The Tyonek Tribal Conservation District

Natural Resource Assessment and Project Implementation Plan

Compiled by the staff of TTCD
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Tyonek Tribal Conservation District

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

Tyonek Native Corporation

THE TYONEK TRIBAL CONSERVATION DISTRICT

NATURAL RESOURCE ASSESSMENT AND PROJECT IMPLEMENTATION PLAN

Authors:

Christy Cincotta
Tyonek Tribal Conservation District

Erin Hoffman
Innovative Funding, LLC

Matthew Schmitt
Tyonek Tribal Conservation District

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Cover photo: Indian Creek road crossing after culvert replacement and restoration project coordinated by the Tyonek Tribal Conservation District. This project, which was developed as a result of the creation of this document, is discussed in more detail in chapters 6 and 12. Photo taken in August 2013 by Christy Cincotta.

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TABLE OF CONTENTS

CHAPTER 1: Executive Summary.....1

A. *Goals & Objectives.....1*
B. *Document Structure.....2*
C. *Methodology & Project Prioritization.....2*
D. *Project Outcomes.....3*

CHAPTER 2: Introduction.....4

A. *Purpose and Need for Action.....4*
B. *TTCD Visions.....4*

CHAPTER 3: Background and History.....7

A. *Tyonek Tribal Conservation District.....7*
B. *Rural Alaska & Challenges.....10*
C. *The Native Village of Tyonek.....12*
D. *Other Communities in TTCD.....14*

CHAPTER 4: Eco-region.....19

A. *Location & Climate.....19*
B. *Geography.....20*
C. *Stakeholders & Current & Potential Projects.....20*

CHAPTER 5: Soils.....23

A. *Overview.....23*
B. *Resource Status & Issues of Concern.....24*
C. *Data Gaps.....26*
D. *Potential Projects.....26*

CHAPTER 6: Freshwater Resources.....29

A. *Overview.....29*
B. *Resource Status & Issues of Concern.....31*
C. *Data Gaps.....38*
D. *Potential Projects.....38*

CHAPTER 7: Marine Resources.....44

A. *Overview*……44
B. *Resource Status & Issues of Concern*……46
C. *Data Gaps & Potential Projects*……49

CHAPTER 8: Air Quality……53

A. *Overview*……53
B. *Resource Status & Issues of Concern*……54
C. *Data Gaps*……55
D. *Potential Projects*……55

CHAPTER 9: Terrestrial Habitat……58

A. *Overview*……58
B. *Resource Status & Human Uses*……60
C. *Issues of Concern*……62
D. *Data Gaps*……64
E. *Potential Projects*……65

CHAPTER 10: Wildlife……69

A. *Overview*……69
B. *Resource Status & Human Uses*……70
C. *Issues of Concern*……75
D. *Data Gaps*……76
E. *Potential Projects*……76

CHAPTER 11: Community Conservation……81

A. *Housing*……81
B. *Recycling & Waste Management*……82
C. *Food Production*……85
D. *Energy*……87
E. *Potential Projects*……95

CHAPTER 12: Conclusions……98

A. *Accomplishments*……98
B. *Future Projects*……101
C. *Final Thoughts*……101

APPENDIX

A. Figures

1. *Overview Map of TTCD*……A-1
2. *Land Ownership within the TTCD*……A-2
3. *Tyonek Historical Locations*……A-3
4. *The Native Village of Tyonek*……A-4
5. *Subsistence Use Areas*……A-5
6. *Potential Project Sites*……A-6
7. *Tyonek and Beluga Vicinity Culvert Locations*……A-7
8. *Future Development within TTCD*……A-8
9. *Vegetation Types in TTCD*……A-9

B. Tables

1. *Overall Project List*……B-1
2. *Tyonek Subsistence Use*……B-5
3. *Beluga Subsistence Use*……B-9

C. Additional Resources

1. *Soils Data & Resources*……C-1
2. *Freshwater Data & Resources*……C-6
3. *Terrestrial Habitat Data & Resources*……C-25
4. *Invasive Plants Survey*……C-29
5. *Wildlife Data & Resources*……C-40

Chapter 1: Executive Summary

In this chapter, we will discuss the goals, methods, and strategies that were used in the development of this document.

In this chapter:

A. Goals & Objectives
B. Document Structure
C. Methodology & Project Prioritization
D. Outcomes

A. Goals & Objectives

Tyonek Tribal Conservation District (TTCD) is a nonprofit 501(c)(3) organization whose mission is to conserve, enhance, and encourage the wise use of the natural resources in our District. In 2012, the U.S. Fish and Wildlife Service (USFWS) awarded TTCD with a grant to develop a Natural Resource Assessment and Project Implementation Plan. The Tyonek Native Corporation (TNC) provided matching funds to TTCD for this project. As part of this project, a list of goals and objectives were identified in discussions between TTCD and USFWS staff. The broad goals for the project were to:

1. Create one comprehensive document compiling current data to centralize the information, avoid duplicating projects, and to provide a tool to assist staff with funding future projects.
2. Prioritize potential projects for each document chapter, broadly covering general natural resource concerns within the district.

The specific objectives associated with these goals included the following:

1. Organize document into chapters.
2. Identify potential partners for each chapter.
3. Collect data and information available from relevant public, private, and governmental entities.
4. Communicate with partners to develop an initial list of priority projects.
5. Connect compiled data with the initial priority list of projects and determine feasibility of the project based on budget and TTCD capacity.
6. Determine information gaps or data needed to complete each priority project.
7. Travel to Game Unit 16B (GMU 16B) to collect data through surveys, inventories, GPS data collection, and photos.
8. Use ArcGIS to create necessary maps for the project including but not limited to streams, rivers, lakes, and wetlands.
9. The final document for each chapter will include a list of priority projects with maps, potential partners, potential funding sources, land ownership, and an estimated budget.

B. Document Structure

This document has been organized into chapters by background information, natural resources, and community conservation issues. All information in this document is relevant to TTCD's District, which shares its boundaries with GMU 16B. The following is a list of the chapters included and relevant information that can be found in each chapter.

- Ch 2: Introduction – Background information on this project as well as TTCD visions.
- Ch 3: Background & History – Background information on TTCD and the communities in the district.
- Ch 4: Eco-region – Climate and geography information.
- Ch 5: Soils – Information on soils, issues, and potential projects.
- Ch 6: Freshwater Resources – Water quality, waterways, aquatic plants, and fish passage.
- Ch 7: Marine Resources – Regulatory information, marine mammals, plants, fish, and invertebrates.
- Ch 8: Air Quality – Information on air quality issues.
- Ch 9: Terrestrial Habitat – Terrestrial habitat types, forestry, medicinal and edible plants, spruce beetle outbreak, and invasive plants.
- Ch 10: Wildlife – Subsistence, large herbivores, small mammals, large predators, and birds.
- Ch 11: Community Conservation – Housing and development, recycling and waste management, food production, and energy.
- Ch 12: Conclusions – Project outcomes including partnerships, completed projects, and overall prioritized list of future projects.

A similar format was used within each natural resource chapter (Chapters 5 – 10). Each of these chapters provides an overview of the resource, as well as the current status of the resource within the district. In addition, each chapter describes issues of concern, data gaps, and prioritized potential projects that relate to the natural resource.

C. Methodology & Project Prioritization

The development of this document has been the result of a collaborative process that TTCD has undergone with local, state, and federal entities, as well as residents and other stakeholders within the district. TTCD staff met with a variety of partners and community members to gather natural resource data and to determine natural resource concerns. As part of this process, data gaps, as well as natural resource issues of concern and potential projects were identified.

Included in each natural resource chapter is a list of potential projects. Along with a description of each project, the location, estimated project duration, anticipated project start date, land manager/partners, and a cost estimate are included. These projects are listed in order of priority

by natural resource within each chapter, as well as by overall priority in Chapter 12 of this document.

Factors Considered for Potential Projects

The priority criteria for TTCD's conservation projects are based on geographic characteristics, community needs, and the intent of resource sustainability. Tyonek and other communities in the district are located off of the road-system. The area is home to a mix of high-value natural resources, including fish, game, forested lands, and mineral deposits. The regions' land resources are owned and managed by a broad range of entities.

- **Sustainability of Natural Resources**
  - Promote sustainable methods of conservation for subsistence harvest activities
  - Promote balanced and thoughtful use of all natural resources regarding: ecosystem function, economic benefits, and community benefits
- **Minimization of External Inputs**
  - Promote energy efficiency and efficient use of local and imported resources
- **Adaptation to Non-Controllable Ecosystem Change**
  - Promote identification and proactive adaptation to ecosystem issues which cannot be directly mitigated, locally, or regionally
- **Community Stewardship**
  - Education is essential for creating community involvement in resource conservation and promoting community stewardship of natural resources
  - Education is also considered essential to sustainable conservation success
- **Promote Proactive Conservation Efforts**
  - Identify potential issues related to development projects within GMU 16B and create strategic, proactive conservation efforts to address the potential issues associated with development(s)

D. Project Outcomes

As a result of this project, TTCD formed many partnerships with federal, state, and other entities. In addition, TTCD staff identified and accomplished several projects as a result of developing this document. Lastly, TTCD staff outlined and prioritized a variety of potential conservation projects for TTCD for the future through the process of completing this plan. A list of partnerships, completed projects, and prioritized future projects can be found in Chapter 12.

The resource assessment document that was developed through this process is meant to be a living document. It is expected that this document will be reviewed and changed over time, as priorities and conditions change. Although projects may change or be eliminated, this document provides a source of information for TTCD to be used in the growth of the organization and to address natural resource issues in the district.

Chapter 2: Introduction

A. Purpose & Need for Action

In 2005, TTCD was formed as the first tribal conservation district in Alaska and the thirty-first in the nation. The district covers a total of 6.6 million acres of land including the Native Village of Tyonek (NVT), and shares its boundaries with Alaska GMU 16B (see Figure 1 in the Appendix).

In 2012, the U.S. Fish and Wildlife Service awarded TTCD a grant to develop a Natural Resource Assessment and Project Implementation Plan. The Tyonek Native Corporation provided matching funds to TTCD for this project. This grant provided the resources for TTCD to create a comprehensive document compiling current data, identifying data that will need to be collected, and prioritizing future natural resource management projects. The need for this plan was identified by TTCD staff and based on the vision statements developed by the TTCD Board of Directors during several meetings held to outline a Seven Generations Plan. The three vision statements that came out of the Seven Generations Planning sessions address several goals for the organization.

B. TTCD Visions

Vision 1: Be Self Sustaining

TTCD is a self-sustaining and professional model district effectively working with entities to assure the continued availability of sufficient renewable natural resources and energy. TTCD provides education, outreach programs, and opportunities for self-sufficiency for future generations. The district will be an advocate for residents in all aspects of natural resources stewardship and supports the needs of the residents' livelihoods regarding fish, wildlife, plants, and future development.

Nina Snodgrass and Alexandria Allowan, harvesting a seal.

Current Situation: In September 2011, TTCD received one year of funding to hire staff to create and implement projects in GMU 16B providing protection, restoration, and stewardship for natural resources. In order to become self-sustaining, it is necessary for TTCD to diversify funding sources (i.e. grants, unrestricted cash, legislative funding, earned income, and/or fundraising) and increase partnerships to maximize resources to address conservation needs.

Vision 2: Protect Natural Resources

Work to ensure an adequate abundance of marine life, land animals, plants, migratory birds, and fowl for our future generations by protecting all lands, waters, and wetlands to provide subsistence. Ensure that development does not impact drinking water supplies, create air pollution, and harm natural resources. Encourage all interested parties working together to protect our natural resources and abundance of harvestable vegetation through protection of our habitats.

Current Situation: The Board of Directors of TTCD identified several natural resource concerns that must be addressed to achieve this second vision. These concerns include:

Nelly and Max Chickalusion, processing fish.

Shellfish supply: Tyonek residents have found that the shellfish supply on West Cook Inlet is limited.

Marine Mammals: Beluga whales, which are a subsistence food source for the Tebughna people, are currently designated as endangered.

Fish: In recent years salmon counts on the West Cook Inlet have been decreasing based on harvest and commercial fishing counts.

Fish Passage: The Alaska Department of Fish and Game has identified several barriers to fish passage in Tyonek and the surrounding areas.

Tyonek from above.

Riparian Erosion: Erosion on riverbanks from boats and natural occurrences have increased.

Pollution: Fishermen leaving garbage on riverbanks.

Disaster preparedness: Possibility for man-made disasters (i.e. oil spills and boating issues) and natural disasters (i.e. wildfires, flooding, and invasive species issues).

Air quality: Dust, due to the use of gravel roads, is currently an issue in Tyonek. In the future, there is also the potential for air quality to be affected by mining developments.

Water quality: Although water quality is currently good, residents are concerned about future contamination from development.

Wildlife: Residents are concerned that there is an inadequate supply of wildlife species to support the subsistence lifestyle.

Coastal erosion: There are several homes along the beach that are in danger due to coastal erosion, and are highly likely to fall into the Cook Inlet. A plan needs to be created to remedy this and to plan appropriately in the future.

Forestry: Residents have noticed an increase in grass species within forests and a need for forest regeneration.

Self Sufficiency: The community is interested in developing community gardens to increase Tyonek's food supply.

Waste Management: The community is interested in developing and supporting a recycling program.

Vision 3: Energy Resources

TTCD will have an integrated sustainable approach to energy use. The energy program will include an appropriate mix of renewable and nonrenewable energy sources that are cost effective and have low pollution impact. The program will explore piping natural gas to the village as well as various forms of biomass utilization for heat and for electrical generation. TTCD will establish an energy working group to coordinate with other energy users in the district on the best regional approach.

A view of Cook Inlet from Tyonek.

Current Situation: At present the cost of electricity as well as fuel is very high. Increasing energy efficiency and the use of renewable energy sources would provide a major benefit to Tyonek and its residents.

The purpose of this document is to develop a Habitat Assessment and Project Implementation Plan to address habitat protection, restoration, and stewardship needs in the TTCD, including the NVT.

Chapter 3: Background and History

In this chapter we will discuss the history of tribal conservation districts and TTCD, the challenges of life in rural Alaska, and the history of Tyonek and other communities with the District.

In this chapter:

A. Tyonek Tribal Conservation District
B. Rural Alaska & Challenges
C. The Native Village of Tyonek
D. Other Communities in TTCD

A. Tyonek Tribal Conservation District

What is the Tyonek Tribal Conservation District?

Tyonek Tribal Conservation District (TTCD) officially formed on August 25, 2005, becoming the first Tribal Conservation District in the state of Alaska. The rationale behind the formation of TTCD was to support efforts in conserving and enhancing natural resources within the district boundaries. The TTCD was formed through a mutual agreement between the Native Village of Tyonek (NVT), Tyonek Native Corporation (TNC) and the United States Department of Agriculture (USDA).

TTCD is a nonprofit 501(c)(3) organization whose mission is to conserve, enhance, and encourage the wise use of the natural resources in the district. The district bases its efforts on three guiding vision statements to meet the needs of the natural resources, stakeholders, and residents of the district. TTCD strives to accomplish its mission through cooperative relationships with any and all interested parties.

TTCD is defined by the exterior boundaries of GMU 16B. The district consists of the drainages into Cook Inlet between Redoubt Creek and the upper reaches of the Yentna River and the Alaska Range on the west, and makes up a total of 6.6 million acres. This area was chosen to be part of the district because it includes the traditional hunting and fishing grounds of the Dena'ina Athabascan residents of Tyonek.

State Conservation Districts & Tribal Conservation

Conservation districts were first formed in this country in 1937, following the environmental disaster known as the Dust Bowl. During the 1930's soil erosion resulted in dust storms across much of the United States, and which often blackened the sky and blocked the sun. This disaster led to the passing of legislation declaring soil and water conservation a national priority

(www.nacdnet.org/). To address this, the Natural Resources Conservation Service (NRCS) was established within the Federal Government as a division of the USDA. As nearly three quarters of the land in the United States is privately owned, Congress realized that only voluntary support from landowners would guarantee successful conservation efforts on private land. Soil and Water Conservation Districts were formed as a division of state governments to provide a local entity to work with landowners. There are now over 3,000 state conservation districts in the country.

A farmer and his two sons during a dust storm in Oklahoma, 1936
www.farmaid.org

Although state conservation districts spread quickly through the United States and assisted with many natural resource conservation projects on private land, it took much longer for assistance to reach tribal lands and eventually Alaska. There are over 560 Federally Recognized Tribes within the United States with landholdings of more than 94 million acres nationwide. In Alaska alone, there are over 40 million acres of Native held lands.

Prior to 1988, the USDA was unable to work directly with Alaska Native Tribes or Alaska Native Corporations to promote programs addressing needs of Alaska Natives related to health, environment, natural resources, food safety, research and education, and provide technical assistance to farmers and ranchers. After Executive Order 13175 (November 6, 2000), the USDA had the capability of signing a mutual agreement with an Alaska Native Tribal Government, thus being able to work directly with that Tribal Government (www.inca-tcd.org/). As a result, the USDA and the NRCS have worked with Tribal Governments and Tribal Corporations in Alaska to create tribal conservation districts (TCD). TCDs provide advantages for both the USDA and Alaska Native Villages or Tribes. The USDA and other federal organizations now have an entity with which to work directly on tribal land, addressing specific native community needs. At this time, there are 34 TCDs in the United States.

NRCS
Natural Resources Conservation Service

TCDs, similar to state conservation districts, focus on soil, water, and natural resource needs of their community or designated district. Land uses and needs are integral parts of Alaska Native culture and food, often referred to as subsistence. Unlike in the contiguous United States, and as a result of the Alaska Native Claims Settlement Act (ANSCA), Alaska Native Villages do not reside on reservations. Instead shareholders have tribal and tribal corporation lands to practice their subsistence way of life including fishing, gathering, hunting, and trapping. As the USDA has worked with the TCDs to provide programs that will work for Alaska Native communities, the USDA recognized that subsistence provides a means of preserving culture, tradition, and livelihood. As Alaska Native Villages become aware of the benefits of TCDs and working with USDA, more are forming throughout the state. The current TCDs in Alaska include these

communities: Tyonek, Nunivak Island, Kwethluk, and Mountain Village. A fifth TCD, the Copper River Ahtna Intertribal Conservation District, is completing the process of signing a mutual agreement with USDA, the State Conservationist, and the Alaska Native Federally Recognized Tribe.

Tyonek Tribal Conservation District History

TTCD formed in 2005 through a mutual agreement between USDA, NVT, and TNC. The original board consisted of five members: two representatives from NVT, two representatives from the TNC, and one selected by the NVT and TNC board members through public notice. The organization established official bylaws in 2009, and held a meeting in early 2010 to develop a Seven Generations Plan.

Angela Sandstol, former chair of the Tyonek Tribal Conservation District, receives the signed MOU between USDA, TNC, and NVT for the establishment of TTCD.

The boundaries of GMU 16B were chosen as those for TTCD, and this area encompasses more than NVT and TNC lands. The district includes four communities: Tyonek, Beluga, Skwentna, and Alexander Creek. We will discuss the history of each of these communities in this chapter. Two maps, one showing an overview map of the district (Figure 1) and another showing land ownership within the district (Figure 2) are located in the Appendix.

In 2005, TTCD worked with the NRCS to coordinate a moose habitat enhancement project near the Village of Tyonek on TNC lands. This was done though an Environmental Quality Incentives Program (EQIP) contract with TNC and involved the whole community, including students, to install willow cuttings as a food source for moose. This was the TTCD's first successful project.

Staff was first hired at the TTCD in 2011, again setting a precedent by becoming the first TCD in Alaska with employees. TNC contributed the initial funds needed to pay staff. As of the time of completion of this document, the organization consists of five board members, and four staff including an Executive Director, Natural Resources Specialist, Program Administrator, and Program Director.

"The TTCD has helped the natural resources conservation effort in the Tyonek area by implementing a process whereby Tyonek residents and other area stakeholders can deal with issues"
–TTCD Board Member

Since hiring staff, the district has been involved in several projects including the development of a Tyonek Community Garden, fish passage improvement through culvert replacement, and a TCD outreach and education project. These projects will be

discussed in greater detail within this document in relevant chapters.

TTCD is a non-regulatory, nonprofit organization whose mission is to conserve, enhance, and encourage the wise use of the natural resources in the district. As such, TTCD has no authority to make decisions about land use or other resources. The role of the TTCD is to provide technical assistance, education, and financial assistance to landowners within the district to achieve their conservation goals.

B. Rural Alaska & Challenges

Alaska Geography

Supply delivery by plane in the Lower Kuskokwim area of Alaska.

Residents of Alaska including Alaska Natives, face significant challenges and barriers unlike any other state including expansive geography, remoteness, lack of infrastructure, inclement weather, and high cost of living. The State of Alaska is the largest state in the United States based on landmass. Alaska is one-fifth the size of the entire United States or 586,412 square miles. Four oceans-North Pacific Ocean, Bering Sea, Chukchi Sea, and Arctic Ocean-surround Alaska, forming 33,904 miles of coastline (NOAA). Alaska's maritime location has a significant influence on weather, transportation, cultures, and traditions of Alaska Native peoples. Alaska's diverse geography includes mountains, rivers, salt water, lakes, glaciers, islands, tidal flats, and tundra. These environments are inhabited by a large array of wildlife and birds, including moose, bears, beluga and humpback whales, caribou, salmon, halibut, beaver, bald eagles, puffin, ducks, and many more (http://commerce.alaska.gov/). Some of the primary mountain ranges in Alaska include the Talkeetna Range, Alaska Range, Brooks Range, Chugach Range, and Wrangell Mountains, while the primary rivers include the Yukon, Kuskokwim, Susitna, and Copper.

Alaska's Economy & Cost of Living

The high cost of living in Alaska's rural communities is largely related to the state's geographic location and the long distances goods must be transported. Anchorage, the primary port for the state, is located 2,200 miles from Seattle, Washington, the closest transportation hub in the contiguous U.S. Once goods reach Anchorage, they must travel further to reach the communities located in GMU 16B, including Tyonek, which is 43 miles southwest and inaccessible by road. Alaska Economic Trends analyzed the cost of goods including fuel and food for a family of four for various communities. In Anchorage, food costs for a week were $131.72, and gasoline was $3.43/gallon. Bethel, a community comparable to those in 16B, has food and fuel costs more

than double that of Anchorage at $272.77 and $5.26/gallon respectively (Fried & Shanks, 2011). As of November 2012, fuel costs have considerably increased. Gasoline was $7.10/gal, while diesel fuel was $7.24/gal. Exacerbating these problems are the high unemployment rates experienced in many parts of rural Alaska, often exceeding 20%, including Tyonek (28.7%). (http://commerce.alaska.gov/).

Prior to contact with Europeans in the 1700's and Euro-Americans in the 1800's, the many cultural groups indigenous to Alaska each had unique adaptations to the environment they occupied. With the coming of outside groups came the devastating effects of diseases, resource exploitation, and cultural exploitation. All Native cultures in Alaska went through dramatic changes in their ways of life, language, and traditions. Natural resource exploitation and competition had some of the most pronounced effects by reducing the amounts of food resources available. Many populations of wildlife were over-exploited and reduced to near extinction in many cases.

Alaska Native Villages have existed for thousands of years, well before Alaska became the 49th state in 1959. Geographical barriers are not a new phenomenon for the villagers. Residents have adapted to the harsh realities of Alaskan seasonal changes from winter to summer (break-up) and from summer to winter for thousands of years. Seasonal transitions in the villages change food/animal patterns and transportation accessibility. Rivers and trails are used for transportation in the villages rather than roads. Therefore, boats, snow machines (snowmobiles), planes, and all-terrain vehicles (ATV's) are the primary means of travel. As rivers either melt or are in the process of freezing, travel is limited and villagers must then use ATV's or snowmachines for travel, contingent on the presence of snow.

Preserving of salmon in a traditional smokehouse.

In addition to the seasonal changes, food/animal patterns also transition. Alaskan Natives have been living off the land for thousands of years performing seasonal practices of fishing, hunting, and gathering berries and herbs. Contiguous U.S. traditional fruits and vegetables (i.e. tomatoes, lettuce, apples, potatoes, beets) are difficult to find and if they are transported to the village, they are often rotten by the time they arrive. TCDs in Alaska are forming at a critical time for food production practices. Villages are facing low return rates of wild game and fish; TCDs are responding in an effort to manage animal habitats and sustain their historical and cultural subsistence way of life. With the mechanism of TCDs, villages are now capable of linking traditional agricultural practices of farming and gardens, with subsistence, the traditional agriculture for the Alaska Natives. TCDs are reaching out to federal, state and local

organizations to use their programs to conserve their land, protect natural resources, and find sustainable food sources for future generations.

C. The Native Village of Tyonek

Overview

The Native Village of Tyonek (NVT) is a Dena'ina Athabascan village located 43 miles southwest of Anchorage. The community lies at approximately 61° North Latitude and -151° West Longitude, and is located within the Anchorage Recording District. Tyonek has long been home to the Tebughna or "the beach people." Today there are 171 residents according to the 2010 Census, however, the Tyonek Native Corporation (TNC) has over 800 shareholders that can practice subsistence hunting, fishing, and gathering within 16B. The community has a sewer system and one school. The village does have a health clinic, but all emergency services are only accessible by flight to Kenai and Anchorage.

Dena'ina Athabascans arrived in the Cook Inlet (or Tikahtnu as it is called in Dena'ina, meaning Big River) region between 500 and 1000 AD. The Cook Inlet Dena'ina peoples were originally from the interior, and when they moved in to this area they kept their inland technologies and also adopted many appropriate for a marine environment. The Dena'ina are unique in this respect, as the only Athabascans to include both strategies. In pre-contact times, it is estimated that 4-5,000 people were living in West Cook Inlet. One regional band of Dena'ina, the Tebughna lived in this region and the Tyonek area was their primary territory.

Photograph of Old Tyonek in 1898.
USGS

In the 18th century Russian fur traders moved into the Cook Inlet region, and in 1794 established a Russian trading post near present day Tyonek. During this time the Dena'ina participated in the fur trade as middlemen between other Natives in the interior with access to more desirable furs and the Russians. The fur trade shifted to Southeast Alaska and collapsed in 1900, but the Russian people left a lasting impact on the region. The first Russian Orthodox mission came to the area in the late 1700s, and the Russian Orthodox religion is still practiced in Tyonek. In the late 1800s the Euro-American presence in Alaska was also growing, due to interest in commercial fishing and mineral exploration. The increased exposure to foreign diseases took a toll on the Dena'ina Athabascans, and a smallpox epidemic in the 1830's reduced their population by over fifty percent. Native villages in the area consolidated, and Tyonek grew as one of the larger villages in Western Cook Inlet (Kari & Fall, 2003).

In 1915, the Moquawkie Indian Reserve of 26,918 acres surrounding the Village of Tyonek was created through an executive order. In 1918 another epidemic, this time influenza, devastated the Dena'ina population once more. Although more people moved in to Tyonek, by 1932 the population was only 650 people. In the 1930's Tyonek moved to its present location due to coastal erosion in its previous location.

In the 1950's and 1960's, oil and gas companies began exploring the Cook Inlet region. In 1960 the Beluga River gas field was discovered north of Tyonek, and offshore production began in 1967. When gas deposits were found on Tyonek lands, the residents of Tyonek received over $12.9 million for drilling rights. This money was used to build 60 new homes, roads, store and coffee shop, water treatment plant, guest house, village maintenance shop and Anchorage real estate. A map showing the past and current locations of the Village of Tyonek (Figure 3) can be found in the Appendix. A map showing the locations of points of interest within Tyonek (Figure 4) can also be found in the Appendix.

Subsistence

View of fish camp site on Old Tyonek Creek in the Tyonek area.

Subsistence, or the use of fish, wildlife, and plants for home use, is vital for the Tyonek community. Tyonek residents harvest rainbow trout (*Oncorhynchus mykiss*), Chinook (king) salmon (*Oncorhynchus tshawytscha*), coho salmon *(Oncorhynchus kisutch*) and sockeye salmon (*Oncorhynchus nerka)* (Holen & Fall 2011). Rainbow trout are caught from rivers and streams during break up in April and May, while salmon are caught from the Cook Inlet beaches within the Tyonek area (Stanek et al., 2007). The Alaska Board of Fisheries identifies salmon in the Tyonek Subdistrict as having "Customary and traditional subsistence uses" (5 AAC 01.566; Holen & Fall, 2011). In addition, the Federal Subsistence Board (FSB) has identified several species, including salmon, bear, and moose as having "customary and traditional subsistence uses" in Tyonek (50 CFR 100.10, 2011; 50 CFR 100.24, 2012).[1] Tyonek residents also harvest small and large mammals, birds, marine mammals, and plants. Subsistence use of resources will be discussed in greater detail in relevant chapters of this document. A map showing subsistence resource use areas for Tyonek and Beluga (Figure 4) is located in the Appendix.

[1] FSB has also identified, dolly varden, trout, char, grayling, burbot, wolf, grouce (spruce and ruffed) and Ptarmigan (rock, willow and white-tailed) as having "Customary and traditional subsistence uses" in Tyonek (50 CFR 100.24, 2012).

D. Other Communities in TTCD

Beluga

General store in Beluga, AK.
raybulson.com

Beluga is located 8 miles northeast of Tyonek, along Cook Inlet in the Kenai Peninsula Borough. Beluga is 40 air miles southwest of Anchorage, and is located in the Anchorage Recording District. Beluga is one of the few communities accessible to Tyonek by road. According to the 2011 Alaska Department of Labor, the current population is estimated to be 19, and the majority of these residents are non-Native. (http://commerce.alaska.gov/).

Historically, various Dena'ina Athabascan settlements were located in this area. There were several Athabascan camps in the area where present day Beluga is located. The Dena'ina name for the mouth of the Beluga River is Nughiltnu Kaq (mouth of the river that flows down). The name Beluga comes from the Russian name Belukha for the small white whale that feeds in the Cook Inlet. In the 1930's and 1940's, commercial fisherman established camps near Beluga at Three Mile Creek, and along Cottonwood Beach. In the 1950's and 1960's, gas deposits were located near Beluga through oil and gas exploration efforts. In 1967 energy production began, and a small settlement of individual households was established. By the early 1980's, a post office and general store were established (Stanek et al., 2007).

Today, Beluga is a primarily non-Native community with a private runway, which provides the only air access to the community. A large gas-powered electrical generation plant is located at the north end of the runway and is operated by Chugach Electric Association and the Municipality of Anchorage. Electrical power from this plant is available to local residents. Most jobs held by Beluga residents are in the services sector, including sport fishing and hunting industries. Many Beluga residents utilize local resources such as fish, wildlife, or wild plants to supplement their food supply and some households rely heavily on these resources as part of their diet. Subsistence use of resources by Beluga residents will be discussed in greater detail in relevant chapters of this document. A map showing subsistence resource use areas for Tyonek and Beluga (Figure 4) is located in the Appendix.

Skwentna

Skwentna (pronounced SKWENT-nuh) is a small town located 62 miles north of Tyonek, on the south bank of the Skwentna River at its junction with Eight Mile Creek. The community lies at 61° North and -151° West, and is located in the Anchorage Recording District. The town is unincorporated, and it is in the Yentna River Valley in the Matanuska Susitna Borough (MSB).

According to a 2011 Alaska Department of Labor Estimate, the current population of Skwentna is 30, and the majority of these residents are Caucasian (http://commerce.alaska.gov/).

Iditarod checkpoint in Skwenta, 1999. dced.state.ak.us

Historically, Dena'ina Athabascans have fished and hunted along the Skwentna and Yentna Rivers for centuries. In 1908, an Alaska Road Commission crew blazed a trail from Seward to Nome, going through Old Skwentna from the Susitna River to Rainy Pass. In 1923, Max and Belle Shellabarger homesteaded and started a guide service followed by a flying service and weather station. In 1937, a post office was opened, and shortly after an airstrip was constructed. The US Army established a radar station at Skwentna in 1950, as well as a recreation camp and state land disposals in the 1960s increasing settlement in the area (http://commerce.alaska.gov/).

Today, Skwentna residents are scattered over a large area-more than 440 square miles-based on the US Census Bureau. There are a number of seasonal-use homes, a local store, and an area residents use snowmachines or aircraft to travel to the post office. According to the 2010 Census, there were 353 housing units in Skwentna and 20 were occupied. In these homes, outhouses are the main means of sewage disposal, with few homes being fully plumbed. There is no central electric system for Skwentna, and all residents with power generate it individually. There is a community refuse incinerator available at an unpermitted dump site that is operated by MSB. However, most residents burn and bury their own refuse. There are schools located in the community, and auxiliary health care is provided by Lake Creek/Skwentna First Responders. Employment in the community is provided through local lodges, the post office, and the air strip. However, the 2006-2010 American Community Survey estimated that zero residents are employed. There is no road access from the George Parks Highway, therefore, residents depend on air travel and snowmachines for travel (http://commerce.alaska.gov/).

Alexander Creek

Photo taken by Otto Thiele (1941) as he snowshoed to Susitna station (Alexander Creek, Incorporated, 2002)

The village of Alexander Creek, also known as Alexander, is located 27 miles northwest of Anchorage, where Alexander Creek empties into the Susitna River just a few miles from its mouth in the Cook Inlet. Originally known as Tuqen Kaq by its native inhabitants, the village was large and thriving due to its substantial natural resources. However, in the early 1900s a wave of epidemics decimated the Alaska Native population and those who survived moved to Tyonek. By 1939, Native families had started to reoccupy this area. Moore and more non-Natives began visiting this area for sport fishing. When Alaska was granted statehood in 1959, much of the land in this area was granted to MSB (Alexander Creek, Incorporated, 2002).

After ANSCA was enacted in 1971 to settle Alaska Native land claims, the Bureau of Indian Affairs (BIA) determined which villages were eligible to receive land. BIA made the initial determination in 1971 that there were 37 natives enrolled in Alexander Creek. However, due to land transfers in 1959, only one third of an acre in the Alexander Creek area remained to be claimed; the remaining land belonging to MSB. This created a land conflict and caused the State of Alaska to challenge Alexander Creek's eligibility. The result of this conflict was that Alexander Creek residents agreed to be given group status and were given lands in the Lake Clark area, under circumstances that the district court has since ruled unconstitutional. Alexander Creek Natives are currently appealing to Congress for recognition of their tribe as well as land selections (Alexander Creek, Incorporated, 2002).

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Chapter 4: Eco-Region Description

The Tyonek Tribal Conservation District (TTCD) is located within the Upper Cook Inlet Basin of Southcentral Alaska. The Cook Inlet Eco-Region is composed of the low-lying basin surrounding Cook Inlet from the south side of the Alaska Range to Kachemak and Tuxedni Bays. It is bordered by Kenai, Chugach, and Talkeetna Mountains on the east; and, on the west it is bordered by the Alaska and Northern Aleutian Ranges. The eco-region includes the west portion of the Kenai Peninsula, Anchorage bowl, West Cook Inlet lowlands, and the Susitna lowlands (The Nature Conservancy of Alaska, 2003).

In this chapter:

A. *Location & Climate*
B. *Geography*
C. *Current & Potential Projects & Partnerships*

A. Location & Climate

The lowlands of the Cook Inlet Eco-Region contain numerous lakes, estuaries, and large river basins, as well as drainages of the Kenai and Susitna rivers. These large rivers terminate in broad estuarine areas in Cook Inlet. The Susitna River provides the greatest amount of freshwater input into Cook Inlet within the eco-region (ADNR, 1999).

Tyonek Village is located on a shallow bluff on the northwest shore of Cook Inlet, 43 miles southwest of Anchorage. The community lies at approximately 75' Above Sea Level (ASL), and is located at 61.068060° North and -151.136940° West. Sec. 01, T011N, R011W, Seward Meridian (State of Alaska, 2013).

Winter temperatures typically range from 4-22° F; summer temperatures average from 46-65° F. Temperature extremes have been recorded from -27-91° F. Average annual precipitation is 23 inches with 82 inches of snow. The nearest ongoing (public) meteorological station is located at the Kenai Airport, approximately 35.65 miles due south of Tyonek Village.

Eco Region:

- Size, 7,802 mi² (4,993,876 Acres)
- Varied, Boreal, Closed broad-leaf and Mixed Forest
- Varied topography; bordered by Alpine tundra, transitioning to bogs, lakes, rivers/streams and estuarine systems.

Climate:

- Average Summer Temps, Highs 55-65F, Lows 40-45F
- Average Winter Temps, Highs 20-25F, Lows 5-10F
- Average Precipitation, 23"
- Average Snowfall, 82"
- Record High, 91F (84F at Beluga point)
- Record Low, -27F (-40F at Beluga point)

(State of Alaska, 2013; Becker 2011)

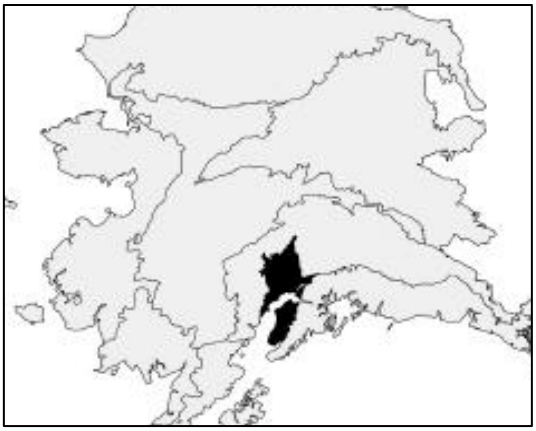

Figure 4.1: Cook Inlet Eco-Region
Nature Conservancy, 2003

B. Geography

TTCD encompasses GMU 16B and contains several drainages, wetlands, and forested areas considered to be high-value habitat (The Nature Conservancy of Alaska, 2003).

The east border of GMU 16B is formed by the Kahiltna River drainage; the west border of GMU 16B is formed by mountain ranges corresponding to the watershed boundaries; and, the south and southeast borders of GMU 16B are formed by the Cook Inlet and the boundary of Lake Clark National Park & Preserve.

> *"Cook Inlet defines the Tebughna, the Beach People."*
> *-TTCD Board Member*

GMU 16B contains several river drainages and lakes, which are of important to conservation practices within the region including Yentna River, Skwentna River, Happy River, Chuitt River, Beluga River, a portion of the Susitna River, and many other streams and creeks. The area also contains extensive forested lands, estuarine lands, and marine coastline. An overview map of TTCD (Figure 1) is included in the Appendix.

C. Stakeholders & Current & Potential Projects

Understanding the goals and concerns of all district stakeholders and interested parties is a key component to practicing inclusive conservation. Diverse stakeholder groups often lead to diverse intentions for land use and development. TTCD strives to find adaptive and proactive conservation solutions to these diverse conservation needs. The following tables outline district stakeholders, development projects, and conservation related projects.

Table 4.1: District Stakeholders and Interested Parties

Stakeholder Group	Land Ownership or Management (Yes/No)	Type of Group (Federal, State, Private, Non-Profit)
General Public (Alaska Residents)	**Y**	**Private, General AK Population**
Native Village of Tyonek	**Y**	**Private**
Tyonek Native Corporation	**Y**	**Private**
U.S. Federal Government (e.g. BLM, USGS, USFS, USFWS, USDA, NRCS, NOAA)	**Y**	**Federal**
State of Alaska (e.g. ADF&G, ADEC,	**Y**	**State**

Mental Health Trust)		
Cook Inlet RCAC	**N**	**Non-Profit (Advisory Council)**
Apache Alaska Corporation	**N**	**Private**
Anadarko Petroleum	**N**	**Private**
Hilcorp	**N**	**Private**

Table 4.2: Notable Development Projects within Tyonek Tribal Conservation District

Entity/Ownership	Type of Development/Project	Conservation Concern?* (Yes/No)
Tyonek Village, TTCD	**Community Food Plot**	**Y**
Pac-Rim	**Chuit Coal Mine**	**Y**
Apache Alaska Corporation	**Oil and Gas Exploration (Cook Inlet)**	**Y**
Anadarko Petroleum	**(On-shore lease)**	**Y**
Hilcorp	**Natural Gas/Oil Extraction**	**Y**

*These are projects that have the potential to impact natural resources.

Table 4.3: Current Conservation and Management Projects in the District

Entity Responsible for Conservation Or Resource Management Project	Type of Conservation Or Management Project	Potential Partner (Yes/No)
TTCD	**Assists Landowners with Conservation Projects**	**N/A**
Alaska Department of Fish and Game	**Sport Fish and Game Management**	**Y**
Kenai Watershed Forum	**1) Salmon Stream Mapping** **2) Juvenile Salmon Trapping**	**Y**
Cook Inletkeeper	**1) Salmon Stream/Climate Project** **2) Clean Energy Program – shift from fossils to renewable** **3) Clean Water Program** **4) Citizens Environmental Monitoring Program**	**Y**
Natural Resource Conservation Service	**1) Wetland Mapping Project**	**Y**
The Cook Inlet Information Management and Monitoring System	**(Information Conglomerate) Aggregated data site**	**Y**

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Chapter 5: Soil

Soil provides many important ecosystem services, functioning as a water filter, a growth medium, and a habitat for billions of organisms. In this chapter we'll discuss the basics of soil, soil issues in our district, and potential conservation projects relating to soil.

In this chapter:

A. Overview
B. Resource Status & Issues of Concern
C. Data Gaps
D. Potential Projects

A. Overview

Soil is a naturally occurring mixture of mineral and organic ingredients with a definite form, structure, and composition. The exact composition of soil changes from one location to another. The following is the average composition by volume of the major soil ingredients:

- 45% Minerals (clay, silt, sand, gravel, stones).
- 25% Water (the amount varies depending upon precipitation and the water-holding capacity of the soil).
- 25% Air (an essential ingredient for living organisms).
- 5% Organic matter or humus (both living and dead organisms).

Soil and the microbes living in it play an important role in growing vegetables.

