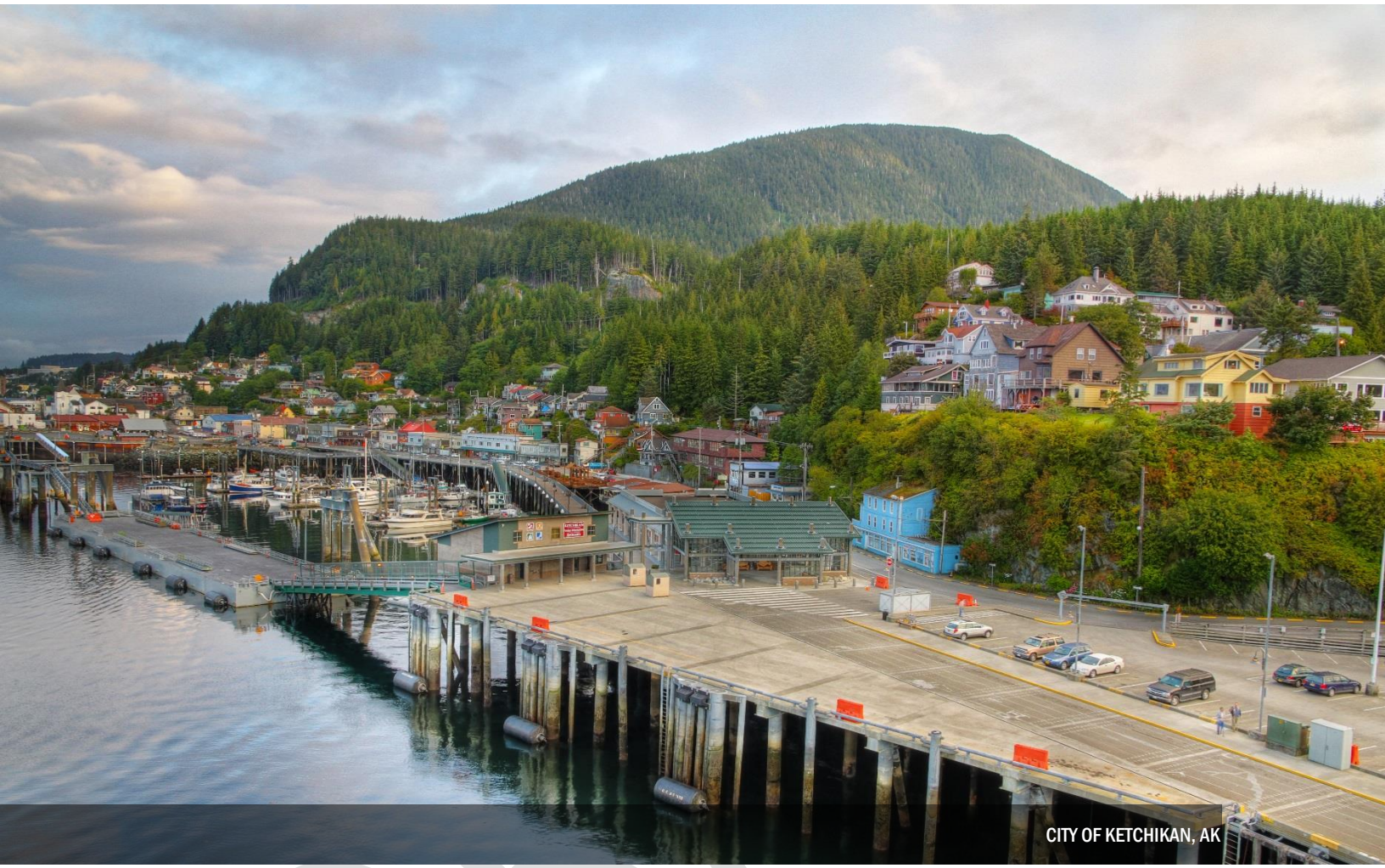

CITY OF KETCHIKAN, AK

Risk Report

FEMA Region X – Ketchikan Gateway Borough, Alaska

Including the Cities of Ketchikan and Saxman

FEMA

DEPARTMENT OF COMMERCE, COMMUNITY AND ECONOMIC DEVELOPMENT

ALASKA GEOLOGICAL AND GEOPHYSICAL SURVEYS

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Executive Summary

Due to its variety of natural hazards, population at risk, and recent events, the Ketchikan Gateway Borough and incorporated cities have been identified as a priority community by the State of Alaska to receive specialized risk data and other information to help community leaders and decision makers increase resiliency. The Federal Emergency Management Agency (FEMA) partnered with the Ketchikan Gateway Borough and the State of Alaska to deploy a Risk Mapping, Assessment, and Planning (Risk MAP) project with the goal to accurately and comprehensively depict the risk throughout the Borough.

This **Risk Report** outlines the results from the natural hazard risk assessments captured in the **Risk Assessment Database**, includes information on best practices to integrate natural hazard mitigation into local planning, and highlights potential mitigation actions throughout the Ketchikan Gateway Borough and incorporated cities. The data summarized in the report may be used to support day-to-day decision making and longer-term planning efforts, such as updates to comprehensive plans and other regulatory tools that inform land use decisions. In conjunction with the **Risk Assessment Database**, this report is intended to**:**

- provide additional data to communities on local hazards;
- connect and integrate this data to pre-existing community planning mechanisms; and
- provide risk and vulnerability assessment results.

More specifically the **Risk Assessment Database** aggregates the natural hazard data developed by various local, State, and partner organizations and quantifies the risks from those natural hazards using community assessor data to determine local risk. While this report summarizes the risk assessment results, the most detailed information is found in the database itself. State and local officials can use the data and analysis provided to update a variety of local plans; communicate risk; inform the modification of development standards; identify mitigation projects; and, ultimately, take action to reduce risk.

Access to the Risk Database can be obtained by contacting:

Sally Russell Cox
State Risk MAP Coordinator
Division of Community and Regional Affairs
Department of Commerce, Community, and Economic Development
907.269.4588 | sally.cox@alaska.gov

1. Introduction

This **Risk Report** outlines the risk assessment results and findings for the Federal Emergency Management Agency (FEMA) Risk Mapping, Assessment, and Planning (Risk MAP) program study. All results, databases, and maps used to generate this **Risk Report** are provided in the **Risk Assessment Database** included with this report. This risk assessment information can support the following local efforts:

- Update local hazard mitigation plans (HMPs), shoreline master plans, and community comprehensive plans;
- Update emergency operations and response plans;
- Increase and improve risk communication;
- Inform the modification of development standards; and
- Identify mitigation projects.

The intended audience for this report includes, but is not limited to:

- Elected officials;
- Tribal leaders;
- Floodplain administrators, engineers, community developers, planners, emergency managers, first responders, and GIS technicians;
- Federal, State, regional, academic, and non-profit organizations interested in hazards or land use; and
- Other stakeholders.

2. Risk and Exposure Assessments

A **risk assessment** analyzes, in detail, how flooding and earthquake hazards affect the built environment, population, and local economy and the likelihood of occurrence. In hazard mitigation planning, risk assessments are the basis for identifying resilience strategies and actions; they define the hazard and enhance the decision-making process. An **exposure assessment** identifies areas that would be impacted by a hazard. This provides an opportunity for State and local officials to prioritize mitigation actions in these areas.

The following risk assessments for flood and earthquakes in Ketchikan Gateway Borough and incorporated cities utilize a free FEMA risk assessment tool, Hazus, which estimates losses due to flood and earthquake for specific buildings. The following exposure assessments for landslides and tsunamis highlight areas affected by these hazards.

For the Ketchikan Gateway Borough and incorporated cities, the following were completed to help individuals describe and visualize the risk for a variety of hazards at the jurisdictional levels:

1. Flood Risk Assessment: Hazus Estimated Loss Information
2. Earthquake Risk Assessment: Hazus Estimated Loss Information
3. Landslide Risk Assessment: Exposure Assessment
4. Tsunami Risk Assessment: Exposure Assessment

While this **Risk Report** provides a summary of the risk assessments, the **Risk Assessment Database** contains the data that is necessary to replicate and expand the results of the hazard analysis produced for the **Risk Report**. By aggregating natural hazard data and quantifying risk to those natural hazards using community assessor data, this dataset can determine local risk to hazards, for every structure in your community. This information can be used for grant applications, local planning and emergency management efforts, identifying vulnerable populations, and communicating risk to various audiences. The risk database is a very powerful dataset that can be used for multiple projects and planning efforts.

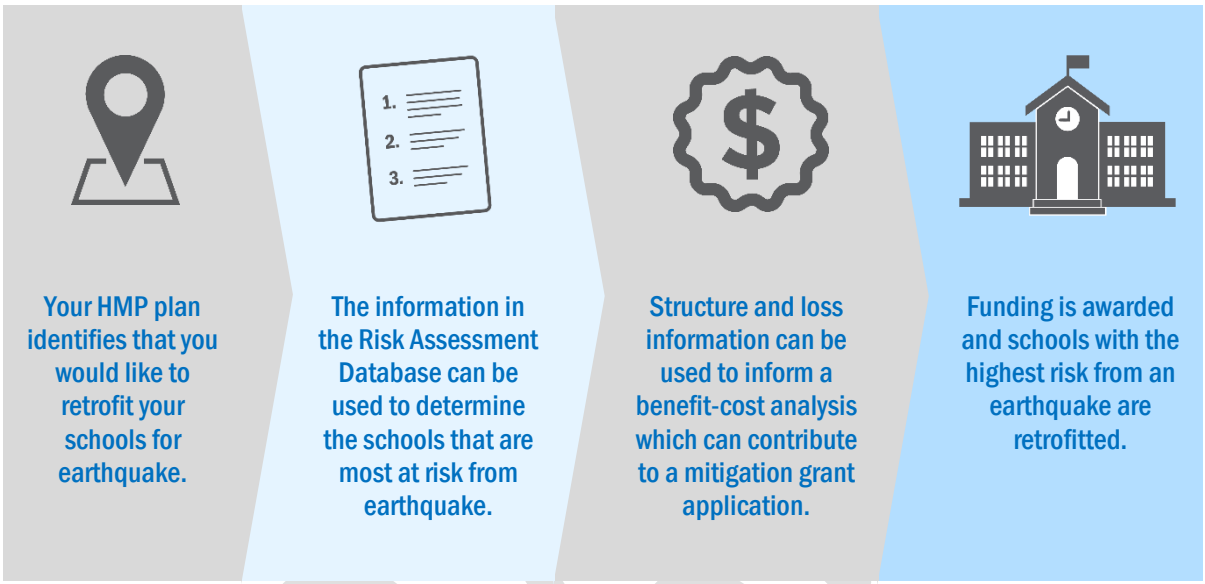


Figure 1: Example of a Risk Assessment Database Application

3. Ketchikan Gateway Borough and Incorporated Cities Risk MAP Overview

Project Scope

The Ketchikan Gateway Borough Risk MAP flood study included updates to coastal and riverine flood areas. Areas of the flood study include the coastal areas of Ketchikan and Saxman, as well as detailed studies of Hoadley, Ketchikan, and Schoenbar Creeks. The study includes Flood Risk Datasets (Flood Depth and Analysis Grids) and a Hazus Flood Risk Assessment.

A flood study project updating riverine and coastal flood hazards in select portions of the Ketchikan Gateway Borough is currently ongoing. FEMA's Production and Technical Services provider, the Strategic Alliance for Risk Reduction II (STARR II); FEMA's Community Engagement and Risk Communication provider, Resilience Action Partners; and the Alaska Division of Community and Regional Affairs are contributing to this project.

The Ketchikan Gateway Borough Risk MAP Hazus Earthquake Risk Assessment analyzed impacts from neighboring Queen Charlotte Fault as well as a probabilistic 500-year Magnitude (M) 7.6 event.

The Ketchikan Gateway Borough Risk MAP tsunami study reviewed tsunami inundation and flow depth stretching from the northern limits of the North Tongass Highway, coastal areas of Ketchikan and

Saxman, around to Beaver Falls, as well as including Pennock Island and the northern coastal areas of Gravina Island.

These Risk MAP datasets, and any additional existing hazard datasets, will be delivered as part of this report.

Project Milestones

Table 1: Project Milestones and Deliverables

August 2013	Risk MAP Discovery Meeting
March 2016	Draft Work Maps
August 2016	Flood Risk Review Meeting
May 2017	Preliminary Digital Flood Insurance Rate Map (DFIRM)/Flood Insurance Study (FIS) Release
June 2017	Consultation coordination Officers Meeting
January 2018	Public Meeting/Workshop
February 2018	Appeal Period Starts
May 2018	Appeal Period Ends
Fall 2018*	Letter of Final Determination
Spring 2019*	Maps and FIS Become Effective

*Dates are shown as projected

The initial Risk MAP meeting was a Discovery Meeting involving FEMA, the State, and local officials held on August 7, 2013. At Discovery, the Borough and cities identified earthquake, flooding, landslide, tsunami, and severe storms as the top five hazards. Based on that meeting, FEMA and State partners prioritized funding and technical assistance for three of those concerns: flood, earthquake, and tsunami.

4. Flood Risk Assessment

Flood Hazard Overview

Flooding can result from heavy rainfall, urban stormwater overflow, rapid snowmelt, rising groundwater, chronic debris deposition, ice jamming, flash flooding, fluctuating lake levels, alluvial fan flooding, glacial lake outbursts, subglacial release, coastal storm surges, and tsunamis. Flooding may occur gradually over time or may be the result of a heavy storm and rapid water level increase. The Ketchikan Gateway Borough is not expected to experience significant flooding. The lack of flooding experienced in the Ketchikan Gateway Borough is due to steep mountain slopes and small watersheds that do not allow for large buildups of water.

