Watershed Characterization for the Chena River Watershed, Alaska

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Executive Summary

This watershed characterization report includes a review of available monitoring data and watershed information that can be used to understand the potential and known impairments in the Chena River watershed. This document summarizes water quality problems in the watershed, potential pollutant sources, and future monitoring plans.

The 5,478 km^2 (2,115 mi^2) Chena River watershed is located in the Fairbanks North Star Borough (FNSB) in interior Alaska, with the city of Fairbanks located in the lower portion of the watershed. The headwaters of the Chena River begin in the White Mountains about 145 km (90 mi) east of Fairbanks and the river flows southwest to its confluence with the Tanana River in Fairbanks.

The watershed characterization focuses on three major waterbodies included on Alaska's section 303(d) list. The state of Alaska has included Noyes Slough (Alaska ID Number 40506-003), Chena Slough (Alaska ID Number 40506-002), and Chena River (Alaska ID Number 40506-007) on its section 303(d) list as water quality-limited due to various pollutants. All three waterbodies are located in the Chena River watershed, which is identified by United States Geological Survey (USGS) Hydrologic Unit Code (HUC) 19040506. Noyes Slough is listed for impairments from sediment, petroleum hydrocarbons, and oil and grease. Chena Slough and the Chena River are listed for impairments from sediment. Both Chena Slough and the Chena River were delisted for petroleum hydrocarbons and oils and grease in 2010 since both waterbodies now meet water quality standards for petroleum hydrocarbons. Table E-1 presents the section 303(d) listing information for each of the waterbodies from Alaska's *Final 2010 Integrated Water Quality Monitoring and Assessment Report* (ADEC 2010a).

Table E-1. Summary of the Section 303(d) List for Waters in the Chena River Watershed

Waterbody	Water Quality Standard	Pollutant	Pollutant Sources
Noyes Slough	Sediment, Petroleum Hydrocarbons, Oil & Grease	Sediment, Petroleum Products	Urban Runoff
Chena Slough	Sediment	Sediment	Urban Runoff
Chena River	Sediment	Sediment	Urban Runoff

Source: Alaska's Final 2010 Integrated Water Quality Monitoring and Assessment Report (July 15, 2010) (ADEC 2010a)

Nutrients have been identified as a potential threat to Chena Slough. Vegetative mats were observed growing in the pools in the Chena Slough in 1996 (Wuttig 1997). Additionally, Scharfenberg (2004) stated that eutrophication is degrading the fisheries habitat and community recreational value of Chena Slough, with nuisance algae, rooted aquatic plant growth, and excessive accumulation of organic fines. However, there are limited nutrient data available to adequately assess the threat.

In September 2010 an invasive plant, *Elodea canadensis*, was documented growing in extensive populations along Chena Slough and isolated populations in the Chena River (FSWCD 2011, Larsen et al. 2010). *Elodea canadensis* is a submersed aquatic plant that forms tangled masses and spreads easily via fragmentation (Larsen et al. 2010). *Elodea* could cause numerous negative impacts to waterbodies, including degraded fish habitat, reduction of native plant species, reduced recreational opportunities, more difficult boat travel, and alteration of freshwater habitat.

Other general water quality problems in the Chena River watershed include: "lack of quality brood production habitat for waterfowl and limited spring and fall migratory bird habitat in and around the Fairbanks/North Pole area and project lands of the Chena River Lakes Flood Control Project; degraded aquatic habitat on streams in the Little Chena River watershed due to mining; and degraded arctic grayling and other fisheries' habitat on Noyes and Chena Sloughs" (USACE 1997). Sloughs in the

Fairbanks area are important to the Arctic grayling's (*Thymallus arcticus*) spawning and rearing habitat (Ihlenfeldt 2006). Arctic grayling are an important species for sport fishing in Interior Alaska. Because of the increase in urbanization and development along the sloughs, degradation of fish spawning and rearing habitat has occurred. Chena Slough (between Chena River and Nordale Road crossing) and Noyes Slough are listed in the *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes* as they support Chinook (*Oncorhynchus tshawytscha*) and chum (*O. keta*) salmon spawning and rearing (Ihlenfeldt 2006). USACE (1997) also states that several tributaries of the Little Chena River, the largest tributary to the Chena River, have been or are currently being mined for gold. The main stem of the Little Chena River and the tributaries that have not been mined are basically pristine.

Although the watershed characterization focuses on the section 303(d) listed waters, all available water quality data (including non-listed waters) were reviewed to identify any additional water quality issues in the Chena River watershed (ADEC 1994, 2005a, 2005b, 2007a, 2007b; Douglas 2008; Kennedy et al. 2004; NSAC 2000a, 2000b; Oasis 2008; Parsons 2006; Scharfenberg 2004; USGS (1990-2003); Water Watch 1992 and 1993; Wuttig 1997). Additional water quality data (pH, water temperature, conductivity, total dissolved solids, dissolved oxygen (DO), ortho-phosphate, nitrate-nitrogen, and coliform bacteria) were collected by the Tanana Valley Watershed Association (TVWA) from 2007 through 2010; however sampling locations were not available at the time this report was completed, therefore, the data were not included.

All available water quality data were compared to Alaska's Water Quality Standards (WQS) (18 AAC 70.020) to evaluate current water quality conditions. Title 18, Chapter 70 of the Alaska Administrative Code (AAC) establishes water quality standards for the waters of Alaska, including the designated uses to be protected and the water quality criteria necessary to protect the uses. For evaluation in this watershed characterization, if the Alaska WQS did not contain numeric criteria for particular pollutants, the National Recommended Water Quality Criteria (NRWQC) (USEPA 2009) were used.

Alaska's WQS (18 AAC 70.020) indicate that the designated uses for fresh waters of the state include (1) water supply, (2) water recreation, and (3) growth and propagation of fish, shellfish, other aquatic life, and wildlife, and are applicable to all fresh waters, unless specifically exempted. According to Alaska's WQS (18 AAC 70.230) the Chena River from the confluence of the Chena River and Chena Slough to the confluence of the Chena River and Tanana River is exempt from meeting the drinking water designated use subclass. The water quality criteria were applied according to the specific designated uses. Initial data analysis was performed using historical data. Since the initial data analysis, DEC collected additional data throughout the watershed in 2009 that will be used along with data collected in 2011 and 2012 to support the findings of the historical analyses.

While it is possible that sediment is posing a threat to or impairing Noyes Slough, Chena Slough, and the Chena River, it is difficult to determine based on available data. DEC collected additional data throughout the watershed in 2009 that will be used along with 2011 and 2012 data to determine whether Noyes Slough, Chena Slough and the Chena River are still impaired and require TMDLs for sediment or support designated uses and can be delisted.

Alaska's water quality criteria for oil and grease are narrative, stating that pollutants may not cause a visible sheen upon the surface of the water. Visible sheens were noted on Noyes Slough, the Chena Slough and the Chena River in 2005, 2007 and 2009 sampling efforts. Field observations during the 2009 sampling noted that sheens were observed but were likely caused by decomposing organic material on the Chena Slough and Chena River (ADEC 2010b). The sheen was observed both above and within the urban area and did not have an odor or the typical characteristics found with hydrocarbon sheens. Therefore, Chena Slough and the Chena River have been delisted for oil and grease impairments (ADEC 2010a). Additionally, analysis of the petroleum hydrocarbon data does not show exceedances of the TAH and

TAqH water quality criteria for any of the three waterbodies. However, some observed sheens on Noyes Slough did have petroleum characteristics. DEC completed, and EPA approved, a TMDL for the sheen component of the petroleum hydrocarbons, oil and grease standard in November 2011 (ADEC 2011a).

Low dissolved oxygen (DO) and high temperature data (Kennedy et al. 2004) indicate that eutrophication might be an issue in Noyes Slough. There are 10 total phosphorus observations and no total nitrogen or chlorophyll *a* data available for the Chena River. Alaska does not have nutrient criteria for comparison to the nutrient data. Additional data for nutrient-related parameters would be helpful in determining impairment and identifying potential sources in all three waterbodies (see Section 6).

Data also included some elevated concentrations of metals in the watershed. One of two copper observations exceeds the copper water quality criterion in Noyes Slough and three of four iron observations are exceeding the water quality criterion. There are also exceedances of the manganese water quality criteria in Chena Slough and Beaver Springs. Because there are limited data, the collection of additional metals data are recommended to confirm any impairment and determine the extent of the impairment and potential sources (see Section 6).

Based on the data analysis, fecal coliform bacteria may also threaten Chena Slough. There are some exceedances of the fecal coliform bacteria criterion; however, there are few observations, so continued monitoring is recommended to determine impairment and potential sources, including wildlife contributions (see Section 6).

Potential pollutant sources in the watershed include both point and nonpoint sources. Point sources include 29 National Pollutant Discharge Elimination System (NPDES) facilities, 14 active placer mines, stormwater runoff, and more than 200 contaminated sites (both active and closed). Potential nonpoint sources include urban runoff, backwater areas upstream of road crossings with undersized, partially blocked, or perched culverts, and failing septic systems (Scharfenberg 2004). Streambank erosion is also a potential problem for the Chena River watershed (USACE 1997). DEC's 2007 water quality sampling effort noted large pieces of scrap metal, such as car bodies, being used by homeowners as riprap along the river banks. Noyes Slough is also plagued by low flows much of the time (see Section 2.2). These low flows and stagnant water are partially caused by debris in the stream as well as beaver dams (USACE 1997) and can cause nutrients and sediment to gather in ponded areas. A Total Maximum Daily Load (TMDL) for residues (in the form of debris) was completed for Noyes Slough and approved by the Environmental Protection Agency (EPA) in 2008.

This watershed characterization report serves to summarize existing data and known impairments and threats to water quality in the Chena River watershed. The information can be used to support subsequent decisions or actions in the watershed. Table E-2 presents the status of existing and potential impairments in the watershed to be addressed or confirmed through additional monitoring, development of TMDLs or 4b demonstrations.

Table E-2. Status of Observed and Potential Impairments in the Watershed

Parameter of Concern	Decisions or Data Needs	Waterbody of Concern		
		Noyes Slough	Chena Slough	Chena River
Currently Listed Impairments				
Sediment	• Determine whether waterbody is impaired by sediment. • If impaired, identify an appropriate water quality target based on the WQS. Either develop a TMDL or 4b demonstration	X	X	X
Petroleum Hydrocarbons	• DEC completed, and EPA approved, a TMDL for the sheen component of the petroleum hydrocarbons, oil and grease standard in November 2011 (ADEC 2011a).	X		
Oil & Grease	• DEC completed, and EPA approved, a TMDL for the sheen component of the petroleum hydrocarbons, oil and grease standard in November 2011 (ADEC 2011a).	X		
Potential Impairments				
Nutrients	• Determine whether waterbody is impaired by nutrients or eutrophication related impacts. • Identify background levels of nutrients.	X	X	X
pH	• Determine whether waterbody is impaired by pH. • Identify potential causes of pH impairment.	X	X	X
Dissolved Oxygen (DO)	• Determine whether waterbody is impaired by low DO levels. • Identify potential causes of low DO.	X	X	X
Temperature	• Determine whether waterbody is impaired by high water temperatures. • Identify potential sources of high water temperature.	X	X	X
Metals	• Determine whether waterbody is impaired by metals parameters. • Identify potential sources of metals. • Identify background levels of metals.	X	X	X
Fecal Coliform Bacteria	• Determine whether waterbody is impaired by fecal coliform bacteria. • Identify potential sources of bacteria.		X	X
Non-pollutant Impairments				
Flow	• Restore natural flow to Noyes Slough • Noyes Slough has been designated as a Brownfield by EPA • The long-term goals for the slough are to increase the occurrence of free-flowing water each year by the removal of beaver dams and accumulated sediment, as well as to improve fish and wildlife habitat and year-round community recreational use	X		
Aquatic habitat	• Removal of invasive aquatic plant species (*Elodea canadensis*) • A steering committee and action committees have been formed to address the growth of *Elodea* through education, survey, control, research, and funding.		X	

1. Introduction

This watershed characterization report was developed for the Chena River watershed in the Fairbanks North Star Borough in interior Alaska. The watershed characterization report includes a review of available monitoring data and watershed information to understand the potential and known impairments in the watershed. This data review and watershed characterization also supports the identification of potential sources and ongoing or potential management strategies.

The characterization focuses on three major waterbodies that are included on Alaska's section 303(d) list. The state of Alaska has included Noyes Slough (Alaska ID Number 40506-003), Chena Slough (Alaska ID Number 40506-002), and the Chena River (Alaska ID Number 40506-007) on its section 303(d) list as water quality-limited due to various pollutants. All three waterbodies are located in the Chena River watershed, which is identified by United States Geological Survey (USGS) Hydrologic Unit Code (HUC) 19040506. Noyes Slough, Chena Slough, and Chena River are currently classified as Category 5 waterbodies. A Category 5 waterbody constitutes the Clean Water Act section 303(d) list of waters impaired by a pollutant(s) for which one or more TMDLs are needed.

Noyes Slough and Chena Slough have been included on Alaska's section 303(d) list since 1994. Noyes Slough and Chena Slough are listed for impairment from sediment. The Chena River has been on the section 303(d) list since 1990 as impaired by sediment. A Total Maximum Daily Load (TMDL) for residues (in the form of debris) was completed for Noyes Slough and approved by the Environmental Protection Agency (EPA) in 2008. DEC completed, and EPA approved, a TMDL for the sheen component of the petroleum hydrocarbons, oil and grease standard in November 2011 (ADEC 2011a). The Chena Slough and Chena River were delisted for petroleum hydrocarbons, oil and grease in 2010 since both waterbodies now meet water quality standards for petroleum hydrocarbons. Table 1-1 presents a more detailed description of the section 303(d) listing information for each of the waterbodies from Alaska's *Final 2010 Integrated Water Quality Monitoring and Assessment Report* (ADEC 2010a).

Nutrients have also been identified by Alaska Department of Environmental Conservation (DEC) as a potential threat to Chena Slough. Vegetative mats were observed growing in the pools in the Chena Slough in 1996 (Wuttig 1997). Additionally, Scharfenberg (2004) stated that eutrophication is degrading the fisheries habitat and community recreational value of Chena Slough, with nuisance algae, rooted aquatic plant growth, and excessive accumulation of organic fines. However, there are limited nutrient data available to adequately assess the threat.

In September 2010 an invasive plant, *Elodea canadensis*, was documented growing in extensive populations along Chena Slough and isolated populations in the Chena River (FSWCD 2011, Larsen et al. 2010). *Elodea canadensis* is a submersed aquatic plant that forms tangled masses and spreads easily via fragmentation (Larsen et al. 2010). *Elodea* could cause numerous negative impacts to waterbodies, including degraded fish habitat, reduction of native plant species, reduced recreational opportunities, more difficult boat travel, and alteration of freshwater habitat.

Other general water quality problems in the Chena River watershed include: "lack of quality brood production habitat for waterfowl and limited spring and fall migratory bird habitat in and around the Fairbanks/North Pole area and project lands of the Chena River Lakes Flood Control Project; degraded aquatic habitat on streams in the Little Chena River watershed due to mining; and degraded arctic grayling and other fisheries' habitat on Noyes and Chena Sloughs" (USACE 1997). Sloughs in the Fairbanks area are important to the Arctic grayling's (*Thymallus arcticus*) spawning and rearing habitat (Ihlenfeldt 2006). Arctic grayling are an important species for sport fishing in Interior Alaska. Because of the increase in urbanization and development along the sloughs, degradation of fish spawning and rearing habitat has occurred. Chena Slough (between Chena River and Nordale Road crossing) and Noyes Slough are listed in the *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes* as they support Chinook (*Oncorhynchus tshawytscha*) and chum (*O. keta*) salmon spawning and rearing (Ihlenfeldt 2006).

USACE (1997) also states that several tributaries of the Little Chena River, the largest tributary to the Chena River, have been or are currently being mined for gold. The main stem of the Little Chena River and the tributaries that have not been mined are basically pristine.

The watershed characterization focuses mainly on the lower Chena River watershed (below Moose Creek Dam) because of the limited water quality data above the dam and because of the belief that the watershed above the dam is fairly pristine (USACE 1997). Note that the watershed characterization focuses on the section 303(d) listed waters, but all available water quality data (including non-listed waters) were reviewed to identify any additional water quality issues in the Chena River watershed. This document summarizes water quality problems in the watershed as well as future monitoring plans.

Table 1-1. Summary of the 2010 Section 303(d) List for Waters in the Chena River Watershed

Waterbody	Water Quality Standard	Pollutant	Pollutant Sources	Details
Noyes Slough	Sediment, Petroleum Hydrocarbons, Oil & Grease	Sediment, Petroleum Products	Urban Runoff	Noyes Slough has been on the Section 303(d) list for non-attainment of the sediment, petroleum hydrocarbons and oils and grease, and residues standards for sediment, petroleum products, and debris since 1994. Numerous water quality violations have been reported. These violations are a result of debris dumped into the slough. DEC completed a debris assessment in 2007. Data from the assessment were used to complete a TMDL for residues in 2008. Water quality data collected in 2005, 2007, and 2009 determined a TMDL was necessary for the petroleum hydrocarbon, oil and grease impairments. A TMDL was completed by DEC and approved by EPA in November 2011. Data are being reviewed for the sediment standard impairment.
Chena Slough	Sediment	Sediment	Urban Runoff	Chena Slough was Section 303(d) listed in 1994 for non-attainment of the petroleum hydrocarbons and oils and grease and of sediment standards. Information presented in the 1994 Statewide Water Quality Assessment survey indicated that a petroleum problem existed and is affecting water quality. File assessment information indicates nonpoint source problems result from the surface water runoff, road construction, site clearing, and dewatering activities from gravel operations. Based on best professional judgment of DEC staff, this water was listed for petroleum products. DEC conducted water quality testing in 2005, 2007, and 2009. Data have shown that the Chena Slough met WQS for the petroleum hydrocarbon standard. Data are currently being reviewed for the sediment standard and Chena Slough remains Section 303(d) listed for sediment.
Chena River	Sediment	Sediment	Urban Runoff	Chena River was Section 303(d) listed in 1990 for turbidity, petroleum hydrocarbons and oils and grease and for sediment. The identified pollutant source is urban runoff. DEC conducted sampling in 2005, 2007, and 2009 for hydrocarbons and sediment. Data have shown that the Chena River met WQS for the petroleum hydrocarbon standard. Data are currently being reviewed for the sediment standard, and Chena River remains Section 303(d) listed for sediment.

Source: Alaska’s Final 2010 Integrated Water Quality Monitoring and Assessment Report (July 15, 2010) (ADEC 2010a)

2. Watershed Description[1]

The following sections provide general background information for the Chena River watershed.

2.1. Location

The Chena River is a tributary of the Tanana River and is located in interior Alaska entirely within the Fairbanks North Star Borough (Figure 2-1). The city of Fairbanks, which is Alaska's second largest city, is located in the lower portion of the Chena River watershed. The headwaters of the Chena River begin in the White Mountains about 145 km (90 mi) east of Fairbanks. The river flows southwest to its confluence with the Tanana River in Fairbanks. The maximum length of the watershed is 161 km (100 mi) and the maximum width is 64.5 km (40 miles). The Chena River drains an area of approximately 5,478 km^2 (2,115 mi^2).

Chena Slough (aka Badger Slough) begins at the city of North Pole and flows for approximately 27 km (17 mi) northwest through the town of North Pole, residential areas, and a park until it empties into the Chena River, 8 km (5 mi) east of Fairbanks. The Chena Slough watershed encompasses approximately 68 km^2 (26 mi^2). Beaver Springs is a tributary to Chena Slough that also flows through the city of North Pole.

Noyes Slough, located in the city of Fairbanks, is 5.5 miles long and is a side branch to the Chena River. Noyes Slough branches off to the north from the Chena River and returns to the north bank of the Chena River upstream of the confluence of the Chena River with the larger Tanana River. The slough is often stagnant in the summer and is used during the winter months for dog mushing, skiing, and dog walking. Noyes Slough and its adjacent wetlands provide habitat for beavers, muskrat, and waterfowl and spawning grounds for grayling and other fish (Kennedy et al. 2004). Noyes Slough is also an officially designated Borough canoe trail and serves as a "living laboratory" where local elementary students observe local wildlife and learn about the value of clean waterways and the effects of urban pollution (Kennedy et al. 2004).

The Little Chena River is the largest tributary to the Chena River and flows into the river below Moose Creek Dam. The Little Chena River originates in the mountains and flows south until it enters the Chena River approximately 11 km (7 mi) upstream of the city of Fairbanks. The Little Chena River watershed encompasses 1,062 km^2 (410 mi^2).

[1] Note that the information presented in Section 2 was summarized from the *Chena River Watershed Study Reconnaissance Report* (USACE 1997) unless otherwise noted.

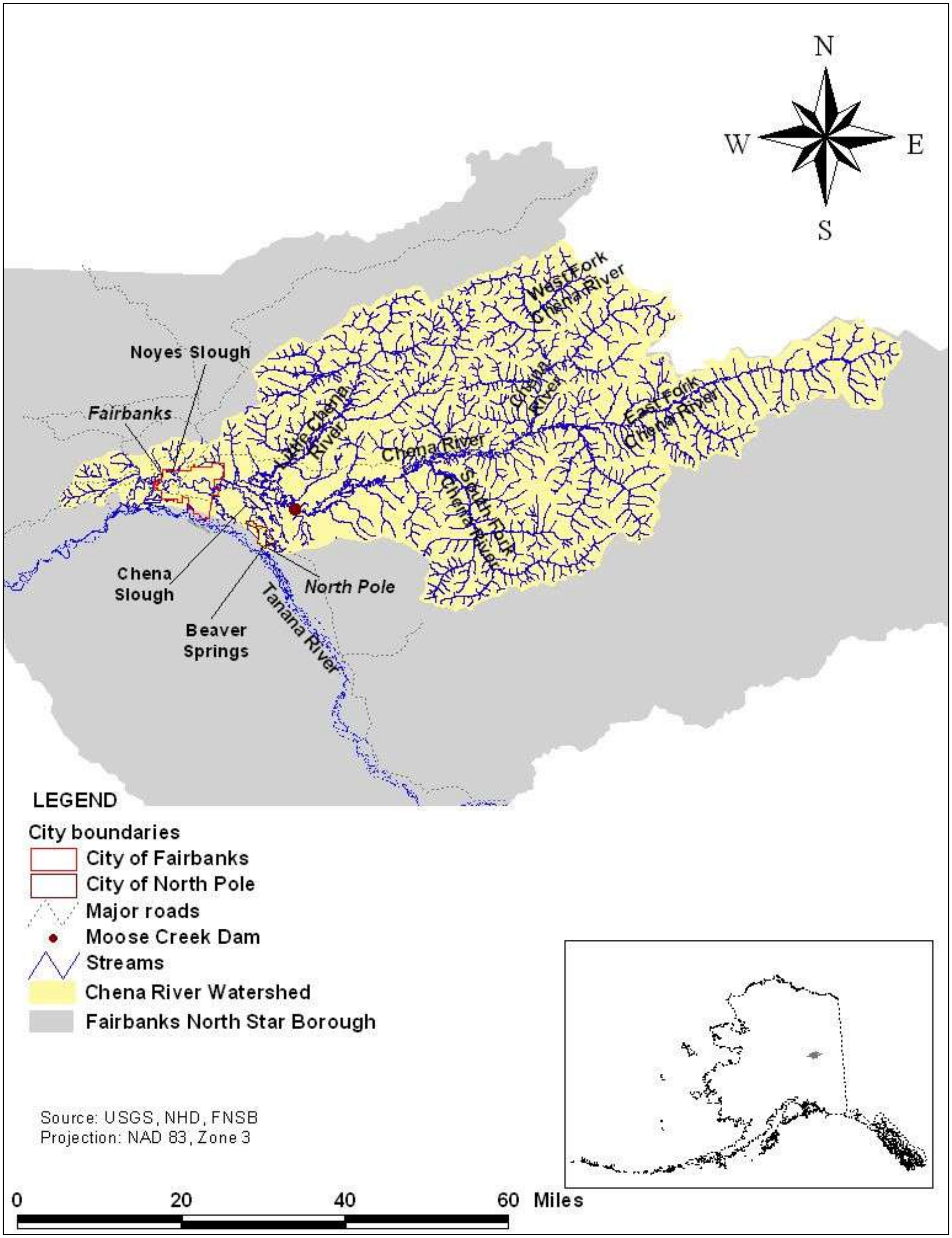

Figure 2-1. Location of the Chena River watershed.