A soil is composed primarily of minerals, which are produced from parent material that is weathered or broken into small pieces. Beyond occasional stones, gravel, and other rock debris, most of the mineral particles are called sand, silt, or clay. These mineral particles give soil texture. Sand particles range in diameter from 2 mm-0.05 mm, are easily seen with the unaided eye, and feel gritty. [One millimeter (mm) is about the thickness of a dime.] Silt particles are between 0.05 mm and 0.002 mm and feel like flour. Clay particles are smaller than 0.002 mm and cannot be seen with the unaided eye. Clay particles are the most reactive mineral ingredient in the soil. Wet clay usually feels sticky.

Water and air occupy the pore spaces—the area between the mineral particles. In these small spaces, water, and air are available

for use by plants. These small pore spaces are essential to the life of soil organisms, to soil productivity, and to plant growth.

The final ingredient of a soil is organic matter. It is comprised of dead plant and animal material and the billions of living organisms that inhabit the soil. To learn more about soil data available in Alaska, please see Soil Data and Resources in the Appendix.

A wide range of decisions can be based, directly or indirectly, on soils information. Examples include decisions about where to put a garden, park, or road. Individuals who might utilize soils information to make decisions include:

- Homeowners with small sites
- County planners, local planning boards, builders, or developers with large sites
- Students exploring careers in soils or educators planning outdoor classrooms
- Scientists or researchers
- Renters or property managers interested in ongoing maintenance or expanded use of existing soils

B. Resource Status & Issues of Concern

Cook Inlet Eco-Region

In the Cook Inlet Eco-Region, extensive glaciations of the past have had a major impact on the landscape, producing silty, fine-grained mudflats with many lakes. The soils of this region are mainly windblown loess (a fine grained silt or clay, usually yellow and calcareous) and volcanic ash overlaying deep glacial deposits. The region is also characterized by interspersed peat deposits. The shoreline of the district is composed of mixed soil and gravel beaches with tidal mud flats (The Nature Conservancy, 2003).

"When I think of soil I think of land, and we live off the land."
- TTCD Board Member

Main Soil Types in GMU 16B

Table 5.1 lists the soil types that are documented within the district. These soil types are in no particular order; they are simply a compiled list of the "main" soil types found in each area.

Table 5.1: Soil Types in GMU 16B (NRCS Web Soil Survey)

Old Tyonek a. Chichantna peat b. Killey and Hilline silt loams c. Kroto-Strandline-Cryorthents complex d. Lucile silt loam e. Nancy-Kashwitna complex f. Slikok muck g. Spenard silt loam h. Starichkof peat i. Strandline-Kroto complex j. Tyonek Peat	Susitna a. Benka silt loam b. Benka-Liten complex c. Cryaquepts depressional d. Cryods e. Riverwash and Niklavar soils f. Susivar-Moose River complex g. Susivar and Niklavar fine sandy loams
Alexander a. Chedatna silt b. Chichantna peat c. Chuit-Nakochna-Rubble land complex d. Doroshin peat e. Hewitt Peat f. Killey and Hiline silt loams g. Rubble Land h. Salamatof peat i. Suntrana silt j. Susitna silt loam k. Susitna-Niklason silt loams l. Wasilla silt loam	Tyonek a. Chichantna peat b. Cryaquents, tidal c. Killey and Hiline silt loams d. Lucile silt loam e. Nancy-Kashwintna complex f. Niklason silt loam g. Slikok muck h. Starichkof peat i. Susinta-Niklason silt loams j. Tyonek peat k. Wasilla silt loam
Skwentna a. Doroshin peat b. Hewitt peat c. Killey-Hiline silt loams d. Kroto-Strandline-Cryorthents complex e. Niklason silt loam f. Puntilla silt loam g. Riverwash h. Salamatof peat i. Schrock silt loam j. Slikok muck k. Starichkof peat l. Strandline-Kroto complex m. Strandline-Spenard-Kroto complex n. Susitna-Niklason silt loam o. Susitna and Niklason silt loam p. Wasilla silt loam	

Two areas of concern for soils in the district have been discussed by Tyonek Tribal Conservation District (TTCD) staff and district residents. The first of these is the quality of the soil in the community garden area as a growing medium. The second area of concern is the potential for soil contamination in developed areas.

C. Data Gaps

1. TTCD is a focal point for natural resource development in Alaska. With the potential development of a bridge built from Anchorage to Point Mackenzie, this area will experience an increase in development of transportation routes. Areas that should be priorities for further mapping include those that are easily accessible and are not currently mapped in the NRCS Web Soil Survey. It is important to understand the soil types of regions both before and after any development takes place.
2. TTCD should identify areas that could be potentially utilized for agricultural purposes, including the community garden in Tyonek. For all identified agricultural area, TTCD will need to work with the community and its landowners to test the soils in these sites to allow for maximum crop production and yield of a given agricultural site.
3. Areas such as landfills and heavy equipment storage areas could potentially have soil contamination issues. At this point there is no available data, and it will be important to conduct soil testing to determine if any contamination issues currently exist.

D. Potential Projects

Garden Soils

TTCD staff, in collaboration with NRCS staff, collected soil samples in three locations within the Tyonek community garden area to determine potential issues for growing. The results of this test showed that the nutrient content is not ideal for growing, most likely due to the removal of top soil when the land was cleared of vegetation, and that nutrient additions will be necessary for optimum plant growth. A composting program is one way to address this concern. The community garden will be discussed in more detail in Chapter 11. For more information, see table 5.2 in this chapter and Figure 6 in the Appendix.

Soil Contamination

There are several areas in the district that are potential soil contamination sites. Landfills, due to the variety of materials that are disposed of there, pose a major threat to the environment. There are landfills in Beluga and Tyonek, and conducting soil testing to verify levels of contamination will be an important step in determining if any remediation is necessary. Areas where fossil fuel powered machinery are used and stored are also at risk for contamination, and should be tested. For more information, see table 5.2 in this chapter and Figure 6 in the Appendix.

Table 5.2: Potential Projects

Priority	Project Description	Location	Estimated Project Duration	Anticipated Project Year	Land Manager/ Partners	Cost Estimate*
1	Test soils around the landfill area.	Tyonek	1-2 months	2015	TNC/NVT	$
2	Test soils at the landing strips and around The Shop where heavy equipment and toxins are stored.	Tyonek	1-2 months	2015	TNC/NVT	$
3	Test soil around the barge area.	Tyonek	1-2 months	2015	TNC/NVT	$
4	Conduct soils test around the Beluga landfill.	Beluga	1-2 months	2015	Multiple	$
5	Develop a composting facility to reduce toxins leeching into the soil and manage waste that can be used to increase nutrients in soil for agricultural use on small community gardens or home gardens.	Tyonek	1-2 years	2015	TNC/NVT	$ - $$
6	TTCD should work with NRCS to establish a time or project aimed at collecting data along and around these regions.	Tyonek	1-2 years	2019	TNC/NVT	$$

*** $** = <$5,000 **$$** = $5,000 – $30,000 **$$$** = $30,001 - $100,000 **$$$$** = $100,00 - $500,000 **$$$$$** = >$500,000

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Chapter 6: Fresh Water Resources

The Cook Inlet region has freshwater of varying types, from small wetlands and ponds, to large glacial rivers and lakes. The sources of these freshwater bodies include glacial melt, snowmelt, precipitation, and groundwater. These habitats play an important role for fish and wildlife, serving as migration corridors, spawning grounds, and wintering habitats. Average instantaneous freshwater discharge into Cook Inlet was estimated to be 116,000 cubic feet per second (CFS) – a volume of about half that of the Yukon (Ourso, 2001; Yanity & Hirsch, 2010). Approximately 20% of the fresh water entering Cook Inlet comes from within the district and the surrounding watersheds. For more information see Tables 2 and 3 and Figure 5 in the Appendix.

In this chapter:

A. *Overview*
B. *Resource Status & Issues of Concern*
C. *Data Gaps*
D. *Potential Projects*

A. Overview

The Importance of Water Quality in Conservation

Conservation efforts and field research are increasingly concerned with addressing and identifying the effects of human caused watershed modifications in relation to the physical, chemical, and biotic integrity of waterways. The ability to measure and describe the health of watersheds in relation to anthropogenic activities has evolved substantially since the subject was first described in *Physical Geography as Modified by Human Action* (Marsh, 1965). Since that time, human populations have increased, causing an increased frequency of human-watershed interface. This becomes a problem when water quality levels are altered to the point that streams and rivers are biologically, physically, or chemically impaired or irreparably damaged. This can occur at landscape development levels as low as 8-20% of total watershed landscape use (Karr & Chu, 2000).

In practice, establishing quantitative connections between human land use and waterway use, with measurable effects on the health of the waterways, can be problematic due to the number of possible stressors. Ranges of anthropogenic related impairments vary with the type and number of allied stressors placed on a watershed (Miltner et al., 2004). It is believed that ecosystem function probably varies with the extent of landscape development, although there are few stream networks in which this prediction has been closely studied (Meyer et al., 2005). For this reason, the Cook Inlet Eco-Region is an exceptional place to study water quality pre- and post-development. The region offers many stream and lake networks that have not experienced human

development on the landscape scale. This makes water quality data from these networks well suited as 'pre-development' comparisons for similar waterways.

General Background

The water quality in the Cook Inlet region is determined by combinations of natural factors and human development. Natural factors include climate, physiography, geology, soils and vegetation. Many of the rivers and streams in this region have origins at high elevation in mountainous terrain. These areas are generally unaffected by human development and often contain large amounts of high quality water. Most of the development in the region is in the lowlands along the shores of Cook Inlet, and in lower alluvial valleys, so most of the human impact on water quality occurs in these areas. Contamination of water resources has the potential to alter water uses and biological cycles and is of concern to area resource managers.
Water quality research on a landscape scale has been conducted within the Cook Inlet Eco-Region, and GMU 16B. The Cook Inlet Basin was one of 59 hydrologic regions selected for general assessment, as part of the 'USGS National Water Quality Assessment Program'. This basin study-unit encompasses over 39,000 square miles of fresh surface and ground water, which drain into the Cook Inlet (Brabets et al., 1999). In 1991, the National Water Quality Assessment Program, with the broad goal of "describing the status of and trends in the quality of the nation's water resources and aquatic ecosystems, and identifying factors affecting water quality," began surveying and collecting watershed data (NAWQA, 2013). Similarly, the EPA's EMAP and National Aquatic Resource Surveys collected data within the region.

The State of Alaska's Anadromous Fish Act (AFA) (AS 16.05.871-.901) specifies that prior approval must be obtained from the Alaska Department of Fish and Game (ADF&G) before an individual, organization, or government entity engages in any activities which "use, divert, obstruct, pollute, or change the natural flow or bed of a specified river, lake, or stream" (5 AAC 95.011(a). This, along with similar legislation mandating the creation and maintenance of fishways, is the state's primary legislative tool for ensuring the conservation and maintenance of waterways, and would apply to all the major waterways within the district. ADF&G is responsible for maintaining the state's Anandromous Waters Catalogue, which is the comprehensive database for anadromous waters – (those to which the AFA would apply) and fish information within the state.

The USGS has operated 49 gauge stations within the basin, with the majority located directly on the road system. The 3 USGS gauge stations listed as located within GMU 16B are 15294450 'Chuitna river near Tyonek,' 15294500 'Chakachatna River near Tyonek,' and 15294410 'Capps Creek near Tyonek'. However these stations appear to be inactive at this time.

Information for natural factors, including climate, physiology, geology, soils, land cover, human disturbance, land use, and water uses, are described in some detail by the USGS, the State of Alaska, and various entities within the region. Summaries of Cook Inlet aquatic ecosystems and

surface to groundwater systems are generally available for review (Kyle & Brabets, 2001) and provide information necessary for interdisciplinary watershed planning. These data sets are less common for areas off of the road system, including substantial portions of the west Cook Inlet. Several other agencies, departments, and groups within the Cook Inlet region also collect and store data.

B. Resource Status & Issues of Concern

Water Quality & Potential Landscape Developments

The district area is home to valuable energy resources and potential landscape development projects. The potential activities that could have cumulative effects on the area's habitats and fish and wildlife populations include:

- Seismic Surveys
- Construction of Facilities
- Drilling
- Mining
- Production Activities (Alaska DNR, 2008-2009)

Some potential cumulative effects of these activities include:

- Physical Disturbances that Could Alter the Landscape, Lakes, Rivers, and Wetlands
- Habitat Change
- Behavior Changes of Fish, Wildlife, and Birds
- Drawdowns and Contamination of Groundwater
- Contamination of terrestrial or freshwater habitats from discharges from well drilling and production, gas blowouts, oil spills and degradation from mining activities (Alaska DNR, 2008-2009).

TTCD contains large areas of mineable coal reserves. The proposed Chuitna Coal mine is a strip mine of more than 5,000 acres, which is planned for the headwaters of the Chuitna watershed, and located on State of Alaska lands. According to the mines NPDES permit application, several of the mine's outfalls would enter directly into tributaries of the Chuit River. This impending project has caused concern for the people who live and subsist in the area. In response to these concerns, the TTCD has initiated an area wide planning process, focused on the future health of the watershed (Becker, 2011).

TTCD requested and received assistance from Natural Resource Conservation Service (NRCS) to compile a 'Rapid Watershed Assessment' (RWA) for the Chuit River. In 2008, NRCS partnered with the 'Village Management Services, LLC' to complete the RWA. According to the RWA, there is a general dearth of information for this watershed (Becker, 2011). One of the priorities identified by the RWA is to collect or facilitate the collection of baseline data for the

region. The initial assessment was completed, submitted to, and published by the U.S. Department of Agriculture. The RWA protocols were designed to lay the groundwork for area-wide watershed planning (USDA, 2005). The RWA protocols also offered an analysis of readily available information sufficient to make qualitative statements as to resource concerns and conditions and to make qualitative estimates of impacts of conservation on local resources (Becker, 2011).

Ground Water & Aquifers

Half of Alaskan residents and 90% of those in rural areas rely on groundwater, whether from private or public systems (ADEC, 2005). However, little is known about the state's groundwater and aquifers, with the exception of those near major population centers and potential development sites. Overall, groundwater is readily available in most areas of the region which do not have permafrost, and the quality of the water is usually suitable to high. Naturally elevated levels of iron, manganese, and arsenic are the most common water-treatment issues (Madison et al., 1986). The major contamination threats to groundwater include septic systems, waste disposal areas, fuel or oil spills, and saltwater intrusion.

TTCD staff conducting basic water quality sample testing (2012)

Relatively little is known about ground water aquifers in the non-populated portions of the Cook Inlet Basin (Brabets et al., 1999). In these areas (such as GMU 16B), ground water availability and quality must be inferred from surficial geology, drainage density, base flow of streams, and other indirect methods (Brabets et al., 1999). In the areas around the Chuitna River, It has been observed that the subterranean coal beds of west Cook Inlet are capable of producing high-quality ground water, which may be discharged through unconfined aquifers. They also appear as surface water and function to recharge streams, lakes, and wetlands independently of precipitation, especially during periods of low stream flow.

Tyonek currently utilizes ground water to supply a community well and distribution system. Well water is pumped and treated onsite for distribution to households and village buildings. The water is treated and stored in a 175,000-gallon tank (Wall, 2007). Since 2007, programs have been put into place to make improvements within the Village of Tyonek. These projects include groundwater wells, water treatment plants, well pump controls, and more (Wall, 2007). Tyonek participated in a survey to determine what projects and goals are important to the community. One of their top priorities is clean water with the intent to reduce health problems and environmental issues.

Streams & Rivers

TTCD contains creeks, rivers, and streams of varying origin. A review of the waterways within the district must put water quality and quantities in perspective with climate, topography, geology, and soils. The diversity of these characteristics across the conservation district effects the distribution, volume, and quality of the aquatic resources. Of the five major drainages in the Cook Inlet Basin, the Tyonek District falls into the unit 'West Cook Inlet Drainage' (Brabets et al., 1999). This catchment flows out of the Alaska Range and drains a land area of approximately 7,273 mi^2. It contains the Chuitna River System, which has been a subsistence fishery and attracted recreational fishing by 'fly-in' sportsmen for large runs of King Salmon. Other major waterways include the Skwenta, Happy, Kahiltna, and Yentna Rivers. The area also contains many lakes and ponds, including the large Chakachamna, Chelatna, and Beluga Lakes.

Water Quality Indicators

The stream and lake systems located within GMU 16B provide a variety of habitats for animals and plant species. Aquatic habitats are defined by combinations of substrate, shoreline definition, morphology, elevation, and the primary source of infiltrating water.

Alaska's Water Quality Standards (18 AAC 70; Mauger 2003). The stream may not exceed 20°C, egg and fry incubation and spawning areas may not exceed 13°C and migration routes and rearing areas 15°C (Mauger, 2003).

The combinations of these factors create a number of varied habitats which are important for the life histories of aquatic species. Stream, river, and lake substrates vary from boulders to cobble to mud and can be defined using combinations of the Rosgen channel type classification methods, Cook Inlet specific habitat assessment guidelines, and other existing methods for describing the state, character, and intactness of stream corridors and in-channel habitats. For more information on water quality monitoring groups, see Table 6.1.

In-stream habitats are defined by the substrate, predominant climate, volume of water, and many other hydraulic and chemical factors. Biologic conditions can be described using regionally specific metrics. General water quality and chemical factors are often sampled and described using federal (EPA, 2010) and state (DNR) guidelines. This may include specified Total Maximum Daily Load (TMDL) and accepted temperature guidelines defined for a given waterway. These data collection guidelines are observed in TTCD's water quality monitoring program and all data collection procedures follow the state or federal protocols for collection.

Suspended Sediment

Suspended sediment in lotic systems is the result of erosion, which can occur naturally or be accelerated by human landscape disturbances such as mining, road building, or logging. Waterways within the conservation district show large variation in the amounts of suspended sediment they carry. The variation in sediment load within these systems is usually associated with a glacial source, the presence of lakes or ponds acting as deposition zones, and often shows

lower dissolved sediment concentrations during winter. An increase in sediment deposition, whether natural or from anthropogenic causes, can clog spawning areas and impede the spawning of salmonids and other species.

Stream Temperatures

Water temperatures are one of the most significant factors in the health of an aquatic system (Kyle & Brabets, 2001). Stream temperature can have effects on species populations by influencing physical, chemical, and biologic properties (Vannote et al., 1979). Alaska has experienced an approximate 3˚ C rise in air temperature since the 1960's (Alaska Regional Assessment Group, 1999). A model (Nash-Sutcliffe Coefficient) using expected air temperatures as input and stream temperature as output was used to estimate an approximate 3-4˚C increase in average stream temperatures across the Cook Inlet Basin based on current climate data (Kyle & Brabets, 2001). As natural or artificial influences change stream temperatures from historic averages, the habitats and corresponding biologic communities will likely change. This makes conservation efforts aimed at promoting biodiversity through varied habitat types very desirable.

Benthic Macroinvertebrates

Benthic macroinvertebrates can reflect the quality of water at a site because they live in the streambed for a large part of their lives. Both by the density of their occurrence and the species composition of the community found in a stream, they can indicate the quality of habitat available to them during a time period of weeks to months. Bioassessment techniques are widespread in their use as indicators of stream degradation or intactness.

Commonly observed Dipterans

Oswood (1997) and others summarized the taxonomic structure of macro invertebrate communities in streams of Alaska. Most of Alaska's streams are typically characterized by low diversity and dominated by Diptera (trueflies) of which a major part is the Chironomidae (non-biting midges):

> "The streams of the Cook Inlet Basin are characterized by Diptera (34 percent), but Ephemeroptera (mayflies) constitute the largest percentage of the community (41 percent)). Plecoptera (stoneflies) at 17.5 percent and Trichoptera (caddisflies) at 7 percent - are also higher in the Cook Inlet Basin than in other regions of the State."

Where residential development influences are present, the percentage of Dipterans tends to increase (Milner & Oswood, 1995), and also where glacial runoff is a dominant part of the in-flow and no lakes are present (Milner & Petts, 1994).

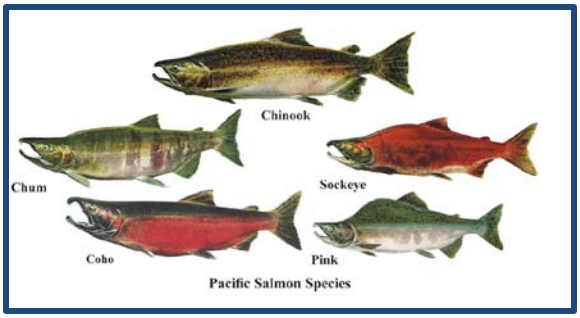
Aquatic Plants

Aquatic plants are studied in investigations of water quality because they are relatively easy and inexpensive to sample, transport, and preserve. As with other aquatic organisms, they are capable of accumulating certain contaminants over time, above ambient concentrations in water. They are a direct measure of the bioavailability of contaminants to plants in the environment. Two groups of aquatic plants are of interest to the NAWQA program as water-quality indicators: macrophytes (those plants large enough to be seen with the naked eye) and algae (Kyle & Brabets, 2001). Several characteristics, in addition to size, make macrophytes better suited for tissue sampling and analysis than algae. Differences in species abundance of macrophytes and algae can also be valuable indicators of environmental change. Rinella and Bogan (2007) formulated a macroinvertebrate and diatom biological assessment index for the Cook Inlet region.

Fish Species as Indicators

Using fish species assessments to determine both the chemical and biological health of waterways is a valuable tool for resource managers and water quality researchers. Many fish species are top aquatic predators and integrate elements of their environment over multiple years. Analysis of fish tissues may reveal bio-accumulated toxins that could pose health risks to people, but are at low levels when sampled directly from the waterway. Information on the following fish species is included in the

Appendix: Rainbow Trout, Dolly Varden, Burbot, Hooligan, Sculpin, Threespine Stickback, Pacific Salmon species and Invasive Northern Pike.



Salmon species present in TTCD (ADF&G)

Fish Passage

In order to find food and cover, juvenile and adult fish need to move between a variety of habitats including streams, wetlands, lakes, sloughs, large rivers, side channels, estuaries, and ocean. Barriers to fish passage, such as undersized road culverts and dams, can change habitat and can delay or block fish from accessing habitats and food sources at critical times of the year (USFWS). See Figure 7 in the Appendix for fish passage and culvert location maps in Tyonek. In the state of Alaska, several federal, state, tribal, and other entities have partnered to identify, assess, and remove barriers to fish passage. ADF&G has inventoried culverts in many parts of the state to determine potential fish passage barriers. The Fish Passage Inventory Database (FPID) is located on the ADF&G website, and contains fish passage data for the Tyonek District.

In 2002, ADF&G inventoried 29 culverts in the Tyonek and surrounding areas. Results from this inventory indicated that 83% of culverts presented a barrier to fish passage, 14% had

indeterminate passage status, and 3% were adequate for fish passage. In May 2012, TTCD coordinated a site visit to assess potential culvert replacement projects in the Tyonek area with Robert Ruffner of the Kenai Peninsula Fish Habitat Partnership (KPFHP) and Gillian O'Doherty of ADF&G. During this site visit, several potential culvert projects were identified to improve fish passage; one particular project was determined to have a high priority for 2012.

Road washout as a result of an undersized culvert on Indian Creek in May, 2012.

Culvert 20601538 (ADF&G's culvert numbering system) is located just outside Tyonek on Indian Creek, at 61.08064°N, -151.17912°W. During ADF&G's initial survey of Tyonek area culverts in June 2002, this culvert was classified as red, or unsuitable for fish passage (O'Doherty, 2010). The culvert is a corrugated metal circular pipe that is situated such that a lake has formed on the upstream side of the culvert with a narrow stream on the downstream side. According to ADF&G, Indian Creek contains pink salmon as well as rearing Coho salmon.

A site visit on May 22, 2012 with KPFHP and ADF&G noted several flaws in culvert 2061583 including that it was undersized, severely weakened, and dented from frequent washouts. TTCD, in partnership with NVT, TNC, KPFHP, and ADF&G secured funding from the USFWS to install a larger culvert in October, 2012. NVT staff completed the construction work, while the revegetation work of the disturbed section of creek was completed in June 2013.

As of this time, TTCD is working on several potential fish passage projects. During a site visit in May 2012, two fish passage barriers were observed on Old Tyonek Creek and Tyonek Creek (see Figure 7 in the Appendix). The barrier on Tyonek Creek was previously assessed by NRCS with and a culvert design completed. TTCD is working on obtaining funding to complete this installation. The two crossings identified on Old Tyonek Creek are each double culverts that currently block fish passage. TTCD is working with multiple partners to determine the best way to remove these barriers, which block a substantial amount of rearing and spawning habitat. TTCD is also completing a prioritization of all culvert projects in the Tyonek District. TTCD has compiled a table listing basic information that can be used to rank culvert projects and will add to this in the future (see Table 6.2) (http://alaska.fws.gov/fisheries/restoration/passage.htm).

Table 6.1: Water Quality Monitoring Groups

Existing Water-Quality Monitoring Groups and Projects*		
Agency or Organization	**Project and Focus Area**	**Possibility for Collaboration**
ADF&G: Alaska Freshwater Fish Inventory	Maintains freshwater fish (anadromous and resident) occurrence data sets compiled from a variety of sources.	Yes
ADF&G: Anadromous Waters Catalog	Specifies various rivers, lakes, and streams of Alaska that are important to the spawning, rearing, or migration of anadromous fish.	Yes
AK DNR Alaska Hydrologic Survey	Provides technical hydrologic information to ensure proper and accurate management of the State's water resources; maintains database of water information.	Yes
Alaska Association of Conservation Districts	Supports conservation districts goals, including water quality monitoring and improvement.	Yes
Alaska Clean Water Actions	Collaboration between ADEC, ADF&G, and DNR. Maintains database of priority waters and identified stewardship actions and offers money for projects that restore, protect, or conserve water quality, quantity, and aquatic habitat.	Yes
Alaska Monitoring and Assessment Program	The data-gathering arm of the ADEC Division of Water. Collects data on waters within Alaska as part of the implementation of the Clean Water Act.	Yes
Cook Inletkeepers	Community-based nonprofit organization with goals of protecting water quality and salmon habitat throughout the Cook Inlet watershed.	Yes
UAF Cooperative Extension Service -- Pacific Northwest Region Water Quality Program	Promotes regional collaboration by acknowledging existing programs and successful efforts; assessing program gaps; identifying potential issues for cross-agency and private sector collaboration; and developing a clearinghouse of expertise and programs.	Yes
University of Alaska Anchorage Environment and Natural Resources Institute (ENRI)	Conducts on-going research in ecosystem and atmospheric processes, including hydrology. TTCD's water quality sampling volunteer and education protocols are based on this information.	Yes
USGS Alaska Science Center Water Resources Office	Monitors surface water, ground water, and water quality parameters across the state in cooperation with various local, state, or federal agencies.	Yes

***It should be noted that many private organizations dedicated to fish conservation and species recovery goals also utilize water quality and habitat programs. However the data produced have often been considered to be dispersed and unreliable without a quality assurance protocol. (Mauger, 2003)**

C. Data Gaps

Data gaps for water quality information are common for waterways within the region. As noted in '2011 Chuitt River RWA,' USGS, and others, there is a notable dearth of both landscape and site specific water quality information for GMU 16B region. Much of the existing physical data (volume and flow) is outdated and monitoring has been discontinued at many former sites.

Many rivers, streams, and lakes within GMU 16B have never been sampled for any water quality parameters; this includes physical, chemical, and biotic parameters. Aquatic sampling associated with identifying climate changes is also generally absent from existing data sets. This is due partially to the lack of ongoing or continuous collection of physical data (i.e. temperature and flow). See Table 6.3 for additional water quality data gap information.

Table 6.3: Data Gaps

Data Gaps – Water Quality/Aquatic Resources	
Wide spread physical water quality data - data sets are available, but most are outdated and/or dispersed and do not reflect a landscape scale representation of the existing waterways.	Velocity, flow, discharge, temperature, EC, TDS, etc.
Site-specific physical water quality data - many of the larger water bodies in GMU 16B (especially larger remote lakes) have no existing or apparent limnologic data available. The majority of these water bodies also lack bathymetric data.	Velocity, flow, discharge, temperature, EC, TDS, etc.
Site-specific biotic data-Benthic Invert/Aquatic plant species - although much work has been completed on the east side of the Cook Inlet, these data types are generally absent for areas within GMU 16B	Rapid bio-assessment, habitat assessments, and benthic community depictions

D. Potential Projects

There are many potential conservation projects associated with water quality and aquatic resources. TTCD is undertaking a prioritization process to the timeline and feasibility of these potential projects. Area-wide watershed planning is currently a high priority project and TTCD is working with a number of stakeholders and Tyonek residents to initiate an area-wide watershed planning project. Potential projects also include Invasive Northern Pike removal, culvert restoration, streambank restoration, and water quality data gathering. For more information, see Table 6.4.

Table 6.2: TTCD Culvert Prioritization

Stream Name	Site ID	Latitude	Longitude	Upstream River Miles	Culvert Condition	Pike Present in system	Fish Sp. Observed (AWC)	Traditional Information
Old Tyonek Creek	20601545	61.03922	-151.32046	19.03	Red		COp,Kp,Ps,OUp	Is now a bridge
Old Tyonek Creek	20601527	61.06265	-151.36830	8.37	Red		COp,Kp,Ps,Oup,Pp	
Indian Creek	20601528	61.06352	-151.14447	2.2	Red	?	CHp,COsr,Kpr,Ps,Sp	
Unnamed	20601529	61.18679	-151.03595	2.5	Red			
Unnamed (Drains Beluga flats)	20601530	61.16111	-151.05745	0.25	Red		CHp,COsr,Kpr,Ps,Sp	
Three Mile Creek	20601537	61.17910	-151.20394	1.82	Red		CHp,COsr,Kpr,Ps,Sp	
Indian Creek	20601538	61.08064	-151.17912	1.4	Red		CHp,COpr,Ksr,Pp,Sp,ALp,PCp	
Tyonek Creek	20601542	61.07268	-151.25554	7.43	Red		COpr,Ps	
Bird lake outlet	20601543	61.05727	-151.40588	0.92	Red			
Unnamed	20601544	61.05249	-151.32423	0.31	Red			
Unnamed (Drains to Nikolai)	20601548	61.07804	-151.57511	0	Red	?	CHp,COsr,Kpr,Ps,Sp	
Unnamed (Drains to Nikolai)	20601549	61.07716	-151.54631	2.46	Red			
Unnamed (Stedatna)	20601551	61.05377	-151.51236	1.4	Red			
Unnamed	20601552	61.03916	-151.47497	0.35	Red			
Congabuna Lake outlet	20601554	61.04711	-151.43969	3.24	Red		COp,Kp,Ps,OUp	
Unnamed (Drains to Nikolai)	20601547	61.07986	-151.58071	0.34	Gray		Cor	
Chuitbuna Lake outlet	20601532	61.11298	-151.15214	0.83	Gray		Cor, P	
Unnamed	20601535	61.06600	-151.32824	0	Gray		Cor, P	
Unnamed (Not anadroumous?)	20601536	61.12798	-151.23031	0.48	Gray			
Unnamed (Drains to Bunka Lake)	20601539	61.06397	-151.17642	0.53	Gray		DVr	
Old Tyonek Creek	20601541	61.03267	-151.31320	20.04	Gray		DVr	
Chuitkilnachna Creek	20601546	61.10620	-151.72560	3.26	Gray		*	
Stedatna Creek	20601550	61.06792	-151.51550	2.56	Gray		*	
Unnamed	20601553	61.03885	-151.47517	0.43	Gray		Oup	
Unnamed (not on road?)	20601555	61.05111	-151.30420	0	Gray			
Three Mile Creek	20601531	61.14405	-151.08348	12.93	Green			
Unnamed (Drains to Chuitna River)	20601533	61.11076	-151.17613	5.8	Green			
Tyonek Creek	20601534	61.07621	-151.31767	4.06	Green			
	20601540	61.04456	-151.18248	0	Green			

RED- culvert sorted by mi upstream

Bird lake outlet	20601543	61.05727	-151.40588	0.92 * lake	Red			
Old Tyonek Creek	20601545	61.03922	-151.32046	19.03	Red (is now a bridge)		COp,Kp,Ps,OUp	
Old Tyonek Creek	20601527	61.06265	-151.36830	8.37	Red		COp,Kp,Ps,Oup,Pp	
Tyonek Creek	20601542	61.07268	-151.25554	7.43	Red		COpr,Ps	
Congabuna Lake outlet	20601554	61.04711	-151.43969	3.24	Red		COp,Kp,Ps,OUp	
Unnamed	20601529	61.18679	-151.03595	2.5	Red			
Unnamed (Drains to Nikolai)	20601549	61.07716	-151.54631	2.46	Red			
Indian Creek	20601528	61.06352	-151.14447	2.2	Red	?	CHp,COsr,Kpr,Ps,Sp	
Three Mile Creek	20601537	61.17910	-151.20394	1.82	Red		CHp,COsr,Kpr,Ps,Sp	
Indian Creek	20601538	61.08064	-151.17912	1.4	Red		CHp,COpr,Ksr,Pp,Sp,ALp,PCp	
Unnamed (Stedatna)	20601551	61.05377	-151.51236	1.4	Red			
Unnamed	20601552	61.03916	-151.47497	0.35	Red			
Unnamed	20601544	61.05249	-151.32423	0.31	Red			
Unnamed (Drains Beluga flats)	20601530	61.16111	-151.05745	0.25	Red		CHp,COsr,Kpr,Ps,Sp	
Unnamed (Drains to Nikolai)	20601548	61.07804	-151.57511	0	Red	?	CHp,COsr,Kpr,Ps,Sp	

***Species Codes:**AC- Arctic char AL- Arctic lamprey AW- Arctic cisco BC- broad whitefish BW- Bering cisco CH- chum salmon CO- coho salmon CT- cutthroat trout DV- Dolly Varden HW- humpback whitefish K- chinook salmon LC- least cisco LP- lamprey, undifferentiated LV- river lamprey OL- longfin smelt OM- rainbow smelt OU- eulachon P- pink salmon PC- Pacific lamprey S- sockeye salmon SF- inconnu SH- Steelhead trout SM- smelt, undifferentiated ST- sturgeon, undifferentiated W- whitefish,

Table 6.4: Potential Projects

Priority	Project Description	Location	Estimated Project Duration	Anticipated Project Year	Land Manager/ Partners	Cost Estimate*
1	Prioritization of potential fish passage projects in 16B.	Tyonek and surrounding area	1-2 months	2013	NVT, TNC, ADFG	$
2	Verify the presence and location of invasive pike species.	Tyonek, Beluga	3 years	2013-2016	NVT, TNC	$$
3	Develop a regional watershed plan addressing fish passage issues.	Tyonek	5 years	2013-2018	NVT, CIRI, State of AK, TNC, etc.	$$$
4	Design and implement a TTCD water quality monitoring program for data collection.	Tyonek	Ongoing	2014	Multiple	$$
5	Remove fish passage barrier at Tyonek Creek crossing upstream with NRCS design.	Tyonek	1-3 years	2014-2015	Multiple	$$$$
6	Remove two fish passage barriers on Old Tyonek Creek.	Tyonek	2-5 years	2014-2016	NVT, TNC, ADFG, USFWS	$$$$$
7	Create and fill an intern position for water quality monitoring.	Tyonek	1-5 years	2015	AWC, ADFG, NVT, etc.	$$
8	Compile 16B specific GIS data and integrate into a "Conservation Dashboard" for the 16B region. Publish on TTCD website.	Tyonek	1-5 years	2016	ADFG, UAA, APU, NVT, etc.	$$

*** $** = <$5,000 **$$** = $5,000 – $30,000 **$$$** = $30,001 - $100,000 **$$$$** = $100,00 - $500,000 **$$$$$** = >$500,000

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Chapter 7: Marine Resources

Cook Inlet is a rich and dynamic marine environment, and provides important resources to those living within the Tyonek Tribal Conservation District (TTCD).

In this chapter:

A. Overview
B. Resource Status & Issues of Concern
C. Data Gaps & Potential Projects

> *"…Marine resources are an integral part of life through the provision of fish, marine mammals, waterfowls and shellfish…"*
>
> *-Tyonek Resident*

A. Overview

Cook Inlet reaches 192 miles into Southcentral Alaska from the Gulf of Alaska. It drains a watershed of 39,000 square miles, ranging from the peaks and tundra of the Alaska Range to the broad sweeps of the Susitna, Matanuska, and Kenai Rivers. It also holds towns and cities – housing the majority of the state's population and a wealth of natural resources.

As the tide moves water in and out of the Cook Inlet, they are funneled by its long narrow shape, creating the fourth highest tides in the world (an average range of 30 feet), while sometimes creating a tidal bore. This tremendous movement of cold, silty water, though it can sometimes be dangerous for those working in the Cook Inlet, holds great potential as a source of tidal power. Cook Inlet is already being used as a source for other kinds of energy – most notably oil, natural gas, and coal. The biotic resources of the inlet, including subsistence, sport, and commercial fisheries of salmon, groundfish, crab, finfish, and shellfish are important for economic and social needs. The subsistence harvest of marine mammals is also very important for local, regional, and state economies and has long been an important cultural feature of the people of the Cook Inlet area.

The combined pressures from harvests and the developments associated with energy extraction have led to declines in some of the Inlet's marine resources and imperiled others. Some of the main activities in the Inlet which threaten marine resources include:

- Commercial fishing
- Oil, gas, and other natural resource development
- Aircraft & ship noise
- Shipping traffic
- Tourism

The following is an overview of some important federal and state regulatory measures affecting the harvest or use of marine resources in Cook Inlet.

International Regulations

Though the waters of Cook Inlet are provinces of the United States, it is worth a brief overview of international fishing agreements. Through the governing body of the United Nations, several treaties and agreements have been ratified, which attempt to regulate fishing activities in international waters. The foremost of these is the United Nations Convention on the Law of the Sea, which establishes a 200-mile exclusive economic zone (EEZ) for each country and establishes procedures for navigation and fishing on the high seas. The second is the United Nations Agreement on Straddling and Highly Migratory Fish Stocks, describing the duties of Regional Fisheries Management Organizations that coordinate the business of managing shared fisheries/fish populations.

Federal Regulations

The branch of the federal government most often involved with marine resources is the National Oceanic and Atmospheric Administration (NOAA), which is a division of the Department of Commerce. Within NOAA, the National Marine Fisheries Service (NMFS) is the primary body overseeing the harvest of marine resources. There are several pieces of legislation which comprise the bulk of these federal marine regulations:

Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 ("Magnuson Act")

The most comprehensive piece of fisheries legislation, first enacted in 1976 and since modified and amended, the Magnuson Act establishes exclusive national control of fisheries within the United States' Exclusive Economic Zone (3 to 200 miles offshore). The act created Regional Fishery Management Councils responsible for developing and implementing fishery management and recovery plans. This includes catch limits and gear regulations, which are submitted to the Secretary of Commerce for approval. Waters around Alaska are under the purview of The North Pacific Fishery Management Council (NPFMC). Council members include commercial and recreational fishermen, marine scientists, and state and federal fisheries resource managers. Highlights of the 2007 reauthorization include:

- Creation of scientific and statistical committees (SSCs) which advise the Councils, with the goal of science playing a greater role in management decisions and promoting a shift towards ecosystem-based management.
- Stricter measures to prevent and ameliorate overfishing.
- Introduction of limited access privilege programs (LAPPs), which attempt to offer managers greater flexibility and accuracy in mechanisms for regulating catch (Public Law 94-265).

Marine Mammal Protection Act (MMPA)

MMPA prohibits both the taking of marine mammals, as well as possession of any parts or

products. Section 101b allows for subsistence harvest of marine mammals by Alaskan Natives for use as food and in native crafts, and section 119 of the MMPA provides for the creation of co-management agreements between NMFS or FWS and Alaska Native Organizations (16 USC Chapter 31 Section 119). These manage for continued subsistence use so long as stocks do not "diminish beyond the point at which they cease to fulfill their role in their ecosystem or to levels that won't allow for sustainable subsistence harvest" (16 USC Chapter 31 Section 2).

Endangered Species Act (ESA)

Enacted in 1973, the ESA created a system in which species could be ranked as "threatened" or "endangered," with associated mandatory steps in management and regulation. The status of "endangered," has wide-reaching repercussions, including prohibiting the taking of the species and the designation of critical habitat, in which all further actions by federal entities (or entities funded by federal monies) must be approved as non-threatening to the species.

State Regulations

States are responsible for management of near-shore waters – those areas which are 0 to 3 miles offshore. The Alaska Department of Fish & Game (ADF&G) is responsible for all hunting and fishing regulations within state jurisdiction. The commissioner is the central executive figure within ADF&G. Reporting to this position is the Board of Fisheries (BOF). The seven members of the BOF are appointed by the governor and serve three-year terms. The board is responsible for setting seasons, bag limits, methods and means for the state's subsistence, commercial, sport, guided sport, and personal use fisheries. The BOF, in turn, is advised by regional advisory committees. Also within ADF&G is the 'Habitat Division' addressing " in fish-bearing streams and in the state's legislatively designated refuges, critical habitat areas, and sanctuaries through a project review and permitting process" (ADF&G, 2013).

The dynamic nature of the fisheries in Alaska changes every year. Recent statistics on the Cook Inlet fisheries are presented below:

B. Resource Status & Issues of Concern

The following sections highlight some of Cook Inlet's important biotic resources and associated conservation issues.

Beluga Whales

The beluga (*Delphinapterus leucas*) is a small, white colored, toothed whale found in circumpolar marine waters and estuaries. It primarily inhabits shallower coastal waters, living in social groups of 10 or more, and feeds on fish, crustaceans, and other marine species. Adults grow to a length of 12-16 feet, and weigh about 3,000 pounds. Dark-colored calves are born in the summer, and attain their white coloring at sexual maturity. Some beluga populations migrate between calving and feeding grounds, however the Cook Inlet population is believed to be sedentary (NOAA, 2013).

