythecium

Bryoerythrophyllum recurvirostrum (Hedw.) P.C.Chen
Bryum
Bryum argenteum Hedw.
Bryum pseudotriquetrum (Hedw.) P.Gaertn. , B.Mey. & Scherb.
Calliergon
Calliergon cordifolium (Hedw.) Kindb.
Calliergon giganteum (Schimp.) Kindb.
Calliergon richardsonii (Mitt.) Kindb.
Calliergon stramineum (Brid.) Kindb.
Campylium
Catoscopium nigritum (Hedw.) Brid.
Ceratodon purpureus (Hedw.) Brid.
Ceratodon purpureus (Hedw.) Brid. var. purpureus
Claopodium
Climacium dendroides (Hedw.) F.Weber & D.Mohr
Cnestrum
Conostomum tetragonum (Hedw.) Lindb.
Cratoneuron
Cynodontium
Dicranella
Dicranoweisia crispula (Hedw.) Lindb. ex Milde
Dicranum
Dicranum polysetum Sw.
Dicranum undulatum Brid.
Didymodon
Distichium capillaceum (Hedw.) Bruch & Schimp.
Ditrichum
Drepanocladus
Drepanocladus exannulatus (Schimp. in Bruch, Schimp. & W.Gƒmbel) Warnst.
Encalypta
Encalypta brevicolla (Bruch & Schimp. in Bruch, Schimp. & W.Gƒmbel) Bruch ex üngstr.
Encalypta ciliata Hedw.
Encalypta rhaptocarpa Schwègr.
Eurhynchium
Fissidens
Funaria hygrometrica Hedw.
Grimmia
Grimmia torquata Hornsch. in Grev.
Hamatocaulis vernicosus (Mitt.) Hedenès
Hedwigia ciliata (Hedw.) P.Beauv.
Helodium blandowii (F.Weber & D.Mohr) Warnst.
Hylocomium splendens (Hedw.) Schimp. in Bruch, Schimp. & W.Gƒmbel
Hypnum
Kiaeria
Leptobryum pyriforme (Hedw.) Wilson
Meesia uliginosa Hedw.

Mnium
Oncophorus
Oncophorus virens (Hedw.) Brid.
Orthotrichum obtusifolium Brid.
Paraleucobryum
Plagiomnium
Plagiomnium cuspidatum (Hedw.) T.Kop.
Plagiomnium rugicum (Laurer) T.Kop.
Plagiothecium
Pleurozium schreberi (Brid.) Mitt.
Pogonatum dentatum (Brid.) Brid.
Pohlia
Pohlia andalusica (Hoehnel) Broth.
Pohlia cruda (Hedw.) Lindb.
Pohlia proligera (Lindb. ex Breidl.) Lindb. ex Arnell
Polytrichastrum longisetum (Brid.) G.L.Sm.
Polytrichum
Polytrichum commune Hedw.
Polytrichum hyperboreum R.Br.
Polytrichum juniperinum Hedw.
Polytrichum piliferum Hedw.
Polytrichum strictum Brid.
Pseudobryum cinclidioides (Huebener) T.Kop.
Psilopilum cavifolium (Wilson) I.Hagen
Pterygoneurum subsessile (Brid.) Jur.
Ptilium crista-castrensis (Hedw.) De Not.
Pylaisiella polyantha (Hedw.) Grout
Racomitrium ericoides (F.Weber ex Brid.) Brid.
Racomitrium lanuginosum (Hedw.) Brid.
Rhizomnium
Rhizomnium punctatum (Hedw.) T.Kop.
Rhytidiadelphus triquetrus (Hedw.) Warnst.
Rhytidium rugosum (Hedw.) Kindb.
Sanionia uncinata (Hedw.) Loeske
Schistidium
Schistidium apocarpum (Hedw.) Bruch & Schimp. in Bruch, Schimp. & W.Gƒmbel
Scorpidium cossonii (Schimp.) Hedenès
Scorpidium scorpioides (Hedw.) Limpr.
Sphagnum
Sphagnum angustifolium (C.E.O.Jensen ex Russow) C.E.O.Jensen in Tolf
Sphagnum fimbriatum Wilson in Wilson & Hook.f. in Hook.f.
Sphagnum fuscum (Schimp.) H.Klinggr.
Sphagnum girgensohnii Russow
Sphagnum lindbergii Schimp. in Lindb.
Sphagnum magellanicum Brid.
Sphagnum platyphyllum (Lindb. ex Braithw.) Sull. ex Warnst.

Sphagnum riparium üngstr.
Sphagnum rubellum Wilson
Sphagnum russowii Warnst.
Sphagnum squarrosum Crome
Sphagnum teres (Schimp.) üngstr.
Sphagnum warnstorfii Russow
Splachnum
Splachnum ampullaceum
Splachnum luteum Hedw.
Splachnum melanocaulon (Wahlenb.) Schwègr.
Splachnum rubrum Hedw.
Splachnum sphaericum Hedw.
Syntrichia
Syntrichia ruralis (Hedw.) F. Weber & D. Mohr
Tetraplodon
Tetraplodon mnioides (Hedw.) Bruch & Schimp. in Bruch, Schimp. & W.Gƒmbel
Thuidium
Thuidium recognitum (Hedw.) Lindb.
Timmia
Timmia austriaca Hedw.
Timmia megapolitana Hedw.
Tomentypnum nitens (Hedw.) Loeske
Tortella fragilis (Drumm.) Limpr.
Tortula
Tortula acaulon (L. ex With.) R.H.Zander
Tortula mucronifolia Schwègr.
Trichodon
Ulota

Genus names represent specimens identified to genus but not yet identified to species. * refers to a lichenicolous fungus.

SOURCE: Racine, Charles, Robert Lichabar, Barbara Murray, Gerald Tande, Robert Lipkin, And Michael Duffy. *A Floristic Inventory And Spatial Database For Fort Wainwright, Interior Alaska*. U.S. Army Corps of Engineers, Cold Regions Research And Engineering Laboratory. Special Report 97-23. Hanover, NH. 1997.

APPENDIX 3.12
Wildlife

Confirmed Fauna of Fort Wainwright and Fort Greely

**Species found only on Fort Wainwright
* Species found only on Fort Greely
(+) Species does not occur in Alaska (mis-identified)
MAMMALS

Scientific Name	Common Name	Habitat
Microtus longicaudus *	long-tailed vole	moist wet meadows, streambanks
Microtus miurus	Alaska (singing) vole	slopes
Microtus pennsylvanicus	meadow vole	meadow
Microtus oeconomus	tundra vole	alpine
Microtus xanthognathus	yellow-cheeked vole	spruce forests
Clethrionomys rutilus	redback (tundra) vole	alpine, forest
Lemmus trimucronatus	brown lemming	alpine
Synaptomys borealis	northern bog lemming	wet alpine tundra, muskeg
Peromyscus maniculatus	deer mouse	dry forest, grassland
Zapus hudsonicus	meadow jumping mouse	grass
Sorex hoyi	pygmy shrew	forest, grassland
Sorex monticulus	dusky shrew	muskeg, forest
Sorex cinereus	masked shrew	subalpine
Sorex tundrensis	tundra shrew	tamarack and spruce swamps
Myotis lucifugus	little brown bat	wooded areas, abandoned buildings
Mustela erminea	short-tailed weasel	forest, brush
Mustela frenata (+)	long-tailed weasel	woodlands
Mustela nivalis	least weasel	brush
Mustela vison	mink	near water
Marmota caligata	hoary marmot	alpine
Marmota monax	woodchuck	dry woods, brushy ravines, rocky slopes
Lontra canadensis	river otter	near water
Lepus americanus	snowshoe hare	forest, brush
Ondatra zibethicus	muskrat	near water, marsh
Spermophilus parryii	Arctic ground squirrel	alpine
Erethizon dorsatum	porcupine	coniferous forest
Tamiasciurus hudsonicus	red squirrel	spruce forest
Glaucomys sabrinus	northern flying squirrel	conifers and mixed hardwood forests, nest boxes
Castor canadensis	beaver	streams

Martes americana	marten	spruce forest
Gulo gulo	wolverine	subalpine, forest
Ursus arctos	brown (grizzly) bear	alpine, subalpine
Ursus americanus	black bear	forests
Canis latrans	coyote	ubiquitous
Canis lupus	gray wolf	alpine, forest, muskeg
Vulpes vulpes	red fox	ubiquitous
Lynx canadensis	lynx	forest, muskeg
Rangifer tarandus	barren ground caribou	tundra, open forest
Alces alces	moose	brush, forest
Ovis dalli *	Dall sheep	alpine
Bison bison *	bison	grassland, along river bars, agricultural areas

FISH

Scientific Name	Common Name
Lampetra japonica	Arctic lamprey
Stenodus leucichthys nelma	sheefish
Coregonus pidschian	humpback whitefish
Prosopium cylindraceum	round whitefish
Oncorhynchus keta	chum salmon
Oncorhynchus kisutch	coho (silver) salmon
Oncorhynchus tshawytscha	chinook (king) salmon
Oncorhyncus mykiss	rainbow trout (stocked)
Esox lucius	northern pike
Couesius plumbeus	lake chub
Catostomus catostomus	longnose sucker
Lota lota	burbot
Cottus cognatus	slimy sculpin
Thymallus arcticus	Arctic grayling
Coregonus sardinella	least cisco
Salvelinus alpinus	Arctic char
Salvelinus namaycush *	lake trout (stocked)

AMPHIBIANS AND REPTILES

Scientific Name	Common Name	Habitat
Rana sylvestris	wood frog	bogs, lakes, marshes