2.2. Hydrology

The Chena River begins in the mountains and flows to the lowlands of the watershed, which are a mosaic of wetlands and braided sloughs at the mouth of the river near Fairbanks. Sources of water in the Chena River watershed are precipitation, upstream flows, and groundwater (from unconfined aquifers). Chena River flow at Fairbanks ranges from 2.83 to 2,107 cubic meters per second (m^3/s) (100 to 74,400 cubic feet per second [cfs]), with an average flow of 38 m^3/s (1,344 cfs) (USACE 1997). High flows occur in the summer months (May through September) and low flows tend to occur in the winter months (November through April). Ice forms on the river in October and breaks up in April and May. The highest flows usually occur in May following spring rains and snow and ice-melt.

Prior to 1945, both the Chena River and the Tanana River contributed water to Chena Slough, which is now the lower Chena River through Fairbanks (Burrows et al. 2000 and Kennedy et al. 2004). Flow in the Chena River watershed has been altered over the past 50 years because of flood-control structures on the Chena and Tanana Rivers. Moose Creek Dike was built across Chena Slough in 1945, blocking flow from the Tanana River. The 1967 flood on the Chena River resulted in the construction of a diversion dam (Moose Creek Dam), a floodway leading to the Tanana River, and a levee along the north bank of the Tanana River to avoid potentially severe flooding in Fairbanks. Peak flows in the Chena River were reduced further in 1980 after the completion of the Chena River Lakes Flood Control Project, which was designed to limit Chena River flow through Fairbanks to 12,000 cfs (Burrows et al. 2000 and Kennedy et al. 2004). The Moose Creek Dam is located approximately 17 miles east of Fairbanks and divides the Chena River into an upper and lower reach. The construction of the dam resulted in blocking many sloughs and side channels of the Tanana River. These waterbodies were once fed by Tanana River flows, but are now fed mainly by groundwater.

The Chena River Lakes Flood Control Project is operated only for flood control and does not permanently hold water upstream of the Moose Creek Dam. The Tanana-Kuskokwim Lowland below the dam is composed of pervious gravels, sands, and silts that let groundwater flow relatively freely. Chena River volumes can vary widely depending on the amount of flow into or out of the groundwater supply. Groundwater is considered to be an important element of the local hydrologic condition and flood control operations in the watershed take groundwater conditions into account. To avoid expanses of standing water within the area downstream of Moose Creek Dam, a network of seepage collector channels has been installed to collect the water moving through the foundation gravels and route it to the Chena River.

Flow in Chena Slough and Noyes Slough has declined over the past 50 years because of construction of the Moose Creek dike and dam. The streamflow in Chena Slough is less than 100 cfs and mainly comes from groundwater (Scharfenberg 2004) as well as local runoff from disturbed areas such as roads and drainage ditches.

The reduction in peak flows in the Chena River likely resulted in reduced flows in Noyes Slough (Burrows et al. 2000 and Kennedy et al. 2004). These flow-reduction measures have also caused down-cutting (lowering) of the Chena River channel bed at the entrance to Noyes Slough, reducing the magnitude and duration of surface water flow from Chena River to the slough. Consequently, Noyes Slough is slowly drying up and flows will likely continue to decline without intervention to reverse the process.

Typically, Noyes Slough is navigable except during low flows. Low flows correspond with the driest parts of the year, mid-summer and early fall. During very dry periods there is standing water in the slough, but there is little to no flow. Many reaches of the slough are stagnant and unsightly due to the presence of debris. At times of no surface water flow from the Chena River into Noyes Slough, pools of water in the deeper parts of the slough correspond to local groundwater levels, indicating input from groundwater. In winter, no water flows in the slough, and the channel is filled with ice and snow (Burrows et al. 2000 and Kennedy et al. 2004).

2.3. Climate/Precipitation

The Chena River watershed is in a subarctic climate and much of the watershed is underlain with discontinuous permafrost. Winter temperatures in interior Alaska are typically 1 °F or less with extremes to -65 °F. Summer temperatures range from 59 °F to 64 °F, with extremes to 99 °F. Average annual precipitation is 10.4 inches with maximum precipitation occurring in July and August. Average snowfall is 66 inches. The extreme sun angle present at interior Alaska's latitude causes southern slopes to be drought-prone, while northern slopes are wet, cold, and subject to permafrost. Daily sunlight varies from less than 3.5 hours in winter to more than 20 hours in summer.

Fairbanks in particular is typified by warm, moist summers and cold, dry winters. Mean minimum January temperature is -19°F, and mean maximum July temperature is 72°F (Burrows et al. 2000). On average, Fairbanks receives about 70 inches of snowfall annually. Mean annual precipitation at Fairbanks International Airport is 11 inches (Burrows et al. 2000).

2.4. Topography

The northern half of the Chena River watershed contains mountains ranging in altitude from 1,219 to 1,829 meters (4,000 to 6,000 feet). These mountains separate the Tanana and Yukon River watersheds. The uplands surrounding the Chena River watershed consist of elongated, well-rounded ridges about 609 to 914 meters (2,000 to 3,000 feet) above sea level. The Chena River originates at an altitude of 1,120 meters (3,675 feet) and flows for 250 km (155 miles), where it joins the Tanana River at an altitude of 131 meters (430 feet).

The topography of the Noyes Slough and Chena Slough immediate drainage areas has very little variation. The area of Noyes Slough is located at 430 feet above sea level while Chena River at the inlet and outlet of the slough is located at 420 feet. There is only a 16-foot elevation difference between the headwaters of Chena Slough and its confluence with the Chena River.

The Little Chena River watershed consists of rounded, even-topped ridges with gentle slopes of 10 to 30 percent. The valley bottoms are flat to moderately sloped, at less than 5 percent.

2.5. Geology

Precambrian Birch Creek Schist (>600 million years old) is the oldest exposed rock in the Chena River watershed. Quartzite schist and quartz mica schist are the most common schists found in the Fairbanks area. Many small masses of igneous rock occur beneath the unconsolidated deposits of the creek valleys. Tertiary volcanics and sediments that are 70 to 3 million years old are exposed in some areas. The sediments indicate a marine or estuarine embayment once covered most of the watershed.

2.6. Soils

Unconsolidated sediments are common in the watershed. The underlying rock only crops out in the higher hills and on steep slopes of the lower hills. The soils in the Chena River watershed are dominated by silt. The uplands are covered by windblown silts that originated from glacial outwash and silts in the lowlands are water-laid sediments derived from glaciers or washed down from hillsides. Discontinuous permafrost underlies much of interior Alaska. Table 2-1 presents the soil types found in the Chena River watershed.

Table 2-1. Soil Types Found in the Chena River Watershed

Soil type	Description
Fairbanks Loess	A massive homogenous, unconsolidated Aeolian silt unit; contains <10 % clay. Very dusty and not suitable for construction purposes. Drainage is moderately good. Depth to bedrock may only be 1 meter (3 feet) in some areas.
Perennially Frozen Silt	Undifferentiated silt retransported from loess-covered uplands compositionally resembles loess except for the presence of organic materials such as beds, lenses, and disseminated flecks. Large masses of ground-ice are present. Due to underlying permafrost, this is impermeable, and in the summer the surface is boggy and locally dotted with lakes. A second type of perennially frozen silt consists of silts in coalescent alluvial fan deposits that mantle alluvial sands and gravel. Organic matter content is low, and larger masses of ground-ice are absent.
Flood Plain Alluvium	Consists of well-stratified layers and lenses of unconsolidated silt, sand, and gravel. Metamorphic rocks, including gneiss, quartzite, slate, and schist are the most common. This unit is subject to permafrost conditions; however, no large patches of ground-ice are present.
Swale and Slough Deposits	These deposits consist of poorly stratified layers and lenses of well-sorted stream-laid silt and sandy silt. This material accumulates in former stream channels, and marshy or boggy conditions prevail throughout the summer.

Source: USACE (1997)

2.7. Vegetation

The vegetation of interior Alaska consists of forest, grassland, shrubs, bog, and tundra. Extreme cold and the short growing season are the dominant environmental factors that dictate which types of vegetation are present. The vegetation of the north-facing slopes is quite different from the south-facing slopes because of the climate and low angle of the sun. The low angle of the sun causes the south-facing slopes to be drought-prone, while the northern slopes are wet, cold, and subject to permafrost. Permafrost is also a dominant factor in the distribution of vegetation types in the watershed.

White spruce (*Picea glauca*) is the dominant tree species on south-facing slopes. White spruce and balsam poplar (*Populus balsamifera*) are the dominant trees on recently formed river alluvium where there is no permafrost. Black spruce (*Picea mariana*) dominates the poorly-drained north-facing slopes and sites underlain with permafrost. These areas are mostly wetlands. Deciduous trees including birch and aspen are common in disturbed, warm, or geologically young sites.

Alpine tundra (i.e., cold climate landscape without trees) is found in the higher hills of the Chena River watershed above the tree line. The tundra vegetation is characterized by short-stemmed perennial herbaceous plants, stunted or prostrate shrubs, lichens, and mosses.

2.8. Land Use

According to the Fairbanks North Star Borough's (FNSB's) zoning districts (18.08.010), land in the upper Chena River watershed above Moose Creek Dam consists entirely of General Use, with a few agricultural areas closer in to the city of Fairbanks. The lower portion of the watershed is a mix of residential, commercial, industrial, and rural uses. The western portion of the city of Fairbanks is dominated by residential, commercial, and industrial uses while the eastern portion of the city is dominated by the Fort Wainwright Military Base. Land north of the city is dominated by rural and agricultural uses. Table 2-2 presents the percent coverage of each zoning district in the watershed and Figures 2-2 and 2-3 present maps of the zoning districts. Note that Figure 2-2 shows the entire watershed, while Figure 2-3 focuses on the lower Chena River watershed since there is more variation in land use near Fairbanks than in other portions of the watershed.

Table 2-2. Percent Land Cover or Zoning Type in the Chena River Watershed

Land Use	Percent Cover (%)
Central business district	0.012
General Commercial	0.098
General Use (this includes reserve area, open space natural area, remote settlement area, rural settlement area, and preferred forest land*)	93.632
Heavy Industrial	0.171
Light commercial	0.004
Light industrial	0.392
Mineral lands	2.006
Multiple-family residential	0.128
Multiple-family residential/professional	0.027
Outdoor recreational	0.147
Rural and agricultural	1.411
Rural estate	0.981
Rural farmstead	0.012
Rural residential	0.760
Single-family residential	0.059
Two-family residential	0.160
Unclassified	0.001
TOTAL	**100**

*Source: FNSB Comprehensive Plan

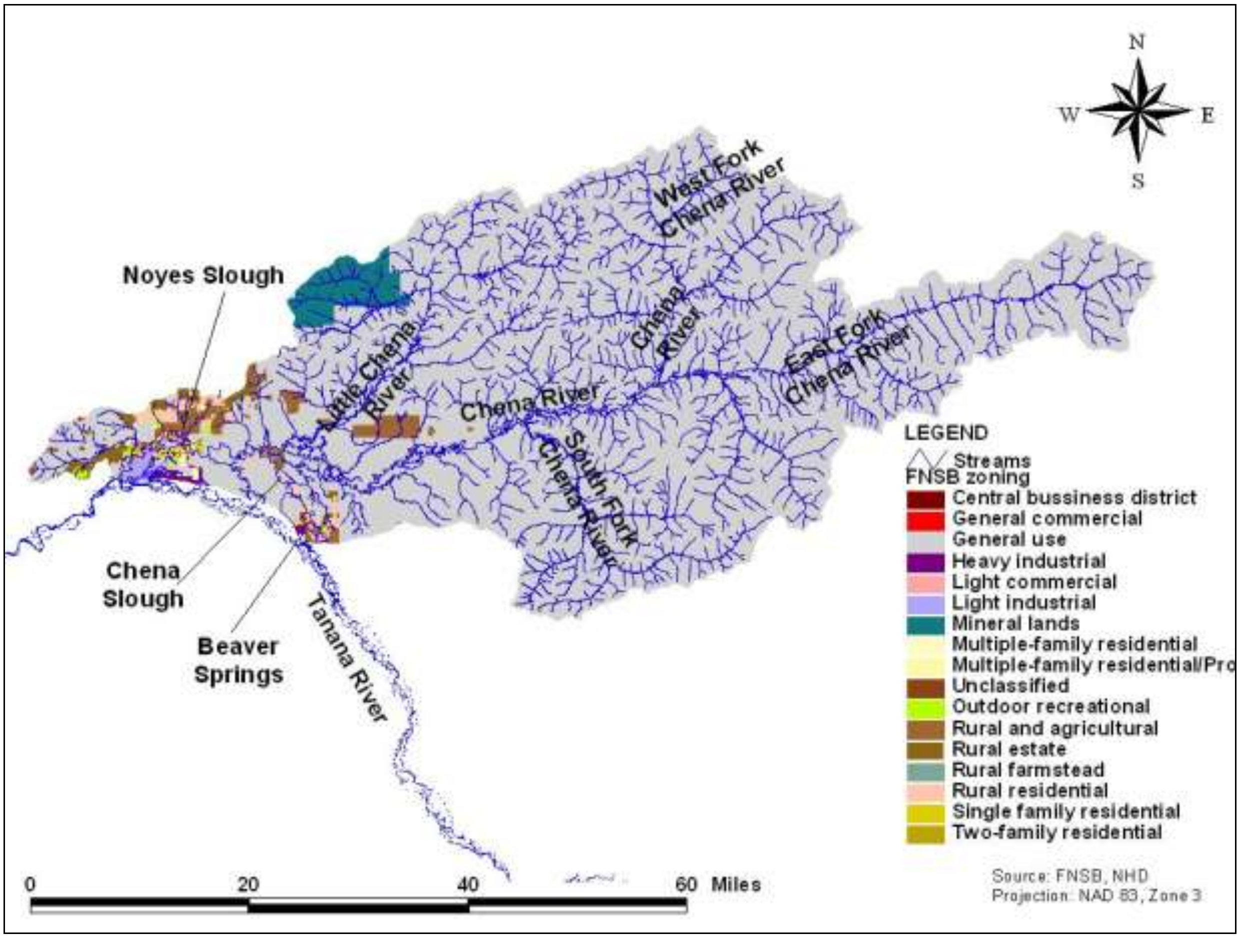

Figure 2-2. Land use zoning districts in the Chena River watershed.

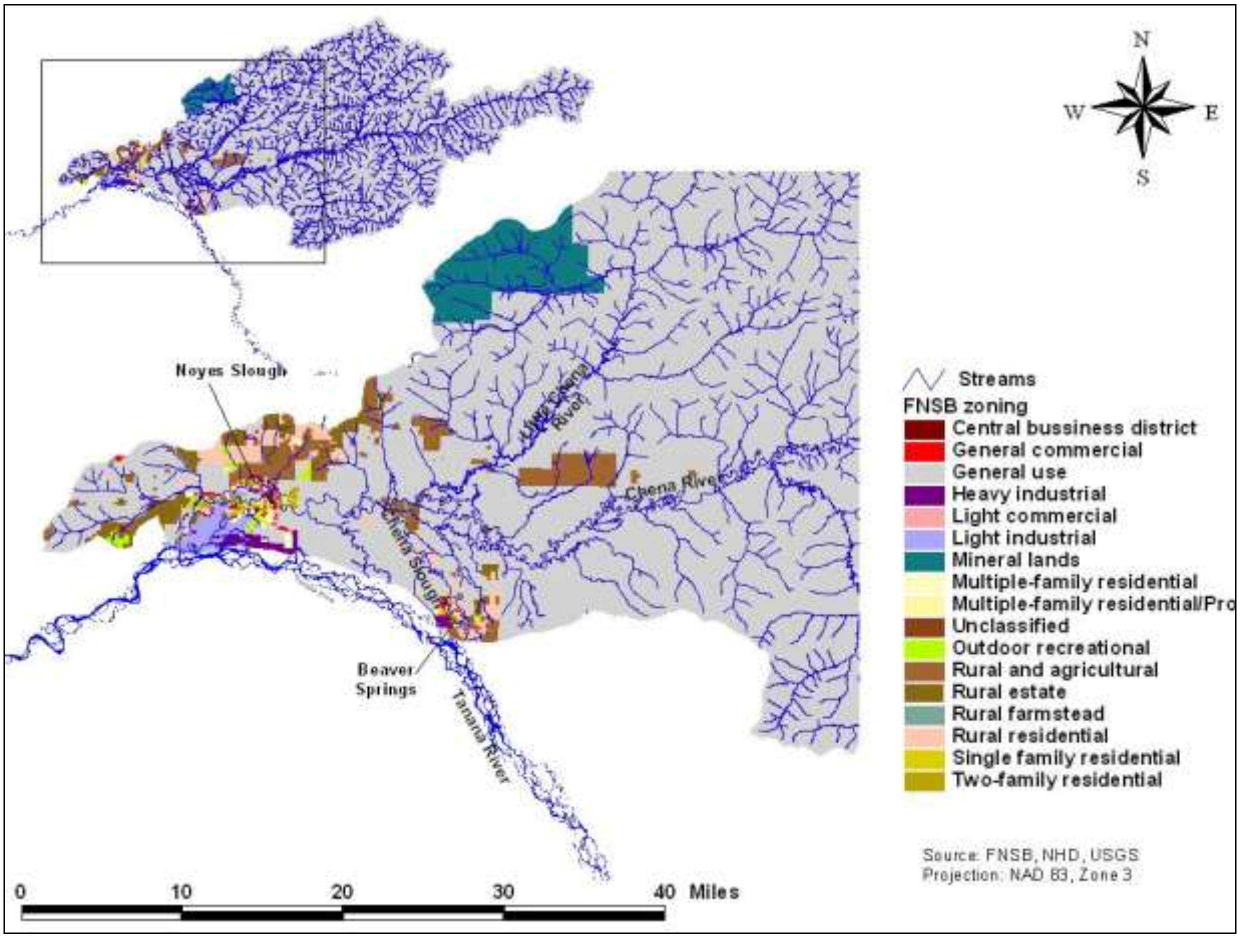

Figure 2-3. Land use zoning districts in the lower Chena River watershed.

2.9. Wildlife

The main mammals found in the Chena River watershed include moose, black bear, brown bear, and beaver. Black bears, which are the most common bear species found in the Chena River watershed, are often sighted at the Moose Creek Dam and Chena Lake Recreation Area as well as throughout the upper Chena River watershed. Brown bears (a.k.a. grizzlies) are also found in the less-populated areas of the watershed.

Beavers along the main stem of the Chena River burrow into the streambanks because the ample amount of water makes damming unnecessary. However, beavers do build dams in other parts of the watershed. Beaver dams often block Noyes Slough and Chena Slough making it difficult for migrating fish, such as arctic grayling, to use the sloughs for spawning and rearing habitat. Scharfenberg (2004) states that Chena Slough and the adjacent wetlands provide critical spawning habitat for grayling and other fish. Beaver dams have also blocked stream culverts in the watershed, causing water to back up and flood nearby property.

There are approximately 70 species of songbirds found in the Chena River watershed including birds of the passerine, kingfisher, nighthawk, and woodpecker orders. There are about 19 species of raptors including various species of hawks, owls, and kestrel. Upland game birds include spruce, ruffed and sharp-tailed grouse, and rock and willow ptarmigan. Waterfowl in the watershed include ducks, geese, and swans. Marsh and shorebirds are present in the watershed during breeding season. These birds include coots, cranes, plovers, sandpipers, and phalaropes.

2.10.Fish Populations

The main fish species of the Chena River watershed include Chinook salmon (*Oncorhynchus tsawytscha*), chum salmon (*Oncorhynchus keta*), and the arctic grayling (*Thymallus arcticus*). Other fish species in the Chena River watershed include longnose sucker (*Catostomus catostomus*), northern pike (*Esox luscious linnaeus*), whitefish, sheefish (*Stendous leucichthys nelma*), burbot (*Lota lota*), arctic lamprey (*Lampetra japonica*), slimy sculpin (*Cottus cognatus*), and lake chub (Couesius plumbeus) (Ihlenfeldt 2006).

A study done by Kennedy et al. (2004) provides fish information specifically for Noyes Slough. Kennedy et al. (2004) document data collected by the U.S. Geological Survey (USGS) in 2001 to assess fish habitat in Noyes Slough. The data collection included the number and type of fish found in the slough. Alaska blackfish (*Dallia pectoralis*) were found in much greater numbers than any other species of fish captured or observed in Noyes Slough. Northern pike (*Esox lucius*) was the second most widely distributed fish and were found mostly in the downstream half of the slough. Other fish captured included Arctic grayling (*Thymallus arcticus*), Arctic lamprey (*Lampetra japonica*), burbot (*Lota lota*), humpback whitefish (*Coregonus pidschian*), lake chub (*Couesius plumbeus*), longnose sucker (*Catostomus catostomus*), and slimy sculpin (*Cottus cognatus*). Most of these species were found within a mile of the Chena River.

The large number of Alaska blackfish throughout most of the slough was indicative of the environmental conditions in the slough. The numerous beaver dams reduce the already limited flow in the slough and create stagnant pools with low dissolved oxygen concentrations. Alaska blackfish are capable of breathing atmospheric oxygen and can live in water that is uninhabitable to other species.

Noyes Slough has the potential to provide high quality habitat for fish and wildlife resources. The Alaska Department of Fish and Game has indicated that Noyes Slough could provide important rearing habitat for Chinook salmon and arctic grayling (USACE 1997) if the slough was readily accessible to fish from the Chena River.

