Gwichyaa Zhee Gwich'in Tribal Government
Hazard Mitigation Plan
March 2019

Prepared for:
State of Alaska
DMVA/DHS&EM
P.O. Box 5800
JBER, Alaska 99505

Prepared in Collaboration with:

LeMay Engineering & Consulting, Inc.

TABLE OF CONTENTS

1. Introduction 1-1

1.1 Hazard Mitigation Planning 1-1
1.2 Planning Requirements 1-1
1.2.1 Local and Tribal Mitigation Plans 1-1
1.3 Grant Programs with Mitigation Plan Requirements 1-1
1.3.1 Hazard Mitigation Assistance (HMA) Unified Programs 1-2
1.4 HMP Description 1-3

2. Prerequisites 2-1

2.1 Adoption by Local Governing Bodies and Supporting Documentation 2-1

3. Community Description 3-1

3.1 Location, Geography, and History 3-1
3.2 Demographics 3-2
3.3 Economy 3-2
3.4 Community Capacity 3-3

4. Planning Process 4-1

4.1 Overview of Planning Process 4-1
4.2 Hazard Mitigation Planning Team 4-2
4.3 Public Involvement & Opportunity for Interested Parties to participate 4-3
4.4 Incorporation of Existing Plans and Other Relevant Information 4-3

5. Hazard Profiles 5-1

5.1 Overview of a Hazard Analysis 5-1
5.2 Hazard Identification and Screening 5-1
5.3 Hazard Profile 5-2
5.3.1 Cryosphere 5-4
5.3.2 Earthquake 5-10
5.3.3 Flood and Erosion 5-17
5.3.4 Weather (Severe) 5-30
5.3.5 Fire 5-39

6. Vulnerability Analysis 6-1

6.1 Overview of a Vulnerability Analysis 6-1

6.2 Current Asset Exposure Analysis 6-1
6.2.1 Critical Asset Infrastructure 6-1

7. Mitigation Strategy 7-1

7.1 Developing Mitigation Goals 7-1
7.2 Identifying Mitigation Actions 7-2
7.3 Evaluating and Prioritizing Mitigation Acts 7-2
7.4 Implementing a Mitigation Action Plan 7-6

8. Plan Maintenance 8-1

8.1 Monitoring, Evaluating, and Updating the HMP 8-1
8.2 Implementation Through Existing Planning Mechanisms 8-2
8.3 Continued Public Involvement 8-3
8.4 Resources 8-4

9. References 9-1

Tables

Table 1—Public Facility and Service Providers in Fort Yukon 3-4
Table 2—Fort Yukon's Regulatory Tools 3-5
Table 3—Fort Yukon's Staff Resources 3-6
Table 4—Financial Resources for Hazard Mitigation 3-7
Table 5—Hazard Mitigation Planning Team 4-2
Table 6—Public Involvement Mechanisms 4-3
Table 7—Identification and Screening of Hazards 5-2
Table 8—Perceived Shaking, Potential Damage, and Peak Ground Acceleration 5-12
Table 9—Historical Earthquakes for Fort Yukon 5-13
Table 10—Historical Flood Events 5-21
Table 11—FEMA Summary of Discharges 5-30
Table 12—Severe Weather Events 5-34
Table 13—Wildfire Locations Since 1939 within 50 Miles of Fort Yukon 5-43
Table 14—Alaska's Critical Infrastructure 6-2
Table 15—Estimated Population and Building Inventory 6-3
Table 16—Fort Yukon Critical Facilities 6-5
Table 17—Potential Hazard Exposure Analysis – Critical Infrastructure 6-7
Table 18—Mitigation Goals 7-1
Table 19—Mitigation Goals and Potential Actions 7-3
Table 20—Evaluation Criteria for Mitigation Actions 7-5
Table 21—Combined GZGTG and City of Fort Yukon Mitigation Action Plan 7-9

Figures

Figure 1—Fort Yukon Location Map 3-1
Figure 2—Fort Yukon Historic Population 3-3
Figure 3—Aerial Photograph of the Fort Yukon Community 3-8
Figure 4—Cryosphere Components Diagram 5-4
Figure 5—Permafrost Distribution Map 5-5
Figure 6—Display of Modeled Soil Temperature Potential Changes 5-6
Figure 7—Map Showing Ground Ice Volume of Permafrost in Alaska 5-7
Figure 8—Permafrost Map of Alaska 5-9
Figure 9—Known-Active Faults 5-14
Figure 10—Image from the "Neotechtonic Map of Alaska" – Fort Yukon 5-15
Figure 11—Fort Yukon's Earthquake Probability 5-17
Figure 12—Fort Yukon Flood Threat 5-25
Figure 13—Fort Yukon's Flood Hazard Area Identified in 1983 5-26
Figure 14—1992 Fort Yukon Flood 5-27
Figure 15—USACE Flood Protection Levee System 5-28
Figure 16—Alaska Fire Management Options 5-41
Figure 17—Fort Yukon's Historical Wildfires 5-44
Figure 18—Fort Yukon's Wildland Fire Risk 5-45
Figure 19—Fort Yukon Land Ownership Map 6-14
Figure 20—Fort Yukon Map 6-15

Appendices

A	Public Involvement
B	Fort Yukon Area Use Map
C	FEMA Review Tool
D	Benefit-Cost Analysis Fact Sheet
E	Plan Maintenance Documents
F	Resolution and Approval

Acronyms/Abbreviations

°F	Degrees Fahrenheit
% g	Percent of the Acceleration of Gravity
AEC	Alaska Earthquake Center
AFG	Assistance to Firefighters Grant
AICC	Alaska Interagency Coordination Center
AKST	Alaska Standard Time
ANA	Administration for Native Americans
ANSCA	Alaska Native Claims Settlement Act
ANTHC	Alaska Native Tribal Health Consortium
APA	American Planning Association
ARC	American Red Cross
ATV	All-Terrain Vehicle
BC	Benefit (Costs)
BFE	Base Flood Elevation
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
CATG	Council of Athabascan Tribal Governments
CD	compact disc
CDBG	Community Development Block Grant
CFP	Community Forestry Program
CHEMS	Community Health and Emergency Medical Services
CFR	Code of Federal Regulations
City	City of Fort Yukon
CR	Cryosphere
DCCED	Department of Commerce, Community, and Economic Development
DCRA	Division of Community and Regional Affairs
DGGS	Division of Geological and Geophysical Survey
DEC	Department of Environmental Conservation
DHSS	Department of Health and Social Services

DHS	Department of Homeland Security
DHS&EM	Division of Homeland Security and Emergency Management
DMA 2000	Disaster Mitigation Act of 2000
DMVA	Department of Military and Veterans Affairs
DNR	Department of Natural Resources
DOE	Department of Energy
DOF	Division of Forestry
DOI	Division of Insurance
DOL	Department of Labor
DOT&PF	Department of Transportation and Public Facilities
DSS	Division of Senior Services
EDA	Economic Development Administration
EQ	Earthquake
FEMA	Federal Emergency Management Agency
FL	Flood
FMA	Flood Mitigation Assistance
FP&S	Fire Prevention and Safety
ft	feet
g	gravity as a measure of peak ground acceleration
GZ	Gwitchyaa Zhee
GZGTC	Gwichyaa Zhee Gwich'in Tribal Council
GZGTG	Gwitchyaa Zhee Gwich'in Tribal Government
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HUD	Housing and Urban Development
HWE	High Water Elevation
IBHS	Institute for Business and Home Safety
ICDBG	Indian Community Development Block Grant
IFG	Individual Family Grant Program
IRA	Indian Reorganization Act
IRS	Internal Revenue Service
M	Magnitude
Mb	Millibars
MAP	Mitigation Action Plan
MMI	Modified Mercalli Intensity
MP	Mile Post
mph	miles per hour

msl	mean sea level
NAHASDA	Native American Housing Assistance and Self Determination Act
NAVD	National American Vertical Datum of 1988
NFIP	National Flood Insurance Program
NWS	National Weather Service
PDM	Pre-Disaster Mitigation
PGA	peak ground acceleration
PSHAs	Probabilistic Seismic Hazard Analyses
RD	U.S. Division of Rural Development
REAA	Rural Education Attendance Area
RFC	Repetitive Flood Claim
RPSU	Rural Power System Upgrade
SAFER	Staffing for Adequate Fire and Emergency Response
SBA	U.S. Small Business Administration
SHMP	Alaska State Hazard Mitigation Plan
Sq.	Square
Stafford Act	Robert T. Stafford Disaster Relief and Emergency Assistance Act
STAPLEE	Social, Technical, Administrative, Political, Legal, Economic, and Environmental
SV	Severe Weather
TCC	Tanana Chiefs Conference
TF	Technical Feasibility
UHMA	United Hazard Mitigation Assistance
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
U.S.	United States
USC	United States Code
USGS	United States Geological Survey
VPSO	Village Public Safety Officer
VA	Veteran's Assistance
VFA-RFAG	Volunteer Fire Assistance and Rural Fire Assistance Grant
WCF	Wildland/Conflagration Fire
WUI	Wildland Urban Interface

This section provides a brief introduction to hazard mitigation planning, the grants associated with these requirements, and a description of this Hazard Mitigation Plan (HMP). This HMP was developed in 2019 for the Gwichyaa Zhee Gwich'in Tribal Government (GZGTG) which was formerly known as "The Native Village of Fort Yukon". GZGTG will be used in this HMP and is synonymous with the Native Village of Fort Yukon. The GZGTG serves the Gwich'in people of Fort Yukon, Alaska.

1.1 HAZARD MITIGATION PLANNING

Hazard mitigation, as defined in Title 44 of the Code of Federal Regulations (CFR), Section §201.4, is "any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards." Many areas have expanded this definition to also include human-caused hazards. As such, hazard mitigation is any work done to minimize the impacts of any type of hazard event before it occurs. It aims to reduce losses from future disasters. Hazard mitigation is a process in which hazards are identified and profiled, people and facilities at risk are analyzed, and mitigation actions are developed. The implementation of the mitigation actions, which include long-term strategies that may include planning, policy changes, programs, projects, and other activities, is the end result of this process. Hazard mitigation is the only phase of emergency management specifically dedicated to breaking the cycle of damage reconstruction, and repeated damage. As such, State, Local, and Tribal governments are encouraged to take advantage of funding provided by Federal Hazard Mitigation Assistance (HMA) programs.

1.2 PLANNING REQUIREMENTS

1.2.1 Local and Tribal Mitigation Plans

On October 30, 2000, Congress passed the Disaster Mitigation Act of 2000 (DMA 2000) (P.L. 106-390) which amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) (Title 42 of the United States Code [USC] 5121 et seq.) by repealing the act's previous mitigation planning section (409) and replacing it with a new mitigation planning section (322). Section 322 directs State, Local, and Tribal entities to closely coordinate mitigation planning and implementation efforts. Additionally, it establishes the HMP requirement for the Federal Emergency Management Agency's (FEMA) HMA.

On October 2, 2015, FEMA published the Mitigation Planning Final Rule in the Federal Register, [Docket ID: FEMA-2015-0012], 44 CFR Part 201, effective November 2, 2015. Planning requirements for Local and Tribal entities are described in detail in Sections §201.6 and §201.7. Locally- and Tribally- adopted and State- and FEMA- approved HMPs qualify jurisdictions for several HMA grant programs. This Tribal HMP for the GZGTG complies with Title 44 CFR and applicable FEMA guidance documents as well as the 2018 Alaska State HMP.

Section 322 of the Stafford Act (42 USC 5165) as amended by P.L. 106-390 provides for State, Local, and Tribal governments to undertake a risk-based approach to reducing risks from natural hazards through mitigation planning. The National Flood Insurance Act of 1968 (42 USC 4001 et seq.) as amended, further reinforces the need and requirement for HMPs, linking Flood Mitigation Assistance (FMA) programs to State, Local, and Tribal HMPs. This change also required participating National Flood Insurance Program (NFIP) communities' risk assessments and mitigation strategies to identify and address repetitively flood damaged properties.

1.3 GRANT PROGRAMS WITH MITIGATION PLAN REQUIREMENTS

FEMA HMA grant programs provide funding to States, Local, and Tribal entities that have a FEMA-approved State, Local, or Tribal HMP. Two of the grants are authorized under the

Stafford Act and DMA 2000, while the remaining three are authorized under the National Flood Insurance Act and the Bunning-Bereuter-Blumenauer Flood Insurance Reform Act. As of June 19, 2008, the grant programs were segregated. The Hazard Mitigation Grant Program (HMGP) is a competitive, disaster-funded grant program whereas the other Unified Mitigation Assistance Programs (Pre-Disaster Mitigation [PDM] and FMA, although competitive) rely on specific pre-disaster grant funding sources, sharing several common elements.

> *"The Department of Homeland Security (DHS) FEMA HMA grant programs present a critical opportunity to protect individuals and property from natural hazards while simultaneously* ***reducing reliance on Federal disaster funds****. The HMA programs provide PDM grants annually to States, Local, and Tribal communities. The statutory origins of the programs differ, but all share the common goal of reducing the loss of life and property due to natural hazards.*
>
> *The PDM program is authorized by the Stafford Act and focuses on mitigation project and planning activities that address multiple natural hazards, although these activities may also address hazards caused by manmade events. The FMA program is authorized by the National Flood Insurance Act and focuses on reducing claims against the NFIP"* (FEMA, 2019h).

1.3.1 Hazard Mitigation Assistance (HMA) Unified Programs

The HMGP provides grants to States, Local, and Tribal entities to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. Projects must provide a long-term solution to a problem; for example, elevation of a home to reduce the risk of flood damages as opposed to buying sandbags and pumps to fight the flood. In addition, a project's potential savings must be more than the cost of implementing the project. Funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The amount of funding available for the HMGP under a particular disaster declaration is limited. FEMA may provide a State or Tribe with up to 20% of the total aggregate disaster damage costs to fund HMGP project or planning grants. The cost-share for this grant is 75% Federal/25% non-Federal.

The PDM grant program provides funds to State, Local, and Tribal entities for hazard mitigation planning and mitigation project implementation prior to a disaster event. PDM grants are awarded on a nationally-competitive basis. Like HMGP funding, a PDM project's potential savings must be more than the cost of implementing the project. In addition, funds may be used to protect either public or private property or to purchase property that has been subjected to, or is in danger of, repetitive damage. The total amount of PDM funding available is appropriated by Congress on an annual basis. In Fiscal Years (FY) 2016 and 2017, PDM program funding totaled approximately $90 million each year. The cost-share for this grant is 75% Federal/25% non-Federal.

The goal of the FMA grant program is to reduce or eliminate flood insurance claims under the NFIP. Particular emphasis for this program is placed on mitigating repetitive loss properties. According to FEMA, there are no repetitive loss properties in the City of Fort Yukon. The primary source of funding for this program is the National Flood Insurance Fund. Grant funding

is available for three types of grants, including Planning, Project, and Technical Assistance. Project grants, which use the majority of the program's total funding, are awarded to States, Local, and Tribal entities to apply mitigation measures to reduce flood losses to properties insured under the NFIP. In FY 2016, FMA funding totaled $199 million. In FY 2017, FMA funding totaled $160 million. The cost-share for this grant is 75% Federal/25% non-Federal.

The City of Fort Yukon has been a member of the NFIP since April 24, 1995. City Ordinance No. 95-06 establishes "…land use regulations to conform to requirements of the NFIP…" The City has an effective flood map dated February 3, 2010. The GZGTG does not participate in the NFIP.

1.4 HMP DESCRIPTION

The remainder of this HMP consists of the following sections and appendices:

Prerequisites

Section 2 addresses the prerequisites of plan adoption, which include adoption by the GWGTG. The adoption resolution is included in Appendix F.

Community Description

Section 3 provides a general history and background of the Fort Yukon community, including historical trends for population and the demographic and economic conditions that have shaped the area. Trends in land use and development are also discussed. A location figure of the area is included. This section also provides the community capacity in terms of public facility and service providers, regulatory tools, and staff and financial resources.

Planning Process

Section 4 describes the planning process and identifies the Planning Team Members, the meetings held as part of the planning process, the LeMay Engineering & Consulting, Inc. planner, and the key stakeholders within the GZGTG and the surrounding area. In addition, this section documents public outreach activities (Appendix A) and the review and incorporation of relevant plans, reports, and other appropriate information.

Hazard Analysis

Section 5 describes the process through which the Planning Team identified, screened, and selected the hazards to be profiled in the development of this HMP. The hazard analysis includes the characteristics, history, location, extent, impact, and recurrence probability statement of future events for each hazard. In addition, historical and hazard location figures are included.

Vulnerability Analysis

Section 6 identifies potentially vulnerable assets—people, residential and nonresidential buildings, and critical facilities and infrastructure—in Fort Yukon. The resulting information identifies the full range of hazards that the GZGTG could face and potential social impacts, damages, and economic losses.

Mitigation Strategy

Section 7 defines the mitigation strategy which provides a blueprint for reducing the potential losses identified in the vulnerability analysis. The Planning Team developed a list of mitigation goals and potential actions to address the risks facing Fort Yukon. Mitigation actions include preventive actions, property protection techniques, natural resource protection strategies, structural projects, emergency services, and public information and awareness activities. Mitigation strategies were developed encouraging participation with the NFIP and the reduction of flood damage to flood-prone structures.

Plan Maintenance

Section 8 describes the Planning Team's formal plan maintenance process to ensure that the HMP remains an active and applicable document. This process includes monitoring, evaluating, and updating the HMP (Appendix E); implementation of the mitigation process through existing planning mechanisms; and continued public involvement.

References

Section 9 lists the reference materials used to prepare this HMP.

Appendix A

Appendix A provides public outreach information, including newsletters, meeting sign-in sheets and agendas, trip reports, and public comments.

Appendix B

Appendix B contains Fort Yukon Land Use Maps.

Appendix C

Appendix C provides the FEMA Tribal Multi-Hazard Mitigation Plan Review Crosswalk which documents compliance of this Tribal HMP with FEMA criteria.

Appendix D

Appendix D contains the Benefit-Cost Analysis Fact Sheet used to prioritize mitigation actions.

Appendix E

Appendix E provides plan maintenance documents, such as an annual review sheet, the progress report form, and a community survey.

Appendix F

Appendix F contains the Adoption Resolution and FEMA approval letter.

2.1 ADOPTION BY LOCAL GOVERNING BODIES AND SUPPORTING DOCUMENTATION

The requirements for the adoption of this HMP by the local governing body, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 REQUIREMENTS: PREREQUISITES

Tribal Plan Adoption and Assurances

Requirement §201.7(c)(5) and (6): The Tribal HMP shall include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan (e.g., Tribal Council). The Tribal HMP must assure FEMA that that Tribe will comply with all applicable statues and regulations in effect with respect to the periods in which it receives grant funding.

Element

- Has the local governing body adopted the new plan?
- Is supporting documentation, such as a resolution, included?
- Has the local governing body provided an assurance of compliance with all applicable statues and regulations?

Source: FEMA, 2015.

Fort Yukon is the home of the Gwichyaa Gwich'in. Fort Yukon lies within an unorganized borough, and is within the village boundary of the Gwitchyaa Zhee (GZ) Corporation, a Village Corporation within the regional Doyon Native Corporation region. Other major organizations include the GZGTG and the Council of Athabascan Tribal Governments (CATG) which is a consortium of the 10 Tribal Governments within the Yukon Flats.

The GZGTG was chartered by the Federal government in 1940 as the Indian Reorganization Act (IRA) council and continues to serve tribal members through a variety of Federal, State, and privately-funded programs for social and economic development projects, capital projects, and provisions of the Bureau of Indian Affairs (BIA) services related to education, social services, employment, housing, natural resources, realty, roads, and tribal operations. The mission of the GZGTG is to exercise governmental authority to promote economic and social development, advocate and secure tribal rights to secure tribal lands, enhance educational opportunities, and protect traditional cultural values with a unified voice on behalf of its tribal members. The GZGTG currently has 1,237 members, of which 138 are living outside Alaska. In 2018, the GZGTG fluctuated between 15-31 permanent, construction, and temporary employees. GZGTG's Executive Director supervises all departments, working side by side with the Gwichyaa Zhee Gwich'in Tribal Council (GZGTC). The Executive Director also works directly with the Tanana Chiefs Conference (TCC). The GZGTG is governed by a seven-member elected GZGTC. The seven GZGTC members are elected by a majority of the GZGTG voters. As the local governing body of the GZGTG, the GZGTC adopted this HMP by resolution on 3 JUNE, 2019. A scanned copy of the resolution is included in Appendix F.

The GZGTG is the local jurisdiction represented in this HMP and meets the requirements of Section 409 of the Stafford Act and Section 322 of DMA 2000. The GZGTG will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c), and will amend its plan whenever necessary to reflect changes in Tribal or Federal laws and statutes as required in 44 CFR 13.11(d).

This page intentionally left blank

This section describes the location, geography, and history; demographics; land use; development trends; and the community capacity in terms of public facility and service providers, regulatory tools, and staff and financial resources for the Fort Yukon community.

3.1 LOCATION, GEOGRAPHY, AND HISTORY

"Fort Yukon is located on the north bank of the Yukon River at the confluence of the Yukon and Porcupine Rivers, eight miles above the Arctic Circle and 140 air miles northeast of Fairbanks at the northern most point of the Yukon River. The community is at the approximate center of a broad alluvial plain known as the Yukon Flats, an area of thousands of lakes and meandering streams. It lies at approximately 66.564720 North Latitude and -145.273890 West Longitude. (Sec. 18, T020N, R012E, Fairbanks Meridian.) Fort Yukon is located in the Fairbanks Recording District." (Department of Community, Commerce, and Economic Development [DCCED], Division of Community and Regional Affairs [DCRA], 2019).

Figure 1—Fort Yukon Location Map

The Fort Yukon community is surrounded by the multi-million-acre Yukon Flats Wildlife Refuge and covers approximately 7.0 square (sq.) miles of land and approximately 0.4 sq. mile of water. Extreme temperature changes occur throughout Alaska's interior. Fort Yukon temperatures range from a winter low of -60 degrees Fahrenheit (°F) to a high of 97 °F. A record low of -75 °F and a record high of 100 °F have been recorded (Fort Yukon, 2017b). The area receives approximately 6.58 inches of rain and 43.4 inches of snow. The Yukon River is ice-free from the end of May through mid-September.

Established in 1847 by the Hudson's Bay Company, Fort Yukon is the largest Athabascan village and one of the oldest settlements in Alaska. Fort Yukon became an important trade center for the Gwichyaa Gwich'ins, who inhabited the vast lowlands of the Yukon Flats and River valleys and the rolling hills of the Chandalar, Sheenjek, Porcupine, and Black River. The Gwitch'in Athabascans have inhabited the Fort Yukon area for thousands of years. The Gwitch'in People refer to Fort Yukon as Gwitchyaa Zhee (house on the flats). The following is the community's brief historical sketch:

1847	Fort Yukon was founded as a Canadian outpost in Russian territory and quickly became an important trade center for the Gwich'in Athabascans.
1847 – 1869	The Hudson Bay Company operated Fort Yukon.
1862	The mission school was established.
1867	Alaska was purchased from Russia by the U.S.
1869	Fort Yukon was found to be located on American soil.
1898	The Post Office was established.
1889 – 1904	There was a whaling boom along the Arctic coast.
1800s	Fur trade and the Klondike gold rush spurred economic activity and provided economic opportunities for the Fort Yukon community.

1860s – 1920s	Major epidemics impacted the Fort Yukon population.
1949	A flood damaged or destroyed many homes in Fort Yukon. Many of the residents moved their homes to the higher ground east of the original townsite. The stores, school, post office, public offices, and the community center are now located in the new location.
1955	The White Alice radar site and an Air Force station were established.
1959	Fort Yukon incorporated as a city.
1959	The Native Village of Fort Yukon was officially incorporated.

Approximately 90% of Fort Yukon's permanent residents are part of the larger Gwich'in Athabascans of Alaska, which occupy approximately 55,000 square miles of traditional territory on the Yukon River Drainage. They were originally a nomadic people; migrating throughout the year between seasonal camps where they harvested wild game and fish and gathered berries and other food sources. Trading supplemented their subsistence life style, allowing tribal members to access goods from those traversing the area. Residents rely on subsistence foods—salmon, whitefish, moose, bear, caribou, and waterfowl provide most meat sources. Half of the villages scattered across the Yukon Flats are above the Arctic Circle. At the western end of the valley, the culture transitions to the Koyukon Athabascans.

Fort Yukon is not a part of the road system. Therefore, the community's only mode of transportation in and out is via airplane, with the exception of boats during the summer and snow machines during the winter.

3.2 DEMOGRAPHICS

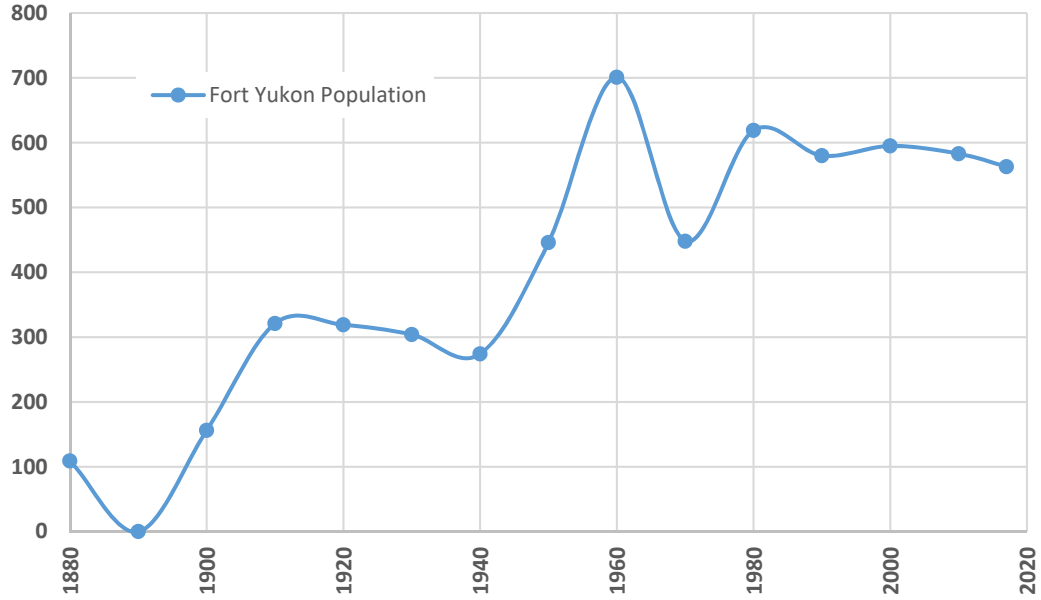
The 2010 U.S. Census recorded 583 residents, of which the median age was 34, indicating a relatively young population. The population of Fort Yukon is expected to remain steady because over half of the population is between 20 and 54 years of age. Fort Yukon is a blended Athabascan community, and about 89.2% of residents recognize themselves as Alaska Native. The remaining residents are typically seasonal transients such as school teachers, fire fighters, and U.S. Air Force workers. The male and female composition is approximately 55.7% and 44.3%, respectively. The 2010 U.S. Census identified 317 households with the average household having approximately three individuals. The most recent 2017 DCCED certified population is 563, derived from the 2017 Department of Labor (DOL) Estimate. Figure 2 illustrates the historic population of Fort Yukon.

All of Fort Yukon's permanent residents except five people are GZGTG members. Approximately 20-30 transient residents reside in the community as school teachers, fire fighters, and construction workers. This HMP defines people as GZGTG members.

3.3 ECONOMY

There are limited employment opportunities in Fort Yukon. Based in Fort Yukon, CATG is the largest Tribal employer in the region, providing 50 jobs with an over 70% local hire rate and managing an annual budget exceeding $5 million. City, State, and Federal agencies and the GZ corporation are the primary employers in Fort Yukon. The school district is also one of the largest employers. Unlike many Alaska villages, tourism is becoming increasingly popular – Fort Yukon is above the Arctic Circle and experiences spectacular Northern Lights in the winter and 24 hours of daylight in the summer. A local resident has a partnership with a Fairbanks

Figure 2—Fort Yukon Historic Population



flight service to provide tours of Fort Yukon to vacationers. One resident holds a commercial fishing permit. The Bureau of Land Management (BLM) operates an emergency firefighting base at the airport in the summer. The U.S. Air Force operates a White Alice Radar Station. The multiple agencies in the region create a strong economic base, which when added to the size of the community makes Fort Yukon an important regional hub within the Yukon Flats region. The community's location and access to important services means that Fort Yukon has long played an important leadership role for the people of the Yukon Flats.

According to the 2010-2014 ACS 5-Year Estimates (DCCED/DCRA, 2019), the median household income in Fort Yukon was $46,250. Approximately 90 individuals (17.7%) were reported to be living below the poverty level. The potential work force (those aged 16 years or older) in Fort Yukon was estimated to be 422 people, of which 266 were actively employed (ADOL, 2016). In 2016, the unemployment rate was 15%; however, this rate included part-time and seasonal jobs, and practical unemployment or underemployment is likely to be significantly higher. Additionally, Fort Yukon is considered a distressed community per the 2017 DOL and Workforce Development, Research, and Analysis Section (DHS&EM, 2018).

3.4 COMMUNITY CAPACITY

The Fort Yukon community's capability assessment reviews the technical and fiscal resources available to the community. This subsection outlines the resources available to Fort Yukon for mitigation and mitigation-related funding and training. Table 1 shows how the City and Tribal governments within Fort Yukon work together to provide essential services to residents.

Table 1—Public Facility and Service Providers in Fort Yukon

Public Services	City of Fort Yukon	GZGTG	Other local Providers	State/Federal Agency
Police	XX			
Fire Protection	Volunteer Fire Department			
Water Utility	XX			
Sewer	XX			
Landfill	XX			
Cable-Television	XX			
Games Operation	XX		XX	
Liquor Store	XX			
Road Maintenance	XX			State of Alaska
Public Works	XX			
Public Safety	XX			
Auto Repair	XX		XX	
Levee and Flood Maintenance	XX			
Road Maintenance	XX			
Development Permit Program	XX			
Washeteria	XX			
Tribal Operation		XX		
Reality Services		XX		
Social Services		XX		State of Alaska
General Assistance		XX		
Natural Resource		XX		
Environmental		XX		
Employment Resources		XX		
Elderly Program		XX		
Clinic and Health			CATG*	Alaska Native Health Services, TCC
Dental Program				
Mental Health				
Public School			Yukon Flats School District**	
Electric Power			G-Z Utilities	
Radio KZPA			Gwandak Public Broadcasting, Inc.	
Magistrate				State of Alaska
Airport Construction and Updates				DOT & PF
Airport Maintenance	Under contract to DOT & PF			DOT & PF
Communication			Interior Telephone Co.	
Fuel			Crowley's (Diesel and Heating Oil) GZ Fuel (unleaded)	

Notes: * CATG was established in 1985 by the Chiefs, Elders, and other members of tribal governments in the Yukon Flats Region and is based in Fort Yukon. The most visible part of CATG is the Yukon Flats Health Center (YFHC). The YFHC provides primary care and a 24-hour emergency support services to other residents in the sub-region and also assists TCC in coordinating other health programs in the region. These include: community health aid program; community health representation, emergency air/ambulance, alcohol rehabilitation, and home health services.
**District offices for the Yukon Flats School District which services the nearby communities of Circle, Beaver, Stevens Village, Chalkyitsik, Arctic Village, and Venetie are located in Fort Yukon.

Table 2—Fort Yukon's Regulatory Tools

Regulatory Tools (ordinances, codes, plans)	Existing?	Comments (Year of most recent update; problems administering it, etc.)
Building code	No	Neither the City or Tribe exercises this authority.
Zoning ordinances	Yes	GZGTG has its own ordinances. The City can only exercise this authority on City land but not on Tribal land. The Village Public Safety Officer may intervene on Tribal land.
Subdivision ordinances or regulations	No	The City can exercise this authority but doesn't. Subdivisions in Fort Yukon are on Tribal land.
Special purpose ordinances (Referenced in City's Comprehensive Plan)	Yes	Floodplain ordinance. Prohibits permanent structure building in old town. New infrastructure and residences are built at higher elevations [above the Base Flood Elevation (BFE)] adjacent to the City.
Comprehensive Plan	Yes	Both entities have their own plan. GZGTG completed their plan in 2006. The City plan was completed in 1996.
Emergency Response Plan	Yes	Completed.
Land Use	Yes	Both entities have their own requirements. GZGTG lists the regulations in their ordinance. The City plan was completed in 1996.
Wildland Fire Protection Plan	Yes	The City has a plan that defines community fire threats.
Sanitation Feasibility Study/Master Plan	Yes	Describes the City's soil types and preliminary engineering and testing; the study considered alternatives for recommended facilities. ANTHC has provided similar testing for GZGTG.
Transportation Plan	Yes	GZGTG completed their plan in 2004.
Fort Yukon Community Plan	Yes	Both entities have adopted the same plan for 2016 -2021.

Table 3—Fort Yukon's Staff Resources

Staff/Personnel Resources	Y/N	Department/Agency and Position
Planner or engineer with knowledge of land development and land management practices	No	Both GZGTG and the City hire consultants with land development and land management knowledge. In addition, GZGTG has reach-back capability to TCC and ANTHC.
Engineer or professional trained in construction practices related to buildings and/or infrastructure	No	Both GZGTG and the City hire consultants with engineering consulting services. In addition, GZGTG has reach-back capability to TCC and ANTHC.
Planner or engineer with an understanding of natural and/or human-caused hazards	No	Both GZGTG and the City hire consultants with hazard mitigation knowledge. In addition, GZGTG has reach-back capability to TCC and ANTHC.
Floodplain Manager	Yes	Jimmy Smith, State Floodplain Manager
Surveyors	No	Both GZGTG and the City hire surveyors. In addition, GZGTG has reach-back capability to TCC and ANTHC.
Staff with education or expertise to assess the jurisdiction's vulnerability to hazards	No	
Personnel skilled in Geospatial Information System (GIS) and/or HAZUS-MH	No	
Scientists familiar with the hazards of the jurisdiction	No	U.S. Fish & Wildlife Service Fairbanks office; Alaska Department of Fish & Game Fairbanks office
Emergency Manager	Yes	City Mayor or Tribal Chief (Situation dependent)
Finance (Grant writers)	Yes	City Manager or GZGTG Executive Director (Situation dependent), GZGTG has one part-time grant writer, TCC grant writers
Public Information Officer	Yes	City Mayor or Tribal Chief (Situation dependent)

Table 4—Financial Resources for Hazard Mitigation

Financial Resource	Accessible or Eligible to Use for Mitigation Activities
General funds	The City has limited funding, can exercise this authority with voter approval.
Community Development Block Grants	Both GZGTG and the City have limited funding, can exercise this authority with voter approval.
Capital Improvement Projects Funding	The City has limited funding, can exercise this authority with voter approval.
Authority to levy taxes for specific purposes	The City has limited funding, can exercise this authority with voter approval.
Incur debt through general obligation bonds	ANTHC is responsible for bonding requirements for GZGTGC. The City can exercise this authority with voter approval.
Incur debt through special tax and revenue bonds	
Incur debt through private activity bonds	
Hazard Mitigation Grant Program (HMGP)	FEMA funding which is available to local communities after a Presidentially-declared disaster. It can be used to fund both pre- and post-disaster mitigation plans and projects. Both GZGTG and the City are eligible as they have individual HMPs.
Pre-Disaster Mitigation (PDM) grant program	FEMA funding which is available on an annual basis. This grant can only be used to fund pre-disaster mitigation plans and projects only. Both GZGTG and the City are eligible as they have individual HMPs.
Flood Mitigation Assistance (FMA) grant program	Only the City participates in the NFIP and can request FEMA funding which is available on an annual basis. This grant can be used to mitigate repetitively flooded structures and infrastructure to protect repetitive flood structures.
United State Fire Administration (USFA) Grants	The local fire department run by the City can request these grants. The purpose of these grants is to assist State, regional, national or Local organizations to address fire prevention and safety. The primary goal is to reach high-risk target groups including children, seniors, and firefighters.
Fire Mitigation Fees	Public works is a City function; thus, they can request these fees which finance future fire protection facilities and fire capital expenditures required because of new development within Special Districts.
BIA Grants	GZGTG receives BIA grants annually.
Federal Highways	GZGTG receives funding for dust control.

Figure 3 depicts an aerial photograph of Fort Yukon obtained from DCCED/DCRA as part of their community mapping effort.

Figure 3—Aerial Photograph of the Fort Yukon Community

Source: DCRA, 2009

This section provides an overview of the planning process; identifies the Planning Team members and key stakeholders; documents public outreach efforts; and summarizes the review and incorporation of existing plans, studies, and reports used to develop this HMP. Additional information regarding the Planning Team and public outreach efforts is provided in Appendix A.

The requirements for the planning process, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Planning Process

Tribal Planning Process

Requirement §201.7(b): An open public involvement process is essential to the development of an effective plan.

In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:

Element

- An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;
- An opportunity for neighboring communities, tribal and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and nonprofit interests to be involved in the planning process; and
- Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.

Requirement §201.7(c)(1): [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.

Element

- Does the plan provide a narrative description of the process followed?
- Does the new plan indicate who was involved in the planning process?
- Does the new plan indicate how the public was involved?
- Does the new plan discuss the opportunity for neighboring communities, agencies, businesses, academia, nonprofits, and other interested parties to be involved in the planning process?
- Does the planning process describe the review and incorporation, if appropriate, of existing plans, studies, reports, and technical information?

Source: FEMA, 2015.

4.1 OVERVIEW OF PLANNING PROCESS

The first step in the planning process began with Shirley Fields being appointed the community point of contact in December, 2018. On January 14, 2019, the GZGTC set the date for their council/public meeting for January 28, 2019. The Planning Team's role was discussed to include: acting as an advocate for the planning process, assisting with gathering information, and providing support for the public meeting and other public participation opportunities. There was also a brief discussion about hazards that affect the community such as flooding/erosion, wildfires, earthquakes, and melting permafrost.

The Planning Team held a public meeting as an agenda item during their regularly scheduled GZGTC meeting on January 28, 2019. The hazard mitigation planning process was described, and participants were asked to help identify hazards that affect the community and to also identify critical facilities. Ms. Jennifer LeMay, PE, PMP, LeMay Engineering & Consulting, Inc., assisted the Planning Team with identifying mitigation actions and projects.

In summary, the following five-step process took place from December 2018 through March 2019.

1. Organize resources: Members of the Planning Team identified resources, including staff, agencies, and local community members, who could provide technical expertise and historical information needed in developing the HMP.
2. Assess risks: The Planning Team identified hazards specific to Fort Yukon, and with the assistance of a hazard mitigation planning consultant (LeMay Engineering & Consulting, Inc.), developed a risk assessment for the identified hazards, including the vulnerability analysis, prior to and during the development of the mitigation strategy.
3. Assess capabilities: The Planning Team reviewed current administrative and technical, legal and regulatory, and fiscal capabilities to determine whether existing provisions and requirements adequately address relevant hazards.
4. Develop a mitigation strategy: After reviewing the risks posed by each hazard, the Planning Team developed a comprehensive range of potential mitigation goals and actions. Mitigation actions were then prioritized based on community concerns.
5. Monitor, evaluate, and update the plan: The Planning Team developed a process to monitor the HMP to ensure it will be used as intended while fulfilling community needs. The team then developed a process to evaluate the HMP on a yearly basis to compare how their decisions affected hazard impacts. They then outlined a method to share their successes with community members to encourage support for mitigation activities and to provide data for incorporating mitigation actions into existing planning mechanisms and providing data for the HMP's five-year update. Opportunities are described in the Continued Public Involvement Section of this HMP (Section 8).

4.2 HAZARD MITIGATION PLANNING TEAM

The Planning Team consisted of Executive Director Dale Hardy, Shirley Fields, Realty and Natural Resources Director, and GZGTG and GZGTC members listed in Table 5. The State of Alaska, DHS&EM provided funding and project oversight. LeMay Engineering & Consulting, Inc., DHS&EM's contractor, provided assistance to the Planning Team.

Table 5—Hazard Mitigation Planning Team

NAME	TITLE	ORGANIZATION	PHONE
Dale Hardy	Executive Director	GZGTG	662.2581
Shirley Fields	Realty and NR Director	GZGTG	662.2581
Steve Ginnis	Traditional Chief	GZGTG	460.4450
Nancy James	First Chief	GZGTC	662.2440
Michael Peter	Second Chief	GZGTC	662.5196
Carol Shewfelt	Tribal Council Member	GZGTC	446.7250
Gerald Alexander	Tribal Council Member	GZGTC	662.5608
Mary Beth Solomon	Tribal Council Member	GZGTC	662.5203
Dacho Alexander	Tribal Council Member	GZGTC	662.3284
Charlotte Kelly-Spencer	Tribal Council Member	GZGTC	662.5120
Jennifer LeMay, PE, PMP	Planner/Consultant	LeMay Engineering & Consulting, Inc.	350.6061
Rick Dembroski	State Hazard Mitigation Planner	DHS&EM	428.7015
Brent Nichols	State Hazard Mitigation Officer	DHS&EM	428.7085

4.3 PUBLIC INVOLVEMENT & OPPORTUNITY FOR INTERESTED PARTIES TO PARTICIPATE

Table 6 lists the community's public involvement initiatives focused to encourage participation and insight for the HMP effort.

Table 6—Public Involvement Mechanisms

Mechanism	Description
Newsletter Distribution (January 14, 2019)	In January 2019, the jurisdiction distributed a newsletter describing the upcoming planning activity. The newsletter encouraged the community to provide hazard and critical facility information either by calling or emailing Jennifer LeMay and/or attending the January 28, 2019 meeting at the Tribal Hall. Newsletter #1 was posted at the Tribal Office, City Office, and the Post Office to ensure the community was aware of the meeting.
Newsletter Distribution (February 5 and 14, 2019)	In February, 2019, the jurisdiction distributed Newsletters 2 and 3 describing the public comment period. The newsletters encouraged the community to review the Draft HMP. Newsletters #2 and 3 were posted at the Tribal Office, City Office, and the Post Office to ensure the community was aware of the public comment period.

An invitation was extended to individuals and entities via a project newsletter describing the planning process and announcing the upcoming public meeting. A newsletter was developed and posted at the Tribal Office, City Office, and the Post Office on January 14, 2019, announcing the first public meeting. Another newsletter was developed and posted at the Tribal Office, City Office, and the Post Office on February 5 and 14, 2019, announcing the public comment period.

The Planning Team held a public meeting during their regularly scheduled Tribal Council meeting on January 28, 2019. During the meeting, the Planning Team led the attending public through a hazard identification update and screening exercise. The attendees developed a list of hazards which periodically impact the community: cryosphere, earthquake, flood/erosion, severe weather, and wildland fire.

Following the hazard screening process, the Planning Team led the attendees through the process of confirming critical facilities in the community based on what was identified in 2017 for the City's HMP. LeMay Engineering & Consulting, Inc. also described the specific information needed from the Planning Team and public to complete the risk assessment including the locations and values of critical facilities in the community.

After the community asset data was collected by the Planning Team, a risk assessment was completed that illustrated the assets that are exposed and vulnerable to specific hazards. Mitigation actions were also developed and prioritized.

On February 5, 2019, the availability of the Draft HMP was announced, and a 30-day public comment period began. GZGTG posted the Draft HMP on their webpage. On February 26, 2019, the Planning Team held a public meeting. During the meeting, mitigation action strategies were reviewed, and public comments were received.

4.4 INCORPORATION OF EXISTING PLANS AND OTHER RELEVANT INFORMATION

During the planning process, the Planning Team reviewed and incorporated information from existing plans, studies, reports, and technical reports into the HMP. The following were reviewed and used as references for the jurisdiction information and hazard profiles in the risk assessment of the HMP:

- *The City of Fort Yukon Hazard Mitigation Plan*, 2017.
- *The City of Fort Yukon Solid Waste Management/Landfill Operations Plan*, 2017.
- *The GZGTG Long-Range Transportation Plan*, 2004.
- *Fort Yukon Community Plan, 2016-2021*: defines the community's goals and priorities and was adopted by GZGTG and the City.
- *Beyond Vision: GZGTG Community Comprehensive Plan*, prepared by Katasse Financial Management in collaboration with Ikayutit, 2006.
- *State of Alaska, Department of Commerce, Community and Economic Development Community Profile, provided historical and demographic information*, 2019.
- *The City of Fort Yukon Comprehensive Plan*, *1996*: explains the City's land use initiatives and natural hazard impacts.
- *U.S. Army Corps of Engineers (USACE), Alaska Baseline Erosion Assessment, Erosion Information Paper – Fort Yukon, Alaska*. January 21, 2008, defined the community's erosion threat.
- *USACE, Alaska Baseline Erosion Assessment, Study Findings and Technical Report*. *March 2009*, defined the community's erosion threat.
- *USACE, Civil Works Branch, Alaska Floodplain Management Flood Hazard Data, Fort Yukon, Alaska.* January 2010, defined the community's erosion threat.
- *Flood Insurance Study, City of Fort Yukon, Alaska, Yukon-Koyukuk Census Area, February 3, 2010*, defines the City's flood and erosion threats.
- *City of Fort Yukon Sanitation Plan*, developed by the Alaska Native Tribal Health Consortium (ANTHC) describes the City's soils, permafrost depth, and sanitation infrastructure needs.

A complete list of references consulted is provided in Section 9.

This section identifies and profiles the hazards that could potentially affect Fort Yukon.