BIRDS

Scientific Name	Common Name
LOONS, GREBES, PELICANS	
Gavia immer	common loon
Gavia arctica	Arctic loon
Gavia stellata	red-throated loon
Gavia pacifica	Pacific loon
Podiceps grisegena	red-necked grebe
Podiceps auritus	horned grebe
WATERFOWL	
*Cygnus buccinator**	trumpeter swan
Cygnus columbianus **	tundra swan
Anser albifrons	greater white-fronted goose
Chen caerulescens	snow/blue goose
Branta canadensis	Canada goose
Branta bernicla nigricans	black brant
Anas platyrhynchos	mallard
Anas strepera	gadwall
Anas crecca	green-winged teal
Anas americana	American wigeon
Anas acuta	northern pintail
Anas clypeata	northern shoveler
Anas discors	blue-winged teal
Aythya americana	redhead
Aythya valisineria	canvasback
Aythya collaris	ring-necked duck
Aythya marila	greater scaup
Aythya affinis	lesser scaup
Bucephala islandica	Barrow's goldeneye
Bucephala clangula	common goldeneye
Bucephala albeola	bufflehead
Mergus merganser	common merganser
Mergus serrator	red-breasted merganser
Clangula hyemalis	oldsquaw
Histrionicus histrionicus	Harlequin duck
Melanitta deglandi	common scoter
Melanitta fusca	white-winged scoter
Melanitta perspicillata	surf scoter
*Melanitta nigra**	black scoter
VULTURES, HAWKS & FALCONS	
Haliaeetus leucocephalus	bald eagle
Aquila chrysaetus	golden eagle
Circus cyaneus	northern harrier
Falco rusticolus	gyrfalcon

Falco peregrinus	peregrine falcon
Falco columbarius	merlin
Falco sparverius	American kestrel
Buteo jamaicensis	red-tailed hawk
Buteo jamaicensis harlani	Harlan's hawk
Buteo lagopus	rough-legged hawk
Buteo swainsoni	Swainson's hawk
Accipter striatus	sharp-shinned hawk
Accipter gentilis	northern goshawk
Pandion haliaetus	osprey
OWLS	
Asio flammeus	short-eared owl
Bubo virginianus	great horned owl
Strix nebulosa	great gray owl
Surnia ulula	northern hawk owl
Nyctea scandiaca	snowy owl
Aegolius funereus	boreal owl
GALLINACEOUS BIRDS	
Lagopus lagopus	willow ptarmigan
Lagopus mutus	rock ptarmigan
Lagopus leucurus	white-tailed ptarmigan
Falcipennis canadensis	spruce grouse
Bonasa umbellus	ruffed grouse
Tympanuchus phasianellus	sharp-tailed grouse
SHOREBIRDS, CRANES, COOTS	
Grus canadensis	sandhill crane
Fulica americana	American coot
Charadrius semipalmatus	semipalmated plover
Charadrius vociferus	killdeer
Pluvialis squatarola	black-bellied plover
Pluvialis dominica	American golden plover
Numenius phaeopus	whimbrel
Bartramia longicauda	upland sandpiper
Tringa flavipes	lesser yellowlegs
Tringa melanoleuca **	greater yellowlegs
Tringa solitaria	solitary sandpiper
Heteroscelus incanus	wandering tattler
Actitis macularia	spotted sandpiper
Phalaropus lobatus **	red-necked phalarope
Limnodromus scolopaceus	long-billed dowitcher
Gallinago gallinago	common snipe
Aphriza virgata	surfbird

Calidris pusilla	semipalmated sandpiper
Calidris mauri	western sandpiper
Calidris minutilla	least sandpiper
Calidris alpina	dunlin
Calidris alba	sanderling
Calidris melanotos *	pectoral sandpiper
Calidris bairdii *	Baird's sandpiper
Stercorarius longicaudus	long-tailed jaeger
GULLS & TERNS	
Larus argentatus	herring gull
Larus canus	mew gull
Larus philadelphia **	Bonaparte's gull
Sterna paradisaea	Arctic tern
DOVES	
Columba livia	rock dove
HUMMINGBIRDS	
Selasphorus rufus	rufous hummingbird
KINGFISHER	
Ceryle alcyon	belted kingfisher
WOODPECKERS	
Picoides villosus	hairy woodpecker
Picoides tridactylus	three-toed woodpecker
Colaptes auratus cafer	northern flicker
Colaptes auratus **	yellow-shafted flicker
Picoides arcticus	black-backed woodpecker
Picoides pubescens	downy woodpecker
PERCHING BIRDS	
Sayornis saya	Say's phoebe
Empidonax alnorum	Alder flycatcher
Empidonax hammondii	Hammond's flycatcher
Empidonax traillii	Traill's (willow) flycatcher
Contopus cooperi	olive-sided flycatcher
Contopus sordidulus	western wood-pewee
Eremophila alpestris	horned lark
Tachycineta bicolor	tree swallow
Tachycineta thalassina	violet-green swallow
Riparia riparia	bank swallow
Petrochelidon pyrrhonota	cliff swallow
Hirundo rustica **	barn swallow
Corvus corax	common raven
Perisoreus canadensis	gray jay

Pica pica	black-billed magpie
Poecile atricapillus	black-capped chickadee
Poecille hudsonicus	boreal chickadee
Poecile cinctus	gray-headed chickadee
Troglodytes troglodytes *	winter wren
Certhia americana	brown creeper
Cinclus mexicanus	American dipper
Turdus migratorius	American robin
Ixoreus naevius	varied thrush
Catharus guttata	hermit thrush
Catharus ustulatus	Swainson's thrush
Catharus minimus	gray-cheeked thrush
Myadestes townsendi	Townsend's solitaire
Oenanthe oenanthe	northern wheatear
Regulus calendula	ruby-crowned kinglet
Phylloscopus borealis	Arctic warbler
Anthus spinoletts	American pipit
Bombycilla garrulus	Bohemian waxwing
Lanius excubitor	northern shrike
Vermivora celata	orange-crowned warbler
Dendroica petechia	yellow warbler
Dendroica coronata	yellow-rumped warbler
Dendroica striata	blackpoll warbler
Seiurus noveboracensis	northern waterthrush
Wilsonia pusilla	Wilson's warbler
Euphagus carolinus	rusty blackbird
Pinicola enucleator	pine grosbeak
Leucosticte tephrocotis	gray-crowned rosy finch
Carduelis hornemanni	hoary redpoll
Acanthis flammea	common redpoll
Carduelis pinus	pine siskin
Loxia leucoptera	white-winged crossbill
Junco hyemalis	dark-eyed junco
Passerculus sandwichensis	savannah sparrow
Melospiza melodia	song sparrow
Spizella passerina	chipping sparrow
Melospiza lincolnii	Lincoln's sparrow
Calcarius pictus	Smith's longspur
Calcarius lapponicus	Lapland longspur
Plectrophenax nivalis	snow bunting
Zonotrichia leucophrys	white-crowned sparrow
Regulus calendula	ruby-crowned kinglet
Spizella arborea	American tree sparrow
Passerella iliaca	fox sparrow
Zonotrichia atricapilla	golden-crowned sparrow
Dendroica townsendii **	Townsend's warbler

SOURCES: *Breeding Bird Survey* forms, Fort Wainwright and Fort Greely.

Summers, H. *Small Mammals Survey on Fort Greely, Alaska*. 1980.

U.S. Dept. of the Army. *Draft Environmental Impact Statement Land Withdrawal, 172nd Infantry Brigade, Fort Wainwright, Alaska*. 1979.

U.S. Dept. of the Army. *Final Environmental Impact Statement Land Withdrawal, 172nd Infantry Brigade, Fort Greely, Alaska*. 1980.

Von Rueden, G.R. *Fish and Wildlife Management Plan, Eielson Air Force Base, Alaska*. 1994.

APPENDIX 3.14
U.S. Fish and Wildlife Service Consultation Letter

United States Department of the Interior

FISH AND WILDLIFE SERVICE

NORTHERN ALASKA ECOLOGICAL SERVICES
101 12th Ave. Box 19, Room 110
Fairbanks, AK 99701
February 16, 1998

Ms. Terri Hicks-Anderson
Colorado State University
Center for Ecological Management of Military Lands
Department of Forest Sciences
Fort Collins, Colorado 80523

Re: Renewal of withdrawal of Ft. Greely and Ft. Wainwright Maneuver Areas

Dear Ms. Hicks-Anderson:

This responds to your request for formal consultation regarding endangered and threatened species and critical habitats pursuant to section 7 of the Endangered Species Act of 1973, as amended (Act). This information is being provided for your use in the preparation of an Environmental Impact Statement to renew the withdrawal of the Fort Greely Maneuver Area and Air Drop Zone, and the Fort Wainwright Maneuver Area from the Bureau of Land Management under the Military Lands Withdrawal Act, Public Law 99-606. The Service does not believe that formal consultation is necessary because, as the following paragraphs explain, these renewals are not expected to affect listed species. Formal consultation, pursuant to section 7(a)(2) of the Act, is a process a Federal agency utilizes when their actions are likely to adversely affect a listed species or to result in jeopardy to the continued existence of a listed species. Instead of proceeding with the formal consultation process, the Service is providing you with a list of species protected by the Act that may occur in the vicinity of the withdrawn lands and our determination of anticipated effects to those species.

One listed species, the endangered American peregrine falcon (*Falco peregrinus anatum*), and one delisted species, the arctic peregrine falcon (*Falco peregrinus tundrius*), occur in the area of proposed activity.

The American peregrine falcon nests in the forested areas of interior Alaska, and migrates through central, southcentral, and southeastern Alaska during spring and fall migration. There is no designated critical habitat for American peregrine falcons in Alaska. There are no known American peregrine falcon nest sites within the areas proposed for renewal of withdrawal from the BLM, however they may migrate through those areas.

The arctic peregrine falcon (*Falco peregrinus tundrius*) was removed from the list of endangered and threatened species on October 5, 1994. This subspecies nests in the tundra areas of northern and western Alaska and migrates throughout the state (except the Aleutian Islands) during spring and fall migration.