Beluga whale.
Whalesandmarinefauna.wordpress.com

Cook Inlet belugas have been the focus of intensive research and management debates in the past several decades. Historic population and harvest records are patchy, but records show that beluga harvests were low from the 1940's through the 1960's and increased again in the 1970's (NOAA, 2013). From an estimated population of 1,300 in 1979, numbers took a sudden downward turn in the 1990s, with a decrease of 47% between 1994 and 1998 (NOAA, 2013; ADF&G, 2013). This prompted dramatic management intervention with subsistence harvest numbers first substantially decreased and then eliminated completely. The Cook Inlet population is now listed as endangered, and a designation of critical habitat includes waters within/near GMU 16B. The 2012 abundance estimate for the endangered Cook Inlet beluga whale population is 312 (Speegle, 2013). Cook Inlet is highly developed (by Alaskan standards), and anthropomorphic activity will likely increase in the future.

Potential human-caused threats to this population include shipping, oil and gas production and transport, indirect and direct adverse effects from commercial fishing gear (e.g., gillnets) and operations, pollution, habitat destruction and alteration, disturbance due to increasing commerce and recreation in Cook Inlet, and noise.

Traditionally, the Tyonek community harvested an average of 1-2 beluga whales a year. Belugas were not always harvested on an annual basis and were typically harvested along with many other marine resources including clams or other shellfish. Beluga whales are harvested on the beach, at the mouths of the Susitna, Beluga, and Theodore Rivers. They were also hunted at Trading and Redoubt Bay. Between 1987 and 2006, Belugas were primarily hunted at the mouth of the Susitna and Beluga Rivers. Beluga whales are regarded as having a high value as subsistence food and have been a part of the traditional subsistence culture for centuries. Traditional use includes the meat, blubber, flippers, tail, teeth, and lower jaw.

Harbor Seals

Harbor seal resting on ice.
Seals-world.com

Harbor Seals (*Phoca vitulina*) – also called qutsaghil' iy – are important parts of traditional subsistence diets. In addition to their meat, seals are valuable sources of fur and other products. The harbor seals in Cook Inlet are part of a population whose range extends to Shelikoff Straight and the Gulf of Alaska, and was estimated in 2011 to be at 22,900 animals (Allen & Anglis, 2012; Boveng et al., 2011). Harbor seal populations have declined in

some areas of Alaska in recent decades, resulting in a petition to list the Lake Iliamna population as endangered (Boveng et al., 2011; NOAA, 2013). There is also concern that high boat traffic, including tour boats, may contribute to a decline in populations (Jansen et al., 2010).

Harbor Seals are protected under the MMPA. The Alaska Native Harbor Seal Commission (ANHSC) is the primary body for co-management agreements in Alaska. Currently there is a standing agreement, known as: "The Alaska Harbor Seal Co-Management Action Plan" between NMFS and ANHSC. Enacted in 2001, this established the goals and recommendations for the subsistence harvest and conservation of harbor seals.

Sea Otters

Sea Otters (*Enhydra lutris*) are also a traditional part of Dena'ina subsistence use. Their fur has been greatly valued for its extreme warmth. Sea otters were hunted nearly to extinction in the 1800's by non-native commercial harvesters and by 1900 their population was a tiny fraction of its former size. A hunting moratorium in 1911 allowed populations to rebound and re-introduction programs returned sea otters to their full historical range. The Southwest Alaska population of sea otters once comprised 50% of the world's sea otters, but the past several decades have seen a precipitous drop in sea otter numbers. The Southwest Alaska population was listed as endangered in 1995. The geographic range of this population is defined as including the western part of Cook Inlet up to the border with GMU 16B (USFWS, 2013). This represents the approximate "inland" extent of sea otter presence in Cook Inlet. Any sea otters within the waters of GMU 16B would presumably be considered part of the Southcentral population, which is considered to be stable. It is not known what caused the current population drop, though increased predation by orca whales – after the orcas' prey bases of great whales and larger marine mammals such as sea lions had been depleted – is one leading theory (USFWS, 2013; Kuker & Barrett-Lennard, 2010). Other theories include increased levels of heavy metal contamination, shifts in the number of predators, disease, or some combination of these stressors (Kuker & Barrett-Lennard, 2010). Sea otters in Kachemak Bay and elsewhere have recently shown increased mortality due to infection by one of a suite of Streptococcal viruses (USFWS, 2003). Sea otters are also very vulnerable to oil spills, as evidenced by the disastrous effects of the 1989 Exxon-Valdez spill.

Sea otter.
www.tripadvisor.com

Unlike belugas and harbor seals, who fall under the provision of NMFS, sea otters are managed by USFWS (a branch of DOI). They are of course still covered by the MMPA. The Alaska Sea Otter & Stellar Sea Lion Commission (TASSC) is the primary Native co-management

organization (similar to ANHSC) in the state.

Marine Plants & Invertebrates

Marine plants such as kelp and eelgrass are not only elements of subsistence harvest but are very important as food and shelter for many marine species including finfish and shellfish. Currently all of Cook Inlet is closed to marine plant harvest, subsistence or otherwise, except the area from Chuitna River south to Granite Point. Within this area there is a limit of 10 pounds "wet plant material per day" or in possession (ADF&G, 2013).

Marine invertebrates also hold important places in the marine ecosystem as prey species for fish and marine mammals in addition to other eco-system functions. Many invertebrates, including crabs of various species, chitons, mollusks, shrimp, and more, are also important for subsistence and commercial harvests.

Marine Fish

Among biotic resources, the cultural and economic importance of marine fish to the communities of Southcentral Alaska is paramount. Fish species harvested in Cook Inlet include:

- herring
- smelt
- salmon
- halibut
- lingcod
- sharks
- rockfishes
- rainbow/steelhead trout
- dolly varden

Commercial fishing has been a major activity in Cook Inlet since the late 1800's. Sockeye salmon comprise the bulk of the industry. The 2012 Upper Cook Inlet commercial salmon fishery brought in 4 million salmon, at a value of $34 million. This catch was the 9th largest in the past 20 years and included all five species of pacific salmon. Alaska's fisheries are considered to be some of the most scientifically managed in the country; however, recent downward fluctuation in commercial hauls and in numbers of spawning salmon have raised concerns about the health of the fishery. In the fall of 2012, Alaska sought and received a federal resource disaster designation for the Cook Inlet fisheries, particularly for king salmon. The state of Alaska estimated economic damages of at least $10 million from decreased commercial, sport, and subsistence catches (Dischner, 2012).

C. Data Gaps & Potential Projects

As the scope and scale of many marine conservation projects are generally large and complex, TTCD has chosen to support and promote existing projects and partnerships as opposed to

undertaking independent conservation projects as an individual organization.

The primary data gaps surrounding activities in Cook Inlet at this time center on the reason(s) for the decline in beluga populations, and the associated task of hastening their recovery. There also remains considerable uncertainty about the effect of various regulations on salmon populations. A detailed understanding of the potential effects of a warming climate and increased runoff and changes in water chemistry are also generally absent.

Table 7.1: Existing Marine Resource Monitoring Groups

Existing Marine Resource Monitoring Groups/Projects		
Agency or Organization	**Project and Focus Area**	**Possibility for Collaboration**
UAA / UAF – specifically School of Fisheries and Ocean Sciences)	Conduct on-going research in marine ecology, management, etc. For example, SFOS began a study in 2003 that focused on water circulation in Cook Inlet	Yes
NOAA	Federal agency, which oversees nearly all marine use and resources issues. Is responsible for beluga whale recovery and associated issues.	Yes
Cook Inletkeepers	Community-based nonprofit organization with goals of protecting water quality and salmon habitat throughout the Cook Inlet watershed.	Yes
USFWS	Federal agency responsible for management of some endangered marine species including sea otters.	Yes
ADF&G	State agency, which regulates marine harvest levels including fisheries.	Yes
Alaska Department of Environmental Conservation	State Agency responsible for ensuring water and air quality standards, pollution control, and spill response.	Yes
Alaska Ocean Observing System	Maintains and promotes a network of ocean and coastal observations, data, and information to aid understanding of the status of Alaska's marine ecosystems.	Yes
Cook Inlet Regional Citizens Advisory Council	Citizen council created to help avoid or improve the response to oil spills and other sources of pollution.	Yes

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Useful Resources

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Chapter 8: Air Quality

Although clean air is necessary for every breath we take, our air is a resource that it is sometimes easy to take for granted. In this chapter, we will discuss air quality, air issues in the district, and potential air quality projects.

In this chapter:

A. Overview
B. Resource Status & Issues of Concern
C. Data Gaps
D. Potential Projects

A. Overview

Air quality impacts both human health and environmental health. Air quality concerns can be broadly classified into four categories: particulate matter, ozone precursors, odor, and greenhouse gases (USDA NRCS, 2013).

> *"Air quality … could be the reason for many lung problems, skin problems, and many other issues. People deserve to breathe pure, dust free air."*
> *-Tyonek Shareholder*

In 1970, the United States Congress created the Environmental Protection Agency (EPA) and passed the Clean Air Act, which represented the first comprehensive federal response to address air pollution (US EPA, 2013). This act led to a variety of programs to reduce air pollution nationwide. The Clean Air Act was revised and expanded in 1990, giving the EPA even broader authority to reduce air pollutant emissions through the implementation and enforcement of regulations. Under the Clean Air Act, the EPA sets limits on air pollutant emissions from sources such as chemical plants, utilities, and steel mills. Individual states and tribes may have their own air pollution laws, but these must all meet the limits set by the EPA.

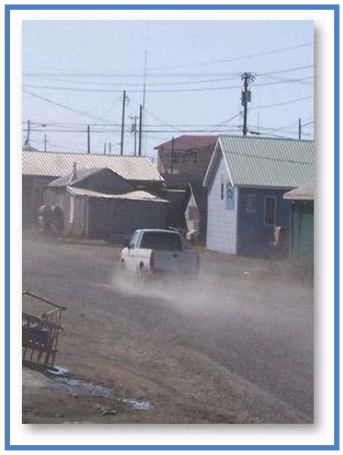
Under Alaska State Law, duties and responsibilities for controlling and mitigating air pollution and for conserving clean air have been established for the Division of Air Quality, which is a part of the Alaska Department for Environmental Conservation (ADEC, 2010). The Division of Air Quality works closely with the local governments of Anchorage and Fairbanks to improve air quality and meet clean air standards. The Division of Air Quality also provides health advisories and suggested protective actions for people to take during natural events with potential air quality impacts (State of Alaska, 2011).

The EPA recognizes that tribes in the State of Alaska face unique challenges with regard to air quality. The EPA lists the following air quality related issues for tribes in Alaska:

- Most Tribes do not have a reservation or defined lands where they can assert jurisdiction to address air quality issues.
- Frozen ground prevents burying waste in landfills, and many communities resort to burning trash which creates air pollution.
- Electricity primarily comes from diesel generators which produce particulate and other air pollutants.
- The cold climate means people spend a lot of time indoors in air tight homes and buildings where indoor air pollution and humidity can rise to unhealthy levels.
- Many homes have older wood stoves which can be inefficient and create air pollution.
- Dust from unpaved roads may contain pollutants that can be inhaled or deposited on subsistence food sources. (US EPA, 2013)

B. Resource Status & Issues of Concern

Currently, there is no data available for air quality in the Tyonek Tribal Conservation District (TTCD). However, there are two air quality issues that are areas of concern for this region: road dust issues and the potential negative impacts of Chuitna Coal Mine.



Road dust from unpaved roads can be problematic in rural Alaska. dec.state.ak.us

Road Dust

Dust is a form of particulate matter that can cause both health and environmental problems. In rural villages with unpaved roads and vehicle traffic, road dust can become an issue. In March of 2010, the ADEC conducted a Rural Dust Survey by distributing survey forms to 250 rural Alaskan communities. Tyonek was one of the communities that reported back that dust was a concern. (ADEC, 2010)

TTCD is interested in assisting Tyonek by working with partners to obtain baseline data. After collecting baseline data to determine the extent of this problem, we hope to assist with the development of procedures to alleviate this problem.

Chuitna Coal Mine

The proposed Chuitna coal strip mine is a potential air quality concern. In 2011, Talbert and Branosky (2011) prepared an assessment for Cook Inletkeeper which assessed the potential costs and benefits of the coal mine. The report states that each phase of the Chuitna coal lifecycle (including extraction, transportation, processing, and combustion) will generate aerial pollutants with public health and ecosystem impacts. They estimated that air quality damages associated

with the project would generate a present value cost of about $53 billion. To view a map showing the location of the potential mine site, please see Figure 8 in the Appendix.

The extraction phase of coal production will rely on fossil fuel powered machinery, which emits greenhouse gases and pollutants such as sulfur dioxide, nitrogen oxide, and particulate matter. In addition, the extraction of coal from beneath the surface causes the release of underground methane, and the removal of overburden on top of coal seams releases aerial sediment and particulate matter. The transportation phase will generate similar pollutants. The processing phase emits more greenhouse gases and pollutants, as well as arsenic, cadmium, lead, and mercury. Even more aerial pollutants will be produced during the combustion phase (Talberth & Branosky, 2011).

Impacts of Aerial Pollutants

Particulate matter causes several human health problems, including asthma, lung cancer, chronic obstructive pulmonary disease, and emphysema. These pollutants also impact environmental health, leading to problems such as eutrophication and acid rain which effect fish, vegetation, and other resources. It will be important to assess and find solutions to both dust and mine related air quality issues in the future.

C. Data Gaps

To date in 2013, very little air quality data is available for the Tyonek District. Without this information, it is not possible to determine threats to air quality that need to be addressed. It is essential that baseline data be collected as development within the district like the Chuitna coal strip mine, may compromise this resource.

D. Potential Projects

In July 2012, TTCD began conversations with the Native Village of Tyonek (NVT) and the Alaska Native Tribal Health Consortium (ANTHC) about obtaining air quality baseline data for Tyonek. TTCD and NVT collaborated and secured funding through a ANTHC mini-grant program. As part of this grant, the three entities and ADEC will work together to obtain one year of baseline data on outdoor particulate matter in the Tyonek area. Federal Reference Method (FRM) air monitors will be used to sample the air for particulate matter 10 micrograms (PM10) in diameter and smaller. The baseline air monitoring provide Tyonek with defensible data showing current air quality conditions, and an assessment of current courses of particulate matter in the air such as road dust and other smoke and dust generating activities. This and other future projects are listed in Table 8.1.

Federal Reference Method (FRM) air monitors being used in Arizona. Navajonationepa.org

Table 8.1: Potential Projects

Priority	Project Description	Location	Estimated Project Duration	Anticipated Project Year	Land Manager/ Partners	Cost Estimate*
1	Collect baseline data on outdoor particulate matter, including road dust.	Tyonek, Beluga	1 year	2013	ANTHC, ADEC, NVT	$$
2	Develop protocols to continually monitor air quality in strategic locations, particularly as coal mine development occurs.	Tyonek, Beluga	Ongoing	2014	ANTHC, ADEC, NVT	$$
3	Distribute educational materials on indoor and outdoor air quality issues.	Tyonek, Beluga	Ongoing	2014	ANTHC, ADEC, NVT	$
4	Based on air quality data collected, work with interested entities to develop protocols to improve outdoor air quality.	Tyonek, Beluga	Ongoing	2014	ANTHC, ADEC, NVT	$$
5	Hold community meetings in Tyonek to learn about indoor and outdoor air quality concerns to develop potential future projects.	Tyonek	1 year	2014	ANTHC, ADEC, NVT	$

*** $** = <$5,000 **$$** = $5,000 – $30,000 **$$$** = $30,001 - $100,000 **$$$$** = $100,00 - $500,000 **$$$$$** = >$500,000

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Chapter 9: Terrestrial Habitat

As discussed in Chapter 3, the Tyonek Tribal Conservation District (TTCD) is located within the Cook Inlet Eco-Region in Southcentral Alaska (The Nature Conservancy of Alaska, 2003). Southcentral Alaska is a diverse region, comprised of many vegetation types which provide habitat for a variety of animals. In this chapter we will discuss these habitat types and associated dominant vegetation of the district, as well as the human uses of vegetation within the district.

In this chapter:

A. *Overview*
B. Resource Status & Human Uses
C. Issues of Concern
D. Data Gaps
E. Potential Projects

A. Overview

Due to the transitional climate of this region, the terrestrial habitat of the Cook Inlet Eco-Region is composed of different overlapping systems, including forest, high brush, tundra, and wetlands (ADNR, 2009). Among these habitat types there are a variety of habitat sub-types with unique features and functions.

Forest

Forests, or tree-dominated landscapes, cover much of GMU 16B. The forests within the district represent a transition between the coastal temperate forests of Southeast Alaska and the boreal forests of Interior Alaska. Four forest types can be identified within the district: coastal western hemlock-Sitka spruce forest, bottomland spruce-poplar forest, upland spruce-hardwood forest, and lowland spruce hardwood forest (ADNR, 2009).

Coastal western hemlock-Sitka spruce forests are found in coastal areas and require cool temperatures, high humidity, and heavy rainfall. On the western side of Cook Inlet, Sitka spruce is the dominant species in this forest, and mountain hemlock begins to replace western hemlock. This vegetation type is found where permafrost is absent (UAA-ISER, 2001).

Sitka spruce, *Picea sitchensis*
www.netstate.com

White spruce, *Picea glauca*
www.fs.usda.gov

Bottomland spruce-poplar forest systems are tall and dense and generally found on level floodplains, low river terraces, and south-facing slopes. Common species include white spruce, cottonwood, balsam poplar, paper birch, and quaking aspen. This forest type is generally present at elevations lower than 1,000 ft. (UAA-ISER, 2001).

Upland spruce-hardwood forests are a dense, mixed forest generally found on well-drained, south slopes at low to mid-elevations and on bench lands. Dominant species include white spruce, Alaska paper birch, quaking aspen, black cottonwood, and balsam poplar. Black spruce trees are found in areas with poor drainage. (UAA-ISER, 2001).

Lowland spruce-hardwood forest is a dense-to-open lowland forest of evergreen and deciduous trees. These forests are usually found on areas of shallow peat, glacial deposits, outwash plains, and on north-facing slopes. Willows and other brush species found in these forests provide good moose habitat (UAA-ISER, 2001).

Devil's club, *Oplopanax horridus*
www.nativeplantsociety.org

High Brush

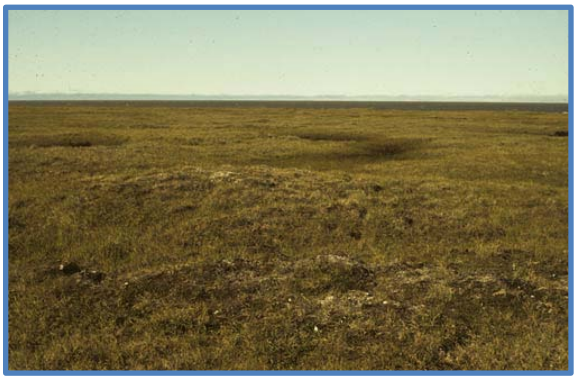
High brush habitats are found along streams, above the timberline, between beaches and forests and between treeline and alpine tundra. Common plants include devil's club, alder, willow, lupine, horsetail, and fireweed (ADNR, 2009). High brush systems range from dense willow along streams to dense alder above the timberline. Although trees such as paper birch and white spruce may be present, they are scattered. Many animals utilize high brush habitats for at least a portion of the year (UAA-ISER, 2001).

Tundra

The tundra is a treeless expanse found in Polar Regions that support sedges, as well as dwarf shrubs. Most precipitation in the tundra falls in the form of snow. Three types of tundra habitat are found in the Cook Inlet Region: moist tundra, wet tundra, and alpine tundra (World Wildlife Fund).

Moist tundra usually forms a complete low-growing ground cover and is highly productive during the summer. Cottongrass tussocks are characteristic of this habitat type. The composition of this vegetation type varies from continuous cottongrass to stands where dwarf shrubs dominate (UAA-ISER, 2001).

Wet tundra is dominated by sedges and cottongrass, and often occurs as a mat. This vegetation type is found on tidal flats and areas near sea level. Soils in these habitats are mainly composed of peat. Waterfowl use this tundra type as a nesting ground, including the trumpeter swan (UAA-ISER, 2001).



Wet tundra
www.arcticatlas.org

Alpine tundra is composed of low mat plants and is typically found on rock of mountains above 2,500 ft. This habitat is usually found above the forest and brush systems. Alpine tundra vegetation is very important to Dall sheep and mountain goat populations (UAA-ISER, 2001).

Wetlands

Based on the low elevation and landscape position of the Cook Inlet Basin, wetlands are common within TTCD. Wetlands are transitional zones between aquatic and terrestrial habitats. The major wetland type found within the district is low brush bog and muskeg. Wetland habitats are used intermittently by mammals and are very important for waterfowl.

In low brush bog and muskeg wetlands, dwarf shrubs dominate over a mat of sedges, mosses, and lichens. Coastal muskegs are dominated by shrubs on exposed dry sites, with scattered western hemlock and Alaska cedar. Another form of this system, interior bogs, are present within the boreal forest. Interior bogs are too wet to support trees, and contain large patches of cottongrass tussocks (UAA-ISER, 2001).

Additional information on the dominant plant species within the district is included in the Appendix in the Terrestrial Habitat section.

B. Resource Status & Human Uses

In the Tyonek area, the current forest has been impacted by logging and historic harvesting for building materials and firewood. Most of the trees surrounding Tyonek are over 60 year old mature trees (Wall, 2007). In the last century, no major fires have disturbed the forest in GMU 16B. Other recent disturbances include road building, seismic exploration, and natural gas development (Wall, 2007). Here we'll discuss major uses of plants within the district by residents, including wood fuel, timber harvest, and traditional use of plants.

Wood Fuel

According to a study completed by Joe Daniels of LCMF, LLC (2005), approximately 800 pickup loads (equivalent of 800 cords) of wood are consumed in Tyonek each year. Tyonek residents were at this time paying about $90 per load of wood, or harvesting the wood

themselves. Several residents of Tyonek have stated that the current price for a cord of wood (as of January 2013) is now generally $120. There are no companies that gather and sell firewood in Tyonek; however, several individuals gather wood for sale to others living in the village.

In Tyonek, firewood is harvested as a family event. Each winter, a Native Village of Tyonek employee will plow areas into the forest for families to drive in and select trees. Chainsaws are used to harvest the trees and then cut into a manageable size. There is currently no overall plan for selection of trees for firewood. In the village, both green and dry wood are burned. Those who collect and sell firewood generally sell a combination of dry and green logs.

Timber Harvest

On Tyonek Native Corporation (TNC) lands surrounding the Village of Tyonek, commercial logging occurred from 1975-1985 by Kodiak Lumber Mills and from 1999-2005 by Gates Construction. Kodiak Lumber Mills (KLM) developed a dock, port facility, processing plant, and residual camp for timber harvest operations. For both KLM and Gates Construction, logging ended due to market reasons. The facilities developed by KLM are now owned by TNC.

A forest stewardship plan was prepared for TNC by IT Alaska, Inc. (2001) as a part of a State of Alaska Department of Natural Resources Forest Stewardship Program. According to this plan, the area immediately adjacent to the Native Village of Tyonek (NVT) consists of 26,919 acres. Within this tract, 16,883 acres of forested land were identified. In 1987, 1988, and 1990, timber cruises and inventories were conducted in this tract. At the time of this study, volumes per acre were calculated for spruce, birch, and cottonwood. Spruce had a volume of 13.12 cords/acre, birch a volume of 13.44 cords/acre, and cottonwood a volume of 1.8 cords/acre. During this timber cruise, spruce bark beetle damage was recognized (Wall, 2007). For the subsequent harvest by Gates Construction, the harvest prescription was to take all merchantable white spruce from upland stands whether infected by spruce bark beetle or not, in order to capture the value of the spruce while keeping an intact forest. During this harvest, hardwoods and spruce saplings and poles were protected.

Although commercial logging occurred in this area in the past, there are currently no logging activities in the forest in the Tyonek village tract. The forest stewardship plan was developed for the 10 year period from 2000 to 2010. There is currently no land management plan in place for this tract of forest.

Traditional and Medicinal Plants

Edible plants and medicinal plants have historically been of great importance to the Tebughna people. The people of Tyonek traditionally followed a seasonal cycle for gathering plants. Cottonwood buds could be gathered as soon as they developed in early spring to be used as medicine. Saltwater algae were gathered as a food source in April and May. New shoots and leaves of willow were the first edible greens to appear, usually in May. These were followed by fern fiddleheads, young stems and leaves of sour dock, wild rhubarb, fireweed, and nettles in late May, as well as wild potatoes. In June vegetable foods such as wild chives, goosetongue, and seashore plantain could be gathered. By late July leafy vegetables become unpalatable, but underground parts of wild rice, wild chives, and seashore plantain would be ready to harvest.

Blueberries, *Vaccinium ovalifolium*
www.farnorthscience.com

> *"The trees and plants are very important around here … We have about six different berries around that people use every year."*
> *-Tyonek resident*

During August, several medicinal plants, such as pineapple weed, cow parsnip, false hellebore, angelica, roseroot, wild geranium, and yarrow, would be available for human use. Wild fruit, such as currants, raspberries, nagoonberries, cloudberries, rosehips, blueberries, crowberries, high bush cranberries, and lingonberries ripen later in the summer (Kari, 1987).

Edible plants, and particularly berries, have remained an important part of subsistence foods in Tyonek. However, although many elders still recognize traditional medicinal plants, these are being used less frequently in recent years. Tables 2 and 3 list subsistence use of resources, including plants, within Tyonek and Beluga, and can be found in the Appendix.

C. Issues of Concern

Spruce Bark Beetle

The spruce bark beetle (*Dendroctonus rufipennis*) is a small insect, which feeds exclusively on spruce trees, most commonly white, lutz, and sitka spruce, and only rarely black spruce. Although spruce bark beetles have been present at low background levels for a long time, it is only in recent years that they have reached outbreak proportions. An environmental change, most likely in climate, has triggered a rapid population buildup, as warm temperatures allow for faster reproduction. Spruce bark beetles feed by boring into spruce trunks and feeding on the live

cambium layer between the bark and wood. If a tree is attacked enough times, the tree will die (Juday, 1998).

In the area around Tyonek, there are several active spruce beetle infestations on stands owned by the Kenai Peninsula Borough, the State of Alaska, and Alaska Native Corporations (Wall, 2007). Spruce stands between Tyonek and Tuxedni Bay have long been infested, and are now composed of over 90% beetle killed spruce. Most of the new beetle activity has been observed north of Tyonek, between the Beluga River drainage and the Little Mt. Susitna (Wall, 2007).

The spruce bark beetle infestation is changing the landscape and changing the habitat significantly within TTCD. The number of standing and down dead trees has greatly increased the risk of catastrophic wildfires, which is now considered to be a medium to high risk for West Cook Inlet. Due to a lack of surviving understory spruce growing to replace older spruce trees and a greatly reduced spruce seed source with few surviving mature spruce trees, the forest composition may be changing. Predictions for future forest composition include increases in heavy grasses and hardwoods. The impact that this change in habitat will have on wildlife is unknown (The Nature Conservancy, 2003).

Invasive Plants

Approximately 130+ invasive plants are currently recorded as present within Alaska, and the following seven are of special concern to Tyonek: splitlip hempnettle (*Galeopsis bifida*), foxtail barley (*Hordeum jubatum*), quackgrass (*Elymus repens*), reed canarygrass (*Phalaris arundinacea*), orange hawkweed (*Hieracium aurantiacum*), narrow leaf hawksbeard (*Crepsis tectorium*), and Canada thistle (*Cirsium arvense*). These plants have already established a presence within the district (AKEPIC). There are several other lower-risk invasive plants present in GMU 16B, which also pose threats to native plant communities. For this reason, emphasis is being placed on the species with the highest invasive capacity and the greatest ability to alter native plant communities.

Invasive plant surveys were conducted by the 'Roving Weed Crew' via the Natural Resources Conservation Service to develop a pest management plan. The IPM (integrated pest management) survey followed USDA guidelines for field work and data collection. Surveys were conducted within TTCD in 2010. The work plan surveyed invasive plant species within the Village of Tyonek and the immediate surrounding area. Invasive plants identified during the survey were categorized by presence and are accompanied in a data table by GPS waypoints (see Appendix for more information). Google Earth maps were created to denote areas of special interest based on high traffic zones and potential for invasive species introduction.

Four General methods of management or mitigation for invasive plant control:

1. Early Detection Rapid Response - The most cost effective method of control focusing on preventative measures to reduce further spread.

2. Manual – Small infestation (under six feet in diameter) can be targeted with manual techniques
   (i.e. pulling, tarping, digging, and cutting).
3. Mechanical – Small infestation (under six feet in diameter) can be targeted with manual techniques (i.e. weed whip or chain saw).
4. Chemical – A last resort technique for mitigation of invasive plants is spraying pesticides or herbicides.

Targeted plants for the survey were: white sweetclover (*Melilotus alba*), white clover (*Trifolium repens*), alsike clover (*Trifolium hybridum*), bird vetch (*Vivia cracca*), bigleaf lupine (*Lupinus polyphyllus*), hawkweeds (*Hieracium sp*.), common tansy (*Tanacetum vulgare*), pineapple weed (*Matricaria discoidea*), thistles (*Cirsium sp.*), oxeye daisy (*Leucanthemum vulgare*), hawkbit (*Leontodon spp.*), reed canarygrass (*Phalaris arundinacea*) and hemp nettle (*Galeopsis tetrahit*).

Follow up plans were created based on the information obtained from the inventory, and were provided to the Village of Tyonek. Recommendations for removal of observed invasives focused on mechanical removal (hand-pulling) of invasive plants and non-chemical means of removal. Areas of priority noted within the report focused on the Tyonek airstrip, the Tyonek dock, and the 'woodchip/industrial' yard outside of Tyonek. These areas were noted as potential vectors for introduction of new invasive species. The complete 2010 Tyonek invasive plant survey is included in the Appendix. Additional information on several invasive plant species is included in the Appendix in the Terrestrial Habitat section.

Land Use

Two major landowners within TTCD, TNC and the Cook Inlet Region Incorporated (CIRI), have expressed concern that trespassers are using their lands and have developed illegal trails to access hunting and fishing areas. CIRI is interested in developing a legal trail system that protects the habitat and allows for the authorized use of trails. The importance of creating a safe way to get from Tyonek to Beluga Lake for hunting and fishing is also a priority.

Traditional Knowledge

Several Tyonek residents have expressed concern that there is a need to increase the amount of traditional knowledge that is being passed down from elders to the youth. The use of native plants both medicinally and as a food source is of historical and cultural significance to the Tebughna people. Preserving this knowledge is a priority to many in Tyonek.

D. Data Gaps

The data gaps observed while researching terrestrial habitat information within the district relate to forest management and invasive species. TNC land, which comprises a substantial portion of GMU 16B, currently lacks a forest management plan. Although an invasive plant management plan was developed in 2010, this plan has not been implemented, and no data collection has

occurred since the baseline study was completed. In addition, the 2010 invasive plant survey centered on specific areas, and a more inclusive study may show invasive plants in other areas.

E. Potential Projects

Invasive Plants

In order to protect native plants and wildlife habitat within the district, invasive plant monitoring should be routinely conducted in the Tyonek area including on major travel routes, landing strips, boat launches, shipping docks, community garden sites/agricultural land, landfills, or other areas experiencing frequent usage by vectors. One way to accomplish this would be to develop a youth crew to be trained to assist surveys and implement mitigation efforts. This crew would provide youth with on-the-job training, team building skills, and income. In addition, youth will have the opportunity to participate in community and environmental stewardship. For more information, see Table 9.1.

Forestry Plan

TNC's forest stewardship plan was developed for the 10 year period from 2000 to 2010, and currently no land management plan is being utilized on their lands. In January of 2013, TTCD began conversations with TNC and the Alaska Department of Natural Resources to discuss the creation of an updated management plan for TNC lands through the Forest Stewardship Program. TTCD and TNC have now begun working with Forest and Land Management, Inc to put together an application for this program, and they are planning to develop a revised Forest Stewardship Plan for all TNC lands in the next year. For more information, see Table 9.1.

Trail Development

TTCD is interested in participating in any major trail planning and development that occurs within the district. It is a priority of TTCD that such trail development is completed in a way that protects habitat, and that plant materials obtained through trail development be utilized in an efficient way. For example, woody materials removed through trail development could be used by residents for household heating. For more information, see Table 9.1.

Traditional Knowledge

As stated earlier, the preservation of traditional knowledge, such as the identification and uses of edible and medicinal plants, is a concern for the residents of Tyonek. TTCD is interested in developing an education and outreach program that assists in the retention and transfer of this knowledge. In particular, the development of an edible and medicinal plant herbarium with Tyonek students could help to accomplish this educational goal. For more information, see Table 9.1.

Table 9.1: Potential Projects

Priority	Project Description	Location	Estimated Project Duration	Anticipated Project Year	Land Manager/ Partners	Cost Estimate*
1	Develop an updated forestry plan for TNC lands through DNR Native Corporation Program to include a plan for sustainable wood fuel harvest to be shared with Tyonek community.	TNC lands	1 year	2014	TNC	$$$
2	Develop and implement an invasive plant monitoring and control plan.	Tyonek	Ongoing	2014	NVT, TNC	$
3	Develop a youth crew to assist with invasive species monitoring and control.	Tyonek	Ongoing	2014	NVT, TNC	$$
4	Implement measures identified in forestry plan.	TNC lands	2-3 years	2017	TNC	$$$
5	Develop educational programs to increase knowledge of traditional uses of plants as part of a conservation education program.	Tyonek	Ongoing	2017	NVT, TNC	$$
6	Trail development in Tyonek area.	Tyonek area	2-3 years	2017-2019	CIRI	$$$

*** $** = <$5,000 **$$** = $5,000 – $30,000 **$$$** = $30,001 - $100,000 **$$$$** = $100,00 - $500,000 **$$$$$** = >$500,000

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Useful Resources

Alaska Department of Natural Resources: Cook Inlet Areawide Final Best Interest Finding - http://dog.dnr.alaska.gov/Leasing/Documents%5CBIF%5CCook_Inlet%5CCookInlet_BIF2009_4_HabFishWildlife.pdf

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Chapter 10: Wildlife

The Tyonek Tribal Conservation District (TTCD) is home to a wide variety of wildlife. A properly maintained and managed ecosystem will result in healthy habitat, which significantly increases wildlife populations in a sustainable and ecologically conscious manner. In this chapter we will discuss wildlife and subsistence related issues in TTCD.

In this chapter:

A. *Overview*
B. *Resource Status & Human Uses*
C. *Issues of Concern*
D. *Data Gaps*
E. *Potential Projects*

A. Overview

The Importance of Subsistence

Subsistence hunting and fishing are an important way of life for many Alaskans, both in the past and the present. Subsistence is defined by federal law as “the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools or transportation; for the making and selling of handicraft articles out of nonedible by-products of fish and wildlife resources taken for personal or family consumption; and for the customary trade, barter or sharing for personal or family consumption” (USDI BLM, 2008).

Alaska state law directs the Board of Game and Board of Fisheries to provide a reasonable opportunity for subsistence uses first, before providing for other uses of any harvestable surplus of a fish or game population (AS 16.05.258(b)). This is often referred to as the “subsistence preference” or sometimes the "subsistence priority." The Alaska Department of Fish and Game (ADF&G) recognizes the definition of subsistence fishing to mean the taking of, fishing for, or possession of fish, shellfish, or other fisheries resources by a resident of the state for subsistence uses with gill net, seine, fish wheel, long line, or other means defined by the Board of Fisheries (ADF&G, 2013). Recreational or sport users of fish and wildlife also are important and significant in the district. More information about subsistence is included in the Appendix.

Wildlife in GMU 16B

As discussed in chapter 9, TTCD contains diverse habitat types. These unique habitats provide food and shelter for an assortment of animals. In addition to large mammals, such as moose, caribou, and sheep, smaller animals such as beaver, muskrat, snowshoe hares, and ground

squirrels are common. Also present in the Cook Inlet Eco-Region are many top-level predators such as brown bear (*Ursus arctos*), black bear (*U. americanus*), gray wolf (*Canis lupus*), wolverine (*Gulo gulo*), lynx (*Lynx canadensis*), and coyote (*C. latrans*) (Rickets et al.1999). The coastal wetlands and bays along the Cook Inlet provide seasonal habitat for many species of waterfowl and shorebirds. As of 2013, the Alaska Department of Fish and Game (ADF&G) has hunting regulations with the District for the following species: brown bear, black bear, caribou, moose, sheep, wolf and wolverine.

B. Resource Status & Human Uses

Large Herbivores

Moose

Moose (*Alces alces*) are the largest members of the deer family, and they are an important animal for the ecology and the economy of Alaska. During the fall and winter, moose rely on willow, birch, and aspen as a food source. In the spring, moose graze as well as browse. In the summer, moose feed on vegetation in ponds, forbs, and leaves of birch, willow, and aspen. Moose are most abundant on recently burned areas, on timberline plateaus, and along major rivers (Harper, 2009).

The moose is the state symbol of Alaska, and an important resource for residents of Tyonek and throughout 16B.
statesymbolusa.org

The Board of Game estimates that there is a need for a minimum of 199-227 harvested moose to meet the amount necessary for subsistence within GMU 16B. According to local information, it is believed that only about half of the moose subsistence needs for the Village of Tyonek are being met. In a 2006 study, it was found that 83% of households utilized moose meat, with only 19% of households harvesting the moose themselves (Stanek et al., 2007). For Tyonek and Beluga harvest and use information, see Tables 2 and 3 in the Appendix.

The moose population within GMU 16B has declined significantly in the past 25 years. In the early 1980's, the moose population was estimated at over 10,000 within the district. In 2003, the population was estimated at 3,387 moose. Since 1996, surveys have shown less than 20 calves per 100 cows. It is estimated that to maintain a stable population, the ratio should be 20-30 calves per 100 cows (Wall, 2007). Due to the reduced moose population in GMU 16B, the general season was closed in 2001, 2002, and 2006-2008, at which time permit levels for existing Tier II hunters were increased to provide for subsistence (Harper, 2009).

Moose have long been an important source of food for the Tebughna. However, harvest numbers have declined along with the moose population. From 1983-1988, an average of 495 moose were harvested annually in the unit. In 2001, the Board of Game reduced the number of tags from the unit from 1,050 for both sport and subsistence harvest to 400 for subsistence only. In 2002, only

69 moose were harvested in the unit. The objective of the Board of Game for GMU 16B is 6,500-7,000 moose, with an annual harvest of 310-600 moose per year for combined sport and subsistence hunters.

When the moose population began dropping in GMU 16B, many suspected that predators such as wolves and bears were the cause. Yet poor moose productivity, disease, and weather conditions are among the other factors that may be impacting the moose population in this region. Heavy snowfall winters have often taken a heavy toll on moose numbers. The 2011/2012 winter season was a particularly hard winter. John Crouse and Tony Kavalok began research in 2005 in GMU 16B to address questions about adult female moose survival, the number of calves born each spring, and the subsequent survival of young moose. In the first year of the study, no collared moose died in the fall and winter. In the spring, biologists tracked two separate mortality signals to find brown bears consuming the carcasses of recently killed cow moose. A few other adult moose were found to have died of unknown causes. These findings do not provide us with any answers for the low numbers of moose in the area. However, when tracking calves born to radiocollared mothers, it was found that very few calves are surviving their first year in GMU 16B, most likely because they are being killed by bears and wolves. Crouse and Kavalok found that fewer than 10% of the calves born survived to five months old (Manning, 2007; Hollander, 2005).

In 2007, the Tyonek Native Corporation (TNC) with support from TTCD, entered into a 5-year contract with NRCS to enhance moose habitat on 60 acres of land. In the first year, 60 acres of land were mechanically treated by exposing the topsoil and dragging birch trees through the area. The following year, 14,000 felt leaf willow were planted and stalked on the mechanically treated area. In 2010, an additional 73 acres of land were mechanically treated with willow crushing and planted 34,000 willow stalks (a mixture of Barclay and Felt Leaf sp.) on 170 acres. Many of the students in Tyonek, as well as community members, worked side by side with NRCS staff on this project. These measures increased the number of willow and birch trees available, and moose have been seen browsing in this area. For this project the pre-application moose population was not estimated. For any similar projects in the future, TTCD is interested in testing empirically for the effects of habitat enhancement on the moose population.

Tyonek residents and students gathering willow cuttings for moose habitat enhancement.

Caribou and Dall Sheep

Caribou (*Rangifer tarandus*) and Dall sheep (*Ovis dalli*) are also present and hunted within the TTCD. Dall sheep are found in mountain ranges within the district, and consume a wide variety

of plants, lichen, and moss throughout the year. Caribou tend to spend winters in boreal forest areas, and their summers in either the tundra or the mountains. Although these species are less utilized than moose by the Tebughna people, both are occasionally harvested within the district. Caribou once ranged widely throughout GMU 16B, but due to habitat changes, now occupy the western mountain foothill areas.

Small Mammals

Shrews, hares, marmots, squirrels, beaver, voles, muskrat, lemming, mouse, porcupine, coyote, fox, marten, ermine, weasel, mink, wolverine, otter, and lynx are all found in the district (Rath TNC Forest Stewardship Plan). Historically, many of these animals were harvested by Tebughna people for fur or food. In an overview of subsistence practices in Tyonek over a twenty year period compiled by Braund & Associates (2007), the hunting and trapping of furbearers and small land mammals are described as practices that are no longer as common as they once were. Those who trap harvest furbearers such as beaver, wolf, wolverine, mink, and marten. Beaver, porcupine, and hare are hunted for their meat (Braund et al., 2007). Stanek et al (2007) also found that 25.5% of households utilized small mammal meat with only 17% of households successfully harvesting the animals themselves, for a total of 206lbs harvested in the study year. For Tyonek and Beluga harvest and use information, see Tables 2 and 3 in the Appendix.