5.1 OVERVIEW OF A HAZARD ANALYSIS

A hazard analysis includes the identification, screening, and profiling of each hazard. Hazard identification is the process of recognizing the natural events that could threaten an area. Natural hazards result from unexpected or uncontrollable natural events of sufficient magnitude. Human, Technological, Economic, and Terrorism-related hazards are beyond the scope of this HMP. Even though a particular hazard may not have occurred in recent history in the study area, all-natural hazards that may potentially affect the study area are considered; the hazards that are unlikely to occur or for which the risk of damage is accepted as being very low, are eliminated from consideration.

Hazard profiling is accomplished by describing hazards in terms of their characteristics, history, magnitude, frequency, location, extent, and recurrence probability statement. Hazards are identified through the collection of historical and anecdotal information, review of existing plans and studies, and preparation of hazard maps of the study area. Hazard maps are used to determine the geographic extent of the hazards and define the approximate boundaries of the areas at risk.

5.2 HAZARD IDENTIFICATION AND SCREENING

The requirements for hazard identification, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Risk Assessment: Identifying Hazards

Identifying Hazards

Requirement §201.7(c)(2)(i): [The risk assessment shall include a] description of the type of all-natural hazards that can affect the jurisdiction.

Element

- Does the new plan include a description of the types of all-natural hazards with the potential to affect the jurisdiction?

Source: FEMA, 2015.

For the first step of the hazard analysis, on January 28, 2019, the Planning Team evaluated possible hazards that could affect Fort Yukon according to the State of Alaska HMP (DHS&EM, 2018). For the Yukon Flats Rural Education Attendance Area (REAA), five of the eight hazards were applicable to Fort Yukon: cryosphere (which includes permafrost), earthquake, flood (which includes erosion), severe weather, and wildland fire. They then evaluated and screened the comprehensive list of potential hazards based on a range of factors, including prior knowledge or perception of the threat and the relative risk presented by each hazard, the ability to mitigate the hazard, and the known or expected availability of information on the hazard (see Table 7). The remaining hazards excluded through the screening process were considered to pose a lower threat to life and property in Fort Yukon due to the low likelihood of low occurrence or the low probability that life and property would be significantly affected.

Table 7—Identification and Screening of Hazards

Hazard Type	Should It Be Profiled?	Explanation
Cryosphere	Yes	Permafrost is present throughout Alaska and periodically causes houses to shift due to permafrost thawing and upheaval. The community has numerous refrigerant rods used to maintain frozen ground, reducing melting permafrost damage.
Earthquake	Yes	Periodic, unpredictable occurrences. Cracks form on the runway. The community experienced no damage from the 11/2003 Denali EQ, but felt the 1964 Good Friday Earthquake.
Flood	Yes	Snowmelt and ice jam flooding occurs during spring thaw. Fall flooding/rainy season events occur from soil saturation. Several minor flood events have caused damage. Severe damages occur from major floods. Fort Yukon has riverine erosion caused by high water flow, ice flows, wind, and surface runoff. Erosion of the Sucker River at 10-20 feet/year is occurring. As of 2017, eight houses are in danger of eroding into the river as they are on the wrong side of the dike. These houses ae not eligible for grant funding as squatters live in these houses and do not own the land.
Ground Failure	No	This hazard does not exist for Fort Yukon per the State of Alaska HMP.
Tsunami & Seiche	No	This hazard does not exist for Fort Yukon per the State of Alaska HMP.
Volcano	No	This hazard does not exist for Fort Yukon per the State of Alaska HMP.
Weather	Yes	Annual weather patterns, severe cold, freezing rain, and snow accumulations are the predominant threats. Severe weather events cause fuel price increases and frozen pipes. Heavy snow loads potentially damage house roofs. Winds potentially remove or damage roofs. The community experiences -68ºF annually, causing # 2 heating oil to freeze.
Wildland Fires and Conflagration Fires	Yes	Fort Yukon and the surrounding area becomes very dry in summer months with weather- and human-caused incidents igniting dry vegetation (i.e., lightning, trash burning, and campfires). The community feels this hazard is increasing because the direction of the wind has changed, and a new neighborhood was built near the lagoon that is adjacent to the woods. The community experiences bad smoke every other year from neighboring communities. A firebreak was built ten years ago, but underbrush has rapidly grown.

5.3 HAZARD PROFILE

The requirements for hazard profiles, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Risk Assessment – Profiling Hazards

Profiling Hazards

Requirement §207.6(c)(2)(i): [The risk assessment shall include a] description of the location and extent of all-natural hazards that can affect the jurisdiction. The plan shall include information on previous occurrences of hazard events and on the probability of future hazard events.

Element

- Does the risk assessment identify the location (i.e., geographic area affected) of each natural hazard addressed in the new plan?
- Does the risk assessment identify the extent (i.e., breadth, magnitude, or severity) of each hazard addressed in the new plan?
- Does the plan provide information on previous occurrences of each hazard addressed in the new plan?
- Does the plan include recurrence probability statements of future events (i.e., chance of occurrence) for each hazard addressed in the new plan?

Source: FEMA, 2015.

The specific hazards selected by the Planning Team for profiling have been examined in a methodical manner based on the following factors:

- Hazard Characteristics;
    - Typical event characteristics;
    - Potential climate change impacts are primarily discussed in the Weather hazard profile but are also identified where deemed appropriate within selected hazard profiles;
- History (geologic as well as previous occurrences);
- Location;
- Extent (breadth, magnitude, and severity);
- Impact (general impacts associated with each hazard are described in the following profiles, and detailed impacts to the community's residents and critical facilities are further described in Section 6 as part of the overall vulnerability summary for each hazard); and
- Recurrence probability statement of future events.

The hazards profiled for Fort Yukon are presented in the rest of Section 5.3. The order of presentation does not signify the level of importance or risk.

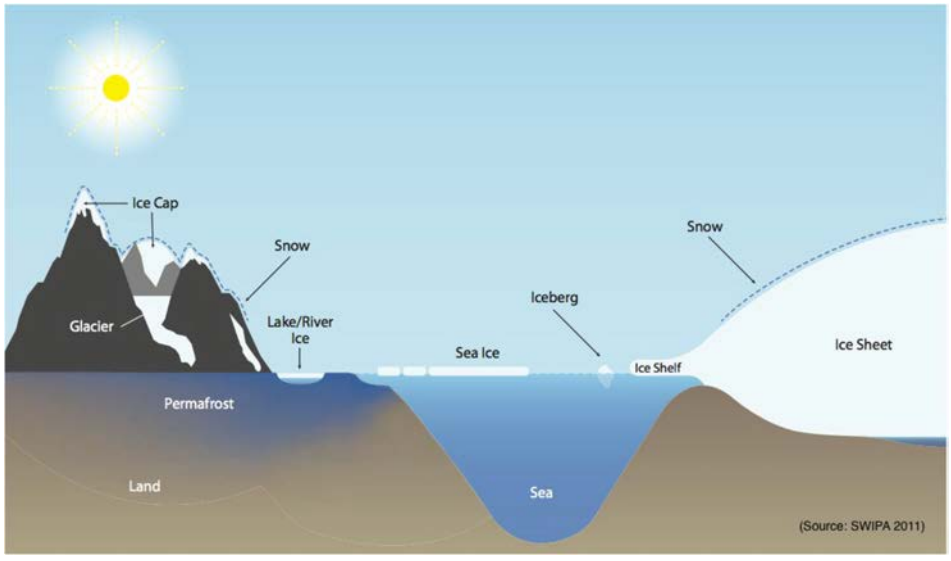
5.3.1 Cryosphere

5.3.1.1 Hazard Characteristic

The "cryosphere" is defined as those portions of Earth's surface and subsurface where water is in solid form, including sea, lake, and river ice, snow cover, glaciers, ice caps and ice sheets, and frozen ground (e.g., permafrost) (Figure 4). The components of the cryosphere play an important role in climate. Snow and ice reflect heat from the sun, helping to regulate the Earth's temperature. They also hold Earth's important water resources, and therefore, regulate sea levels and water availability in the spring and summer. The cryosphere is one of the first places where scientists are able to identify global climate change.

Related hazards to the cryosphere include flooding, erosion, and permafrost which all affect the Fort Yukon community.

Figure 4—Cryosphere Components Diagram



Source: DHS&EM, 2018

Hazards of the cryosphere can be subdivided into four major groups:

- Glaciers;
- Permafrost and periglacial;
- Sea ice; and
- Snow avalanche.

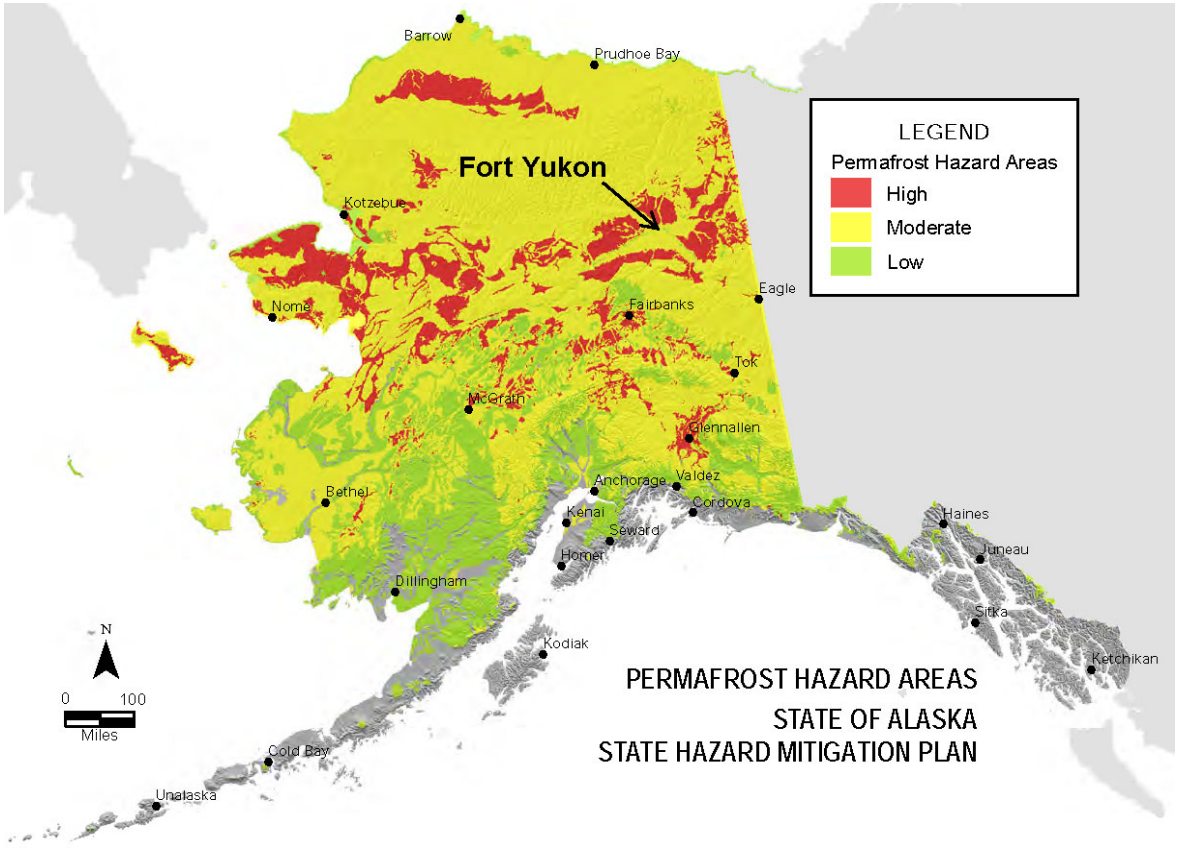
Of these four major groups, only permafrost applies to the Fort Yukon community.

Permafrost is caused by the effects of changing perennially frozen soil, rock, or sediment and the landscape processes that result from extreme seasonal freezing and thawing (Figure 5). Permafrost is found in nearly 85% of Alaska and is thickest and most extensive in Arctic Alaska north of the Brooks Range. It is present virtually everywhere and extends as much as 2,000 feet below the surface of the Arctic Coastal Plain.

Southward from the Brooks Range, permafrost becomes increasingly thinner and more discontinuous, broken by pockets of unfrozen ground until it becomes virtually absent in Southeast Alaska, with the exception of pockets of high-elevation alpine permafrost.

Permafrost, defined as ground with a temperature that remains at or below freezing (32°F) for two or more consecutive years, can include rock, soil, organic matter, unfrozen water, air, and ice. Regions with permafrost are typically categorized by % of surface area underlain by permafrost (Figure 5): continuous (>90%), discontinuous (50-90%), sporadic (10-50%), and isolated (<10%) permafrost. GZGTG confirmed during the January 28, 2019 public meeting that Fort Yukon has discontinuous permafrost which is why they put down gravel pads before building in an effort to keep the ground frozen.

Figure 5—Permafrost Distribution Map

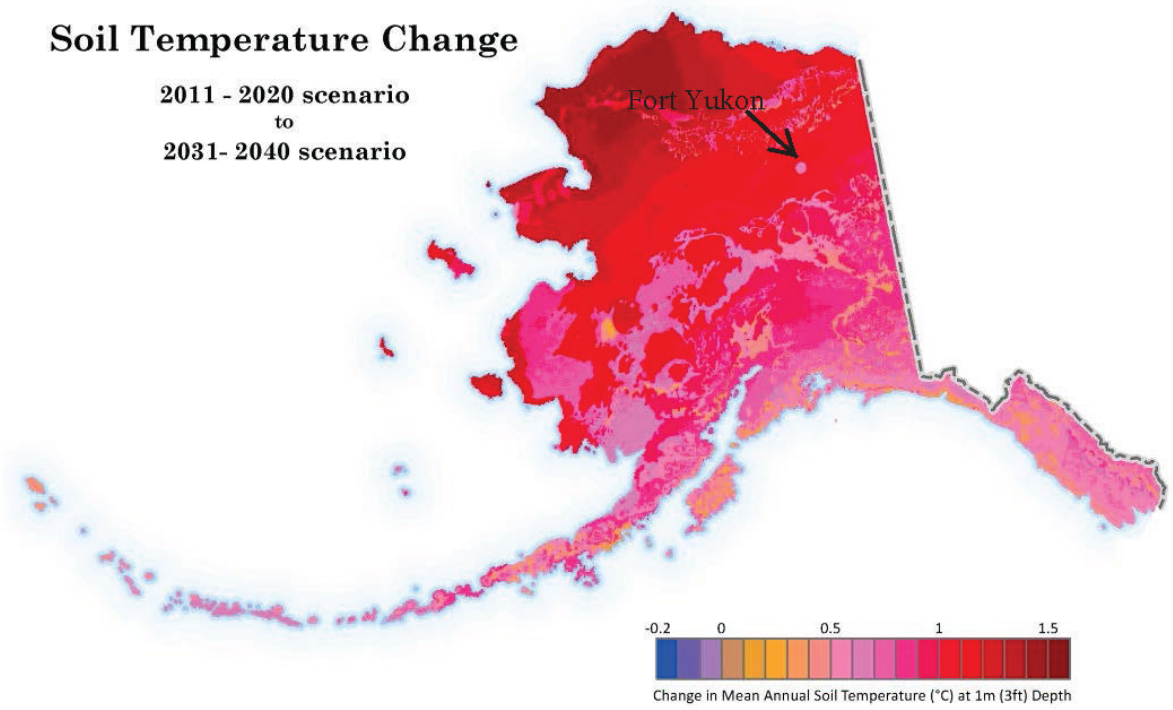


Source: DHS&EM, 2018

Permafrost provides a stable foundation for structures and infrastructure in cold-climate regions as long as the temperature of the frozen ground is well below freezing. A major hazard of warming and thawing permafrost is that ground ice degrades, and the soil surface collapses. Fluctuations in temperature over the seasons also cause the ground to move as the upper layers freeze (i.e., ice lens formation) and thaw (i.e., loss of ice). Segregated ice lenses may form under wet conditions as the ground freezes, especially in fine-grained soils such as silt or clay. Upon thawing, ground ice can cause an excess of liquid water that cannot be stored in the soil and needs to flow out of the soil as gravity consolidates the soil after thawing.

Permafrost temperatures throughout Alaska are showing warming trends (Figure 6); as permafrost approaches the freezing point (32°F), it becomes increasingly unstable and prone to collapse. Unstable permafrost requires very little trigger to initiate degradation.

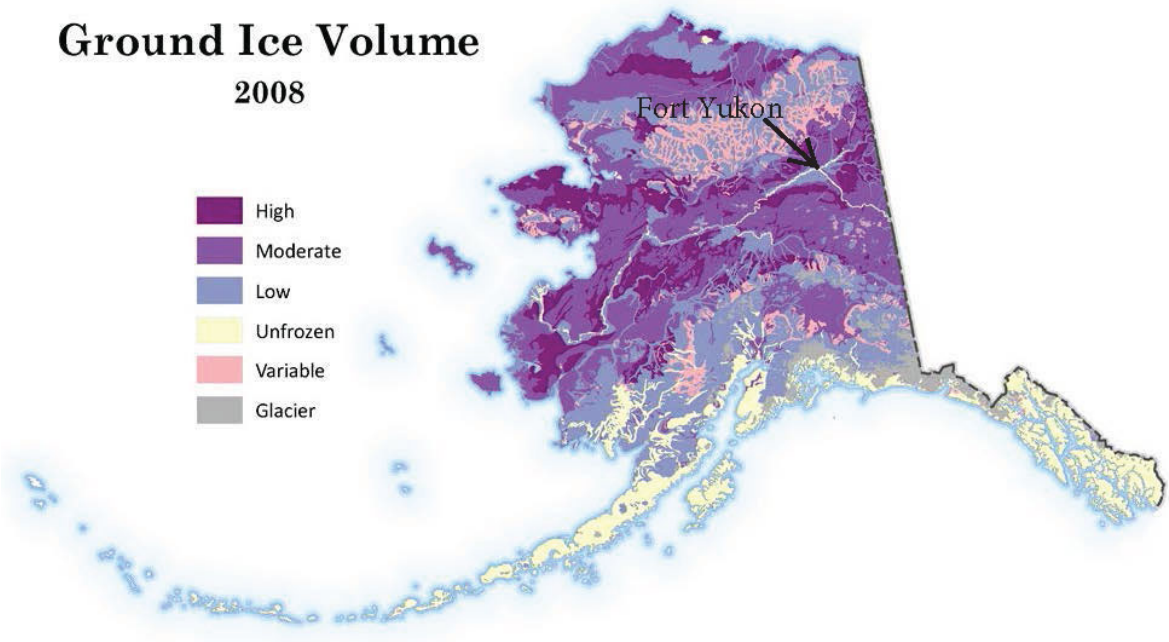
Figure 6—Display of Modeled Soil Temperature Potential Changes



Source: DHS&EM, 2018

Ice content is the measure of frozen water in a given volume of permafrost (Figure 7). Because permafrost by definition is any earth material that remains below freezing for more than two consecutive years, permafrost composition is highly variable, ranging from solid rock to soils that are composed almost entirely of ice. Studies near Cape Halkett and Drew Point on the Artic coast have demonstrated that the rate of coastal erosion of ice-rich permafrost coast is much faster than non-ice-rich coast. In Alaska, yedoma that may be tens of feet thick occurs in the Arctic Foothills, in the northern part of the Seward Peninsula, and in interior Alaska; these areas will be particularly susceptible to catastrophic thaw collapse as temperatures warm. For example, the In'upiat community of Noorvik sits on 65 to 100 feet of massive ground ice that will be at risk of collapse if trends continue.

Figure 7—Map Showing Ground Ice Volume of Permafrost in Alaska



Source: DHS&EM, 2018

5.3.1.2 Climate Factors

Climate has a major effect on cryosphere hazards because these hazards are so closely linked to snow, ice, and permafrost. Changes in climate can modify natural processes and increase the magnitude and recurrence frequency of certain geologic hazards (e.g., floods, erosion, and permafrost thaw), which if not properly addressed, could have a damaging effect on Alaska's communities and infrastructure, as well as on the livelihoods and lifestyles of Alaskans.

During the last several decades, Alaska has warmed twice as fast as the rest of the U.S. Permafrost is at an increased risk of thawing as a result of climate change. The major climatic factor leading to warming and thawing permafrost is an increase in air temperatures. Another important factor is the potential increase in snow depth predicted by the majority of climate models. Snow insulates permafrost from low winter temperatures, which leads to an increase in ground temperatures and diminishes permafrost stability. When soils are warm, permafrost becomes unstable and is sensitive to catastrophic collapse in conjunction with flooding and erosion. Even in non-ice-rich soils, process-driven models show more material is available for erosion and transport when the soil is thawed, which leads to increased exposure of underlying or adjacent frozen material to thermal and physical stressors.

Human-induced ground warming can often degrade permafrost much faster than natural degradation caused by a warming climate. Permafrost degradation can be caused by constructing warm structures on the ground surface, allowing heat transfer to the underlying ground. Under this scenario, improperly designed and constructed structures can settle as the ground subsides, resulting in loss of the structure or expensive repairs. Permafrost is also degraded by damaging the insulating vegetative ground cover, allowing the summer thaw to extend deeper into the soil, causing subsidence of permafrost.

5.3.1.3 Cryosphere Hazard History

There is no written record defining permafrost impacts. Uneven settling throughout the years within the area has damaged buildings and roads constructed. This hazard has gotten a lot worse this decade.

5.3.1.4 Location, Extent, Impact, and Recurrence Probability

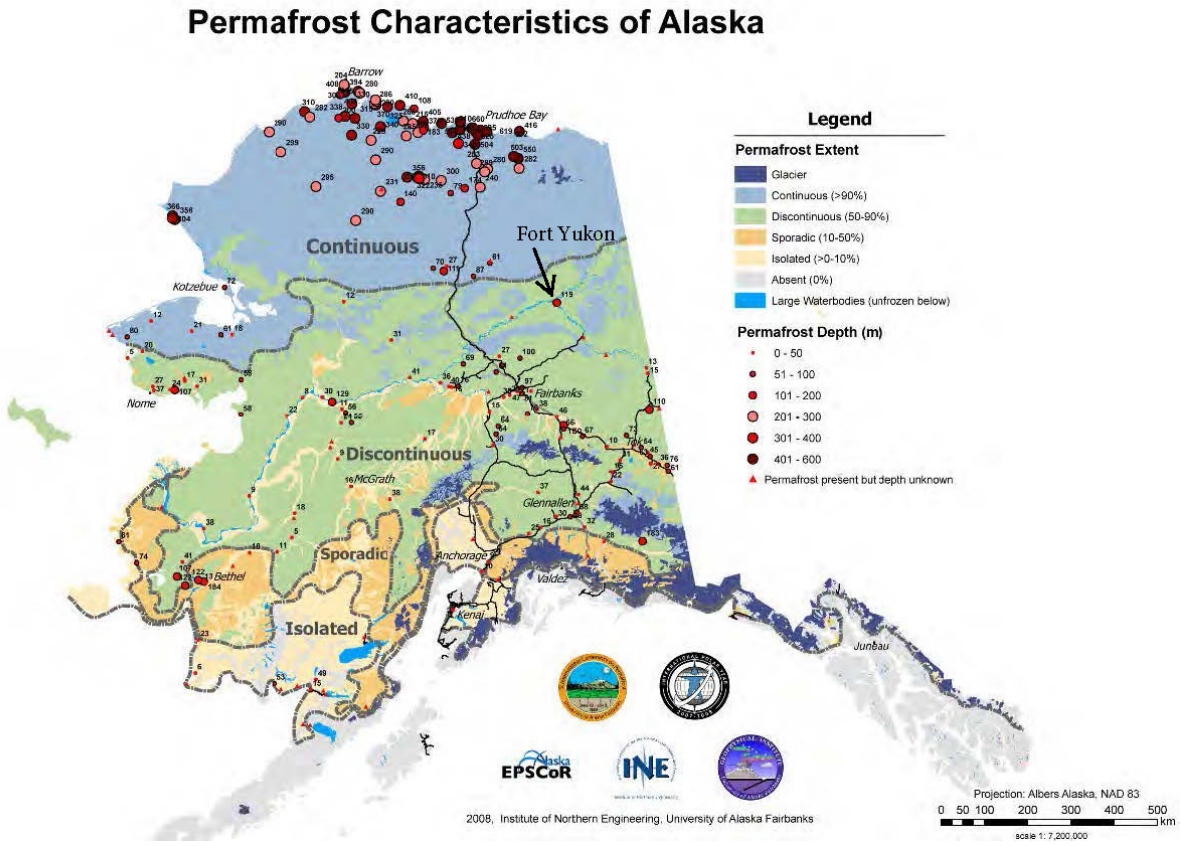
Location

Cryosphere hazards can impact any place in Alaska where water occurs seasonally or permanently in solid form, including permafrost and snow cover in Fort Yukon. The City of Fort Yukon's Comprehensive Plan states "Permafrost is present throughout the [community]' and subsequently discusses its soils types and permafrost locations:

> *"…The permafrost tables here are usually 4 or more feet below the surface and may be absent close to the river. These well-drained soils also have the best potential for construction if the particular area is not subject to flooding.*
>
> *A secondary soil type in the Yukon Flats is found in the many shallow slough and old stream channels. It is mostly poorly drained and is perennially frozen at shallow depths; permafrost tables are within 2 feet of the surface. Soil with these characteristics present severe construction limitations. Dominant vegetation is mosses, stunted black spruce, dwarf birch, sedge tussocks, and lichens. Maintaining vegetation in these areas is important in keeping the permafrost tables at existing levels. If vegetation is removed, the permafrost tables lower, resulting in settling of the ground surface, and erosion along the streams.*
>
> *Permafrost is discontinuous in the Yukon Flats, but in poorly drained areas it may occur to a considerable depth. At Fort Yukon, the depth of permafrost was found to exceed 320 feet. Beneath water bodies and well-drained sites, the ground is frozen. Layers of unfrozen deposits can also be found within zones of permafrost. Ground ice is common in the permafrost areas. In some locations where it has melted and left depressions, lakes have formed. These are known as "thaw" or "cave-in" lakes.*
>
> *Because of permafrost, there is little groundwater except near streams. Aquifers apparently do not exist and the yield from wells is low. Springs exist in the area, and the best known is Circle Hot Springs. All water in the area appears to be of the calcium bicarbonate type, which is categorized as hard water"* (Fort Yukon, 2017).

According to a permafrost map completed by the Institute of Northern Engineering, University of Alaska Fairbanks located in the Alaska Hazard Mitigation Plan 2013, the City's Comprehensive Plan, and comments received from the Planning Team, the entire Fort Yukon area is underlain by discontinuous permafrost (Figure 8).

Figure 8—Permafrost Map of Alaska



Source: DHS&EM, 2013

Extent

Permafrost is found beneath nearly 85% of Alaska. Thawing causes ground subsidence, flooding, and erosion. The damage magnitude could range from minor with some repairs required and little to no damage to transportation, infrastructure, or the economy to major if a critical facility (such as the airport) were damaged and transportation was affected. GZGTG noted that permafrost typically is encountered at four to six feet below ground surface when digging grave sites.

Impacts

Permafrost impacts include a full range of damage from comparatively minor bending or buckling of manmade features due to heterogeneous movement, to complete destruction of infrastructure and buildings due to catastrophic ground failure. Permafrost has generated comparatively slow ongoing phenomena in the past, but warming climate is expected to increase the breadth, magnitude, and frequency of damaging permafrost collapse.

Impacts associated with degrading permafrost include surface subsidence, infrastructure, structure, and/or road damage. Permafrost does not pose a sudden and catastrophic hazard, but improperly designed and constructed structures can settle as the ground subsides, resulting in loss of the structure or expensive repairs. Permafrost restricts use of the ground surface, and affects the location and design of roads, buildings, communities,

pipelines, airfields, and bridges. To avoid costly damage to these facilities, careful planning and design in the location and construction of facilities is warranted.

Recurrence Probability

There is no written record defining permafrost impacts for Fort Yukon. Fort Yukon residents are noting that the cryosphere hazard is worsening every year and that permafrost damage occurs annually to structures and roads throughout the community.

5.3.2 Earthquake

Alaska is one of the most seismically active regions in the world and is at risk of societal and economic losses due to damaging earthquakes. On average, Alaska has one "great" magnitude [(M) >8] earthquake every 13 years, one M 7-8 earthquake every year, and six M 6-7 earthquakes every year. Earthquakes have killed more than 130 people in Alaska during the past 60 years (DHS&EM, 2018).

It is not possible to predict the time and location of the next big earthquake, but the active geology of Alaska guarantees that major damaging earthquakes will continue to occur and can affect almost anywhere in the state. Scientists have estimated where large earthquakes are most likely to occur, along with the probable levels of ground shaking to be expected. With this information, as well as information on soil properties and landslide potential, it is possible to estimate earthquake risks in any given area.

Alaska earthquake statistics include:

- Alaska is home to the second-largest earthquake ever recorded (1964 Great Alaska Earthquake, M 9.2);
- Alaska has 11% of the world's recorded earthquakes;
- Three of the eight largest earthquakes in the world were in Alaska; and
- Seven of the ten largest earthquakes in the U.S. were in Alaska.

In addition to the previously mentioned large earthquake, since 1900, Alaska has had an average of:

- 45 M 5-6 earthquakes per year;
- 320 M 4-5 earthquakes per year; and
- 1,000 earthquakes located in Alaska each month.

Source: Alaska Earthquake Center (AEC)

5.3.2.1 Hazard Characteristics

An earthquake is a sudden motion or trembling caused by a release of strain accumulated within or along the edge of the earth's tectonic plates. The effects of an earthquake can be felt far beyond the site of its occurrence. Earthquakes usually occur without warning and after only a few seconds can cause massive damage and extensive casualties. The most common effect of earthquakes is ground motion, or the vibration or shaking of the ground during an earthquake.

Ground motion generally increases with the amount of energy released and decreases with distance from the fault or epicenter of the earthquake. An earthquake causes waves in the earth's interior (i.e., seismic waves) and along the earth's surface (i.e., surface waves). Two kinds of seismic waves occur: P (primary) waves are longitudinal or compressional waves similar in character to sound waves that cause back and forth oscillation along the direction of travel (vertical motion), and S (secondary) waves, also known as shear waves, are slower than P waves and cause structures to vibrate from side to side (horizontal motion). There are also two types of surface waves: Raleigh waves and Love waves. These waves travel more slowly and typically are significantly less damaging than seismic waves.

In addition to ground motion, several secondary natural hazards can occur from earthquakes such as:

- **Strong Ground Motion** is ground shaking. Strong ground motion intensity is directly correlated with earthquake magnitude (i.e., the larger the earthquake magnitude, the more intense and widespread the ground shaking will be). The strong ground motion severity is also dependent on distance from the energy source; the strongest shaking occurs near the earthquake epicenter. The damage extent at any given location is dependent on many factors: the magnitude of the earthquake; distance from the epicenter; local geology; and site-specific factors, such as building height and construction type (DHS&EM, 2018).
- **Surface Rupturing** occurs when the subsurface patch of fault that slips in an earthquake intersects the earth's surface. This causes discrete, differential ground movement during intense earthquake shaking. The relative crustal block motion is dictated by the rupture's fault type, which can be horizontal, vertical, or a combination of both. Earthquakes larger than M 6.5 have sufficient energy to create surface ruptures, but whether or not this occurs is dependent on the earthquake's depth. The shallower a depth at which a significant earthquake occurs, the more likely it is to create a surface rupture. The permanent displacement along faults can be substantial. For example, the 2002 Denali rupture (M 7.9, right-lateral rupture) was roughly 211 miles in length and had maximum lateral offsets of 28.9 feet and maximum vertical offsets of 13.1 feet. Surface ruptures, as a product of intense strong ground motion, can cause severe damage to existing structures (DHS&EM, 2018).
- **Liquefaction** describes the phenomenon in which saturated or partially-saturated soil materials lose significant stiffness because of an applied stress; in this case, earthquake strong ground motion. The sudden shaking causes the soil to behave like a viscous fluid. Liquefaction or plastic flow in underlying materials can lead to **Lateral Spread**, creating subsequent soil or rock mass movement. Liquefaction and lateral spread can occur even in moderate earthquakes, and are responsible for a tremendous amount of damage in historical earthquakes worldwide (DHS&EM, 2018).
- **Landslides/Debris Flows** occur as a result of horizontal seismic inertia forces induced in the slopes by the ground shaking. The most common earthquake-induced landslides include shallow, disrupted landslides such as rock falls, rockslides, and soil slides. Debris flows are created when surface soil on steep slopes becomes totally saturated with water. Once the soil liquefies, it loses the ability to hold together and can flow downhill at very high speeds, taking vegetation and/or structures with it. Slide risks increase after an earthquake during a wet winter.

The severity of an earthquake can be expressed in terms of intensity and magnitude. Intensity is based on the damage and observed effects on people and the natural and built environment. It varies from place to place depending on the location with respect to the earthquake epicenter, which is the point on the earth's surface that is directly above where the earthquake occurred. While the epicenter usually experiences the most intense earthquake effects (e.g., shaking), the total area affected can cover hundreds of thousands of square miles, depending on the earthquake's magnitude.

Conversely, larger earthquakes are less common than smaller earthquakes, such that the smallest earthquakes are extremely frequent, while the largest earthquakes are relatively infrequent. The moment magnitude scale succeeds the Richter and Local magnitude scales, which were based on the amplitude of shaking recorded on paper seismographs (DHS&EM, 2018).

Earthquakes are also classified by their felt effects (e.g., the perceived shaking intensity). However, the effects of an earthquake are directly related to the distance from the earthquake rupture, among other parameters (such as the type of crust where the earthquake occurs). In general, the closer one is to an earthquake epicenter, the more severe the felt effects and damage will be. An earthquake's intensity is described by the Modified Mercalli Intensity (MMI) Scale. As shown in Table 8, the MMI Scale consists of 12 increasing levels of intensity that range from imperceptible to catastrophic destruction. Peak ground acceleration (PGA) is also used to measure earthquake intensity by quantifying how hard the earth shakes in a given location. PGA can be measured as acceleration due to gravity (g) (MMI, 2006).

M is the measure of the earthquake strength. It is related to the amount of seismic energy released at the earthquake's hypocenter, the actual location of the energy released inside the earth. It is based on the amplitude of the earthquake waves recorded on instruments, known as the Richter magnitude test scales, which have a common calibration (see Table 8).

Table 8—Perceived Shaking, Potential Damage, and Peak Ground Acceleration

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.05	0.3	2.8	6.2	12	22	40	75	>139
PEAK VEL.(cm/s)	*<0.02*	*0.1*	*1.4*	*4.7*	*9.6*	*20*	*41*	*86*	*>178*
MMI scale	I	II–III	IV	V	VI	VII	VIII	IX	X+

5.3.2.2 History

The Planning Team determined that the Fort Yukon community has not experienced damaging effects from their historical earthquake events and only need to be concerned with earthquakes with a magnitude > M 5. Table 9 lists historical earthquakes from 1971 to the present which exceeded M 5 located within 100 miles of Fort Yukon. These earthquakes did not induce any major damage due primarily to their community structure types and foundation support system designs.

Table 9—Historical Earthquakes for Fort Yukon

Year	Mo	Day	Orig. Time (24 hr)	Lat	Long	Magnitude	Distance (Miles)
1994	3	30	15:50	66.46	-148.03	5.1	11.2
2006	2	5	7:55	66.32	-142.55	5.1	0.6
1991	2	7	12:28	66.35	-147.96	5.2	6.2
1994	1	5	0:43	67.7	-147.08	5.5	6.8
2006	2	5	8:52	66.3	-142.69	5.5	6

(USGS, 2019)

From 1971-2010, 349 earthquakes were recorded within a 100-mile radius of Fort Yukon. The average magnitude of these earthquakes was M 3.0. There was a noticeable increase within 2016 and 2017 of more than 1,000 earthquakes recorded within the same 100-mile radius, mostly around M 1.0. From 1971 to 2017, 1,853 earthquakes were recorded within a 100-mile radius of Fort Yukon. The average magnitude of these earthquakes is M 1.8 (this is a decrease from the M 3.0 reported in the 2010 City HMP since most of the earthquakes from 2015 to 2017 were +/- M 1.0). The largest recorded earthquakes within 100 miles of Fort Yukon measured M 5.5 occurring on January 5, 1994, and February 5, 2006. They caused no damage to critical facilities, residences, non-residential buildings, or infrastructure.

Planning Team members stated that Fort Yukon experienced moderate to severe ground shaking from the November 3, 2002, M 7.9 Denali Earthquake located approximately 300 miles away. No significant damage occurred from this event. However, North America's strongest recorded earthquake occurred on March 27, 1964, in Prince William Sound, measuring M 9.2 and was felt by many residents throughout Alaska. Fort Yukon felt ground motion resulting from this historic event; however, no local damage occurred.

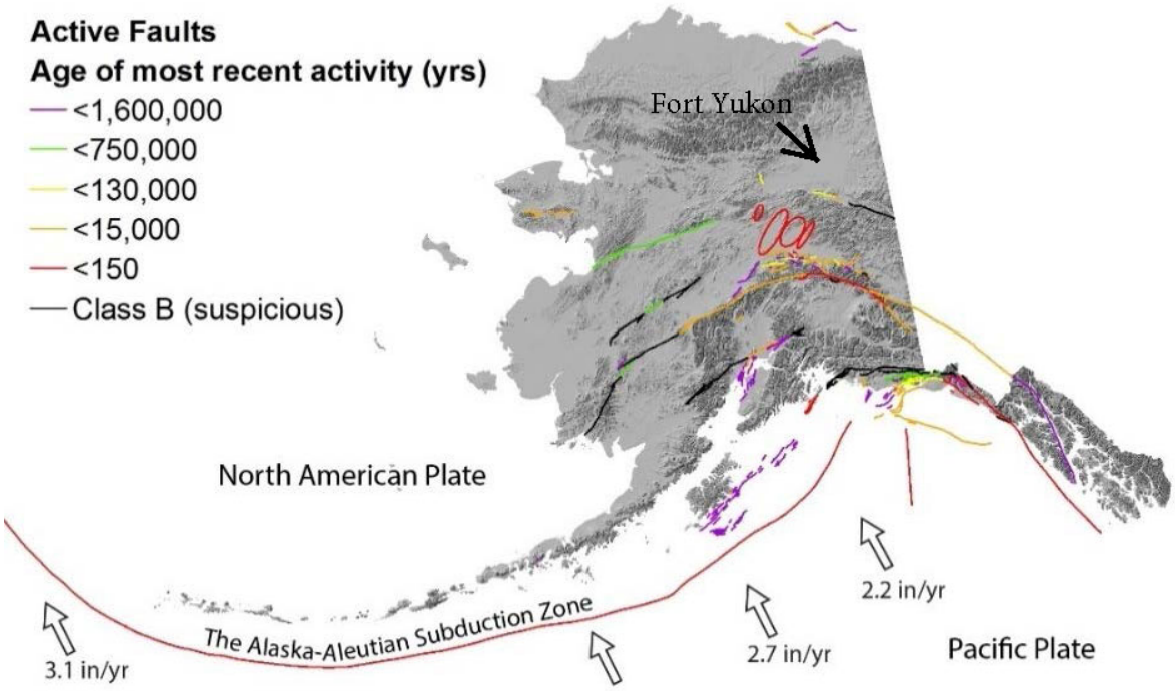
5.3.2.3 Location, Extent, Impact, and Recurrence Probability

Location

The entire geographic area of Alaska, and thus, Fort Yukon, is prone to earthquake effects. The Denali Fault is located about 300 miles south of Fort Yukon and comprises a fault system of smaller faults running east to west along the border of the Brooks Range. The community lies north of the Preacher, Medicine Lake Lineament, Tintina, and Champion Creek faults and can expect to be impacted by future earthquake events (GSA, 1998).

Of the 1,853 recorded earthquakes from 1971 to 2017, five exceeded M 5.0 and two were M 5.5. (USGS, 2017). They both occurred with the epicenter located between six and seven miles from the community. Figure 9 shows the locations of active and potentially active faults in Alaska.

Figure 9—Known-Active Faults

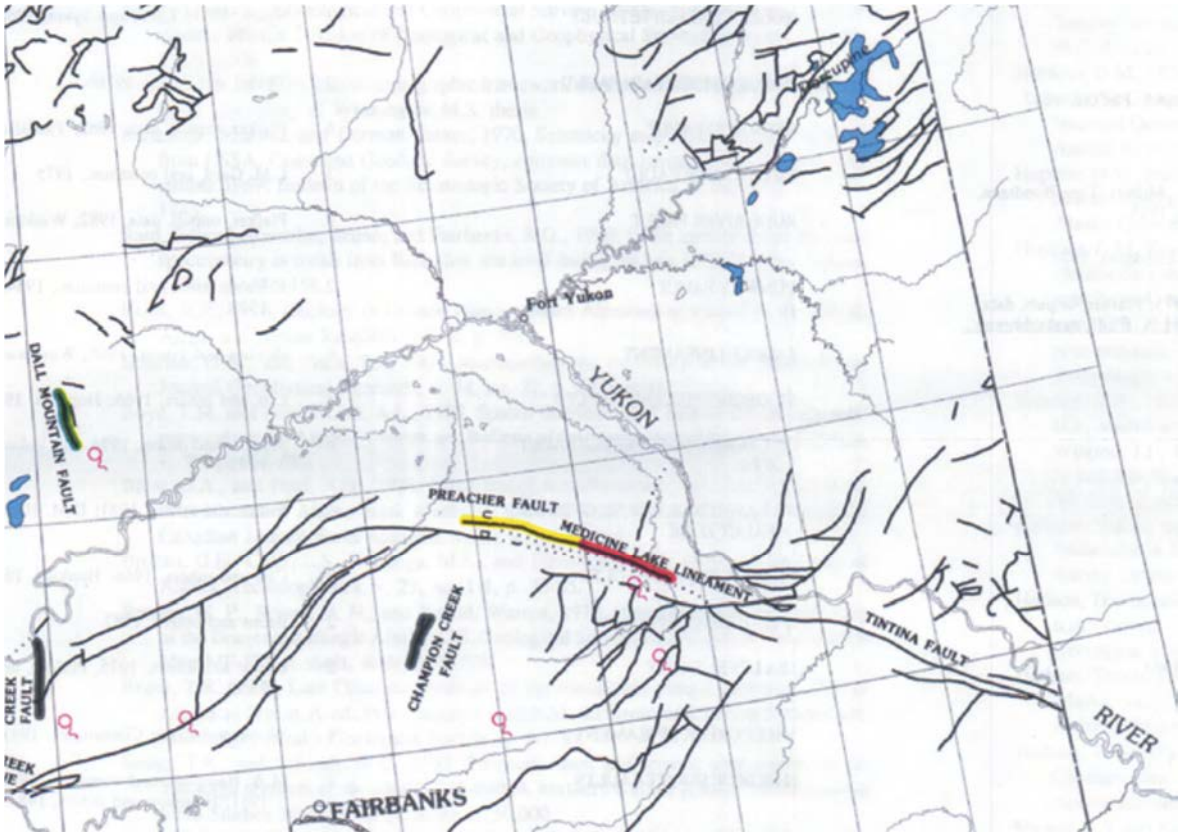


Colored by activity recency. The North American plate and the Pacific plate are converging at the Alaska-Aleutian subduction zone at a rate of several inches per year. Source: DGGS, 2018 via DHS&EM, 2018.

The Department of Geological and Geophysical Survey (DGGS) Neotectonic Map of Alaska depicts Alaska's known earthquake fault locations. DGGS states:

> *"The Neotectonic Map of Alaska is the most comprehensive overview of Alaskan Neotectonics published to date; however, users of this map should be aware of the fact the map represents the author's understanding of Alaskan Neotectonics at the time of publication. Since publication of the Neotectonic map, our understanding of Alaskan Neotectonics has changed and earthquakes have continued to occur. For example, M 7.9 Denali fault earthquake ruptured three faults, including the Susitna Glacier fault, which was previously undiscovered..."* (DGGS, 2009).

Figure 10—Image from the "Neotechtonic Map of Alaska" – Fort Yukon



Source: DGGS, 2009

Extent

Earthquakes felt in the Fort Yukon area have only exceeded M 5.5 twice in the past 46 years (1994 and 2006), and damage has never been reported due to an earthquake event.

"Alaska has changed significantly since the damaging 1964 earthquake, and the population has more than doubled. Many new buildings are designed to withstand intense shaking; some older buildings have been reinforced, and development has been discouraged in some particularly hazardous areas.

Despite these precautions, and because practices to reduce vulnerability to earthquakes are not applied consistently in regions of high risk, future earthquakes may still cause life-threatening damage to buildings, cause items within buildings to be dangerously tossed about, and disrupt the basic utilities and critical facilities that we take for granted.

FEMA estimates that with the present infrastructure and policies, Alaska will have the second highest average annualized earthquake-loss ratio (ratio of average annual losses to infrastructure) in the country. Reducing those losses requires public commitment to earthquake-conscious siting, design, and construction. The Seismic Hazards Safety Commission is committed to addressing these issues. Earthquake-risk mitigation measures developed by similar boards in other states have prevented hundreds of millions of dollars in losses and significant reductions in casualties when compared to other seismically active areas of the world that do not

implement effective mitigation measures. The San Francisco (1989), Northridge (1994), and Nisqually (2001) earthquakes caused comparatively low losses as a result of mitigation measures implemented in those areas. Many of these measures were recommended by the states' seismic safety commissions."

Source: HAZUS 99 Estimated Annualized Earthquake Losses for the United States, FEMA Report 66. September 2000. Via DHS&EM, 2018.

