

# The Tyonek Area Watershed Action Plan



An action plan directed by community, reviewed by experts, and implemented in collaboration with the Tyonek Tribal Conservation District, landowners, and numerous partners around the common goal of protecting the natural resources within the Tyonek Area Watershed on the Westside of the Cook Inlet.



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Cover photo: Photo taken August 2016 by John Hagan while flying over the upper bends of the Beluga River within the Tyonek Area Watershed.

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## Vision and Purpose

Tyonek Tribal Conservation District (TTCD) is a non-regulatory, nonprofit 501c3 organization that addresses local issues through community-driven conservation. Our mission is to conserve, enhance, and encourage the wise use of natural resources. The District shares its boundaries with Game Management Unit 16B, and includes Tyonek, Beluga, Alexander Creek, Skwentna, and Shirleyville. TTCD works with landowners and stakeholders in the District to help them achieve their conservation goals.

TTCD was formed in 2005 through an agreement between the Native Village of Tyonek, the Tyonek Native Corporation, and the US Department of Agriculture, and first acquired staff in 2011. The District is guided by three core values: meet the needs of District stakeholders, form cooperative relationships, and use what the earth has to give. TTCD strives to accomplish its mission through cooperative relationships with any and all interested parties.

The Tebughna (“Beach People”) that TTCD serves have fished in the Tyonek area for hundreds of years, and preserving the salmon resource goes hand in hand with preserving the cultural identity of this people. Therefore, protecting fish habitat and supporting healthy salmon populations has been a major priority for TTCD since its formation. In 2013, TTCD applied for funding through the US Fish & Wildlife Service Tribal Wildlife Grant (TWG) Program to develop a Tyonek Area Watershed Action Plan. In 2014, TTCD received funding through the Tribal Wildlife Grant which provided financial support to start this process. In 2015, TTCD received additional funding to support this project through the Natural Resources Conservation Service Regional Conservation Partners Program.

Through the Tyonek Area Watershed Action Plan, Tyonek Tribal Conservation District (TTCD) seeks to restore, enhance, and protect freshwater systems in the Tyonek Area Watershed from Nikolai Creek to Beluga River that support important subsistence resources. The vision for this document was outlined in collaboration with landowners, community members, stakeholders, and experts of the Tyonek Area Watershed. This watershed planning and action effort identified priority watershed resources and the potential threats to those resources, established baseline water quality, fish population, and invasive species monitoring data and methods, completed installation and restoration projects, and developed an action plan outlining goals, objectives, strategies, and tasks for the next ten years.

The Watershed Action Plan was designed as a tool used for TTCD and the Native Village of Tyonek (NVT) to implement watershed conservation projects. This plan is a living document and will be revised every five years by TTCD and partners to evaluate progress and effectiveness of objectives and strategies, update priority projects, concerns, and tasks, and revise the content and list of signatories of the landowner best practices agreement.

## Watershed Description

A watershed is defined as an area of land from which all precipitation and groundwater drains to a common body of water, such as a lake, inlet or ocean. A watershed does not only include waterways, but also the topography through which the water drains. There are many scales to describe a watershed, from a single creek, to an entire network of major rivers.

The Tyonek Area watershed is located on the West side of Cook Inlet in southcentral Alaska, with all waterways draining into Cook Inlet (Figure 1). In deciding on the scope and spatial boundaries of the Tyonek Area Watershed, TTCD chose to focus on the area from Nikolai Creek north to the Beluga River; encompassing all the drainages in between. TTCD selected this area because it includes the majority of the population within the Tyonek Tribal Conservation District, as well as the majority of potential impacts to watershed health.

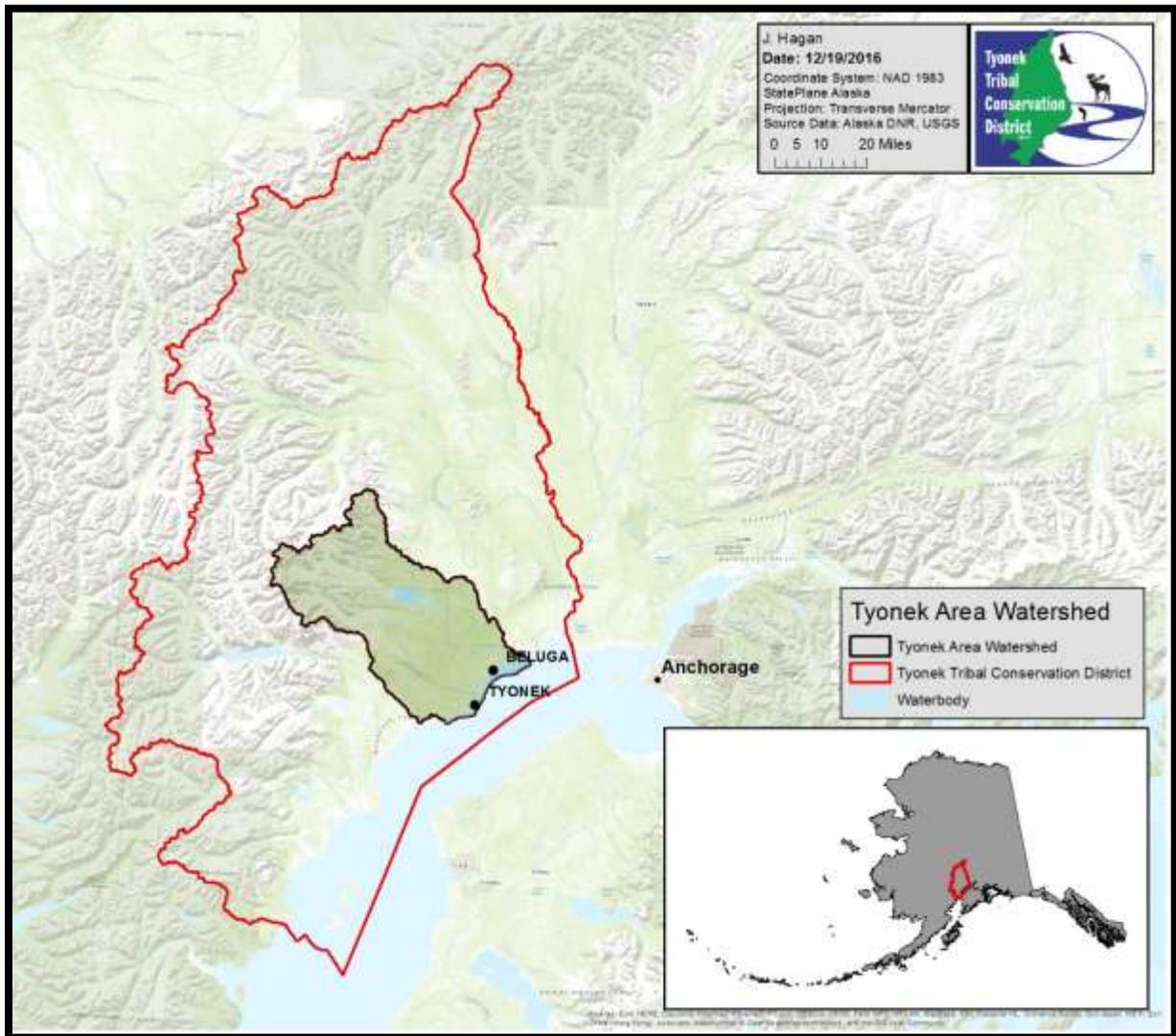


Figure 1: The Tyonek Area Watershed and its location within the Tyonek Tribal Conservation District and Southcentral Alaska.

The Watershed has 378 lakes and approximately 1,624 river miles of freshwater. Within the Watershed are eight subwatersheds: Beluga River, Chuitna River, Coastal Creeks (Roberts, Tyonek and Indian Creeks), Nikolai Creek, Upper Nikolai Creek, Chichantna River, Strandline Lake and Coal Creek. Strandline Lake, Chichantna River and Coal Creek watersheds all flow into Beluga Lake before becoming the Beluga River and reaching Cook Inlet. Upper Nikolai Creek enters Nikolai creek before reaching Cook Inlet, and the Coastal Creeks and the Chuitna River directly enter Cook Inlet (Figure 2).

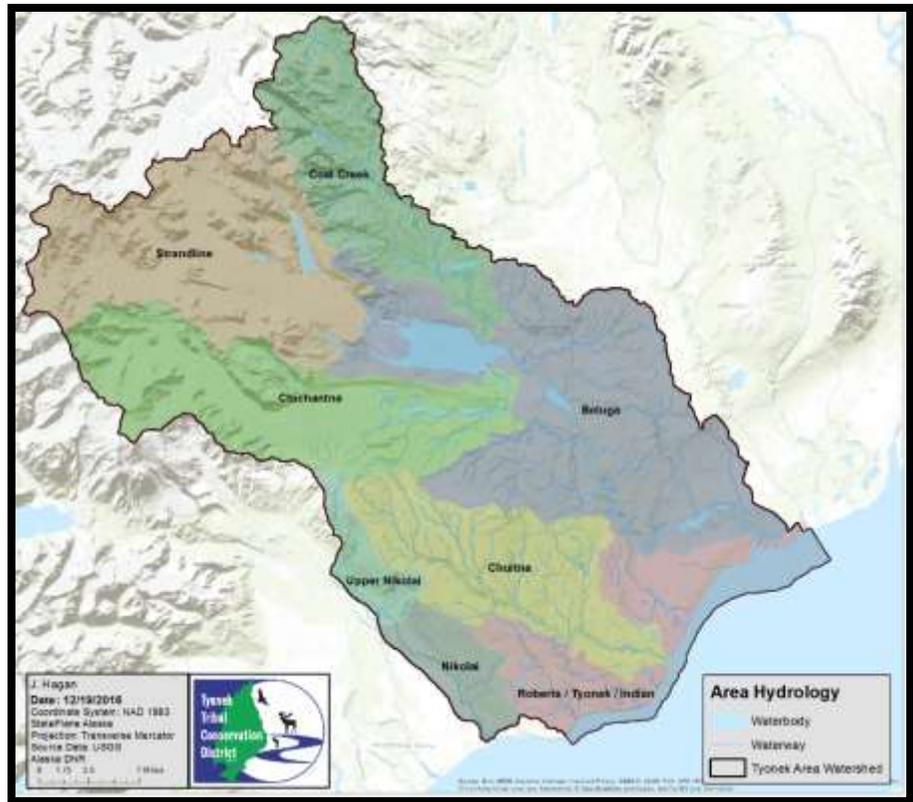


Figure 2: Tyonek Area Watershed subwatersheds.

The two largest sub-watersheds, the Chuitna and Beluga Rivers, are large, complex stream systems with numerous tributaries, forks, and connected lakes. The Beluga River is glacially influenced, while the Chuitna is ground water dominated. The remaining six sub-watersheds are either short, low gradient, coastal run systems or major tributaries of the Beluga River. This diversity within the Watershed provides a diverse array of freshwater habitats.

### Landscape Description

The Tyonek Area Watershed is located between the Tordrillo Mountains and the Cook Inlet, covering an area of 818,909 acres. The regional elevation profile ranges between 9,000 ft. and sea level. The watershed is situated in the Cook Inlet- Eco region and features a diversity of land systems including forest, high brush, tundra, and wetlands. The dominate ground cover is spruce-paper birch-quaking aspen forest, followed by alder and willow shrubs typical of Alaskan lowlands. The Watershed is home to two major glaciers, the Capps and Triumvirate Glaciers, both part of the East Torbert Cirque.

The Tyonek Area Watershed supports a wide diversity of native and non-native fauna. The anadromous waterways of the Watershed support all five species of Pacific salmon: Chinook (*Oncorhynchus tshawytscha*), Sockeye (*Oncorhynchus nerka*), Coho (*Oncorhynchus kisutch*),

Pink (*Oncorhynchus gorbuscha*) and Chum (*Oncorhynchus keta*). In addition to salmon, the region is home to other native fish species: Dolly Varden (*Salvelinus malma*), Rainbow trout (*Oncorhynchus mykiss*), Arctic Grayling (*Thymallus arcticus*), Pacific Lamprey (*Lampetra tridentata*), Slimy Sculpin (*Cottus cognatus*), Stickleback (*Pungitius spp.*), and Eulachon (*Thaleichthys pacificus*). Major subsistence fisheries are focused on Pacific salmon and Eulachon, which are regionally referred to as Hooligan. There is a population of Northern Pike (*Esox lucius*) in a portion of the Watershed, this species is considered highly invasive and was introduced illegally to the region in the 1950's.

The Tyonek Area Watershed supports healthy terrestrial and avian wildlife populations as well. Major subsistence hunting species include Brown (*Ursus arctos*) and Black (*Ursus americanus*) bear, as well as Moose (*Alces alces*). Wolf (*Canis lupus*) are present in the region, as well as Red Fox (*Vulpes vulpes*) and Coyote (*Canis latrans*). There are numerous avian species, many of which use the Watershed as seasonal nesting habitat, this includes waterfowl, raptors and common birds.

## Community Descriptions

Among the abundance of streams, lakes, and rivers within the Tyonek Area Watershed, there are two main communities in which the process for this watershed action plan was influenced; the Native Village of Tyonek and Beluga.