The Ketchikan Gateway Borough is susceptible to coastal and riverine flooding primarily in the City of Ketchikan. Though the probability of an event is not significant, should a flood event occur, the Greater Ketchikan Area could experience separation from the rest of the State and experience building damage to coastal areas (Greater Ketchikan Area MHMP, 2009). While no Presidentially Declared Disasters have occurred within the Ketchikan Gateway Borough, isolation from the rest of Alaska poses problems for emergency response, rescue, and emergency repair availability. The Ketchikan Gateway Borough's proximity to the sheltered coastline and streams flowing through the urban areas does put structures at risk of flooding.

Risk MAP Program Study of Flood Hazards in the Ketchikan Gateway Borough

The Flood Risk Assessment found in this **Risk Report** is a summary of information that can be found in the **Risk Assessment Database** and can be used to provide more details and a larger mapping footprint.

Table 2: Flood-Related Risk MAP Products, Study Areas, and Product Uses and Benefits

Depth Grids	Displace flood depths for a 0.2-, 1-, 2-, 4-, and 10-percent-annual-chance flood events (Hoadley Creek, Ketchikan Creek, and Schoenbar Creek) and the 1-percent-annual-chance flood event in coastal areas. (Map 5).	Depth grids can help community officials and the public assess, visualize, and communicate a variety of local flood scenarios.
Water Surface Elevation Grids	Display the Base Flood Elevation (BFE) for 1-percent-annual-chance riverine flood areas (Map 6).	The water surface elevation grids allow community officials to better understand and communicate flood risk and can allow for the identification of surface elevation information at site-specific locations.
BFE+ Grids	Coastal depth grids along the Ketchikan Gateway Borough and the cities of Ketchikan and Saxman include depth grids with increases of +1, +2, and +3 feet above the BFE. These grids allow users to review the inundation occurring at 1-foot increases to the 1-percent-annual-chance flood event (Map 7).	BFE+ grids can be used to identify areas affected by increased storm surge, storms greater than the 1-percent-annual-chance event, and areas that could potentially be affected by sea level rise.
Percent Annual Chance Grids	Percent Annual Chance Grids displaying the annual probability of a flood event and the probability of a flood event over a 30-year period in riverine areas (Map 8).	These flood risk products can be utilized as outreach tools to show the hazards of flooding. Properties shown to be affected by a flood event would be excellent locations for mitigation projects. Some of these potential mitigation projects are highlighted in the section of this report for each community.

Flood Frequencies and National Flood Insurance Participation Information

While the flood risk assessments in the Ketchikan Gateway Borough and incorporated cities were conducted for the 1-percent-annual-chance flood event, it is important to note that flood frequencies can also be defined as other percent chances of occurrence, such as the 0.2-percent-annual-chance event or 10-percent-annual-chance event. These frequencies are referred to in multiple ways, but all

refer to the same rate of occurrence. Table 3 summarizes the terms used to categorize flood frequencies.

Table 3: Estimated Probability of a Flood Event

EVENT	ANNUAL CHANCE OF OCCURRENCE	ADDITIONAL WAYS TO REFERENCE THE OCCURRENCE
10-year flood	10 percent	• During the span of a 30-year mortgage, a home has a 96-percent chance of being flooded at least once.
25-year flood	4 percent	• During the span of a 30-year mortgage, a home has a 71-percent chance of being flooded at least once.
50-year flood	2 percent	• During the span of a 30-year mortgage, a home has a 45-percent chance of being flooded at least once.
100-year flood	1 percent	• SFHA • During the span of a 30-year mortgage, a home has a 26-percent chance of being flooded at least once.
500-year flood	0.2 percent	• During the span of a 30-year mortgage, a home has a 6-percent chance of being flooded at least once.

Note: Each flood has its respective chance of occurrence each year, regardless of recent history. For example, if a 100-year flood occurred last year, there is still a 1-percent chance that a flood of this magnitude will occur this year as well.

The National Flood Insurance Program (NFIP) requires flood insurance for property owners with structures carrying a federally insured mortgage that are located within the SHFA. The Ketchikan Gateway Borough and its incorporated communities participate in the NFIP. Table 4 provides a brief overview of program participants, past flood claims, total policies, and total insurance coverage.

The information in Table 4 can be used to highlight areas that are already affected by flooding and with a history of flood claims. In addition, the insurance coverage can be compared to the dollar losses shown below to determine if enough coverage exists for a specific event. The Borough is the only participating community in the Community Rating System, categorized as a Class 9 community and receiving a 5-percent discount on flood insurance premiums. Comparing total policies and insurance coverage to the flood results below can help identify gaps in protecting property across the Borough.

Table 4: Community Characteristics in the Ketchikan Gateway Borough

COMMUNITY NAME	TOTAL POPULATION	CRS COMMUNITY (AS OF OCT 2017)	FLOOD CLAIMS	TOTAL LOSSES PAID	REPETITIVE LOSS PROPERTIES	TOTAL POLICIES	TOTAL INSURANCE COVERAGE
KETCHIKAN GATEWAY BOROUGH*	13,856	YES - 9	6	$99 K	0	48	$19 M
KETCHIKAN, CITY OF	8,208	No	-	-	-	-	-
SAXMAN, CITY OF	418	No	-	-	-	-	-

- (no data available)
Note: Population estimate from US Census, American Fact Finder. Insurance data from FEMA Community Information System platform.
*The Ketchikan Gateway Borough does not include the cities of Ketchikan and Saxman

Special Flood Hazard Area Overview

The flood risk assessment was completed using Hazus-MH 4.0, FEMA's loss estimation software, with individual parcel data provided by the Borough. Only properties with buildings (improvements) were incorporated into the analysis; therefore, no impacts to vacant land were assessed. Depth grids derived from the Risk MAP project were also used for this analysis. Buildings in areas where depth grids were available were incorporated into Hazus, which provided building, content, and/or inventory loss values.

Since Depth Grid data was limited, all structures were analyzed to show whether they intersected an SFHA. Exposed value of the structure's building and contents and the percentage of overall value is provided in Table 5, where the flood hazard boundary data was available.

Table 5: Flood Hazard Exposure

BASE DATA			1-PERCENT ANNUAL CHANCE FLOOD EXPOSURE			
COMMUNITY NAME	TOTAL STRUCTURES	TOTAL VALUE (BUILDING AND CONTENTS)	STRUCTURES EXPOSED IN A SPECIAL FLOOD HAZARD AREA	PERCENT OF STRUCTURES EXPOSED IN A SPECIAL FLOOD HAZARD AREA	EXPOSED VALUE (BUILDING AND CONTENTS)	PERCENT OF EXPOSED VALUE (BUILDING AND CONTENTS)
KETCHIKAN GATEWAY BOROUGH*	2,308	$753.3 M	62	2.7%	$114.7 M	15.2%
KETCHIKAN, CITY OF	2,252	$965.4 M	112	5.0%	$57.1 M	5.9%
SAXMAN, CITY OF	119	$35.9 M	3	2.5%	$484 K	1.4%
TOTAL	**4,679**	**$1.8 B**	**177**	**3.8%**	**$172.2 M**	**9.8%**

*The Ketchikan Gateway Borough does not include the cities of Ketchikan and Saxman

An exposure assessment determines the number of structures intersecting the SFHA for riverine and coastal events. Of the 177 Borough structures within the SFHA, nearly two-thirds reside within the City of Ketchikan. However, less than one-third of the total exposed value is in the City of Ketchikan. About twice as much value is exposed in the rest of the Borough. In total, nearly 10-percent of the Borough building and content value is located within the SFHA. See Map 1 for a spatial distribution of exposed structures.

Hazus loss estimate analyses have been performed for coastal and riverine flooding and can be viewed in the following tables. Coastal loss values for the 1-percent-annual-chance flood event are available for the Borough and two incorporated jurisdictions. Flood loss values for riverine areas of the Ketchikan Gateway Borough and incorporated cities were assessed for the 0.2-, 1-, 2-, 4-, and 10-percent-annual-chance flood frequencies. Riverine assessments have only provided estimates for the City of Ketchikan (due to data availability). The analysis is limited to where flood hazard boundaries and depth grids have been developed. Results from this study can be explored in Tables 7 through 12.

A more detailed assessment projecting the loss ratio (value of building and contents expected to be lost during a flood event divided by the total value of the building and contents) is provided.

ed from a riverine flood event.

Table 6 identifies the number of structures assessed for each flood hazard. Of the 177 structures exposed to flood hazards, 73 have loss values associated from a coastal flood event, while 72 structures have loss values associated from a riverine flood event.

Table 6: Flood Hazus Assessment Summary - Ketchikan Gateway Borough

COMMUNITY NAME	STRUCTURES EXPOSED	PERCENT OF STRUCTURES EXPOSED	EXPOSED VALUE	PERCENT OF EXPOSED VALUE	COASTAL STRUCTURES WITH HAZUS FLOOD LOSS ESTIMATE	PERCENT OF COASTAL STRUCTURES WITH HAZUS FLOOD LOSS ESTIMATE	RIVERINE STRUCTURES WITH HAZUS FLOOD LOSS ESTIMATE	PERCENT OF RIVERINE STRUCTURES WITH HAZUS FLOOD LOSS ESTIMATE
KETCHIKAN GATEWAY BOROUGH*	62	2.7%	$114.7 M	15.2%	30	1.3%	No Data Available	No Data Available
KETCHIKAN, CITY OF	112	5.0%	$57.1 M	5.9%	41	1.8%	72	3.2%
SAXMAN, CITY OF	3	2.5%	$484 K	1.4%	2	1.7%	No Data Available	No Data Available
TOTAL	**177**	**3.8%**	**$172.2 M**	**9.8%**	**73**	**1.6%**	**72**	**1.5%**

*The Ketchikan Gateway Borough does not include the cities of Ketchikan and Saxman

Tables 7 and 8 provide loss values for each studied flood event. A 1-Percent Coastal flood event is anticipated to cause the most in damages to the Borough, with nearly $74 million in damage. Riverine flood events range in total damages of $4.5 million (0.2-Percent Riverine flood event) to $1.8 million (10-Percent Riverine flood event). Maps 2, 3, and 4 (see below) display losses across the Borough for each flood hazard.

Table 7: Coastal 1-Percent-Annual-Chance Flood Hazus Assessment - Ketchikan Gateway Borough

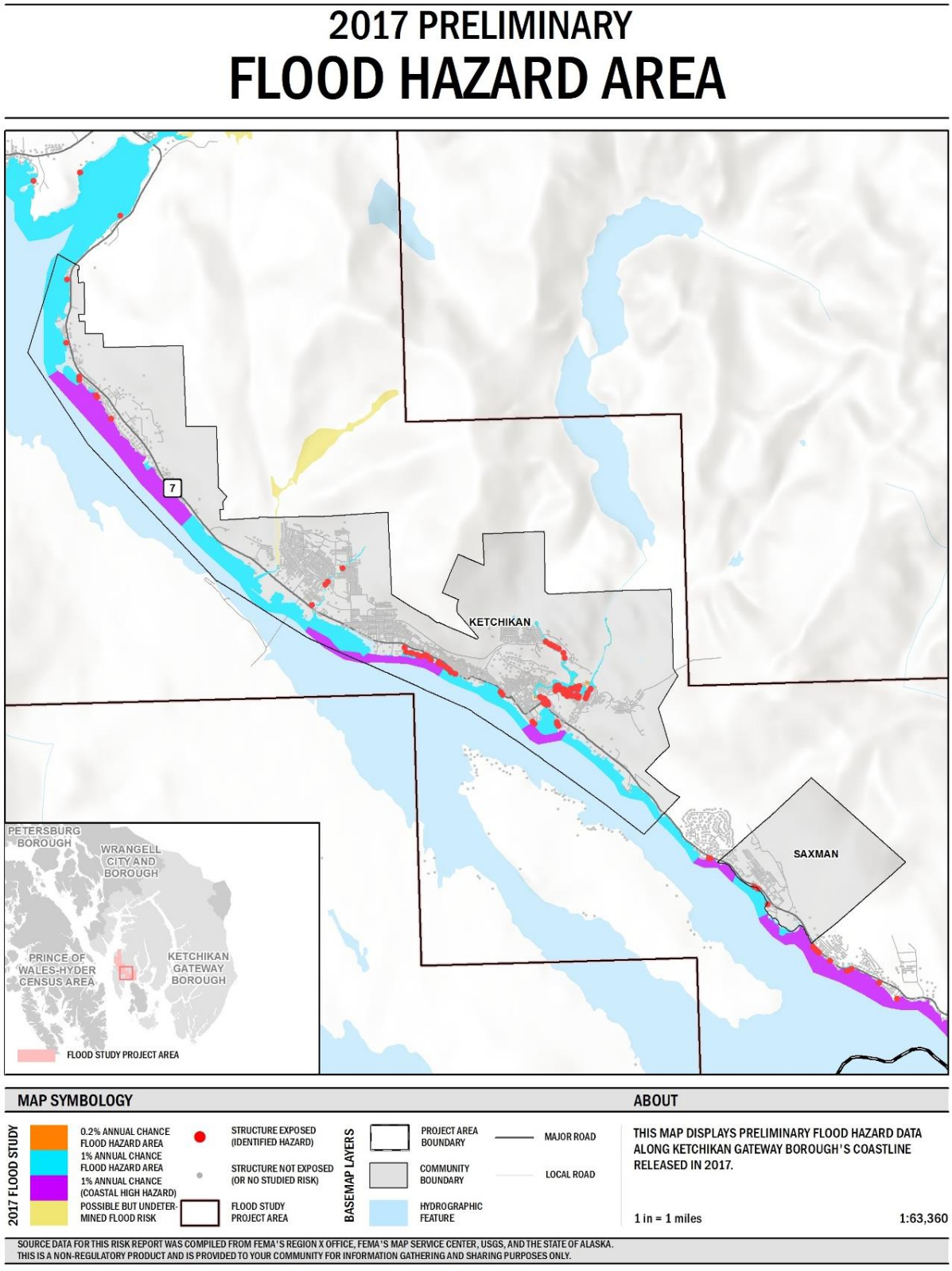
COMMUNITY NAME	STRUCTURES EXPOSED	PERCENT OF STRUCTURES EXPOSED	EXPOSED VALUE	PERCENT OF EXPOSED VALUE	COASTAL STRUCTURES WITH 1-PERCENT HAZUS FLOOD LOSS ESTIMATE	PERCENT OF COASTAL STRUCTURES WITH 1-PERCENT HAZUS FLOOD LOSS ESTIMATE	LOSS VALUE (BUILDING AND CONTENTS)	LOSS RATIO (BUILDING AND CONTENTS)
KETCHIKAN GATEWAY BOROUGH*	62	2.7%	$114.7 M	15.2%	30	1.3%	$55.3 M	7.4%
KETCHIKAN, CITY OF	112	5.0%	$57.1 M	5.9%	41	1.8%	$18.4 M	1.9%
SAXMAN, CITY OF	3	2.5%	$484 K	1.4%	2	1.7%	$33 K	<1%
TOTAL	**177**	**3.8%**	**$172.2 M**	**9.8%**	**73**	**1.6%**	**$73.8 M**	**4.2%**

