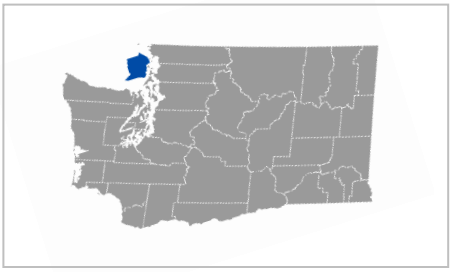
FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 1



SAN JUAN COUNTY, WASHINGTON

AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
TOWN OF FRIDAY HARBOR	530150
SAN JUAN COUNTY	530149

FEMA

PRELIMINARY:

July 22, 2016

FLOOD INSURANCE STUDY NUMBER

530149CV001A

VERSION NUMBER 2.3.2.1

TABLE OF CONTENTS
Volume 1

		Page
SECTION 1.0 – INTRODUCTION		**1**
1.1	The National Flood Insurance Program	1
1.2	Purpose of this Flood Insurance Study Report	2
1.3	Jurisdictions Included in the Flood Insurance Study Project	2
1.4	Considerations for using this Flood Insurance Study Report	4
SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS		**15**
2.1	Floodplain Boundaries	15
2.2	Floodways	15
2.3	Base Flood Elevations	33
2.4	Non-Encroachment Zones	33
2.5	Coastal Flood Hazard Areas	33
2.5.1	Water Elevations and the Effects of Waves	33
2.5.2	Floodplain Boundaries and BFEs for Coastal Areas	35
2.5.3	Coastal High Hazard Areas	36
2.5.4	Limit of Moderate Wave Action	37
SECTION 3.0 – INSURANCE APPLICATIONS		**37**
3.1	National Flood Insurance Program Insurance Zones	37
3.2	Coastal Barrier Resources System	38
SECTION 4.0 – AREA STUDIED		**38**
4.1	Basin Description	38
4.2	Principal Flood Problems	38
4.3	Non-Levee Flood Protection Measures	39
4.4	Levees	39
SECTION 5.0 – ENGINEERING METHODS		**40**
5.1	Hydrologic Analyses	40
5.2	Hydraulic Analyses	41
5.3	Coastal Analyses	41
5.3.1	Total Stillwater Elevations	42
5.3.2	Waves	44
5.3.3	Coastal Erosion	44
5.3.4	Wave Hazard Analyses	44
5.4	Alluvial Fan Analyses	54

TABLE OF CONTENTS *(continued)*
Volume 1 *(continued)*

SECTION 6.0 – MAPPING METHODS **58**
6.1 Vertical and Horizontal Control 58
6.2 Base Map 59
6.3 Floodplain and Floodway Delineation 61
6.4 Coastal Flood Hazard Mapping 62
6.5 FIRM Revisions 64
6.5.1 Letters of Map Amendment 69
6.5.2 Letters of Map Revision Based on Fill 69
6.5.3 Letters of Map Revision 69
6.5.4 Physical Map Revisions 70
6.5.5 Contracted Restudies 70
6.5.6 Community Map History 70

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION **72**
7.1 Contracted Studies 72
7.2 Community Meetings 72

SECTION 8.0 – ADDITIONAL INFORMATION **72**

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES **74**

Figures

Page

Figure 1: FIRM Panel Index 7
Figure 2: FIRM Notes to Users 8
Figure 3: Map Legend for FIRM 11
Figure 4: Floodway Schematic 16
Figure 5: Wave Runup Transect Schematic 35
Figure 6: Coastal Transect Schematic 37
Figure 7: Frequency Discharge-Drainage Area Curves 40
Figure 8: 1% Annual Chance Total Stillwater Elevations for Coastal Areas 43
Figure 9: Transect Location Map 52

Tables

Page

Table 1: Listing of NFIP Jurisdictions 3
Table 2: Flooding Sources Included in this FIS Report 17
Table 3: Flood Zone Designations by Community 38
Table 4: Coastal Barrier Resources System Information 38
Table 5: Basin Characteristics 38
Table 6: Principal Flood Problems 39
Table 7: Historic Flooding Elevations 39
Table 8: Non-Levee Flood Protection Measures 39
Table 9: Levees 39

TABLE OF CONTENTS *(continued)*

Volume 1 *(continued)*

Tables *(continued)*

Table 10: Summary of Discharges 40
Table 11: Summary of Non-Coastal Stillwater Elevations 40
Table 12: Stream Gage Information used to Determine Discharges 41
Table 13: Summary of Hydrologic and Hydraulic Analyses 41
Table 14: Roughness Coefficients 41
Table 15: Summary of Coastal Analyses 42
Table 16: Tide Gage Analysis Specifics 44
Table 17a: Stillwater Elevations 46
Table 17b: Total Water Levels 48
Table 18: Summary of Alluvial Fan Analyses 58
Table 19: Results of Alluvial Fan Analyses 58
Table 20: Countywide Vertical Datum Conversion 59
Table 21: Stream-by-Stream Vertical Datum Conversion 59
Table 22: Base Map Sources 60
Table 23: Summary of Topographic Elevation Data used in Mapping 61
Table 24: Floodway Data 62
Table 25: Flood Hazard and Non-Encroachment Data for Selected Streams 62
Table 26: Summary of Coastal Transect Mapping Considerations 64
Table 31: Incorporated Letters of Map Change 70
Table 32: Community Map History 71
Table 33: Summary of Contracted Studies Included in this FIS Report 72
Table 34: Community Meetings 72
Table 35: Map Repositories 73
Table 36: Additional Information 73
Table 37: Bibliography and References 75

Exhibits

Flood Profiles Panel

[Not Applicable to this Flood Risk Project]

Published Separately

Flood Insurance Rate Map (FIRM)

FLOOD INSURANCE STUDY REPORT
SAN JUAN COUNTY, WASHINGTON

SECTION 1.0 – INTRODUCTION

1.1 The National Flood Insurance Program

The National Flood Insurance Program (NFIP) is a voluntary Federal program that enables property owners in participating communities to purchase insurance protection against losses from flooding. This insurance is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

For decades, the national response to flood disasters was generally limited to constructing flood-control works such as dams, levees, sea-walls, and the like, and providing disaster relief to flood victims. This approach did not reduce losses nor did it discourage unwise development. In some instances, it may have actually encouraged additional development. To compound the problem, the public generally could not buy flood coverage from insurance companies, and building techniques to reduce flood damage were often overlooked.

In the face of mounting flood losses and escalating costs of disaster relief to the general taxpayers, the U.S. Congress created the NFIP. The intent was to reduce future flood damage through community floodplain management ordinances, and provide protection for property owners against potential losses through an insurance mechanism that requires a premium to be paid for the protection.

The U.S. Congress established the NFIP on August 1, 1968, with the passage of the National Flood Insurance Act of 1968. The NFIP was broadened and modified with the passage of the Flood Disaster Protection Act of 1973 and other legislative measures. It was further modified by the National Flood Insurance Reform Act of 1994 and the Flood Insurance Reform Act of 2004. The NFIP is administered by the Federal Emergency Management Agency (FEMA), which is a component of the Department of Homeland Security (DHS).

Participation in the NFIP is based on an agreement between local communities and the Federal Government. If a community adopts and enforces floodplain management regulations to reduce future flood risks to new construction and substantially improved structures in Special Flood Hazard Areas (SFHAs), the Federal Government will make flood insurance available within the community as a financial protection against flood losses. The community's floodplain management regulations must meet or exceed criteria established in accordance with Title 44 Code of Federal Regulations (CFR) Part 60.3, *Criteria for land Management and Use*.

SFHAs are delineated on the community's Flood Insurance Rate Maps (FIRMs). Under the NFIP, buildings that were built before the flood hazard was identified on the community's FIRMs are generally referred to as "Pre-FIRM" buildings. When the NFIP was created, the U.S. Congress recognized that insurance for Pre-FIRM buildings would be prohibitively expensive if the premiums were not subsidized by the Federal Government. Congress also recognized that most of these floodprone buildings were built by individuals who did not have sufficient knowledge of the flood hazard to make informed decisions. The NFIP requires that full actuarial rates reflecting the complete flood risk be charged on all buildings constructed or substantially improved on or after

the effective date of the initial FIRM for the community or after December 31, 1974, whichever is later. These buildings are generally referred to as "Post-FIRM" buildings.

1.2 Purpose of this Flood Insurance Study Report

This Flood Insurance Study (FIS) report revises and updates information on the existence and severity of flood hazards for the study area. The studies described in this report developed flood hazard data that will be used to establish actuarial flood insurance rates and to assist communities in efforts to implement sound floodplain management.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive than the minimum Federal requirements. Contact your State NFIP Coordinator to ensure that any higher State standards are included in the community's regulations.

1.3 Jurisdictions Included in the Flood Insurance Study Project

This FIS Report covers the entire geographic area of San Juan County, Washington.

The jurisdictions that are included in this project area, along with the Community Identification Number (CID) for each community and the 8-digit Hydrologic Unit Codes (HUC-8) sub-basins affecting each, are shown in Table 1. The Flood Insurance Rate Map (FIRM) panel numbers that affect each community are listed. If the flood hazard data for the community is not included in this FIS Report, the location of that data is identified.

The location of flood hazard data for participating communities in multiple jurisdictions is also indicated in the table.

Jurisdictions that have no identified SFHAs as of the effective date of this study are indicated in the table. Changed conditions in these communities (such as urbanization or annexation) or the availability of new scientific or technical data about flood hazards could make it necessary to determine SFHAs in these jurisdictions in the future.

Table 1: Listing of NFIP Jurisdictions

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Town of Friday Harbor	530150	17110003	53055C0270C	
San Juan County	530149	17110003	53055C0105C, 53055C0115C, 53055C0120C, 53055C0130C, 53055C0135C, 53055C0145C, 53055C0155C, 53055C0160C, 53055C0165C, 53055C0170C, 53055C0180C, 53055C0185C, 53055C0190C, 53055C0195C, 53055C0215C, 53055C0230C, 53055C0235C, 53055C0245C, 53055C0255C, 53055C0260C, 53055C0265C, 53055C0270C, 53055C0280C, 53055C0285C, 53055C0290C, 53055C0295C, 53055C0305C, 53055C0310C, 53055C0315C, 53055C0320C, 53055C0360C, 53055C0380C, 53055C0385C, 53055C0405C, 53055C0410C, 53055C0420C, 53055C0430C, 53055C0435C, 53055C0440C, 53055C0445C	

1.4 Considerations for using this Flood Insurance Study Report

The NFIP encourages State and local governments to implement sound floodplain management programs. To assist in this endeavor, each FIS Report provides floodplain data, which may include a combination of the following: 10-, 4-, 2-, 1-, and 0.2-percent annual chance flood elevations (the 1% annual chance flood elevation is also referred to as the Base Flood Elevation (BFE)); delineations of the 1% annual chance and 0.2% annual chance floodplains; and 1% annual chance floodway. This information is presented on the FIRM and/or in many components of the FIS Report, including Flood Profiles, Floodway Data tables, Summary of Non-Coastal Stillwater Elevations tables, and Coastal Transect Parameters tables (not all components may be provided for a specific FIS).

This section presents important considerations for using the information contained in this FIS Report and the FIRM, including changes in format and content. Figures 1, 2, and 3 present information that applies to using the FIRM with the FIS Report.

- Part or all of this FIS Report may be revised and republished at any time. In addition, part of this FIS Report may be revised by a Letter of Map Revision (LOMR), which does not involve republication or redistribution of the FIS Report. Refer to Section 6.5 of this FIS Report for information about the process to revise the FIS Report and/or FIRM.

  It is, therefore, the responsibility of the user to consult with community officials by contacting the community repository to obtain the most current FIS Report components. Communities participating in the NFIP have established repositories of flood hazard data for floodplain management and flood insurance purposes. Community map repository addresses are provided in Table 32, “Map Repositories,” within this FIS Report.

- New FIS Reports are frequently developed for multiple communities, such as entire counties. A countywide FIS Report incorporates previous FIS Reports for individual communities and the unincorporated area of the county (if not jurisdictional) into a single document and supersedes those documents for the purposes of the NFIP.

  Refer to Table 29 for information about subsequent revisions to the FIRMs.

- Selected FIRM panels for the community may contain information (such as floodways and cross sections) that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels. In addition, former flood hazard zone designations have been changed as follows:

Old Zone	New Zone
A1 through A30	AE
V1 through V30	VE
B	X (shaded)
C	X (unshaded)

- Selected FIRM panels for the community may contain information (such as floodways and cross sections) that was previously shown separately on the corresponding Flood

Boundary and Floodway Map panels. In addition, former flood hazard zone designations have been changed as follows:

Community	CID	HUC-8 Sub-Basin(s)	Located on FIRM Panel(s)	If Not Included, Location of Flood Hazard Data
Town of Friday Harbor	530150	17110003	53055C0270C	
San Juan County	530149	17110003	53055C0025C*, 53055C0030C*, 53055C0040C*, 53055C0045C*, 53055C0075C*, 53055C0100C*, 53055C0105C, 53055C0110C*, 53055C0115C, 53055C0120C, 53055C0130C, 53055C0135C, 53055C0140C*, 53055C0145C, 53055C0155C, 53055C0160C, 53055C0165C, 53055C0170C, 53055C0180C, 53055C0185C, 53055C0190C, 53055C0195C, 53055C0205C*, 53055C0215C, 53055C0230C, 53055C0235C, 53055C0240C*, 53055C0245C, 53055C0255C, 53055C0260C, 53055C0265C, 53055C0270C, 53055C0280C, 53055C0285C, 53055C0290C, 53055C0295C, 53055C0305C, 53055C0310C, 53055C0315C, 53055C0320C, 53055C0350C*, 53055C0360C, 53055C0375C*, 53055C0380C, 53055C0385C, 53055C0390C*, 53055C0395C*, 53055C0405C, 53055C0410C, 53055C0415C*, 53055C0420C, 53055C0430C, 53055C0435C, 53055C0440C, 53055C0445C, 53055C0475C*, 53055C0500C*, 53055C0525C* 53055C0550C*, 53055C0575C*	

* Panel not printed

- FEMA does not impose floodplain management requirements or special insurance ratings based on Limit of Moderate Wave Action (LiMWA) delineations at this time. The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. If the LiMWA is shown on the FIRM, it is being provided by FEMA as information only. For communities that do adopt Zone VE building standards in the area defined by the LiMWA, additional Community Rating System (CRS) credits are available. Refer to Section 2.5.4 for additional information about the LiMWA.