Native Village of Tyonek:

The Native Village of Tyonek (NVT) is a Dena'ina Athabascan village located 43 miles southwest of Anchorage, along Cook Inlet and in the Kenai Peninsula Borough. The population of Tyonek is currently about 190 people, although the actual population within the village may vary during seasonal activities such as active fish camps or large construction projects. The community consists of 85 homes, as well as a health clinic, a school, and a tribal center. The community has a sewer system as well as a Municipal Class III landfill.

Many local residents engage in fishing for subsistence, and several also engage in commercial fishing. NVT employs a large number of residents in administrative and support positions for the village. The Tebughna School employs a few shareholders permanently. Although more economic opportunities are wanted, not all residents approve of large development or commercial projects due to the potential environmental risks.

The road systems in the Tyonek area have been built over time, generally by oil and gas or timber companies, and a majority of the roads on Tyonek Native Corporation land are private. These roads connect to Beluga to the north and Shirleyville to the south. Access is also possible by plane through the airstrip in Tyonek, or by boat.

Beluga:

Beluga is located 40 miles southwest of Anchorage, along Cook Inlet and in the Kenai Peninsula Borough. Beluga is eight miles northeast of Tyonek, and is one of the few communities

accessible to Tyonek by road. The current population is estimated to be 20. Beluga is a primarily non-Native community with a private runway, which provides air access to landowners and other stakeholders. 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. 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:**

The residents of these communities rely heavily on the natural resources within the Tyonek Area Watershed. Much of the flora and fauna in the region including moose, salmon, and wild berries are used for subsistence activities by local communities (Figure 3). In 2013, the average Tyonek household harvested 385 pounds of wild resources annually.<sup>1</sup>

While many subsistence resources are invaluable to the communities within the Watershed, salmon are arguably the most important cultural and nutritional resource within the Tyonek Area watershed. The total subsistence harvest for Tyonek in 2013 was 24,249 pounds, with salmon 69% of the total harvest—16,766 total pounds or 118 pounds per capita. This example depicts a community that is culturally, spiritually, and nutritionally connected to salmon as well as other subsistence resources.

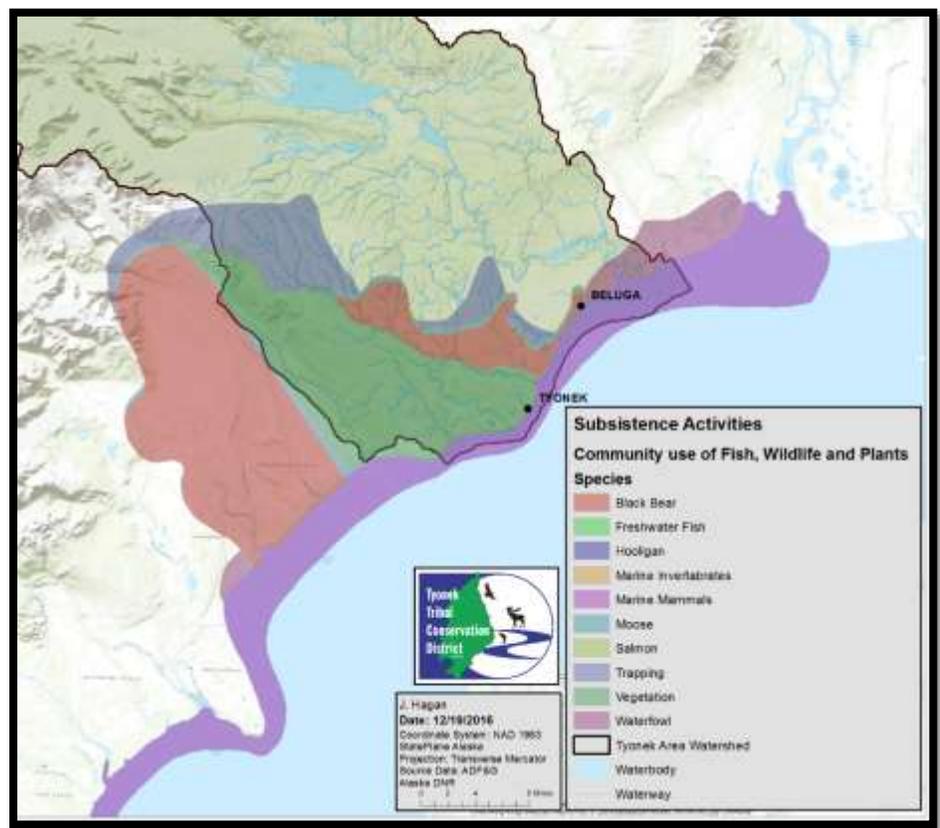


Figure 3: Community use of fish, wildlife and plants in the Tyonek/Beluga region. The regions within the watershed where specific species are harvested is pictured. Since many subsistence species have large ranges and diverse life-histories, these areas shift seasonally.

<sup>1</sup>. Jones, B., D. Holen, and D. S. Koster. 2015. The harvest and use of wild resources in Tyonek, Alaska, 2013. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 404. Anchorage.

## Stakeholders

In addition to these small communities there are numerous stakeholders and landowners that have personal or economic stake in the natural resources of the Tyonek Area Watershed ranging from sport fishing, electric power management, oil and gas development, and other activities. The following list portrays the most influential stakeholders within the Tyonek area watershed.

Tyonek Native Corporation: 45,000 acres

Tyonek Native Corporation (TNC) is an Alaska Native Corporation formed under the Alaska Native Claims Settlement Act of 1971 (ANCSA). The company owns over 190,000 acres of land, primarily on the West side of Cook Inlet in South Central Alaska. TNC has corporate headquarters in Anchorage, Alaska with a satellite office in the Native Village of Tyonek that provides for direct interface with its shareholders.

Cook Inlet Region Inc.: 146,609 acres

Cook Inlet Region Inc. (CIRI) is an Alaska Native Regional Corporation formed under the Alaska Native Claims Settlement Act of 1971 (ANCSA) in settlement of aboriginal land claims. CIRI was incorporated in Alaska on June 8, 1972. Headquartered in Anchorage, Alaska, CIRI is a for-profit corporation, and is owned by more than 7,300 Alaska Native shareholders.

Native Village of Tyonek: 2,059 acres

The Native Village of Tyonek (NVT) is a Dena'ina Athabascan village located 43 miles southwest of Anchorage. Tyonek has long been home to the Tebughna people. Today there are about 190 residents in the village; however, the Tyonek Native Corporation (TNC) has over 800 shareholders.

Alaska Department of Natural Resources: 549,727 acres

The Alaska Department of Natural Resources (DNR), is a department within the state government of Alaska. DNR's mission is to responsibly develop Alaska's resources by making them available for maximum use and benefit consistent with the public interest. DNR manages all state-owned land, water and natural resources, except for fish and game. DNR also owns the freshwater resources of the state, a resource that equals about 40% of the entire nation's freshwater flow.

Alaska Mental Health Trust: 137, 896 acres

Alaska Mental Health Trust is a major land owner in the state of Alaska. In 1956, Congress passed the Alaska Mental Health Enabling Act, entitling the then-Territory of Alaska to select one million acres of federal land to be used for revenue generation to support mental health services. Once Alaska achieved statehood, the Trust retained the land rights. The Alaska Mental Health Trust has a lands management office headquartered in Anchorage, AK.

Kenai Peninsula Borough: 8,690 acres

The Kenai Peninsula Borough was incorporated in 1964 as a second-class borough under the authority of the State of Alaska Borough Act of 1961. The Borough's governmental responsibilities are comparable to those of a county.

Chugach Electric Inc.: 105 acres

Chugach Electric Association is an electric cooperative, owned and democratically controlled by members; co-op members elect their board of directors from within the membership. Chugach Electric owns and operates the Beluga Power Plant located in the community of Beluga west side of Cook Inlet. Power from the plant is sent to the Anchorage power grid and is also available to local residents.

Hilcorp: 8 acres

Hilcorp is one of the largest privately-held oil and natural gas exploration and production companies in the United States. Marathon Oil Company, owned by Hilcorp, has a pipeline right of way easement on TNC lands. The easement contains 63 acres of a fifty foot wide corridor that is 10.45 miles long on Tyonek lands. The term of the agreement is for 30 years, beginning November 25, 1990 and ending November 24, 2020 (unless extended to November 24, 2035). Hilcorp also leases lands from CIRI.

Aurora Gas: Leaseholders

Aurora is a family of privately held companies dedicated to resource development in south central Alaska. Aurora owns and operates all 12 producing wells on TNC land. Aurora is the only lessee with operations on TNC Land.

PacRim Coal: Leaseholders

The Chuitna Coal Project is a proposal submitted by the development corporation PacRim Coal, LLC to create a coal mine and associated infrastructure near Tyonek. The proposed mine itself would cover approximately 5,000 acres of land and including anadromous waterways. PacRim is proposing a lease on Alaska DNR land.

Since formation, TTCD has reached beyond its core group of stakeholders to work closely with a wide variety of partners. TTCD was formed through a cooperative agreement between the Native Village of Tyonek, Tyonek Native Corporation, and USDA, and as such represents a partnership between several entities. TTCD's board of directors includes representatives from Native Village of Tyonek, Tyonek Native Corporation, and Cook Inlet Region, Inc, three of the major stakeholders in the District. Through these diverse partnerships, TTCD has served as a forum for natural resource decision making involving community members, tribal entities, corporations, private landowners, development companies, nonprofits, and more. Through cooperative relationships, TTCD has successfully completed conservation projects and brought partners together in areas where they can find common ground. This strategy will be used in the future to implement the Tyonek Area Watershed Action Plan.



## Process and Partners

### Process

In the development of the Tyonek Area Watershed Action Plan, TTCD defined the following objectives:

1. Monitor the overall health of the Tyonek Area Watershed.
2. Identify current and future threats to the health of the Tyonek Area Watershed.
3. Work with landowners to address current watershed issues.
4. Develop best practices to maintain watershed health.

Incorporating the goals and concerns of community members in both Tyonek and Beluga was a major priority for TTCD in developing the watershed action plan. In 2015, TTCD held community meetings in both Tyonek and Beluga to gather information from local residents. Input gathered from these meetings provided the framework for the plan by defining the top priorities for watershed health. A more in-depth look at the priorities identified for each community is described below in the community concerns section.

After priorities had been identified, TTCD met with partners and set up a scientific advisory committee. This committee assisted in the development of methods to monitor watershed health and of strategies to address issues known to impact watershed health. For more information about the TTCD Scientific Advisory Committee, see the Partners section below.

### Partners

Native Village of Tyonek (NVT):

NVT is the primary partner for this project. As a federally recognized tribe, and as the largest community within the Tyonek Area Watershed, NVT was an important partner in this project. TTCD met with the NVT tribal council, the NVT environmental department, and individual community members throughout the development of this plan.

Tyonek Native Corporation (TNC):

TNC is the primary landowner within the Tyonek Area Watershed, and as such played an important role in this project. In particular, TTCD met with the TNC lands department, as well as the TNC lands committee and TNC board of directors throughout the development of this plan.

Scientific Advisory Committee:

In early 2015, TTCD reached out to experts from many different agencies to join a scientific advisory committee to provide feedback on the development of the Tyonek Area Watershed Action Plan. The group included representatives from:

- US Fish & Wildlife Service

- Alaska Department of Fish & Game
- University of Alaska Fairbanks Extension Service
- Cook Inletkeeper
- Cook Inlet Aquaculture Association

The committee members included experts in hydrology, fish biology, subsistence, invasive plants, invasive pike, water quality, and fish passage. This group met in 2015 and again in 2016 to provide feedback and advice on the development of the plan, strategies, methods, and project planning. TTCD plans to continue to work with the Scientific Advisory Committee in the future as we move forward to implement the Tyonek Area Watershed Action Plan and develop Best Practices.

US Fish & Wildlife Service (USFWS):

US FWS provided financial support for the development of this document through the Tribal Wildlife Grant program, as well as technical support through participation in the TTCD Scientific Advisory Committee.

#### Community Input and Concerns:

The direction for this watershed action plan came directly from community members and stakeholders within the Tyonek Area Watershed. TTCD held community meetings to identify important natural resources and the potential threats to those resources. Feedback was gathered both in written and verbal form and was tallied and organized into concept categories.

Figure 5 displays the written survey provided to community members during meetings in both Tyonek and Beluga, as well as the Tebughna School in Tyonek. Figure 6 and Figure 7 display the results of the community member input from Tyonek where community members were asked to vote for their highest priority concerns of the concerns outlined during the community meeting. Beluga community input was collected through a written survey and verbally during the community meeting and reflected similar concerns to those of Tyonek residents.

Concerns ranged from blocked salmon habitat, waste management issues, air quality, proposed mining developments, wild dogs and more (Figure 7). After tallying votes from community members, three main categories were selected that aim to encompass all concerns and threats to the watershed (Figure 7). As ecosystems are interconnected, so were community concerns for natural resources. Nearly all concerns could be linked back to the cherished resource: salmon. For example, many water quality and invasive species concerns such as dewatering of streams from potential mining developments or invasive pike were directly linked to the related potential impacts on salmon. However, many other concerns and important resources were mentioned and are also represented in the following sections. Examples of other concerns included impacts on moose habitat and berries, threats to drinking water, improper waste management, current and proposed oil and gas developments, climate change, and ATV impacts.