*The Ketchikan Gateway Borough does not include the cities of Ketchikan and Saxman

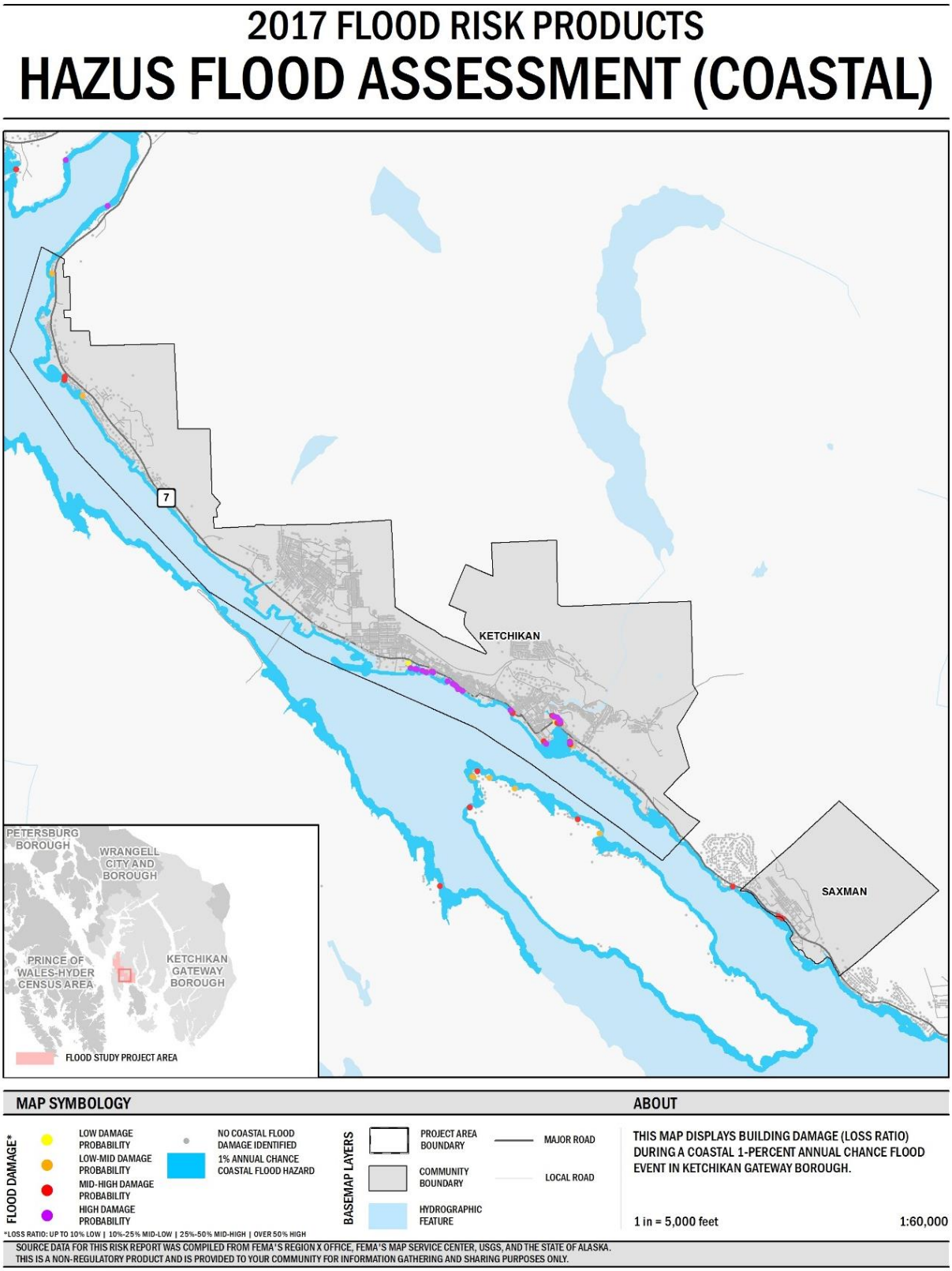
Table 8: Riverine Flood Hazus Assessments for the City of Ketchikan

	0.2-PERCENT-ANNUAL-CHANCE FLOOD	1-PERCENT-ANNUAL-CHANCE FLOOD	2-PERCENT-ANNUAL-CHANCE FLOOD	4-PERCENT-ANNUAL-CHANCE FLOOD	10-PERCENT-ANNUAL-CHANCE FLOOD
LOSS VALUE (BUILDING AND CONTENTS)	$4.5 M	$2.8 M	$2.3 M	$1.8 M	$1.1 M

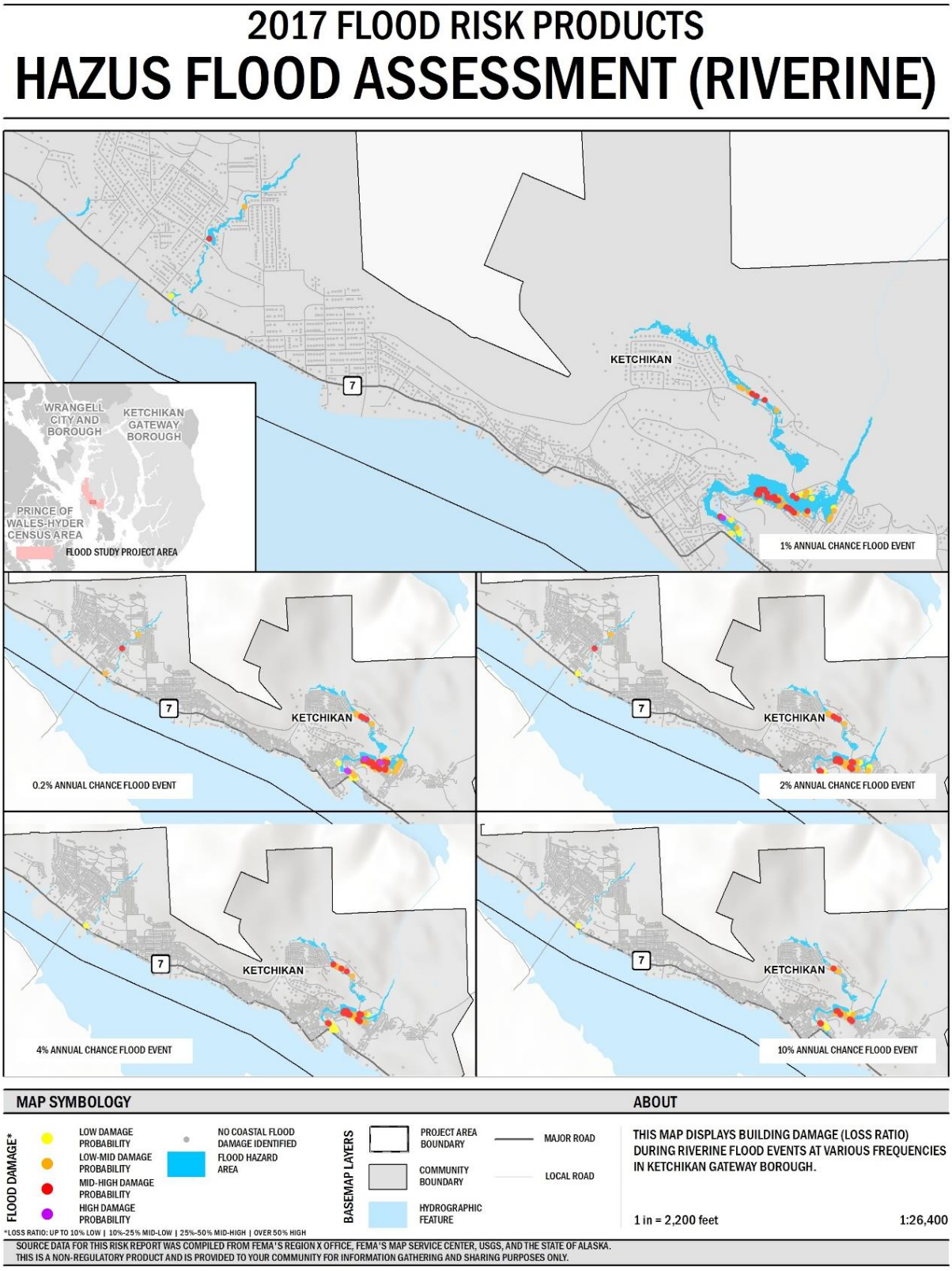
Note: Riverine flood Hazus assessments were not conducted for areas outside of the City of Ketchikan



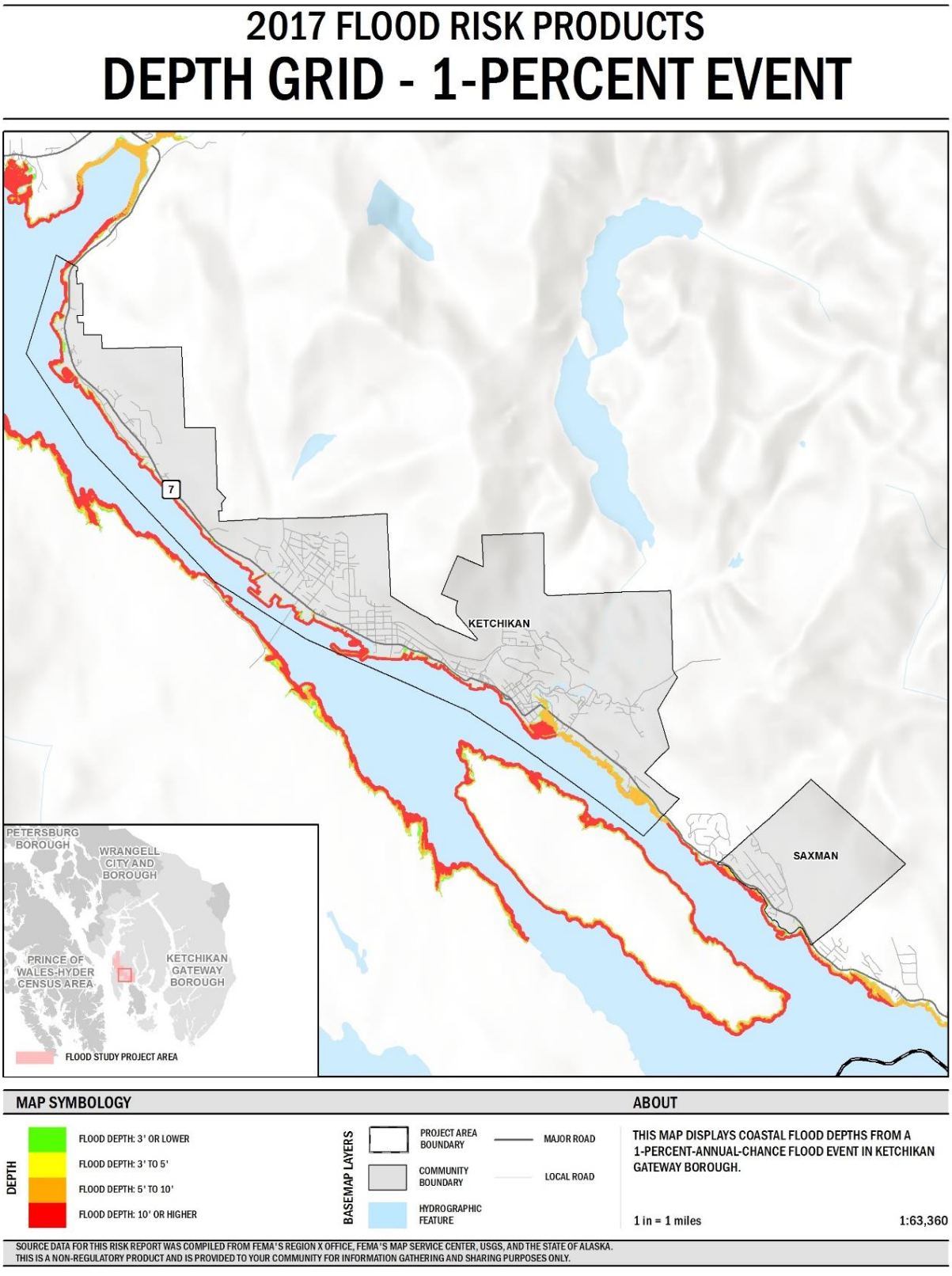
Map 1: Flood Damage (1-Percent Coastal Event) - Ketchikan Gateway Borough