2.11.Population

The population for Fairbanks North Star Borough recorded in the 2010 Census is 97,581, with 31,535 people in the city of Fairbanks and 2,117 people in the city of North Pole (U.S. Census Bureau 2010). This is an 18% increase in population in FNSB since 2000.

3. Water Quality Standards

Water quality standards designate the "uses" to be protected (e.g., water supply, recreation, aquatic life) and the "criteria" for their protection (e.g., how much of a pollutant can be present in a waterbody without impairing its designated uses).

Title 18, Chapter 70 of the Alaska Administrative Code (AAC) establishes water quality standards for the waters of Alaska, including the designated uses to be protected and the water quality criteria necessary to protect the uses. Available data are compared to water quality criteria to evaluate current water quality conditions. However, when water quality criteria are narrative, it is necessary to identify a numeric target to not only evaluate current water quality conditions but also establish a target by which to gauge future progress in restoring the watershed and waterbodies. For evaluation in this watershed characterization, if the Alaska water quality standards did not contain criteria for particular pollutants, the National Recommended Water Quality Criteria (NRWQC) (USEPA 2009) were used (see Section 3.2). This section reviews the applicable water quality standards for the Chena River watershed.

3.1. Alaska Water Quality Criteria

3.1.1. Designated Uses

Designated uses for Alaska's waters are established by regulation and are specified in the State of Alaska Water Quality Standards (18 AAC 70.020). For fresh waters of the state, these designated uses include (1) water supply, (2) water recreation, and (3) growth and propagation of fish, shellfish, other aquatic life, and wildlife, and are applicable to all fresh waters, unless specifically exempted. According to Alaska's Water Quality Standards (18 AAC 70.230) the Chena River from the confluence of the Chena River and Chena Slough to the confluence of the Chena River and Tanana River is exempt from meeting the drinking, culinary, and food processing designated use subclass. The designated use subclass of drinking, culinary, and food processing water must be protected in all other waterbodies in the watershed whether or not they are used for drinking water per Alaska water quality standards. The Chena River and Chena Slough do not fully support their designated uses because of elevated in-stream levels of sediment. Noyes Slough does not fully support its designated uses because of the occurrence of visible sheens on the waterbody (petroleum products), sediment and debris. The sheens can indicate the presence of petroleum hydrocarbons, which can cause a wide range of impairments to aquatic life and habitat, including lethal or sublethal effects. Although not currently included on Alaska's section 303(d) list, DEC has also identified nutrients as a cause of potential impairment in Noyes Slough, Chena Slough, Beaver Springs, and the Chena River. Note that the pollutants vary by waterbody; please see Table 1-1 for details.

3.1.2. Numeric and Narrative Criteria

Numeric and narrative water quality criteria are established in the State of Alaska Water Quality Standards (18 AAC 70.020) for fresh waters of the state. Alaska's Water Quality Standards (Amended as of September 19, 2009) have been approved by EPA except for some specific pollutants including residues, fluoride, and various carcinogens for particular designated uses. The criteria relevant to the water quality problems in the Chena River watershed are included in Tables 3-1 and 3-2. These criteria include those for petroleum hydrocarbons, oil and grease, residues, sediment, and turbidity. Note that none of the waterbodies in the Chena River watershed are included on the section 303(d) list for turbidity. However, turbidity water quality criteria are included as a surrogate parameter for sediment because turbidity is a measure of the water's optical properties that cause light to be scattered or absorbed. Turbidity can be affected by different suspended particles such as clay, silt, and microorganisms, many of which are the same substances that form suspended solids (TSS). Note that Alaska does not have water quality criteria for nutrients. All water quality criteria included in Tables 3-1 and 3-2 are from the State of Alaska Water Quality Standards (18 AAC 70.020) (2009) unless otherwise noted. DEC's memo titled Comparison of State and Federally Approved Water Quality Standards (2010c) was used to determine which Alaska Water Quality Criteria were approved by EPA.

Table 3-1. Applicable Fresh Water Alaska Water Quality Standards for the Chena River Watershed

Designated use	Description of criteria
Petroleum hydrocarbons, oils and grease	
(A) Water Supply	
(i) drinking, culinary, and food processing	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.
(ii) agriculture, including irrigation and stock watering	May not cause visible sheen upon the surface of the water.
(iii) aquaculture	Total aqueous hydrocarbons (TAqH) in the water column may not exceed 15 µg/L (see note a). Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 µg/L (see note a). There may be no 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.
(iv) industrial	May not make the water unfit or unsafe for the use.
(B) Water Recreation	
(i) contact recreation	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.
(ii) secondary recreation	Same as contact recreation above
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	Total aqueous hydrocarbons (TAqH) in the water column may not exceed 15 µg/L (see note a). Total aromatic hydrocarbons (TAH) in the water column may not exceed 10 µg/L (see note a). There may be no 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.
Toxic and other deleterious organic and inorganic substances (see Table 3-2)	
(A) Water supply	
(i) Drinking, culinary, and food processing	The concentration of substances in water may not exceed the numeric criteria for drinking water and human health for consumption of water and aquatic organisms shown in the *Alaska Water Quality Criteria Manual* (2008). Substances may not be introduced at concentrations that cause, or can reasonably be expected to cause, either singly or in combination, odor, taste, or other adverse effects on the use.

Designated use	Description of criteria
(ii) Agriculture, including irrigation and stock watering	The concentration of substances in water may not exceed the numeric criteria for drinking and stockwater and irrigation water shown in the *Alaska Water Quality Criteria Manual* (2008). Substances may not be introduced at concentrations that cause, or can reasonably be expected to cause, either singly or in combination, odor, taste, or other adverse effects on the use.
(iii) Aquaculture	The concentration of substances in water may not exceed the numeric criteria for aquatic life for fresh water and human health for consumption of aquatic organisms only shown in the *Alaska Water Quality Criteria Manual* (2008), or any chronic and acute criteria established in this chapter, for a toxic pollutant of concern to protect sensitive and biologically important life stages of resident species of this state. 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, adverse effects on aquatic life or produce undesirable or nuisance 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 bioassay or organoleptic tests.
(iv) industrial	Concentrations of substances that pose hazards to worker contact may not be present.
(B) Water recreation	
(i) contact recreation	The concentration of substances in water may not exceed the numeric criteria for drinking water shown in the *Alaska Water Quality Criteria Manual* (2008). Substances may not be introduced at concentrations that cause, or can reasonably be expected to cause, either singly or in combination, odor, taste, or other adverse effects on the use.
(ii) secondary recreation	Concentrations of substances that pose hazards to incidental human contact may not be present.
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	The concentration of substances in water may not exceed the numeric criteria for aquatic life for fresh water and human health for consumption of aquatic organisms only shown in the *Alaska Water Quality Criteria Manual* (2008), or any chronic and acute criteria established in this chapter, for a toxic pollutant of concern to protect sensitive and biologically important life stages of resident species of this state. 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, adverse effects on aquatic life or produce undesirable or nuisance 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 bioassay or organoleptic tests.

Designated use	Description of criteria
Residues – Floating solids, debris, sludge, deposits, foam, scum, or other residues[b]	
(A) Water supply	
(i) Drinking, culinary, and food processing	May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use, cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines, cause leaching of toxic or deleterious substances, or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines.
(ii) Agriculture, including irrigation and stock watering	May not be pres*ent in quantities to cause soil* plugging or reduced crop yield, or to make the water unfit or unsafe for the use.
(iii) Aquaculture	May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use.
(iv) industrial	Same as Residues (A)(iii).
(B) Water recreation	
(i) contact recreation	Same as Residues (A)(i).
(ii) secondary recreation	Same as Residues(A)(i).
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	May not, alone or in combination with other substances or wastes, make the water unfit or unsafe for the use, or cause acute or chronic problem levels as determined by bioassay or other appropriate methods. May not, alone or in combination with other substances, cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines, or cause leaching of toxic or deleterious substances, or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines.
Sediment (Not applicable to groundwater)	
(A) Water Supply	
(i) drinking, culinary, and food processing	No measurable increase in concentration of settleable solids above natural conditions, as measured by the volumetric Imhoff cone method.
(ii) agriculture, including irrigation and stock watering	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.
(iii) aquaculture	No imposed loads that will interfere with established water supply treatment levels.
(iv) industrial	Same Sediment (A) (iii).
(B) Water Recreation	
(i) contact recreation	Same as Sediment (A) (i).
(ii) secondary recreation	May not pose hazards to incidental human contact or cause interference with the use.

Designated use	Description of criteria
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	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 from 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). In all other surface waters no sediment loads (suspended or deposited) that can cause effects on aquatic animal or plant life, their reproduction or habitat may be present.
Turbidity (Not applicable to groundwater)	
(A) Water Supply	
(i) drinking, culinary, and food processing	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.
(ii) agriculture, including irrigation and stock watering	May not cause detrimental effects on indicated use.
(iii) aquaculture	May not exceed 25 NTU above natural conditions. For all lake waters, may not exceed 5 NTU above natural conditions.
(iv) industrial	May not cause detrimental effects on established water supply treatment levels.
(B) Water Recreation	
(i) contact recreation	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.
(ii) secondary recreation	May not exceed 10 NTU above natural conditions when natural turbidity is 50 NTU or less, and may not have more than 20% increase in turbidity when the natural turbidity is greater than 50 NTU, not to exceed a maximum increase of 15 NTU. For all lake waters, turbidity may not exceed 5 NTU above natural turbidity.
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	Same as Turbidity (A)(iii).
Fecal Coliform Bacteria	
(A) Water Supply	
(i) drinking, culinary, and food processing	30-day geometric mean<20 FC/100 mL; no more than 10% of samples > 40 FC/ 100 mL. For groundwater, the FC concentration must be less than 1 FC/100 ml, using the fecal coliform Membrane Filter Technique, or less than 3 FC/100 ml, using the fecal coliform most probable number (MPN) technique.
(ii) agriculture, including irrigation and stock watering	30-day geometric mean<200 FC/100 mL; no more than 10% of samples > 400 FC/ 100 mL

Designated use	Description of criteria
(iii) aquaculture	30-day geometric mean<200 FC/100 mL; no more than 10% of samples > 400 FC/ 100 mL
(iv) industrial	30-day geometric mean<200 FC/100 mL; no more than 10% of samples > 400 FC/ 100 mL
(B) Water Recreation	
(i) contact recreation	30-day geometric mean<100 FC/100 mL; no more than 10% of samples > 200 FC/ 100 mL
(ii) secondary recreation	30-day geometric mean<200 FC/100 mL; no more than 10% of samples > 400 FC/ 100 mL
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	--
Dissolved Gas	
(A) Water Supply	
(i) drinking, culinary, and food processing	DO > or = 4 mg/L (this does not apply to lakes or reservoirs in which supplies are taken from below the thermocline, or to groundwater).
(ii) agriculture, including irrigation and stock watering	DO > 3 mg/L
(iii) aquaculture	DO > 7 mg/L; The concentration of total dissolved gas may not exceed 110% of saturation at any point of sample collection.
(iv) industrial	May not cause detrimental effects on established water supply treatment levels.
(B) Water Recreation	
(i) contact recreation	DO > or = 4 mg/L
(ii) secondary recreation	DO > or = 4 mg/L
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	DO > 7 mg/L in waters used by anadromous or resident fish; DO > or = 5 mg/l to a depth of 20 cm in the interstitial waters of gravel used by anadromous or resident fish for spawning (see note 2); For waters not used by anadromous or resident fish, DO > or = 5 mg/L. DO < or = 17 mg/l for all waters; Total dissolved gas < or = 110% of saturation.
Dissolved Inorganic Substances	
(A) Water Supply	
(i) drinking, culinary, and food processing	TDS < or = 500 mg/L; chlorides and sulfates < or = 250 mg/L
(ii) agriculture, including irrigation and stock watering	TDS < or = 1,000 mg/L; Sodium adsorption ratio < 2.5; Sodium percentage < 60%; Residual carbonate < 1.25 milliequivalents/liter.
(iii) aquaculture	TDS < or = 1,000 mg/L; A concentration of TDS may not be present in water if that concentration causes or reasonably could be expected to cause an adverse effect to aquatic life.
(iv) industrial	No amounts above natural conditions that can cause corrosion, scaling, or process problems.
(B) Water Recreation	
(i) contact recreation	--

Designated use	Description of criteria
(ii) secondary recreation	--
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	TDS < or = 1,000 mg/L; A concentration of TDS may not be present in water if that concentration causes or reasonably could be expected to cause an adverse effect to aquatic life.
pH	
(A) Water Supply	
(i) drinking, culinary, and food processing	> or = 6.0 and < or = 8.5
(ii) agriculture, including irrigation and stock watering	> or = 5.0 and < or = 9.0
(iii) aquaculture	> or = 6.5 and < or = 8.5; May not vary more than 0.5 pH unit from natural conditions.
(iv) industrial	> or = 5.0 and < or = 9.0
(B) Water Recreation	
(i) contact recreation	> or = 6.5 and < or = 8.5; If the natural condition pH is outside this range, substances may not be added that cause an increase in the buffering capacity of the water.
(ii) secondary recreation	> or = 5.0 and < or = 9.0
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	> or = 6.5 and < or = 8.5; May not vary more than 0.5 pH unit from natural conditions.
Temperature	
(A) Water Supply	
(i) drinking, culinary, and food processing	< or = 15 degrees C
(ii) agriculture, including irrigation and stock watering	< or = 30 degrees C
(iii) aquaculture	< or = 20 degrees C; The following maximum temperatures may not be exceeded, where applicable: Migration routes: 15 deg. C, spawning areas: 13 deg. C, rearing areas: 15 deg. C, egg & fry incubation: 13 deg. C. For all other waters, the weekly average temperature may not exceed site-specific requirements needed to preserve normal species diversity or to prevent appearance of nuisance organisms.
(iv) industrial	< or = 25 degrees C
(B) Water Recreation	
(i) contact recreation	< or = 30 degrees C
(ii) secondary recreation	--
(C) Growth and propagation of fish, shellfish, other aquatic life, and wildlife	< or = 20 degrees C; The following maximum temperatures may not be exceeded, where applicable: Migration routes: 15 deg. C, spawning areas: 13 deg. C, rearing areas: 15 deg. C, egg & fry incubation: 13 deg. C. For all other waters, the weekly average temperature may not exceed site-specific requirements needed to preserve normal species diversity or to prevent appearance of nuisance organisms.

Source: 18 AAC 70.020 (2003 and 2009)

[a]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) or EPA Method 624 to quantify monoaromatic hydrocarbons and to measure TAH; and (B) EPA Method 610 or EPA Method 625 to quantify polynuclear aromatic hydrocarbons listed in EPA method 610.
[b] Alaska's 2009 water quality criteria for residues have not been approved by EPA, therefore, the residues criteria presented here are from 18 AAC 70.020 (2003).

Table 3-2. Applicable Alaska Water Quality Standards for Toxics in the Chena River Watershed

Parameter	Chena River (from the mouth of Chena Slough to the confluence with the Tanana River)	All other waterbodies
Ammonia as N[a]	15.4 mg/L 15,400 µg/L	15.4 mg/L/15,400 µg/L (Chena River); 6.77 mg/L/6,770 µg/L (Noyes & Chena Sloughs); 9.64 mg/L/9,640 µg/L (Beaver Springs)
1,1,1-Trichloroethane	--	0.2 mg/L 200 µg/L[b]
1,1,2-Trichloroethane	0.420 mg/L 420 µg/L[c,d]	0.005 mg/L 5 µg/L[b]
1,2,4-Trichlorobenzene	0.94 mg/L 940 µg/L[c]	0.07 mg/L 70 µg/L[b]
1,2-Dichlorobenzene	17 mg/L 17,000 µg/L[c]	0.6 mg/L 600 µg/L[e]
1,2-Dichloroethane	0.99 mg/L 990 µg/L[c,d]	0.0038 mg/L 3.8 µg/L[d]
1,2-Dichloropropane	--	0.005 mg/L 5 µg/L[b]
1,3-Dichlorobenzene	2.6 mg/L 2,600 µg/L[c]	0.4 mg/L 400 µg/L[e]
1,4-Dichlorobenzene	2.6 mg/L 2,600 µg/L[c]	0.075 mg/L 75 µg/L[b]
2,4,5-TP (Silvex)	--	0.05 mg/L 50 µg/L[b]
2,4-D	--	0.07 mg/L 70 µg/L[b]
Acenaphthene	2.7 mg/L 2,700 µg/L[c]	1.2 mg/L 1,200 µg/L[e]
Anthracene	110 mg/L 110,000 µg/L[c]	9.6 mg/L 9,600 µg/L[e]
Arsenic	0.05 mg/L 50 µg/L[f]	0.01 mg/L 10 µg/L[b]
Benzene	0.71 mg/L 710 µg/L[c,d]	0.005 mg/L 5 µg/L[b]
Benzo[a]pyrene	0.00031 mg/L 0.31 µg/L[c,d]	0.000028 mg/L 0.028 µg/L[e,d]
Cadmium	0.01 mg/L 10 µg/L[f]	0.005 mg/L 5 µg/L[b]
Carbon Tetrachloride	0.044 mg/L 44 µg/L[c,d]	0.0025 mg/L 2.5 µg/L[e,d]
Chlorides	860 mg/L 860,000µg/L[g,h]	< or = 250 mg/L < or = 250,000 µg/L[i]
Chlorobenzene	21 mg/L 21,000 µg/L[c]	0.68 mg/L 680 µg/L[e]
cis-1,2 Dichloroethylene (DCE)	--	0.07 mg/L 70 µg/L[b]
Copper	0.2 mg/L 200 µg/L[k]	0.0147 mg/L 14.7 µg/L (Noyes Slough)[k]
Dalapon	--	0.2 mg/L

Parameter	Chena River (from the mouth of Chena Slough to the confluence with the Tanana River)	All other waterbodies
		200 µg/L [b]
Dinoseb	--	0.007 mg/L 7 µg/L [b]
Ethylbenzene	29 mg/L 29,000 µg/L [c]	0.7 mg/L 700 µg/L [b]
Fluoranthene	0.37 mg/L 370 µg/L [c]	0.3 mg/L 300 µg/L[e]
Fluorene	14 mg/L 14,000 µg/L[c]	1.3 mg/L 1,300 ug/L[e]
Fluoride	1.0 mg/L 1,000 µg/L[j]	2.0 mg/L 2,000 µg/L [b]
Iron	1 mg/L 1,000 µg/L[l]	1 mg/L 1,000 µg/L[l]
Manganese	0.1 mg/L 100 µg/L[c]	0.05 mg/L 50 µg/L[e]
Methylene Chloride	--	0.005 mg/L 5 µg/L[b]
Nitrate (NO3-N)	--	10 mg/L 10,000 µg/L [b]
Nitrite	--	1 mg/L 1,000 µg/L [b]
Nitrite-Nitrate	--	10 mg/L 10,000 µg/L [b]
Pyrene	11 mg/L 11,000 µg/L[c]	0.96 mg/L 960 µg/L[e]
Residual carbonate[i]	< 1.25	< 1.25
Styrene	--	0.1 mg/L 100 µg/L [b]
Sulfates	--	< or = 250 mg/L < or = 250,000 µg/L[i]
Toluene	200 mg/L 200,000 µg/L [c]	1 mg/L 1,000 µg/L [b]
Total Alkalinity[l]	20 mg/L (minimum) 20,000 µg/L (minimum)	20 mg/L (minimum) 20,000 µg/L (minimum)
Vinyl Chloride	5.25 mg/L 5,250 µg/L[d,c]	0.002 mg/L 2 µg/L [b]
Xylenes, Total	--	10 mg/L 10,000 µg/L [b]
Zinc (dissolved)	--	0.02168 mg/L 21.68 µg/L (Noyes Slough)[k]

Source: 18 AAC 70 (2009)
[a] Acute ammonia criteria with salmonids present based on average pH for each waterbody.
[b] MCL (drinking water)
[c] human health criteria for consumption of aquatic organisms only
[d] Alaska's 2009 water quality criteria for certain carcinogens have not been approved by EPA; therefore, the criteria presented here are from the federally approved 40 CFR 131.36
[e] Human health criteria for consumption of water + aquatic organisms
[f] Agriculture-stockwater
[g] Applies to dissolved chloride when associated with sodium
[h] Aquatic Life Fresh Water Acute criterion

[i] Source: 18 AAC 70.020 (2009) – Water Supply – drinking, culinary, and food processing
[j] Agriculture-irrigation water
[k] Copper and zinc criteria for Noyes Slough based on average hardness in Noyes Slough (110 mg/L based on 3 observations).
[l] Aquatic Life Fresh Water Chronic criterion

3.1.3. Antidegradation

Alaska's Water Quality Standards (18 AAC 70.015) (2009) also include an antidegradation policy, which states that existing water uses and the level of water quality necessary to protect the existing uses must be maintained and protected.

Water quality must be maintained and protected unless the state finds that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the water is located. In allowing such degradation or lower water quality, the state must ensure water quality adequate to fully protect existing uses of the water.

The methods of pollution prevention, control, and treatment found to be the most effective and reasonable will be applied to all discharges. All discharges will be treated and controlled to achieve the highest statutory and regulatory requirements for point sources and all cost-effective and reasonable best management practices for nonpoint sources.

State water exhibiting high quality water constitutes an outstanding national resource and must be maintained and protected.

In cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy must be consistent with section 316 of the federal Clean Water Act.

3.2. National Recommended Water Quality Criteria

The *National Recommended Water Quality Criteria* (USEPA 2009) were applied where no Alaska water quality criteria were available for comparison to data. The National Recommended Water Quality Criteria applicable to this project are summarized in Table 3-3. Note that the National Recommended Water Quality Criteria do contain criteria for nutrients; however, they are based on EPA's Ecoregional Criteria (http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/ecoregions/index.cfm). There are currently no Ecoregional Criteria specifically for Alaska, therefore, nutrient criteria were not presented as part of this watershed characterization.