The Service recommends that agencies and applicants avoid impacts to arctic peregrine falcons as they have recently recovered from threatened status, and could be emergency listed at any time if survey data indicate a reversal in recovery. There are also no known arctic peregrine falcon nest sites within the areas proposed for renewal of withdrawal from the BLM, however, they may migrate through those areas.

Based on the project description provided, and the fact that no new impact areas are proposed, the Service concludes that this project is not likely to adversely impact listed species. Preparation of a Biological Assessment or further consultation under section 7 of the Act regarding this project is not necessary at this time. If project plans change, additional information on listed or proposed species becomes available, or new species are listed that may be affected by the project, consultation should be reinitiated.

This letter relates only to endangered species under our jurisdiction. It does not address other legislation or responsibilities under the Fish and Wildlife Coordination Act, Clean Water Act, or National Environmental Policy Act.

Thank you for your cooperation in meeting our joint responsibilities under the Act. If you need further assistance, please contact Cathy Donaldson at (907) 456-0354.

Sincerely,

Patrick Sousa

Patrick Sousa
Field Supervisor

APPENDIX 3.18
Cultural Resources

Appendix 3.18.A
Summary of Regional Cultural Chronology

Summary of Regional Cultural Chronology

This summary of regional prehistory and history is excerpted from the *Draft Integrated Cultural Resources Management Plans* for Fort Wainwright and Fort Greely developed by the Alaska State Historic Preservation Office, 1998.

Prehistory

Prehistoric occupation of the lands comprising Fort Wainwright and Fort Greely began about 12,000 years ago. Evidence of this prehistory has been discovered throughout interior Alaska. Early sites, dating back almost 3,500 years, have been discovered near Fort Wainwright on the University of Alaska Fairbanks (UAF) campus (Mobley 1984). Archaeological sites on Fort Wainwright date back about 1,800 years, while some on Fort Greely date back 9,000 years. The earliest evidence of human habitation in Alaska was discovered just north of Fort Greely, leading archaeologists to hypothesize that prehistoric occupation of the lands goes back at least 12,000 years (Bacon et al. 1986). Archaeologists believe that with more research, older sites will be discovered on both posts.

Alaska's earliest inhabitants probably arrived by crossing the dry expanse of land that existed between Alaska and Siberia during the last ice age. They were nomadic hunters traveling in small bands, probably following migrating animals from Siberia to Alaska. Due to geologic and ecologic conditions, their mobile lifestyle, and the organic nature of their cultural material, little evidence of their culture has been found. Remnants of their stone tool technology is represented by small tear-drop projectile points and triangular points (U.S. Department of Interior 1996).

About 11,000 years ago, a microblade technology appeared in the tool kits of Interior groups. This tradition of tool making, called the Paleoarctic Tradition, consisted of small stone blades struck from prepared wedge-shaped cores. The tradition appears to have lasted until about 8,000 years ago, although research suggests that it lasted much longer in interior Alaska (Mobley 1984). The Denali Complex, represented at the Campus Site in Fairbanks, may be a later example of this tradition. Radiocarbon dating methods have produced dates of approximately 3,500 years ago, while analysis of lithic artifacts discovered at the site suggest an affiliation with the Paleoarctic Tradition and possibly the later Northern Archaic tradition. Sites dating from this period have been discovered just east of Fort Wainwright, near Eielson Air Force Base, indicating that it is highly probable that sites will be discovered on Fort Wainwright. Approximately 20 sites representing the Paleoarctic Tradition have been clearly identified on Fort Greely (Bacon and Holmes 1979).

As noted previously, there appears to be some overlapping of the earlier Paleoarctic tradition and the Northern Archaic tradition. This tradition first appeared in northwestern Alaska about 6,500 years ago and lasted until about

1,000 years ago. This coincided with a warming trend and the appearance of spruce in the southern Arctic, suggesting that its development was promoted by the expansion of the boreal forest. Tool kits reflected an adaptation to a new environment. Assemblages containing microblades, bifacial knives and side notched projectile points are associated with the Tuktu Complex, an Interior variation of this tradition (Anderson 1996). Approximately 15 sites representing or believed to represent this tradition have been identified on Forts Wainwright and Greely (Bacon et al. 1986).

Linguistic evidence suggests that Athapaskan Tradition appeared in the Tanana Valley about 2,500 years ago. Athapaskan legends refer to two migrations into the region, one from the upper Yukon in Canada and the other from the lower Copper River Valley. The Athapaskan Tradition placed greater emphasis on wood and bone in manufacturing tools and jewelry (It should be noted that sites associated with this tradition are generally more recent and therefore better preserved than previous traditions. More research may reveal similar cultural complexity in previous cultures.). Bone, fish hooks, beads, bone buttons, birch bark trays, and bone gaming pieces are representative of Athapaskan cultural items. In the upper Tanana region, copper was available and was utilized in the manufacture of tools such as knives and axes (Clark 1981, Reckord 1983).

Athapaskan settlement patterns depended greatly on the availability of subsistence resources. The Ahtna of the Copper River region had a much greater resource base than interior Athapaskans. They were able to store large quantities of salmon for the winter months, staying in semi-permanent winter camps. Interior bands lived an almost completely nomadic lifestyle, depending primarily on game animals for sustenance. They often had to traverse vast areas to support themselves (Reckord 1983). The Salcha band's annual hunting round encompassed parts of Fort Wainwright and Fort Greely. They spent much of the winter engaged in subsistence activities. It was often necessary to divide into smaller units to find game. Salmon runs on the Tanana River were smaller, shorter, and less varied than those of the Copper River and thus did not form a major subsistence resource. However, salmon supplemented their diet during the lean winter months when finding game animals was most difficult (Andrews 1975).

Use of the region varied greatly from one band to another. Lieutenant Castner observed a small hunting party of "Upper Copper River Indians" (Ahtna) camped near the headwaters of the Delta River during his expedition in 1898 (Castner 1984). It is probable that one or more Ahtna bands used the southern region of Fort Greely during lean periods. The Salcha, Goodpastor, Wood River, and Chena bands of the lower Tanana Athapaskans, and the Healy Lake band of the Tanacross Athapaskans all utilized certain portions of Forts Wainwright and Greely (Mckennan 1981). On Fort Wainwright, the Blair Lakes Archaeological District holds the most promise for producing information on the prehistory of this tradition. Several villages have been reported on or near the installation. One occupied by the Wood River band was located in the southern part of Fort

Wainwright but has not been found (Bacon et al. 1986). Discovery of this site would aide in the understanding of historic and prehistoric Athapaskan life.

Recent History

Contact to the Goldrush, 1847-1928

In 1847, the Hudson Bay Company established a trading post at Fort Yukon. Trade was generally carried out through native middlemen until the late 1860s or 1870s. During this later time, prospectors and traders began entering the Yukon River tributaries (Dixon 1980). In 1894, gold was discovered on Birch Creek, and the gold rush town of Circle City was established. With this, prospectors exploring the Tanana Valley had a closer source of supplies. Salcha natives began direct trade at Circle City, establishing a trade route up the Salcha River to Birch Creek, and prospectors soon followed. A resulting increase in mining and trading activities in the region led the Army to consider the need for better communications in the region, responding with the construction of the Washington-Alaska Military Cable Telegraph System (WAMCATS) in 1899. A section of this system ran from Fort Liscum to Fort Egbert and then across the Fortymile region, east of Fort Greely, to the Tanana River (Dixon 1980).

Additional gold discoveries in 1902 resulted in the settlement of Fairbanks. John E. Bonnifield struck gold at Gold King Creek in 1903 and established the Bonnifield Trail, which crosses the Tanana Flats Training Area, to supply his mining operation. To supply Fairbanks and the interior mining camps, the Fairbanks-Valdez Trail was developed. Thousands of people and tons of supplies came into the interior gold camps over this route, taking advantage of the numerous roadhouses that established themselves along the route. In 1903 there were 500 settlers in the Tanana Valley; six years later there were 15,000 (Naske and Rowinski 1981).

Gold production peaked in 1909, then began a period of decline. Discoveries in the Iditarod district coincided with this decline, inducing laborers to leave for the new fields. Activities in the Iditarod district were followed by World War I, resulting in a further decrease in the population of Fairbanks. The shrinking population and declining economic activities fostered a decrease in construction activities. Throughout the early 1920s, the population of Fairbanks remained at about 1,200. This long period of decline and consolidation ended with the completion of the Alaska Railroad in 1923. By 1926, the population increased slightly to about 1,700. Fairbanks Exploration Company began operations in 1928, bolstering this trend of growth and renewal (Robe 1970).

Numerous sites associated with this period exist, or can be expected to be discovered, in the withdrawal area. Late prehistoric and early contact village sites have been reported on or near Fort Wainwright. Discovery of these sites would increase our understanding of the impact of European contact on native peoples in the region at the turn of the century. Cabins from this period are known to exist on Fort Wainwright, and the Bonnifield Trail, connecting Fairbanks to Bonnifield's camp, crosses the Tanana Flats Training Area. The trail is still used by the Army during winter training missions (Breun, Personal Communication 1997). Cabins were reportedly located along the trail; however an attempt to discover them has never been initiated (Bacon et al. 1986). Three roadhouses, associated with the Fairbanks-Valdez Trail, have been reported in the vicinity of Dyke Range on Fort Wainwright and are known to exist on Fort Greely.

The Alaskan Air Base, 1928-1941

Throughout the 1910s and 1920s, aviation played an increasingly important role in Fairbanks' development. In 1913, the first airplane to fly in Alaska flew at Fairbanks during the Fourth of July celebration. Fairbanks' location in the Interior and lack of roads throughout Alaska made the airplane an attractive mode of transportation. In 1939, thirty-five commercial aircraft were based at the local airport. Heavy machinery, food, mail and passengers were flown regularly from Fairbanks to hundreds of interior mining camps (Cashen 1971, Robe 1970). It was Fairbanks' status as an aviation hub that compelled Colonel Arnold to recommend that it be considered as the site for an airbase in 1934 (Cloe and Monaghan 1984).