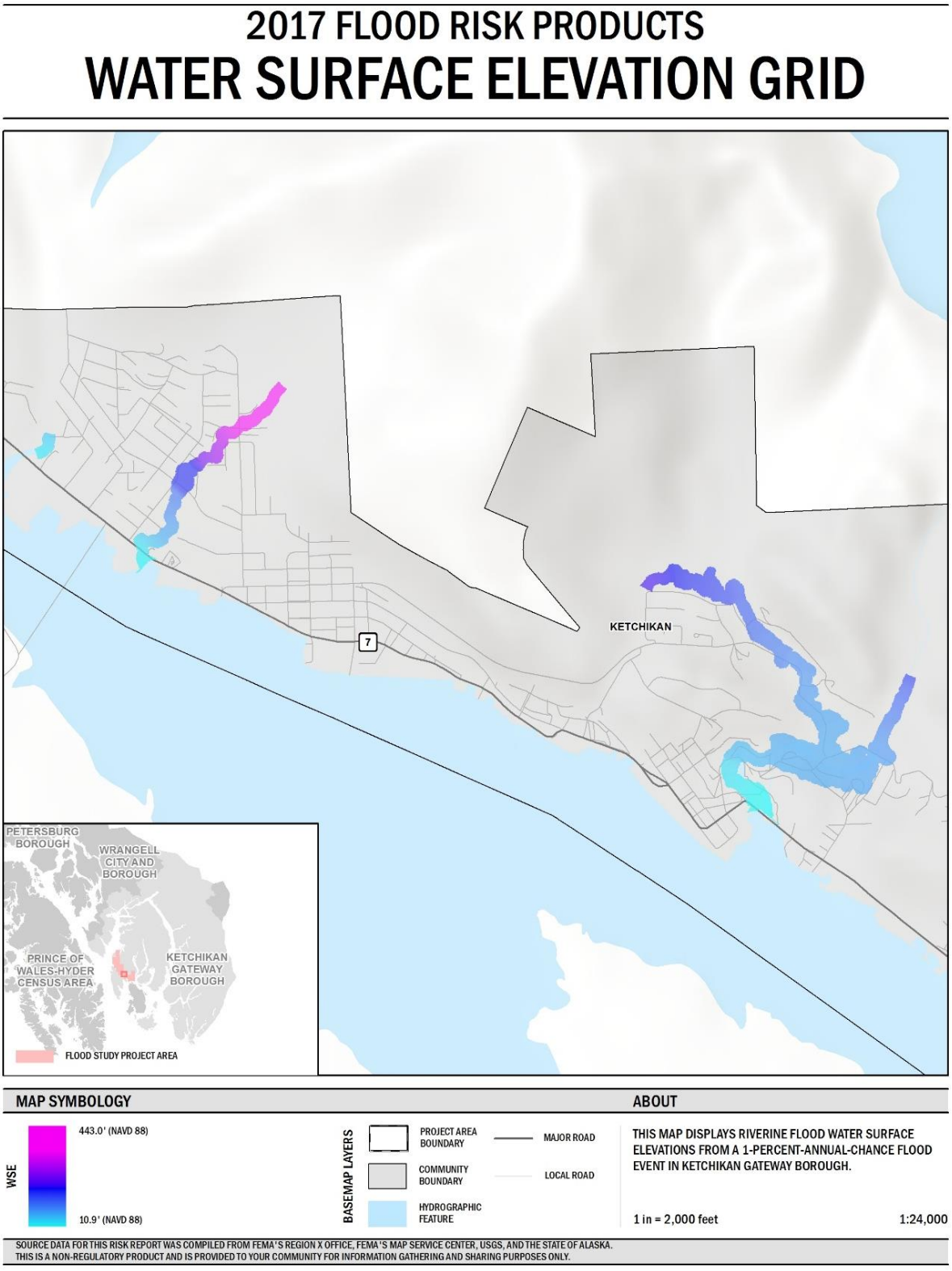
Map 2: Flood Damage (1-Percent Coastal Event) - Ketchikan Gateway Borough



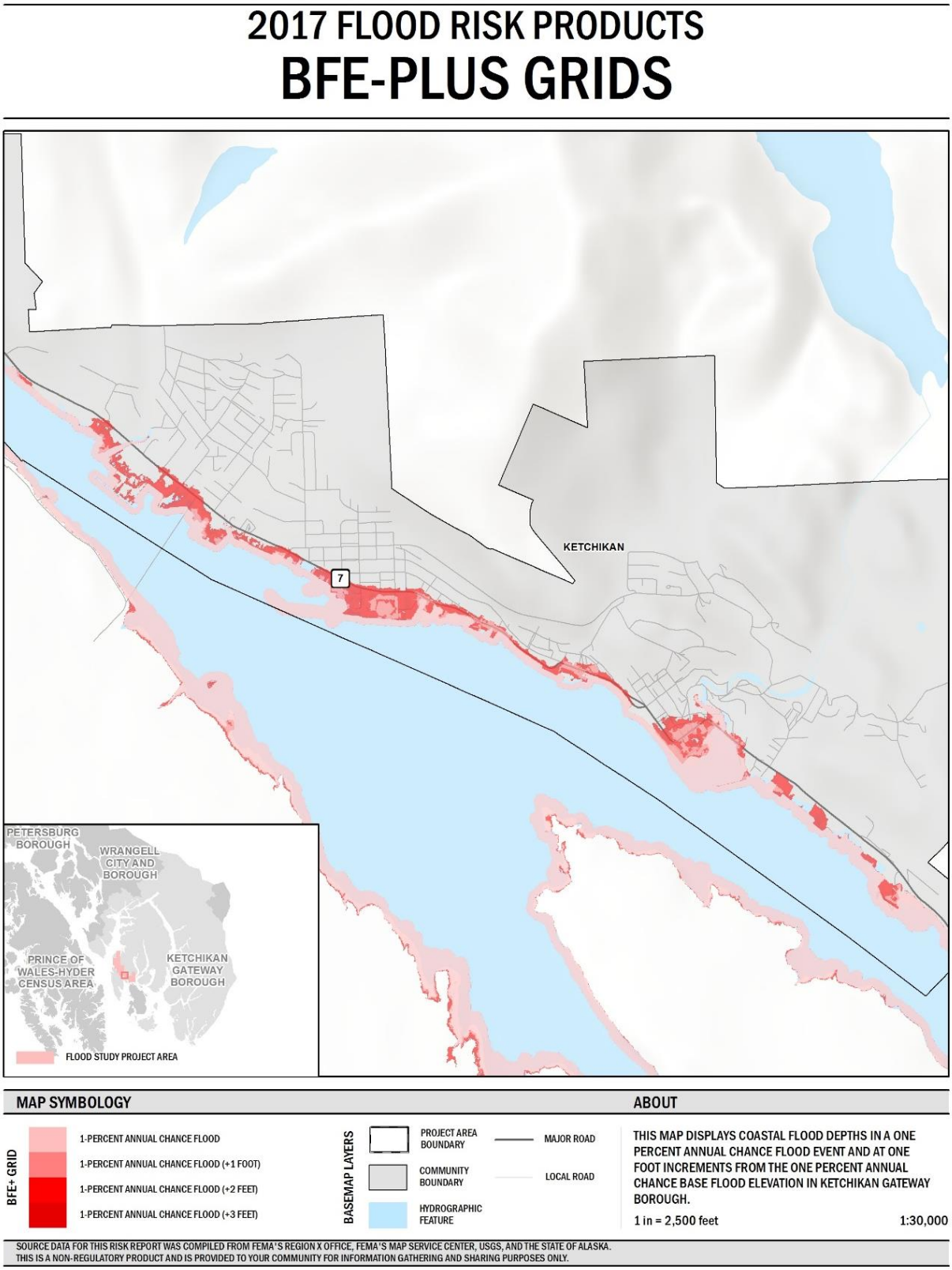
Map 3: Flood Damage (Various Riverine Events) - Ketchikan Gateway Borough



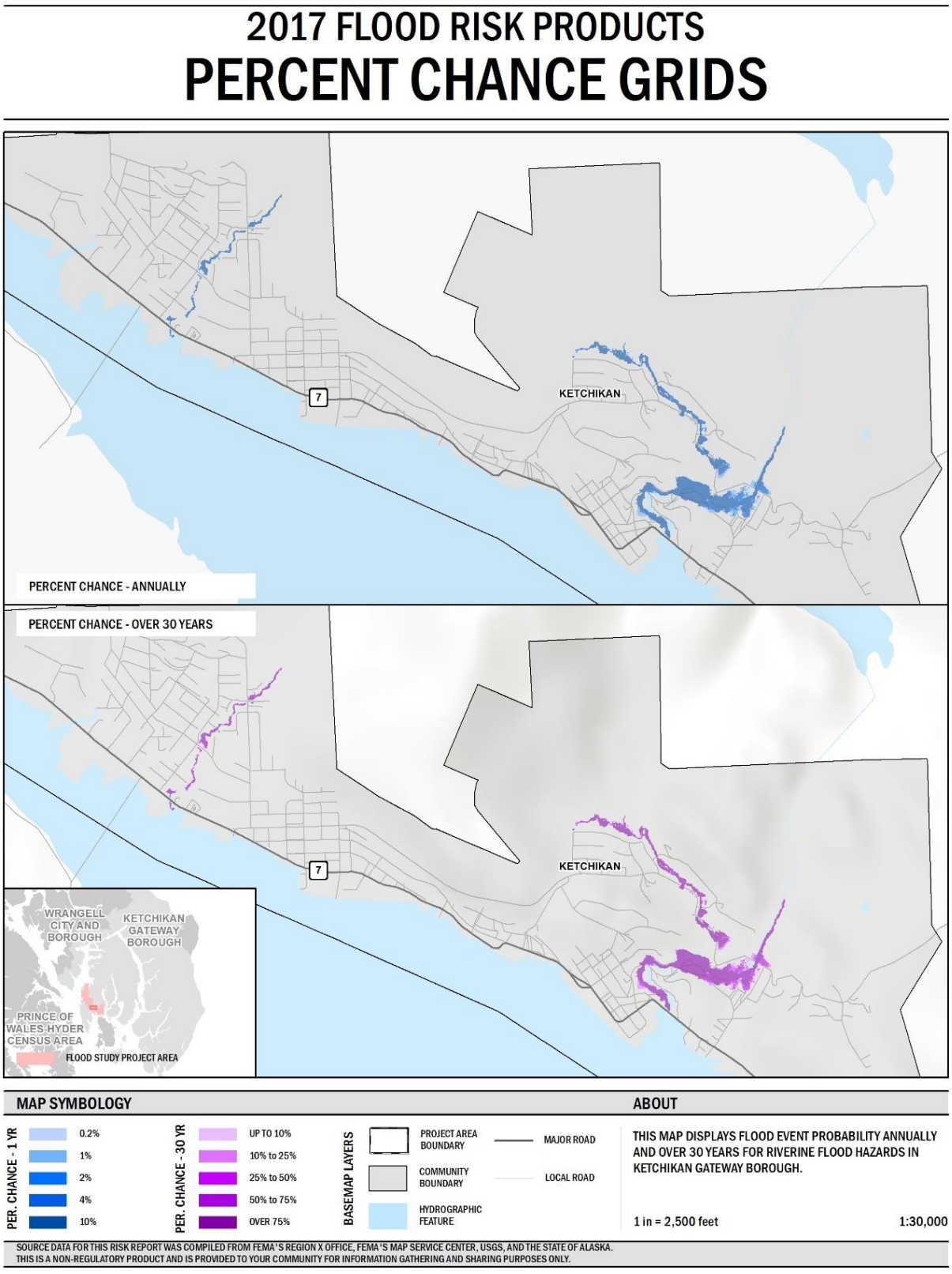
Map 4: Flood Depth Grid (1-Percent Event) - Ketchikan Gateway Borough



Map 5: Flood Water Surface Elevation Grid (Riverine 1-Percent Event) - Ketchikan Gateway Borough



Map 6: Flood BFE+ Grid (Coastal Event) - Ketchikan Gateway Borough



Map 7: Flood Percent Chance Grids (Riverine Event) - Ketchikan Gateway Borough

5. Earthquake Risk Assessment

Earthquake Hazard Overview

Alaska, in general, is one of the most seismically active regions in the world. With 11-percent of the world's earthquakes occurring here, earthquake hazard mitigation is of the highest concern (Greater Ketchikan Area Multi Hazard Mitigation Plan, 2009). Additional factors resulting from earthquake events are liquefaction of soils, landslides, and tsunamis. Liquefaction occurs when sandy and silty soils with high water content act as a liquid resulting in ground failure. Ground failure can be a factor of earthquake-induced landslides, creating the potential for damage. Tsunamis result in increased wave action due to immense energy from earthquake events. Tsunamis may also occur when an underwater landslide occurs, causing mass movement of soil and increased wave action.