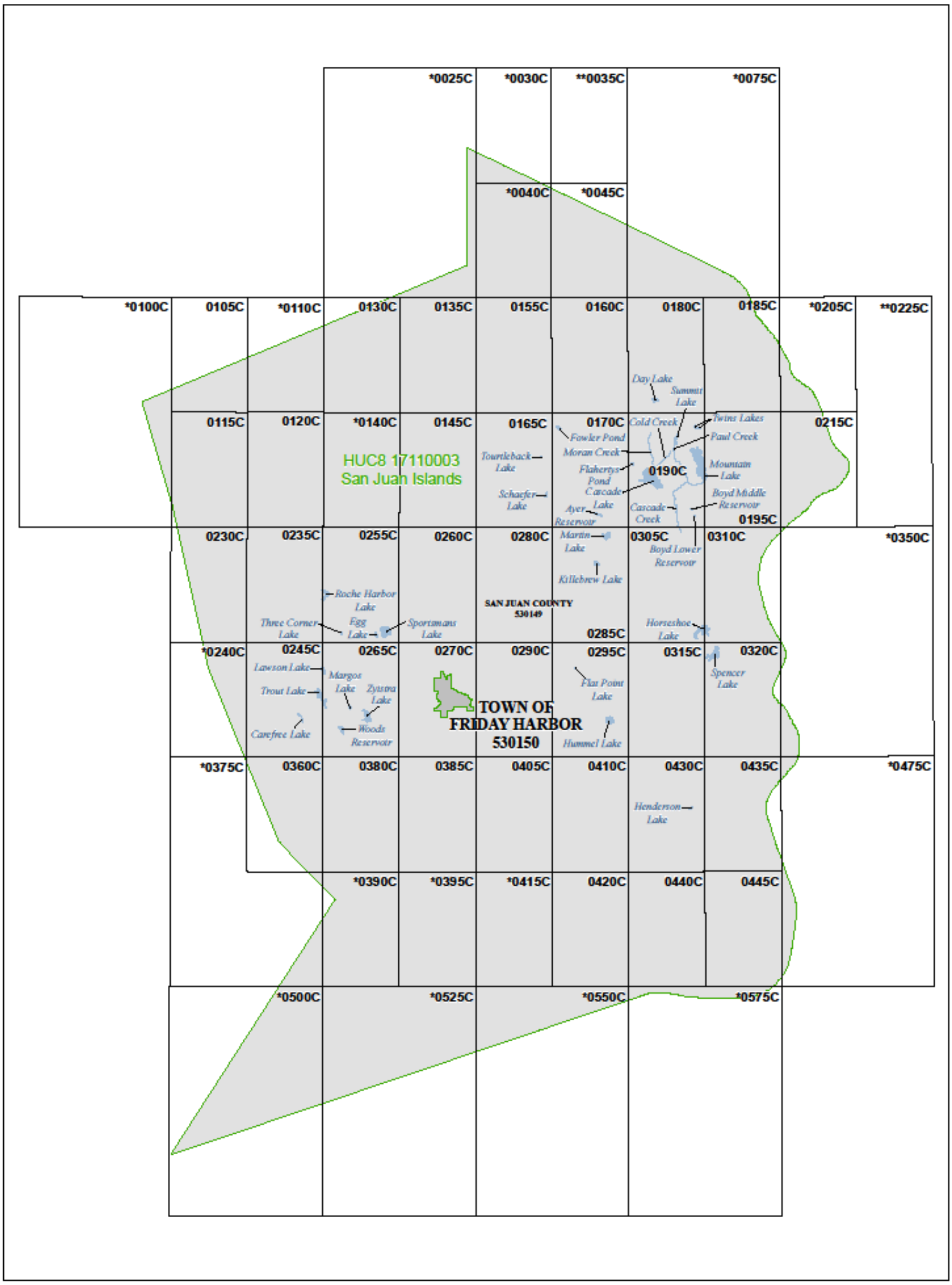
  The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. Visit the FEMA Web site at http://www.fema.gov or contact your appropriate FEMA Regional Office for more information about this program.

- Previous FIS Reports and FIRMs may have included levees that were accredited as providing protection from the 1% annual chance flood based on the information available and the mapping standards of the NFIP at that time. For FEMA to continue to accredit the identified levees with providing protection from the base flood, the levees must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."

Since the status of levees is subject to change at any time, the user should contact the appropriate agency for the latest information regarding levees presented in Table 9 of this FIS Report. For levees owned or operated by the U.S. Army Corps of Engineers (USACE), information may be obtained from the USACE national levee database. For all other levees, the user is encouraged to contact the appropriate local community.

- FEMA has developed a *Guide to Flood Maps* (FEMA 258) and online tutorials to assist users in accessing the information contained on the FIRM. These include how to read panels and step-by-step instructions to obtain specific information. To obtain this guide and other assistance in using the FIRM, visit the FEMA Web site at http://www.fema.gov.

Figure 1: FIRM Panel Index



1 inch = 18,750 feet 1:225,000

0 5,000 10,000 20,000 30,000 40,000 feet

Map Projection:
Universal Transverse Mercator Zone 10 North;
North American Datum 1983

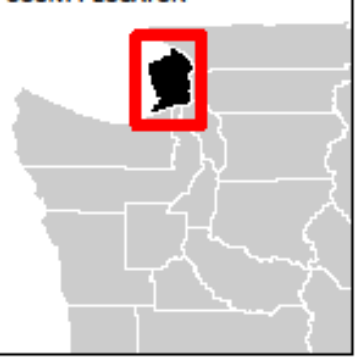
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTP://MSC.FEMA.GOV

SEE FLOOD INSURANCE STUDY FOR ADDITIONAL INFORMATION

* PANEL NOT PRINTED - AREA IN ZONE A
** PANEL NOT PRINTED - AREA OUTSIDE OF COUNTY BOUNDARY

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP INDEX

SAN JUAN COUNTY, WASHINGTON
and Incorporated Areas

PANELS PRINTED:

0105, 0115, 0120, 0130, 0135, 0145, 0155, 0160, 0165, 0170, 0180, 0185, 0190, 0195, 0215, 0230, 0235, 0245, 0255, 0260, 0265, 0270, 0280, 0285, 0290, 0295, 0305, 0310, 0315, 0320, 0360, 0380, 0385, 0405, 0410, 0420, 0430, 0435, 0440, 0445

FEMA

MAP NUMBER
53055CIND0A

MAP REVISED

Figure 2: FIRM Notes to Users

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates, refer to Table 28 in this FIS Report.

To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

PRELIMINARY FIS REPORT: FEMA maintains information about map features, such as street locations and names, in or near designated flood hazard areas. Requests to revise information in or near designated flood hazard areas may be provided to FEMA during the community review period, at the final Consultation Coordination Officer's meeting, or during the statutory 90-day appeal period. Approved requests for changes will be shown on the final printed FIRM.

The map is for use in administering the NFIP. It may not identify all areas subject to flooding, particularly from local drainage sources of small size. Consult the community map repository to find updated or additional flood hazard information.

BASE FLOOD ELEVATIONS: For more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables within this FIS Report. Use the flood elevation data within the FIS Report in conjunction with the FIRM for construction and/or floodplain management.

Coastal Base Flood Elevations shown on the map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the FIS Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on the FIRM.

FLOODWAY INFORMATION: Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the FIS Report for this jurisdiction.

Figure 2. FIRM Notes to Users *(continued)*

FLOOD CONTROL STRUCTURE INFORMATION: Certain areas not in Special Flood Hazard Areas may be protected by flood control structures. Refer to Section 4.3 "Non-Levee Flood Protection Measures" of this FIS Report for information on flood control structures for this jurisdiction.

PROJECTION INFORMATION: The projection used in the preparation of the map was Universal Transverse Mercator. The horizontal datum was North American Datum 1983. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

ELEVATION DATUM: Flood elevations on the FIRM are referenced to NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

Local vertical monuments may have been used to create the map. To obtain current monument information, please contact the appropriate local community listed in Table 31 of this FIS Report.

BASE MAP INFORMATION: Base map information shown on the FIRM was provided by the USDA-FSA Aerial Photography Field Office. This information was derived from digital orthophotography produced at a resolution of 1-meter pixel, dated October 2013. For information about base maps, refer to Section 6.2 “Base Map” in this FIS Report.

The map reflects more detailed and up-to-date stream channel configurations than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables may reflect stream channel distances that differ from what is shown on the map.

Corporate limits shown on the map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after the map was published, map users should contact appropriate community officials to verify current corporate limit locations.

NOTES FOR FIRM INDEX

REVISIONS TO INDEX: As new studies are performed and FIRM panels are updated within San Juan County, Washington, corresponding revisions to the FIRM Index will be incorporated within the FIS Report to reflect the effective dates of those panels. Please refer to Table 28 of this FIS Report to determine the most recent FIRM revision date for each community. The most recent FIRM panel effective date will correspond to the most recent index date.

Figure 2. FIRM Notes to Users *(continued)*

SPECIAL NOTES FOR SPECIFIC FIRM PANELS This Notes to Users section was created specifically for San Juan County, Washington, effective TBD.
LIMIT OF MODERATE WAVE ACTION: Zone AE has been divided by a Limit of Moderate Wave Action (LiMWA). The LiMWA represents the approximate landward limit of the 1.5-foot breaking wave. The effects of wave hazards between Zone VE and the LiMWA (or between the shoreline and the LiMWA for areas where Zone VE is not identified) will be similar to, but less severe than, those in Zone VE. FLOOD RISK REPORT: A Flood Risk Report (FRR) may be available for many of the flooding sources and communities referenced in this FIS Report. The FRR is provided to increase public awareness of flood risk by helping communities identify the areas within their jurisdictions that have the greatest risks. Although non-regulatory, the information provided within the FRR can assist communities in assessing and evaluating mitigation opportunities to reduce these risks. It can also be used by communities developing or updating flood risk mitigation plans. These plans allow communities to identify and evaluate opportunities to reduce potential loss of life and property. However, the FRR is not intended to be the final authoritative source of all flood risk data for a project area; rather, it should be used with other data sources to paint a comprehensive picture of flood risk.

Figure 3: Map Legend for FIRM

SPECIAL FLOOD HAZARD AREAS: *The 1% annual chance flood, also known as the base flood or 100-year flood, has a 1% chance of happening or being exceeded each year. Special Flood Hazard Areas are subject to flooding by the 1% annual chance flood. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights. See note for specific types. If the floodway is too narrow to be shown, a note is shown.*

	Special Flood Hazard Areas subject to inundation by the 1% annual chance flood (Zones A, AE, AH, AO, AR, A99, V and VE)
Zone A	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. No base (1% annual chance) flood elevations (BFEs) or depths are shown within this zone.
Zone AE	The flood insurance rate zone that corresponds to the 1% annual chance floodplains. Base flood elevations derived from the hydraulic analyses are shown within this zone, either at cross section locations or as static whole-foot elevations that apply throughout the zone.
Zone AH	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the hydraulic analyses are shown at selected intervals within this zone.
Zone AO	The flood insurance rate zone that corresponds to the areas of 1% annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the hydraulic analyses are shown within this zone.
Zone AR	The flood insurance rate zone that corresponds to areas that were formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
Zone A99	The flood insurance rate zone that corresponds to areas of the 1% annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or flood depths are shown within this zone.
Zone V	The flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations are not shown within this zone.
Zone VE	Zone VE is the flood insurance rate zone that corresponds to the 1% annual chance coastal floodplains that have additional hazards associated with storm waves. Base flood elevations derived from the coastal analyses are shown within this zone as static whole-foot elevations that apply throughout the zone.
	Regulatory Floodway determined in Zone AE.

Figure 3: Map Legend for FIRM *(continued)*

OTHER AREAS OF FLOOD HAZARD	
	Shaded Zone X: Areas of 0.2% annual chance flood hazards and areas of 1% annual chance flood hazards with average depths of less than 1 foot or with drainage areas less than 1 square mile.
	Future Conditions 1% Annual Chance Flood Hazard – Zone X: The flood insurance rate zone that corresponds to the 1% annual chance floodplains that are determined based on future-conditions hydrology. No base flood elevations or flood depths are shown within this zone.
	Zone X Protected by Accredited Levee: Areas protected by an accredited levee, dike or other flood control structures. See Notes to Users for important information.
OTHER AREAS	
	Zone D (Areas of Undetermined Flood Hazard): The flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible
NO SCREEN	Unshaded Zone X: Areas determined to be outside the 0.2% annual chance floodplain
FLOOD HAZARD AND OTHER BOUNDARY LINES	
	Flood Zone Boundary (white line)
	Limit of Study
	Jurisdiction Boundary
	Limit of Moderate Wave Action (LiMWA): Indicates the inland limit of the area affected by waves greater than 1.5 feet
GENERAL STRUCTURES	
Aqueduct *Channel* *Culvert* *Storm Sewer*	Channel, Culvert, Aqueduct, or Storm Sewer
Dam *Jetty* *Weir*	Dam, Jetty, Weir
	Levee, Dike or Floodwall accredited or provisionally accredited to provide protection from the 1% annual chance flood
	Levee, Dike or Floodwall not accredited to provide protection from the 1% annual chance flood.
Bridge	Bridge

Figure 3: Map Legend for FIRM *(continued)*

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AND OTHERWISE PROTECTED AREAS (OPA): *CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas. See Notes to Users for important information.*	
CBRS AREA 09/30/2009	Coastal Barrier Resources System Area: Labels are shown to clarify where this area shares a boundary with an incorporated area or overlaps with the floodway.
OTHERWISE PROTECTED AREA 09/30/2009	Otherwise Protected Area
REFERENCE MARKERS	
22.0	River mile Markers
CROSS SECTION & TRANSECT INFORMATION	
B 20.2	Lettered Cross Section with Regulatory Water Surface Elevation (BFE)
5280 21.1	Numbered Cross Section with Regulatory Water Surface Elevation (BFE)
17.5	Unlettered Cross Section with Regulatory Water Surface Elevation (BFE)
8	Coastal Transect
	Profile Baseline: Indicates the modeled flow path of a stream and is shown on FIRM panels for all valid studies with profiles or otherwise established base flood elevation.
	Coastal Transect Baseline: Used in the coastal flood hazard model to represent the 0.0-foot elevation contour and the starting point for the transect and the measuring point for the coastal mapping.
513	Base Flood Elevation Line (shown for flooding sources for which no cross sections or profile are available)
ZONE AE (EL 16)	Static Base Flood Elevation value (shown under zone label)
ZONE AO (DEPTH 2)	Zone designation with Depth
ZONE AO (DEPTH 2) (VEL 15 FPS)	Zone designation with Depth and Velocity

Figure 3: Map Legend for FIRM *(continued)*

BASE MAP FEATURES	
Missouri Creek	River, Stream or Other Hydrographic Feature
234	Interstate Highway
234	U.S. Highway
234	State Highway
234	County Highway
MAPLE LANE	Street, Road, Avenue Name, or Private Drive if shown on Flood Profile
RAILROAD	Railroad
	Horizontal Reference Grid Line
	Horizontal Reference Grid Ticks
+	Secondary Grid Crosshairs
Land Grant	Name of Land Grant
7	Section Number
R. 43 W. T. 22 N.	Range, Township Number
$^{42}76^{000m}$E	Horizontal Reference Grid Coordinates (UTM)
365000 FT	Horizontal Reference Grid Coordinates (State Plane)
80° 16’ 52.5”	Corner Coordinates (Latitude, Longitude)

SECTION 2.0 – FLOODPLAIN MANAGEMENT APPLICATIONS

2.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1% annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2% annual chance (500-year) flood is employed to indicate additional areas of flood hazard in the community.