### TTCD Watershed Action Plan

The Tyonek Tribal Conservation District is working with NVT, landowners and partners to develop a watershed action plan for all waterways from Nikolai Creek to Beluga River. The overall goal of this plan is to provide a framework to restore, enhance, and protect the freshwater systems in this area.

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**This project will include the following objectives:**

1. Monitor the overall health of the Tyonek Area Watershed
2. Identify current and future threats to health of the Tyonek Area Watershed
3. Work with landowners to address current watershed issues (i.e. pike, fish passage, invasive plants, etc.)
4. Develop best practices to maintain watershed health

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TTCD is committed to a locally driven, cooperative approach to protecting natural resources. By working closely with all landowners, stakeholders and partners to develop the Tyonek Area Watershed Plan, TTCD plans to address local concerns at the community level and to deal with issues that are of concern for the entire watershed.

To achieve these goals, we need your input!  
Please see the reverse side for a short survey, make your voice heard!

### We need your input!

Please list the top three natural resources that you value and want to protect in your watershed. Next to each, list three current threats or concerns to that resource.

Important resource in your watershed	Threats or concerns for resource
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**Other Suggestions/Solutions:**

Figure 5: Survey previously distributed at each community meeting to gather community input and explain intentions and goals.

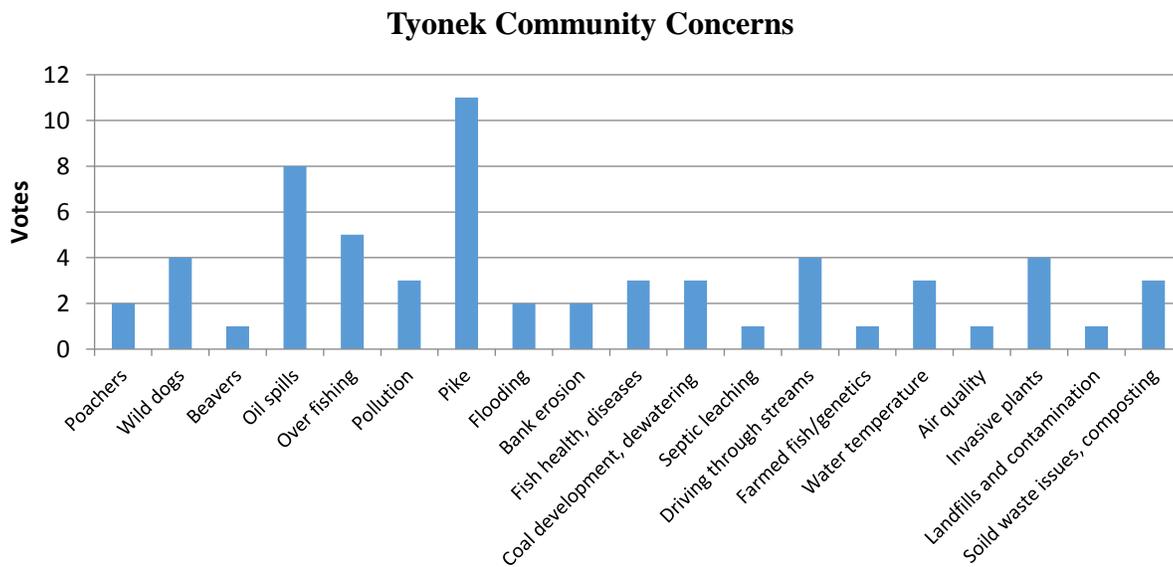


Figure 6: Tyonek community members were asked to voice their concerns for natural resources within their watershed. Once topics had been gathered, each community member was asked to vote on the top three concerns.

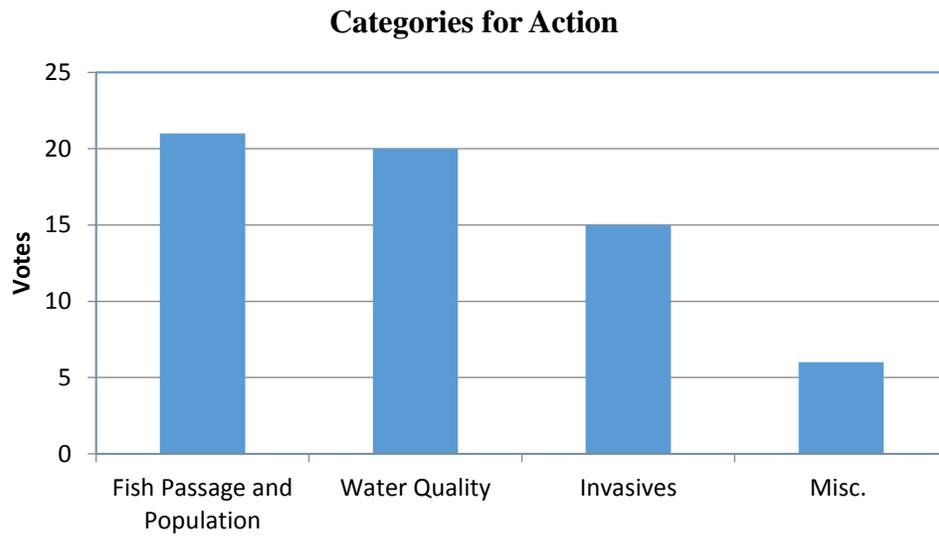


Figure 7: Community member concerns organized into categories for action.

## Proposed Developments

During the TTCD held community meetings in Beluga and Tyonek, potential large-scale development projects were a lively topic of both hope and concern. Many concerns outlined during the meetings were directly related to the potential environmental impacts of these proposed projects. The following section outlines the proposals of these projects within the Tyonek Area Watershed.

Due to the resource-rich deposits and proximity to Anchorage, the Tyonek Area Watershed is the location of three large scale development projects and a pipeline right-of-way (Figure 8). These proposals have brought about both hope and concern for Tyonek area watershed community members and stakeholders. It is important to acknowledge these concerns however, it is not the purpose of this document to advise whether or not development should proceed but rather to provide a guideline and plan for gathering applicable baseline data to detect change, minimalizing impacts to resources, and gathering stakeholders, partners, experts, and community members around the common goal of protecting natural resources within the watershed.

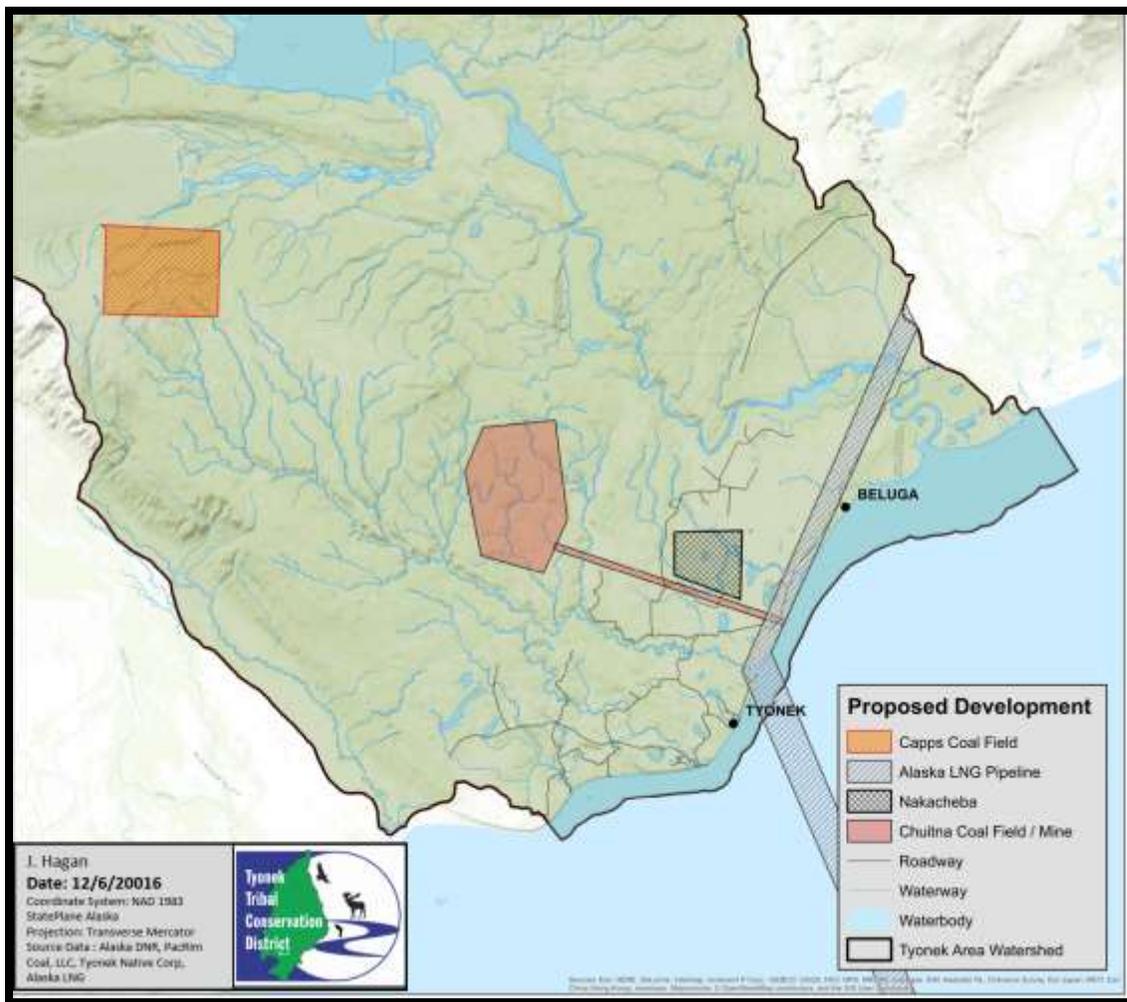


Figure 8: Proposed development in the Tyonek Area Watershed. Pictured are the locations of several development projects described below. Note, these are all proposed sites, not active sites.

The following projects are in various stages of proposal, none have final approval nor has any physical development begun.

#### Capps Coal Project:

The Capps Coal field is located 24 miles north-northwest of Tyonek. The land is owned by Cook Inlet Region Incorporated (CIRI) and leased to Beluga Coal Company. The project has been in a state of stagnation since the late 1990s and is unlikely to become active in the near future.

#### Chuitna Coal Project:

The Chuitna Coal Project is located 12 miles from Tyonek near the headwaters of the Chuitna River. The project is funded by PacRim Coal and the mine itself, if built, would cover approximately 5,000 acres. Additional construction would include mine facilities and a small town containing, an access road, and an airstrip. Coal from the mine would be transported to a proposed port on a 12-mile partially covered conveyor belt.

#### Susitna-Beluga Coal Project:

The Susitna-Beluga Coalfield lies within the vicinity of Tyonek and covers an estimated 5,800 square miles. Estimates for the amount of identified coal in the Susitna-Beluga Coalfield vary. No current plans are in place to begin development, nor has a specific location been named.

#### Nakacheba Subdivision:

Nakacheba is a proposed subdivision 6 miles from Tyonek. The preliminary plot was created and approved by the Kenai Peninsula Borough. The subdivision includes residential lots and some large tracts to be conveyed to the state trustee. The lots were envisioned to go to the shareholders of Tyonek. The proposal includes a conveyer corridor for PacRim's potential coal development.

#### Alaska LNG Pipeline:

The Alaska LNG project would be one of the world's largest natural gas development projects. A gas liquefaction plant and marine terminal is being proposed in Nikiski, directly across Cook Inlet from Tyonek, with a pipeline connecting the two. In addition to liquefaction and storage in Nikiski, the proposal includes a processing plant on the North Slope and approximately 804 miles of 42-inch-diameter pipeline from Prudhoe Bay through the Tyonek Area Watershed on its way to Nikiski. This massive pipeline would cross the Inlet just north of Tyonek and follow the inlet past Beluga before turning again toward Bethel. The pipeline would be built to carry 3 billion to 3.5 billion cubic feet of natural gas per day.

#### Concerns Summary:

Each of the topics raised during the Tyonek and Beluga community meetings, were considered by TTCD in the development of the watershed action plan. TTCD utilized these community inputs to develop categories of action to be addressed through this plan. With the help of partners such as TTCD's Scientific Advisory Committee, TTCD developed strategies to address these concerns that are reflected in later sections of this document.

## Categories of Action:

The community and stakeholder feedback as well as TTCD's expertise and consultation with the scientific advisory committee outlined the following categories for watershed action planning:

- Fish Passage and Population
- Water Quality
- Invasive Species

For each community watershed concern category, TTCD staff, along with partners and scientific advisory committee, developed objectives, strategies, evaluation methods, and project lists. Methodologies were tested in 2015 and 2016 and improvements were made as needed.

All projects listed in this document are subject to landowner/stakeholder approval. TTCD is a non-regulatory organization, and implementation of conservation work is conducted in partnership with landowners and stakeholders in the District.

## Categories of Action Sections Outline:

The following sections describe each category of action in the following manner:

- Background Information
- Topic status within the Tyonek Area Watershed and TTCD's involvement
- TTCD's Accomplishments to date (Table)
- Goals and Objectives (Table)
- Task Schedule (Table)

## Fish Passage and Population

### Background

Pacific salmon are considered a keystone species in Alaska. People and wildlife alike rely on salmon for subsistence and nutrients. Salmon provide economic opportunities, hold cultural and spiritual significance for Native Alaskans and are an overall indicator of ecological health of a watershed. The importance of having salmon begins and ends with a healthy watershed, hence the importance to monitor, restore and protect the waterways and habitats of the Tyonek Area Watershed.