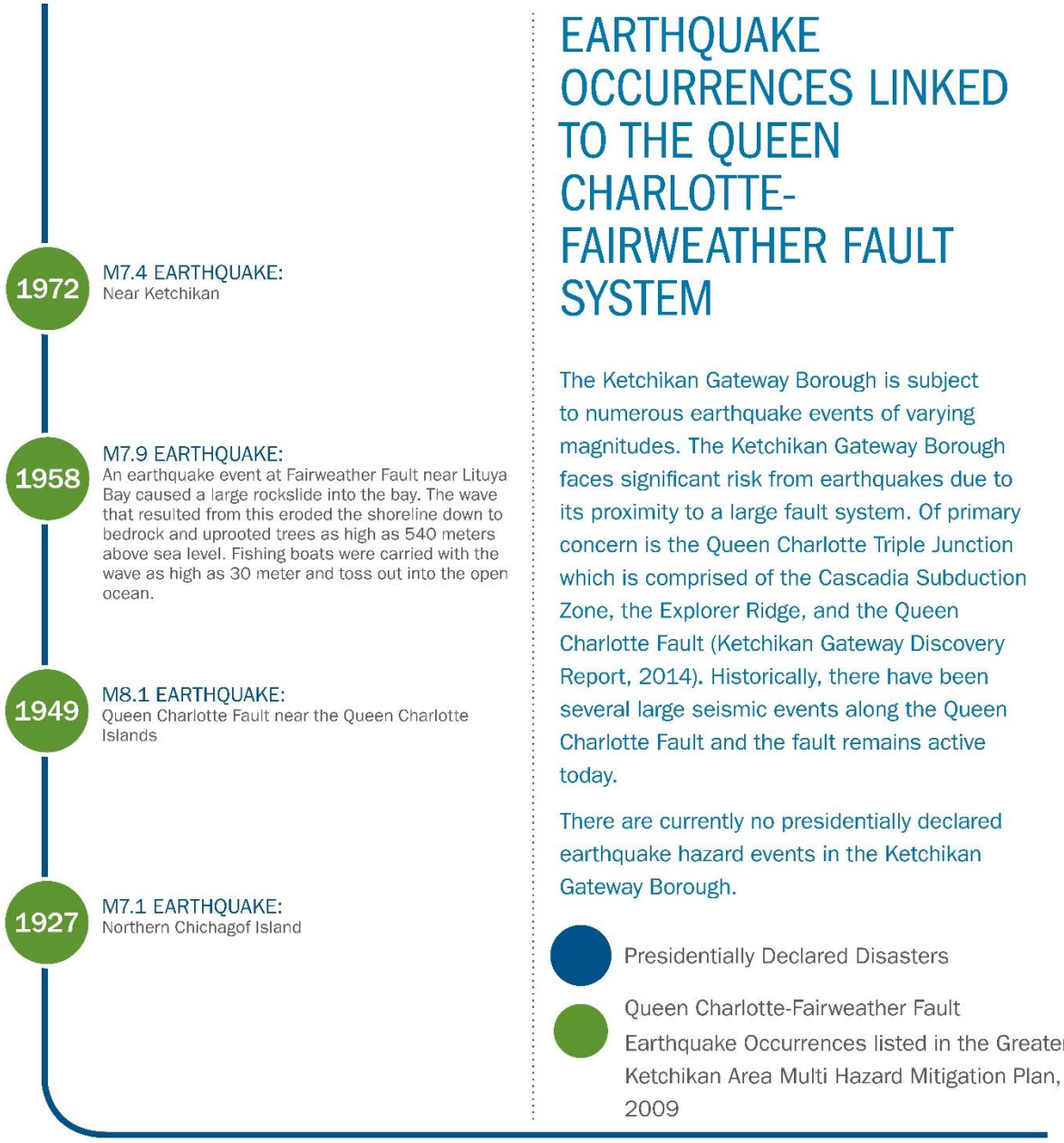


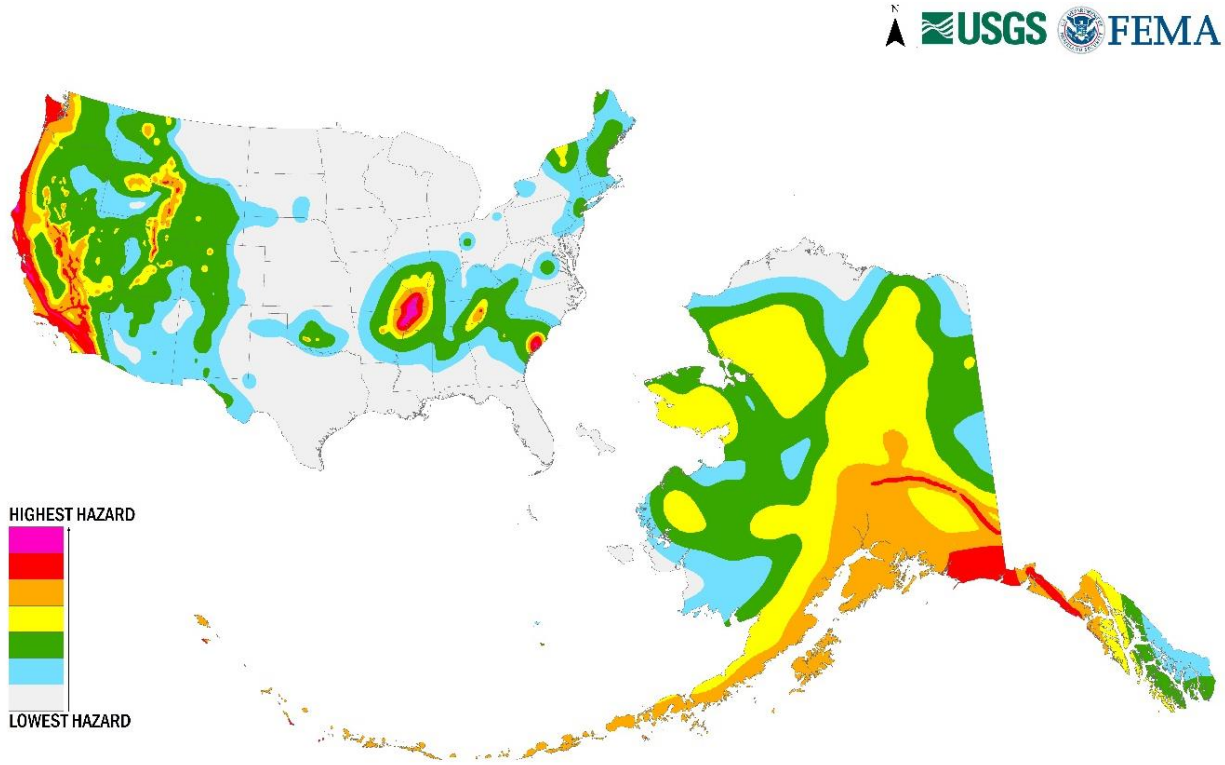
Figure 2: Earthquake Occurrences Linked to the Queen Charlotte-Fairweather Fault System

ShakeMaps

Maps depicting the shaking intensity and ground motion produced by an earthquake, called ShakeMaps, can be produced in near-real time for events or created for specific scenarios by regional seismic network operators in cooperation with the U.S. Geological Survey (USGS). ShakeMaps can be used for response, land use, and emergency planning purposes. A ShakeMap was not attainable from the USGS or Alaska Earthquake Center for this study.

Alternatively, a map depicting overall earthquake hazard risk has been included and can be viewed in the graphic below (Map 9). Based on the map, the Ketchikan Gateway Borough is at a relatively low risk

to earthquake events compared to the rest of Alaska, and while not likely to experience direct effects from an event, it is still subject to many additional factors resulting from an earthquake event.



Map 8: Overall Earthquake Hazard Assessment of the United States

Earthquake Risk Assessment Overview

During the Discovery process, a Queen Charlotte Fault earthquake was a reported concern for the Borough. Due to this concern, a Queen Charlotte Fault M7.6 earthquake was assessed for the Ketchikan Gateway Borough. However, the results were inconclusive given that the epicenter for this event was closer to Sitka and Juneau than the Ketchikan Gateway Borough and resulted in minimal losses. This may not provide an accurate assessment of potential damages to the structures within the Borough and will need to be revisited through a scenario with closer proximity to the Borough.

After analyzing the Queen Charlotte Fault scenario, and due to the lack of other available earthquake scenarios in the Ketchikan Gateway Borough area, a probabilistic scenario was evaluated. The probabilistic earthquake scenario is an M7.6, 500-year event. This scenario provided minimal measurable losses to the Borough and its communities. Future assessments of earthquake risk in this area may require newly generated scenarios with epicenters closer to the Ketchikan Gateway Borough.

For this study, individual building data from the Ketchikan Gateway Borough was incorporated into Hazus to allow losses to be reported at the structure level. Only properties with buildings (improvements) were incorporated into the analysis; therefore, no impacts to vacant land were assessed. The building losses from the earthquake assessment are summarized below in Table 9.

Table 9: Earthquake Risk Assessment

COMMUNITY NAME	TOTAL STRUCTURES	TOTAL VALUE (BUILDING AND CONTENTS)	STRUCTURES EARTHQUAKE LOSS RATIO >= 10 PERCENT	PERCENT OF STRUCTURES EARTHQUAKE LOSS RATIO >= 10 PERCENT*	LOSS VALUE (BUILDING AND CONTENTS)	LOSS RATIO (BUILDING AND CONTENTS)
KETCHIKAN GATEWAY BOROUGH*	2,308	$753.3 M	0	0.0%	$2.7 M	0.4%
KETCHIKAN, CITY OF	2,252	$965.4 M	0	0.0%	$3.6 M	0.4%
SAXMAN, CITY OF	119	$35.9 M	0	0.0%	$111 K	0.3%
TOTAL	**4,679**	**1.8 B**	**0**	**0.0%**	**$6.4 M**	**0.4%**

Note: This table shows an assessment of total structures. Loss estimates are shown via loss values and loss ratios for the probabilistic M7.6 event.

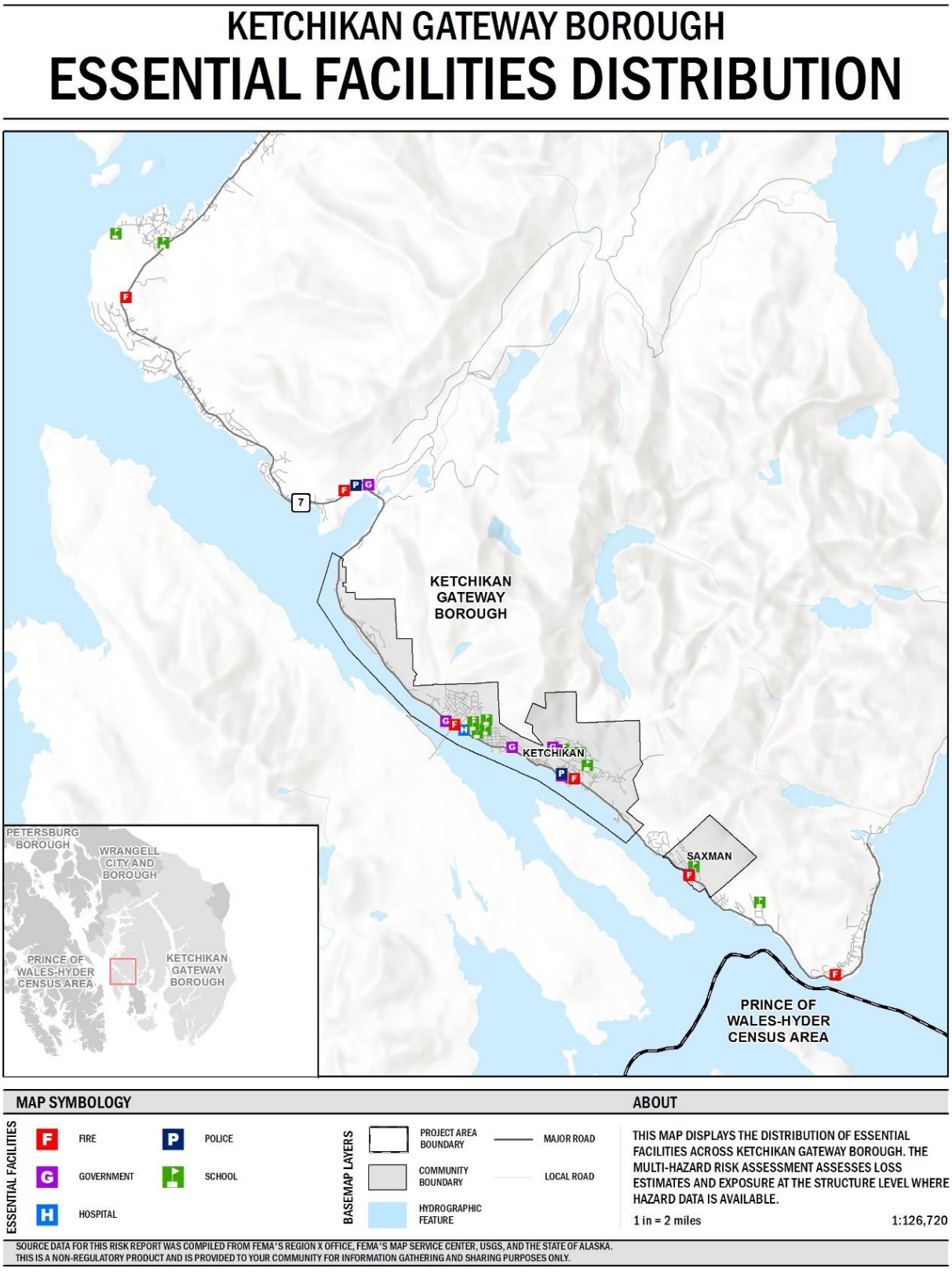
*The Ketchikan Gateway Borough does not include the cities of Ketchikan and Saxman

Results from the probabilistic scenario show a minimal 0.4-percent loss ratio and losses to building and content value at $6.4 million. None of the 4,679 structures were identified to have a loss ratio greater than 10 percent.

Given the low loss values, it is important to note that this scenario may not fully represent the earthquake hazard in the Borough. Loss estimates are representative of the number of structures in the area, the building and content values, and the amount of exposure to the earthquake event. Additionally, year and quality of build are considered to determine loss estimates for structures in the incorporated and unincorporated areas of the Borough.

Essential Facilities

Analysis of essential facilities is dependent on available cost and structure data. In many communities, values for facilities like schools, medical facilities, police, and fire departments are not available. While assessor data is not available for the facilities, they have been digitally captured for exposure assessments. Essential Facilities were reviewed for exposure to flood, tsunami, and landslide hazards. Based on the available flood, tsunami, and landslide data, key facilities were not identified in hazard areas. A distribution of essential facilities across the Borough can be seen in Map 9.



