

Alaska Department of Environmental Conservation
610 University Avenue
Fairbanks, Alaska 99709

**Total Maximum Daily Load (TMDL)
for Residue in the Waters of
Noyes Slough in Fairbanks, Alaska**

Final Report
May 2008

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Total Maximum Daily Load for Residue in the Waters of Noyes Slough in Fairbanks, Alaska

TMDL AT A GLANCE:

<i>Water Quality-limited?</i>	Yes
<i>Hydrologic Unit Code:</i>	19040506
<i>Criteria of Concern:</i>	Residues (debris)
<i>Designated Uses Affected:</i>	Water supply; water recreation; growth and propagation of fish, shellfish, other aquatic life, and wildlife
<i>Major Source(s):</i>	Littering and urban runoff from residential and commercial development
<i>Loading Capacity:</i>	Zero (0); the standard for residues prohibits deposits on or in the streambeds and streambanks
<i>Wasteload Allocation:</i>	Zero (0)
<i>Load Allocation:</i>	Zero (0) residues above natural condition
<i>Margin of Safety:</i>	Zero (0)

Executive Summary

Noyes Slough is located in the City of Fairbanks and is a tributary to the Chena River. The state of Alaska has included Noyes Slough on its section 303(d) list since 1994 as water quality-limited due to sediment, petroleum hydrocarbons, oil and grease, and residues (in the form of debris). The slough (Alaska ID Number 40506-003) is currently classified as a Category 5 waterbody (i.e., TMDL is needed). A Total Maximum Daily Load (TMDL) is established in this document to meet the requirements of section 303(d) of the Clean Water Act (CWA) and the U.S. Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] Part 130), which require the establishment of a TMDL for the achievement of water quality standards when a waterbody is water quality-limited. A TMDL is composed of the sum of individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background loads. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. A TMDL represents the amount of a pollutant the waterbody can assimilate while maintaining compliance with applicable water quality standards (USEPA 1991).

This document addresses only the debris impairment to Noyes Slough. The sediment, petroleum hydrocarbons, and oil and grease impairments will either be established in a separate TMDL document or will be delisted in the future based on data sources available. It is important to note that the term *debris* used in this document refers only to human-caused residues, and should not be confused with naturally occurring woody debris. The major sources of debris in the watershed include urban runoff and direct dumping. The debris typically consists of appliances, scrap building materials, concrete, and asphalt

(Burrows et al. 2000) as well as shopping carts, tires, litter, paper products, cans and empty barrels. The debris enters Noyes Slough directly from littering or indirectly from stormwater runoff and snowmelt.

Noyes Slough does not fully support its designated uses of water supply, water recreation, and growth and propagation of fish, shellfish, other aquatic life, and wildlife due to elevated in-stream debris levels. The presence of debris detracts from recreation and can introduce contaminants to the water column. Debris deposited in the stream can also block culverts and fish passage, which inhibits the designated use of growth and propagation of fish.

Since the water quality standard for debris does not allow for any unpermitted, human-caused inputs to the system, the TMDL for debris in Noyes Slough is set to zero. Similarly, the loading capacity and waste load allocation are also set to zero, and the margin of safety is implicit in the TMDL. Due to the nature of debris impairment, the main focus of this TMDL is to develop strategies for reducing the presence of debris in Noyes Slough. Solving the debris problem in Noyes Slough includes clean-up activities and the prevention of debris entering the waterbody. A number of actions, including increased public awareness of the importance of Noyes Slough as a resource, increased use of appropriate garbage receptacles by private land owners, and increased enforcement of local ordinances, can significantly reduce the amount of debris input into the stream. However, as it is not practical to expect that all debris will be controlled even with the best preventative measures, cleanup activities will likely be an integral, ongoing part of the solution to the debris problem in Noyes Slough. Many of these activities are already ongoing through the work of the Tanana Valley Watershed Association (TVWA) and the municipal separate storm sewer system (MS4) permits for the co-permittees of 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 (AKS-053406) and for the Fairbanks North Star Borough (FNSB) (AKS-053414).

1. Overview

Section 303(d)(1)(C) of the Clean Water Act and the U.S. Environmental Protection Agency's (EPA) implementing regulations (40 CFR Part 130) require the establishment of a Total Maximum Daily Load (TMDL) for the achievement of state water quality standards when a waterbody is water quality-limited. A TMDL identifies the amount of pollution control needed to maintain compliance with standards and includes an appropriate margin of safety. The focus of the TMDL is reduction of pollutant inputs to a level (or "load") that fully supports the designated uses of a given waterbody. The mechanisms used to address water quality problems after the TMDL is developed can include a combination of best management practices (BMPs) and/or effluent limits and monitoring required through National Pollutant Discharge Elimination System permits. This report presents TMDL for residue (debris) in Noyes Slough, Alaska.

1.1. Scope of the TMDL

The state of Alaska has included Noyes Slough on its section 303(d) list since 1994 as water quality-limited due to sediment, petroleum hydrocarbons, oil and grease, and residues (in the form of debris). The term *debris* used in this document refers only to human-caused debris, and should not be confused with naturally occurring woody debris. The debris typically consists of appliances, scrap building materials, concrete, and asphalt (Burrows et al. 2000) as well as shopping carts, tires, litter, paper products, cans and empty barrels. Debris also refers to human-caused woody debris from cut vegetation.

The slough (Alaska ID Number 40506-003) is currently classified as a Category 5 waterbody. 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. Alaska's Final 2006 Integrated Water Quality Monitoring and Assessment Report states:

"This waterbody has been on the Section 303(d) list for non-attainment of the Sediment, Petroleum Hydrocarbons, Oil & 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. Urban run-off is also a problem. Snow dumps from the removal of snow from city streets and parking lots located adjacent to the slough contain oil, grease, litter, anti-freeze, and salts. Melting snow carries these pollutants into the waterbody."

The pollutant source identified on the section 303(d) list is urban runoff. Direct dumping is also a major source of debris to the slough. This document presents the TMDL to address the debris impairment in Noyes Slough. The sediment, petroleum hydrocarbons, and oil and grease impairments will either be established in a separate TMDL document or will be delisted in the future based on data available.

The following sections provide general background information on the Noyes Slough watershed.

1.2. Location

Noyes Slough is a 5.5 mile long slough located in the City of Fairbanks and is a tributary to the Chena River (Figure 1-1). 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 stagnant and is used mostly 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 a popular

canoeing area 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).

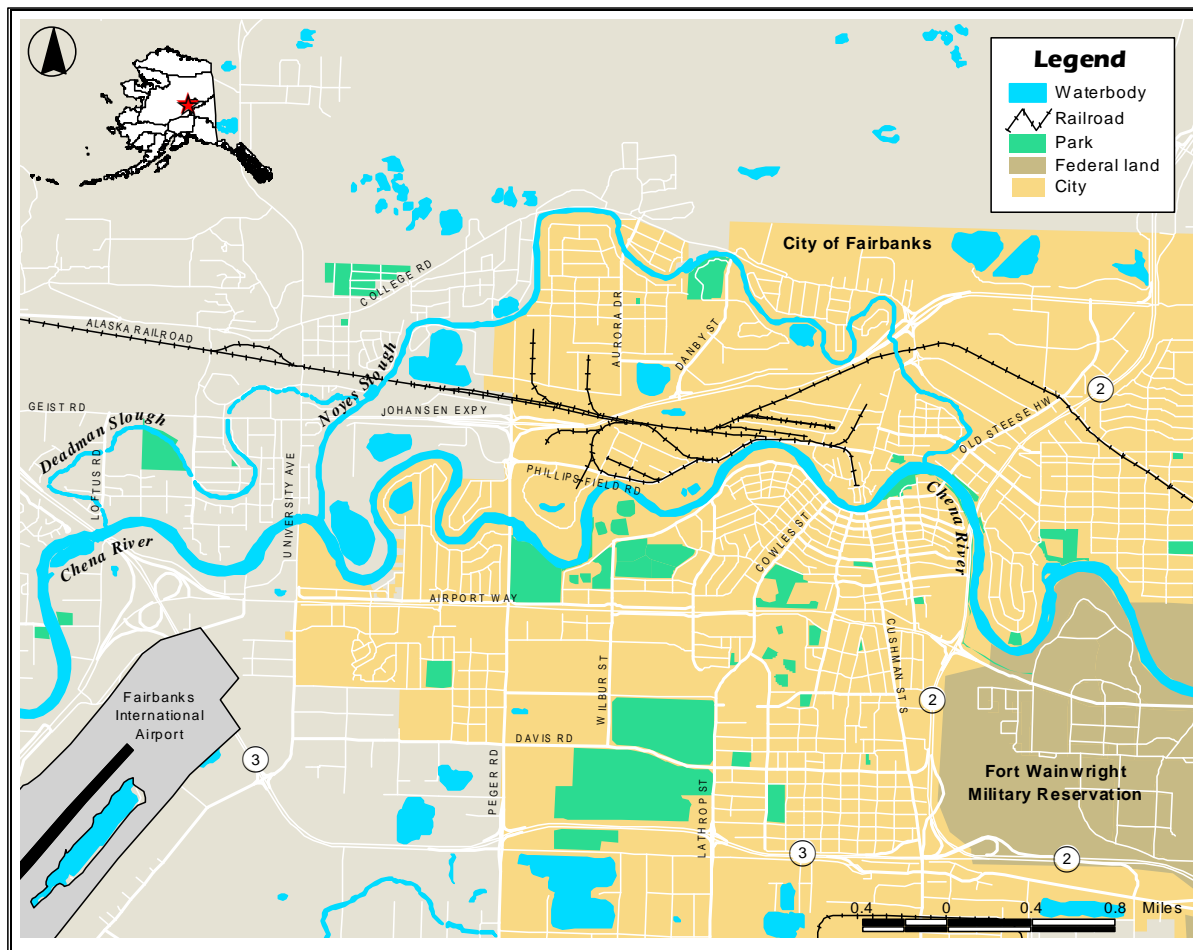


Figure 1-1. Noyes Slough and surrounding areas.