Between the wars, the military realized the need for an airfield in Alaska. General Mitchell predicted that Japan would one day attack the U.S. and that the Aleutians would become a theater of war. He emphasized Alaska's strategic location during a 1925 speech, observing that "he who holds Alaska holds the world" (Clark 1981, Reckord 1983). In 1928, a joint Army-Navy plan established a defensive triangle in the Pacific Ocean to defend the continental United States from such an attack. *Plan Orange* designated Hawaii, Panama, and Alaska as the limits of the triangle. However, funding for Alaska's defenses was not made available until circumstances required it some ten years later.

The Air Corps' inexperience in the Arctic played an important role in the drive for an Alaskan air base. This was underscored when Colonel Ben Eielson disappeared in a winter storm, while flying a rescue mission in the Bering Sea in 1929. Aviators from Alaska, Canada, and Russia joined in the search for Eielson. When assistance was requested from the Air Corps, they responded that they did not have anyone, except Eielson, that was experienced in Arctic flying (U.S. Department of the Interior 1996). Mitchell's farsightedness and Eielson's misfortune served as catalysts for an airfield in Alaska.

Citing Alaska's strategic location and the need for a cold weather airfield, Alaska Delegate Anthony J. Dimond introduced the Dimond Bill in 1934. The bill called for construction of an Alaskan airfield. That same year, following a string of cold weather-related Air Corps accidents, the Baker Board was established by Congress to investigate the inadequacies of the Air Corps. In January 1935, Congressman Wilcox of Florida introduced the Wilcox Bill, which incorporated the findings and recommendations of the Baker Board and the Dimond Bill. An airfield in Alaska was one of six called for in the bill. Billy Mitchell testified during congressional hearings that, "Alaska is the most central place in the world for aircraft, and that is true of Europe, Asia, or North America" and reemphasized the danger posed by Japan (Mitchell 1982). The bill was signed into law as the "Wilcox National Air Defense Act" on August 12, 1935. On March 31, 1937, President Roosevelt signed Executive Order 7596, officially withdrawing 960 acres near Fairbanks for the establishment of an airfield (Cloe and Monaghan; Fairbanks Daily News-Miner 1937).

In 1939, four million dollars was appropriated for construction of the base (Cloe and Monaghan 1984). The initial authorization called for the construction of a concrete runway 5000 feet by 150 feet, 9 buildings for administration and housing of 561 officers and enlisted men, 6 buildings for technical use, a Medical Corps building, tactical gasoline and oil storage facilities, utilities, roads, drainage, parking apron, and a railroad spur from Fairbanks. A ground garrison camp for 280 officers and enlisted men was later added to the original authorization. In August 1939, a site was selected and work begun. Local laborers worked throughout the winter clearing land for the runway and buildings. Construction of a railroad spur from Fairbanks to the site was one of the first things completed. The "Alaskan Air Base" as it was referred to was officially named Ladd Field in honor of Major Arthur K. Ladd who died when his airplane crashed in South Carolina in 1935 (Bush 1984, Kerns 1991).

Construction of Ladd Field presented challenges for planners and construction crews. General Arnold observed that overseas garrisons were usually constructed in the tropics. He commented, "We have much to learn, and the building of these new air bases brings this out" (Arnold 1940). Clearing and excavating frozen ground to depths of at least two feet and, in some instances 15 feet, proved difficult in winter. Steam had to be utilized to thaw permanently frozen ground and tundra before stripping. Plans had to be revised to accommodate building conditions. It was a cold weather test in itself.

When the Army Corps of Engineers took over construction of Ladd Field from the Quartermaster Corps in January 1941, eighty percent of the construction was complete. "All quarters, with exception of the bachelor officer's [were] completed on the exterior, and interior work [was in progress] (Alaska Air Command Collection 1940)." It was estimated that they would all be completed by the end of January 1941. Steel for the hospital, Hanger #I, and the barracks were being erected and estimated to be completed by August 1941. In December 1940, it was noted that there were eight sets of married officer's quarters, 33 sets of bachelor officers' quarters, and 26 sets of noncommissioned officers' quarters in place (Bacon and Holmes 1979).

Cold Weather Testing

The garrison was activated on April 14, 1940, with the arrival of Major Gaffney and Lieutenant Walseth of the Air Corps, and 15 enlisted men. In July, General

Henry Arnold visited Ladd Field. While visiting he decided to activate the Cold Weather Station earlier by housing men and aircraft in temporary structures while permanent facilities were being completed. Later that month the first men, numbering 50 in all, to form the Cold Weather Detachment arrived at Ladd Field. Two B-17s, two YP-37s, and Major Gaffney's 0-38F were assigned to the base the first winter (Cole and Monaghan 1984). In October of 1940, General Arnold observed that in sub-zero temperatures "metal bomb sites, machine guns, and plane controls need special adjustments" (Arnold 1940). The first winter's testing proved this. Starting engines proved to be a formidable task, instruments failed with regularity, and hydraulic systems presented major problems. The electric hydraulic motor, which raised and lowered landing gear, was burdened so much by cold, congealed hydraulic fluid that the hand pump had to be used. Fuel pumps failed, oil filter casings split, and seals broke. Controls became stiff at extremely low temperatures and, in a few cases, failed (Lauer 1944, Cloe and Monaghan 1984).

The Cold Weather Detachment was briefly disbanded in spring 1942 when the Japanese invaded the Aleutians. Discussions with Russian pilots, in preparation for delivery of Land-Lease aircraft, made it clear that fighter aircraft operating at the Eastern Front would have to be capable of operating at temperature as low as -65°F. There was not a cargo or fighter plane in the Air Corps' inventory or under development that could operate well under -25°F (Cloe and Monaghan 1984). The urgent need for cold weather research and development necessitated the reactivation of the Cold Weather Detachment in July (Lauer 1944, Cloe and Monaghan 1984). In order to streamline operations, representatives of aircraft and engine manufacturers, and other agencies were assigned to Ladd Field. This allowed them to experience and witness the effects of cold weather on themselves and the aircraft first hand and better communicate needs to superiors. By 1944, there were 558 people assigned to the Cold Weather Test Detachment (Lauer 1944).

WORLD WAR II, 1941-1945

Air Depot

United States entry into World War II had a significant impact on Ladd Field. After the Japanese attack on Pearl Harbor, Ladd Field was placed on alert status and civilians were evacuated to the Lower 48. The availability of strategic supplies was a continuing problem in Alaska. A limited number of facilities, small capacity, and resupply problems resulted in major logistics problems. To help alleviate this, the Sixth Air Depot Group, consisting of 25 officers and 567 enlisted men, and eight attached units consisting of eight officers and 283 enlisted men, arrived at Ladd Field in July 1942. Its mission was to supply and repair aircraft engaged in the Aleutian campaigns (Lauer 1944).

Activities of Sixth Air Depot Group, the Cold Weather Test Station, and later in

1942, the Air Transport Command resulted in a major expansion of facilities at Ladd Field. This buildup continued almost non-stop throughout the War. Expansions included an extension to the existing runway and construction of a new one, eight hangers, thirty-seven 50,000 gallon fuel storage tanks, a half million square yards of parking area, and 12,000 feet of taxiway. Housing for additional personnel was also constructed.

ALSIB (Alaska-Siberia) Lend-Lease Program

Ladd Field's mission as the North American terminus of the ALSIB route was its best known contribution to the war effort. It was here, from 1942 to 1945, that the Soviet Union received United States' lend-lease aircraft. Soviet pilots received training in U.S. aircraft at Ladd Field before flying them across Siberia to the Eastern Front. Almost 8,000 aircraft were delivered over this route during the three year period it was in operation.

To facilitate delivery of lend-lease aircraft, a unit of the Air Transport Command (ATC) was activated at Ladd Field. The first planes, consisting of five A-20s, arrived at Ladd Field on September 3, 1942. On September 11, a second group of planes, comprised of 22 P-40's, arrived. The first Russian pilots arrived at Ladd Field on September 24 to begin five days of training before flying the new planes to Russia. On October 9, Lieutenant Colonel Nedosekin, of the Soviet Air Force, led the first flight of twelve A-20s (Brandon 1975, Lauer 1944). Only about 150 aircraft were delivered in 1942. This increased to about 2,500 in 1943 and, at its height in 1944, over 3,000 aircraft were transferred.

1946 to Present

Relations between the United States and the Soviet Union deteriorated rapidly after World War II. In response, Ladd Field was maintained and the Strategic Air Command (SAC) established. SAC organized its first unit at Ladd Field in 1946 to begin developing a system of Polar navigation (White 1994). After the formation of the Air Force in 1947, Ladd Field was designated an Air Force Base. Electronic intelligence (ELINT) B-29s, a prototype of the RB-29, began flying electronic reconnaissance missions out of Ladd AFB in 1947. The object of these missions was to map Soviet radar capabilities and develop appropriate countermeasures (Farquhar 1995). Throughout the late 1940s and 1950s ,various SAC missions were carried out from Ladd AFB.

The Army's mission at Ladd AFB included antiaircraft and ground defense, cold weather training, and emergency preparedness for nuclear attack. Antiaircraft artillery (AAA) batteries were installed around Fairbanks in the early 1950s to support its defense mission. These were replaced by the Nike Missile system in 1959 (Denfield 1994). To support Ladd Air Force Base's dual service missions, a major construction program was initiated in the 1950s. Bassett Army Hospital, housing on South Post, new barracks, and a new communications center were part of this buildup (Midnight Sun 1951).