Salmon populations have been in decline for the last several years, with 2012 and 2013 suffering record lows. These marked declines have continued with the 2016 Alaska Department of Fish and Game (ADF&G) harvest estimate being 19% less than the recent 10-year average annual harvest. Specifically, Chinook salmon numbers have been so low that commercial and subsistence fisheries have been closed. The specific driver of these declines hasn't been conclusively determined, however climate change and warming of inland waterways have been linked to increased salmon mortality.

Monitoring salmon populations and habitat is possible at their juvenile and adult spawning life-stages. During these two periods, salmon are present in the Watershed preparing for two pivotal tasks: juveniles are preparing to smolt (leave freshwater and head to the ocean) and adults are preparing to spawn (lay and fertilize eggs in a "redd", which is essentially a nest). In order to find food and cover, anadromous fish such as salmon need to move between a variety of habitats. 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 their life cycle. For this reason, TTCD has worked with partners to address this threat to salmon within the Tyonek Area Watershed.

Fish passage barriers, including culverts and dams, were introduced to the Tyonek Area Watershed in the 1960's when logging and oil and gas development began in the area. Oil companies built access roads to oil pads and wells and logging companies built access roads to timber, each of which required culverts to cross streams and lake outlets. Many of these roads were built quickly and did not accurately consider fish passage, leading to poorly installed or undersized culverts, a common fish passage barrier. Oil development in the region has been in decline for the last decade and many oil pads sit abandoned, however the roads and culverts remain. Despite the disuse of these roads for their intended purpose, many have become thoroughfares for hunting, firewood collection, and transportation between communities. Thus, the problem for fish passage yet the importance of maintaining access roads. Figure 9 shows the locations of all known culverts within the Watershed and lists the current fish passage status of each culvert as described by ADF&G.

There are several ways to assess the health and abundance of both juvenile and adult salmon populations in a particular stream. At TTCD, we employ methods well vetted by agencies such

as Alaska Department of Fish and Game and the US Fish and Wildlife Service. All surveys are conducted during the summer/fall field season.

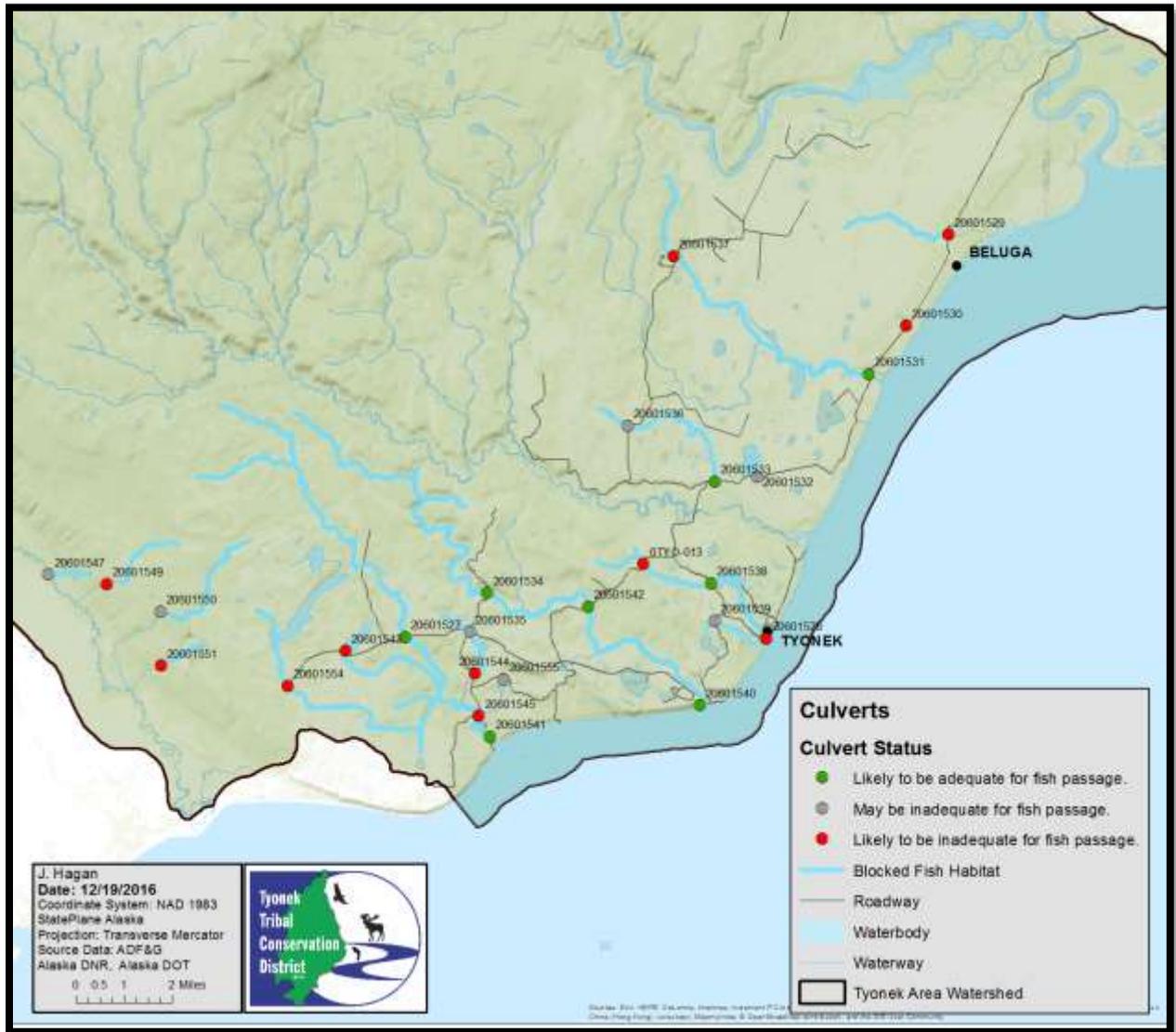


Figure 9: Location and status of culverts as fish passage barriers within the Tyonek Area Watershed. The highlighted stream sections estimate the habitat potentially blocked from salmon access.

## Accomplishments

### Fish Passage:

In 2012, TTCD received funding from the US Fish & Wildlife Service (USFWS) to develop a TTCD Natural Resource Assessment and Project Implementation Plan, to guide future conservation in the District. As a result of this project, fish passage improvement was identified as a priority focus area for TTCD. As of 2016, TTCD has addressed three fish passage issues and opened over 20 miles of salmon habitat with the Watershed.

In May 2012, TTCD coordinated travel for USFWS, ADF&G, and the Kenai Peninsula Fish Habitat Partnership to meet with Tyonek Native Corporation and Native Village of Tyonek staff in Tyonek to view potential fish passage barriers. At this meeting, a priority culvert project was identified on Indian Creek (culvert # 20601538 in Figure 9), where an undersized culvert caused frequent washouts. USFWS and the Tyonek Native Corporation provided funding for the design and installation of an appropriately sized fish friendly culvert at this site in October 2012, opening 2.4 miles of habitat for salmon. Restoration of this site, including the placement of vegetative mats, coir logs and willows was completed in June 2013. Despite major flooding in the fall of 2012 and 2013, this culvert has continued to function and no new road washouts at this location have occurred. Salmon have been observed upstream of the new culvert, indicating that removal of this barrier was a success.

TTCD next focused on a double culvert located on middle Tyonek Creek (culvert # 20601542 in Figure 9) that presented a barrier to fish passage. In 2010, the USDA Natural Resources Conservation Service (NRCS) developed a design for this project. In 2014, TTCD utilized this design to replace the original undersized, perched culverts with a 17' span, 11.2' rise arch pipe to ensure passage. By partnering with multiple organizations, TTCD raised the needed funds to complete this project. Tyonek Contractors LLC was hired to install this fish friendly culvert, and employed several local residents. With a much larger culvert in place, over 11 miles of habitat for spawning and rearing is now available to salmon at this site.

TTCD and TNC first began planning for a culvert replacement project on upper Old Tyonek Creek in 2013 (culvert #20601527 in Figure 9), when TTCD contracted Dowl HKM to complete an alternatives analysis at this site. Tyonek Native Corporation selected the option of replacing the undersized culverts with a much larger fish friendly culvert. Old Tyonek Creek provides spawning and rearing habitat for a number of anadromous fish including king salmon, silver salmon, pink salmon, and hooligan which require unobstructed movement throughout the watershed to maintain healthy populations. Prior to completion of this project in 2015, the culverts at this location created barriers for the migration of adult and juvenile fish. This project, was completed through partnerships with multiple federal and state agencies and local partners, and opened up over 10 miles of important upstream salmon habitat.

In 2014, TTCD began conversations with AK Department of Natural Resources Division of Forestry regarding culverts on state land. The DNR Div. of Forestry had completed an inventory of culverts on old state forestry roads in 2012, and in 2014 representatives from DNR and TTCD visited several fish passage barriers near Nikolai Creek. In 2016, DNR received funding to replace one culvert (#20601554 on Figure 9) and remove two others (#20601550 and #20601549 on Figure 9). As of December 2016, these culverts are in the design phase and planned for implementation in 2017.

In 2016, TTCD completed additional surveys of all culverts in western Cook Inlet with Alaska Department of Fish & Game and US Fish & Wildlife Service staff. Through the additional data collected during these visits, TTCD has developed a prioritization list for completion of additional fish passage projects within the Tyonek Area Watershed (Table 4). As of December

2016, three culvert replacement projects in the Indian Creek drainage are in the design phase and planned for construction in 2017.

#### Salmon Population Monitoring:

In 2014, TTCD met with the watershed action plan Scientific Advisory Committee, as well as several individual experts, to develop strategies to monitor salmon populations within the Watershed. TTCD first began sampling efforts in 2015 through juvenile fish trapping. In 2016, TTCD continued to conduct juvenile fish trapping, conducted a spawning ground survey, and also collaborated with ADF&G to update the Anadromous Waterways Catalogue.

#### Juvenile Fish Trapping:

Since 2015, juvenile salmon have been surveyed on two streams within the Tyonek Area Watershed directly by TTCD staff. Numerous other streams were monitored for juvenile salmon with partnering groups such as Alaska Department of Fish and Game and the U.S Fish and Wildlife Service. The two streams surveyed by TTCD staff are Robert's (Old Tyonek) Creek and Threemile Creek (Figure 10). TTCD plans to continue long term monitoring of these sites through juvenile fish trapping.

Surveys have been conducted using baited minnow traps. These galvanized steel traps are baited with borax soaked roe. Traps were placed at 10 locations within each system for at least 3 hours. When the traps were retrieved, the first 25 salmonids were measured, per our ADF&G permit, and the remaining fish were noted for their species, overall condition and location. This data can provide insight into comparing populations from year to year.

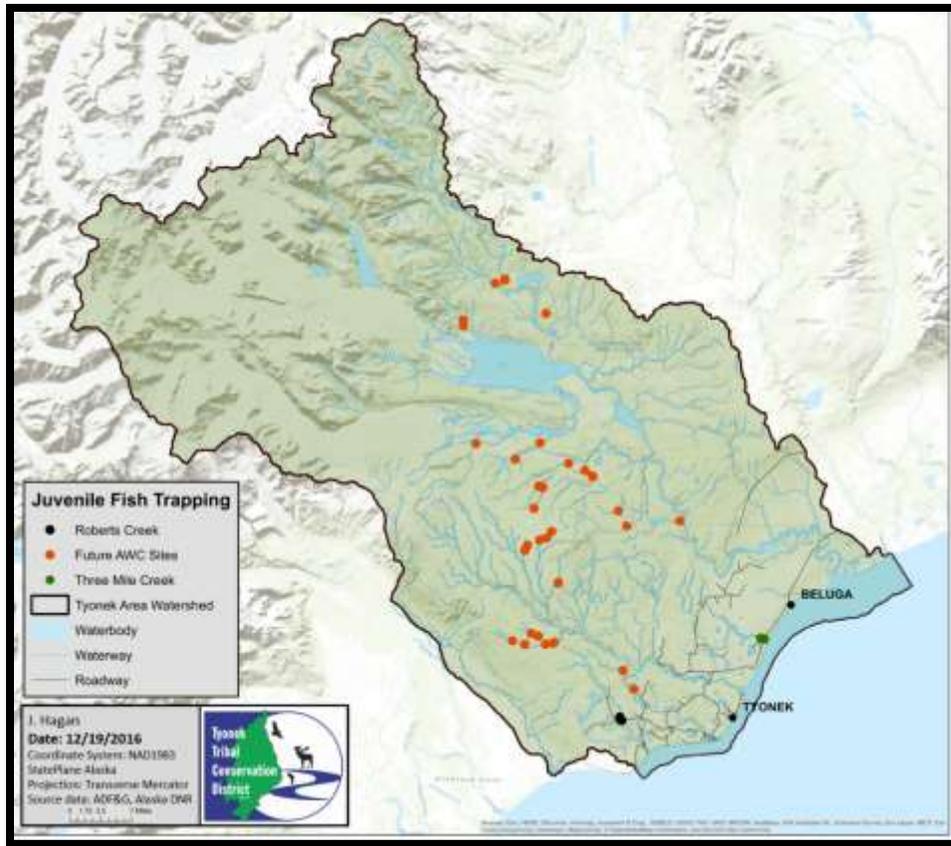


Figure 10: Locations of juvenile fish trapping efforts conducted by TTCD and ADF&G in 2015 and 2016.

