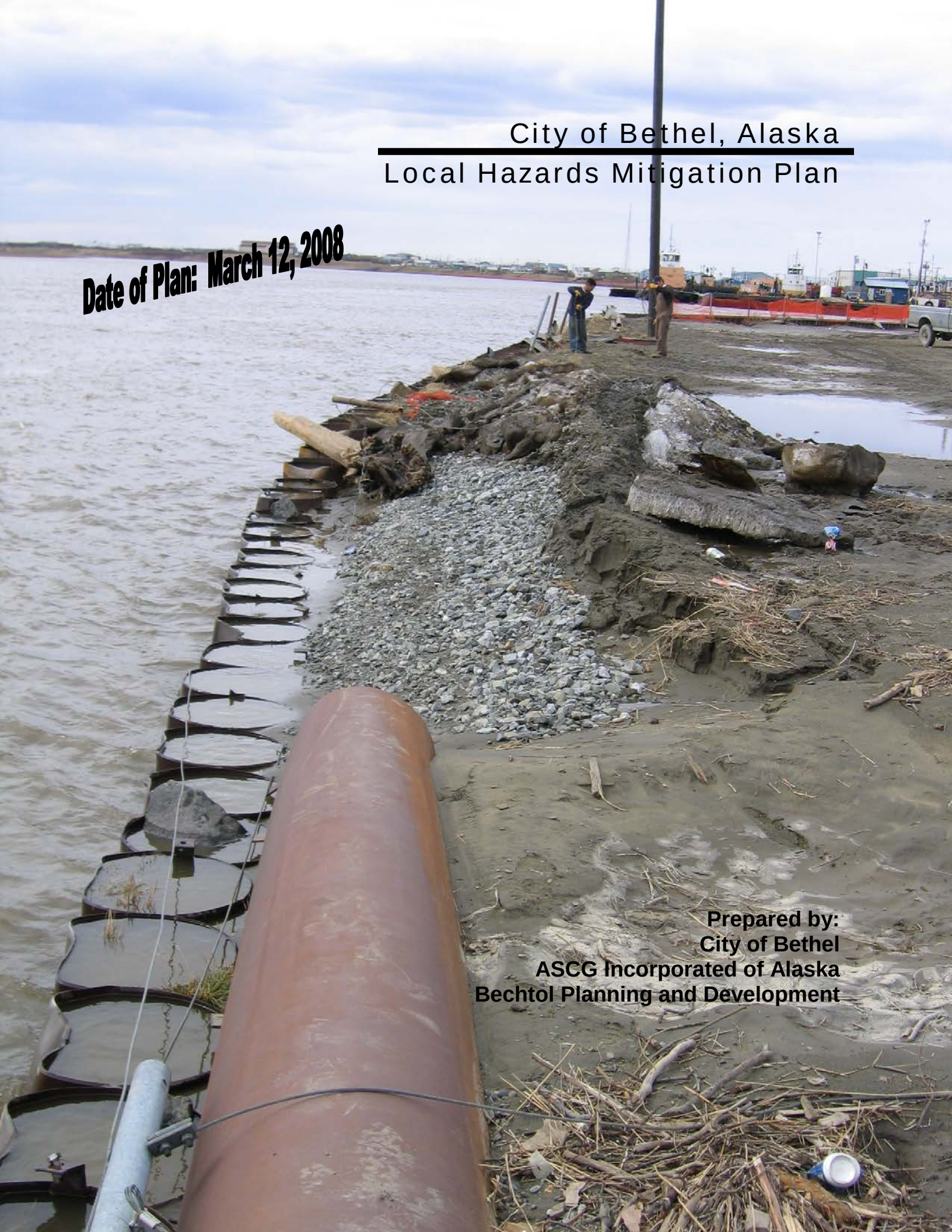

City of Bethel, Alaska

Local Hazards Mitigation Plan

Date of Plan: March 12, 2008

Prepared by:
City of Bethel
ASCG Incorporated of Alaska
Bechtol Planning and Development

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Photos by the Bethel Planning Department

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Acronyms

AEIS	Alaska Earthquake Information System
AWCG	Alaska Wildfire Coordinating Group
BFE	Base Flood Elevation (100 year flood)
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
cps	cubic feet per second
CRS	Community Rating System
CRSA	Coastal Resource Service Area
DCCED	(Alaska) Department of Commerce, Community and Economic Development
DHS&EM	(Alaska) Division of Homeland Security and Emergency Management
DMA	Disaster Mitigation Act
DOT&PF	(Alaska) Department of Transportation & Public Facilities
EMS	Emergency Medical Services
FBFM	Flood Boundary and Floodway Maps
FDIC	Federal Deposit Insurance Corporation
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Maps

FHLBB	Federal Home Loan Bank Board
FIRM	Flood Insurance Rate Maps
fps	feet per second
GIS	Geographic Information System
LHMP	Local Hazards Mitigation Plan
MLLW	Mean Lower Low Water
NFIP	National Flood Insurance Program
NOAA	National Oceanographic and Atmospheric Administration
PDMG	Pre Disaster Mitigation Grant
RAPIDS	Rural Alaska Identification and Delivery System
SBA	Small Business Administration
USARC	U.S. Arctic Research Commission
USCOE	United States Army Corps of Engineers
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
YKHC	Yukon-Kuskokwim Health Corporation

Sample Resolution

City of Bethel, Alaska
Local Hazards Mitigation Plan Adoption Resolution
Resolution # _____

Adoption of the City of Bethel Local Hazards Mitigation Plan

Whereas, the City of Bethel recognizes the threat that local natural hazards pose to people and property; and

Whereas, undertaking hazard mitigation projects before disasters occur will reduce the potential for harm to people and property and save taxpayer dollars; and

Whereas, an adopted Local Hazards Mitigation Plan is required as a condition of future grant funding for mitigation projects; and

Whereas, the Bethel Local Hazards Mitigation Plan has been sent to the Alaska Division of Homeland Security and Emergency Management and the Federal Emergency Management Agency for their approval;

Now, therefore, be it resolved, that the Bethel City Council*,* hereby adopts the City of Bethel Local Hazards Mitigation Plan as an official plan; and

Be it further resolved, that the City of Bethel will submit the adopted Local Hazards Mitigation Plan to the Alaska Division of Homeland Security and Emergency Management and the Federal Emergency Management Agency officials for final review and approval.

Passed: _____
Date

_____
Certifying Official

Chapter 1. Planning Process and Methodology

Introduction

The scope of this plan is natural hazards: flooding, erosion, severe weather, and earthquake hazards. However, some of the mitigation projects for the natural hazards would also mitigate impacts from other hazards.

The City of Bethel Local Hazards Mitigation Plan (LHMP) includes information to assist the city government, the Tribal government and residents with planning to avoid potential future disaster losses. The plan provides information on natural hazards that affect Bethel, descriptions of past disasters, and lists projects that may help the community prevent disaster losses. The plan was developed to help the City make decisions regarding natural hazards that affect Bethel.

Plan Development

Location

With a population of almost 6,000 people, the City of Bethel is the main port of the Kuskokwim River in the Yukon Kuskokwim Delta. Bethel serves as the regional hub for 56 surrounding Native villages. The region is land-locked from urban areas in Alaska. (Bethel City website)

Bethel is located at the mouth of the Kuskokwim River, 40 miles inland from the Bering Sea. It lies in the Yukon Delta National Wildlife Refuge, 400 air miles west of Anchorage. It lies at approximately 60.792220° North Latitude and -161.75583° West Longitude. (Sec. 09, T008N, R071W, Seward Meridian.) Bethel is located in the Bethel Recording District. The area encompasses 43.8 square miles of land and 5.1 square miles of water. Precipitation averages 16 inches a year in this area and snowfall averages 50 inches per year. Summer temperatures range from 42 to 62 degrees Fahrenheit. Winter temperatures range from -2 to 19 degrees Fahrenheit.

Project Staff

The Bethel City Planner Rick Abboud, oversaw the project. Planner Jeff Lee Harbormaster Heath Martin, Fire Chief George Young provided input.

ASCG Incorporated and Eileen R. Bechtol of Bechtol Planning & Development were hired to write the plan.

Scott Simmons and Ervin Petty of the Alaska Division of Homeland Security & Emergency Management (DHS&EM) provided technical assistance and reviewed the drafts of this plan.

Plan Research

The plan was developed utilizing existing Bethel plans and studies as well as outside information and research. Outside sources are credited in parenthesis after their inclusion and in the bibliography. The following plans and studies and the web

1. *Alaska State Hazard Plan*. Prepared by and for DHS&EM. September 2007

2. *Bethel Coastal Management Plan*. Conceptually Approved Draft. City of Bethel, June 1983.

3. *Bethel Coastal Management Plan*. Enforceable Policies. City of Bethel, January 1984.

4. *Bethel Coastal Management Plan Amendment*. City of Bethel, BP&D, January 2007.

5. *Bethel Comprehensive Plan*. City of Bethel, August 1997.

6. *Bethel Comprehensive Economic Development Strategy*. City of Bethel, May 2003.

7. *Bethel City website* http://www.cityofbethel.org/.

8. *Bethel Emergency Operations Plan*, 2005. City of Bethel, Alaska.

9. *Bethel Port Development Plan*. City of Bethel, January 1994.

10. *Climate change impacts, vulnerabilities, and adaptation in Northwest Alaska (No. 06-11).*_ Gregory, R., Failing, L., & Leiserowitz, A. (2006). Eugene: Decision Research. http://www.decisionresearch.org/Projects/Climate_Change/

11. *FEMA Benefit-Cost Analysis Website:* http://www.fema.gov/government/grant/bca.

12. FEMA How to Guides

Getting Started: Building Support For Mitigation Planning (FEMA 386-1) Understanding Your Risks: Identifying Hazards And Estimating Losses (FEMA 386-2) Developing The Mitigation Plan: Identifying Mitigation Actions And Implementing Strategies (FEMA 386-3) Bringing the Plan to Life: Implementing the Hazard Mitigation Plan (FEMA 386-4)

Using Benefit-Cost Review in Mitigation Planning (FEMA 386-5)

13. *Potential Consequences of Climate Variability and Change for Alaska.* Parson, Edward A., et al. (1999) A Report of the Alaska Regional Assessment Group for the U.S. Global Change Program. Prepared for the Center for Global Change and Arctic Research. Fairbanks.

Web Sites

American Planning Association:	http://www.planning.org
Association of State Floodplain Managers:	http://www.floods.org
Developing the Implementation Strategy:	www.pro.gov.uk
Federal Emergency Management Agency:	http://www.fema.gov/fima/planning.shtm
Community Rating System:	http://www.fema.gov/nfip/crs.htm
Flood Mitigation Assistance Program:	http://www.fema.gov/fima/planfma.shtm
Hazard Mitigation Grant Program:	http://www.fema.gov/fima/hmgp
Individual Assistance Programs:	http://www.fema.gov/rrr/inassist.shtm
Interim Final Rule:	http://www.access.gpo.govl
National Flood Insurance Program:	http://www.fema.gov/nfip
Public Assistance Program:	http://www.fema.gov/rrr/pa

Public Involvement

Site visits were conducted on July 19, 2006, October 10, 11, 2006 and February 8, 9, 2007. During these meetings the contractor met with the Bethel City Staff and attended public luncheons. The Bethel Planning Commission held a public worksession on February 8, 2007.

The public input meetings were advertised using usual city meeting notices, including flyers and attendance at these meetings were the Bethel City Council, Bethel City Staff, and members of the public. A copy of the draft Plan was available for public perusal at City Hall, Bethel Public Works Department, and Bethel Planning Commission.

Other organizations, besides each department in City, who were notified regarding the LHMP were the following:

- Village Native Council: Orutsararmuit Native Council

- Village Native Corporation: Bethel Native Corporation
- Regional Native Corporation: Calista Corporation
- Regional Health Corporation: Yukon-Kuskokwim Health Corporation
- Economic Development: Lower Kuskokwim Resource Conservation & Development
- Coastal Management District:

Another round of public input will be conducted after pre-approval by the State of Alaska and FEMA. The Planning Commission and the City Council will review and approve the plan after pre-approval by the State of Alaska and FEMA.

A copy of the draft Plan is available for public perusal at City Hall, Bethel Public Works Department, and Bethel Planning Commission.

Plan Implementation

The City Council of Bethel will be responsible for adopting the Bethel LHMP and all future updates or changes. This governing body has the authority to promote sound public policy regarding hazards. The Hazards Mitigation Plan will be assimilated into other Bethel plans and documents as they come up for review according to each plan's review schedule. Please see the following table for plan review schedules.

Table 1. Bethel Plans

Document	Completed	Next Review
Bethel Comprehensive Plan	2002	2007
Capital Improvement Projects Plan	Annually	2007
Emergency Operations Plan	2005	2007
Comprehensive Economic Development Strategy Plan	2003	2008
Bethel Water and Sewer Plan	2005	2010
Bethel Coastal Management Plan	2007	2012

Continuing Review Process

The City Planner of Bethel will evaluate the Bethel LHMP on an annual basis to determine the effectiveness of programs and to reflect changes in land development, status, or other situations that make changes to the plan necessary. The City Planner and his staff will review the mitigation project items to determine their relevance to changing situations in the city, as well as changes in state or federal policy and to ensure that mitigation continues to address current and expected conditions. The City Planner will review the hazard analysis information to determine if this information should be updated and/or modified, given any new available data or changes in status.

Continued Plan Development

The plan will continue to be developed as resources become available. Additional hazards not currently covered in the plan, including technological and manmade hazards, will be added, if funding becomes available during the next five-year update cycle.

The plan will be updated every five years or as funded or directed by DHS&EM or FEMA.

The City Planner will be responsible for updating and maintaining the plan by adding additional hazards and completing vulnerability assessments for existing hazard chapters.

The following table lists the schedule for completion of these tasks, provided that funds are available to do so:

Table 2. Continued Plan Development

Hazard	Status	Hazard Identification Completion Date	Vulnerability Assessment Completion Date
Floods	Completed	2007	2007
Erosion	Completed	2007	2007
Severe Weather	Completed	2007	2012
Wildland Fire	Completed	2007	2012
Earthquake	Completed	2006	2012
Economic	Future Addition	2009	2015
Technological	Future Addition	2009	2015
Public Health Crisis	Future Addition	2009	2015

Continued Public Involvement

The following methods were used for continued public involvement.

Spring break-up meetings.

City website: http://www.cityofbethel.org

Places where the hazard plan will be kept:

City Planning Department
City Public Works Department

City Hall
City Library
Orutsararmuit Native Council.

Risk Assessment Methodology

The goal of mitigation is to reduce the future impacts of a hazard including loss of life, property damage, and disruption to local and regional economies, environmental damage and disruption, and the amount of public and private funds spent to assist with recovery.

Mitigation efforts begin with a comprehensive risk assessment. A risk assessment measures the potential loss from a disaster event caused by an existing hazard by evaluating the vulnerability of buildings, infrastructure, and people. It identifies the characteristics and potential consequences of hazards and their impact on community assets.

A risk assessment typically consists of three components: hazards identification, vulnerability assessment, and risk analysis.

1. *Hazards Identification* – The first step in conducting a risk assessment is to identify and profile hazards and their possible effects on the jurisdiction. This information can be found in Chapter 3: Hazards.

2. *Vulnerability Assessment* – Step two is to identify the jurisdiction's vulnerability--the people and property that are likely to be affected. It includes everyone who enters the jurisdiction including employees, commuters, shoppers, tourists, and others.

Populations with special needs such as children, the elderly, and the disabled should be considered; as should facilities such as the health clinic because of their additional vulnerability to hazards.

Inventorying the jurisdiction's assets to determine the number of buildings, their value, and population in hazard areas can also help determine vulnerability. A jurisdiction with many high-value buildings in a high-hazard zone will be extremely vulnerable to financial devastation brought on by a disaster event.

Identifying hazard-prone critical facilities is vital because they are necessary during response and recovery phases. Critical facilities include:

- Essential facilities, which are necessary for the health and welfare of an area and are essential during response to a disaster, including hospitals, fire stations, police stations, and other emergency facilities;

- Transportation systems such as highways, airways and waterways;

- Utilities; water treatment plants, communications systems, power facilities;
- High potential loss facilities such as the levee and bulk fuel storage facilities; and
- Hazardous materials sites.

Other items to identify include economic elements, areas that require special considerations, historic, cultural and natural resource areas and other jurisdiction-determined important facilities.

3. *Risk Analysis* – The next step is to calculate the potential losses to determine which hazard will have the greatest impact on the jurisdiction. Hazards should be considered in terms of their frequency of occurrence and potential impact on the jurisdiction. For instance, a possible hazard may pose a devastating impact on a community but have an extremely low likelihood of occurrence; such a hazard must take lower priority than a hazard with only moderate impact but a very high likelihood of occurrence.

Additionally, the risk analysis must utilize a multi-hazard approach to mitigation. One such approach might be through a composite loss map showing areas that are vulnerable to multiple hazards.