Impact

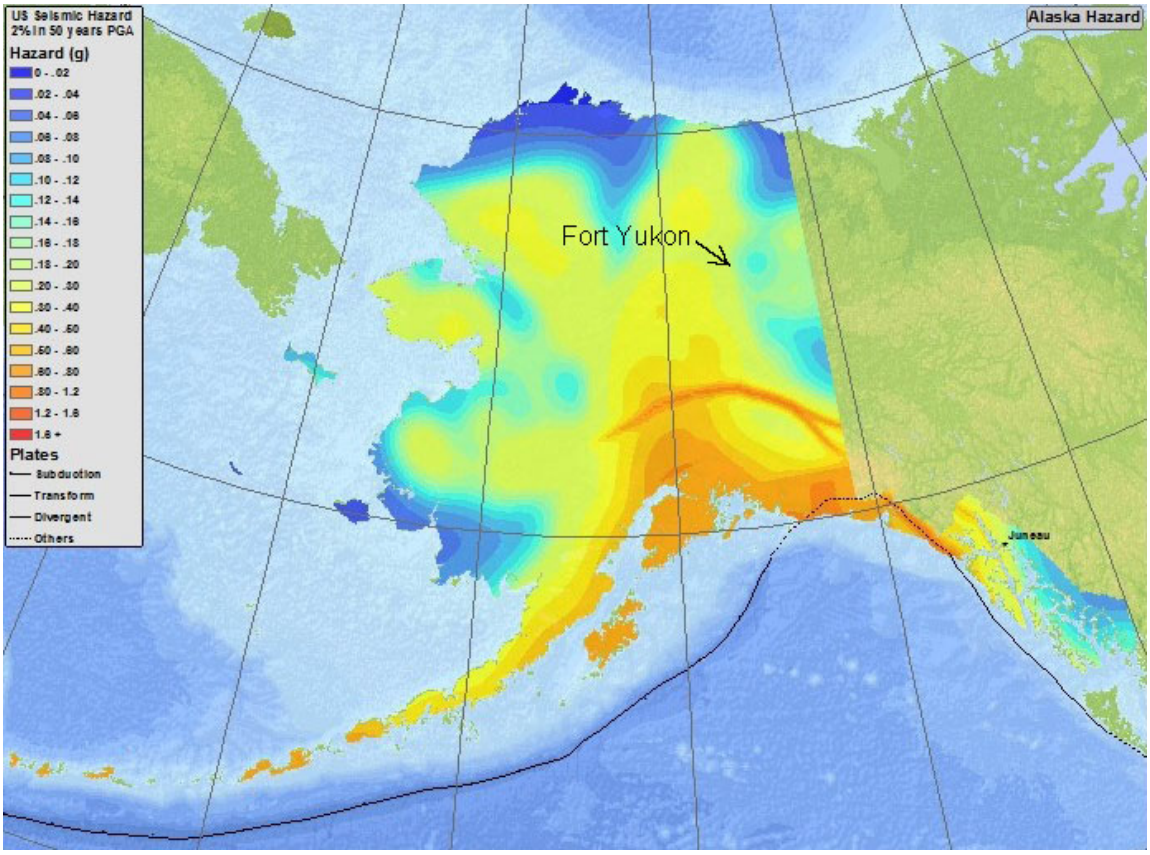
Fort Yukon is located in an area that is less active than others in the State, although the effects of earthquakes centered elsewhere are expected to be felt in the community. Impacts to the community such as significant ground movement that may result in infrastructure damage are not expected. Minor shaking may be seen or felt based on past events. Impacts to future populations, residences, critical facilities, and infrastructure are anticipated to remain the same.

Recurrence Probability

Fort Yukon has no official record of significant earthquake activity resulting in damage or injuries. The varying degrees of damage associated with earthquakes are a direct result of the strong ground motions from seismic shaking. The objective classification of earthquake shaking at a point is based on ground accelerations. Ground accelerations (described as a percent of the acceleration of gravity, % g) are measured instrumentally and can be extrapolated between seismic stations after an earthquake occurs. Additionally, ground accelerations are described at different spectral wavelengths to describe the types of shaking that affect different building styles; for example, spectral wavelengths of 0.2 seconds affect short, rigid buildings whereas one second wavelengths affect multi-story structures.

Because earthquakes are impossible to predict, scientists must use a unique approach in describing the hazards posed by earthquakes. Probabilistic Seismic Hazard Analyses (PSHAs) describe earthquake shaking levels and the likelihood that they will occur in Alaska. PSHAs are based on known, mapped geologic faults throughout Alaska and all background seismicity from unknown faults. The result is a visual representation of the PGA that has a certain percent chance of being exceeded in a given amount of time (usually 50 years). Figure 12 indicates that the U.S. Geological Survey (USGS) earthquake probability model places the probability of an earthquake with a likelihood of experiencing strong shaking (0.2g to 0.3g PGA) with a 2% probability in 50 years, based on the USGS Alaska hazard model. A 2% probability in 50 years is the rare, large earthquake, and statistically, it happens on average every 2,500 years.

Figure 11—Fort Yukon's Earthquake Probability



Source: USGS, 2017

According to Peter Haeussler, USGS, Alaska Region:

> *"The occurrence of various small earthquakes does not change earthquake probabilities. In fact, in the most dramatic case, the probability of an earthquake on the Denali fault was/is the same the day before the 2002 earthquake as the day afterward. Those are time-independent probabilities. The things that change the hazard maps is changing the number of active faults or changing their slip rate. For… [Fort Yukon], I don't think anything has changed"* (Haeussler, 2009).

5.3.3 Flood and Erosion

5.3.3.1 Hazard Characteristics

Approximately 6,600 miles of Alaska's coastline and many low-lying areas along Alaska's riverbanks are subject to severe flooding and erosion. The U.S. Government Accountability Office reported in 2003 that flooding and erosion affect 184 out of 213 (86%) of Alaska Native villages. Many of the problems are long-standing, although studies indicate that increased flooding and erosion are being caused in part by changing climate (DHS&EM, 2018). Flooding and erosion occur together in Fort Yukon because of increased water currents that get raised above the normal riverbank.

Flooding is the overflow of excess water from a stream, river, lake, reservoir, glacier, or coastal body of water onto adjacent floodplains or normally dry land. Floodplains are lowlands adjacent to water bodies that are subject to recurring floods. Floods are natural events that are considered hazards only when people and property are affected. Flooding is Alaska's most common disaster, often costing in excess of one million dollars annually, causing major disruptions to society and occasionally loss of life (DHS&EM, 2018).

Primary types of flooding that occur in Fort Yukon include: riverine floods; rainfall-runoff floods; snowmelt floods; ice jam floods; and ice overflow (aufeis) flooding. Many floods are predictable based on rainfall patterns. Most of the annual precipitation is received from April through October with August being the wettest. This rainfall leads to flooding in early/late summer and/or fall. Spring snowmelt increases runoff, which can cause flooding. It also breaks the winter ice cover, which causes localized ice-jam floods.

Riverine Flooding

This type of flooding occurs when river levels rise and overflow their banks or the edges of their main channel and inundate areas normally above water level. The main driver of riverine flooding is rainfall, but additional factors may include temperature (for melting snow or ice), slope steepness, and the physical characteristics of the soil or rock forming the riverbed. The damage from a river flood can be widespread as the overflow affects smaller rivers downstream, often causing dams and dikes to break and inundate nearby areas.

Rainfall-Runoff Flood

Rainfall-runoff flooding is the most common type of flooding in Alaska, typically occurring in late summer through early fall. Rainfall intensity, duration, distribution, as well as pre-existing soil moisture conditions and geomorphic characteristics of the watershed all contribute to the flood's magnitude. These floods result from high rainfall amounts and accompanying high surface runoff rates.

Snowmelt Flooding

Snowmelt floods typically occur from April through June, but are most common in the spring when rapidly warming temperatures quickly melt the snow. Snowpack depth, spring weather patterns, and geomorphic characteristics of the watershed influence the magnitude of flooding. Rainfall and high temperatures can exacerbate snowmelt floods.

Ice Jam Flooding

Ice jam flooding occurs when water backs up into surrounding areas because a river or stream is blocked by ice buildup or other debris blockage. Ice jams may occur any time when ice is present, but typically form during the following three situations:

- Fall freeze up;
- Midwinter, when stream channels freeze and form anchor ice; and
- Spring break-up (i.e., when the existing ice cover weakens and breaks apart, flows downstream, and jams together at narrow sections of the stream channel where the ice blocks are forced to sink to the bottom from upriver water forces, forming a dam).

Ice jams commonly develop in areas where the channel slope decreases, becomes shallower, or where constrictions occur such as at bridges, bends in the river, headwaters, and reservoirs. Ice jams frequently impede water along big rivers during spring break-up.

Water levels increase upstream behind the location of the ice jam. The result is flooding of an area by creating a lake-like effect covering a large area. Little damage typically occurs from the water current upstream of the ice jam, but significant damage can result from flooding. However, the downstream effect is very different. As soon as the ice jam is breached, there is usually rapid draining of the dammed water. Downstream water levels rise substantially after the ice jam is breached and strong water currents are created, which can cause erosion and other significant damages. Additionally, the rising water causes the ice to float while increased velocities of water move the ice further downstream. The motion of large solid ice blocks is often destructive to natural and material property in the vicinities. When ice jams cause flood events during spring break-up, snowmelt can contribute to the flood. Notable large floods in recent years on the Kuskokwim, Koyukuk, and Yukon Rivers (and locally the Porcupine and Sucker Rivers) were all caused by ice jams and snowmelt. Six-inch-thick ice can destroy large trees and knock houses off their foundations (DHS&EM, 2018).

Ice Overflow (Aufeis) Flood

Aufeis is glaciation or icing of streams and rivers, affecting road surfaces and infrastructure. Aufeis forms during the winter when emerging ground water freezes. Stream glacial flooding occurs when ice forms from the bottom up, not from the top down forcing water out of the stream channel. If aufeis occurs on a roadway, it makes travel difficult. For example, the Steese Highway frequently has an aufeis problem in the winter months. In the mid-1980s, several homes in Fox suffered from an aufeis event occurring at the wellhead. The homes flooded six feet deep, then froze.

Erosion is the action of surface processes (such as water) that remove soil, rock, or dissolved material from one location and transport it to another location. Erosion can be gradual or occur quite quickly as the result of a flash flood, storm, or other event. Most of the geomorphic change to a river system is due to peak flow events that can dramatically increase the erosion rate. Erosion is a problem in developed areas where disappearing land threatens development and infrastructure (DHS&EM, 2018). Erosion rarely causes death or injury. However, erosion causes the destruction of property, development, and infrastructure.

Riverine erosion or scour occurs from high water flow forces and ice formations that wear away rock and soil along a riverbed and its embankments. This erosion also involves the breaking down of rock particles being carried downstream by the river. Eroded sediment is deposited in slower-moving sections of the river, such as the insides of river bends or places where the river widens. River erosion and deposition leads to lateral stream movement, with the streams meandering across the valley bottom by alternately eroding the sediment on the outsides of curves (cut banks) and depositing sediment on the insides of curves (point bars). Erosion is a problem in developed areas where disappearing land threatens development and infrastructure.

People in Alaska are losing the ground beneath their feet because of erosion. Riverine erosion is a major threat to Fort Yukon as it threatens the embankment, structures, and the subsistence livelihood of Fort Yukon's residents. Not only do thawing permafrost and high river flow rates (such as during breakup) contribute to increased erosive scour, climate change has accelerated the normal process along Alaska's rivers; warmer temperatures degrade the permafrost that helped bind together the soil, and heavier rains produce more floods and swollen rivers that wash away the soil (DHS&EM, 2018).

5.3.3.2 Climate Factors

Climate and weather are the two primary drivers of flooding and erosion in Alaska. Weather (i.e., the day-to-day state of the atmosphere) affects these hazards on the short-term with individual episodes of rainfall, wind, and temperature that initiate or intensify individual episodes of flooding or erosion. Climate is affecting the long-term incident rate and severity of these hazards, especially in Alaska, which is particularly vulnerable due to its high northern latitude and the unique importance of snow, ice, and permafrost.

In 2012 and 2013, Alaska's riverine communities experienced two of the quickest spring thaws on record. The Special Supplement to the Bulletin of the American Meteorological Society (published in August 2013) noted that the climate of the arctic in 2012 was dominated by continued significant changes in the cryosphere, with new records for minimum sea ice extent and permafrost warming in northernmost Alaska. Southerly airflow into the arctic had a major impact on lake ice break-up, snow cover extent, and mass loss from arctic glaciers and ice caps. Meltwater inundated many watersheds, and the swollen rivers broke their ice cover prematurely, creating large ice dams downstream. The 2013 Spring Floods disaster (DR-4122) was one of the largest events of its kind in Alaska's history (DHS&EM, 2018). The Yukon Flats REAA (which includes Fort Yukon) was one of the communities impacted.

5.3.3.3 Flood and Erosion History

Riverine communities, such as Fort Yukon, have lengthy flooding and erosion histories. Rapid snowmelt, ice jams, heavy precipitation, and seasonal variations all increase the risk.

Table 10 contains a comprehensive list of USACE's and NWS' recorded historical flood events affecting Fort Yukon.

Table 10—Historical Flood Events

Location	Date	Event	Description
Fort Yukon	1889	Ice Jam Flood	Ice jam in mouth of Porcupine River, probably aggravated by late runoff.
Fort Yukon	1927	Ice Jam Flood	
Fort Yukon	1934	Ice Jam Flood	
Fort Yukon	1936	Flood	Probably local ice jam in Yukon forcing water through the slough.
Fort Yukon	1937	Ice Jam Flood	Immediately below town.
Fort Yukon	1945	Ice Jam Flood	Late, rapid breakup compounded by ice jam.
Fort Yukon	1948	Ice Jam Flood	
Fort Yukon	1949	Ice Jam Flood	Porcupine River Ice jam release caused high water flow once the ice jam was breached. "A still water elevation of 435 feet (ft) above mean sea level (MSL) was reported in the community center. The floodwaters were 7 ft deep on Main Street." The town relocated to higher ground after this event (USACE, 2009b).
Fort Yukon	1957	Ice Jam Flood	
Fort Yukon	1961	Ice Jam Flood	
Fort Yukon	1963	Ice Jam Flood and Excessive Spring Runoff	Ice jam and excessive spring runoff.
Fort Yukon	June 1964	Flood	This non-ice jam flood occurred in June 1964 with an estimated elevation between 441 and 442 [National American Vertical Datum of 1988(NAVD 88)].
Fort Yukon	1975	Ice Jam Flood	
Fort Yukon	1979	Ice Jam Flood	
Fort Yukon	5/17/1982	Ice Jam Flood	Ice jams, excessive stream flow, and abnormal temperature variations caused flooding in the community of Fort Yukon, located at the juncture of the Porcupine and Yukon rivers. The flood resulted in extensive damage to public and private property and forced the dislocation of several hundred residents. The Governor's Proclamation of a Disaster Emergency enabled DHS&EM to draw on the Disaster Relief Fund to provide both public assistance and grants to individuals and families. In addition to State assistance, the Small Business Association made disaster loans in the area, and the American Red Cross provided assistance using the organization's Disaster Relief Fund.
Fort Yukon	5/6/1989	Flood	Flooding of the Yukon River during Spring Breakup caused damage to public and private property. This event occurred one day after the Circle flood and also was included in the Presidential Declaration. FEMA declared Presidential Declaration DR-0832 on June 10, 1989. This Major Disaster incorporated 16 local declarations and applied to all communities on the Yukon, Kuskokwim, and Kobuk rivers and their tributaries. Public and individual assistance to repair damage was provided.
Fort Yukon	1990	Ice Jam Flood	
Fort Yukon	1991	Ice Jam Flood	Mild breakup; water rose over bank.
Upper Yukon River	6/1992	Flood	Very late spring, post-breakup (snow melt) flooding of the Yukon River and its tributaries from Fort Yukon to Rampart. Flood waters rose slowly over a period of days and receded gradually. Major damage was sustained by both public and private property. The IFG program was implemented in Fort Yukon, Beaver, Stevens Village, and North Pole.
Fort Yukon	1993-1994	Flood	There was a hazard mitigation AK-0909 pilot program in Fort Yukon designed to confirm the need for long-range flood mitigation measures to prevent flooding.
Upper Yukon Valley	6/15-21/1997	Flood	Rain of up to 3.8 inches during the 12th through 15th caused significant rises in streams over the zone. Several homes were flooded at Chalkyitsik on the Black River, and a road at Fort Yukon had some minor flooding near the confluence of the Porcupine and Sucker Rivers.

Location	Date	Event	Description
Upper Yukon Valley	8/26-31/1997	Thunderstorm Generated Flood	A large thunderstorm (complex) produced rains of 0.9 to 1.1 inches.
Upper Yukon River	6/17/2002	Flood	A very late spring combined with above average snow packs resulted in post-breakup (snow melt) on the Yukon River and tributary flooding from Fort Yukon to Rampart. Flood waters rose slowly over a period of days and receded gradually. The Individual Family Grant (IFG) program was implemented in Fort Yukon.
Yukon Flats	5/01-3/2005	Flood	An Ice Jam on the Yukon River produced minor flooding of road and a few structures in the Village of Fort Yukon. Damage amount is a rough estimate ($3,000).
Yukon Flats	5/7-9/2009	Ice Jam Flood	The Presidentially-declared 2009 Yukon Flats Food had tremendous impact on Fort Yukon (DR-1843). A large volume of water (20-mile long ice run) passed Fort Yukon. The water levels rose rapidly at Fort Yukon during the late evening of the 7th, and several streets were flooded and people were evacuated from low-lying areas that were flooding. The flooding became more severe overnight as water began to inundate portions of the village with water several feet deep in some homes and low-lying areas near the river. About one-half of the village flooded, and the main taxiway at the airport was damaged. The levee in front of town also received some damage. The water levels remained high, and the flooding continued into the 8th. The water levels began to recede on the morning of the 9th, and dropped approximately 7 feet by the evening of the 9th. (Damages for this event are estimated at $190,000,000 for all affected communities).
Yukon Flats	6/22-24/2011	Flooding	Heavy rainfall in excess of an inch on the 22nd caused a six-mile section of the Steese Highway between Birch Creek and Circle to washout in spots on the 23rd. Repairs were made to the gravel road on the 23rd, but additional rainfall on the 23rd into the 24th caused another washout on the evening of the 24th with reports of 2 feet of water flowing over the road. The water flowing over the road was likely caused by plugged culverts and was not associated with flash flooding.
Yukon Flats	5/28-29/2012	Heavy Rain-Flood	The combination of heavy rainfall in excess of an inch, residual winter snowpack in the uplands, and frozen ground in spots caused the Crooked Creek near Central to flood. The water levels peaked during the afternoon hours on the 28th, and at 1345 Alaska Standard Time (AKST) water was entering the museum. Water also flooded residential yards, and some roadways adjacent to Crooked Creek on the north side of the Steese Highway.
Yukon Flats	5/17 – 6/10, 2013	Ice Jam Flood	Excessive snow pack and ice thickness, combined with rapid spring warming caused ice jams and severe flooding. Approximately 194 homes (requiring evacuations and sheltering) were severely damaged in all affected communities. This event cost Federal and State funds $71,402,492. Fort Yukon was not one of the affected Yukon Flats' communities affected.
Fort Yukon	5/20-5/23/2013	Ice Jam Flood	On the 20th, a surge of water and ice from the upstream river ice breakup moved to near Fort Yukon, causing flooding of low-lying areas. A large sheet of ice became stuck 12 miles upstream of Fort Yukon, causing widespread flooding of low-lying areas to persist. This affected the ball field, the old tank farm, the area surrounding the tribal hall, several homes, and one of several access roads to the airport. Around midnight on the 21st, the ice jam partially released though river levels did not rise significantly in town as a result. Later on the 22nd, river levels began to slowly fall, and by the morning of the 23rd levels were below flood stage. Damage amounts included repairs to 4 homes with major damage and 1 home with minor damage, along with affected roads, buildings, and emergency response needs.

Location	Date	Event	Description
YUKON FLATS NEARBY UPLANDS	5/6/2014	Ice Jam Flood	An ice jam formed downstream of Circle City on the 5th and remained in place on the 6th while flowing water continued to be impounded behind the jam. This water backed up and flooded portions of the village beginning on the morning of the 6th. Water entered the basements of several residences and in the fire hall...up to one foot of water entered the General Store. The State of Alaska DOT road to the airport was overtopped during the flooding. The ice jam released in the mid-afternoon of the 6th, and water levels began to slowly fall through the remainder of the afternoon and evening.
Fort Yukon	5/20-27/2015	Flood	Warmer than normal temperatures in mid-May caused rapid snowmelt in the highlands of northeastern Alaska, causing a corresponding rise in runoff in the Yukon and Porcupine Rivers. By May 20, the water levels overtopped the Porcupine River in some locations and inundated the Fort Yukon area with up to two feet of water. There was flood-related damage to three roads, and the embankment of the sewage lagoon. Water rose enough to flood a portion of the Sucker River Road. Other low-lying areas received flooding, but no structures were impacted, nor were other roads in town. A total of $50,000 Public Assistance funds was made available for this event. The City met its funding obligations, but the community maintains this was only enough money to repair drainage, gabion, and road using a lower 48 pay scale. No mitigation measures were done.

(Lingaas 2010, Fort Yukon 1996, USACE, 2009a and b, Disaster Cost Index 2018)

The USACE completed a 2009 Baseline Erosion Assessment for Fort Yukon which stated,

> *"The river bank is used for a variety of community activities such as fishing, hunting, fish processing, beachcombing, cultural and social events, and driftwood collecting. It also includes boat ramps, snow machine ramps, ATV ramps, barge access, boat storage, and several residences"* (USACE, 2009b).

The City of Fort Yukon's Comprehensive Plan… states,

> *"Riverbank erosion has always been a major problem, especially since 1955 when a large amount of gravel was removed from the river for construction of the Air Force site. The increased velocity of the river added to the erosion caused by periodic flooding and permafrost thaw. Along some stretches of the river through Fort Yukon, the bank has been eroded away to a depth of several hundred feet.*
>
> *The Corps of Engineers completed a slough closure dike upstream from the town in 1967. This dike diverted slough flow through the main channel and alleviated the major erosion problem. It has also caused a buildup of sediment adjacent to the townsite, moving the channel outward several hundred feet. The U.S. Soil Conservation built seven dikes along the slough and river banks in 1992. They appear to be working. In the summer of 1976, the barge bringing supplies to Fort Yukon was not able to unload until a new loading site was prepared further downstream. In time, the new site will also be threatened with sedimentation"* (Fort Yukon, 1996).

In addition to the actions identified in the City's Comprehensive Plan, the USACE erosion assessment stated,

> *"The riverbank is eroding at an estimated rate of 10 to 15 feet per year. The present erosion site is 1,200 to 1,500 feet horizontally and 15 feet vertically, extending from the Y-shaped slough downstream and beyond the barge landing to the finger dikes upstream… These dikes appear to be working, although flooding and erosion have washed away some of the dike material. FEMA sponsored a Conceptual Design Study*

> *Report for Flood Damage Reduction at Fort Yukon in 1994, and a resulting ring levee was constructed in 1995 to provide protection from a 20- to 25-year flood event"* (USACE, 2009b).

No further erosion studies have been completed.

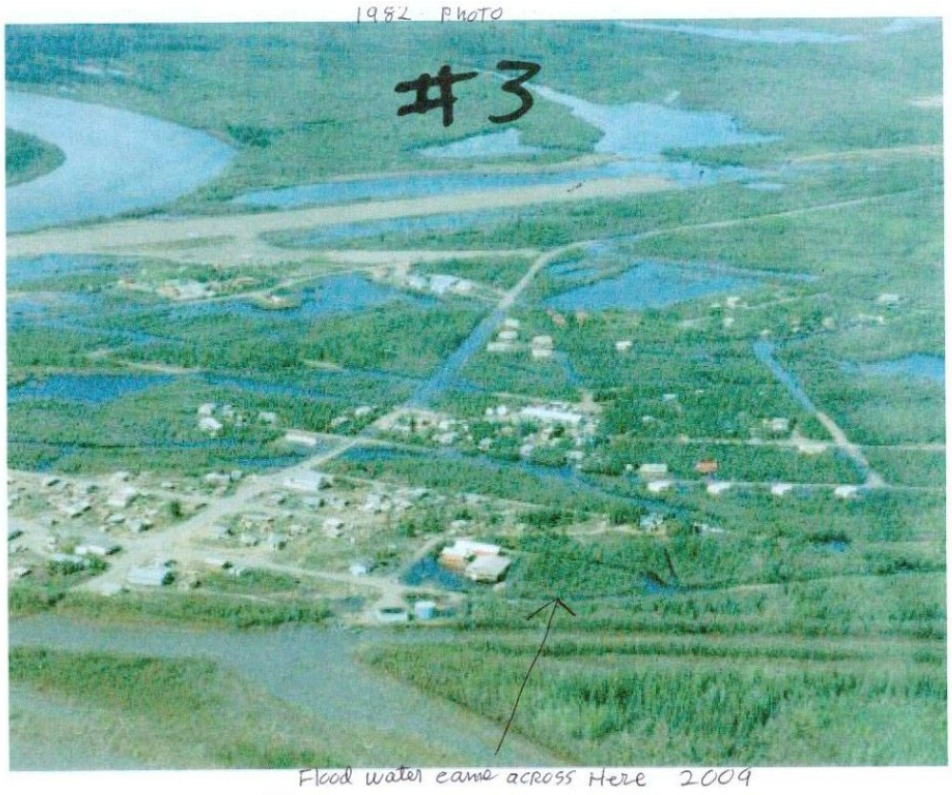
5.3.3.4 Location, Extent, Impact, and Recurrence Probability

Location

The City's Comprehensive Plan states,

> *"Almost all of the Fort Yukon townsite is subject to flooding except the eastern portion called Crow Town and the Air Force Aircraft Control & Warning and communication sites. Flooding from spring runoff is often made worse by ice jams. The most damaging flood in recent times occurred in 1949 as a result of the Porcupine River north of Fort Yukon… Flood damage is sometimes slight from a monetary standpoint, but it is a hardship to residents and a deterrent to development.*
>
> *Relocation of the townsite has also been proposed. Residents have resisted moving because the river is a lifeline for supplies and important to their subsistence hunting and fishing and because there is no available high ground within a reasonable distance. Land elevations within the community vary between 428 and 438 feet above sea level…*
>
> *Most of the town lies below the base flood elevation of 440 feet. The construction of dikes and flood control levees will have an important impact on land use within Fort Yukon… [a] ring levee, was constructed in 1995… around the most populated and flood prone areas of the community, and did not involve changing the shoreline or channel of the Yukon River… built to a height of 439 feet, or about eight feet above ground level at its highest point…The project is designed to protect the town from 20-25 year flood events, but not against 100-year and 500-year events. The height is a compromise between the need to protect property from flood, cost, physical access problems, and unsightly visual barriers.*
>
> *The levee is designed to keep flood waters from entering the inside of the ring. In the event flood waters do exceed the height of the levee, a series of one-way culverts should drain the impounded area, thus avoiding the potential for a "bathtub effect"* (Fort Yukon, 1996).

Figure 12—Fort Yukon Flood Threat



Source: Fort Yukon, 2017

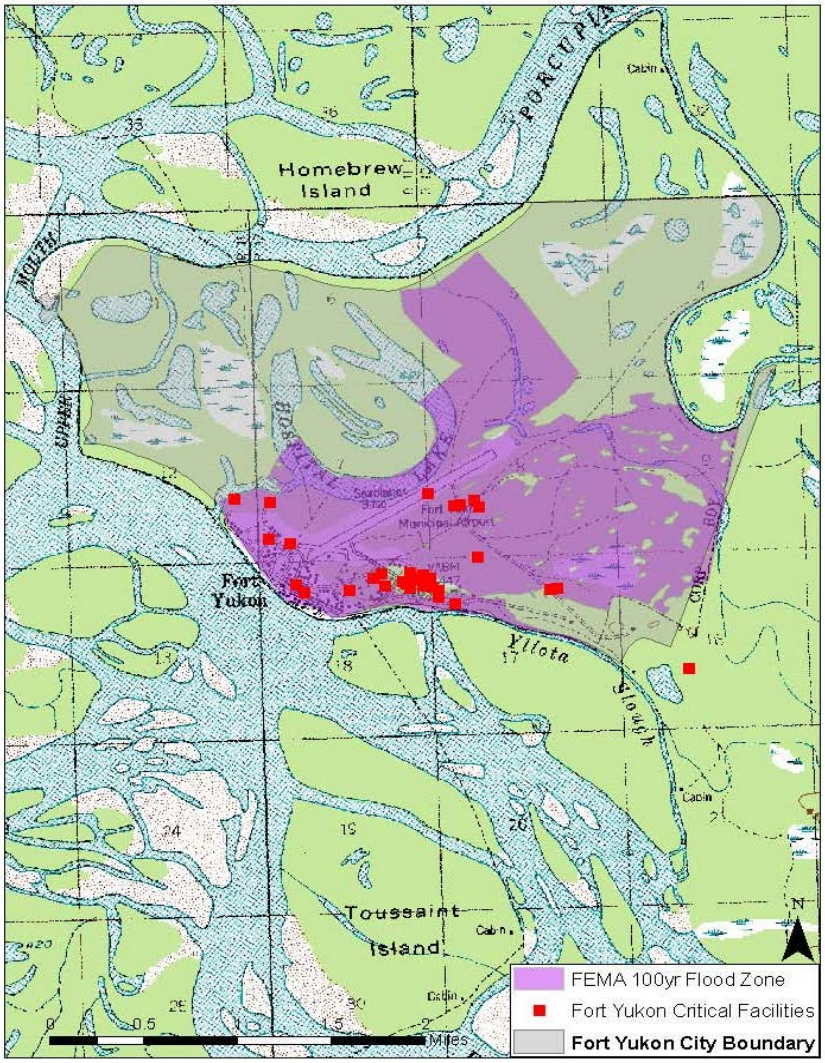
Subsequently, the entire community is susceptible to flood impacts and is supported by the USACE's *Floodplain Management Flood Hazard Data Report*:

> *"There are two vertical datum in the community. The USACE datum is based on the U.S. Coast and Geodetic Survey's 1953 documentation. The other datum is the one preferred by Fort Yukon because much of the infrastructure was constructed using this datum. The difference between the two datum is 4.5 ft. Therefore, the Fort Yukon datum base flood elevation (BFE) of 439.5 ft corresponds to the USACE datum BFE of 435.0 ft. High Water Elevation (HWE) signs are distributed throughout town. Full bank is at approximately 432.2 ft"* (USACE, 2009b).

Figure 14 depicts the City's FEMA identified 100-year flood hazard area with Fort Yukon's critical facilities identified to depict their potential threat.

The *2016-2021 Fort Yukon Community Plan* states that with the exception of the eastern portion (i.e., where the U.S. Air Force Station is) of the City Limits, Fort Yukon is subject to flooding. A few floods have occurred due to surface rains, but most occur during spring breakups and are usually caused by ice jams on the Yukon River. Damage caused by the floods is a result of the large thick ice slabs that the water carries in as well as the water itself.

Figure 13—Fort Yukon's Flood Hazard Area Identified in 1983



Extent

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence.

The following factors contribute to riverine flooding frequency and severity:

- Rainfall intensity and duration.
- Antecedent moisture conditions.
- Watershed conditions, including terrain steepness, soil types, amount, vegetation type, and development density.
- The attenuating feature existence in the watershed, including natural features such as swamps and lakes and human-built features such as dams.
- The flood control feature existence, such as levees and flood control channels.

- Flow velocity.
- Availability of sediment for transport, and the bed and embankment watercourse erodibility.
- Village or city location related to the BFE as indicated with their certified high-water mark.

The State of Alaska HMP defines the extent of flooding and erosion as a 0.25-mile buffer along riverine threatened communities (DHS&EM, 2018).

Fort Yukon's typical flood extent is portrayed by Figures 13 and 15.

Figure 14—1992 Fort Yukon Flood

Source: FAA, 2010

A variety of natural and human-induced factors influence the erosion process within the community. River orientation and proximity to up and downstream river bends can influence erosion rates. Embankment composition also influences erosion rates, as sand and silt will erode easily, whereas boulders or large rocks are more erosion resistant. Other factors that may influence riverine erosion include:

- Geomorphology;
- Amount of encroachment in the high hazard zone;
- Proximity to erosion inducing structures;
- Nature of the topography;
- Density of development;
- Structure types along the embankment; and
- Embankment elevation.

The 1996 *City's Comprehensive Plan* states, "Erosion is a serious problem in Fort Yukon. Past erosion control and bank stabilization efforts have been largely successful; however, erosion and subsequent downstream sediment deposition requires Fort Yukon to continually relocate boat docks and barge landing sites."

The USACE lists Fort Yukon's erosion threat as a "Monitor Conditions". This classification is applied to communities that have reported significant erosion impacts, but the impacts are not likely to affect Fort Yukon's viability. However, Federal, State, or other agency intervention may be necessary to prevent the threat from worsening (USACE, 2009a).

Figure 15 depicts the USACE and other agencies' erosion abatement efforts. The USACE has not conducted an update since 2009.

Figure 15—USACE Flood Protection Levee System

Source: USACE, 2009b

The riverbanks adjacent to Fort Yukon are essential to the lives of the residents. According to the USACE, "Two residences are in danger of falling into the river, the city landing for boats is no longer usable due to erosion damage, and the barge landing is in danger of becoming unusable. Outbuildings, residential fuel tanks, food storage structures, drying racks, smoke houses, a main access road, utility poles, power lines, a sewage lagoon, sites of significant cultural and archeological value, pathways, and a park area are all less than 100 feet from the active erosion area" (USACE, 2009b). Both of these endangered residences were moved by GZGTG in 2011 to safe locations within the community. The community stated in 2017 that erosion has since lessened in that particular area identified in 2009 due to mitigation measures.

As of 2017, eight houses are on the "wrong side of the dike" and are subject to future erosion (City, 2017). These houses are not eligible for grant funding as squatters live in these houses and do not own the land.

Impact

Nationwide, floods result in more deaths than any other natural hazard. Flooding is Alaska's greatest threat, causing extensive property damage and losses, which include the following:

- Structure flood inundation causes water damage to structural elements and contents.
- High water flow storm surge floods scour or erode embankments, protection barriers, and result in infrastructure and residential property losses. Additional impacts can include roadway embankment collapse, foundations exposure, footings for bridge piers, and other features.
- Damage to structures, roads, bridges, culverts, and other features occur from high-velocity flow and debris carried by floodwaters. Such debris may also accumulate on bridge piers and in culverts, decreasing water conveyance and increasing loads which may cause feature overtopping or backwater damages.
- Sewage, hazardous or toxic materials release, materials transport from wastewater treatment plants or sewage lagoon inundations, storage tanks damages, and/or severed pipelines damages can be catastrophic to rural remote communities.

Floods also result in economic losses through business and government facility closure; utilities such as energy generation, communications, potable water, and wastewater; and transportation services disruptions. Floods result in excessive expenditures for emergency response, and generally disrupt the normal function of a community.

Impacts and problems also related to flooding are deposition and river bank erosion. Deposition is the accumulation of soil, silt, and other particles on a river bottom or delta. Deposition leads to the destruction of fish habitat, presents a challenge for navigational purposes, and prevents access to historical boat and barge landing areas. Deposition also reduces channel capacity, resulting in increased flooding or bank erosion. Embankment erosion involves removal of material from the bank. When bank erosion is excessive, it becomes a concern because it results in loss of embankment vegetation, loss of fish habitat, and loss of land, property, and essential infrastructure (BKP, 1988).

Impacts from erosion include loss of land and any development on that land. Erosion can cause increased sedimentation of river deltas and hinder channel navigation—affecting marine transport. Other impacts include reduction in water quality due to high sediment loads, loss of native aquatic habitats, damage to public utilities (fuel headers and electric and water/wastewater utilities), and economic impacts associated with the costs of trying to prevent or control erosion sites.

Figure 15 depicts Fort Yukon's U.S. Soil Conservation Service's 1992 finger dike construction project and the 1995 USACE ring levee installed to protect the community from flood impacts.

Recurrence Probability

Fort Yukon has historically experienced flood and erosion events. Many of these events are under-reported or not measured, and very few communities have a 100-year flood analysis. For this reason, recurrence probabilities are not easily computed for flood and erosion hazards.

FEMA's 2010 *Flood Insurance Study* for the City states,

> *"For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood-hazard data required for this study. Flood events of a magnitude that is expected to be equaled or*

exceeded once on the average during any 10-, 50-, 100- or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and or flood insurance rates. These events, commonly termed 10-, 50-, 100- or 500-year flood, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. For example, the risk of having a flood that equals or exceeds the 1-percent-annual-chance flood in any 50-year period is approximately 40 percent (4 in 10); for any 90-year period, the risk increased to approximately 60 percent (6 in 10)…Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

No stream record exists for the Yukon or Porcupine Rivers at Fort Yukon; however, the Porcupine River has 12 years of record, and the Yukon has 27 years of record at sites near Fort Yukon. Peak flood frequencies were developed for nearby sites using the Log-Pearson Type III method as outlined by the Water Resources Council. From these frequency curves, flood peaks were derived for the 10, 2, 1, and 0.2 percent annual chance flood events using the cubic feet per square mile ratio for the Porcupine River and the Yukon River at Fort Yukon. These data are shown in the table below."

Table 11—FEMA Summary of Discharges

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	**Drainage Area (square miles)**	**10% Annual Chance Flood**	**2% Annual Chance Flood**	**1% Annual Chance Flood**	**0.2% Annual Chance Flood**
Yukon River below Fort Yukon	182,000	720,000	900,000	980,000	1,200,000
Yukon River at Fort Yukon	126,200	500,000	670,000	720,000	890,000
Porcupine River at Fort Yukon	56,000	430,000	590,000	640,000	810,000

Source: Fort Yukon, 2017

5.3.4 Weather (Severe)

5.3.4.1 Hazard Characteristics

Severe weather occurs throughout Alaska with extremes experienced by the community of Fort Yukon that includes thunderstorms and lightning, hail, heavy and drifting snow, heavy rain/freezing rain/ice storm, extreme cold, high winds, and winter storms. Fort Yukon experiences periodic severe weather events such as the following:

Thunderstorms

Thunderstorm hazards include lightning, heavy rain, snow, updrafts, downdrafts, severe aircraft turbulence and icing, damaging hail, high winds, and flash flooding. A thunderstorm is considered severe if winds reach 58 miles per hour (mph) or generates surface hail at least one inch in diameter. Thunderstorms affect relatively small areas; the average thunderstorm is about 15 miles in diameter and lasts less than 30 minutes in any given location.

Lightning exists in all thunderstorms. It is formed from built-up charged ions within the thundercloud. Lightning is hazardous to humans and frequently starts wildfires in Alaska's interior northern boreal forests. The BLM lightning activity sensors positioned across the interior locate an average of 26,000 cloud-to-ground lightning strikes per year. Very active thunderstorm days may feature 8,000 to 12,000 lightning strikes, mainly occurring during the late afternoon hours from the end of June to the beginning of July.

Lightning-caused injuries and deaths are unusual in Alaska. However, in 1986, one person was killed and three others injured near Tok, when they took shelter under a tree that was struck by lightning.

Hail

Thunderstorms produce hail in ball or irregular shapes greater than 0.75 inch in diameter. The size and severity of the storm determine the size of the hailstones. Alaskan hail is small (pea-sized) and fairly rare.

Heavy and Drifting Snow

Heavy snow generally means an accumulation of more than 12 to 24 inches of snow inside of 24 hours. It immobilizes a community and brings transportation to a stop. Airports and major roadways will close, disrupting supply flow and emergency response service access. Excessive accumulation will collapse roofs, knock down trees and power lines, damage parked light aircraft, and capsize small boats. Heavy snow increases flooding risks. Snow removal, damage repairs, and business loss financially impacts Fort Yukon. Heavy snow is associated with vehicle accidents, overexertion, and hypothermia. Drifting is the uneven distribution of snowfall and snow depth caused by strong surface winds. Drifting snow may occur during or after a snowfall.

Heavy Rain/Freezing Rain/Ice Storm

Freezing rain and ice storms describe occasions when excessive ice accumulations are expected during a heavy rain event. They are a particularly hazardous winter weather phenomena and often cause numerous automobile accidents, power outages, and personal injury. Ice storms form from freezing rain and pass through a thin layer of cold air just above the ground and cool to below freezing. The drops remain in a liquid state until they impact a surface and freeze on contact. Ice accumulations can damage trees, utility poles, and communication towers which disrupts transportation, power, and communications.

Extreme Cold

The definition of extreme cold varies according to the normal climate of a region. In areas unaccustomed to winter weather, near freezing temperatures are considered "extreme". In Fort Yukon, extreme cold usually involves temperatures between -20 to -72°F. Excessive cold may accompany winter storms or can occur without storm activity during clear skies with high barometric pressure. Extreme cold accompanied by wind exacerbates exposure injuries such as frostbite and hypothermia.

Extreme cold interferes with infrastructure across Alaska for days or sometimes weeks at a time. Liquid fuels may congeal or freeze, denying motorized transportation, heat, and electricity generation. In desperation, some people choose to burn propane stoves indoors, increasing their risk to carbon monoxide poisoning. Aircraft may be grounded, delaying the resupply of food

and emergency supplies to remote villages. Water and sewer pipes often freeze and rupture; flooding occurs later when frozen pipes thaw.

High Winds

High winds occur in Alaska when there are winter low-pressure systems in the North Pacific Ocean and the Gulf of Alaska, and in the interior, due to strong pressure differences. Alaska's high winds can equal hurricane force but fall under a different classification because they are not cyclonic nor do they possess other characteristics of hurricanes. In Alaska, high winds (winds in excess of 60 mph) occur frequently over the coastal areas along the Bering Sea and the Gulf of Alaska. They can also combine with loose snow to produce blizzards.

Down slope wind storms created by temperature and pressure differences on mountainous terrain can produce winds in excess of 120 mph. Areas like the Coast Mountains, Brooks Range, and the Alaska Range experience down slope winds.

Localized downdrafts, downbursts, and microbursts, are also common wind hazards in Alaska. Downbursts and microbursts are often generated by thunderstorms. Downbursts are areas of rapidly falling rain-cooled air. Upon reaching the ground, the downburst spreads out in all directions in excess of 125 mph. Microbursts are smaller scale, more concentrated downbursts reaching speeds up to 150 mph. Both types of wind, commonly lasting five to seven minutes, are hazardous to aviation. These winds reach hurricane force and have the potential to seriously damage community infrastructure (especially above ground utility lines) while disrupting vital marine transportation.

Winter Storms

Winter storms include a variety of phenomena described above and may include several components such as wind, snow, and ice storms. Ice storms include freezing rain, sleet, and hail and can be the most devastating of winter weather phenomena; often causing automobile accidents, power outages, and personal injury. Freezing rain coats every surface it falls on with an icy glaze. Freezing rain most commonly starts in a narrow band on the cold side of a warm front, where surface temperatures are at or just below freezing temperatures. Ice crystals high in the atmosphere grow by collecting water vapor molecules, sometimes supplied by evaporating cloud droplets. As the crystals fall, they encounter a layer of warm air where the particles melt and collapse into raindrops. As the raindrops approach the ground, they encounter a layer of cold air and cool to temperatures below freezing.

5.3.4.2 Climate Change Influences

Climate change is described as a phenomena of water vapor, carbon dioxide, and other gases in the earth's atmosphere acting like a blanket over the earth, absorbing some of the heat of the sunlight-warmed surfaces instead of allowing it to escape into space (the thicker the blanket, the warmer the earth). Trees and other plants cannot absorb carbon dioxide through photosynthesis if foliage growth is inhibited. Therefore, carbon dioxide builds up and changes precipitation patterns, increases storms, wildfires, and flooding frequency and intensity; and substantially changes flora, fauna, fish, and wildlife habitats.

In contemporary usage, climate change commonly refers to the change in global or regional climate patterns that spans from the mid- to late 20th century to the present. Evidence collected by scientists and engineers from around the world tells an unambiguous story: the planet is

warming. Climate change at high northern latitudes, such as Alaska, is causing rapid and severe environmental change.

Alaska's temperature rise rate has been twice the average of the rest of the U.S. in recent decades. During the period from 1949 to 2014, the statewide average annual air temperature increased by 3°F, and the average winter temperature increased by 6°F (ACRC, 2018). This included considerable annual and regional variability, and was accompanied by a greater number of extremely warm days and fewer extremely cold days (CCSP, 2008). The statewide average annual precipitation during this same period has increased by about 10%, with recent decades showing amounts largely above normal throughout Alaska, but with substantial annual and regional variability (Shulski and Wendler, 2007, ACRC, 2018).

Global climate is projected to continue changing over this century, and changes to Alaska's climate are expected to be unprecedented (Chapin et al, 2014). Average annual temperatures in Alaska are projected to rise by an additional 2°F to 4°F by 2050, and by 6°F to 12°F by the end of the century depending on emission levels (Stewart et al, 2013). Projections of annual precipitation show an increase across Alaska as part of the broad pattern of increases projected for high northern latitudes.

The state's rapidly changing climate impacts are already pronounced, and will intensify as climate continues to change. The societal impacts of a changing climate are exacerbated as the frequency and magnitude of the physical processes that control climate-related natural hazards are amplified, threatening community resilience, and increasing natural hazard vulnerability of infrastructure and property.

Alaska's glaciers are in steep decline and are among the fastest-melting glaciers in the world. Increases in the duration and intensity of melt on glaciers will lead to more runoff and flooding in some catchments and declining dry-season flow in others as water storage is reduced.