Table 3-3. Federal Criteria for All Parameters without Alaska Water Quality Standards

Parameter	Human health for consumption of water + organism	Human health for consumption of organism only	Freshwater CMC	Freshwater CCC
1,1,2,2-Tetrachloroethane	0.17 µg/L 0.00017 mg/L	4 µg/L 0.004 mg/L	--	--
1,2-Dichloropropane	--	15 µg/L 0.015 mg/L	--	--
Benzo(a)anthracene	0.0038 µg/L 0.0000038 mg/L	0.018 µg/L 0.000018 mg/L	--	--
Benzo(b)fluoranthene	0.0038 µg/L 0.0000038 mg/L	0.018 µg/L 0.000018 mg/L	--	--
Benzo(k)fluoranthene	0.0038 µg/L 0.0000038 mg/L	0.018 µg/L 0.000018 mg/L	--	--

Parameter	Human health for consumption of water + organism	Human health for consumption of organism only	Freshwater CMC	Freshwater CCC
Bromoform	4.3 µg/L 0.0043 mg/L	140 µg/L 0.140 mg/L	--	--
Chloroform	5.7 µg/L 0.0057 mg/L	470 µg/L 0.470 mg/L	--	--
Chrysene	0.0038 µg/L 0.0000038 mg/L	0.018 µg/L 0.000018 mg/L	--	--
Dibenzo(a,h)anthracene	0.0038 µg/L 0.0000038 mg/L	0.018 µg/L 0.000018 mg/L	--	--
Hexachlorobutadiene	0.44 µg/L 0.00044 mg/L	18 µg/L 0.018 mg/L	--	--
Indeno(1,2,3-cd)pyrene	0.0038 µg/L 0.0000038 mg/L	0.018 µg/L 0.000018 mg/L	--	--
Methylene Chloride	--	590 µg/L 0.590 mg/L	--	--

4. Data Summary

USGS flow data are available for the Chena River and Little Chena River. Water quality data are available for Beaver Springs, Noyes Slough, Chena Slough, and the Chena River. There are no water quality data available for any other tributaries in the watershed and there are not many data available for the upper watershed above Moose Creek Dam. An inventory of all available water quality data (post 1989) and flow data is included in the following sections.

4.1. Flow Data Inventory and Analysis

There are eight USGS flow gages in the Chena River watershed (Figure 4-1). Seven of the flow gages have flow data for the Chena River, while one of the gages has flow data for the Little Chena River. Four of the gages, have long-term continuous flow data. Table 4-1 presents the names and station numbers of the USGS flow gages as well as their periods of record. Figures 4-2 through 4-5 show the average monthly streamflow for each of the stations with recent continuous flow data. High flow typically occurs during the spring and summer months, while low flow tends to occur during the winter months. The highest flows occur in May at all four stations as a result of spring snowmelt.

Table 4-1. Summary of Available USGS Flow Data for the Chena River Watershed

Station number	Station name	Period of record	Notes
15493000	Chena R nr Two Rivers, AK	10/1/1967-11/1/2007	--
15493400	Chena R bl Hunts C nr Two Rivers, AK	10/1/1991-10/15/2007	not continuous
15493500	Chena R nr N Pole, AK	5/1/1972-9/30/1980	--
15493700	Chena R bl Moose C Dam, AK	8/1/1979-10/15/2007	not continuous
15511000	L Chena R nr Fairbanks, AK	8/1/1966-9/30/2007	--
15512000	Chena Sl nr Fairbanks, AK	5/1/1948-9/30/1952	--
15514000	Chena R at Fairbanks, AK	8/1/1947-10/15/1947; 5/1/1948-9/30/2007; 10/4/2007-3/3/2008	--
15514003	Chena R bl Mus at Lathrop St at Fairbanks, AK	10/18/2002-4/24/2007	not continuous

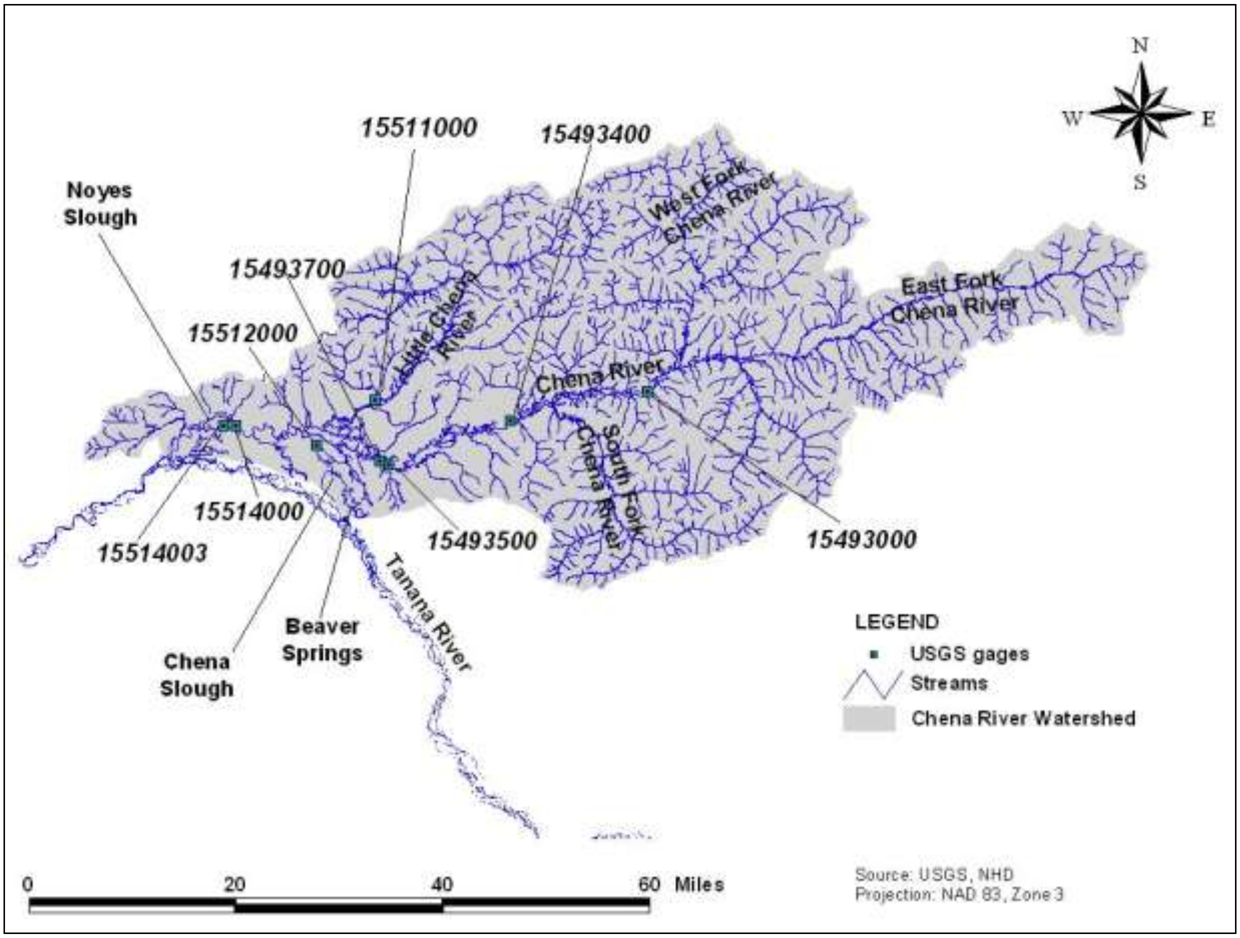

Figure 4-1. Location of USGS flow gages in the Chena River watershed.

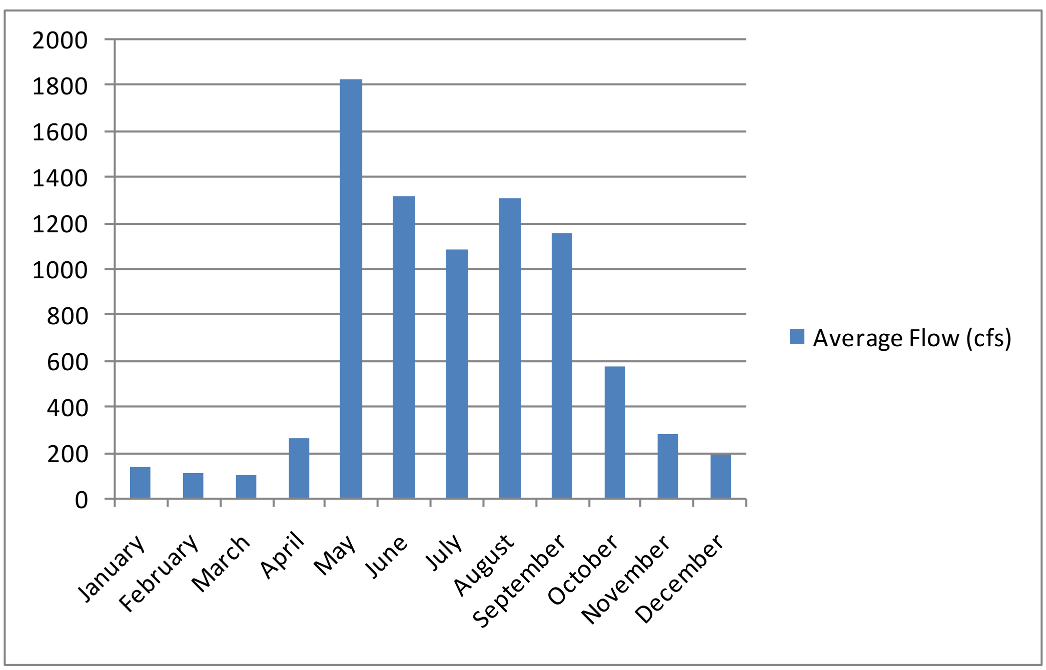

Figure 4-2. Monthly average Chena River flow at USGS gage 15493000 for October 1, 1967 through November 1, 2007.

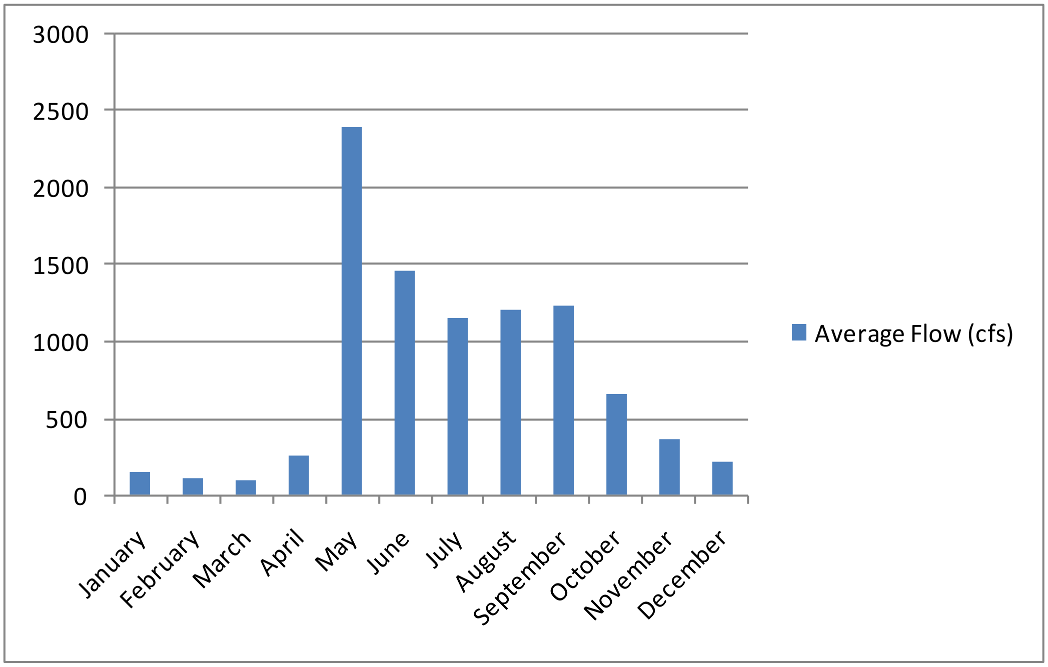

Figure 4-3. Monthly average Chena River flow at USGS gage 15493500 for May 1, 1972 through September 30, 1980.

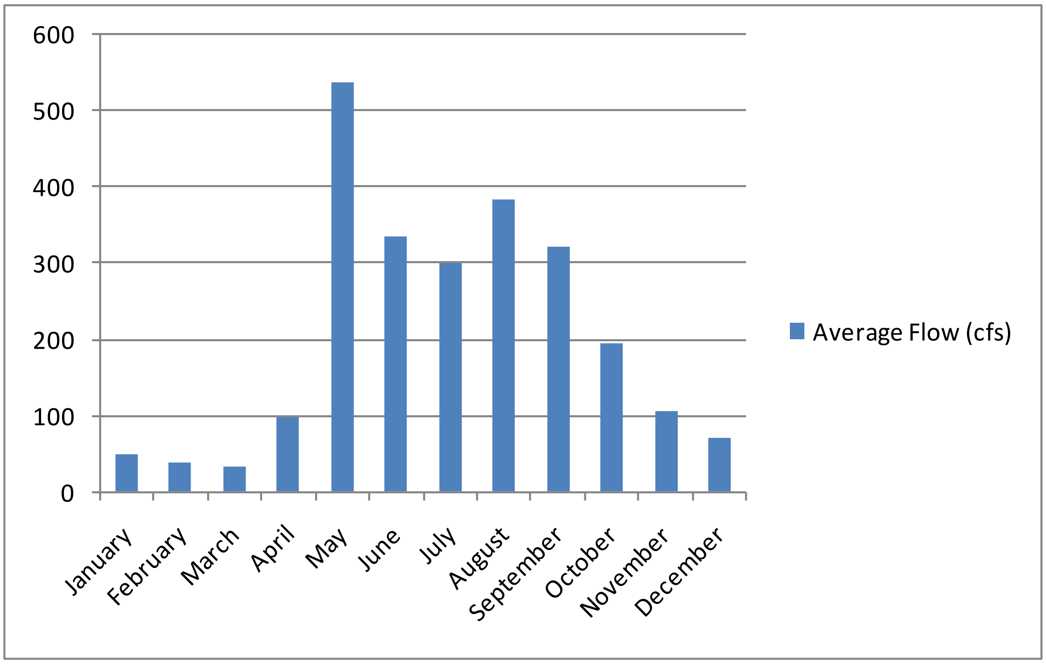

Figure 4-4. Monthly average Little Chena River flow at USGS gage 15511000 for August 1, 1966 through September 30, 2007.

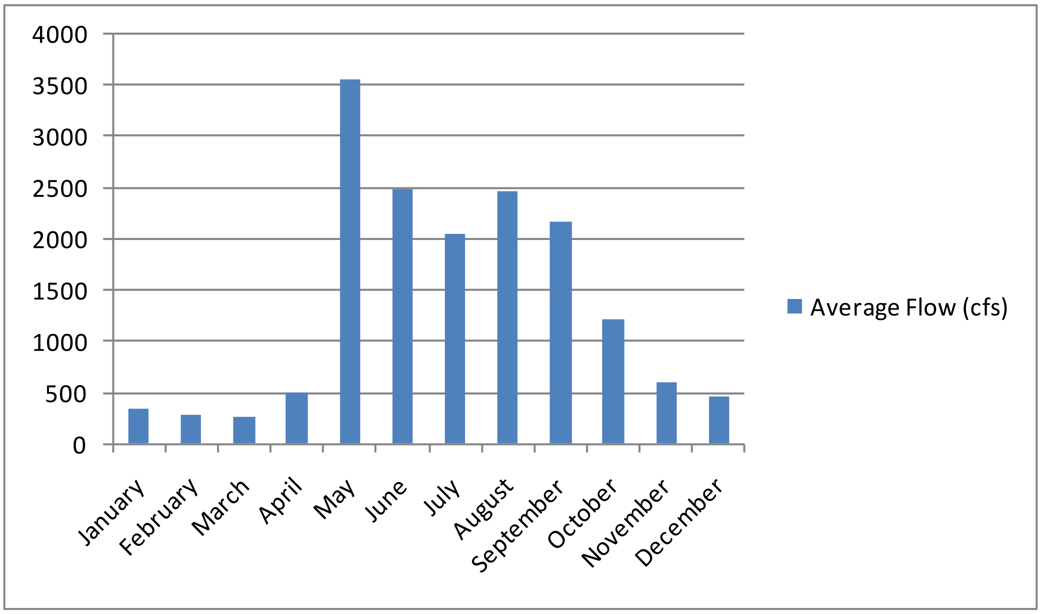

Figure 4-5. Monthly average Chena River flow at USGS gage 15514000 for May 1, 1948 through September 30, 2007.

4.2. Water Quality Data Inventory and Analysis

This section provides an inventory and summary of surface water quality, stormwater quality, and groundwater quality data available for the Chena River watershed. Note that only data collected from 1990 through the present are included. All information on debris in Noyes Slough is included in the 2008 TMDL document for Noyes Slough and is not included here.

4.2.1. Surface Water Data

Surface water data in the watershed were available from several different sources (ADEC 1994, 2005a, 2005b, 2007a, 2007b; Douglas 2008; Kennedy et al. 2004; NSAC 2000a, 2000b; Oasis 2008; Parsons 2006; Scharfenberg 2004; USGS (1990-2003); Water Watch 1992 and 1993; Wuttig 1997). Additional water quality data (pH, water temperature, conductivity, total dissolved solids, dissolved oxygen, ortho-phosphate, nitrate-nitrogen, and coliform bacteria) were collected by the Tanana Valley Watershed Association (TVWA) from 2007 through 2010; however sampling locations were not available at the time this report was completed, therefore, the data were not included. Appendix A presents a summary of all the available surface water quality data in the Chena River watershed. The water quality data include observations for the Chena River, Chena Slough, Noyes Slough, and Beaver Springs.

Figures 4-6, 4-7, 4-8, and 4-9 present the approximate locations of the surface water quality sampling stations for Noyes Slough, Chena Slough, Chena River, and Beaver Springs, respectively. Note that during DEC's 2007 sampling the locations of some stations were changed. These stations are indicated in Figures 4-6 through 4-9 with a 2007 after the station number. Some of the station names in Noyes Slough (Figure 4-6) were abbreviated for mapping purposes and some Noyes Slough stations have multiple names and or numbers. Stations with multiple names are represented by only one name in Figure 4-6 for simplicity purposes; therefore, Table 4-2 provides a key to those stations with abbreviated or multiple names.

All available data were compared to the most stringent applicable criteria to determine water quality impairments in the watershed. While all available data and data sources are summarized in Appendix A, Appendices B, C, D, and E present summaries of only those parameters with data that exceed water quality criteria in Noyes Slough, Chena Slough, Chena River, and Beaver Springs, respectively.

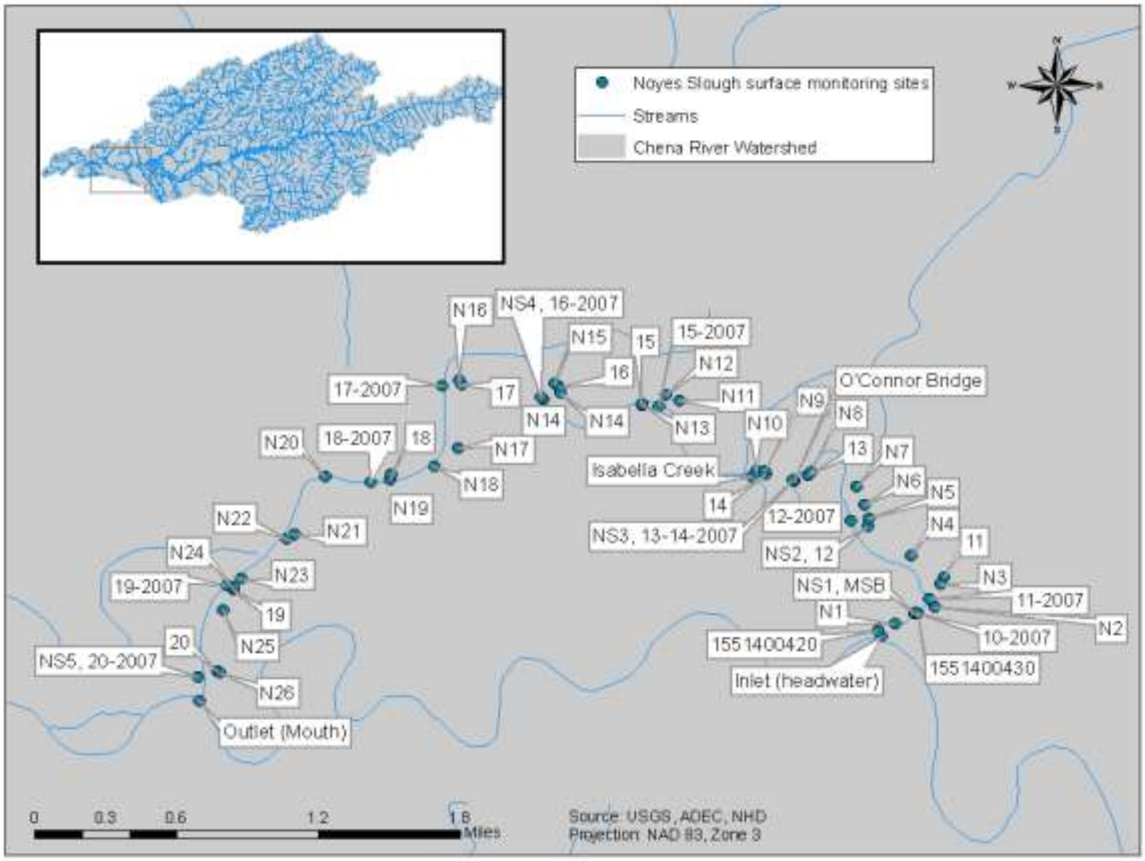

Figure 4-6. Surface water quality sampling locations in Noyes Slough.

Table 4-2. Station Key for Noyes Slough

Station number in Figure 4-6[a]	Actual and additional station names[d]
IC, above[b]	Isabella Creek, above
MSB[b]	Minnie Street Bridge
N1[c]	Noyes Slough Inlet near Wendell Street (1551400415)
N2[c]	Minnie Street Bridge (1551400425)
N3[c]	Charles Street (1551400428)
N4[c]	East College Road near Sam's Club (1551400431)
N5[c]	Illinois Street Bridge (1551400435)
N6[c]	East Alaska Railroad (1551400440)
N7[c]	East Johansen on-ramp (1551400445)
N8[c]	O'Connor Road Bridge (1551400455)
N9[c]	Isabella Creek (above) (1551400465)

Station number in Figure 4-6[a]	Actual and additional station names[d]
N10[c]	Isabella Creek (below) (6451261474349)
N11[c]	Danby Street Bridge (above) (1551400550)
N12[c]	Danby Street Bridge (below) (6451421474437)
N13[c]	Lions Park Northwest (1551400570)
N14[c]	Aurora Drive Bridge (above) (1551400650)
N15[c]	Aurora Drive Bridge (below) (6451441744535)
N16[c]	Smith Street (1551401515)
N17[c]	Central Avenue (1551401520)
N18[c]	Deere Street (1551401525)
N19[c]	Commerce Street (1551401527)
N20[c]	Spafford Lane (1551401530)
N21[c]	West Alaska Railroad (above) (1551401535)
N22[c]	West Alaska Railroad (below) (6451081474751)
N23[c]	West Johansen Bridge (above) (6450591474814)
N24[c]	West Johansen Bridge (below) (1551401550)
N25[c]	Indiana Avenue (1551401570)
N26[c]	Goldizen Avenue Bridge (1551401580)

[a]The numbers in this column represent the station numbers presented in Figure 4-6. Some of these are the actual station number while others are abbreviations for station names that were too long to fit on the figure.
[b]This station name is presented in Figure 4-6; however, note that this station also goes by the additional names presented in column 2 of Table 4-2.
[c]Note that Station numbers N1 through N26 in Figure 4-6 are not the actual station names, but abbreviated station names given to all stations in the watershed with names too long to fit in Figure 4-6. The actual station names are provided column 2 of Table 4-2.
[d]The station names in this column indicate the actual station name for those stations whose names were abbreviated in Figure 4-6 for the purpose of fitting them on the figure. This column also includes additional names for stations that have multiple names. Only 1 name was presented to represent each station in Figure 4-6 for simplicity purposes.