Each flooding source included in the project scope has been studied and mapped using professional engineering and mapping methodologies that were agreed upon by FEMA and San Juan County as appropriate to the risk level. Flood risk is evaluated based on factors such as known flood hazards and projected impact on the built environment. Engineering analyses were performed for each studied flooding source to calculate its 1% annual chance flood elevations; elevations corresponding to other floods (e.g. 10-, 4-, 2-, 0.2-percent annual chance, etc.) may have also been computed for certain flooding sources. Engineering models and methods are described in detail in Section 5.0 of this FIS Report. The modeled elevations at cross sections were used to delineate the floodplain boundaries on the FIRM; between cross sections, the boundaries were interpolated using elevation data from various sources. More information on specific mapping methods is provided in Section 6.0 of this FIS Report.

Depending on the accuracy of available topographic data (Table 24), study methodologies employed (Section 5.0), and flood risk, certain flooding sources may be mapped to show both the 1% and 0.2% annual chance floodplain boundaries, regulatory water surface elevations (BFEs), and/or a regulatory floodway. Similarly, other flooding sources may be mapped to show only the 1% annual chance floodplain boundary on the FIRM, without published water surface elevations. In cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% annual chance floodplain boundary is shown on the FIRM. Figure 3, "Map Legend for FIRM", describes the flood zones that are used on the FIRMs to account for the varying levels of flood risk that exist along flooding sources within the project area. Table 2 and Table 3 indicate the flood zone designations for each flooding source and each community within San Juan County, respectively.

Table 2, "Flooding Sources Included in this FIS Report," lists each flooding source, including its study limits, affected communities, mapped zone on the FIRM, and the completion date of its engineering analysis from which the flood elevations on the FIRM and in the FIS Report were derived. Descriptions and dates for the latest hydrologic and hydraulic analyses of the flooding sources are shown in Table 13. Floodplain boundaries for these flooding sources are shown on the FIRM (published separately) using the symbology described in Figure 3. On the map, the 1% annual chance floodplain corresponds to the SFHAs. The 0.2% annual chance floodplain shows areas that, although out of the regulatory floodplain, are still subject to flood hazards.

Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data. The procedures to remove these areas from the SFHA are described in Section 6.5 of this FIS Report.

2.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the

encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard.

For purposes of the NFIP, a floodway is used as a tool to assist local communities in balancing floodplain development against increasing flood hazard. With this approach, the area of the 1% annual chance floodplain on a river is divided into a floodway and a floodway fringe based on hydraulic modeling. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment in order to carry the 1% annual chance flood. The floodway fringe is the area between the floodway and the 1% annual chance floodplain boundaries where encroachment is permitted. The floodway must be wide enough so that the floodway fringe could be completely obstructed without increasing the water-surface elevation of the 1% annual chance flood more than 1 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 4.

To participate in the NFIP, Federal regulations require communities to limit increases caused by encroachment to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this project are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway projects.

Figure 4: Floodway Schematic

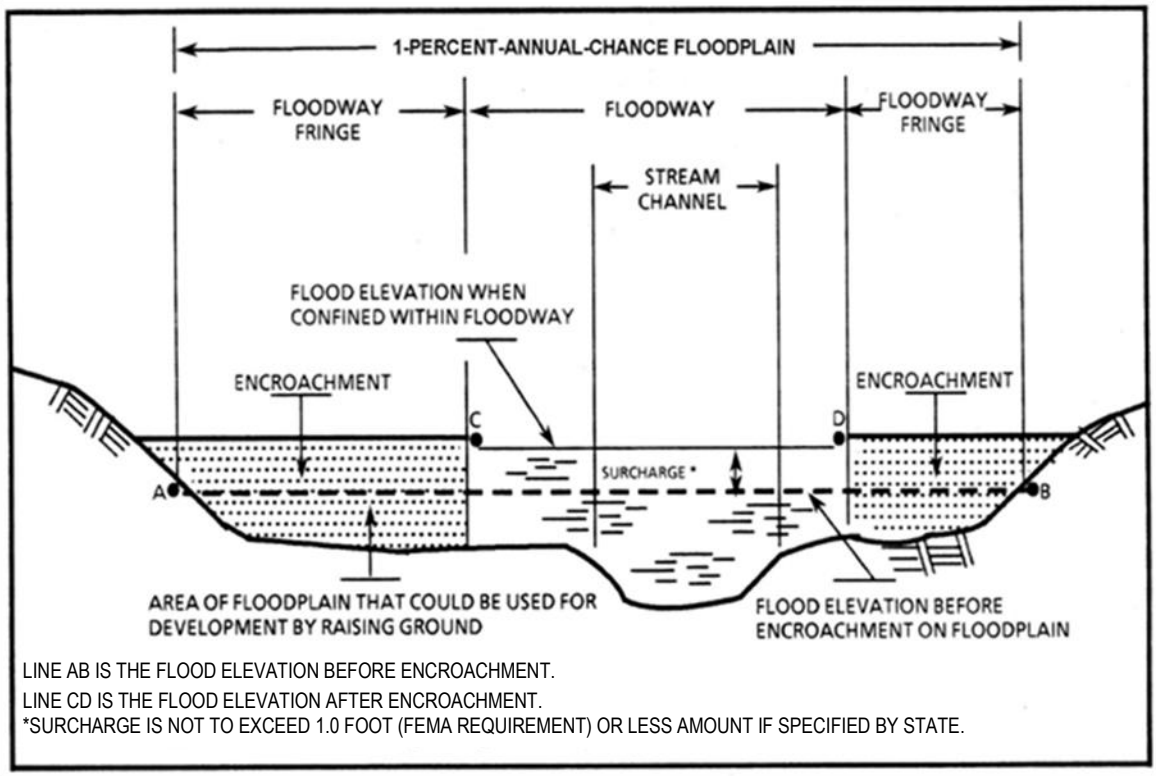


Table 2: Flooding Sources Included in this FIS Report

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	103 Estenson Road, Lopez Island WA	35 Cedars Lane, Lopez Island WA	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	1039 Parks Bay Drive, Shaw Island WA	Tift Rocks	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	105 Orcas Road, Eastsound WA	Martha P Farish TTEE Property	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	1053 Deer Point Road, Olga WA	2403 Obstruction Pass Road, Olga WA	17110003	0.4		N	AE	07/01/2015
SALISH SEA	San Juan County	1142 Port Stanley Road, Lopez Island WA	Approximately 330 feet East of 193 Old Kelp Mill Road, Lopez Island WA	17110003	0.9		N	AE	07/01/2015
SALISH SEA	San Juan County	130 Killdeer Lane, Friday Harbor WA	Approximately 260 feet Southwest of 551 Killdeer Lane, Friday Harbor WA	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	1329 Decatur Head Road, Anacortes WA	Approximately 540 feet East of 199 Shipward Drive, Anacortes WA	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	1351 Deer Harbor Road, Eastsound WA	1984 Deer Harbor Road, Eastsound WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	136 Catboat Place, Orcas WA	496 Deer Harbor Road, Eastsound WA	17110003	0.4		N	VE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	137 Calle Aguila, Lopez Island, WA	Approximately 340 feet Northwest of 4004 Dusty Road, Lopez Island	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	137 Fisher King Ln, Eastsound WA	Approximately 450 feet North of 2353 Channel Road, Eastsound WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	1373 Bayshore Road, Lopez Island WA	Approximately 140 feet Northeast of 473 Peninsula Drive, Lopez Island WA	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	1390 San Juan Drive, Friday Harbor WA	Approximately 260 feet North of 596 Rocky Bay Road, Friday Harbor WA	17110003	0.7		N	VE	07/01/2015
SALISH SEA	San Juan County	1428 Bayshore Road, Lopez Island WA	150 Weeks Point Way, Lopez Island WA	17110003	1.0		N	AE	07/01/2015
SALISH SEA	San Juan County	149 Morley Drive, Eastsound WA	136 Catboat Place, Orcas WA	17110003	0.3		N	AE	07/01/2015
SALISH SEA	San Juan County	152 Privacy Lane, Eastsound WA	5872 Deer Harbor Road, Eastsound WA	17110003	0.3		N	AE	07/01/2015
SALISH SEA	San Juan County	1715 White Beach Road, Orcas WA	EdwaRoad Burns and Sarah Layman Property	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	184 Armandale Road, Friday Harbor WA	37 Waters Edge Lane, Friday Harbor WA	17110003	0.4		N	AE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	1984 Deer Harbor Road, Eastsound WA	Northeast of Indian Point	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	2036 Davis Bay Road, Lopez Island WA	Kings Point, Lopez Island WA	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	220 Arbutus Lane, Friday Harbor WA	63 Seal Rock Lane, Friday Harbor WA	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	227 Kulshan View Road, Anacortes WA	1329 Decatur Head Road, Anacortes WA	17110003	0.6		N	AE	07/01/2015
SALISH SEA	San Juan County	235 Gull Cove Lane, Shaw Island WA	Approximately 350 feet Northwest of 416 Lonesome Cove Road, Friday Harbor WA	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	236 Walling Road, Friday Harbor WA	2553 Turn Point, Friday Harbor WA	17110003	0.4		N	AE	07/01/2015
SALISH SEA	San Juan County	2399 South Side Road, Friday Harbor WA	1499 Lighthouse Road, Friday Habor WA	17110003	0.7		N	VE	07/01/2015
SALISH SEA	San Juan County	240 Myers Road, Friday Harbor WA	236 Walling Road, Friday Harbor WA	17110003	0.7		N	AE	07/01/2015
SALISH SEA	San Juan County	2403 Obstruction Pass Road, Olga WA	Stone Bay LLC Property	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	241 Seacliff Trail, Olga WA	Approximately 200 feet West of 707 Old Sentinel Road, Olga WA	17110003	0.3		N	VE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	245 Racoon Point Road, Eastsound WA	Approximately 280 feet South from 859 Bluebell Springs, Eastsound WA	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	2553 Turn Point, Friday Harbor WA	4283 Pear Point Drive, Friday Harbor WA	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	256 Woodside Farm Road, Olga WA	1053 Deer Point Road, Olga WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	267 Preservation Lane, Anacortes WA	Johnson Crosby Road, Anacortes WA	17110003	0.5		N	AE	07/01/2015
SALISH SEA	San Juan County	285 Beverly Lane, Lopez Island WA	Approximately 550 feet North of Spencer's Landing Marina	17110003	0.6		N	AE	07/01/2015
SALISH SEA	San Juan County	290 Old Midden Lane, Shaw Island WA	William and Joanne Fraser Property	17110003	0.5		N	AE	07/01/2015
SALISH SEA	San Juan County	328 North Star Road, Lopez Island WA	Allen D Israel TTEE of Kona Residence Trust Property	17110003	0.5		N	AE	07/01/2015
SALISH SEA	San Juan County	340 Blind Bay Road, Shaw Island WA	East of Shaw Island Ferry Facilities	17110003	0.3		N	AE	07/01/2015
SALISH SEA	San Juan County	35 Cedars Lane, Lopez Island WA	93 Oystercatcher Lane, Lopez Island WA	17110003	0.3		N	AE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	361 Luos Lane, Shaw Island WA	Approximately 500 feet Southeast of 1205 Tibbs Road, Shaw Island WA	17110003	0.3		N	AE	07/01/2015
SALISH SEA	San Juan County	37 Waters Edge Lane, Friday Harbor WA	939 Afterglow Drive, Friday Harbor WA	17110003	0.6		N	AE	07/01/2015
SALISH SEA	San Juan County	3729 Bailer Hill Road, Friday Harbor WA	455 Carefree Way, Friday Harbor WA	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	377 Meadow Lane, Lopez Island WA	1373 Bayshore Road, Lopez Island WA	17110003	1.1		N	AE	07/01/2015
SALISH SEA	San Juan County	41 Hummingbird Lane, Orcas WA	149 Morley Drive, Orcas WA	17110003	0.2		N	VE	07/01/2015
SALISH SEA	San Juan County	410 ocean Mist Way, Eastsound, WA	East of Rosario Point on Cascade Bay, Eastsound WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	42 Spyglass Hill Road, Friday Harbor WA	Snug Harbor Resort, Friday Harbor	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	4283 Pear Point Drive, Friday Harbor WA	Approximately 230 feet Southwest of 168 Wilks Way, Friday Harbor WA	17110003	0.7		N	VE	07/01/2015
SALISH SEA	San Juan County	436 Olga Road, Eastsound WA	Approximately 475 feet West of 653 Crescent Beach Drive, Eastsound WA	17110003	0.5		N	VE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	441 Langdom Road, Eastsound WA	436 Olga Road, Eastsound WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	455 Carefree Way, Friday Harbor WA	90 Judy Lane, Friday Harbor WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	466 Marine Drive, Blakely Island	Entrance of Blakely Island Marina	17110003	0.4		N	AE	07/01/2015
SALISH SEA	San Juan County	481 Barlow Bay Road, Lopez island WA	137 Calle Aguila, Lopez Island, WA	17110003	0.8		N	AE	07/01/2015
SALISH SEA	San Juan County	496 Deer Harbor Road, Eastsound WA	1351 Deer Harbor Road, Eastsound WA	17110003	0.2		N	VE	07/01/2015
SALISH SEA	San Juan County	498 Peninsula Drive, Anacortes WA	227 Kulshan View Road, Anacortes WA	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	498 Shoreline Lane, Friday Harbor WA	University of Washington Property	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	503 Channel Road, Eastsound WA	137 Fisher King Lane, Eastsound WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	57 Stony Point Lane, Friday Harbor WA	Approximately 500 feet S of 726 Mineral Point Road, Friday Harbor WA	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	5872 Deer Harbor Road, Eastsound WA	503 Channel Road, Eastsound WA	17110003	0.4		N	VE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	609 Englehartson Road, Eastsound WA	Point Doughty, Eastsound WA	17110003	0.7		N	VE	07/01/2015
SALISH SEA	San Juan County	6286 Cattle Point Road, Friday Harbor WA	Warren Road Associate Property	17110003	1.0		N	VE	07/01/2015
SALISH SEA	San Juan County	63 Seal Rock Lane, Friday Harbor WA	Walter and Sue Guldi Property	17110003	0.2		N	VE	07/01/2015
SALISH SEA	San Juan County	672 Presidents Channel, Eastsound WA	609 Englehartson Road, Eastsound WA	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	705 Gleenwood Inn Road, Eastsound WA	73 Sunset Avenue, Eastsound WA	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	73 Sunset Avenue, Eastsound WA	Approximately 215 feet Northwest of 285 Raptor Road, Eastsound WA	17110003	0.7		N	VE	07/01/2015
SALISH SEA	San Juan County	748 Sperry Road, Lopez Island WA	Alexander Bright Rev Trust Property	17110003	0.7		N	VE	07/01/2015
SALISH SEA	San Juan County	749 Bonanza Drive, Lopez Island WA	Approximately 360 feet North of 496 North Star Road, Lopez Island WA	17110003	0.4		N	AE	07/01/2015
SALISH SEA	San Juan County	891 Smugglers Cove Road, Shaw Island WA	340 Blind Bay Road, Shaw Island WA	17110003	0.6		N	AE	07/01/2015
SALISH SEA	San Juan County	90 Judy Lane, Friday Harbor WA	42 Spyglass Hill Road, Friday Harbor WA	17110003	0.5		N	VE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	93 Oystercatcher Lane, Lopez Island WA	Approximately 386 North of Odlin Park Road, Lopez Island WA	17110003	0.6		N	AE	07/01/2015
SALISH SEA	San Juan County	99 Main Road, Blakely Island WA	466 Marine Drive, Blakely Island	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	Alexander Bright Rev Trust Property	Entrance of McArdle Bay	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	Allen D Israel TTEE of Kona Residence Trust Property	748 Sperry Road, Lopez Island WA	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 140 feet NORTHEAST of 473 Peninsula Drive, Lopez Island WA	103 Estenson Road, Lopez Island WA	17110003	0.7		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 200 feet West of 707 Old Sentinel Road, Olga WA	Jeremy and Angela Foster TTEE Property	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 215 meters Northwest of 285 Raptor Road, Eastsound WA	Approximately 340 feet West of 364 Matia View Drive, Eastsound WA	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 230 feet Southwest of 168 Wilks Way, Friday Harbor WA	Approximately 240 feet North of 259 Halsey Road, Friday Harbor WA	17110003	1.2		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 240 feet North of 259 Halsey Road, Friday Harbor WA	130 Killdeer Lane, Friday Harbor WA	17110003	1.1		N	VE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	Approximately 260 feet North of 596 Rocky Bay Road, Friday Harbor WA	57 Stony Point Lane, Friday Harbor WA	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 260 feet Southwest of 551 Killdeer Lane, Friday Harbor WA	6286 Cattle Point Road, Friday Harbor WA	17110003	0.3		N	AE	07/01/2015
SALISH SEA	San Juan County	Approximately 280 feet South from 859 Bluebell Springs, Eastsound WA	Lawrence Point, Eastsound WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 330 feet East of 193 Old Kelp Mill Road, Lopez Island WA	Lavina Davis Downs Property	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 330 feet south of Transect 62	99 Main Road, Blakely Island WA	17110003	0.4		N	AE	07/01/2015
SALISH SEA	San Juan County	Approximately 340 feet Northwest of 4004 Dusty Road, Lopez Island	2036 Davis Bay Road, Lopez Island WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 350 feet Northwest of 416 Lonesome Cove Road, Friday Harbor WA	1390 San Juan Drive, Friday Harbor WA	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 360 feet N of 496 North Star Road, Lopez Island WA	328 North Star Road, Lopez Island WA	17110003	0.7		N	AE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	Approximately 380 feet NORTHWEST of 360 Driftwood Drive, Blakely Island WA	Blakely Island Maint Comm Inc Property	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 386 North of Odlin Park Road, Lopez Island WA	285 Beverly Lane, Lopez Island WA	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 400 feet Southeast of 2 Lighthouse Road, Friday Harbor WA	121 Over the Hill Road, Friday Harbor WA	17110003	0.9		N	AE	07/01/2015
SALISH SEA	San Juan County	Approximately 450 feet North of 2353 Channel Road, Eastsound WA	William and Lorraine Manly TTEES Property	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 475 feet West of 653 Crescent Beach Drive, Eastsound WA	Eastern corner of Madrona Point	17110003	0.7		N	AE	07/01/2015
SALISH SEA	San Juan County	Approximately 500 feet South of 726 Mineral Point Road, Friday Harbor WA	498 Shoreline Lane, Friday Harbor WA	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 500 feet Southeast of 1205 Tibbs Road, Shaw Island WA	891 Smugglers Cove Road, Shaw Island WA	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	Approximately 340 feet West of 364 Matia View Drive, Eastsound WA	245 Racoon Point Road, Eastsound WA	17110003	0.3		N	VE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	Blakely Island Maint Comm Inc Property	Approximately 330 feet south of Transect 62	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	Charles and Gwendolyn Lillis TTEES Property	Guthrie Bay Entrance	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	Chris and Hilleary Property	Robert and Mark Cameron Burn Property	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	Cove along Johns Pass	Cove along Johns Pass	17110003	0.6		N	AE	07/01/2015
SALISH SEA	San Juan County	Daniel M Hoard Property	Approximately 380 feet Northwest of 360 Driftwood Drive, Blakely Island WA	17110003	0.7		N	VE	07/01/2015
SALISH SEA	San Juan County	Delacombe Point, Friday Harbor WA	Bell Point, Friday Harbor WA	17110003	0.9		N	AE	07/01/2015
SALISH SEA	San Juan County	Diane and Jarecki Ttee Property	41 Hummingbird Lane, Orcas WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Donald and Margaret Weir TTEE Property	Approximately 300 feet E of 521 Davison Head Drive, Friday Harbor WA	17110003	0.2		N	VE	07/01/2015
SALISH SEA	San Juan County	East of Gossip and Cementary Islands	2399 S Side Road, Friday Harbor WA	17110003	0.3		N	VE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	East of Rosario Point on Cascade bay, Eastsound WA	441 Langdom Road, Eastsound WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	East of Shaw Island Ferry Facilities	Point Hudson, Shaw Island WA	17110003	0.4		N	AE	07/01/2015
SALISH SEA	San Juan County	Eastern corner of MaDriveona Point	105 Orcas Road, Eastsound WA	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	EdwaRoad Burns and Sarah Layman Property	Charles and Gwendolyn Lillis Ttees Property	17110003	0.2		N	VE	07/01/2015
SALISH SEA	San Juan County	Entrance of McARoadle Bay	Iceberg Point, Lopez Island WA	17110003	0.8		N	VE	07/01/2015
SALISH SEA	San Juan County	Eric and Andrea Anderson Property	184 Armandale Road, Friday Harbor WA	17110003	0.3		N	AE	07/01/2015
SALISH SEA	San Juan County	Gullwing LLC Property	672 Presidents Channel, Eastsound WA	17110003	0.7		N	VE	07/01/2015
SALISH SEA	San Juan County	Guthrie Bay Entrance	Diane and Jarecki Ttee Property	17110003	0.1		N	VE	07/01/2015
SALISH SEA	San Juan County	Henry Island Associates Property	Eric and Andrea Anderson Property	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Iceberg Point, Lopez Island WA	481 Barlow Bay Road, Lopez island WA	17110003	0.8		N	VE	07/01/2015
SALISH SEA	San Juan County	James H Jannard Property	Crane Island ASSN Inc Property	17110003	0.3		N	AE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	Jeremy and Angela Foster TTEE Property	Scott Norquist and Karen Hays Property	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	John M Cherry TTEE Property	1715 White Beach Road, Orcas WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Johns Pass/ Tail End of Johns Island	East of Gossip and Cementary Islands	17110003	0.2		N	VE	07/01/2015
SALISH SEA	San Juan County	Johnson Crosby Road, Anacortes WA	497 Peninsula Drive, Anacortes WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Kings Point, Lopez Island WA	377 Meadow Lane, Lopez Island WA	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	L JYL Peterson and Barbara A Sanborn Property	San Juan Preservation Trust Property	17110003	0.2		N	VE	07/01/2015
SALISH SEA	San Juan County	Lavina Davis Downs Property	749 Bonanza Drive, Lopez Island WA	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	Lawrence Point, Eastsound WA	241 Seacliff Trail, Olga WA	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	Martha P Farish TTEE Property	Orcas Island Foundation Property	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	Mary Stuart Clark Property	410 Ocean Mist Way, Eastsound, WA	17110003	0.2		N	VE	07/01/2015
SALISH SEA	San Juan County	NORTHEAST of Indian Point	William H Clapp TTEE Property	17110003	0.4		N	VE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	Norman Spieler TTEE Property	Daniel Hoard Property	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Northwest side of Entrance of False Bay	3729 Bailer Hill Road, Friday Harbor WA	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	Orcas Island Foundation Property	John M Cherry TTEE Property	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Picnic Cover Entrance, Shaw Island WA	University of Washington Property	17110003	1.0		N	VE	07/01/2015
SALISH SEA	San Juan County	Point George, Shaw Island WA	1039 Parks Bay Drive, Shaw Island WA	17110003	0.2		N	AE	07/01/2015
SALISH SEA	San Juan County	Point Doughty, Eastsound WA	705 Gleenwood Inn Road, Eastsound WA	17110003	0.4		N	VE	07/01/2015
SALISH SEA	San Juan County	Point Hammond Farm LLC Property	L JYL Peterson and Barbara A Sanborn Property	17110003	0.6		N	VE	07/01/2015
SALISH SEA	San Juan County	Point Hudson, Shaw Island WA	Picnic Cover Entrance, Shaw Island WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Robert and Mark Cameron Burn Property	Shawn A Huntley Property	17110003	0.8		N	AE	07/01/2015
SALISH SEA	San Juan County	San Juan Preservation Trust Property	Chris and Hilleary Property	17110003	0.7		N	VE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	San Juan Preservation Trust Property	San Juan Preservation Trust Property	17110003	0.9		N	VE	07/01/2015
SALISH SEA	San Juan County	Scott Norquist and Karen Hays Property	Norman Spieler TTEE Property	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Southeast side of Entrance of False Bay	Northwest side of Entrance of False Bay	17110003	1.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Starting at Snug Harbor Resort across the entrance of Mosquito Bay	Starting at Snug Harbor Resort across the entrance of Mosquito Bay	17110003	0.3		N	AE	07/01/2015
SALISH SEA	San Juan County	Starting Bell Point across the entrance of Westcott Bay	Starting at Delacombe Point across the entrance of Horseshoe Bay	17110003	0.3		N	AE	07/01/2015
SALISH SEA	San Juan County	Starting Bell Point across the entrance of Westcott Bay	Starting Bell Point across the entrance of Westcott Bay	17110003	0.7		N	AE	07/01/2015
SALISH SEA	San Juan County	Stone Bay LLC Property	Mary Stuart Clark Property	17110003	0.2		N	VE	07/01/2015
SALISH SEA	San Juan County	Tifeet Rocks	290 Old Midden Lane, Shaw Island WA	17110003	0.2		N	VE	07/01/2015
SALISH SEA	San Juan County, Town of Friday Harbor	University of Washington Property	240 Myers Road, Friday Harbor WA	17110003	0.4		N	AE	07/01/2015