With the creation of Ladd AFB in 1947, the War Department designated Big Delta, an inactive World War II airfield, an Army post. An Arctic Training Center was established, and cold weather testing and training became the focus of activities at Big Delta. Many new facilities were constructed in the 1950s to support the post's cold weather missions. New housing, warehouses, and the military's first nuclear power plant were part of this program. After numerous name changes, the post was designated Fort Greely in 1955 (Anchorage Daily News 1972).

Ladd AFB was transferred to the Army and renamed Fort Wainwright in 1961. This allowed the Army to enhance its cold weather testing and training program in Alaska. An example of this expansion was the establishment of the Cold Regions Research and Engineering Laboratory (CRREL) that same year. Throughout the late 1960s and early 1970,s military resources were directed towards the war in Vietnam. Improvements came in the form of equipment modernization. Arctic training was again emphasized in the 1970s, with exercises being conducted annually. With the activation of the 6th Infantry Division (Light) at Fort Wainwright in 1986, a major construction program was undertaken to build support facilities. A new post exchange, gymnasium, medical center, and battalion headquarters building were part of this program (Denfield 1994).

After the closure of Clark Air Force base in the Philippines in 1992, the Air Force's COPE THUNDER program, a Major Flying Exercise, was moved to Alaska. Through cooperation with the Army, the Air Force developed training areas on Forts Wainwright and Greely. Those include mock enemy air bases on the Fort Wainwright Maneuver Area and Fort Greely Training Area and a variety of equipment designed to test pilots' skills and give feedback. Four COPE THUNDER exercises are flown annually and generally involve about 1,200 people.

In the post Cold War period, Forts Wainwright and Greely have been the focus of significant military drawdown. Instead of stationing a division at Fort Wainwright as planned, a brigade was activated. As part of the Base Realignment and Closure (BRAC), Fort Greely began realigning under the command of Fort Wainwright in 1995.This has resulted in a significant troop reduction for the post, with most of the housing empty and in the process of being surplused.

Appendix 3.18.B
Alaska State Historic Preservation Office Consultation Letter

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF PARKS AND OUTDOOR RECREATION
OFFICE OF HISTORY AND ARCHAEOLOGY

3601 C STREET, SUITE 1278
ANCHORAGE, ALASKA 99503-5921
PHONE: (907)269-8721
FAX: (907)269-8908

September 23, 1998

File No.: 3130-1R Army

Subject: Renewal of Land Withdrawals

LT COL Mark Nelson
Public Works
Headquarters, U.S. Army Alaska
600 Richardson Drive, #5000
Fort Richardson, AK 99505-5000

Dear LT COL Nelson;

Thank you for your letter on the referenced subject. Generally, an undertaking as defined in 36 CFR 800, the implementing regulations for Section 106, includes activities that have the potential to affect historic properties. The proposed activity would only continue the existing management practices, so we agree that this is not an undertaking for Section 106 purposes.

Please contact me at 269-8715 if there are any questions or if we can be of further assistance.

Sincerely,

Judith Bittner

Judith E. Bittner
State Historic Preservation Officer

JEB:tas

APPENDIX 3.19
Socioeconomics

Appendix 3.19.A
Economic History of Wainwright and Greely Area

Economic History of the Fort Wainwright and Fort Greely Area

Interior Alaska's economy is best understood by reviewing its history of development. The military has had an extensive influence in the area for many years, and has, to a large degree, shaped the development of interior Alaska by affecting the location of towns, transportation corridors, and other economic infrastructure.

Archaeological evidence from Healy Lake has indicated more than 10,000 years of human habitation in interior Alaska. An Indian freight trail ran through Northway, Tetlin, Tanacross, and Dot Lake and on north to the Yukon River. A trading route also ran south through the Copper River region and out to the Prince William Sound. Dot Lake was used as a seasonal hunting camp for residents of George Lake and Tanacross. The mouth of the Chena River at its confluence with the Tanana River had a semi-permanent camp prior to the gold rush (U.S. Dept. of Interior and U.S. Dept. of Defense 1994a).

Census data cannot reveal economic history for several reasons, and caution should be taken with zero census figures cited in the Socioeconomic Section. Alaska is still largely wilderness, not having acquired territorial status until 1912, or statehood until 1958. Indigenous people were not made citizens until the 1920s. Even so, the remoteness of many villages and the seasonal nature of the subsistence lifestyle made a census count after that point difficult. Finally, the gold rush forever changed the social, economic, and political structure of interior Alaska; villages were abandoned, the old ways were left behind. Gold rush towns also came and went.

Fairbanks started as a gold mining town at the turn of the century. As such, it was a boom-bust economy from the start. Interior Alaska had little more than small Athapaskan villages and camps when Felix Pedro discovered gold near Cleary Summit in 1900. Soon thousands flooded into the Interior, and Fairbanks was quickly established as a center of commerce, government, and education. By 1910, the population of Fairbanks was 3,541, with over 7,000 in area mining camps.

In 1903, an overland trail had been established between Fairbanks and Valdez. The following year, the U.S. Signal Corps built a telegraph line from Valdez to Eagle. Rika's Roadhouse was established in 1910 near the junction of the Delta and Tanana Rivers; it still operates today in the Delta Junction area. Mining occurred north of the Delta River during this period in the Tenderfoot area and also to the south in the Chisana area.

The initial placer mining gold boom faded somewhat after 1910. World War I interrupted production, but mining resumed after the war. Throughout the 1920s and 1930s, annual production more than doubled. When the military arrived in the late 1930s, Fairbanks and interior Alaska were still dominated by the gold mining industry. Mining technology had evolved to large-scale bucket dredge operations throughout interior Alaska, and Fairbanks continued to be the center of economic activity, with a rail link established in 1923.

In the early developments of World War II, Alaska became important as a Pacific defense theater. After the attack on Pearl Harbor, construction of the Alaska Highway was ordered in conjunction with extensive development of Naval, Army, and Air Force bases of operations in Alaska. Between 1939 and 1943, troop deployment in Alaska went from 311 to over 150,000 individuals. Ultimately, the only battles of World War II on American soil were fought in the Aleutian Islands of Alaska.

The Alaska Highway initially opened for defense purposes. It still provides Alaska with the only road link to the continental United States. It was constructed in 1942 and totals 1,400 miles, with 1,200 miles of it through Canada. Over 11,000 troops were employed during construction. The Alaska Highway construction terminated at its junction with the Richardson Highway, built in 1920, at Delta Junction. The Richardson Highway continues on to Fairbanks. The traffic count on this highway is still a primary economic indicator for interior Alaska.

Fort Wainwright began as Ladd Field with construction of administration and housing for 561 officers and men beginning in 1938. When the first troops arrived in 1940, the value of the base approximated $12 million. In that year, 1,200 men were recruited from all parts of Alaska and the U.S. to complete work on the runway. The census for that year indicated a total population of 3,400 in Fairbanks. Thus, Fort Wainwright was a large economic enterprise. In 1941 it was expanded, adding a garrison camp for 280 more officers and enlisted men.

During World War II, the base was used as a staging area for the Lend-Lease program. In 1943, the Air Transport Command assumed responsibility for the installation, retaining control throughout the war. Also during 1943, construction began on Eielson Air Force Base. Initial construction consisted of housing for 108 officers and 330 enlisted men. During the Lend-Lease program, it was used as a satellite installation of Ladd Field, housing additional Lend-Lease aircraft. It expanded to over 2,000 men.

Additional Army posts were constructed in Galena, Big Delta, Tanacross, and Northway. The Civil Aeronautics Administration airstrip near Delta Junction was taken over by the Air Transportation Command. This field eventually became Allen Army Air Field. In the winter of 1947-1948, this post was the site for the first post-war cold weather maneuver, Exercise Yukon. Construction of permanent buildings began in 1954, and the post took on its present name of Fort Greely in 1955.

Census data reveal no population counts for these years in the Fort Greely area. Fort Greely was constructed in an area surrounded by wilderness with no more than a few roadhouses and unincorporated subsistence communities. Census data showed no population in any of the existing local communities of Big Delta, Delta Junction, Fort Greely, and Healy Lake until 1950, when Big Delta had a resident population of 155. Existing local towns grew with the installation and the Alaska Highway.

The interior mining industry was interrupted by World War II. Requisition of material and equipment was required for the war, as well as drafting of men. Mining rebounded on a lesser scale in 1946, but never regained its prominence. The military economy had come to dominate Fairbanks and interior Alaska by this time. All subsequent economic literature emphasizes this point, right up to the construction of the Trans-Alaska oil pipeline.

After World War II, Fort Wainwright continued to grow, adding a hospital and housing quarters through the 1950s. The scope of military operations increased through the 1960s. Eielson's manpower also increased and its mission was updated with the onset of the Cold War. Distant Early Warning line stations were installed throughout Arctic Canada and the United States for detection of enemy aircraft, with obvious strategic response provided by the Eielson-Wainwright military complex.

Over the same two decades, the mining industry was on the decline as inflation decreased the profit margin on gold, which was fixed at $35 an ounce. Prior to World War I, production stood at nearly 800,000 ounces. After the war, production initially hovered around 300,000 ounces. Production steadily declined over the next 20 years, and was almost nonexistent by 1970 (Alaska State Division of Geological and Geophysical Surveys 1996). Most of the dredges had ceased operations and were abandoned by the 1960s. The national defense industry took over as the main economic force in interior Alaska during this period, accounting for 75% of the direct purchases. Coal mining activity increased substantially.

In the late 1960s, Fort Wainwright and Eielson Air Force Base accounted for 62.4% of the Fairbanks area economy (Jones 1968). This figure included direct plus induced (multiplier effect) activity. The study period included the years 1965-1967. The troop strength of Fort Wainwright averaged 4,666 over those years; Department of Army civilian employees averaged 702. Eielson military personnel averaged 3,313, with 429 Department of Air Force civilians. These total 9,110 in direct employment.