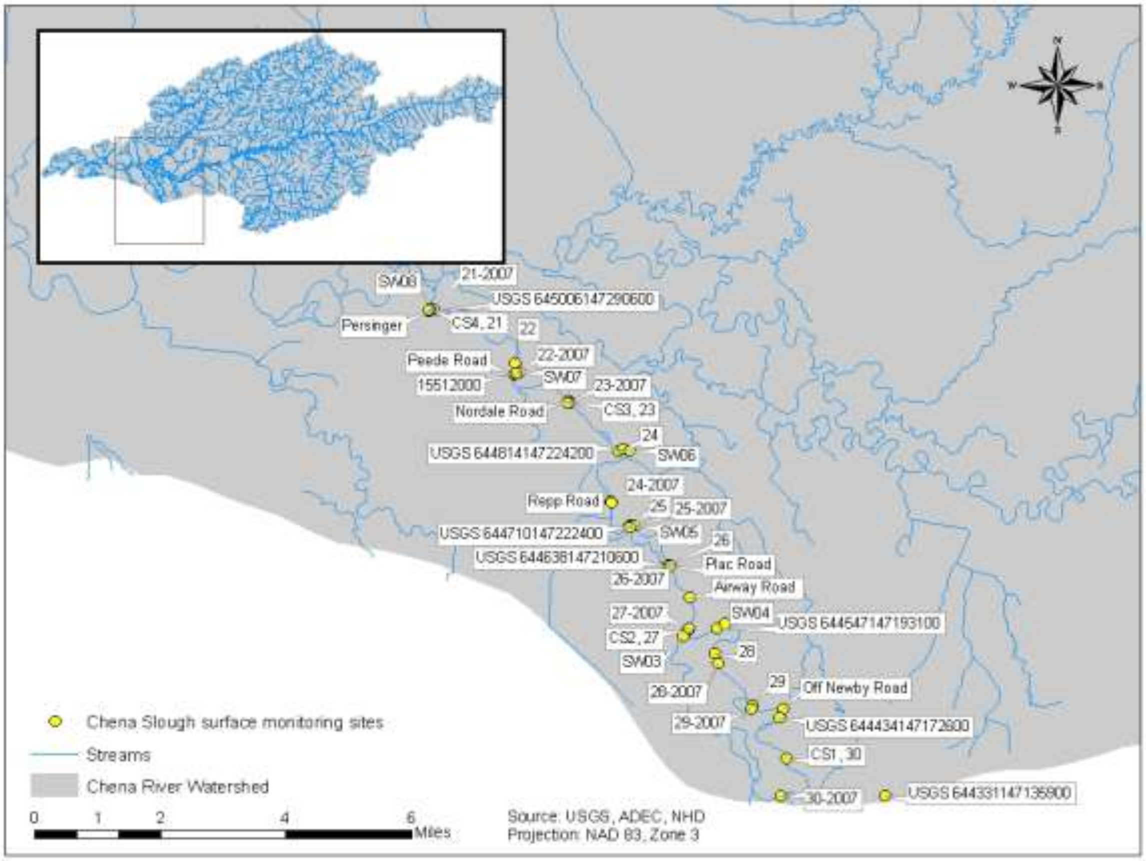

Figure 4-7. Surface water quality sampling locations in Chena Slough.

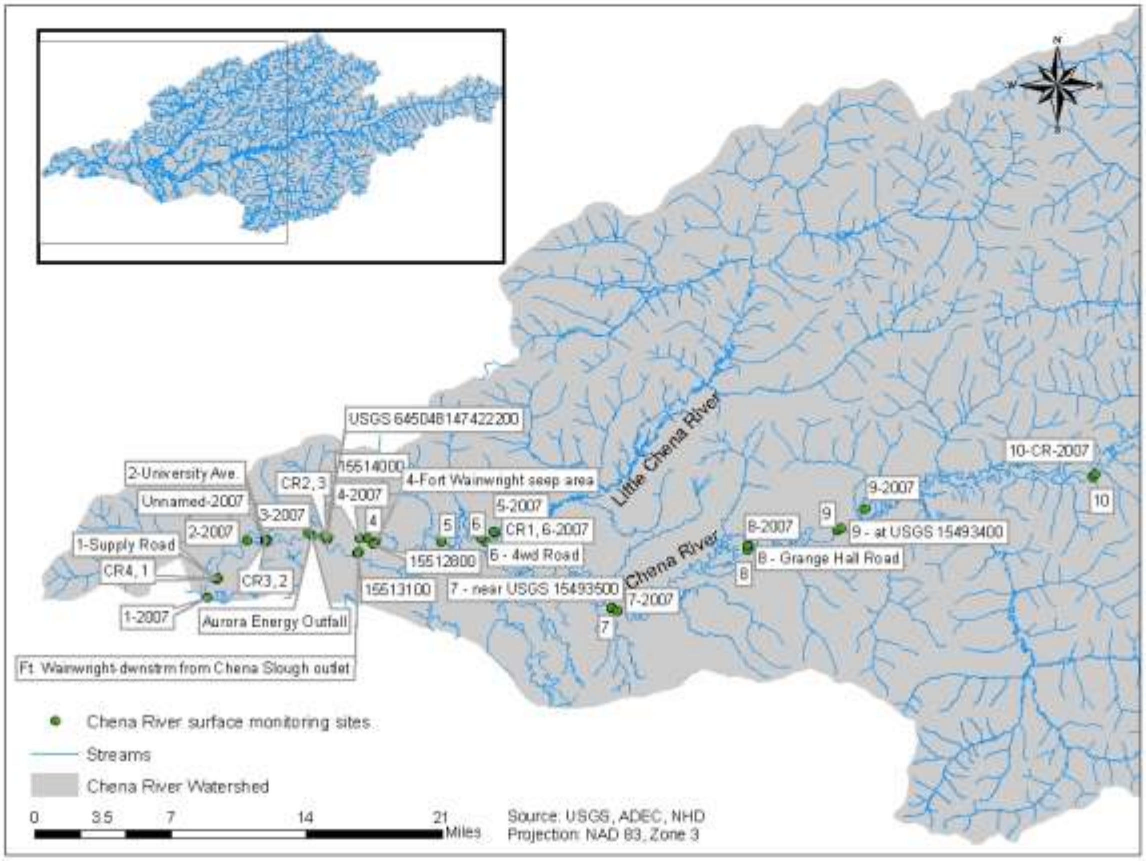

Figure 4-8. Surface water quality sampling locations in the Chena River.

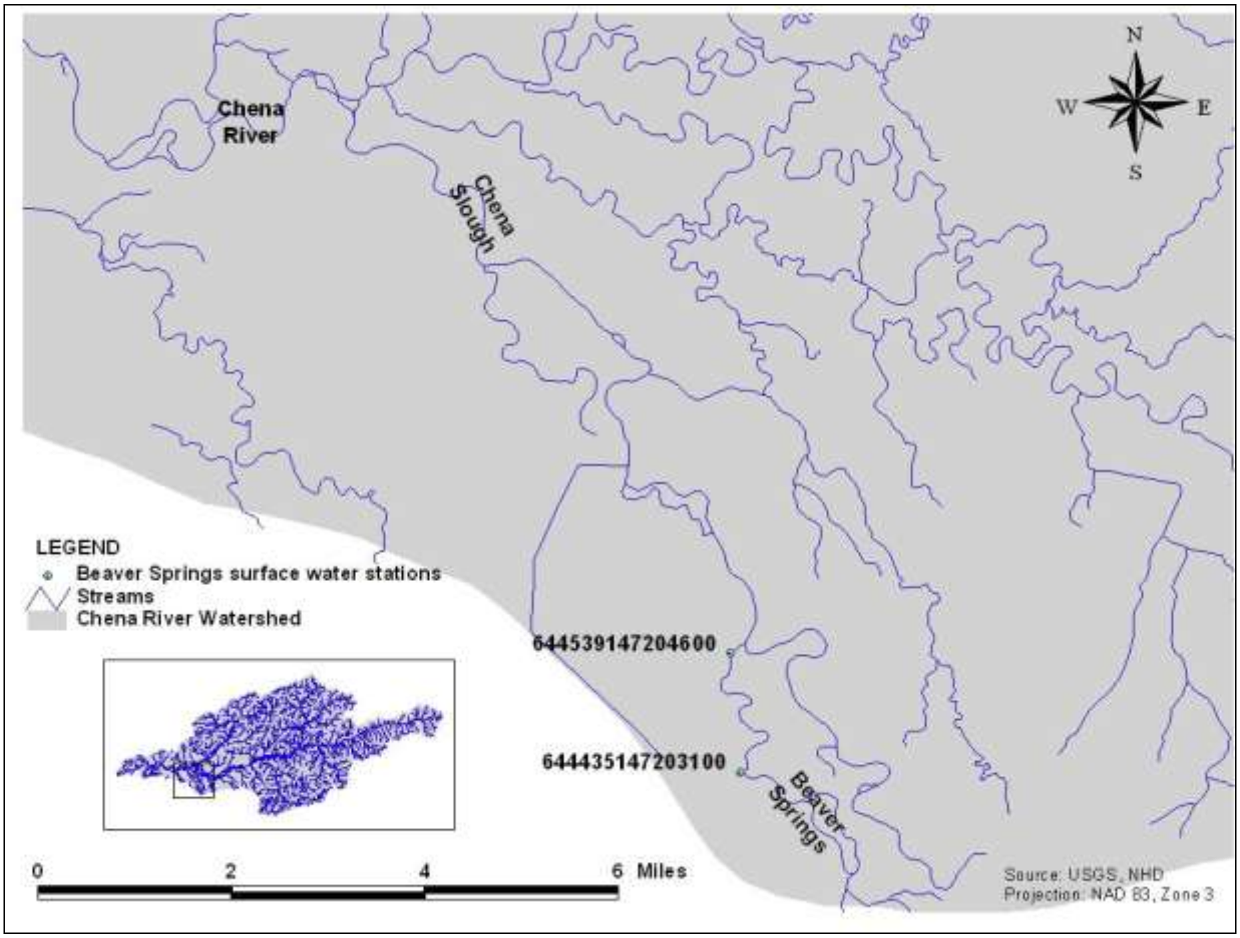

Figure 4-9. Surface water quality sampling locations in Beaver Springs.

Noyes Slough

Noyes Slough was included on Alaska's 2010 section 303(d) list for petroleum hydrocarbons, oil and grease, and sediment impairments. DEC completed, and EPA approved, a TMDL for the sheen component of the petroleum hydrocarbons, oil and grease standard in November 2011. The slough was initially included on the section 303(d) list for petroleum hydrocarbon impairments based on a qualitative assessment by DEC. DEC's 1989 Nonpoint Source Water Quality Assessment indicates a suspected petroleum hydrocarbon problem because of a large industrial area along Noyes Slough that stores petroleum on site. DEC's section 303(d) listing documents also indicate urban runoff from melting snow and deliberate snow dumps into the slough containing petroleum products as reasons for including the petroleum hydrocarbons impairment on the section 303(d) list. Although Noyes Slough was listed for petroleum hydrocarbons, a comparison of the data to the total aromatic hydrocarbons (TAH) and total aqueous hydrocarbons (TAqH) water quality criteria for petroleum hydrocarbons do not indicate impairment. TAH is the sum of benzene, ethylbenzene, toluene, and xylene isomers (BTEX), while TAqH is the sum of BTEX and the polycyclic aromatic hydrocarbons (PAHs) listed in EPAs method 610 (acenapthene, acenapthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorine, ideno(1,2,3-cd)pyrene, naphthalene, phenanthene, and pyrene). Many of the observations were non-detects, which were treated as 0 (zero) for data analysis purposes and, therefore, do not exceed the water quality criteria (see Appendix A).

Additional petroleum hydrocarbon data were collected from Noyes Slough by DEC in 2009. The 2009 data were collected and analyzed after the initial analysis of historical data presented above and are, therefore, presented separately. Petroleum hydrocarbon data were collected at five stations (NS1, NS2, NS3, NS4, and NS5) throughout the year, including during spring break up in May. All petroleum hydrocarbon data collected on Noyes Slough in 2009 were non-detects, which were treated as 0 (zero) for data analysis purposes and, therefore, do not exceed the water quality criteria (see Appendix A). However visible sheens, which can indicate the presence of petroleum hydrocarbons were observed during DEC's 2005, 2007, and 2009 water quality sampling efforts on Noyes Slough (ADEC 2005a, 2007a, 2010b). DEC (2010b) indicates that hydrocarbon pollution is generally not present during storm flow or base flow conditions in Noyes Slough; however Noyes Slough did have a presence of odor and sheens in the area. Diesel range organics were detected; however, there are no water quality criteria to which to compare them.

In addition to TAH and TAqH, individual toxic pollutants were compared to water quality criteria. See Tables 3-2 and 3-3 in Section 3 for a list of toxic pollutants analyzed in this study. None of the available toxic pollutant data are exceeding the applicable water quality criteria. Many of the observations were non-detects, which were treated as 0 (zero) for data analysis purposes and, therefore, do not exceed the water quality criteria (see Appendix A).

There are 4 fecal coliform bacteria observations at 4 stations in Noyes Slough. None of the observations are exceeding the "no more than 10 percent of samples greater than 40 count/100 mL" fecal coliform bacteria criterion, with a maximum value of 34 counts/100 mL at the Minnie Street Bridge station on June 18, 2000. Not enough data were available for comparison to the 30-day geometric mean criterion of less than 20 counts/100 mL.

There is a total of two copper and four iron observations in Noyes Slough. One of the copper observations is exceeding the hardness-based criterion of 14.7 µg/L and three of the iron observations are exceeding the 1,000 µg/L criterion. The copper criterion is based on the average hardness value of 110 mg/L in Noyes Slough (based on three observations). Table B-1 in Appendix B presents a summary of metals data that exceed water quality criteria, or might be naturally occurring, in Noyes Slough.

There are 30 sampling stations with dissolved oxygen (DO) observations on Noyes Slough, and there are exceedances of the no-less-than-7-mg/L DO criterion at 27 of these stations (Table B-2, Appendix B). The lowest DO observation is 0.2 mg/L at station 1551401530 (N20) in 2001. There are also exceedances of the 15 °C temperature criterion at all but 5 of the 30 stations with temperature data on Noyes Slough (Table B-3, Appendix B). The highest observed temperature was 21 °C at station 1551401530 (N20) in summer 2001. There are 10 chlorophyll *a* observations, 11 total nitrogen observations, and 12 total phosphorus observations available for Noyes Slough. All chlorophyll *a* data are from one sampling event in May 2007. All total nitrogen and total phosphorus data are from two sampling events in September 2003 and May 2007. Alaska does not have water quality criteria for comparison to the chlorophyll *a*, total nitrogen, and total phosphorus data.

There are few exceedances of the pH criterion of greater than or equal to 6.5 and less than or equal to 8.5. These pH values are lower than the 6.5 criterion. The lowest observed pH value is 5. Table B-4 in Appendix B presents a summary of the pH data in Noyes Slough.

There are 68 TSS (from 1991-2001) and 97 turbidity (from 2005-2007) observations in Noyes Slough. Alaska's sediment and turbidity criteria are based on background conditions; however, background conditions are not currently available for Noyes Slough. DEC collected additional sediment data throughout the watershed in 2009 that will be used along with data collected in 2011 and 2012 to determine whether Noyes Slough is still impaired and requires a TMDL for sediment or supports designated uses and can be delisted. DEC plans on collecting turbidity and TSS data from reference locations in their 2011 and 2012 sampling efforts to support data analysis (ADEC 2011b).

Pollutants with enough data were compared to flow to determine if there are any relationships between potential impairments and flow in Noyes Slough. Note that there are no continuous flow data available for Noyes Slough, so data were compared to flow data at USGS flow gage 15514000 (Chena River at Fairbanks, AK), which is located below the mouth of Chena Slough and above the inlet to Noyes Slough (Figure 4-1). Although the Chena River flow gage (15514000) does not represent the actual flow in the much smaller Noyes Slough, it was used to indicate times of high and low flow in the watershed in general. This assumes, for example, that during high flow in the Chena River it is also high flow in Noyes Slough. Note that Chena River must flow at about 2,400 cfs or more for flow to enter Noyes Slough (Burrows et al. 2000). Water typically flows in Noyes Slough for only 106 days during the open-water season. The pollutants compared to flow for Noyes Slough include DO, temperature, and turbidity.

There are several DO observations in Noyes Slough; however, most of them are on the same day at multiple stations. This did not allow for a useful comparison of DO versus flow over time. No trend between DO and flow was observed. There are continuous temperature data available for summer 2001 in Noyes Slough and comparison of the temperature data with the flow data show higher temperatures during periods of low flow. Comparison of the turbidity data to the Chena River flow does not show any strong turbidity/flow relationship (Figures C-1 through C-3, Appendix C).

Chena Slough

Chena Slough was included on Alaska's 2008 section 303(d) list for petroleum hydrocarbons, oil and grease, and sediment; however, the slough was delisted for petroleum hydrocarbons and oil and grease in 2010. A comparison of the data to the total aromatic hydrocarbons (TAH) and total aqueous hydrocarbons (TAqH) water quality criteria for petroleum hydrocarbons do not indicate impairment. Many of the observations were non-detects, which were treated as 0 (zero) for data analysis purposes and, therefore, do not exceed the water quality criteria (see Appendix A).

Additional petroleum hydrocarbon data were collected from Chena Slough by DEC in 2009. The 2009 data were collected and analyzed after the initial analysis of historical data presented above and are, therefore, presented separately. Petroleum hydrocarbon data were collected at four stations (CS1, CS2, CS3, and CS4) throughout the year, including during spring break up in May (Appendix A). All petroleum hydrocarbon data collected on Chena Slough in 2009 were non-detects, which were treated as 0 (zero) for data analysis purposes and, therefore, do not exceed the water quality criteria (see Appendix A). Sheens were observed on Chena Slough during the 2009 sampling event, but were likely caused by decomposing organic material. The sheen was observed both above and within the urban area and did not have an odor or the typical characteristics found with hydrocarbon sheens (ADEC 2010b).

In addition to TAH and TAqH, individual toxic pollutants were compared to water quality criteria. See Tables 3-2 and 3-3 in Section 3 for a list of toxic pollutants analyzed in this study. None of the available toxic pollutant data are exceeding the applicable water quality criteria. Many of the observations were non-detects, which were treated as 0 (zero) for data analysis purposes and, therefore, do not exceed the water quality criteria (see Appendix A).

There are 24 fecal coliform bacteria observations at 15 stations in Chena Slough. Four of these stations show exceedances of the "no more than 10 percent of samples greater than 40 count/100 mL" fecal coliform bacteria criterion, with a maximum value of 93 counts/100 mL at station 15512000 in August 2003. Table D-1 in Appendix D presents a summary of fecal coliform bacteria data in Chena Slough. Not enough data were available for comparison to the 30-day geometric mean criterion of less than 20 counts/100 mL.

There are 12 stations with a total of 32 iron and manganese observations in Chena Slough. None of the observations are exceeding the 1,000 µg/L aquatic life criterion for iron. Manganese observations are exceeding the 50 µg/L human health manganese criterion for consumption of water and aquatic organisms at 11 of the 12 stations. Table D-2 in Appendix D presents a summary of the manganese data that exceed water quality criteria in Chena Slough.

There are 10 stations with a total of 226 temperature observations for Chena Slough. Forty of these observations are exceeding the 15 °C temperature criterion. However, note that the maximum observation is 17.3 °C, which is only 1.3 °C over the criterion (Table D-3, Appendix D). There are nine DO observations for Chena Slough between 1993 and 2003. None of the observations are below the 7 mg/L DO criterion. There are 20 chlorophyll *a* observations, 21 total nitrogen observations, and 78 total phosphorus observations for Chena Slough (Appendix A). All of the chlorophyll a and total nitrogen data are from one sampling season in 1996. The total phosphorus data are from the 1996 sampling season as well as sampling events in 2003 and 2004. Alaska does not have water quality criteria for comparison to the chlorophyll *a*, total nitrogen, and total phosphorus data.

There are 12 stations with a total of 35 pH observations in Chena Slough. Only 1 of these observations is exceeding the criterion and is above the 8.5 limit (the observation is 8.7). Table D-4 in Appendix D presents a summary of the pH data in Chena Slough.

There are 20 TSS (from 2005-2007) and 31 turbidity (from 1993-1996) observations in Chena Slough. Alaska's sediment and turbidity criteria are based on background conditions; however, background conditions are not currently available for Chena Slough. DEC collected additional sediment data throughout the watershed in 2009 that will be used along with data collected in 2011 and 2012 to determine whether Chena Slough is still impaired and requires a TMDL for sediment or supports designated uses and can be delisted. DEC plans on collecting turbidity and TSS data from reference locations in their 2011 and 2012 sampling efforts to support data analysis (ADEC 2011b).

Pollutants with enough data were compared to streamflow to determine if there are any relationships between potential impairments and flow in Chena Slough. Note that there are no continuous flow data available for Chena Slough, so data were compared to flow data at USGS flow gage 15514000 (Chena River at Fairbanks, AK), which is located below the mouth of Chena Slough and above the inlet to Noyes Slough (Figure 4-1). Although the Chena River flow gage (15514000) does not represent the actual flow in the smaller Chena Slough, it was used to indicate times of high and low flow in the watershed in general. This assumes, for example, that during high flow in the Chena River it is also high flow in Chena Slough. The pollutants compared to flow for Chena Slough include chlorophyll *a*, fecal coliform bacteria, iron, manganese, temperature, total nitrogen, total phosphorus, and turbidity.

Several chlorophyll *a* observations were available for 1996 in Chena Slough. Comparison of the observations with the flow data shows the higher chlorophyll *a* values at times of low flow (Figure C-4, Appendix C).

The 2003 fecal coliform bacteria data for Chena Slough were compared to the Chena River flow since they were the most recent data. The comparison does not show a strong relationship between bacteria and flow; however the highest observations occur during lower flows (Figure C-5, Appendix C).

The most abundant and recent data for manganese were available for summer 2004 and were compared to the flow data. There was no strong relationship between flow and manganese (Figure C-6, Appendix C).

Daily temperature data were available in summer 1996 for Chena Slough. These temperature data were compared to the Chena River flow data and showed the same relationship that occurred in Noyes Slough. The higher temperatures occurred at low flows (Figure C-7, Appendix C).