Table 2: Flooding Sources Included in this FIS Report *(continued)*

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
SALISH SEA	San Juan County	University of Washington Property	Point George, Shaw Island WA	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	University of Washington Property	University of Washington Property	17110003	0.9		N	VE	07/01/2015
SALISH SEA	San Juan County	Walter and Sue Guldi Property	Henry Island Associates Property	17110003	0.3		N	VE	07/01/2015
SALISH SEA	San Juan County	Warren Road Associate Property	Southeast side of Entrance of False Bay	17110003	0.7		N	VE	07/01/2015
SALISH SEA	San Juan County	William and Joanne Fraser Property	361 Luos Lane, Shaw Island WA	17110003	0.2		N	AE	07/01/2015
SALISH SEA	San Juan County	William and Lorraine Manly TTEES Property	Gullwing LLC Property	17110003	0.5		N	VE	07/01/2015
SALISH SEA	San Juan County	William H Clapp TTEE Property	152 Privacy Lane, Eastsound WA	17110003	0.4		N	VE	07/01/2015

Floodway widths presented in this FIS Report and on the FIRM were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. For certain stream segments, floodways were adjusted so that the amount of floodwaters conveyed on each side of the floodplain would be reduced equally. The results of the floodway computations have been tabulated for selected cross sections and are shown in Table 25, "Floodway Data."

All floodways that were developed for this FIS project are shown on the FIRM using the symbology described in Figure 3. In cases where the floodway and l% annual chance floodplain boundaries are either close together or collinear, only the floodway boundary has been shown on the FIRM. For information about the delineation of floodways on the FIRM, refer to Section 6.3.

2.3 Base Flood Elevations

The hydraulic characteristics of flooding sources were analyzed to provide estimates of the elevations of floods of the selected recurrence intervals. The Base Flood Elevation (BFE) is the elevation of the 1% annual chance flood. These BFEs are most commonly rounded to the whole foot, as shown on the FIRM, but in certain circumstances or locations they may be rounded to 0.1 foot. Cross section lines shown on the FIRM may also be labeled with the BFE rounded to 0.1 foot. Whole-foot BFEs derived from engineering analyses that apply to coastal areas, areas of ponding, or other static areas with little elevation change may also be shown at selected intervals on the FIRM.

Cross sections with BFEs shown on the FIRM correspond to the cross sections shown in the Floodway Data table and Flood Profiles in this FIS Report. BFEs are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM.

2.4 Non-Encroachment Zones

Some States and communities use non-encroachment zones to manage floodplain development. While not a FEMA designated floodway, the non-encroachment zone represents that area around the stream that should be reserved to convey the 1% annual chance flood event.

2.5 Coastal Flood Hazard Areas

For most areas along rivers, streams, and small lakes, BFEs and floodplain boundaries are based on the amount of water expected to enter the area during a 1% annual chance flood and the geometry of the floodplain. Floods in these areas are typically caused by storm events. However, for areas on or near ocean coasts, large rivers, or large bodies of water, BFE and floodplain boundaries may need to be based on additional components, including storm surges and waves. Communities on or near ocean coasts face flood hazards caused by offshore seismic events as well as storm events.

Coastal flooding sources that are included in this FIS project are shown in Table 2.

2.5.1 Water Elevations and the Effects of Waves

Specific terminology is used in coastal analyses to indicate which components have been included in evaluating flood hazards.

The stillwater elevation (SWEL or still water level) is the surface of the water resulting from astronomical tides, storm surge, and freshwater inputs, but excluding wave setup contribution or the effects of waves.

- *Astronomical tides* are periodic rises and falls in large bodies of water caused by the rotation of the earth and by the gravitational forces exerted by the earth, moon and sun.
- *Storm surge* is the additional water depth that occurs during large storm events. These events can bring air pressure changes and strong winds that force water up against the shore.
- *Freshwater inputs* include rainfall that falls directly on the body of water, runoff from surfaces and overland flow, and inputs from rivers.

The 1% annual chance stillwater elevation is the stillwater elevation that has been calculated for a storm surge from a 1% annual chance storm. The 1% annual chance storm surge can be determined from analyses of tidal gage records, statistical study of regional historical storms, or other modeling approaches. Stillwater elevations for storms of other frequencies can be developed using similar approaches.

The total stillwater elevation (also referred to as the mean water level) is the stillwater elevation plus wave setup contribution but excluding the effects of waves.

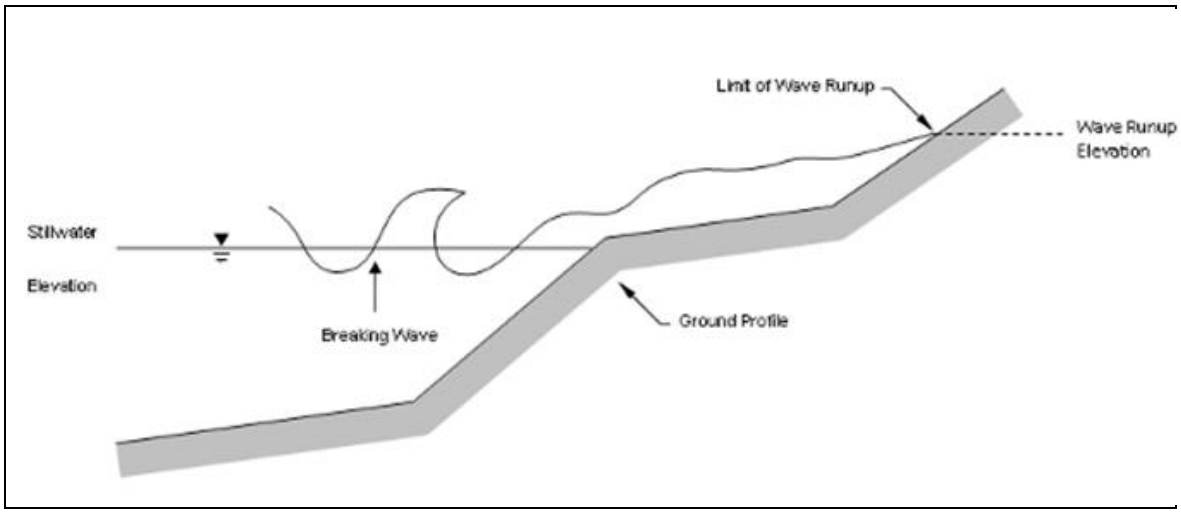
- *Wave setup* is the increase in stillwater elevation at the shoreline caused by the reduction of waves in shallow water. It occurs as breaking wave momentum is transferred to the water column.