Beaver

The beaver (*Castor canadensis*) is the largest rodent in North America, and it is known as a keystone species because of its importance within an ecosystem and its ability to drastically alter its surroundings. Beaver dams can raise the water table and increase water storage, as well as increase wetland habitat for birds and other wildlife (Shephard & Golden, 2008).

Beaver gathering building material
animals.nationalgeographic.com

In Tyonek, spring beaver trapping and hunting historically began in late winter when beaver appeared in open water areas and along riverbanks in search of food. Hunting with firearms continued into May if the animals were taken for food. Pelts, having worn thin, are not desirable this late in the year. Today, beaver are not often harvested in Tyonek. Beaver dams frequently clog culverts within Tyonek, sometimes leading to road washouts. Beaver, therefore, are often seen as a nuisance in Tyonek.

Large Predators

Black Bear

Black bears (*Ursus americanus*) are the smallest of North American bears. These bears eat a wide variety of foods, including vegetation, berries, insects, salmon, and newborn moose calves (ADF&G). Black bears are taken primarily because they are viewed as a threat, with only

periodic harvesting for food (Braund et al., 2007). In 2006, 4.3% of Tyonek households utilized black bear meat, with a total of 488lbs harvested that year (Stanek et al., 2007). For Tyonek and Beluga harvest and use information, see Tables 2 and 3 in the Appendix.

In 1992, ADF&G adopted a black bear population objective for GMU 16B to maintain a population size that is unaffected by human harvest, with a harvest not to exceed 56 sows per year. The Board of Game adjusted their black bear population and human use objectives in 1999 and 2001 to reduce the population. The purpose of the reduction was to positively impact the moose population, as it is believed that black bears may be negatively impacting the moose population. TNC now provides opportunities to hunt black bear at the Tyonek Lodge. Guides in Beluga also provide guided bear hunting opportunities.

Black bear, *Ursus americanus*
adfg.alaska.gov

Brown Bear

Brown bears (*Ursus arctos*) are found throughout the state and are the top predator in Alaska. Alaska contains about 98 percent of the U.S. brown bear population with an estimated 30,000 brown bears statewide. These predators are known to consume salmon, berries, grasses, sedges, horsetails, cow parsnips, fish, ground squirrels, and roots, as well as both young and adult moose and caribou. These predators are typically solitary, with sows and cows staying together for several years (ADF&G). Because of their salmon-rich diet, brown bears are an important vector for salmon-derived Nitrogen into riparian ecosystems (Hilderbrand et al., 1999).

Brown bear (*Ursus arctos*) with cubs.
true-wildlife.blogspot.com

According to the Wildlife and Resource Management Plan developed by NRCS, AVI, and TNC, the population of brown bear in GMU 16B was estimated at 530-1,050 bears in 2005. Little historical data on brown bear populations in GMU 16B is available. Brown bears were last harvested for food in Tyonek in the 1950's. Since then, brown bears have mainly been shot as a nuisance animal, when they have interfered with fish camps or posed a threat (Braund et al., 2007). In Beluga, however, brown bear hunts by guides have been a significant source of annual income.

As of 2009, the goal of the Board of Game was to reduce the population by maintaining a minimum three-year average harvest of 28 female bears over two years of age (Harper, 2009). In order to increase the brown bear harvest in GMU 16B, the Board of Game has extended the brown bear season, eliminated the brown bear tag fee, and increased the brown bear bag limit to one per year. In 2013, the limit increased to two per year.

Wolf

Wolves (*Canis lupus*) are social animals that live in packs. As predators, wolves hunt both large and small animals, as well as occasional birds and fish. In Alaska, the main causes of mortality for wolves are hunting, trapping, and predation by other wolves (Harper, 2009).

Wolf (*Canis lupus*).
animals.nationalgeographic.com

The first systematic population estimate of wolves with GMU 16B occurred in 1993, at which time the population was estimated to be 48-62 wolves. In a 2007 study, the wolf population in GMU 16B was estimated to be 104-130. In 2003, the Board of Game voted to approve a predator control program in GMU 16B, with the purpose of reducing wolf numbers and increasing moose calf recruitment. This resulted in a decrease in the wolf population. The management objective for GMU 16B as of 2009 is to maintain a wolf population of 22-45 wolves in 3-5 packs. As of 2009, the wolf population in the entire GMU 16B had remained stable between 100-150 animals. However, it remains to be seen if wolves are in fact having a major impact on the moose population. (Harper, 2009)

Birds

Resident Birds and/or Upland Game Birds

Game birds are an important subsistence food source for the people of Tyonek. Ptarmigan (*Lagopus spp*), spruce grouse (*Dendragapus Canadensis*), and ruffed grouse (*Bonasa umbellus*) occur throughout the forested and tundra areas around Tyonek. Each of these birds is harvested by Tyonek residents. In a study by Stanek et al. (2007) 28% of Tyonek households utilized upland birds, with 25.5% of residents successfully harvesting upland birds in the year of the study. Grouse are generally taken in early fall in conjunction with moose hunting, and ptarmigan are typically taken after freeze up and throughout winter when they move from higher tundra to open stands of willow near Tyonek (Stanek et al., 2007). For Tyonek and Beluga harvest and use information, see Tables 2 and 3 in the Appendix.

Ruffed grouse in winter.
adfg.alaska.gov

Migratory Birds

The coastal areas along Cook Inlet within the district provide prime seasonal habitat for waterfowl and shorebirds. Birds such as the Wrangell Island snow goose (*Chen caerulescens* (Wrangel Island)), rock sandpipers (*Calidris ptilocnemis* (Pribilof)), western sandpipers (*C. mauri*), dunlin (*C. alpina*), Hudsonian godwits (*Limosa haemastica*), and the Tule white-fronted

goose (*Anser albifrons elgasi*) are found in the eco-region, as are high concentrations of overwintering bald eagles (*Haliaeetus leucocephalus*) (The Nature Conservancy, 2003). For Tyonek and Beluga harvest and use information, see Tables 2 and 3 in the Appendix.

The hunting of migratory birds is an important part of the subsistence economy of Tyonek. Migratory birds were traditionally harvested during spring migration and fall migration. Spring bird hunting and egg gathering were barred by the 1918 Migratory Bird Treaty Act. In 1997, this was amended to allow for taking of birds and eggs during spring and summer in Alaska. In 2003 a season was implemented for Tyonek residents through federal law in a portion of GMU 16B.

Ducks are most commonly harvested, including mallards (*Anas platyrhynchos*), northern pintails (*Anas acuta*), green-winged teal (*Anas crecca*), wigeons (*Anas americana*). Geese also, such as Canada geese (*Branta canadensis*) and snow geese (*Chen caerulescens*) are taken in the district. Residents occasionally utilize gull eggs (*Larus glaucescens*) as a food source. Migratory birds are primarily hunted at the mouth of the Nikolai River, the flats near McArthur River, the mouth of the Chuitna River, and the Susitna Flats State Refuge (Stanek et al., 2007).

C. Issues of Concern

Moose Population

As noted earlier in this chapter, the moose population within GMU 16B has been decreasing in recent years. As moose are an important part of the diet and economy of Tyonek, the reduction in moose numbers is of major concern to the residents of Tyonek, as well as others living in GMU 16B who rely on subsistence for a portion of their food.

> *"Wildlife is not only our nutrition; it is our mental health as well. Many Tyonek people have sat and watched seals, birds, bears, and any animals that would allow us the time to watch them and take a quiet moment to ourselves."*
>
> *– Tyonek shareholder*

Invasive Animals

Invasive animal species can alter Alaskan ecosystems by displacing competitors or preying on native species, contaminating gene pools by interbreeding with native species, and through widespread killing of native plant species, as seen with invasive insects in native spruce forests (Schrader et al., 2005). Within the state of Alaska, invasive animals have been intentionally introduced for sport hunting and commercial endeavors such as fur farming. Although non-native terrestrial animal species are found in Alaska, few are considered invasive or threatening to ecosystem function or integrity (Schrader et al., 2005). Rats and other rodents, raccoons, hares, pigeons, starlings and slugs have been

introduced to Southeast and Southcentral Alaska. Raccoons do not appear to have a sustained population in the Cook Inlet Eco-Region. Two species of invasive slug are common within the region, but do not appear to have an effect on native forests. Rats have not been reported as present within the Tyonek area, but with a functioning dock on the shore of Cook Inlet, invasive rats could pose a threat to native species and health concerns within GMU 16B if they were to be introduced by a visiting barge or ship.

Furbearer Management

In Tyonek, many residents are concerned with the problems that may be connected with the growing beaver population. The clogging of culverts by beavers has led to road washouts. Large beaver dams can also make fish passage difficult.

D. Data Gaps

1. Subsistence use of wildlife resources has only been thoroughly documented and studied in Tyonek and Beluga. More information regarding subsistence use in Skwentna, Alexander Creek, and other parts of the district is needed.
2. Although predator control is often the management strategy for improving the moose population, it is unknown how effective this strategy has been. The development ecosystem-level approach that looks at all factors effecting moose may be more beneficial.

E. Potential Projects

Moose Population

The decline in moose population is of concern not only to Tyonek residents but all district residents. Residents noted an increase in moose in the willow enhancement area following the moose habitat enhancement project from 2007-2010. It would be beneficial to develop a moose population management plan, outlining potential projects such as habitat enhancement through willow plantings, scarification, or controlled burns. See table 10.1 for more information.

Invasive Animals

Although invasive animals are not yet a problem in Tyonek, this is something that could potentially pose a threat to wildlife in the future. Prevention is the least costly and most effective way to deal with invasive species. TTCD recommends that a management strategy involving the steps outlined below be implemented in district. See table 10.1 for more information. For site locations, see Figure 7 in the Appendix.

- Investigate potential vectors and invasive pathways
    - Tyonek dock facility

        - Assess potential for introduction of invasive animals such as rats, rodents, and aquatic species via the dock facility
    - Tyonek airstrip
        - Assess potential for introduction of invasive animals, particularly non-native bait fish via the Tyonek airstrip
- Inform residents of the potential threats and impacts of invasive species
    - Enlist the help of residents in monitoring the potential for invasive introductions via the transportation facilities within the community
    - Ask community members to report sightings of invasive species

Furbearer Management

Although an important part of the ecosystem, beavers are considered to be a problem in Tyonek due to their impacts on waterways and roads. An evaluation of the current impacts of beaver in the Tyonek area and possible management strategies may be beneficial. See table 10.1 for more information.

Education and Outreach

Conservation districts can play a role in providing environmental education within the communities that they serve. TTCD is interested in developing a wildlife education program that could be implemented in the Tebughna School in Tyonek. See table 10.1 for more information.

Table 10.1: Potential Projects

Priority	Project Description	Location	Estimated Project Duration	Anticipated Project Year	Land Manager/ Partners	Cost Estimate*
1	Develop and implement a wildlife education program as part of a conservation education program.	Tebughna School	Ongoing	2014	TNC, NVT	$
2	Develop plans for projects to improve the moose population in 16B. Possible strategies could include willow enhancement, scarification, and controlled burns to improve moose habitat.	TBD	Ongoing	2015	TNC, NVT, and others	$ - $$$
3	Develop a plan to monitor for and prevent the arrival of invasive animals in 16B.	Entry points to District	Ongoing	2017	Multiple	$$
4	Develop strategies for furbearer management in Tyonek.	Tyonek	Ongoing	2018	TNC, NVT	$ - $$

*** $** = <$5,000 **$$** = $5,000 – $30,000 **$$$** = $30,001 - $100,000 **$$$$** = $100,00 - $500,000 **$$$$$** = >$500,000

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Chapter 11: Community Conservation

Adaptive community based conservation strives to find proactive and adaptive solutions to the complex conservation issues which stem from multiple land uses and potentially conflicting land use objectives. Community conservation issues range from but are not limited to sustainable and efficient housing, energy use, forest, game and fisheries projects, and food production.

Tyonek Tribal Conservation District (TTCD) has numerous land owners and stakeholders including: The Native Village of Tyonek (NVT), Tyonek Native Corporation TNC), Cook Inlet Regional, Inc. (CIRI), The Nature Conservancy, Mental Health Trust, State of Alaska, US Federal Government, and numerous lease holders. Maps of these areas are included in the appendix. The goals of an adaptive community conservation approach are not to limit the rights or opportunities of any stakeholder, but instead to find sustainable solutions to managing landscapes for multiple use objectives through inclusive participation and cooperation of all stakeholders and interested parties.

In this Chapter:

A. *Housing & Development*
B. *Recycling & Waste Management*
C. *Food Production*
D. *Energy*
E. *Potential Projects*

A. Housing & Community Development

TTCD is able to assist and support communities and/or landowners in GMU 16B, including Tyonek, with future projects related to infrastructure development, housing, and natural resource conservation projects. As a facilitator, TTCD is capable of working with communities and connecting partners and agencies in order to accomplish identified projects.

Public Access to the Community

At this time there is limited development in the West Cook Inlet. However, as development projects increase, especially in western Cook Inlet, rural villages such as Tyonek will be easier to access. This could be a potential issue of concern for Tyonek, as they are a closed, private community wanting to remain as such.

Housing

Tyonek currently has 85 housing units with sixty-five of these buildings in use. The average size of a residential home in Tyonek is 1,440 ft^2. One home is a duplex and two are trailers. Fifty-eight of the homes are prefabricated and were barged over to Tyonek in the mid-1960s. In 1978-79, twenty-seven wood frame homes were built through assistance by the Department of Housing and Urban Development. The newer homes were built west of the airstrip in what is known as the Indian Creek subdivision.

There are several issues of concerns relevant to housing in Tyonek, from not having enough housing, to needing housing updates/weatherization, providing housing for seniors and younger community members, and the need to move homes that are in dangerous areas.

At this time, NVT does not have an employee in the housing department, delaying future work projects. As all of the homes were built prior to the 1980's, the majority of homes need weatherization updates to decrease energy use and costs. Previously, one house at a time was eligible through HUD to receive updates; however, this has been stalled due to a lack of staff.

In addition to weatherization and updates, additional housing is needed to accommodate families. At this time, the majority of Tyonek shareholders live in Anchorage or Kenai; however, it has been reported that if more housing and jobs were available, more people would likely stay in the village. Additionally, the Tyonek community believes building multi-family residences and/or apartments would attract young adults and prevent them from moving out of the village. Senior community members also report leaving the village because of a lack of housing and to be closer to medical care. Tyonek desires to have a senior living center, where senior residents can live and receive medical assistance.

Other issues include the actual site location of the village; Tyonek was built on a bluff overlooking the West Cook Inlet. Natural erosion from tidal fluxes and powerful winds is severely eroding the bluff. At this time there are approximately 5 homes located on the bluff at risk of falling into the inlet from erosion. To protect the homes and the families living in them, these homes need to be relocated from the bluff to a safer location.

B. Recycling & Waste Management

Recycling and waste management are important issues for community conservation. Proper waste-stream management and recycling programs can have many positive impacts on rural and remote communities, ranging from financial gains to habitat improvement and sustainability to increased job opportunities for local residents. There

are many State and Federal programs available to assist communities in creating and operating effective recycling and waste management programs.

Current Status

The community of Tyonek does not currently have any recycling or waste stream programs in place. The largest buildings in the community are the Tebughna School and the Tribal Center; additional waste stream sources include residential waste outputs from the village neighborhood and the newer sub-division.

Local Challenges & Issues

- Location and cost of back-haul
- Lack of infra-structure to process waste-streams
- Local waste-dump
- Waste-dump needs increased/improved management and a fence

"State law requires landfills to be permitted by the Solid Waste Program. Funding is another important factor. Though the Solid Waste Program does not have funds available for landfills, there are other organizations that do. A community with a permitted landfill will rank higher in the selection process than an unpermitted landfill." (ADEC)

Current Landfill Status

The Tyonek landfill is a Municipal Class III landfill. It is non-permitted. Its last permit expired August 31, 1990. The primary Borough contact is listed as Lanie Hughes, Kenai Peninsula Borough. The Rural Specialist for the area is currently listed as Kym Bronson. Alaska Statutes state that boroughs may provide or facilitate waste services but are not obliged to do so. Kenai Peninsula Borough states on its website that it "has an integrated solid waste program which includes the development, operations, and maintenance for the following locations…" which includes the Tyonek landfill. "The Solid Waste Department provides recycling and hazardous waste collection stations, environmental monitoring, and litter programs to ensure feasible and cost-effective waste management in compliance with regulatory requirements."

Example Waste Stream & Recycling Projects in Village Communities

Many communities throughout Alaska have implemented a variety of projects related to waste management. All of these efforts required collaboration between individuals, organizations, and programs. Sample selections are highlighted below:

- Koyukuk improved organization of and access to their landfill and improved their salvage and recycling abilities.
- Nightmute moved their dump area away from the river and established fencing, signs, and a metal salvage area. They later purchased a burn box to facilitate disposal.

- Kwigillingok fenced their dump and separates multiple products for recycling.
- Kiana moved their burn barrels out of town, collects waste oil for heating, creates and uses cardboard "logs" for heating, purchased a burn box, and implemented a recycling program.
- Selawik created a 'Hazardous Materials Exchange Connex', where community members can donate extra or left-over household hazardous materials like paint thinner for other people to use.
- The Northwest Arctic Solid Waste Working Group, comprised of the villages of Noatak, Noorvik, Kiana, Buckland, Shungnak, Selawik, Deering, Kivalina, and Kotzebue implemented a multi-aspect waste management plan
- Kotlik built their own burn box and banned Styrofoam and plastic bags from their store.
- Atmautluak operates a collection program to minimize human presence at the dump (for health and safety reasons), built their own burn box, and operates a recycling program.

Table 11.1: Organizations and entities supporting waste management and recycling efforts

Name	Activity/Purpose	Potential Partner
ADEC Solid Waste Program Division	State office responsible for permitting and regulation of landfills and other solid waste systems.	Yes
Alaska Forum on the Environment	Offers free Rural Alaska Landfill Operators (RALO) Training.	Yes
Alaska Materials Exchange	Part of GreenStar, this is a free web-based materials exchange (like craigslist) to facilitate usable items finding new homes.	Yes
Alaskans for Litter Prevention and Recycling	Non-profit organization dedicated to eliminating litter and increasing economically-viable recycling in Alaska.	Yes
EPA Indian Environmental General Assistance Program	Offers grants to federally recognized tribes and tribal consortia for planning, developing, and establishing environmental protection programs, as well as for developing and implementing solid and hazardous waste programs on tribal lands.	Yes
EPA's Tribal Solid Waste Management Program	Encourages municipal solid waste and hazardous waste management practices that are protective of human health and the environment. Acts as a clearinghouse for federal grants, information, and other resources.	Yes
Institute for Tribal	Assists communities in identifying possible hazardous	Yes

Environmental Professionals' Hazardous Substances Website	substances, offers resources to learn more about those substances, and outlines steps to prioritize response actions.	
Rural Alaska Community Action Program, Inc.	Hosts an expert solid waste liaison that provides solid waste management technical assistance to rural communities. Resources are provided for dump management activities, collaborating with funders for funding and technical assistance on solid waste management, recycling, and backhaul.	Yes
Solid Waste Association of North America, Alaska Chapter	Their mission is to improve the management of solid waste in Alaska by offering education and training and promoting the dissemination of information, continuing education, professional development, and research programs.	Yes
Total Reclaim, Anchorage	Provides recycling and management services for hazardous materials. Also provides outreach and training to communities.	Yes

C. Food Production

Food production is an important conservation issue for Alaska and in the community of Tyonek. Associated issues include food security, food quality, transportation costs, and sustainability; benefits of increasing local food production include improved health, decreased food costs, job creation, and community building.

A 2007 study conducted by the USDA shows only 5% of the food consumed in Alaska is produced within the state (Gutierrez, 2013). The Alaska Farm Bureau states that if food imports were cut off to Alaska, there would be an approximate 3-5 day supply of groceries before local stores ran out (Watson, 2013). The vast majority of the food that reaches Alaska is shipped via barge, truck, or plane. At minimum, these goods travel about 1,200 miles from ports in the State of Washington to Anchorage. These shipping methods contribute to global carbon emissions and supply food that is not as fresh as local produce, which comes at a greater cost compared to the same food items in the contiguous United States. In Tyonek, most non-subsistence foods arrive via airplane with an additional $0.40/lb for freight charges. Perishables such as fruits and vegetables are particularly expensive and difficult to ship, leading to a decrease in their presence in rural food programs in favor of more processed food items (though it should be noted that subsistence foods offset and supplement this deficit to a degree). This cost/availability scenario can contribute to health-related issues such as obesity and diabetes.

Students planting vegetable starts in 2012.

Producing food locally can help to create healthy and sustainable communities. The economic benefits of local production can be significant for rural communities by creating jobs and eliminating the need for secondary shipping via airplane. Producing, processing, and distributing food locally using sustainable methods can provide viable additional job opportunities for rural communities. Community gardens and local food production offer excellent learning opportunities for school-aged children, and have the potential to strengthen ties between community members of all ages.

Planting day in Tyonek community garden, 2012.

The Village of Tyonek and TTCD are currently working together with other partners to create and promote a sustainable, organic system of food production within the community. The goals for this system include educational opportunities for the Tebughna School, job opportunities for community members, and an end-to-end production system, which utilizes local resources and waste streams to produce food sustainably within the community.

The Tyonek community garden was initially planned in 2007 and clearing started in 2010. The garden space sat dormant for almost 2 years and improvement efforts were restarted in 2012.

Current capacity includes a 1.5-acre outdoor garden containing two high tunnels (under construction 2013) and a spacious outdoor crop area. Irrigation and power have been provided to the community garden via a 2kW solar array and submerged water pump. High tunnels were obtained via the NRCS high tunnel program with assistance from TTCD. The high tunnels will allow extended growing seasons and increased garden yields, and solar power will provide the necessary electricity to the garden and eliminate the need for intensive fossil fuel use.

To create an ‘end-to-end system’ and provide educational opportunities for students, Tebughna School has been incorporated as a core component of the community garden efforts. The school, with the help of its students and teachers, will be maintaining an indoor vegetable garden for continuous production of lettuces, tomatoes and other salad greens/vegetables (completion date in 2014). The indoor garden at the school will be a focal point for earth-science, health, and nutrition-based curriculum (for middle and high school), and provide all of the necessary plant-starts for the outdoor community garden,

as well as, provide fresh food for school lunches. Waste streams from the school lunchroom and other facilities will be used in composting to help reduce the need for shipping of garden inputs such as soils and fertilizers.

The food produced in the Tyonek community garden has been offered first to the food bank, then to elders, and remaining surpluses will be sold at low cost back to the community. For 2013, any garden revenue will be offered to the school in support of their gardening efforts.

In addition to growing food crops in the community garden, there has also been interest expressed from community members regarding traditional and native food sources and plant uses. TTCD is currently working with Tyonek community members to develop a plan for cataloguing the local knowledge of native food and medicinal plant uses.

D. Energy

Energy Use

The Village of Tyonek contains a few large commercial/community buildings in addition to about 60 occupied homes. Many of the homes and buildings within the village are more than 40 years old. Energy use for space heating, lighting, and appliances may be substantially reduced by undertaking energy efficiency measures. Assessing the efficiency of the homes and larger tribal and public buildings in Tyonek will be the first step toward reducing energy costs. Many programs are available to address energy efficiency and can be accessed through a number of State and Federal offices.

Salad greens and tomatoes harvested in Tyonek in 2012.

TTCD has issued basic energy use and weatherization surveys (spring 2013) and is gathering information to determine appropriate programs for energy efficiency and community assistance. Chugach Electric has tentatively offered a ‘smart power’ training course for residents and students of the Village. Watt meters and basic energy saving tips will be offered as a first step for community members to begin assessing their energy use and efficiency.

Electricity

Chugach Electric Association (CEA) provides the electric utilities in Tyonek. According to personal communication with CEA, the current [January 2013] electric rate for Tyonek is 12.75 cents per kilowatt hour.

Heating

According to the 2007-2011 American Community Survey, Tyonek has 98 occupied housing units (http://commerce.alaska.gov/). The 2010 census indicated that Tyonek had 70 occupied homes and 171 residents; these figures fluctuate on a seasonal and yearly basis.

Almost half were built in the 1970's, with many of the rest built in either the 1960's or 1980's. None are recorded as being built after 2000. Of the 98 units, 30 are shown as being heated by electricity, 23 heated with fuel oil/kerosene, and 45 heated with wood. Many homes also use a combination of energy types to provide heat. According to the state's bi-annual report on heating fuel costs, the area had an average cost of about $5.52+/gallon for 2012. This figure tends to fluctuate and has been on the rise through 2013.

Gasoline/Diesel

Gasoline and diesel are purchased from within the village. The average rates for 2012 were over $5+/gallon. Fuel use may fluctuate depending on the time of year and may increase during seasonal activities such as fishing and hunting.

Cordwood

Cordwood is used in many homes and buildings in Tyonek for space heating. The current approximate price for a cord of seasoned firewood in the Anchorage area is $250-$275, but cordwood is often sold by the 'pickup load' in Tyonek and pay similar rates. Residents currently obtain firewood by cutting it themselves from village lands or by purchasing 'pickup' loads from other residents.

Table 11.2: Energy Type and Approx. Cost

Energy Type	Cost/unit	Provider
Electric	.12/kw/h	Chugach Electric
Fuel Oil	$5/gal	Correspondence
Gasoline	$5+/gal	Correspondence
Diesel	$6+/gal	Correspondence
Cordwood	Approx. $250/cord	Locally sourced

Conservation & Efficiency

There are many potential options for conserving energy and improving energy efficiency within the community's existing energy structure:

- Weatherizing existing homes
    - This involves improving the ability of houses to hold and utilize heat by increasing insulation, plugging gaps and leaks, improving ventilation, and circulation, etc.
- Unplug appliances
    - It is a simple but effective technique. Unplugging appliances when not in use can result in considerable energy savings.
- Thermostat monitors
    - Buildings with central heat can improve efficiency by installing inexpensive timer thermostats which automatically lower the temperature at night or at times of day when the building is not occupied.
- Efficient lighting
    - Replacing conventional bulbs with LED light fixtures improves lighting quality while decreasing costs. LED last longer and use less energy than all other light fixture types.

Further improvements in efficiency can be made by replacing older, less-efficient structures and appliances.

- Houses
    - Great strides have been made designing affordable houses for cold-climate remote areas, with emphasis on insulation, energy efficiency, and ease of construction. Information is available from many sources including the 'Cold Climate Housing Research Center.
- Appliances
    - Many manufacturers now offer energy-efficient appliances, including refrigerators, televisions, washer/dryer, etc.
- More efficient energy/generator systems
    - Throughout Alaska, many villages have experimented with modification or replacement of outdated generators, boilers, heaters, etc. For example, basic diesel generators lose about 2/3 of their energy as heat, which can be captured and reused.

Renewable Energy

The Village of Tyonek has many opportunities for renewable energies. Solar and wind are the most viable options for reducing or replacing certain types of energy consumption, particularly electric. TTCD supports the investigation and integration of all

conservation-minded strategies for energy use. Wind and solar power are already utilized within the community at the community garden and also on the barge dock.

Wind Power

Tyonek's location on the shorelines of Cook Inlet offers substantial opportunities to offset electric-grid consumption by intercepting wind energies. Alaska Energy Authority (AEA) maps depict Tyonek's location as a "class 2-3" for wind energies at heights of 50m and 50w/M². At the current electric rate of .12/Kw/h, large scale systems are likely not financially justifiable and may yield poor returns on investment (ROI), based on the AEA's general site description for wind class ratings.

Site specific systems – for individual households or buildings – are an option to reduce personal electric grid consumption and promote energy sustainability. Site specific systems are generally affordable to operate, have minimal maintenance issues associated with operation, and can operate in wind speeds substantially lower than those required by large scale commercial systems (many updated wind systems have cut-in speeds of 5mph or less). TTCD will be installing a 'Power Predictor Pak' at the community garden site this summer to collect data on small-scale wind viability at the garden site. Generalized wind data and potential energy charts are available from the AEA (http://www.akenergyauthority.org/programwindmap.html).

Solar Power

Solar power is a viable option in Tyonek. However the current relatively low electric rates of approximately .12/kw/h will make solar energy less attractive from an ROI standpoint for large scale use. Installation of photovoltaic systems for site specific use is more likely to be successful from an economic standpoint.

Solar array at Tyonek community garden, installed 2013

The National Renewable Energy Laboratory estimates monthly average solar insolation at Tyonek to be approximately 3-4kw/h/m²/day.

There has been less of a trend towards solar development in Alaska than in other parts of the country due to the fact that for much of the year Alaska receives short daylight hours. However, some groups have moved ahead with the installation and testing of a variety of solar power and heating systems. TTCD is currently supporting the installation and use of a photovoltaic system in the community garden, and there is additional potential for installation of these systems at the local fish camps.

Biomass

Burning organic material, either sustainably harvested or that which is considered "waste," such as sawdust or mill bi-products has the potential to reduce fossil fuel needs.

Forest resource development accompanied by a comprehensive resource management plan could have potential economic and environmental benefits for the Tyonek region. A forest resources management plan is helpful in determining the amounts and types of forest resources that can be sustainably harvested. TTCD is undertaking a forest resource survey and management plan in 2013.

Existing Village Wind and Solar Energy Projects

Wind Power

Alaska has begun to develop its wind resources on commercial, community, and private scales. One of the first large-scale wind projects, which began producing power in September of 2012, is on Fire Island, which lies in Cook Inlet between Tyonek and Anchorage. A number of villages have installed systems to harness wind energy. Most of these projects have been facilitated by local utilities such as Alaska Village Electric Cooperative (AVEC) or dedicated community groups like Chaninik Wind Group.

Example Projects:

- Tuntutuliak has five turbines which, combined with advanced energy monitoring and efficiency practices and residential electric thermal storage technology, are expected to decrease their consumption of diesel fuel.
- Kasigluk and Nunapitchuk get some of their power from three turbines installed in 2006. The turbines displace 52,000 gallons of fuel annually (AEA).
- Chevak has four turbines which came online in 2010.
- Saint Paul Island's three turbines have saved $250,000/year in electricity and fuel costs.
- Selawik has four turbines currently installed and functioning.
- Toksook Bay, Tununak and Nightmute share the power produced by three turbines.
- Nome –The Bering Straits Corp. has undertaken substantial renewable energy projects including solar and wind projects. In http://directives.sc.egov.usda.gov/viewerFS.aspx?hid=21400, Bering Straits Corporation installed a solar array on their office building in Nome. The array produces 16,000 kWhs/year. This installation offsets about 1000 gallons of diesel annually. (AEA)

Many Federal and State groups offer renewable energy programs and helpful information, There is considerable overlap between entities which support energy efficiency and renewable energies.

Non-Renewable Energy

Coal

The Susitna-Beluga Coalfield lies within the GMU 16B and covers an estimated 5,800 square miles (Meyer, 1987). The coal lies in layers ranging from 5 to 30 feet thick; at a depth of 20 to 400 feet (Maloney, 1958). Surface coal is also present in some areas. The coal is sub-bituminous and very low in sulfur (AK DNR, 2012). Estimates for the amount of identified coal in the Susitna-Beluga Coalfield vary. Barnes (Flores, 2004) suggests 2.4 billion tons; Merrit and Hawley (Flores, 2004) estimate 11.1 billion tons. Much of the current public information surrounding the proposed Chuitna mine cites the figure 1.1 billion, but the source of this number and the area to which it is referring are unclear.

The proximity of this coalfield to major centers of population has made the resource of particular interest to developers. At this time, the Chuitna Coal Project has proposed a >5,000 acre strip coal mine located near the headwaters of the Chuitna River, approximately 10 miles from NVT. The proposed mine site is located on state land and 2013 permits are currently being processed. Alaska Department of Natural Resources reports that the mine will have a minimum life of 25 years and produce an estimated 12 million tons of coal a year. Strip mining (aka open cast, mountaintop, or surface mining) not only has the potential to negatively affect surrounding wildlife habitat, but may also have a negative impact on air and water quality. As the topsoil is disrupted by heavy equipment, dust and particles pollute the air. In addition to soil particles, coal dust is also exposed to the air, further impacting air quality.

The mine has yet to begin operation, however a start date is pending and the project has been in progress since 2007.


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At this time, NVT does not have baseline information on outdoor air quality in their area, but air quality projects are pending for 2013 with the assistance of TTCD. Without this information the measurable impact of the mine will be unknown, making reclamation challenging and making it difficult to assess the effects of the coal mine. Therefore, collecting baseline outdoor air quality data in the Tyonek area prior to development is a priority.

The Chuitna Coal Project is a proposal by development corporation PacRim (partially owned by the Petro-Hunt Group, one of the largest private energy groups in the world) to create the mine and associated infrastructure near Tyonek (AK DNR, 2013; Petro-Hunt

LLC). The proposed mine itself would cover approximately 5,000 acres and yield 27 million metric tons of coal over a 25-year span (Chuitna Coal Project SEIS, 2011). Additional construction would include mine facilities and a small town containing, housing, an access road, and airstrip (Chuitna Coal Project SEIS, 2011). Coal from the mine would be transported to the coast on a 12-mile partially covered conveyor belt (Chuitna Coal Project SEIS, 2011). There the coal would be loaded onto ships via the proposed Ladd Landing Development, which includes a logistics center and coal export terminal (Chuitna Coal Project SEIS, 2011).

Conservation Issues

There are many questions surrounding the potential of the proposed mine to negatively affect wildlife, water quality, and human health. One environmental concern centers around the fact that the proposed mine would completely remove 11 miles of productive salmon habitat in Middle Creek, a tributary of the Chuitna River, and that to date, no successful re-creation of a salmon stream after mining or similar operations has yet been achieved. Another concern is that effluent and wastewater from the mine will impact the health of adjacent and down-stream waterways.

Coal dust blown from the conveyor belt and Ladd Landing facilities could negatively impact air quality in the area. The construction and use of the Ladd facilities themselves, including increased shipping traffic, could have adverse consequences for marine resources including salmon and belugas.

Oil and Natural Gas

The State of Alaska offered a lease opening for all state land in the Cook Inlet to oil and gas companies from 2009 – 2018 as a revenue source for the state. The offering allows the grantee the right to “drill, extract, remove, clean, process, and dispose of oil, gas, and associated substances” with an appropriate plan, permits, and permission. The State of Alaska has great interest in providing oil and gas leases as it produces significant revenue, $67.7 million since 1959.

The State of Alaska states that wildlife and habitat can be cumulatively impacted by oil and gas production having a potential to impact the physical disruption to “land, lakes, rivers, and wetlands; habitat change; behavior changes of fish, wildlife and birds; drawdowns and contamination of groundwater; and contamination of terrestrial or freshwater habitats from discharges from well drilling and production, gas blowouts, or oil spills.” Such activities may emit Carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), particulate matter-10 (PM10), (PM2.5), volatile organic compounds (VOC), ozone, and greenhouse gases including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).

Natural gas production in the Cook Inlet Basin has long been the source of the majority gas for the state's major population centers, as well as being exported to Asian markets. After an initial peak in the 1960's, gas exploration and extraction has continued at a lower but fairly steady rate until about 2006, when productivity began to drop (AK DOG, 2012).

In the broadest terms, the large, easily-accessible fields are now beginning to run dry, and though much natural gas remains, it is in mid-size or smaller fields which require greater extraction effort. This decrease in productivity from aging wells coupled with a rising energy demand from the state's growing population points toward an impending imbalance between supply and demand (AK DNR, 2012). Estimates for the amount of natural gas remaining in the Cook Inlet's fields vary (as do questions of feasibility, cost of extraction and timelines). The Alaska DNR believes there to be 1.1 trillion cubic feet of remaining producible reserves in the existing fields (for reference, by 2010 the Cook Inlet fields had produced 7.8 trillion cubic feet) (Stanley et al., 2011). A 2011 USGS Report found that there were 19 trillion cubic feet of "technically recoverable natural gas" in the basin – a designation that does not take economic feasibility of extraction into account (Stanley et al., 2011).

Potential/Current Developers of Resource

The year 2012 was described by many as a "renaissance" for gas development in Cook Inlet (AK DNR, 2013). Efforts by the State to promote investment and exploration yielded an upswing in the number of companies and drill rigs in the inlet. In November of 2012 there were 17 rigs in the Cook Inlet; corporate investors include Apache, Hilcorp, Armstrong, Linc, Buccaneer, Nordaq, Furie, Cook Inlet Energy, ConocoPhillips, and CIRI (AK DNR, 2013).

Conservation Issues

Natural gas extraction and use falls about mid-level on the spectrum of environmental concerns. The wells themselves, unlike mines, have fairly small footprints, which decreases, though cannot eliminate, habitat loss and disturbance. Burning natural gas releases carbon dioxide and other greenhouse gasses, especially methane, but at lower rates than burning coal or oil (EPA). A primary concern in Cook Inlet centers on the ship traffic associated with natural gas transport. Ship traffic carries the risk of fuel oil spills and sound disturbance.

Oil

The history and status of oil extraction in the Cook Inlet Basin has for the most part paralleled that of natural gas, although oil has comprised a much smaller percentage of the resources extracted (ADNR, 2012). The USGS estimates that there are about 600 million barrels of technically recoverable oil remaining in Cook Inlet (compared to 1300 million removed by 2010) (Stanley et al., 2011). Because oil and natural gas have such

similar extraction processes, the same companies typically work with both, meaning that the same suite of developers involved in natural gas would also be developing oil resources. Spills are the primary safety and conservation issue with oil development. Historically, oil spills in the state have had devastating effects on wildlife and fisheries.

E. Potential Projects

Housing and Development

Within Tyonek, there are several homes located along the coast of the Cook Inlet. As this bluff erodes, these homes are in danger. NVT is interested in trying to relocate these homes to prevent them from being lost.

Recycling and Waste Management

The current system of waste management in Tyonek currently allows for very little recycling or reusing of waste. TTCD is interested in working with NVT to assist with improving waste management to recapture wastes for other sources (such as garden nutrients or oil), and developing a more thorough recycling program. In addition, NVT is interested in relocating the landfill site, and TTCD would like to assist with this process.

Food Production

TTCD has been very involved with the development of the Tyonek Community Garden, and plans to continue to assist with the progress of this project. TTCD is currently working with NVT on plans to assist with building garden infrastructure, continuing to support food production at the Tebughna School, and assisting with food storage and distribution.

Energy

TTCD has begun the process of collecting information on energy usage in Tyonek. In the future TTCD plans to research potential programs and projects to improve energy efficiency and provide alternative energy sources. In particular, TTCD plans to work with NVT on weatherization of homes to improve energy efficiency for residents.

General Community Conservation

In terms of general conservation projects, TTCD staff are interested in developing a conservation education program that TTCD staff would implement in Tyonek. This program could include visits to the Tebughna School as well as summer programs. In addition, TTCD plans to provide weather monitoring equipment to the Tebughna School and to assist with the development of a weather data collection program.

Table 11.3: Potential Projects

Priority	Project Description	Location	Estimated Project Duration	Anticipated Project Year	Land Manager/ Partners	Cost Estimate*
1	Assist with the development of a weather data collection program and have TTCD manage data.	Tebughna School	2 years	2013	NVT, Tebughna School	$
2	Collect information on energy usage and research potential programs/projects to improve energy efficiency and alternative energy.	Tyonek	Ongoing	2013-2019	NVT, Tyonek Residents	$
3	Continue to assist with food production and education.	Tyonek	Ongoing	2013-2019	NVT, Tyonek Residents	$$
4	Continue to assist with garden infrastructure.	Tyonek	Ongoing	2013-2019	NVT, Tyonek Residents	$$$
5	Continue to support food production at Tebughna School.	Tyonek	2 years	2014-2015	NVT, Tebughna School	$$$
6	Work with NVT to have homes weatherized to improve fuel efficiency and decrease fuel costs.	Tyonek	Ongoing	2014-2018	NVT, Tyonek Residents	$$$
7	Relocating the homes on the eroding bluff.	Tyonek	24 months	2014-2019	NVT, Tyonek Residents	$$$$
8	Continue to assist with food distribution storage.	Tyonek	Ongoing	2014-2019	NVT, Tyonek Residents	$$
9	Develop a conservation education program.	Tebughna School	Ongoing	2014-2019	Tebughna School	$$$
10	Develop a waste management program that recaptures wastes to be used for other sources (i.e. garden nutrients, oil, toyo stoves, etc.).	Tyonek/ Beluga	24 months	2015	NVT, Tebughna School, Tyonek residents	$$$
11	Assist NVT with relocating the landfill site in Tyonek to a different location. This landfill is supposed to be managed by the Kenai Peninsula Borough, but there have been issues with land ownership.	Tyonek	12 months	2016	NVT, TNC	$$$$
12	Develop a recycling program for the village including a method of transporting recycled goods from the village to Anchorage.	Tyonek/ Beluga	18 months	2016	NVT, Tebughna School, Tyonek residents	$$$

* **$** = <$5,000 **$$** = $5,000 – $30,000 **$$$** = $30,001 - $100,000 **$$$$** = $100,00 - $500,000 **$$$$$** = >$500,000

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Useful Resources

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Chapter 12: Conclusions

In this chapter we will discuss accomplishments that occurred over the course of developing this document, as well as an overall prioritization of future projects for TTCD.

In this chapter:

A. *Accomplishments*
B. *Future Projects*
C. *Final Thoughts*

A. Accomplishments

In the process of developing the Natural Resource Assessment and Project Implementation Plan for the Tyonek Tribal Conservation District (TTCD), partnerships were developed, projects were identified, and projects were implemented.