For example, there might be several schools exposed to one hazard but one school may be exposed to four different hazards. A multi-hazard approach will identify such high-risk areas and indicate where mitigation efforts should be concentrated.

Currently there are insufficient funds and data with which to conduct an accurate risk analysis for all the hazards affecting Bethel. However, risk analysis information will be added as it is completed.

Vulnerability Assessment Methodology

The purpose of a vulnerability assessment is to identify the assets of a community that are susceptible to damage should a hazard incident occur.

Critical facilities are described in the Community Profiles Section of this hazard plan. A vulnerability matrix table of critical facilities as affected by each hazard is provided in Chapter 3 of this document.

Facilities were designated as critical if they are (1) vulnerable due to the type of occupant (children or elderly for example); (2) critical to the community's ability to function (roads, power generation facilities, water treatment facilities, etc.); (3) have a historic value to the community (cemetery); or (4) critical to the community in the event of a hazard occurring (emergency shelter, etc.).

Based on a pilot program the Federal Emergency Management Agency (FEMA) and the Alaska DHS&EM has initiated to inventory critical facilities in Alaska, it should be taken into consideration that Alaska critical facilities vary fundamentally from other states. A local post office in a rural community in Alaska may also be the location of the police station, emergency operations center, hospital, and only store within 100 miles.

This hazard plan includes an inventory of critical facilities, if applicable, from the Bethel City records and land use map.

Federal Requirement for Risk Assessment

Recent federal regulations for hazard mitigation plans outlined in 44 CFR Part 201.6 (c) (2) include a requirement for a risk assessment. This risk assessment requirement is intended to provide information that will help the community identify and prioritize mitigation activities that will prevent or reduce losses from the identified hazards. The federal criteria for risk assessments and information on how the Bethel LHMP meets those criteria are outlined below:

Table 3. Federal Requirements

Section 322 Requirement	How is this addressed?
Identifying Hazards	Bethel community members identified natural hazards at community meeting on September 18, 2006. This information was used in developing the Plan.
Profiling Hazard Events	The hazard-specific sections of the Bethel LHMP provide documentation for all of the large-scale natural hazards that may affect the City. Where information was available, the Plan lists relevant historical hazard events.
Assessing Vulnerability: Identifying Assets and Estimating Potential Losses	Vulnerability assessments for floods, erosion, severe weather, wildland fire and earthquakes have been completed and are contained within the hazard chapter. Additional vulnerability assessments will be added as they are funded and completed.
Assessing Vulnerability: Analyzing Development Trends	The Community Profile Section and Chapter 3 include a description of development in Bethel and the land use maps lists all the structures and utilities in the community.

Chapter 2: Community Profile

Community Overview

With a population of almost 6,000 people, the City of Bethel is the main port of the Kuskokwim River in the Yukon Kuskokwim Delta. Bethel serves as the regional hub for 56 surrounding Native villages. The region is land-locked from urban areas in Alaska. (Bethel City website)

Bethel is located at the mouth of the Kuskokwim River, 40 miles inland from the Bering Sea. It lies in the Yukon Delta National Wildlife Refuge, 400 air miles west of Anchorage, at approximately 60.792220° North Latitude and -161.75583° West Longitude. (Sec. 09, T008N, R071W, Seward Meridian.) Bethel is located in the Bethel Recording District. The area encompasses 43.8 square miles of land and 5.1 square miles of water. Precipitation averages 16 inches a year in this area and snowfall averages 50 inches per year. Summer temperatures range from 42 to 62 degrees Fahrenheit. Winter temperatures range from -2 to 19 degrees Fahrenheit.

Yup'ik Eskimos who called the village "Mumtrekhlogamute", meaning "Smokehouse People", named for the nearby fish smokehouse, first established Bethel. There were 41 people in Bethel during the 1880 U.S. Census. At that time, it was an Alaska Commercial Company Trading Post. The Moravian Church established a mission in the area in 1884. The community was moved to its present location due to erosion at the prior site. A post office was opened in 1905. Before long, Bethel was serving as a trading, transportation and distribution center for the region, which attracted Natives from surrounding villages. The City was incorporated in 1957. Over time, federal and state agencies established regional offices in Bethel.

A federally recognized tribe is located in the community—the Orutsararmuit Native Council. The population of the community is 68 percent Alaska Native or part Native. The region is fortunate in that rapid development did not occur

before the importance of protecting the Native culture was realized. The traditional Yup'ik Eskimo practices and language remain predominant in the area. Subsistence activities and commercial fishing are major contributors to residents' livelihoods. The sale of alcohol is banned in the community, although importation or possession is allowed. During the 2000 U.S. Census, total-housing units numbered 1,990 and vacant housing units numbered 249. Vacant housing units used only seasonally numbered 61. U.S. Census data for 2000 showed 2,459 residents as employed. The unemployment rate at that time was 8.95 percent, although 33.49 percent of all adults were not in the work force. The median household income was $57,321, per capita income was $20,267, and 11.18 percent of residents were living below the poverty level. (Alaska Department of Commerce, Community, and Economic Development (DCCED) website)

History

The history of Bethel began with the establishment of the permanent Eskimo village of Mumtrekhlogamute. The date has not been determined when the settlement first originated. Across the river from the village the first trading post was established by Reinhold Separe in the early 1870s. The settlement was known as Mumtrekhlogamute Station. A second trading post owned by the Alaska Commercial Company was established at the upriver end of the settlement near Brown Slough. The inventory of goods was owned by Separe, however the store was operated by Edward Lind (Oswalt). Moravian missionaries arrived at Mumtrekhlogamute Station in 1884 in search of a place to establish a mission. The following year John Kilbuck and William Weinland founded a mission one-half mile west of the trading post. The first school was opened in 1886, and by the turn of the century the Bethel Mission was well established.

Reindeer herding and fur farms were among the early industries in Bethel. The first reindeer were introduced to Alaska in 1892 in an effort to revitalize the Alaskan economy. In 1901, the Moravian mission received 175 reindeer. By the early 1930s approximately 43,000 reindeer grazed along the Kuskokwim River. The population of reindeer gradually diminished and in 1946 only 600 remained. During the 1930s, several residents of Bethel owned fur farms where mink and fox were raised. Remnants of an early fur farm can still be seen near the present site of the Chevron oil storage tanks.

As a result of the commercial activities associated with early industries and river uses, Bethel emerged as an economic and trade center for the surrounding region. Its role as a regional center was further reinforced with the development of transportation facilities and extensive capital projects financed by the government. Government and social services grew considerably during the 1960s and soon became the dominant force in Bethel's economy. Although many economic changes have occurred in Bethel since its beginnings, the traditional lifestyle and culture of the Yup’ik people remain visible today.

Climate

Bethel is located in a transitional climate zone. The major Influences on climate are the storms and weather patterns originating from the Bering Sea, 86 miles to the west. Bethel is also influenced by the inland continental climate, resulting in the warm mid-summer temperatures and the very cold midwinter temperatures. Bethel has a mean July temperature of 54.7° F and a mean January temperature of 6.0° F, with recorded temperature extremes ranging from 90° F to -52° F. The warmer summer winds are predominantly SSW, shifting to a cool NNE winds from October through March, then shifting to predominantly NW winds from April through June. Bethel has an average growing season of 101 days, the average last freezing temperature being recorded on May 30 and the average first freezing temperature being recorded on September 9. (DCCED website)

Transportation, Facilities, Utilities

Some residents are connected to the central piped water and sewer system. Approximately 75 percent of households have water delivered and sewage hauled by truck. Several facilities in Bethel have individual wells and septic tanks. For health reasons the City ruled that residents can no longer use honey buckets. Extensions of the piped systems to the City Subdivision and Old Town are under construction. Water Treatment Plant improvements have been completed in Bethel Heights. Additional funding has been requested to connect 105 homes to the piped system. Electricity is provided by Bethel Utilities Corporation.

There are six schools located in the community, attended by 1,328 students. Local hospitals or health clinics include Yukon-Kuskokwim Delta Regional Hospital (543-6511); Bethel Family Health Clinic (543-3773). The hospital is a qualified Acute Care facility, and the clinic is a qualified Emergency Care Center. Specialized Care: YKHC Phillips Alcohol Program (City-operated health care, lodging, rehabilitation); YKHC Outpatient Services (Calista-operated health care, information); Bethel Community Services' Malon. Bethel is classified as a large town/Regional Center, it is found in EMS Region 7A in the Yukon/Kuskokwim Region. Emergency Services have limited highway, river, floatplane, and airport access. Emergency service is provided by 911 Telephone Service, volunteers and a health aide. Auxiliary health care is provided by Bethel Fire Department and Ambulance Service; Yukon Kuskokwim Health Corporation Ambulance, and Aeromed International Medevac.

The State-owned Bethel Airport is the regional transportation center, and is served by a number of passenger airlines, cargo carriers, and numerous air taxi services. Bethel is the third busiest airport in Alaska. It offers a 6,398-foot-long by 150-foot-wide asphalt runway and 1,850-foot-long by 75-foot-wide gravel crosswind runway, and is currently undergoing a $7 million renovation and expansion. Two floatplane bases are nearby, Hangar Lake and H Marker Lake. The Port of Bethel includes a small boat harbor, dry land storage, and up to 5,000 feet of transient moorage on the seawall. River travel is

the primary means of local transportation in the summer, and the Kuskokwim River becomes a 150-mile ice road to surrounding villages in the winter. A barge service based in Bethel provides goods to the Kuskokwim villages. There are 16 miles of graded dirt roads maintained by the City and 22 miles of paved roads maintained by the State DOT. Winter trails are marked to Napakiak (1.1 miles) and Akiachak (19 miles). (DCCED website)

Soils

The most recent soil survey of the Bethel area was completed in 1966. The total map area is 11,465 acres (including 1,020 acres of water area), or about one-third of the area within the city limits. Most Bethel soils are silty, acidic, poorly drained, have a low shrink-swell potential, and have variable to high frost action. Most soils are not suitable for agricultural or urban uses.

Permafrost

Permafrost is defined as 1) permanently frozen material underlying the soil (upper soil horizons), or 2) a permanently frozen soil horizon (Brady). Permafrost underlies most of Bethel but is absent from localized areas close to large water bodies. The permafrost begins 12 to 40 inches below the surface, has an average depth of 400 feet, and a maximum depth of 600 feet. The typical temperature of the permafrost at depths just below the layer of seasonal variation ranges from 28° to 31.5° F, with some spots as much as 2° F above freezing (Malone, personal communication).

The geology beneath Bethel is very young, composed almost entirely of flood plain alluvium and silt deposits. Northeast of Hangar Lake is an area of reworked silt. Floodplain alluvium is composed of recent deposits of mud, silt, sand, gravel, boulders, and intermixed wood, peat, and other vegetal material. Silt deposits contain abundant permafrost, and are composed of organic "mulch" which becomes sandier with depth and contains areas of pebbles and wood fragments. Silt deposits probably originated from the river but some areas may include wind and marine deposits. Reworked silt is a plain, transitional with or slightly above younger flood plain 2-5 deposits and separated from older silt deposits by an erosional scarp 10 to 50 feet high. The scarp suggests that the plain is an erosional feature formed by dissection and almost complete removal of the upper part of older silt deposits (USES).

Table 4. Community Information

Community Information	Contact Information and Type
Current Population	5,960 (DCCED 2005 Cert. Pop.)
Incorporation Type	Second Class City Rick Abboud City of Bethel P.O. 388 Bethel, AK 99559 (907) 543-5301, Fax (907)543-4186 Email: rabboud@cityofbethel.net
Borough Located In	Unorganized
Village Native Council	Orutsararmuit Native Council P.O. Box 927 Bethel, AK 99559-0927 Phone 907-543-2608 Fax 907-543-2639 E-mail folrun@nativecouncil.org
Village Native Corporation	Bethel Native Corporation P.O. Box 719 Bethel, AK 99559 Phone 907-543-2124 Fax 907-543-2897
Regional Native Corporation	Calista Corporation 301 Calista Court, Suite A Anchorage, AK 99518-3028 Phone 907-279-5516 Fax 907-272-5060 E-mail calista@calistacorp.com Web http://www.calistacorp.com

Community Information	Contact Information and Type
Regional Native Non-Profit	Association of Village Council Presidents, Inc. 101 A Main Street, Pouch 219 Bethel, AK 99559 Phone 907-543-7300 Fax 907-543-3596 E-mail Myron_Naneng@avcp.org Web http://www.avcp.org
Regional Health Corporation	Yukon-Kuskokwim Health Corp. P.O. Box 528 Bethel, AK 99559 Phone 907-543-6020 Fax 907-543-6006 E-mail gene_peltola@ykhc.org Web http://www.ykhc.org/
Economic Development	Lower Kuskokwim Resource Conservation & Development P.O. Box 1869 Bethel, AK 99559 Phone 907-543-7157
Coastal Management District	Ceñaliulriit Coastal Resource Service Area P.O. Box 219 Bethel, AK 99559 Phone 877-827-8747 E-mail cenaliulriit@starband.net

Community Assets

This section outlines the resources, facilities and infrastructure that, if damaged, could significantly impact public safety, economic conditions, and environmental integrity of Bethel.

Community Map

1994 Land Use Plan
FIRM map

Critical Facilities: Those facilities and infrastructure necessary for emergency response efforts.

- Bethel Airport

- Bethel Harbor

Essential Facilities: Those facilities and infrastructure that supplement response efforts.

- Designated Shelters

Table 5. Bethel Designated Shelters

NAME	ADDRESS	CONGREG-ATE CARE
Church of JC of LDS	Tundra Ridge, Bethel	88
Kilbuck Elementary	Fourth Ave, Bethel	840
Bethel Primary School	Ridgecrest Dr., Bethel	396
Lower Kuskokwi School District	Ridgecrest Dr., Bethel	837
Bethel Regional High	Ridgecrest Dr., Bethel	1474
Bethel Community College	Akiak Dr., Bethel	660
Bethel Assembly of God	Sixth Ave., Bethel	120
National Guard Armory	Fourth Ave., Bethel	278
US Fish & Wildlife	State Highway., Bethel	261
Moravian Church	Third Ave., Bethel	115
Moravian Office Bldg	Third Ave., Bethel	46
Bethel Covenant Church	State Highway, Bethel	53

Source: Bethel Emergency Operation Plan, 2005

- City Hall Building
- Police Department
- Public Works Department
- Fire Department
- Bulk Fuel Storage Tank Farm

Critical Infrastructure: Infrastructure that provides services to Bethel.

- Telephone lines
- Power lines
- Transportation networks
- Wastewater collection
- Lift Stations

Vulnerable Populations: Locations serving population that have special needs or require special consideration.

- Bethel High School

Cultural and Historical Assets: Those facilities that augment or help define community character, and, if lost, would represent a significant loss for the community.

- Bethel Community Center
- Orutsararmuit Native Council

Community Resources

This section outlines the resources available to Bethel for mitigation and mitigation-related funding and training.

Federal Resources

The federal government requires local governments to have a hazard mitigation plan in place to be eligible for funding opportunities through FEMA, such as through the Pre-Disaster Mitigation Assistance Program and the Hazard Mitigation Grant Program. The Mitigation Technical Assistance Programs available to 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. Five key resource documents are available from FEMA Publication Warehouse (1-800-480-2520) and are briefly described below:

- **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 mirror the four major phases of hazard mitigation planning used in the development of the Bethel Hazard Mitigation Plan. 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 Disaster Mitigation Act (DMA) 2000 requirements (http://www.fema.gov/fima/planhowto.shtm).

- **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 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 CD.** FEMA 372, September 2001. This CD contains a wealth of information about mitigation and is useful for state 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 and local governments, the President's disaster assistance program (administered by FEMA) is the primary source of federal assistance. This handbook discusses the procedures and processes 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 Bethel businesses.

Other federal resources include:

- **Department of Agriculture.** 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, 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 Housing and Urban Development, 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.** Administered by DCCED, Division of Community Advocacy. 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, 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 the Federal Deposit Insurance Corporation (FDIC) or Federal Home Loan Bank Board (FHLBB) may be permitted to waive early withdrawal penalties for Certificates of Deposit and Individual Retirement Accounts.

- **Internal Revenue Service, 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.

- **United States 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 the Alaska DHS&EM.

Other resources: The following are websites that provide focused access to valuable planning resources for communities interested in sustainable development activities.

- **Federal Emergency Management Agency,** 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,** 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,** http://ibhs.org – an initiative of the insurance industry to reduce deaths, injuries, property damage, economic losses, and human suffering caused by natural disasters. Online resources provide information on natural hazards, community land use, and ways citizens can protect their property from damage.

State Resources

DHS&EM is responsible for coordinating all aspects of emergency management for the State of Alaska. Public education is one of its identified main categories for mitigation efforts.

Improving hazard mitigation technical assistance for local governments is another high priority item for the State of Alaska. Providing hazard mitigation training, current hazard information, and the facilitation of communication with other agencies would encourage local hazard mitigation efforts. DHS&EM provides resources for mitigation planning on their website at http://www.ak-prepared.com.