### Spawning Ground Surveys:

Spawning ground surveys were implemented in 2016 on Indian Creek. During this survey, 6 active Coho salmon redds were documented as well as over 20 spawning-stage adults. Spawning surveys on Robert's (Old Tyonek) Creek, Threemile Creek and Tyonek Creek are planned for the 2017 field season and beyond.

### Anadromous Waterways Cataloguing (AWC):

In 2016, TTCD staff assisted ADF&G with AWC updates in the Tyonek Area Watershed. Staff visited 31 remote sites and electrofished small stream reaches for juvenile salmon (Figure 11). Over 100 fish were entered into the catalogue and 10 previously uncatalogued tributaries of the Chuitna and Beluga Rivers were added to the database.

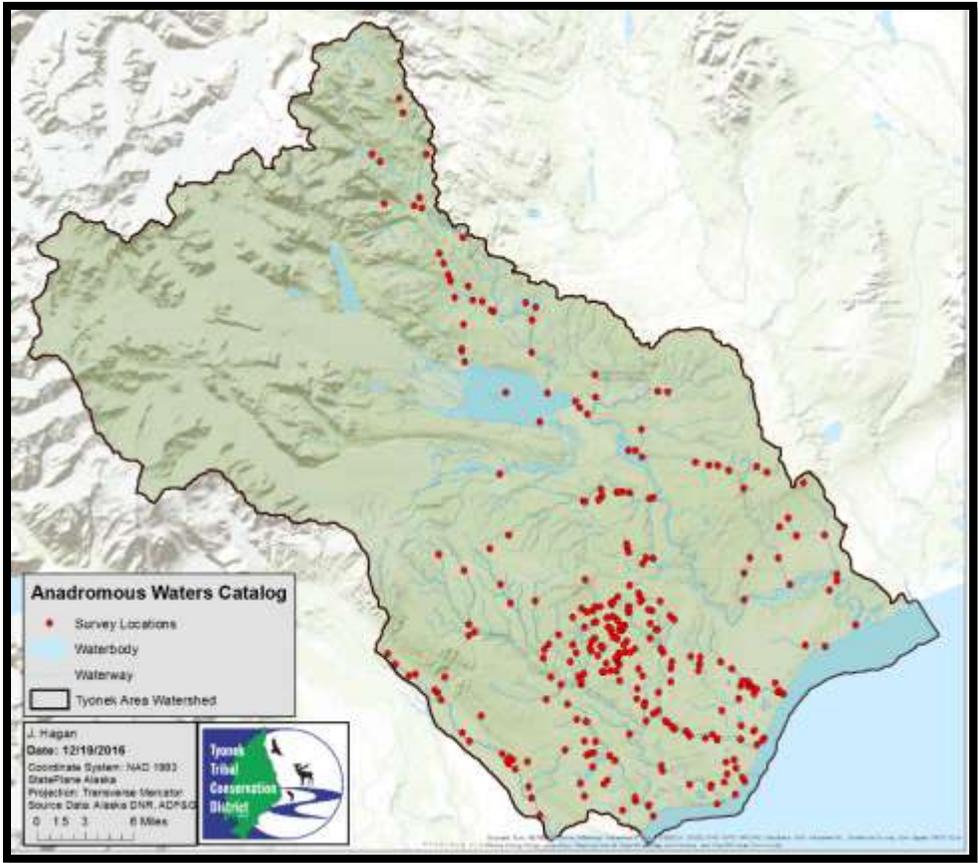


Figure 11: Total anadromous waterways catalog data within the Tyonek Area Watershed.

**Current Activities and Work Plan**

The experience derived from the 2012-2016 work on fish passage assessments and improvements and fish populations surveys (Table 1) has led to the following outline of goals and objectives (Table 2), and timeline of tasks (Table 3, Table 4). The following charts discuss plans forward for monitoring and project implementation.

**Accomplishments to Date:**  
Monitor and improve fish populations

**Categories**

Fish Passage Assessment and Improvements

Fish Population Surveys

Year	Fish Passage Assessment and Improvements	Fish Population Surveys
2012	<ul style="list-style-type: none"> <li>• TCD developed partnerships and plans to address three fish passage issues.</li> <li>• Completed initial culvert survey in Tyonek and Beluga</li> <li>• Met with ADFG, USFWS, TNC, NVT, and Kenai Watershed Forum to develop a plan to address fish passage issues. Identified three priority fish passage issues.</li> <li>• Worked with USFWS to develop a design to replace middle Indian Creek culvert.</li> <li>• Worked with NVT to complete installation of middle Indian Creek culvert (#1538).</li> </ul>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>
2013	<ul style="list-style-type: none"> <li>• Completed revegetation work on middle Indian Creek culvert (#1538).</li> <li>• Worked with NRCS, USFWS, ADFG to develop design for middle Tyonek Creek culvert replacement (#1542).</li> <li>• Completed alternatives analysis for two fish passage barriers on Old Tyonek Creek.</li> </ul>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>
2014	<ul style="list-style-type: none"> <li>• Completed culvert replacement and revegetation work on middle Tyonek Creek (#1542).</li> <li>• Worked with partners to develop design for middle Old Tyonek Creek culvert replacement.</li> </ul>	<ul style="list-style-type: none"> <li>• N/A</li> </ul>
2015	<ul style="list-style-type: none"> <li>• Completed culvert replacement and revegetation work on middle Old Tyonek Creek.</li> </ul>	<ul style="list-style-type: none"> <li>• Collected catch per unit effort (CPUE) data on juvenile salmon in Robert's Creek and Threemile Creek</li> <li>• Additions to the anadromous waterways catalog on Robert's Creek</li> <li>• Set up long-term monitoring sites in Three Mile Creek</li> </ul>
2016	<ul style="list-style-type: none"> <li>• Completed assessment of all culverts in District with ADFG and USFWS.</li> <li>• Developed a prioritization list for all remaining fish passage barriers in the District.</li> <li>• Started design work for three fish passage barriers on Indian Creek.</li> </ul>	<ul style="list-style-type: none"> <li>• Juvenile salmon monitoring continued for Robert's and Threemile Creek using minnow traps for CPUE estimates</li> <li>• TCD collaborated with ADFG on efforts to update the AWC, visiting many sites within the watershed and along roadcrossings</li> <li>• Spawning survey conducted on Indian Creek</li> </ul>

Table 1: Fish passage and population accomplishments to date.

**Overarching Goal**

Monitor and improve fish populations

**Objectives**

Remove and Replace Fish Passage Barriers

Monitor Completed Fish Passage Projects

Improve Fish Habitat

Monitor Fish Populations

Prevent Degradation of Fish Passage and Habitat

**Strategies**

- Develop 5 year culvert replacement plan using a diverse set of criteria including community needs, miles affected, species diversity, expert input, and project feasibility
- Annual updates of fish passage prioritization including a mixture of community input, collaborations with ADFG, FWS, etc.
- Partner with agencies and organizations for expertise and project effectiveness

- Annual surveying of revegetation efforts
- Annual observations of culvert longevity and stability
- Monitor adult salmon population return
- Spawning surveys beginning in 2016
- Video weir by 2020

- Identify priority spawning and rearing regions
- Implement long-term monitoring protocol for important spawning regions
- Develop database and field protocol for stream habitat type monitoring and mapping for important subsistence streams
- Annually monitor and implement control efforts for invasive species (both fish and plant)

- Implement annual monitoring efforts of juvenile salmon
- CPUE of juvenile salmon on important waterbodies (subsistence and/or culvert project areas)
- Monitor effects of culvert replacement on juvenile salmon populations
- Implement annual monitoring of adult salmon (spawning surveys, video weir, etc.)

- Collect data that updates and provides better understanding of extent of fish habitat
  - Add to AWC
- Develop anadromous stream best practices with landowners and contractors
- Provide landowner education on existing statutes
- Community education on fish habitat and passage

**Evaluation Measures**

- Number of culverts replaced
- Number of miles of salmon habitat improved

- Number of revegetation surveys completed
- Number of culvert stability assessments
- Completion of salmon monitoring efforts
- Number of spawning surveys and redds reported

- Increases in spawning regions identified
- Completion of monitoring protocol
- Completion of database and times shared with partners
- Number of invasive species surveys and control methods

- Number of years and sites monitored
- Number of stream miles monitored
- Number of populations monitored
- Number of culverts monitored
- Number of spawning regions identified

- Completion of best practices document
- Number of signatories to best practices document
- Number of outreach participants
- Number of outreach events

Table 2: Outline of the overall goal for fish passage and population and the objectives, strategies, and evaluation measures to meet that goal.

## Task Schedule

### Monitor and Improve Fish Populations

#### Objectives

#### Remove and Replace Fish Passage Barriers

- Complete designs for 3 culvert replacements within Indian Creek drainage
- Remove 2 barriers within Indian Creek drainage
  - Raise funds needed to complete projects
  - Obtain permits
  - Hire contractor
  - Close out projects
- Complete designs for 2 additional culvert replacements for 2018

- Remove all remaining barriers within Tyonek Area Watershed
  - Complete designs for culverts
  - Raise funds to complete projects
  - Obtain permits

- Educate landowners and stakeholders to prevent new fish passage barriers
- Develop a best practices commitment program for landowners and stakeholders

#### Monitor Completed Fish Passage Projects

- Continue efforts to fund and implement video weir
- Conduct spawning surveys on past culvert replacements and future replacements waterways for baseline data
- Continue juvenile salmon monitoring on Robert's Creek to test methods
- Continue basic water quality measurements
- Conduct revegetation monitoring

- Finalize comprehensive monitoring plan by 2019
- Implement monitoring plan
- Continue spawning ground surveys
- Revegetation surveys

- Assess effectiveness of monitoring programs
- Assess change in data salmon populations
- Assess revegetation effectiveness and plan improvements if necessary

#### Improve Fish Habitat

#### Action Items 1 yr (2017)

- Add streambank vegetation at middle Tyonek Creek culvert site (#1542) to increase shade and improve fish habitat
- Work with USFWS to make improvements at middle Indian Creek culvert site (#1538) to improve fish habitat quality

#### 5 yrs (2021)

- Complete assessment of watershed area to determine possible fish habitat enhancement projects

#### 10 yrs (2026)

- Complete fish habitat enhancement projects

#### Monitor Fish Populations

- Continue juvenile salmon monitoring at established sites on Threemile Creek
- Analyze Threemile Creek juvenile data to share and assess methods with area biologist
- Continue spawning surveys

- Develop plan to add adult salmon monitoring to Threemile, Roberts Creek, and other important systems by 2019
- Monitor juvenile populations and habitat before and after culvert replacements

- Assess effectiveness of monitoring program
- Update monitoring plan
- Share data with partners

#### Prevent Degradation of Fish Passage and Habitat

- Continue collaborations with partners sampling streams to add to AWC and understanding of species distribution
- Develop anadromous stream best practices
- Scientific committee meetings and approval of best practices
- Begin landowner outreach about best practices

- Landowner signatories of best practices
- Biannual signatory outreach and compliance discussion
- Community outreach
- Partner with development teams to work on common goal of protecting salmon habitat

- Assess best practices document and propose any relevant amendments
- Signatory outreach and compliance discussions

Table 3: TTCD's task schedule for fish passage and population objectives over the next 1, 5, and 10 years.

Table 4: Proposed fish passage project timeline.

Project Year	Culvert #	Watershed	Description	Salmon Species	Landowner
2017	20601528	Indian Creek	Most downstream	CO	Tyonek Native Corporation
2017	20601538	Indian Creek	Middle, fixed in 2012, needs work	CO, P	Tyonek Native Corporation
2017	TYO 01-13	Indian Creek	Most upstream	CO, P	Tyonek Native Corporation
2017 (maybe)	20601539	Indian Creek	side channel, needs to be assessed for fish presence	CO	Tyonek Native Corporation
2017 (maybe)	20601542	Tyonek Creek	Middle, revegetation work	CO	Tyonek Native Corporation
2017	20601554	Nikolai Creek	Congabuna Lake Outlet, DNR Div. of Forestry project	CO, P, eulachon	State
2017	20601550	Nikolai Creek	Stedatna Creek, DNR Div. of Forestry project	CO, DV	State
2017	20601549	Nikolai Creek	Unnamed tributary of Nikolai Creek, DNR Div. of Forestry project	CO	State
2018	20601545	Old Tyonek Creek	Side channel on road to fish camp	CO	Tyonek Native Corporation
2018	20601544	Old Tyonek Creek		CO	Tyonek Native Corporation
2018	20601543	Bird Lake Outlet			State
2018	20601546	Chuitkilnachna	Need agreement from landowner not to replace	CO	State- Refuge
2019	TYO - 27		ATV fords needed		State
2019	TYO - 30		ATV fords needed		State
2019	20601541	Old Tyonek Creek	Fish camp	CO	Tyonek Native Corporation
2019	20601533	Old Tyonek Creek	Upper	CO	Tyonek Native Corporation
2019 (maybe)	20601539	Indian Creek	side channel, needs to be assessed for fish presence		Tyonek Native Corporation
2019	20601536	Unnamed	PanAm road		Tyonek Native Corporation
2020	20601540	Tyonek Creek	Most downstream, needs a lot of work	CO	Tyonek Native Corporation
2020	20601535		grated culvert, needs work		Tyonek Native Corporation

2021	20601531	Threemile	lower, may need replacing	CO, K, P, S	Tyonek Native Corporation / State
2021	20601537	Threemile	upper, washed out, replace with ford	CO, K, P, S	State
2021	20601532	Chuitbuna outlet			Tyonek Native Corporation
2021	20601534	Tyonek Creek	upper, may not be needed, determine after 2016 fix completed	CO	Tyonek Native Corporation

## Water Quality

### Background

Water quality is a critical component of a healthy salmon stream. Salmon, as well as macroinvertebrates, vegetation, and other fish species, rely on clean, oxygen-rich water free of pollutants and foreign minerals. There are many ways water quality can be compromised including contaminant spills, improper waste management, runoff from urban areas, roads, industrial sites, or farms, and much more. For example, landfill location and contents can impact water quality via ground and surface water runoff. When rain and snow fall into landfills, they collect contaminants and can end up in the river. The first step in preventing this type of contamination is removing anything toxic from the immediate vicinity of a waterway and assuring that proper containment and response techniques are in place. Examples of such contaminants are: lead batteries, e-waste (computers, etc) and volatile organic compounds (VOCs), which are found in paint and household cleaning supplies.