Total nitrogen data from summer 1996 were also plotted with the flow data. There are not enough available data to determine whether or not there is a strong relationship with flow, but it appears that the higher nitrogen observations occurred during low flows (Figure C-8, Appendix C). Total phosphorus data from 2004 were also compared to the flow data, but there do not appear to be enough available data to show whether or not there is a relationship with flow (Figure C-9, Appendix C). Turbidity also did not show a strong relationship with flow (Figure C-10, Appendix C).

Chena River

The Chena River was included on Alaska's 2008 section 303(d) list for petroleum hydrocarbons, oil and grease, and sediment impairments. The Chena River was delisted for petroleum hydrocarbons, oil and grease impairments on the 2010 section 303(d) list. The river was initially included on the section 303(d) list for petroleum hydrocarbon impairments based on a qualitative assessment. DEC's *Statewide Water Quality Assessments* (1992 and 1994) indicate a suspected petroleum hydrocarbon problem because of visible sheen on the river as well as observed spills. Additional DEC documentation indicates snow melt from roadways and parking lots that flows into the stormwater system and eventually into the river as a potential pollutant source and a reason for including petroleum hydrocarbons on the section 303(d) list (ADEC e-mail correspondence 1997). Although the Chena River was included on Alaska's 2008 section 303(d) list for petroleum hydrocarbons, a comparison of the data to the total aromatic hydrocarbons (TAH) and total aqueous hydrocarbons (TAqH) water quality criteria for petroleum hydrocarbons does not indicate impairment. Many of the observations were non-detects, which were treated as 0 (zero) for data analysis purposes and, therefore, do not exceed the water quality criteria (see Appendix A).

Additional petroleum hydrocarbon data were collected from the Chena River by DEC in 2009. The 2009 data were collected and analyzed after the initial analysis of historical data presented above and are, therefore, presented separately. Petroleum hydrocarbon data were collected at four stations (CR1, CR2, CR3, and CR4) throughout the year, including during spring break up in May (Appendix A). The only petroleum hydrocarbon parameter observed above the method detection limit in 2009 was an Ethylbenzene sample at CR1 with a concentration of 1.7 µg/L, which is well below Alaska's water quality criterion for of 700 µg/L. All other petroleum hydrocarbon data collected on the Chena River in 2009 were non-detects, which were treated as 0 (zero) for data analysis purposes and, therefore, do not exceed the water quality criteria (see Appendix A). Sheens were observed on the Chena River during the 2009 sampling event, but were likely caused by decomposing organic material. The sheen was observed both above and within the urban area and did not have an odor or the typical characteristics found with hydrocarbon sheens (ADEC 2010b).

In addition to TAH and TAqH, individual toxic pollutants were compared to water quality criteria. See Tables 3-2 and 3-3 in Section 3 for a list of toxic pollutants analyzed in this study. None of the available toxic pollutant data are exceeding the applicable water quality criteria. Many of the observations were non-detects, which were treated as 0 (zero) for data analysis purposes and, therefore, do not exceed the water quality criteria (see Appendix A).

There are 4 DO observations at 2 stations in the Chena River collected between 1997 and 2003. None of the DO observations are below the 7 mg/L DO criterion. There are 34 temperature observations for the Chena River at four stations from 1997-2006. All 34 observations are below the 20°C temperature criterion applicable to the Chena River below Chena Slough. There is one station (SW02) in the Chena River with 10 total phosphorus observations. There are no other nutrient data available for the Chena

River (see Appendix A). Alaska does not have water quality criteria for comparison to the total phosphorus data.

There are also 34 pH observations in the Chena River collected between 1994 and 2006. All of the pH observations meet the applicable water quality criteria (Appendix A).

There are 25 TSS (from 2005-2007) and 29 turbidity (from 1997-2006) observations in the Chena River. Alaska's sediment and turbidity criteria are based on background conditions; however, background conditions are not currently available for the Chena River. DEC collected additional sediment data throughout the watershed in 2009 that will be used along with data collected in 2011 and 2012 to determine whether the Chena River is still impaired and requires a TMDL for sediment or supports designated uses and can be delisted. DEC plans on collecting turbidity and TSS data from reference locations in their 2011 and 2012 sampling efforts to support data analysis (ADEC 2011b).

TSS and turbidity data were compared to flow in the Chena River to determine if there is any relationship between flow and sediment in the river. The TSS data were compared to flow data at USGS flow gage 15514000 (Chena River at Fairbanks, AK) (Figure 4-1); however no relationship was observed based on the few TSS data available (Figure C-11, Appendix C). Tom Douglas (2008) performed a yearlong water quality study in the Chena River, which included flow and turbidity (among other data). The flow and turbidity from Douglas's study were plotted against each other and also did not show a strong relationship between the two (Figure C-12, Appendix C).

Beaver Springs

There are three benzo(a)pyrene observations in Beaver Springs that were compared to the water quality criterion of 0.000028 mg/L. None of the benzo(a)pyrene observations are exceeding the applicable water quality criteria. All of the observations were non-detects, which were treated as 0 (zero) for data analysis purposes and, therefore, do not exceed the water quality criteria (see Appendix A).

There are two stations with one manganese observation each in Beaver Springs. Both of these observations are exceeding the 50 µg/L human health criterion. Table E-1 in Appendix E presents a summary of the metals data that exceed water quality criteria in Beaver Springs.

There are two stations with two pH and iron observations each from September 2003. Neither of these observations is exceeding the applicable water quality criteria. There are no DO or temperature data available for comparison to the water quality criteria.

There were not enough data at Beaver Springs for comparison with flow data.

4.2.2. Stormwater Data

Prior to 2006 there were limited stormwater data available (Gould 2002), but since 2006, the city of Fairbanks and FNSB have been collecting outfall data as part of their stormwater monitoring program. This section summarizes the stormwater data available from the Fairbanks Urbanized Area (FUA 2006-2010). The stormwater data include observations of several pollutants. However, only those pollutants determined to be potential causes of impairment during the surface water data analysis were analyzed. Therefore, BTEX, dissolved oxygen, oil & grease, PAH, pH, temperature, and TSS stormwater data were compared to surface water quality criteria. There were no nutrient stormwater data available. The stormwater sampling locations are shown in Figure 4-10.

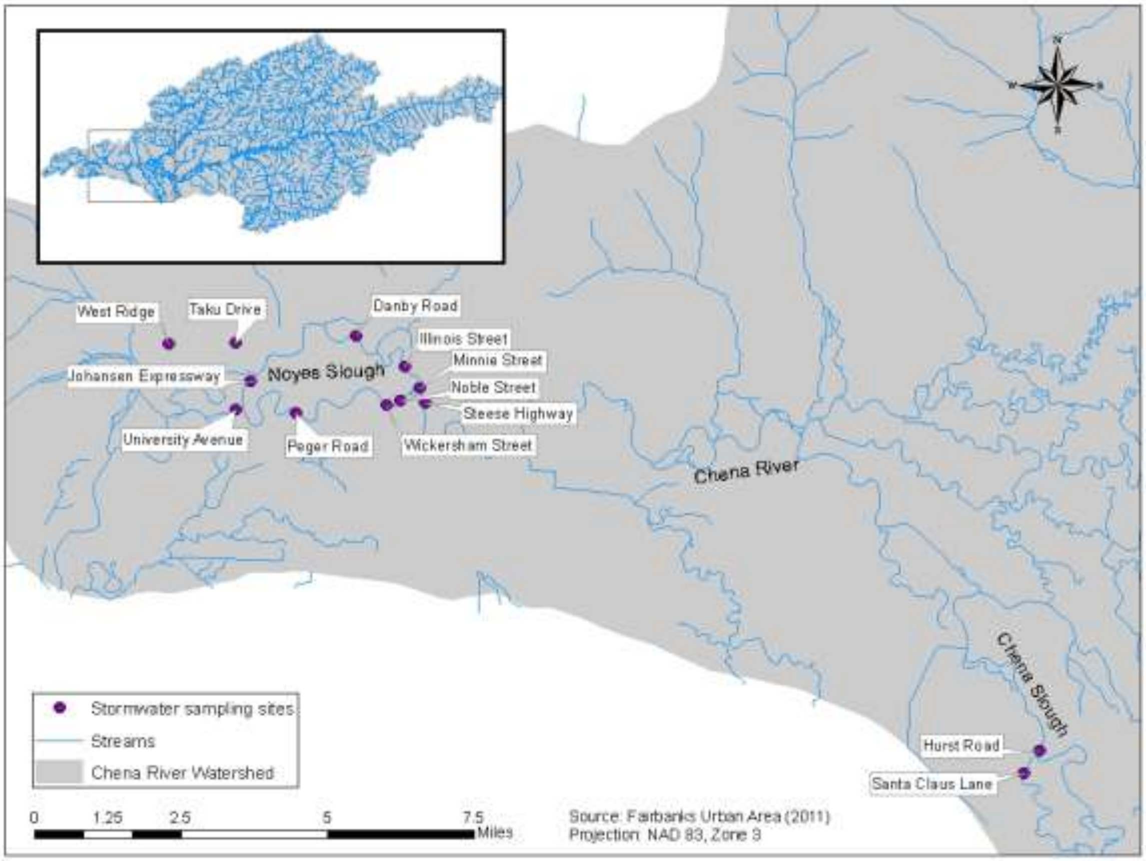

Figure 4-10. Locations of stormwater quality sampling.

There are 13 stormwater sampling locations for BTEX and a total of 54 BTEX observations in the Chena River watershed (FUA 2006-2010). All observations are below the MDL or MRL except the April 2009 observation at the Illinois Street outfall, which drains to Noyes Slough (Table F-1, Appendix F). The BTEX observation at this station is 15.1 µg/L and exceeds the 10 µg/L surface water criterion for TAH (BTEX = TAH).

There are 13 stormwater sampling locations for oil & grease and a total of 54 oil & grease observations in the Chena River watershed (FUA 2006-2010). Alaska does not have numeric criteria for oil & grease for comparison to the observations. Oil & grease was observed at 7 of the 13 sampling locations. Samples at the remaining stations were below the MDL or MRL. All observations above the MDL or MRL were collected at outfalls on either Noyes Slough or the Chena River. The maximum oil & grease observation was 11 mg/L at the Danby Road and Johansen Expressway outfalls to Noyes Slough in September 2008. A summary of the available oil & grease stormwater data is presented in Table F-2 in Appendix F.

There are 12 stormwater sampling locations for PAH and a total of 26 PAH observations in the Chena River watershed (FUA 2006-2010). All PAH observations are below the MDL or MRL and are, therefore, treated as 0 (Table F-3, Appendix F). DEC completed, and EPA approved, a TMDL for the sheen component of the petroleum hydrocarbons, oil and grease standard in November 2011. Noyes Slough does not fully support its designated uses due to the occurrence of visible sheens on the waterbody. The sheens can indicate the presence of petroleum hydrocarbons. Since the narrative water quality criterion for oil & grease and petroleum hydrocarbons does not allow for any visible sheens on surface waters, the TMDL for sheens in Noyes Slough is set to zero.

There are 10 stormwater sampling locations for dissolved oxygen and a total of 23 dissolved oxygen observations in the Chena River watershed (FUA 2006-2010). Alaska's water quality criteria require DO to be > 7 mg/L and the concentration of total dissolved gas may not exceed 110% saturation at any point of sample collection. Dissolved oxygen observations are below the 7 mg/L criterion at 9 of the 10 sampling locations and the % saturation is above 110% at 5 of the 10 stations (Table F-4, Appendix F). The lowest dissolved oxygen observation was 0.03 mg/L at the Santa Claus Lane outfall to Beaver Springs in September 2008 and the highest % saturation was 428.5% in September 2008 at the Steese Highway outfall to the Chena River.

There are 13 stormwater sampling locations for pH and a total of 56 pH observations in the Chena River watershed (FUA 2006-2010). Only one of the pH observations is exceeding Alaska's pH water quality criterion of greater than or equal to 6.5 and less than or equal to 8.5. A pH observation of 8.54 was observed in April 2009 at the Johansen Expressway outfall on Noyes Slough (Table F-5, Appendix F).

There are 10 stormwater sampling locations for temperature and a total of 23 temperature observations in the Chena River watershed (FUA 2006-2010). None of the temperature observations is exceeding Alaska's surface water temperature criterion of > or = 15 °C (Table F-6, Appendix F).

There are 13 stormwater sampling locations for TSS and a total of 56 TSS observations in the Chena River watershed (FUA 2006-2010). Alaska's sediment criteria are based on background conditions; however, background conditions are not currently available for the Chena River watershed. Therefore, Alaska does not currently have numeric criteria for comparison to the TSS observations. DEC plans on collecting TSS data from reference locations during their 2011 and 2012 sampling efforts to support data analysis (ADEC 2011b). The maximum TSS observation was 708 mg/L at the Johansen Expressway outfall on Noyes Slough in September 2008 (Table F-7, Appendix F). The minimum observation was 2.4 mg/L in August 2006 at the Santa Claus Lane outfall on Beaver Springs (Table F-7, Appendix F).

4.2.3. Groundwater Data

Groundwater data for the Chena River watershed were available from USGS and Scharfenberg (2004). Note that these data do not include all groundwater data available in the watershed. Several groundwater studies are already ongoing or have been completed for contaminated sites in the Chena River watershed. See Section 5.1.5 and 5.1.6 for more detail on the contaminated sites. The groundwater data include observations of several pollutants. However, only those pollutants determined to be potential causes of impairment during the surface water data analysis were analyzed. Therefore, fecal coliform bacteria, metals, nitrite-nitrate, DO, and temperature groundwater data were compared to water quality criteria. There are no water quality criteria for comparison to the sediment and nutrient data. Figure 4-11 shows the locations of the groundwater stations. Note that because of the large number of groundwater sampling locations in the watershed, only those stations with observations exceeding the water quality standards are included in Figure 4-11 and that the stations included in Groups 1, 2, and 3 are listed in Table 4-3.

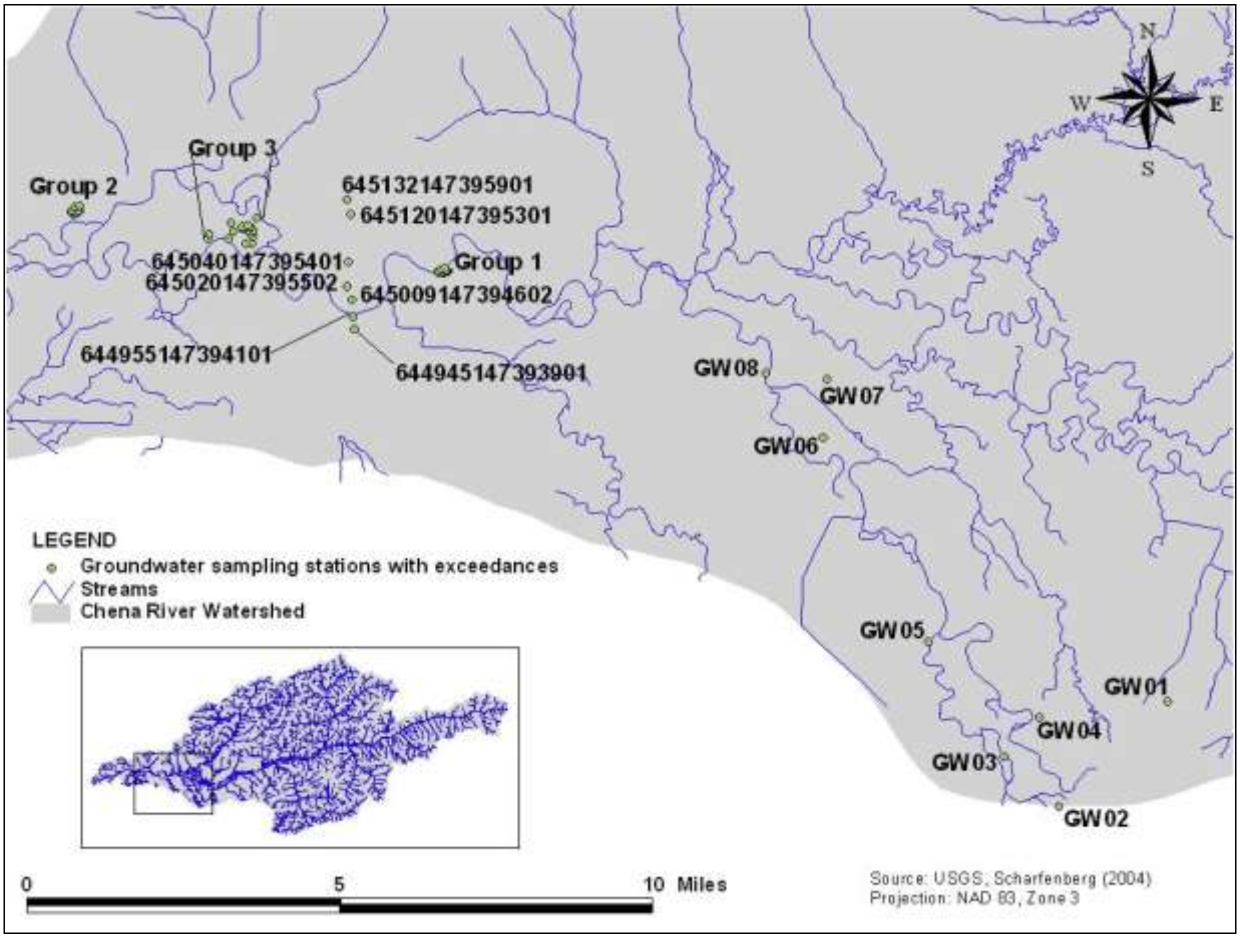

Figure 4-11. Location of groundwater quality sampling stations.

Table 4-3. Groundwater Stations in Groups 1, 2, and 3

Group number	Station number
1	645033147364801
	645033147365704
	645034147364101
	645034147364102
	645034147364201
	645034147364801
	645034147364901
	645035147364002
	645035147364003
	645035147364004
	645035147364202
	645035147364204
	645035147364205
	645035147364206
	645035147364207

Group number	Station number
	645035147364302
	645035147364303
	645035147364304
	645035147365902
	645035147365909
	645036147365101
	645036147365301
	645037147364601
	645037147364701
	645113147485301
	645114147484401
	645115147485001
	645115147485701
2	645116147485501
	645117147484001
	645117147484301
	645119147485001
	645121147484001
	645053147430301
	645053147431501
	645056147442901
	645057147434801
	645057147434901
	645057147434902
	645059147430101
	645100147442601
	645101147430601
3	645103147434001
	645104147430201
	645104147431101
	645105147432101
	645107147430601
	645107147431701
	645107147432301
	645108147431101
	645110147434501
	645115147425401

There was one fecal coliform bacteria observation (0.5 counts/100 mL) at station 644402147182601 in the Chena River watershed and it was below the water quality criterion of < 1 FC/100 mL (FC Membrane Filter Technique) or < 3 FC/100 mL (MPN). Table G-1 in Appendix G contains a summary of the fecal coliform bacteria groundwater data.

There are 14 groundwater sampling stations for iron and a total of 39 iron observations in the Chena River watershed. Eight of the stations have exceedances of the 1,000 µg/L chronic aquatic life criterion. Fifty to 100 percent of the observations are exceeding the iron criterion at these stations. The maximum iron observation is 16,000 µg/L at station 645113147485301 on July 5, 1995 (Table G-2, Appendix G).

There are 32 groundwater sampling stations for manganese and a total of 67 manganese observations in the Chena River watershed. All but two of the observations exceed the 50 µg/L manganese criterion. The maximum manganese observation is 6,380 µg/L at station GW02 in spring 2004 (Table G-3, Appendix G).

In addition to the iron and manganese data, there are 30 copper observations at USGS station 645001147445302 in August 1996. None of these observations are exceeding the 0.0147 mg/L copper criterion for Noyes Slough (calculated based on hardness). Table G-4 in Appendix G presents a summary of the available copper groundwater data.

There are 67 groundwater sampling stations for dissolved oxygen and a total of 133 dissolved oxygen observations in the Chena River watershed. All but one of the observations exceed the > 7 mg/L DO criterion. The minimum DO observation is 0 mg/L at several stations (Table G-5, Appendix G).

There are 11 stations with nitrite observations and 11 with nitrite-nitrate observations. None of the observations are exceeding their respective water quality criteria (Table G-6, Appendix G).

There are 73 stations with temperature data and a total of 183 observations. None of the observations are exceeding the 15 °C criterion (Table G-7, Appendix G).

4.3. Non-pollutant Impairments

Kennedy et al. (2004) conducted a study in 2001-2002 to assess fish habitat, water quality, and contaminants in streambed sediments in Noyes Slough. The study found that the availability of physical habitat for fish in Noyes Slough does not appear to be limited, although some beaver dams and shallow water may restrict movement, particularly during low flow. Kennedy et al. (2004) found that elevated summer water temperatures and low dissolved-oxygen in the slough are the main factors that adversely affect water quality in Noyes Slough. They also found that increased streamflow mitigated poor water-quality conditions and reduced the number of possible fish barriers; therefore, flow appears to be strongly shaping water quality and fish habitat in Noyes Slough.

Ihlenfeldt (2006) cites the sloughs in the Chena River watershed as important to Arctic grayling (*Thymallus arcticus*) spawning and rearing habitat. Increased urbanization and development along the sloughs has caused degradation of fish spawning and rearing habitat. Chena Slough, Beaver Springs, and Noyes Slough are some of the most prominent sloughs in the area. Chena Slough (between Chena River and Nordale Road crossing) and Noyes Slough are listed in the *Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes* as they support Chinook (*Oncorhynchus tshawytscha*) and chum (*O. keta*) salmon spawning and rearing.

The U.S. Army Corps of Engineers' *Chena River Watershed Reconnaissance Report* (1997) identifies potential non-pollutant impairments in the Chena River watershed including a lack of quality brood production habitat for waterfowl and limited spring and fall migratory bird habitat in and around the Fairbanks/North Pole area. Degraded aquatic habitat has also been observed on tributaries of the Little Chena River because of mining.

In September 2010 an invasive plant, *Elodea canadensis*, was documented growing in extensive populations along Chena Slough and isolated populations in the Chena River (FSWCD 2011, Larsen et al. 2010). *Elodea canadensis*, also known as common waterweed or Canadian waterweed, is a submersed aquatic plant that forms tangled masses and spreads easily via fragmentation (Larsen et al. 2010). *Elodea* could cause numerous negative impacts to the watershed, including degraded fish habitat, reduction of native plant species, reduced recreational opportunities, more difficult boat travel, and alteration of freshwater habitat. A group of concerned citizens and key agency personnel met in December 2010 to discuss options for action regarding *Elodea*. A steering committee and action committees were formed, and plans were made for education, survey, control, research, and funding.

4.4. Summary

Table 4-4 and sections 4.4.1 through 4.4.4 present a summary of conclusions based on the surface water quality data analysis for the Chena River watershed. The parameters that are exceeding water quality criteria are indicated with an X in Table 4-4.