Like the stillwater elevation, the total stillwater elevation is based on a storm of a particular frequency, such as the 1% annual chance storm. Wave setup is typically estimated using standard engineering practices or calculated using models, since tidal gages are often sited in areas sheltered from wave action and do not capture this information.

Coastal analyses may examine the effects of overland waves by analyzing storm-induced erosion, overland wave propagation, wave runup, and/or wave overtopping.

- *Storm-induced erosion* is the modification of existing topography by erosion caused by a specific storm event, as opposed to general erosion that occurs at a more constant rate.
- *Overland wave propagation* describes the combined effects of variation in ground elevation, vegetation, and physical features on wave characteristics as waves move onshore.
- *Wave runup* is the uprush of water from wave action on a shore barrier. It is a function of the roughness and geometry of the shoreline at the point where the stillwater elevation intersects the land.
- *Wave overtopping* refers to wave runup that occurs when waves pass over the crest of a barrier.

Figure 5: Wave Runup Transect Schematic



2.5.2 Floodplain Boundaries and BFEs for Coastal Areas

For coastal communities along the Atlantic and Pacific Oceans, the Gulf of Mexico, the Great Lakes, and the Caribbean Sea, flood hazards must take into account how storm surges, waves, and extreme tides interact with factors such as topography and vegetation. Storm surge and waves must also be considered in assessing flood risk for certain communities on rivers or large inland bodies of water.

Beyond areas that are affected by waves and tides, coastal communities can also have riverine floodplains with designated floodways, as described in previous sections.

Floodplain Boundaries

In many coastal areas, storm surge is the principle component of flooding. The extent of the 1% annual chance floodplain in these areas is derived from the total stillwater elevation (stillwater elevation including storm surge plus wave setup) for the 1% annual chance storm. The methods that were used for calculation of total stillwater elevations for coastal areas are described in Section 5.3 of this FIS Report. Location of total stillwater elevations for coastal areas are shown in Figure 8, "1% Annual Chance Total Stillwater Levels for Coastal Areas."

In some areas, the 1% annual chance floodplain is determined based on the limit of wave runup or wave overtopping for the 1% annual chance storm surge. The methods that were used for calculation of wave hazards are described in Section 5.3 of this FIS Report.

Table 27 presents the types of coastal analyses that were used in mapping the 1% annual chance floodplain in coastal areas.

Coastal BFEs

Coastal BFEs are calculated as the total stillwater elevation (stillwater elevation including storm surge plus wave setup) for the 1% annual chance storm plus the additional flood hazard from overland wave effects (storm-induced erosion, overland wave propagation, wave runup and wave overtopping).

Where they apply, coastal BFEs are calculated along transects extending from offshore to the limit of coastal flooding onshore. Results of these analyses are accurate until local topography, vegetation, or development type and density within the community undergoes major changes.

Parameters that were included in calculating coastal BFEs for each transect included in this FIS Report are presented in Table 17a and 17b, "Coastal Transect Parameters." The locations of transects are shown in Figure 9, "Transect Location Map." More detailed information about the methods used in coastal analyses and the results of intermediate steps in the coastal analyses are presented in Section 5.3 of this FIS Report. Additional information on specific mapping methods is provided in Section 6.4 of this FIS Report.

2.5.3 Coastal High Hazard Areas

Certain areas along the open coast and other areas may have higher risk of experiencing structural damage caused by wave action and/or high-velocity water during the 1% annual chance flood. These areas will be identified on the FIRM as Coastal High Hazard Areas.

- *Coastal High Hazard Area (CHHA)* is a SFHA extending from offshore to the inland limit of the primary frontal dune (PFD) or any other area subject to damages caused by wave action and/or high-velocity water during the 1% annual chance flood.

- *Primary Frontal Dune (PFD)* is a continuous or nearly continuous mound or ridge of sand with relatively steep slopes immediately landward and adjacent to the beach. The PFD is subject to erosion and overtopping from high tides and waves during major coastal storms.

CHHAs are designated as "V" zones (for "velocity wave zones") and are subject to more stringent regulatory requirements and a different flood insurance rate structure. The areas of greatest risk are shown as VE on the FIRM. Zone VE is further subdivided into elevation zones and shown with BFEs on the FIRM.

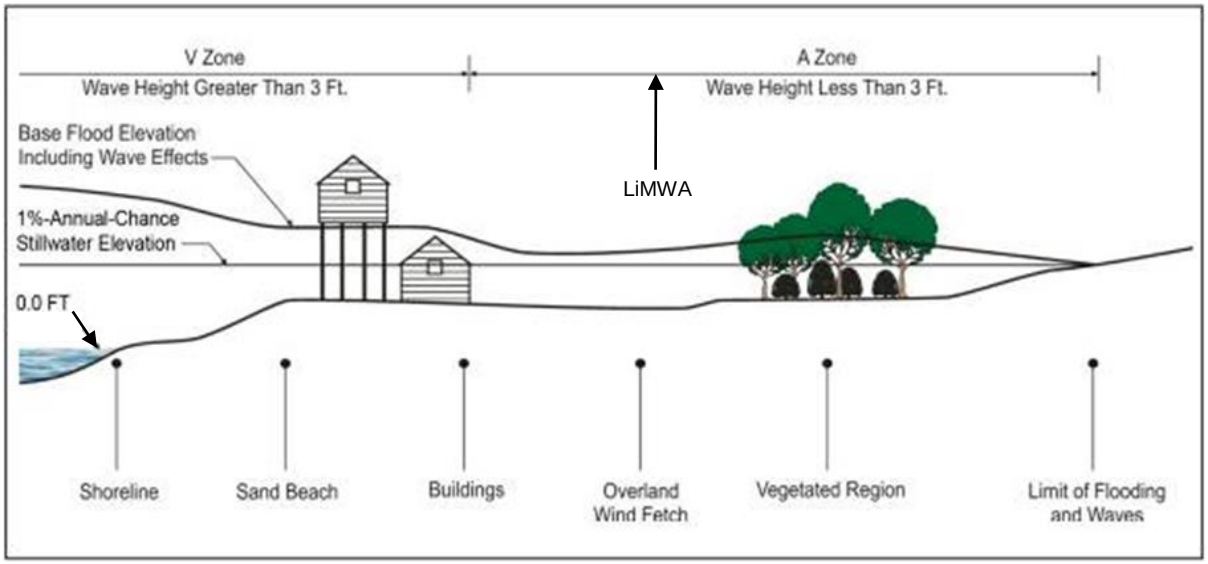
The landward limit of the PFD occurs at a point where there is a distinct change from a relatively steep slope to a relatively mild slope; this point represents the landward extension of Zone VE. Areas of lower risk in the CHHA are designated with Zone V on the FIRM. More detailed information about the identification and designation of Zone VE is presented in Section 6.4 of this FIS Report.

Areas that are not within the CHHA but are SFHAs may still be impacted by coastal flooding and damaging waves; these areas are shown as "A" zones on the FIRM.

Figure 6, "Coastal Transect Schematic," illustrates the relationship between the base flood elevation, the 1% annual chance stillwater elevation, and the ground profile as well as the

location of the Zone VE and Zone AE areas in an area without a PFD subject to overland wave propagation. This figure also illustrates energy dissipation and regeneration of a wave as it moves inland.

Figure 6: Coastal Transect Schematic



Methods used in coastal analyses in this FIS project are presented in Section 5.3 and mapping methods are provided in Section 6.4 of this FIS Report.

Coastal floodplains are shown on the FIRM using the symbology described in Figure 3, "Map Legend for FIRM." In many cases, the BFE on the FIRM is higher than the stillwater elevations shown in Table 17 due to the presence of wave effects. The higher elevation should be used for construction and/or floodplain management purposes.

2.5.4 Limit of Moderate Wave Action

This section is not applicable to this Flood Risk Project.

SECTION 3.0 – INSURANCE APPLICATIONS

3.1 National Flood Insurance Program Insurance Zones

For flood insurance applications, the FIRM designates flood insurance rate zones as described in Figure 3, "Map Legend for FIRM." Flood insurance zone designations are assigned to flooding sources based on the results of the hydraulic or coastal analyses. Insurance agents use the zones shown on the FIRM and depths and base flood elevations in this FIS Report in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

The 1% annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (e.g. Zones A, AE, V, VE, etc.), and the 0.2% annual chance floodplain boundary corresponds to the boundary of areas of additional flood hazards.

Table 3 lists the flood insurance zones in the unincorporated and incorporated areas of San Juan County.

Table 3: Flood Zone Designations by Community

Community	Flood Zone(s)
Friday Harbor, Town of	AE
San Juan, Unincorporated Areas	AE, VE

3.2 Coastal Barrier Resources System

The Coastal Barrier Resources Act (CBRA) of 1982 was established by Congress to create areas along the Atlantic and Gulf coasts and the Great Lakes, where restrictions for Federal financial assistance including flood insurance are prohibited. In 1990, Congress passed the Coastal Barrier Improvement Act (CBIA), which increased the extent of areas established by the CBRA and added "Otherwise Protected Areas" (OPA) to the system. These areas are collectively referred to as the John. H Chafee Coastal Barrier Resources System (CBRS). The CBRS boundaries that have been identified in the project area are in Table 4, "Coastal Barrier Resource System Information."

Table 4: Coastal Barrier Resources System Information

[Not Applicable to this Flood Risk Project]

SECTION 4.0 – AREA STUDIED

4.1 Basin Description

Table 5 contains a description of the characteristics of the HUC-8 sub-basins within which each community falls. The table includes the main flooding sources within each basin, a brief description of the basin, and its drainage area.

Table 5: Basin Characteristics

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (square miles)
San Juan Islands	17110003	Pacific Ocean (Salish Sea)	San Juan Islands	625

4.2 Principal Flood Problems

Table 6 contains a description of the principal flood problems that have been noted for San Juan County by flooding source.

Table 6: Principal Flood Problems

Flooding Source	Description of Flood Problems
Pacific Ocean (Salish Sea)	High astronomical tides topped with surge and waves caused by strong winds during winter storms are responsible for coastal flooding. The greatest concern for surge is with wind out of the southwest, which causes water to pile up in embayments and sounds. Since a majority of the shoreline is rocky bluffs, flooding primarily occurs in the low-lying coastal and estuary areas.

Table 7 contains information about historic flood elevations in the communities within San Juan County.

Table 7: Historic Flooding Elevations

Flooding Source	Location	Historic Peak (Feet NAVD88)	Event Date	Approximate Recurrence Interval (years)	Source of Data
Inundation River	Outlet of Inundation River at Big Ocean	19.8	1986	80	USGS gage
South Fork Inundation River	700 feet upstream of Fulton Road	18.8	2007	50	NRCS high water marks

4.3 Non-Levee Flood Protection Measures

Table 8 contains information about non-levee flood protection measures within San Juan County such as dams, jetties, and or dikes. Levees are addressed in Section 4.4 of this FIS Report.

Table 8: Non-Levee Flood Protection Measures

[Not Applicable to this Flood Risk Project]

4.4 Levees

This section is not applicable to this Flood Risk Project.

Table 9: Levees

[Not Applicable to this Flood Risk Project]

SECTION 5.0 – ENGINEERING METHODS

For the flooding sources in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded at least once on the average during any 10-, 25-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 25-, 50-, 100-, and 500-year floods, have a 10-, 4-, 2-, 1-, and 0.2% annual chance, respectively, of being equaled or exceeded during any year.

Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedance) during the term of a 30-year mortgage is approximately 26 percent (about 3 in 10); for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

The engineering analyses described here incorporate the results of previously issued Letters of Map Change (LOMCs) listed in Table 28, “Incorporated Letters of Map Change”, which include Letters of Map Revision (LOMRs). For more information about LOMRs, refer to Section 6.5, “FIRM Revisions.”

5.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak elevation-frequency relationships for floods of the selected recurrence intervals for each flooding source studied. Hydrologic analyses are typically performed at the watershed level. Depending on factors such as watershed size and shape, land use and urbanization, and natural or man-made storage, various models or methodologies may be applied. A summary of the hydrologic methods applied to develop the discharges used in the hydraulic analyses for each stream is provided in Table 13. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

Table 10: Summary of Discharges

[Not Applicable to this Flood Risk Project]

Figure 7: Frequency Discharge-Drainage Area Curves

[Not Applicable to this Flood Risk Project]

Table 11: Summary of Non-Coastal Stillwater Elevations

[Not Applicable to this Flood Risk Project]

Table 12: Stream Gage Information used to Determine Discharges

[Not Applicable to this Flood Risk Project]

5.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Base flood elevations on the FIRM represent the elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations. These whole-foot elevations may not exactly reflect the elevations derived from the hydraulic analyses. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM. The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

For streams for which hydraulic analyses were based on cross sections, locations of selected cross sections are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 6.3), selected cross sections are also listed on Table 25, "Floodway Data."

A summary of the methods used in hydraulic analyses performed for this project is provided in Table 13. Roughness coefficients are provided in Table 14. Roughness coefficients are values representing the frictional resistance water experiences when passing overland or through a channel. They are used in the calculations to determine water surface elevations. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation.

Table 13: Summary of Hydrologic and Hydraulic Analyses

[Not Applicable to this Flood Risk Project]

Table 14: Roughness Coefficients

[Not Applicable to this Flood Risk Project]

5.3 Coastal Analyses

For the areas of San Juan County that are impacted by coastal flooding processes, coastal flood hazard analyses were performed to provide estimates of coastal BFEs. Coastal BFEs reflect the increase in water levels during a flood event due to extreme tides and storm surge as well as overland wave effects.

The following subsections provide summaries of how each coastal process was considered for this FIS Report. Greater detail (including assumptions, analysis, and results) is available in the

archived project documentation. Table 15 summarizes the methods and/or models used for the coastal analyses. Refer to Section 2.5.1 for descriptions of the terms used in this section.