Snow cover extent and depth have been decreasing in most places in Alaska for nearly three decades. Warmer winter temperatures change the precipitation frequency of snow and rain, and are producing more frequent rain-on-snow events.

Permafrost has warmed by several degrees in northern Alaska and has already started thawing in many other parts of the state. Thawing permafrost will impact many communities and thousands of miles of road as landscape water balances shift, and subsidence occurs.

5.3.4.3 History

Table 12 lists the NWS' major storm events for Fort Yukon's Weather Zone. Each weather event may not have specifically impacted the community, but they were listed due to Fort Yukon's close proximity to the listed communities or by location within the identified zone.

Table 12—Severe Weather Events

Location	Date	Event	Description
	1927	Record Warm Winter Temperatures	Record high winter temperature in Fort Yukon of 40ºF.
Statewide	1/2/89 to 5/10/89	Extreme cold	Omega Block Cold Spell, with record breaking temperatures as low as -85ºF. The State conducted a wide variety of emergency actions, which included: emergency repairs to maintain & prevent damage to water, sewer & electrical systems, emergency resupply of essential fuels & food, & DOT&PF support in maintaining access to isolated communities.
Fort Yukon	5/9/1989	Flood	Flooding of the Yukon River occurred one day after the Circle flood and was included in the Presidential Declaration of Major Disaster, which incorporated 16 local declarations and applied to all communities on the Yukon, Kuskokwim and Kobuk Rivers and their tributaries.
Upper Yukon River	6/1992	Flood	Very late spring, post-breakup (snow melt) flooding of the Yukon River and its tributaries from Fort Yukon to Rampart. Flood waters rose slowly over a period of days and receded gradually. Major damage was sustained by both public and private property. The IFG program was implemented in Fort Yukon, Beaver, Stevens Village, and North Pole.
Upper Yukon Valley	2/16-18/1996	Blizzard	A strong storm event produced snow; approximately 6 inches.
Upper Yukon Valley	6/15-21/1997	Flood	Rain of up to 3.8 inches during the 12th through 15th caused significant rises in streams over the zone. Several homes were flooded at Chalkyitsik on the Black River, and a road at Fort Yukon had some minor flooding near the confluence of the Porcupine and Sucker Rivers.
Upper Yukon Valley	8/26-31/1997	Thunderstorm Generated Flood	A large thunderstorm (complex) produced rains of 0.9 to 1.1 inches.
Upper Yukon Valley	2/1-12/1999	Extreme Wind Chill	While northern Alaska was under a relatively cold air mass, a large pool of colder air moved from the Russian high arctic and proceeded to Interior Alaska. Fort Yukon reached -60ºF.
Upper Yukon Valley	2/09-12/1999	Blizzard	A low-pressure system generated blizzard conditions.
Yukon Flats	1/6-7/2005	Blizzard	A small low-pressure system induced a snow storm.
Yukon Flats	5/1-3/2005	Flood	An Ice Jam on the Yukon River produced minor flooding of a road and a few structures in Fort Yukon. The Damage amount was $3,000.
Yukon Flats	12/27-31/2008	Extreme Cold/Wind Chill	A significant cold snap developed across Interior Alaska on December 27th and continued into January. Fort Yukon temperatures dropped to -54ºF on 12/31/08.
Yukon Flats	1/1-12/2009	Extreme Cold/Wind Chill	Continuing cold temperatures from Northern Alaska. Fort Yukon temperatures dropped to -61ºF on 1/4/09.
Yukon Flats	1/15-17/2009	Warm Chinook Winter Temperatures	The cold snap ended with extreme warm temperatures. Fort Yukon reached 46ºF. The previous high was 40ºF in 1927.

Location	Date	Event	Description
	02/19/2009	Winter Storm	A 970 millibar (mb) low in the central Bering Sea on the afternoon of the 17th tracked to the southern Chukchi Sea on the afternoon of the 18th, and then along the arctic coast on the 19th. This storm system brought heavy snow and blizzard conditions to much of northern Alaska. High winds were also observed in the passes of the Alaska Range. Zone 220: Snow and strong winds were observed at Eagle Summit along the Steese Highway during the morning hours on the 19th. It was estimated from DOT reports that the wind was gusting over 45 mph with low visibilities with blowing and heavy drifting snow.
Yukon Flats	5/7-9/2009	Ice Jam Flood	A large volume of water and a considerable amount of ice moved down river after the historic flooding at Eagle and moderate flooding at Circle. A 35-mile-long ice run that moved by Circle during the evening of the 6th, diminished to a 20-mile-long ice run as it passed Fort Yukon. The water levels rose rapidly at Fort Yukon during the late evening of the 7th, and several streets were flooded and people were evacuated from the low-lying areas that were flooding. The flooding became more severe overnight as water began to inundate portions of the village with water several feet deep in some homes and low-lying areas near the river. About one-half of the village flooded and the main taxiway at the airport was damaged. The levee in front of town also received some damage. The water levels remained high and the flooding continued into the 8th. The water levels began to recede on the morning of the 9th, and dropped approximately 7 feet by the evening of the 9th. (Damages for this event were estimated at $190,000,000).
Yukon Flats	11/12-11/13/2009	Blizzard	A 955 mb near Nome at 9 am on the 11th tracked across the Seward Peninsula and slowly weakened to 982 mb near Selawik by 3 pm on the 12th. The low brought a moist westerly flow into the interior, and produced heavy snowfall in the Upper Koyukuk Valley, parts of the Central Interior, and across the higher elevations in the Middle Tanana Valley around Fairbanks. Here are some snowfall reports that were received from this event: Zone 219: Heavy snow fell in Bettles with a storm total of 25.3 inches (three-day total from the 11th through the 13th). The heaviest snow fell on the 12th, with a 24-hour total of 14.2 inches. Zone 220: Blizzard conditions likely occurred along parts of the Steese Highway in the vicinity of Eagle Summit from the late afternoon hours on the 12th through the late morning hours on the 13th. According to a statement from the State of Alaska DOT, travel was not advised on the Steese Highway Mile Post (MP) 101 to MP 121. Strong winds, heavy snow, and drifting snow were reported with low to zero visibility.
Yukon Flats	12/18/2009	Extreme Cold/Wind Chill	A 979 mb low in the eastern Yukon Territory on the morning of the 18th weakened and moved east during the day. The low produced a period of stronger wind along the Steese Highway summits. A west wind of 25 to 35 mph combined with temperatures of -25°F to -30°F to produce wind chills as low as -65°F. The strongest wind and lowest wind chills were observed at Eagle Summit.
Yukon Flats	11/22-11/24/2010	Ice Storm	An extremely warm and moist air mass moving around a large ridge of high-pressure in the north Pacific produced a prolonged period of freezing rain across much of interior Alaska on November 22-24, 2010. Zone 220: A mix of freezing rain and snow was observed at Central, Circle, and Fort Yukon. Three-day totals of just under one half inch of liquid precipitation were observed at the above locations.

Location	Date	Event	Description
Yukon Flats	2/25/2011	Blizzard	A 968 mb low in the central Bering Sea at 2100 AKST on the 23rd moved to the Gulf of Anadyr as a 976 mb low at 0900 AKST on the 24th. The low tracked to the northeast as a 978 mb low in the southern Chukchi Sea at 2100 AKST on the 24th. The low then tracked to the east and passed just south of Banks Island as a 980 mb low by 0900 AKST on the 25th. The storm produced widespread blizzard conditions along the west coast as well as the arctic coast and heavy snowfall and high winds in parts of the interior. There were also areas of flooding and high water observed along parts of the west coast. Zone 220: The Steese Highway was closed in areas from 12 mile to Eagle Summit by the evening of the 25th due to extensive blowing and drifting snow and high winds. The Dalton Highway remained open, but travel was not advised. It is likely that winds gusted to at least 60 mph across the higher summits.
Yukon Flats	6/22-6/24/2011	Heavy Rain	Heavy rainfall in excess of an inch on the 22nd caused a six-mile section of the Steese Highway between Birch Creek and Circle to washout in spots on the 23rd. Repairs were made to the gravel road on the 23rd, but additional rainfall on the 23rd into the 24th caused another washout on the evening of the 24th with reports of 2 feet of water flowing over the road. The water flowing over the road was likely caused by plugged culverts and was not associated with flash flooding.
Yukon Flats	1/23-25/2012	Extreme Cold/Wind Chill	The combination of temperatures of -35°F to -40°F with a north wind of 15 to 30 mph produced wind chills as low as -78°F at Eagle Summit. The wind chills were -60°F or lower from approximately Midnight AKST on the 23rd through 1800 AKST on the 25th. The strong wind also produced areas of blowing and drifting snow and locally poor visibility near the summit.
Yukon Flats	5/28-29/2012	Heavy Rain-Flood	The combination of heavy rainfall in excess of an inch, residual winter snowpack in the uplands, and frozen ground in spots caused the Crooked Creek near Central to flood. The water levels peaked during the afternoon hours on the 28th, and at 1345 AKST water was entering the museum. Water also flooded residential yards and some roadways adjacent to Crooked Creek on the north side of the Steese Highway.
Yukon Flats	9/16/2012	High Wind	A 975 mb low near Unalakleet at 2100 AKST on the evening of the 16th moved north to near Kivalina and weakened to 981 mb by 0300 AKST on the morning of the 17th. A strong cold front moved from west to east across the interior and was associated with high winds. As the cold front moved east across the eastern Alaska Range around 2200AKST on the 16th, it is suspected that a mountain wave that had developed to the lee of the Alaska Range on the north side broke out of its stable layer to descend to near ground level over eastern zone 223 and southwestern zone 224, primarily affecting the community of Tanacross in zone 224 and Dry Creek in zone 223, along with the stretch of the Alaska Highway between these two locations. Zone 220: A peak wind gust of 64 mph was observed at the Eagle Summit SNOTEL at 2200 AKST on the 16th.

Location	Date	Event	Description
YUKON FLATS NEARBY UPLANDS	5/19/2013	Ice Jam Flood	An ice jam released upstream of Circle City and sent a surge of water and ice through the city during the 19th, causing major flooding by inundating the city with 5 to 8 feet of water. Most structures were flooded except for the school which was slightly more elevated. All residents were evacuated to higher ground. The area upstream from the boat launch on the slough was most affected as the water levels brought a considerable amount of ice right into the homes in that area. Elsewhere, the main effects were water damage. One vehicle carrying village elders tried to drive through the flooded street to safety and went off of the road into the ditch. They were rescued in the bucket of a front-end loader and taken to safety. Water levels, according to a long-time resident, were the 2nd highest in over 50 years, with only the floods in 1989 more severe. Water levels began falling in the late afternoon and receded below flood level by mid-evening on the 19th. Damage amounts included repairs to 8 homes with major damage and 7 homes with minor damage, along with nearly 1 million dollars expended in emergency response and road repair.
YUKON FLATS NEARBY UPLANDS	5/20-5/23/2013	Ice Jam Flood	On the 20th, a surge of water and ice from the upstream river ice breakup moved to near Fort Yukon causing flooding of low-lying areas. A large sheet of ice became stuck 12 miles upstream of Fort Yukon, causing widespread flooding of low-lying areas to persist. This affected the ball field, the old tank farm, the area surrounding the tribal hall, several homes, and one of several access roads to the airport. Around midnight on the 21st, the ice jam partially released though river levels did not rise significantly in town as a result. On the 22nd, river levels began to slowly fall and by the morning of the 23rd levels were below flood stage. Damage amounts included repairs to 4 homes with major damage and 1 home with minor damage, along with affected roads, buildings, and emergency response needs.
YUKON FLATS NEARBY UPLANDS	11/14/2013	Strong Wind	A complex low-pressure center of 993 mb over Kamchatka on the morning of the 12th moved to the southeast Beaufort Sea near Barter Island on the morning of the 14th deepening to 979 mb. This storm brought a variety of hazardous weather to northern Alaska; another surge of sea water across Norton Sound, rising 4 to 8 feet to prolong the inundation which had occurred just a few days earlier though the peak surge did occur during the falling tide so the overall rise in sea level was not as high as the previous event. A strong warm front with this system spread precipitation across the west coast and interior starting out as freezing rain, then rain, though remaining as snow near the Brooks Range. Some locations in the interior received nearly 1 inch of ice, with many locations receiving one-quarter to one-half inch overall. Very strong westerly winds gusting from 50 to 75 mph developed just behind the warm front as it moved across the west coast and interior of northern Alaska on the afternoon of the 13th through the morning of the 14th. In addition to the wintry mix of precipitation and strong winds, temperatures soared into the lower 40s when the wind arrived. As the low-pressure center continued east of Barter island on the 14th, a short period of blizzard conditions occurred there. Zone 220: Circle Hot Springs resident reported damage to the siding of a barn, as well as a bent flagpole. An estimate of 0.07 inch of freezing rain fell at Fort Yukon.

Location	Date	Event	Description
YUKON FLATS NEARBY UPLANDS	5/6/2014	Ice Jam Flood	An ice jam formed downstream of Circle City on the 5th and remained in place on the 6th while flowing water continued to be impounded behind the jam. This water backed up and flooded portions of the village beginning in the morning of the 6th. Water entered the basements of several residences and in the fire hall...up to one foot of water entered the General Store. The State of Alaska DOT road to the airport was overtopped during the flooding. The ice jam released in the mid-afternoon of the 6th and water levels began to slowly fall through the remainder of the afternoon and evening.
YUKON FLATS NEARBY UPLANDS	5/20-25/2015	Flooding - Heavy Rain / Snow Melt	High river levels due to increasing snowmelt occurred at Fort Yukon from the Porcupine River. Water rose enough to flood a portion of the Sucker River Road. Other low-lying areas received flooding, but no structures were impacted, nor were other roads in town. The rapid snowmelt occurred due to above seasonal warming over eastern Alaska.
YUKON FLATS NEARBY UPLANDS	5/31/2015	Strong Winds	A cold front moved southeast over the interior of Alaska on the night of the 31st and through the day on the 1st of June...bringing locally gusty winds and an unseasonable snowfall to selected locations, on the 1st, which melted later in the day. Event continued into June. Zone 220 - Gusty winds toppled some trees in Stevens Village the evening of the 31st resulting in several power lines being downed and a portion of the village without power. Wind gusts from the Seven Mile RAWS were reported as high as 45 mph during the evening of the 31st. Damage amount is a guesstimate on the repair of the several power lines.

Source: Lingaas 2010, DHS&EM 2018

5.3.4.4 Location, Extent, Impact, and Recurrence Probability

Location

Fort Yukon experiences periodic severe weather impacts. The NWS has continued to modify their system for assigning weather zones to facilitate and more accurately confine weather patterns to relevant geographic areas. Consequently, the data in Table 12 reflects different zone numbering patterns and should be used to depict weather events that have historically impacted the area; some of which may not have impacted Fort Yukon as severely as other areas within the same zone.

Extent

The entire Fort Yukon community is equally vulnerable to the effects of severe weather. Blizzard conditions and heavy snow depths for the area can reach 4.5 inches per storm event; wind speed can exceed 28.7 mph; and extreme low temperatures have reached -75ºF.

Impact

The intensity, location, and the land's topography influence the impact of severe weather conditions on a community. Extreme weather events such as rain, snow, wind, or a combination of these conditions can immobilize a community by bringing transportation (e.g., air, boat, road, snow machine, and ATVs) to a halt. Impacts can range from unfortunate to catastrophic. Airports and roadways are impacted, even closed completely, stopping the flow of supply deliveries, emergency response, and medical transport; and critical activities cannot resume until the weather clears, and the population can move about safely.

Heavy snow accumulations can cause roofs to collapse and knock down trees and power lines. Heavy snow can also damage light aircraft and sink small boats. A quick thaw after a heavy

snow can cause substantial flooding. The cost of snow removal, damage repairs, and business disruptions can have severe economic impacts to individuals and public infrastructure.

Weather injuries and deaths usually occur as a result of vehicle and/or snow machine accidents. Casualties also occur due to overexertion while shoveling snow and hypothermia caused by overexposure to the cold weather.

Aircraft may be grounded due to extreme cold and ice fog conditions, cutting off access and delaying community supply deliveries. Long cold spells can cause rivers to freeze, disrupt shipping, and increase the likelihood of ice jams and associated flooding or overflow threats.

Extreme weather also interferes with community infrastructure and its proper functions. It can cause fuel to congeal in storage tanks and supply lines, stopping electric power generation, which in turn causes heaters and furnaces to stop. Without electricity, heaters and furnaces do not work, causing water and sewer pipes to freeze or rupture. If extreme cold conditions are combined with low or no snow cover, the ground's frost depth can increase, disturbing buried pipes. The greatest danger from extreme cold is its effect on people. Prolonged exposure to the cold can cause frostbite or hypothermia and become life-threatening. Infants and elderly people are most susceptible. The risk of hypothermia due to exposure greatly increases during episodes of extreme cold, and carbon monoxide poisoning is possible as people use supplemental heating devices not intended for indoor use during extreme weather events.

While the scope, severity, and pace of future climate change impacts are difficult to predict, it is clear that potential changes could impact U.S. agencies' ability to fulfill their respective missions. The challenges posed by climate change, such as more intense storms, frequency of heavy precipitation, heat waves, drought, and extreme flooding could significantly alter the types and magnitudes of hazards faced by communities and the emergency management professionals serving them.

Recurrence Probability

Alaska will continue to experience diverse and seasonal weather events. Severe weather will occur annually in Fort Yukon.

5.3.5 Fire

While a part of the natural ecosystem, fires in Alaska are a dangerous hazard when they involve remote communities. During the five-year period spanning 2013 through 2018, over 82 fire-related fatalities were recorded in Alaska. Since 2013, the State has declared over 3,077 fire-related emergencies or disasters (DHS&EM, 2018).

For the purposes of profiling the hazard in Alaska, fires in this HMP are characterized by their primary fuel sources into two categories:

- Wildland fire, which consumes natural vegetation.
- Community fire conflagration, which propagates among structures and infrastructure.

Fire is a natural wildland management force in the Alaskan Interior. It is a key environmental factor in cold-dominated ecosystems. Without fire, organic matter accumulates, the permafrost table rises, and ecosystem productivity declines. Fire rejuvenates an ecosystem by removing decaying matter and returning their nutrients to the soil, preserving vegetative diversity and wildlife habitat unique to Alaska. In the absence of wildland fires, many plant and animal species would no longer thrive.

While fire is critical for maintaining the viability of Alaska's ecosystems, it must be tempered with the need to protect human life and property. This is particularly true of fires burning in "wildland urban interface" areas, where structures and other human development meet or intermingle with undeveloped wildland. Wildland urban interface (WUI) has gained importance throughout Alaska with increased development adjacent to wildlands.

Urban conflagration is a large destructive fire that is widespread throughout an urban area or community involving one or more developed areas in the community. In contrast to the commonly destructive individual property fire, conflagrations frequently overwhelm resources and damage infrastructure. In rural Alaskan communities, the loss of a critical building, such as a school, may arrange a local disaster declaration.

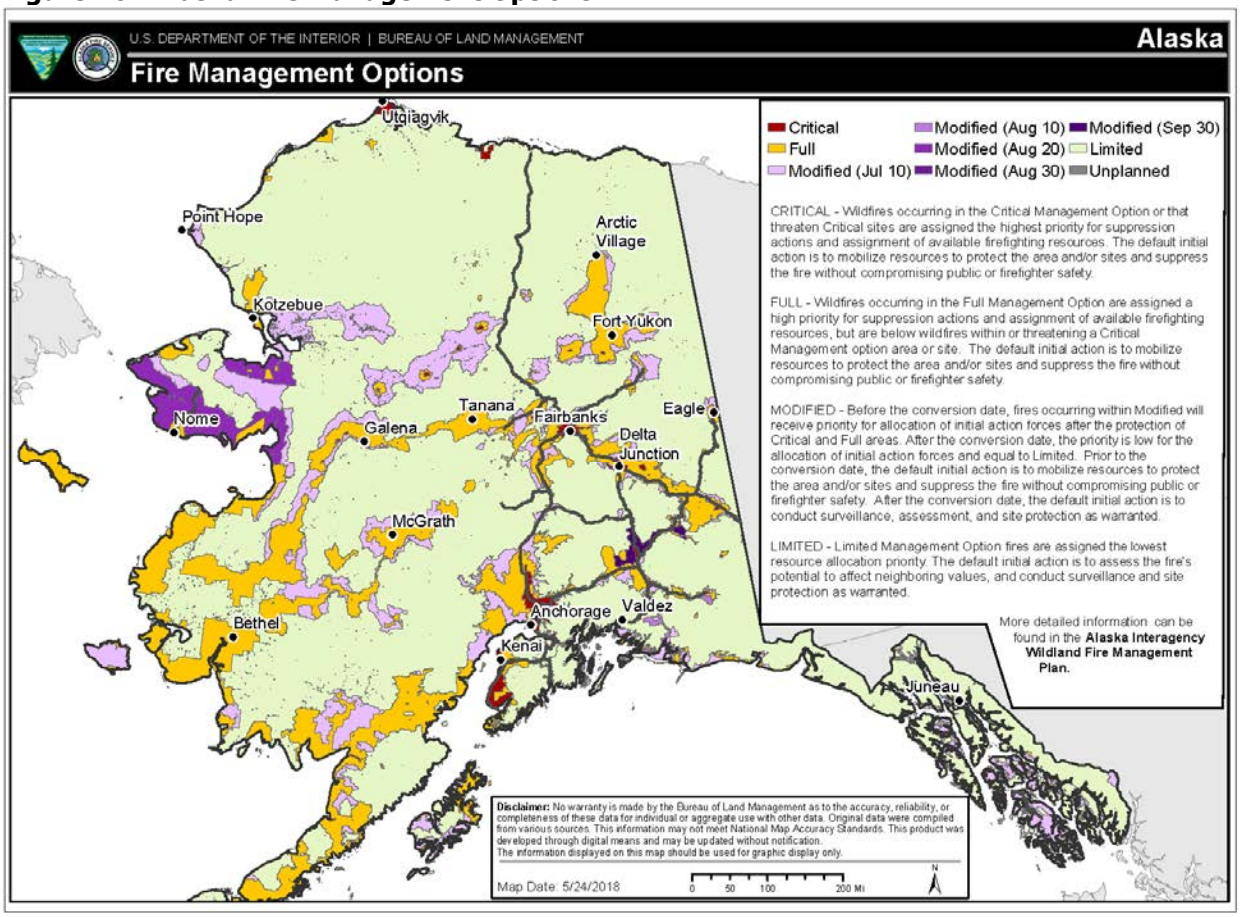
Firefighter and public safety are the primary concern of each local and wildland response agency. In Alaska, thousands of acres burn every year in 300 to 800 fires, primarily between the months of March and October. According to the Alaska Interagency Coordination Center (AICC), Alaska lost 7,815,368 acres from 2013 to 2017. This figure consisted of the 2,408 wildland fires that started throughout that same time period. This is an average of 3,246 acres per wildland fire (DHS&EM, 2018).

5.3.5.1 Management in Alaska

Wildland fire management in Alaska is a joint effort among Federal, State, Local, and Tribal governments, Native organizations, Local fire departments, communities, and landowners. The land management agencies, also known as jurisdictional agencies, have the overall land and resource management responsibilities as provided by Federal, State, Local or Tribal law.

BLM in coordination with the AICC provides the BLM Alaska Fire Management Plan Interactive Web Maps to support their fire mitigation initiatives. Figure 16 displays Alaska's wildland fire management options. Fort Yukon is considered Full. Full means: Wildfires occurring in the Full Management Option are assigned a high priority for suppression actions and assignment of available firefighting resources, but are below wildfires within or threatening a Critical Management option area or site. The default initial action is to mobilize resources to protect the area and/or sites and suppress the fire without compromising public or firefighter safety.

Figure 16—Alaska Fire Management Options



Source: AICC, 2018

5.3.5.2 Hazard Characteristics

A wildland fire is a type of wildfire that spreads through consumption of vegetation. It often begins unnoticed, spreads quickly, and is usually signaled by dense smoke that may be visible for miles around. Wildland fires can be caused by human activities (such as arson or unattended campfires) or by natural events such as lightning. Wildland fires often occur in forests or other areas with ample vegetation. In addition to wildland fires, wildfires can be classified as tundra fires, urban fires, interface or intermix fires, and prescribed burns.

The following three factors contribute significantly to wildland fire behavior and can be used to identify wildland fire hazard areas.

- **Topography:** As slope increases, the rate of wildland fire spread increases. South-facing slopes are also subject to more solar radiation, making them drier and thereby intensifying wildland fire behavior. However, ridgetops may mark the end of wildland fire spread since fire spreads more slowly or may even be unable to spread downhill.
- **Fuel:** The type and condition of vegetation plays a significant role in the occurrence and spread of wildland fires. Certain types of plants are more susceptible to burning or will burn with greater intensity. Dense or overgrown vegetation increases the amount of

combustible material available to fuel the fire (referred to as the "fuel load"). The ratio of living to dead plant matter is also important. Climate change is deemed to increase wildfire risk significantly during periods of prolonged drought as the moisture content of both living and dead plant matter decreases. The fuel load continuity, both horizontally and vertically, is also an important factor.

- **Weather:** The most variable factor affecting wildland fire behavior is weather. Temperature, humidity, wind, and lightning can affect chances for ignition and spread of fire. Extreme weather, such as high temperatures and low humidity, can lead to extreme wildland fire activity. By contrast, cooling and higher humidity often signal reduced wildland fire occurrence and easier containment. Climate change increases the susceptibility of vegetation to fire due to longer dry seasons.

The frequency and severity of wildland fires is also dependent on other hazards, such as lightning, drought, and infestations (such as the damage caused by spruce-bark beetle infestations). If not promptly controlled, wildland fires may grow into an emergency or disaster. Even small fires can threaten lives and resources and destroy improved properties; they can also impact transportation corridors and/or infrastructure. In addition to affecting people, wildland fires may severely affect livestock and pets. Such events may require emergency water/food, evacuation, and shelter.

The indirect effects of wildland fires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance rivers and stream siltation, thereby enhancing flood potential, harming aquatic life, and degrading water quality. Lands stripped of vegetation are also subject to increased debris flow hazards.

Conflagration fires are very difficult to control. Complicating factors are wind, temperature, slope, proximity of structures, and community firefighting capability, as well as building construction and contents. Additional factors facing response efforts are hazardous substance releases, structure collapse, water service interruptions, unorganized evacuations, and loss of emergency shelters. Historical national conflagration examples include the Chicago City Fire of 1871 and the San Francisco City Fire following the 1906 earthquake.

Many wildland firefighters are neither equipped nor trained for structure fires. Structural fire suppression within defined service areas is the responsibility of volunteer fire departments. When wildland firefighters encounter structure, vehicle, dump or other non-vegetative fires during the performance of their wildland fire suppression duties, firefighting efforts are often limited to wildland areas.

5.3.5.3 Climate Factors

According to the Global Climate Change Impacts in the U.S., published in 2009 by the U.S. Global Change Research Program, "Under changing climate conditions, the average area burned per year in Alaska is projected to double by the middle of this century. By the end of this century, area burned by fire is projected to triple under a moderate greenhouse gas emissions scenario and to quadruple under a higher emissions scenario." (DHS&EM, 2018).

Since 1990, Alaska has experienced nearly twice the number of wildfires per decade compared to a period from 1950 to 1980. Additionally, the sparsely populated arctic region experienced

only three wildfires over 1,000 acres from 1950 to 1970. Since 2000, there have been over 33 large wildfires in this same region.

The average duration of the wildfire season in the arctic region runs from May through July. Other regions south of the arctic may run from late April through mid-September. Average annual precipitation in Alaska has increased since 1950, but not quite as much as the average annual temperature.

5.3.5.4 History

Wildland fires have not been documented within the boundaries of Fort Yukon; however, wildland fires have occurred in the vicinity. The AICC maintains a website (http://fire.ak.blm.gov/aicc.php) to consolidate Alaska's wildland fire information. Information in Table 13 and Figure 17 were obtained from this site. The school burned down in 1994, but the cause was arson.

Over 94 wildland fires occurred within 50 miles of the community. Table 13 lists ten wildfires that exceeded 300 acres burned for the most recent 79-year historical period (i.e., from 1939 to 2018).

Table 13—Wildfire Locations Since 1939 within 50 Miles of Fort Yukon

Fire Name	Fire Year	Estimated Acres	Specific Cause
Fort Yukon #2	1950	2000	Smokers
Yukon - Porcupine	1951	700	Campfire
Sucker River	1953	500	Campfire
DUTCH LAKE	1959	300	Burning Debris
932003	1989	640	Human
432116	1994	406.7	Warming Fire
Canvasback Lake	2010	35455.7	Lightning
Discovery Creek	2013	13473.8	Lightning
Crazy Slough	2015	8019.8	Lightning
Chandalar River	2016	2847.8	Lightning

Figure 17—Fort Yukon's Historical Wildfires

5.3.5.5 *Location, Extent, Impact, and Recurrence Probability*

Location

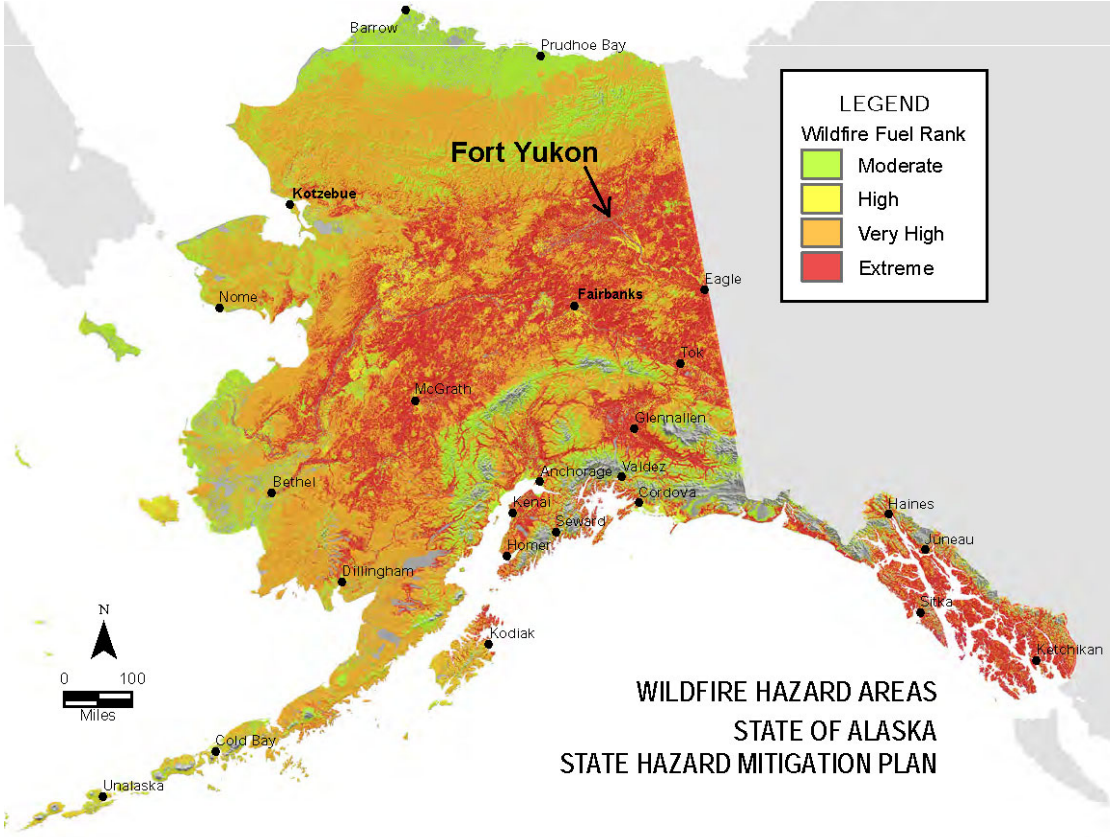
Under certain conditions, wildland fires may occur in any area with fuel surrounding Fort Yukon. Since fuels data is not readily available, for the purposes of this HMP, all areas outside City limits (i.e., GZGTG lands) are considered to be vulnerable to wildland fire impacts. Since 1939, over 94 wildland fire events have occurred within 50 miles of the City limits (Figure 17). Vegetation undergrowth has grown thick and dense. Numerous lots of standing black spruce and willow brush are located throughout the community. Figures 17 and 18 depict Fort Yukon's historical wildfires and the critical facilities and their relation to Fort Yukon's wildland fire threat.

No conflagration fires have occurred in Fort Yukon, but this type of fire is definitely a concern.

Extent

Generally, fire vulnerability dramatically increases in the late summer and early fall as vegetation dries out, decreasing plant moisture content, and increasing the ratio of dead fuel to living fuel. However, various other factors, including humidity, wind speed and direction, fuel load and type, and topography can contribute to the intensity and spread of wildland fires. The common causes of wildland fires in Alaska include lightning strikes and human negligence.

Figure 18—Fort Yukon's Wildland Fire Risk



Fuel, weather, and topography influence wildland fire behavior. Fuel (e.g., slash, dry undergrowth, flammable vegetation) determines how much energy the fire releases, how quickly the fire spreads, and how much effort is needed to contain the fire. Weather is the most variable factor. High temperatures and low humidity encourage fire activity while low temperatures and high humidity retard fire spread. Wind affects the speed and direction of fire spread. Topography directs the movement of air, which also affects fire behavior. When the terrain funnels air, as happens in a canyon, it can lead to faster spreading. Fire also spreads up slope faster than down slope.

Impact

Impacts of a wildland fire that interfaces with the population center could grow into an emergency or disaster if not properly controlled. A small fire can threaten lives and resources and destroy property. In addition to impacting people, wildland fires may severely impact livestock and pets. Such events may require emergency watering and feeding, evacuation, and alternative shelter.

Indirect impacts of wildland fires can be catastrophic. In addition to stripping the land of vegetation and destroying forest resources, large, intense fires can harm the soil, waterways, and the land itself. Soil exposed to intense heat may lose its capability to absorb moisture and support life. Exposed soils erode quickly and enhance siltation of rivers and streams, thus increasing flood potential, harming aquatic life, and degrading water quality.

Recurrence Probability

Increased community development, fire fuel accumulation, and weather pattern uncertainties indicate that seasonal wildfires will continue into the future. Fort Yukon needs to develop plans to address this ever-increasing threat.

This section provides an overview of the vulnerability analysis and describes the five specific steps: asset inventory, methodology, development changes and trends, data limitations, and areas of future development.

6.1 OVERVIEW OF A VULNERABILITY ANALYSIS

A vulnerability analysis predicts the exposure extent that may result from a given hazard event and its impact intensity within regional areas. This qualitative analysis provides data to identify and prioritize potential mitigation measures by allowing State agencies and communities to focus attention on areas with the greatest risk. A vulnerability or risk analysis is divided into the following five focus areas:

1. Asset Inventory
2. Infrastructure Risk, Vulnerability, and Losses from Identified Hazards
3. Development Changes and Trends
4. Data Limitations
5. Future Development Considerations

DMA 2000 requirements and implementing state governance regulations for developing risk and vulnerability assessment initiatives:

DMA 2000 Requirements: Risk Assessment, Assessing Vulnerability, Overview

Assessing Vulnerability: Overview

Requirement §201.7(c)(2)(ii): [The risk assessment shall include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description **shall** include an overall summary of each hazard and its impact on the community.

Element

- Does the new plan include an overall summary description of the jurisdiction's vulnerability to each hazard?
- Does the new plan address the impact of each hazard on the jurisdiction?

Source: FEMA, 2015.

This HMP has been developed for the GZGTG which is a singe jurisdiction. As Fort Yukon is a rural remote village, all infrastructure is considered critical, and the Risk/Vulnerability Analysis uses critical infrastructure that the City of Fort Yukon owns and describes in their 2017 HMP. All of Fort Yukon's permanent residents with the exception of five people are GZGTG members. Approximately 20-30 transient residents temporarily reside in the community as school teachers, fire fighters, and construction workers. Land use and the boundaries of the City, GZGTG, and GZ Corporation are discussed in Section 6.2.1.3.

6.2 CURRENT ASSET EXPOSURE ANALYSIS

6.2.1 Critical Asset Infrastructure

Assets that may be affected by hazard events include population (for community-wide hazards), residential buildings, and critical facilities and infrastructure. Assets are grouped into two structure types: critical infrastructure and residential properties. The assets and associated values throughout Fort Yukon are identified and discussed in detail in the following subsections.

DMA 2000 Recommendations: Risk Assessment, Assessing Vulnerability, Identifying Structures

Assessing Vulnerability: Identifying Structures

Requirement §201.7(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Element

- Does the new plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas?
- Does the new plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?

Source: FEMA, 2015.

6.2.1.1 Critical Infrastructure

Critical infrastructure is defined as a facility that provides essential products and services to the general public, such as preserving quality of life while fulfilling important public safety, emergency response, and disaster recovery functions. Due to Fort Yukon's remote rural location, almost all facilities are deemed "critical" to a community's survival. Critical facilities and infrastructure profiled in this HMP include the following (see also Table 14):

- Government: Federal, State, City, and Tribal administrative offices, departments, or agencies;
- Emergency Response: including police department, Village Public Safety Officer (VPSO), and fire-fighting equipment;
- Educational: including K-12 (which is a boarding school for neighboring communities) and the university;
- Health Care: medical clinics, congregate living, health, residential and continuing care, and retirement facilities;
- Community Gathering Places: community, Tribal hall, and culturally significant and ceremonial facilities; and
- Utilities: electric and alternative power generation, communications, water and waste water treatment, sewage lagoons, and landfills.

Table 14—Alaska's Critical Infrastructure

• Hospitals, Clinics, & Assisted Living Facilities	• Satellite Facilities	• Power Generation Facilities	• Oil & Gas Pipeline Structures & Facilities	• Schools
• Fire Stations	• Radio Transmission Facilities	• Potable Water Treatment Facilities	• Service Maintenance Facilities	• Community Washeterias
• Police Stations	• Highways and Roads	• Reservoirs & Water Supply Lines	• Community Halls & Civic Centers	• National Guard Facilities
• Emergency Operations Centers	• Critical Bridges	• Waste Water Treatment Facilities	• Community Stores	• Landfills & Incinerators
• Any Designated Emergency Shelter	• Airports	• Fuel Storage Facilities	• Community Freezer Facilities	• Community Cemeteries
• Telecommunications Structures & Facilities		• Harbors / Docks / Ports		

Population data for Fort Yukon was obtained from the 2010 U.S. Census. Fort Yukon's total population for 2010 was 583, and 2017 DCCED/DCRA data reported a population of 563 (Table 15).

Table 15—Estimated Population and Building Inventory

Population		Residential Buildings	
2010 U.S. Census	DCCED 2017 Data	Total Building Count	Total Value of Buildings[1]
583	563	317	$79,250,000

Sources: The City of Fort Yukon, U.S. Census 2010, and 2017 DCCED/DCRA population data.
[1] Average structural value of all single-family residential buildings is $250,000 per structure.

There are 317 housing units in Fort Yukon. Most homes are frame and/or log construction, and nearly all units are single-family homes. Few of these homes meet current codes for construction or energy conservation. There are a few apartment units, but no apartment buildings and only eight mobile homes. Most residents own their homes. Rental housing is virtually non-existent. There are very few vacant, livable dwellings.

DMA 2000 Recommendations: Estimating Potential Losses

Assessing Vulnerability: Estimating Potential Losses

Requirement §201.7(c)(2)(ii)(B): [The plan should describe vulnerability in terms of an] estimate of the potential dollar losses to vulnerable structures identified in paragraph (c)(2)(ii)(A) of this section and a description of the methodology used to prepare the estimate.

Element

- Does the new plan estimate potential dollar losses to vulnerable structures?
- Does the new plan describe the methodology used to prepare the estimate?

Source: FEMA, 2015.

Estimated replacement values for those structures, as shown in Table 15, were obtained from the 2010 U.S. Census, and DCCED/DCRA. A total of 317 single-family residential buildings were considered in this analysis. However, the GZGTG stated that residential replacement values are generally understated as the cost for materials, shipping, and labor exceed the U.S. Census determined value.

Due to Fort Yukon's remote rural location, most facilities are deemed "critical" to the community's survival. The total number of critical facilities is listed in Table 16. This table shows both the City and GZGTG's shared critical facilities.

DMA 2000 Recommendations: Cultural and Sacred Sites

Assessing Vulnerability: Identifying Cultural and Sacred Sites

Requirement §201.7(c)(2)(ii)(D): [The plan should describe vulnerability in terms of] cultural and sacred sites that are significant, even if they cannot be valued in monetary terms.

Element

- Does the new plan describe cultural sites?
- Does the new plan describe sacred sites?

Source: FEMA, 2015.

Historic sites in the Fort Yukon community are:

- Two-acre cemetery in old village (prior to the 1949 flood) (this is located in the flood zone);
- Octagon adjacent to cemetery;
- Tribal Hall (cultural dances are held here, and there are displays of Tribal/cultural artifacts);
- Land six miles from Fort Yukon on the Porcupine River (used for fish camps, kids' camps to teach about cultural resources, fish nets, and how to smoke/dry fish, elder camps); and
- The territorial school by Joe Carroll's house.

6.2.1.2 Infrastructure Risk, Vulnerability, and Losses from Identified Hazards

There is limited GIS data available for Fort Yukon. The results of the GIS based exposure analysis for loss estimations are summarized in Table 16. The following discussion contains data from GIS analysis and information obtained from the Planning Team.

DMA 2000 Recommendations: Assessing Vulnerability

Assessing Vulnerability

Requirement §201.7(c)(2)(ii)(A): The plan should describe vulnerability in terms of the types and numbers of existing and future buildings, infrastructure, and critical facilities located in the identified hazard area.

Element

- Does the new plan describe vulnerability in terms of the types and numbers of existing buildings, infrastructure, and critical facilities located in the identified hazard areas?
- Does the new plan describe vulnerability in terms of the types and numbers of future buildings, infrastructure, and critical facilities located in the identified hazard areas?

Source: FEMA, 2015.