DCCED, Division of Community Advocacy: Provides training and technical assistance on all aspects of the National Flood Insurance Program (NFIP) and flood mitigation.

Other state resources include:

- **Division of Senior Services:** Provides special outreach services for seniors, including food, shelter, and clothing.

- **Division of Insurance**: Provides assistance in obtaining copies of policies and provides information regarding filing claims.

- **Department of Military and Veteran's Affairs:** Provides damage appraisals and settlements for VA-insured homes, and assists with filing of survivor benefits.

Other Funding Sources and Resources

- **Real Estate Business.** State law for properties within flood plains requires real estate disclosure.

- **American Red Cross.** 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, and essential tools. 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.

Local Resources

Bethel has a very limited number of planning and land management tools that will allow it to implement hazard mitigation activities. The resources available in these areas have been assessed by the City, and are summarized in the following tables:

Table 6. Legal and Technical Capability

Regulatory Tools (ordinances, codes, plans)	Local Authority (Y/N)
Building code	No
Zoning ordinance	Yes
Subdivision ordinance or regulations	Yes
Special purpose ordinances (floodplain management, stormwater management, hillside or steep slope ordinances, wildfire ordinances, hazard setback requirements)	Yes
Growth management ordinances (also called "smart growth" or anti-sprawl programs)	No
Site plan review requirements	Yes
Comprehensive plan	Yes
A capital improvements plan	Yes
An economic development plan	Yes
An emergency response plan	Yes
A post-disaster recovery plan	No
A post-disaster recovery ordinance	No
Real estate disclosure requirements	No

Table 7. Administrative and Technical Capability

Staff/Personnel Resources	Y/N
City Manager	Yes
City Clerk	Yes
Public Works Director	Yes
Librarian	No
Volunteer Fire Chief and Volunteer Dragon Slayer firefighters	Yes
Planner(s) or engineer(s) with knowledge of land development and land management practices	Yes
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	Yes
Planners or Engineer(s) with an understanding of natural and/or human-caused hazards	No
Floodplain manager	Yes
Surveyors	No
Staff with education or expertise to assess the community's vulnerability to hazards	Yes
Personnel skilled in GIS and/or HAZUS	Yes
Scientists familiar with the hazards of the community	No
Emergency manager	Yes
Grant writers	Yes
Environmental Advisory Council	No

Table 8. Fiscal Capability

Financial Resources	Accessible or Eligible to Use (Yes or No)
Community Development Block Grants (CDBG)	Yes
Capital improvements project funding	Yes
Authority to levy taxes for specific purposes	Yes
Fees for sewer	Yes
Impact fees for homebuyers or developers for new developments/homes	No
Incur debt through general obligation bonds	Yes
Incur debt through special tax and revenue bonds	Yes
Incur debt through private activity bonds	No
Withhold spending in hazard-prone areas	No

Chapter 3: Hazards

Hazard Matrices – City of Bethel

Table 9. Hazard Matrix

Hazard Matrix – City of Bethel					
Flood	**Wildland Fire**	**Earthquake**	**Volcano**	**Avalanche**	**Tsunami & Seiche**
Y-H	Y-L	N	N	N	N
Severe Weather	**Landslides**	**Erosion**	**Drought**	**Technological**	**Economic**
Y-H	N	Y-H	N	Y	Y-L

Hazard Identification:	
Y:	Hazard is present in jurisdiction but probability unknown
N:	Hazard is not present
U:	Unknown if the hazard occurs in the jurisdiction
Risk:	
L :	Hazard is present with a low probability of occurrence. Event has up to 1 in 10 years chance of occurring.
M :	Hazard is present with a moderate probability of occurrence. Event has up to 1 in 3 year's chance of occurring.
H :	Hazard is present with a high probability of occurrence. Event has up to 1 in 1 year chance of occurring.

Source: Alaska State All-Hazards Plan, 2007

Table 10. Previous Occurrences and Extent of Hazards

Previous Occurrences and Extent – City of Bethel					
Flood	**Wildland Fire**	**Earthquake**	**Volcano**	**Avalanche**	**Tsunami & Seiche**
13 - L	0	0	0	0	0
Severe Weather	**Ground Failure**	**Erosion**	**Drought**	**Technological**	**Economic**
5 - L	0	2 - L	0	3 - L	0

Extent Z - Zero - Used for historical information. An event occurred but may not have caused damage or loss.
L - Limited – Minimal through maximum impact to part of community.
Falls short of the definition for total extent.
T - Total – Impact encompasses the entire community.
Number: Number of occurrences

Source: Alaska State All-Hazards Plan, 2007

Hazard Vulnerability Assessment Matrix

Identification of Assets

The Hazard Vulnerability Matrix below includes a list of facilities, utilities and businesses and their vulnerability to natural hazards.

- Essential facilities, which are necessary for the health and welfare of an area and are essential during the response and recovery phase of a disaster such as city facilities, health clinic and schools.

- Transportation systems such as the airport and roads.

- Lifeline utility systems such as potable water and wastewater treatment plant, fuel farms, electrical generation facilities, power grid and communications systems.

- Businesses that provides services or commodities.

The following table was prepared by the City Planning Department files and NFIP maps.

Table 11. Bethel Hazard Vulnerability Matrix

Facility	Flood/Erosion	Tundra/Grassland Fire	Severe Weather	Earthquake
Bethel Airport		X	X	X
First National Bank	X	X	X	X
Prop Shop	X	X	X	X
Hoffman Fuel	X	X	X	X
Swanson Store	X	X	X	X
North Star Gas	X	X	X	X
Swanson Grocery	X	X	X	X
Swanson Lumber	X	X	X	X
Swanson Hardware	X	X	X	X
Swanson Polaris	X	X	X	X
River Street Auto	X	X	X	X
Front Street Café	X	X	X	X
Yukon Lodge	X	X	X	X
Corina's Case Lot	X	X	X	X
Restaurant	X	X	X	X
Nickleson Auto	X	X	X	X
Napa Store	X	X	X	X
Lumber Yard	X	X	X	X
Datu's Restaurant	X	X	X	X
Shogun Restaurant	X	X	X	X

Facility	Flood/Erosion	Tundra/Grassland Fire	Severe Weather	Earthquake
Swanson Furniture	X	X	X	X
Long House Hotel	X	X	X	X
Bently's B&B	X	X	X	X
Alaska Inn	X	X	X	X
Bethel Family Clinic	X	X	X	X
Ed's Auto Shop	X	X	X	X
Faulkner Walsh Construction Company	X	X	X	X
Pizzeria Restaurant	X	X	X	X
Valcarce Law Offices	X	X	X	X
Angstman Law	X	X	X	X
Catholic Church	X	X	X	X
Boat Shop	X	X	X	X
Anica River Store	X	X	X	X
Radio Shack	X	X	X	X
Kuskokwim Lighterage	X	X	X	X
Northland Services	X	X	X	X
Stan Barber Shop	X	X	X	X
Anvil Gun Shop	X	X	X	X
Lisa's Depot	X	X	X	X
Unicom	X	X	X	X
Back Creek Marina	X	X	X	X
Lomack Building	X	X	X	X
Bering Sea Veterinary Clinic	X	X	X	X
The White House B & B	X	X	X	X
Kuskokwim Cab Shop	X	X	X	X
Y-K Delta Regional Hospital		X	X	X
City Hall		X	X	X
Public Works Department		X	X	X
Police/Fire Department		X	X	X
State of Alaska Fish and Wildlife	X	X	X	X
KCC Correctional	X	X	X	X
Post Office		X	X	X
UAF – Kuskokwim Comm. College	X	X	X	X

Facility	Flood/Erosion	Tundra/Grassland Fire	Severe Weather	Earthquake
Killuck Elementary School	X	X	X	X
Bethel Regional High School		X	X	X
ONC Building		X	X	X
Federal Fish and Wildlife		X	X	X
AC Store		X	X	X
Bethel Native Corporation		X	X	X

Bethel's Vulnerability to Identified Hazards:

In summary, most identified hazards are area wide. The principal hazards of flood, erosion, wildland fire, severe weather and earthquake could potentially impact any part of Bethel.

Flooding events, even for those properties unaffected directly, will suffer due to road closures, impacts to public safety (access and response capabilities), limited availability of perishable commodities, and isolation. Please see the Bethel Flood Overlay map in and flood section on the following pages.

A severe weather event would create an area-wide impact and could damage structures and potentially isolate Bethel from the rest of the state.

Earthquake damage would be area wide with potential damage to critical infrastructure up to and including the complete abandonment of key facilities. Limited building damage assessors are available in Bethel to determine structural integrity following earthquake damage. Priority would have to be given critical infrastructure to include: public safety facilities, healthcare facilities, shelters and potential shelters, and finally public utilities.

The City of Bethel does not collect property tax, therefore property values for the above listed facilities and businesses is not available. At the February 8, 2007 meeting the Planning Commission listed the following businesses as the most expensive to replace if they were destroyed by a natural hazard.

Long House Hotel
Bethel Family Clinic
Radio Shack
Kuskokwim Lighterage
Northland Services
Swanson Facilities

Section 1. Floods and Erosion

Hazard Description and Characterization

The following hazard description and characterization were, in part, taken from the *Ceñaliulriit CRSA Coastal Management Plan Amendment, 2007* and *Climate change impacts, vulnerabilities, and adaptation in Northwest Alaska (No. 06-11).* Please see the bibliography for the complete citations.

Since Bethel is located 40 miles upstream from the Bering Sea the flooding and erosion hazards are river flooding, wave and slough erosion, river ice, and melting permafrost. Permafrost and erosion place constraints on the development of resources, transportation and utility systems, and community expansion within the Bethel community.

The effects of climate change are expected to add to natural hazards including flooding in coastal areas. As sea level rises and the offshore ice pack retreats, more flooding can be expected.

Flooding is also caused by ice jams, snowmelt, and rainfall. The highest flood level recorded in Alaska is 46 feet. In areas of low elevation, such as deltas and flat tundra, a 6-inch rise in the water level can flood a vast area.

Factors that affect the level of coastal flooding include wind conditions, exposure of the site and ice conditions. Due to climate change, some coastal areas of Alaska are freezing later in the season; with the later formation of protective shore ice, shorelines will become increasingly vulnerable to fall storms and associated storm surges.

The entire community of Bethel is subject to continuous permafrost, although in some areas the top layer of the land may thaw during summer. All soils are subject to thermal degradation, and ice-rich fine-grained soil is the most problematic. Melting permafrost can result in lakes or depressions.

Over 80 percent of Alaska is covered by permafrost, and permafrost is recognized as a natural hazard in the scientific literature. A number of institutions have developed extensive research on permafrost including the U.S. Army Corps of Engineers (COE) Cold Regions Research and Engineering Laboratory and the Permafrost Laboratory at the University of Alaska Geophysical Institute.

Ice Override: Movement of ice to a point more than 33 feet from the high-water mark is known as ice override (movements less than that are called ice pile up). Ice override events are often slowed by ice pile-ups. In the Canadian Arctic, ice pile-ups have reached the height of 98 feet.

Arctic residents have reported ice override events that occurred without warning. Areas more susceptible than others to ice override include areas where the nearshore slope is steep and where there are no offshore bars or shoals to slow the movement of ice. Ice override has implications for offshore drilling platforms, ice and gravel islands and shoreside facilities. Most of the ice override events observed in the Beaufort Sea were on the barrier islands including Cross, Jeannette and Narwahl Islands.

Gravel islands in the shorefast ice zone can accumulate piles of ice. Early in the winter the forces related to the ice pile up are not great, but later in the winter, ice rubble can transfer more significant loads to the island.

Melting permafrost: A task force commissioned by the U.S. Arctic Research Commission (USARC) in 2002 found that permafrost plays three key roles in the context of climate changes: as a record keeper (temperature archive); as a translator of climatic change (subsidence and related impacts); and as a facilitator of climatic change (impact on the global carbon cycle). The potential for melting of ice-rich permafrost constitutes a significant environmental hazard in high-latitude regions.

Permafrost records temperature changes and other information about environmental changes; it has a memory of past temperatures. Temperature trends spanning a century or more can be recorded in thick permafrost. Analysis of data gathered from boreholes made by the U.S. Geological Survey in northern Alaska show that the temperature of permafrost on the North Slope has generally risen by 2 to 4°F in the past century.

Thawing of ice-rich permafrost may result in settlement of the ground surface, which often has severe consequences for human infrastructure and natural ecosystems. Melting of glaciers in Alaska and elsewhere will increase the rates of coastal erosion in areas of ice-rich permafrost, already among the highest in the world. Sediment input to the Arctic shelf derived from coastal erosion may exceed that from river discharge. Thawing effects to the active layer of permafrost may alter the activities and functions of the permafrost. Soil moisture content has an important effect on its thermal qualities, soil heat flow and the vegetation is supports.

Permafrost can facilitate further climate change through the release of greenhouse gases. Considerable amounts of carbon are trapped in the upper layers of permafrost; an increase in the thickness of the thawed layer of permafrost could release large quantities of CO_2 and CH_4 to the atmosphere. This could amplify regional and global warming. A further problem in some areas in the Alaskan arctic is the presence of a significant number of sites where contaminants were buried in previous decades. Contaminants are mobile in the active layer of permafrost and some can be mobile within frozen ground. When permafrost thaws, the ground becomes permeable, allowing contaminants to spread laterally and reach other layers.

The thawing of permafrost will cause changes in hydrology. Where it has a high ice content, thawing can result in severe, uneven subsidence of the surface, called

thermokarst, which has been observed to exceed 16 feet. Flooding or draining of an area may result from permafrost melt, affecting the uses of the surface.

Shoreline erosion: Storms systems along coasts produce high winds that in turn generate large waves and currents. Storm surges can temporarily raise water levels by as much as 23 feet, increasing the vulnerability of shorelines and floodplains to changes to tidal ranges in rivers and bays, and changes in sediment and nutrient transport which drive beach processes.

Floodwaters pose a health hazard by picking up contaminants and disease as they travel. Outhouses, sewers, septic tanks, and dog yards are all potential sources of disease transported by floodwaters. Lack of a water source is a significant concern for flood victims, especially if the flood has been extensive enough to contaminate the public water supply. In such a case, outside bottled water is at times the only source of clean water.

Local Flood and Erosion Hazard Identification

Kuskokwim Riverbank Erosion.

Because of its location on the largest oxbow curve in the Kuskokwim River, Bethel is highly susceptible to the river's erosive force. When it was founded, Bethel was protected from the river by several islands. By 1939, however, the river had eroded the islands and threatened the city. High velocity water eats away at the outside bend of the river. Erosion at Bethel is exacerbated by a number of other factors. Steep banks of unconsolidated silty sand or sandy silt material are easily eroded. Warm-water eddies and a south facing aspect melt the permafrost in the riverbank causing slumping of the steep material. Wave action from southerly storm winds exacerbates bank instability.

Documentation of the Bethel riverbank erosion began in 1939. Erosion now averages eight feet per year along the town front and twenty-five feet per year in front of the old PHS hospital and the Chevron tank farm. The channel on the east side of the island in front of Bethel is becoming the main channel of the river. The erosion rate should increase in the east channel and decrease in front of Bethel. The bank erosion process begins when wind and boat traffic drive waves into the bank, eroding the toe. The southeast exposure to the sun and rain along the high bank melts the permafrost and saturates the soil. The soil saturation combined with the toe erosion creates bank instability, which results in the bank sliding into the river. The eroded material is carried away by the river and exposes more of the bank to the erosion process. Erosion is further compounded by removal of vegetation along the top of the riverbank and by ice gouging.

Past bank stabilization efforts have included a timber bulkhead, submarine netting, and the infamous junked cars. All past efforts have failed and many buildings have been destroyed, with many more in immediate danger. The U.S. Army Corps of Engineers

Bank Stabilization Study recommended three alternatives for further study: 1) Articulated concrete mattress, at a cost of $25,200,000 and estimated maintenance costs of $600,000 every five years over the fifty year lifespan; 2) Rock riprap, at a cost of $14.7 million and maintenance costs of $250,000 every five years over the fifty year lifespan; 3) River diversion structure with bank stabilization, at a cost of $27.0 million and maintenance costs of $1.8 million every five years. Other options that were rejected because of expense, public acceptance, or engineering feasibility included a steel wall with articulated concrete mattress toe protection, steel wall and sloped bank, river diversion dike, river diversion channel, and a nonstructural alternative of intensive riverfront land use management. The Corps selected plan is rock riprap and this proposal is currently being reviewed by Congress for federal funding.

Onshore Erosion

The primary cause of onshore erosion is improper construction of buildings and roads. Many buildings are constructed on sand pads, and in the past water erosion and ponding problems have resulted from little consideration of natural drainage when siting buildings. Road construction has resulted in similar drainage problems. Road and building construction also often results in a large quantity of unconsolidated sand and silt. The sand and silt clogs culverts and drainage pipes and is picked up by the wind which aggravates the dusty air conditions common in Bethel during the summer.