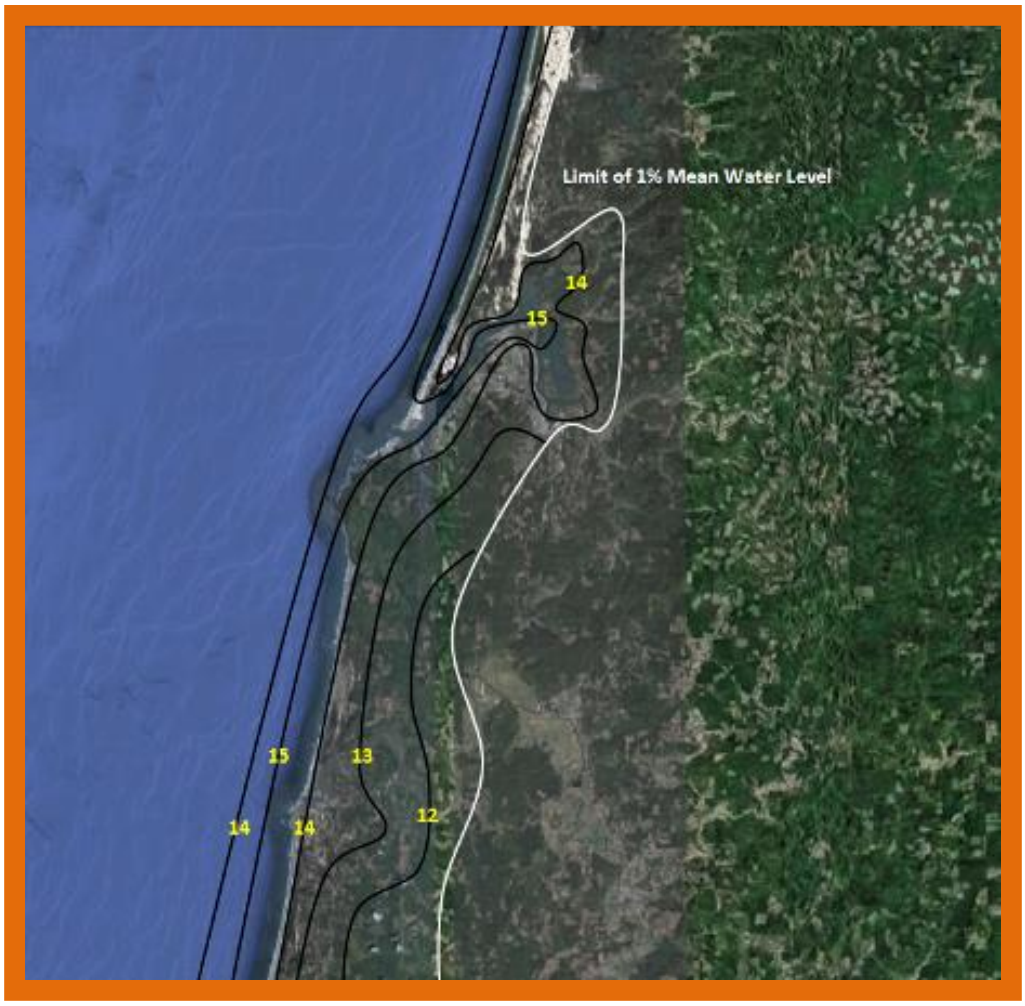
Table 15: Summary of Coastal Analyses

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Pacific Ocean (Salish Sea)	Entire Coastline of San Juan County	Entire Coastline of San Juan County	Wave Runup	ADCIRC (2003)	11/30/2012

5.3.1 Total Stillwater Elevations

The total stillwater elevations (stillwater including storm surge plus wave setup) for the 1% annual chance flood were determined for areas subject to coastal flooding. The models and methods that were used to determine storm surge and wave setup are listed in Table 15. The stillwater elevation that was used for each transect in coastal analyses is shown in Table 17a/b, "Coastal Transect Parameters."

Figure 8: 1% Annual Chance Total Stillwater Elevations for Coastal Areas



Astronomical Tide

Astronomical tidal statistics were generated directly from local tidal constituents by sampling the predicted tide at random times throughout the tidal epoch.

Storm Surge Statistics

Storm surge is modeled based on characteristics of actual storms responsible for significant coastal flooding. The characteristics of these storms are typically determined by statistical study of the regional historical record of storms or by statistical study of tidal gages.

When historic records are used to calculate storm surge, characteristics such as the strength, size, track, etc., of storms are identified by site. Storm data was used in conjunction with numerical hydrodynamic models to determine the corresponding storm surge levels. An extreme value analysis was performed on the storm surge modeling results to determine a stillwater elevation for the 1% annual chance event.

Tidal gages can be used instead of historic records of storms when the available tidal gage record for the area represents both the astronomical tide component and the storm surge

component. Table 16 provides the gage name, managing agency, gage type, gage identifier, start date, end date, and statistical methodology applied to each gage used to determine the stillwater elevations.

Table 16: Tide Gage Analysis Specifics

[Not Applicable to this Flood Risk Project]

Combined Riverine and Tidal Effects

[Not Applicable to this Flood Risk Project]

Wave Setup Analysis

Wave setup was computed during the storm surge modeling through the methods and models listed in Table 15 and included in the frequency analysis for the determination of the total stillwater elevations. The oscillating component of wave setup, dynamic wave setup, is negligible in the Salish Sea.

5.3.2 Waves

A SWAN grid and simulations were used for modeling wave dynamics. The final SWAN grid extended from the mouth of the Juan de Fuca Strait at Neah Bay, WA and covered the main basin of the Salish Sea, excluding Puget Sound. It contained 175,248 elements and 93,364 nodes with a maximum grid resolution of 225 meters. Waves were purely wind-driven, with wind forcing derived from the previously-completed SELFE modeling for the open coast of Region X. Water levels for each simulation were uniformly applied across the domain and derived from the Salish Sea ADCIRC modeling previously completed.

5.3.3 Coastal Erosion

A single storm episode can cause extensive erosion in coastal areas. Storm-induced erosion was evaluated to determine the modification to existing topography that is expected to be associated with flooding events. Erosion was evaluated using the methods listed in Table 15.

5.3.4 Wave Hazard Analyses

Overland wave hazards were evaluated to determine the combined effects of ground elevation, vegetation, and physical features on overland wave propagation and wave runup. These analyses were performed at representative transects along all shorelines for which waves were expected to be present during the floods of the selected recurrence intervals. The results of these analyses were used to determine elevations for the 1% annual chance flood.

Transect locations were chosen with consideration given to the physical land characteristics as well as development type and density so that they would closely represent conditions in their locality. Additional consideration was given to changes in the total stillwater elevation. Transects were spaced close together in areas of complex topography and dense development or where total stillwater elevations varied. In areas having more uniform characteristics, transects were spaced at larger intervals. Transects shown in Figure 9, "Transect Location Map," are also depicted on the FIRM. Table 17 provides the location, stillwater elevations, and starting wave conditions for each transect evaluated for overland wave hazards. In this table, "starting" indicates the parameter value at the beginning of the transect.

Wave Height Analysis

Wave height analyses were performed to determine wave heights and corresponding wave crest elevations for the areas inundated by coastal flooding and subject to overland wave propagation hazards. Refer to Figure 6 for a schematic of a coastal transect evaluated for overland wave propagation hazards.

Wave heights and wave crest elevations were modeled using the methods and models listed in Table 15, "Summary of Coastal Analyses".

Wave Runup Analysis

Wave runup analyses were performed to determine the height and extent of runup beyond the limit of stillwater inundation for the 1% annual chance flood. Wave runup elevations were modeled using the methods and models listed in Table 15.

Table 17a: Stillwater Elevations

Coastal Transect Number	San Juan County Stillwater Elevations (ft NAVD88)			
	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
SJ-001	12.1	12.3	12.3	12.4
SJ-002	12.1	12.3	12.3	12.4
SJ-003	12.0	12.2	12.2	12.3
SJ-004	11.9	12.1	12.1	12.2
SJ-005	11.9	12.1	12.1	12.2
SJ-006	11.8	12.1	12.1	12.2
SJ-007	12.0	12.2	12.3	12.3
SJ-008	12.1	12.3	12.4	12.4
SJ-009	12.2	12.4	12.4	12.5
SJ-010	12.2	12.4	12.4	12.5
SJ-011	12.2	12.4	12.4	12.5
SJ-012	12.2	12.4	12.4	12.5
SJ-013	12.1	12.3	12.4	12.5
SJ-014	12.1	12.3	12.3	12.4
SJ-015	11.9	12.1	12.2	12.2
SJ-016	11.9	12.1	12.1	12.2
SJ-017	11.8	12.0	12.1	12.1
SJ-018	11.8	12.0	12.1	12.1
SJ-019	11.8	12.0	12.0	12.1
SJ-020	11.8	12.0	12.0	12.1
SJ-021	11.8	12.0	12.0	12.1
SJ-022	11.6	11.8	11.8	11.9
SJ-023	11.5	11.7	11.8	11.9
SJ-024	11.5	11.8	11.8	11.9
SJ-025	11.6	11.8	11.8	11.9
SJ-026	11.6	11.8	11.8	11.9
SJ-027	11.6	11.8	11.9	11.9
SJ-028	11.6	11.8	11.9	12.0
SJ-029	11.6	11.9	11.9	12.0
SJ-030	11.7	11.9	11.9	12.0
SJ-031	11.7	11.9	11.9	12.0
SJ-032	11.7	11.9	11.9	12.0
SJ-033	11.6	11.8	11.9	12.0
SJ-034	11.6	11.8	11.9	12.0
SJ-035	11.6	11.8	11.8	11.9
SJ-036	11.5	11.8	11.8	11.9
SJ-037	11.5	11.7	11.8	11.9
SJ-038	11.5	11.7	11.8	11.8
SJ-039	11.6	11.8	11.8	11.9
SJ-040	11.5	11.8	11.8	11.9
SJ-041	11.6	11.8	11.9	11.9
SJ-042	11.6	11.8	11.9	11.9
SJ-043	11.6	11.8	11.9	11.9
SJ-044	11.6	11.8	11.9	12.0
SJ-045	11.6	11.8	11.9	12.0
SJ-046	11.6	11.8	11.9	12.0
SJ-047	11.6	11.8	11.9	12.0
SJ-048	11.6	11.9	11.9	12.0
SJ-049	11.7	11.9	12.0	12.1
SJ-050	11.7	11.9	12.0	12.0
SJ-051	11.7	11.9	12.0	12.1
SJ-052	11.7	11.9	12.0	12.1
SJ-053	11.8	12.0	12.0	12.1
SJ-054	11.8	12.0	12.1	12.2
SJ-055	11.9	12.1	12.1	12.2
SJ-056	12.0	12.2	12.2	12.3
SJ-057	12.0	12.2	12.3	12.3
SJ-058	12.1	12.3	12.3	12.4
SJ-059	11.7	11.9	12.0	12.0
SJ-060	11.6	11.8	11.9	11.9
SJ-061	11.5	11.7	11.7	11.8
SJ-062	11.5	11.7	11.7	11.8
SJ-063	11.5	11.7	11.8	11.8
SJ-064	11.5	11.7	11.8	11.8
SJ-065	11.5	11.7	11.7	11.8
SJ-066	11.4	11.6	11.6	11.7
SJ-067	11.3	11.5	11.5	11.6
SJ-068	11.4	11.6	11.7	11.7
SJ-069	11.4	11.6	11.7	11.7
SJ-070	11.5	11.7	11.8	11.8
SJ-071	11.5	11.7	11.8	11.8
SJ-072	11.5	11.7	11.8	11.8
SJ-073	11.5	11.7	11.7	11.8
SJ-074	11.4	11.7	11.7	11.8
SJ-075	11.4	11.6	11.7	11.7

Table 17a: Stillwater Elevations (continued)

Coastal Transect Number	San Juan County Stillwater Elevations (ft NAVD88)			
	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
SJ-076	11.4	11.6	11.7	11.7
SJ-077	11.4	11.6	11.7	11.7
SJ-078	11.2	11.4	11.5	11.5
SJ-079	11.2	11.4	11.4	11.5
SJ-080	11.0	11.2	11.3	11.3
SJ-081	11.0	11.2	11.2	11.3
SJ-082	11.0	11.2	11.2	11.3
SJ-083	11.0	11.2	11.2	11.3
SJ-084	11.0	11.2	11.2	11.3
SJ-085	11.0	11.2	11.2	11.3
SJ-086	11.0	11.2	11.3	11.3
SJ-087	11.2	11.4	11.5	11.5
SJ-088	11.3	11.5	11.6	11.6
SJ-089	11.4	11.6	11.6	11.7
SJ-090	11.4	11.6	11.7	11.7
SJ-091	11.4	11.6	11.7	11.7
SJ-092	11.4	11.6	11.7	11.7
SJ-093	11.5	11.7	11.7	11.8
SJ-094	11.5	11.7	11.7	11.8
SJ-095	11.7	11.9	11.9	12.0
SJ-096	11.6	11.8	11.9	11.9
SJ-097	11.6	11.8	11.8	11.9
SJ-098	11.6	11.8	11.8	11.9
SJ-099	11.6	11.8	11.8	11.9
SJ-100	11.5	11.7	11.8	11.8
SJ-101	11.4	11.6	11.7	11.8
SJ-102	11.4	11.7	11.7	11.8
SJ-103	11.5	11.7	11.8	11.9
SJ-104	11.7	11.9	11.9	12.0
SJ-105	11.6	11.9	11.9	12.0
SJ-106	11.7	11.9	11.9	12.0
SJ-107	11.7	11.9	12.0	12.0
SJ-108	11.7	11.9	12.0	12.0
SJ-109	11.6	11.8	11.8	11.9
SJ-110	11.6	11.8	11.9	11.9
SJ-111	11.8	12.0	12.1	12.1
SJ-112	11.8	12.0	12.1	12.1
SJ-113	11.8	12.0	12.1	12.1
SJ-114	11.8	12.0	12.0	12.1
SJ-115	11.8	12.0	12.0	12.1
SJ-116	11.7	11.9	12.0	12.0
SJ-117	11.6	11.8	11.8	11.9
SJ-118	11.6	11.8	11.8	11.9
SJ-119	11.6	11.8	11.8	11.9
SJ-120	11.6	11.8	11.8	11.9
SJ-121	11.4	11.6	11.6	11.7
SJ-122	11.3	11.5	11.6	11.7
SJ-123	11.3	11.6	11.6	11.7
SJ-124	11.4	11.6	11.6	11.7
SJ-125	11.2	11.4	11.5	11.5
SJ-126	11.1	11.3	11.4	11.5
SJ-127	10.9	11.1	11.1	11.2
SJ-128	10.9	11.1	11.1	11.2
SJ-129	10.9	11.1	11.1	11.2
SJ-130	10.9	11.1	11.1	11.2
SJ-131	10.9	11.1	11.2	11.2
SJ-132	11.0	11.3	11.3	11.4
SJ-133	11.1	11.4	11.4	11.5
SJ-134	11.2	11.4	11.5	11.5
SJ-135	11.2	11.4	11.5	11.6
SJ-136	11.2	11.4	11.5	11.5
SJ-137	11.3	11.5	11.6	11.6
SJ-138	11.3	11.5	11.6	11.6
SJ-139	11.3	11.5	11.6	11.6
SJ-140	11.4	11.6	11.6	11.7
SJ-141	11.3	11.6	11.6	11.7
SJ-142	11.4	11.7	11.7	11.8
SJ-143	11.5	11.7	11.8	11.8
SJ-144	11.5	11.7	11.8	11.8
SJ-145	11.6	11.8	11.8	11.9
SJ-146	11.8	12.0	12.1	12.1
SJ-147	11.7	11.9	12.0	12.1
SJ-148	11.7	11.9	12.0	12.1
SJ-149	11.6	11.8	11.9	11.9
SJ-150	11.6	11.8	11.8	11.9