Monitoring water quality can provide valuable insight into the presence of contaminants and can isolate the issues that need to be addressed in order to achieve good water quality to protect all species that rely on the fresh water systems within the Tyonek Area Watershed.

#### Stream Temperature:

The average monthly temperature for July in Tyonek is expected to increase by as much as 3.5 degrees Celsius by the end of the century<sup>2</sup>. As Alaska faces this significant change, the importance of monitoring freshwater temperature is paramount. Juvenile salmonids rely on consistent water temperatures throughout their developmental stages, and strong correlations between declining salmon runs and freshwater warming have been made. During the summer months of 2016, stream temperature

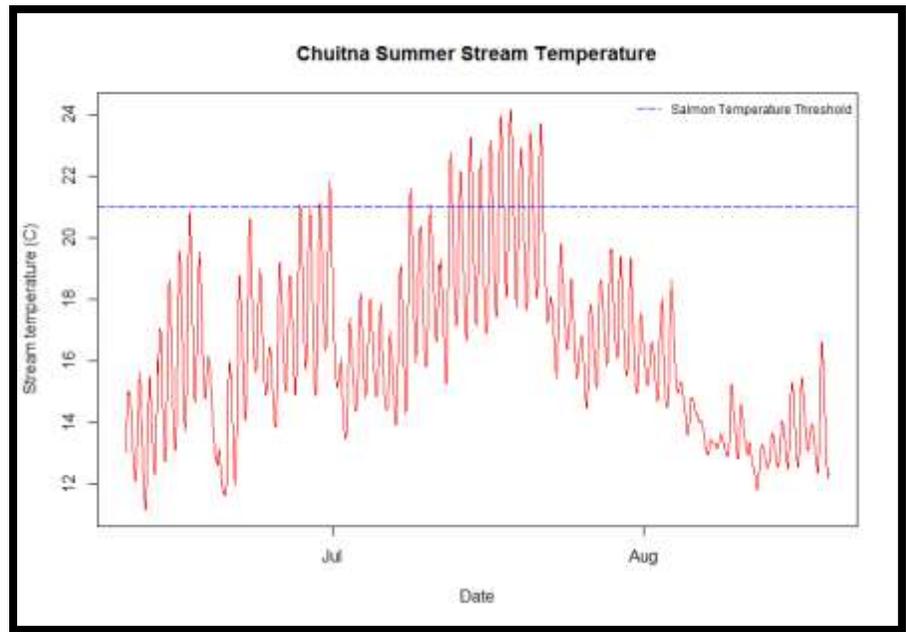


Figure 12: Stream temperature data from the TTCD temperature logger in the Chuitna River. Pictured, is data from June 1<sup>st</sup>, 2016 to August 31<sup>st</sup>, 2016. The blue dashed line represents the EPA stream temperature threshold for a healthy salmon stream, 21°C. Note the frequency the stream temperature exceeds the threshold.

<sup>2</sup> Scenarios Network for Alaska and Arctic Planning, University of Alaska. 2016.

[https://www.snap.uaf.edu/sites/all/modules/snap\\_community\\_charts/charts.php](https://www.snap.uaf.edu/sites/all/modules/snap_community_charts/charts.php). Retrieved 12/22/2016 from <https://www.snap.uaf.edu/>.

routinely breached the EPA designated juvenile salmon upper temperature threshold of 21 °C (Figure 12)<sup>3</sup>. As TTCD and other agencies continue to monitor the Tyonek Area Watershed's salmon populations, the importance of understanding the dynamics of stream temperature in relation to the warming climate is important for conservation efforts and understanding salmon population dynamics.

## Accomplishments

### Water Quality Monitoring:

In 2014, TTCD developed and implemented initial water quality monitoring methods at each major road stream crossing within the Watershed. Data collected included pH, temperature, conductivity, and dissolved oxygen, as well as aquatic macroinvertebrate samples. TTCD continued to collect this data in 2015 at five sites where stream temperature loggers had been deployed (Figure 13). In 2016, TTCD purchased and began utilizing a Hanna Instruments multi-parameter water sensor for increased accuracy and to lengthen the duration of sampling events. This instrument has been used to collect data at the five sites in 2015. TTCD measured levels of dissolved oxygen, suspended solids, potential of hydrogen (ph.), and alkalinity. Data are cataloged in the TTCD database and can be shared with other agencies or landowners upon request and landowner permission.

Currently, TTCD maintains five in-situ stream temperature loggers and two air temperature loggers throughout the watershed. Loggers have been deployed on: The Chuitna River, Roberts Creek, Threemile Creek, Tyonek Creek, and Indian Creek. Loggers collect hourly stream temperature year round. All sensors are checked for accuracy using methods outlined in Mauger et al. 2014<sup>4</sup>.

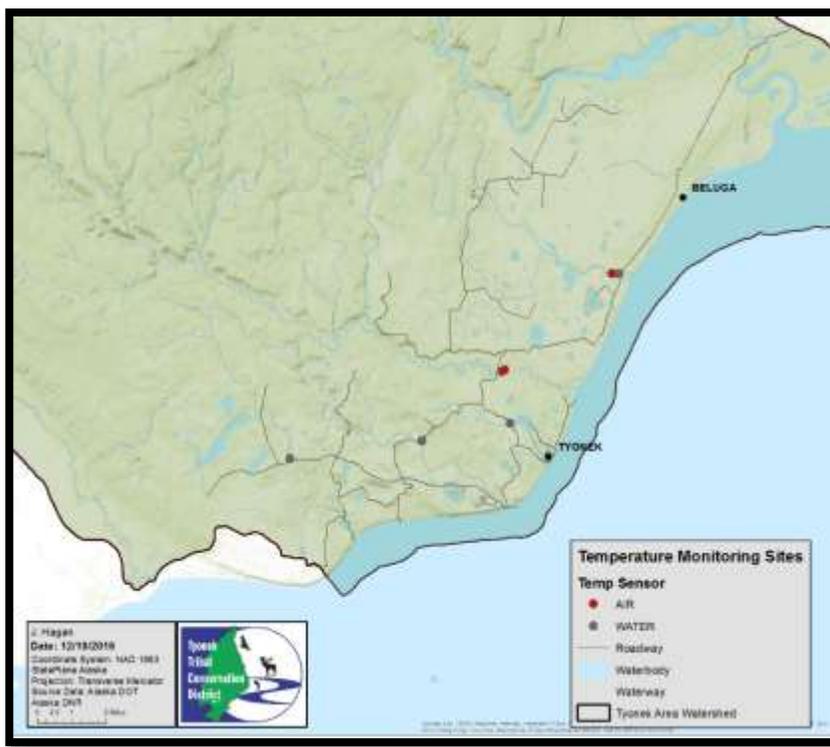


Figure 13: Location of current temperature monitoring sites within the Tyonek Area Watershed.

<sup>3</sup> U.S. EPA. 2013. Best practice for continuous monitoring of temperature and flow in wadeable streams. Page 123. Washington DC.

<sup>4</sup> Mauger, S., R. Shaftel, E.J. Trammell, M. Geist, and D. Bogan. 2014. Stream temperature data collection standards and protocol for Alaska: minimum standards to generate data useful for regional-scale analyses. Cook Inletkeeper, Homer, AK and Alaska Natural Heritage Program, UAA, Anchorage, AK. 53 pp.

Water temperature monitoring will continue in 2017 and beyond with the possibility to expand the water temperature monitoring program to additional waterways. In 2016, Cook InletKeeper performed a FLiR survey on the Chuitna River. FLiR is Forward Looking Infrared Imagery, a fine-scale thermal imagery capable of capturing surface temperature with  $\pm 0.5m$  accuracy. FLiR data is capable of determining areas of cold-water refuge, critical rearing habitat for juvenile salmonids. The capability to map such habitat will greatly benefit any future restoration projects in the Chuitna sub-basin.

#### Waste Management/Removal in Tyonek:

In 2014, TTCD held preliminary discussions with the Native Village of Tyonek and Tyonek Native Corporation regarding waste management and waste removal in Tyonek. TTCD continued to meet with stakeholders as well as waste management experts in 2015 and 2016 to develop plans to address waste issues. In 2015, TTCD signed a Memorandum of Agreement with the Alaska Forum, Inc, and GreenStar, two organizations that provide assistance with waste reduction and other related conservation efforts. Through this agreement, GreenStar assisted TTCD in 2015 in the removal of 3,000 lbs of lead batteries from the Tyonek area as well as a community trash cleanup event.

In 2016, TTCD completed further assessments of waste issues in Tyonek and conducted a site visit in Tyonek with representatives from both GreenStar and Alaska Central Recycling. Through these assessments, TTCD now has resources to develop a plan for a large-scale backhaul event to remove legacy waste and potential contaminants from Tyonek. TTCD worked with the Native Village of Tyonek to collect lead batteries and prepare them for removal, and to collect electronic waste to prepare for removal. In December 2016, TTCD backhauled 500 lbs of electronic waste.

#### Beluga Cabin Removal:

The Susitna Flats State Game Refuge extends into the northeast portion of the Tyonek Area Watershed. Within this portion of the refuge, along the Beluga River, there are four abandoned cabins that represent potential threats to water quality through contamination (Figure 14). In 2016, TTCD worked with the Susitna Flats State Game Refuge to visit and assess four abandoned cabins within the watershed. All four sites are in pristine areas and

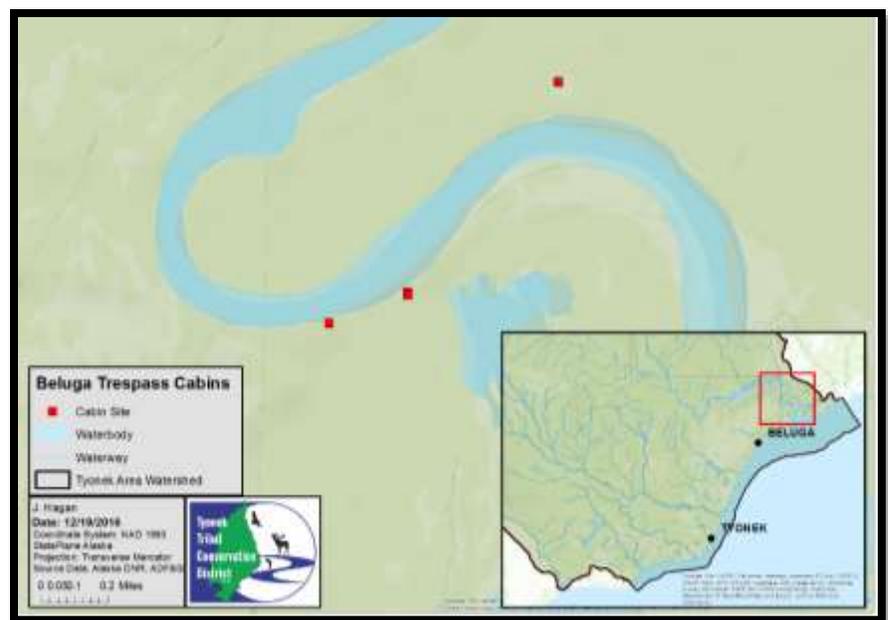


Figure 14: Locations of abandoned cabins within Susitna Flats State Game Refuge.

located close to the banks of the Beluga River. During this visit, it was determined that these cabins represent a potential threat to watershed health, and TTCD and ADFG have begun planning efforts to address these issues.

#### **Current Activities and Work Plan**

The experience derived from the 2014-2016 water quality work including water quality and stream temperature monitoring and waste management (Table 5) has led to the following outline of goals and objectives (Table 6), and timeline of tasks (Table 7). The following charts discuss plans forward for monitoring and project implementation.