Map 9: Essential Facilities - Ketchikan Gateway Borough, Alaska

6. Landslide Exposure Assessment

Landslide Hazard Overview

Landslides occur throughout the U.S. and can be caused by a variety of factors including earthquakes, storms, volcanic eruptions, fire, and human modification of land. Landslides can occur quickly, especially during the wet winter months. Landslides usually occur in steep areas, but not exclusively. Occurrence can happen at ground failure of river bluffs, cut-and-fill failures associated with road and building excavations, collapse of mine-waste piles, and slope failures associated with open-pit mines and quarries. Underwater landslides usually involve areas of low relief and slope gradients in lakes and reservoirs or in offshore marine settings.

According to a 1975 report conducted by the USGS, landslides and slumps in the Ketchikan Gateway Borough may occur on land or underwater following earthquake events. The coastal areas of the Ketchikan Gateway Borough are determined to be most susceptible to earthquake-induced slides and slumps. Fan-delta deposits and manmade fill in the area are contributing factors of susceptibility and may result in liquefaction of deposits. Liquefaction increases the potential for a slide or slump event to occur. Limitations to this study include environmental changes that have occurred in the roughly 45 years since the report was issued, including changes to the coastline and fill. A reassessment of the fan-delta and manmade fill would increase the knowledge of landslide susceptibility in the Borough. Per the Greater Ketchikan Area Multi-Hazard Mitigation Plan, landslide concerns increase with the growth of development, population, and external factors altering the landscape of the area.

There have been no Presidentially Declared Disasters related to landslide in the Ketchikan Gateway Borough area.

Landslide Exposure Assessment

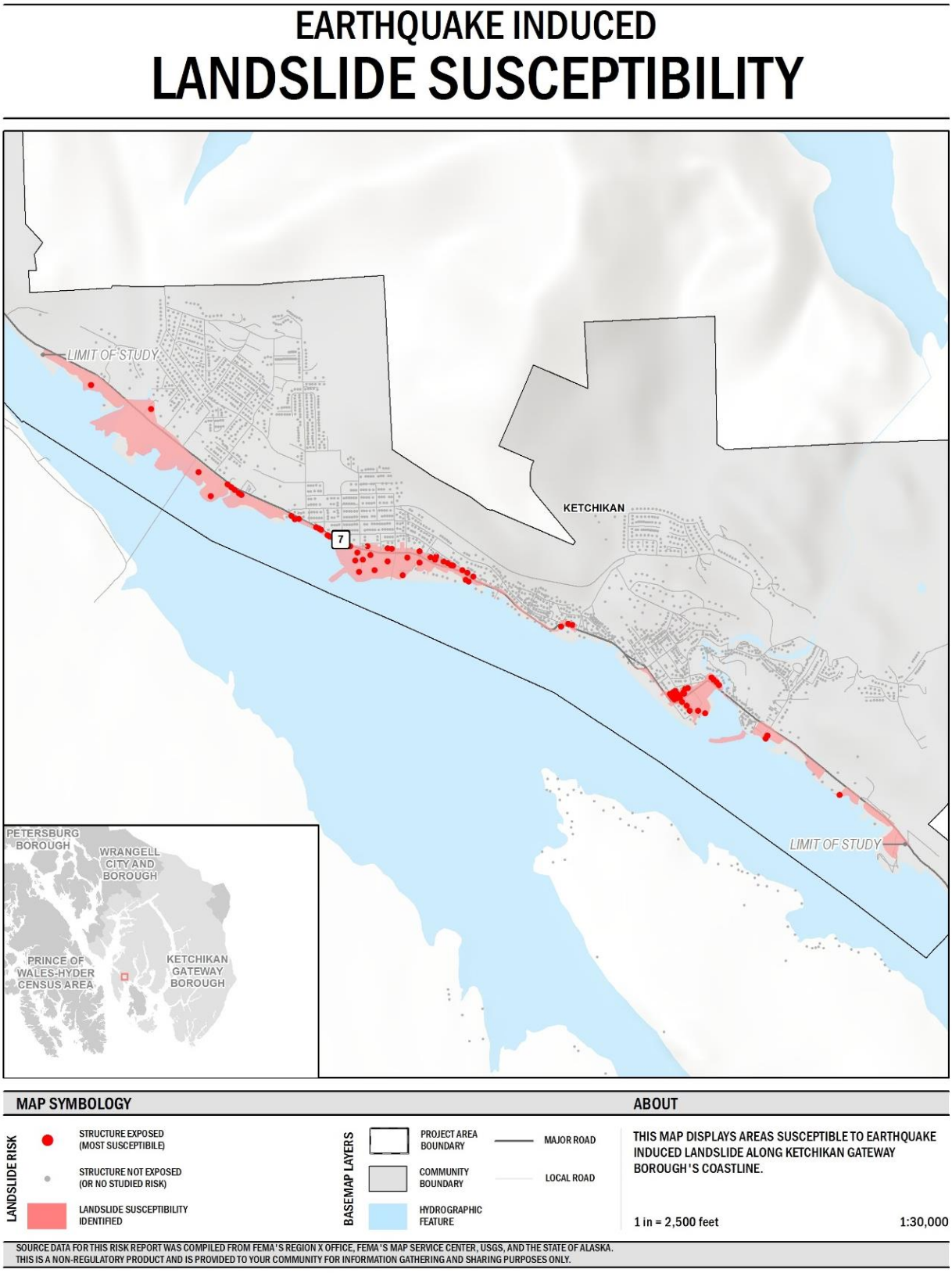
The "*Reconnaissance Engineering Geology of the Ketchikan Area*" report referenced above was published in 1975 and analyzed potential concerns to landslide and slump susceptibility. The report is hosted by Alaska Division of Geological and Geophysical Surveys and is available for reference. As part of this risk assessment, the original map was digitized and captured spatially (Map 10) to identify landslide susceptibility in the Ketchikan Gateway Borough area along alluvial fan-deltas and manmade fill deposits. A building exposure assessment for areas of landslide concern can be reviewed in Table 10.

Table 10: Landslide Susceptibility Exposure Assessment

COMMUNITY NAME	TOTAL STRUCTURES	TOTAL VALUE (BUILDING AND CONTENTS)	STRUCTURES EXPOSED IN A LANDSLIDE HAZARD AREA	PERCENT OF STRUCTURES EXPOSED IN A LANDSLIDE HAZARD AREA	EXPOSED VALUE (BUILDING AND CONTENTS)	PERCENT OF EXPOSED VALUE (BUILDING AND CONTENTS)
KETCHIKAN GATEWAY BOROUGH*	2,308	$753.3 M	0	0%	0	0
KETCHIKAN, CITY OF	2,252	$965.4 M	86	3.8%	$88.7 M	9.2%
SAXMAN, CITY OF	119	$35.9 M	0	0%	0	0
TOTAL	**4,679**	**$1.8 B**	**86**	**1.8%**	**$88.7 M**	**5.1%**

*The Ketchikan Gateway Borough does not include the cities of Ketchikan and Saxman

The City of Ketchikan contains 86 potentially impacted structures. There is no available data for the unincorporated areas of the Borough or the City of Saxman. Per the study and georeferenced data, an estimated 5 percent of structure value across the Borough is susceptible to landslide while nearly 10 percent of the City of Ketchikan's building stock value is susceptible. It is important to note that this is a potential loss value and would only be reflective of 100-percent damage to the 86 exposed structures – not portions thereof. To better assess risk in this area, a new study using updated topography and geologic data, as available, would be recommended.



Map 10: Landslide Susceptibility (due to Earthquake Events) - Ketchikan Gateway Borough

7. Tsunami Exposure Assessment

Tsunami Hazard Overview

A tsunami is a series of large, powerful waves that are generated by water displacement in the ocean. This displacement occurs when a large amount of energy is shifted by events such as underwater earthquakes, landslides, and volcanic eruptions (Ketchikan Gateway Borough Multi Hazard Mitigation Plan, 2014). Tsunami waves begin as fast, long, and low waves, but as they near the coastline, they become slower, shorter, and higher. The increased height creates a wall of powerful water that is the basis of much destruction.

Due to the sheltered topography and indirect access to the open ocean, a damaging tsunami in the Ketchikan Gateway Borough would be unlikely. For the 200 years of recorded tsunamis there have been no resulting damages from a tsunami event in the Borough. There is no direct path to open ocean and thus, any tsunami wave impacts would be greatly reduced. However, should an event occur, 25 percent or more of property could be damaged. There is a 1 in 10-year chance that an event will occur in the Ketchikan Gateway Borough (Ketchikan Gateway Borough Multi Hazard Mitigation Plan, 2009). There are currently no Presidentially Declared Disasters in the Ketchikan Gateway Borough. However, tsunamis have occurred along the western coast. Those presidentially declared disasters are summarized Figure 3.

Figure 3: Recent West Coast Tsunami Disasters

Note: Information on the timeline has been pulled from the FEMA Disaster Declarations Summary - Open Government Dataset, the FEMA Hazard Mitigation Program Summary - Open Government Dataset, and FEMA's Disasters web page. The summaries listed above are categorized as having a tsunami disaster type.

Tsunami Exposure Assessment

A tsunami exposure assessment was conducted for the coastal areas of the Ketchikan Gateway Borough including the incorporated areas of Ketchikan and Saxman. This assessment focused on earthquake-induced tsunamis using the maximum inundation line to determine structures that were in or out of the

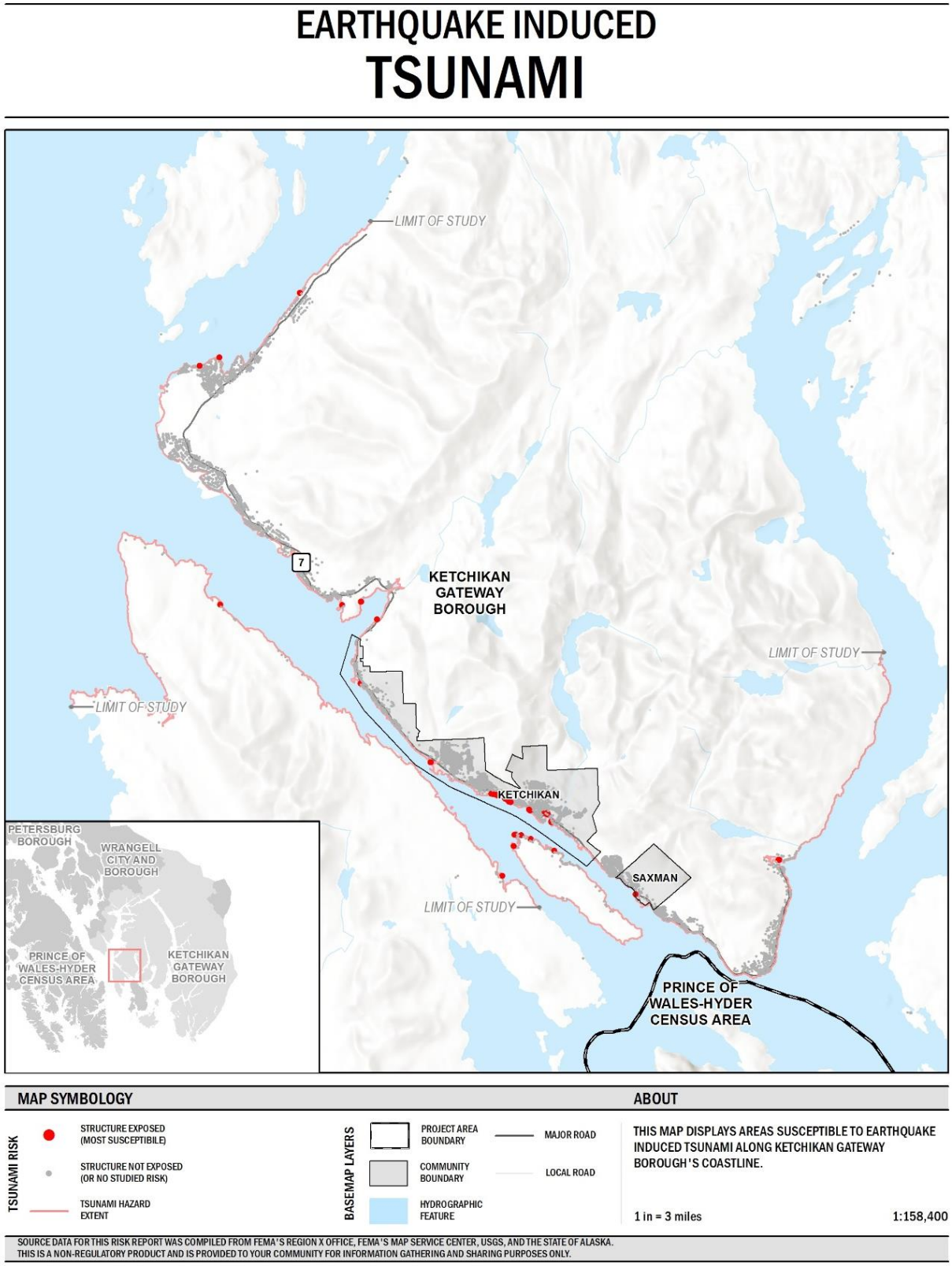
tsunami inundation zone. The maximum inundation line provided endpoints that were used to create the inundation zone polygon and results from this assessment can be viewed in Table 11 and Map 12.