Partnerships

As a result of reaching out to entities to gather information for this document, several partnerships were formed. TTCD is now a member of two Fish Habitat Partnerships whose boundaries are within the District: the Kenai Peninsula FHP and the Mat-Su FHP. During the development of this document TTCD has also formed and/or strengthened relationships with other partners, including US Fish and Wildlife Service (USFWS), the Alaska Department of Fish and Game (ADF&G), Tyonek Native Corporation (TNC), the Native Village of Tyonek (NVT), Cook Inlet Aquaculture Association (CIAA), Cook Inlet Region Incorporated (CIRI), PacRim, Apache, Aurora Gas, The Nature Conservancy, Cook Inletkeeper, GreenStar, U.S. Department of Agriculture (USDA), UAF Extension, Tyonek Contractors LLC, Alaska Native Tribal Health Consortium (ANTHC), Chugach Electric, Kenai Borough School District, National Oceanic and Atmospheric Administration (NOAA), and others. Several of these partnerships are listed in Table 12.1 along with relevant projects.

Projects

As a result of developing relationships with the entities discussed above, TTCD staff developed several projects with partners. These projects are listed in Table 12.1 and will be discussed here by resource.

Freshwater

By developing relationships, TTCD has facilitated collaborative projects within the district. TTCD coordinated travel for USFWS, ADF&G, and the Kenai Peninsula Fish Habitat Partnership to meet with TNC and NVT staff in Tyonek, while touring potential fish passage barrier sites. At this meeting, one priority culvert project was identified at Indian Creek. USFWS

provided funding for the design and installation of a new culvert at this site. USFWS funds allowing for NVT staff to install an appropriately sized fish friendly culvert in October 2012. Restoration of this site, including the placement of willow mats and coir logs, was completed in late May.

Indian Creek culvert replacement site after revegetation work, August 2013.

USFWS staff also provided information to TTCD about a culvert design developed by USDA NRCS for Tyonek Creek to address another fish passage barrier. TTCD obtained the design, and then applied for funding from USFWS to complete bid documents and permitting for the project. TTCD also applied for funding for the installation of the culvert, and if successful, will undertake this project in 2014.

In further discussions with USFWS and ADF&G, two other fish passage barriers were discussed. These barriers are both on Old Tyonek Creek, one at the mouth of the creek near a fish camp site and one further upstream. USFWS and ADF&G staff recommended that an alternatives analysis be done at each of these sites to determine the most effective solution for each of these barriers. ADF&G has provided funding for TTCD to hire a contractor to complete the alternatives analysis. The completed report would then be used to apply for funding to remove these barriers. This analysis is expected to be completed by June 30, 2013.

In working with ADF&G and USFWS, TTCD staff compiled an overall culvert prioritization list for the Tyonek area based on ADF&G standards. This chart is included in Chapter 6: Freshwater Resources.

Air Quality

In discussions with NVT Environmental Department, TTCD staff found that air quality issues are a major concern for Tyonek residents, particularly with potential future development in the district. Currently there is no baseline data for air quality in the Tyonek area. TTCD brought this concern to the ANTHC, and later assisted NVT with an application for assistance with air quality monitoring from ANTHC. This application was successful and will fund time for NVT staff to collect data starting in June 2013. ANTHC and the Alaska Department of Environmental Conservation will assist NVT data collection and provide the needed equipment and technical assistance.

Terrestrial

In reviewing terrestrial data for the preparation of this document, TTCD staff examined the TNC Forest Stewardship Plan, a ten year plan that was developed in 2001 through the Alaska Department of Natural Resources (DNR) program. After further research with the Alaska DNR and the U.S. Forest Service, staff found that TNC was eligible for a grant to revise and update

their Forest Stewardship plan. TTCD and TNC staffs are working with Forest and Land Management, Inc to participate in this program. TTCD anticipates completing the plan in 2014.

Invasive plants are another natural resource issue of concern noted in the Terrestrial Habitat Chapter (Chapter 9) of this document. After discussing this issue with the USFWS, TTCD is now in the process of putting together a project with USFWS to address invasive plant issues district-wide. In 2014, TTCD plans to begin a two-year project including an initial year of conducting inventory of invasive plants in Tyonek, Beluga, Skwentna, and Alexander Creek, creating a control plan and implementing control measures in project year two. TTCD submitted this project proposal to USFWS in May 2013.

Energy

In reaching out to stakeholders in the district, TTCD began conversations with Chugach Electric. In March, 2013, TTCD staff met with Chugach Electric staff, learning that they were interested in implementing an educational program for energy efficiency in the Anchorage schools, and would be open to bringing this curriculum to the Tebughna School in Tyonek. TTCD staff is now facilitating the development of this project with Tebughna School staff and Chugach Electric. A school assembly date has been set for late August 2013 to start this program.

Multiple Resource/Other

Throughout the development of this document, TTCD has worked closely with both the TNC and NVT, keeping both entities informed on the progress. This project, as well as the projects mentioned above that grew out of this document, have greatly strengthened the relationship between these three entities. In April 2013, NVT hired TTCD to complete a Long Term Environmental Plan for Tyonek. The information compiled in this assessment will be very helpful in developing this plan for Tyonek.

Another multi-resource project that progressed throughout the creation of this document was the development of the Tyonek Community Garden. In January of 2012, TTCD began working with NVT to assist with the garden project, leading to the production of 400lbs of food in the garden in the 2012 season. In 2012, TTCD also assisted with planning for 2013, including applying for high tunnels through the USDA NRCS Environmental Quality Incentive Program (EQIP). NVT received cost-share funding in 2013 for the purchase of two 22’x48’ high tunnels. TTCD also purchased equipment an 8 panel solar system to provide power for the irrigation and ventilation systems of these high tunnels. TTCD will continue to provide technical and financial assistance for the Tyonek Community Garden.

Newly constructed high tunnels in Tyonek community garden, June 2013.

B. Future Projects

In each natural resource focused chapter of this document, a list of potential projects is listed in order of priority. These projects were selected based on the information compiled in this document as well as staff and board discussions. In Table 12.2, all projects from the previous chapters are listed in overall order of priority for TTCD. These projects are listed based on current projects and organizational staffing capacity, anticipated future capacity to accomplish these projects, and need for a project to be accomplished. For more information on each project, see the noted chapter.

C. Final Thoughts

The process of developing the Natural Resource Assessment and Project Implementation Plan has been very important for the development of TTCD. TTCD was a new organization when this process began, and in meeting with different partners and learning about local concerns, TTCD has formed relationships and developed project ideas that will continue to guide the organization for many years to come. This document will serve as a tool to track progress and seek future funding. It is the vision of the TTCD staff that this document functions as a living document that can be continually reviewed and updated over time.

Table 12.1. TTCD Accomplishments

Resource	Accomplishment
Multiple	Joined Kenai Peninsula Fish Habitat Partnership.
Multiple	Joined the Mat-Su Fish Habitat Partnership.
Multiple	Have developed and/or strengthened working relationships with: Kenai Peninsula FHP, Mat-Su FHP, ADF&G, USFWS, TNC, NVT, CIAA, CIRI, PacRim, Apache, Aurora Gas, The Nature Conservancy, Cook Inletkeeper, GreenStar, USDA, UAF Extension, TCLLC, ANTHC, Chugach Electric, Kenai Borough School District, NOAA, and others.
Freshwater	Indian Creek culvert replacement project: Worked with USFWS, TNC, NVT, ADF&G, and KPFHP to plan and carry out culvert replacement to remove fish passage barrier.
Freshwater	Tyonek Creek culvert replacement project: Obtained completed culvert design for replacement at Tyonek creek fish passage barrier from NRCS, and worked with ADF&G and USFWS to develop potential project. Applied for NOAA funding for culvert replacement in Feb 2013 and working with USFWS to obtain funding for permitting and creating bid documents.
Freshwater	Old Tyonek Creek fish passage improvement projects: Identified two fish passage barriers on Old Tyonek Creek and developed strategies with USFWS and ADF&G to move forward. Have obtained ADF&G funding to obtain

	alternatives analysis (or pre-feasibility study) for both sites to determine best alternative for moving forward.
Air Quality	Worked with NVT, ANTHC, and ADEC to obtain funding for NVT IGAP staff to conduct air quality baseline monitoring.
Terrestrial (and others)	Developing district-wide invasive plant assessment and control project, with focus on reed canarygrass, orange hawkweed, and others.
Multiple	In April 2013, began working with NVT and other partners to develop the NVT Long Term Environmental Plan for Tyonek and the surrounding area.
Multiple	Working with NVT, TNC, NRCS, UAF extension, and many others to increase food security in the Tyonek Community Garden, including incorporating a solar energy system.
Energy	Began working with Chugach Electric and are currently developing plan to implement energy efficiency program in Tyonek school in September 2013.
Terrestrial	Forestry plan: Have begun working with TNC, NVT, USFWS, and ADNR to develop revised forestry plan for all TNC lands.

Table 12.2: Overall Project List

Chapter	Project Description	Location	Estimated Project Duration	Anticipated Project Year	Land Manager/Partners	Cost Estimate*
6	Prioritization of potential fish passage projects in 16B.	Tyonek and surrounding area	1-2 months	2013	NVT, TNC, ADFG	$
8	Collect baseline data on outdoor particulate matter, including road dust.	Tyonek, Beluga	1 year	2013	ANTHC, ADEC, NVT	$$
11	Assist with the development of a weather data collection program and have TTCD manage data.	Tebughna School	2 years	2013	NVT, Tebughna School	$
6	Verify the presence and location of invasive pike species.	Tyonek, Beluga	3 years	2013-2016	NVT, TNC	$$
6	Develop a regional watershed plan addressing fish passage issues.	Tyonek	5 years	2013-2018	NVT, CIRI, State of AK, TNC, etc.	$$$
11	Collect information on energy usage and research potential programs/projects to improve energy efficiency and alternative energy.	Tyonek	Ongoing	2013-2019	NVT, Tyonek Residents	$
11	Continue to assist with food production and education.	Tyonek	Ongoing	2013-2019	NVT, Tyonek Residents	$$
11	Continue to assist with garden infrastructure.	Tyonek	Ongoing	2013-2019	NVT, Tyonek Residents	$$$
6	Design and implement a TTCD water quality monitoring program for data collection.	Tyonek	Ongoing	2014	Multiple	$$
8	Develop protocols to continually monitor air quality in strategic locations, particularly as coal mine development occurs.	Tyonek, Beluga	Ongoing	2014	ANTHC, ADEC, NVT	$$
8	Distribute educational materials on indoor and outdoor air quality issues.	Tyonek, Beluga	Ongoing	2014	ANTHC, ADEC, NVT	$
8	Based on air quality data collected, work with interested entities to develop protocols to improve outdoor air quality.	Tyonek, Beluga	Ongoing	2014	ANTHC, ADEC, NVT	$$
8	Hold community meetings in Tyonek to learn about indoor and outdoor air quality concerns to develop potential future projects.	Tyonek	1 year	2014	ANTHC, ADEC, NVT	$
9	Develop an updated forestry plan for TNC lands through DNR Native Corporation Program to include a plan for sustainable wood fuel harvest to be shared with Tyonek community.	TNC lands	1 year	2014	TNC	$$$
9	Develop and implement an invasive plant monitoring and control plan.	Tyonek	Ongoing	2014	NVT, TNC	$
9	Develop a youth crew to assist with invasive species monitoring and control.	Tyonek	Ongoing	2014	NVT, TNC	$$
10	Develop and implement a wildlife education program as part of a conservation education program	Tebughna School	Ongoing	2014	TNC, NVT	$
6	Remove fish passage barrier at Tyonek Creek crossing upstream with NRCS design.	Tyonek	1-3 years	2014-2015	Multiple	$$$$
11	Continue to support food production at Tebughna School.	Tyonek	2 years	2014-2015	NVT, Tebughna School	$$$
6	Remove two fish passage barriers on Old Tyonek Creek	Tyonek	2-5 years	2014-2016	NVT, TNC, ADFG, USFWS	$$$$$
11	Work with NVT to have homes weatherized to improve fuel efficiency and decrease fuel costs.	Tyonek	Ongoing	2014-2018	NVT, Tyonek Residents	$$$
11	Relocating the homes on the eroding bluff.	Tyonek	24 months	2014-2019	NVT, Tyonek Residents	$$$$
11	Continue to assist with food distribution storage.	Tyonek	Ongoing	2014-2019	NVT, Tyonek Residents	$$
11	Develop a conservation education program.	Tebughna School	Ongoing	2014-2019	Tebughna School	$$$
10	Develop plans for projects to improve the moose population in 16B. Possible strategies could include willow enhancement, scarification, and controlled burns to improve moose habitat.	TBD	Ongoing	2018	TNC, NVT	$ - $$$

* **$** = <$5,000 **$$** = $5,000 – $30,000 **$$$** = $30,001 - $100,000 **$$$$** = $100,00 - $500,000 **$$$$$** = >$500,000

Table 12.2: Overall Project List (2)

Chapter	Project Description	Location	Estimated Project Duration	Anticipated Project Year	Land Manager/Partners	Cost Estimate*
5	Test soils around the landfill area.	Tyonek	1-2 months	2015	TNC/NVT	$
5	Test soils at the landing strips and around The Shop where heavy equipment and toxins are stored.	Tyonek	1-2 months	2015	TNC/NVT	$
5	Test soil around the barge area.	Tyonek	1-2 months	2015	TNC/NVT	$
5	Conduct soils test around the Beluga landfill.	Beluga	1-2 months	2015	Multiple	$
5	Develop a composting facility to reduce toxins leeching into the soil and manage waste that can be used to increase nutrients in soil for agricultural use on small community gardens or home gardens.	Tyonek	1-2 years	2015	TNC/NVT	$ - $$
6	Create and fill an intern position for water quality monitoring.	Tyonek	1-5 years	2015	AWC, ADFG, NVT, etc.	$$
11	Develop a waste management program that recaptures wastes to be used for other sources (i.e. garden nutrients, oil, toyo stoves, etc.).	Tyonek/ Beluga	24 months	2015	NVT, Tebughna School, Tyonek residents	$$$
6	Compile 16B specific GIS data and integrate into a "Conservation Dashboard" for the 16B region. Publish on TTCD website.	Tyonek	1-5 years	2016	ADFG, UAA, APU, NVT, etc.	$$
11	Assist NVT with relocating the landfill site in Tyonek to a different location. This landfill is supposed to be managed by the Kenai Peninsula Borough, but there have been issues with land ownership.	Tyonek	12 months	2016	NVT, TNC	$$$$
11	Develop a recycling program for the village including a method of transporting recycled goods from the village to Anchorage.	Tyonek/ Beluga	18 months	2016	NVT, Tebughna School, Tyonek residents	$$$
9	Implement measures identified in forestry plan.	TNC lands	2-3 years	2017	TNC	$$$
9	Develop educational programs to increase knowledge of traditional uses of plants as part of a conservation education program.	Tyonek	Ongoing	2017	NVT, TNC	$$
10	Develop a plan to monitor for and prevent the arrival of invasive animals in 16B.	Entry points to District	Ongoing	2017	Multiple	$$
9	Trail development in Tyonek area.	Tyonek area	2-3 years	2017-2019	CIRI	$$$
10	Develop strategies for furbearer management in Tyonek.	Tyonek	Ongoing	2018	TNC, NVT	$ - $$
5	TTCD should work with NRCS to establish a time or project aimed at collecting data along and around these regions.	Tyonek	1-2 years	2019	TNC/NVT	$$

* **$** = <$5,000 **$$** = $5,000 – $30,000 **$$$** = $30,001 - $100,000 **$$$$** = $100,00 - $500,000 **$$$$$** = >$500,000

APPENDIX

APPENDIX

A. Figures

1. *Overview Map of TTCD*……A-1
2. *Land Ownership within the TTCD*……A-2
3. *Tyonek Historical Locations*……A-3
4. *The Native Village of Tyonek*……A-4
5. *Subsistence Use Areas*……A-5
6. *Potential Project Sites*……A-6
7. *Tyonek and Beluga Vicinity Culvert Locations*……A-7
8. *Future Development within TTCD*……A-8
9. *Vegetation Types in TTCD*……A-9

B. Tables

1. *Overall Project List*……B-1
2. *Tyonek Subsistence Use*……B-5
3. *Beluga Subsistence Use*……B-9

C. Additional Resources

1. *Soils Data & Resources*……C-1
2. *Freshwater Data & Resources*……C-6
3. *Terrestrial Habitat Data & Resources*……C-25
4. *Invasive Plants Survey*……C-29
5. *Wildlife Data & Resources*……C-40

Figure 1. Overview Map of TTCD

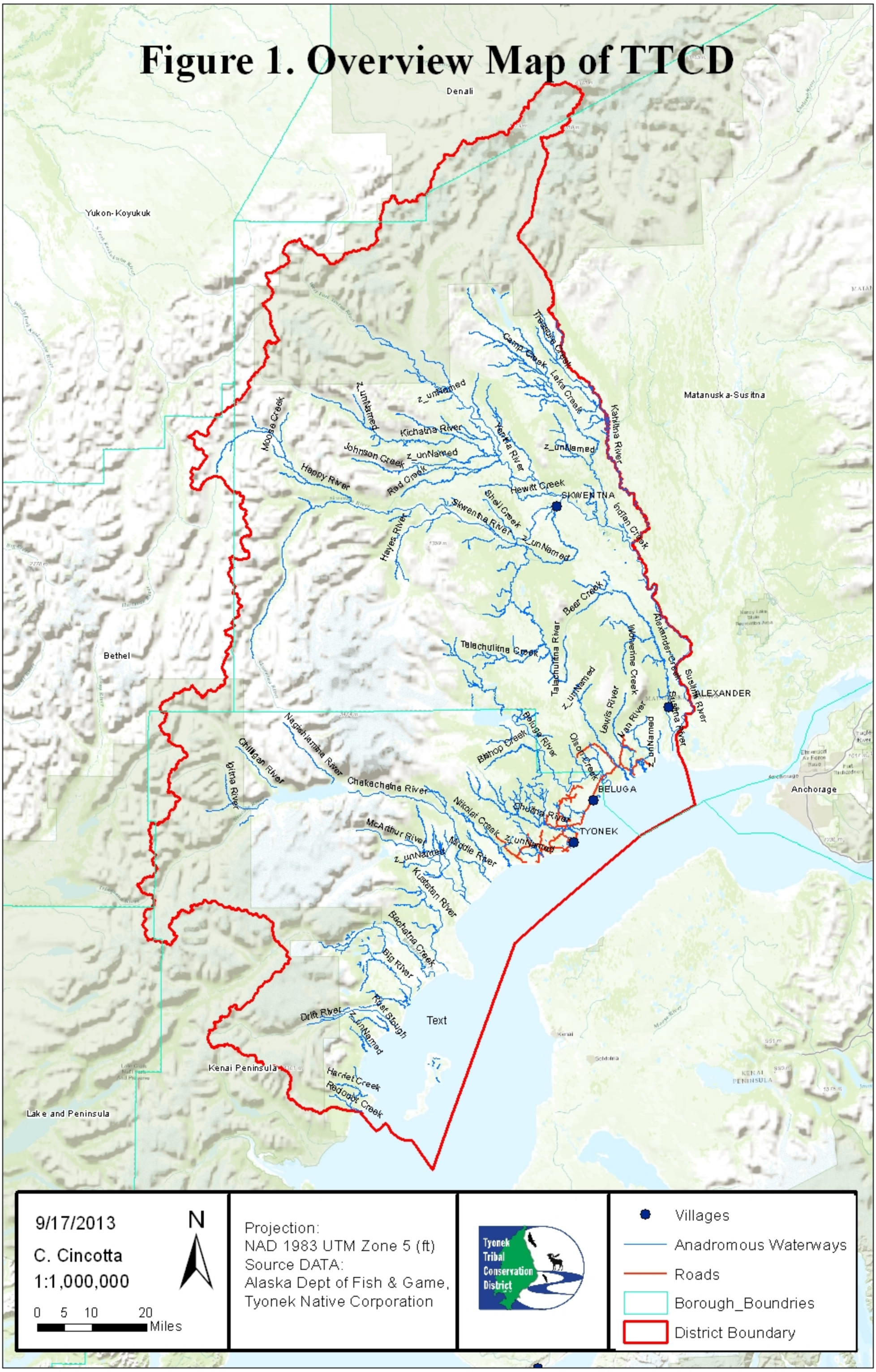


Figure 2. Land Ownership within the TTCD

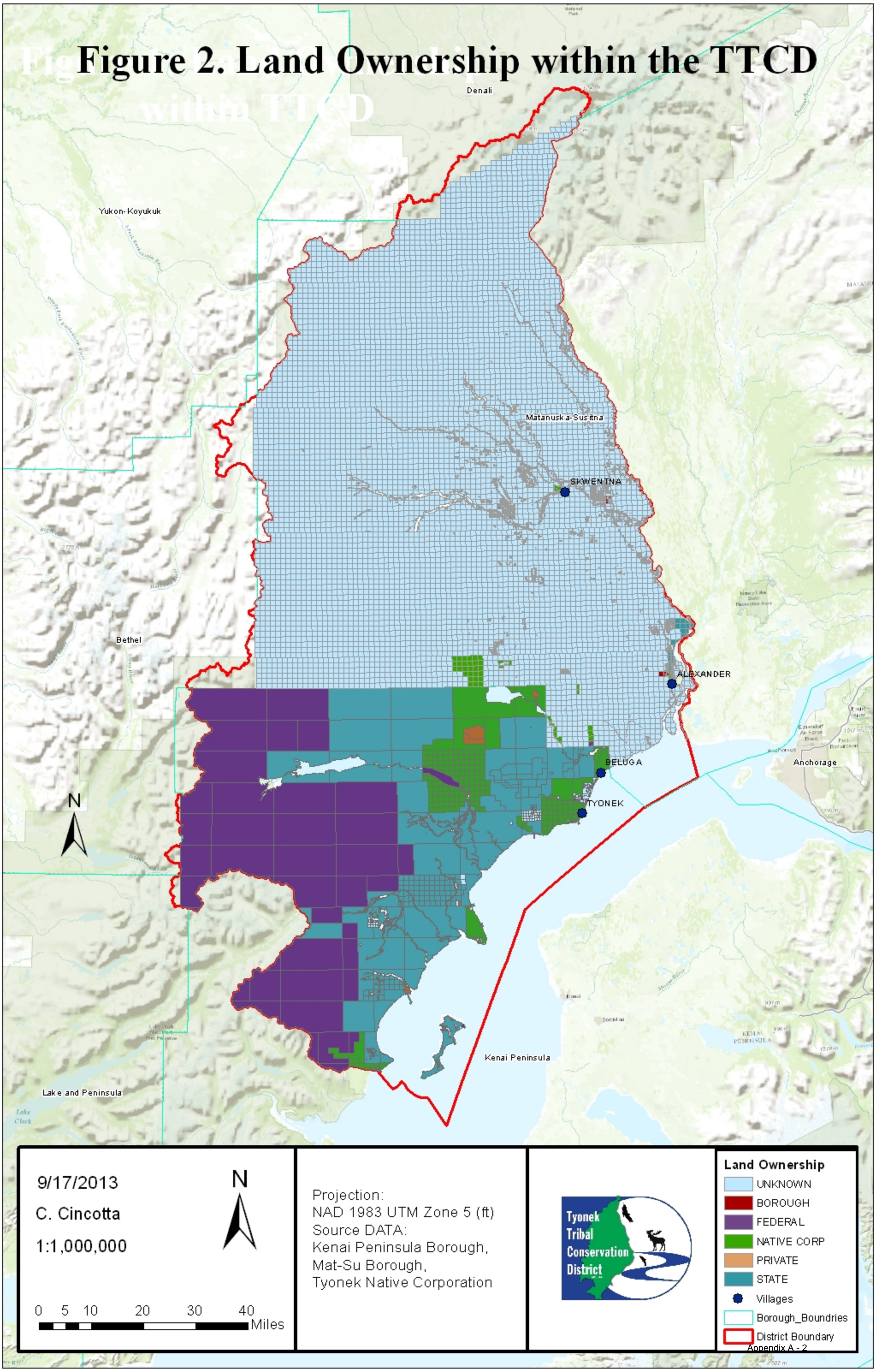


Figure 3. Tyonek Historical Locations

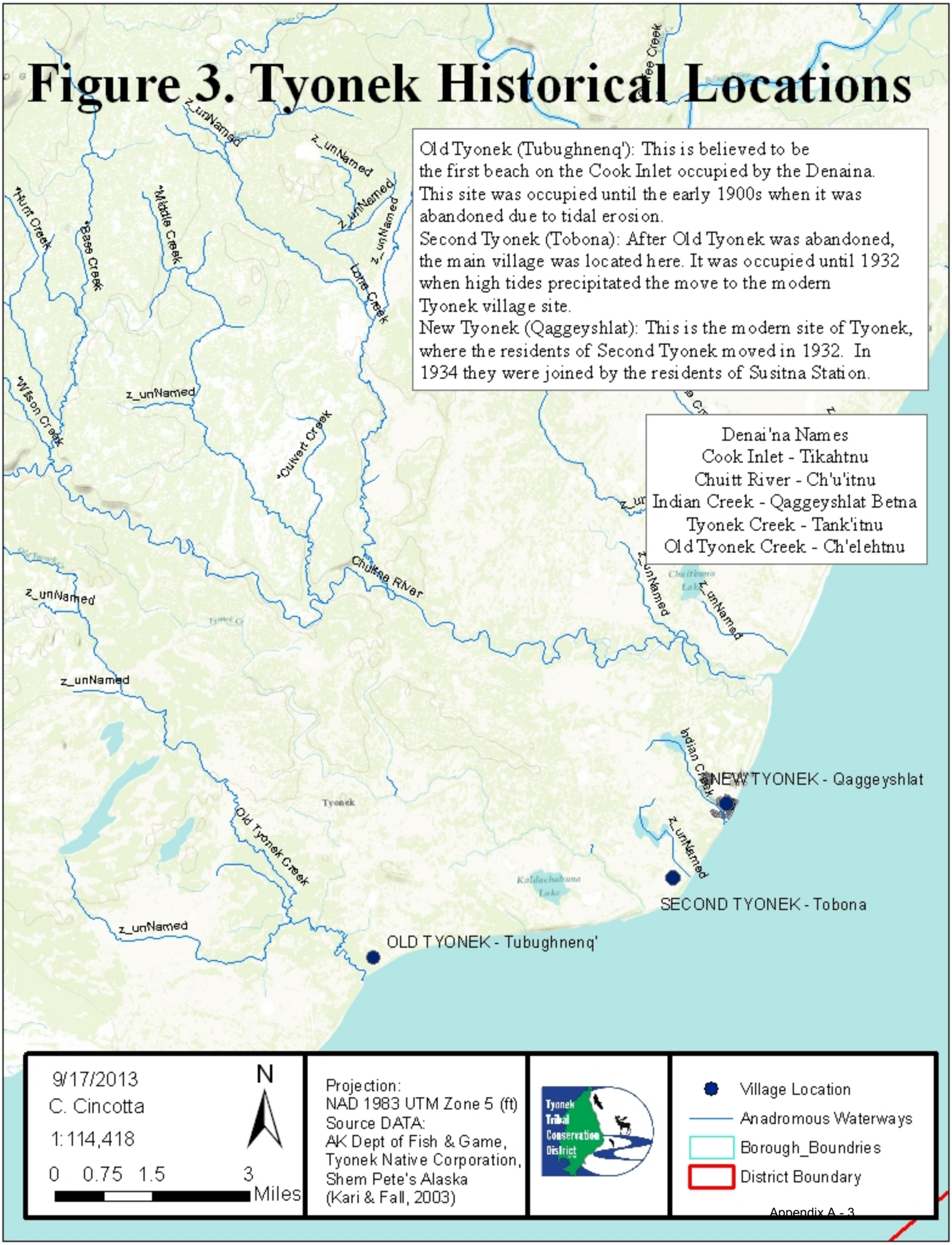
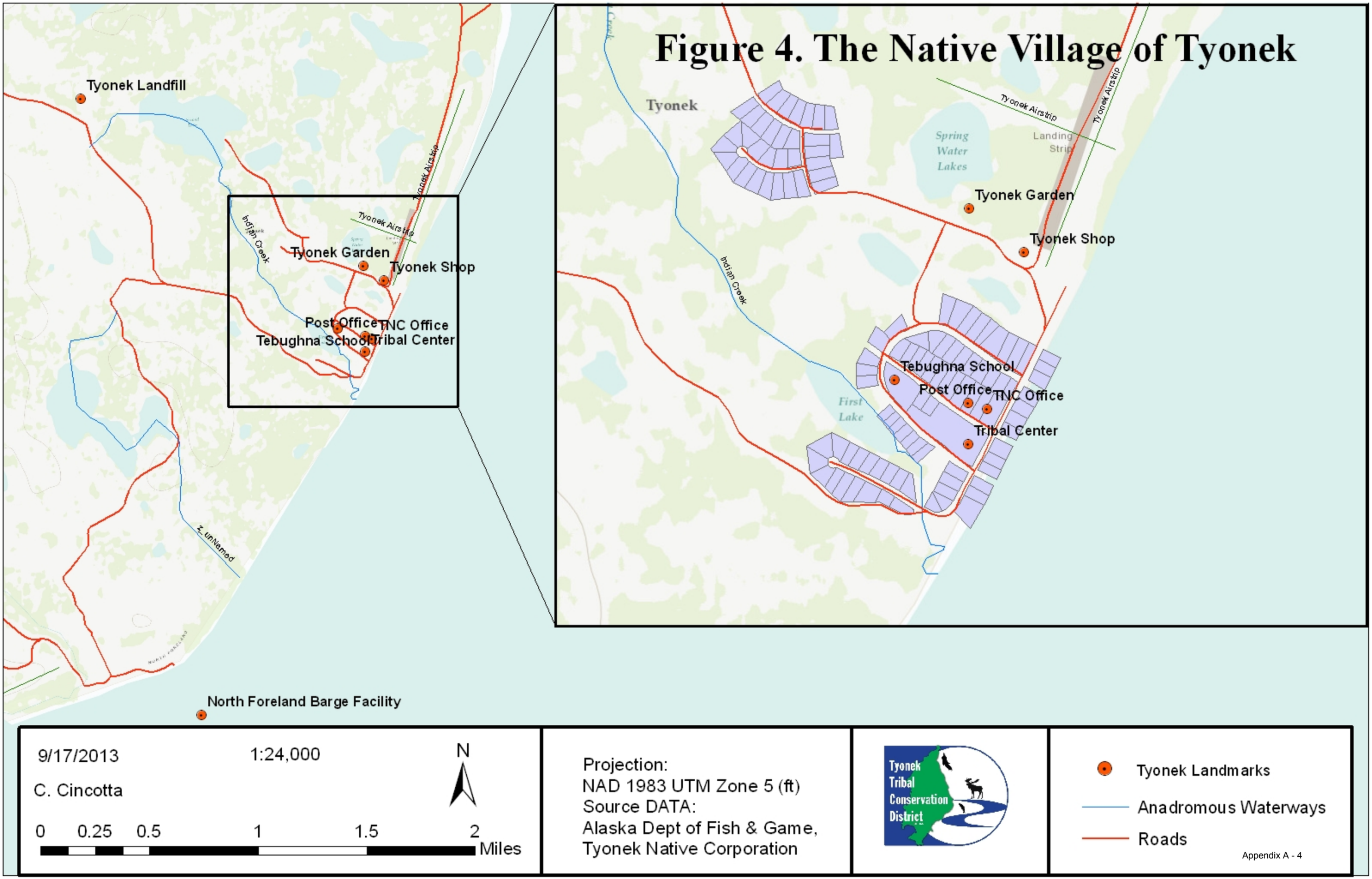


Figure 4. The Native Village of Tyonek



9/17/2013 1:24,000

C. Cincotta

N

0 0.25 0.5 1 1.5 2 Miles

Projection:
NAD 1983 UTM Zone 5 (ft)
Source DATA:
Alaska Dept of Fish & Game,
Tyonek Native Corporation

Tyonek Tribal Conservation District

Tyonek Landmarks
Anadromous Waterways
Roads

Figure 5. Subsistence Use Areas

Reference: Braund, S. R. (2007). subsistence and traditional knowledge studies, subsistence use areas and traditional knowledge study for tyonek and beluga, ak. In Anchorage, Alaska: DVren Corporation, Pacrim Coal Chuitna Coal Project