## Accomplishments to Date:

Monitor water quality and overall health of the Tyonek Area Watershed

### Categories

Water Quality Monitoring

Waste Management

**2014**

- Collected basic water quality data at each main road stream crossing including pH, temperature, conductivity, and dissolved oxygen
- Collected aquatic invertebrate samples at each main road stream crossing to record basic water quality indicator

- Preliminary meetings with landowners and experts about waste management

**2015**

- Stream temperature monitors were deployed in 5 streams or rivers within Tyonek Area Watershed to collect hourly water temperature
- Basic water quality samples were taken during each biweekly water temperature data logger check during the field season
- Basic water quality data was collected during each salmon sampling event

- Discussed landfill management with Tyonek Native Corporation to determine current management
- Coordinated the backhaul of 3,000 lbs of lead batteries from the Tyonek area
- Held community cleanup event on Earth Day

**2016**

- Purchased water quality sampling equipment to improve accuracy and lengthen duration of sampling datasets
- Basic water quality samples were taken during each biweekly water temperature data logger check during the field season
- Basic water quality data was collected during each salmon sampling event

- Met with waste management experts and made a plan for waste management improvements in Tyonek
- Coordinated an assessment of the Tyonek landfill and received suggestions
- Backhauled approximately 500 lbs of electronic waste
- TTCD upgraded to use of biodegradable products at the Tyonek Garden and for all TTCD community events to reduce amounts of plastic waste in Tyonek
- Worked with Susitna Flats State Game Refuge manager (ADFG) to visit and assess four abandoned cabins within the Beluga River drainage that represent a potential contamination threat

Table 5: Water quality accomplishments to date.

**Overarching Goal**

Monitor water quality and overall health of the Tyonek Area Watershed

**Objectives**

Develop a water quality monitoring protocol for stream and aquatic life health

- Monitor Stream temperatures
- Collect basic water quality data during all field work efforts
  - Temperature, pH, dissolved oxygen, conductivity, nitrogen, etc.
  - Determine sites vulnerable to pollution
- Develop data collection plan for vulnerable sites
- Collect continuous water quality data throughout field seasons at priority sites
- Develop database of water quality data
- Share data and train with NVT IGAP staff

Define, monitor, and improve waste management practices

- Define and assess waste management in the TAW
- Collect soil and/or water quality data near priority sites in necessary
- Work with waste managers and experts to improve waste management
- Develop and implement backhaul and recycling programs
- Develop and implement reuse programs
- Provide public outreach on waste management
- Host community events about waste management

**Strategies**

**Evaluation Measures**

- Number of waterways monitored for temperature data
- Number of waterways included in water quality database
- Completion of prioritizing sites
- Completion of water quality database
- Number of meetings and/or trainings with NVT IGAP department about water quality

- Completion of management description
- Number of waste management improvements at dumps
- Number of data collections around point source pollutions (dumps, spills, etc.)
- Number of events hosted
- Number of community members and stakeholders reached
- Pounds of waste recycled
- Pounds of waste removed
- Pounds of waste reused

Table 6: Outline of the overall goal for water quality and the objectives, strategies, and evaluation measures to meet that goal.

## Task Schedule

### Monitor water quality and overall health of the Tyonek Area Watershed

#### Objectives

Develop a water quality monitoring protocol for stream and aquatic life health

Define, monitor, and improve waste management practices

#### Action Items 1 yr (2017)

- Continue and add to stream temperature monitoring
  - Add additional data loggers to replace lost data loggers due to flooding and add additional backup loggers
  - Share data with AKOATS
- Implement longer data collection efforts in Indian Creek and other priority systems with new data logger
- Present current findings to scientific committee and reassess methods
- Assess macroinvertebrate data collected in 2014 and develop plans for 2018

- Remove all lead batteries from collection area near airstrip, backhaul and properly dispose of batteries.
- Remove legacy electronic waste from Tyonek through collection events and backhaul to recycling centers in Anchorage.
- Hold a community cleanup event to celebrate Earth Day, involving Tebughna School students.
- Coordinate with Susitna Flats State Game Refuge manager (ADFG) to develop a plan for cleanup efforts at four abandoned cabin sites near Beluga River.

#### 5 yrs (2021)

- Continue collection of longer datasets in systems of concern including Indian Creek
- Collect bacteria samples in priority waterbodies
- Collect effective conductivity data in Indian Creek representing all levels of waterflow to monitor potential impacts of landfill
- Present concerns to landowners adjacent to affected waterbodies and offer technical assistance for solutions if needed or requested
- Provide training for the Native Village of Tyonek's IGAP department on water quality monitoring methods

- Hold a large scale backhaul event in Tyonek and Beluga to remove all legacy waste.
  - Remove all refrigerators and freezers from landfill
  - Remove metals, including old vehicles, old culverts
  - Backhaul items to Anchorage for appropriate disposal and recycling
- Set up a recycling station and backhaul program to properly dispose of future waste, such as lead batteries, electronic waste, and recyclable items such as aluminum and plastic.
- Work with Susitna Flats State Game Refuge to implement cleanup efforts at four abandoned cabin sites near Beluga River.

#### 10 yrs (2026)

- Continue long term monitoring of stream temperature
- Continue basic water quality data collection

- Implement recycling station and backhaul program for proper disposal of future waste.

Table 7: TTCD's task schedule for water quality objectives over the next 1, 5, and 10 years.

## Invasive Species

### Background

Invasive species are defined as species of plants, animals, fish, fungi, insects, and other organisms that were introduced and cause harm to resources important to the invaded region. These species are most often spread through human activity and have become a challenge in most populated regions of Alaska. By significantly altering habitat, invasive species pose threats to many subsistence resources including fish, moose, berries, and more. In the Tyonek Area Watershed, both invasive plants and fish have become a concern. Frequent transportation of people and goods from highly invaded areas such as Anchorage and Kenai has resulted in the introduction of species that have begun to damage subsistence resources in the Watershed. These damages and threats to the natural ecosystems in the Tyonek Area Watershed are unacceptable outcomes to the concerned community members and stakeholder of the Watershed.

#### Plants:

Alaska has taken a uniquely united approach towards invasive plant data collection, management, and collaboration. The Alaska Natural Heritage Program (AKNHP) manages a statewide database of invasive plants that allows researchers, citizens, and land managers the opportunity to collect, share, and use invasive species data with standardized methods. The AKNHP also documents the potential severity of invasive species aiding in the prioritization of infestations across the state of Alaska. In alignment with the invasive species management philosophy of early detection, rapid response, the AKNHP system encourages frequent systematic surveying and data sharing for fast collaborative responses.

The first known invasive plant survey was conducted in the Tyonek Area Watershed in 2010. This brief survey highlighted the need for action due to the confirmation that invasive plants had arrived on the West side of the Cook Inlet. Community members were concerned about invasive species and had already seen negative changes occurring and asked that TTCD get involved.

#### Pike:

In the 1950's, invasive pike were illegally introduced to the West side of Cook Inlet in Bulchitna lake, opening up a 40,000 square miles of the Yentna River system and beyond to invasive pike. Currently, there are at least 150 lakes, creeks, and rivers that have reported cases of invasive pike in Southcentral Alaskan waterways (ADF&G Database). Pike have been known to swim through brackish water between waterways throughout the Cook Inlet, move between lakes during flood events, and to travel substantial distances throughout watersheds. Areas conducive to Pike infestations include low gradient, sinuous reaches with high concentrations of reed-like vegetation

Pike are voracious eaters. One large female pike can eat hundreds of thousands of juvenile salmon and lay 500,000 eggs a year<sup>5</sup>. Pike have been a significant factor in salmon population

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<sup>5</sup> Rutz, D. S. 1996. Seasonal movements, age and size statistics, and food habits of northern pike in upper Cook Inlet during 1994 and 1995. Alaska Department of Fish and Game, Fishery Data Series Report No. 96-29. Anchorage

collapses in sensitive systems within Southcentral Alaska. Two of these affected systems, Alexander and the Threemile, exist just outside and within the Tyonek Area Watershed respectively. The Alaska State Department of Natural Resources has been conducting pike control in the Alexander Creek system since 2011 and it is expected that the efforts to continue for many years in order to combat the complex issue.

**Accomplishments:**

**Invasive Plants:**

Due to the level of community concerns, the potential impact, and the growing populations of invasive plants within the Tyonek Area Watershed, TTCD’s goal is to participate in monitoring, controlling, and preventing invasive plant species. In 2014, TTCD began annual invasive plant surveys along roadsides, airstrips, private

properties, industrial worksites, trails, and stream crossings. As of 2016, TTCD has confirmed 11 high priority invasive species within Tyonek area watershed and surveyed 46 invasive species sites (*Figure 15*). TTCD has coordinated both mechanical and chemical control efforts to manage invasive weeds in Tyonek and Beluga and has additionally conducted public outreach on the identification and prevention of invasive plants. Table 8 describes TTCD’s accomplishments on invasive plant species from 2014-2016.

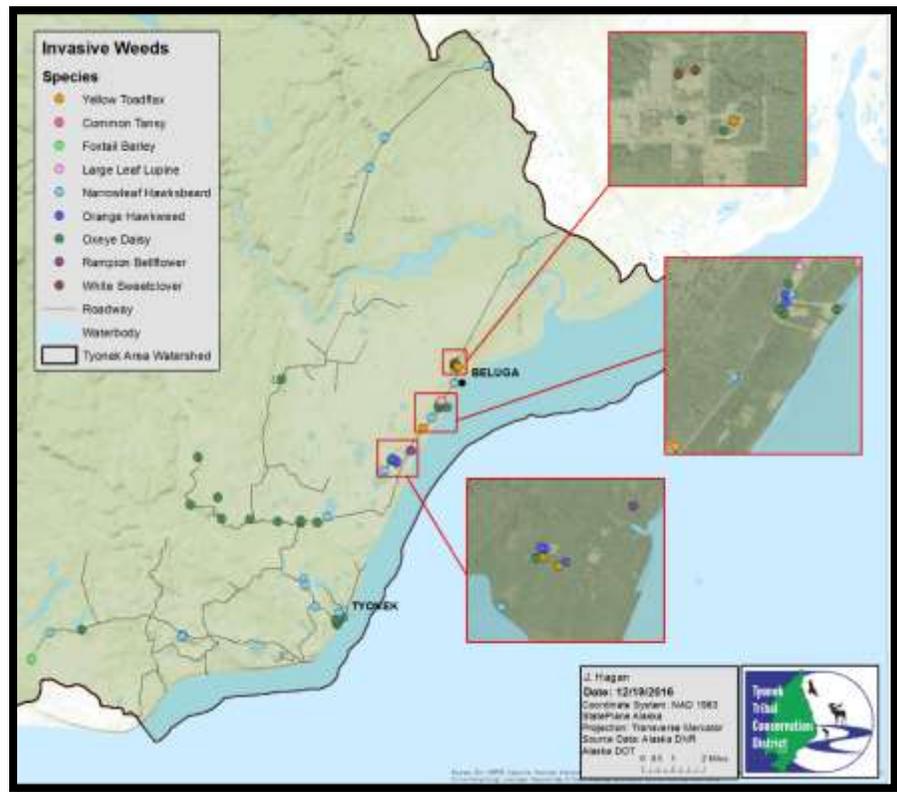


Figure 15: Locations of known invasive plant species recorded during the 2014-16 field season.

**Pike:**

Due to the negative impact of pike on salmon populations and the lack of data on pike’s extent within the watershed, TTCD’s goal is to determine the extent of pike and develop a control plan on priority populations and waterbodies. Since 2015, TTCD has begun monitoring for pike locations, coordinating pike derbies in Beluga and Tyonek, and planning for future pike control efforts in the coming field seasons. Pike derbies have resulted in the removal of 223 pike ranging in size from 8 to 90cm from waterways around Tyonek and Beluga. Derbies have provided outreach, removed pike, and confirmed pike presence in numerous lakes. However, pike extent is

believed to be much more extensive than the confirmed waterbodies and TTCD is actively pursuing techniques to determine pike locations.

One collaboration to determine pike extent took place in 2015 with the Cook Inlet Aquaculture Association (CIAA). This effort tested a new sampling method for locating pike called environmental DNA (eDNA). This method involves a water sample from the suspected waterbody that is then tested in a laboratory for pike DNA to determine presence. This method has been proven to be successful but challenging to implement in remote field settings due to the requirement of large water samples and sterile equipment. CIAA is working with TTCD and other partners to determine if smaller 50ml water samples can be accurately be collected in the field in order to increase the feasibility of the method for remote regions of Alaska. Once results are evaluated, TTCD plans to use eDNA as a detection method in waterbodies likely to have pike to determine extent. The Figure 16 displays the current known extent for pike and areas that are likely to have pike due to habitat type, waterway gradient, and the waterways connectivity to a waterbody with a confirmed catch.