Table 11: Tsunami Exposure (Earthquake Induced)

COMMUNITY NAME	TOTAL STRUCTURES	TOTAL VALUE (BUILDING AND CONTENTS)	STRUCTURES EXPOSED IN A TSUNAMI HAZARD AREA	PERCENT OF STRUCTURES EXPOSED IN A TSUNAMI HAZARD AREA	EXPOSED VALUE (BUILDING AND CONTENTS)	PERCENT OF EXPOSED VALUE (BUILDING AND CONTENTS)
KETCHIKAN GATEWAY BOROUGH*	2,308	$753.3 M	23	1.0%	$100.8 M	13.4%
KETCHIKAN, CITY OF	2,252	$965.4 M	39	1.7%	$33.9 M	3.5%
SAXMAN, CITY OF	119	$35.9 M	1	0.8%	$377 K	1.1%
TOTAL	**4,679**	**$1.8 B**	**63**	**1.3%**	**$134.1 M**	**7.7%**

*The Ketchikan Gateway Borough does not include the cities of Ketchikan and Saxman

Exposure to an earthquake-induced tsunami event is minimal borough-wide with a small portion of structures expected to be affected. 63 structures in the Borough are within the assumed tsunami inundation zone with the highest number of affected structures seen in the City of Ketchikan. A potential exposure of approximately $135 million of assets intersects the tsunami inundation zone. Losses are highest along the coastline of unincorporated areas (a loss ratio of just over 13 percent and slightly over $100 million in total value). Within incorporated communities, 40 structures are exposed with their values representing nearly 5 percent of their communities' total building and content loss.



Map 11: Tsunami Inundation (Earthquake Generated) - Ketchikan Gateway Borough

8. Plan Integration

A community is best able to reduce its risk when hazard mitigation becomes a fully considered part of its normal planning processes. That means the community's existing planning mechanisms—the plans, policies, codes, and programs that guide development—are informed by data on natural hazards, support the community's mitigation goals, and are used to implement its mitigation strategy. When these tools all reference and support each other, it helps the community protect people and property, identify actions and activities to reduce losses, and maintain important services after a hazard event.

This **Risk Report** and accompanying **Risk Assessment Database** should therefore not be viewed in isolation; rather, they can be an integrated parts of planning processes in the Ketchikan Gateway Borough. The data summarized in the report may be used to support day-to-day decision making and longer-term planning efforts, such as updates to comprehensive plans and other regulatory tools that inform land use decisions.

This section will provide a brief overview of how risk data, hazard mitigation, and local plans can work together and strengthen each other; highlight some of the ways that this is already being done in the Ketchikan Gateway Borough; identify additional steps to take; and describe the benefits of these efforts. For a more in-depth look at this topic, visit https://www.fema.gov/media-library/assets/documents/89725 for a guide to plan integration within FEMA Region X, or visit https://www.fema.gov/media-library/assets/documents/31372 for additional recommendations, case studies, and tools.

Using the Risk Report

Among the ways that local officials can use this report is during the development of community plans. The risk assessment can help communities generate appropriate strategies and avoid decisions that increase exposure to risk. In particular, communities may wish to consult this report when developing or updating the following:

- Local hazard mitigation plan
- Comprehensive plan
- Land use maps or designations
- Zoning ordinance
- Subdivision regulation
- Building codes
- Future planned development areas
- Capital improvement plan
- Transportation projects
- Utility projects
- Economic or community development strategies
- Evacuation routes
- Emergency response plans
- Continuity of operations plans
- Growth management plans
- Conservation and restoration priorities
- Water resource inventory areas
- Critical area regulation

The datasets delivered with this report can be incorporated into any mapping used to support the development of these plans and projects. The risk assessment can also be used in stakeholder outreach and public meetings that are part of planning processes. Specific sections may be useful in certain planning contexts.

Overall Integration

In addition to the potential uses of this **Risk Report** and **Risk Assessment Database**, there are steps communities can take to make natural hazard mitigation is an integrated part of local planning. The community's comprehensive plan, HMP, and other tools that inform land use decisions should all work together toward unified goals and objectives.

Integrating natural hazard mitigation into comprehensive planning has many benefits. Integration will:

- Enhance both the comprehensive planning process and the natural hazard mitigation strategy;
- Reduce a community's vulnerability to disasters;
- Support effective pre- and post-disaster decision making;
- Create effective planning tools;
- Help to speed the return of an affected community to normalcy following a hazard event;
- Provide a forum for analysis of potentially sensitive issues;
- Improve coordination and information sharing among departments; and
- Increase awareness and implementation of natural hazard mitigation.

The relationship between a community's comprehensive plan and HMP is key to achieving this. The comprehensive plan establishes policies that are intended to guide day-to-day land use decisions and capital facilities expenditures. These policies have a major impact on whether people and property are exposed to natural hazards. Meanwhile, the HMP forms the groundwork for a community's long-term strategy to reduce disaster losses.

Table 12: Interconnection of the Comprehensive Plan and HMP

HOW THE COMPREHENSIVE PLAN SUPPORTS THE HMP	HOW THE HMP SUPPORTS THE COMPREHENSIVE PLAN
• The comprehensive plan is a key regulatory capability that can be used to implement the HMP's mitigation strategy and guide development away from high-hazard areas. • Including hazard information and goals in the comprehensive plan elevates the importance of mitigation and makes it part of the community's overall vision.	• Through the HMP planning process, the community has already identified its biggest risks and vulnerabilities, most important goals, and top mitigation priorities. • The HMP identifies data sources for obtaining up-to-date information on natural hazards and high-hazard areas.

Integration in the Ketchikan Gateway Borough

The Greater Ketchikan Area Multi-Jurisdictional Hazard Mitigation Plan (MJHMP) was approved by FEMA in October 2015 and will not expire until 2022.

Through the planning process, information from multiple existing local and regional plans was incorporated into the MJHMP, including the Ketchikan Gateway Borough Comprehensive Plan, Greater Ketchikan Area Emergency Operations Plan, Ketchikan Transit Development Plan, and Ketchikan Coordinated Transportation Plan. The MJHMP maintenance process, outlined in Section 1.3 of the plan, includes processes for integration with other programs that can support or enhance hazard mitigation.

Section 3.3 of the MJHMP incorporates an excerpt of the goals and objectives for future land use development trends from the 2009 Comprehensive Plan and calls for the incorporation of these sections upon the completion of the pending update to that plan. In addition to these, the Comprehensive Plan contains goals, objectives, and policies relevant to the MJHMP related to conservation and coastal management, potable water, drainage, and capital improvements. These include the following:

- Objective 101.4 – The Borough may adopt Zoning Regulations which direct future growth from areas subject to periodic flooding.
- Policy 101.4.2 – The Borough shall discourage the placement of mobile homes within the Coastal High Hazard Area.
- Policy 101.7.1 – The Borough encourages the Planning and Community Development Department staff to create and maintain an up-to-date socioeconomic and physical database linked to the Borough GIS for use in managing future land use. The database shall incorporate the latest Census information.
- Goal 203 – The Ketchikan Gateway Borough encourages the prioritizing of shoreline land uses and establishing criteria for shoreline development in order to preserve and enhance coastal resources and to ensure the continued economic viability of the Borough in accordance with the Coastal Management Plan.
- Objective 203.2 – The Ketchikan Gateway Borough encourages revisions to the Borough Code pertaining to structures built over water (including, but not limited to, boat docks, fishing piers, and observation decks) to provide compliance and consistency with existing State and Federal regulations.
- Objective 301.2 – The Borough encourages development of transportation plans that are coordinated with plans and programs of appropriate State agencies and local governments and are consistent with State and Federal regulations.
- Policy 301.2.2 – The Borough supports all roadway improvements to be consistent with the policies of the Coastal Management and Conservation Element of the Comprehensive Plan.
- Policy 801.1.3 – The Borough encourages responsible development that includes preventative measures to address downstream erosion and flooding.

In addition, Section 3.10 of the Ketchikan Gateway Borough Comprehensive Plan outlines intergovernmental coordination processes, including detailed goals, policies, and objectives, to encourage effective integration across jurisdictions and levels of governance, and to encourage meaningful public involvement. These sections could also be leveraged or incorporated into the MJHMP to lay the foundation for increased coordination and alignment across plans.

Improving Integration

To achieve effective integration, communities should make sure their comprehensive plans include background information on natural hazards; clearly identify any hazard-prone areas in the community; and incorporate mitigation goals, objectives, policies, and projects into the appropriate plan elements.

While the hazardous areas component provides a clear opportunity to integrate hazard mitigation into the comprehensive plan, it is not the only element pertinent to hazard mitigation. Language on hazard mitigation strategies or actions may be integrated across all elements of the plan. Communities may want to consider how their mitigation priorities relate to these components:

- Rural areas and natural resource lands;

- Services, facilities, and utilities;
- Transportation;
- Shorelines;
- Urban Communities;
- Economic development; and
- Parks, open space, and cultural resources.

Other specific steps that Ketchikan Gateway Borough can take to improve plan integration include the following:

- Incorporate the specific policies associated with the future land use development trend goals and objectives and update the referenced goals and objectives based on the new Ketchikan Gateway Borough Comprehensive Plan once it is finalized.
- Update the Borough's floodplain ordinance to reference the MJHMP and evaluate whether the ordinance reflects the HMP's and Comprehensive Plan's flood-specific objectives.
- Add the acquisition of repetitive loss properties and prevention of new residential development in hazardous areas to the Ketchikan Gateway Borough Comprehensive Plan's chapter on housing.
- Consider adding a chapter or section summarizing hazard risk beyond flooding, or explicitly referencing information contained in the MJHMP within the Comprehensive Plan.

FEMA can assist communities that are preparing to update an existing planning document, provide examples of successful integration, and/or help communities come up with an integration strategy.

9. Areas of Mitigation Interest

This section of the **Risk Report** takes risk findings from Hazus models and other hazard overlays and focuses on specific areas where mitigation efforts should occur. These areas are called Areas of Mitigation Interest (AOMIs) and were developed through conversations with each community during the Risk MAP process as well as through analysis of various datasets for flood, earthquake, erosion, landslide, tsunami, and volcano/lahar hazards. The AOMI targets areas where potential damage, economic loss, and casualties could occur from a hazard event.

FEMA has provided strategies for mitigation in these specific areas. These resilience strategies advise ways the risks to hazards can be reduced, thereby decreasing potential damages, economic loss, and casualties during hazard events. The resilience strategies suggest potential projects for hazard mitigation, encouraging local collaboration, and communicating how various mitigation activities can successfully reduce risk. This information is intended to serve as a tool for discussion among local stakeholders to develop strategies specific to a community's socioeconomic and political geographies. The strategies are samples of a starting point. The AOMI section in this **Risk Report** provides a high-level summary of the critical facilities that will be most impacted by a chosen hazard scenario. The **Risk Assessment Database** provides a comprehensive analysis of all critical facilities provided in the Ketchikan Gateway Borough Assessor's dataset and the estimated damage costs from all of the hazard scenarios presented in this **Risk Report**. Other plans such as the Borough's MJHMP and Comprehensive Plan provide additional details that complement the information provided here and are reviewed in this section.

Ketchikan Gateway Borough

Areas of Mitigation Interest and Recommended Resilience Strategies

Based on the Hazus risk assessment, the project team completed an overall hazard assessment for the Borough that includes the buildings most affected by multiple hazards. Table 13 highlights examples of the buildings at risk from local hazards within the Ketchikan Gateway Borough, including the Cities of Ketchikan and Saxman. For a more comprehensive list of hazard impacts to critical facilities and all other structures in the Ketchikan Gateway Borough, please reference the **Risk Assessment Database**.

Table 13: Areas of Mitigation Interest, Ketchikan Gateway Borough*

CATEGORY	ADDRESS	COMMUNITY	TOTAL VALUE (BUILDING)	1-PERCENT ANNUAL CHANCE COASTAL FLOOD EVENT LOSS VALUE	1-PERCENT ANNUAL CHANCE FLOOD EVENT LOSS RATIO	IDENTIFIED HAZARDS
IND2	PO BOX 7095	CITY OF KETCHIKAN	$7.0 M	$3.9 M	56.2%	FLOOD, TSUNAMI
IND2	PO BOX 772**	KETCHIKAN GATEWAY BOROUGH***	$19.3 M	$3.9 M	55.1%	FLOOD, TSUNAMI
COM1	PO BOX 5700	KETCHIKAN GATEWAY BOROUGH***	$488 K	$316 K	64.8%	FLOOD, TSUNAMI
COM1	5 SALMON LANDING, SUITE 100	CITY OF KETCHIKAN	$4.4 M	$1.7 M	39.5%	FLOOD
IND2	240 HALIBUT ST	CITY OF SAXMAN	$377 K	$0	0%	FLOOD, TSUNAMI

Note: Hazards are considered identified if the following applies

1. Flood: Subject is within a 0.2-percent-annual-chance or 1-percent-annual-chance coastal or riverine flood hazard area
2. Earthquake – Subject's estimated loss ratio is greater than 10 percent for any studied earthquake event.
3. Landslide – Subject intersects an identified landslide hazard area.
4. Tsunami – Subject intersects an identified tsunami hazard area.

*Local Borough Assessor parcel data for this analysis was provided by the Ketchikan Gateway Borough as best available data.
**Eight different structures identified in the Borough's parcel data at PO Box 772 were combined for the purposes of this table.
*** The Ketchikan Gateway Borough does not include the cities of Ketchikan and Saxman.

Hazard Mitigation Plan and Comprehensive Plan Analysis

Table 14 highlights how the information in this **Risk Report**, and the corresponding **Risk Assessment Database**, could be leveraged to support future updates to existing plans. The overall goal of this table is to provide examples of how Risk MAP data can support ongoing planning processes and potentially reduce the resources required to update plans such as the *Ketchikan Gateway Borough Comprehensive Plan 2020* and the *2016 Greater Ketchikan Area Multi-Jurisdictional Hazard Mitigation Plan.*

Information is organized first by the local plan from which it was pulled. Next, there is a "Plan Link," which lists the specific action number or section for referencing the original documents. Several "Plan Goals and Objectives," which could be supported by data in this report, are highlighted in the next column. To make connections between the information in this report and the existing local plan, the "Relevant Risk MAP products" column points to the most closely connected Risk MAP data sources. Finally, the "How to Use Risk MAP Products" column explains some of the ways in which the data and

products could be used to move strategies and actions forward, and how they could be used to provide more detail in future plan updates.