Table 16—Fort Yukon Critical Facilities

Occupancy Type	Facility Name	Location/Address	Structure/ Per Mile Replacement Value	Total Miles/ Feet/Gallons/ Occupants
Government Facility	City Office, Police, Fire Dept, Maintenance Facility	7th Avenue	$100,000	6 Occ
	Gwitchyaa Zhee (GZ) Offices - Gas Station	East 4th Avenue	$100,000	4 Occ
	GZ Offices - Utilities	Spruce Street	$100,000	1 Occ
	State Office, Court, F&W, Public Health	East 3rd Avenue	$500,000	4 Occ
	Tribal Council Building, with Housing Department	East Third and Alder Street	$1,000,000	15 Occ
	Fish and Wildlife Office and warehouse	East 4th Avenue	$250,000	3 Occ
	Post Office	East 3rd Avenue	$500,000	2 Occ
	National Guard	East 3rd Avenue	$350,000	0 Occ (inactive)
Transportation Facilities	Airport	Airport Road	$18,050,000	0 Occ
	D&D, LLC	Airport Terminal	$100,000	0 Occ
	Barge Landing Area	End 1st Avenue	$200,000	0 Occ
	Former AC Company Shop (now owned by GZGTG)	East 3rd Avenue	$200,000	2 Occ
	City Maintenance Facility	7th Avenue	$500,000	3 Occ
	GZGTG Garage	4th Avenue	$250,000	2 Occ
	GZ Corporation Garage	4th Avenue	$500,000	3 Occ
	Shop Oil Co Truck Garage	William Loola Street	$300,000	4 Occ
	School Shop	East 3rd Avenue	$750,000	2 Occ
	Yukon Flats Health Center Shop	FAA Site off Spruce Street	$1,482,334	1 Occ
	Yukon Flats Garage	East 2nd Avenue	$100,000	1 Occ
Emergency Response Facility	Police and Fire	See City Office Info		
	Fort Yukon Police Dept	See City Office Info		
	BLM Station (seasonal)	Airport Road	$500,000	0 Occ
Educational Facility	Fort Yukon School	East 3rd Avenue	$10,000,000	150 Occ
	Yukon Flats School District Office	Hill Street	$750,000	12 Occ
	Resource Center - Council of Athabascan Tribal Governments (CATG)	East 4th Avenue	$1,550,000	5 Occ
	University of Alaska Fort Yukon Learning Center	East 5th Avenue	$2,000,000	10 Occ
	Yukon Flats School District Dormitory	Ramstead Rd	$664,786	20
	CATG Education Building	E Second Ave	$120,000	5
	CATG Natural Resource	E 7th Ave & Vera Vehthii	$250,000	3
	Vocational Education Center	Ramstead Road	$3,000,000	20 Occ
Care Facility	Yukon Flats Health Center Clinic	East 8th Avenue	$11,212,717	37 Occ
Community Facility	Assembly of God Church	East 3rd Avenue	$200,000	2 Occ
	Baptist Church	East 4th Avenue	$300,000	2 Occ
	Episcopal Church	William Loola Street	$300,000	2 Occ
	Community Center	East 3rd Avenue	$5,000,000	20 Occ
	Elder Building – Addie Shewfelt	4th Avenue	$1,000,000	10 Occ
	School Housing – Duplex	Ramstead Road	$627,360	6 Occ
	AC Company Store	East 3rd Avenue	$2,000,000	30 Occ

Occupancy Type	Facility Name	Location/Address	Structure/ Per Mile Replacement Value	Total Miles/ Feet/Gallons/ Occupants
	City Games	Spruce Avenue	$213,117	2 Occ
	Community Liquor Store	1st Avenue	$200,000	5 Occ
	Temporary Housing – GZ Units Seasonal	Ramstead Road	$5,000,000	3 Occ
	Community Gardens	Old Village Townsite 1st Avenue	$150,000	2 Occ
	Cemetery 1	East 2nd Avenue	$250,000	N/A
	Cemetery 2	Old Village Townsite 1st Avenue	$250,000	N/A
	Greenhouse			N/A
Roads	Roads (BIA/Community)			37.5 Miles
	Ramstead Road			0.6 Miles
	Barge Landing Road			0.6 Miles
	Base Road			1 Mile
Bridges	Ivar's Bridge		$300,000	N/A
Utilities	Water Treatment Building	Base Road	$1,795,632	1 Occ
	Water Building #2	N/A	$327,818	0 Occ
	Lift Stations (5)		$663,516	0 Occ
	Long Range Radar Site (former DEW line)	Base Road	$17,000,000	5 Occ
	GZ Power Plant	4th Avenue	$200,000	2 Occ
	KZPA 900, with CATG Offices	East 3rd Avenue	$1,000,000	12 Occ
	Police and Fire, 500 gal fuel tanks	7th Avenue	$3,500	0 Occ
	Ft. Yukon Public Water System	City wide	$35,000,000	0 Occ
	City Satellite Dish	7th Avenue	$10,000	Occ
	GCI Satellite Dish	8th Avenue	$35,000	0 Occ
	Interior Telephone Satellite Dish	William Loola Street	$35,000	1 Occ
	Washeteria	See City Office Info		
	Tank Farm	1st Avenue	$2,000,000	0 Occ
	AC Store Generator	East 3rd Avenue	$200,000	0 Occ
	School Generator	East 3rd Avenue	$200,000	0 Occ
	Landfill/Incinerator	End of Runway	$500,000	0 Occ
	Sewage Lagoon	NE of City Center	$1,000,000	0 Occ

Source: Fort Yukon, 2017a

Table 17—Potential Hazard Exposure Analysis – Critical Infrastructure

			Government and Emergency Response		Educational		Care		Community	
Hazard Type	Hazard Area	Methodology	# Bldgs/ # Occ	Value ($)	# Bldgs/ # Occ	Value ($)	# Bldgs/ # Occ	Value ($)	# Bldgs/ # Occ	Value ($)
Cryosphere	Entire State	Descriptive	--	--	--	--	--	--	--	--
Earthquake	Moderate	3.9-9.2 %g	7/43	3,300,000	4/185	16,550,000	1/30	11,212,717	11/76	14,000,000
Riverine Flood/ Riverbank Erosion	High	Potentially impacting community within 0.25 mile of major river	5/29	2,050,000	3/35	6,550,000	1/30	11,212,717	7/24	6,700,000
Severe Weather	Entire State	Descriptive	--	--	--	--	--	--	--	--
Fire	Low	Low fuel rank	6/37	3,200,000	4/185	16,550,000	1/30	11,212,717	10/66	13,000,000
	Moderate	Moderate fuel rank	3/25	1,600,000	2/25	4,550,000	1/30	11,212,717	6/22	6,700,000

Potential Hazard Exposure Analysis – Critical Infrastructure

			Highway		Bridges		Transportation Facilities		Utilities	
Hazard Type	**Hazard Area**	**Methodology**	**Miles**	**Value ($)**	**No.**	**Value ($)**	**# Bldgs/ # Occ**	**Value ($)**	**# Bldgs/ # Occ**	**Value ($)**
Cryosphere	Entire State	Descriptive								
Earthquake	Moderate	Descriptive	37.5	--	1	300,000	9/17	20,850,000	14/16	41,979,132
Riverine Flood/ Riverbank Erosion	High	100-year floodplain	--	--	--	--	7/12 Occ.	19,600,000	8/3 Occ.	2,783,500
	Hight	Within 300 ft of erosion areas	--	--	--	--	--	--	2	2,663,516
Severe Weather	Entire State	Descriptive	--	--	--	--	--	--	--	--
Fire	Low	Low fuel rank	--	--	--	--	8/14 Occ.	20,350,000	6/3 Occ.	3,635,000
	Moderate	Moderate fuel rank	--	--	1	300,000	4/8 Occ.	1,100,000	11/16 Occ.	40,579,132

Cryosphere Vulnerabilities

Alaska can expect to experience ever-changing effects from melting polar ice sheets, mountain glaciers, and other cryosphere impacts. According to mapping completed by the USGS, Fort Yukon is underlain by discontinuous permafrost, thus exposed to the impacts from this hazard (see Section 5.3.1.4). This includes 563 people in 317 residences (worth $79,250,000) and all 69 critical facilities (worth approximately $123,914,860).

Based on human location and habitation, a person could experience infrastructure damage and personal injury throughout the Alaska Interior where permafrost and subsurface conditions are changing. Hunting and fishing subsistence capacity will be affected. The existing, transient, and future population, residential structures, critical facilities, and infrastructure are exposed to changing cryospheric impacts (Section 5.3.1).

Impacts associated with degrading permafrost include surface subsidence, infrastructure, structure, and/or road damage. Buildings that are built on slab foundations and/or not constructed with materials designed to accommodate the movement associated with building on permafrost land are more vulnerable to the impacts of permafrost.

Similar to weather vulnerabilities, changing cryospheric conditions also vary across Alaska. Therefore, the entire population and infrastructure is vulnerable to recurrent cryosphere hazard impacts. To lessen future impacts, GZGTG has instituted land use controls prohibiting new construction in permafrost zones and building codes to accommodate the effects of permafrost on structures.

Earthquake Vulnerabilities

Alaska should expect the full spectrum of potential earthquake ground motion scenarios. Severe shaking may result in infrastructure damage that is equally as extreme. Although all structures are at some risk due to earthquakes, short wooden buildings are less vulnerable than multi-story and complex masonry/steel structures. The majority of Alaska's schools, State, and Federal buildings are built and sited based on stringent seismic construction standards and are expected to survive major earthquake events.

Based on PSHAs conducted by USGS in 2007, the entire state may be at risk of experiencing moderate to significant earthquake impacts. The 2018 State of Alaska HMP categorizes the Fort Yukon area at risk of experiencing moderate earthquake impacts (see Section 5.3.2.3). Impacts to the community such as significant ground movement that may result in infrastructure damage are not expected. Impacts to future populations, residences, critical facilities, and infrastructure are anticipated to remain the same.

For this Vulnerability Analysis, it is assumed that the population and residential/commercial structures from Table 17 will be affected. This includes 367 people in 48 critical facilities (worth approximately $108,191,849).

Impacts to the community such as significant ground movement that may result in infrastructure damage are not expected. Minor shaking may be seen or felt based on past events. Although all structures are exposed to earthquakes, buildings within Fort Yukon constructed with wood have slightly less vulnerability to the effects of earthquakes than those with masonry.

Due to Alaska's highly active geologic setting at a tectonic plate boundary, future populations, residential structures, critical facilities, and infrastructure will be exposed to continued

earthquakes of various magnitudes—from those that are barely felt to those that detrimentally affect large regions of the state.

Flood and Erosion Vulnerabilities

The 2018 State of Alaska HMP categorizes the Fort Yukon area at risk of experiencing high flooding and erosion impacts. Impacts associated with flooding in Fort Yukon include levee and finger dike damage, water damage to structures and contents, roadbed erosion and damage, boat strandings, areas of standing water in roadways, and damage or displacement of fuel tanks, power lines, or other infrastructure. Buildings on slab foundations, not located on raised foundations, and/or not constructed with materials designed to withstand flooding events (e.g., cross vents to allow water to pass through an open area under the main floor of a building) are more vulnerable to the impacts of flooding (see Section 5.3.3.3).

The City of Fort Yukon has participated in the NFIP since April 24, 1995 with new D-FIRMs dated February 3, 2010. However, they do not have a repetitive flood property inventory that meets the repetitive or severely repetitive loss criteria as the loss thresholds are below FEMA values. Jimmy Smith, NFIP Floodplain Manager for Alaska, stated that as of May 2, 2017, there are no active NFIP flood insurance policies for the City, and there are no NFIP repetitive loss properties in Fort Yukon. GZGTG does not participate in the NFIP.

For this Vulnerability Analysis, it is assumed that the population and residential/commercial structures from Table 17 will be affected. This includes 133 people in 31 critical facilities (worth approximately $48,896,217). Fort Yukon's flood- and erosion-threatened population and infrastructure potentially include: the existing, transient, and future population, residential structures, critical facilities, and infrastructure that are exposed to changing flooding and erosion impacts (Section 5.3).

Based on local knowledge, areas within Fort Yukon that are affected by erosion are located on the "wrong side" of the dike (see Section 5.3.3.3). These houses are not eligible for grant funding as squatters live in these houses and do not own the land. There were two critical facilities: one bridge and a lift station (worth $4,095,632) located in historically erosion-prone areas. The City's tank farm was relocated in 2010 outside its previously erosion-prone area. Ivar's Bridge was moved in 2018.

Impacts from erosion include loss of land and any development on that land. Erosion can cause increased sedimentation of harbors and river deltas and hinder channel navigation, reduction in water quality due to high sediment loads, loss of native aquatic habitats, damage to public utilities (docks, harbors, electric and water/wastewater utilities), and economic impacts associated with costs trying to prevent or control erosion sites. In Fort Yukon, only the location of a building can lessen its vulnerability to erosion.

To lessen future impacts, GZGTG has instituted land use controls prohibiting new construction in permafrost zones and building codes to accommodate the effects of permafrost on structures. Impacts to future populations, residential structures, critical facilities, and infrastructure are anticipated to increase over historical impact rates due to changing climate, inconsistent weather patterns, classical melt, and rain/snowmelt run-off.

The City identified raising 1,600 feet of Base Road to enable it to act as a barrier from flood inundation as a mitigation strategy in their 2017 HMP. This would protect approximately 80 homes located adjacent to the road and eliminate the need to elevate each home individually to mitigate future damages or losses. One feet of lift was added to Base Road since the 2010 City

HMP. Public Works has indicated more lifts are needed. GZGTG will retain this as one of their mitigation strategies in Section 7 of this HMP.

Severe Weather Vulnerabilities

The 2018 State of Alaska HMP categorizes the Fort Yukon area at risk of experiencing moderate severe weather impacts. Impacts associated with severe weather events include roof collapse, trees and power lines falling, damage to light aircraft and sinking small boats, injury and death resulting from snow machine or vehicle accidents, overexertion while shoveling (all due to heavy snow). A quick thaw after a heavy snow can also cause substantial flooding. Impacts from extreme cold include hypothermia, halting transportation from fog and ice, congealed fuel, frozen pipes, disruption in utilities, frozen pipes, and carbon monoxide poisoning. Section 5.3.4.4 provides additional detail regarding the impacts of severe weather. Buildings that are older and/or not constructed with materials designed to withstand heavy snow and wind (e.g., hurricane ties on crossbeams) are more vulnerable to the impacts of severe weather. The entire State is threatened by severe weather events.

Severe weather will occur annually in Fort Yukon. Using information provided by Fort Yukon and the NWS, the entire existing and future population, residences, critical facilities, and infrastructure are equally exposed to the effects of a severe weather event. This includes 563 people in 317 residences (worth $79,250,000) and all 69 critical facilities (worth approximately $123,914,860).

Climate change impacts vary across Alaska. These conditions will negatively impact future populations, residential structures, critical facilities, and infrastructure. To lessen future impacts, the City has instituted building codes to accommodate the effects of severe weather on structures.

Fire Vulnerabilities

The 2018 State of Alaska HMP categorizes the Fort Yukon area at risk of experiencing moderate fire impacts. Impacts associated with a wildland fire event include the potential for loss of life and property. It can also impact livestock and pets and destroy forest resources and contaminate water supplies. Buildings closer to the outer edge of town, those with a lot of vegetation surrounding the structure, and those constructed with wood are some of the buildings that are more vulnerable to the impacts of wildland fire.

According to the Alaska Fire Service, there are no wildland fire areas within Fort Yukon's boundaries. However, 94 wildland fires have occurred within a 50-mile radius of Fort Yukon (see Section 5.3.5.4). There is potential for wildland fire to interface with the population center of Fort Yukon. There are 126 people and 28 critical facilities (worth approximately $90,026,849) located in Fort Yukon and potentially threatened by moderate wildfire events.

Dry forest and tundra conditions increase fire fuels and insect infestations. These conditions create optimum conditions for wildfire propagation, especially around housing and other areas where fire fuels are not controlled near public or private structures. Future populations, residential structures, critical facilities, and infrastructure located in dryer regions of Alaska are anticipated to experience increased wildfire events compared to historical impacts.

6.2.1.3 Land Use and Development Trends

The requirements for land use and development trends, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Recommendations: Risk Assessment, Assessing Vulnerability, Analyzing Development Trends

Assessing Vulnerability: Analyzing Development Trends

Requirement §201.7(c)(2)(ii)(C): [The plan should describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.

Element

- Does the new plan describe land uses and development trends?

Source: FEMA, 2015.

Fort Yukon lies at the confluence of the Yukon and Porcupine Rivers and encompasses about 7.5 sq. miles. Land use in Fort Yukon is predominantly residential with limited area for commercial services and community (or institutional) facilities. Suitable developable vacant land is in short supply within the boundaries of Fort Yukon, and open space and various hydrological bodies surround the community. The largest owners of property include the U.S. Government, GZ Corporation, and the GZGTG.

Fort Yukon is surrounded by the Yukon Flats National Wildlife Refuge, which lies about 15 miles from Fort Yukon in most directions. Management plans recognize and support traditional subsistence and trapping activities on the refuge. The Alaska National Interest Lands Conservation Act (ANILCA) excludes Native lands from refuge management control.

Surface lands were transferred to GZ Corporation through an interim conveyance dated 1983 or 1985, and a final conveyance from the BLM dated June 27, 2007 (Patent No. 50-2007-0573). GZGTG (formerly known as the Native Village of Fort Yukon) was officially incorporated in 1959. Surface land ownership in the Fort Yukon area consists primarily of ANCSA-conveyed lands owned by GZ Corporation and Native allotments. GZ Corporation owns 214,600 surface land acres, of which approximately 617 surface land acres are on and adjacent to the Fort Yukon Long Range Radar Site and 0.50 surface land acres impacted by the Cache Site.

In 1993, the GZ Corporation and the GZGTG signed an agreement to transfer 103,680 acres to GZGTG. This conveyance followed a majority vote by shareholders of the Corporation. Additionally, GZGTG leases two acres that their Tribal Office and Hall sit on from the City of Fort Yukon, including the former recycling center measuring 125 feet by 90 feet, two acres for a community garden, one acre for the GZ Corporation Utility Plant, and one lot for the GZ Corporation Gas Station. The tribe also uses two acres as a wood staging area for a biomass project.

The Fort Yukon Townsite consisted of 144 acres (nine tracts) and was patented to the Townsite trustees (the City) for municipal reserves, streets, public services, etc. The City is laid out between the airport along Hospital Lake and Yllota Slough. There are five Native Allotments within City limits in fee status. Current residential use includes 14 acres under the Federal Townsite and five acres for homesteads. Future residential use includes 10 new blocks or 10 acres to accommodate 80 new homes.

Because Fort Yukon serves as a regional center for the outlying villages, an unusually large percentage of land is devoted to public service facilities (school, clinic, and state or federal offices). The airport occupies 510 acres and is owned by the State of Alaska. Although nearby Hospital Lake is used for float plane access, the community prefers this area remain primarily for local subsistence use. The Air Force site and public facilities occupy 23 acres. Commercial development totals four acres.

The Fort Yukon Townsite was originally concentrated in the western portion of the Townsite, but the flood of 1949 forced relocation of much of the town to the higher ground of Crow Town—that portion presently occupied by the school, community center, U.S. Post Office, Alaska Commercial, and the majority of newer residences. Virtually all high ground at Crow Town has now been developed. The U.S. Department of Housing and Urban Development has provided funding for houses that have been built on slightly lower ground just within the northern boundary of the Townsite. Within the central portion of Crow Town, stores and offices have been developed among some of the home sites. This results in more traffic around the homes and causes uncertainty in terms of the expansion potential for commercial and public uses. The location of the Alaska Commercial Store is convenient to the school, community center, U.S. Post Office, and other places where residents have business. Few platted sites remain, and future residential growth will require additional surveys and platting. The western portion of the Townsite is occupied by the GZ Electric Utility Company and the Yukon Fuel storage facility.

To the southeast of the Townsite are the U.S. Air Force Aircraft Control and Warning site, and the related communication network facility operated by a private contractor. This is one of the few areas above the BFE. The U.S. Air Force has two properties in Fort Yukon: the old White Alice site and the Long Range Radar Site. The land is leased from the GZ Corporation.

GZ Corporation is responsible for opening up lands for growth. In the mid 1970's, the Angel Pond Subdivision was formed and extended as the subdivision filled with homes. Additionally, GZ Corporation has formed another subdivision called Rabbit Line. First National Bank obtained a leasehold from GZ Corporation to form an additional subdivision called Dagoo Subdivision. In the early 2000's, GZ Corporation acquired the BLM Barracks, which is utilized as summer rentals.

Fort Yukon has at least two sand and gravel material sources for local construction projects. The Grace Thomas gravel pit is located adjacent to the Sucker River, about one mile from the center of town. The Doyon Ltd./GZ Corporation gravel pit is located adjacent to Yllota Slough, about three miles east of town. ANTHC mines gravel for Doyon. Figures 19 and 20 show land use ownership and the Townsite.

Figure 19—Fort Yukon Land Ownership Map

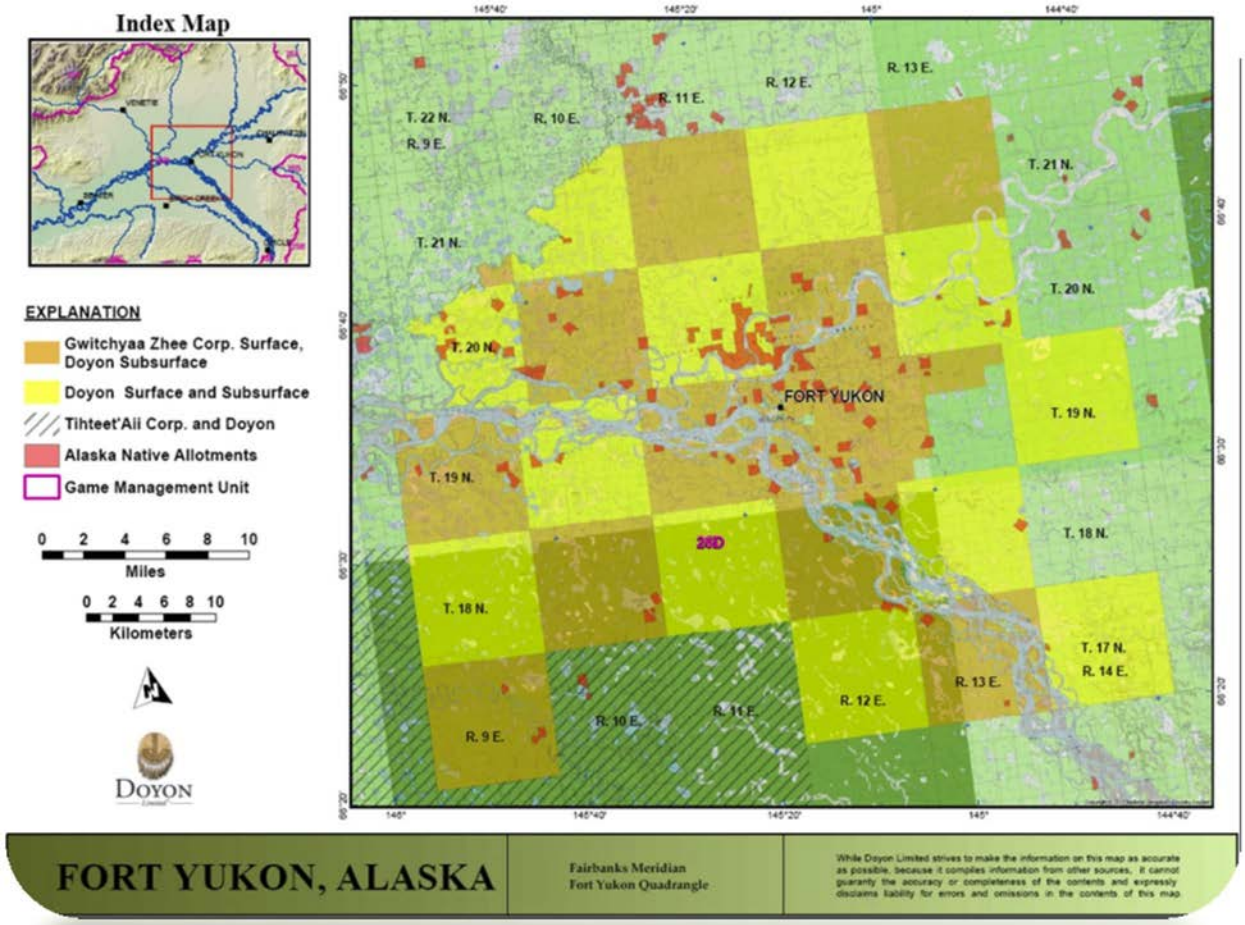
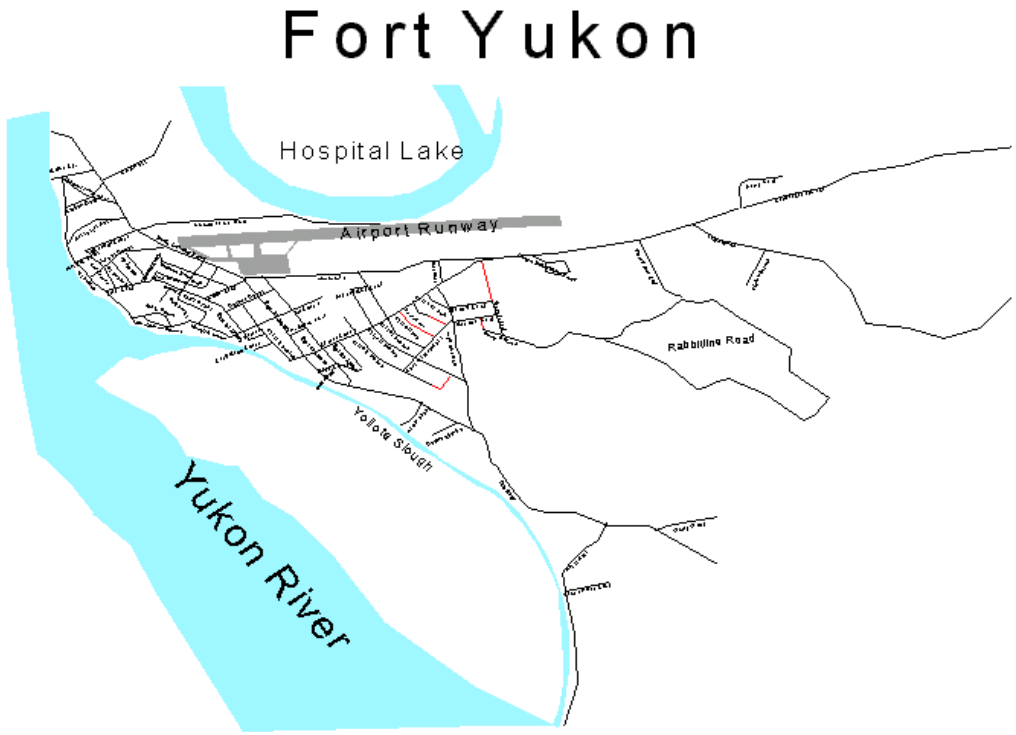


Figure 20—Fort Yukon Map



Source: GZGTG Long Range Transportation Plan, 2004

Development Trends

Fort Yukon has benefited from numerous funding opportunities to assist them with upgrading their infrastructure. A new sewage lagoon was built in 1988, and the waste heat recovery system was upgraded. The 1990s brought substantial airport improvements such as new land acquisition resurfacing, apron expansion, and apron lighting; housing major renovations and modernizations included lead paint removal, new exterior doors and windows, and wood stove gaskets; a new school was built to replace the former school that was destroyed by fire; roads received resurfacing; a new Community Center/Tribal Hall was built; and the landfill was upgraded. The turn of the century brought fire alarm upgrades to the Yukon Flats School and Care Center; water

and sewer upgrades, building renovations, road resurfacing and fire upgrades, and police vehicle upgrades. The City received funds to begin repairs to the piped water system and to construct a piped gravity sewer system to serve 250 residents and the local businesses. This project eliminated the majority of residential septic systems and outhouses. In 2010, an extensive airport rehabilitation project occurred that raised the ground surface ten feet. In 2011, the community extended the piped water system gravity and gravity fed septic system to the new subdivisions with a 325,000-gallon water tank. The Power Plant House Biomass project was completed in Summer 2017. A new landfill and sewage lagoon are currently being designed.

Military debris was located at a location referred to as the Fort Yukon Long Range Radar Station Cache Site. Debris consisting of military-style ration containers and military-style rations protruded from the east bank of the southern end of Yllota Slough. Ration containers and rations are occasionally scoured out of the bank by ice movement during spring breakup, where they end up in the base of Yllota Slough. The metal containers that house the rations are partially rusted and deformed by the scouring action of ice in Yllota Slough during spring break-up, resulting in many small holes and sharp edges. Site visitors are at risk of lacerations from sharp, jagged, rusty metal containers when traversing the slough bank when fishing, hunting, trapping, or firewood gathering. GZGTG Natural Resource Department recently relocated debris from the Cache site to the landfill and rehabilitated the site. A picnic area has been built on that land.

6.2.1.4 Data Limitations

The vulnerability estimates provided herein use the best data currently available, and the methodologies applied result in a risk approximation. These estimates may be used to understand relative risk from hazards and potential losses. However, uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning hazards and their effects on the built environment as well as the use of approximations and simplifications that are necessary for a comprehensive analysis.

It is also important to note that the quantitative vulnerability assessment results are limited to the exposure of people, buildings, and critical facilities and infrastructure to the identified hazards. It was beyond the scope of this HMP to develop a more detailed or comprehensive assessment of risk (including annualized losses, people injured or killed, shelter requirements, loss of facility/system function, and economic losses). Such impacts may be addressed with future updates of this HMP.

6.2.1.5 Future Development Considerations

The most serious limitation on expansion is the relative lack of high ground. All available land has been locked in agreements, and no one is buying or selling land at the present time. GZ Corporation has fulfilled its obligations under ANCSA Section (14)(c)(1)(2) and (4).

The mitigation strategy provides the blueprint for implementing desired activities that will enable the GZGTG to continue to save lives and preserve infrastructure by systematically reducing hazard impacts, damages, and community disruptions. This section outlines the five-step process for preparing a mitigation strategy including:

1. Develop Mitigation Goals to mitigate the hazards identified (see Section 6).
2. Identify Mitigation Actions to meet the Mitigation Goals.
3. Evaluate Mitigation Actions.
    a. Describe and analyze Tribal mitigation policies, programs, and funding sources.
    b. Evaluate Federal and State hazard management policies, programs, capabilities, and funding sources.
4. Implement the Mitigation Action Plan (MAP).

7.1 DEVELOPING MITIGATION GOALS

The requirements for the Tribal hazard mitigation goals, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Mitigation Strategy – Tribal Hazard Mitigation Goals

Tribal Hazard Mitigation Goals

Requirement §201.7(c)(3)(i): [The hazard mitigation strategy shall include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.

Element

- Does the plan include a description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards?

Source: FEMA, 2015.

The exposure analysis results were used as a basis for developing the mitigation goals and actions. Mitigation goals are defined as general guidelines that describe what a community wants to achieve in terms of hazard and loss prevention. Goal statements are typically long-range, policy-oriented statements representing community-wide visions. As such, seven goals were developed to reduce or avoid long-term vulnerabilities to the identified hazards (Table 18).

Table 18—Mitigation Goals

No.	Goal Description
Multi-Hazards (MH)	
MH 1	Promote recognition and mitigation of all-natural hazards that have the ability to affect Fort Yukon.
MH 2	Promote cross-referencing Tribal mitigation goals and actions with City planning mechanisms and projects.
Natural Hazards	
CR 3	Reduce potential cryosphere (CR) vulnerability, damage, and loss.
EQ 4	Reduce potential earthquake (EQ) vulnerability, damage, and loss.
FL 5	Reduce potential riverine flood (FL) and erosion vulnerability, damage, and loss.
SV 6	Reduce potential severe weather (SV) vulnerability, damage, and loss.
F 7	Reduce potential wildland fire and conflagration fire (F) vulnerability, damage, and loss.

7.2 IDENTIFYING MITIGATION ACTIONS

The requirements for the identification and analysis of mitigation actions, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Mitigation Strategy - Identification and Analysis of Mitigation Actions

Identification and Analysis of Mitigation Actions

Requirement §201.7(c)(3)(ii): [The mitigation strategy shall include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.

Element

- Does the new plan identify and analyze a comprehensive range of specific mitigation actions and projects for each hazard?
- Do the identified actions and projects address reducing the effects of hazards on new buildings and infrastructure?
- Do the identified actions and projects address reducing the effects of hazards on existing buildings and infrastructure?

Source: FEMA, 2015.

After mitigation goals and actions were developed, the Planning Team assessed the potential mitigation actions to carry forward into the mitigation strategy. Mitigation actions are activities, measures, or projects that help achieve the goals of a mitigation plan. Mitigation actions are usually grouped into three broad categories: property protection, public education and awareness, and structural projects. The Planning Team placed particular emphasis on projects and programs that reduce the effects of hazards on both new and existing buildings and infrastructure. These potential projects are listed in Table 19.

7.3 EVALUATING AND PRIORITIZING MITIGATION ACTS

The requirements for the evaluation and implementation of mitigation actions, as stipulated in DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Mitigation Strategy - Implementation of Mitigation Actions

Implementation of Mitigation Actions

Requirement: §201.7(c)(3)(iii): [The mitigation strategy section shall include] an action plan describing how the actions identified in Section (c)(3)(ii) will be prioritized, implemented, and administered by the Tribal Government. Prioritization shall include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.

Element

- Does the new mitigation strategy include how the actions are prioritized?
- Does the new mitigation strategy address how the actions will be implemented and administered?
- Does the new prioritization process include an emphasis on the use of a cost-benefit review to maximize benefits?

Source: FEMA, 2015.

Mitigation actions are activities, initiatives, measures, or projects that help achieve the goals of an HMP. Mitigation actions are usually grouped into three broad categories: property protection, public education and awareness, and construction projects.

The Planning Team developed each of the mitigation actions on January 28, 2019, to determine which actions would be included in the MAP. The MAP contained in Table 21 represents potential mitigation projects and programs to be implemented through the cooperation of GZGTG and the City.

Table 19—Mitigation Goals and Potential Actions

(Bold ID items were selected for implementation by the Planning Team)

Goals		Actions	
No.	**Description**	**ID**	**Description**
MH 1	Promote recognition and mitigation of all-natural hazards that have the ability to affect the Native Village of Fort Yukon.	A	Develop, produce, and distribute information materials concerning mitigation, preparedness, and safety procedures for all jurisdictional identified natural hazards.
		B	Develop and implement strategies and educational outreach programs for debris management from natural hazard events.
		C	Disseminate FEMA pamphlets to educate and encourage homeowners concerning structural and non-structural retrofit benefits.
		D	Identify and pursue funding opportunities to implement mitigation actions.
		E	Encourage the City to maintain membership in the National Flood Insurance Program to reduce monetary losses to individuals and the community.
MH 2	Promote cross-referencing Native Village of Fort Yukon mitigation goals and actions with City planning mechanisms and projects.	**A**	GZGTG and the City will aggressively manage their existing plans to ensure they incorporate mitigation planning provisions into all community planning processes such as comprehensive, capital improvement, and land use plans, etc. to demonstrate multi-benefit considerations and facilitate using multiple funding source consideration.
		B	Integrate the Mitigation Plan findings for enhanced emergency planning.
		C	Increase power line wire size and incorporate quick disconnects (break away devices) to reduce ice load and wind storm power line failure during severe wind or winter ice storm events.
		D	Acquire (buy-out), demolish, or relocate structures from hazard prone area. Property deeds shall be restricted for open space uses in perpetuity to keep people from rebuilding in hazard areas.
		E	Harden utility headers located along river embankments to mitigate potential flood, debris, and erosion damages.
		F	Develop vegetation projects to restore clear-cut and riverine erosion damage.
CR 3	Reduce potential CR vulnerability, damage, and loss.	**A**	Identify and map existing permafrost areas to assist in new critical facility siting and existing facility relocation siting.
		B	Promote permafrost sensitive construction practices in permafrost areas.
EQ 4	Reduce potential EQ vulnerability, damage, and loss.	A	The City has the authority to inspect, prioritize, and retrofit any critical facility or public infrastructure on City land that does not meet current State Adopted Building Codes.
		B	Evaluate critical public facility seismic performance for fire station, public works building, potable water system, wastewater system, electric power system, and bridge. Neither City nor GZGTG have authority.
		C	Encourage utility companies to evaluate and harden vulnerable infrastructure elements for sustainability.
		D	Install non-structural seismic restraints for large furniture such as bookcases, filing cabinets, and appliances to prevent toppling damage and resultant injuries.
FL 5		**A**	Maintain and update erosion hazard locations, identify critical facilities potentially impacted and develop mitigation initiatives such as bank stabilization or facility relocation to prevent or reduce the threat.

Goals		Actions	
No.	**Description**	**ID**	**Description**
	Reduce potential riverine flood and erosion vulnerability, damage, and loss.	B	Install bank protection such as rip-rap (large rocks), sheet pilings, gabion baskets, articulated matting, concrete, asphalt, vegetation, or other armoring or protective materials to provide river bank protection.
		C	Harden culvert entrance bottoms with asphalt, concrete, rock, or similar material to reduce erosion or scour.
		D	Install walls at the end of a drainage structure to prevent embankment erosion at its entrance or outlet (end or wing walls).
		E	Raise 1600 Feet of "Base Road" roadbed to enable the road to act as a levee to protect flood threatened homes. This action will eliminate the need to elevate these threatened homes.
		F	Elevate road adjacent to the slough to enable the road to act as a levee to protect flood threatened homes.
		G	Elevate structures that are likely to flood in next flood as they are in the floodplain.
SV 6	Reduce potential SV vulnerability, damage, and loss.	**A**	Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms.
		B	Develop critical facility list needing emergency back-up power systems, prioritize, seek funding, and implement mitigation actions.
		C	Develop and implement tree clearing mitigation programs to keep trees from threatening lives, property, and public infrastructure from severe weather events.
		D	Develop personal use and educational outreach training for a "safe tree harvesting" program. Implement along utility and road corridors, preventing potential winter storm damage.
F 7	Reduce potential wildland fire and conflagration fire vulnerability, damage, and loss.	**A**	Develop Community Wildland Fire Protection Plans for all at-risk communities.
		B	Hold FireWise workshop to educate residents and contractors concerning fire resistant landscaping.
		C	Promote FireWise building siting, design, and construction materials.
		D	Provide wildland fire information in an easily distributed format for all residents.
		E	Identify, develop, implement, and enforce mitigation actions such as fuel breaks and reduction zones for potential wildland fire hazard areas.

The Planning Team reviewed the simplified social, technical, administrative, political, legal, economic, and environmental (STAPLEE) evaluation criteria (Table 20) and the Benefit-Cost Analysis Fact Sheet (Appendix D) to consider the opportunities and constraints of implementing each particular mitigation action. For each action considered for implementation, a qualitative statement is provided regarding the benefits and costs and, where available, the technical feasibility. A detailed cost-benefit analysis is anticipated as part of the application process for those projects GZGTG and the City choose to implement.

Table 20—Evaluation Criteria for Mitigation Actions
Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE)

Evaluation Category	Discussion "It is important to consider…"	Considerations
Social	The public support for the overall mitigation strategy and specific mitigation actions.	Community acceptance Adversely affects population
Technical	If the mitigation action is technically feasible and if it is the whole or partial solution.	Technical feasibility Long-term solutions Secondary impacts
Administrative	If the community has the personnel and administrative capabilities necessary to implement the action or whether outside help will be necessary.	Staffing Funding allocation Maintenance/operations
Political	What the community and its members feel about issues related to the environment, economic development, safety, and emergency management.	Political support Local champion Public support
Legal	Whether the community has the legal authority to implement the action, or whether the community must pass new regulations.	Local, Tribal, State, and Federal authority Potential legal challenge
Economic	If the action can be funded with current or future internal and external sources, if the costs seem reasonable for the size of the project, and if enough information is available to complete a FEMA Benefit-Cost Analysis.	Benefit/cost of action Contributes to other economic goals Outside funding required FEMA Benefit-Cost Analysis
Environmental	The impact on the environment because of public desire for a sustainable and environmentally healthy community.	Effect on local flora and fauna Consistent with community environmental goals Consistent with Local, Tribal, State, and Federal laws

On January 28, 2019, the hazard mitigation Planning Team considered each hazard's history, extent, and probability to determine each potential action's priority. A rating system based on high, medium, or low was used. High priorities are associated with actions for hazards that impact the community on an annual or near annual basis and generate impacts to critical facilities and/or people. Medium priorities are associated with actions for hazards that impact the community less frequently and do not typically generate impacts to critical facilities and/or people. Low priorities are associated with actions for hazards that rarely impact the community and have rarely generated documented impacts to critical facilities and/or people. Prioritizing the mitigation actions in the MAP Matrix was completed on February 26, 2019, to provide GZGTG and the City with an approach to implementing the MAP. Table 21 defines the mitigation action priorities.

7.4 IMPLEMENTING A MITIGATION ACTION PLAN

The requirements for Tribal Government policies in mitigation strategies, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Mitigation Strategy – Tribal Government's Pre- and Post- Disaster Policies

Implementation of Mitigation Actions

Requirement: §201.7(c)(3)(iv): [The mitigation strategy section shall include] a discussion of the Tribal Government's pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including: An evaluation of tribal laws, regulations, policies, and programs related to hazard mitigation as well as development in hazard-prone areas; and a discussion of tribal funding capabilities for hazard mitigation projects.

Element

- What will happen to the Fort Yukon community if no mitigation actions are implemented?
- What will happen to the Fort Yukon community if mitigation actions are implemented?
- What tribal laws, regulations, policies, and programs pertain to hazard mitigation?
- Do land use regulations exist to prevent development in hazard-prone areas?

Source: FEMA, 2015.

DMA 2000 Requirements: Mitigation Strategy – Current and Potential Sources of Funding

Implementation of Mitigation Actions

Requirement: §201.7(c)(3)(v): [The mitigation strategy section shall include] identification of current and potential sources of Federal, Tribal, or private funding to implement mitigation actions.

Element

- What are current sources of Federal, Tribal, or private funding to implement mitigation actions?
- What are future sources of Federal, Tribal, or private funding to implement mitigation actions?

Source: FEMA, 2015.

If no mitigation actions from Table 21 are implemented, Fort Yukon will continue to be vulnerable to all hazards identified in Section 5 and the risks associated with those hazards in Section 6. If mitigation actions from Table 21 are implemented, Fort Yukon will become a resilient community that is prepared for potential hazards identified in Section 5 and the risks associated with those hazards in Section 6. GZGTG includes Tribal Land Management in Section 7 of their Constitution. These regulations exist to prevent development in hazard-prone areas.

The GZGTG has six divisions—Administration, Finance, Housing Authority, Transportation, Tribal Member Services, and Lands & Natural Resources to provide valuable services for tribal members and residents of the Fort Yukon community. The GZGTG operates a number of Federal and State programs within its six divisions including the Native American Housing Assistance and Self-Determination Act (NAHASDA) housing program, a tribal court, Administration for Native Americans (ANA) grant administration Indian Child Welfare Acts programs, a recycling program, an environmental cleanup program, solid and hazardous waste management, wildlife services, and land management. Most notably from a mitigation perspective, the GZGTG:

- Receives NAHASDA funds from U.S. Department of Housing and Urban Development (HUD) for its Housing Program. GZGTG constructs between one to three new houses

each year for low-income GZGTG, in addition to providing rehabilitation services (i.e., address mold damage, add running water/sewer services) to existing homes. The GZGTC serves concurrently as the Gwichyaa Zhee Gwich'in Housing Authority.
    - 2016-2018 Projects:
      NAHASDA Self-Help and Rehabilitation Program;
      Indian Community Development Block Grant (ICDBG): and
    - BIA Housing Improvement Program (HIP) under HUD to rehabilitate homes.
- Is responsible for the administration of Restricted Native Allotments, Wills, and Probates.
- Assists the community by providing transportation services. The Transportation Division oversees the sale and delivery of gravel for residential purposes, repair of roads in its inventory, and is working toward implementing a transit system.
- The Tribal Operations Department is responsible for maintaining the archives of organization materials, overseeing ANA Grant Administration, and for drafting of ordinances.
- The Finance Office is responsible for financial management of all grants and contracts including the Annual Funding Agreement compact, in accordance with the rules that govern the granting agencies.
- The Environmental Program oversees Brownfield cleanup, backhaul of vehicles and white goods, and community cleanup and recycling efforts.
- Is responsible for the Recycling Program; Solid Waste Management; and Hazardous Waste Management.
- The Department of Natural Resources is responsible for overseeing Wildlife Survey and Land Issues. This department is developing a traditional comprehensive land use management manual.

The Tribal Constitution has the following ordinances:

Section 1:
GENERAL PROVISIONS FOR ALL TITLES
SOVEREIGN IMMUNITY
ADOPTING, AMENDING, AND REPEALING TRIBAL ORDINANCES
ETHIC STANDARDS

Section 2:
TRIBAL COUNCIL STRUCTURE
COUNCIL MEETINGS
TRIBAL ELECTIONS
POPULAR PARTICIPATION
RIGHTS OF GWICHYAA ZHEE GWICH'IN TRIBAL MEMBERS

Section 3:
MEMBERSHIP AND ENROLLMENT
COOPERATIVE AGREEMENTS
EDUCATION ORDINANCE
ECONOMIC DEVELOPMENT ORDINANCE

Section 4:
TRIBAL COURT
COURT OF APPEALS

Section 5:
CHILD/FAMILY PROTECTION

Section 6:
TRIBAL EMPLOYEES

Section 7:
TRIBAL LAND MANAGEMENT
NATURAL AND CULTURAL RESOURCES
TRIBAL WATER QUALITY ORDINANCE
AIR QUALITY
SOLID WASTE DISPOSAL
SAFE DRINKING WATER

Table 21—Combined GZGTG and City of Fort Yukon Mitigation Action Plan
(See acronym and abbreviations list for complete titles)

Action ID	Description	Priority	Responsible Department	Potential Funding	Timeframe	Benefit-Costs / Technical Feasibility
MH 1C	Disseminate FEMA pamphlets to educate and encourage homeowners concerning structural and non-structural retrofit benefits.	Medium	City Manager of Fort Yukon, GZGTG Executive Director	NAHASDA Self-Help and Rehabilitation Program; ICDBG; BIA HIP under HUD	2019-2020	B/C: Sustained mitigation outreach programs have minimal cost and will help build and support area-wide capacity. This type of activity enables the public to prepare for, respond to, and recover from disasters. TF: This low-cost activity can be combined with recurring community meetings where hazard specific information can be presented in small increments. This activity is ongoing demonstrating its feasibility.
MH 1D	Identify and pursue funding opportunities to implement mitigation actions.	High	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG, State of Alaska Advanced Assistance Application Development, NAHASDA, ANA	2019-2024	B/C: This ongoing activity is essential as there are limited funds available to accomplish effective mitigation actions. TF: This activity is ongoing demonstrating its feasibility.
MH 1E	Maintain membership in the National Flood Insurance Program to reduce monetary losses to individuals and the community.	High	City Manager of Fort Yukon	City of Fort Yukon	2019-2024	B/C: NFIP participation, while one of FEMA's highest priorities, also enables communities with an effective program focus priority flood locations and projects. TF: The City is currently a member. Continuation is relatively simple.
MH 2A	Both GZGTG and the City will aggressively manage their existing plans to ensure they incorporate mitigation planning provisions into all community planning processes such as comprehensive, capital improvement, and land use plans, etc. to demonstrate multi-benefit considerations and facilitate using multiple funding source consideration.	Medium	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG	2019-2024	B/C: Coordinated planning ensures effective damage abatement and ensures proper attention is assigned to reduce losses and damage to structures and residents. TF: This is feasible to accomplish as no cost is associated with the action and only relies on member availability and willingness to serve their community.
MH 2B	Integrate the HMP findings for enhanced emergency planning.	Medium	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG	2019-2024	B/C: Coordinated planning ensures effective damage abatement and ensures proper attention is

Action ID	Description	Priority	Responsible Department	Potential Funding	Timeframe	Benefit-Costs / Technical Feasibility
						assigned to reduce losses and damage to structures and residents. TF: This is feasible to accomplish as no cost is associated with the action and only relies on member availability and willingness to serve their community.
MH 2D	Acquire (buy-out), demolish, or relocate structures from hazard prone area. Property deeds shall be restricted for open space uses in perpetuity to keep people from rebuilding in hazard areas.	High	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG, FEMA, State of Alaska HMGP	2019-2024	B/C: This project would remove threatened structures from hazard areas, eliminating future damage. F: This project is feasible using existing staff skills, equipment, and materials.
MH 2E	Encourage utility companies to evaluate and harden vulnerable infrastructure elements for sustainability.	Medium	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG	2019-2024	B/C: Hardening infrastructure to reduce hazard impacts reduces potential future loses and replacement costs. TF: GZGTG and the City have the technical capability to manage and conduct this project.
CR 3A	Identify and map existing permafrost areas to assist in new critical facility siting and existing facility relocation siting.	Medium	City Manager of Fort Yukon, GZGTG Executive Director	DGGS, USGS	2019-2024	B/C: Identifying permafrost locations is a minimal cost which would decrease damage to facilities if they were sited appropriately. Project must be associated with a relocation or construction project. TF: Technically feasible as the community currently has identified permafrost locations but they have not created a map defining the area and they dig test holes to determine permafrost depth prior to construction.
CR 3B	Promote permafrost-sensitive construction practices in permafrost areas.	Medium	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG	2019-2024	B/C: Sustained mitigation outreach programs have minimal cost and will help build and support community capacity enabling the public to prepare for, respond to, and recover from disasters. Siting education can ensure structures are sited away from known hazard areas. TF: This project is technically feasible using existing Tribal and City ordinances.
EQ 4C	Encourage utility companies to evaluate and harden vulnerable infrastructure elements for sustainability.	Medium	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG	2019-2024	B/C: Hardening infrastructure to reduce hazard impacts reduces potential future loses and replacement costs. TF: GZGTG and the City have the technical capability to manage and conduct this project.