Table 4-4. Summary of Water Quality Data Analysis[a,b]

	Waterbody			
Parameter	**Noyes Slough**	**Chena Slough**	**Chena River**	**Beaver Springs**
TAH	--	--	--	NA
TAqH	--	--	--	NA
Visible sheen[c]	X	--	--	NA
Fecal coliform bacteria	--	X	NA	NA
Copper	X	NA	NA	NA
Iron	X	--	--	--
Manganese	--	X	--	X
Dissolved oxygen	X	--	--	NA
Temperature	X	X	--	NA
pH	X	X	--	--

[a]Note that Table 4-4 does not summarize all available data, but only those data showing exceedances of the applicable water quality criteria and data for parameters related to potential impairments (parameters of concern).
[b]X indicates that one or more observation is exceeding the applicable water quality criteria and does not necessarily indicate impairment; -- indicates that available data are meeting applicable water quality criteria; NA indicates that no data are available for this parameter
[c]Note that the visible sheens on Chena Slough and Chena River were likely caused by decomposing organic material, not petroleum hydrocarbons (ADEC 2010b).

4.4.1. Noyes Slough

Although petroleum hydrocarbons are included on the section 303(d) list, the petroleum hydrocarbon observations do not exceed the TAH and TAqH water quality criteria and exhibit uniformly low levels of PAH concentrations in the water column. A recent Brownfield assessment report for Noyes Slough (URS 2010) also indicated that concentrations of petroleum hydrocarbons in the sediments of the slough were below the Threshold Effects Levels (TELs) and Probable Effects Levels (PELs) that are used as screening values for evaluating sediment quality (NOAA SQuiRTs; Buchman 2008). TELs define chemical sediment concentrations below which toxic effects are rarely observed in sensitive species, while PELs define concentrations above which effects are frequently or always observed.

There are no numeric oil and grease data available for Noyes Slough; however, Parsons (2006) noted some “visible sheen” on the slough in 2005 as did DEC in its 2007 and 2009 sampling efforts. Alaska’s water quality criteria for oil and grease are narrative, stating that pollutants may not cause a visible sheen upon the surface of the water. The main sources of oil and grease appear to be urban runoff, Fort Wainwright, and the Brownfield sites discussed in Section 5.

Based on the data analysis, metals may also threaten Noyes Slough in addition to the impairments already included on the section 303(d) list. There are currently exceedances of the iron and copper water quality criteria in Noyes Slough, but this is only based on 4 iron and 2 copper observations. Additional metals data are recommended for determining impairment.

Low DO and high temperature data indicate that eutrophication might be an issue in Noyes Slough. Low DO and high temperature in the slough might be a result of the low flow issues (see Section 2.2), since nutrient input to the slough is not regularly washed out or diluted by streamflow.

Data analysis does indicate some low pH observations; however, there are few exceedances of the pH criterion (< 6.5), with the lowest observed pH value being 5. The most recent pH data available for Noyes Slough are from September 2003.

None of the fecal coliform bacteria observations are exceeding the criteria; however, the most recent fecal coliform bacteria data available for Noyes Slough are from June 2003.

Alaska’s sediment and turbidity criteria are based on background conditions; however, background conditions are not currently available for Noyes Slough. Therefore, comparison of the sediment and turbidity data to water quality criteria was not possible. DEC collected additional sediment data throughout the watershed in 2009 that will be used along with data collected in 2011 and 2012 to determine whether Noyes Slough is still impaired and requires a TMDL for sediment or supports designated uses and can be delisted. DEC plans on collecting turbidity and TSS data from reference locations in their 2011 and 2012 sampling efforts to support data analysis (ADEC 2011b).

A study in 2001-2002 to assess fish habitat, water quality, and contaminants in streambed sediments in Noyes Slough (Kennedy et al. 2004) found that the availability of physical habitat for fish in Noyes Slough does not appear to be limited, although some beaver dams and shallow water may restrict movement, particularly during low flow. The study indicates that flow, specifically the lack of flow, appears to be shaping water quality and fish habitat in Noyes Slough.

4.4.2. Chena Slough

As with Noyes Slough, petroleum hydrocarbons were included on the 2008 section 303(d) list for Chena Slough. However, available data do not show exceedance of the TAH and TAqH water quality criteria. The data analysis supports the *Delisting Document for Chena River, Chena Slough, and Noyes Slough, Alaska (Section 303(d) listed for PHC/Oil & Grease, TSS)* (Parsons 2006) that indicates that petroleum hydrocarbons (as represented by PAHs) should be delisted based on uniformly low levels of PAH concentrations in both the water column and sediment. Based on the additional petroleum hydrocarbon data collected in 2009, DEC has delisted Chena Slough for petroleum hydrocarbon impairment (ADEC 2010a).

There are no numeric oil & grease data available for Chena Slough; however, Parsons (2006) noted some “visible sheen” on the slough in 2005 as did DEC in its 2007 and 2009 sampling efforts. Alaska’s water quality criteria for oil & grease are narrative (may not cause a visible sheen upon the surface of the water). DEC (2010b) noted that sheens were observed on Chena Slough during the 2009 sampling event, but were likely caused by decomposing organic material. The sheen was observed both above and within the urban area and did not have an odor or the typical characteristics found with hydrocarbon sheens. Therefore, Chena Slough has been delisted for oil and grease impairments (ADEC 2010a).

Based on the data analysis, fecal coliform bacteria, metals, and high water temperature may also threaten Chena Slough in addition to the impairments already include on the section 303(d) list. There are some exceedances of the fecal coliform bacteria criterion; however, because there are few observations, continued monitoring is recommended to determine impairment and potential sources.

There are currently several exceedances of the manganese water quality criteria in Chena Slough. Because there are limited data, additional data are recommended to confirm any impairment and determine the extent of the impairment and potential sources.

Alaska's 2004 Integrated Report indicated nutrients as a potential impairment for Chena Slough. Although nutrients are not mentioned as a potential impairment in the 2010 Integrated Report, DEC staff has indicated that nutrients are still a potential pollutant of concern in the slough. All dissolved oxygen observations are above the 7 mg/L criterion; however, there are exceedances of the 15°C temperature criterion. Additional data would be helpful in determining impairment and identifying potential sources.

Eutrophication is degrading the fisheries habitat and community recreational value of Chena Slough, with nuisance algae, rooted aquatic plant growth, and excessive accumulation of organic fines (Scharfenberg 2004). In September 2010 an invasive aquatic plant, *Elodea canadensis*, was observed growing in extensive populations along Chena Slough and isolated populations in the Chena River (FSWCD 2011, Larsen et al. 2010). *Elodea canadensis* has the potential to degrade fish habitat, reduce native plant species, reduce recreational opportunities, make boat travel difficult, and alter freshwater habitat.

Data analysis shows only one exceedance of the 8.5 pH criterion. The most recent pH data available for Chena Slough are from September 2003. Additional data would be helpful in determining impairment and identifying potential sources.

Alaska's sediment and turbidity criteria are based on background conditions; however, background conditions are not currently available for Chena Slough. Therefore, comparison of the sediment and turbidity data to water quality criteria was not possible. DEC collected additional sediment data throughout the watershed in 2009 that will be used along with data collected in 2011 and 2012 to determine whether Chena Slough is still impaired and requires a TMDL for sediment or supports designated uses and can be delisted. DEC plans on collecting turbidity and TSS data from reference locations in their 2011 and 2012 sampling efforts to support data analysis (ADEC 2011b).

4.4.3. Chena River

As with Noyes and Chena Sloughs, petroleum hydrocarbons were included on the 2008 section 303(d) list, but data do not show exceedances of the TAH and TAqH water quality criteria. The data analysis supports the *Delisting Document for Chena River, Chena Slough, and Noyes Slough, Alaska (Section 303(d) listed for PHC/Oil & Grease, TSS)* (Parsons 2006) that indicated that petroleum hydrocarbons (as represented by PAHs) should be delisted based on uniformly low levels of PAH concentrations in both the water column and sediment. Based on the additional petroleum hydrocarbon data collected in 2009, DEC has delisted the Chena River for petroleum hydrocarbon impairment (ADEC 2010a).

Parsons (2006) noted some "visible sheen" on the river in 2005. Alaska's water quality criteria for oil & grease are narrative (may not cause a visible sheen upon the surface of the water). ADEC (2010b) noted that sheens were observed on the Chena River during the 2009 sampling event, but were likely caused by decomposing organic material. The sheen was observed both above and within the urban area and did not have an odor or the typical characteristics found with hydrocarbon sheens. Therefore, the Chena River has been delisted for oil and grease impairments (ADEC 2010a).

None of the DO or temperature data for the Chena River are exceeding their respective criteria; however, additional data for nutrient-related parameters, including DO, and temperature, are recommended to determine if eutrophication is a threat to the river.

None of the pH observations in the Chena River are exceeding the applicable water quality criteria; however, the most recent pH data are from 2006.

Alaska's sediment and turbidity criteria are based on background conditions; however, background conditions are not currently available for the Chena River. Therefore, comparison of the sediment and turbidity data to water quality criteria was not possible. DEC collected additional sediment data throughout the watershed in 2009 that will be used along with data collected in 2011 and 2012 to determine whether the Chena River is still impaired and requires a TMDL for sediment or supports designated uses and can be delisted. DEC plans on collecting turbidity and TSS data from reference locations in their 2011 and 2012 sampling efforts to support data analysis (ADEC 2011b).

4.4.4. Beaver Springs Conclusions

Manganese is exceeding the water quality criteria in Beaver Springs, but there are only two observations from 2003. In general there are not many data available for Beaver Springs. Additional data would be helpful in determining any impairments and identifying potential sources.

All pH and iron observations (from September 2003) are meeting the applicable water quality criteria. There are no DO or temperature data available for comparison to the water quality criteria in beaver Springs.

5. Potential Pollutant Sources

The identification of pollutant sources is important to the successful implementation of a watershed plan and the control of pollutant loading to a stream. Characterizing watershed sources can provide information on the relative magnitude and influence of each source and its impact on in-stream water quality conditions. This section discusses the potential pollutant sources in the watershed, including point and nonpoint sources.

The pollutant source identified on the 2010 section 303(d) list for Noyes Slough, Chena Slough, and the Chena River is urban runoff.

5.1. Point Sources

5.1.1. NPDES Permits

A search of EPA's Integrated Compliance Information System (ICIS) database was conducted to find National Pollutant Discharge Elimination System (NPDES) permitted facilities in the cities of Fairbanks, Fort Wainwright, North Pole, Fox, Skiland, Two Rivers, and Pleasant Valley. After mapping the facilities in GIS using location information and consulting with DEC staff, it was found that 29 NPDES facilities are in the Chena River watershed (Appendix H).

5.1.2. Placer Mining

Placer mining is the mining of any mineral (typically gold) that has been concentrated by erosion in stream, river, or glacial gravels. Surface excavation is the most common form of placer mining, however, underground placer mines do exist (NAEC 2002). Mining has historically taken place in the Fish Creek subwatershed of the Chena River watershed (USACE 1997). Fish Creek is a tributary to the Little Chena River, which is the largest tributary to the Chena River.

Placer mining has taken place in the Fish Creek watershed since the early 1900s and has disturbed a substantial part of the surface of the valley bottom along the length of Fish Creek (USACE 1997). Disturbance from placer mining is also apparent along Monte Cristo, Barnes, Pearl, Yellow Pup, and Last Chance Creeks. All the drainages within the Fish Creek watershed, except Upper Barnes and Solo Creeks, have been affected by previous mining operations. The Little Chena River and its tributaries upstream of Fish Creek have not been mined to the extent of Fish Creek and should have relatively pristine water quality (USACE 1997).

DEC has identified 14 active placer mines in the Chena River watershed (Table 5-1).

Table 5-1. Active Placer Mines in the Chena River Watershed

Name	Owner	Facility ID	Latitude*	Longitude
Ester Creek	Kevin Bergman	AKG370335	64.850000	-148.083333
Ester Creek	Earl W. Voytilla	AKG370821	--	--
Fairbanks Creek	Steven R. Gavora	AKG370647	--	--
Fairbanks Creek	Earth Movers of Fairbanks, Inc.	AKG370459	--	--
Fairbanks Creek	Paul Manual	AKG370828	--	--
Happy Creek	Silverado Gold Mines	AKG370182	64.879722	-147.960000
Nugget Creek	David A. Eberhardt	AKG370774	--	--
Nugget Creek	Kenneth Monzulla	AKG370770	--	--

Name	Owner	Facility ID	Latitude*	Longitude
Ottertail Creek	Walter and William Bohan	AKG370877	145 52'17.608"W	64 57'20.997"N
Ottertail Creek	Walter and William Bohan	AKG371269	145 52'17.608"W	64 57'20.997"N
Ready Bullion Creek	Gerald Hassel	AKG370577		
Shamrock Creek	Keith Clark	AKG370782	145 22'59.574"W	64 59'3.091"N
Sullivan Creek	David A. Eberhardt	AKG370719	64.886366	-147.462776
Victoria Creek	Fred Heflinger	AKG370695	65.129189	-147.844179

*Location information is provided where available.

5.1.3. Construction and Industrial Stormwater

As of October 31st, 2009, DEC is now the stormwater permitting authority in Alaska. Notice of Intents (NOIs) prior to October 2009 were searched for in the EPA eNOI database and NOIs post-October 2009 were searched for in Alaska's eNOI database. According to the Instructions for Completing a NOI Form for Stormwater Discharges Associated with Construction Activity Under an Alaska Pollutant Discharge Elimination System (APDES) Construction General Permit, operators of construction sites where one or more acres are disturbed or smaller sites that are part of a larger common plan of development where there is a cumulative disturbance of at least one acre must submit a NOI to obtain coverage under an APDES construction general permit. Rainwater and snowmelt can run off construction and industrial sites and pick up pollutants such as sediment, heavy metals, oil and grease, litter/debris, nutrients and many other pollutants on the way to nearby waterbodies.

A search of EPA's eNOI database was conducted to search for NOIs submitted for the cities of Fairbanks, Fort Wainwright, North Pole, Fox, Skiland, Two Rivers, and Pleasant Valley. After mapping the NOIs in GIS, it was found that there are 117 active NOI records in the Chena River watershed (Appendix I). The majority (95) of the permits are construction general permits. The remaining permits are multi-sector general permits (11 industrial stormwater permits, three low erosivity waivers, and eight no exposure applications).

A search of DEC's eNOI database was also conducted to search for NOIs submitted for the cities of Fairbanks, Fort Wainwright, North Pole, Fox, Skiland, Two Rivers, and Pleasant Valley. The search of DEC's eNOI database found 226 active NOI records in these cities. Note that although these NOIs were submitted for the aforementioned cities, they might not all be located in the Chena River watershed. DEC's eNOI database did not provide location information; therefore, it was not possible to map the permits. A list of these NOIs in included in Appendix J.

5.1.4. Municipal Stormwater Permits

Municipal stormwater systems are possible point source contributors to the watershed. Stormwater discharges are generated by runoff from urban land and impervious areas such as paved streets, parking lots, and rooftops during precipitation events. These discharges often contain high concentrations of pollutants such as sediment, oil and grease, solvents, detergents, heavy metals, litter/debris, pesticides, fertilizers, nutrients, and pathogens that can eventually enter nearby waterbodies. Many stormwater discharges are considered point sources and require coverage by an APDES permit.

Under the APDES stormwater program, operators of large, medium, and regulated small municipal separate storm sewer systems (MS4s) must obtain authorization to discharge pollutants. The Stormwater Phase I Rule (55 *Federal Register* 47990, November 16, 1990) requires all operators of medium and large

MS4s to obtain an NPDES permit and develop a stormwater management program. Medium and large MS4s are defined by the size of the population within the MS4 area, not including the population served by combined sewer systems. A medium MS4 has a population of between 100,000 and 249,999. A large MS4 has a population of 250,000 or more.

Phase II requires a select subset of small MS4s to obtain an NPDES stormwater permit. A small MS4 is any MS4 not already covered by the Phase I program as a medium or large MS4. The Phase II Rule automatically covers all small MS4s in urban areas, as defined by the Bureau of the Census. It also includes small MS4s outside an urban area that are so designated by NPDES permitting authorities, case by case (USEPA 2000).

There are no Phase I MS4 permits in the Chena River watershed; however, there are two Phase II MS4 permits (AKS-053406 and AKS-053414). MS4 permit AKS-053406 includes the city of Fairbanks, the city of North Pole, the University of Alaska - Fairbanks, and the Alaska Department of Transportation and Public Facilities - Northern Regional Office. MS4 permit AKS-053414 includes the Fairbanks North Star Borough. The urban area included in the MS4 permits is shown in Figure 5-1. The locations of stormwater outfalls in the Chena River watershed are presented in Figure 5-2.

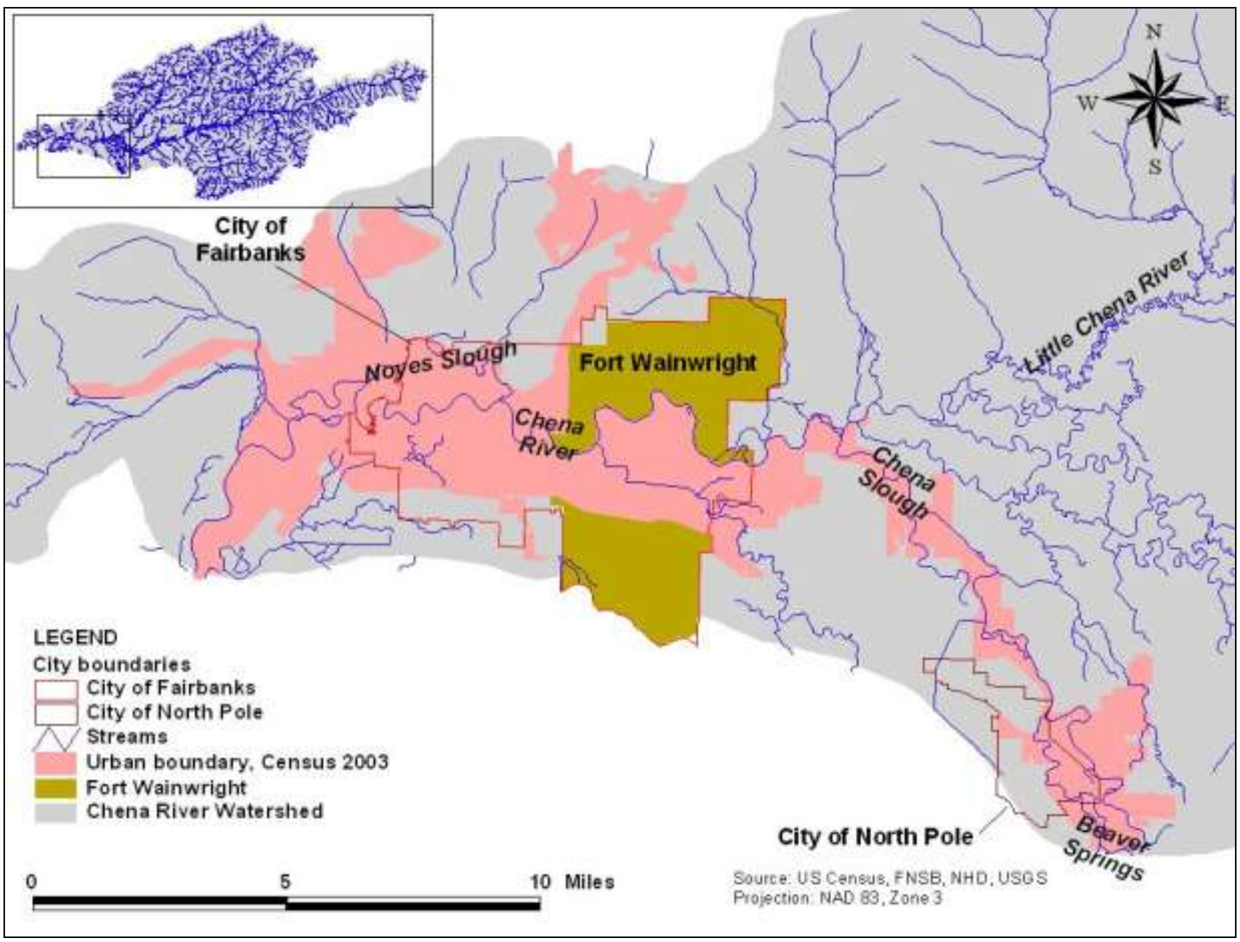

Figure 5-1. Urban area covered by municipal stormwater permits.

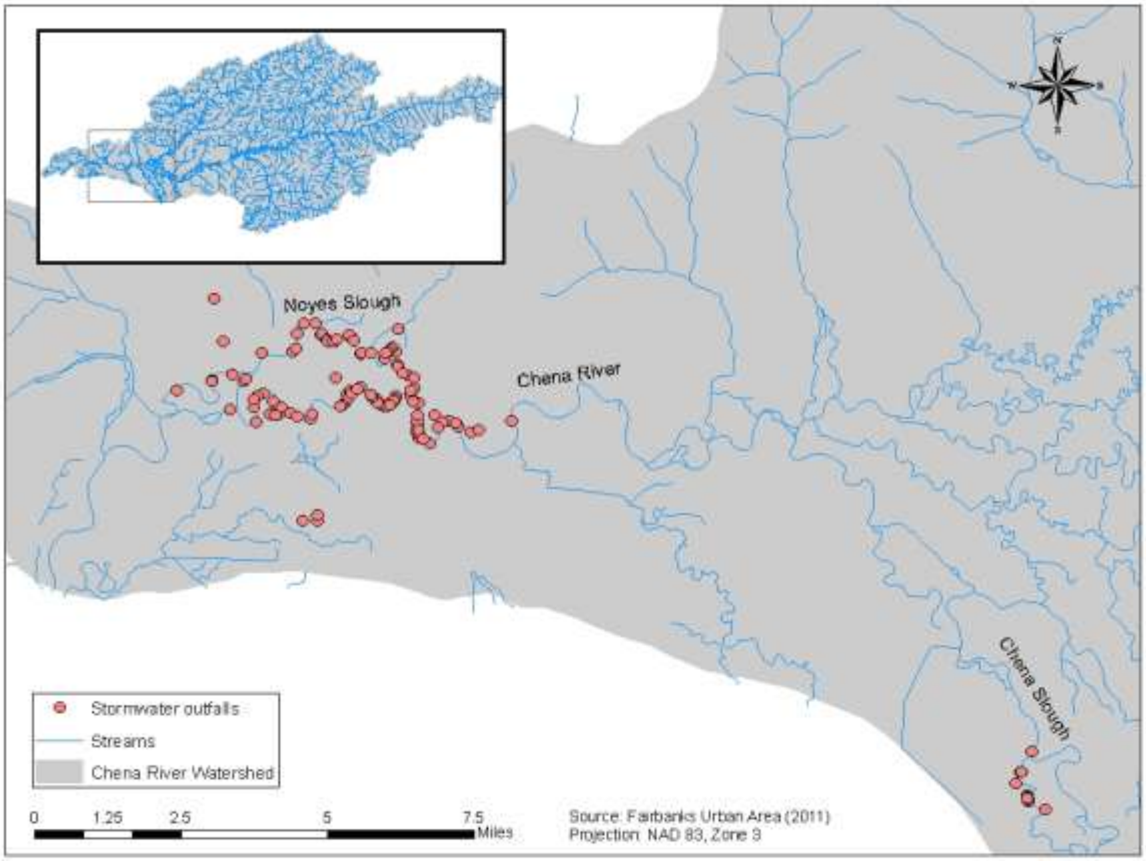

Figure 5-2. Location of stormwater outfalls in the Chena River watershed.