Previous Occurrences

Bethel, July 10, 1985 High water accompanying breakup of the Kuskokwim River caused erosion damage at the city petroleum dock and washout of fill at the end of the seawall. Undercutting of riverbank also threatened eight private residences. The Governor's Proclamation of Disaster Emergency provided public assistance to replace fill at the petroleum dock and seawall end. The State also provided funds to relocate the endangered homes, with the provision that the City of Bethel guarantee that the threatened property remain undeveloped.

Bethel, July 2, 1990 Abnormally high water in the Kuskokwim River during breakup and continuing for an extended period after breakup resulted in scouring of toe material along the Bethel bulkhead, dislocation of the pipe pilings that form the bulkhead, and loss of material behind these pilings. The disaster declaration supported repair of the bulkhead and placement of riprap material along the toe of affected sections.

Bethel Sinkhole Erosion On June 5, 1995, the Governor declared that a condition of disaster emergency exist in the City of Bethel, as a result of erosion during spring breakup. As a result of this disaster the face of the protective sea wall was damaged causing erosion under the City Dock to create and expand sinkholes on the dock.

00-191 Central Gulf Coast Storm declared February 4, 2000 by Governor Murkowski then FEMA declared (DR-1316) on February 17, 2000: On Feb 4 2000, the Governor declared a disaster due to high impact weather events throughout an

extensive area of the state. The State began responding to the incident since the beginning of December 21, 1999. The declaration was expanded on February 8 to include City of Whittier, City of Valdez, Kenai Peninsula Borough, Matanuska-Susitna Borough and the Municipality of Anchorage. On February 17, 2000, President Bill Clinton determined the event disaster warranted a major disaster declaration under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93-288 as amended ("the Stafford Act). On March 17, 2000, the Governor again expanded the disaster area and declared that a condition of disaster exists in Aleutians East, Bristol Bay, Denali, Fairbanks North Star, Kodiak Island, and Lake and Peninsula Boroughs and the census areas of Dillingham, **Bethel**, Wade Hampton, and Southeast Fairbanks, which is of sufficient severity and magnitude to warrant a disaster declaration. Effective on April 4, 2000, Amendment No. 2 to the Notice of a Major Disaster Declaration, the Director of FEMA included the expanded area in the presidential declaration. Public Assistance, for 64 applicants with 251 PW's, totaled $12.8 million. Hazard Mitigation totaled $2 million. The total for this disaster is $15.66 million.

Spring Floods, FEMA declared (DR-0832) on June 10, 1989 Presidential Declaration of Major Disaster, incorporated sixteen local declarations and applied to all communities on Yukon, **Kuskokwim** and Kobuk rivers and their tributaries. Provided public and individual assistance to repair damage.

'89 Spring Floods Hazard Mitigation, April 14, 1990 The Major Disaster Declaration by the President in response to **statewide flooding** in the Spring of 1989 authorized the commitment of federal funds to projects designed to mitigate flood damage in future years. Since the federal funding required a State-matching share, the Governor declared a disaster to provide these funds and authorize their expenditure.

Lower Kuskokwim, September 4, 1990 A severe storm compounded by high tides caused extensive flooding in coastal communities of the **Kuskokwim** and Bristol Bay areas and along the lower Kuskokwim River. The flooding caused damage to both public and private property. The disaster declaration authorized assistance to local governments, individuals and families affected by the flooding.

Central Gulf Coast Storm declared February 4, 2000 by Governor Murkowski then FEMA declared (DR-1316) on February 17, 2000: On Feb 4 2000, the Governor declared a disaster due to high impact weather events throughout an extensive area of the state. The State began responding to the incident since the beginning of December 21, 1999. The declaration was expanded on February 8 to include City of Whittier, City of Valdez, Kenai Peninsula Borough, Matanuska-Susitna Borough and the Municipality of Anchorage. On February 17, 2000, President Bill Clinton determined the event disaster warranted a major disaster declaration under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, P.L. 93-288 as amended ("the Stafford Act). On March 17, 2000, the Governor again expanded the disaster area and declared that a condition of disaster exists in Aleutians East, Bristol Bay, Denali, Fairbanks North Star, Kodiak Island, and Lake and Peninsula Boroughs and the census areas of Dillingham, **Bethel**, Wade Hampton, and Southeast Fairbanks, which is of sufficient severity and magnitude to warrant a disaster declaration. Effective on April 4, 2000, Amendment No.

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Flood and Erosion Hazard Vulnerability

To some degree, flooding occurs in Bethel annually. The COE has determined that a significant portion of Bethel is a Special Flood Hazard Zone. Bethel's Special Flood Hazard Areas are those areas where the ground elevation is below 17.1 feet mean lower low water (MLLW).

Eighty percent of the residential and commercial areas have been flooded in the past. Areas such as Brown's Slough are the most flood prone and contain a high density of the residential development. Flooding is typically caused by ice jams during breakup, but heavy rains in late summer and early fall can also flood Bethel. Poor drainage, frozen ground, permafrost, and low relief contribute to the flooding problems. Ice jams occur because of tight meander bends and islands downstream of Bethel create narrow channels where ice floes become blocked. Because the river flows at a shallow gradient near Bethel, it does not have enough force to free the blockage resulting in a backwater affect causing flooding in Bethel. Similar ice jams, on a smaller scale, occur on sloughs. Frozen culverts have also caused flooding (City of Bethel Comprehensive Plan Background Study, August 1997).

Projects to try to control erosion have been ongoing since 1966 when a timber bulkhead with wood pilings was constructed. By 1971, the bulkhead had been undermined by scour and failed. After that, the community began placing junk automobiles and other large objects along the bank. While moderately successful, the practice was stopped by the State out of concern for pollution. In 1982, a multi-year erosion-protection project funded by the State of Alaska began. The construction technique used was to drive steel casings, underground tiebacks, and a rock embankment under water at the toe of these casings that sloped outward away from the wall. This system has incurred high maintenance costs but has prevented any further land loss where installed and maintained.

Drainage. Low relief, permanently frozen ground, and a general lack of effective drainage throughout the developed area also contribute to flooding problems. Exclusive of when the Kuskokwim River overtops its banks, the City experiences localized flooding following winter rains and spring snowmelt. In general, drainage conditions in the community improve as elevation increases. The lowest, flattest areas of the community are also subject to the worst drainage problems. Areas such as Lousetown, Swanson's business area, Elm Plant Dock area, and Alligator Acres experience localized flooding problems due to poor drainage. Higher areas, near the airport and west end of town are better drained because of higher elevations. Medium elevation areas (25-100 ft elevation) are typically better drained than the low areas, but may also be subject to localized areas of flooding due to drainage patterns.

The primary cause of flooding in Bethel is ice jams. The magnitude of the flood is influenced by several factors including snowmelt, winter and spring temperatures, precipitation, and ice thickness. The greatest flooding usually occurs in the spring when a thick river-ice buildup experiences rapid warming before breakup. Flooding is also common in late summer and early fall when Bethel experiences its heaviest rainfall of the year. Most of the developed part of Bethel is located within the 100-year flood plain. As previously mentioned, 80 percent of the major residential and commercial areas have been inundated by floods in the past. The lower Brown Slough area and Lousetown are flooded to some degree almost every year. A major flood can create a maximum river velocity of ten feet per second (fps), as compared to an average velocity of less than two fps The highest discharge recorded during a flood is almost 580,000 cubic feet per second, (cfs) compared to the average discharge of 60,000 cfs.

Community Participation in the NFIP

The City of Bethel participates in the NFIP.

The function of the NFIP is to provide flood insurance at a reasonable cost to homes and businesses located in floodplains. In trade, the City of Bethel would agree to regulate new development and substantial improvement to existing structures in the floodplain, or to build safely above flood heights to reduce future damage to new construction. The program is based upon mapping areas of flood risk, and requiring local implementation to reduce flood damage primarily through requiring the elevation of structures above the base (100-year) flood elevations. Table 12 describes the Flood Insurance Rate Map (FIRM) zones.

Table 12. FIRM Zones

Firm Zone	***Explanation***
A	Areas of 100-year flood; base flood elevations and flood hazard not determined.
AO	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet, average depths of inundation are shown but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood.
C	Areas of minimal flooding.
D	Areas of undetermined, but possible, flood hazards.

Development permits for all new building construction, or substantial improvements, are required by the City in all A, AO, AH, A-numbered Zones. Flood insurance purchase may be required in flood zones A, AO, AH, A-numbered zones as a condition of loan or grant assistance. An Elevation Certificate is required as part of the development permit. The Elevation Certificate is a form published by the Federal Emergency Management Agency required to be maintained by communities participating in the NFIP. According to the NFIP, local governments maintain records of elevations for all new construction, or substantial improvements, in floodplains and to keep the certificates on file.

Elevation Certificates are used to:

1. Record the elevation of the lowest floor of all newly constructed buildings, or substantial improvement, located in the floodplain.
2. Determine the proper flood insurance rate for floodplain structures
3. Local governments must insure that elevation certificates are filled out correctly for structures built in floodplains. Certificates must include:
   - The location of the structure (tax parcel number, legal description and latitude and longitude) and use of the building.
   - The Flood Insurance Rate Map panel number and date, community name and source of base flood elevation date.
   - Information on the building's elevation.
   - Signature of a licensed surveyor or engineer.

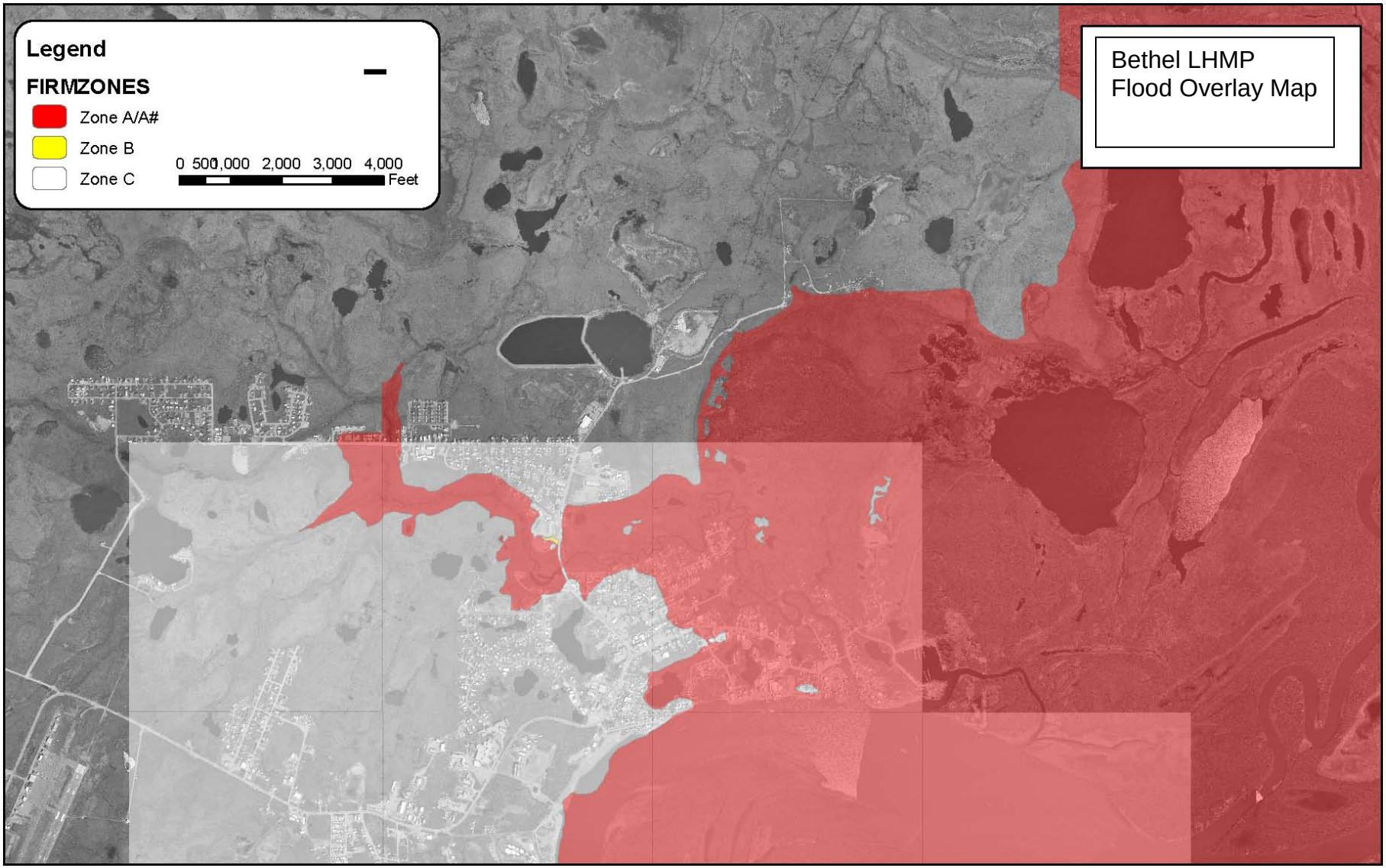
Table 13. NFIP Statistics

Emergency Program Date Identified	**Regular Program Entry Date**	**Map Revision Date**	**NFIP Community Number**	**CRS Rating Number**	**Total # of Current Policies (07/31/06)**
6/28/1974	3/16/1976	2/15/1985	020104 A	N/A	122
Total Premiums (07/31/06)	**Total Loss Dollars Paid**	**Average Value of Loss**	**AK State # of Current Policies**	**AK State Total Premiums**	**AK Total Loss Dollars Paid**
$108,187	$67,009	$5,155	2,559	$1.6 million	$3.4 million
Bethel Average Premium	**AK State Average Premium**	**Repetitive Loss Claims**	**Dates of Rep. Losses**	**Total Rep. Loss**	**Average Rep. Loss**
$887	$629	1 property – 3 losses	2005 1999 1995	$21,040	$7,013

Bethel Floodplain Coordinator	Rick Abboud City of Bethel P.O. 388 Bethel, AK 99559 (907) 543-5301, Fax (907)543-4186 Email: rabboud@cityofbethel.net
State of AK Floodplain Coordinator Taunnie Boothby	Floodplain Management Programs Coordinator Division of Community and Regional Affairs Department of Commerce, Community & Economic Development 550 W. 7th Avenue, Suite 1640 Anchorage, AK 99501 (907) 269-4567 (907) 269-4563 (fax) Email: taunnie_boothby@commerce.state.ak.us Website: http://www.commerce.state.ak.us/dca/nfip/nfip.htm
	Source: DCCED, DCRA, Floodplain Management

Please see Flood Overlay Map on the following page.

Figure 1. Bethel LHMP Flood Overlay Map



Flood and Erosion Mitigation Goals, Objectives and Projects

Goals and Objectives

Goal 1. Reduce flood damage.

Objective 1.1: Support elevation, flood proofing, buyout or relocation of structures that are in danger of flooding or are located on eroding banks.

Goal 2. Prevent future flood damage.

Objective 2.1: Continue enforcing NFIP regulations.

Goal 3. Increase public awareness

Objective 3.1 Increase public knowledgeable about mitigation opportunities, floodplain functions, emergency service procedures, and potential hazards.

Flood Projects

After receiving public input, it is the recommendation of this plan that the City of Bethel, along with other local, State and Federal entities look at the following projects for flood and erosion control.

Bethel Cargo Dock/Replacement Seawall

Replace the seawall at the Bethel Cargo Dock. This project has an estimated cost of $8.5 million.

Repair and Expand Harbor

This project would replace dirt in cages around the harbor with geoweb membrane material and rocks to help prevent erosion from the Kuskokwim River. The rocks must be barged into Bethel at a cots of approximately $10 million. The project is scheduled to be completed in 2011.

Continued Repair of Existing Seawall

This project would place hydro-seed on the existing seawall to help prevent the seawall from eroding, at a cost of $70,000.

Tie-back Replacement and Armor Rock Project

The existing seawall is in disrepair and requires tieback replacements and the addition of new armor rock to protect against flooding and erosion. The rock need to be barged in from St. Paul or Dillingham at an estimated cost of approximately $105/ton with 25 tons needed.

Replacement of Timber Seawall

The timber seawall, located on the east side of city dock should be replaced with a sheet pile wall system. This project is estimated to cost $4.3 million.

Structure Elevation and/or Relocation

A list of homes, commercial structures and critical facilities that are in danger of flooding and in erosion danger, should be identified and mitigation projects for elevating and/or relocating the structures determined.

Bethel Maps

Accurate flood maps should be prepared that delineate areas of flooding and upland areas.

Continue compliance with NFIP

Ensure that new structures and existing structure comply with the National Flood Insurance Program.

Public Education

Increase public knowledgeable about mitigation opportunities, floodplain functions, emergency service procedures, and potential hazards. This would include advising property owners, potential property owners, and visitors about the hazards. In addition, dissemination of a brochure or flyer on flood hazards in Bethel could be developed and distributed to all households.

Section 2. Severe Weather

Hazard Description and Characterization

Weather is the result of four main features: the sun, the planet's atmosphere, moisture, and the structure of the planet. Certain combinations can result in severe weather events that have the potential to become a disaster.