1.3. Population

The population for Fairbanks North Star Borough recorded in the 2000 Census is 82,840, with more than 30,000 people in the city of Fairbanks and approximately 6,500 people residing in the area immediately surrounding Noyes Slough.

1.4. Topography

The topography of the Noyes Slough immediate drainage area has very little variation. The area of the 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.

1.5. Land Use

Land between Noyes Slough and the Chena River is a mix of residential, commercial and industrial uses (Figure 1-2). The upper reaches pass through industrial and commercial areas, and lower reaches pass through residential and recreational areas. Land north of the slough is dominated by rural and agricultural uses.

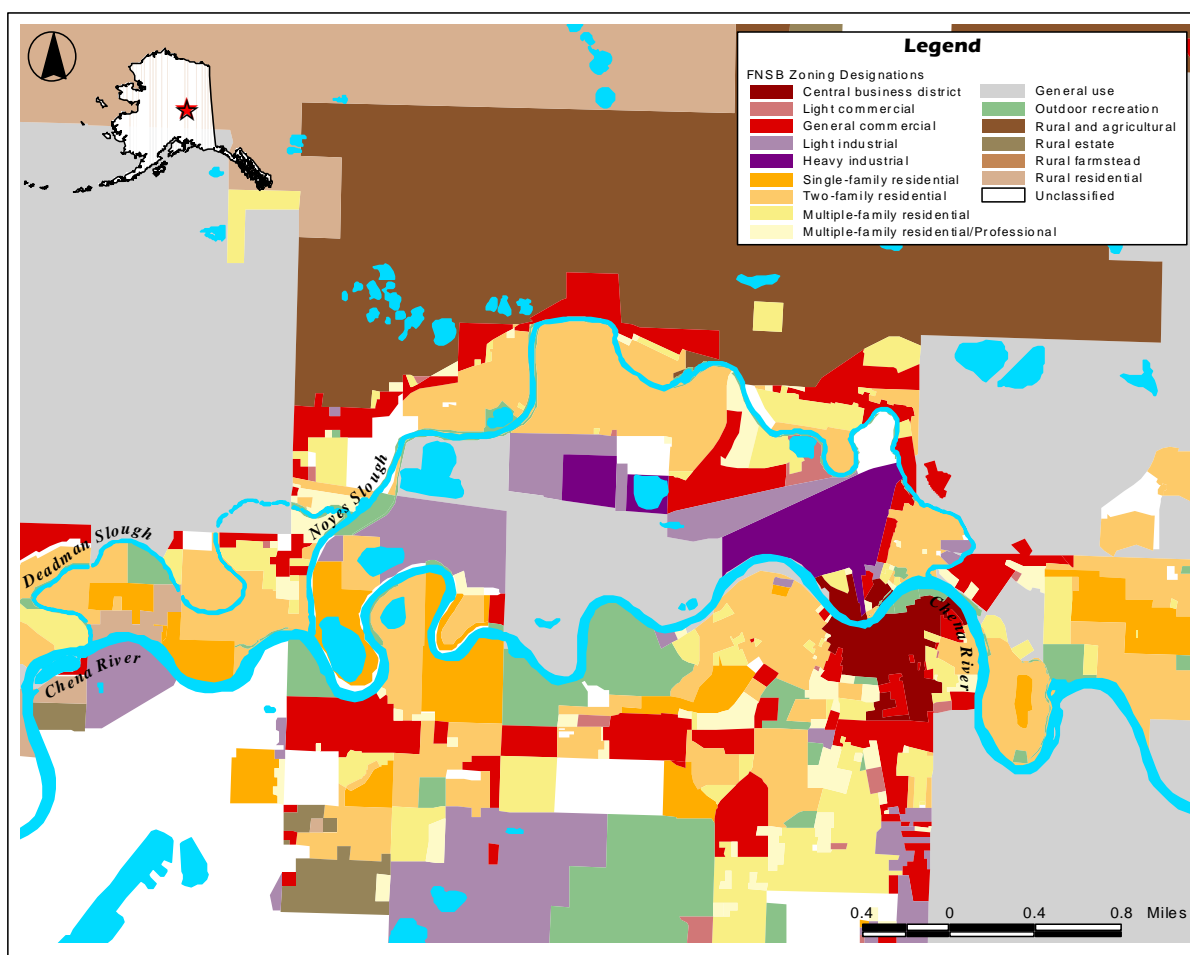


Figure 1-2. Land use surrounding Noyes Slough.

1.6. Climate

Fairbanks has a continental climate 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).

1.7. Hydrology¹

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. Noyes Slough acts as an overflow channel during high flows on the lower Chena River. Flow in Noyes Slough has declined 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

¹ Information in this section is taken from Burrows et al. (2000) and Kennedy et al. (2004).

Control Project, which was designed to limit Chena River flow through Fairbanks to 12,000 cubic feet per second (cfs). The reduction in peak flows in the Chena River likely resulted in reduced flows in Noyes Slough. 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. During very dry periods there is still standing water in the slough, but there is little to no flow. Many reaches of the slough are stagnant and unsightly due to the 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.

When Noyes Slough does not receive much flow, debris (trash and brush) may accumulate, changing the entrance conditions to the slough. When the slough receives significant flow, the debris is washed out and flow conditions improve. This alternating debris pattern at the slough entrance and the groundwater inflow and outflow likely account for the variation in discharge measurements at lower flows.

1.8. Fish Populations

Kennedy et al. (2004) documents 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. Alaska blackfish are highly tolerant of degraded stream conditions. They 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 (USACOE 1997) if the slough was readily accessible to fish from the Chena River.

2. Water Quality Standards and TMDL Target

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). TMDLs are developed to meet applicable water quality standards, which may be expressed as numeric water quality criteria or narrative criteria for the support of designated uses. The TMDL target identifies the numeric goals or endpoints for the TMDL that equate to attainment of the water quality standards. The TMDL target may be equivalent to a numeric water quality standard where one exists, or it may represent a quantitative interpretation of a narrative standard. This section reviews the applicable water quality standards and identifies an appropriate TMDL target for calculation of the debris TMDL for Noyes Slough.

2.1. Applicable Water Quality Standards

Title 18, Chapter 70 of the Alaska Administrative Code (ACC) 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. Designated uses established in the State of Alaska Water Quality Standards (18 AAC 70.020) 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. Residue water quality standards for all uses are applicable to Noyes Slough. These standards are presented in Table 2-1. The TMDL for residue in Noyes Slough will be developed to meet all applicable criteria, the most stringent of which is the criteria for water supply and water recreation.

Table 2-1. Alaska Water Quality Standards for Residues in Fresh Waters

Designated use	Description of criteria
(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 present <i>in quantities to cause soil</i> 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 (1)(A)(iii).
(B) Water recreation	
(i) contact recreation	Same as (1)(A)(i).
(ii) secondary recreation	Same as (1)(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.
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Source: 18 AAC 70.020

Alaska's Water Quality Standards (18 AAC 70.015) also include an antidegradation policy (ADEC 2003), 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.

2.2. Designated Use Impacts

Designated uses for Alaska's waters are established by regulation and are specified in the State of Alaska Water Quality Standards (18 AAC 70). 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. Noyes Slough does not fully support its designated uses because of elevated in-stream debris levels. Although Noyes Slough is not currently used for drinking water, the designated use of water supply must also be protected per Alaska water quality standards.

The presence of debris detracts from recreation and can introduce contaminants to the water column. Debris from household garbage can attract undesirable wildlife. Debris deposited in the stream can block culverts and fish passage, which inhibits the designated use of growth and propagation of fish.

2.3. TMDL Target

The TMDL target is the numeric endpoint used to evaluate the loading capacity and necessary load reductions and represents attainment of applicable water quality standards. In the case of debris in Noyes Slough, the TMDL target is zero, consistent with applicable water quality standards allowing no debris in the stream.

3. Data Summary

Unlike most numeric TMDLs where specific loadings are calculated, the data available regarding debris in Noyes Slough are largely qualitative. According to the guidelines used by the Alaska Department of Environmental Conservation (ADEC), the best professional judgment of a resource agency professional or other credible source can be used to determine whether a waterbody persistently exceeds water quality standards or designated uses (e.g., fish habitat, recreational areas are adversely affected) are not supported because of residues. Direct monitoring data, photographs and videos, and written reports within the last 5 years are additional sources of information that ADEC uses to determine whether a waterbody is impaired or water quality limited due to residues for section 303(d) listing purposes.

3.1. Data Inventory

Water quality data have been collected in Noyes Slough over the past few years, but there is no consistent measure of debris that allows a comparison over time. Clean-up activities that have taken place in the Noyes Slough watershed are described below.

The Noyes Slough Action Committee was responsible for several clean-up events along Noyes Slough beginning in September 1999. Clean-up days continued to occur in the fall and spring of 2000, 2001, and 2002. The cleanup days were typically attended by 50-80 volunteers including committee members, students and parents, and Noyes Slough residents. The volunteers removed log jams and other debris to help restore flow to the slough and enhance habitat potential.

The Fairbanks Stormwater Advisory Committee (FSWAC) hosted a clean-up day for Noyes Slough on September 17, 2005, to complete one of the measurable goals for public involvement / participation activities specified in the stormwater management plan (SWMP) associated with the co-permittees stormwater permit (USKH, Inc. 2006). More than 30 volunteers collected debris from Noyes Slough in more than 50 30-gallon trash bags as well as an assortment of large items including car bumpers, shopping carts, Styrofoam boxes, and animal carcasses.

On June 19, 2007, the Tanana Valley Watershed Association (TVWA) and Alaska Trappers Association conducted a clean-up event for Noyes Slough with help from the City of Fairbanks and ADEC. Examples of debris removed from the slough and banks of the slough during this clean-up include shopping carts, tools, a bike frame, shoes, bottles, picnic benches, a car tire, and a bicycle tire (Eshleman 2007).