Table 17b: Total Water Levels

Flooding Source	Coastal Transect Number	Total Water Elevations (ft NAVD88)			
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Pacific Ocean (Salish Sea)	SJ-001	12.7	12.9	13.0	13.1
Pacific Ocean (Salish Sea)	SJ-002	12.7	13.0	13.1	13.2
Pacific Ocean (Salish Sea)	SJ-003	16.3	17.1	17.3	17.7
Pacific Ocean (Salish Sea)	SJ-004	15.6	16.3	16.5	16.8
Pacific Ocean (Salish Sea)	SJ-005	14.7	15.6	15.9	16.5
Pacific Ocean (Salish Sea)	SJ-006	13.6	14.1	14.3	14.6
Pacific Ocean (Salish Sea)	SJ-007	12.6	12.9	12.9	13.1
Pacific Ocean (Salish Sea)	SJ-008	14.1	14.5	14.6	14.7
Pacific Ocean (Salish Sea)	SJ-009	12.8	13.1	13.1	13.3
Pacific Ocean (Salish Sea)	SJ-010	14.4	14.8	14.9	15.1
Pacific Ocean (Salish Sea)	SJ-011	15.8	16.3	16.4	16.6
Pacific Ocean (Salish Sea)	SJ-012	15.7	16.2	16.3	16.5
Pacific Ocean (Salish Sea)	SJ-013	18.3	18.9	19.0	19.1
Pacific Ocean (Salish Sea)	SJ-014	17.5	18.1	18.2	18.3
Pacific Ocean (Salish Sea)	SJ-015	15.3	15.8	15.9	16.1
Pacific Ocean (Salish Sea)	SJ-016	19.8	20.6	20.7	20.9
Pacific Ocean (Salish Sea)	SJ-017	20.1	20.8	21.0	21.1
Pacific Ocean (Salish Sea)	SJ-018	18.1	18.9	19.1	19.3
Pacific Ocean (Salish Sea)	SJ-019	17.7	18.3	18.4	18.6
Pacific Ocean (Salish Sea)	SJ-020	17.6	18.2	18.4	18.6
Pacific Ocean (Salish Sea)	SJ-021	19.1	19.8	19.9	20.1
Pacific Ocean (Salish Sea)	SJ-022	12.4	12.8	12.9	13.0
Pacific Ocean (Salish Sea)	SJ-023	14.8	15.8	16.1	16.7
Pacific Ocean (Salish Sea)	SJ-024	15.2	16.1	16.3	16.8
Pacific Ocean (Salish Sea)	SJ-025	16.0	16.7	16.9	17.2
Pacific Ocean (Salish Sea)	SJ-026	14.1	14.8	15.0	15.3
Pacific Ocean (Salish Sea)	SJ-027	15.6	16.3	16.5	16.8
Pacific Ocean (Salish Sea)	SJ-028	13.8	14.4	14.7	15.1
Pacific Ocean (Salish Sea)	SJ-029	14.3	15.0	15.2	15.6
Pacific Ocean (Salish Sea)	SJ-030	11.9	12.2	12.3	12.4
Pacific Ocean (Salish Sea)	SJ-031	14.9	15.6	15.7	16.0
Pacific Ocean (Salish Sea)	SJ-032	15.0	15.6	15.8	16.1
Pacific Ocean (Salish Sea)	SJ-033	16.3	17.0	17.2	17.4
Pacific Ocean (Salish Sea)	SJ-034	15.5	16.1	16.3	16.5
Pacific Ocean (Salish Sea)	SJ-035	15.0	15.6	15.7	15.9
Pacific Ocean (Salish Sea)	SJ-036	16.3	17.0	17.2	17.5
Pacific Ocean (Salish Sea)	SJ-037	15.6	16.2	16.4	16.6
Pacific Ocean (Salish Sea)	SJ-038	18.8	19.3	19.4	19.5
Pacific Ocean (Salish Sea)	SJ-039	15.4	16.0	16.2	16.5
Pacific Ocean (Salish Sea)	SJ-040	16.0	16.5	16.6	16.8
Pacific Ocean (Salish Sea)	SJ-041	14.7	15.2	15.4	15.6
Pacific Ocean (Salish Sea)	SJ-042	13.3	13.8	13.9	14.2
Pacific Ocean (Salish Sea)	SJ-043	13.8	14.4	14.6	14.9

Table 17b: Total Water Levels (continued)

Pacific Ocean (Salish Sea)	SJ-044	14.6	15.3	15.5	15.8
Pacific Ocean (Salish Sea)	SJ-045	14.1	14.6	14.7	15.0
Pacific Ocean (Salish Sea)	SJ-046	14.1	14.6	14.8	15.0
Pacific Ocean (Salish Sea)	SJ-047	15.9	16.5	16.6	16.9
Pacific Ocean (Salish Sea)	SJ-048	14.6	15.1	15.3	15.5
Pacific Ocean (Salish Sea)	SJ-049	12.4	12.7	12.8	13.0
Pacific Ocean (Salish Sea)	SJ-050	13.3	13.8	13.9	14.2
Pacific Ocean (Salish Sea)	SJ-051	13.9	14.4	14.6	14.9
Pacific Ocean (Salish Sea)	SJ-052	14.4	15.0	15.2	15.5
Pacific Ocean (Salish Sea)	SJ-053	15.9	16.6	16.7	17.0
Pacific Ocean (Salish Sea)	SJ-054	15.5	16.1	16.3	16.7
Pacific Ocean (Salish Sea)	SJ-055	14.6	15.7	16.1	17.1
Pacific Ocean (Salish Sea)	SJ-056	14.4	15.2	15.4	15.9
Pacific Ocean (Salish Sea)	SJ-057	14.5	15.2	15.5	16.0
Pacific Ocean (Salish Sea)	SJ-058	14.7	15.5	15.8	16.4
Pacific Ocean (Salish Sea)	SJ-059	14.0	14.4	14.5	14.6
Pacific Ocean (Salish Sea)	SJ-060	17.8	18.5	18.6	18.8
Pacific Ocean (Salish Sea)	SJ-061	19.6	20.4	20.6	20.9
Pacific Ocean (Salish Sea)	SJ-062	13.0	13.5	13.7	13.9
Pacific Ocean (Salish Sea)	SJ-063	15.4	16.1	16.3	16.6
Pacific Ocean (Salish Sea)	SJ-064	12.0	12.3	12.3	12.4
Pacific Ocean (Salish Sea)	SJ-065	14.9	15.2	15.3	15.4
Pacific Ocean (Salish Sea)	SJ-066	12.1	12.4	12.4	12.5
Pacific Ocean (Salish Sea)	SJ-067	19.4	20.2	20.3	20.6
Pacific Ocean (Salish Sea)	SJ-068	11.6	11.8	11.8	11.9
Pacific Ocean (Salish Sea)	SJ-069	14.3	14.8	14.9	15.2
Pacific Ocean (Salish Sea)	SJ-070	13.7	14.2	14.3	14.5
Pacific Ocean (Salish Sea)	SJ-071	13.2	13.6	13.7	13.9
Pacific Ocean (Salish Sea)	SJ-072	11.7	11.9	12.0	12.0
Pacific Ocean (Salish Sea)	SJ-073	16.4	16.9	17.0	17.2
Pacific Ocean (Salish Sea)	SJ-074	16.0	16.5	16.6	16.8
Pacific Ocean (Salish Sea)	SJ-075	13.4	13.8	13.9	14.1
Pacific Ocean (Salish Sea)	SJ-076	12.4	12.7	12.7	12.9
Pacific Ocean (Salish Sea)	SJ-077	13.3	13.7	13.8	13.9
Pacific Ocean (Salish Sea)	SJ-078	12.9	13.3	13.5	13.7
Pacific Ocean (Salish Sea)	SJ-079	17.5	18.3	18.5	18.9
Pacific Ocean (Salish Sea)	SJ-080	15.6	16.2	16.4	16.7
Pacific Ocean (Salish Sea)	SJ-081	14.6	15.2	15.4	15.7
Pacific Ocean (Salish Sea)	SJ-082	12.9	13.6	13.9	14.3
Pacific Ocean (Salish Sea)	SJ-083	11.9	12.3	12.5	12.8
Pacific Ocean (Salish Sea)	SJ-084	16.7	17.7	18.0	18.5
Pacific Ocean (Salish Sea)	SJ-085	14.9	15.7	16.0	16.4
Pacific Ocean (Salish Sea)	SJ-086	15.2	16.1	16.4	16.9
Pacific Ocean (Salish Sea)	SJ-087	16.0	16.6	16.7	16.9
Pacific Ocean (Salish Sea)	SJ-088	12.4	12.9	13.0	13.3
Pacific Ocean (Salish Sea)	SJ-089	13.0	13.5	13.6	13.9
Pacific Ocean (Salish Sea)	SJ-090	12.6	12.9	13.0	13.2

Table 17b: Total Water Levels (continued)

Pacific Ocean (Salish Sea)	SJ-091	12.6	12.9	13.0	13.2
Pacific Ocean (Salish Sea)	SJ-092	13.5	14.1	14.3	14.7
Pacific Ocean (Salish Sea)	SJ-093	11.7	11.9	12.0	12.1
Pacific Ocean (Salish Sea)	SJ-094	13.1	13.5	13.6	13.8
Pacific Ocean (Salish Sea)	SJ-095	13.0	13.3	13.4	13.6
Pacific Ocean (Salish Sea)	SJ-096	14.2	14.6	14.7	14.9
Pacific Ocean (Salish Sea)	SJ-097	13.2	13.5	13.6	13.8
Pacific Ocean (Salish Sea)	SJ-098	12.9	13.2	13.3	13.5
Pacific Ocean (Salish Sea)	SJ-099	12.2	12.6	12.7	12.8
Pacific Ocean (Salish Sea)	SJ-100	15.8	16.3	16.4	16.6
Pacific Ocean (Salish Sea)	SJ-101	12.6	13.0	13.1	13.4
Pacific Ocean (Salish Sea)	SJ-102	16.3	17.1	17.3	17.6
Pacific Ocean (Salish Sea)	SJ-103	15.3	16.2	16.5	17.0
Pacific Ocean (Salish Sea)	SJ-104	12.2	12.5	12.6	12.7
Pacific Ocean (Salish Sea)	SJ-105	14.6	15.2	15.4	15.6
Pacific Ocean (Salish Sea)	SJ-106	14.6	15.1	15.2	15.4
Pacific Ocean (Salish Sea)	SJ-107	11.9	12.1	12.1	12.2
Pacific Ocean (Salish Sea)	SJ-108	12.6	12.9	13.0	13.1
Pacific Ocean (Salish Sea)	SJ-109	13.3	13.8	13.9	14.2
Pacific Ocean (Salish Sea)	SJ-110	13.0	13.4	13.5	13.6
Pacific Ocean (Salish Sea)	SJ-111	15.0	15.5	15.6	15.8
Pacific Ocean (Salish Sea)	SJ-112	15.3	15.7	15.9	16.1
Pacific Ocean (Salish Sea)	SJ-113	14.3	14.7	14.8	15.0
Pacific Ocean (Salish Sea)	SJ-114	15.5	16.0	16.1	16.3
Pacific Ocean (Salish Sea)	SJ-115	17.0	17.5	17.6	17.8
Pacific Ocean (Salish Sea)	SJ-116	14.3	14.7	14.8	14.9
Pacific Ocean (Salish Sea)	SJ-117	15.1	15.5	15.6	15.8
Pacific Ocean (Salish Sea)	SJ-118	12.6	12.9	13.1	13.2
Pacific Ocean (Salish Sea)	SJ-119	13.4	13.7	13.8	13.9
Pacific Ocean (Salish Sea)	SJ-120	12.3	12.7	12.8	13.0
Pacific Ocean (Salish Sea)	SJ-121	18.6	19.5	19.7	20.0
Pacific Ocean (Salish Sea)	SJ-122	15.3	15.8	16.0	16.2
Pacific Ocean (Salish Sea)	SJ-123	15.2	15.7	15.8	16.0
Pacific Ocean (Salish Sea)	SJ-124	16.5	17.2	17.4	17.6
Pacific Ocean (Salish Sea)	SJ-125	15.9	16.5	16.7	16.9
Pacific Ocean (Salish Sea)	SJ-126	12.6	13.0	13.1	13.2
Pacific Ocean (Salish Sea)	SJ-127	16.1	16.8	17.0	17.2
Pacific Ocean (Salish Sea)	SJ-128	16.6	17.1	17.3	17.4
Pacific Ocean (Salish Sea)	SJ-129	16.7	17.4	17.5	17.7
Pacific Ocean (Salish Sea)	SJ-130	20.0	20.8	21.0	21.3
Pacific Ocean (Salish Sea)	SJ-131	20.1	20.9	21.0	21.2
Pacific Ocean (Salish Sea)	SJ-132	23.5	24.7	24.9	25.2
Pacific Ocean (Salish Sea)	SJ-133	17.5	18.4	18.7	19.1
Pacific Ocean (Salish Sea)	SJ-134	15.6	16.2	16.3	16.5
Pacific Ocean (Salish Sea)	SJ-135	14.8	15.8	16.1	16.8
Pacific Ocean (Salish Sea)	SJ-136	11.3	11.5	11.6	11.7
Pacific Ocean (Salish Sea)	SJ-137	12.5	12.9	13.0	13.2

Table 17b: Total Water Levels (continued)

Pacific Ocean (Salish Sea)	SJ-138	12.3	12.7	12.8	12.9
Pacific Ocean (Salish Sea)	SJ-139	13.2	13.5	13.7	13.8
Pacific Ocean (Salish Sea)	SJ-140	14.1	14.8	15.0	15.4
Pacific Ocean (Salish Sea)	SJ-141	17.3	18.3	18.6	19.0
Pacific Ocean (Salish Sea)	SJ-142	13.7	14.6	15.0	15.7
Pacific Ocean (Salish Sea)	SJ-143	12.6	13.0	13.1	13.3
Pacific Ocean (Salish Sea)	SJ-144	12.9	13.3	13.5	13.7
Pacific Ocean (Salish Sea)	SJ-145	11.8	12.0	12.1	12.2
Pacific Ocean (Salish Sea)	SJ-146	12.4	12.6	12.7	12.8
Pacific Ocean (Salish Sea)	SJ-147	12.0	12.3	12.3	12.5
Pacific Ocean (Salish Sea)	SJ-148	14.3	14.8	14.9	15.1
Pacific Ocean (Salish Sea)	SJ-149	15.7	16.3	16.5	16.8
Pacific Ocean (Salish Sea)	SJ-150	18.3	19.2	19.4	19.7

Figure 9: Transect Location Map

Haro Strait
Prevost Harbor
JAMES ISLAND
STUART ISLAND
JOHNS ISLAND
Red Harbor
New Channel
San Juan County
SPIEDEN ISLAND
Spieden Channel
North Harbor
HENRY ISLAND
Nelson Bay
Wescott Bay
SAN JUAN ISLAND
Open Bay
Roche Harbor Lake
Garrison Bay
Haro Strait
Mitchell Bay
146
147
149
150
146
109
110
145
111
142
143
112
144
138
140
139
141
113
114
137
136
135