In Alaska, there is great potential for weather disasters. High winds can combine with loose snow to produce a blinding blizzard and wind chill temperatures to 75°F below zero. Extreme cold (-40°F to -60°F) and ice fog may last a week at a time. Heavy snow can impact the interior and is common along the southern coast. A quick thaw means certain flooding.

Winter Storms

Winter storms originate as mid-latitude depressions or cyclonic weather systems. High winds, heavy snow, and cold temperatures usually accompany them. To develop, they require:

- Cold air - Subfreezing temperatures (below 32ºF, 0ºC) in the clouds and/or near the ground to make snow and/or ice.

- Moisture - The air must contain moisture in order to form clouds and precipitation.

- Lift - A mechanism to raise the moist air to form the clouds and cause precipitation. Lift may be provided by any or all of the following:

- The flow of air up a mountainside.

- Fronts, where warm air collides with cold air and rises over the dome of cold air.

- Upper-level low pressure troughs.

Heavy Snow

Heavy snow, generally more than 12 inches of accumulation in less than 24 hours, can immobilize a community by bringing transportation to a halt. Until the snow can be removed, airports and major roadways are impacted, even closed completely, stopping the flow of supplies and disrupting emergency and medical services. Accumulations of snow can cause roofs to collapse and can 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, repairing damages, and the loss of business can have severe economic impacts on cities and towns. Injuries and deaths related to heavy snow usually occur as a result of vehicle accidents. Casualties also occur due to overexertion while shoveling snow and hypothermia caused by overexposure to the cold weather.

Extreme cold

What is considered an excessively cold temperature varies according to the normal climate of a region. In areas unaccustomed to winter weather, near freezing temperatures are considered "extreme cold". In Alaska, extreme cold usually involves temperatures below –40 degrees Fahrenheit. Excessive cold may accompany winter storms, be left in their wake, or can occur without storm activity.

Extreme cold can bring transportation to a halt across interior Alaska for days or sometimes weeks at a time. Aircraft may be grounded due to extreme cold and ice fog conditions, cutting off access as well as the flow of supplies to northern villages.

Extreme cold also interferes with a community's infrastructure. It causes fuel to congeal in storage tanks and supply lines, stopping electric generation. Without electricity, heaters 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.

Ice Storms

The term ice storm is used to describe occasions when damaging accumulations of ice are expected during freezing rain situations. They can be the most devastating of winter weather phenomena and are often the cause of automobile accidents, power outages and personal injury. Ice storms result from the accumulation of freezing rain, which is rain that becomes super cooled and freezes upon impact with cold surfaces. Freezing rain most commonly occurs in a narrow band within a winter storm that is also producing heavy amounts of snow and sleet in other locations.

Freezing rain develops as falling snow encounters a layer of warm air in the atmosphere deep enough for the snow to completely melt and become rain. As the rain continues to fall, it passes through a thin layer of cold air just above the earth's surface and cools to a temperature below freezing. The drops themselves do not freeze, but rather they become super cooled. When these super cooled drops strike the frozen ground, power lines, tree branches, etc., they instantly freeze.

Table 14. Bethel Weather Summary

BETHEL WSO AIRPORT, ALASKA
Period of Record General Climate Summary - Temperature

	Daily Extremes						Monthly Extremes					
	Max.	Min.	High	Date	Low	Date	Highest Mean	Year	Lowest Mean	Year	<= 32 F	<= 0 F
	F	F	F	dd/yyyy or yyyymmdd	F	dd/yyyy or yyyymmdd	F	-	F	-	# Days	# Days
January	12.4	-0.5	48	17/1963	-48	28/1989	25.7	1985	-12.9	1989	30.4	16.1
February	15.1	1.3	46	13/1970	-39	02/1954	26.1	1989	-13.2	1984	27.7	13.4
March	21.5	5.4	48	31/1954	-42	01/1956	29.4	1981	-3.1	1966	30.6	12.4
April	33.0	17.2	63	30/2004	-31	05/1956	34.9	1993	8.3	1985	28.0	4.4
May	49.4	32.5	80	31/1993	4	03/1965	48.1	1981	31.0	1964	15.4	0.0
June	60.0	43.0	86	19/1959	28	01/1960	57.8	1957	45.1	1978	0.6	0.0
July	62.9	48.0	86	11/1951	31	17/1959	61.1	2004	50.5	1959	0.0	0.0
August	59.6	46.7	87	09/2003	28	26/1984	59.4	2004	49.0	1969	0.1	0.0
September	51.9	38.4	72	10/1979	18	27/1957	50.2	1995	37.6	1992	5.8	0.0
October	35.7	24.3	65	02/1954	-6	30/2001	36.3	2002	23.4	2001	25.5	0.4
November	23.7	11.6	51	06/2002	-24	30/1990	27.4	1970	2.8	1963	28.5	6.6
December	13.8	0.8	45	21/1963	-41	28/1957	25.3	1985	-10.7	1999	30.5	15.7
Annual	**36.6**	**22.4**	**87**	**20030809**	**-48**	**19890128**	**34.3**	**2002**	**24.7**	**1956**	**223.0**	**69.0**
Winter	13.8	0.6	48	19630117	-48	19890128	21.8	2001	-2.7	1965	88.5	45.1
Spring	34.7	18.4	80	19930531	-42	19560301	36.6	1981	16.5	1972	74.0	16.8
Summer	60.8	45.9	87	20030809	28	19600601	58.8	2004	50.1	1965	0.7	0.0
Fall	37.1	24.8	72	19790910	-24	19901130	36.4	2002	25.2	1956	59.7	7.1

Table updated on Nov 2, 2006
For monthly and annual means, thresholds, and sums:
Months with 5 or more missing days are not considered
Years with 1 or more missing months are not considered
Seasons are climatological not calendar seasons

Source: Western Regional Climate Center, wrcc@dri.edu

Previous Occurrences

As indicated by the table above, Bethel is at most danger from extreme cold. The following severe weather event for the entire state was declared in 1989.

Omega Block Disaster, January 28, 1989 & FEMA declared (DR-00826) on May 10, 1989. The Governor declared a statewide disaster to provide emergency relief to communities suffering adverse effects of a record-breaking cold spell, with temperatures as low as -85 degrees. The State conducted a wide variety of emergency actions, which included: emergency repairs to maintain and prevent damage to water, sewer and electrical systems, emergency resupply of essential fuels and food, and Alaska Department of Transportation and Public Facilities (DOT&PF) support in maintaining access to isolated communities.

Hazard Mitigation Cold Weather, 1990 The Presidential Declaration of Major Disaster for the Omega Block cold spell of January and February 1989 authorized federal funds for mitigation of cold weather damage in future events. The Governor's declaration of disaster provided the State matching funds required for obtaining and using this federal money.

Severe Weather Hazard Vulnerability

Please see Hazard Vulnerability Assessment Matrix and description at the beginning of this chapter.

Severe Weather Mitigation

Severe Weather Goals and Projects

Goal 1: Mitigate the effects of extreme weather by instituting programs that provide early warning and preparation.

Goal 2: Educate people about the dangers of extreme weather and how to prepare.

Goal 3: Develop practical measures to warn in the event of a severe weather event.

"*Storm Ready*" Project

Research and consider instituting the National Weather Service program of *"Storm Ready"*.

Storm Ready is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle all types of severe weather—

from tornadoes to tsunamis. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations.

To be officially Storm Ready, a community must:

1. Establish a 24-hour warning point and emergency operations center.
2. Have more than one way to receive severe weather forecasts and warnings and to alert the public.
3. Create a system that monitors local weather conditions.
4. Promote the importance of public readiness through community seminars.
5. Develop a formal hazardous weather plan, which includes training severe weather spotters and holding emergency exercises.
6. Demonstrate a capability to disseminate warnings.

Specific *Storm Ready* guidelines, examples, and applications also may be found on the Internet at: www.nws.noaa.gov/stormready

Other Severe Weather Mitigation Projects

Conduct special awareness activities, such as Winter Weather Awareness Week, Flood Awareness Week, etc.

Expand public awareness about National Oceanographic and Atmospheric Administration (NOAA) Weather Radio for continuous weather broadcasts and warning tone alert capability.

Encourage weather resistant building construction materials and practices.

Install sirens to warn people of a severe weather event or disaster event.

Install automated weather sensors. Automated weather sensors are the chief method by which the National Weather Service detects the occurrence of incoming severe weather.

Section 3. Tundra/Grassland Fire

Hazard Description and Characterization

Wildland fires occur in every state in the country and Alaska is no exception. Each year, between 600 and 800 wildland fires, mostly between March and October, burn across Alaska causing extensive damage.

Fire is recognized as a critical feature of the natural history of many ecosystems. It is essential to maintain the biodiversity and long-term ecological health of the land. In

Alaska, the natural fire regime is characterized by a return interval of 50 to 200 years, depending on the vegetation type, topography and location. The role of wildland fire as an essential ecological process and natural change agent has been incorporated into the fire management planning process. The full range of fire management activities is exercised in Alaska to help achieve ecosystem sustainability, including its interrelated ecological, economic, and social consequences. Firefighter and public safety and welfare, natural and cultural resources threatened, and the other values to be protected dictate the appropriate management response to a fire. Firefighter and public safety is always the first and overriding priority for all fire management activities.

Fires can be divided into the following categories:

Structure fires – originate in and burn a building, shelter or other structure.

Prescribed fires – ignited under predetermined conditions to meet specific objectives, to mitigate risks to people and their communities, and/or to restore and maintain healthy, diverse ecological systems.

Wildland fire – any non-structure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Use – a wildland fire functioning in its natural ecological role and fulfilling land management objectives.

Wildland-Urban Interface Fires – fires that burn within the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. The potential exists in areas of wildland-urban interface for extremely dangerous and complex fire burning conditions, which pose a tremendous threat to public and firefighter safety.

Fuel, weather, and topography influence wildland fire behavior. Wildland fire behavior can be erratic and extreme causing firewhirls and firestorms that can endanger the lives of the firefighters trying to suppress the blaze. Fuel 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. Temperature and humidity also affect fire behavior. High temperatures and low humidity encourage fire activity while low temperatures and high humidity help retard fire behavior. Wind affects the speed and direction of a fire. Topography directs the movement of air, which can also affect fire behavior. When the terrain funnels air, as happens in a canyon, it can lead to faster spreading. Fire can also travel up slope quicker than it goes down.

Wildland fire risk is increasing in Alaska due to the spruce bark beetle infestation. The beetles lay eggs under the bark of a tree. When the larvae emerge, they eat the tree's phloem, which is what the tree uses to transport nutrients from its roots to its needles. If enough phloem is lost, the tree will die. The dead trees dry out and become highly flammable.

Previous Occurrences of Tundra/Grassland Fires

The City of Bethel Fire Department estimates that there are approximately five to eight tundra/grassland fires each summer. When the tundra becomes too dry it is easily combustible and has threaten the city several times over the last thirty years. The city has not been damaged by tundra fire yet, however, aviation has been hampered by smoke several times each summer.

Delta Fire, June 18, 1979 During the period from May to June of 1979, abnormally dry weather resulted in over 200 wild forest and grassland fires in the interior of Alaska. At that time the Alaska Department of Natural Resources (DNR) was conducting its fire suppression activities with funds contained in a special account created by the Legislature in 1978 in the amount of $750,000. When these funds were depleted, the Governor proclaimed a Disaster Emergency in order to permit the immediate transfer of funds from the Disaster Relief Fund to DNR's Fire Suppression Fund. This transfer thus represents public assistance provided through DES to a State agency, the Department of Natural Resources. In part as a result of this Disaster Emergency Proclamation and the depletion of DNR's Fire Suppression Fund, the Alaska Legislature increased the fund to $5,000,000 in 1980-81, and again to $9,000,000 in 1982. No assistance to individuals and families was provided as a result of this incident.

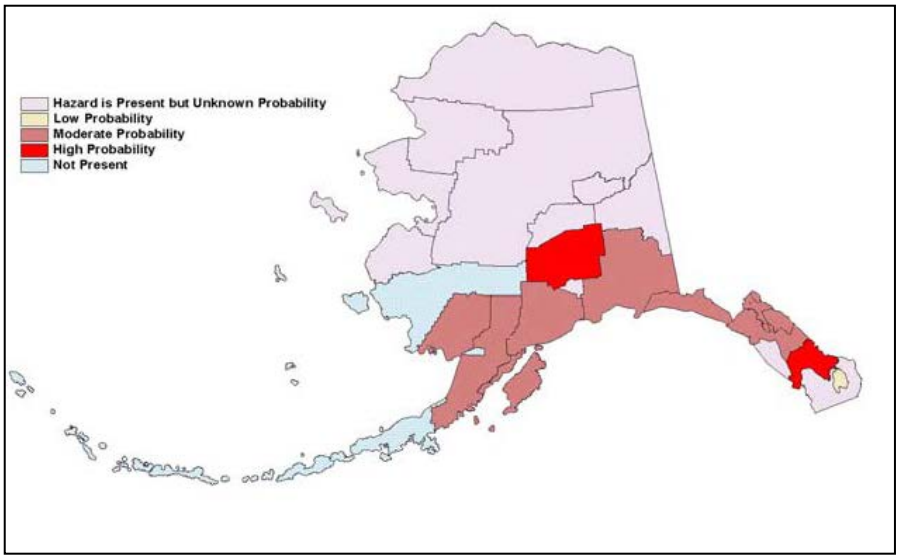
Statewide Fires, July 4, 1990 The wildland fire season, with all-time records in the number and gravity of fires, caused fire suppression requirements beyond the normal capability of the Dept. of Natural Resources. The Governor declared a disaster in order to authorize the use of the resources of the Alaska National Guard in support of the State's wildland fire management programs. The Federal Emergency Management Agency authorized federal payment of up to 70% of fire expenditures that exceeded the average annual fire management budget.

Local Tundra/Grassland Hazard Identification

The City of Bethel has recorded five to eight tundra/grassland fires a year.

The following map from the Alaska State Hazard Plan depicts Bethel as being in a low probability area of the state, due to the low risk factor for Bethel.

Figure 2. Alaska Hazard Plan - Fire Risk Map



Bethel is located in a full protection area of the state protection option areas. Full protection is suppression action provided on a wildland fire that threatens uninhabited private property, high-valued natural resource areas, and other high-valued areas such as identified cultural and historical sites. The suppression objective is to control the fire at the smallest acreage reasonably possible. The allocation of suppression resources to fires receiving the full protection option is second in priority only to fires threatening a critical protection area.

Tundra/Grassland Fire Hazard Vulnerability

Please see Hazard Vulnerability Assessment Matrix and description at the beginning of this chapter.

Tundra/Grassland Fire Hazard Mitigation

Wildland Fire Goals and Projects

Goal 1: Establish building regulations to mitigate against fire damage.

Goal 2: Conduct outreach activities to encourage the use of Fire Wise development techniques.

Goal 3: Encourage the evaluation of emergency plans with respect to wildland fire assessment.

Goal 4: Acquire information on the danger of wildland fires and how best to prepare.

Mitigation Projects for Tundra/Grassland Fires

Continue to support the local fire department with adequate firefighting equipment and training.

Promote Fire Wise building design, siting, and materials for construction.

The Alaska Fire Wise Program is designed to educate people about wildland fire risks and mitigation opportunities. It is part of a national program that is operated in the State by the Alaska Wildfire Coordinating Group (AWCG).

Establish construction fire regulation and requirements.

Encourage development of building codes and requirements.

Enhance public awareness of potential risk to life and personal property.

Encourage mitigation measures in the immediate vicinity of their property.

Section 4. Earthquake

Hazard Description and Characterization

Approximately 11 percent of the world's earthquakes occur in Alaska, making it one of the most seismically active regions in the world. Three of the ten largest quakes in the world since 1900 have occurred here. Earthquakes of magnitude 7 or greater occur in Alaska on average of about once a year; magnitude 8 earthquakes average about 14 years between events.

Most large earthquakes are caused by a sudden release of accumulated stresses between crustal plates that move against each other on the earth's surface. Some earthquakes occur along faults that lie within these plates. The dangers associated with earthquakes include ground shaking, surface faulting, ground failures, snow avalanches, seiches and tsunamis. The extent of damage is dependent on the magnitude of the quake, the geology of the area, distance from the epicenter and structure design and construction. A main goal of an earthquake hazard reduction program is to preserve lives through economical rehabilitation of existing structures and constructing safe new structures.

Ground shaking is due to the three main classes of seismic waves generated by an earthquake. Primary waves are the first ones felt, often as a sharp jolt. Shear or secondary waves are slower and usually have a side-to-side movement. They can be very damaging because structures are more vulnerable to horizontal than vertical motion. Surface waves are the slowest, although they can carry the bulk of the energy in a large earthquake. The damage to buildings depends on how the specific

characteristics of each incoming wave interact with the buildings' height, shape, and construction materials.

Earthquakes are usually measured in terms of their magnitude and intensity. Magnitude is related to the amount of energy released during an event while intensity refers to the effects on people and structures at a particular place. Earthquake magnitude is usually reported according to the standard Richter scale for small to moderate earthquakes.