During a water quality assessment by ADEC in May 2007 photos were taken of the large amounts of debris in Noyes Slough to try to persuade the FSWAC to consider Noyes Slough as the main focus for the permit-required stream-clean-up event scheduled for August 25, 2007. This was successful and the FSWAC changed the focus stream from the Chena River to Noyes Slough. The stream clean-up was sponsored by the FSWAC in partnership with the TVWA and Fairbanks Soil and Water Conservation District. Volunteers cleared debris, working on the stream banks and from canoes. The clean-up yielded 2.38 tons (4,760 pounds) of debris from the Noyes Slough watershed. Photographs of the August 2007 clean-up show a variety of debris including shopping carts, bikes, doors, propane tanks, barrels, and tires. Photos of the August 2007 clean-up activities are presented in Appendix A.

A debris assessment was also conducted by ADEC on August 3, 2007. The assessment led to the discovery of 11 beaver dams along Noyes Slough. These dams trap debris as it flows through the slough. Typical large debris on Noyes Slough includes shopping carts, tires, and barrels. Specific items found during the August 3rd debris assessment include shopping carts, a TV, a freezer, pieces of cars, metal, concrete, tires, barrels, bikes, and chairs among other items. The largest pieces of debris were

photographed and a GPS location was taken for future removal activities. The area located near the Bently Mall behind the Granger Building is a debris-prone area. During a water quality assessment in May 2007, this area had the largest amount of debris in the water including carts and trash bags. Photos of the debris assessment in August 2007 are provided in Appendix B.

4. Pollutant Sources

The types of debris observed along Noyes Slough include appliances, scrap building materials, concrete, and asphalt (Burrows et al. 2000) as well as shopping carts, tires, paper products, cans and empty barrels. The reduced flows combined with the abuse of the waterway as a refuse site have depleted the slough's value as aquatic and wildlife habitat (Burrows et al. 2000). The slough has been a dumping ground for refuse and a catchment for storm runoff that introduces point and nonpoint source pollution.

The identification of pollutant sources is important to the successful implementation of a TMDL 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 sources of debris to Noyes Slough, including point and nonpoint sources.

4.1. Point Sources

Discharge of debris into surface waters is prohibited in the State of Alaska, so no permits have been issued for this activity in the Noyes Slough watershed. Although not permitted to discharge debris into Noyes Slough, Phase II stormwater systems are possible point source contributors to the slough. 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 that can eventually enter nearby waterbodies. Many stormwater discharges are considered point sources and require coverage by a National Pollutant Discharge Elimination System (NPDES) permit.

Under the NPDES 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 Noyes Slough 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 Region. MS4 permit AKS-053414 includes the Fairbanks North Star Borough. The urban area included in the MS4 permits is shown in Figure 4-1. The entire length of Noyes Slough flows through the urban area, however, there are portions of the watershed north of the slough that are not included in the urban area boundary.

Most debris in Noyes Slough appears to be a product of direct input from residential, commercial, and industrial areas and transient populations or indirect inputs brought into the slough through urban runoff. The Phase II MS4 permits only regulate the indirect inputs brought into the slough through the stormwater conveyance system. Debris that enters the slough from stormwater runoff likely includes

smaller forms of debris such as bottles, cans, and paper products; however, it is impossible to determine which portion of the debris content is delivered from the MS4 and non-MS4 areas.

4.2. Nonpoint and Natural Sources

Beaver dams are a natural source of debris to Noyes Slough. A study by Kennedy et al. (2004) identified 10 beaver dams along Noyes Slough in the summer of 2001 and a debris assessment conducted by ADEC in August 2007 found 11 beaver dams along Noyes Slough. These dams trap debris as it flows through the slough. The dams are likely to be barriers to fish at low flow and sometimes at high flows as well (Kennedy et al. 2004). Beaver dams can have an effect on fish movement as well as flow in the slough. The dams can be useful in providing woody debris for fish habitat, but they can also be a hindrance to fish movement. Kennedy et al. (2004) noted that during low flow there were notable differences in water level and water quality on either side of most dams.

The residue impairment discussed in this document refers only to human-caused debris and does not include naturally occurring woody debris that is important to maintain in-stream habitat. Therefore, background or natural sources of debris in the watershed are not addressed in this TMDL.

Most human-caused debris in Noyes Slough appears to be a product of direct input from residential, commercial, and industrial areas and transient populations or indirect inputs brought into the slough through urban runoff. In some areas, snow removal activities on streets and parking lots adjacent to the slough cause debris to be placed in the flood plain and on the banks of the creek where it enters the creek upon snowmelt. In addition, some debris may originate in areas north of the slough that are not included within the urban area boundary.

Some specific expected nonpoint sources of debris to Noyes Slough are a construction company located along the slough and winter recreational users. There is a large amount of industrial debris (e.g., concrete blocks and rebar) in the slough adjacent to the construction company property. There is also a tire embankment along the slough where the tires are being used as riprap; however, the tires are falling into the water. The U.S. Army Corps of Engineers has been working with the property owner to find a better way to stabilize the land, but a new stabilizer has not been put in place yet, and the tires have not been removed.

It is suspected that cut vegetation blocking the slough is from winter recreational users that cut the vegetation to gain better passage and let the vegetation fall into the slough to form a better base for winter recreational activities. The slough is a multi-use designated recreation trail for the Fairbanks North Star Borough (Ordinance No. 2006-24). The slough is also used as a route for the Open North American Sled Dog Race.

As mentioned in the previous section, some portion of the debris carried to the slough through surface runoff might originate in areas outside of the MS4 areas. However, it is impossible to determine which portion of the debris content is delivered from the MS4 and non-MS4 areas.

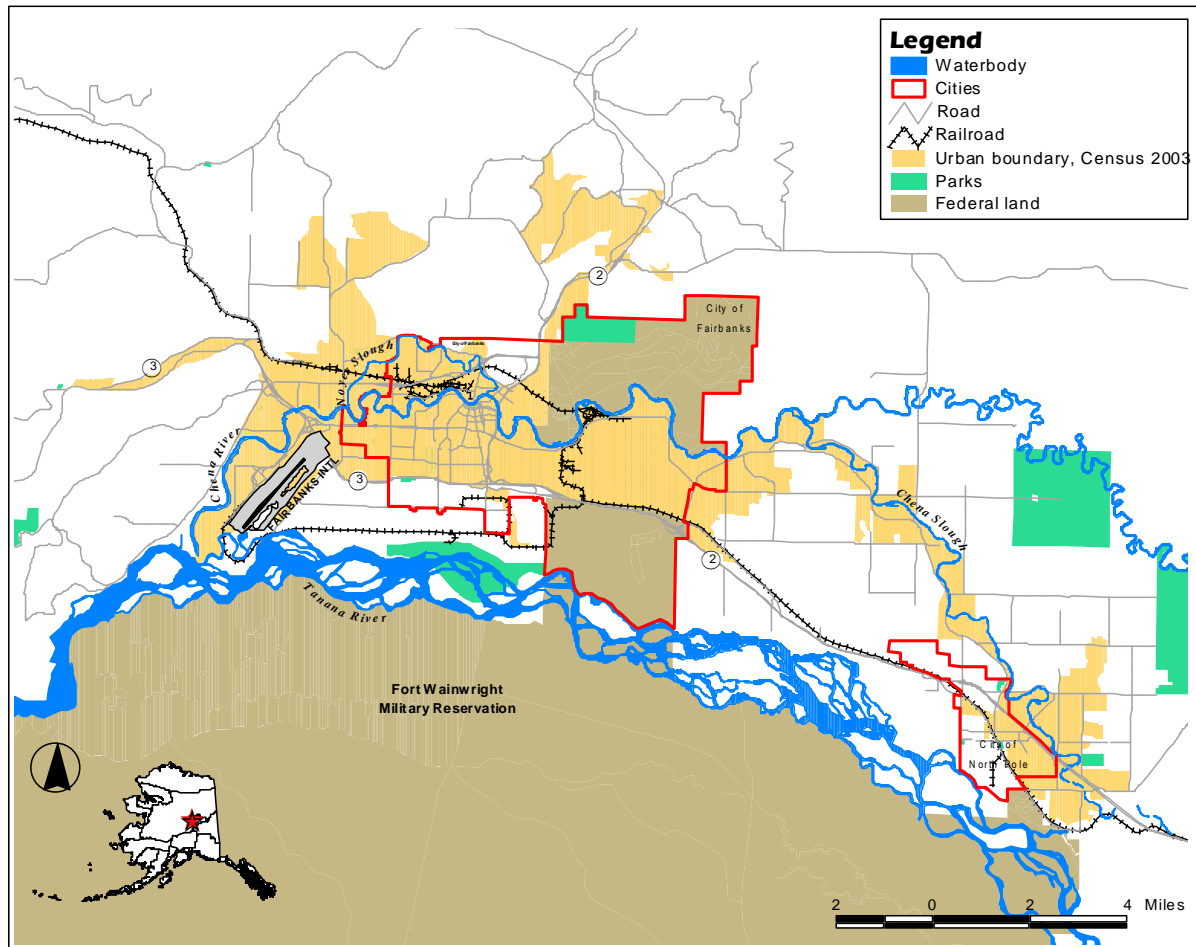


Figure 4-1. Urban area covered by Phase II MS4 stormwater permits.

5. Technical Approach

The impairment to Noyes Slough does not fit the model for the typical loading capacity determination because the nature of debris does not lend well to quantitative analysis. However, because Alaska water quality standards do not allow for any debris delivered to a stream, no loading calculation is necessary. Therefore, the TMDL will be set to zero, and the TMDL document will focus on implementation of strategies that will help keep debris out of the slough and allow it to meet the applicable water quality standards.