Considering that the Fairbanks North Star Borough census averaged 37,000 between 1960 and 1970 (as the Borough had not formed until 1964, the 1960 figure refers to the greater Fairbanks census area) (State Department of Community and Regional Affairs 1990), it is understandable why the impact was estimated to be so high. Today the total direct employment of the military installations is at 9,688. The population of the Borough is over 80,000. Thus military employment has fallen in relative size by half.

Oil was discovered at Prudhoe Bay in 1968. It was the largest discovery of oil on the continent and was on state property. This single field eventually produced nearly 25% of the nation's oil supply, with the pipeline transporting up to two million barrels of oil a day (Department of Revenue website).

The economic transition began with oil revenues skyrocketing from $112 million to over $1 billion in fiscal year 1970 due to nearly $1 billion in Prudhoe Bay cash bonus lease sales. Oil related state revenues went from 31% to 88% of the total. Revenues dropped, awaiting the completion of the pipeline and royalties on the state's share.

However, in the early 1970s, the economic times were not favorable in Fairbanks primarily due to military downsizing. In 1971, Congress settled long-standing claims brought by the indigenous people of Alaska against the federal government through the Alaska Native Claims Settlement Act (ANCSA). The settlement provided nearly 1 billion dollars and over 40 million acres of land. Native (for profit) Corporations were established by law to oversee the land and money. The lands under military withdrawal were reserved from selection. The local Alaska regional native corporation is Doyon, which operates successfully as an oilfield service contractor. In addition to the regional and village ANCSA corporations, a village may have a separate federally recognized council, and may or may not have a municipal government.

In 1971 Fort Wainwright experienced a downsizing of about 1,500 military personnel with deactivation of the 171st Brigade. The military personnel payroll for 1973 was about $1 million, down from about $3 million in 1965. Fairbanks North Star Borough census data showed a population decline relative to the previous decade, although the population in the city of Fairbanks itself was up slightly.

When the pipeline reached Fairbanks, it could not have arrived at a better time. With preliminary work beginning in 1973, employment eventually increased to over 30,000 direct pipeline workers in 1976. The boom was particularly explosive in Fairbanks, as it was the transportation hub for the construction of the road to Prudhoe Bay, along with the pipeline. Fort Wainwright and Eielson Air Force Base were useful as a storage and freight terminal facility during the pipeline construction.

The effects of the pipeline were enormous, with population skyrocketing, schools operating on split shifts, and wages and rents tripling. Between January 1973 and January 1976, food stamp recipients went from over 3,000 to about 300. Nearly everyone was working on, or because of, the pipeline.

After 1976 the construction boom subsided, with the first oil production out of

Prudhoe Bay in 1977. Oil revenues gained quickly to over $2 billion in 1980; ten times what they were in 1973. Revenues exceeded $3 billion each year until the crash of 1987. After the flood of oil dollars, the federal government retained its position as the number one employer in the State of Alaska. However, the Alaska state government increased its relative share.

Oil wealth is still the primary component of the Alaska economy. State spending, particularly for education, is often the largest single source of a local community's economy (Alaska Economic Trends 1988). Initially, schools were constructed throughout the state in virtually every human settlement. State funding for the operation of schools increased from just over $250 million in 1980 to over half a billion by 1986. The State of Alaska typically leads the nation in operating expenditures, currently averaging over $7,500 per student.

Alaska abolished its income tax and has no state sales tax. The Alaska Permanent Fund was established as a savings account from the oil revenues. Each year Alaskans receive a check from a portion of the earnings on this fund. This dividend was approximately $1,300 per person in 1997. Military personnel have the same eligibility requirements as Alaskans, and may therefore receive the permanent fund dividend.

Despite the oil wealth, the military continued to exert a strong influence on the economy and provided a stabilizing influence in the oil crash of the mid 1980s (Fried and Huff 1987). The State's population grew rapidly as the oil industry took off. The military share of the Alaska population fluctuated from 15.7% in 1980 to 12.5% in 1985, and up to 13.4% in 1987.

From 1980 to 1983, the Institute for Social and Economic Research estimated that the military accounted for 15% to 17% of all jobs in Alaska. The Air Force was the largest employer, and its share of military employment in Alaska had increased to 44% by 1986, given the Army's decline in absolute numbers. The share of National Guard and Army Corps of Engineers also increased. Alaska ranked second behind Hawaii in military personnel per citizen population.

Of particular note was the change in the relative size of the civilian military work force over the 1980s. The ratio of active duty per civilian employee fell from 3.4 to 2.8, from 1980 to 1986. The civilian military work force is paid higher in general, and also lives off-base. The multiplier is higher as more goods and services are purchased directly from the local economy.

The 6th Infantry Division Light was re-activated at Fort Wainwright in 1986. This brought an increase in military personnel of 570 the next year. The full deployment was not scheduled until 1992, with an additional 3,564 soldiers and 300 civil service jobs at Fort Wainwright. The Fairbanks North Star Borough Community Research Center estimated that an additional 1,490 direct and indirect nonmilitary jobs were created from the deployment of the division. The construction phase provided between 585 and 755 jobs between 1988 and 1989.

Fort Greely was still the third largest Army post in Alaska in 1987, based on population. The military population remained steady through the 1980s. In 1987, the military accounted for nearly 2,000 people in the area; about 32% of the area's population.

Appendix 3.19.B
Socioeconomics

Military Employment and Payroll of Fort Wainwright, Fort Greely, and Eielson Air Force Base

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Fort Wainwright											
Military Personnel	3360	4100	4430	4494	4792	5003	5085	4490	4576	4585	4525
Family Members	5160	5030	5570	6356	7359	6709	6691	6301	6029	5639	5431
Civilian Employment	860	920	1030	1120	1058	1157	1277	1222	1197	1225	1257
Payroll Military	68.4	82.3	88.3	100.3	115.2	139.9	194.9	143.7	136.8	136.4	137.3
Civilian	25.5	30.7	33.1	33.5	35.0	39.5	44.2	45.6	46.0	46.7	51.3
Total	93.1	113.0	121.4	133.8	150.2	179.4	239.1	189.3	182.8	183.1	186.6
Non-Personnel Expend	101.0	140.1	103.9	115.3	91.4	89.7	103.6	126.9	146.7	112.0	101.9
Eielson Air Force Base											
Military Personnel	3460	3261	3299	3356	3465	2981	2771	2730	2741	2725	2992
Family Members	5009	4819	5088	5109	5483	4439	4284	4230	4483	4477	4441
Civilian Employment	838	783	773	908	873	908	1076	605	785	759	1014
Payroll Military	81.6	83.6	87.3	89.0	100.1	89.7	90.5	92.6	92.7	91.5	93.1
Civilian	21.6	22.5	22.4	30.1	34.9	31.5	29.6	23.3	25.5	26.0	25.8
Total	103.2	106.1	109.7	119.1	135.0	121.2	120.1	115.9	118.2	117.5	122.9
Non-Personnel Expend	61.9	64.3	58.1	70.5	53.7	95.0	61.3	60.4	67.6	95.9	71.0
Fort Greely											
Military Personnel	610	600	580	444	437	426	417	390	402	299	298
Family Members	1000	980	950	748	724	672	708	612	641	474	467
Civilian Employment	380	330	330	377	365	370	370	368	345	330	320
Payroll Military	12.8	12.8	12.4	10.7	8.8	8.2	8.7	8.7	8.0	6.9	6.9
Civilian	9.5	10.0	10.5	11.0	12.0	12.9	12.9	12.4	13.3	13.5	13.3
Total	22.3	22.8	24.6	21.7	20.8	21.1	21.6	22.1	21.3	20.4	20.2
Non-Personnel Expend	1.0	5.6	0.6	17.1	20.6	18.6	19.9	18.1	14.8	8.3	12.8

Note on information for employment/payroll data on bases: Greely data is from the annual "command information card", whereas the Wainwright/Eielson numbers do not include BLM positions or contract civilians. The Greely numbers had no BLM component and include all civilian positions. Information on additional expenditures for Greely are scant for '87-'89. Over 700 Air National Guard at Eielson appears to be left out of the FNSB Research Quarterly data.

Employment and Payroll Attributed To the military in the Fairbanks North Star Borough and Delta area.

		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Total FNSB	**Employ-ment**	25490	25471	26545	26869	27613	29122	29255	29998	30404	31360	32100
Wainwright and Eielson	**Troops**	6820	7361	7729	7850	8257	7984	7856	7220	7317	7310	7517
	Sum	32310	32832	34274	34719	35870	37106	37111	37218	37721	38670	39617
	Percent	0.237806	0.24898	0.24902	0.25321 9	0.25550	0.24070	0.241874	0.211473	0.21600	0.20987	0.216632
Total FNSB	**Payroll**	709.8	683.4	729.5	748.0	779.0	853.0	854.0	874.6	904.6	893.4	--
Wainwright and Eielson	**Soldier Pay**	150.0	165.9	175.6	189.3	215.3	229.6	285.4	236.3	229.5	227.9	230.4
	Sum	859.8	849.3	905.1	937.3	994.3	1082.6	1139.4	1110.9	1134.1	1121.3	230.4
	Percent	0.229239	0.25797	0.25533	0.26981 8	0.28683	0.27766	0.315254	0.274732	0.26540	0.26808	
	Employ-ment	0.237806	0.24898	0.24902	0.25321 9	0.25550	0.24070	0.241874	0.211473	0.21600	0.20987	--
	Payroll	0.229239	0.25797	0.25533	0.26981 8	0.28683	0.27766	0.315254	0.274732	0.26540	0.26808	--
Delta	**Employ-ment**	820	748	790	795	890	912	948	943	--	--	--
	Troops	610	600	580	444	437	426	417	390	--	--	--
	Sum	1430	1348	1370	1239	1327	1338	1365	1333	--	--	--
	Percent	0.692308	0.68991	0.66423	0.66263 1	0.60437	0.59491	0.576557	0.568642	--	--	--
	Aggre-gate Employ-ment	32920	33432	34854	35163	36307	37532	37528	37608	--	--	--

Employment and Payroll Attributed To the military in the Fairbanks North Star Borough and Delta area.