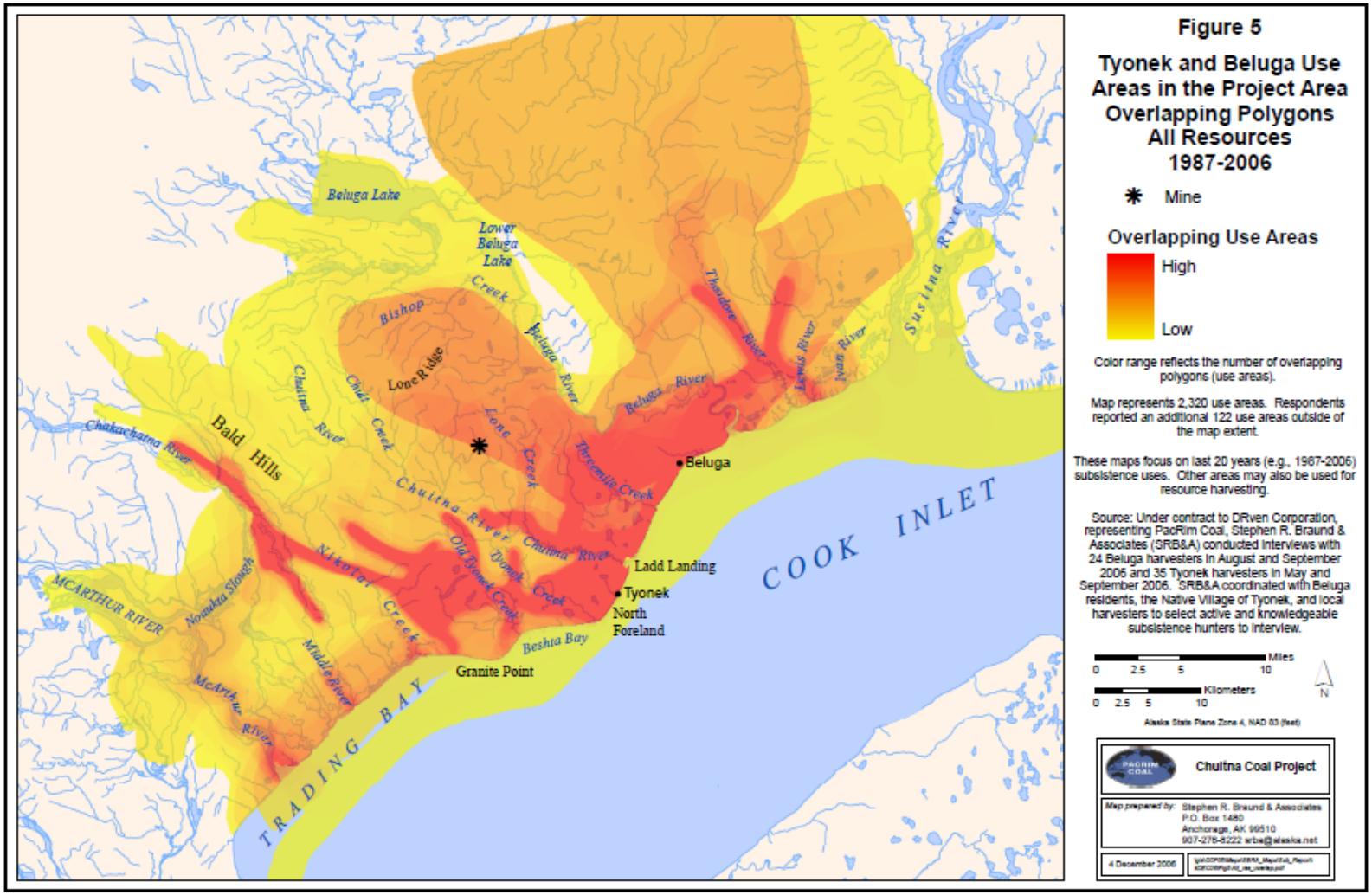


Figure 6. Potential Project Sites

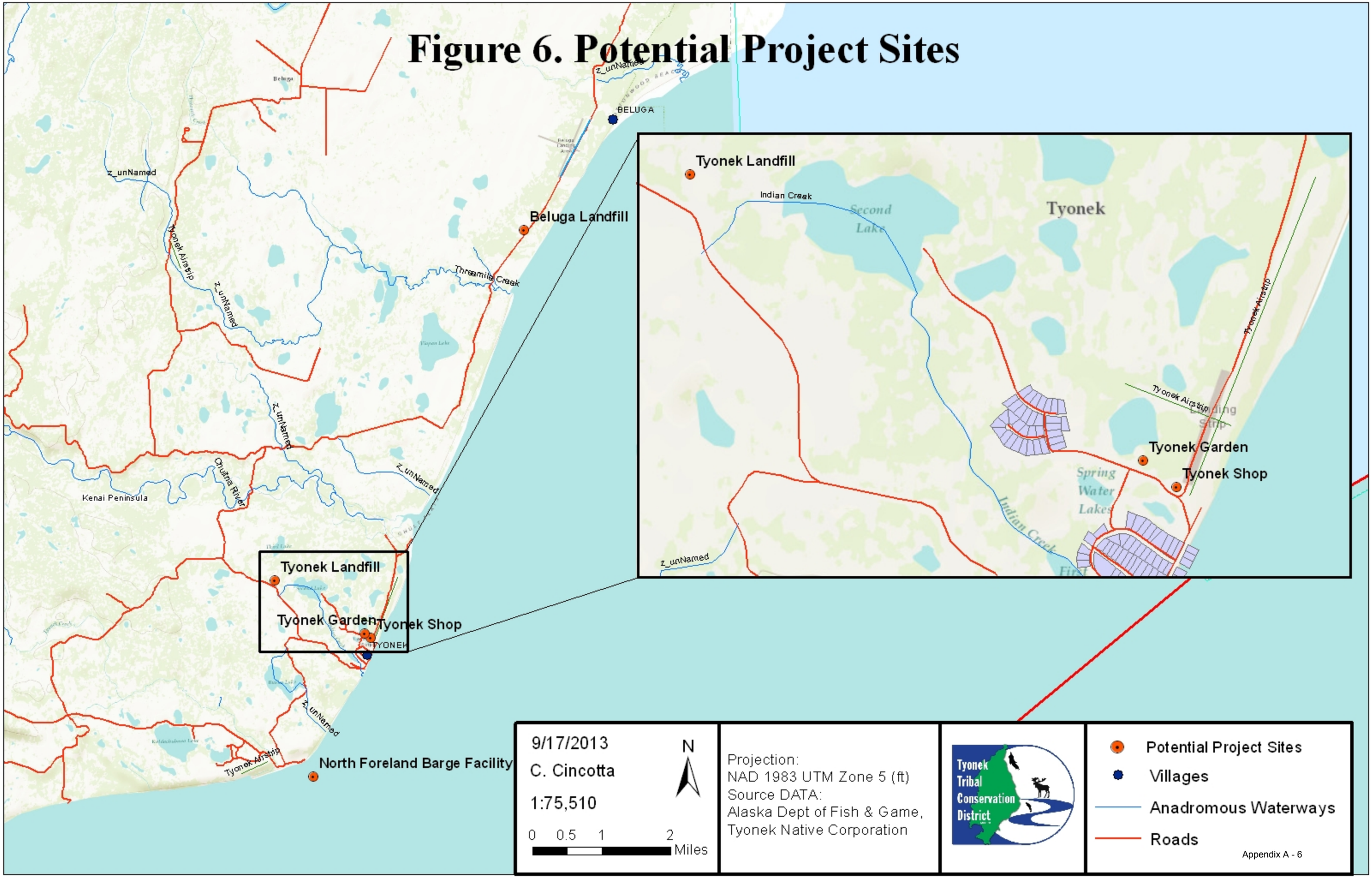


Figure 7. Tyonek and Beluga Vicinity Culvert Locations

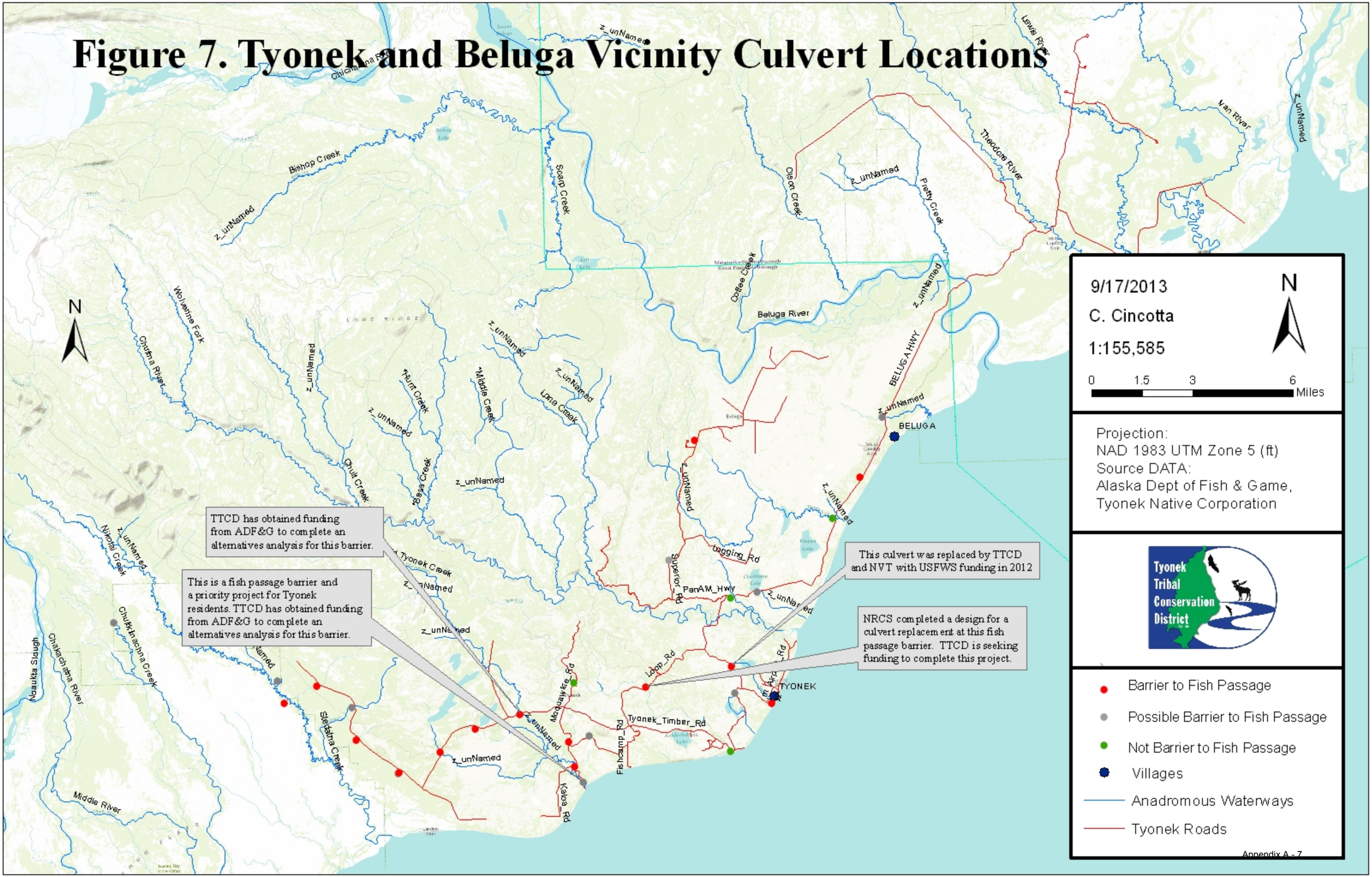


Figure 8. Future Development within TTCD

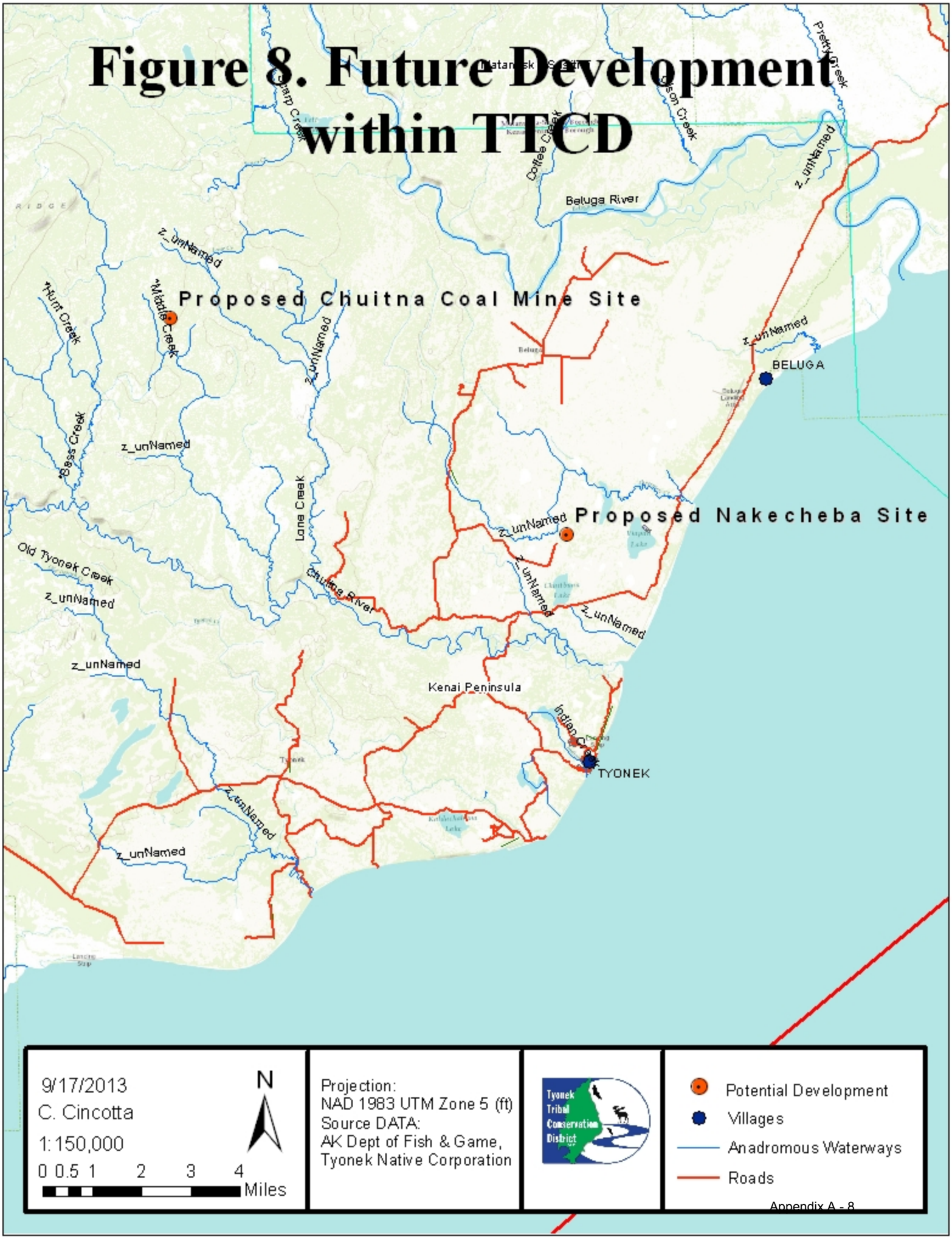


Figure 9. Vegetation Types in TTCD

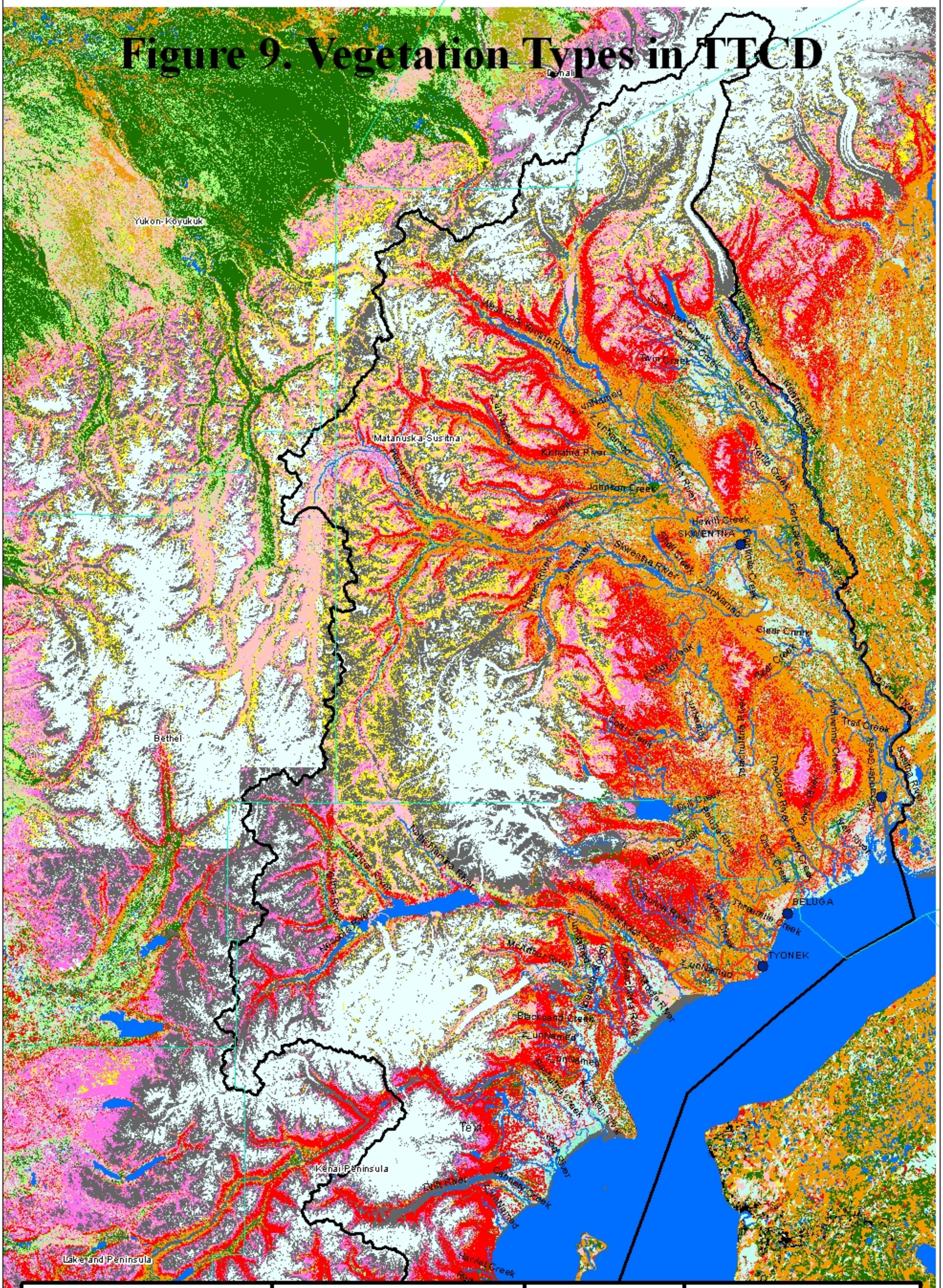


Table 1. Overall Project List

Chapter	Project Description	Location	Estimated Project Duration	Anticipated Project Year	Land Manager/Partners	Cost Estimate*
6	Prioritization of potential fish passage projects in 16B	Tyonek and surrounding area	1-2 months	2013	NVT, TNC, ADFG	$
8	Collect baseline data on outdoor particulate matter, including road dust	Tyonek, Beluga	1 year	2013	ANTHC, ADEC, NVT	$$
11	Assist with the development of a weather data collection program and have TTCD manage data	Tebughna School	2 years	2013	NVT, Tebughna School	$
6	Verify the presence and location of invasive pike species	Tyonek, Beluga	3 years	2013-2016	NVT, TNC	$$
6	Develop a regional watershed plan - addressing issues such as Invasive species	Tyonek	5 years	2013-2018	NVT, CIRI, State of AK, TNC, etc.	$$$
11	Collect information on energy usage and research potential programs/projects to improve energy efficiency and alternative energy	Tyonek	Ongoing	2013-2019	NVT, Tyonek Residents	$
11	Continue to assist with food production and education	Tyonek	Ongoing	2013-2019	NVT, Tyonek Residents	$$
11	Continue to assist with garden infrastructure	Tyonek	Ongoing	2013-2019	NVT, Tyonek Residents	$$$
6	Design and implement a TTCD water quality monitoring program for data collection	Tyonek	Ongoing	2014	NVT, ADFG, UAA, USDA, NRCS, AWC	$$
8	Develop protocols to continually monitor air quality in strategic locations, particularly as coal mine development occurs	Tyonek, Beluga	Ongoing	2014	ANTHC, ADEC, NVT	$$

8	Distribute educational materials on indoor and outdoor air quality issues	Tyonek, Beluga	Ongoing	2014	ANTHC, ADEC, NVT	$
8	Based on air quality data collected, work with interested entities to develop protocols to improve outdoor air quality	Tyonek, Beluga	Ongoing	2014	ANTHC, ADEC, NVT	$$
8	Hold community meetings in Tyonek to learn about indoor and outdoor air quality concerns to develop potential future projects	Tyonek	1 year	2014	ANTHC, ADEC, NVT	$
9	Develop an updated forestry plan for TNC lands through DNR Native Corporation program. Plan should include plan for sustainable wood fuel harvest to be shared with Tyonek community	TNC lands	1 year	2014	TNC	$$$
9	Develop and implement an invasive plant monitoring and control plan	Tyonek	Ongoing	2014	NVT, TNC	$
9	Develop a youth crew to assist with invasive species monitoring and control	Tyonek	Ongoing	2014	NVT, TNC	$$
10	Develop and implement a wildlife education program as part of a conservation education program	Tebughna School	Ongoing	2014	TNC, NVT	$
6	Remove fish passage barrier at Tyonek Creek crossing upstream with NRCS design	Tyonek	1-3 years	2014-2015	NVT, TNC, ADFG, USFWS, NRCS, NOAA	$$$$
11	Continue to support food production at Tebughna School	Tyonek	2 years	2014-2015	NVT, Tebughna School	$$$
6	Remove two fish passage barriers on Old Tyonek Creek	Tyonek	2-5 years	2014-2016	NVT, TNC, ADFG, USFWS	$$$$$
11	Work with NVT to have homes weatherized to improve fuel efficiency and decrease fuel costs	Tyonek	Ongoing	2014-2018	NVT, Tyonek Residents	$$$

11	Relocating the homes on the eroding bluff	Tyonek	24 months	2014-2019	NVT, Tyonek Residents	$$$$
11	Continue to assist with food distribution storage	Tyonek	Ongoing	2014-2019	NVT, Tyonek Residents	$$
11	Develop a conservation education program	Tebughna School	Ongoing	2014-2019	Tebughna School	$$$
10	Develop plans for projects to improve the moose population in 16B. Possible strategies could include willow enhancement, scarification, and controlled burns to improve moose habitat	TBD	Ongoing	2015	TNC, NVT, possibly others	$ - $$$
5	Test soils around the landfill area	Tyonek	1-2 mos	2015	TNC/NVT	$
5	Test soils at the landing strips and around The Shop where heavy equipment and toxins are stored	Tyonek	1-2 mos	2015	TNC/NVT	$
5	Test soil around the barge area	Tyonek	1-2 mos	2015	TNC/NVT	$
5	Conduct soils test around the Beluga landfill	Beluga	1-2 mos	2015	Multiple	$
5	Develop a composting facility to reduce toxins leeching into the soil and manage waste that can be used to increase nutrients in soil for agricultural use on small community gardens or home gardens	Tyonek	1-2 yrs	2015	TNC/NVT	$ - $$
6	Create and fill Intern position for water quality monitoring	Tyonek	1-5 years	2015	AWC, ADFG, NVT all interested parties	$$
11	Develop a waste management program that recaptures wastes to be used for other sources (i.e. garden nutrients, oil, toyo stoves, etc.)	Tyonek/ Beluga	24 months	2015	NVT, Tebughna School, Tyonek residents	$$$
6	Compile 16B specific GIS data and integrate into a “Conservation Dashboard” for the 16B region. Publish on TTCD website	Tyonek	1-5 years	2016	ADFG, UAA, APU, NVT, all interested stakeholders	$$

11	Assist NVT with relocating the landfill site in Tyonek to a different location. This landfill is supposed to be managed by the Kenai Peninsula Borough, but there have been issues with land ownership	Tyonek	12 months	2016	NVT and TNC	$$$$
11	Develop a recycling program for the village including a method of transporting recycled goods from the village to Anchorage	Tyonek/ Beluga	18 months	2016	NVT, Tebughna School, Tyonek residents	$$$
9	Implement measures identified in forestry plan	TNC lands	2-3 years	2017	TNC	$$$
9	Develop educational programs to increase knowledge of traditional uses of plants as part of a conservation education program	Tyonek	Ongoing	2017	NVT, TNC	$$
10	Develop a plan to monitor for and prevent the arrival of invasive animals in 16B	Entry points to the District	Ongoing	2017	Multiple	$$
9	Trail development in Tyonek area	Tyonek area	2-3 years	2017-2019	CIRI	$$$
10	Develop strategies for furbearer management in Tyonek	Tyonek	Ongoing	2018	TNC, NVT	$ - $$
5	TTCD should work with NRCS to establish a time or project aimed at collecting data along and around these regions	Tyonek	1-2 yrs	2019	TNC/NVT	$$

* **$** = <$5,000 **$$** = $5,000 – $30,000 **$$$** = $30,001 - $100,000 **$$$$** = $100,00 - $500,000 **$$$$$** = >$500,000

Table 2. Tyonek Subsistence Use

Resource Name	Percentage of Households					Pounds Harvested			Amount Harvested*		95% Conf Limit (+/-)
	Use	Att	Harv	Recv	Give	Total	Mean HH	Percapita	Total	Mean HH	Harvest
All Resources	95.7%	93.6%	93.6%	91.5%	83.0%	43829.2	664.1	216.7			19.1%
Fish	87.2%	76.6%	74.5%	59.6%	66.0%	32556.7	493.3	161.0			19.6%
Salmon	85.1%	76.6%	74.5%	38.3%	61.7%	30447.5	461.3	150.6	3367.4 Ind	51.0	21.1%
Chum Salmon	0%	2.1%	0%	0%	0%	0.0	0.0	0.0	0 Ind	0	0%
Coho Salmon	68.1%	59.6%	57.4%	25.5%	40.4%	4762.1	72.2	23.6	1011.1 Ind	15.3	20.0%
Chinook Salmon	85.1%	74.5%	72.3%	29.8%	46.8%	24104.0	365.2	119.2	2013.7 Ind	30.5	13.9%
Pink Salmon	6.4%	6.4%	6.4%	0%	0%	17.7	0.3	0.1	7.0 Ind	0.1	6.3%
Sockeye Salmon	34.0%	31.9%	31.9%	10.6%	17.0%	1557.5	23.6	7.7	332.8 Ind	5.0	9.2%
Landlocked Salmon	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Spawnouts	2.1%	2.1%	2.1%	0%	2.1%	6.1	0.1	0.0	2.8 Ind	0	0%
Spawning Sockeye	2.1%	2.1%	2.1%	0%	2.1%	6.1	0.1	0.0	2.8 Ind	0	0%
Non-Salmon Fish	57.4%	31.9%	27.7%	42.6%	29.8%	2109.3	32.0	10.4			11.5%
Herring	0%	0%	0%	0%	0%	0	0	0.0	0 Gal	0	0%
Herring Roe	2%	0%	0%	2%	2%	0	0	0.0	0 Gal	0	0%
Eulachon (hooligan, candlefish)	44.7%	21.3%	19.1%	31.9%	17.0%	1811.8	27.5	9.0	557.5 Gal	8.4	8.7%
Cod	2%	0%	0%	2%	2%	0	0	0.0	0 Ind	0	0%
Pacific Cod (gray)	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Pacific Tom Cod	2%	0%	0%	2%	2%	0	0	0.0	0 Ind	0	0%
Walleye Pollock (whiting)	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Flounder	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Greenling	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Lingcod	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Halibut	14.9%	4.3%	2.1%	14.9%	2%	5.6	0.1	0.0	5.6 Lbs	0.1	3.3%
Rockfish	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Sablefish (black cod)	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Sculpin	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Shark	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Sole	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Stickleback (needlefish)	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Wolffish	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Blackfish	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Burbot	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Char	8.5%	6.4%	6.4%	2.1%	6.4%	29.5	0.4	0.1	21.1 Ind	0.3	2.9%
Dolly Varden	8.5%	6.4%	6.4%	2.1%	6.4%	29.5	0.4	0.1	21.1 Ind	0.3	2.9%
Dolly Varden-saltwater	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Grayling	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%

Resource Name	Percentage of Households					Pounds Harvested			Amount Harvested*		95% Conf Limit (+/-)
	Use	Att	Harv	Recv	Give	Total	Mean HH	Percapita	Total	Mean HH	Harvest
Northern Pike	2.1%	2.1%	2.1%	0%	0%	12.6	0.2	0.1	4.2 Ind	0.1	0%
Sucker	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Trout	27.7%	19.1%	14.9%	8.5%	17.0%	249.7	3.8	1.2	178.3 Ind	2.7	7.7%
Rainbow Trout	21.3%	14.9%	14.9%	6.4%	12.8%	239.8	3.6	1.2	171.3 Ind	2.6	5.3%
Steelhead	6.4%	4.3%	4.3%	2.1%	6.4%	9.8	0.1	0.0	7.0 Ind	0.1	3.2%
Unknown Trout	4.3%	4.3%	0%	0%	2.1%	0	0	0.0	0 Ind	0	0%
Whitefish	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Land Mammals	83.0%	57.4%	31.9%	76.6%	51.1%	8277.7	125.4	40.9			32.7%
Large Land Mammals	83.0%	57.4%	19.1%	76.6%	42.6%	8071.7	122.3	39.9			24.6%
Black Bear	4.3%	6.4%	4.3%	0%	2.1%	488.7	7.4	2.4	8.4 Ind	0.1	2.9%
Brown Bear	4.3%	4.3%	4.3%	0%	0%	0.0	0.0	0.0	4.2 Ind	0.1	5.3%
Caribou	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Deer	2.1%	0.0%	0.0%	2.1%	0.0%	0.0	0.0	0.0	0.0 Ind	0.0	0.0%
Moose	83%	57%	19%	77%	43%	7583	115	37.5	17 Ind	0	19%
Dall Sheep	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0 Ind	0.0	0.0%
Small Land Mammals	25.5%	29.8%	17.0%	8.5%	14.9%	206.1	3.1	1.0			18.6%
Beaver	17.0%	17.0%	13%	4%	11%	111	2	0.5	14 Ind	0	5%
Coyote	2.1%	2.1%	2%	0%	0%	0	0	0.0	3 Ind	0	0%
Fox	2.1%	2.1%	2%	0%	0%	0	0	0.0	3 Ind	0	0%
Red Fox	2.1%	2.1%	2.1%	0%	0.0%	0	0	0.0	2.8 Ind	0	0%
Hare	2.1%	2.1%	2.1%	0%	2.1%	6	0	0.0	2.8 Ind	0	0%
Snowshoe Hare	2.1%	2.1%	2%	0%	2%	6	0	0.0	3 Ind	0	0%
Land Otter	2%	2%	2%	0%	0%	0	0	0.0	3 Ind	0	0%
Lynx	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Marmot	0.0%	0.0%	0.0%	0%	0.0%	0	0	0.0	0.0 Ind	0.0	0.0%
Marten	4%	4%	4%	0%	2%	0	0	0.0	38 Ind	1	2%
Mink	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Muskrat	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0 Ind	0.0	0.0%
Porcupine	19.1%	19%	11%	6%	9%	90	1	0.4	11 Ind	0	8%
Squirrel	2%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Parka Squirrel (ground)	0.0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Tree Squirrel	2%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Weasel	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Wolf	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Wolverine	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0 Ind	0.0	0%
Marine Mammals	46.8%	6.4%	4.3%	42.6%	27.7%	857.3	13.0	4.2			2.9%
Seal	10.6%	6.4%	4.3%	4.3%	6.4%	157.3	2.4	0.8	4.2 Ind	0.1	3.3%
Harbor Seal (saltwater)	10.6%	6.4%	4.3%	4.3%	6.4%	157.3	2.4	0.8	4.2 Ind	0.1	3.3%
Sea Otter	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%

Resource Name	Percentage of Households					Pounds Harvested			Amount Harvested*		95% Conf Limit (+/-)
	Use	Att	Harv	Recv	Give	Total	Mean HH	Percapita	Total	Mean HH	Harvest
Steller Sea Lion	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0 Ind	0	0.0%
Whale	46.8%	6.4%	2.1%	42.6%	27.7%	700.0	10.6	3.5	1.0 Ind	0	31.7%
Belukha	46.8%	6.4%	2.1%	42.6%	27.7%	700.0	10.6	3.5	1.0 Ind	0.0	31.7%
Bowhead	2.1%	0.0%	0.0%	2.1%	2.1%	0.0	0.0	0.0	0.0 Ind	0.0	0.0%
Birds and Eggs	38.3%	44.7%	34.0%	12.8%	23.4%	566.1	8.6	2.8			12.2%
Migratory Birds	32%	28%	26%	11%	21%	413	6	2.0	409 Ind	6	8%
Ducks	31.9%	27.7%	25.5%	11%	21.3%	238.6	3.6	1.2	325.8 Ind	4.9	7%
Bufflehead	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Canvasback	2%	2%	2%	0%	2%	8	0	0.0	7 Ind	0	0%
Gadwall	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Goldeneye	0.0%	2.1%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0 Ind	0.0	0.0%
Mallard	26%	21%	21%	9%	17%	112	2	0.6	112 Ind	2	4%
Merganser	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Northern Pintail	19%	15%	15%	6%	15%	65	1	0.3	81 Ind	1	3%
Scaup	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Scoter	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0 Ind	0.0	0.0%
Northern Shoveler	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0 Ind	0.0	0.0%
Teal	12.8%	12.8%	12.8%	2%	8.5%	27.0	0.4	0.1	89.9 Ind	1.4	2%
Green Winged Teal	12.8%	12.8%	12.8%	2%	8.5%	27.0	0.4	0.1	89.9 Ind	1.4	2%
Wigeon	2.1%	2.1%	2.1%	0.0%	2.1%	14.7	0.2	0.1	21.1 Ind	0.3	0%
American Wigeon	2.1%	2.1%	2.1%	0.0%	2.1%	14.7	0.2	0.1	21.1 Ind	0.3	0.0%
Unknown Ducks	4.3%	4.3%	2.1%	2.1%	2.1%	11.7	0.2	0.1	14.0 Ind	0.2	3.3%
Geese	14.9%	14.9%	14.9%	2%	12.8%	127.0	1.9	0.6	77.2 Ind	1.2	3.8%
Canada Geese	14.9%	14.9%	14.9%	2.1%	12.8%	85.0	1.3	0.4	59.0 Ind	0.9	3.6%
Lesser Canada Geese (taverner/parvi	10.6%	10.6%	10.6%	0%	10.6%	52.2	0.8	0.3	43.5 Ind	0.7	2.5%
Unknown Canada Geese	4%	4%	4%	2%	2%	33	0	0.2	15 Ind	0	3%
Snow Geese	6%	6%	6%	0%	4%	42	1	0.2	18 Ind	0	2%
White-fronted Geese	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Swan	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Crane	2%	2%	2%	0%	2%	47	1	0.2	6 Ind	0	0%
Sandhill Crane	2%	2%	2%	0%	2%	47	1	0.2	6 Ind	0	0%
Shorebirds	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Common Snipe	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Seabirds & Loons	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Other Birds	27.7%	34.0%	25.5%	4.3%	14.9%	153.3	2.3	0.8	219.1 Ind	3.3	13.4%
Upland Game Birds	27.7%	34.0%	25.5%	4.3%	14.9%	153.3	2.3	0.8	219.1 Ind	3.3	13.4%
Grouse	26%	28%	23%	4%	13%	94	1	0.5	135 Ind	2	8%
Spruce Grouse	26%	25.5%	23%	4%	13%	94	1	0.5	135 Ind	2	7%
Ruffed Grouse	0.0%	0.0%	0.0%	0%	0.0%	0.0	0.0	0.0	0.0 Ind	0.0	0.0%

Resource Name	Percentage of Households					Pounds Harvested			Amount Harvested*		95% Conf Limit (+/-)
	Use	Att	Harv	Recv	Give	Total	Mean HH	Percapita	Total	Mean HH	Harvest
Unknown Grouse	0%	2%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Ptarmigan	11%	17%	11%	0%	6%	59	1	0.3	84 Ind	1	8%
Bird Eggs	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Marine Invertebrates	40.4%	9%	9%	34.0%	6%	249	4	1.2			3%
Clams	40%	9%	9%	34%	6%	185	3	0.9	62 Gal	1	3%
Butter Clams	9%	0%	0%	9%	0%	0	0	0.0	0 Gal	0	0%
Freshwater Clams	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0 Gal	0	0%
Horse Clams (Gaper)	0%	0%	0%	0%	0%	0	0	0.0	0 Gal	0	0%
Pacific Littleneck Clams (Steamers)	2.1%	2.1%	2.1%	0.0%	2.1%	4.2	0.1	0.0	1.4 Gal	0.0	0.0%
Pinkneck Clams	0.0%	0%	0%	0.0%	0%	0	0	0.0	0 Gal	0	0%
Razor Clams	36.2%	6.4%	6.4%	31.9%	4.3%	181.1	2.7	0.9	60.4 Gal	0.9	1%
Unknown Clams	2.1%	0.0%	0.0%	2.1%	0.0%	0.0	0.0	0.0	0.0 Gal	0.0	0%
Cockles	4%	2%	2%	2%	2%	63	1	0.3	21 Gal	0	0%
Crabs	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Mussels	0%	0%	0%	0%	0%	0	0	0.0	0 Gal	0	0%
Octopus	0%	0%	0%	0%	0%	0	0	0.0	0 Ind	0	0%
Scallops	0%	0%	0%	0%	0%	0	0	0.0	0 Gal	0	0%
Shrimp	0.0%	0.0%	0.0%	0.0%	0.0%	0.0	0.0	0.0	0.0 Gal	0.0	0.0%
Vegetation	91.5%	91.5%	91.5%	38.3%	63.8%	1322.8	20.0	6.5			11.6%
Berries	74.5%	70.2%	70.2%	21.3%	38.3%	963	15	4.8	240.8 Gal	3.6	17.5%
Plants/Greens/Mushrooms	31.9%	27.7%	27.7%	8.5%	10.6%	359	5	1.8	89.9 Gal	1.4	11.5%
Wood	85.1%	85.1%	85.1%	23.4%	38.3%	0	0	0.0	522.4 Cor	7.9	10.4%

* Amount of resource harvested is individual units, unless otherwise specified.

SOURCE: Alaska Department of Fish and Game, Division of Subsistence Household Surveys, 2006.

Table 3. Beluga Subsistence Use

Resource Name	Percentage of Households					Pounds Harvested			Amount Harvested*		95% Conf Limit (+/-)
	Use	Att	Harv	Recv	Give	Total	Mean HH	Percapita	Total	Mean HH	Harvest
All Resources	100.0%	100.0%	100.0%	100.0%	85.7%	8085.8	539.1	204.0			14.9%
Fish	92.9%	92.9%	85.7%	85.7%	85.7%	4905.7	327.0	123.7			15.5%
Salmon	92.9%	92.9%	85.7%	64.3%	85.7%	3471.8	231.5	87.6	583.0 Ind	38.9	12.5%
Chum Salmon	7.1%	7.1%	7.1%	0%	7.1%	112.5	7.5	2.8	21.4 Ind	1.4	0%
Coho Salmon	92.9%	78.6%	78.6%	42.9%	71.4%	1534.1	102.3	38.7	325.7 Ind	21.7	6.2%
Chinook Salmon	92.9%	92.9%	85.7%	42.9%	71.4%	1271.6	84.8	32.1	106.2 Ind	7.1	20.1%
Pink Salmon	21.4%	21.4%	21.4%	0%	0%	62.1	4.1	1.6	24.6 Ind	1.6	8.4%
Sockeye Salmon	57.1%	42.9%	35.7%	21.4%	35.7%	491.4	32.8	12.4	105.0 Ind	7.0	8.0%
Landlocked Salmon	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Spawnouts	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Spawning Sockeye	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Non-Salmon Fish	85.7%	71.4%	71.4%	64.3%	42.9%	1433.9	95.6	36.2			15.4%
Herring	0%	0%	0%	0%	0%	0	0	0	0 Gal	0	0%
Herring Roe	0%	0%	0%	0%	0%	0	0	0	0 Gal	0	0%
Eulachon (hooligan, candlefish)	57.1%	50.0%	50.0%	14.3%	35.7%	160.2	10.7	4.0	49.3 Gal	3.3	9.1%
Cod	7.1%	0%	0%	7.1%	0%	0	0	0	0 Ind	0	0%
Pacific Cod (gray)	7.1%	0%	0%	7.1%	0%	0	0	0	0 Ind	0	0%
Pacific Tom Cod	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Walleye Pollock (whiting)	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Flounder	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Greenling	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Lingcod	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Halibut	57.1%	7.1%	7.1%	57.1%	7.1%	53.6	3.6	1.4	53.6 Lbs	3.6	0%
Rockfish	7.1%	0%	0%	7.1%	0%	0	0	0	0 Ind	0	0%
Sablefish (black cod)	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Sculpin	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Shark	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Sole	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Stickleback (needlefish)	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Wolffish	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Blackfish	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Burbot	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Char	35.7%	35.7%	35.7%	0%	7.1%	73.5	4.9	1.9	52.5 Ind	3.5	6.1%
Dolly Varden	28.6%	28.6%	28.6%	0%	7.1%	70.5	4.7	1.8	50.4 Ind	3.4	3.9%
Dolly Varden-saltwater	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Grayling	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%

Resource Name	Percentage of Households					Pounds Harvested			Amount Harvested*		95% Conf Limit (+/-)
	Use	Att	Harv	Recv	Give	Total	Mean HH	Percapita	Total	Mean HH	Harvest
Northern Pike	71.4%	57.1%	57.1%	21.4%	21.4%	549.6	36.6	13.9	183.2 Ind	12.2	8.7%
Sucker	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Trout	71.4%	57.1%	57.1%	14.3%	21.4%	597.0	39.8	15.1	426.4 Ind	28.4	15.5%
Rainbow Trout	71.4%	57.1%	57.1%	14.3%	21.4%	594.0	39.6	15.0	424.3 Ind	28.3	15.6%
Steelhead	7.1%	7.1%	7.1%	0%	0%	3.0	0.2	0.1	2.1 Ind	0.1	0%
Unknown Trout	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Whitefish	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Land Mammals	100.0%	64.3%	42.9%	92.9%	57.1%	2409	161	61			22.9%
Large Land Mammals	100.0%	64.3%	35.7%	92.9%	50.0%	2403.2	160.2	60.6			12.7%
Black Bear	42.9%	28.6%	28.6%	28.6%	28.6%	372.9	24.9	9.4	6.4 Ind	0.4	10.3%
Brown Bear	0%	21.4%	0%	0%	0%	0	0	0	0 Ind	0	0%
Caribou	29%	0%	0%	29%	0%	0	0	0	0 Ind	0	0%
Moose	100.0%	64%	21%	85.7%	43%	1735.7	115.7	43.8	3.2 Ind	0.2	18.2%
Muskox	14.3%	7.1%	7.1%	7.1%	7.1%	295	20	7	1.1 Ind	0.1	0%
Dall Sheep	7.1%	7.1%	0%	7.1%	0%	0	0	0	0 Ind	0	0%
Small Land Mammals	42.9%	42.9%	35.7%	7.1%	14.3%	5.4	0.4	0.1			14.4%
Beaver	28.6%	28.6%	21.4%	7.1%	0%	0.0	0.0	0.0	37.5 Ind	2.5	12.0%
Coyote	21.4%	21.4%	21.4%	0%	0%	0	0	0	9.6 Ind	0.6	4.0%
Fox	28.6%	28.6%	28.6%	0%	7%	0	0	0	10.7 Ind	0.7	6.2%
Red Fox	28.6%	28.6%	28.6%	0%	7.1%	0	0	0	10.7 Ind	0.7	6.2%
Hare	7.1%	7.1%	7.1%	0%	0%	4.3	0	0	2.1 Ind	0.1	0%
Snowshoe Hare	7.1%	7.1%	7.1%	0%	0%	4.3	0.3	0.1	2.1 Ind	0.1	0%
Land Otter	14.3%	14.3%	7.1%	0%	0%	0	0	0	4.3 Ind	0.3	6.1%
Lynx	0%	7.1%	0%	0%	0%	0	0	0	0 Ind	0	0%
Marmot	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Marten	35.7%	35.7%	28.6%	7.1%	0%	0	0	0	126.4 Ind	8.4	13.2%
Mink	7.1%	7.1%	7.1%	0%	0%	0	0	0	3.2 Ind	0.2	0%
Muskrat	7.1%	7.1%	7.1%	0%	0%	0	0	0	10.7 Ind	0.7	0%
Porcupine	7.1%	7.1%	7.1%	0%	0%	0	0	0	6.4 Ind	0.4	0%
Squirrel	21.4%	21.4%	21.4%	0%	0%	1.1	0.1	0.0	49.3 Ind	3.3	4.6%
Parka Squirrel (ground)	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Tree Squirrel	21.4%	21.4%	21.4%	0%	0%	1.1	0.1	0.0	49.3 Ind	3.3	4.6%
Weasel	14.3%	14.3%	14.3%	0%	0%	0	0	0	11.8 Ind	0.8	5.0%
Wolf	28.6%	35.7%	28.6%	0%	7.1%	0	0	0	6.4 Ind	0.4	6.0%
Wolverine	7.1%	21.4%	0%	7.1%	0%	0	0	0	0 Ind	0	0%
Marine Mammals	0%	0%	0%	0%	0%	0	0	0			0%
Seal	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Harbor Seal (saltwater)	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Sea Otter	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%

Resource Name	Percentage of Households					Pounds Harvested			Amount Harvested*		95% Conf Limit (+/-)
	Use	Att	Harv	Recv	Give	Total	Mean HH	Percapita	Total	Mean HH	Harvest
Steller Sea Lion	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Whale	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Belukha	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Birds and Eggs	78.6%	78.6%	78.6%	14.3%	21.4%	266.7	17.8	6.7			14.7%
Migratory Birds	35.7%	35.7%	35.7%	7.1%	7.1%	82.2	5.5	2.1	58.9 Ind	3.9	7.6%
Ducks	28.6%	28.6%	28.6%	7.1%	0%	35.9	2.4	0.9	40.7 Ind	2.7	5.6%
Bufflehead	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Canvasback	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Gadwall	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Goldeneye	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Mallard	28.6%	28.6%	28.6%	7.1%	0%	24.6	1.6	0.6	24.6 Ind	1.6	5.2%
Merganser	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Northern Pintail	14.3%	14.3%	14.3%	0%	0%	6.9	0	0	8.6 Ind	0.6	1.5%
Scaup	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Scoter	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Northern Shoveler	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Teal	7.1%	7.1%	7.1%	7.1%	0%	0.6	0	0	2.1 Ind	0.1	0%
Green Winged Teal	7.1%	7.1%	7.1%	7.1%	0%	0.6	0	0	2.1 Ind	0.1	0%
Wigeon	7.1%	7.1%	7.1%	0%	0%	3.8	0	0	5.4 Ind	0.4	0%
American Wigeon	7.1%	7.1%	7.1%	0%	0%	3.8	0.3	0.1	5.4 Ind	0.4	0%
Unknown Ducks	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Geese	28.6%	35.7%	28.6%	0%	7.1%	28.3	1.9	0.7	16.1 Ind	1.1	8.6%
Canada Geese	21.4%	35.7%	21.4%	0%	0%	10.3	0.7	0.3	8.6 Ind	0.6	9.0%
Lesser Canada Geese (taverner/parvipes	21.4%	35.7%	21.4%	0%	0%	10.3	0.7	0.3	8.6 Ind	0.6	9.0%
Unknown Canada Geese	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Snow Geese	0%	7%	0%	0%	0%	0	0	0	0 Ind	0	0%
White-fronted Geese	14.3%	14.3%	14.3%	0%	7.1%	18.0	1.2	0.5	7.5 Ind	0.5	2.2%
Swan	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Crane	7.1%	29%	7.1%	0%	0%	18.0	1.2	0.5	2.1 Ind	0.1	14.8%
Sandhill Crane	7.1%	28.6%	7.1%	0%	0%	18.0	1.2	0.5	2.1 Ind	0.1	14.8%
Shorebirds	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Common Snipe	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Seabirds & Loons	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Other Birds	78.6%	78.6%	78.6%	7.1%	21.4%	184.5	12.3	4.7	263.6 Ind	17.6	17.1%
Upland Game Birds	78.6%	78.6%	78.6%	7.1%	21.4%	184.5	12.3	4.7	263.6 Ind	17.6	17.1%
Grouse	78.6%	78.6%	78.6%	0%	21.4%	158.3	10.6	4.0	226.1 Ind	15.1	19.8%
Spruce Grouse	78.6%	78.6%	78.6%	0%	21.4%	156.0	10.4	3.9	222.9 Ind	14.9	19.7%
Ruffed Grouse	14.3%	21.4%	14.3%	0%	0%	2	0	0	3.2 Ind	0.2	6.1%
Unknown Grouse	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%

Resource Name	Percentage of Households					Pounds Harvested			Amount Harvested*		95% Conf Limit (+/-)
	Use	Att	Harv	Recv	Give	Total	Mean HH	Percapita	Total	Mean HH	Harvest
Ptarmigan	42.9%	50.0%	35.7%	7.1%	0%	26.3	1.8	0.7	37.5 Ind	2.5	10.9%
Bird Eggs	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Marine Invertebrates	50.0%	35.7%	35.7%	21.4%	21.4%	65.6	4.4	1.7			15.8%
Clams	50.0%	35.7%	35.7%	21.4%	21.4%	64.3	4.3	1.6	150.0 Gal	10.0	15.8%
Butter Clams	0%	0%	0%	0%	0%	0	0	0	0 Gal	0	0%
Freshwater Clams	7.1%	7.1%	7.1%	0%	0%	3	0	0	1.1 Gal	0.1	0%
Horse Clams (Gaper)	0%	0%	0%	0%	0%	0	0	0	0 Gal	0	0%
Pacific Littleneck Clams (Steamers)	0%	0%	0%	0%	0%	0	0	0	0 Gal	0	0%
Pinkneck Clams	0%	0%	0%	0%	0%	0	0	0	0 Gal	0	0%
Razor Clams	50.0%	28.6%	28.6%	21.4%	21.4%	61.1	4.1	1.5	148.9 Gal	9.9	12.2%
Unknown Clams	0%	0%	0%	0%	0%	0	0	0	0 Gal	0	0%
Cockles	7.1%	7.1%	7.1%	0%	0%	1.3	0.1	< 0.1	0.4 Gal	0.0	0%
Crabs	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Mussels	0%	0%	0%	0%	0%	0	0	0	0 Gal	0	0%
Octopus	0%	0%	0%	0%	0%	0	0	0	0 Ind	0	0%
Scallops	0%	0%	0%	0%	0%	0	0	0	0 Gal	0	0%
Shrimp	0%	0%	0%	0%	0%	0	0	0	0 Gal	0	0%
Vegetation	92.9%	92.9%	92.9%	35.7%	50.0%	439.3	29.3	11.1			8.1%
Berries	92.9%	92.9%	92.9%	35.7%	50.0%	325.7	21.7	8.2	81.4 Gal	5.4	10.1%
Plants/Greens/Mushrooms	42.9%	42.9%	42.9%	7.1%	21.4%	113.6	7.6	2.9	28.4 Gal	1.9	9.7%
Wood	78.6%	78.6%	78.6%	7.1%	28.6%	0	0	0	66.4 Cor	4.4	8.4%
Other Wood	7.1%	7.1%	7.1%	0%	0%	0	0	0	3.2 Cor	0.2	0%

* Amount of resource harvested is individual units, unless otherwise specified.