Action ID	Description	Priority	Responsible Department	Potential Funding	Timeframe	Benefit-Costs / Technical Feasibility
FL 5A	Maintain and update erosion hazard locations, identify critical facilities potentially impacted. and develop mitigation initiatives such as bank stabilization or facility relocation to prevent or reduce the threat.	High	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG, HMGP, PDM, FEMA	2019-2024	B/C: Identifying threatened infrastructure proximity to natural hazards is vital to their sustainability. TF: The project is technically feasible as the community has staff and resources they have used in the past to relocate and elevate buildings.
FL 5E	Raise 1,600 Feet of "Base Road" roadbed to enable the road to act as a levee to protect flood-threatened homes.	High	City Manager of Fort Yukon, GZGTG Executive Director	BIA, Federal Highways, Doyon	2019-2024	B/C: Unless Doyon donated the gravel, the cost would be extremely high. TF: The project is technically feasible as the community has staff and resources they have used in the past to elevate roads and install culverts.
FL 5F	Elevate Ramstead Road adjacent to the Yllota Slough to enable the road to act as a levee to protect flood-threatened homes. Also, build back road to clinic.	High	City Manager of Fort Yukon, GZGTG Executive Director	BIA, Federal Highways, State of Alaska Advanced Assistance Application Development	2019-2024	B/C: A drainage system installed in the downtown area to the airport may be a better option. It would be beneficial to use see money to conduct a H&H study. TF: The project is technically feasible as the community has staff and resources they have used in the past to elevate roads and install culverts.
FL 5G	Elevate Tribal Hall, Tribal Office, and five post and pad houses that are in danger of flooding.	High	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG, HMGP, FEMA	2019-2022	B/C: The Tribal Hall needs to be raised four feet, and eight houses have been identified as meeting FEMA criteria. A B/C has been calculated and is above 1. TF: The project is technically feasible as the community has staff and resources they have used in the past to elevate roads and install culverts.
SV 6A	Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms.	Low	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG, DCCED/CDBG, Denali Commission	2019-2024	B/C: Scheduling maintenance and implementing mitigation activities will potentially reduce severe winter storm damages caused by heavy snow loads and icy rain. TF: This type of activity is technically feasible within the community typically using existing labor, equipment, and materials. Specialized methods are not new to rural communities as they are used to importing required contractors.
SV 6B	Develop critical facility list needing emergency back-up power systems, prioritize, seek funding, and implement mitigation actions.	High	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG, HMGP, PDM	2019-2024	B/C: The community uses the school as an emergency shelter. If the Tribal Hall had a backup generator, it would be an ideal shelter location since it has a kitchen. TF: This type of activity is technically feasible within the community typically using existing labor,

Action ID	Description	Priority	Responsible Department	Potential Funding	Timeframe	Benefit-Costs / Technical Feasibility
						equipment, and materials. Specialized methods are not new to rural communities as they are used to importing required contractors.
SV 6 C/D	Develop and implement tree clearing mitigation programs to keep trees from threatening lives, property, and public infrastructure from severe weather events. This mitigation action could be combined with F 7C.	High	City Manager of Fort Yukon, GZGTG Executive Director	City of Fort Yukon, GZGTG, U.S. Fish and Wildlife, BLM	2019-2024	B/C: Fort Yukon is surrounded by three rivers, but there is nothing to protect the community from a wild fire on the back side. TF: In 2008, the U.S. Fish & Wildlife gave Fort Yukon a grant to thin and clear trees. This activity was successfully implemented by the community.
F 7A	Develop Community Wildland Fire Protection Plans.	High	City Manager of Fort Yukon, GZGTG Executive Director Alaska Fire Service, Division of Forestry, US Forest Service	City of Fort Yukon, GZGTG, DOF, Federal Fire Fighters Grants	2019-2024	B/C: This project will ensure the community looks closely at their wildland fire hazard to ensure they can safely address actions and needs during a wildland fire event. TF: This is technically feasible using existing City and Tribal resources with existing State and Federal agency support and guidance.
F 7B	Provide wildland fire information in an easily distributed format for all residents.	Medium	City Manager of Fort Yukon, GZGTG Executive Director Alaska Fire Service, Division of Forestry, US Forest Service	BLM, DOF FireWise Program	2019-2024	B/C: Sustained mitigation outreach program has minimal cost and will help build and support area-wide capacity. This type of activity enables the public to prepare for, respond to, and recover from disasters. TF: This low-cost activity can be combined with recurring community meetings where hazard specific information can be presented in small increments. This activity is ongoing demonstrating its feasibility.
F 7C	Construct a new firebreak around the Fort Yukon community.	High	City Manager of Fort Yukon, GZGTG Executive Director Alaska Fire Service, Division of Forestry, US Forest Service	BLM, DOF FireWise Program	2019-2024	B/C: Fort Yukon is surrounded by three rivers, but there is nothing to protect the community from a wild fire on the back side. TF: In 2008, the U.S. Fish & Wildlife gave Fort Yukon a grant to thin and clear trees. This activity was successfully implemented by the community.

This section describes a formal plan maintenance process to ensure that this HMP remains an active and applicable document. It includes an explanation of how the GZGTG's Planning Team intends to organize their efforts to ensure that improvements and revisions to the HMP occur in a well-managed, efficient, and coordinated manner.

The following three process steps are addressed in detail here:

1. Monitoring, evaluating, and updating the HMP;
2. Implementation through existing planning mechanisms; and
3. Continued public involvement.

8.1 MONITORING, EVALUATING, AND UPDATING THE HMP

The requirements for monitoring, evaluating, and updating the HMP, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Plan Maintenance Process - Monitoring, Evaluating, and Updating the Plan

Monitoring, Evaluating and Updating the Plan

Requirement §201.7(c)(4)(i and ii): [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.

Element

- Does the new plan describe the method and schedule of monitoring the plan, including the responsible department?
- Does the new plan describe a system for monitoring implementation of mitigation measures and project closeouts?
- Does the new plan describe the method and schedule for updating the plan within the five-year cycle?

Source: FEMA, 2015.

DMA 2000 Requirements: Plan Maintenance Process – Reviewing Progress on Achieving Goals and Projects

Requirement §201.7(c)(4)(v): [The plan maintenance process shall include a] system for reviewing progress on achieving goals as well as activities and projects identified in the mitigation strategy.

Element

- Does the new plan explain how progress will be reviewed?

Source: FEMA, 2015.

The HMP was prepared as a collaborative effort among the Planning Team and LeMay Engineering & Consulting, Inc. To maintain momentum, GZGTG will use the Planning Team to monitor, evaluate, and update the HMP. Each authority identified in Table 21 will be responsible for implementing the Mitigation Action Plan. The Executive Director will serve as the primary point of contact and will coordinate local efforts to monitor, evaluate, and revise the HMP.

Each member of the Planning Team will conduct an annual review during the anniversary week of the plan's official FEMA approval date to monitor the progress in implementing the HMP, particularly the MAP. As shown in Appendix E, the Annual Review Worksheet will provide the basis for possible changes in the HMP MAP by refocusing on new or more threatening hazards, adjusting to changes to or increases in resource allocations, and engaging additional support for the HMP implementation. The Planning Team Leader will initiate the annual review two months prior to the scheduled planning meeting date to ensure that all data is assembled for discussion with the Planning Team. The findings from these reviews will be presented at the annual Planning Team Meeting. Each review, as shown on the Annual Review Worksheet, will include an evaluation of the following:

- Participation of authorities and others in the HMP implementation;
- Notable changes in the risk of natural or human-caused hazards;
- Impacts of land development activities and related programs on hazard mitigation;
- Progress made with the MAP (identify problems and suggest improvements as necessary and provide progress reports on implemented mitigation actions); and
- The adequacy of local resources for implementation of the HMP.

A system of reviewing the progress on achieving the mitigation goals and implementing the MAP activities and projects will also be accomplished during the annual review process. During each annual review, each authority administering a mitigation project will submit a Progress Report to the Planning Team. As shown in Appendix E, the report will include the current status of the mitigation project, including any changes made to the project, the identification of implementation problems and appropriate strategies to overcome them, and whether or not the project has helped achieve the appropriate goals identified in the HMP.

In addition to the annual review, the Planning Team will update the HMP every five years. To ensure that this update occurs, in the fourth year following adoption of the HMP, the Planning Team will undertake the following activities:

- Request grant assistance from DHS&EM to update the HMP (this can take up to one year to obtain and one year to update the plan);
- Thoroughly analyze and update the risk of natural hazards;
- Provide a new annual review (as noted above), plus a review of the three previous annual reviews;
- Provide a detailed review and revision of the mitigation strategy;
- Prepare an updated MAP for the GZGTG;
- Prepare an updated Draft HMP;
- Submit an updated HMP to the DHS&EM and FEMA for approval;
- Submit the FEMA-approved plan for adoption by the GZGTG; and
- Return adoption resolution to DHS&EM and FEMA to receive formal approval.

8.2 IMPLEMENTATION THROUGH EXISTING PLANNING MECHANISMS

The requirements for implementation through existing planning mechanisms, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Plan Maintenance Process - Incorporation into Existing Planning Mechanisms

Incorporation into Existing Planning Mechanisms

Requirements §201.7(c)(1)(iv) and §201.7(c)(4)(iii): [The plan shall include a] process by which the Tribal Government integrates the HMP into other ongoing tribal planning efforts as well as other FEMA programs and initiatives as well as master plans or capital improvement plans when appropriate.

Element

- Does the new plan identify other tribal planning mechanisms available for incorporating the mitigation requirements of the mitigation plan?
- Does the new plan include a process by which the tribal government will incorporate the mitigation strategy and other information contained in the plan (e.g., risk assessment) into other planning mechanisms, when appropriate?

Source: FEMA, 2015.

After the adoption of the HMP, each Planning Team Member will ensure that the HMP, in particular each Mitigation Action Project, is incorporated into existing planning mechanisms. Each member of the Planning Team will achieve this incorporation by undertaking the following activities.

- Conduct a review of the community-specific regulatory tools to assess the integration of the mitigation strategy. These regulatory tools are identified in the capability assessment section (see Section 3.4).
- Work with pertinent community departments to increase awareness of the HMP and provide assistance in integrating the mitigation strategy (including the MAP) into relevant planning mechanisms. Implementation of these requirements may require updating or amending specific planning mechanisms.
- The GZGTG Executive Director will be responsible for providing a copy of this HMP to contractors focused on developing new or updating existing Tribal Plans and ensuring that this HMP is incorporated into plans as applicable.

GZGTG will involve the public to continually reshape and update this HMP. A paper copy of this HMP will be available at the Tribal Office. This HMP will also be stored on the State DCCED/DCRA's plans website for public reference. Planners are encouraged to integrate components of this HMP into their own plans.

8.3 CONTINUED PUBLIC INVOLVEMENT

The requirements for continued public involvement, as stipulated in the DMA 2000 and its implementing regulations, are described below.

DMA 2000 Requirements: Plan Maintenance Process - Continued Public Involvement

Continued Public Involvement

Requirement §201.7(c)(4)(iv): [The plan maintenance process shall include a] discussion on how the Tribal Government will continue public participation in the plan maintenance process.

Element

- Does the new plan explain how continued public participation will be obtained?

Source: FEMA, 2015.

The GZGTG is dedicated to involving the public directly in the continual reshaping and updating of the HMP. A paper copy of the HMP and any proposed changes will be available at the Tribal

Office. An address and phone number of the Planning Team Leader to whom people can direct their comments or concerns will also be available at the Tribal Office.

The Planning Team will continue to raise community awareness about the HMP and the hazards that affect Fort Yukon. Each year in October, GZGTG has an annual meeting that is an all-day event that includes information booths that the community visits regarding various programs. The City and GZGTG will jointly sponsor a booth as their main community outreach activity regarding the HMP. Community surveys will be provided at the booth to remind the community about the potential hazards that could affect Fort Yukon as well as to provide an opportunity for the community to comment on their concerns. See Appendix E for a public opinion survey. Any public comments received regarding the HMP will be collected by the Planning Team Leader, included in the annual report, and considered during future HMP updates.

8.4 RESOURCES

Federal Resources

The Federal government requires Tribal and Local governments to have a HMP in place to be eligible for mitigation funding opportunities through FEMA such as the UHMA Programs and the HMGP. The Mitigation Technical Assistance Programs available to Tribal and Local governments are also a valuable resource. FEMA may also provide temporary housing assistance through rental assistance, mobile homes, furniture rental, mortgage assistance, and emergency home repairs. The Disaster Preparedness Improvement Grant also promotes educational opportunities with respect to hazard awareness and mitigation.

- FEMA, through its Emergency Management Institute, offers training in many aspects of emergency management, including hazard mitigation. FEMA has also developed a large number of documents that address implementing hazard mitigation at the local level. Key resource documents are available from the FEMA Publication Warehouse (1-800-480-2520) and are briefly described here:
  - How-to Guides. FEMA has developed a series of how-to guides to assist States, communities, and Tribes in enhancing their hazard mitigation planning capabilities. The first four guides describe the four major phases of hazard mitigation planning. The last five how-to guides address special topics that arise in hazard mitigation planning such as conducting cost-benefit analysis and preparing multi-jurisdictional plans. The use of worksheets, checklists, and tables make these guides a practical source of guidance to address all stages of the hazard mitigation planning process. They also include special tips on meeting DMA 2000 requirements.
  - Post-Disaster Hazard Mitigation Planning Guidance for State and Local Governments. FEMA DAP-12, September 1990. This handbook explains the basic concepts of hazard mitigation and shows State, Tribal, and Local governments how they can develop and achieve mitigation goals within the context of FEMA's post-disaster hazard mitigation planning requirements. The handbook focuses on approaches to mitigation, with an emphasis on multi-objective planning.
  - Mitigation Resources for Success compact disc (CD). FEMA 372, September 2001. This CD contains a wealth of information about mitigation and is useful for State, Tribal, and Local government planners and other stakeholders in the mitigation process. It provides mitigation case studies, success stories, information about Federal

mitigation programs, suggestions for mitigation measures to homes and businesses, appropriate relevant mitigation publications, and contact information.

- A Guide to Federal Aid in Disasters. FEMA 262, April 1995. When disasters exceed the capabilities of State, Tribal, and Local governments, the President's disaster assistance programs (administered by FEMA) is the primary source of Federal assistance. This handbook discusses the procedures and process for obtaining this assistance, and provides a brief overview of each program.
- The Emergency Management Guide for Business and Industry. FEMA 141, October 1993. This guide provides a step-by-step approach to emergency management planning, response, and recovery. It also details a planning process that businesses can follow to better prepare for a wide range of hazards and emergency events. This effort can enhance a business's ability to recover from financial losses, loss of market share, damages to equipment, and product or business interruptions. This guide could be of great assistance to a community's industries and businesses located in hazard prone areas.
- The FEMA Hazard Mitigation Assistance Guidance and Addendum, February 5, 2015. The guidance introduces the five HMA grant programs, funding opportunities, award information, eligibility, application and submission information, application review process, administering the grant, contracts, additional program guidance, additional project guidance, and contains information and resource appendices (FEMA, 2015).

- Department of Agriculture (USDA). Assistance provided includes: Emergency Conservation Program, Non-Insured Assistance, Emergency Watershed Protection, Rural Housing Service, Rural Utilities Service, and Rural Business and Cooperative Service.
- Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy, Weatherization Assistance Program. This program minimizes the adverse effects of high energy costs on low-income, elderly, and handicapped citizens through client education activities and weatherization services such as an all-around safety check of major energy systems, including heating system modifications and insulation checks.
- Department of Health and Human Services, Administration of Children & Families, Administration for Native Americans (ANA). The ANA awards funds through grants to American Indians, Native Americans, Native Alaskans, Native Hawaiians, and Pacific Islanders. These grants are awarded to individual organizations that successfully apply for discretionary funds. ANA publishes in the Federal Register an announcement of funds available, the primary areas of focus, review criteria, and the method of application.
- Department of Housing and Urban Development (HUD), Office of Homes and Communities, Section 108 Loan Guarantee Programs. This program provides loan guarantees as security for Federal loans for acquisition, rehabilitation, relocation, clearance, site preparation, special economic development activities, and construction of certain public facilities and housing.
- Department of Housing and Urban Development, Community Development Block Grants (HUD/CDBG). Provides grant assistance and technical assistance to aid communities in planning activities that address issues detrimental to the health and safety of local residents, such as housing rehabilitation, public services, community facilities, and

infrastructure improvements that would primarily benefit low-and moderate-income persons.

- Department of Labor (DOL), Employment and Training Administration, Disaster Unemployment Assistance. Provides weekly unemployment subsistence grants for those who become unemployed because of a major disaster or emergency. Applicants must have exhausted all benefits for which they would normally be eligible.
- Federal Financial Institutions. Member banks of Federal Deposit Insurance Corporation, Financial Reporting Standards or Federal Home Loan Bank Board may be permitted to waive early withdrawal penalties for Certificates of Deposit and Individual Retirement Accounts.
- Internal Revenue Service (IRS), Tax Relief. Provides extensions to current year's tax return, allows deductions for disaster losses, and allows amendment of previous tax returns to reflect loss back to three years.
- U.S. Small Business Administration (SBA). May provide low-interest disaster loans to individuals and businesses that have suffered a loss due to a disaster. Requests for SBA loan assistance should be submitted to DHS&EM.
- USACE Alaska District's Civil Works Branch studies potential water resource projects in Alaska. These studies analyze and solve water resource issues of concern to the local communities. These issues may involve navigational improvements, flood control or ecosystem restoration. The agency also tracks flood hazard data for over 300 Alaskan communities on floodplains or the sea coast. These data help local communities assess the risk of floods to their communities and prepare for potential future floods. The USACE is a member and co-chair of the Alaska Climate Change Sub-Cabinet.

State Resources

- DHS&EM is responsible for improving hazard mitigation technical assistance for Tribal and Local governments for the State of Alaska. Providing hazard mitigation training, current hazard information, and communication facilitation with other agencies will enhance local hazard mitigation efforts. DHS&EM administers FEMA mitigation grants to mitigate future disaster damages such as those that may affect infrastructure including the elevation, relocation, or acquisition of hazard-prone properties. DHS&EM also provides mitigation funding resources for mitigation planning.
- Division of Senior Services (DSS): Provides special outreach services for seniors, including food, shelter, and clothing.
- Division of Insurance (DOI): Provides assistance in obtaining copies of policies and provides information regarding filing claims.
- Department of Military and Veterans Affairs (DMVA): Provides damage appraisals and settlements for VA-insured homes, and assists with filing of survivor benefits.
- The Community Health and Emergency Medical Services (CHEMS) is a section within the Division of Public Health within the Department of Health and Social Services (DHSS). DHSS is charged with promoting and protecting the public health and one of CHEMS' responsibilities is developing, implementing, and maintaining a statewide comprehensive emergency medical services system. The department's statutory mandate (Alaska Statute 18.08.010) requires it to:

  - Coordinate public and private agencies engaged in the planning and delivery of emergency medical services, including trauma care, to plan an emergency medical services system;
  - Assist public and private agencies to deliver emergency medical services, including trauma care, through the award of grants in aid;
  - Conduct, encourage, and approve programs of education and training designed to upgrade the knowledge and skills of health personnel involved in emergency medical services, including trauma care; and
  - Establish and maintain a process under which hospitals and clinics can represent themselves to be trauma centers because they voluntarily meet criteria adopted by the department which are based on an applicable national evaluation system.
- DCRA within the DCCED. DCRA administers the HUD/CDBG, FMA Program, and the Climate Change Sub-Cabinet's Interagency Working Group's program funds and administers various flood and erosion mitigation projects, including the elevation, relocation, or acquisition of flood-prone homes and businesses throughout the State. This department also administers programs for State "distressed" and "targeted" communities.
- Division of Environmental Conservation (DEC). The DEC's primary roles and responsibilities concerning hazards mitigation are ensuring safe food and safe water, and pollution prevention and pollution response. DEC ensures water treatment plants, landfills, and bulk fuel storage tank farms are safely constructed and operated in communities. Agency and facility response plans include hazards identification and pollution prevention and response strategies.
- Department of Transportation and Public Facilities (DOT/PF) personnel provide technical assistance to the various emergency management programs, to include mitigation. This assistance is addressed in the DHS&EM-DOT/PF Memorandum of Agreement and includes, but, is not limited to: environmental reviews, archaeological surveys, and historic preservation reviews.

  In addition, DOT/PF and DHS&EM coordinate buy-out projects to ensure that there are no potential right-of-way conflicts with future use of land for bridge and highway projects, and collaborate on earthquake mitigation.

  Additionally, DOT/PF provides safe, efficient, economical, and effective operation of the State's highways, harbors, and airports. DOT/PF uses it's Planning, Design and Engineering, Maintenance and Operations, and Intelligent Transportation Systems resources to identify the hazard, plan and initiate mitigation activities to meet the transportation needs of Alaskans and make Alaska a better place to live and work. DOT/PF budgets for the temporary replacement bridges and materials necessary to make the multi-modal transportation system operational following a natural disaster.
- The Department of Natural Resources (DNR) administers various projects designed to reduce stream bank erosion, reduce localized flooding, improve drainage, and improve discharge water quality through the stormwater grant program funds. Within DNR, the Division of Geological and Geophysical Survey (DGGS) is responsible for the use and development of Alaska's mineral, land, and water resources, and collaboration on earthquake mitigation.

- DNR's DGGS collects and distributes information about the State's geologic resources and hazards. Their geologists and support staff are leaders in researching Alaska's geology and implementing technological tools to most efficiently collect, interpret, publish, archive, and disseminate that information to the public
- The DNR's Division of Forestry (DOF) participates in a statewide wildfire control program in cooperation with the forest industry, rural fire departments, and other agencies. Prescribed burning may increase the risks of fire hazards; however, prescribed burning reduces the availability of fire fuels, and therefore, the potential for future, more serious fires.
- DOF also manages various wildland fire programs, activities, and grant programs such as the FireWise Program, the Community Forestry Program (CFP) and the Volunteer Fire Assistance and Rural Fire Assistance Grant (VFA-RFAG) programs.

Other Funding Sources and Resources

The following provide focused access to valuable planning resources for communities interested in sustainable development activities.

- FEMA, http://www.fema.gov - includes links to information, resources, and grants that communities can use in planning and implementation of sustainable measures.
- American Planning Association (APA), http://www.planning.org - a non-profit professional association that serves as a resource for planners, elected officials, and citizens concerned with planning and growth initiatives.
- Institute for Business and Home Safety (IBHS), http://ibhs.org - an initiative of the insurance industry to reduce deaths, injuries, property damage, economic losses, and human suffering caused by natural disasters.
- American Red Cross (ARC). Provides for the critical needs of individuals such as food, clothing, shelter, and supplemental medical needs. Provides recovery needs such as furniture, home repair, home purchasing, essential tools, and some bill payment may be provided.
- Crisis Counseling Program. Provides grants to State and Borough Mental Health Departments, which in turn provide training for screening, diagnosing, and counseling techniques. Also provides funds for counseling, outreach, and consultation for those affected by disaster.

ACRC (Alaska Climate Research Center). *2018: Temperature Change in Alaska*. Available: http://climate.gi.alaska.edu/ClimTrends/Change/TempChange.html (January 2019).

AICC (Alaska Interagency Coordination Center). 2018. Available: http://fire.ak.blm.gov/aicc.php. (January 2019).

ADOL (Alaska Department of Labor and Workforce Development, Research, and Analysis Section). Available: live.laborstats.alaska.gov/alari/details.cfm?yr=2016&dst=01&dst=03&dst=04&dst=06&dst=09&dst=07&r=3&b=29&p=104. (January 2018).

ANTHC (Alaska Native Tribal Health Consortium). *City of Fort Yukon Sanitation Plan*.

BKP. 1988. Baker, V.R.; Kochel, R.C.; Patton, P.C. *Flood Geomorphology*, Published by Wiley-Interscience, April 1988. Available: http://books.google.com/books?id=snLfvo2w-ngC&pg=PA176&lpg=PA176&dq=geomorphology+debris+deposition+during+floods&source=bl&ots=cixFlUnKLb&sig=3gLzWfoyciL3vcYfCOIUcky-ErM&hl=en&ei=E-JxSs-8CYzatAOL2tTMDA&sa=X&oi=book_result&ct=result&resnum=5. (January 2010).

CCSP (U.S. Climate Change Science Program). 2008. *Weather and Climate Extremes in a Changing Climate – Regions of Focus – North America, Hawaii, Caribbean, and U.S. Pacific Islands. A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research*. Vol. 3.3T.R. Karl, G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray, Eds. Department of Commerce, NOAA's National Climatic Data Center, 164 pp.

Chapin, F.S., III, S.F. Trainor, P. Cochran, H. Huntington, C. Markon, M. McCammon, A.D. McGuire, and M. Serreze. 2014. Ch. 22: *Alaska. Climate Change Impacts in the U.S.: The Third National Climate Assessment*, J. M. Melillo, Terese.

DCCED/DCRA (Department of Community and Commerce and Economic Development [DCCED]/Division of Community and Regional Affairs [DCRA]). 2019. Community Profile: https://www.commerce.alaska.gov/dcra/DCRAExternal/community. (January 2019).

DCRA. 2010a. Photo Credit, Fort Yukon "*Aerial View*"©. Available: http://dcra.commerce.alaska.gov/PHOTOS/FortYukon/FORT_YUK22.JPG. (January 2010).

DGGS (Division of Geological and Geophysical Survey [DGGS]). 2009. Available: http://www.dggs.dnr.state.ak.us/index.php?menu_link=publications&link=neotectonic_map&sub2_link=statewide (January 2010)

DHS&EM (Division of Homeland Security and Emergency Management), 2018, Alaska State Hazard Mitigation Plan, 2018. Accessed January 2019.

DHS&EM. 2018. *Disaster Cost Index, June 2018*. (January 2019).

DOF (Alaska Division of Forestry). 2009. Role of Fire in the Alaskan Environment. http://forestry.alaska.gov/fire/fireplans.htm (January 2010)

FEMA-a, (Federal Emergency Management Agency), "Local Mitigation Plan Review Guide – September 30, 2011." Available: https://www.fema.gov/media-library-data/20130726-1809-25045-7498/plan_review_guide_final_9_30_11.pdf (January 2019).

FEMA-b, "Mitigation Planning How-To Guides, 2013." Available: https://www.fema.gov/media-library/resources-documents/collections/6 (January 2019).

FEMA-c, "Local Mitigation Planning Handbook." Updated January 1, 2015. Available: https://www.fema.gov/media-library/assets/documents/31598 (January 2019).

FEMA-d, "Local Mitigation Assistance Guidance and Addendum, February 27, 2015. Available: https://www.fema.gov/media-library/assets/documents/103279 (January 2019).

FEMA-e, "Mitigation Planning Fact Sheet, February 27, 2015. Available: https://www.fema.gov/media-library/assets/documents/5756 (January 2019).

FEMA-f, "Hazard Mitigation Assistance Cost Share Guide, May 2016. Available: https://www.fema.gov/media-library-data/1463766664964-4e6dd22652cb7c8a6162904f3b1b2022/FinalHMACostShareGuide508.pdf (January 2019).

FEMA-g, "Flood Frequently Asked Questions." Available: https://www.floodsmart.gov/faqs (January 2019).

FEMA-h, "Flood Facts." Available: https://www.floodsmart.gov/why/why-buy-flood-insurance (January 2019).

FEMA-i, "Community Status Book Report." Available: http://www.fema.gov/cis/AK.html (January 2019).

FEMA-j, "Flood Map Service Center Portal." Available: msc-theme-template-v1. (January 2019).

FEMA-k, "Tribal Plan Review Guide." Available: https://www.fema.gov/media-library/assets/documents/18355 (January 2019).

FEMA, 2010. *Flood Insurance Study for the City of Fort Yukon, Alaska, Yukon-Koyukuk Census Area,* February 3, 2010.

Fort Yukon, 2017a. City of Fort Yukon Hazard Mitigation Plan. (October 2017).

Fort Yukon, 2017b. Fort Yukon Solid Waste Management and Landfill Operations Plan.

Fort Yukon, 2016. Fort Yukon Community Plan. Available: https://www.commerce.alaska.gov/dcra/DCRARepoExt/RepoPubs/Plans/Fort%20Yukon%20Community%20Plan%202016-2021.pdf. (April 2017).

Fort Yukon, 1996. *City of Fort Yukon, 1996 Comprehensive Plan. Available: http://www.commerce.state.ak.us/dca/plans/FortYukonPlan.pdf.* (January 2010).

GSA. 1998. Avé Lallemant, H.G.; Gottschalk, R.R.; Sisson, V.B.; Oldow, J.S. (1998) Structural analysis of the Kobuk fault zone, north-central Alaska. Special Paper 324: Architecture of the Central Brooks Range Fold and Thrust Belt, Arctic Alaska: Vol. 324, No. 0 pp. 261–268. http://books.google.com/books?id=B11CjDRbh90C&pg=PA261&lpg=PA261&dq=Structural+analysis+of+the+Kobuk+fault+zone,+north-central+Alaska.+Special+Paper+324&source=bl&ots=iOc9lQ2Q1r&sig=iO7HsgxE7onDHLt-

oSCRG8sXIL8&hl=en&ei=UDVmStqNIYSQsgPCh9nqDg&sa=X&oi=book_result&ct=result&resnum=1. (January 2010).

GZGTG (Gwichyaa Zhee Gwich'in Tribal Government). 2004. *Native Village of Fort Yukon BIA Long-Range Transportation Plan*.

GZGTG. 2006. *Beyond Vision: GZGTG Community Comprehensive Plan*, prepared by Katasse Financial Management in collaboration with Ikayutit, 2006.

Haeussler, P. USGS (United States Geologic Survey). 2009. E-mail correspondence concerning 2002 Shake Maps. Available: http://eqint.cr.usgs.gov/eqprob/2002/. (January 2010).

Katasse Financial Management in collaboration with Ikayutit. 2016. *Beyond Vision: Gwichyaa Zhee Gwich'in Tribal Government Community Comprehensive Plan*.

Lingaas, J.W., Warning Coordination Meteorologist, Northern Area, NWS/NOAA. (January 2010).

MMI. 2006. *Modified Mercalli Intensity Scale.* Michigan Technical University. Available: http://www.geo.mtu.edu/UPSeis/Mercalli.html. (January 2010).

NOAA. 2001. *Winter Storms: The Deceptive Killers: A Preparedness Guide*. National Weather Service. Available: http://www.nws.noaa.gov/om/winterstorm/winterstorms.pdf. (January 2010).

NOAA. 2006a. *National Weather Service Definitions*. Available: http://www.weather.gov/glossary/index.php?letter=F. (January 2010).

NWS. (National Weather Service (NWS), Climate Search Results 2010. Available: http://www.arh.noaa.gov/clim/climDataSearch.php?stnid=CTEA2 (February 2010).

NWS. 2009 National Weather Service. High Water Marks, Fort Yukon, Available: http://aprfc.arh.noaa.gov/gages/HWM/HWMsite_fyu.html (January 2010)

Shulski, M., and G. Wendler. 2007. *The Climate of Alaska*. University of Alaska Press. 208 pp.

Stewart, B. C., K. E. Kunkel, L.E. Stevens, L. Sun, and J. E. Walsh. 2013. *Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Part 7. Climate of Alaska*. NOAA Technical Report NESDIS 142-7. 60 pp.

USACE. (U.S. Army Corps of Engineers). 2009. *Civil Works Branch, Alaska Floodplain Management Flood Hazard Data, Fort Yukon, Alaska.* Available: http://www.poa.usace.army.mil/en/cw/fld_haz/Fort Yukon.htm (January 2010).

USACE. 2009a. *Alaska Baseline Erosion Assessment, Study Findings and Technical Report, March 2009,* Available: http://www.poa.usace.army.mil/en/cw/planning_current%20projects%20info/Alaska%20Baseline%20Erosion%20Assessment%20(BEA)%20Main%20Report.pdf (January 2010).

USACE. 2009b. *Alaska Baseline Erosion Assessment, Erosion Information Paper – Fort Yukon, Alaska January 21, 2008,* Available: Alaska.Erosion.POA@poa02.usace.army.mil (January 2010).

USGS (United States Geologic Survey). 2007. *NEIC Historic Earthquake Search Results*. Available: http://neic.usgs.gov/neis/epic/epic_circ.html (January 2010).

USGS. 2009. National Earthquake Information Center, Probability Mapping: Available: http://eqint.cr.usgs.gov/eqprob/2002/. (January 2010).

U.S. Global Change Research Program. "Global Climate Change Impacts in the United States" report. http://www.globalchange.gov/usimpacts

Appendix A: Public Involvement

This page was intentionally left blank.

Gwichyaa Zhee Gwich'in Tribal Government
(Formerly known as the Native Village of Fort Yukon, IRA)
P.O. Box 126
Fort Yukon, AK 99740
Phone: (907) 662-2581
Fax: (907) 662-2222

January 28, 2019

Brent Nichols, CFM
State of Alaska
DMVA DHS&EM
P.O. Box 5750
Joint Base Elmendorf-Richardson, Alaska 99505-5750

Mr. Nichols:

This letter serves as the Gwichyaa Zhee Gwich'in Tribal Government's Letter of Commitment to support DMVA DHS&EM and LeMay Engineering & Consulting, Inc. in their Federal Emergency Management Agency (FEMA) Pre-Disaster Mitigation (PDM) planning grant to develop the Tribal hazard mitigation plan for the Gwichyaa Zhee Gwich'in Tribal Government.

The end goal of this grant is a State- and FEMA- approved Tribal Hazard Mitigation Plan that the Gwichyaa Zhee Gwich'in Tribal Government will adopt.

Sincerely,

Dale Hardy
GZGTG, Executive Director

1-28-19

Cc: File

Hazard Mitigation Plan for the Tribal Village of Fort Yukon, Alaska

Newsletter #1: January 14, 2019

The State of Alaska, Department of Military and Veterans Affairs, Division of Homeland Security and Emergency Management (DHS&EM) was awarded a Pre-Disaster Mitigation Program grant from the Federal Emergency Management Agency (FEMA) to develop a hazard mitigation plan (HMP) for the Native Village of Fort Yukon. This plan will assist the Tribal Council as a valuable resource tool in making decisions. Additionally, communities must have a State- and FEMA-approved and community-adopted HMP to receive FEMA pre- and post- disaster grants.

LeMay Engineering & Consulting, Inc. was contracted to assist the Native Village of Fort Yukon with developing a 2019 HMP. The HMP will identify all applicable natural hazards. The HMP will identify the people and facilities potentially at risk and ways to mitigate damage from future hazard impacts.

Join the planning team and offer your advice: Any interested community member may join the planning team. To join, call or send Jennifer LeMay an email at jlemay@lemayengineering.com. The purpose of this newsletter is to introduce this project and encourage public involvement during this process. The goal is to receive comments, identify key issues or concerns, and improve mitigation ideas.

Attend the January 28, 2019, Tribal Council/Community Introductory Meeting at 5:30 pm at the Tribal Office: The Hazard Mitigation Plan will be on the agenda, and Jennifer LeMay will summarize the hazard mitigation plan process. You're invited to provide input to the plan. Specifically, we'll be discussing which of the following hazards are realistic for Fort Yukon: earthquake, flood/erosion, ground failure, severe weather, wildland fire, and climate change? Also, what facilities are critical to your community?

For more information, contact:
Dale Hardy, Tribal Administrator (907) 662-2581
Jennifer LeMay, PE, PMP, Lead Planner, (907) 350-6061
Brent Nichols, DMVA, DHS&EM Project Manager, (907) 428-7085

Fort Yukon Public Meeting for 2019 Hazard Mitigation Plan Update

January 28, 2019

5:30 pm at the Tribal Office

Name	Organization Represented or Fort Yukon Resident	Contact Information (phone and email)
ANDREW FIRMIN	CFY	662-5176
JENNIFOR LEMAY	LEMAY ENGINEERING + CONSULTING	350-6061
Diana Peter	Tribal Member	9076625411
Brady Spann	FYPD	907-662-5505
Roger Spann	FYPD	662-5505
GERALD ALEXANDER	GGTG FYCM	662-5608
Dale Hardy	GZGTG	
[illegible]	GZGTG	662-5129
Shanna Peter-Horace	GZGTG	662-5053
Dena Drake	GZGTG	444-6690
Frannie Haines	BCC	6622933
Dacho Alexander	GZGTG	712-7185
Michael Peter	Tribal Council	662-5196
Paul Shemfelt	Tribal Member	662-5134

Name	Organization	Contact Information (phone and email)
via phone Michelle Peters	GIZGTG	
via phone Janet Cadyow	GIZGTG	378-1383

Gwichyaa Zhee Gwich'in Tribal Government
(Formerly known as the Native Village of Fort Yukon, IRA)
P.O. Box 126
Fort Yukon, AK 99740
Phone: (907) 662-2581 Fax: (907) 662-2222

Gwichyaa Zhee Gwich'in Regular Tribal Council Meeting
January 28, 2019 at 5:30 p.m.
Chief Ezias Loola Tribal Hall
Draft Agenda

I. OPENING PRAYER
II. CALL TO ORDER
III. ROLL CALL/ESTABLISH A QUORUM
IV. APPROVAL OF AGENDA
V. APPROVAL OF MEETING MINUTES
December 3, 2018 Regular Tribal Council Meeting
VI. TRIBAL MEMBER COMMENTS
VII. EXECUTIVE DIRECTOR AND STAFF REPORTS
VIII. COUNCIL MEMBER TRAVEL REPORTS
IX. OLD BUSINESS
X. NEW BUSINESS
a. 9 Structure FEMA Grant Meeting-Lemay Engineering
b. Adopt Budget FY19
XI. RESOLUTIONS
XII. TRIBAL ENROLLMENT
XIII. EXECUTIVE SESSION
XIV. ADJOURNMENT

ALL TRIBAL MEMBERS ARE ENCOURAGED TO ATTEND

Jennifer L. LeMay, PE, PMP
Vice President
4272 Chelsea Way
Anchorage, AK 99504
(907) 350-6061
jlemay@lemayengineering.com

January 29, 2019

Brent A. Nichols, EMSII, CFM
State Hazard Mitigation Officer
Department of Military and Veterans Affairs (DMVA)
Division of Homeland Security and Emergency Management (DHS&EM)
P.O. Box 5750
JBER, AK 99505-5750

Subject: **Hazard Mitigation Planning Process Trip Report**
Gwichyaa Zhee Gwich'in Tribal Government (GZGTG) which was formerly known as The Native Village of Fort Yukon

On January 28, 2019, Jennifer L. LeMay, PE, PMP of LeMay Engineering & Consulting, Inc. traveled to Fort Yukon, Alaska. The purpose of this trip was to conduct an introductory meeting, gather hazard data, review with community leaders the applicable hazards for the area, review potential mitigation strategies, and identify the critical facilities within the community.

The GZGTG Executive Director, Dale Hardy, provided a commitment letter that the GZGTG will participate in the development of the 2019 Hazard Mitigation Plan and present it to the Tribal Council for adoption. The public comment period on the Draft Hazard Mitigation Plan will begin February 4, 2019. A public review meeting is scheduled at the Fort Yukon Tribal Hall on March 4, 2019, as an agenda item during the GZGTG Tribal Council Meeting to provide a summary of mitigation strategies and receive public comments on the Draft Hazard Mitigation Plan.

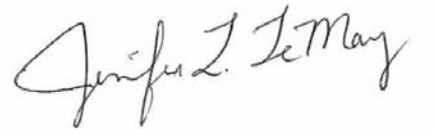
Two meetings occurred during the site visit. I met with Dale Hardy and Shirley Fields, GZGTG Realty & NR Director from 2:30 to 4:30 to discuss development of the plan.

I also attended the GZGTG Tribal Council Meeting to provide an overview of the hazard mitigation planning process. This meeting occurred from 5:30 to 8:00. Meeting attendees included:

Jennifer L. LeMay, PE, PMP	LeMay Engineering & Consulting, Inc.
Dale Hardy	GZGTG Executive Director
Nancy James	First Chief
Michael Peter	Second Chief
Dacho Alexander	GZGTG Tribal Council Member
Gerald Alexander	GZGTG Tribal Council Member
Charlotte Kelly-Spencer	GZGTG Tribal Council Member
Michelle Peter via phone	GZGTG
Janet Cadyaw via phone	GZGTG
Andrew Firmin	Fort Yukon City Manager
Diana Peter	Resident
Brody Spann	Resident
Roger Spann	Resident
Shanna Peter-Horace	GZGTG
Dena Drake	GZGTG
Frannie Hughes	GZ Corporation
Paul Sheufet	Resident

The meeting resulted in valuable information to develop the GZGTG Hazard Mitigation Plan.

If you have any questions, please do not hesitate to call me at (907) 350-6061.



1/29/19

Jennifer L. LeMay, PE, PMP/Date
LeMay Engineering & Consulting, Inc.

Hazard Mitigation Plan for the GZGTG (formerly known as the Native Village of Fort Yukon, Alaska)

Newsletter #2: February 4, 2019

The State of Alaska, Department of Military and Veterans Affairs, Division of Homeland Security and Emergency Management (DHS&EM) was awarded a grant from FEMA to develop the GZGTG hazard mitigation plan (HMP). This plan that is currently being developed will assist the Tribe as a valuable resource tool in making decisions. LeMay Engineering & Consulting, Inc. was contracted to assist with HMP development and attended the January 28 GZGTG meeting to discuss the HMP and discuss hazards affecting the area and mitigation strategies.

You're Invited to Comment on the Plan: The goal of Newsletter #2 is to announce the availability of the Draft HMP and invite you to provide comments, identify key issues or concerns, and improve mitigation ideas. This plan has been posted on GZGTG's website and is at the GZGTG and City offices for your review. Comments can be provided verbally to Jennifer LeMay at (907) 350-6061 or emailed to jlemay@lemayengineering.com.

Attend the March 4, 2019, Public Hearing as an Agenda Item of the GZGTC Meeting at 5:30 pm at the Tribal Hall:

One of the agenda items will be a summary of the HMP process by Jennifer LeMay. You're invited to provide input to the HMP. Specifically, we'll be discussing the proposed mitigation strategies.

For more information, contact:
Dale Hardy, Executive Director (907) 662-2581
Jennifer LeMay, PE, PMP, Lead Planner, (907) 350-6061
Brent Nichols, DMVA, DHS&EM Project Manager, (907) 428-7085

jlemay@lemayengineering.com

From: Shirley Fields <shirley.fields@fortyukon.org>
Sent: Wednesday, February 13, 2019 3:00 PM
To: jlemay@lemayengineering.com
Subject: Re: Newsletter #2 to Post

On 2/13/2019 5:55 PM, jlemay@lemayengineering.com wrote:

> Hi, Shirley,
>
> I'm sorry I did not get this to you on Tuesday as anticipated. I've been out of the office this week to help a friend who lost her husband unexpectedly. I will make this my first priority tomorrow.
>
> Jennifer

From: Shirley Fields <shirley.fields@fortyukon.org>
Sent: Thursday, February 7, 2019 12:33 PM
To: jlemay@lemayengineering.com
Subject: Re: Newsletter #2 to Post

On 2/4/2019 12:54 PM, jlemay@lemayengineering.com wrote:

> Hi, Shirley,
>
> Please post the attached flyer at the Tribal Office, City Office, and Post Office.
>
> Thanks,
>
> Jennifer LeMay, PE, PMP
> Vice President
> (907) 350-6061
>
> LeMay Engineering & Consulting, Inc.

Jennifer

Nancy James, GZGTG 1st Chief asked if you can make the flyer more friendly and a little shorter and larger. The first 2 paragraphs should be taken out she recommended. I did hang up the flyer all over town and will do so with the new version. She wanted this also inserted.

"March 4, GZGTG Housing Meeting @ 5:30p.m.

and

March 5, 2019 @ 5:30p.m."

Please email for me review. Thanks.

Shirley Fields

There is no attachment.

Hazard Mitigation Plan for the GZGTG (formerly known as the Native Village of Fort Yukon, Alaska)

Newsletter #3: February 15, 2019

Attend the March 4, 2019, Public Hearing as an Agenda Item of the GZGTC Housing Meeting at 5:30 pm at the Tribal Hall: One of the agenda items will be a summary of the proposed mitigation strategies for inclusion into the Draft Hazard Mitigation Plan. You are invited to provide comment, identify key issues or concerns, and improve mitigation ideas. This plan has been posted on GZGTG's website and is at the GZGTG and City offices for your review.

Attend the March 5, 2019, GZGTC Meeting at 5:30 pm at the Tribal Hall.