This is not an exhaustive list of plan integration opportunities. **Contact your Risk MAP coordinator for further clarification or technical assistance requests to follow up on any of the information listed below.**

Risk MAP Product Overview

Special Flood Hazard Area (SFHA)	The result of coastal and riverine flood studies for the Ketchikan Gateway Borough depicting areas with a 1-percent-annual-chance of flooding. These areas, sometimes referred to as 1-percent-annual-chance flood zones, are used to create new draft and preliminary Flood Insurance Rate Maps, or FIRMs. FIRMs are regulatory resources that greatly help community officials and the public assess, visualize, and communicate local flood risk.
0.2-percent-annual-chance flood zone	Spatial data showing locations with a projected 0.2-percent-annual-chance of flooding. 0.2-percent-annual-chance flood zones can be used to identify areas beyond the SFHA which are at risk to flooding and could be at greater risk under future or changing conditions.
Flood Depth Grids	Spatial data identifies flood depth for the 1-percent-annual-chance flood for the coastal and riverine areas within the Ketchikan Gateway Borough. Officials can use the 1-percent-annual-chance depth grid as an outreach tool to show the flood risk. The properties identified as having flood risk would be excellent locations for mitigation projects.
Hazus Flood Output / Flood Risk Assessment	An assessment of the total building values, number of buildings, losses by coastal and riverine flood hazards along with the number of structures within SFHAs. The loss data from Hazus and the exposure analysis can highlight areas affected by flooding. This information can be used by State, local, and Tribal officials to identify properties for mitigation projects as well as additional outreach needs in the area.
Flood Exposure Assessment	Spatial and tabular data identifying the number of improved parcels in the SFHA. Local officials can use the flood exposure assessment to identify properties for mitigation projects as well as areas for additional outreach.
Hazus Earthquake Output	Spatial and tabular data providing specific building and content loss data for properties affected by a probabilistic M7.6 event earthquake scenario.
Landslide and Tsunami Exposure Assessments	Spatial and tabular data identifying the number of improved parcels in the landslide and tsunami hazard areas.

Table 14: Existing Local Planning and Related Risk MAP Support for the Ketchikan Gateway Borough

LOCAL PLAN	PLAN LINK	PLAN GOALS AND OBJECTIVES	RELEVANT RISK MAP PRODUCTS	HOW TO USE RISK MAP PRODUCTS
Multi-Jurisdictional Hazard Mitigation Plan (2016)	Chapter 4, Section 1, Goal 1	Reduce and prevent flood damage. Support elevation, flood proofing, and buyout or relocation of structures that are in danger of flooding or are located on eroding banks.	**Flood Hazard Area** **Depth Grid** **Hazus Flood Output**	Use Hazus Flood Output to prioritize properties for buyouts or elevation projects. Additional flood hazard maps can help identify areas at risk to flooding and can support future development and regulatory restrictions.
	Chapter 4, Section 1, Goal 2	Increase public awareness Increase public knowledge about mitigation opportunities, floodplain functions, emergency service procedures, and potential hazards.	**Flood Hazard Area** **Depth Grid**	Use the Flood Hazard Area spatial data to prioritize outreach efforts. Depth Grids can also be utilized as a communication tool to show residents the depth of water at assessed percent-annual-chance flood events.
	Chapter 4, Section 2	Project E-1. Identify buildings and facilities that must be able to remain operable during and following an earthquake event. Project E-2. Contract a structural engineering firm to assess the identified buildings and facilitates to determine their structural integrity and strategy to improve their earthquake resistance.	**Hazus Earthquake Output**	Use Hazus earthquake outputs to identify and prioritize critical facilities for detailed structural integrity studies.
	Chapter 4, Section 2	Goal 1. Increased Public Education about Tsunamis and Seiches.	**Tsunami Exposure Assessment**	Use tabular data to target outreach efforts as needed and leverage maps showing the maximum inundation area for outreach purposes.
	Chapter 4, Section 2	Project T-1. Sirens have been added at both ends and the center of town for Tsunami and other hazardous warnings. Add four additional sirens to the City of Ketchikan. (Goal 1)	**Tsunami Exposure Assessment**	Incorporate value of exposed properties in benefit-cost analysis of future funding applications for additional sirens.
Ketchikan Gateway Borough Comprehensive Plan 2020 (2010)	Chapter 1, Objective 101.4	The Borough may adopt Zoning Regulations which direct future growth away from areas subject to periodic flooding.	**Flood Hazard Area** **Depth Grid** **Hazus Flood Output**	Host or link to new flood hazard data and Hazus flood outputs on local permitting website. Use data to prioritize and inform zoning regulations and development standards.

LOCAL PLAN	PLAN LINK	PLAN GOALS AND OBJECTIVES	RELEVANT RISK MAP PRODUCTS	HOW TO USE RISK MAP PRODUCTS
	Chapter 1, Objective 101.7	The Borough shall create and maintain a Borough Geographic Information System (GIS), consistent with budget resources, providing an up-to-date database for use in implementing the goals, objectives and policies of the Comprehensive Plan.	**Flood Hazard Area** **Hazus Earthquake Output** **Tsunami Exposure Assessment** **Landslide Exposure Assessment**	Incorporate spatial and tabular data on flood, earthquake, tsunami, and landslide risk and exposure into the Borough's GIS database to help inform future land use decisions.
	Chapter 2, Objective 204.1	The Ketchikan Gateway Borough encourages the maintenance and increase of the amount of public access to the beach and/or shoreline consistent with the public need.	**Hazus Flood Output**	Use Hazus Flood Output to identify properties with high projected losses from flooding to prioritize for buyout to allow public access points to the beach or shoreline.
	Chapter 8, Policy 801.1.3	The Borough encourages responsible development that includes preventative measures to address downstream erosion and flooding.	**Flood Hazard Area** **Depth Grid** **Hazus Flood Output**	Review Risk MAP flood products to identify potential downstream flooding issues that could arise from new development.
	Chapter 9, Objective 901.4	The Borough supports use of publicly owned recreation for activities such as fishing, hunting, hiking, and passive recreation uses (leave no footprint).	**Flood Hazard Area** **Hazus Earthquake Output** **Tsunami Exposure Assessment** **Landslide Exposure Assessment**	Use spatial and tabular data on flood, earthquake, tsunami, and landslide risk and exposure to identify potential locations for recreational use.

LOCAL PLAN	PLAN LINK	PLAN GOALS AND OBJECTIVES	RELEVANT RISK MAP PRODUCTS	HOW TO USE RISK MAP PRODUCTS
	Chapter 12, Policy 1201.1.2	The Borough may annually update the Comprehensive Plan Five-Year Schedule of Capital Improvements. Proposed revisions to the Schedule, including those addressing replacement and renewal of capital facilities, shall be evaluated, updated, and ranked.	**Flood Hazard Area** **Hazus Earthquake Output** **Tsunami Exposure Assessment** **Landslide Exposure Assessment**	Use spatial and tabular data on flood, earthquake, tsunami, and landslide risk and exposure to help select locations for replacement of capital facilities to minimize public risk to hazards.

Recommended Resilience Strategies

Based on the assessment above, FEMA recommends the strategies summarized in Table 15. Additional strategies can be found by referencing the FEMA document *Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards* at https://www.fema.gov/media-library/assets/documents/30627.

Table 15: Recommended Resilience Strategies for the Ketchikan Gateway Borough

HAZARD	PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Flood	There are 177 structures in the Ketchikan Gateway Borough exposed to a 1-percent-annual-chance flood, with an exposed value of approximately $172.2M. In total, there are 48 structures with flood insurance coverage through the NFIP. *1-Percent-Annual-Chance Flood Exposure: 5% of the structures, representing 5.9% of the total building and contents value in the City of Ketchikan, are exposed to flood hazards.*	• Consider limiting development in flood hazard areas identified in the risk assessment and identified as "frequently flooded areas" based on Borough zoning code. • Use flood risk assessment data, including projected damage, to prioritize essential facilities for floodproofing/flood mitigation. • Develop a buyout program for repetitive loss properties. • Provide outreach to homeowners and business owners regarding flood risk and flood insurance options.
Earthquake	The Probabilistic M7.6 event studied in this report projects approximately $6.4M in building and content value across the Borough, representing a minimal 0.4-% loss ratio. None of the structures were projected to see a loss ratio above 10 %. However, because this event had an epicenter closer to Sitka and Juneau than the Ketchikan Gateway Borough, it may not provide an accurate assessment of potential earthquake damage in the Borough.	• Adopt and enforce updated building code provisions the reduce earthquake risk. • Develop a priority list for essential facility earthquake retrofits. • Develop an outreach program about earthquake risk and mitigation activities in homes, schools, and businesses.

HAZARD	PROBLEM STATEMENT	RECOMMENDED STRATEGIES
Landslide	There are 86 structures located in the Landslide Hazard Area in the City of Ketchikan (about 4% of all structures in the city, and about 2% of all structures in the Borough), with an exposed value of over $88.7M. *The original report used to analyze landslide susceptibility for this Risk Report did not contain the data needed to assess landslide risk in the City of Saxman or the Ketchikan Gateway Borough.*	• Apply stabilization measures and debris flow measures to reduce damage in sloping areas. • Restrict development in landslide zones. • Relocate critical infrastructure outside of landslide zones. • Develop a buyout program for homes in landslide areas. Provide education and outreach materials to educate residents about risks.
Tsunami	63 structures in the Ketchikan Gateway Borough are exposed in the Tsunami Hazard Area, with a total exposed value of approximately $135M, representing 7.7% of the total building and contents value in the Borough.	• Educate citizens regarding the dangers of tsunamis and inform them of emergency procedures should a tsunami warning be issued. • Identify and equip facilities to function as public shelters.

While Federal funding for the above projects is limited, FEMA recommends incorporating these projects into the HMP should disaster funds become available. Additional funding may be available through the community Capital Improvement Planning process; bond authority; or other local, State, or private funding source. More information on how to mitigate for natural hazards can be found in the FEMA *Local Mitigation Planning Handbook* at: http://www.fema.gov/media-library/assets/documents/31598?id=7209.

Additional information on integrating the HMP with the local planning process can be found at http://www.fema.gov/media-library/assets/documents/19261?id=4267.

10. Additional Resources

Risk Assessment Database

To obtain, email: Sally.Cox@Alaska.gov.

The Risk Database provides the base data for the Ketchikan Gateway Borough Risk Report. The database aggregates natural hazard data by various local, State, and patterners and quantifies risk to those natural hazards using community assessor data to determine local risk. Furthermore, the database includes:

- Hazard layers and mapping footprints; and
- A complete and comprehensive analysis of all critical facilities provided in the Ketchikan Gateway Borough Assessor's dataset and the estimated damage costs from all hazard scenarios analyzed for flood and earthquake.

AK Risk MAP Website

The Department of Commerce, Community, and Economic Development Division of Community and Regional Affairs has partnered with FEMA to provide state-wide Risk MAP support. Through this partnership, the Division of Community and Regional Affairs assists FEMA in implementing the Risk MAP program to reduce flood hazards and mitigate natural hazards in our communities.

AK Resilience Resource Guide

To obtain, email: Sally.Cox@Alaska.gov.

An informational packet containing Alaska State Risk MAP contacts, and funding, training, and community support and technical assistance opportunities.

FEMA Risk MAP Website
This FEMA website discusses the Risk MAP program and what the program can mean to communities. This website is intended for a variety of audiences, including State and community officials; homeowners, renters, and business owners; real estate, lending, and insurance professionals; and engineers, surveyors, and architects.

National Flood Insurance Program
FloodSmart.gov is the official website of the National Flood Insurance Program. Find information about why and how to buy or renew insurance, what to do before and after a flood, and a guide to understand the costs of insurance.

FEMA - Local Mitigation Planning Handbook
The Local Mitigation Planning Handbook is the official guide for local governments to develop, update, and implement local mitigation plans.

FEMA - Hazard Mitigation: Integrating Best Practices into Planning
This document, prepared by the American Planning Association (APA) and supported through a contract with FEMA, seeks to close the gap that often exists between hazard mitigation planning and other local planning and regulatory land use processes. It introduces hazard mitigation as a vital area of practice for planners; provides guidance on how to integrate hazard mitigation strategies into comprehensive, area, and functional plans; and shows where hazard mitigation can fit into zoning and subdivision codes. Best practices and practical applications are provided.

FEMA - Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards
The purpose of this document is to provide a resource that communities can use to identify and evaluate a range of potential mitigation actions for reducing risk to natural hazards and disasters. The focus of this document is mitigation, which is action taken to reduce or eliminate long-term risk to hazards. Ideas for mitigation actions are presented for the following natural hazards: Drought, Earthquake, Erosion, Extreme temperatures, Flood, Hail, Landslide, Lightning, Sea level rise, Severe wind, Severe winter weather, Storm surge, Subsidence, Tornado, Tsunami, and Wildfire.

11. References Cited

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Lemke, R.W., U.S. Geological Survey, 1975, Reconnaissance Engineering Geology of the Ketchikan Area, Alaska, with Emphasis on Evaluation of Earthquake and other Geologic Hazards. http://www.dggs.alaska.gov/pubs/id/11073

Ketchikan Gateway Borough Comprehensive Plan 2020, Department of Planning & Community Development, 2009. https://www.borough.ketchikan.ak.us/216/Comprehensive-Plan

12. Appendix

Acronyms and Definitions

AOMI	Area of Mitigation Interest
BFE	Base Flood Elevation
DFIRM	Digital Flood Insurance Rate Map
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
GIS	Geographic Information System
HMP	Hazard Mitigation Plan
LiDAR	Light Detection and Ranging
M	Magnitude
MJHMP	Greater Ketchikan Area Multi-Jurisdictional Hazard Mitigation Plan
NFIP	National Flood Insurance Program
HMP	Hazard Mitigation Plan
Risk MAP	Risk Mapping, Assessment, and Planning
SFHA	Special Flood Hazard Area
USGS	U.S. Geological Survey