SOURCE: Alaska Department of Fish and Game, Division of Subsistence Household Surveys, 2006.

Soils Data & Resources

Taking a Soil Test

If you intend to send your sample to the land grant university in your state, contact the local Cooperative Extension Service for information and sample bags. If you intend to send your sample to a private testing lab, contact them for specific details about submitting a sample.

Follow the directions carefully for submitting the sample. The following are general guidelines for taking a soil sample.

1. Sample when the soil is moist but not wet.
2. For each acre of land to be tested, 10 to 15 sub-samples are recommended. Areas that appear different or that have been used differently should be sampled separately. For example, a separate sample should be submitted for an area that has been in a garden and one that has been lawn.
3. Obtain a clean pail or similar container.
4. Clear away the surface litter or grass.
5. With a spade or soil auger, dig a small amount of soil to a depth of 6 inches.
6. Place the soil in the clean pail.
7. Repeat steps d through f until the required number of samples have been collected.
8. Mix the samples together thoroughly.
9. From the mixture, take the sample that will be sent for analysis.
10. Send immediately. Do not dry before sending.

TTCD and NRCS staff taking a soil sample in Tyonek.

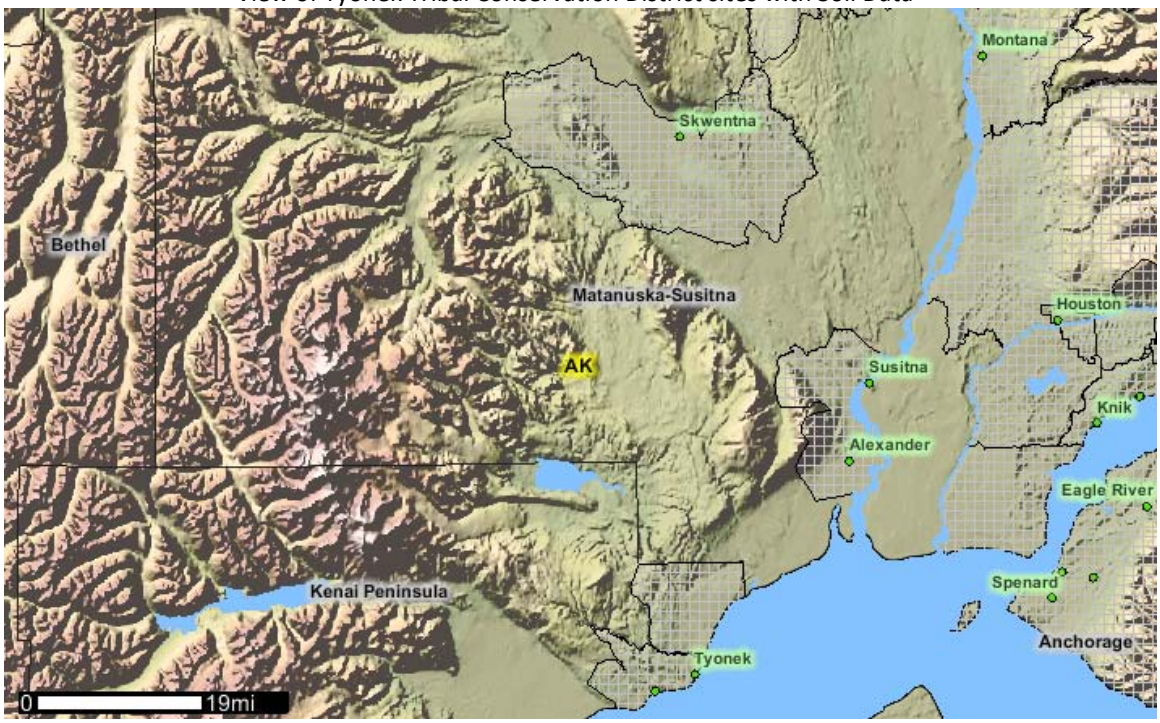
If you are using a home soil testing kit, follow the above steps for taking your sample. Follow the directions in the test kit carefully.

How to utilize/navigate the USDA, (NRCS) Web Soil Survey

1. Go to http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Allow time for the imaging to load.
2. Under the Area of Interest tab ensure Alaska is in the “View Extent” box.

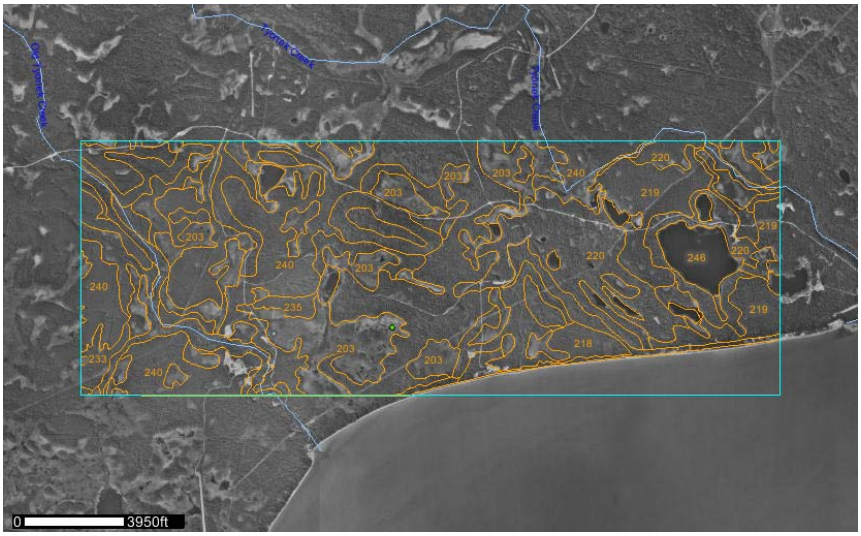
3. Click on the magnifying glass tool with the plus sign to zoom to your area of interest.
2. Once you have located the site to be assessed click on either the “Define AOI by Rectangle” or “Define AOI by Polygon” tool in the tool bar. NOTE an AOI can be no larger than 10,000 acres.
3. Once your area is selected a blue box with diagonal lines will appear over your selected AOI.
4. Next to the Area of Interest Tab select the “Soil Map” tab.
5. A new Map appears with orange lines on it separating the soil types in your selected AOI as well as providing a number that defines what the soil type in that particular section of your AOI is. (The soil numbers will match the key to the left of the map, and will give you information about a specific soil type within the AOI as well as a cumulative list of all the types of soil within your AOI to include Water, if it is applicable.
6. Once an Area Of Interest (AOI) is selected on the USDA, NRCS Web Soil Survey and the soils have been reviewed for the selected AOI you can select the “Soil Properties and Qualities” tab. This tab will provide you with soil site-specific information such as general information about soils, helpful definitions, Soil Chemical Properties, Soil Erosion Factors, Soil Physical Properties, Soil Qualities, as well as Water Feature information. This information can be used to support a potential project on a specific site. For example, if you needed data to support why the soil at site X would offer the best place to put a community garden, you can simply find the data on the USDA, NRCS Web Soil Survey and collect the information you need to support your plan. Remember to always site the source where your information/data was retrieved from to avoid plagiarism.

View of Tyonek Tribal Conservation District sites with Soil Data



The Map above has a grid over areas that have been surveyed and assessed by NRCS through the Web Soil Survey. The areas with soil data are Old Tyonek, Tyonek, Alexander, Susitna, and Skwentna.

The map below is an example of what AOI will look like when it is displayed in the Soil Map.



The soil information for the AOI Soil Map above is pasted below as an example of the information that can be retrieved, reviewed, and collected on a given site.

Yentna Area, Alaska (AK631)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
203	Chichantna peat, 0 to 8 percent slopes	1040.4	16.7%
214	Killey and Hiline silt loams	197.8	3.2%
216	Kroto-Strandline-Cryorthents complex, 30 to 45 percent slopes	22.9	0.4%
217	Lucile silt loam, 0 to 2 percent slopes	83.3	1.3%
218	Nancy-Kashwitna complex, 0 to 2 percent slopes	68.0	1.1%
219	Nancy-Kashwitna complex, 2 to 7 percent slopes	431.7	6.9%
220	Nancy-Kashwitna complex, 7 to 12 percent slopes	803.0	12.9%
221	Nancy-Kashwitna complex, 12 to 20 percent slopes	67.5	1.1%
222	Nancy-Kashwitna complex, 20 to 30 percent slopes	31.3	0.5%
223	Nancy-Kashwitna complex, 30 to 45 percent slopes	129.3	2.1%
233	Slikok muck, 0 to 5 percent slopes	227.0	3.6%
235	Spenard silt loam, 0 to 7 percent slopes	117.5	1.9%
236	Starichkof peat, 0 to 7 percent slopes	22.8	0.4%
237	Strandline-Kroto complex, 20 to 45 percent slopes	297.1	4.8%
240	Strandline-Spenard-Kroto complex, 2 to 30 percent slopes	1913.9	30.7%
244	Tyonek peat, 0 to 2 percent slopes	121.8	2.0%
246	Water	236.1	3.8%

In an effort to consolidate soil data in a reader friendly manner each site that has soil data had an Area of Interest Highlighted and then the soil types were added to a list (below) for each area. For more accurate and specific soil types on a given site within one of the above-mentioned areas please visit: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

Soil Properties and Regions

Chart compiled from the Soil Reports Tab off the NRCS Web Soil Survey.

Soil Name	Average pH of soil type
Chichantna peat	pH 5.1 - 6.5
Killey and Hiline silt	pH 4.0 - 6.0 *(combined avg. of both soil types)*
Kroto-Strandline-Cryorthents complex	pH 3.6 - 6.0 *(combined avg. of all 3 soil types)*
Lucile silt loam	pH 4.0 – 6.0
Nancy-Kashwitna complex	pH 3.6 – 6.0 *(combined avg. of all 3 soil types)*
Slikok muck	pH 4.5 – 5.5
Spenard silt loam	pH 4.0 – 6.0
Starichkof peat	pH 4.1 – 5.5
Strandline-Kroto complex	pH 3.6 – 6.0 *(combined avg. of all 3 soil types)*
Tyonek Peat	pH 4.1 – 6.5

Freshwater Data & Resources

Species Descriptions

Steelhead trout and Rainbow trout are essentially the same species (*Oronchys mykiss*). Steelhead trout migrate to the ocean while Rainbow trout stay in freshwater throughout their entire life. Steelhead trout start out as hatchlings in freshwater but after about two years they migrate to saltwater until it's time to spawn, when they return to their original freshwater habitat (AK DNR DOG 2009). Trout within the Tyonek conservation district may be subject to predation by invasive Northern Pike. Northern Pike and their predation on native trout species is covered thoroughly in the Invasive Northern Pike section of this report.

Dolly Varden (*Salvelinus malma***)** are a cosmopolitan freshwater fish species, capable of inhabiting a wide variety of water types, including high elevation streams, large and small rivers and lakes. Within a single population there may be individuals that remain in freshwater systems their entire lives, while other individuals may migrate between fresh and saltwater systems (sometimes known as "coasters"). Dolly Varden are harvested by both sport and subsistence fishing activities.

Burbot (*Lota lota*) are found in the larger and deeper rivers and lakes throughout the Cook Inlet area. They spawn in the winter usually between February and March (Armstrong 1996). Young burbot feed primarily on invertebrates. As Burbot grow larger they begin to feed on fish such as slimy sculpin, lampreys, and young salmon; by age 5 their diet is primarily fish (Armstrong 1996). Burbot have been studied extensively in northern Alaska (Bernard et al.1993), but few studies are available specific to the Cook Inlet area.

Hooligan (*Thaleichthys pacificus*), also known as 'Euchelon' and 'Candle fish' are a small member of the Herring family. Hooligan are a popular fish, targeted by sport-fish netting along the shores of Cook Inlet (some subsistence use has been reported as well). The annual runs of Hooligan also provide a high value food source for salmon and Beluga whales, There are no bag or possession limits for Hooligan, for personal use fishing within the waters of Cook Inlet (ADF&G).

Sculpin are found in freshwaters of the Cook Inlet area. Three species are present: Slimy Sculpin (*Cottus cognatus*), Prickly Sculpin (*C. aster*) and Coast Range Sculpin (*C. aleuticus*). They are generally foundon the bottom of lakes and streams. They feed mostly on insects, although occasionally they eat fish and fish eggs. Sculpins have been found to be particularly senstive to acidification of waters, and are thus a good indication species for this issue (ADF&G).

Threespine Sticklebacks (*Gasterosteus aculeatus*) are abundant in lakes, ponds, and slow-moving streams. They spawn in June and July, with the female laying eggs in a nest built by the male (Armstrong 1996). Their life span is only 2 years. Stickleback feed on zooplankton, insects, and occasionally on their own eggs and young. They form an important food source for Salmonids and other large fish. The ubiquity of sticklebacks makes them a popular species for various monitoring and modeling studies (ADF&G).

Pacific Salmon species

Most of the fisheries work within the Cook Inlet Basin has focused on salmon rather than on the resident fish, because the salmon represent an important cultural, recreational, and economic component of the Cook Inlet Basin. In 1997, approximately 4 million salmon were harvestedin the upper Cook Inlet fishery.

Five species of Pacific salmon are found in the Cook Inlet area: Chinook (*Oncorhynchus tshawytscha*), sockeye (*O. nerka*), coho (*O. kisutch*), pink (*O. gorbuscha*), and chum (*O. keta*).

Although salmon life histories can vary widely depending on species and population, most salmon spawn in freshwater streams between June and September. Some pink salmon also spawn in intertidal areas. Eggs are laid are generally deposited in the

gravel where they remain through the winter.

Pacific Salmon Species

Wild populations of pacific salmon have generally been observed to be in decline. This may be due to combinations of landscape and watershed issues such as logging, water pollution, and blockage of migration routes, destruction of critical spawning and rearing habitats for the fish, over-fishing and changes in climate. To help reduce damage being done to critical salmon habitat, organizations such as the Institute for Fisheries Resources (IFR) have implemented restoration programs. These programs include: reform within the forestry industry, safer agricultural practices, reducing manmade barriers on important migration routes, dam removal, and mentoring programs. Although the IFR is based in California, they list several Alaska specific alliances on their program webpage.

Invasive Aquatic Species

The Introduction of invasive, non-indigenous aquatic species can cause significant environmental and economic damage (Ruiz and Carlton 2003). This includes predation on native species, shifts in trophic structure and nutrient cycling, competition for space, habitat alteration, disease transmission, hybridization, loss of biodiversity, and declines in fisheries harvest (Taylor et al. 1984, Wilcove et al. 1998, Mack et al. 2000 from Harvey, 2009). Certain invasive aquatic species have the potential to cause long lasting and possibly irreparable damage to natural systems within the 16b conservation district. Invasive aquatic species are of particular concern within the region due to the impacts on subsistence, commercial and recreational fishing. The state of Alaska has conducted a substantial amount of work regarding aquatic invasives, and has implemented strategies and developed protocols for managing non-native aquatic

species. Emphasis within the conservation district may be modeled after the ADF&G protocols; focusing on preventing introductions and responding to the highest and most immediate invasive threats.
Aquatic invaders have the vector advantage of interconnected waterways and drainage systems in addition to a number of other dispersal mechanisms, making prevention of dispersion difficult and complicating eradication efforts.

There are currently three invasive fish species of priority concern to the region. These are the Northern Pike, Yellow Perch and Atlantic salmon.

Northern Pike are documented as present and potentially established in several areas of the conservation district. This species is a priority concern to the TTCD and the community of Tyonek. Several pike removal programs are in place within the larger eco-region, and TTCD is undertaking its own Pike removal projects. Expanded information regarding this species is contained in this chapter.

Yellow Perch have not been documented as present within the District, but due to the physiology and life history of the species, could pose a serious threat. An isolated population of Yellow Perch has been found on the Kenai Peninsula, likely as the result of intentional stocking. The population has been removed by ADF&G, and no further populations have been discovered.

Atlantic salmon, pose a substantial threat to native salmon stocks throughout the state. This farm-originated species is documented as capable of reproducing in the wild (Gaudet, 2002), juvenile Atlantic Salmon exhibit substantially more aggressive behavior than Pacific Salmon and may outcompete native stocks, and may spawn on multiple occasions. Other potential aquatic invasive species include aquatic plants, invertebrates and certain pathogens.

Invasive Aquatic Species

Invasive Aquatic Invertebrates

Scientific Name	Common Name	Presence in 16B
Pacifastacus leniusculus	Signal Crayfish	
Eriocheir sinensis	Chinese Mitten Crab	
Dreissena polymorpha	Zebra Mussel	
Potamopyrgus antipodarum	New Zealand Mud Snail	
Carcinus maenas	Green Crab	
Bythotrephes longimanus	Spiny Water Flea	

Invasive Aquatic Plants

Scientific Name	Common Name	Presence in Alaska
Hydrilla verticillata	Hydrilla, water thyme	
Landoltia (Spirodela) punctata	Dotted duckweed	
Lythrum salicaria	Purple loostrife	
Myriophyllum spicatum	Eurasion water-milfoil	Present
Phalaris arundinacea	Reed Canary grass	Present
Polygonum cuspidatum	Japanese knotweed	Present
Spartina alterniflora	Salt marsh cordgrass	
Spartina densifora	Dense-flowered cordgrass	
Utricularia inflate	Swollen bladderwort	

Invasive Fish Species

Scientific Name	Common Name	Invasive Rank
Salmo salar	Atlantic salmon	High
Salvelinus fontinalis	Brook trout	Low
Oncorhynchus kisutch	Coho salmon	
Carassius auratus	Goldfish	Low
Esox lucius	Northern pike	High
Sp.	Ornamental aquarium fish	
Astronotus ocellatus	Oscars	
Oncorhynchus mykiss	Rainbow trout	Low, High
Gasterosteus aculeatus	Threespine stickleback	

Non-Native Aquatic Pathogens

Scientific Name	Common Name	Presence
Myxobolus cerebralis	Whirling disease	
	Pacific herring virus	
Novirhabdovirus sp	Viral Hemorrhagic Septicemia	
	Atlantic Ocean herring disease	

An expanded section regarding Northern Pike is included in this report. Pike have been determined to be a current priority by the community of Tyonek and the Tyonek Tribal Conservation District. Pike removal projects have been designed and are scheduled to begin in winter 2013/2014.

Invasive Northern Pike

The invasive Northern Pike (Esox lucius) is considered a destructive 'aquatic nuisance species' (ADF&G, 2010).The presence of Northern Pike (Esox lucius) has been reported within several areas of the Tyonek Conservation district. Reports of Pike observations

have come from subsistence fishing activities, Alaska Department of Fish and Game reports, and various documented correspondences from within the community of Tyonek.

The GMU 16B and the Tyonek region is considered to be outside of the historic range for this species. The Northern Pike is native to Alaska, north and west of the Alaska Range (Morrow 1980). Northern pike were introduced to the Northern Susitna basin of South-central Alaska in the 1950's, and have since spread throughout the upper Cook Inlet Basin (Haught, Hippell 2011). Changes in climate and the corresponding changes in habitat and seasonal variation in water quality parameters have likely exacerbated the infiltration and dispersal of invasive Pike within the Tyonek Conservation District.

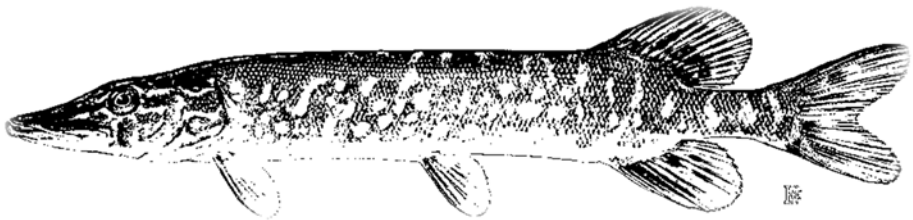
'... Females are more active and susceptible to capture in summer (Harvey,2009).'

This fact may be useful for Pike management strategies by designing Pike control programs that select for sexually mature females.

Invasive Pike have been shown to be detrimental to salmon stocks due to predation on juvenile Salmon. Pike are voracious feeders and prey heavily on juvenile salmon and trout causing concern for the stability of economic, subsistence and ecosystem resources within their invasive ranges (ADF&G, 2010).

Background, Ecology, Biology and Physical Traits

Pike are an ancient Holarctic family represented by the single genus Esox. Like all five species within the genus, Northern Pike have an elongated body with dorsal and anal fins that are placed well back on the body to allow rapid acceleration (Hubbs and Lagler 2004). Pike display morphology consistent with that of a top aquatic predator. Esox lucious has a duck-bill shaped head, with an elongated jaw; dentition is elaborate and recurved for retention of prey. The jaw contains 5 sensory pores spaced along both sides of the lower jaw. The body and portions of the anterior are covered with small cycloid scales. Eyes tend to be yellowish and highly mobile (Lefevre 1999). Crypsis is consistent with that of a northern aquatic predator; Ventral coloring is often off-white or cream colored which transitions to a mix of green or brown barred or spotted patterning on the sides and dorsal area. Diet and water quality parameters can affect apparent coloring of Esox Lucious at different locations.



(New York DNR, 2006)

Growth Rates and Age Composition

Northern pike can live as long as 30 years in the wild (Stewart and Watkinson 2004), but only 40% of North American Pike populations contain individuals older than 7 years (Casselman 1996). Females tend to live longer, grow faster, and are larger than males. Sex ratio of sampled fish appears to favor females in summer and winter, and males in spring and fall, but this is difficult to quantify because variations in sampling methods (netting, angling, spearing) select the sexes differently (Casselman 1975). Nets, weirs and anglers tend to take more females than males, because *females are more active and susceptible to capture in summer (Harvey, 2009).*

Juvenile Pike grow fast, often producing a 15cm fish by the end of the first summer (Scott & Crossman 1973, from Harvey 2009). Growth rates in the central and southern portions of the range average nearly 10mm per week post-hatch (Harvey, 2009). Growth rates have been shown to decrease with increases in latitude, a trait which is consistent with many northern aquatic species. Climate has been shown to affect growth rates most in year one, with the influence effect lessening by ages 3-5 (Diana, 1996, from Harvey 2009).

Physiology and Habitat Requirements

Northern Pike are extremely cosmopolitan and can tolerate a wide range of habitat conditions. This is a factor which makes the species exceedingly fit for dispersion outside of historic ranges and consequently increases their invasive capacity. Physiology, feeding activity and reproduction are all influenced by temperature, dissolved oxygen, pH and salinity.

Temperature

Northern Pike are a cool-water species. Optimum temperature is slightly higher for young-of-the-year than for juveniles and adults (Casselman, 1996). Increased Northern Pike abundance in Lake Ontario over 70 years correlate strongly with increases in water temperature (Casselman, Deitrich 2003). Observations of climate-change may correlate to the species invasive expansion at the northern edge of its historic range.

Optimum temperatures for growth rates of body mass are between 10˚C-19˚C, optimum temperature for growth rates of length are from 19˚C-21˚C (Casselman 1978, from Harvey 2009). Upper and lower lethal temperature ranges are 29.4˚C and .01˚C respectively (Casselman, 1978).

Tolerance ranges for pH

Northern Pike can tolerate a wide range of alkalinities. Reports of populations of pike living in systems with pH ranges from 6.1-8.6 are common. Self-sustaining Pike

populations have been recorded in aquatic systems with pH ranges as low as 5.0 (Harvey, 2009)

Dissolved Oxygen

The species is extremely tolerant of variations in dissolved oxygen levels (changes in physiology, feeding activity and reproduction occur at various predominant D.O. conditions) and have been shown to survive dissolved oxygen levels as low as .03mg/liter. Feeding generally ceases at levels beneath 2.0mg/l, and Pike will actively seek higher oxygen levels at a threshold of approximately 4.0mg/l (Harvey 2009).

Salinity

Pike populations are generally found in freshwater lakes and rivers, but the species can survive in brackish and salt waters. Populations of pike exist in brackish waters with salinity concentrations as high as 6ppt. There are several reports of Pike caught in commercial coastal fisheries. The South-Central Alaska Northern Pike Control Committee describes cases of Pike captured in Cook Inlet (2006). The northern Pikes ability to tolerate slightly saline waters or tidal saline waters for substantial time durations suggests an advantageous adaption for dispersal through coastal waterways.

Spawning Behavior, Larval and Fry Growth

Pike exhibit a pattern of external fertilization in shallow waters, in which the species often migrates to for spawning. Observations suggest the participation of several males per female over a period of several days (Scott & Crossman, 1973). Spawning congregations can be large; a report of an estimated 6,000 fish at one site was reported during sampling in a creek in Saskatchewan (Harvey, 2009). Females deposit eggs in batches of less than 100 on the substrate. Eggs deposited on silt or sand have a higher hatch-success than those deposited on aquatic vegetation. Eggs hatch approximately 2 weeks after fertilization (Harvey 2009).

Newly hatched larvae are generally 6-8mm long, and immediately swim upward and attach to aquatic vegetation or other substrate while absorbing the yolk-sack. Once 12-15mm long, the fry begin to feed on aquatic planktons and then invertebrates.

Feeding Characteristics and Behavioral Movements

Scott and Crossman (1973) describe a report of a population of 2,594 Pike consuming 112 tons of prey-fish in a year (or approximately 86.5lbs of prey fish per pike, per year). Feeding behaviors are often crepuscular and rely on ambush-style behaviors requiring crypsis and utilization of aquatic vegetation for cover (Harvey 2009).

Prey abundance will affect growth rate, but is not critical to survival. In the absence of prey-fish species, Pike become opportunistic and/or cannibalistic feeders.

Juvenile Diet consists of aquatic plant materials for 7-10 days following the absorption of the yolk sack. Feeding then turns to aquatic invertebrates and then fishes. Young Pike generally become carnivorous by the time they reach 5cm long (Scott and Crossman 1973, from Harvey 2009).

Adult Northern Pike are opportunistic feeders and can adapt to a wide range of food sources. Preferred prey size is considered to be 1/3rd to ½ the Pikes total body length. Prey species include fishes, invertebrates, mice, ducks and muskrats (Harvey 2009). Feeding opportunity, not prey size will generally determine feeding behaviors and females will generally eat more than males. Cannibalism is a commonly observed trait in Pike populations lacking diversity or abundance of food sources, and appears to be a natural population control mechanism (Harvey 2009).

Behavioral Movements

Although Pike can tolerate a wide range of habitat conditions, they will seek different locations within habitats due to environmental factors, prey availability and reproductive reasons. Pike may seek cooler, deeper water during the height of the summer, and will move toward the water-ice interface in winter as oxygen levels deplete (Casselman, 1995 from Harvey 2009). For most of the year, Pike appear to be fairly sedentary, and slightly territorial. This is consistent with 'ambush feeding' adaptions and consistent with the observable morphology of the species. During spawning, Pike may travel from the teens, to hundreds of Kilometers to spawn in tributary streams. Pike have been observed to avoid rivers and stream tributaries with velocities over 4.5ft/sec (1.5 m/s) (Harvey, 2009).

Bio-accumulation, Parasites and Disease

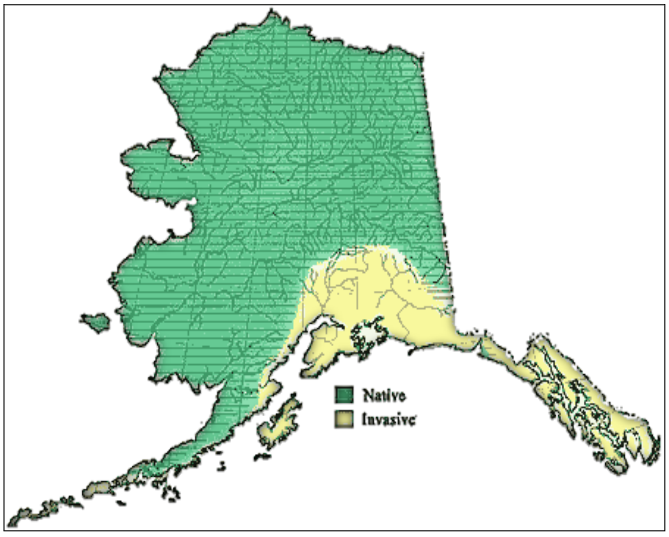
The Northern Pike is susceptible to a wide range of parasites and disease, which likely reflects their variable diet and cosmopolitan nature. Pike are susceptible to numerous parasites including fungi and protozoa, mollusks, worms and leeches. Northern Pike are also carriers of several types of disease, and have been shown to be susceptible to VHS, Viral Hemorrhagic Septicemia. Salmonid species are also susceptible to this VHS. The disease is most common in farmed Salmonid and pike populations, but documentation of VHS in wild populations has been recorded in the U.S., in Michigan, and in Northern Europe (World Animal Health Organization, 1996).

Additionally, Egtved virus can cause a similar hemorrhagic septicemia usually in rainbow trout that can be transmitted to salmon (ADF&G, 2002). Pike embryos and larvae can be infected by the virus through water, food, and injection. Pike populations can carry the virus and be potential Egtved reservoirs. Use of this Disease for pike reduction is not a consideration because of the potential impacts to wild stocks of trout and salmon. Pike fry Rhabdovirus and Egtved viruses are defined as Class I diseases of critical concern for Alaska.

Northern Pike, like many top-level aquatic predators, are susceptible to bio-accumulation of environmental toxins. Exceedingly high levels of mercuric compounds have been found in Canadian lakes, and high levels of PCB's, and organochlorides have been observed in Pike from the Yukon.

Invasive Capacity

The Alaska Natural heritage program evaluated 116 species of invasive terrestrial and aquatic organisms currently present in Alaska. Northern Pike were given an invasive capacity designation of "High" on a scale of low-med-high (McClory & Gotthart 2008). The impacts of invasive Northern Pike can be grouped into five categories: Habitat alteration, trophic alteration, loss of native species diversity and disease introduction. The impacts of invasive Pike within the Tyonek conservation district will likely be similar to the documented impacts within other areas of the Cook Inlet basin. Of chief concern to the community of Tyonek is the impact of invasive Pike on Salmon and Trout stocks.



Pike are unlikely to coexist with self-sustaining populations of Salmon or Trout (Spens & Ball, 2008) and will consume native fry as a preferred prey species until the abundance of Salmonids is reduced to the point that other native prey species are utilized. Loss of native species due to Pike infiltration has been thoroughly documented by the ADF&G within the Cook Inlet basin. Time lines for extirpations of native species vary depending upon factors such as lake and stream morphology, size of the lotic or lentic system, and habitat and prey diversity, However; the number of years elapsed from the date of invasive pike introduction has been shown to correlate strongly as a predictor for calculating timelines of extirpation of native species populations (Haught & Hippell, 2011).

Management Strategies for Invasive Pike

Top-Down Management • ***Methods may only need to be employed once for successful removal*** • ***Obtaining public support for***	***- methods such as rotenone application(fish toxicant) or reduction of water levels to completely kill off/sterilize the lake or impoundment***

use of fish toxicants may be problematic	
Selective Management • ***Methods may often have to be repeated or involve a 'maintenance' component.*** • ***The cost of the ongoing effort may need to be balanced against the economic and social gains of the project***	***-Involves programs which selectively harvest/remove the invasive species. Angling, nets, weirs and spearing may all be considered for selective management efforts***
Adaptive Management Strategies • ***This method requires substantial support from local communities, which may be difficult to achieve based on variable views of a resource(s) value and appropriate use***	***-Involves utilizing the most abundant resource to meet economic needs and/or provide a community benefit.*** ***This may mean that invasive species are harvested for community use, promoted as a sport-fish opportunity to generate revenue, (through permits etc) or left unmanaged***

Currently Implemented Strategies and Programs

National: NANPACA –National Aquatic Nuisance Prevention and Control Act of 1990 **(NANPACA 101-636)** established the Aquatic Nuisance Species Program Taskforce. The group is tasked with creating programs which seek to prevent the introduction of ANS into U.S. waters, establish monitoring and management programs and disseminate information regarding ANS.

State: Under **Executive Order 13112**, *states are responsible for developing a management plan* for species which are defined as "invasive" based on the criteria: 1) that a species is nonnative to the ecosystem under consideration, and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

The state of Alaska has developed the 'Alaska Aquatic Nuisance Species Management Plan', which has been approved under section 1204 of the Federal ANPC Act of 1990 by the ANSP taskforce. The state has received limited funding under this program.

The State of Alaska ANSMP addresses: Alaska's history of invasion, species considered to be the highest threat, pathways for introduction, management actions to prevent the introduction or spread of invasive species, methods to promote early detection and rapid response actions, and control or eradicate invasive species.

Regional: Within the Cook Inlet eco-region, there are existing programs for pike management. Some of these programs are directed by the state, usually funded and implemented through the ADF&G. The state programs address Invasive Pike through public education, angling regulations and sampling and survey work. ADF&G also engages in management strategies utilizing fish toxicants and recently used rotenone to remove Pike from the Stormy Lake system (upper Cook Inlet).
Citizen and non-profit groups such as the Cook Inlet Keeper, Cook Inlet Aquaculture Association and the Upper Cook Inlet Invasive Pike Control Committee have established formal stances on Invasive Pike management are currently implementing programs to address the issue.
Examples of implementation include CIAA's project to install an electrified fish fence (Kenai Peninsula) to stop the dispersion of Pike and the potential for implementing a water cannon for herding northern pike and potentially dispensing of them.

Projects for the Alexander creek waterway have also been funded and are underway. The Alaska Department of Fish and Game was awarded 635,000 from the AK sustainable salmon fund for a multi-year program to accelerate removal efforts for Northern Pike from within the Alexander creek drainage. King salmon data will be collected in conjunction with Pike removal efforts to determine the effectiveness of removal on salmon populations (SOA 2009).

Potential Implementation Strategies for TTCD

- **Invasive Species Education**
    - Public outreach programs to inform of the detrimental effects of invasive species and illegal Pike stocking
    - Creation of brochures, websites, radio and television ads etc.
    - USFWS produced a 'pike fishing' video intended to increase the sport-harvest effectiveness of invasive Pike
    - Community workshops or learning groups focused on invasive species education
- **Reduce or Relax existing sport-fishing regulations/harvest strategies for Pike harvest (ADF&G partnership)**
    - Reducing regulations for sport-harvested pike can increase angler effectiveness and help to reduce overall Pike numbers
    - Increase bag and possession limits
    - Expand allowable methods of harvest i.e. spearing, netting
    - A harvest strategy designed to reduce a population is an unusual exception to
      management practices in the State of Alaska, but is within the authority of the Department's commissioner to manage, protect, maintain, improve, and extend the fish, game, and aquatic plant resources of the state in the

interest of the economy and general well-being of Alaska as specified in AS 16.05.020(2) (ADFG 2009)

- **Implement Community Programs for Pike removal**
  - A cooperative conservation district and community operated weir is planned for Pike removal within the Tyonek region. Data will be gathered from all Pike including: Age, weight, length, stomach contents. -Start date May 2013
  - A community Pike (Ice-fishing) derby is planned for the Tyonek region, data will be recorded from all Pike Harvested, including: Age, weight, length, stomach contents. (Winter 2012/2013)
- **Establish and expand partnerships with existing Invasive Species and Pike control groups**
  - Participation in the Alaska Invasive Species Working Group
  - Partnership with active Pike control entities listed in tables below

Current Invasive Species Programs and Invasive Pike Programs

Entity/Agency/Group	Project title	Timeline	Budget
ADF&G	'Alexander Creek Pike Removal Project'	**4 years, start 2011**	**$635,000**
USFS	'Alaska Region Invasive Species Program' (Forest Service Administered Lands Only)	**Start 2006,ongoing**	**?**
USFWS	Aquatic Nuisance Species and Coastal programs administered by the U.S. Fish and Wildlife Service Test Netting Program: Cook Inlet, Northern Kenai Pen, and Yakutat Mgmt areas. Test netting for presence/Pike detection is underway	**Start 1997, ongoing**	**?**
Alaska Invasive Species Working Group (UAF) Participating Groups: ADF&G, USFWS, PWSCW, APHIS (USDA), USGS, Nature Conservancy, National Park Service, NOAA, AKSeagrant, NRCS, AKDNR, US Dept. of Interior, AK DEC, USFS, PWS Keeper, AK Soil & Water Conserv. Districts, Cook Inlet RCAC, AK EPMT, US Coast Guard Dist. 12, AK intertribal Council, AK Sea Life Center	Working Group Mission Statement: "To minimize invasive species in Alaska by facilitating collaboration, cooperation and communication between AISWG members"	**Ongoing**	**?**

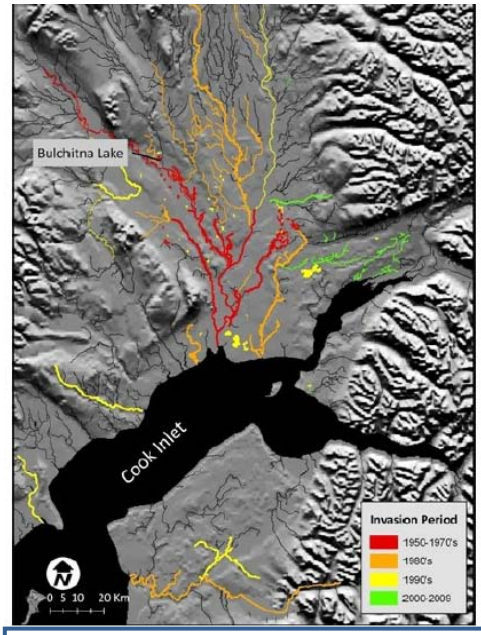
Potential partnerships

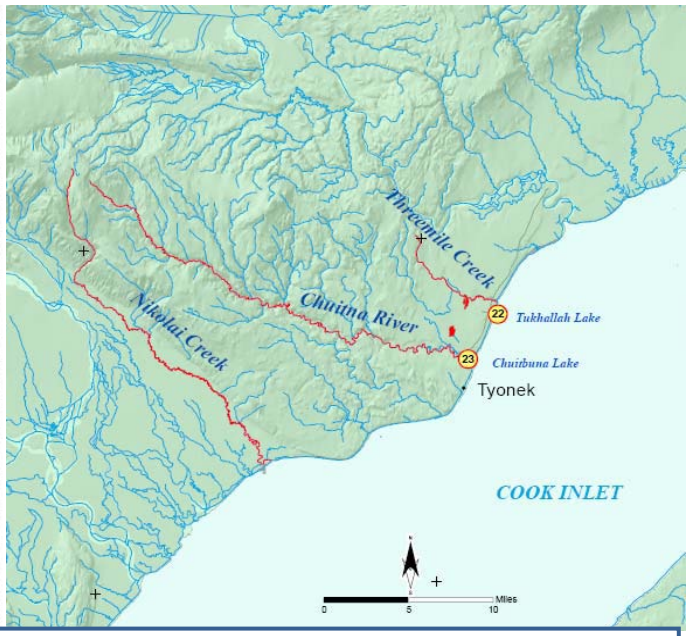
- ADF&G
- CIAA
- Cook Inlet Keeper
- Alaska Invasive Species Working Group (UAF)

Information gaps regarding Invasive Pike in 16B

- ***Lake charts, maps and bathymetric data are absent sites of reported Invasive Pike Presence***
    - *Field mapping, particularly depth profiles, volume estimates and hydraulic retention time estimates would be beneficial at the site-specific level, for areas of reported Invasive Pike presence; this includes the First lake system within the Village of Tyonek, Second and Third lakes, Bunka Lake and the Spring Water Lakes system*
- ***General Climate data is absent for site specific locations of invasive Pike reports***
    - *Installation of a simple/low budget weather data logger would be beneficial for determining energy budgets and climate trends within these aquatic systems*
- ***Pike Presence, Abundance and population data is lacking for the aquatic systems within and around the Village of Tyonek***
    - *Community based Pike removal projects are planned for 2012/2013 and will record data including: number of Pike removed, size, weight, age, sex and stomach contents and time/location of removal*
- ***Water Quality data for the region is present, but dispersed***
    - *Localized water quality data and a robust community level data collection program would be beneficial for supporting management efforts for habitat improvement and biotic community restoration during Pike removal activities*
    - *TTCD has in place a standardized CEMP water quality monitoring program, however full scale data collection has not been conducted yet*

Invasive Northern Pike – Distribution Maps





Maps of Invasive Pike Presence and Dispersal. (ADFG)
*Note the presence of invasive Pike within the Chuitna, Threemile and Nikolai drainages near Tyonek Village. Proximity to the village may warrant priority for these waterways
(ADF&G)

List of Cook Inlet Eco-Region Waters with Invasive Pike Observations

Alexander Creek
- Alexander Lake
- Sucker Lake
- Trail Lake
- Rabbit Lake

Lower Susitna
- Figure 8 Lake
- Flathorn Lake

Yentna River
- Bulchitna Lake
- Cabin Lake (Big Bend)
- Chelatna Lake
- Dog Leg
- Donkey Lake
- Fish Creek Lake 1
- Fish Creek Lake 2
- Fish Creek Lake 3
- Fish Creek Lake 4
- Hewitt Lake
- No Name (Big Bend)
- Pear Lake (Upper

Skwentna River
- Bob Lake (Shell Creek drainage)
- Eight Mile Lake
- No Name (east of Shell Lake)
- No Name (Herk Strip)
- One Stone Lake
- Seven Mile Lake
- Shell Lake

Deshka River
- Amber Lake
- Kroto Lake
- Neil Lake
- No Name Lake
- No Name (1mi SW Parker Lake)
- No Name (2mi SW Parker Lake)
- No Name (Moose Creek)
- No Name (Moose Creek)
- Parker Lake
- Rocky Lake

Susitna Tributaries
- Alexander Creek
- Anderson Creek*
- Birch Creek*
- Bottle Creek
- Caswell Creek
- Chulitna River*
- Deshka River
- Donkey Creek
- Eightmile Creek
- Fish Creek (Flathorn)
- Fish Creek (Kroto)
- Fish Lake Creek
- Hewitt Creek
- Indian (Chulitna)*
- Indian Creek (Yentna)
- Johnson Creek
- Kutna Creek (Yentna)
- Lake Creek

Skwentna) • Stickleback Lake • Whiskey Lake Mid-Susitna • Ding Dong • Lady Slipper • Lockwood Lake • Unnamed • Unnamed • Unnamed • Vern Lake • Witsol Lake • Witsoe Lake • Jim Lake • Knik Lake • Little Susitna River • Meadow Creek (Big Lake) • Mink Creek • Swan Lake*	• Trapper Lake Knik Arm Drainages • Fire Creek • Fish Creek (Big Lake) **West Cook Inlet** • **Chuit River** • **Chuitbunga Lake** • **Nikolai River** • **Threemile/Tukhallah Creek**	• Montana Creek • Moose Creek • Otter Creek • Rabideux Creek • Rolly Creek • Shell Creek • Skwentna River • Sucker Creek • Sunshine Creek* • Talachulitna Creek* • Trappers Creek • Trapper (Talkeetna)* • Tokositna • Unnamed (Lower Susitna) • Wiggel Creek* • Witsoe Creek • Yentna River

***indicates reported, but not confirmed presence (ADFG 2009)**

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http://fisheriesreports.org/inventory-of-fish-distribution-in-matanuska-susitna-basin-streams-southcentral-alaska-2007/

Terrestrial Habitat Data & Resources

Dominant Species and Species of Note

Black spruce (*Picea mariana*): Black spruce is the dominant species in wetter areas of the district, and is characteristic of cold, poorly drained, nutrient poor sites. This small evergreen tree is generally 7-10 m tall at maturity, with short needles (1-2 cm).