For more information, contact:
Dale Hardy, Executive Director (907) 662-2581
Jennifer LeMay, PE, PMP, Lead Planner, (907) 350-6061
Brent Nichols, DMVA, DHS&EM Project Manager, (907) 428-7085

GWICHYAA ZHEE GWICH'IN TRIBAL GOVERNMENT

PUBLIC MEETING

THERE WILL BE A PUBLIC MEETING
FEBRUARY 26, 2019 @ 5:30P.M.
DURING THE GZGTG REGULAR MEETING
TO DISCUSS THE DRAFT HAZARD MITIGATION PLAN FOR THE TRIBE.

EVERYONE IS INVITED.

(THIS PLAN IS POSTED ON THE GZGTG WEBSITE AND IS AT THE TRIBAL OFFICE FOR YOUR REVIEW)

FOR MORE INFORMATION PLEASE CONTACT:

DALE HARDY, GZGTG EXECUTIVE DIRECTOR (907) 662-2581
JENNIFER LEMAY, PE, PMP, LEAD PLANNER, (907) 350-6061

Fort Yukon Public Meeting for 2019 Hazard Mitigation Plan Update

February 26, 2019

5:30 pm at the Tribal Office

Name	Organization Represented or Fort Yukon Resident	Contact Information (phone and email)
Charlotte Kelly Spencer	Tribal Council	662-5120
[illegible]	GZGTG Councilwoman	446-7250
Dale Hardy	GZGTG	907-662-2581
Shirley Fields	GZGTG	907-662-2581
[illegible]	IGAP	stanjonas232@gmail.com
Mike Peter	Council	michael.peter@fortyukon.org
[illegible]		Gwichyaa Zhee
Robert Peter	member	[illegible]
Ron Englishoe	member	446-7155
Julia Mahen	member	
Michael	member	
Pat Stanley		stanley.pat@gmail.com
Lacy		
Mason		

JENNIFER LEMAY — LEMAY ENGINEERING + CONSULTING, INC. — jlemay@lemayengineering.com

NANCY JAMES — FIRST CHIEF

GZGTG Hazard Mitigation Plan Summary

Prepared by LeMay Engineering & Consulting, Inc. for the Community of Fort Yukon

GZGTG Multi-Hazard Mitigation Plan (HMP) Development

- The State of Alaska, Department of Military and Veterans Affairs, Division of Homeland Security and Emergency Management (DHS&EM) was awarded a Pre-Disaster Mitigation Program grant from FEMA to assist the GZGTG in developing a HMP.
- LeMay Engineering & Consulting, Inc. was contracted to assist the GZGTG with developing the HMP in 2018. Work started in December.
- This plan is a new HMP and is required by FEMA to obtain mitigation project grants within a community.
- FEMA requires HMPs to be updated every 5 years.

What is a Hazard Mitigation Plan (HMP)?

HMPs are community plans which include:

- 1. Profiles of natural hazards that affect a community.
- 2. An assessment of the community's vulnerability to hazards.
- 3. Mitigation actions to reduce the community's vulnerability to hazards.

Natural Hazard Profiles

Hazard profiles detail the:

- Nature of hazard;
- History of hazard's impacts on community;
- Location (proximity to community);
- Extent (breadth, magnitude, and severity);
- Impact on community; and
- Recurrence probability of future events.

Natural Hazards affecting Fort Yukon and GZGTG Residents

The GZGTG HMP identifies and profiles the following hazards:

- Cryosphere;
- Flood/Erosion;
- Severe Weather;
- Wildland Fire; and
- Earthquake.

Mitigation Actions

A mitigation action is a planned activity that will reduce the community's vulnerability to natural hazards. Mitigation actions are broadly categorized as:

- Prevention;
- Property Protection;
- Public Education and Awareness;
- Natural Resource Protection;
- Emergency Services; and
- Structural Projects.

Cryosphere– Hazard Profile Overview

- Discontinuous permafrost is impacting Fort Yukon.

Goal

Goal 1. Reduce potential cryosphere vulnerability, damage, and loss.

Mitigation Actions
1. Identify and map existing permafrost areas to assist in new critical facility siting and existing facility relocation siting.
2. Promote permafrost-sensitive construction practices in permafrost areas.

Flood/Erosion – Hazard Profile Overview

- The Tribe does not participate in the NFIP.
- Riverine erosion affecting Fort Yukon includes:
  - High water flow;
  - Ice flows;
  - Wind; and
  - Surface Runoff.
  - Erosion occurs at the lower end of the community below the dock and barge landing at a rate of 50 x 500 feet per year.
- The Porcupine and Yukon Rivers flood.
  - Rapid snowmelt;
  - Ice jams; and
  - Heavy precipitation.

Flood/Erosion – Goal

- **Goal 1. Reduce potential riverine flood and erosion vulnerability, damage, and loss.**

Mitigation Action Plan

Mitigation Actions
1. Maintain and update erosion hazard locations, identify critical facilities potentially impacted, and develop mitigation initiatives such as bank stabilization or facility relocation to prevent or reduce the threat.
2. Raise 1,600 feet of "base road" roadbed to enable the road to act as a levee to protect flood-threated homes.
3. Elevate road adjacent to the slough to enable the road to act as a levee to protect flood-threatened homes. Also, build back road to clinic.
4. Elevate post and pad structures that are in danger of flooding (Tribal Hall to be raised 4 feet and eight homes to be elevated).

Severe Weather – Hazard Profile Overview, Goals, and Mitigation Actions

- Severe weather for Fort Yukon includes: Heavy Snow and High Winds.
- Goal 1: Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms.
- Goal 2: Develop critical facility list needing emergency back-up power systems.

Mitigation Action Plan (Severe Weather)

Mitigation Actions
1. Develop and implement programs to coordinate maintenance and mitigation activities to reduce risk to public infrastructure from severe winter storms.
2. Develop critical facility list needing emergency back-up power systems, prioritize, seek funding, and implement mitigation actions.
2a. The Tribal Hall needs an emergency generator. Dena is currently writing a grant for HMGP funding to obtain an emergency generator. With backup power, the Tribal Hall could serve as an Emergency Shelter if needed.
3. Develop and implement tree clearing mitigation programs to keep trees from threatening lives, property, and public infrastructure from severe weather events. This mitigation action could be combined with F 7C.

Wildland Fire – Hazard Profile Overview, Goal, and Mitigation Actions

- With the exception of the school fire in 1994, no fires have occurred within Fort Yukon.

Goal 1: Reduce potential wildland fire and conflagration fire vulnerability, damage, and loss.

Mitigation Actions
1. Develop Community Wildland Fire Protection Plan.
2. Provide wildland fire information in an easily distributed format for all residents.
3. Construct a new firebreak around the Fort Yukon community.

Earthquake – Hazard Profile Overview

Goal 1: Reduce potential earthquake vulnerability, damage, and loss.

Mitigation Actions
1. Encourage utility companies to evaluate and harden vulnerable infrastructure elements for sustainability.

Take Action

- Remember the HMP is a plan. It is ultimately the responsibility of the community to initiate projects and seek out funding.
- The HMP should be also be referenced and incorporated into other community planning mechanisms to create a cohesive strategy for future actions.

Keeping the HMP Current

- Perform annual reviews using the review sheet in Appendix E of the plan.
- Gather public information about hazards using survey in Appendix E of the plan.
- Initiate HMP update process before 2024.

Steps to 2019 HMP Completion

- February 26: GZGTG Meeting
  - The plan has been available for review since February 4, 2019.
    - Comment on plan
      - 1. Commenting at February 26 meeting
      - 2. Email your comments to jlemay@lemayengineering.com
      - 3. Call Jennifer LeMay with your comments-907-350-6061
- March: State of Alaska reviews 2019 GTGTG HMP
- April - May: FEMA reviews 2019 GTGTG HMP
- June – GZG Tribal Council adopts HMP by resolution

LeMay Engineering & Consulting, Inc.

Jennifer L. LeMay, PE, PMP
Vice President
4272 Chelsea Way
Anchorage, AK 99504
(907) 350-6061
jlemay@lemayengineering.com

February 28, 2019

Brent A. Nichols, EMSII, CFM
State Hazard Mitigation Officer
Department of Military and Veterans Affairs (DMVA)
Division of Homeland Security and Emergency Management (DHS&EM)
P.O. Box 5750
JBER, AK 99505-5750

Subject: **Hazard Mitigation Planning Process Trip Report**
Gwichyaa Zhee Gwich'in Tribal Government (GZGTG) which was formerly known as The Native Village of Fort Yukon

On February 26, 2019, Jennifer L. LeMay, PE, PMP of LeMay Engineering & Consulting, Inc. traveled to Fort Yukon, Alaska. The purpose of this trip was to present a summary of the Draft Hazard Mitigation Plan to the community, review mitigation strategies, and receive comments on the Draft Hazard Mitigation Plan. The public comment period on the Draft Hazard Mitigation Plan began February 4 and will end March 4.

Two meetings occurred during the site visit. I met with Dale Hardy, GZGTG Executive Director and Shirley Fields, GZGTG Realty & NR Director from 2 to 3 to discuss remaining questions. I also attended the GZGTG Public Meeting to provide an overview of the Draft Hazard Mitigation Plan. This meeting occurred from 5:30 to 6:30 at the Tribal Hall. The meeting resulted in valuable information to finalize the GZGTG Hazard Mitigation Plan. Meeting attendees included:

Jennifer L. LeMay, PE, PMP	LeMay Engineering & Consulting, Inc.
Dale Hardy	GZGTG Executive Director
Nancy James	First Chief
Michael Peter	Second Chief
Charlotte Kelly-Spencer	GZGTG Tribal Council Member
Carol Shewfelt	GZGTG Tribal Council Member
Shirley Fields	GZGTG Realty and NR Director
Stan Jon	GZGTG IGAP Coordinator
Ron Englishoe	Resident
Julie Mahea	Resident
Pat Stanley	Resident
Robert	Resident
Michael	Resident
Lucy	Resident
Mason	Resident
Indecipherable Signature	Resident

One comment was received before the meeting via telephone from the City. The City would like the GZGTG and the City to sign memorandums of agreements for all mitigation action work.

Comments received during the meeting included:

1. The community is concerned about potential flooding of the Porcupine River. Most agencies are concerned with the Yukon River, but the Porcupine River has flooded once and could flood again. If both the Porcupine and Yukon Rivers should flood at the same time, Fort Yukon would essentially become an island.
2. The road outside the Tribal Office to Carrolville needs to raised three to four feet with gravel to act as a levee to protect flood-threatened homes. Currently, the Tribe's Federal Highways grant funds are used for road maintenance. Also, Ramstead Road needs to be elevated; it is adjacent to the first slough that overflows.
3. USDA R&D is replacing culverts this year where road wash-outs frequently occur.
4. Bruce Smith with CATG has been talking about developing a Community Wildland Fire Protection Plan.
5. ANTHC will repair seawall adjacent to the Yukon River this summer.
6. Ron invited Jennifer LeMay to watch a video of the 1949 flood. After the meeting, they went to the Addie Shewfelt Elder Building and watched the video.
7. The GZGTG would like to formally request that the USACE evaluate the dike and finger dikes. There is a problem with standing water/mosquitos in the spring, and the community thinks there is water leaking through the dike(s). The community would also like to see the dike extended farther down the river bank to where the boats are parked.
8. At least 10-20 feet of the Sucker River is eroding per year. No prevention measures have been taken as a mitigation action.
9. The community would like to see long-term protection of the Yukon River down by the old village site, fish wheels, etc.
10. Don Young told the community that the Air Force base will never close as it is essential to the U.S. based on it being located above the arctic circle. Eight people staff the base. The cook is from Fort Yukon. The GZGTG would like to pursue grants with the Base to obtain Federal Transportation Grants funding for airport work.
11. The community said Fort Yukon is sitting on an island. They've been talking of the same actions for years, and action is needed. Potential flooding of the slough, Porcupine, Yukon, and Sucker Rivers are the largest community concern. More work needs to be done to elevate key areas with gravel and promote drainage.
12. The Economic Development Plan prioritizes centralizing historical buildings together in one location for ease of tourism.

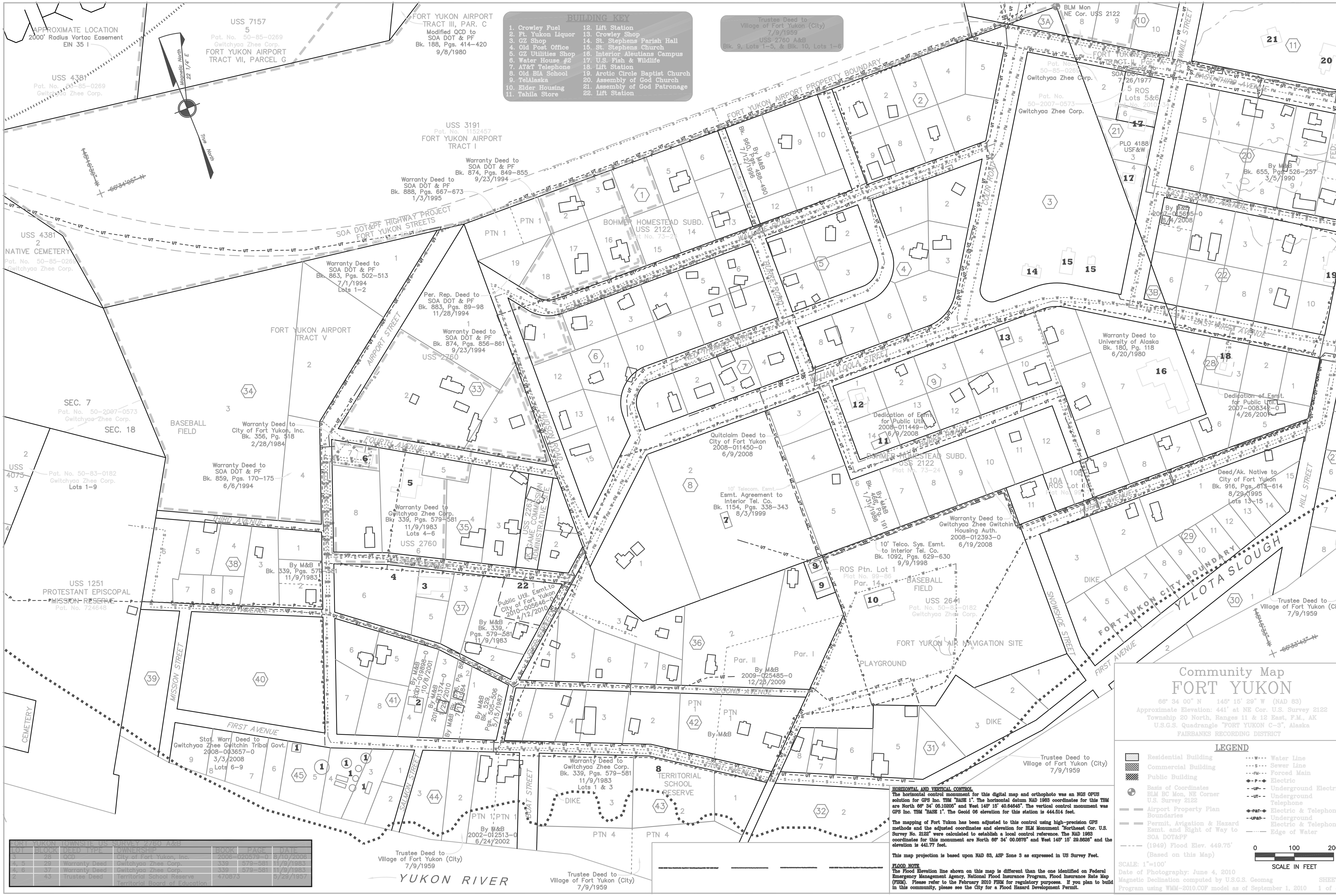
If you have any questions, please do not hesitate to call me at (907) 350-6061.

2/28/19

Jennifer L. LeMay, PE, PMP/Date
LeMay Engineering & Consulting, Inc.

Appendix B: Fort Yukon Area Use Map

This page was intentionally left blank.


Community Map
FORT YUKON
66° 34 00" N 145° 15' 29" W (NAD 83)
Approximate Elevation: 441' at NE Cor. U.S. Survey 2122
Township 20 North, Ranges 11 & 12 East, F.M., AK
U.S.G.S. Quadrangle "FORT YUKON C-3", Alaska
FAIRBANKS RECORDING DISTRICT
LEGEND
Residential Building
Commercial Building
Public Building
Basis of Coordinates BLM BC Mon, NE Corner U.S. Survey 2122
Airport Property Plan Boundaries
Permit, Avigation & Hazard Esmt. and Right of Way to SOA DOT&PF
(1949) Flood Elev. 449.75' (Based on this Map)
Water Line
Sewer Line
Forced Main
Electric
Underground Electric
Underground Telephone
Electric & Telephone
Underground Electric & Telephone
Edge of Water
0 100 200
SCALE IN FEET
SCALE: 1"=100'
Date of Photography: June 4, 2010
Magnetic Declination computed by U.S.G.S. Geomag Program using WMM-2010.COF model as of September 1, 2010
SHEET 1 of 4
BUILDING KEY
1. Crowley Fuel
2. Ft. Yukon Liquor
3. GZ Shop
4. Old Post Office
5. GZ Utilities Shop
6. Water House #2
7. AT&T Telephone
8. Old BIA School
9. TelAlaska
10. Elder Housing
11. Tahila Store
12. Lift Station
13. Crowley Shop
14. St. Stephens Parish Hall
15. St. Stephens Church
16. Interior Aleutians Campus
17. U.S. Fish & Wildlife
18. Lift Station
19. Arctic Circle Baptist Church
20. Assembly of God Church
21. Assembly of God Patronage
22. Lift Station
HORIZONTAL AND VERTICAL CONTROL
The horizontal control monument for this digital map and orthophoto was an NGS OPUS solution for GPS Inc. TBM "BASE 1". The horizontal datum NAD 1983 coordinates for this TBM are North 66° 34' 05.10205" and West 145° 15' 40.64645". The vertical control monument was GPS Inc. TBM "BASE 1". The Geoid 06 elevation for this station is 444.514 feet.
The mapping of Fort Yukon has been adjusted to this control using high-precision GPS methods and the adjusted coordinates and elevation for BLM Monument "Northeast Cor. U.S. Survey No. 2122" were calculated to establish a local control reference. The NAD 1983 coordinates for this monument are North 66° 34' 00.0878" and West 145° 15' 29.8626" and the elevation is 441.77 feet.
This map projection is based upon NAD 83, ASP Zone 3 as expressed in US Survey Feet.
FLOOD NOTE
The Flood Elevation line shown on this map is different than the one identified on Federal Emergency Management Agency, National Flood Insurance Program, Flood Insurance Rate Map (FIRM). Please refer to the February 2010 FIRM for regulatory purposes. If you plan to build in this community, please see the City for a Flood Hazard Development Permit.
FORT YUKON TOWNSITE US SURVEY 2760 A&B
LOT BLOCK DEED TYPE OWNERSHIP BOOK PAGE DATE
3 28 QCD City of Fort Yukon, Inc. 2006-020579-0 8/10/2006
4, 5 29 Warranty Deed Gwitchyaa Zhee Corp. 339 579-581 11/9/1983
4, 6 37 Warranty Deed Gwitchyaa Zhee Corp. 339 579-581 11/9/1983
2 43 Trustee Deed Territorial School Reserve Territorial Board of Education 470873 5/29/1957
Trustee Deed to Village of Fort Yukon (City) 7/9/1959 USS 2760 A&B Blk. 9, Lots 1-5, & Blk. 10, Lots 1-6
APPROXIMATE LOCATION 2000' Radius Vortac Easement EIN 35 I
Magnetic North 22 1/4° E
True North
FORT YUKON AIRPORT TRACT VII, PARCEL G
FORT YUKON AIRPORT TRACT III, PAR. C
FORT YUKON AIRPORT TRACT I
FORT YUKON AIRPORT TRACT V
FORT YUKON AIRPORT PROPERTY BOUNDARY
SOA DOT&PF HIGHWAY PROJECT FORT YUKON STREETS
NATIVE CEMETERY
BASEBALL FIELD
PROTESTANT EPISCOPAL MISSION RESERVE
BOHMER HOMESTEAD SUBD. USS 2122
AK GAME COMMISSION ADMINISTRATIVE SITE
TERRITORIAL SCHOOL RESERVE
FORT YUKON AIR NAVIGATION SITE
PLAYGROUND
CEMETERY
FORT YUKON CITY BOUNDARY
YLLOTA SLOUGH
YUKON RIVER
AIRPORT STREET
HUDSON ROAD
FOURTH AVENUE
THIRD AVENUE
SECOND AVENUE
FIRST AVENUE
MISSION STREET
SALMON STREET
BOAT STREET
SNOWSHOE STREET
WILLIAM LOOLA STREET
COLIN ROAD
HILL STREET
DIKE
FED. RESERVE

Community Map
FORT YUKON

66° 34' 00" N 145° 15' 29" W (NAD 83)
Approximate Elevation: 441' at NE Cor. U.S. Survey 2122
Township 20 North, Ranges 11 & 12 East, F.M., AK
U.S.G.S. Quadrangle "FORT YUKON C-3", Alaska
FAIRBANKS RECORDING DISTRICT

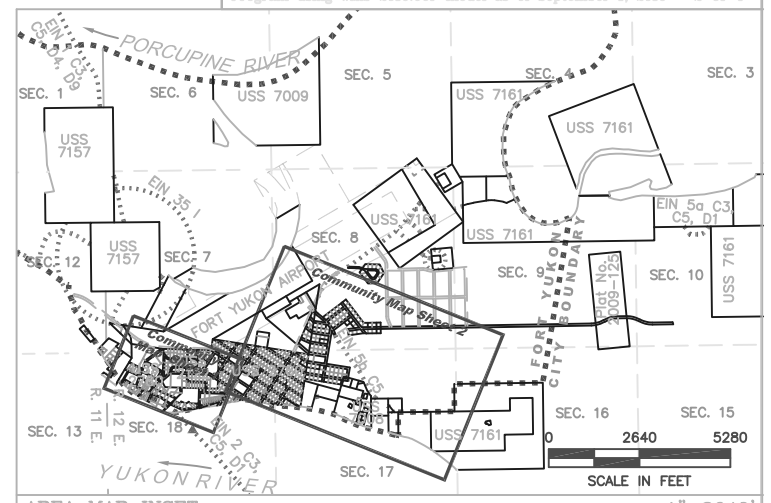
LEGEND

- Residential Building
- Commercial Building
- Public Building
- Edge of Water
- Airport Property Plan Boundaries
- (1949) Flood Elev. 449.75' (Based on this Map)
- Water Line
- Sewer Line
- Forced Main
- Electric
- Underground Electric
- Underground Telephone
- Electric & Telephone
- Underground Electric & Telephone

0 200 400
SCALE IN FEET

SCALE: 1"=100'
Date of Photography: June 4, 2010
Magnetic Declination computed by U.S.G.S. Geomag
Program using WMM-2010.COF model as of September 1, 2010

SHEET 2 of 4



AREA MAP INSET 1"=2640'

LOT	BLOCK	DEED TYPE	OWNERSHIP	BOOK	PAGE	DATE
1, 4	1	Warranty Deed	SOA DOT&PF	175	604	5/8/1980
2, 3	1	Amended Lease	SOA Dept. of Administration	755	800-801	7/17/1992
11	2	Warranty Deed	Gwitchyaa Zhee Corp.	339	579-581	11/9/1983
1	3	Warranty Deed	Gwitchyaa Zhee Corp.	339	579-581	11/9/1983
1	4	Warranty Deed	SOA DOT&PF	163	647	7/24/1980
2, 4, 5, 18	4	Warranty Deed	Gwitchyaa Zhee Corp.	339	579-581	11/9/1983
1-8	5	Warranty Deed	Gwitchyaa Zhee Corp.	339	579-581	11/9/1983
1-4, 8-10	8	Pat. 50-83-0182	Gwitchyaa Zhee Corp.	323	518-520	8/22/1983
1-7	8	Warranty Deed	Gwitchyaa Zhee Corp.	339	579-581	11/9/1983
1-2	8A	Warranty Deed	Gwitchyaa Zhee Corp.	339	579-581	11/9/1983
1	17	Warranty Deed	Chalkytsik Native Corp.	633	827	8/29/1990
1	18	QuitClaim Deed	Yukon Flats School Dist.	653	394-395	2/8/1990
1	18	Stat. Warr. Deed	Yukon Flats School Dist.	905	2	6/6/1995
1	19	Pat. No. 1221102	State of Alaska	131	380	8/21/1961

FORT YUKON TOWNSITE US SURVEY 2760 A&B

BUILDING KEY

1. BLM Buildings
2. FAA Garage
3. YFHC Garage
4. Yukon Flats Health Center
5. City of Ft. Yukon Office
6. CATG - Natural Resources
7. CATG - Daycare
8. Assembly of God Church
9. Armory
10. State of Alaska Office
11. State of Alaska Garage
12. CATG/KZPA Radio
13. Ft. Yukon Public School
14. School Shop
15. Arctic Circle Baptist Church
16. Yukon Flats School District
17. School Oil Tanks
18. Richard Carroll Building
19. GZGTG Garage
20. Alaska Commercial Company
21. Post Office
22. CATG Education Building
23. Lift Station
24. ANTHC Garages
25. City of Ft. Yukon-Games
26. GZGTG Recycle Center
27. City of Ft. Yukon Pumphouse
28. Water Storage Tank
29. Future Water Storage
30. GZGTG Garage
31. Chief Ezias Loola Cultural Center
32. GZGTG
33. Vocation Education YFSD
34. Studend Dorm YFSD
35. Airforce Monitoring Station
36. Airforce Utility
37. Airforce Radar
38. GZ Utilities

FLOOD NOTE
The Flood Elevation line shown on this map is different than the one identified on Federal Emergency Management Agency, National Flood Insurance Program, Flood Insurance Rate Map (FIRM). Please refer to the February 2010 FIRM for regulatory purposes. If you plan to build in this community, please see the City for a Flood Hazard Development Permit.

MAP NOTES
This map was prepared by the Alaska Department of Commerce, Community, and Economic Development, Division of Community and Regional Affairs (Commerce) using funding from the Initiative for Accelerated Infrastructure Development (IAID). The IAID is supported by grants from the Denali Commission, USDA Rural Development, Alaska Department of Transportation and Public Facilities and Commerce. Commerce contracted with Global Positioning Services, Inc. in May of 2010 to prepare the map.

This map should not be construed as a survey. On-site surveys should be conducted prior to engineering or construction. This map was compiled to meet horizontal and vertical accuracy in accordance with national map accuracy standards.

Property and utility information has been generated from readily available sources with limited accuracy checks. Property information is not intended to represent a title search of the Recorders Office record. Utility location is approximate and shows only the main lines. Generally, the information is current as of December 2010. ANTHC provided sanitation facility records.

This map is based on photography acquired on June 8, 2010, at a nominal scale, of 1 in = 800 ft. Aero-Metric Anchorage prepared the orthophoto and topographic mapping. The topographic contours were prepared at two (2) foot intervals with index contours every ten (10) feet.

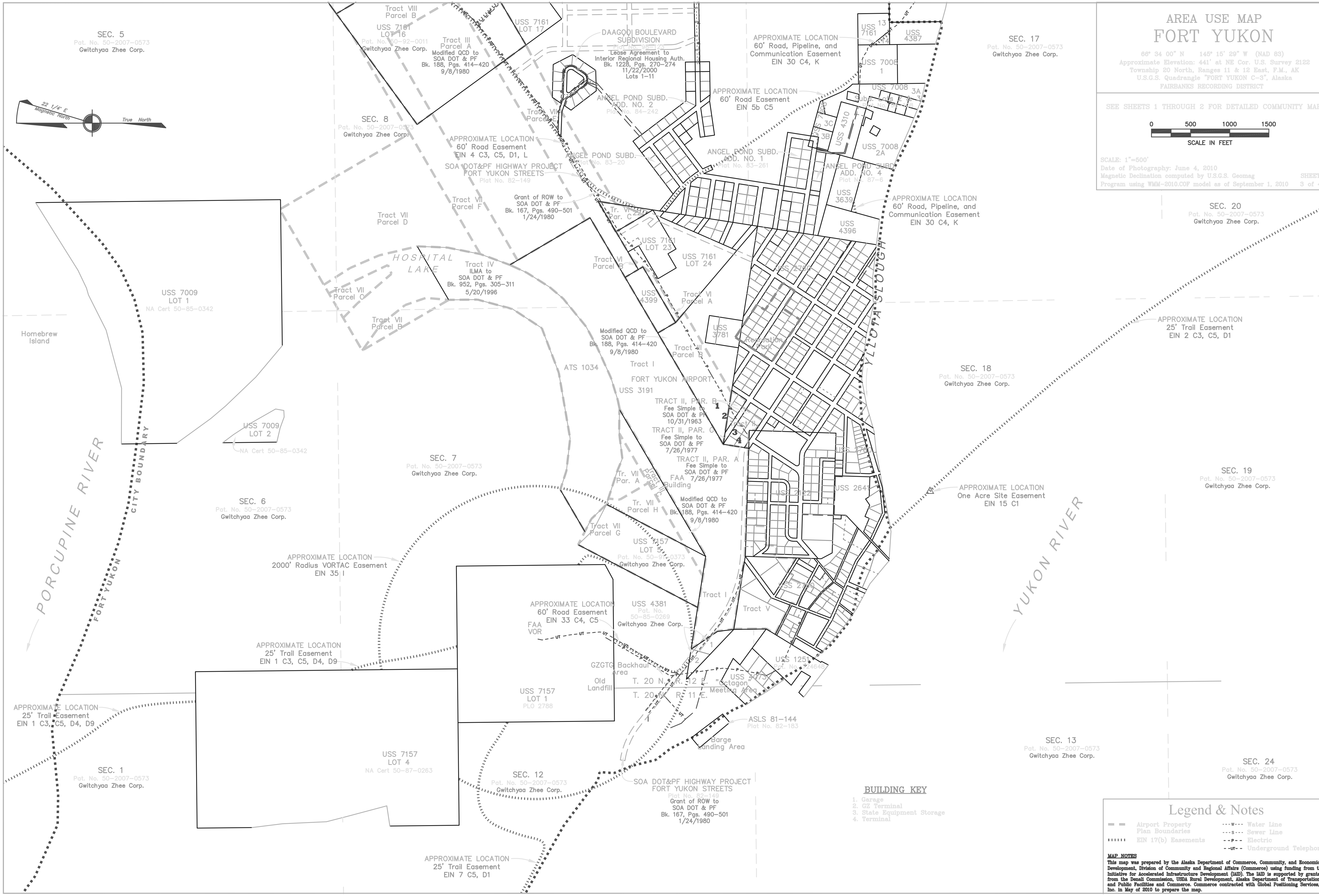
AREA USE MAP
FORT YUKON

66° 34' 00" N 145° 15' 29" W (NAD 83)
Approximate Elevation: 441' at NE Cor. U.S. Survey 2122
Township 20 North, Ranges 11 & 12 East, F.M., AK
U.S.G.S. Quadrangle "FORT YUKON C-3", Alaska
FAIRBANKS RECORDING DISTRICT

SEE SHEETS 1 THROUGH 2 FOR DETAILED COMMUNITY MAP

SCALE: 1"=500'
Date of Photography: June 4, 2010
Magnetic Declination computed by U.S.G.S. Geomag Program using WMM-2010.COF model as of September 1, 2010

SHEET 3 of 4



BUILDING KEY

1. Garage
2. GZ Terminal
3. State Equipment Storage
4. Terminal

Legend & Notes

Airport Property Plan Boundaries	---W--- Water Line
EIN 17(b) Easements	---S--- Sewer Line
	--P-- Electric
	--UT-- Underground Telephone

MAP NOTES

This map was prepared by the Alaska Department of Commerce, Community, and Economic Development, Division of Community and Regional Affairs (Commerce) using funding from the Initiative for Accelerated Infrastructure Development (IAID). The IAID is supported by grants from the Denali Commission, USDA Rural Development, Alaska Department of Transportation and Public Facilities and Commerce. Commerce contracted with Global Positioning Services, Inc. in May of 2010 to prepare the map.

AREA USE MAP
FORT YUKON

66° 34' 00" N 145° 15' 29" W (NAD 83)
Approximate Elevation: 441' at NE Cor. U.S. Survey 2122
Township 20 North, Ranges 11 & 12 East, F.M., AK
U.S.G.S. Quadrangle "FORT YUKON C-3", Alaska
FAIRBANKS RECORDING DISTRICT

SEE SHEETS 1 THROUGH 2 FOR DETAILED COMMUNITY MAP

0 500 1000 1500
SCALE IN FEET

SCALE: 1"=500'
Date of Photography: June 4, 2010
Magnetic Declination computed by U.S.G.S. Geomag
Program using WMM-2010.COF model as of September 1, 2010

Map Legend

- Airport Property Plan Boundaries
- EIN 17(b) Easements
- Water Line
- Sewer Line
- Electric
- Underground Telephone

22 1/4° E
Magnetic North
True North

USS 7161 LOT 8
NA Cert 50-85-0079

USS 7161 LOT 11
NA Cert 50-86-0560

USS 7161 LOT 7
NA Cert 50-86-0249

APPROXIMATE LOCATION
26' Road Easement
EIN 5a C3, C5, D1

SEC. 3
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

LAURA LAKE

SEC. 10
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

Gravel Pit

SEC. 15
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

SEC. 22
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

60' Public Drainage Esmt.
2005-009717-0
5/19/2005

LANDFILL TRACT
LANDFILL - LAGOON SUBDIVISION
Plat No. 2009-125

New City Landfill

LAGOON TRACT
LANDFILL-LAGOON SUBDIVISION
Plat No. 2009-125
Sewage Lagoon

USS 7161 LOT 10
NA Cert 50-86-0226

USS 7161 LOT 9
NA Cert 50-86-0226

LAGOON ACCESS ROAD
Plat No. 2009-125

SEC. 16
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

FORT YUKON CITY BOUNDARY

SEC. 4
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

SEC. 21
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

Doyon Gravel Pit

SEC. 9
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

USS 7161 LOT 27
FORT YUKON LONG RANGE RADAR SITE
PTN. OF PAR. 1, TR. A
QCD to Gwitchyaa Zhee Corp.
2005-013803-0
7/8/2005

USS 7161 LOT 25
PLO 1396

LANDFILL ROS
ADEC Permit No. 8631-BA006
Plat No. 2001-43

KZPA Radio Tower

YLLOTA SLOUGH

SUCKER RIVER

SEC. 4
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

Community Garden

USS 7161 LOT 6B

USS 7161 LOT 6C

USS 7161 LOT 6A
NA Cert 50-87-0183
Lots 6A-6C

USS 7161 LOT 5
NA Cert 50-89-0500

Airforce Buildings

SEC. 20
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

USS 7161 LOT 21

USS 7161 LOT 20
PLO 1248

Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.
Deed to City of Fort Yukon
Bk. 923, Pgs. 57-61
10/11/1995

USS 7161 LOT 17
NA Cert 50-94-0021

APPROXIMATE LOCATION
300' Radius RCAG Easement
EIN 100 +

USS 7161 LOT 19
SAA FOR PLO

RECORD OF SURVEY
FORT YUKON ROAD IMPROVEMENTS
Plat No. 2009-14

(Rabbit Line Subd.)

Tract VIII Parcel A

City Landfill

Tract VIII Parcel C

APPROXIMATE LOCATION
100' Proposed Easement
EIN 4c, C3, C5, D1, L

APPROXIMATE LOCATION
60' Road Easement
EIN 4 C3, C5, D1, L

APPROXIMATE LOCATION
60' Road Easement
EIN 4b C4

FORT YUKON LONG RANGE RADAR SITE
PTN. OF PAR. 1, TR. A
QCD to Gwitchyaa Zhee Corp.
2005-013803-0
7/8/2005

USS 7161 LOT 26

Tract VIII Parcel B

USS 7161 LOT 16
Pat. No. 50-92-0011
Gwitchyaa Zhee Corp.

Tract III Parcel A
Modified QCD to SOA DOT & PF
Bk. 188, Pgs. 414-420
9/8/1980

DAAGOO BOULEVARD SUBDIVISION
Lease Agreement to Interior Regional Housing Auth.
Bk. 1228, Pgs. 270-274
11/22/2000
Lots 1-11

USS 13

USS 4387

USS 7008 1

APPROXIMATE LOCATION
60' Road, Pipeline, and Communication Easement
EIN 30 C4, K

SEC. 5
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

SEC. 17
Pat. No. 50-2007-0573
Gwitchyaa Zhee Corp.

YUKON RIVER

Appendix C: FEMA Review Tool

This page was intentionally left blank.

FEMA Region 10 Tribal Mitigation Plan Review Tool

The *Tribal Mitigation Plan Review Tool* records how the tribal mitigation plan meets the regulations in 44 CFR §§ 201.7 and 201.5 (if applicable) and offers FEMA plan reviewers an opportunity to provide feedback to the tribal government.

- **Section 1**: The Regulation Checklist documents FEMA's evaluation of whether the plan has addressed all requirements. If plan requirements are not met, FEMA uses each Required Revisions section to indicate necessary changes.
- **Section 2**: The Strengths and Opportunities for Improvement summary identifies plan's strengths as well as areas for improvement as part of the next plan update.

The FEMA mitigation planner must reference the *Tribal Mitigation Plan Review Guide* when completing the *Tribal Mitigation Plan Review Tool*.

Tribal Jurisdiction: Gwichyaa Zhee Gwich'in Tribal Government	**Title of Plan:** Gwichyaa Zhee Gwich'in Tribal Government, formerly known as the Native Village of Fort Yukon, Tribal Hazard Mitigation Plan	**Date of Plan:** March 4, 2019
Tribal Point of Contact: Dale Hardy		**Address:** PO BOX 126 Fort Yukon, AK 99740
Title: Executive Director		
Agency: Gwichyaa Zhee Gwich'in Tribal Government		
Phone Number: 907-662-2581		**Email:** dale.hardy@fortyukon.org; Shirley.fields@fortyukon.org

State Reviewer (if applicable):	**Title:**	**Date:**
Mike Johnson	State Planner	April 2, 2019

FEMA Reviewer:	**Title:**	**Date:**
John Schelling	Regional Hazard Mitigation Planning Manager	05/14/2019
Date Received in FEMA Region 10	04/02/2019	
Plan Not Approved		
Plan Approvable Pending Adoption	05/14/2019	
Plan Approved	06/07/2019	

Section 1: REGULATION CHECKLIST

1. Standard Regulation Checklist Regulation (44 CFR § 201.7 Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT A. PLANNING PROCESS			
A1. Does the plan document the planning process, including how it was prepared and who was involved in the process? [44 CFR § 201.7(c)(1)]	How: PDF 23-25, 115-137, Who: PDF 23-24, 116-118, 120-122, 125-127, 136-137	X	
A2. Does the plan document an opportunity for public comment during the drafting stage and prior to plan approval, including a description of how the tribal government defined "public"? [44 CFR § 201.7(c)(1)(i)]	PDF 9, 13, 16, 25, 116, 122, 125-126, plan will be uploaded to DHS&EM website for review	X	
A3. Does the plan document, as appropriate, an opportunity for neighboring communities, tribal and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? [44 CFR § 201.7(c)(1)(ii)]	PDF 25, 116, 122, 125-126, plan will be uploaded to DHS&EM website for review	X	
A4. Does the plan describe the review and incorporation of existing plans, studies, and reports? [44 CFR § 201.7(c)(1)(iii)]	PDF 25-26	X	
A5. Does the plan include a discussion on how the planning process was integrated to the extent possible with other ongoing tribal planning efforts as well as other FEMA programs and initiatives? [44 CFR § 201.7(c)(1)(iv)]	PDF 18-21, 94-97	X	
A6. Does the plan include a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within the plan update cycle)? [44 CFR § 201.7(c)(4)(i)]	101-104,161-169	X	
A7. Does the plan include a discussion of how the tribal government will continue public participation in the plan maintenance process? [44 CFR § 201.7(c)(4)(iv)]	PDF 103-104, 165-169	X	
ELEMENT A: REQUIRED REVISIONS			
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			

1. Standard Regulation Checklist Regulation (44 CFR § 201.7 Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
B1. Does the plan include a description of the type, location, and extent of all natural hazards that can affect the tribal planning area? [44 CFR § 201.7(c)(2)(i)]	Type: PDF 30-34, 36-38, 43-46, 56-59, 65-69 Location: PDF 34-35, 39-41, 50-52, 64, 70 Extent: PDF 35, 41-42, 52-54, 64, 70-71	X	
B2. Does the plan include information on previous occurrences of hazard events and on the probability of future hazard events for the tribal planning area? [44 CFR § 201.7(c)(2)(i)]	Previous Occurrences: PDF 34, 38-39, 47-48, 59-64, 69-71 Recurrence Probabilities: PDF 36, 42-43, 55-56, 65, 72	X	
B3. Does the plan include a description of each identified hazard's impact as well as an overall summary of the vulnerability of the tribal planning area? [44 CFR § 201.7(c)(2)(ii)]	Impact: PDF 35-36, 42, 55, 64-65, 71 Overall Vulnerability Summary: PDF 79-83	X	
ELEMENT B: REQUIRED REVISIONS			
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan include a discussion of the tribal government's pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including an evaluation of tribal laws and regulations related to hazard mitigation as well as to development in hazard-prone areas? [44 CFR §§ 201.7(c)(3) and 201.7(c)(3)(iv)]	PDF 18-21, 94-96	X	
C2. Does the plan include a discussion of tribal funding sources for hazard mitigation projects and identify current and potential sources of Federal, tribal, or private funding to implement mitigation activities? [44 CFR §§ 201.7(c)(3)(iv) and 201.7(c)(3)(v)]	PDF 18-21, 94-100, 104-108	X	
C3. Does the Mitigation Strategy include goals to reduce or avoid long-term vulnerabilities to the identified hazards? [44 CFR § 201.7(c)(3)(i)]	PDF 89	X	
C4. Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with emphasis on new and existing buildings and infrastructure? [44 CFR § 201.7(c)(3)(ii)]	PDF 90-92	X	

1. Standard Regulation Checklist Regulation (44 CFR § 201.7 Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
C5. Does the plan contain an action plan that describes how the actions identified will be prioritized, implemented, and administered by the tribal government? [44 CFR § 201.7(c)(3)(iii)]	PDF 93-100	X	
C6. Does the plan describe a process by which the tribal government will incorporate the requirements of the mitigation plan into other planning mechanisms, when appropriate? [44 CFR § 201.7(c)(4)(iii)]	PDF 101-103, 161-169	X	
C7. Does the plan describe a system for reviewing progress on achieving goals as well as activities and projects identified in the mitigation strategy, including monitoring implementation of mitigation measures and project closeouts? [44 CFR §§ 201.7(c)(4)(ii) and 201.7(c)(4)(v)]	PDF 101-103, 162-164	X	
ELEMENT C: REQUIRED REVISIONS			
ELEMENT D. PLAN UPDATES			
D1. Was the plan revised to reflect changes in development? [44 CFR § 201.7(d)(3)]	N/A: Tribal plan is not an update.		
D2. Was the plan revised to reflect progress in tribal mitigation efforts? [44 CFR §§ 201.7(d)(3) and 201.7(c)(4)(iii)]	N/A: Tribal plan is not an update.		
D3. Was the plan revised to reflect changes in priorities? [44 CFR § 201.7(d)(3)]	N/A: Tribal plan is not an update.		
ELEMENT D: REQUIRED REVISIONS			
ELEMENT E. ASSURANCES AND PLAN ADOPTION			
E1. Does the plan include assurances that the tribal government will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, including 2 CFR Parts 200 and 3002, and will amend its plan whenever necessary to reflect changes in tribal or Federal laws and statutes? [44 CFR § 201.7(c)(6)]	PDF 13	X	
E2. Does the plan include documentation that it has been formally adopted by the governing body of the tribal government requesting approval? [44 CFR § 201.7(c)(5)]	Appendix F once the resolution is received		

1. Standard Regulation Checklist Regulation (44 CFR § 201.7 Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT E: REQUIRED REVISIONS. The plan does not meet element E2. Once an Approvable Pending Adoption status is achieved the tribe intends on formal adoption and inclusion in Appendix F of this plan.			