Large earthquakes, like those that commonly occur in Alaska are reported according to the moment-magnitude scale because the standard Richter scale does not adequately represent the energy released by these large events.

Intensity is usually reported using the Modified Mercalli Intensity Scale. This scale has 12 categories ranging from not felt to total destruction. Different values can be recorded at different locations for the same event depending on local circumstances such as distance from the epicenter or building construction practices. Soil conditions are a major factor in determining an earthquake's intensity, as unconsolidated fill areas will have more damage than an area with shallow bedrock. Surface faulting is the differential movement of the two sides of a fault. There are three general types of faulting.

Strike-slip faults are where each side of the fault moves horizontally. Normal faults have one side dropping down relative to the other side. Thrust (reverse) faults have one side moving up and over the fault relative to the other side.

Earthquake-induced ground failure is often the result of liquefaction, which occurs when soil (usually sand and course silt with high water content) loses strength as a result of the shaking and acts like a viscous fluid.

Liquefaction causes three types of ground failures: lateral spreads, flow failures, and loss of bearing strength. In the 1964 earthquake, over 200 bridges were destroyed or damaged due to lateral spreads. Flow failures damaged the port facilities in Seward, Valdez and Bethel.

Similar ground failures can result from loss of strength in saturated clay soils, as occurred in several major landslides that were responsible for most of the earthquake damage in Anchorage in 1964. Other types of earthquake-induced ground failures include slumps and debris slides on steep slopes.

Local Earthquake Hazard Identification

The following tables were obtained from the University of Alaska, Fairbanks, and Alaska Earthquake Information System (AEIS) website at: http://www.giseis.alaska.edu/Seis/. The tables and other information at the website list the Bethel area as having a low probability of an earthquake. However, since all of Alaska is at risk for an earthquake

event Bethel could be at risk for an earthquake or have secondary impact from an earthquake in the region.

Figure 3. AEIS Earthquake Active Faults

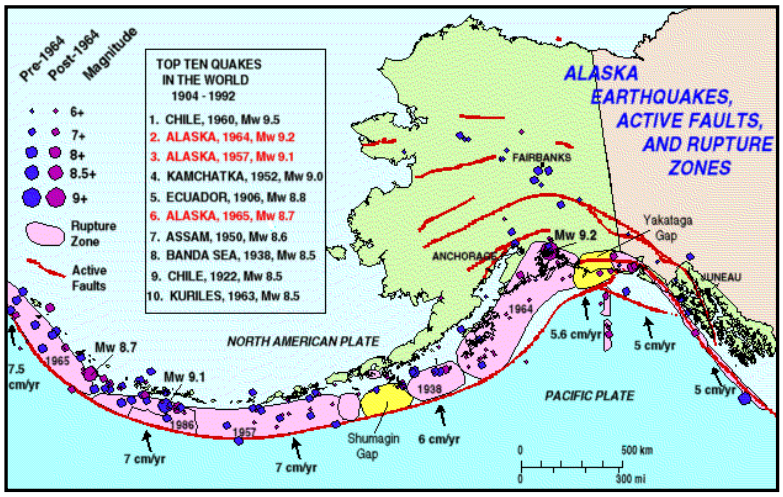
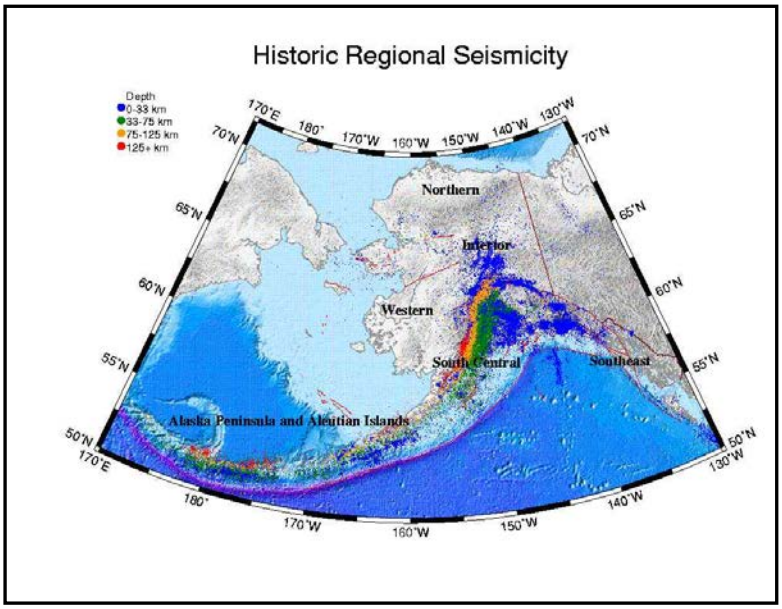


Figure 4. AEIS Historic Regional Seismicity



The State of Alaska State Hazard Plan designates Bethel as in a Zone 1 of potential earthquake danger (on a scale of 0 being the lowest).

Earthquake Hazard Vulnerability

Please see Hazard Vulnerability Assessment Matrix and description at the beginning of this chapter.

Previous Occurrences of Earthquake Hazards

There have been no reported incidences of earthquakes in Bethel.

Earthquake Mitigation

Earthquake Goals

Goal 1: Obtain funding to protect existing critical infrastructure from earthquake damage.

Earthquake Projects

If funding is available, perform an engineering assessment of the earthquake vulnerability of each identified critical infrastructure owned by the City of Bethel.

Identify buildings and facilities that must be able to remain operable during and following an earthquake event.

Contract a structural engineering firm to assess the identified buildings and facilities to determine their structural integrity and strategy to improve their earthquake resistance.

Section 5. Description of Hazards Not Present in Bethel

Avalanche, Landslides and Volcanoes

Bethel is located on a flat floodplain with a gentle topographic relief in the city estimated to be 10 to 12 feet. There is no danger from avalanches, landslides or volcanoes because there are no mountains or steep slopes in the city.

Tsunamis and Seiches

There is no danger of tsunamis and seiches since Bethel is located forty miles from the Bering Sea.

Chapter 4: Mitigation Strategy

Benefit - Cost Review

This chapter of the plan outlines Bethel's overall strategy to reduce its vulnerability to the effects of the hazards studied. Currently the planning effort is limited to the hazards determined to be of the most concern; flooding, erosion, severe weather and earthquake; however the mitigation strategy will be regularly updated as additional hazard information is added and new information becomes available.

The projects listed on following Benefit and Costs Listing Table, were prioritized using a listing of benefits and costs review method as described in the FEMA *How-To-Guide Benefit-Cost Review in Mitigation Planning* (FEMA 386-5).

Due to monetary as well as other limitations, it is often impossible to implement all mitigation actions. Therefore, the most cost-effective actions for implementation will be pursued for funding first, not only to use resources efficiently, but also to make a realistic start toward mitigating risks.

The City of Bethel considered the following factors in prioritizing the mitigation projects. Due to the dollar value associated with both life-safety and critical facilities, the prioritization strategy represents a special emphasis on benefit-cost review because the factors of life-safety and critical facilities steered the prioritization towards projects with likely good benefit-cost ratios.

1. Extent to which benefits are maximized when compared to the costs of the projects, the Benefit Cost Ratio must be 1.0 or greater.

2. Extent the project reduces risk to life-safety.

3. Project protects critical facilities or critical city functionality.

    A. Hazard probability.

    B. Hazard severity.

Other criteria that was used to developing the benefits – costs listing depicted on the Cost Benefit Review Listing table:

1. Vulnerability before and after Mitigation

Number of people affected by the hazard, areawide, or specific properties.
Areas affected (acreage) by the hazard
Number of properties affected by the hazard
Loss of use
Loss of life (number of people)

Injury (number of people)

1. List of Benefits

Risk reduction (immediate or medium time frame)
Other community goals or objectives achieved
Easy to implement
Funding available
Politically or socially acceptable

2. Costs

Construction cost
Programming cost
Long time frame to implement
Public or political opposition
Adverse environmental effects

This method supports the principle of benefit-cost review by using a process that demonstrates a special emphasis on maximization of benefits over costs. Projects that demonstrate benefits over costs and that can start immediately were given the highest priority. Projects that the costs somewhat exceed immediate benefit and that can start within five years (or before the next update) were given a description of medium priority, with a timeframe of one to five years. Projects that are very costly without known benefits, probably cannot be pursued during this plan cycle, but are important to keep as an action were given the lowest priority and designated as long term.

The Bethel Planning Commission will hold another round of public meetings on the LHMP Update. The plan is subject to final Bethel City Council approval after pre-approval is obtained by DHS&EM.

After the LHMP Update has been approved, the projects must be evaluated using a Benefit-Cost Analysis (BCA) during the funding cycle for disaster mitigation funds from DHS&EM and FEMA.

A description of the BCA process follows, briefly, BCA is the method by which the future benefits of a mitigation project are determined and compared to its cost. The result is a Benefit-Cost Ratio, which is derived from a project's total net benefits divided by its total cost. The BCR is a numerical expression of the cost-effectiveness of a project. Composite BCRs of 1.0 or greater have more benefits than costs, and are therefore cost-effective.

Benefit-Cost Review vs. Benefit-Cost Analysis (FEMA 386-5) states in part:
Benefit-Cost Review for mitigation planning differs from the benefit cost analysis (BCA) used for specific projects. BCA is a method for determining the potential positive effects of a mitigation action and comparing them to the cost of the action. To assess and demonstrate the cost-effectiveness of mitigation actions, FEMA has developed a suite of BCA software, including hazard-specific modules. The analysis determines whether a mitigation project is technically cost-effective. The principle behind the BCA is that the benefit of an action is a reduction in future damages.

DMA 2000 does not require hazard mitigation plans to include BCA's for specific projects, but does require that a BCR be conducted in prioritizing projects.

Benefit-Cost Analysis

The following section is reproduced from a document prepared by FEMA, which demonstrates on how to perform a Benefit –Cost Analysis. The complete guidelines document, a benefit-cost analysis document and benefit-cost analysis technical assistance is available online http://www.fema.gov/government/grant/bca.

Facilitating BCA

Although the preparation of a BCA is a technical process, FEMA has developed software, written materials, and training that simplifies the process of preparing BCAs. FEMA has a suite of BCA software for a range of major natural hazards: earthquake, fire (wildland/urban interface fires), flood (riverine, coastal A-Zone, Coastal V-Zone), Hurricane Wind (and Typhoon), and Tornado.

Sometimes there is not enough technical data available to use the BCA software mentioned above. When this happens, or for other common, smaller-scale hazards or more localized hazards, BCAs can be done with the Frequency Damage Method (i.e., the Riverine Limited Data module), which is applicable to any natural hazard as long as a relationship can be established between how often natural hazard events occur and how much damage and losses occur as a result of the event. This approach can be used for coastal storms, windstorms, freezing, mud/landslides, severe ice storms, snow, tsunami, and volcano hazards.

Applicants and Sub-Applicants must use FEMA-approved methodologies and software to demonstrate the cost-effectiveness of their projects. This will ensure that the calculations and methods are standardized, facilitating the evaluation process. Alternative BCA software may also be used, but only if the FEMA Regional Office and FEMA Headquarters approve the software.

To assist Applicants and Sub-applicants, FEMA has prepared the *FEMA Mitigation BCA Toolkit* CD. This CD includes all of the FEMA BCA software, technical manuals, BC training courses, Data-Documentation Templates, and other supporting documentation and guidance.

The *Mitigation BCA Toolkit* CD is available free from FEMA Regional Offices or via the BC Helpline (at bchelpline@dhs.gov or toll free number at (866) 222-3580.

HAZARD EVENT (Frequency & Severity)	**X**	PROPERTY EXPOSED TO THE HAZARD	**=**	HAZARD RISK Dollars ($$)
Probability of Damaging Hazard Events		Value & Vulnerability of Property Exposed to the Hazard		Severity of the Hazard Threat to the Built Environment

The BC Helpline is also available to provide BCA software, technical manuals, and other BCA reference materials as well as to provide technical support for BCA.

For further technical assistance, Applicants or Sub-Applicants may contact their State Mitigation Office, the FEMA Regional Office, or the BC Helpline. FEMA and the BC Helpline provide technical assistance regarding the preparation of a BCA.

Benefit Cost Review Listing Table

Table 15. Benefit Cost Review Listing

* Priorities: High = Clearly a life/safety project, or benefits clearly exceed the cost or can be implemented, 0 – 1 year.
Medium = More study required to designate as a life/safety project, or benefits may exceed the cost, or can be implemented in 1 – 5 years.
Low = More study required to designate as a life/safety project, or not known if benefits exceed the costs, or long-term project, implementation will not occur for over 5 years.

** PDMG Pre-Disaster Mitigation Grant

*** HMGP Hazard Mitigation Grant Program

****FMA Flood Mitigation Assistance (Program)

Mitigation Projects	Benefits (pros)	Costs (cons)	High
Flood/Erosion (FLD)			
FLD-1. Structure Elevation and/or Relocation	Life/Safety project Benefit to government facilities and private properties. Potential PDMG**, HMGP***, FMA****	Dollar cost unknown, >$50k 1 – 5 year implementation	Medium
FLD-2. Updated FIRM Bethel Maps	FEMA, PDMG**, HMGP*** and State DCRA funding available. USCOE facilitated project. Can be started immediately.	Expensive, at least $100,000	High
FLD-3. Public Education	DCRA funding may be available. Could be done yearly. Inexpensive <$1,000City	Not clear if there would be community interest or participation.	Medium
FLD-4. Install upgraded streamflow and rainfall measuring gauges	Life/Safety project Benefit to government facilities and private properties. Potential PDMG**, HMGP***, FMA****	Dollar cost unknown, >$50k 1 – 5 year implementation	Medium
FLD-5. Apply for grants/funds to implement riverbank protection methods.	Life/Safety project Benefit to government facilities and private properties. Potential PDMG**, HMGP***, FMA****	Dollar cost unknown, >$50k 1 – 5 year implementation	Medium
FLD-6. Pursue obtaining a CRS rating to lower flood insurance rates.	High capability by city to do on an annual basis Will reduce NFIP insurance for entire community. <$1,000/year	Staff time.	High

Mitigation Projects	Benefits (pros)	Costs (cons)	High
FLD-7. Obtain flood insurance for all City structures, and continue compliance with NFIP.	High capability by city to do on an annual basis. Public benefit to have public buildings insured through NFIP. Inexpensive, approx.$3,000/year.	Staff time	High
FLD-8. Bethel Cargo Dock/Replacement Seawall	Property Damage Reduction during flooding. USCOE responsibility. Benefit to public and private properties. Potential PDMG. Ongoing project.	Expensive $8.5 million	High
FLD-9. Repair and Expand Harbor	Benefit to entire community. Life/Safety issue Funding potential from PDMG or HMGP. Ongoing Project.	Expensive $10 million	High
FLD-10. Continued Repair of Existing Seawall	Benefit to entire community. Life/Safety issue Funding potential from PDMG or HMGP. Annual responsibility.	Relatively inexpensive, $70k	High
FLD-11. Tie-back Replacement and Armor Rock Replacement	Life/Safety issue Property damage reduction. Benefit to entire community Potential funding from USCOE, PDMG. Important to replace eroding infrastructure.	Specific Cost unknown, approximately 25 tons would be needed at $105/ton. Design and construction method needs to be determined.	Medium

Mitigation Projects	Benefits (pros)	Costs (cons)	High
Severe Weather (SW)			
SW-1. Research and consider instituting the National Weather Service program of *"Storm Ready"*.	Life/Safety issue Risk reduction Benefit to entire community Inexpensive State assistance available Could be implemented annually	Staff time	High
SW-2. Conduct special awareness activities, such as Winter Weather Awareness Week, Flood Awareness Week, etc.	Life/Safety issue Risk reduction Benefit to entire community Inexpensive State assistance available Could be an annual event	Staff time	High
SW-3. Expand public awareness about NOAA Weather Radio for continuous weather broadcasts and warning tone alert capability	Life/Safety issue Risk reduction Benefit to entire community Inexpensive State assistance available Could be an annual event	Staff time	High
SW-4. Encourage weather resistant building construction materials and practices.	Risk and damage reduction. Benefit to entire community.	Would require ordinance change. Potential for increased staff time. Research into feasibility necessary. Political and public support not determined. 1 – 5 year implementation	Medium
SW-5. Install a siren to warn people of a severe weather event.	Life/Safety issue Risk reduction Benefit to entire community Inexpensive State assistance available Could be implemented immediately.	Less than $5,000	High
SW-6. Installation of automated weather sensors.	Life/Safety issue Risk reduction Benefit to entire community	Expensive. Need to secure funding. 1 – 5 years implementation	Medium

Mitigation Projects	Benefits (pros)	Costs (cons)	High
Tundra/Wildland Fire (WF)			
WF-1. Continue to support the local fire department with adequate firefighting equipment and training.	Life/Safety issue Risk reduction Benefit to entire community State assistance available Annual project.	Dollar cost not determined. Staff time to research grants	High
Project WF-2. Promote Fire Wise building design, siting, and materials for construction.	Life/Safety issue Risk reduction Benefit to entire community, Annual project. State assistance available	Dollar cost not determined. Staff time to research grants	High
WF-3: Continue to enforce development of building codes and requirements for new construction.	Life/Safety issue Risk reduction Benefit to entire community Inexpensive State assistance available Could be implemented annually	Staff time	High
WF-4: Enhance public awareness of potential risk to life and personal property. Encourage mitigation measures in the immediate vicinity of their property.	Life/Safety issue Risk reduction Benefit to entire community Inexpensive State assistance available Could be implemented annually	Staff time	High
Earthquake (E)			
E-1. If funding is available, perform an engineering assessment of the earthquake vulnerability of each identified critical infrastructure owned by the City of Bethel.	Life/Safety issue/Risk reduction Benefit to entire community Inexpensive State assistance available Could be an annual event	Staff time	High
E-2. Identify buildings and facilities that must be able to remain operable during and following an earthquake event.	Life/Safety issue/Risk reduction Benefit to entire community Inexpensive State assistance available Could be an annual event	Staff time	High
E-3. Contract a structural engineering firm to assess the identified bldgs and facilities.	Benefit to entire community Risk reduction	Feasibility and need analysis needed. 1 – 5 years	Medium

Mitigation Project Plan Table

Table 16. Mitigation Strategy Plan Table

* Priorities: High = Clearly a life/safety project, or benefits clearly exceed the cost or can be implemented, 0 – 1 year.
Medium = More study required to designate as a life/safety project, or benefits may exceed the cost, or can be implemented in 1 – 5 years.
Low = More study required to designate as a life/safety project, or not known if benefits exceed the costs, or long-term project, implementation will not occur for over 5 years.