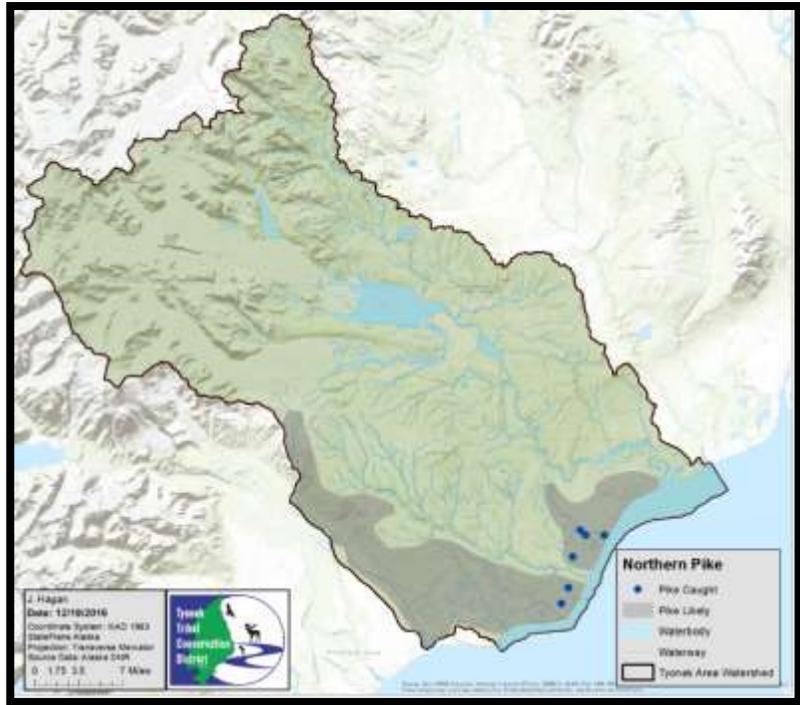


Figure 16: Pike caught: Locations where Northern Pike have been caught during TTCD pike derbies. Pike Likely: Waterways where presence of pike is likely due to habitat type, waterway gradient, and the waterways connectivity to a waterbody with a confirmed catch.

TTCD plans to use eDNA as a detection method in waterbodies likely to have pike to determine extent. The Figure 16 displays the current known extent for pike and areas that are likely to have pike due to habitat type, waterway gradient, and the waterways connectivity to a waterbody with a confirmed. TTCD plans on implementing appropriate control measures such as netting, electrofishing, and pesticides to control pike populations in priority waterbodies once pike extent and population is better understood (Table 9).

### Current Activities and Work Plan

The experience derived from the 2014-2016 invasive species work including plant surveys, derbies, pike monitoring, and invasive plant control (Table 8) has led to the following outline of goals and objectives (Table 9), and timeline of tasks (Table 10). The following charts discuss plans forward for monitoring and control.

## Accomplishments to Date:

### Invasive Species

#### Categories

#### Invasive Plant Surveys

#### Invasive Plant Control

#### Pike Monitoring

2014

- TTCD began conducting annual invasive plant surveys targeting high priority species in disturbed areas
  - TTCD adopted AKNHP survey and data collection techniques for state-wide data continuity and intra-organization collaboration.
  - The annual surveys targeted human frequented and disturbed areas including airstrips, roadways, creek crossings, yards, industrial sites, landfills, and trails.

• N/A

• N/A

2015

- By using the AKNHP non-native plant species ranking system, TTCD was able to focus surveying and control efforts to those species that pose the greatest threat to important natural resources to community members.

- TTCD coordinated the removal of Common Tansy (*Tanacetum vulgare*) from its one known location within TAW, the Tyonek graveyard. The majority of invasive species removal efforts require subsequent control efforts. In 2016, herbicide was applied with the help of the Tyonek Native Corporation (TNC). Follow up removal efforts will be evaluated given post herbicide survival rates.
- Narrowleaf hawksbeard (*Crepis tectorum*) was mechanically removed (pulled) from the roadside in Tyonek by TTCD, Tyonek youth, and interns. Efforts will be repeated in 2017.

- TTCD held the first spring and summer pike derbies in collaboration with the village of Tyonek and the community of Beluga. These efforts resulted in the removal of 85 pike.
- The pike derbies also confirmed and/or identified pike presence in three lakes.
- Through collaboration with the Cook Inlet Aquaculture Association (CIAA), TTCD explored the possibilities of other pike locations through a sampling technique called environmental DNA (eDNA). If successful, this technique could effectively and quickly identify other infested waterbodies within the TAW.

2016

- Three annual surveys (2014-2016) have been conducted with a total of 30 invasive plant data points and 11 high priority species.
- TTCD plans on annual invasive plant surveys in Tyonek area watershed as a part of the Fish Passage and Habitat Program.

- TTCD coordinated herbicide application on approximately 10 acres of orange hawkweed (*Hieracium aurantiacum*), oxeye daisy (*Leucanthemum vulgare*), white sweetclover (*Melilotus alba*), and common toadflax (*Linaria vulgaris*) in Beluga along the airstrip, on private yards, roadsides, driveways, and trails.
- Follow up efforts are planned for 2017. Subsequent efforts and monitoring in future field seasons are expected.

- TTCD held spring and fall pike derbies removing a total of 181 pike in Tyonek and Beluga
- TTCD received information on potential new pike locations:
  - Derby participant caught pike in Big Lake, not known to have pike previously
  - Preliminary eDNA results show the possibility of pike in Nikolai Creek, suggesting pike presence in suitable habitat
- Began developing plans for a netting program in 2017 in the Threemile system

Table 8: Invasive species accomplishments to date.

**Overarching Goal**

Monitor and participate in the control of invasive plant and fish populations

**Objectives**

Monitor Invasive Plant Species

Implement Control Efforts for Invasive Plants

Monitor Invasive Pike

Control Invasive Pike Populations

Inhibit the Introduction of New Species Invasion

**Strategies**

- Semi-annual district-wide surveys
- Public outreach and education
- Invasive plant identification application training
- Design and implement elodea survey plan

- Annual updating of infestation prioritization
- Participation in CNIPM network for partnerships and funding resources
- In-house certification of conservation department
- Annual monitoring and evaluation of control sites
- Annual efforts of control: weed pulls and herbicide control

- Semi-annual community pike derbies collecting location and abundance data
- Encouraging community information sharing on fish location
- Expanding monitoring methods to include EDNA sampling

- Semi-annual pike derbies
- Develop population prioritization rubric
- Spring netting efforts to reduce spawning success
- Data collection on known populations to attain
- Develop 5 and 10 year control efforts plan with landowners, partners, and experts
- Community outreach to avoid humans as vectors

- Annual community outreach
- Semi-annual pike derbies
- Permanent signs at airstrips and any other high use areas
- Hire and involve local landowner and community members in control efforts
- Incorporate best practices policies within TCD protocol
- Incorporate invasive species best practices in landowner agreements
- Require the use of certified weed-free products of all development products (revegetation, gravel, soil, compost, etc.)

**Evaluation Measures**

- Number of annual surveys
- Number of miles surveyed
- Number of species identified
- Number of data points added to state dataset AKeptic
- Annual number of new sites surveyed

- Acres of control efforts
- Number of species eradicated from District
- Amount of funding achieved

- Number of pike derbies
- Number of locations monitored
- New location recorded
- Locations shared with ADF&G and other partners

- Number of pike removed annually
- Development of and completion of tasks within control plan
- Number of populations controlled/eradicated

- Number of:
  - People reached annually
  - Local employees trained
  - Permanent signs posted
  - Community meetings
  - Community reports for invasive species sightings
  - Signatories on best practices
  - Acres represented by best practices signatories

Table 9: Outline of the overall goal for invasive species and the objectives, strategies, and evaluation measures to meet that goal.

## Task Schedule

### Monitor and participate in the control of invasive plant and fish populations

#### Objectives

Monitor Invasive Plant Species	Implement Control Efforts for Invasive Plants	Monitor Invasive Pike	Control Invasive Pike Populations	Inhibit the Introduction of New Species Invasion
<ul style="list-style-type: none"> <li>• Continue invasive weed Survey                             <ul style="list-style-type: none"> <li>◦ Identify and map unsurveyed areas</li> <li>◦ Extend survey to remaining trails, industrial sites, roads, private lands, etc.</li> </ul> </li> <li>• Extend elodea surveys to include high traffic waterways</li> </ul>	<ul style="list-style-type: none"> <li>• Continue Beluga invasive weed control efforts                             <ul style="list-style-type: none"> <li>◦ Evaluate effectiveness of 2016 control efforts</li> <li>◦ Reapply herbicide to affected areas</li> </ul> </li> <li>• Determine status of white sweetclover gravel pit infestation</li> <li>• Continue collaboration on weed removal in Tyonek's graveyard</li> </ul>	<div style="border: 1px solid black; border-radius: 15px; padding: 5px; width: fit-content; margin: 0 auto;"> <b>Action Items 1 yr (2017)</b> </div> <ul style="list-style-type: none"> <li>• CIAA collaboration on eDNA methods</li> <li>• Spring pike derby in Beluga and Tyonek</li> <li>• Create plan and begin ground-truthing pike</li> </ul>	<ul style="list-style-type: none"> <li>• Obtain netting permit</li> <li>• Research pike control and population estimate methods such as electrofishing</li> <li>• Collaborate with CIAA on netting control plans and efforts</li> </ul>	<ul style="list-style-type: none"> <li>• Design outreach signs and boot brush stations for Tyonek and Beluga airstrips</li> <li>• Pike derby outreach about the pike invasion problem</li> </ul>
<ul style="list-style-type: none"> <li>• Semiannual invasive plant surveys</li> </ul>	<ul style="list-style-type: none"> <li>• Reassess invasive plant priority infestations for control planning</li> <li>• Develop a 5 year invasive weed control plan</li> <li>• Public outreach to prevent spread of invasive species</li> </ul>	<div style="border: 1px solid black; border-radius: 15px; padding: 5px; width: fit-content; margin: 0 auto;"> <b>5 yrs (2021)</b> </div> <ul style="list-style-type: none"> <li>• Annual pike derby</li> <li>• Assessment of pike in 2019                             <ul style="list-style-type: none"> <li>◦ eDNA</li> <li>◦ Derbies</li> <li>◦ Netting</li> <li>◦ Electrofishing</li> <li>◦ Other methods</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Annual netting</li> <li>• Assessment of pike extent completed: 2019                             <ul style="list-style-type: none"> <li>◦ Derbies, eDNA, electrofishing, etc.</li> </ul> </li> <li>• Develop control plan: 2021                             <ul style="list-style-type: none"> <li>◦ Prioritize waterbodies</li> <li>◦ Implement appropriate methods such as weir, pesticide, and netting</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Encourage citizen science opportunities and collaboration to detect invasive species</li> <li>• Install signs and boot brushes at runways and other high traffic areas</li> </ul>
<ul style="list-style-type: none"> <li>• Continued semiannual surveys</li> <li>• Revisit control plan and update direction</li> </ul>	<ul style="list-style-type: none"> <li>• Continue control efforts as appropriate</li> </ul>	<div style="border: 1px solid black; border-radius: 15px; padding: 5px; width: fit-content; margin: 0 auto;"> <b>10 yrs (2026)</b> </div> <ul style="list-style-type: none"> <li>• Determine current pike extent</li> </ul>	<ul style="list-style-type: none"> <li>• Assess control effort effectiveness</li> <li>• Develop control plan for next 5 years</li> <li>• Implement control efforts as needed</li> </ul>	<ul style="list-style-type: none"> <li>• Continued outreach as needed</li> </ul>

Table 10: TTCD's task schedule for invasive species objectives over the next 1, 5, and 10 years.

## Conclusion and Next Steps

Through this watershed action plan, TTCD has laid out goals, objectives, strategies, and evaluation measures within the three categories of action identified at the start of this project. For each category of action, TTCD has also identified action items and a projected timeline for each objective spanning 2017 – 2026. As TTCD moves forward to achieve these goals through the action items listed in this document, TTCD will work closely with landowners and stakeholders within the Tyonek Area Watershed.

As stated at the beginning of this document, TTCD is a non-regulatory nonprofit organization whose mission is to conserve, enhance, and encourage the wise use of natural resources. As TTCD does not own land, all conservation projects are completed in collaboration with landowners and other stakeholders. This model has proven to be effective as a way to cooperatively achieve joint conservation goals with stakeholder input.

All action items and tasks described in this document are subject to landowner and stakeholder approval, and will only be completed with the explicit permission of landowners. TTCD has spent the last five years developing solid, productive relationships with landowners and stakeholders within the District and plans to continue to work with partners to continue to achieve conservation goals.

Upon completion of this document, TTCD will take the following next steps:

- Present Tyonek Area Watershed Action Plan to TTCD's Scientific Advisory Committee for review: TTCD will present updates annually to the scientific advisory committee and call upon their individual expertise as needed throughout the project.
- Share the Tyonek Area Watershed Action Plan with major stakeholders and landowners: TTCD will meet with each major landowner and stakeholder to discuss questions, ideas, concerns, and/or comments about this watershed action plan to continue dialogue and collaboration around the common goal of protecting natural resources.
- Take steps to implement action items listed for 2017: TTCD will take the necessary steps including fundraising, coordinating, researching, and implementation of the outlined tasks for 2017.
- Take steps to implement action items listed for 2018-2021
- Review and update this document every five years
- Create best practices document that outlines guidelines to help further the goals and objectives outlined in this document: Best practices will be created in collaboration with the scientific advisory committee, landowners, and stakeholders and will seek to acquire signatures from participating landowners to form a voluntary watershed coalition.

Through continued monitoring, collaborative efforts to address issues, and continued efforts to evaluate the current status of the Tyonek Area Watershed, TTCD along with partners will maintain and improve the overall health of the Watershed.