5.1. Loading Capacity

Loading capacity is the ability of the receiving waters to assimilate a given pollutant. For Noyes Slough, the pollutant is residue in the form of debris. The debris loading capacity for Noyes Slough is derived directly from the water quality standards, which require no unpermitted, human-caused debris to be deposited within the stream. As such, the loading capacity of Noyes Slough for debris is zero.

5.2. Wasteload Allocation

The wasteload allocation is the portion of the TMDL that is allocated to point sources. Discharge of debris into surface waters is prohibited in the State of Alaska, so the wasteload allocation for debris in Noyes Slough is zero.

5.3. Load Allocation

The load allocation is the portion of the TMDL that is allocated to nonpoint sources and background levels. Since there are no background sources of debris and water quality standards do not allow for any debris inputs, the load allocation for debris in Noyes Slough is zero.

5.4. Margin of Safety

Clean Water Act section 303(d) requires that a TMDL incorporate a margin of safety (MOS) to account for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can be implicit (e.g., incorporated into the TMDL analysis through conservative assumptions) or explicit (e.g., expressed in the TMDL as a portion of the loadings) or a combination of both. Because the loading capacity determined from water quality standards allows no debris in the stream, there is neither a load nor wasteload of debris allocated for Noyes Slough, and, the explicit MOS is set to zero.

5.5. Seasonal Variation

There is some seasonal variation in the debris loading into Noyes Slough. Debris input is generally lower in the winter since snow and ice reduce runoff that can carry debris from the surrounding watershed into the slough. Spring snowmelt brings higher loading to the slough, as increased runoff transports debris accumulated throughout the winter from the streambank into the slough. Warmer weather also increases pedestrian and vehicle traffic in the residential and commercial areas where littering is common. The warm-weather debris input is mostly from illegal dumping by local residents and from the transient population.

Debris input, however, still occurs during the winter since Noyes Slough is a heavily used waterway for winter recreation such as dog mushing, dog walking, snowmachining, biking, and cross country skiing. Most debris input during the winter season is from brush cutting to create a clear and safe pathway for the winter recreational users. Seasonal variation is considered by timing education, enforcement, and clean-up activities with key times of usage and seasonal target audiences.

6. Implementation

The main focus of this TMDL is to develop strategies for reducing the presence of debris in Noyes Slough. Reducing debris in Noyes Slough includes clean-up activities and the prevention of debris entering the waterbody. Increased public awareness of the importance of Noyes Slough as a resource, increased use of appropriate garbage receptacles by private land owners, and increased enforcement of local ordinances can significantly reduce the amount of debris input into the slough. It is not practical to expect that all debris will be controlled even with the best preventative measures, therefore clean-up activities will be an integral, ongoing part of the solution to the debris problem in Noyes Slough.

There are a number of local groups that are concerned with the health of Noyes Slough and are already working toward the goal of reducing debris and other pollutants in the slough, including the TVWA, the co-permittees of the Fairbanks MS4 permit, Fairbanks North Star Borough, and the 6th grade class of the Anne Wien Elementary School. Some of the activities being led by these groups are described in Sections 6.1 through 6.4. Note that the requirements of the MS4 permits described in Section 6.2 are directed at general storm water education, not Noyes Slough specifically. Past stream clean-up efforts have focused on Noyes Slough; however, there is not a commitment to continue focusing those efforts on this particular waterbody.

6.1. Watershed Groups

The TVWA is a local non-profit organization that seeks to ensure the recreational and economic benefits of the Tanana River and its tributaries, including Noyes Slough (TVWA 2007). The goal of the TVWA is to promote and improve the health of the Tanana Valley watershed through education, restoration, collaborative research, and community involvement. TVWA is currently organizing an adopt-a-stream program, which is a volunteer-based effort. The goal of the program is to get residents and local businesses involved in monitoring the water quality and fish and wildlife habitat of local streams. One of the activities associated with the adopt-a-stream program is litter pick-up. Volunteers are asked to clean up their section of stream at least two times per year.

The TVWA has received funding and technical support from the U.S. Fish and Wildlife Service (USFWS) and the National Park Service (NPS) to develop a riparian management plan. The TVWA is partnering with the Fairbanks Northstar Borough's Planning Department to develop the riparian management plan to address riparian set-back and low impact development BMPs.

6.2. MS4 Permits

6.2.1. Permit for the City of Fairbanks, City of North Pole, University of Alaska – Fairbanks, Alaska Department of Transportation and Public Facilities – Northern Regional Office

The MS4 permit for the co-permittees of the City of Fairbanks, the City of North Pole, the University of Alaska - Fairbanks, and the Alaska Department of Transportation and Public Facilities - Northern Region (AKS-053406) requires a SWMP. The SWMP must include "BMPs, control techniques, system design, engineering methods, and other provisions the co-permittees or EPA determines appropriate for the control of pollutants in discharges from the MS4" (USEPA 2005a).

The MS4 permit includes the following six minimum control measures:

1. Public education and outreach

2. Public involvement/participation
3. Illicit discharge detection and elimination
4. Construction site storm water runoff control
5. Post-construction storm water management in new development and redevelopment
6. Pollution prevention and good housekeeping for municipal operations

The minimum measures that are most relevant to controlling debris in Noyes Slough are public education/outreach, public involvement/participation, and pollution prevention and good housekeeping from municipal operations.

The public involvement and participation measure of the MS4 permit requires the co-permittees to host an annual clean-up day (Shannon & Wilson, Inc. 2003). Clean-up days focus on removing trash and debris from small streams in the area, including Noyes Slough. Local residents canoe through the slough, and pick up and haul trash and debris that has accumulated in the waterbody and along its banks. The co-permittees are also required to organize an ongoing volunteer monitoring program and an Adopt-A-Stream program. Currently the co-permittees are working with the TVWA to coordinate efforts on this Adopt-A-Stream program and the volunteer monitoring program permit requirements.

Education is another tool that can be used to help reduce sources of debris to Noyes Slough. The MS4 permit requires stormwater education materials to be distributed annually. Educational items might include fliers, posters, magnets, and other items to promote interest. The MS4 permit also requires public service announcements (PSAs) to run annually in April. Newspaper, radio, and television can be used to show the public the impacts of stormwater pollution. Local newspapers can and are being used to highlight pollution issues in Noyes Slough including articles on local individuals working to prevent pollution, articles highlighting pollution along the slough, and articles showing sources of the pollution/debris. Stormwater issues can also be discussed on local radio talk shows in addition to radio PSAs.

The 2005 clean-up day sponsored by FSWAC also presented an educational opportunity to reach residents who live and work along Noyes Slough. Information pamphlets that detailed the cleanup activities were mailed to residents who live along the slough and reminded them not to dump yard clippings and waste into the slough. PSAs were broadcast that addressed the cleanup efforts. In addition, the cleanup efforts were documented in a September 18, 2005, article in the Fairbanks News-Miner (USKH, Inc. 2006).

The MS4 co-permittees also host an educational event each year called “Stormwater is Cool” in which a presentation is given in local elementary schools to deliver the message of how storm water can carry pollutants into surface waters and how those pollutants adversely affect the flora and fauna in our local water bodies (City of Fairbanks 2007). It is estimated that in the spring of 2007, more than 400 students at nine elementary schools attended the presentation of “Stormwater is Cool.”

The purpose of pollution prevention and good housekeeping is to develop and implement an operation and maintenance program (Shannon & Wilson, Inc. 2003). The City of Fairbanks and all other co-permittees have implemented a maintenance and operations program to evaluate the effectiveness of street sweeping, storm drain cleaning, and waste disposal practices, within the co-permittee jurisdictions. This program is documented in the 2007 Annual Report.

6.2.2. FNSB Permit

The general requirements of the Fairbanks North Star Borough (FNSB) MS4 permit (AKS-053414) indicate that the FNSB must submit to EPA a written description of how SWMP activities control the discharge of sediment, petroleum products, and debris to waters of the United States from MS4s.

As with the City of Fairbanks, City of North Pole, University of Alaska - Fairbanks, and Alaska Department of Transportation and Public Facilities - Northern Region MS4 permit (AKS-053406) described above, FNSB's permit requires the six minimum control measures (public education and outreach; public involvement/participation; illicit discharge detection and elimination; construction site storm water runoff control; post-construction storm water management in new development and redevelopment; and pollution prevention and good housekeeping for municipal operations).

The public education and participation requirements of the permit include

- Planning and implementing a public education program for local audiences
- Distributing stormwater education materials to target audiences
- Preparing and distributing outreach material to local print and broadcast media
- Organizing and hosting an annual "Stream Clean-up day"
- Developing an appropriate and ongoing means of providing stormwater information to the public and for receiving information from the public such as a website or staffed telephone hotline
- Convening and participating in a volunteer citizen committee to guide and advise the Borough on its stormwater activities.

The FNSB is working with the City of Fairbanks, City of North Pole, University of Alaska – Fairbanks, and Alaska Department of Transportation and Public Facilities - Northern Region (i.e., co-permittees of the other MS4 permit in the watershed) to meet the public education and participation requirements of their permit (FNSB 2007). The FNSB's MS4 permit requires the borough to host an annual stream cleanup day (also described in Section 6.2.1). The co-permittees have conducted the stream cleanup day for the past three years, but the FNSB will be conducting 2008's cleanup day. It has not been decided if the stream cleanup day will focus on Noyes Slough or on the main stem of the Chena River.

The FNSB MS4 permit requires the adoption of an ordinance or other control measure to prohibit any non-stormwater discharges to the stormwater system and implement appropriate enforcement procedures and actions. The permit also outlines a plan to detect and address non-stormwater discharges, including illegal dumping. The plan includes informing public employees, businesses, and the general public of the hazards associated with illegal discharges and improper waste disposal. The FNSB has not established an ordinance or other control measure to prohibit illicit discharges in the MS4 to date, but the FNSB is planning on developing an implementation plan for illicit discharge detection and elimination ordinances to meet the permit requirements in 2008 (FNSB 2007).