** PDMG Pre-Disaster Mitigation Grant

*** HMGP Hazard Mitigation Grant Program

****FMA Flood Mitigation Assistance (Program)

Mitigation Projects	Responsible Agency	Cost	Funding Sources Possible	Priority*
Flood and Erosion Projects				
Project FLD 1. Structure Elevation and/or Relocation	City DCRA, DHS&EM FEMA	To be Determined	PDMG** HMGP*** FMA****	Medium
Project FLD 2. Update Bethel FIRM Maps	FEMA USCOE	>$10,000	PDMG** HMGP*** FMA****	High
Project FLD 3. Public Education	City DCRA	Staff Time	DCRA	Medium
Project FLD 4. Install upgraded streamflow and rainfall measuring gauges	City DHS&EM	$10,000	PDMG HMGP	Medium
Project FLD 5. Apply for grants/funds to implement riverbank protection methods.	City	Staff Time	PDMG HMGP	Medium
Project FLD 6. Pursue obtaining a CRS ranking to lower flood insurance rates.	City DCRA	Staff Time	City	High
Project FLD 7. Obtain flood insurance for all City structures, and continue compliance with NFIP.	City	$1,500	City	High
Project FLD 8. Bethel Cargo Dock/Replacement Seawall	USCOE FEMA City, DHS&EM	$8.5 million	PDMG USC0E	High
Project FLD 9. Repair and Expand Harbor	USCOE FEMA City, DHS&EM	$10 million	PDMG USC0E	High

Mitigation Projects	Responsible Agency	Cost	Funding Sources Possible	Priority*
Project FLD 10. Continued Repair of Existing Seawall	USCOE FEMA City/DHS&EM	>$70,000	PDMG HMGP	High
Project FLD-11. Tie-back Replacement and Armor Rock Replacement	USCOE FEMA City/DHS&EM	To be determined	USCOE PDMG	Medium
Severe Weather Projects				
Project SW 1: Research and consider instituting the National Weather Service program of *"Storm Ready"*.	City	Staff Time	DCRA	High
Project SW 2: Conduct special awareness activities, such as Winter Weather Awareness Week, Flood Awareness Week, etc.	City DCRA DHS&EM	Staff Time	DCRA DHS&EM FEMA	High
Project SW 3: Expand public awareness about NOAA Weather Radio for continuous weather broadcasts and warning tone alert capability.	City	Staff Time	NOAA	High
Project SW 4: Encourage weather resistant building construction materials and practices.	City	Staff Time	City	Medium
Project SW 5: Install a siren to warn people of a severe weather or disaster event.	City DCRA DHS&EM	>$5,000	DCRA DHS&EM FEMA	High
Project SW 6: Installation of automated weather sensors. Automated weather sensors are the chief method by which the National Weather Service detects the occurrence of incoming severe weather.	DHS&EM	>$20,000	PDMG	Medium
Tundra/Wildland Fire Projects				
Project FIRE 1. Acquire additional firefighting equipment and training for personnel.	City DHS&EM	>$20,000	State Grant	High

Mitigation Projects	Responsible Agency	Cost	Funding Sources Possible	Priority*
Project FIRE 2. Promote Fire Wise building design, siting, and materials for construction.	State Div of Forestry	NA	State Grants	High
Project FIRE 3. Establish additional fire regulation and requirements.	City	Staff Time	State Grants	High
Project FIRE 4. Purchase additional fire fighting equipment and vehicles, such as a Fire Truck and fire extinguishers.	City State Div of Forestry	>$150,000	State Grants	High
Earthquake Hazard Projects				
Project EQ 1: Encourage development of earthquake resistance building codes and requirements.	City	Staff Time	State Grants	High
Project EQ 2: Enhance public awareness of potential risk to life and personal property from earthquakes. Encourage mitigation measures in the immediate vicinity of their property.	City DHS&EM DCRA	Staff Time	State Grants	High
Project EQ 3: If funding is available, perform an engineering assessment of the earthquake vulnerability of each identified critical infrastructure owned by the City of Bethel.	City DHS&EM	Staff Time	PDMG	Medium
Project EQ 4: Identify buildings and facilities that must be able to remain operable during and following an earthquake event.	City DHS&EM	Combine with Project EQ-3	PDMG	Medium
Project EQ 5: Contract a structural engineering firm to assess the identified buildings and facilities to determine their structural integrity and strategy to improve their earthquake resistance.	City DHS&EM	Combine with Project EQ-3	PDMG	Medium

Glossary of Terms

A-Zones

Type of zone found on all Flood Hazard Boundary Maps (FHBMs), Flood Insurance Rate Maps (FIRMs), and Flood Boundary and Floodway Maps (FBFMs).

Acquisition

Local governments can acquire lands in high hazard areas through conservation easements, purchase of development rights, or outright purchase of property.

Asset

Any manmade or natural feature that has value, including, but not limited to people; buildings; infrastructure like bridges, roads, and sewer and water systems; lifelines like electricity and communication resources; or environmental, cultural, or recreational features like parks, dunes, wetlands, or landmarks.

Base Flood

A term used in the National Flood Insurance Program to indicate the minimum size of a flood. A community as a basis for its floodplain management regulations uses this information. It is the level of a flood, which has a one-percent chance of occurring in any given year. Also known as a 100-year flood elevation or one-percent chance flood.

Base Flood Elevation (BFE)

The elevation for which there is a one-percent chance in any given year that floods water levels will equal or exceed it. The BFE is determined by statistical analysis for each local area and designated on the Flood Insurance Rate Maps. It is also known as 100-year flood elevation.

Base Floodplain

The area that has a one percent chance of flooding (being inundated by flood waters) in any given year.

Building

A structure that is walled and roofed, principally above ground and permanently affixed to a site. The term includes a manufactured home on a permanent foundation on which the wheels and axles carry no weight.

Building Code

The regulations adopted by a local governing body setting forth standards for the construction, addition, modification, and repair of buildings and

other structures for the purpose of protecting the health, safety, and general welfare of the public.

Community

Any state, area or political subdivision thereof, or any Indian tribe or tribal entity that has the authority to adopt and enforce statutes for areas within its jurisdiction.

Community Rating System (CRS)

The Community Rating System is a voluntary program that each municipality or county government can choose to participate in. The activities that are undertaken through CRS are awarded points. A community's points can earn people in their community a discount on their flood insurance premiums.

Critical Facility

Facilities that are critical to the health and welfare of the population and that are especially important during and after a hazard event. Critical facilities include, but are not limited to, shelters, hospitals, and fire stations.

Designated Floodway

The channel of a stream and that portion of the adjoining floodplain designated by a regulatory agency to be kept free of further development to provide for unobstructed passage of flood flows.

Development

Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or of equipment or materials.

Digitize

To convert electronically points, lines, and area boundaries shown on maps into x, y coordinates (e.g., latitude and longitude, universal transverse mercator (UTM), or table coordinates) for use in computer

Disaster Mitigation Act (DMA)

DMA 2000 (public Law 106-390) is the latest legislation of 2000 (DMA 2000) to improve the planning process. It was signed into law on October 10, 2000. This new legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur.

Earthquake

A sudden motion or trembling that is caused by a release of strain accumulated within or along the edge of the earth's tectonic plates.

Elevation

The raising of a structure to place it above flood waters on an extended support structure.

Emergency Operations Plan

A document that: describes how people and property will be protected in disaster and disaster threat situations; details who is responsible for carrying out specific actions; identifies the personnel, equipment, facilities, supplies, and other resources available for use in the disaster; and outlines how all actions will be coordinated.

Erosion

The wearing away of the land surface by running water, wind, ice, or other geological agents.

Federal Disaster Declaration

The formal action by the President to make a State eligible for major disaster or emergency assistance under the Robert T. Stafford Relief and Emergency Assistance Act, Public Law 93-288, as amended. Same meaning as a Presidential Disaster Declaration

Federal Emergency Management Agency (FEMA)

A federal agency created in 1979 to provide a single point of accountability for all federal activities related to hazard mitigation, preparedness, response, and recovery.

Flood

A general and temporary condition of partial or complete inundation of water over normally dry land areas from (1) the overflow of inland or tidal waters, (2) the unusual and rapid accumulation or runoff of surface waters from any source, or (3) mudflows or the sudden collapse of shoreline land.

Flood Disaster Assistance

Flood disaster assistance includes development of comprehensive preparedness and recovery plans, program capabilities, and organization of Federal agencies and of State and local governments to mitigate the adverse effects of disastrous floods. It may include maximum hazard reduction, avoidance, and mitigation measures, as well policies, procedures, and eligibility criteria for Federal grant or loan assistance to State and local governments, private organizations, or individuals as the result of the major disaster.

Flood Elevation

Elevation of the water surface above an establish datum (reference mark), e.g. National Geodetic Vertical Datum of 1929, North American Datum of 1988, or Mean Sea Level.

Flood Hazard

Flood Hazard is the potential for inundation and involves the risk of life, health, property, and natural value. Two reference base are commonly used: (1) For most situations, the Base Flood is that flood which has a one-percent chance of being exceeded in any given year (also known as the 100-year flood); (2) for critical actions, an activity for which a one-percent chance of flooding would be too great, at a minimum the base flood is that flood which has a 0.2 percent chance of being exceeded in any given year (also known as the 500-year flood).

Flood Insurance Rate Map

Flood Insurance Rate Map (FIRM) means an official map of a community, on which the Administrator has delineated both the special hazard areas and the risk premium zones applicable to the community.

Flood Insurance Study

Flood Insurance Study or Flood Elevation Study means an examination, evaluation and determination of flood hazards and, if appropriate, corresponding water surface elevations, or an examination, evaluations and determination of mudslide (i.e., mudflow) and/or flood-related' erosion hazards.

Floodplain

A "floodplain" is the lowland adjacent to a river, lake, or ocean. Floodplains are designated by the frequency of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by the 10-year flood. The 100-year floodplain by the 100-year flood.

Floodplain Management

The operation of an overall program of corrective and preventive measures for reducing flood damage, including but not limited to emergency preparedness plans, flood control works and floodplain management regulations.

Floodplain Management Regulations

Floodplain Management Regulations means zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as floodplain ordinance, grading ordinance and erosion control ordinance) and other applications of police power. The term describes such state or local regulations, in any combination thereof,

which provide standards for the purpose of flood damage prevention and reduction.

Flood Zones

Zones on the Flood Insurance Rate Map (FIRM) in which a Flood Insurance Study has established the risk premium insurance rates.

Flood Zone Symbols

A - Area of special flood hazard without water surface elevations determined.
A1-30 - AE Area of special flood hazard with water surface elevations determined.
AO - Area of special flood hazard having shallow water depths and/or unpredictable flow paths between one and three feet.
A-99 - Area of special flood hazard where enough progress has been made on a protective system, such as dikes, dams, and levees, to consider it complete for insurance rating purposes.
AH - Area of special flood hazard having shallow water depths and/or unpredictable flow paths between one and three feet and with water surface elevations determined.
B - X Area of moderate flood hazard.
C - X Area of minimal hazard.
D - Area of undetermined but possible flood hazard.

Geographic Information System

A computer software application that relates physical features of the earth to a database that can be used for mapping and analysis.

Governing Body

The legislative body of a municipality that is the assembly of a borough or the council of a city.

Hazard

A source of potential danger or adverse condition. Hazards in the context of this plan will include naturally occurring events such as floods, earthquakes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. A natural event is a hazard when it has the potential to harm people or property.

Hazard Event

A specific occurrence of a particular type of hazard.

Hazard Identification

The process of identifying hazards that threaten an area.

Hazard Mitigation

Any action taken to reduce or eliminate the long-term risk to human life and property from natural hazards. (44 CFR Subpart M 206.401)

Hazard Mitigation Grant Program

The program authorized under section 404 of the Stafford Act, which may provide funding for mitigation measures identified through the evaluation of natural hazards conducted under §322 of the Disaster Mitigation Act 2000.

Hazard Profile

A description of the physical characteristics of hazards and a determination of various descriptors including magnitude, duration, frequency, probability, and extent. In most cases, a community can most easily use these descriptors when they are recorded and displayed as maps.

Hazard and Vulnerability Analysis

The identification and evaluation of all the hazards that potentially threaten a jurisdiction and analyzing them in the context of the jurisdiction to determine the degree of threat that is posed by each.

Mitigate

To cause something to become less harsh or hostile, to make less severe or painful.

Mitigation Plan

A systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards typically present in the State and includes a description of actions to minimize future vulnerability to hazards.

National Flood Insurance

The Federal program, created by an act of Congress in Program (NFIP) 1968 that makes flood insurance available in communities that enact satisfactory floodplain management regulations.

One Hundred (100)-Year

The flood elevation that has a one-percent chance of occurring in any given year. It is also known as the Base Flood.

Planning

The act or process of making or carrying out plans; the establishment of goals, policies, and procedures for a social or economic unit.

Repetitive Loss Property

A property that is currently insured for which two or more National Flood Insurance Program losses (occurring more than ten days apart) of at least $1000 each have been paid within any 10-year period since 1978.

Risk

The estimated impact that a hazard would have on people, services, facilities, and structures in a community; the likelihood of a hazard event resulting in an adverse condition that causes injury or damage. Risk is often expressed in relative terms such as a high, moderate, or low likelihood of sustaining damage above a particular threshold due to a specific type of hazard event. It can also be expressed in terms of potential monetary losses associated with the intensity of the hazard.

Riverine

Relating to, formed by, or resembling rivers (including tributaries), streams, creeks, brooks, etc.

Riverine Flooding

Flooding related to or caused by a river, stream, or tributary overflowing its banks due to excessive rainfall, snowmelt or ice.

Runoff

That portion of precipitation that is not intercepted by vegetation, absorbed by land surface, or evaporated, and thus flows overland into a depression, stream, lake, or ocean (runoff, called immediate subsurface runoff, also takes place in the upper layers of soil).

Seiche

An oscillating wave (also referred to as a seismic sea wave) in a partially or fully enclosed body of water. May be initiated by landslides, undersea landslides, long period seismic waves, wind and water waves, or a tsunami.

Seismicity

Describes the likelihood of an area being subject to earthquakes.

State Disaster Declaration

A disaster emergency shall be declared by executive order or proclamation of the Governor upon finding that a disaster has occurred or that the occurrence or the threat of a disaster is imminent. The state of disaster emergency shall continue until the governor finds that the threat or danger has passed or that the disaster has been dealt with to the extent that emergency conditions no longer exist and terminates the state of disaster emergency by executive order or proclamation.

Along with other provisions, this declaration allows the governor to utilize all available resources of the State as reasonably necessary, direct and compel the evacuation of all or part of the population from any stricken or threatened area if necessary, prescribe routes, modes of transportation and destinations in connection with evacuation and control ingress and egress to and from disaster areas. It is required before a Presidential Disaster Declaration can be requested.

Topography

The contour of the land surface. The technique of graphically representing the exact physical features of a place or region on a map.

Tribal Government

A Federally recognized governing body of an Indian or Alaska native Tribe, band, nation, pueblo, village or community that the Secretary of the Interior acknowledges to exist as an Indian tribe under the Federally Recognized Tribe List Act of 1994, 25 U.S.C. 479a. This does not include Alaska Native corporations, the ownership of which is vested in private individuals.