Balsam poplar (*Populus balsamifera*): This medium sized tree (up to 25m tall) is usually found in moist depressional areas and along streams, rivers, and floodplains.

Black cottonwood (Populus balsamifera subsp. trichocarpa): The largest American poplar, these trees grow to a height of 30-60m (USDA Plants). Black cottonwood is found bordering streams and along the shores of the Cook Inlet. (TNC)

White spruce (*Picea glauca*): This tree is found on well-drained moise soils, and is widespread throughout the district. White spruce reaches 7-20 m in height, with branches having a bottlebrush appearance due to arrangement of the stiff, short needles (Plants of the Western Forest).

Quaking aspen (*Populus tremuloides*): This small deciduous tree (up to 20m tall) is common in upland forests of the district and grows best in well-drained, moist, loamy soils. Stands are formed by a tree sending up suckers from an extensive shallow root system (Plants of the Western Forest).

Paper birch (*Betula papyrifera*): A small deciduous tree (up to 15m) with bark that peels off in papery strips. This tree is found in dense woodlands and grows on well-drained moist sites (Plants of the Western Forest).

Western hemlock (*Tsuga heterophylla*): Although this evergreen is not common in the district, Western hemlock is of note because its presence in the

district is unique. Two small stands of western hemlock near village of Tyonek, the most westerly and northerly stands of hemlock in North America – TNC has restricted their harvest (TNC)

Bluejoint grass (*Calamagrostis canadensis*): This species is common both in open forest stands and wetlands. A bunch forming perennial, plants can grow 60-120 cm tall (Plants of the Western Forest).

Invasive Plants

Splitlip Hempnettle (*Galeopsis bifida*): Ability to reduce availability of soil moisture and nutrients also retards ability for native plants to establish in disturbed areas. Can grow in lowlight conditions and shade out underlying vegetation. Create dense populations of over 400 plants per square meter. Each plant is capable of producing 10,000 seeds under certain circumstances. Seeds can be spread by wind and water, as well as animal fur and through excrement from ingestion of seeds. Seeds can be spread by farm machinery after contamination of crop seed. This invasive Grows well in disturbed and sparsely vegetated areas, and does not grow as well in established vegetation. Hempnettle has been observed growing in riparian areas, lakeshores and sloughs. Hempnettle is native to Europe and Asia. (AKEPIC assessment)

Foxtail Barley (*Hordeum jubatum*)**:** Records indicate that Foxtail Barley is native to eastern interior Alaska, prior to human activity. This plant has spread due to anthropogenic disturbance. Foxtail Barley reduces soil salinity by accumulating high amounts of salt in leaves and stems. 2/3 of seeds are still viable after being buried in soil for over a year. Seeds are able to disperse over long distances by wind and animals. Planted as an ornamental, Foxtail barley has the potential to be an agricultural contaminant. Foxtail Barley is prevalent in areas with high water tables and high soil salinity. Once established, it is extremely difficult to eradicate. Planting disturbed areas with desirable plants and controlling water levels is an effective means of reducing populations. (AKNHP, UAA)

Quack Grass (*Elymus repens*)**:** This species limits regeneration of native woody plants, croplands, rangelands, pastures and grasslands by forming dense stands. Quack Grass reduces soil moisture and limits available nutrients. The species begins to photosynthesize in early spring and out-competes plants which photosynthesize later. Quack Grass is allelopathic, exuding toxins from shoots and roots, suppressing growth and reproductive success of surrounding vegetation. By

dominating recently burned areas, it may alter secondary succession following fires. Quack Grass reproduces sexually via seeds which can remain dormant in the soil for 2-3 years and can reproduce vegetatively from a shallow mass of rhizomes. A typical stem produces 20-40 seeds each but may produce up to 400 per stem. Plants can spread up to 3m annually and produce 200+ new shoots. The species readily colonizes disturbed areas but can also colonize undisturbed grassland (AKNHP)

Reed Canary Grass (*Phalaris arundinacea*)**:** Create dense stands in wetland habitats and displace native vegetation. Promotes silt deposition, causing waterway constriction. Has potential to alter soil hydrology. This species establishes in disturbed areas, usually involved with the alteration of a hydrologic system. Seeds have no long distance dispersal mechanism but do have the ability to travel via water pathways. Has been planted intentionally as a forage crop and for use in erosion control. Canary Grass grows best in fine to medium textured soils that are generally neutral in pH to slightly acidic. It is shade intolerant but can withstand temperatures as low at -39 degrees Celsius. No herbicides currently exist that are species-specific enough to use in wetlands without negatively affecting wetland habitat. Plants reestablish quickly after removal and currently there are no feasible biological controls for use in management (AKNHP).

Orange Hawkweed (*Hieracium aurantiacum*)**:** Creates dense monocultures, choking out native vegetation and reducing habitat and biodiversity. In addition to being allelopathic, hawkweed reduces soil moisture and nutrient availability. New plants can sprout from any root fragments left in the soil. Hawkweed freely hybridize with native and invasive members of *Hieracium* . Often planted as an ornamental in urban areas, the species has the ability to disperse by wind, animals and humans.

Mowing down hawkweed only promotes flowering and vegetative spread and does nothing to inhibit growth of the plant. This species grows best in coarse, well drained soils, in full sunlight to moderate shade (AKNHP).

Narrowleaf Hawksbeard (*Crepsis tectorium*)**:** A Highly aggressive plant that displaces native species by creating dense stands, capable of reaching densities of 300 plants per square meter. This species is associated with insect pests, parasites, fungi and

diseases. Narrowleaf Hawksbeard may out-compete native plants for pollinators in the Hymenoptera order. Likely to reduce moisture availability in soil and delay the establishment of native species in the wake of natural disturbances. A single plant can produce anywhere from 3,000 to 49,000 seeds. Seeds are capable of long distance dispersal via wind and water or in combination with their ability to attach to animals. Narrowleaf Hawksbeard readily establishes within disturbed areas, both of natural and anthropogenic origins. This species can grow in a wide range of soil conditions and climates (AKNHP).

Canada Thistle (*Cirsium arvense*)**:** Competes for water and nutrients and displaces native vegetation and reduces species diversity. Canada thistle is allelopathic, producing chemicals which displace native species. Pollinating insects are more apt to pollenate the Canada thistle vs. surrounding native vegetation. Plays host to bean aphid, stalk borer and sod-web worm, all pests. Has potential to increase fire frequency due to its easily ignitable litter. A single plant can produce up to 40,000 seeds. However, Canada thistle has a difficult time establishing itself in undisturbed areas. Seed dispersal may occur through a number of means, from being a hitchhiker on vehicles or farm equipment, to contaminating crop seed and hay. The seeds also float, allowing them to be dispersed along bodies of water. Canada thistle is capable of growing in most soil types, however it is not a shade tolerant species. Distribution of Canada thistle is nearly worldwide, with the exception of Antarctica (AKNHP Species Bio Page)

Nonnative Conifers: Nine nonnative boreal conifers in three genera (Abies, Larix, and Pinus) have been introduced to mainland Alaska. Lodgepole pine (*Pinus contorta var. latifolia Engelm.*) and the Siberian larches (*Larixsibirica Ledeb.* and *L.sukaczewii* N. Dyl.) were the most widely introduced species and may be the first nonnative conifers to become naturalized in the state (Alden, 2006).State forestry programs have also experimented with non-native conifer species in test plots around the state. Most naturalized tree species are non-invasive (Alden, 2006). Historically, the primary reasons for introducing nonnative species were to increase wood yields for industrial forestry. Introduced nonnative tree species can enrich biodiversity and improve the productivity of low-diversity forests, in terms of yield and growth rate (Andersson and Rosvall 1999, from Alden, 2006). Due to the non-invasive nature of most boreal conifers, these species are not currently a priority concern to conservation efforts within the 16B region.

*Surveys have been conducted in both the Village of Tyonek and Skwentna, a list of the known invasive plant infestations can be found at: http://aknhp.uaa.alaska.edu/maps/akepic/, and a list of invasive tree populations can be found by visiting www.fs.fed.us/pnw/pubs/pnw_gtr664.pdf. Included next in the Appendix is the report documenting the Tyonek invasive plant survey in 2010.

NRCS Natural Resources Conservation Service

ALASKA ASSOCIATION OF CONSERVATION DISTRICTS

Pest Management Work Plan

Conservation Practice Job Sheet *AK- 595-AACD*

What is Pest Management?

- Pest management is using environmentally sensitive prevention, avoidance, monitoring and suppression strategies to manage weeds, insects, diseases, animals and other organisms that directly or indirectly cause damage or annoyance.

Purposes

Pest management systems are applied as part of a Resource Management System or as a stand-alone plan to support one or more of the following:

- Enhance the quantity and quality of agricultural commodities.
- Minimize the negative impacts of pest control on soil, water, air, plant, animal and human resources.
- Reduce the spread of invasive and noxious weeds.

Pest Management Includes

- Evaluating the environmental risk of pest management off-site.
- Providing mitigation alternatives to minimize the environmental risk
- Adoption of Integrated Pest Management (IPM) methods.
- Implementation of a pest management component of an overall conservation plan.

Benefits

Pest management systems:

- Maximize economic returns.
- Minimize environmental risks.
- Improve food, water, and air quality.

Resource Management Systems

Pest management should be used as a component of a resource management system (RMS). It should be used in conjunction with crop residue management, nutrient management, conservation buffers, and other conservation practices, which are applied on a site-specific basis to address both natural resource concerns and the landowner's objectives.

General Criteria

- Utilize IPM strategies that strive to balance economics, efficacy, and environmental risks where available.

- Implement mitigation and management techniques to address the environmental risks of pest management activities. These techniques are incorporated in the attached specification.
- When applying cultural or mechanical control methods of pest management, crop rotation, residue management, and other practices, must comply with the rest of the conservation plan or with land owner objectives.
- When developing alternatives and applying chemical controls of pest management, the following will apply:

  1. Utilize pesticide label instructions when developing chemical control alternatives. Pay special attention to environmental hazards and site-specific application criteria.

  2. An appropriate set of mitigation techniques must be used to address risks to humans and non-target aquatic and terrestrial plants and wildlife when using any pesticide that has significant potential to negatively impact important water resources, appropriate mitigation techniques are incorporated in the attached specification and should be utilized along with label instructions to prevent negative environmental impacts.

- Methods of pest management must comply with Federal, State, and local regulations.

Plans and Specifications

Practice specifications are provided to ensure that pest management and system components meet the resource needs and landowner's objectives. The specifications are based on the crop sequence/rotation or existing cover, target pests, soils, and application methods used by the applicator. These requirements are recorded on page 3 and 4 of this job sheet.

The pest management component of a conservation plan or a stand-alone pest management plan shall be prepared in accordance with the criteria of the NRCS 595 Standard and shall describe the requirements for applying the practice to achieve its intended purpose(s).

Minimum components:
- plan map
- soil map
- location map
- location of sensitive resources and setbacks
- operation and maintenance requirements
- Adequate mitigation techniques to minimize risk of off-site movement of pesticides.

Operation, Maintenance, and Safety

- o Review and update the plan before implementation to incorporate new IPM technology, respond to pest complex changes, and avoid the development of pest resistance.
- o See attached safety guidelines for the information on safe operation of power tools and gardening tools.
- o See attached Pesticide Safety Manual for tips on avoiding exposure, if chemical application is selected as a control method
- o Maintain mitigation techniques identified in the plan in order to ensure continued effectiveness.
- o Follow federal, state, and local label requirements for mixing/loading setbacks from wells, intermittent streams and rivers, natural or impounded ponds, lakes, or reservoirs.
- o Post signs according to label directions and/or Federal, State, tribal and local laws around sites that have been treated. Follow restricted entry intervals.
- o Dispose of pesticides and pesticide containers in accordance with label directions and adhere to Federal, State, and local regulations.
- o Read and follow label directions and maintain appropriate Material Safety Data Sheets (MSDS).
- o Calibrate application equipment according to Extension and/or manufacturer recommendations before each seasonal use and with each major chemical change.
- o Replace worn nozzle tips, cracked hoses, and faulty gauges.
- o Maintain records of pest management for at least two years. Pesticides application records shall be in accordance with USDA Agricultural Marketing Service's Pesticide Record Keeping Program requirements.

» For human exposure questions in Alaska contact the:

Name: **ORGEON POISON CONTROL CENTER**

Phone: **1-800-222-1222**

» The National Pesticide Telecommunications Network (NPTN) telephone number in Corvallis, OR, is available:

1-800-424-7378

(6:30a.m. – 4:30p.m. Mon. – Fri., Pacific Time)

For information on exposure of chemicals to animals contact:

Your local veterinarian or American Society for the Prevention of Cruelty to Animals (ASPCA): **1-888-426-4435**.

Operation, Maintenance, and Safety

» For emergency assistance with agrochemical spills, the local contact is:

» Remember to always bring the label or chemical names to medical office if exposure occurs and requires medical attention

Name: DEC Area Response Team (Central Alaska)

Phone: 907-269-3063

Fax: 907-269-7648

Location: Anchorage, Alaska

Outside normal operation hour's call:

1-800-478-9300

The nearest hazardous waste disposal facility is:

Municipality of Anchorage: Hazardous Waste Disposal

1111 East 56th Avenue

Anchorage, AK 99518-1754

907-343-6262

www.muni.org

The National 24-hour CHEMTREC telephone number for emergency assistance is:

1-800-424-9300

» For an animal emergency contact the national Animal Poison Control Center:

1-800-548-2423

(There may be a fee for service.)

Pest Management Guidelines

Provide adequate plant nutrients and soil moisture and favorable pH and soil conditions to reduce plant stress, improve plant vigor, and increase the plant's overall ability to tolerate pests.

- Diversify treatment methods to minimize the development of pest resistance.
- Delay pesticide applications when climatic conditions are conducive to offsite pesticide movement.
- Apply conservation practices and management techniques that reduce runoff and erosion.
- Use conservation buffers to reduce offsite movement of pollutants.
- Prevent disruption of Native American artifacts and other cultural resources with land disturbing activities.

PEST MANAGEMENT DESIGN AND SPECIFICATIONS

Landowner: Tyonek
Date: 8/27/10
Assisted by: AJ Hoffman, Jen Kain, Darcy Etcheverry, Jennifer Robinette
GPS Coordinates: (*See Notes)
Land Cover: (see maps)
Predominant soil: (See soils map)
Size of Area to be Treated: To be determined once survey is completed (See Notes**)

PURPOSE (Check all that apply)					
X	Invasive Weeds	X	Minimize negative impact on soil, water, air, plant, animal & humans	X	Other Survey for other suspected invasives

Target Pest Name	**Survey:** White Sweet Clover Melilotus alba, White Clover Trifolium repens, Alsike clover Trifolium hybridum, Bird Vetch Vivia cracca, Big Leaf Lupine Lupinus polyphyllus, Hawkweeds Hieracium sp. , Common Tansy Tanacetum vulgare, Pinapple weed Matricaria discoidea,Thistles Cirsium sp., Oxeye daisy Leucanthemum vulgare, Hawkbit Leontodon spp., Reed Canary Grass Phalaris arundinacea and Hemp Nettle Galeopsis tetrahit
Management method (selected alternative)	A survey was conducted with the IPC and the Roving Weed Crew throughout the Tyonek, or Tebughna Tribal area. After Survey is conducted control plan will be discussed with the Tribe to determine the best possible solution for controlling the discovered colonies of invasive weed colonies as well as prevention methods to help control future infestations before they become an environmental issue. **Control:** Mechanical control such as hand pulling will be utilized in conjunction with Early Detection Rapid Response if it is determined that mechanical controls will be effective on the given invasive species. Survey will be conducted as an educational outreach workshop to teach the people from village as well as children from local school how to identify and control invasive weeds. (See Notes ***)
Application techniques (i.e., rate, timing, and method)	Survey and when applicable a Mechanical pull is timed in late August so detection can be monitored, controlled, and documented throughout the rest of this year's growing season. Land is being surveyed as an initial survey to provide the local people of Tyonek with educational tools to be able to implement and identify invasive plants within their community. Areas of future development will be surveyed for negative data so the people of Tyonek have the data to be able to trace how the invasive plants are introduced in future years
Additional specifications	• Village of Tyonek has multiple methods for receiving goods from larger communities. These areas will be a major point to inspect and survey during the IP outreach. • The air strip was heavily surveyed due to the amount and different varieties of invasive plants found at the Anchorage Airport. • The wood chip or industrial park in Tyonek is also another high priority area to be surveyed for invasive plants due to the barge dock located at this site.

Standard Mitigation Techniques	**Use of IPM Techniques:** Use appropriate non-chemical control methods whenever possible by combining pest scouting and immediate control of small infestations of invasive weeds by hand pulling or other cultural/mechanical methods. **Application Timing:** Avoid applying pesticides during periods of heavy rains or during windy conditions. By avoiding adverse weather conditions mitigation of 100 percent of losses to surface waters is possible. **Formulations and Adjuvants:** Adjuvants (additives) can enhance plant uptake of pesticides. Increasing plant uptake helps prevent runoff and leaching. Adjuvant is a broad term and includes surfactants, crop oils, antifoaming agents, stickers, and spreaders. Pesticide formulation describes the physical state of a pesticide and determines how it will be applied. Formulation differences, in some cases, can significantly reduce runoff losses. **Lower Application Rates:** Reducing the rate of pesticide application or using the lowest recommended rate is usually the most effective way to lower pesticide concentration and losses to water resources. **Partial Treatment or Spot Spraying:** Partial applications that lower the overall per-area application rate result in well-documented reductions in pollution potential. **Setbacks:** Setbacks are specified distances that must be maintained between those areas where pesticides are applied and nearby water resources. Setbacks are a simple and practical mitigation technique to protect water resources and biota. It is well documented that setbacks of 33 feet for ground sprays and 330 feet for aerial applications, are effective to protect nearby water resources.
Other Information: Invasive Plant Coordinators were invited to come to Tyonek and educate the people about invasive plants and the different methods of identifying the different invasive species. The Invasive Plant Coordinators are also putting a presentation together for the youth of the community, and different methods youth can use to help control and identify invasive plant colonies.	

Pest Management Job Sketch

- Draw or sketch the planning unit- show any sensitive areas and required setback zones, buildings. Indicate field location and acres.
- Include other relevant information-complementary practices or adjacent field conditions

SEE ATTACHED MAP

Perform the following operations and maintenance:

- Maintain pest management records in accordance with USDA requirements. Retain for a
- Handle all pesticides with caution and wear appropriate protective clothing according to
-

Pest Management Narrative:

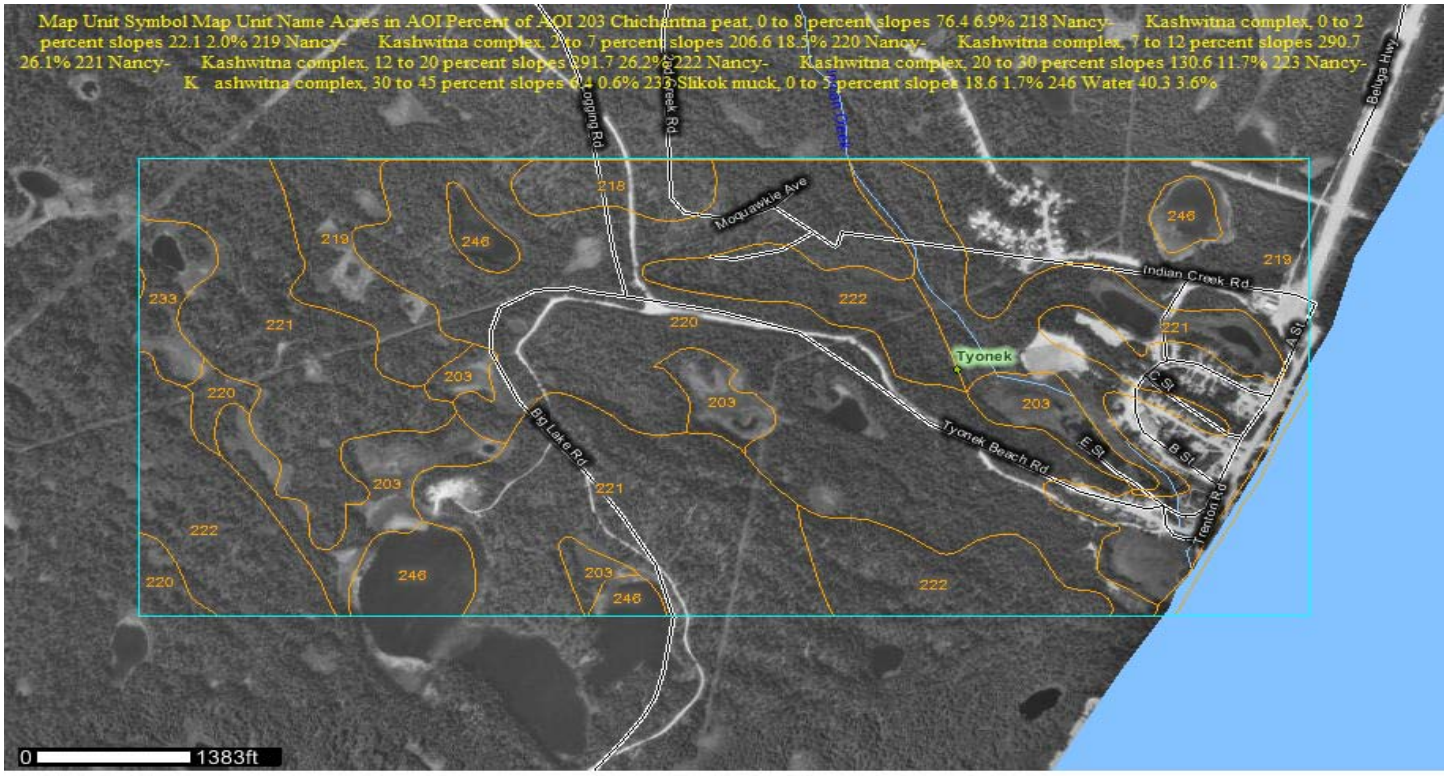
- Additional description of selected alternatives
- IPM opportunities, overall conservation plan integration issues

Notes:

- GPS coordinates will be updated once area of infestation is surveyed by IP Coordinator
    - IP Coordinators landed at the following GPS coordinates:
    - The other GPS infestations are attached to work plan
    - Area is being surveyed as initial survey and as an educational outreach to the people of the Tyonek community. Invasive Plants found during the educational outreach and survey will be documented as well as shown to the locals and effective control methods will be discussed.
    - The IP Coordinators will provide Tyonek with follow up plans as well as control methods for the Invasive Plants that are located within the Anchorage and Kenai Area so the village can utilize Early Detection Rapid Response and prevent further spreading of invasive colonies

Follow Up Plan:

- See follow up plan section attached to work plan.
- The IP Coordinators provided the Village of Tyonek with contact numbers of agencies and personnel around Alaska that can be an asset to their Invasive Plant problems in the future.



Yentna Area, Alaska (AK631)

Map Unit Symbol Map Unit Name Acres in AOI Percent of AOI 203 Chichantna peat, 0 to 8 percent slopes 34.9 4.0% 219 Nancy-Kashwitna complex, 2 to 7 percent slopes 92.5 10.7% 220 Nancy-Kashwitna complex, 7 to 12 percent slopes 268.4 30.9% 221 Nancy-Kashwitna complex, 12 to 20 percent slopes 206.8 23.8% 222 Nancy-Kashwitna complex, 20 to 30 percent slopes 99.1 11.4% 223 Nancy-Kashwitna complex, 30 to 45 percent slopes 11.1 1.3% 236 Starichkof peat, 0 to 7 percent slopes 5.4 0.6% 246 Water 33.3 3.8%

Waypoints of known infestations in Tyonek Area

Waypoints of Infestations:

Latitude	Longitude	Elevation	Invasive Plant Code/ Common Name/ Scientific name
61.06761	-151.14046	41	GABI3/ Splitlip hempnettle/ Galeopsis bifida
61.06761	-151.14046	41	PLMA2/ Common Plantain/ Pantago Major
61.06761	-151.14046	41	TAOFO/ Common Dandelion/ Taraxacum officinale
61.06761	-151.14046	41	MADI6/ Disc Mayweed/ Matricaria discoidea
61.06761	-151.14046	41	STME2/ Common Chickweed/ Stellaria media
61.06791	-151.13681	41	CABU2/ Shepards Purse/ Capsella bursa-pastoris
61.06791	-151.13681	41	POAV/ Prostrate knotweed/ Polygonum aviculare L.
61.06791	-151.13681	41	MADI6/ Disc Mayweed/ Matricaria discoidea
61.06791	-151.13681	41	TAOFO/ Common Dandelion/ Taraxacum officinale
61.06791	-151.13681	41	PLMA2/ Common Plantain/ Pantago Major
61.06791	-151.13681	41	HOJU/ Foxtail barley/ Hordeum jubatum L.
61.06791	-151.13681	41	GABI3/ Splitlip hempnettle/ Galeopsis bifida
61.06791	-151.13681	41	CHALA/ Lambsquarter/ Chenopodium albulm L.
61.07091	-151.13783	52	GABI3/ Splitlip hempnettle/ Galeopsis bifida
61.07091	-151.13783	52	CABU2/ Shepards Purse/ Capsella bursa-pastoris
61.07091	-151.13783	52	MADI6/ Disc Mayweed/ Matricaria discoidea
61.07091	-151.13783	52	STME2/ Common Chickweed/ Stellaria media
61.07091	-151.13783	52	PLMA2/ Common Plantain/ Pantago Major
61.07091	-151.13783	52	TAOFO/ Common Dandelion/ Taraxacum officinale
61.07091	-151.13783	52	TRRE3/ White clover/ Trifolium repens L.
61.07049	-151.13565	-52	HOJU/ Foxtail barley/ Hordeum jubatum L.
61.07049	-151.13565	-52	TAOFO/ Common Dandelion/ Taraxacum officinale
61.07049	-151.13565	-52	MADI6/ Disc Mayweed/ Matricaria discoidea
61.07049	-151.13565	-52	PLMA2/ Common Plantain/ Pantago Major
61.07049	-151.13565	-52	POAV/ Prostrate knotweed/ Polygonum aviculare L.
61.07049	-151.13565	-52	RUAC3/ Common sheep sorrel/ Rumex Acetosells L.
61.07049	-151.13565	-52	STME2/ Common Chickweed/ Stellaria media
61.07259	-151.13998	62	TAOFO/ Common Dandelion/ Taraxacum officinale
61.07455	-151.14684	61	MADI6/ Disc Mayweed/ Matricaria discoidea
61.07455	-151.14684	61	TAOFO/ Common Dandelion/ Taraxacum officinale
61.07455	-151.14684	61	PLMA2/ Common Plantain/ Pantago Major
61.07455	-151.14684	61	STME2/ Common Chickweed/ Stellaria media
61.06781	-151.17293	132	TRRE3/ White clover/ Trifolium repens L.
61.05713	-151.17361	160	TRRE3/ White clover/ Trifolium repens L.
61.0464	-151.17719	35	HOJU/ Foxtail barley/ Hordeum jubatum L.
61.0464	-151.17719	35	PLMA2/ Common Plantain/ Pantago Major
61.0464	-151.17719	35	TRRE3/ White clover/ Trifolium repens L.
61.05665	-151.2597	195	TRRE3/ White clover/ Trifolium repens L.
61.04516	-151.17799	-7	HOJU/ Foxtail barley/ Hordeum jubatum L.
61.06652	-151.13994	94	ELRE4/ Quackgrass/ Elymus repens L.
61.06652	-151.13994	94	CIAR4/ Canada thistle/ Cirsium arvense L.

61.06652	-151.13994	94	CRTE3/Narrowleaf Hawksbeard/ Crepis tectorum L.
61.06652	-151.13994	94	PLMA2/ Common Plantain/ Pantago Major
61.06652	-151.13994	94	TAOFO/ Common Dandelion/ Taraxacum officinale
61.06652	-151.13994	94	TRRE3/ White clover/ Trifolium repens L.
61.04543	-151.17526	0	TRRE3/ White clover/ Trifolium repens L.
61.04543	-151.17526	0	HOJU/ Foxtail barley/ Hordeum jubatum L.
61.04543	-151.17526	0	PLMA2/ Common Plantain/ Pantago Major
61.07663	-151.15495	-52	MADI6/ Disc Mayweed/ Matricaria discoidea
61.06602	-151.17915	115	PLMA2/ Common Plantain/ Pantago Major
61.06602	-151.17915	115	TAOFO/ Common Dandelion/ Taraxacum officinale
61.06727	-151.13992	37	TAOFO/ Common Dandelion/ Taraxacum officinale
61.06727	-151.13992	37	PLMA2/ Common Plantain/ Pantago Major
61.06727	-151.13992	37	CRTE3/Narrowleaf Hawksbeard/ Crepis tectorum L.
61.06758	-151.14308	23	CHALA/ Lambsquarter/ Chenopodium albulm L.
61.06758	-151.14308	23	CABU2/ Shepards Purse/ Capsella bursa-pastoris
61.06758	-151.14308	23	PLMA2/ Common Plantain/ Pantago Major
61.06758	-151.14308	23	TAOFO/ Common Dandelion/ Taraxacum officinale
61.06758	-151.14308	23	STME2/ Common Chickweed/ Stellaria media
61.06758	-151.14308	23	MADI6/ Disc Mayweed/ Matricaria discoidea
61.06758	-151.14308	23	GABI3/ Splitlip hempnettle/ Galeopsis bifida
61.06758	-151.14308	23	POAV/ Prostrate knotweed/ Polygonum aviculare L.
61.06758	-151.14308	23	TRRE3/ White clover/ Trifolium repens L.

Photo is of Canada Thistle outside Tribal Council building

Wildlife Data & Resources

USDA has recognized subsistence as a means of culture, tradition, and livelihood. EQIP standards state in 515.51 (F) that "Subsistence producers: Individuals and families engaged in agricultural production for subsistence purposes are eligible for EQIP if they meet the requirements of (***See*** 440-CPM, Section 515.51(c))," therefore, individuals from tribal communities are eligible for USDA programs if production exceeds $1,000. (USDA NRCS)

Chronology of Subsistence Management in Alaska

Pre-1867	For thousands of years, Alaska Natives harvest fish and wildlife resources.
1867-1959	Following the Alaska Purchase, the Federal government manages Alaska's fish and wildlife resources.
1960	The Federal government transfers the authority to manage fish and wildlife in Alaska to the new State government.
1971	Congress passes the Alaska Native Claims Settlement Act, (ANCSA) which conveys to Alaska Natives title to more than 40 million acres of land and nearly $1 billion in compensation. ANCSA also extinguishes aboriginal hunting and fishing rights. The Conference Committee report expresses the expectation that the Secretary of the Interior and the State of Alaska would take the action necessary to protect the subsistence needs of Alaska Natives.
1978	State subsistence law creates a priority for subsistence use over all other uses of fish and wildlife, but does not define subsistence users
1980	Congress passes the Alaska National Interest Lands Conservation Act (ANILCA), which protects the subsistence needs of rural Alaskans.
1982	The Alaska Board of Fisheries and Game adopts regulations creating a rural subsistence priority. The State program is in compliance with ANILCA.

1989	The Alaska Supreme Court rules that the rural residency preference violates the Alaska Constitution.
1990	The Federal government begins managing subsistence hunting, trapping and fishing on Alaska's Federal public lands and non-navigable waters.
1992	The Federal government adopts final subsistence management regulations for Federal public lands.
1993	Federal Regional Advisory Councils are established.
1995	The Ninth Circuit Court of Appeals rules that the Federal Subsistence Board should expand its management of subsistence fisheries to include all navigable waters in which the United States holds reserve water rights, such as waters on or next to wildlife refuges, national parks, and national forests. Congressional moratoriums prevent this ruling from taking effect until October 1, 1999.
1999	Federal subsistence management expands to include fisheries on all Federal public lands and waters. (alaska.fws.gov/asm/shared/chron.htm)

"The current rural subsistence harvest is about 354 pounds of food per person per year. That is more than the U.S. average consumption of 255 pounds of domestic meat, fish, and poultry per year. (The average American uses a total of 1,371 pounds of all foods a year.) However, there are other important uses of subsistence products, such as:

- Clothing: Wild furs and hides are still the best materials for ruffs (wind guards), mitts, parkas, kuspuks, clothes lining, and mukluks (winter boots) in many regions.
- Fuel: Wood is a major source of energy in rural homes, and is used for smoking and preserving fish and meat.
- Transportation: Fish, seals, and other products are used to feed dog teams.
- Construction: Spruce, birch, hemlock, willow, and cottonwood are used for house logs, sleds, fish racks, and innumerable other items.
- Home goods: Hides are used as sleeping mats. Seal skins are used as pokes to store food. Wild grasses are made into baskets and mats.

- Sharing: Fish and wildlife are widely given out to support neighbors who cannot harvest for themselves because of age, disability, or other circumstances.
- Customary trade: Specialized products like seal oil are bartered and exchanged in traditional trade networks between communities. Furs sold to outside markets provide an important source of income to many rural areas.
- Ceremony: Traditional products are used in funerals, potlatches, marriages, Native dances, and other ceremonial occasions.
- Arts and Crafts: Ivory, grass, wood, skins, and furs are crafted into beautiful items for use and sale.
- All of these uses of wild resources are recognized and protected in law. Subsistence is a rich pattern of living, of which food is but one important part (www.blm.gov/ak/st/en/prog/subsistence.html)."

Management

- Management of subsistence fishing in state of Alaska-managed fisheries is handled by the Alaska Department of Fish and Game, Division of Commercial Fisheries (www.adfg.alaska.gov/index.cfm?adfg=subsistence.fishing).
- Management of subsistence fishing in Alaska became a bit more complex, however, when in 1990 the Federal government began managing subsistence hunting, trapping, and fishing on Alaska's Federal public lands and non-navigable waters, and again in 1999, when federal subsistence management expanded to include fisheries on all Federal public lands and waters (www.adfg.alaska.gov/index.cfm?adfg=subsistence.fishing).

List of Invasive Animal Species

*Description of 'Invasiveness Risk' is based on biological and physical scoring criteria for invasive fitness. Criteria for scoring are described in 'Non-native and Invasive Animals of Alaska: A Comprehensive List and Select Species Status Reports' by McClory and Gottarhdt 2008

Taxon	Scientific Name	Common Name	Invasiveness Risk*
Amphibian	*Pseudacris regilla*	Pacific chorus frog	Low
Amphibian	*Rana aurora*	Red-legged frog	High
Birds	*Strix varia*	Barred Owl	
Birds	*Colinus virignianus*	Bobwhite Quail, Northern Bobwhite	
Birds	*Molothrus ater*	Brown-headed Cowbird	
Birds	*Alectoris chukar*	Chukar	
Birds	*Streptopelia decaocto*	Eurasian Collared Dove	
Birds	*Carpodacus mexicanus*	House Finch	
Birds	*Passer domesticus*	House Sparrow	
Birds	*Lophura leucomelanos, others*	Other pheasants (Mongolian, Nepal, Brown-eared, Kalij, Reeves, Cheer)	
Birds	*Phasianus colchicus*	Ring-necked Pheasant	
Birds	*Columba umbellus*	Rock dove, rock pigeon	Low
Birds	*Sturnus vulgaris*	Starling	Low, High
Birds	*Meleagris gallopavo*	Wild Turkey	
Mammals	*Alopex lagopus*	Arctic fox	
Mammals	*Spermophilus paryii ablusus*	Arctic ground squirrel	
Mammals	*Spermophilus paryii nebulicola*	Arctic ground squirrel	
Mammals	*Castor canadensis*	Beaver	
Mammals	*Bos bison*	Bison	
Mammals	*Rattus rattus*	Black rat, Roof rat	High
Mammals	*Canis latrans*	Coyote	
Mammals	*Peromyscus maniculatus*	Deer mouse	
Mammals	*Felis catus*	Domestic cat	High
Mammals	*Canis familiaris*	Domestic dog	High
Mammals	*Mustela putorius furo*	Domestic ferret	
Mammals	*Cervus canadensis*	Elk	Moderate, High
Mammals	*Oryctolagus cuniculus*	European rabbit	High
Mammals	*Mus musculus*	House mouse	Low, High
Mammals	*Oreamnos americanus*	Mountain goat	
Mammals	*Ovibos moschatus*	Muskox	
Mammals	*Ondatra zibethicus*	Muskrat	
Mammals	*Rattus norvegicus*	Norway rat, Brown rat	High

Mammals	*Procyon lotor*	Raccoon	
Mammals	*Vulpes vulpes*	Red fox	High
Mammals	*Rangifer tarandus asiaticus*	Reindeer	
Mammals	*Bos taurus*	Scottish cattle	
Mammals	*Sus scrofa*	Wild boar, feral swine, feral hogs	High
Parasites	*Trichodectes canis*	Biting dog louse	
Pathogens	*Erwinia amylovora*	Bacterial fire blight	
Pathogens	*Apiosporina morbosa*	Black knot	
Pathogens	*Myxobolus cerebralis*	Whirling disease parasite	
Pathogens	*Cronartium ribicola*	White pine blister rust	
Reptile	*Macrochelys temminickii*	Alligator snapping turtle	

Taxon	**Scientific Name**	**Common Name**	**Invasiveness Risk**
Invertebrates	*Eriocampa ovata*	Alder woolly sawfly	Low
Invertebrates	*Profemusa thomsoni*	Amber-marked birch leafminer	High
Invertebrates	*Fenusa pusilla*	Birch leafminer	Moderate
Invertebrates	*Epinotia solandriana*	Birch leafroller	Moderate
	Heterarthrus nemoratus	Birch-edge leafminer	Low
Invertebrates	*Schizoporella uniconis*	Bryozoan	
Invertebrates	*Heteromastus filiformis*	Capitellid worm	
Invertebrates	*Crassostrea gigas*	Cultured oyster	
Invertebrates	*Nematus ribesii*	Currantworm	Low
Invertebrates	*Adelges piceae*	Eastern spruce gall aphid	Low
Invertebrates	*Arion ater*	European black slug	Low
Invertebrates	*Lymantria dispar*	European gypsy moth, Asian gypsy moth	High
Invertebrates	*Rhyacionia buoliana*	European pine shoot moth	Low
Invertebrates	*Noctua pronuba*	European Yellow Underwing Moth	
Invertebrates	*Arion sp.*	Garden slug	Low
Invertebrates	*Garvia franciscana*	Hydroid	
Invertebrates	*Opercularella lacerata*	Hydroid	
Invertebrates	*Proboscidactila flavicirrata*	Hydroid	
Invertebrates	*Pristiphora erichsonii*	Larch sawfly	High
Invertebrates	*Limax maximus*	Leopard slug	Low
Invertebrates		Oysters	
Invertebrates	*Procambarus clarkii*	Red swamp crayfish	
Invertebrates	*Manayunkia speciosa*	Sabellid worm	

Invertebrates	*Pacifastacus leniusculus*	Signal crayfish	High
Invertebrates	*Schizoporella unicornis*	Single horn bryozoan	
Invertebrates	*Pissodes strobi*	Sitka spruce weevil	Moderate
Invertebrates	*Mya arenaria*	Soft-shelled clam	
Invertebrates	*Elatobium abietinum*	Spruce aphid	Moderate
Invertebrates	*Otiorhynchus ovatus*	Strawberry root weevil	Low
Invertebrates	*Archips cerasivorana*	Uglynest caterpillar	Low
Invertebrates	*Malacosoma californicum*	Western tent caterpillar	High
Invertebrates	*Pikonema alaskensis*	Yellow-headed Spruce Sawfly	

Wildlife References & Resources

http://alaska.fws.gov/asm/shared/chron.htm

http://www.blm.gov/ak/st/en/prog/subsistence.html

http://www.adfg.alaska.gov/index.cfm?adfg=subsistence.fishing