Each annual report required by the MS4 permit must include a description of the FNSB's efforts to prevent or reduce pollutant runoff from the municipal operations through the operation and maintenance program, including a description of the activities to reduce floatables and other pollutants to the MS4; and a description of the controls for reducing or eliminating the discharge of pollutants from areas owned or operated by the FNSB, including streets, roads, and highways; municipal parking lots; maintenance and storage yards; waste transfer stations; fleet or maintenance shops with outdoor storage areas; salt/sand storage locations; and snow disposal sites (USEPA 2005b). According to the 2007 Annual Report (FNSB 2007), the FNSB does not currently have a "formal schedule for activities, maintenance, or long term inspection procedures for controls to reduce floatables and other pollutants to the MS4." The development of a formal schedule and description of maintenance, inspection, and control activities is planned to be included in the 2008 Annual Report.

6.3. Local Ordinances

In addition to the requirements of the MS4 permits, the City of Fairbanks and the Fairbanks North Star Borough have ordinances regarding garbage and litter. The City of Fairbanks has six ordinances that relate to garbage and littering: 1) construction site storm water runoff, 2) post-construction storm water management; 3) illicit discharge detection and elimination; 4) public streets; 5) general; and 6) offenses regarding nuisances.

The purpose of the construction site storm water runoff and post-construction storm water management ordinances is to establish minimum stormwater management requirements and controls to reduce storm water runoff rates and volumes, soil erosion, and nonpoint source pollution at all new subdivisions or development sites disturbing 10,000 square feet of land or more. The illicit discharge ordinance prohibits the deposition of any solid waste, garbage, rubbish, junk, fill, dirt, snow or other material in such a manner as to obstruct, impound, pollute, or cause siltation of any waterbody unless allowed by federal, state, or local permit. If any of these ordinances is violated, the violator must remediate or restore the affected property within an established deadline or the work will be done by a designated government agency or contractor at the violator's expense.

The City of Fairbanks requires the owners or occupants of any property bordering a city street, alley, or sidewalk to remove any debris transported from their property onto the city streets, alleys, or sidewalks. There is a minimum fine of \$50 for any violation of this ordinance. General ordinances for the City of Fairbanks also require the disposal of all trash through the regular services of the city. Property owners are prohibited from keeping any trash on their property. Property owners must maintain the premises in a clean and sanitary condition, including any alleys bordering the property. The City of Fairbanks's offenses regarding nuisances indicate that a person commits the offense of littering if he or she places litter any place other than a public or authorized private trash receptacle.

Fairbanks Northstar Borough (FNSB) has one ordinance relevant to garbage and littering. The FNSB General Prohibition ordinance prohibits the disposal of solid wastes or sludge in any unauthorized locations and prohibits the discarding of any litter into water or land within the borough. The penalty for violation of this ordinance is \$100.00 for the first offense, \$200.00 for the 2nd offense, and \$300.00 for each subsequent offense within a 5-year period.

Increased enforcement of the City of Fairbanks's and FNSB's ordinances is important to reducing debris in Noyes Slough. Measures such as reducing a garbage-related fine if the violator agrees to pick up litter should be considered. Placing more garbage receptacles that are easily visible within the commercially and residentially developed portion of Noyes Slough may help to cut down on littering. Centralized recycling containers, placed in convenient locations such as outside of grocery stores and in shopping centers, may help to encourage recycling and reduce the amount of garbage that accumulates between pickups.

6.4. Other Education Efforts

Education about Noyes Slough can also occur in local classrooms. The 6th grade class from Anne Wien Elementary School, which is adjacent to Noyes Slough, has been involved with conservation efforts along Noyes Slough for several years. The students are working on restoring the Noyes Slough area. The students also built and maintain the Noyes Nature Trail in Lion's Park. The restoration effort is ongoing and building momentum (Anne Wien School 2007). The students have been picking up litter, clearing the nature trail along the slough, and keeping the waterway free of obstructions (Duffy 2006). The class uses the nature trail along Noyes Slough as a living laboratory for science lessons. The children learn about the

life cycles of plants and animals that live along the slough. Students collect samples from water and sediments.

6.5. Stormwater Attitude Survey

While the quantifiable goal of this TMDL is “zero” trash in Noyes Slough, an additional measure of success of the various implementation activities is the “stormwater attitude survey” required by the City of Fairbanks’s MS4 permit. The permit requires the co-permittees to develop a stormwater attitude survey that may be able to address why residents dump debris into the slough. The survey will assess public knowledge and attitudes related to stormwater management in the Fairbanks urban area and help to identify whether or not residents understand the effect they have on the nonpoint sources of pollutants entering nearby waterbodies.

The Storm Water Attitude Survey was published in both hardcopy format and online on March 28, 2008, and can be found at <http://co.fairbanks.ak.us/PWorks/StormWaterManagementProgram/>; although, the survey is not required to be developed until 2009 and the results are due to EPA and ADEC in November 2009. The first distribution of the survey was made March 28-30th at the Northern Living Home Show in Fairbanks and future distributions are planned for a variety of other local events throughout the summer. The survey period will remain open through September 30, 2008. ; The survey may be very helpful in assessing Fairbanks area residents’ current views on stormwater, while stormwater education is just getting started in the area, versus later when stormwater education has been ongoing for several years. A second survey should be required as part of the next MS4 permit, as the current permit expires in May 2010. A comparison between the two surveys will help to evaluate the success of the stormwater education program.

7. Monitoring

There is currently no requirement to monitor for litter and there is no measureable goal for the Stream Cleanup Days and Adopt-a-Stream programs. As part of the monitoring strategy in Noyes Slough, agencies and volunteers should be encouraged to actively observe and note the presence of trash in and around water quality sampling locations. The type and amount of debris collected during clean-up events should also be recorded (in addition to photographs). In addition to general monitoring, specific monitoring of sites where strategies have been implemented to reduce debris input into the slough should be monitored to evaluate effectiveness.

Benchmarks to assess the effectiveness of the various implementation strategies in their progress toward the TMDL target can be useful. According to EPA's fact sheet on best management practices (BMPs) for trash management (USEPA 2008), "a successful trash management program depends on citizen awareness." Programs to promote citizen awareness of the trash/debris problem in Noyes Slough are already underway (see Section 6). Benchmarks to assess the effectiveness of these education programs could include an increase in the number of volunteers involved in the TVWA's adopt-a-stream program and the co-permittees and FNSB's stream clean-up days. An increase in volunteers in association with a reduction in the amount of trash collected over several clean up events and over several years will provide insight into whether or not the implementation programs currently in place are helping to achieve the TMDL target of zero trash in Noyes Slough.

8. Public Comments

Federal regulations require EPA to notify the public and seek comment concerning TMDLs it prepares. This TMDL was developed under contract to EPA, and a public review period was held seeking comments, information, and data from the public and any other interested party. A pre-public draft of the TMDL was sent to agencies and interested stakeholders on March 10th 2008. The notice for the public review period was posted on March 24, 2008, and the review period closed on April 22, 2008. The notice was posted in the local news paper the Fairbanks Daily News Miner, on DEC's website, and on the State of Alaska's Public Notice Web Site. A fact sheet was also available on DEC's website. A public meeting regarding the Noyes Slough residues TMDL was also held on April 10, 2008 at ADEC in Fairbanks.

Comments on the TMDL were received from Fairbanks North Star Borough's Department of Public Works, Alaska Department of Transportation and Public Facilities – Northern Region, and the City of Fairbanks. Comments and additional information submitted during this public comment period were used to inform or revise this TMDL document. See Appendix C for detailed information on the response to comments.

Appendix A: Photographs, August 2007 Noyes Slough Clean-up

(Source of photos: Alaska Department of Transportation)





Appendix B: Photographs, August 2007 Noyes Slough Debris Assessment

(Source of photos: Alaska Department of Environmental Conservation)



Tire in Noyes Slough



Shopping cart in Noyes Slough



Tires on the banks of Noyes Slough



Barrel in Noyes Slough



Typical large debris



Trash and cuttings in Noyes Slough

Appendix C Comments on Noyes Slough Debris TMDL
March 2008 Draft for Public Comment

ID	Comment	Comment / Resulting Change	Affected Section
<i>General Comments:</i>			
1	<p>I am concerned with proposed TMDL for Noyes Slough because it lack sufficient information to address how DEC will use it to address existing and proposed storm water systems and outfalls to Noyes Slough (e.g. non-domestic waste water permit under 18AAC72). On the one hand it appears from all the evidence provided in the document that storm water is not a significant cause of residue (debris) pollution. However, the document is sufficiently vague to leave me guessing on the residue (debris) issue related to storm water. I understand the jury is still out on possible other pollutants in stormwater. This would be the subject of a future TMDL. I agree there is a significant litter and dumping problem which could be at least partially addressed through MS4 permit control measures. I am hoping the proposed TMDL can further address whether or how DEC permitting will be affected.</p>	<p>Stormwater is not the sole source of residue (debris) to Noyes Slough. Direct litter and illegal dumping is also a major source. This point has been clarified in the TMDL document. There is a strong focus on the MS4 permits in the Implementation section of this document because the permits have some existing programs that will be useful in educating the public about dumping in Noyes Slough. This does not suggest that stormwater is the sole source of pollutants. See the responses to the remaining comments for specific changes that have been made. ADEC's role in the implementation of this TMDL will be detailed in the implementation plan, which will be completed at a later stage in the TMDL process.</p>	Throughout the document.