5.1.5. CERCLA Sites

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund, was established to address abandoned hazardous waste sites (USEPA 2007a). CERCLA allows the USEPA to clean up hazardous waste sites and for responsible parties to perform cleanups or reimburse the government for USEPA-lead cleanups. The Superfund process involves the assessment of sites, placement of sites on the National Priorities List (NPL), and the establishment and implementation of cleanup plans. DEC has identified three CERCLA sites in the Chena River watershed: 1) Alaska Battery Enterprises, 2) Arctic Surplus, and 3) Fort Wainwright. Note that Alaska Battery Enterprises and Arctic Surplus have been cleaned up and removed from the National Priorities List (NPL).

Alaska Battery Enterprises (EPA ID AKD004904215) was a battery recycling facility on about 1 acre that operated from the early 1960s until about 1988 (USEPA 2010). It is located approximately 1 ½ miles south of Fairbanks in a light industrial and residential area. The primary contaminant of concern at the site was high concentrations of lead in the soil from the disposal of battery acid directly into the soil. The site was deleted from the NPL on July 1996.

The Arctic Surplus (EPA ID AKD980988158) site occupies approximately 25 acres and is located six miles southeast of Fairbanks (USEPA 2007b). Salvage operations were conducted at the site, which accepted military equipment and materials, asbestos insulation, and various oils. In addition, battery cracking and transformer burning operations were conducted to recover metals. In 1988, DEC conducted a site inspection and detected elevated levels of metals on-site. Significant amounts of bulk asbestos and thousands of drums of liquid waste were also found on-site. On-site groundwater was contaminated with trichloroethylene (TCE). On-site soil was contaminated with industrial solvents, polychlorinated biphenyls (PCBs), and lead. Clean-up has been completed and the site was deleted from the NPL in September 2006.

Fort Wainwright (EPA ID AK6210022426) encompasses over 900,000 acres on the eastern boundary of Fairbanks (USEPA 2007c). The main purpose of Fort Wainwright is to train soldiers and test equipment in arctic conditions. The Chena River runs through the contaminated area of Fort Wainwright. In most source areas, groundwater is contaminated with solvents and petroleum products. In a few source areas, groundwater is contaminated with pesticides and/or fuel additives. Soil contains some solvents, petroleum products, pesticides, lead and polynuclear aromatic hydrocarbons (PAHs). Sediments contain PAHs and low level pesticides. The site is being addressed through six project areas, each consisting of multiple source areas. A five-year review was completed for Fort Wainwright in September 2001 and a second five-year review was completed in September 2006. It was determined that all treatment systems and institutional controls are functioning as intended and that the selected remedies for the five project areas remain protective of human health and the environment. A sixth Project Area was discovered in 2005. This area is a former Communication Site, also known as Taku Gardens. After excavation for a new housing project, PCBs were discovered. High level PCBs, UXO, munition constituents, RDX, herbicides, petroleum products, metal debris and solvents were discovered at this apparent scrap disposal area. Physical cleanup activities have been completed at the Fort Wainwright site.

5.1.6. Contaminated Sites

In addition to the three CERCLA sites there are 237 contaminated sites in the Chena River watershed that are included in Alaska's Contaminated Sites database. Cleanup is complete at 124 of these sites, while 113 sites are still considered to be open. Appendix K presents a listing of all 237 contaminated sites in the watershed.

5.1.7. Brownfields

"Brownfields" are lands that typically contain hazardous substances and are redeveloped and reused under the Brownfields Program (USEPA 2006). For purposes of obtaining financial assistance from the federal government, the EPA has developed a definition of "brownfield" as "real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contamination" (Small Business Liability Relief and Brownfields Revitalization Act 2002). EPA's Brownfields Program works with states, tribes, communities, and other stakeholders to assess, safely clean up, and reuse Brownfields. Understanding of Brownfield sites and information generated during site assessment and cleanup can provide information on potential past and current pollutant sources in a watershed. The Chena River watershed contains three Brownfield sites: 1) Noyes Slough, 2) former Universal Recycling, Inc., and 3) Fairview Manor at Weeks Field. Each site is described below.

Noyes Slough

Noyes Slough has been designated by EPA as a Brownfield, and may qualify for funding for an environmental assessment and cleanup. The Tanana Valley Watershed Association (TVWA) applied for and was awarded assistance from EPA for a Targeted Brownfield Assessment (TBA) of Noyes Slough. One of the TVWA's goals is to restore Noyes Slough to a natural recreational asset to the community of Fairbanks (Oasis 2008). The long-term goals for the slough are to increase the occurrence of free-flowing water each year by the removal of beaver dams and accumulated sediment, as well as to improve fish and wildlife habitat and year-round community recreational use (URS 2010).

The "EPA Targeted Brownfields Site Assessment Questionnaire" (TVWA 2006) indicates that residents along Noyes Slough have expressed concern over the deteriorating flow conditions in the slough as well as pollutants that have entered the slough. The questionnaire indicates that some reaches of the slough have become solid-waste dumping grounds and catchments for stormwater runoff that is a source of nonpoint source pollution.

DEC's Reuse and Development Program funded a preliminary record review in support of the TBA awarded to the TVWA. The report from this review, called *Summary of Environmental Research: Noyes Slough Reclamation Evaluation, Fairbanks, Alaska* (Oasis 2008), included research and compilation of information on the environmental impacts to Noyes Slough. The TVWA eventually intends to increase flow in the slough, which might require dredging as well as engineering controls to divert additional water into the slough from the Chena River. The report can be used to help determine the potential effects these measures might have on the environmental condition of the slough and adjacent lands (Oasis 2008).

URS Corporation performed the EPA-funded TBA at Noyes Slough in 2009 as part of the site assessment activities identified by TVWA (URS 2010). The purpose of the TBA was to evaluate sediment quality in Noyes Slough in support of potential stream rehabilitation and redevelopment efforts. Based on the Oasis (2008) *Summary of Environmental Research* report, the TBA focused on the following pollutants in their sediment characterization:

- Gasoline range organics (GRO)
- Benzene, toluene, ethylbenzene, and xylenes (BTEX)
- Diesel range organics (DRO)
- Residual range organics (RRO)
- Volatile organic compounds (VOCs) (including chlorinated solvents)
- Semi-volatile organic compounds (SVOCs) (including PAHs)
- Total organic carbon (TOC)
- Target analyte list (TAL) metals
- Pesticides and polychlorinated biphenyls (PCBs)

Sediment samples were collected from 16 locations along the Noyes Slough channel and one location upstream of the slough on the Chena River (URS 2010). A column of fine sediment was collected at each sample location. The results of the sampling effort were compared to freshwater sediment screening values from NOAA's SQuiRTs. NOAA SQuiRTs Threshold Effects Level (TEL) and Probable Effects Level (PEL) Sediment Quality Guidelines (SQGs) were both used in the screening for sediment evaluation at Noyes Slough. Exceedances of the SQGs do not necessarily indicate contamination, but only the need for additional evaluation to assess risk (URS 2010). TELs represent the concentrations below which adverse effects on benthic organisms are expected to rarely occur, while PELs represent concentrations above which effects on benthic organisms are frequently expected.

A total of six analytes, all metals, exceeded the TEL and/or PEL values. These metals included arsenic, copper, lead, mercury, nickel, and zinc. Many other analytes were detected, but were either below the TEL and/or PEL values or do not have TEL or PEL values listed in the NOAA SQuiRTs. These analytes include metals (barium, beryllium, chromium, cobalt, cyanide, manganese, molybdenum, selenium, vanadium); pesticides (cis-Nonachlor, mirex); petroleum hydrocarbons (diesel range organics, gasoline range organics, residual range organics); VOCs (acetone, cis-1,2-dichloroethene, m,p-Xylene, methyl acetate); SVOCs (bis(2-ethylhexyl)phthalate, 4-methylphenol, acenapthene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzofuran, di-n-butylphthalate, di-n-octylphthalate, fluoranthene, fluorine, naphthalene, phenanthrene, and pyrene). Many of the SVOCs are PAHs (polycyclic aromatic hydrocarbons), which are indicators of petroleum hydrocarbon impairment. None of the sampled PAHs are exceeding their respective TELs or PELs; therefore indicating that petroleum hydrocarbons are not impairing the sediments of Noyes Slough. PCBs were not detected at any sampling location. No other data analysis other than identifying exceedances has been done at this point. These data will be used by TVWA and DEC to conduct further data analysis, interpretation, and reporting.

Former Universal Recycling, Inc.

The former Universal Recycling site, also known as Interior Services, Alaska Solid Waste, or Bartlett Industries, is located at 400 Sanduri Street in Fairbanks and is approximately 3.4 acres in size (ADEC 2010d). This site is located in a light-industrial area and surrounded by the community landfill, a scrap metal and pipe business, and is approximately 1,000 feet from a mobile home park with an estimated 175 mobile homes.

The site was initially developed in 1985 as a refuse collection and recycling company. The site became a recycling center for paper, scrap metal, glass and plastic, along with recycled batteries, waste oil, and miscellaneous items. In 1991 the presence of used-oil on the ground from a leaking 55-gallon drum was noticed and in 1992, DEC issued a non-compliance report stating that lead-acid batteries were being improperly stored at the site. Several more leaking drums were seen in 1993. Recycling operations at the site stopped in 1997 and the site has remained dormant since.

The FNSB took the property through foreclosure proceedings in 2003. Shortly after FNSB took ownership, an Emergency Management HAZMAT Response Team packed approximately 40 55-gallon barrels of unknown substances and placed batteries and transformers into impervious fish totes. Once contained, items were moved to a cement pad centrally located on site. Debris and approximately 20 additional drums remained scattered around the site.

DEC conducted a DEC Brownfield Assessment in 2004, which encompassed a phase I and limited phase II environmental site assessment. Also in 2004, the Borough got an EPA Brownfield Assessment Grant to complete the phase II assessment. But the need to clean up a large amount of debris on site prevented completion of the assessment work. In 2008 DEC approved a workplan for site characterization, to describe the extent and type of contamination. The site assessment was completed and several areas of concern were identified. A total of 54 cubic yards of contaminated soil were excavated and removed from the site along with mixed burned debris and ash. Groundwater monitoring occurred in 2004 and 2007 and no contaminants of concern were observed above cleanup levels.

The site is currently listed as “cleanup closure complete” on DEC’s Contaminated Sites database. Hazardous materials no longer present at the site included: petroleum wastes/products or mixtures of solvents and used-oil coolants, lead-acid batteries (some with casings cracked/leaking), transformers that may or may not have contained PCBs, ash from the burning of wire barrels, containers of unknown liquids or chemicals, and scrap appliances that contain Freon.

Fairview Manor at Weeks Field

Fairview Manor, located in downtown Fairbanks, is a 50-year-old housing project built on the former Weeks Field airstrip (ADEC 2008a; USEPA 2008). The property is part of a redevelopment project that will replace existing unlivable apartment housing with new housing. The proposed mixed-use property will include affordable housing, a retirement community, assisted living, and commercial businesses.

Through close coordination with the city of Fairbanks, DEC, and the Weeks Field Development Group, EPA conducted a Targeted Brownfield Assessment (TBA) at the site in 2007. Concerns of contamination were originally identified at this site when the ownership of the buildings changed hands in 1992. A site assessment then identified solvent and petroleum contamination. EPA's investigation of the site looked for any contamination that would interfere with development or require cleanup. No significant concentrations were detected in areas of greatest impact. It was recommended that the development team use the guidance of environmental professionals as they excavate.

5.2. Nonpoint and Natural Sources

The Chena Slough Technical Advisory/Restoration Committee cites increased urbanization along the slough as a cause of the excess growth of aquatic plants and nuisance algae (CSTAC/RC 2005). Particular problems caused by the increased urbanization include excess growth of aquatic plants and nuisance algae, impoundment of water and sediment upstream of several road crossings, reduction of natural surface water inflow, and discharge from failing septic systems (CSTAC/RC 2005). Some portions of Chena Slough have extensive backwater areas upstream of road crossings with undersized, partially blocked, or perched culverts (Scharfenberg 2004).

It is possible that the eutrophication of Chena Slough is due to seasonal groundwater fluctuations that flush excess nutrients from failing septic systems into the slough (Scharfenberg 2004). There are anecdotal reports from many Chena Slough residents that seasonally flooded or leaking septic systems occur along several reaches of the slough (Scharfenberg 2004). Studies suggest that levels of chlorophyll *a* and phosphorus in Chena Slough are higher than other nearby sloughs with less urban development. However, Chena Slough is also a naturally productive system and eutrophication might be an effect of internal nutrient loading and recycling. Organic fines accumulate in Chena Slough because flow velocities are not high enough to flush the fines downstream. The accumulated organic fines may act as a nutrient storage bank (Scharfenberg 2004). As previously mentioned, there are several culverted road crossings along Chena Slough, as well as beaver dams, that cause ponding where nutrients gather and can't flow out. This causes the formation of algal mats (USACE 1997).

Noyes Slough is also plagued by low flows much of the time (see Section 2.2). These low flows and stagnant water are partially caused by debris in the stream as well as beaver dams (USACE 1997) and can also cause nutrients and sediment to gather in ponded areas of the slough, much like in Chena Slough.

Streambank erosion is a potential problem for the Chena River (USACE 1997). There is the potential for the degradation of water quality and habitat with uncontrolled erosion and the potential loss of important riparian habitat as landowners along the river attempt to protect their property (USACE 1997). DEC's 2007 water quality sampling effort noted large pieces of scrap metal, such as car bodies, being used by homeowners as riprap along the river banks.

6. Summary

Based on the section 303(d) listings, the pollutants of focus in the Chena River watershed are sediment, petroleum hydrocarbons, and oil and grease. While these pollutants cause or have caused known problems in the watershed, additional pollutants identified in the data analysis and by DEC staff as potential problems include nutrients, metals, bacteria, low dissolved oxygen, temperature, pH, low flow, and habitat alteration.

This watershed characterization report serves to summarize existing data and known impairments and threats to water quality in the Chena River watershed. The information can be used to support subsequent decisions or actions in the watershed. Next steps to be supported or confirmed through additional monitoring, development of TMDLs or restoration plans are summarized in this section. Table 6-1 presents the status of existing and potential impairments in the watershed to be addressed or confirmed through additional monitoring, development of TMDLs or 4b demonstrations.

Table 6-1. Status of Observed and Potential Impairments in the Chena River Watershed

Parameter of Concern	Decisions or Data Needs	Waterbody of Concern		
		Noyes Slough	Chena Slough	Chena River
Currently Listed Impairments				
Sediment	• Determine whether waterbody is impaired by sediment. • If impaired, identify an appropriate water quality target based on the WQS. Either develop a TMDL or 4b demonstration	X	X	X
Petroleum Hydrocarbons	• DEC completed, and EPA approved, a TMDL for the sheen component of the petroleum hydrocarbons, oil and grease standard in November 2011 (ADEC 2011a).	X		
Oil & Grease	• DEC completed, and EPA approved, a TMDL for the sheen component of the petroleum hydrocarbons, oil and grease standard in November 2011 (ADEC 2011a).	X		
Potential Impairments				
Nutrients	• Determine whether waterbody is impaired by nutrients or eutrophication related impacts. • Identify background levels of nutrients.	X	X	X
pH	• Determine whether waterbody is impaired by pH. • Identify potential causes of pH impairment.	X	X	X
Dissolved Oxygen (DO)	• Determine whether waterbody is impaired by low DO levels. • Identify potential causes of low DO.	X	X	X
Temperature	• Determine whether waterbody is impaired by high water temperatures. • Identify potential sources of high water temperature.	X	X	X
Metals	• Determine whether waterbody is impaired by metals parameters. • Identify potential sources of metals. • Identify background levels of metals.	X	X	X
Fecal Coliform Bacteria	• Determine whether waterbody is impaired by fecal coliform bacteria. • Identify potential sources of bacteria.		X	X
Non-pollutant Impairments				

Parameter of Concern	Decisions or Data Needs	Waterbody of Concern		
		Noyes Slough	Chena Slough	Chena River
Flow	• Restore natural flow to Noyes Slough • Noyes Slough has been designated as a Brownfield by EPA • The long-term goals for the slough are to increase the occurrence of free-flowing water each year by the removal of beaver dams and accumulated sediment, as well as to improve fish and wildlife habitat and year-round community recreational use	X		
Aquatic habitat	• Removal of invasive aquatic plant species (*Elodea canadensis*) • A steering committee and action committees have been formed to address the growth of *Elodea* through education, survey, control, research, and funding.		X	

A monitoring program for the three impaired waterbodies in the Chena River watershed (Chena River, Chena Slough, and Noyes Slough) was developed based on this data analysis and the primary objectives and concerns for the watershed. The quality assurance project plan (QAPP) and sampling and analysis plan (SAP) developed for the watershed, *Surface Water Monitoring in the Chena Watershed for the Development of TMDLs*, is included as Appendix L of this report and provides additional details on the monitoring conducted in 2009. A revised QAPP (ADEC 2011b) was completed in 2011 for the 2011 and 2012 sampling collection (see Appendix M). In addition to the section 303(d)-listed pollutants, other pollutants have been identified as potential causes of impairment or as parameters of public interest in one or more of the three waterbodies. Therefore, the QAPP addresses both the short-term need to collect high priority information with which to support an immediate decision regarding impairment status and sources of impairment for sediment, as well as the longer-term desire to evaluate other parameters of public interest (e.g., nutrients, metals, bacteria), some of which may be collected in the future by other organizations in collaboration with DEC. Additional water quality monitoring was completed by DEC in 2009 that will be used along with data collected in 2011 and 2012 to support subsequent decisions or actions in the watershed.

DEC collected additional sediment data throughout the watershed in 2009 that will be used along with data collected in 2011 and 2012 to determine whether Noyes Slough, Chena Slough, and the Chena River are still impaired and require TMDLs for sediment or support designated uses and can be delisted. 2009 monitoring included monthly base flow measurements of sediments (settleable solids) at multiple locations in the Chena watershed from spring to fall (freezing) to characterize conditions and potentially locate sources of impairment due to sediment. Measurements were also taken during the spring break-up period of sediments (settleable solids). DEC plans on collecting turbidity and TSS data from reference locations in their 2011 and 2012 sampling efforts to support data analysis (ADEC 2011b).

Petroleum hydrocarbon and oil and grease data collected in 2009 indicated that Chena Slough and the Chena River meet the water quality criteria for petroleum hydrocarbons, therefore, these two waterbodies have been delisted for petroleum hydrocarbons and oil and grease on the 2010 section 303(d) list. Monitoring showed that TMDLs for petroleum hydrocarbons and oil and grease were needed for Noyes Slough. The TMDL was completed in 2011.

The monitoring of nutrients, DO, temperature, metals, and fecal coliform bacteria are documented in the QAPP for implementation by DEC in the future. A summary of the issues for these parameters is summarized in the following sections and the associated monitoring design is detailed in the QAPP in Appendix M.

6.1. Eutrophication

Based on the data analysis, excessive nutrients are possibly threatening the waterbodies in the Chena watershed. Low DO and high temperature data indicate that eutrophication might be an issue for Noyes Slough. Low DO and high water temperatures in the slough might be a result of the low flow issues (see Section 2.2), since nutrient input to the slough is not regularly washed out or diluted by streamflow.

The current Brownfields effort on Noyes Slough (see Section 5.1.7) may address some of these issues since it is trying to restore flow to the slough through removal of beaver dams and possibly dredging. Therefore, continued monitoring is necessary to observe whether increased flow in the slough alleviates the sediment and eutrophication issues.

The limited DO and temperature data in Chena Slough and the Chena River do not indicate impairment; however, the collection of additional nutrient-related parameters, such as DO and temperature, is recommended since the most recent data from these two waterbodies is from 2006. Future monitoring plans for nutrients (total phosphorus, total nitrogen, and nutrient-related parameters including dissolved oxygen and temperature) in Noyes Slough, Chena Slough or the Chena River should include baseflow and stormflow measurements and baseflow measurements of chlorophyll *a* at targeted locations and reference sites to characterize actual or potential eutrophication due to nutrient enrichment. See Appendix M for more details on future nutrient monitoring and sampling locations.

6.2. Metals

Few data for metals are available in the Chena River watershed. The limited data available did include some measurements that exceeded the water quality criteria for iron (based on 4 observations), copper (based on 2 observations) in Noyes Slough and for manganese in Chena Slough. Data available for Chena River did not show exceedances of metals criteria.

There are no current monitoring plans for metals in Noyes Slough, Chena Slough or Chena River; however, future monitoring should include baseflow measurements of total recoverable metals (i.e., aluminum (Al), iron (Fe), manganese(Mg), and selenium (Se)) and dissolved metals (i.e., arsenic (Ar), cadmium (Cd), chromium III ($Cr3+$), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), silver (Ag) and zinc (Zn)) at targeted locations (i.e., near known or suspected metal sources) as well as sites representative of natural conditions (i.e., reference sites) from spring to fall to characterize current conditions with respect to metals of interest and locate potential sources of impairment if present. Measurements during the spring break-up period could be used to characterize loadings of metals during spring thaw. Stormflow measurements from spring to winter for total recoverable and dissolved metals will be used to characterize wet-weather contributions of metals from potential sources apart from background See Appendix M for more details on the future metals monitoring and the sampling locations.

6.3. Fecal Coliform Bacteria

Fecal coliform bacteria data are available only for Noyes Slough and Chena Slough and indicate bacteria are a potential threat for Chena Slough. There are some exceedances of the fecal coliform bacteria criterion in Chena Slough; however, there are very few observations, making it difficult to draw any conclusions regarding impairment. No fecal coliform bacteria data are available for the Chena River. DEC has indicated that bacteria is not an expected concern in Noyes Slough; however, is a potential in Chena River and Chena Slough due to the presence of septic systems. Future monitoring is recommended to determine impairment and potential sources for Chena River and Chena Slough.

There are no current monitoring plans for fecal coliform bacteria in Chena Slough or Chena River; however, the QAPP included in Appendix M presents a plan for future monitoring. Monitoring should include baseflow and stormflow measurements of fecal coliform bacteria at urbanized locations as well as reference sites in the Chena River and Chena Slough to characterize actual or potential impairment due to bacteria and sources of bacteria impairment. See Appendix M for more details on the future bacteria monitoring and sampling locations.

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