Tsunami

A sea wave produced by submarine earth movement or volcanic eruption with a sudden rise or fall of a section of the earth's crust under or near the ocean. A seismic disturbance or landslide can displace the water column, creating a rise or fall in the level of the ocean above. This rise or fall in sea level is the initial formation of a tsunami wave.

Vulnerability

Describes how exposed or susceptible to damage an asset it. Vulnerability depends on an asset's construction, contents, and the economic value of its functions. The vulnerability of one element of the community is often related to the vulnerability of another. For example, many businesses depend on uninterrupted electrical power – if an electrical substation is flooded, it will affect not only the substation itself, but a number of businesses as well. Other, indirect effects can be much more widespread and damaging than direct ones.

Vulnerability Assessment

The extent of injury and damage that may result from hazard event of a given intensity in a given area. The vulnerability assessment should address impacts of hazard events on the existing and future built environment.

Watercourse

A natural or artificial channel in which a flow of water occurs either continually or intermittently.

Watershed

An area that drains to a single point. In a natural basin, this is the area contributing flow to a given place or stream.

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8. *Bethel City website* http://www.cityofbethel.org/.

9. *Bethel Emergency Operations Plan*, 2005. City of Bethel, Alaska.

10. *Bethel Port Development Plan*. City of Bethel, January 1994.

11. *Climate change impacts, vulnerabilities, and adaptation in Northwest Alaska (No. 06-11).*_ Gregory, R., Failing, L., & Leiserowitz, A. (2006). Eugene: Decision Research. http://www.decisionresearch.org/Projects/Climate_Change/

12. *FEMA Benefit-Cost Analysis Website:* http://www.fema.gov/government/grant/bca.

13. FEMA How to Guides

    Getting Started: Building Support For Mitigation Planning (FEMA 386-1) Understanding Your Risks: Identifying Hazards And Estimating Losses (FEMA 386-2) Developing The Mitigation Plan: Identifying Mitigation Actions And Implementing Strategies (FEMA 386-3) Bringing the Plan to Life: Implementing the Hazard Mitigation Plan (FEMA 386-4)

Using Benefit-Cost Review in Mitigation Planning (FEMA 386-5)

14. *Potential Consequences of Climate Variability and Change for Alaska.* Parson, Edward A., et al. (1999) A Report of the Alaska Regional Assessment Group for the U.S. Global Change Program. Prepared for the Center for Global Change and Arctic Research. Fairbanks.

Web Sites

American Planning Association:	http://www.planning.org
Association of State Floodplain Managers:	http://www.floods.org
Developing the Implementation Strategy:	www.pro.gov.uk
Federal Emergency Management Agency:	http://www.fema.gov/fima/planning.shtm
Community Rating System:	http://www.fema.gov/nfip/crs.htm
Flood Mitigation Assistance Program:	http://www.fema.gov/fima/planfma.shtm
Hazard Mitigation Grant Program:	http://www.fema.gov/fima/hmgp
Individual Assistance Programs:	http://www.fema.gov/rrr/inassist.shtm
Interim Final Rule:	http://www.access.gpo.govl
National Flood Insurance Program:	http://www.fema.gov/nfip
Public Assistance Program:	http://www.fema.gov/rrr/pa

Appendix

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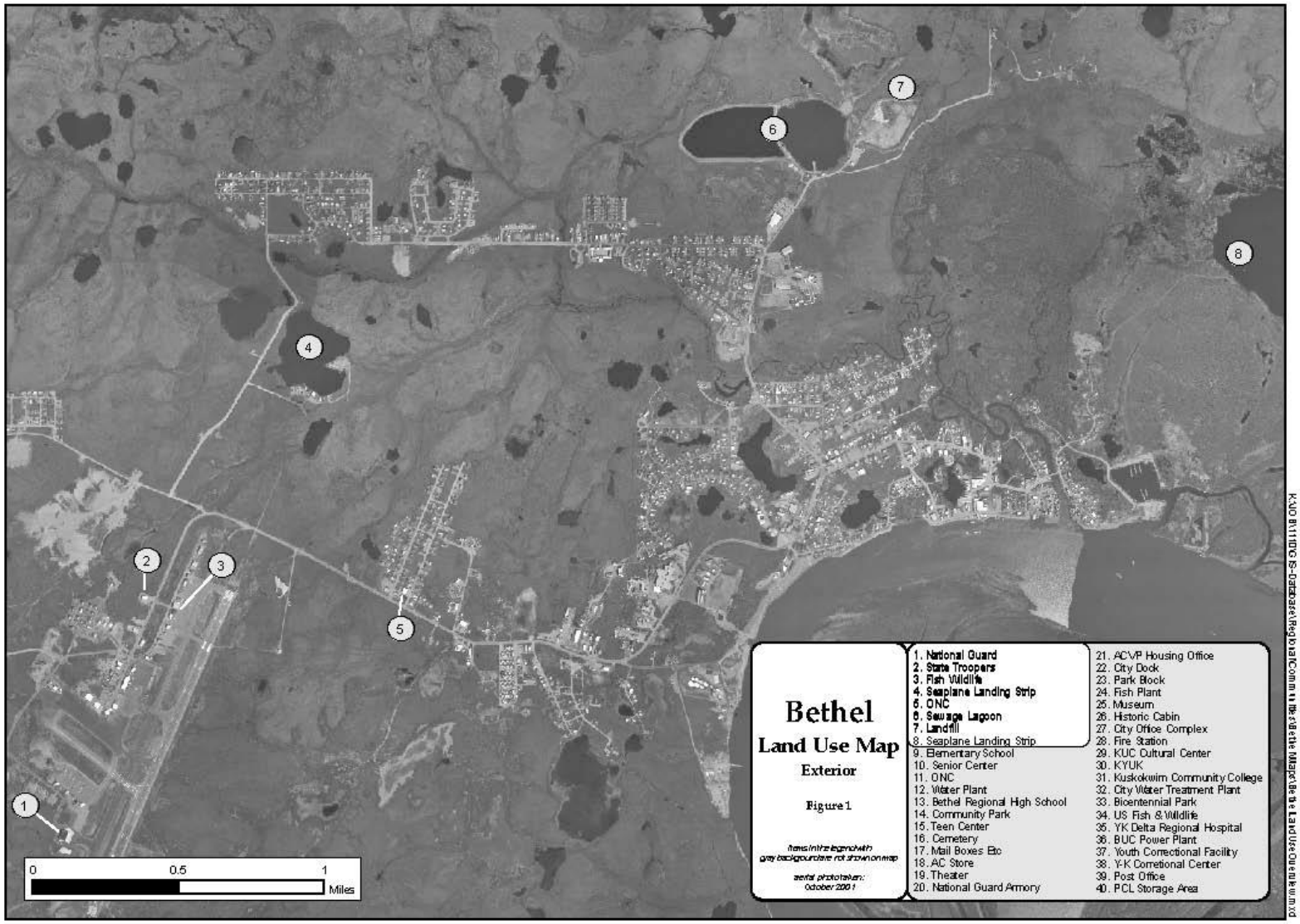
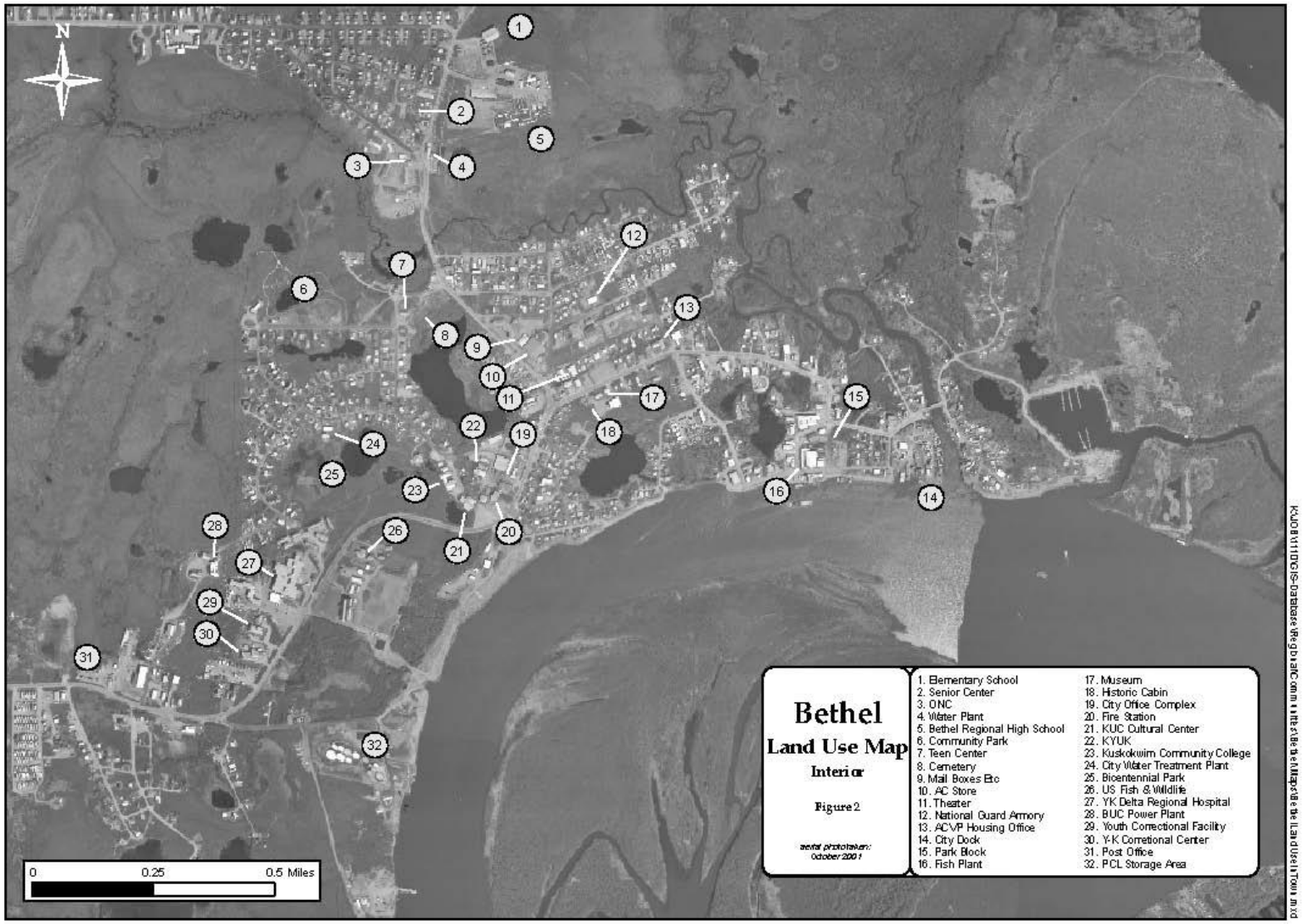
1. Figure 1. Bethel Land Use Map, Exterior
2. Figure 2. Bethel Land Use Map, Interior
3. Figure 3. Bethel Land Use Map, Vicinity


Bethel
Land Use Map
Exterior
Figure 1
Items in this legend with gray background are not shown on map
aerial photo taken: October 2001
1. National Guard
2. State Troopers
3. Fish Wildlife
4. Seaplane Landing Strip
5. ONC
6. Sewage Lagoon
7. Landfill
8. Seaplane Landing Strip
9. Elementary School
10. Senior Center
11. ONC
12. Water Plant
13. Bethel Regional High School
14. Community Park
15. Teen Center
16. Cemetery
17. Mail Boxes Etc
18. AC Store
19. Theater
20. National Guard Armory
21. ACVP Housing Office
22. City Dock
23. Park Block
24. Fish Plant
25. Museum
26. Historic Cabin
27. City Office Complex
28. Fire Station
29. KUC Cultural Center
30. KYUK
31. Kuskokwim Community College
32. City Water Treatment Plant
33. Bicentennial Park
34. US Fish & Wildlife
35. YK Delta Regional Hospital
36. BUC Power Plant
37. Youth Correctional Facility
38. Y-K Corretional Center
39. Post Office
40. PCL Storage Area
0
0.5
1
Miles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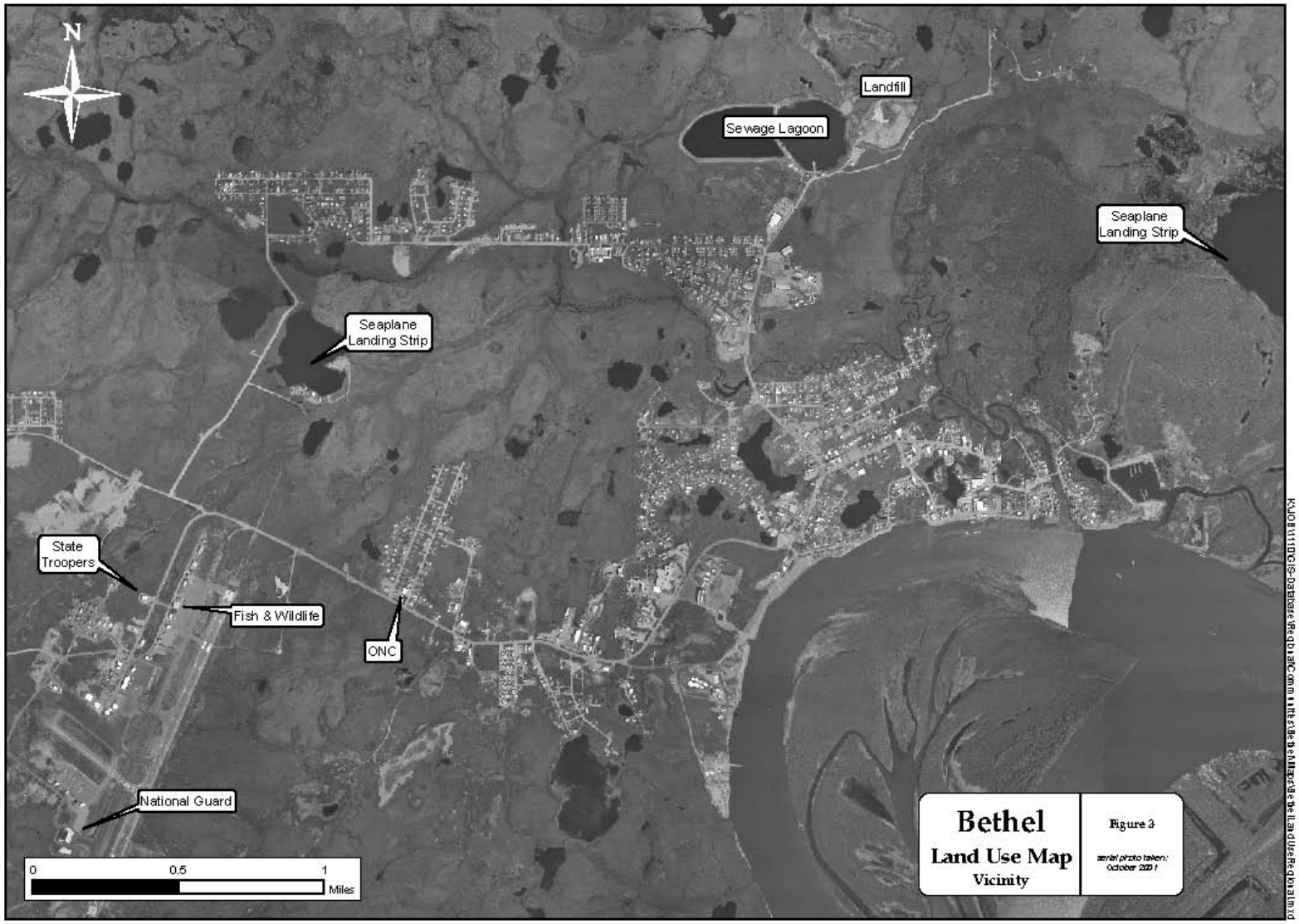
23
24
25
26
27
28
29
30
31
32
0
0.25
0.5 Miles
Bethel
Land Use Map
Interior
Figure 2
aerial photo taken:
October 2001
1. Elementary School
2. Senior Center
3. ONC
4. Water Plant
5. Bethel Regional High School
6. Community Park
7. Teen Center
8. Cemetery
9. Mail Boxes Etc
10. AC Store
11. Theater
12. National Guard Armory
13. ACVP Housing Office
14. City Dock
15. Park Block
16. Fish Plant
17. Museum
18. Historic Cabin
19. City Office Complex
20. Fire Station
21. KUC Cultural Center
22. KYUK
23. Kuskokwim Community College
24. City Water Treatment Plant
25. Bicentennial Park
26. US Fish & Wildlife
27. YK Delta Regional Hospital
28. BUC Power Plant
29. Youth Correctional Facility
30. Y-K Corretional Center
31. Post Office
32. PCL Storage Area
K:\JOB\11\11\DGIS-Database\Reg\arc\comm\Bethel\Maps\Bethel Land Use\Town.mxd


N
Landfill
Sewage Lagoon
Seaplane Landing Strip
Seaplane Landing Strip
State Troopers
Fish & Wildlife
ONC
National Guard
0
0.5
1
Miles
Bethel
Land Use Map
Vicinity
Figure 3
aerial photo taken: October 2001