ID	Comment	Comment / Resulting Change	Affected Section
2	<p>[With stormwater in mind...]</p> <p>page 1 - The scope section of the proposed TMDL does not clearly define or discuss what will be regulated. One sentence in the scope identifies "debris impairment" will be addressed with no qualification. However, other sections discuss residue (debris). The scope should be comprehensive and provide enough information to determine whether something falls under the TMDL. Of particular concern is what is the smallest size unit that will be regulated under this TMDL. Without knowing this one cannot evaluate whether the premises of the TMDL are valid. The smaller the debris unit the more significant the margin of safety becomes and the bigger the question of whether the proposed trash TMDL can be address with technology and/or BMPs.</p>	<p>Note that Alaska's 2003 Water Quality Standards (WQS) identify residues as "floating solids, debris, sludge, deposits, foam, scum, or other residues". Debris is the type of residue that has been identified on the section 303(d) list as the cause of the use impairment. Therefore, the term "debris" is used throughout the document to refer to the more specific pollutants found in the slough. Language has been added to the Scope to identify debris as the type of residue being addressed by this TMDL. Examples of debris have also been included.</p> <p>There is not a particular "size unit" of debris that will be regulated under the TMDL. Alaska's 2003 WQS state that residues "May not, alone or in combination with other substances, ...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". Therefore, the target is zero in order to meet the applicable WQS.</p>	Section 1.1 Scope of the TMDL

ID	Comment	Comment / Resulting Change	Affected Section
3	<p>[With stormwater in mind...]</p> <p>Page 6, last sentence - This statement is inaccurate. It is clear the existing water quality standards on page 5 allow for a residue quantity that does not exceed the specified criteria. The apparent intent of a zero TMDL is reduce existing loads so that it will meet applicable water quality standards at some point in the future. This should be defined consistent with 18AAC70.</p>	<p>Alaska's 2003 WQS state that residues "May not, alone or in combination with other substances, ...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".</p> <p>Therefore, the target is zero in order to meet the applicable WQS.</p>	
4	<p>[With stormwater in mind...]</p> <p>Page 9, first paragraph - A large majority of the large debris identified is the result of dumping. No specific connection is made to storm water for these types of pollutants. Is this TMDL aimed at storm water or not? Is the residue (debris) pollution contribution by storm water very small compared to outright dumping?</p>	<p>The larger debris is a result of dumping, while some of the smaller debris (e.g., paper products, cans, bottles, etc...) can be a result of stormwater runoff as well as direct dumping. Stormwater runoff is not the only source of debris to the slough. Language has been changed throughout the document to clarify this.</p>	Throughout the document
5	<p>[With stormwater in mind...]</p> <p>Page 9, third paragraph - If discharge of debris is prohibited what is the point of a TMDL? This is not a Phase I area. This paragraph identifies phase II storm water as "possible point source". It appears there is not enough information to address residue (debris) for storm water.</p>	<p>It is possible for waters to violate water quality standards despite prohibition of the discharge of the pollutant, and a TMDL is required for any water that does not meet water quality standards. Therefore a TMDL is required for Noyes Slough because it does not meet water quality standards for residues (debris).</p> <p>"Phase I" has been removed from this sentence. Phase II stormwater has been identified as a "possible point source", but please note the report has been modified throughout to indicate that direct dumping is also an expected source of debris to the slough.</p>	Section 4.1, paragraph 1

ID	Comment	Comment / Resulting Change	Affected Section
6	[With stormwater in mind...] Page 9, last paragraph - Second to last sentence does not make sense. Once stormwater enters the slough it is part of the waters of the US not MS4 stormwater runoff.	This sentence has been removed.	Section 4.1
7	[With stormwater in mind...] Page 10, first sentence - This contradicts previous statements. Which is correct do all the pollutants come from inside the UA boundary or not.	Noyes Slough itself flows entirely through the UA, however, there are parts of the watershed (north of the slough) not inside the UA boundary. Language has been added to clarify this.	Section 4.1
8	[With stormwater in mind...] Page 10, last paragraph - The criteria that residue (debris) is only human caused and all other criteria should be discussed in the scope page 1.	Language has been added to the Scope to describe the human-caused debris addressed by this TMDL. The purpose of the Scope is to present the waterbody addressed by this TMDL and its impairment. The water quality standards are discussed in detail in Section 2.	Section 1.1 Scope of the TMDL
9	[With stormwater in mind...] Page 12, 1st paragraph - From the WQ criteria indicated on page 5, the level of residue allow must not exceed the criteria. This criteria allows for some pollutant load. Based on this, It appears the statement that WQ standards don't allow for any debris delivered to a stream is false. If this statement is true it appears the TMDL is pointless because it is already regulated by law. From the description it appears the technical approach proposed is flawed.	Alaska's 2003 WQS state that residues "May not, alone or in combination with other substances, ...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". Therefore, the criteria do not allow for any pollutant load, resulting in a target load of zero.	Section 2 and Section 5

ID	Comment	Comment / Resulting Change	Affected Section
10	<p>[With stormwater in mind...]</p> <p>Page 12, 5th paragraph - The MOS at zero is not a practical standard that can be addressed with any BMP or technology at this point. There are many areas of uncertainty and lack of knowledge discussed in the document. A more rigorous analysis of the MOS should be performed.</p>	<p>The loading capacity determined from water quality standards allows no debris in the stream, therefore there is neither a load nor wasteload of debris allocated for Noyes Slough and the MOS must be set to zero. Note that page v and the first paragraph in Section 6 indicate that it is not practical to expect that all debris will be controlled even with the best preventative measures, cleanup activities will likely be an integral, ongoing part of the solution to the debris problem in Noyes Slough.</p>	Section 5.4 and Section 6
11	<p>[With stormwater in mind...]</p> <p>Pages 21-23, - all of the pictures indicate a serious dumping and litter problem not an stormwater problem</p>	<p>Stormwater is not the sole source of residue (debris) to Noyes Slough. Direct litter and illegal dumping is also a major source. This point has been clarified in the TMDL document. Note that there are also photos of smaller items of debris including bottles and paper products that could be a product of stormwater runoff or direct dumping. It is not possible to determine the portion directly deposited versus that delivered through stormwater runoff.</p>	Throughout the document

ID	Comment	Comment / Resulting Change	Affected Section
12	<p>Debris, Urban runoff, and the MS4</p> <p>The word “runoff” is commonly associated with storm or snow melt events. It is not the appropriate word to describe the major source of debris in Noyes Slough. Based on the evidence presented in the TMDL document, the major source of debris in the slough is illegal disposal and dumping activities. Much of the debris described as typically found in the slough (appliances, scrap building materials, concrete, asphalt, shopping carts, tires, and empty barrels) is not debris that is deposited via runoff. I think it is important to be clear on how the major sources of debris enter the slough. I understand that “urban runoff” is listed as the pollutant source in the Category 5 table for Noyes Slough in the Integrated Report; however, in the comments section of this table there is a clear distinction drawn between dumping of debris and urban runoff from snow melt. I think this distinction should be more adequately reflected in the TMDL document.</p> <p>There is also significant emphasis placed on the MS4 permits throughout the TMDL document. The permits do authorize the permittees to discharge storm water from their respective storm sewer systems into the slough; however, the permits do not cover surface runoff from private residential or commercial lands that discharge directly from those lands into the slough. This is an important distinction as not all surface runoff enters the MS4. Small pieces of litter can certainly enter the slough through the MS4 outfalls, but small pieces of litter can also enter the slough from a variety of other sources of surface runoff and non-surface runoff (wind, cars, people, etc.). The statement on page 9 that “<i>All of the debris deposited into the slough and carried through runoff from the “urban” area is covered under the MS4 permits</i>” is false. Please do not confuse the definition of the urban area and the definition of the MS4. Also, please note that because the FNSB does not have area wide road powers, the only systems of storm water conveyance that we own or operate are those systems located within our road service areas. This is actually only a small portion of the total urban area.</p>	<p>Stormwater is not the sole source of residue (debris) to Noyes Slough. Direct litter and illegal dumping is also a major source. This point has been clarified in the TMDL document. There is a strong focus on the MS4 permits in the Implementation section of this document because the permits have some existing programs that will be useful in educating the public about dumping in Noyes Slough. This does not suggest that stormwater is the sole source of pollutants.</p> <p>The sentence “<i>All of the debris deposited into the slough and carried through runoff from the “urban” area is covered under the MS4 permits</i>” on page 9 has been deleted.</p>	Throughout the document and Sections 4.1 and 4.2

ID	Comment	Comment / Resulting Change	Affected Section
13	<p>Failure to support designated use.</p> <p>There is not enough evidence in the document to suggest that debris is the cause of Noyes Slough not supporting its designated use. I think it is appropriate to say that the debris levels are a factor, but I do not see the evidence to suggest that it is the cause. Based on the hydrology discussion alone, there are more factors than debris impacting water quality. Noyes Slough is described as a natural overflow channel with flows decreasing significantly over the years because of area flood control measures and the subsequent down-cutting of the Chena River channel bed at the mouth of the slough. This seems to indicate that the slough's natural function (its naturally dedicated use) is obsolete. That it isn't needed for overflow and that low flows and stagnant water are to be expected as the slough continues to dry up. There are a number of beaver dams along the slough, but the TMDL document does not address the effect these dams likely have on flow conditions. The document tries to tie debris into the low flow problem, mentioning stagnant water and changed entrance conditions, but there is little support. Low flow might make debris accumulate in areas and make the stream more unsightly, but is debris really the cause of diminished flows? I agree that it is important to address debris, but there is no evidence to suggest that Noyes Slough will support its designated uses once debris is removed, even if it is consistently kept out of the water.</p>	<p>There may be factors other than debris affecting the uses of Noyes Slough; however, this TMDL only addresses the debris impairment. The hydrology discussion in Section 1.7 is meant only to provide some background information on the waterbody. Section 2.3 includes a discussion about the effects debris has on the designated uses of Noyes Slough.</p> <p>Beaver dams are a problem in Noyes Slough and language has been added to Section 4.2 describing them as a natural source of debris to the slough.</p>	Section 4.2
14	<p>Ongoing MS4 permit activities.</p> <p>I think it should be made clear that the public education and outreach requirements of the MS4 permits are directed at general storm water education not Noyes Slough. While past stream clean-up efforts have focused on Noyes Slough, there is not necessarily a commitment to continue focusing those efforts on this particular slough. Also, the TMDL document lumps the efforts of others into the MS4 permit requirements...for instance the conservation efforts performed by Anne Wien's 6th grade class. Are the schools efforts really related to either MS4 permit?</p>	<p>Language has been added to Section 6 to clarify that the requirements of the MS4 permits are directed at general stormwater education, not only Noyes Slough.</p> <p>The Anne Wein Elementary School's conservation efforts are not related to the MS4 permits and the discussion of their efforts has been moved to its own section (6.4).</p>	Section 6, paragraph 2 Section 6.4