2. Enhanced Regulation Checklist Regulation (44 CFR § 201.5 Enhanced Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ENHANCED ELEMENT F. STANDARD PLAN REQUIREMENTS			
F1. Does the enhanced plan include all elements of the standard tribal mitigation plan? [44 CFR §§ 201.3(e)(3), 201.5(b), and 201.7]			
ENHANCED ELEMENT F: REQUIRED REVISIONS			
ENHANCED ELEMENT G. INTEGRATED PLANNING			
G1. Does the enhanced plan demonstrate integration to the extent practicable with other tribal and/or regional planning initiatives and FEMA mitigation programs and initiatives? [44 CFR §§ 201.3(e)(3) and 201.5(b)(1)]			
ENHANCED ELEMENT G: REQUIRED REVISIONS			
ENHANCED ELEMENT H. TRIBAL MITIGATION CAPABILITIES			
H1. Does the tribal government demonstrate commitment to a comprehensive mitigation program? [44 CFR §§ 201.3(e)(3) and 201.5(b)(4)]			
H2. Does the enhanced plan document capability to implement mitigation actions? [44 CFR §§ 201.3(e)(3), 201.5(b)(2)(i), 201.5(b)(2)(ii), and 201.5(b)(2)(iv)]			
H3. Is the tribal government using existing mitigation programs to achieve mitigation goals? [44 CFR §§ 201.3(e)(3), 201.5(a) and 201.5(b)(3)]			
ENHANCED ELEMENT H: REQUIRED REVISIONS			

2. Enhanced Regulation Checklist Regulation (44 CFR § 201.5 Enhanced Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ENHANCED ELEMENT I. HMA GRANTS MANAGEMENT PERFORMANCE			
I1. With regard to HMA, is the tribal government maintaining the capability to meet application timeframes and submitting complete project applications? [44 CFR §§ 201.3(e)(3), 201.5(b)(2)(iii)(A)]			
I2. With regard to HMA, is the tribal government maintaining the capability to prepare and submit accurate environmental reviews and benefit-cost analyses? [44 CFR §§ 201.3(e)(3) and 201.5(b)(2)(iii)(B)]			
I3. With regard to HMA, is the tribal government maintaining the capability to submit complete and accurate quarterly progress and financial reports on time? [44 CFR §§ 201.3(e)(3) and 201.5(b)(2)(iii)(C)]			
I4. With regard to HMA, is the tribal government maintaining the capability to complete HMA projects within established performance periods, including financial reconciliation? [44 CFR §§ 201.3(e)(3) and 201.5(b)(2)(iii)(D)]			
ENHANCED ELEMENT I: REQUIRED REVISIONS			

SECTION 2: PLAN ASSESSMENT

A. Plan Strengths and Opportunities for Improvement

This section provides a discussion of the strengths of the plan document and identifies areas where these could be improved beyond minimum requirements.

Element A: Planning Process

Plan Strengths

- The plan does a good job of describing the timeline for the planning process and the public engagement opportunities.
- The sign-in sheets included within the plan show that there was a good cross section of the community involved and very active participation by the public within the planning process, including tribal leadership.

Opportunities for Improvement

- The hazard mitigation plan does an adequate job of listing existing plans and studies (USACE Erosion Assessment, Comprehensive Plan, Transportation Plan, etc.) and how they were used to help inform various aspects of the hazard mitigation plan, such as the hazard and risk assessments, etc. Consider the planning process that was used to create the hazard mitigation plan and, as the plan is implemented, how it can be more fully integrated with other ongoing tribal planning efforts that the Tribe is engaged with to support identified mitigation strategies.

Element B: Hazard Identification and Risk Assessment

Plan Strengths

- The plan includes hazards that are unique to the area and are applicable to the Tribe and does a good job of documenting historical hazards, current probability, and extent of hazard that may affect the Tribe in the future.
- Where data is available, the plan also includes forecast information (cryosphere/permafrost hazards, flood hazards, etc.), to help inform the potential future state and discusses proactive measures, such as land use and building codes, related to minimizing risk.
- The assessment of potential climate impacts on each hazard are well described and include, to the degree possible, future planning considerations for the Tribe.
- The vulnerability assessment thoroughly describes potential losses of critical infrastructure and the impacts for each hazard. This will lead to an improved understanding of mitigation opportunities to help minimize risk, especially as the plan notes how Fort Yukon serves as an important regional hub for outlying villages.

Opportunities for Improvement

- The plan describes how building codes and land use considerations are made for various hazards; however, the description of the City and GZGTG's regulatory tools on page 3-5 note that these authorities are not used. This needs to be clarified within the plan.
- The plan summarizes past development trends within Fort Yukon and the surrounding areas; however, additional information regarding projected future development could be expanded upon within the vulnerability analysis. Consider past development trends and use

that information along with existing plans to more fully describe vulnerability to future buildings, infrastructure, and critical facilities that may be located in hazard zones.

- Consider using additional maps to show where hazard events can and have occurred, especially for flood and erosion hazards within Fort Yukon.
- The Tribal Planning Area can be better described within the plan and/or referenced on a map.

Element C: Mitigation Strategy

Plan Strengths

- The mitigation strategy includes a broad range of mitigation actions that could be pursued by the Tribe to reduce or eliminate risk from identified hazards, including acquisition or elevation of structures that are located in floodprone areas; creating defensible space around the Fort Yukon community for increased wildfire protection; and aggressively managing their plans to integrate mitigation measures into land use planning, capital improvement planning, etc.
- The mitigation strategy is very focused on concrete, specific mitigation actions for the community as opposed to more general preparedness-related objectives. This helps demonstrate a good connection to the risk and vulnerability assessment along with a strong indication of the capacity the Tribe and City have for proceeding with these actions.

Opportunities for Improvement

- Consider including additional parties, such as leaders of the Tribal Departments/Offices referenced on pages 7-5 and 7-6, rather than just the Executive Director and City Manager as the responsible entity within Mitigation Action Plan and designate a lead for each action. This may help provide additional capacity to successfully accomplish implementation.
- Future updates may wish to crosswalk mitigation action plans item with the Tribal Department/Office that aligns most closely with or has authority for that function.

Section 1: REGULATION CHECKLIST

1. Standard Regulation Checklist Regulation (44 CFR § 201.7 Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT A. PLANNING PROCESS			
A1. Does the plan document the planning process, including how it was prepared and who was involved in the process? [44 CFR § 201.7(c)(1)]	PDF 22, 24-257 Section 3, Page 3-1 to 3-11 Section 3.1, Page 3-2 to 3-3 Section 3.2, Page 3-3 to 3-4, Table 3-1 Section 3.3, Page 3-4 to 3-5 Section 3.4, Page 3-5 to 3-6, Table 3-2	X	
A2. Does the plan document an opportunity for public comment during the drafting stage and prior to plan approval, including a description of how the tribal government defined "public"? [44 CFR § 201.7(c)(1)(i)]	PDF 25-26 Section 3.2: Pages 3-3 to 3-4, & Table 3-1 Section 3.3, Page 3-4 to 3-5 Section 3.4, Page 3-5 to 3-6, Table 3-2	X	
A3. Does the plan document, as appropriate, an opportunity for neighboring communities, tribal and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? [44 CFR § 201.7(c)(1)(ii)]	Appendix D Section 3.2: Pages 3-3 to 3-4, & Table 3-1 Section 3.3: Pages 3-4 to 3-5 Section 3.4, Pages 3-5 to 3-6, & Table 3-2	X	
A4. Does the plan describe the review and incorporation of existing plans, studies, and reports? [44 CFR § 201.7(c)(1)(iii)]	Section 3.5.1, Page 3-6 to 3-7 Section 3.5.2, Page 3-7 to 3-8 Section 7.8, Page 7-23 Cited throughout plan	X	
A5. Does the plan include a discussion on how the planning process was integrated to the extent possible with other ongoing tribal planning efforts as well as other FEMA programs and initiatives? [44 CFR § 201.7(c)(1)(iv)]	Section 1.1 Page 1-1 Section 1.2 Page 1-1 Table 1-1 page 1-2 Section 1.3 Page 1-3	X	
A6. Does the plan include a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within the plan update cycle)? [44 CFR § 201.7(c)(4)(i)]	PDF 32 Section 3.5.4, Page 3-7 to 3-10 & Appendix F	X	
A7. Does the plan include a discussion of how the tribal government will continue public participation in the plan maintenance process? [44 CFR § 201.7(c)(4)(iv)]	Section 3.5.3, Page 3-7 Section 7.7, Page 7-23	X	
ELEMENT A: REQUIRED REVISIONS			

1. Standard Regulation Checklist Regulation (44 CFR § 201.7 Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT B. HAZARD IDENTIFICATION AND RISK ASSESSMENT			
B1. Does the plan include a description of the type, location, and extent of all natural hazards that can affect the tribal planning area? [44 CFR § 201.7(c)(2)(i)]	**Earthquake:** Nature: Section 5.3.1.1, Page 5-4 to 5-6 Location: Section 5.3.2.2, Page 5-7 Extent: Section 5.3.1.2, Page 5-8 & Figure 5-3 **Flood:** Nature: Section 5.3.2.1, Pages 5-10 to 5-11 Location: Section 5.3.2.3, Page 5-12 & Figure 5-5 Extent: Section 5.3.2.3, Page 5-12 to 5-13 **Ground Failure** with Climate Change Nature: Section 5.3.3.1, Pages 5-14 to 5-16 Location: Section 5.3.3.3, Page 5-16 to 5-17, & Figure 5-6 Extent: Section 5.3.3.3, Page 5-17 **Severe Weather** with Climate Change: Nature: Section: 5.3.4.1, Pages 5-18 to 5-20 Location: Section 5.3.4.3, Page 5-28 Extent: Section 5.3.4.3, Page 5-28 **Volcano:** Nature: Section: 5.3.5.1, Pages 5-29 to 5-31 & Table 5-8 Location: Section 5.3.5.3, Page 5-34 to 5-38, Figure 5-12, 5-13, 5-14, 5-15, 5-16, & Table 5-10 Extent: Section 5.3.5.3, Page 5-39	X	

1. Standard Regulation Checklist Regulation (44 CFR § 201.7 Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
B2. Does the plan include information on previous occurrences of hazard events and on the probability of future hazard events for the tribal planning area? [44 CFR § 201.7(c)(2)(i)]	**Earthquake:** History: Section 5.3.1.2, Page 5-6 to 5-7 & Table 5-4 Probability: Section 5.3.1.3, Page 5-8 to 5-9, & Figure 5-4 **Flood** History: Section 5.3.2.2, Page 5-11 to 5-12 Probability: Section 5.3.2.3, Page 5-14 **Ground Failure** History: Section 5.3.3.2, Page 5-16 Probability: Section 5.3.3.2, Page 5-17 to 5-18 **Severe Weather** History: Section 5.3.4.2, Page 5-20 to 5-28, & Figure 5-9 & 5-10, Table 5-5, 5-6, & 5-7 Probability: Section 5.3.43, Page 5-29 **Volcano:** History: Section 5.3.5.2, Page 5-32 to 5-34, Figure 5-11, & Table 5-9 Probability: Section 5.3.5.3, Page 5-40	X	
B3. Does the plan include a description of each identified hazard's impact as well as an overall summary of the vulnerability of the tribal planning area? [44 CFR § 201.7(c)(2)(ii)]	**Earthquake** Impact: Section 5.3.1.3, Page 5-8 **Flood** Impact: Section 5.3.2.3, Page 5-13 to 5-14 **Ground Failure** Impact: Section 5.3.3.3, Page 5-17 **Severe Weather** Impact: Section 5.3.4.3, Page 5-29 **Volcanic Hazards** Impact: Section 5.3.5.3, Page 5-39 to 5-40 **Overall Vulnerability:** Section 6, Page 6-1 to 6-19	X	
ELEMENT B: REQUIRED REVISIONS			

1. Standard Regulation Checklist Regulation (44 CFR § 201.7 Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT C. MITIGATION STRATEGY			
C1. Does the plan include a discussion of the tribal government's pre- and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including an evaluation of tribal laws and regulations related to hazard mitigation as well as to development in hazard-prone areas? [44 CFR §§ 201.7(c)(3) and 201.7(c)(3)(iv)]	Section 1, Page 1-1 to 1-8, & Table 1-1 & 1-2 Section 7-2, Page 7-2 to 7-5 Tables 7-1, 7-4, & 7-5	X	
C2. Does the plan include a discussion of tribal funding sources for hazard mitigation projects and identify current and potential sources of Federal, tribal, or private funding to implement mitigation activities? [44 CFR §§ 201.7(c)(3)(iv) and 201.7(c)(3)(v)]	Section 7.2, Page 7-2 to 7-6, & Table 7-1, 7-4, & 7-5 Section 7-4, Page 7-6 to 7-9, & Table 7-7 Section 7-6 Page 7-11 to 7-22, & Table 7-9 & 7-10 Appendix A	X	
C3. Does the Mitigation Strategy include goals to reduce or avoid long-term vulnerabilities to the identified hazards? [44 CFR § 201.7(c)(3)(i)]	Section 7.3, Page 7-5 to 7-6 & Table 7-6	X	
C4. Does the plan identify and analyze a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with emphasis on new and existing buildings and infrastructure? [44 CFR § 201.7(c)(3)(ii)]	Section 7.4, Page 7-8 to 7-11, & Table 7-7 Section 7.5, Page 7-9 to 7-11	X	
C5. Does the plan contain an action plan that describes how the actions identified will be prioritized, implemented, and administered by the tribal government? [44 CFR § 201.7(c)(3)(iii)]	Section 7.5, Page 7-9 to 7-11, & Table 7-8 Section 7.6, Page 7-11 to 7-22, & Table 7-10 STAPLEE	X	
C6. Does the plan describe a process by which the tribal government will incorporate the requirements of the mitigation plan into other planning mechanisms, when appropriate? [44 CFR § 201.7(c)(4)(iii)]	Section 3.5, Page 3-6 to 3-7 Section 7.8, Page 7-23	X	
C7. Does the plan describe a system for reviewing progress on achieving goals as well as activities and projects identified in the mitigation strategy, including monitoring implementation of mitigation measures and project closeouts? [44 CFR §§ 201.7(c)(4)(ii) and 201.7(c)(4)(v)]	Section 3.5.4, Page 3-9 to 3-10 Section 7.7, Page 7-23 Section 7.8, Page 7-23	X	
ELEMENT C: REQUIRED REVISIONS			

1. Standard Regulation Checklist Regulation (44 CFR § 201.7 Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ELEMENT D. PLAN UPDATES			
D1. Was the plan revised to reflect changes in development? [44 CFR § 201.7(d)(3)]	N/A This is a new plan		
D2. Was the plan revised to reflect progress in tribal mitigation efforts? [44 CFR §§ 201.7(d)(3) and 201.7(c)(4)(iii)]	N/A This is a new plan		
D3. Was the plan revised to reflect changes in priorities? [44 CFR § 201.7(d)(3)]	N/A This is a new plan		
ELEMENT D: REQUIRED REVISIONS			
ELEMENT E. ASSURANCES AND PLAN ADOPTION			
E1. Does the plan include assurances that the tribal government will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, including 2 CFR Parts 200 and 3002, and will amend its plan whenever necessary to reflect changes in tribal or Federal laws and statutes? [44 CFR § 201.7(c)(6)]	Section 4.2, Page 4-1 to 4-2	X	
E2. Does the plan include documentation that it has been formally adopted by the governing body of the tribal government requesting approval? [44 CFR § 201.7(c)(5)]	After FEMA provides conditional approval the plan will be locally adopted and resolution will be found in Appendix C	X	
ELEMENT E: REQUIRED REVISIONS			

2. Enhanced Regulation Checklist Regulation (44 CFR § 201.5 Enhanced Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ENHANCED ELEMENT F. STANDARD PLAN REQUIREMENTS			
F1. Does the enhanced plan include all elements of the standard tribal mitigation plan? [44 CFR §§ 201.3(e)(3), 201.5(b), and 201.7]	N/A		
ENHANCED ELEMENT F: REQUIRED REVISIONS			
ENHANCED ELEMENT G. INTEGRATED PLANNING			
G1. Does the enhanced plan demonstrate integration to the extent practicable with other tribal and/or regional planning initiatives and FEMA mitigation programs and initiatives? [44 CFR §§ 201.3(e)(3) and 201.5(b)(1)]	N/A		
ENHANCED ELEMENT G: REQUIRED REVISIONS			
ENHANCED ELEMENT H. TRIBAL MITIGATION CAPABILITIES			
H1. Does the tribal government demonstrate commitment to a comprehensive mitigation program? [44 CFR §§ 201.3(e)(3) and 201.5(b)(4)]	N/A		
H2. Does the enhanced plan document capability to implement mitigation actions? [44 CFR §§ 201.3(e)(3), 201.5(b)(2)(i), 201.5(b)(2)(ii), and 201.5(b)(2)(iv)]	N/A		
H3. Is the tribal government using existing mitigation programs to achieve mitigation goals? [44 CFR §§ 201.3(e)(3), 201.5(a) and 201.5(b)(3)]	N/A		
ENHANCED ELEMENT H: REQUIRED REVISIONS			

2. Enhanced Regulation Checklist Regulation (44 CFR § 201.5 Enhanced Tribal Mitigation Plans)	Location in Plan (section and/or page number)	Met	Not Met
ENHANCED ELEMENT I. HMA GRANTS MANAGEMENT PERFORMANCE			
I1. With regard to HMA, is the tribal government maintaining the capability to meet application timeframes and submitting complete project applications? [44 CFR §§ 201.3(e)(3), 201.5(b)(2)(iii)(A)]	N/A		
I2. With regard to HMA, is the tribal government maintaining the capability to prepare and submit accurate environmental reviews and benefit-cost analyses? [44 CFR §§ 201.3(e)(3) and 201.5(b)(2)(iii)(B)]	N/A		
I3. With regard to HMA, is the tribal government maintaining the capability to submit complete and accurate quarterly progress and financial reports on time? [44 CFR §§ 201.3(e)(3) and 201.5(b)(2)(iii)(C)]	N/A		
I4. With regard to HMA, is the tribal government maintaining the capability to complete HMA projects within established performance periods, including financial reconciliation? [44 CFR §§ 201.3(e)(3) and 201.5(b)(2)(iii)(D)]	N/A		
ENHANCED ELEMENT I: REQUIRED REVISIONS			

Section 2: STRENGTHS AND OPPORTUNITIES FOR IMPROVEMENT

INSTRUCTIONS: The purpose of the ***Strengths and Opportunities for Improvement*** section is for FEMA to provide more comprehensive feedback on the tribal mitigation plan to help the tribal government advance mitigation planning. The intended audience is the tribal staff responsible for the mitigation plan update. FEMA will address the following topics:

1. Plan strengths, including specific sections in the plan that are above and beyond the minimum requirements; and
2. Suggestions for future improvements.

FEMA will provide feedback and include examples of best practices, when possible, as part of the *Tribal Mitigation Plan Review Tool,* or, if necessary, as a separate document. The tribal mitigation plan elements are included below in italics for reference. FEMA is not required to provide feedback for each element.

Required revisions from the **Regulation Checklist** are not documented in the **Strengths and Opportunities for Improvement** section. Results from the **Strengths and Opportunities for Improvement** section are not required for Plan Approval.

Plan Strengths

- Good Figure 2-5 of the City and Native Village of Diomede that includes structures.
- Good summary of socio-economic data on community and discussion of community specific needs.
- Great inclusion of the Potential Impacts from Future Climate Conditions into hazard analyses and summaries.
- Great inclusion of impacts of culturally and sacred site sensitivity, including meat caches.
- Clear Table 7-7 and explanation of actions that rose to the top of priorities for inclusion in Table 7-10.
- Thorough Capability Assessment that provides good information to inform mitigation actions.
-

Opportunities for Improvement

- For the plan update, consider an alternative community-up approach to the planning process based on needs of the City and Native Village and ability of both to manage Hazard Mitigation Assistance grants.
- Consider including more specific information and expanding the documenting of the steps for plan creation more clearly, using dates/including meeting minutes.
- Consider alternative forms, or times of year, for community engagement since no public comments were received.

- For the update, consider illustrating each hazard on the aerial map provided on the City and Native Village. This would provide a better understanding of each hazard's potential for impacting the specific planning area and infrastructure.
- Consider becoming more specific with additional impacts; for example, not only that ground failure can exacerbate permafrost, but what specific structures would that failure hurt? This information can be used to develop mitigation actions and the basis of identifying priority projects for grant funding.
- Consider providing specific funding ideas, instead of the responsible agency. This focus will help narrow grant application or other project ideas moving forward to implement actions.
- Include additional information on grants management specific to the Native Village of Diomede to more strongly support requirements C1, C2, and C6.

B. Resources for Implementing Your Approved Plan

The **Region 10 Integrating Natural Hazard Mitigation into Comprehensive Planning** is a resource specific to Region 10 states and provides examples of how communities are integrating natural hazard mitigation strategies into comprehensive planning. You can find it in the FEMA Library at http://www.fema.gov/media-library/assets/documents/89725.

The **Integrating Hazard Mitigation Into Local Planning: Case Studies and Tools for Community Officials** resource provides practical guidance on how to incorporate risk reduction strategies into existing local plans, policies, codes, and programs that guide community development or redevelopment patterns. It includes recommended steps and tools to assist with local integration efforts, along with ideas for overcoming possible impediments, and presents a series of case studies to demonstrate successful integration in practice. You can find it in the FEMA Library at http://www.fema.gov/library/viewRecord.do?id=7130.

The **Mitigation Ideas: A Resource for Reducing Risk from Natural Hazards** resource presents ideas for how to mitigate the impacts of different natural hazards, from drought and sea level rise, to severe winter weather and wildfire. The document also includes ideas for actions that communities can take to reduce risk to multiple hazards, such as incorporating a hazard risk assessment into the local development review process. You can find it in the FEMA Library at http://www.fema.gov/library/viewRecord.do?id=6938.

The **Local Mitigation Planning Handbook** provides guidance to local governments on developing or updating hazard mitigation plans to meet and go above the requirements. You can find it in the FEMA Library at http://www.fema.gov/library/viewRecord.do?id=7209.

The **Integration Hazard Mitigation and Climate Adaptation Planning: Case Studies and Lessons Learned** resource is a 2014 ICLEI publication for San Diego with a clear methodology that could assist in next steps for integration impacts of climate change throughout mitigation actions. http://icleiusa.org/wp-content/uploads/2015/08/Integrating-Hazard-Mitigation-and-Climate-Adaptation-Planning.pdf

The **Local Mitigation Plan Review Guide and Tool** resource is available through FEMA's Library and should be referred to for the next plan update.
http://www.fema.gov/library/viewRecord.do?id=4859

The **Tribal Multi-Hazard Mitigation Planning Guidance:** This resource is specific to tribal governments developing or updating tribal mitigation plans. It covers all aspects of tribal planning requirements and the steps to developing tribal mitigation plans. You can find the document in the FEMA Library at http://www.fema.gov/media-library/assets/documents/18355

Volcanic Eruption Mitigation Measures: For information on Mitigation Actions for Volcanic Eruptions that would satisfy the C4 requirement, please visit: http://earthzine.org/2011/03/21/volcanic-crisis-management-and-mitigation-strategies-a-multi-risk-framework-case-study/ and http://www.gvess.org/publ.html.

The FEMA Region 10 **Risk Mapping, Analysis, and Planning program (Risk MAP)** releases a monthly newsletter that includes information about upcoming events and training opportunities, as well as hazard and risk related news from around the Region. Past newsletters can be viewed at http://www.starr-team.com/starr/RegionalWorkspaces/RegionX/Pages/default.aspx. If you would like to receive future newsletters, email rxnewsletter@starr-team.com and ask to be included.

The mitigation strategy may include eligible projects to be funded through FEMA's hazard mitigation grant programs (Pre-Disaster Mitigation, Hazard Mitigation Grant Program, and Flood Mitigation Assistance). Contact your State Hazard Mitigation Officer, Brent Nichols at Brent.Nichols@alaska.gov, for more information.

Appendix D: Benefit-Cost Analysis Fact Sheet

This page was intentionally left blank.

Benefit Cost Analysis Fact Sheet

Hazard mitigation projects are specifically aimed at reducing or eliminating future damages. Although hazard mitigation projects may sometimes be implemented in conjunction with the repair of damages from a declared disaster, the focus of hazard mitigation projects is on strengthening, elevating, relocating, or otherwise improving buildings, infrastructure, or other facilities to enhance their ability to withstand the damaging impacts of future disasters. In some cases, hazard mitigation projects may also include training or public education programs if such programs can be demonstrated to reduce future expected damages.

A Benefit-Cost Analysis (BCA) provides an estimate of the "benefits" and "costs" of a proposed hazard mitigation project. The "benefits" considered are avoided future damages and losses that are expected to accrue as a result of the mitigation project. In other words, benefits are the reduction in expected future damages and losses (i.e., the difference in expected future damages before and after the mitigation project). The costs considered are those necessary to implement the specific mitigation project under evaluation. Costs are generally well-determined for specific projects for which engineering design studies have been completed. The timing and severity of benefits, however, must be estimated probabilistically because they depend on the improved performance of the building or facility in future hazard events.

All benefit-costs must be:

- Credible and well documented
- Prepared in accordance with accepted BCA practices
- Cost-effective (BCR $\geq$ 1.0)

General Data Requirements:

- All data entries (other than FEMA) standard or default values) must be documented in the application.
- Data must be from a credible source.
- Provide complete copies of reports and engineering analyses.
- Detailed cost estimate.
- Identify the hazard (e.g., flood, wind, seismic).
- Discuss how the proposed measure will mitigate against future damages.
- Document the project's useful life.
- Document the proposed Level of Protection.
- The Very Limited Data (VLD) BCA module cannot be used to support cost-effectiveness (screening purposes only).
- Alternative BCA software must be approved in writing by FEMA HQ and FEMA Region 10 staff prior to submittal of the application.

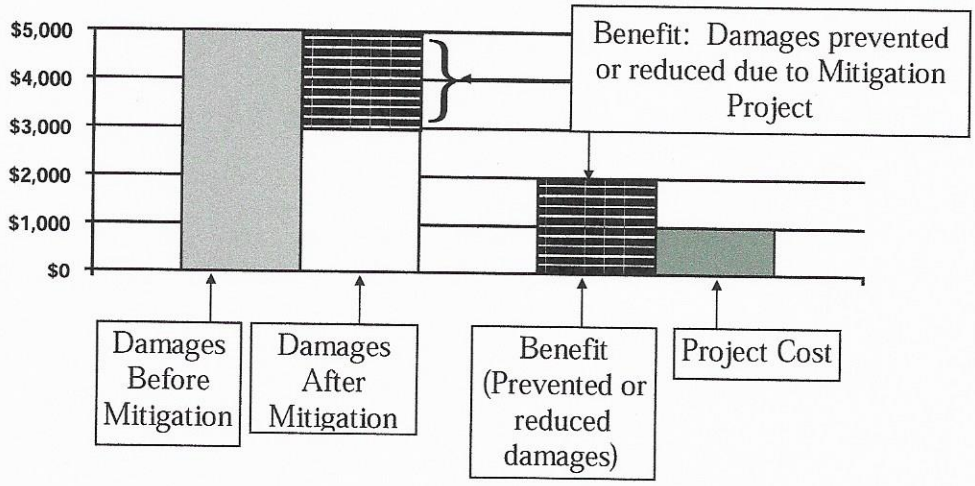
Damage and Benefit Data

- Well documented for each damage event.
- Include estimated frequency and method of determination per damage event.
- Data used in place of FEMA standard or default values must be documented and justified.
- The Level of Protection must be documented and readily apparent.

Benefit Cost Analysis Process

How to Determine Cost-Effectiveness of Mitigation Projects

When Congress enacted the Stafford Act's mitigation provisions, one of the criteria to determine priorities for mitigation funding was cost effectiveness. This cost effective provision was in response to the recognition that there would never be enough funding to completely mitigate against every hazard. To determine the cost effectiveness of proposed mitigation projects, FEMA implemented a benefit cost analysis (BCA) requirement to mitigation grant funding applications. The basic requirement of the BCA is that the benefit of the mitigation project must equal or exceed the cost, a benefit cost ratio (BCR) of 1:1 or greater. Over several years, FEMA developed a set standard values for use in BCA and custom software that establishes mitigation benefits and calculates the BCR. Benefit cost analysis submitted to FEMA to justify mitigation funding requires substantial documentation of project costs and benefits. FEMA provides the custom BCA software and training online at https://www.fema.gov/benefit-cost-analysis. An overview of the BCA process for a mitigation projects follows.



FEMA Basic Benefit-Cost Model. For more information about FEMA's Benefit-Cost Modules, please contact the FEMA Region X Mitigation Division at 425-487-4600.

It is important to understand that benefit-cost analysis is basically the same for each type of hazard mitigation project. The only differences are the types of data that are used in the calculations, depending on whether the project is for floods, earthquakes, or other natural hazards. For example, whereas the depth of flooding is used to estimate damage for flood mitigation projects, the severity of ground shaking is used to estimate damage for earthquake mitigation projects.

Calculating the Benefit – Cost Ratio

In the graph above, cost-effectiveness is determined by comparing the project cost of $1,000, to the value of damages prevented after the mitigation measure, which is $2,000. Because the dollar value of benefits exceeds the costs of funding the project, the project is cost-effective. This relationship is depicted numerically by dividing the benefits by the costs, resulting in a benefit-cost ratio (BCR). The BCR is simply a way of stating whether benefits exceed project costs, and

by how much. To derive the BCR, divide the benefits by the cost ($2,000 ÷ $1,000); if the result is 1.0 or greater, then the project is cost-effective. In this instance, the BCR is 2.0, which far exceeds the 1.0 level. On the other hand, if the cost of the project is $2,000 and the benefits are only $1,000, the project would have a BCR of 0.50 ($1,000 ÷ $2,000) and would not be cost-effective.

Conducting a benefit-cost analysis determines one of two things: either the project is cost-effective (BCR > 1.0), or it is not (BCR < 1.0). If the project is cost-effective, then no further work or analysis needs to be done, there is no third step other than to move the project to the next phase in the approval process. However, if the project is not cost-effective, then it is generally not eligible for FEMA mitigation grant funding.

There are four key elements to all benefit-cost analyses of hazard mitigation projects:

1. An estimate of damages and losses before mitigation
2. An estimate of damages and losses after mitigation
3. An estimate of the frequency and severity of the hazard causing damages (e.g., floods), and
4. The economic factors of the analysis (e.g., discount rate and mitigation project's useful lifetime)

These four key elements and their relationships to one another are detailed in the following example.

Consider a 1,500 square foot, one-story, single family residence located in the Acorn Park subdivision along Squirrel Creek. A proposed mitigation project will elevate the structure four feet at a cost of $20,000. Whether this project is cost-effective depends on the damages and losses from flooding without the mitigation project, the effectiveness of the mitigation project in reducing those damages and losses, the frequency that the house is flooded and the depth of the flood water, and the mitigation project's useful lifetime.

If the pre-mitigation damages are frequent and/or severe, then the project is more likely to be cost-effective. Even minor damage that occurs frequently can, over the life of a project, exceed the up-front costs of implementing a mitigation measure. On the other hand, if the building in the example above only flooded once, then it may not be cost-effective to elevate, unless the damages were significant in relation to the value of the structure and its contents.

- When using the Limited Data (LD) BCA module, users cannot extrapolate data for higher frequency events for unknown lower frequency events.

Building Data

- Should include FEMA Elevation Certificates for elevation projects or projects using First Floor Elevations (FFEs).
- Include data for building type (tax records or photos).
- Contents claims that exceed 30 percent of building replacement value (BRV) must be fully documented.
- Method for determining BRVs must be documented. BRVs based on tax records must include the multiplier from the County Tax Assessor.
- Identify the amount of damage that will result in demolition of the structure (FEMA standard is 50 percent of pre-damage structure value).
- Include the site location (e.g., miles inland) for the hurricane module.

Use Correct Occupancy Data

- Design occupancy for hurricane shelter portion of tornado module.
- Average occupancy per hour for the tornado shelter portion of the tornado module.
- Average occupancy for seismic modules.

Questions to Be Answered

- Has the level of risk been identified?
- Are all hazards identified?
- Is the BCA fully documented and accompanied by technical support data?
- Will residual risk occur after the mitigation project is implemented?

Common Shortcomings

- Incomplete documentation.
- Inconsistencies among data in the application, BCA module runs, and the technical support data.
- Lack of technical support data.
- Lack of a detailed cost estimate.
- Use of discount rate other than FEMA-required amount of 7 percent.
- Overriding FEMA default values without providing documentation and justification.
- Lack of information on building type, size, number of stories, and value.
- Lack of documentation and credibility for FFEs.
- Use of incorrect project useful life (not every mitigation measure equals 100 years).

Appendix E: Plan Maintenance Documents

This page was intentionally left blank.

Annual Review Questionnaire

PLAN SECTION	QUESTIONS	YES	NO	COMMENTS
PLANNING PROCESS	Are there internal or external organizations and agencies that have been invaluable to the planning process or to mitigation action			
	Are there procedures (e.g. meeting announcements, plan updates) that can be done more efficiently?			
	Has the planning team undertaken any SHMAC or SHMP meetings or activities regarding the SHMP or mitigation action implementation?			
HAZARD PROFILES	Has a natural and/or manmade/ technologically caused disaster occurred during this reporting period?			
	Are there natural and/or manmade/ technologically caused hazards that have not been addressed in this SHMP and should be?			
	Are additional maps or new hazard studies available? If so, what have they revealed?			
VULNERABILITY ANALYSIS	Do any critical facilities or infrastructure need to be added to the asset lists?			
	Have there been development pattern changes that could influence the hazard impacts or that create additional risks?			
MITIGATION STRATEGY	Are there different or additional resources (financial, programmatic, human, or technical) that are now available for mitigation planning within the State, Cities or Tribal communities? Define.			
	Are the SHMP's goals still applicable?			
	Should new mitigation actions be added to the Mitigation Strategies' Mitigation Action Plan (MAP)?			
	Do existing MAP mitigation actions need to be reprioritized			
	Are the MAP mitigation actions appropriate for available resources?			

Mitigation Action Progress Report

Progress Report Period: _____ (Date) To _____ (Date)

Project Title: _____ Project ID#: _____

Responsible Agency: _____

Address: _____

: _____

Contact Person: _____ Title: _____

Phone #(s): _____ email Address(s): _____

_____ _____

List Supporting Agencies and Contacts: _____

_____

_____

Total Project Cost: _____

Anticipated Cost Overrun/Underrun: _____

Project Approval Date: _____ Project Start Date: _____

Anticipated Completion Date: _____

Description of project (describe each phase, if applicable, and the time frame for completing each phase: _____

_____

_____

Milestones	Complete	Projected Completion Date

Mitigation Action Progress Report *(Continued)*

Plan Goal(s) Addressed:

Goal:

Success Indicators:

Project Status

☐ On Schedule
☐ Completed
☐ Delayed*

* Explain:

☐ Canceled

Project Cost Status

☐ Cost Unchanged
☐ Cost Overrun**

** Explain:

☐ Cost Underrun***

*** Explain:

Summary of progress on project for this report:

A. What was accomplished during this reporting period?

B. What obstacles, problems, or delays did you encounter, if any?

C. How was each problem resolved?

Next Steps: What is/are the next step(s) to accomplish over the next reporting period?

Other Comments:

Community Local Hazard Mitigation Plan Survey

This survey is an opportunity for you to share your opinions and participate in the mitigation planning process. The information that you provide will help us better understand your concerns for hazards and risks, which could lead to mitigation activities that will help reduce those risks and the impacts of future hazard events.

The hazard mitigation process is not complete without your feedback. All individual responses are strictly confidential and will be used for mitigation planning purposes only.

Please help us by taking a few minutes to complete this survey and return it to:

GZGTG Executive Director

Vulnerability Assessment

The following questions focus on how vulnerable the community or its facilities are to damage from a particular hazard type using the following vulnerability scale:

0= Don't Know 1 =Minimally Vulnerable 2=Moderately Vulnerable 3=Severely Vulnerable

1. How vulnerable to damage are the *structures* in the community from:

a. Flooding?	0 1 2 3
b. Wildfire?	0 1 2 3
C. Earthquakes?	0 1 2 3
d. Volcanoes?	0 1 2 3
e. Snow Avalanche?	0 1 2 3
f. Tsunami/Seiches?	0 1 2 3
g. Severe weather storms?	0 1 2 3
h. Ground failure (landslide, permafrost)?	0 1 2 3
i. Coastal erosion?	0 1 2 3
j. Climate change?	0 1 2 3
k. Other hazards?	0 1 2 3
Please Specify:	

2. How vulnerable to damage are the *critical facilities* within our community from:

[Critical facilities include airport, community shelter, bulk fuel storage tanks, generators, health clinic, law enforcement office (VPO, VPSO, police department), school, public works, e.g. washeteria/water treatment, reservoir/water supply, satellite dish, communications tower, landfills, sewage lagoons, and stores.]

a. Flooding?	0 1 2 3
b. Wildfire?	0 1 2 3

C. Earthquakes?	0 1 2 3
d. Volcanoes?	0 1 2 3
e. Snow Avalanche?	0 1 2 3
f. Tsunami/Seiches?	0 1 2 3
g. Severe weather storms?	0 1 2 3
h. Ground failure (landslide, permafrost)?	0 1 2 3
i. Coastal erosion?	0 1 2 3
j. Climate change?	0 1 2 3
k. Other hazards?	0 1 2 3

Please Specify:

3. How vulnerable to displacement, evacuation or life-safety is the community from:

a. Flooding?	0 1 2 3
b. Wildfire?	0 1 2 3
C. Earthquakes?	0 1 2 3
d. Volcanoes?	0 1 2 3
e. Snow Avalanche?	0 1 2 3
f. Tsunami/Seiches?	0 1 2 3
g. Severe weather storms?	0 1 2 3
h. Ground failure (landslide, permafrost)?	0 1 2 3
i. Coastal erosion?	0 1 2 3
j. Climate change?	0 1 2 3
k. Other hazards?	0 1 2 3

Please Specify:

4. Do you have a record of damages incurred during past flood events? Yes No

If yes, please describe:_____

_____

_____

Preparedness

Preparedness activities are often the first line of defense for protection of your family and the community. In the following list, please check those activities that you have done, plan to do in the near future, have not done, or are unable to do. *Please check one answer for each preparedness activity*.

Have you or someone in your household:	Have Done	Plan to do	Not Done	Unable to do
Attended meetings or received written information on natural disasters or emergency preparedness?	☐	☐	☐	☐
Talked with family members about what to do in case of a disaster or emergency?	☐	☐	☐	☐
Made a "Household/Family Emergency Plan" in order to decide what everyone would do in the event of a disaster?	☐	☐	☐	☐
Prepared a "Disaster Supply Kit" extra food, water, medications, batteries, first aid items, and other emergency supplies)?	☐	☐	☐	☐
In the last year, has anyone in your household been trained in First Aid or CPR?	☐	☐	☐	☐

5. Would you be willing to make your home more resistant to natural disasters? ☐ Yes ☐ No

6. Would you be willing to spend more money on your home to make it more disaster resistant? ☐ Yes ☐ No ☐ Don't know

7. How much <u>are you willing to spend</u> to better protect your home from natural disasters? *(Check only one)*

☐	Less than $100	☐	Desire to relocate for protection
☐	$100-$499	☐	Other, please explain
☐	$500 and above		
☐	Nothing / Don't know		
☐	Whatever it takes		

Mitigation Activities

A component of the Local Hazard Mitigation Plan activities is developing and documenting additional mitigation strategies that will aid the community in protecting life and property from the impacts of future natural disasters.

Mitigation activities are those types of actions you can take to protect your home and property from natural hazard events such as floods, severe weather, and wildfire. Please check the box for the following statements to best describe their importance to you. Your responses will help us determine your community's priorities for planning for these mitigation activities.

Statement	Very Important	Somewhat Important	Neutral	Not Very Important	Not Important
Protecting private property	☐	☐	☐	☐	☐

Protecting critical facilities (clinic, school, washeteria, police/fire department, water/sewer, landfill)	☐	☐	☐	☐	☐
Preventing development in hazard areas	☐	☐	☐	☐	☐
Protecting natural environment	☐	☐	☐	☐	☐
Protecting historical and cultural landmarks	☐	☐	☐	☐	☐
Promoting cooperation within the community	☐	☐	☐	☐	☐
Protecting and reducing damage to utilities, roads, or water tank	☐	☐	☐	☐	☐
Strengthening emergency services (clinic workers, police/fire)	☐	☐	☐	☐	☐

8. Do you have other suggestions for possible mitigation actions/strategies?

_____

_____

_____

_____

_____

General Household Information

9. Please indicate your age: _____

and Gender: ☐ Male ☐ Female

10. Please indicate your level of education:

☐	Grade school/no schooling	☐	College degree
☐	Some high school	☐	Postgraduate degree
☐	High school graduate/GED	☐	Other, please specify
☐	Some college/trade school		

11. How long have you lived in Fort Yukon?

☐ Less than 5 years ☐ 5 to 10 years ☐ 11 to 20 years ☐ 21 or more years

12. Do you have internet access? ☐ Yes ☐ No

13. Do you own or rent your home? ☐ Own ☐ Rent

If you have any questions regarding this survey or would like to learn about other ways that you can participate in the development of the Local Hazard Mitigation Plan, please contact the GZG Executive Director.

Thank You for Your Participation!

This survey may be submitted anonymously; however, if you provide us with your name and contact information below we will have the ability to follow up with you to learn more about your ideas or concerns (optional):

Name: _____

Address: _____

_____

Phone: _____

Appendix F: Adoption Resolution and Approval Letter

This page was intentionally left blank.

U.S. Department of Homeland Security
FEMA Region 10
130 – 228th Street, SW
Bothell, Washington 98021

FEMA

May 14, 2019

The Honorable Nancy James
First Chief
Gwichyaa Zhee Gwich'in Tribal Government
PO Box 126
Fort Yukon, AK 99740

Dear First Chief James:

The Federal Emergency Management Agency (FEMA) Region 10 completed a pre-adoption review of the draft *Gwichyaa Zhee Gwich'in Tribal Mitigation Plan*. The attached Mitigation Plan Review Tool documents the Region's review and compliance with all required elements of 44 CFR Part 201.7. This letter serves as Region 10's commitment to approve the plan upon receiving documentation of its adoption by the tribe.

Formal adoption documentation must be submitted to FEMA Region 10 within one calendar year of the date of this letter, or the entire plan must be updated and resubmitted for review.

Please contact John Schelling, Regional Mitigation Planning Program Manager, at (425) 487-2140 or john.schelling@fema.dhs.gov with any questions.

Sincerely,

Tamra Biasco
Chief, Risk Analysis Branch

cc: Brent Nichols, Alaska Division of Homeland Security and Emergency Management

Enclosures

JS:vl

2Gwichyaa Zhee Gwich'in Tribal Government
(Formerly known as the Native Village of Fort Yukon, IRA)
P.O. Box 126 Third & Alder Street
Fort Yukon, AK 99740-0126 www.fortyukon.org
Phone: (907) 662-2581 Fax: (907) 662-2222

Resolution 2019-05

Adoption of the Draft Federal Emergency Management Agency (FEMA) Region 10 – Draft Gwichyaa Zhee Gwichin Tribal Mitigation Plan.

WHEREAS: the Gwichyaa Zhee Gwich'in Tribal Government, also known as Native Village of Fort Yukon, IRA, is the duly constituted Native American Tribe recognized by the Federal Government of the United States, and

WHEREAS: the Gwichyaa Zhee Gwich'in Tribal Council is the duly elected governing body of the Tribe, authorized to act by and on behalf of its member, and

WHEREAS: The community of Fort Yukon recognized the threat from natural disasters posed to residents and property; and

WHERE AS: undertaking hazard mitigation projects before disaster occur will reduce the potential for harm to residents and property and save taxpayer dollars; and

WHEREAS: the Federal Emergency Management Agency (FEMA) Region 10 completed a pre-adoption review of the draft *Gwichyaa Zhee Gwich'in Tribal Mitigation Plan".* The Mitigation Plan Review Tool documents the Region's review and compliance with all required elements of 44 CFR Part 201.7

WHEREAS: formal adoption documentation must be submitted to FEMA Region 10 within one calendar year from May 14, 2019.

NOW THEREFORE BE IT RESOLOVED, by the Gwichyaa Zhee Gwith'in Tribal Government to formally adopt the Federal Emergency Management Agency (FEMA) Region 10 – Draft Gwichyaa Zhee Gwich'in Tribal Mitigation Plan.

CERTIFICATION OF RESOLUTION

This certifies that the above resolution was duly adopted at a convened meeting of the Gwichyaa Zhee Gwich'in Tribal Government, at which time a quorum was present. This resolution was adopted by a vote of ____for, ____against, ____abstain on June 3, 2019.

In Witness Thereto

First Chief — June 3, 2019 — Date

Carol Shewfelt
Tribal Operations Officer — ATTEST

U.S. Department of Homeland Security
Region X
130 228th Street, SW
Bothell, WA 98021-9796

FEMA

JUN 10 2019

The Honorable Nancy James
First Chief
Gwichyaa Zhee Gwich'in Tribal Government
P.O. Box 126
Fort Yukon, Alaska 99740

Dear First Chief James:

Congratulations, on June 7, 2019, the United States Department of Homeland Security's Federal Emergency Management Agency (FEMA) Region X approved the Gwichyaa Zhee Gwich'in Tribal Government Hazard Mitigation Plan as a Tribal Mitigation Plan, in accordance with the Code of Federal Regulations Title 44 Part 201.

An approval provides the Gwichyaa Zhee Gwich'in Tribal Government with eligibility to apply directly with FEMA for Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) programs, i.e., Pre-Disaster Mitigation project grants, Public Assistance (Categories C-G), Fire Management Assistance and Hazard Mitigation Grant Program (HMGP) projects through June 6, 2024. Recipients are required to develop and maintain hazard mitigation plans compliant with FEMA standards as a condition for receiving funds. To continue eligibility, within five years from date of this letter, tribes must review, revise as appropriate and re-submit plans for approval. For further assistance on hazard mitigation planning, please contact our Regional Mitigation Planning Program Manager, John Schelling, at (425) 487-2104.

FEMA evaluates applications for funding according to the specific requirements of the applicable program. A mitigation action identified in the plan may, or may not, meet a program's eligibility requirements. For assistance with hazard mitigation grant funding, please contact FEMA-R10-HMA@fema.dhs.gov.

We look forward to continuing a productive relationship between FEMA Region X and the Gwichyaa Zhee Gwich'in Tribal Government. Our Regional Tribal Liaison Ramona VanCleve, at 907-271-4302, is available to facilitate this relationship and delivery of our programs. You are also welcome to contact me directly, at (425) 487-4604.

Sincerely,

Michael F. O'Hare
Regional Administrator

Enclosures

cc: Brent Nichols, Alaska Division of Homeland Security and Emergency Management