		1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	Percent	0.288821	0.29893	0.29959	0.30426 9	0.30269	0.28895	0.293008	0.260716	--	--	--

Alaska Wildlife Harvest, 1994-1995. Harvest reporting is not required for some species in some Game Management Units. GMU = Game Management Unit.

GMU	Area (mi^2)	Bison	Black Bear	Brown Bear	Caribou	Deer	Elk	Moose	Mt. Goat	Musk Ox	Sheep
1	18,500	--	137	34	--	1,755	--	96	121	--	--
2	3,620	--	237	--	--	2,824	--	--	--	--	--
3	2,970	--	217	1	--	850	--	19	--	--	--
4	5,820	--	--	118	--	10,836	--	--	52	--	--
5	5,770	--	14	28	--	5	--	69	12	--	--
6	10,140	--	205	30	--	2,687	--	149	56	--	--
7	3,520	--	86	4	28	--	--	68	80	--	4
8	5,100	--	--	177	--	10,400	85	--	42	--	--
9	33,639	--	0	25	573	--	--	236	--	--	4
10	9,680	--	--	7	77	--	--	--	--	--	--
11	12,780	0	18	6	--	--	--	36	14	--	114
12	9,980	--	34	16	--	--	--	88	--	--	195
13	23,380	--	101	102	3,579	--	--	955	2	--	172
14	6,625	--	94	10	--	--	--	723	32	--	112
15	6,630	--	170	16	--	--	--	636	68	--	33
16	4,880	--	112	50	57	--	--	243	--	--	12
17	18,770	--	13	50	--	--	--	297	--	--	0
18	41,160	--	0	6	47	--	--	87	--	25	--
19	36,490	22	7	48	--	--	--	604	--	--	116
20	50,400	38	328	44	312	--	--	1,286	--	--	95
21	43,925	--	6	13	--	--	--	658	--	--	--
22	25,230	--	--	44	--	--	--	211	--	--	--
23	43,420	--	--	33	1,130	--	--	133	--	--	28
24	26,060	--	4	16	--	--	--	155	--	--	15
25	53,120	--	1	18	175	--	--	154	--	--	137
26	79,250	--	--	36	341	--	--	84	--	7	3
Total	570,833	60	1,787	933	8,884	29,628	85	7,116	479	32	1,040

Appendix 3.19.C
Fort Wainwright Voluntary Expenditure Survey

Fort Wainwright Voluntary Expenditure Survey

Methods and Application

The following work assumes that there is a significant channel by which money moves from Fort Wainwright into the North Star Borough. This channel is defined by analyzing the yearly total personal spending by Fort Wainwright personnel and their families.

The summation of dollars spent by Fort Wainwright personnel (and their families) will determine the magnitude of Fort Wainwright's contribution to the economic well being of the North Star Borough.

To quantify the significance of Fort Wainwright to the North Star Borough's economy, a survey of Fort Wainwright personnel was taken in the summer of 1998. Two thousand (2000) voluntary surveys were distributed by unit heads (between June 24th and July 10th, 1998) upon being issued through Fort Wainwright's Public Affairs Department (FWPAD).

Survey questions pertained to purchases made in the 1997 tax year. Categories under Section I are considered those goods and services purchased frequently (i.e. on a daily, weekly, or monthly basis).

Section II purchases encompass yearly durable and other yearly expenses. Section III allows calculation of a survey respondent's total taxes paid and disposable income in interpretations of survey. Section IV may give closer insight to Fort Wainwright's economic contribution to Alaska tourism.

Multiplying the sum of a respondent's answers to "$ Off-Post" in Survey Section I (not including "Loans/Credit payments" responses *by twelve* (12) yields total yearly family expenditures on non-durable goods in the North Star Borough (**TFE_{nd}**). The summation of "$ OFF-Post" answers in Section II yields total yearly family expenditure on durable and miscellaneous goods and services (**TFE_{dm}**). "Miscellaneous goods and services" include education, health care, and recreation. The calculation of total yearly expenses in the North Star Borough by each respondent is demonstrated through Equation #1. These survey answers will be supported by comparisons with respondent-supplied tax information.

Equation #1:

$$\text{Total Yearly Expenses (per family)} = TFE_{nd} + TFE_{dm}$$

The summation of all survey respondent's Total Yearly North Star Borough Off-Post Expenditures (**TOPE**), *divided* by the number of voluntary surveys returned, will yield the average Off-Post yearly expenditure (See Equation #2) per survey respondent (**AYE_{family}**). *Multiplying* this average by current post personnel population will give a significant estimation of Fort Wainwright's dollar contribution to the North Star Borough's economy (See Equation #3).

Equation #2:

$$AYE_{family} = TOPE / \text{number of voluntary surveys received.}$$

Equation #3:

$$\$\ \text{Ft. Wainwright contributes to FBNSB} = AYE_{family} * \text{Current population of post personnel}$$

According to FWPAD, approximately 4,600 personnel were engaging in post activities on June 19, 1998. Ninety-three percent of the personnel on post at this time were randomly sampled. Seventy-eight percent of post population lie within the 172nd Brigade. 172nd Brigade received 84% of the surveys (1,678). Headquarters Company (USAG) represented 7% of post personnel and were given 7.5% of the distributed surveys (150). 4/123D AVN represented 8% of the post personnel and were given 8.6% of the distributed surveys (172). [Note: 1,678 + 172 + 150 = 2,000].

Results

This expenditure survey of Fort Wainwright personnel had 95 returned and completed surveys, yielding a 4.75% response rate. Over 2% of the post was surveyed.

The average age of respondents was twenty-nine (29). Personnel had lived an average of two (2) years in Alaska and had been enlisted in the military for eight (8) years.

Seventy percent of the respondents were married and/or had children, and approximately 35% lived Off-post.

It was found that respondents spent 69% of their disposable income in the North Star Borough. The table below provides the descriptive statistics of expenditures by personnel and their families in 1997:

Descriptive Statistics

	On-Post Expenditures	Off-Post Expenditures		
	TFE_{nd}	TFE_{dm}	TFE_{nd}	TFE_{dm}
Average	$5,278.60	$872.00	$7,027.67	$6,215.28
Minimum	$0.00	$0.00	$0.00	$0.00

	On-Post Expenditures	Off-Post Expenditures		
	TFE_{nd}	TFE_{dm}	TFE_{nd}	TFE_{dm}
Maximum	$26,620.00	$16,355.00	$41,640.00	$54,808.00
Standard Deviation	$4,784.00	$2,428.39	$9,501.20	$10,869.64

Note: OFF-Post refers to goods and services purchased by the respondent (and his or her family) in the North Star Borough.

TFE = Total Family Expenditures
nd = non-durable goods
dm = durable goods; miscellaneous goods and services

The addition of On-post TFE_{nd} and TFE_{dm} yielded average 1997 On-post purchases by individual military personnel and their families (i.e. AYE_{family}) of $6,150.60. Similarly, the addition of Off-post TFE_{nd} and TFE_{dm} yielded an average 1997 Off-post AYE_{family} of $13,242.95. Total yearly family expenditures (i.e. On and Off-post) were $19,393.55.

Multiplying average Off-post AYE_{family} by the current estimate of 4,600 personnel, Fort Wainwright personnel and their families purchased an estimated 61 million dollars worth of goods and services from the North Star Borough in 1997. An estimated $28 million was spent On-post by military families.

Respondents disclosed an average of $27,021.52 when asked to provide 1997 wage income before taxes, and an average of $2,708.21 in additional income. Since Federal, State, and property taxes averaged to equal $4,814.19 average disposal income was calculated to be $24,915.54. Subtracting disposable income by total yearly family expenditures ($19,393.55) yields a difference of $5,521.99.

The difference between the summation of On/Off-post total family expenditures and tax information may be partially explained by each respondent's auto and credit card debt payments. On average, yearly debt payments equaled $6,136.84, yielding average monthly payments of $511.40. As a result, survey questions may have overestimated total yearly family expenditures by an average of $614.85.

Thirty-five of the 95 respondents (37%) had visitors from outside of Alaska. On average, each respondent had 1.14 visitors, each staying 7.5 days.

This survey estimates Fort Wainwright to account for over 5,200 visitors (not specifically to the North Star Borough). If each visitor stayed the average number of days, more than 39,000 "visitor days" may be attributed to Fort Wainwright's personnel.

Appendix 3.19.D
Cost of Fighting Fires on Withdrawal Lands

The dollar cost of fires was provided by the Alaska Fire Service:

Cost of Fires Caused by Military Activity

Year	Yukon Training Area	Fort Greely West Training Area	Fort Greely East Training Area	Total Cost
1987	$1,370.00	$31,008.00	$2,592,007.00	$2,624,385.00
1988	$17,288.43	$25,858.33	N/F	$43,146.76
1989	$7,257.36	$25,858.33	N/F	$22,589.21
1990	$22,179.78	$98,430.93	N/F	$120,610.71
1991	$185,648.25	$14,886.43	N/F	$200,534.68
1992	$738.51	$45,331.65	N/F	$46,070.16
1993	$7,459.61	$9,595.41	$80,790.15	$97,845.17
1994	$8,876.15	$770.77	$131.30	$9,778.22
1995	N/F	$770.77	$5,680.98	$5,680.98
1996	$4,799,16	N/F	$1,748.66	$678,512.75
1997	$1,239,37	N/F	N/F	$1,239.37
1998	$1,118,14	$388.15	N/F	$1,506.29
Total	$257,974.76	$913,566.45	$2,680,358.09	$3,851,899.30
Average/Year	$23,452.25	$83,051.50	$243,668.92	$3,851,899.30

N/F = No Fire

The above figures demonstrate that the costs of fighting fires are low relative to operations. Total base and post expenditures exceed $500 million per year. So firefighting costs on the withdrawal lands themselves average less than $.0007 per dollar of total expenditure in the local economy.