ID	Comment	Comment / Resulting Change	Affected Section
15	<p>MS4 permit ordinance requirements.</p> <p>Illicit discharge and detection efforts outlined in the MS4 permits pertain to the storm sewer system. Please note that Noyes Slough is not part of the storm sewer system. Noyes Slough is a water of the U.S. While illicit discharge ordinances may in some way be used to educate the public on the general problems associated with such discharges, I want to make sure it is clear that these ordinances will not directly impact Noyes Slough.</p>	<p>Illicit Discharge Detection and Elimination is no longer referenced as one of the minimum measures relevant to controlling debris in Noyes Slough.</p>	<p>Section 6.2.1</p>
16	<p>General question – the role and responsibility of DEC is not mentioned in the document, so that is not clear – maybe that also fits into the implementation phase.</p>	<p>DEC’s role will be included in the later Implementation Phase of the TMDL.</p>	
17	<p>Executive Summary – The term debris is defined for this document as referring to only human-caused inputs. There should be a clarification of terminology, because the term <i>debris</i> could be replaced with litter, trash, or refuse in most instances throughout the document. Also, there should be more accounting of naturally occurring woody debris, primarily due to the high prevalence of beavers and beaver dams in Noyes Slough. In addition, there are human-caused inputs of woody and vegetative debris into the slough. The statement that <i>the major source of debris in the watershed is urban runoff</i> needs clarification. While urban runoff does account for some contaminants and potentially some of the smaller litter getting into the slough, a good portion of the trash and refuse present in Noyes Slough is from littering and dumping. Clarification and consistency in terminology throughout the document will help in identifying the causes of pollution in Noyes Slough, and also help with resulting solutions.</p>	<p>Language has been added throughout the document to clarify this point. Language has been added to Section 1.1 providing examples of the debris addressed by this TMDL. Sections 4.1 and 4.2 have also been revised to explain the difference between urban runoff and direct dumping. A discussion about beaver dams as a natural source has also been added to Section 4.2. Human-caused inputs of woody debris are discussed in Section 4.2.</p> <p>Terminology has been modified throughout the document to consistently use “debris.”</p>	<p>Throughout document, Sections 1.1, 4.1, and 4.2</p>
18	<p>Section 1.7, Hydrology – There should be more accounting for natural debris in the system, particularly regarding beavers and beaver dams.</p>	<p>The Hydrology section is meant only as general background information for the watershed. A discussion of beaver dams as a natural source of debris is included in Section 4.2.</p>	<p>Section 4.2</p>

ID	Comment	Comment / Resulting Change	Affected Section
19	Section 2.2, Designated Use Impacts – Effects of beaver dams, woody debris, and reduced flows not addressed.	This TMDL only addresses human-caused debris, therefore beaver dams are not mentioned in Section 2.2 (now 2.3) as a designated use impact. They are discussed in Section 4.2 as a natural source. Human-caused woody debris is discussed in Section 4.2 as well.	Sections 2.3 and 4.2
20	Section 3.1, Data Inventory – The term <i>trash</i> used more in this section, and it does highlight the littering and refuse dumping problem. Using the term <i>debris</i> in this section brings to mind woody and naturally occurring debris. Beaver dams addressed appropriately, and given that at least 11 were identified, their presence and influence should be carried into more areas of the document.	Language has been added to Section 1.1 describing what constitutes debris and the term “trash” in Section 3.1 has been changed to “debris” for consistency. A discussion of beaver dams has been added to Section 4.2.	Sections 1.1, 3.1, and 4.2
21	Section 4, Pollutant Sources – Using the term <i>residue</i> may not fit with the types of trash dumped into the slough. This section correctly identifies reduced flow and the input of refuse into the waterway as important factors. Reduced flows should be attributed to the reduced flow into the slough, beaver dams and natural debris, human-caused woody and vegetative debris, and trash or refuse.	“Residue” has been changed to “debris” to be consistent. Reduced flow can be a factor in how much debris accumulates in the slough. However, reduced flows do not control the input of debris to the slough. If flows were higher, the residues impairment would still exist and it might also extend to downstream areas in Chena River because of greater amounts of debris being washed out of the slough into the river.	Section 4

ID	Comment	Comment / Resulting Change	Affected Section
22	<p>Section 4.1, Point Sources – Discussion of MS4 Phase I information not needed in this section. The connection of <i>debris</i> (refuse and trash) to storm water runoff has not been made. Most of the <i>debris</i> as discussed in this document is far too large to be carried by storm water. Other factors seem to contribute much more significantly to this residue or debris TMDL than storm water. Conversely, these flow restricting factors do combine to make storm water runoff management into the Noyes Slough system important. The sentence - <i>All the debris deposited into the slough through runoff from the “urban” area is permitted</i> is unclear and could be revised to state that there is an MS4 permit in place to cover storm water runoff. Maybe there needs to be a specific definition as to what types of debris is carried into the slough by storm water. This may also clarify the types of debris that could be carried to the slough from areas to the north, from outside the urbanized area boundary.</p>	<p>Sections 4.1 and 4.2 have been reworded to differentiate between stormwater runoff and direct dumping to the slough.</p> <p>The discussion of Phase I is used to put the Phase II permits in context. Paragraph 4 in Section 4.1 states that “There are no Phase I MS4 permits in the Noyes Slough watershed; however, there are two Phase II MS4 permits...”</p>	Sections 4.1 and 4.2
23	<p>Section 4.2, Nonpoint and Natural Sources – No mention of beaver cuttings and dams is included in this section. This should be addressed as this is a large potential for flow obstruction.</p>	<p>Discussion of beaver dams and other nonpoint sources has been added.</p>	Section 4.2
24	<p>Section 6, Implementation (generally) – My understanding was that the implementation steps would be addressed at a later stage in the process. The TVWA is doing a great job in helping with Noyes Slough and is key to progress being made. It is agreed that the MS4 co-permittees and FNSB do help considerably, but the storm water runoff management is more secondary to the debris and flow obstructions addressed in this document. Because of the “impairments” to Noyes Slough, storm water runoff is important – although storm water runoff is not the direct cause of the impairments. The efforts of the co-permittees will greatly aid in water quality for Noyes Slough by improving storm water quality, particularly resulting from public outreach and education.</p>	<p>The actual Implementation Plan will be developed at a later stage in the TMDL process. This Implementation section is being used to highlight the many existing programs in the watershed that can be used to address the debris issue in Noyes Slough.</p>	Section 6

ID	Comment	Comment / Resulting Change	Affected Section
25	Section 7, Monitoring – The monitoring of <i>debris</i> (trash and refuse) is not part of the MS4 permit, appears to be too much emphasis on the MS4 permits to solve a problem that is not caused by storm water. The benchmarks listed should be part of the future implementation phase of the Noyes Slough TMDL.	“MS4 permit” has been removed from Section 7. The future Implementation Plan will provide a more detailed Monitoring Strategy.	Section 7
26	Figure 1 – Please replace label “Airport Frontage Road” with “Airport Way.”	Figure has been updated.	
27	Section 1.7, Hydrology – There is no discussion of how the 11 existing beaver dams in Noyes Slough affect flow (as later discussed in Section 3.1). Please document and discuss in Section 1.7 how these beaver dams affect the hydrology of the slough. Also, I understand there are proposals to remove some if not all of these beaver dams to help restore flow and allow fish passage. Please contact the TVWA for more information on potential removal of beaver dams.	There is no documented information regarding how beaver dams affect flow of the slough, so it is not included in Section 1.7. Additional language regarding beaver dams has been added to Section 4.2. TVWA did have a plan to remove some beaver dams through their Adopt-a-Stream program, but as of now it appears that will not happen, therefore this information has not been included in the TMDL document.	Section 4.2
28	Section 3.1, Data Inventory (third paragraph) – Please replace phrase “...City of Fairbanks’ stormwater permit...” with “... co-permittees MS4 permit...”	Replaced	Section 3.1
29	Section 3.1, Data Inventory (fourth paragraph) – Please replace the first sentence with the following “On June 19, 2007, the Tanana Valley Watershed Association (TVWA) and Alaska Trappers Association conducted a cleanup event for Noyes Slough with help from the City of Fairbanks and ADEC.”	Replaced	Section 3.1
30	Section 3.1, Data Inventory (fifth paragraph) – Please identify who conducted the May 2007 water quality assessment and persuaded the FSWAC to select Noyes Slough for the annual Stream Cleanup Day.	ADEC conducted the assessment. This information has been included.	Section 3.1