BLM pays for the costs of fighting fires on military lands. The Alaska Fire Service provides those firefighting services, and is housed without charge on Fort Wainwright. It is the most efficient arrangement for fighting fires in interior Alaska. Were each land management unit to pay the cost of independent operations, expenses would be higher.

APPENDIX 3.20
Subsistence

FF-035871

COMPLIANCE WITH ANILCA
SECTION 810

Case File No: FF-035872
Date: 9/86

Evaluation and Finding

CASE DATA

APPLICANT United States Department of the Army

PROPOSED ACTION: Renewal of Land Withdrawal for the 172d Infantry Brigade (Alaska) at Fort Greely for Military Training and Cold Regions Test Center.

LOCATION: Public Domain Tract A (571,995 acres) and (attach map)

Tract F (51,590 acres). See the attached map.

SECTION 810 FINDING FOR PROPOSED ACTION

X This proposed action will not significantly restrict subsistence uses. No reasonably foreseeable and significant decrease in the abundance of harvestable resources, no reasonably foreseeable alteration in the distribution of harvestable resources, and no reasonably foreseeable limitations on harvester access will result from the proposed action.

___ A reasonably foreseeable and significant decrease in the abundance of ____________, or a significant alternation in the distribution of ____________, or significant restrictions on the access of subsistence harvestors from the village(s) of ____________ are foreseen and the Authorized Officer has concluded that a significant restriction of subsistence uses would result from implementation of this action.

- Additional Comments (optional): The withdrawal action itself is not a new withdrawal, but is a formal recognition of the existing land uses which have been in place for over 30 years. The withdrawal prevents development of the land, tends to protect wildlife habitat, and acts as a "game preserve" for some species of wildlife. Proposed legislation gives responsibility for multiple use lands and resource mangement to the Bureau of Land Management to the extent compatible with military purposes.

SOURCES

- Literative references (pps), personal contacts inventories, etc: Final EIS for Fort Greely Land Withdrawal (U.S. Army, Nov. 1980). BLM Land Report and Record of Decision, 1981.

Terry Haines, Alaska Dept. of Fish and Game, Subsistence Coordinator (Phone Conversation, 8/26/86). Jr. Kearns, U.S.Army NRS/Wildlife Biologist (Personal Contact, 8/26/86).

FF-035871
Case File No. FF-035872

Specific Points of 810 Evaluation

Provide information or data which fully addresses the points outlined below. When making an evaluation, state the reasons supporting your evaluation or provide adequate background information including specific sources which led to your conclusions. Use additional sheets of paper if needed. Do not write "irrelevant" or "not applicable" without an explanation. Cite sources of information where appropriate. Note: Appropriate specialists should sign under specific information sections or their names should be listed if they were otherwise coordinated with, such as by phone.

1. The effect of the proposed action on subsistence uses and needs:

FISHERIES

-Expected reduction, if any, in harvestable resources:
NONE.

-Expected reduction, if any, in availability of resources due to alterations in resource distribution, migration, or location.
NONE.

Signed: Joseph F. Webb   Date: 8/27/86
Joseph F. Webb, Fisheries Biologist

WILDLIFE

-Expected reduction, if any, in harvestable resources:
No direct reduction in resources is anticipated. However, indirect reduction may occur if access for trapping and hunting is further restricted due to changes in policy, regulation, enforcement or expansion of "off limits" areas.

-Expected reduction, if any, in availability of resources due to alterations in resource distribution, migration, or location.
No reduction due to alteration of wildlife distribution, migration or location is anticipated.

Signed: Bruce M. Durtsche   Date: 8/27/86
Bruce M. Durtsche, Wildlife Biologist

OTHER

Other Renewable Resources (including drinking water, wood, berries, etc.)

-Expected reduction, if any, in harvestable resources:

Reductions of these harvestable resources would be minimal and short-term.

-Expected reduction, if any, in availability of resources due to alterations in resource distribution, migration, or location.

This reduction would be minimal and/or none.

Signed: Jerry W McGee
Jerry McGee, Natural Resource Specialist

Date: 8/26/86

ACCESS

-Expected limitations, if any, in the access of subsistence users resulting from the proposed action.

NONE. Land is accessible to subsistence users under a noncost army permit designed to make users aware of unsafe or contaminated areas and military policies. Land is subject to Alaska Fish and Game Regulations (Jr. Kearns, U.S. Army NRS). No new limitations to access as land has been military for over 30 years.

Signed: Jerry W McGee
Jerry McGee, Natural Resource Specialist

Date: 8/26/86

2. The availability of other lands, if any, for the purposes sought to be achieved:

Other suitable lands are developed or selected by various interests and thus are not readily available for military purposes.

3. Other alternatives, if any, which would reduce or eliminate the use, occupancy, or disposition of Public Lands needed for subsistence purposes:

Other alternatives for military purposes were considered, including nonrenewal of the withdrawal (See EIS). The proposed renewal of the withdrawal is the preferred alternative. [No alternatives relating directly to subsistence purposes were considered. Subsistence is not mentioned in the EIS. No subsistence studies were completed, there is no mention of who, where, or when subsistence use has taken place in the withdrawal (Susan M. Will, BLM Archeologist).]

FF-035871
FF-035872

Misc. other factors relevant to subsistence 810 evaluation:

Most users of the area (other than military) are from Delta or Fairbanks North Star Borough and are classified by Alaska State Fish and Game as "urban" users. Some rural users in surrounding area of Delta are classified as subsistence users. No subsistence villages are recognized as affected. Subsistence use is low. (Source; Terry Haines, Subsistence Coordinator for Alaska Fish and Game, ph. conversation 8/26/86.)

Public hearings were held and steps to minimize adverse effects were considered. Multiple Use to the extent compatible with military use is advocated in the proposed legislation. ANILCA was passed Dec.2,1980; The US Army Final Environmental Impact Statement was signed Nov. 1980 prior to the existence of "810" subsistence review. BLM policy for subsistence "810" evaluation was not developed when the 1981 land report was written. The land report recognizes historic subsistence uses of the area prior to the 1950's. (JWM)

There is no mention of subsistence use in the EIS and insufficient information on hunting, trapping, and fishing, etc. to make an adequate "810" assessment at this time. (Source; Susan Will BLM Archeologist 9/9/86)

Prepared by: Jerry W. McGee Date: 9/30/86
Jerry McGee, Natural Resource Specialist

Reviewed by: Donald E. Runberg Date: 11-21-86
Don Runberg, Steese-White Mountains District Manager

Attachments:
- Figure 1-1 Project Location
- Figure 1-2 Land Status of Study Area
- Summary Sheet for Environmental Impact Statement US Army

COMPLIANCE WITH ANILCA

SECTION 810

Evaluation and Finding

Case File No.: F-020174

Date: 8/29/88

Instructions

Provide information or data which fully addresses the points outlined below. When making an evaluation, state the reasons supporting your evaluation or provide adequate background information which led to your conclusions. Use additional sheets of paper if needed. Do not simply use "irrelevant" or "not applicable" without an explanation.

Evaluation of Effects on Subsistence Uses and Needs

Fisheries

1. Expected reduction, if any, in harvestable resources:

No reduction in harvestable fish resources that could be used for subsistence purposes is anticipated from this action

2. Expected reduction, if any, in availability of resources due to alterations in resource distribution, migration, or location.

No alteration in fish distribution/migration that could be used for subsistence purposes is anticipated from this action

Signed: Louis H. Carufel **Date:** 8/29/88

Wildlife

1. Expected reduction, if any, in harvestable resources:

No reduction in potential harvestable subsistence is expected.

2. Expected reduction, if any, in availability of resources due to alterations in resource distribution, migration, or location.

Resource availability is expected to remain the same as a result of this action.

Signed: Winston Hobgood **Date:** 8/29/88

Other Renewable Resources (e.g., Drinking Water, Wood, Berries)

1. Expected reduction, if any, in harvestable resources:

No reduction in any harvestable resource is expected as a result of this action.

Case File No.: F-020174

2. Expected reduction, if any, in availability of resources due to alterations in resource distribution, migration, or location

This action will not alter resource distribution, migration or location, therefore there is no expected reduction

R. Everett 8/31/88

Access

3. Expected limitations, in any, in the access of subsistence users resulting from the proposed action.

No limitations or restrictions on access will occur as a result of this action.

4. Availability of other lands, if any, for the purpose sought to be achieved.

No other lands are available for this purpose. Action is administrative.

5. Other alternatives, if any, which would reduce or eliminate the use, occupancy, or dispostion of Public Lands needed for subsistence purposes.

The subject lands are not used for subsistence purposes. Proposed action is to convey to the State.

R. Everett, 8/31/88

Finding

[✓] This proposed action will not significantly restrict subsistence uses. No reasonably foreseeable and significant decrease in the abundance of harvestable resources, no reasonably foreseeable alteration in the distribution of harvestable resources, and no reasonably foreseeable limitations on harvester access will result from the proposed action.

[ ] A reasonably foreseeable and significant decrease in the abundance of ____________, or a significant alteration in the distribution of ____________, or significant restrictions on the access of subsistence harvesters from the village(s) of ____________ are foreseen and the Authorized Officer has concluded that a significant restriction of subsistence uses would result from implementation of this action.

6. Rationale and supporting statement for the finding:

No limitation, reduction in [illegible] harvestable subsistence resources through transfer. Land not used for subsistence resources.

Prepared By: Rodney J. Everett Date: 8/31/88

Reviewed By: Susan M. Mee Date: 9/01/88