ID	Comment	Comment / Resulting Change	Affected Section
31	Section 3.1, Data Inventory (last paragraph) – Please verify date of debris assessment conducted by ADEC. The first sentence indicates the assessment was conducted on August 3, 2007. The last sentence indicates the assessment was conducted in June 2007. Appendix B also indicates June 2007.	The debris assessment was in August 2007. The date in Section 3.1 and in Appendix B has been changed to reflect this.	Section 3.1, Appendix B
32	Section 4.1, Point Sources – The Phase I versus Phase I discussion is confusing. For instance, the first paragraph states “...Phase I and II stormwater systems are possible point source contributors to the slough.” However, there are no Phase I (medium or large) MS4 systems in Fairbanks. We are operating under Phase II (small) MS4 regulations because our population within the urbanized area (and Borough for that matter) has yet to exceed 100,000 people. I would recommend clarifying or removing discussion of Phase I MS4 systems (especially as potentially contributing point source pollutants to the slough).	Phase I stormwater systems have been removed as a potential source to the slough in paragraph 1, but discussion of Phase I has been left in the remainder of the section to provide background and context for the Phase II permit discussion.	Section 4.1
33	Section 4.1, Point Sources (fourth paragraph) – Please replace phrase “...Alaska Department of Transportation and Public Facilities - Northern Regional Office.” with “...Alaska Department of Transportation and Public Facilities - Northern Region. ”	Replaced	Section 4.1
34	Section 5.5, Seasonal Variation (second paragraph) – The recreation activities listed in this section are not consistent with those listed on Page 1 of the Factsheet. Please make them consistent.	All activities on the Fact Sheet have been included.	Section 5.5
35	Section 6.2.1, Co-permittees MS4 Permit – Please clarify throughout this section that the co-permittees MS4 permit (AKS-053406) requires us to implement the six control measures listed, not the SWMP. The SWMP is outdated, and only serves as a guide to help us achieve the intent of the permit requirements. For instance, the fourth paragraph states “...the SWMP requires the co-permittees to host an annual stream cleanup day.” This is not true. The co-permittees MS4 permit makes this requirement, not the SWMP. Paragraphs four and five should be revised accordingly.	SWMP has been replaced with MS4 permit.	Section 6.2.1

ID	Comment	Comment / Resulting Change	Affected Section
36	Section 6.2.1, Co-permittees MS4 Permit (ninth and tenth paragraphs) – Please note the City of Fairbanks has already passed the following ordinances in July 2007: Construction Site Storm Water Runoff (No. 5702), Illicit Discharge Detection and Elimination (No. 5703), and Post-construction Storm Water Management (No. 5704) in accordance with our MS4 permit requirements. The City of Fairbanks and all other co-permittees have also already implemented a maintenance and operations program to evaluate the effectiveness of street sweeping, storm drain cleaning, and waste disposal practices, which is documented in the co-permittees 2007 Annual Report.	The ninth paragraph has been deleted since these ordinances are already discussed in Section 6.3. Paragraph 10 has been changed to reflect that the maintenance and operations program has already been implemented.	Sections 6.2.1 and 6.3
37	Section 6.2.2, FNSB MS4 Permit – Please clarify the differences between the co-permittees and FNSB MS4 permits. Specifically, the co-permittees are required to organize a Volunteer Monitoring Program and Adopt-a-Stream Program, and host an annual Stream Cleanup Day. Of these three measures, the FNSB is only required to host an annual Stream Cleanup Day. The co-permittees have conducted the Stream Clean-up Day in for the past 3 years. The FNSB will be conducting this year's (2008) Stream Cleanup Day. The FNSB has yet to decide, however, whether they will hold the event at Noyes Slough again or concentrate this year's event on the main channel of the Chena River.	Language has been added to clarify what the requirements of the FNSB's MS4 permit entail.	Section 6.2.2
38	Section 6.2.2, FNSB MS4 Permit (fourth paragraph) – Please replace phrase "...City of Fairbanks, City of North Pole, Alaska Department of Environmental Conservation, and Alaska Department of Transportation and Public Safety Northern Region..." with "...City of Fairbanks, City of North Pole, University of Alaska – Fairbanks , and Alaska Department of Transportation and Public Facilities - Northern Region... "	Replaced	Section 6.2.2
39	Section 6.3, Local Ordinances (first paragraph) – Please add "construction site storm water runoff" to the list of City of Fairbanks ordinances related to garbage and littering.	Added	Section 6.3

ID	Comment	Comment / Resulting Change	Affected Section
40	Section 6.4, Storm Water Attitude Survey – Please note the Storm Water Attitude Survey will be distributed in April or May 2008 during spring break-up (if you wanted to narrow down the timeframe).	See comment 44	Section 6.5 (previously 6.4)
41	Section 7, Monitoring (first paragraph) – There is no “litter pick-up program” per se. Are you referring to the Steam Cleanup Days or Adopt-a-Stream Program? Please clarify.	This sentence was referring to the Steam Cleanup Days and Adopt-a-Stream Program, and it has been updated to include the correct names.	Section 7
42	Section 7, Monitoring (second paragraph) – The co-permittees MS4 permit does not require an increase in the number of volunteers present at the Stream Cleanup Day events. The permit only requires us to host an annual event. The SWMP may propose the measureable goal of having an increase in volunteers, but again, this is not a requirement.	The MS4 permits do not require an increase in the number of volunteers. This is only a suggested benchmark for success. The language in the Monitoring section has been revised to remove the reference to the MS4 permit to clarify.	Section 7
43	Section 1.8, Fish Populations (last paragraph) – Recommend removal of paragraph. This paragraph is not relevant to the loading analysis for residues, fails to identify natural processes (i.e. existing flow dynamics and beaver dam construction) as sources inhibiting habitat quality for rearing fish, and provides opportunity for the reader to construe debris as limiting the potential of Noyes Slough becoming high quality habitat for fish (when other, natural factors are present).	The inclusion of this paragraph regarding fish in Noyes Slough was included in response to a previous reviewer’s comment. Although natural factors may be affecting habitat quality in the slough (see section 4.2 for a discussion on beaver dams), debris (including vegetation cut by humans) can also be a factor.	Sections 1.8 and 4.2
44	Section 6.4, Storm Water Attitude Survey – The Storm Water Attitude Survey was published in both hardcopy format and online on March 28, 2008, and can be found at http://co.fairbanks.ak.us/PWorks/StormWaterManagementProgram/ . The first distribution was made March 28-30 th at the Northern Living Home Show in Fairbanks, and future distributions are planned for a variety of other local events throughout the summer. The survey period will remain open through September 30, 2008.	This information has been added to Section 6.5 (previously 6.4).	Section 6.5

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45	Section 6, Implementation – Please identify how the ADEC will enforce implementation of the TMDL.	ADEC's role in the implementation of this TMDL will be detailed in the implementation plan, which will be completed at a later stage in the TMDL process.	
46	Section 7, Monitoring – Please identify ADEC's role and schedule for monitoring the proposed TMDL. If the ADEC is setting the TMDL, the ADEC should have integral role in planning the monitoring strategy to determine future and ongoing compliance.	ADEC's role in the implementation and monitoring of this TMDL will be detailed in the implementation plan, which will be completed at a later stage in the TMDL process.	

8.1. References

AAC (Alaska Administrative Code). 2006. Section 18.70 Water Quality Standards. Alaska Department of Environmental Conservation. Juneau, AK.

ADEC. (Alaska Department of Environmental Conservation). 2003. Noyes Slough Fact Sheet.

ADEC. (Alaska Department of Environmental Conservation). 2006. *Alaska's Final 2006 Integrated Water Quality Monitoring and Assessment Report*. Alaska Department of Environmental Conservation, Juneau, AK.

Anne Wien School 6th Grade. 2007. Noyes Slough Project website. <http://www.northstar.k12.ak.us/schools/awe/noyes/noyesmain.html>. Accessed November 16, 2007.

Burrows, R.L., D.E. Langley, and D.M. Evetts. 2000. *Preliminary Hydraulic Analysis and Implications for Restoration of Noyes Slough, Fairbanks, Alaska*. U.S. Geological Survey Water-Resources Investigation Report 00-4227. Anchorage, AK.

City of Fairbanks. 2007. 2007 Annual Report: Municipal Separate Storm Sewer System (MS4) NPDES Permit No. AKS-053406. City of Fairbanks Engineering Division. Fairbanks, AK.

Duffy, R. 2006. Students honored for Noyes Slough conservation work. Fairbanks Daily News-Miner. Fairbanks, AK.

Eshleman, C. 2007. Making a beautiful Noyes. Fairbanks Daily News-Miner. <http://newsminer.com/wp-content/themes/fdnm/single-print.php?post=7573>. Accessed 11/2/2007.

FNSB (Fairbanks North Star Borough). 2007. 2007 Annual Report. Municipal Separate Storm Sewer System (MS4) NPDES Permit No. AKS-053414. Fairbanks North Star Borough Department of Public Works. Fairbanks, AK.

Kennedy, B.W., M.S. Whitman, R.L. Burrows, and S.A. Richmond. 2004. *Assessment of Fish Habitat, Water Quality, and Selected Contaminants in Streambed Sediments in Noyes Slough, Fairbanks, Alaska, 2001-2002*. U.S. Geological Survey Water-Resources Investigation Report 03-4328. Anchorage, AK.

Parsons. 2006. *Delisting Document for Chena River, Chena Slough, and Noyes Slough*, Alaska.

Shannon & Wilson, Inc. 2003. Stormwater Management Plan Fairbanks Urbanized Area. Fairbanks, AK.

TVWA (Tanana Valley Watershed Association). TVWA web site. www.tvwatershed.com Fairbanks, AK. Accessed November 16, 2007.

USACOE (United States Army Corps of Engineers). 1997. *Chena River Watershed Study Reconnaissance Report*. Anchorage, AK.

USEPA (United States Environmental Protection Agency). 1991. *Guidance for Water Quality-based Decisions: The TMDL Process*. EPA 440/-4-91-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (United States Environmental Protection Agency). 2005a. Permit for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems Permit No. AKS-053406. U.S. Environmental Protection Agency. Seattle, WA.

USEPA (United States Environmental Protection Agency). 2005b. Permit for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems Permit No. AKS-053414. U.S. Environmental Protection Agency. Seattle, WA.

USEPA (United States Environmental Protection Agency). 2006. Flyer: Using Brownfields Grants for Watershed Restoration and Revitalization. September, 2006.

USEPA (United States Environmental Protection Agency). 2008. National menu of BMPs: Trash Management. <http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm>. Accessed February 15, 2008.

USKH, Inc. 2006. 2006 Annual Report: Municipal Separate Storm Sewer System (MS4) NPDES Permit No. AKS-053406. Fairbanks, AK.