1 inch equals 0.9 miles

N

Miles

0 0.75 1.5

Map Projection:
Universal Transverse Mercator Zone 10 North
North American Datum 1983

COUNTY LOCATOR

San Juan County

NATIONAL FLOOD INSURANCE PROGRAM

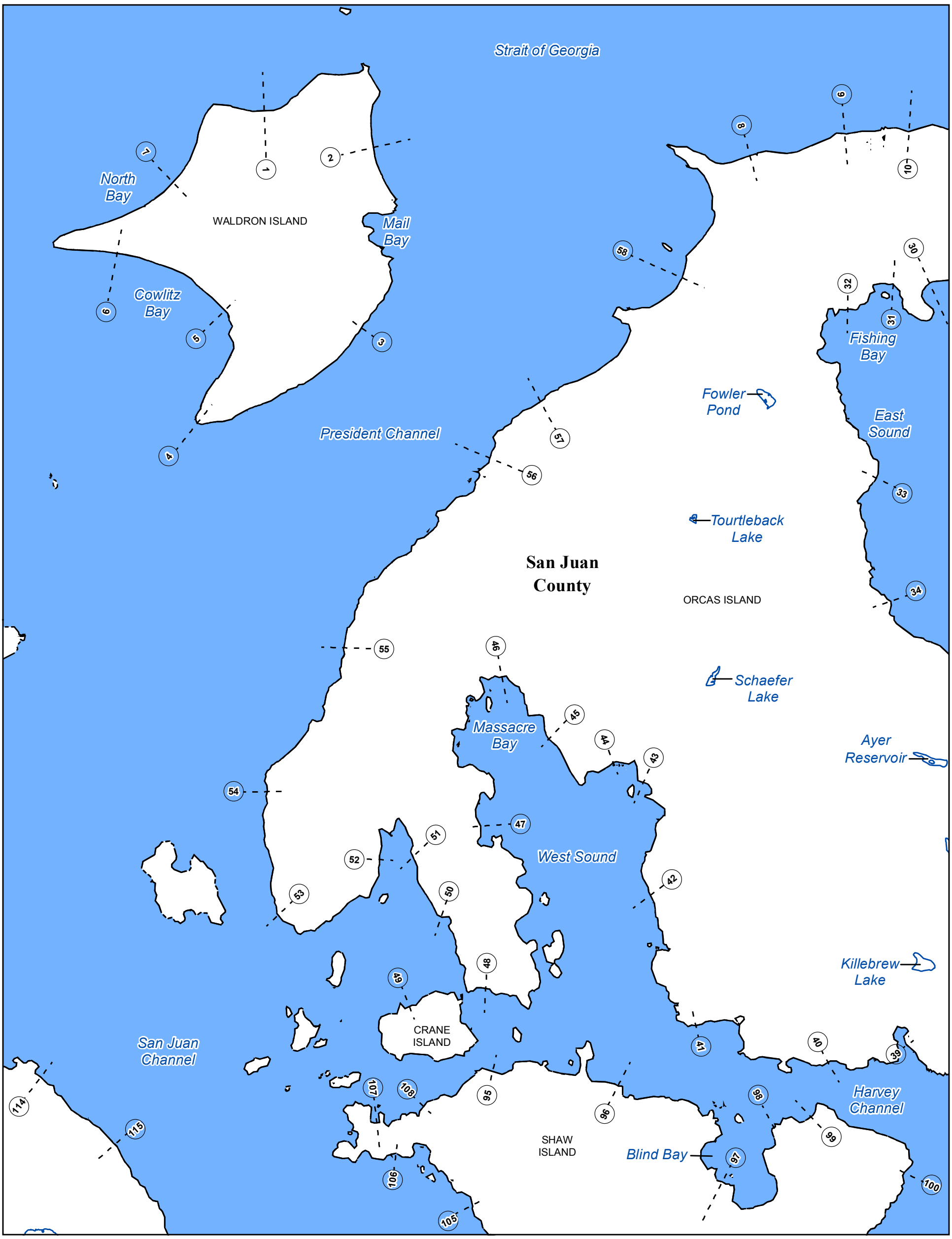
Transect Locator Map

PANELS WITH TRANSECTS:

0115, 0120, 0135, 0145, 0155, 0160, 0165, 0170, 0180, 0190, 0195, 0230, 0235, 0245, 0255, 0260, 0270, 0280, 0285, 0290, 0305, 0310, 0315, 0320, 0360, 0380, 0385, 0405, 0410, 0420, 0430, 0435, 0440, 0445

FEMA

Figure 9: Transect Location Map (continued)



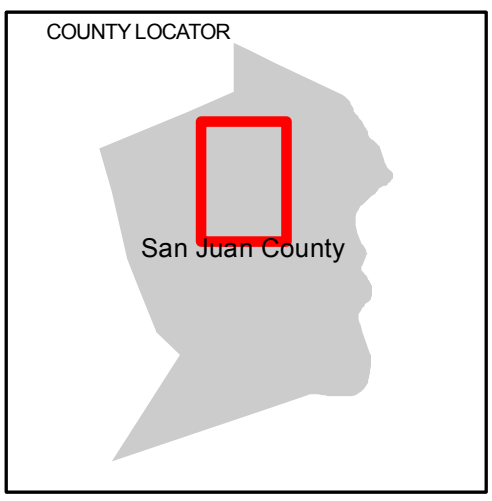
1 inch equals 0.9 miles

N

Miles

0 0.75 1.5

Map Projection:
Universal Transverse Mercator Zone 10 North
North American Datum 1983



NATIONAL FLOOD INSURANCE PROGRAM

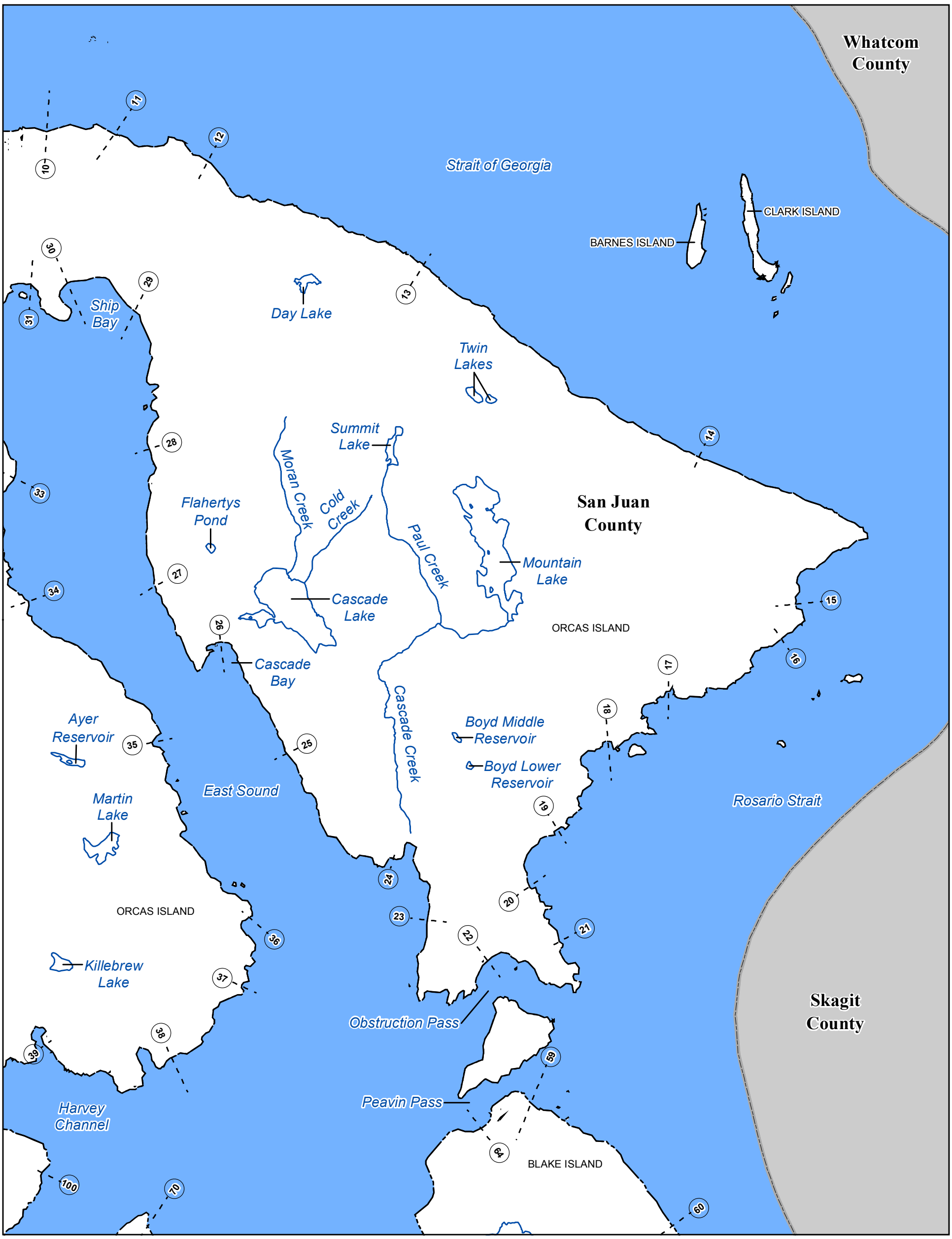
Transect Locator Map

PANELS WITH TRANSECTS:

0115, 0120, 0135, 0145, 0155, 0160, 0165, 0170, 0180, 0190, 0195, 0230, 0235, 0245, 0255, 0260, 0270, 0280, 0285, 0290, 0305, 0310, 0315, 0320, 0360, 0380, 0385, 0405, 0410, 0420, 0430, 0435, 0440, 0445

FEMA

Figure 9: Transect Location Map (continued)



1 inch equals 0.9 miles

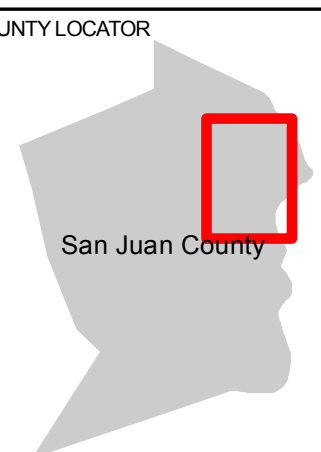
N

Miles

0 0.75 1.5

Map Projection:
Universal Transverse Mercator Zone 10 North
North American Datum 1983

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

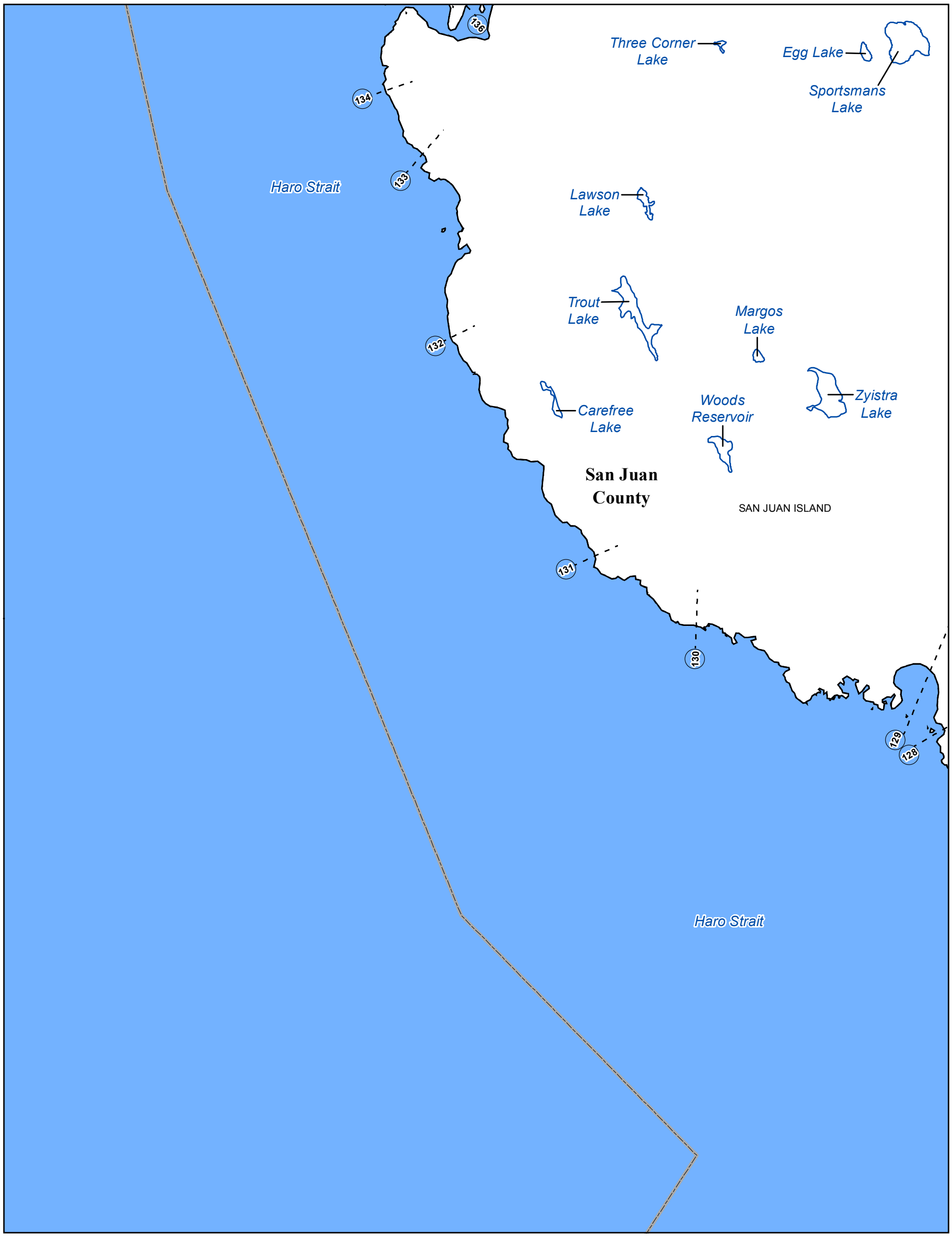
Transect Locator Map

PANELS WITH TRANSECTS:

0115, 0120, 0135, 0145, 0155, 0160, 0165, 0170, 0180, 0190, 0195, 0230, 0235, 0245, 0255, 0260, 0270, 0280, 0285, 0290, 0305, 0310, 0315, 0320, 0360, 0380, 0385, 0405, 0410, 0420, 0430, 0435, 0440, 0445

FEMA

Figure 9: Transect Location Map (continued)



1 inch equals 0.9 miles

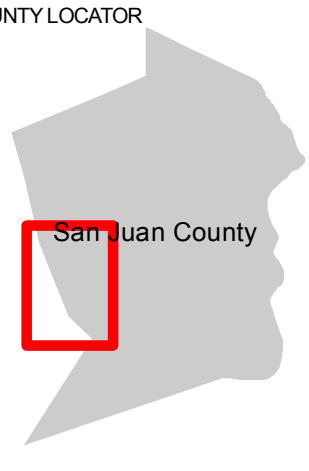
N

Miles

0 0.75 1.5

Map Projection:
Universal Transverse Mercator Zone 10 North
North American Datum 1983

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

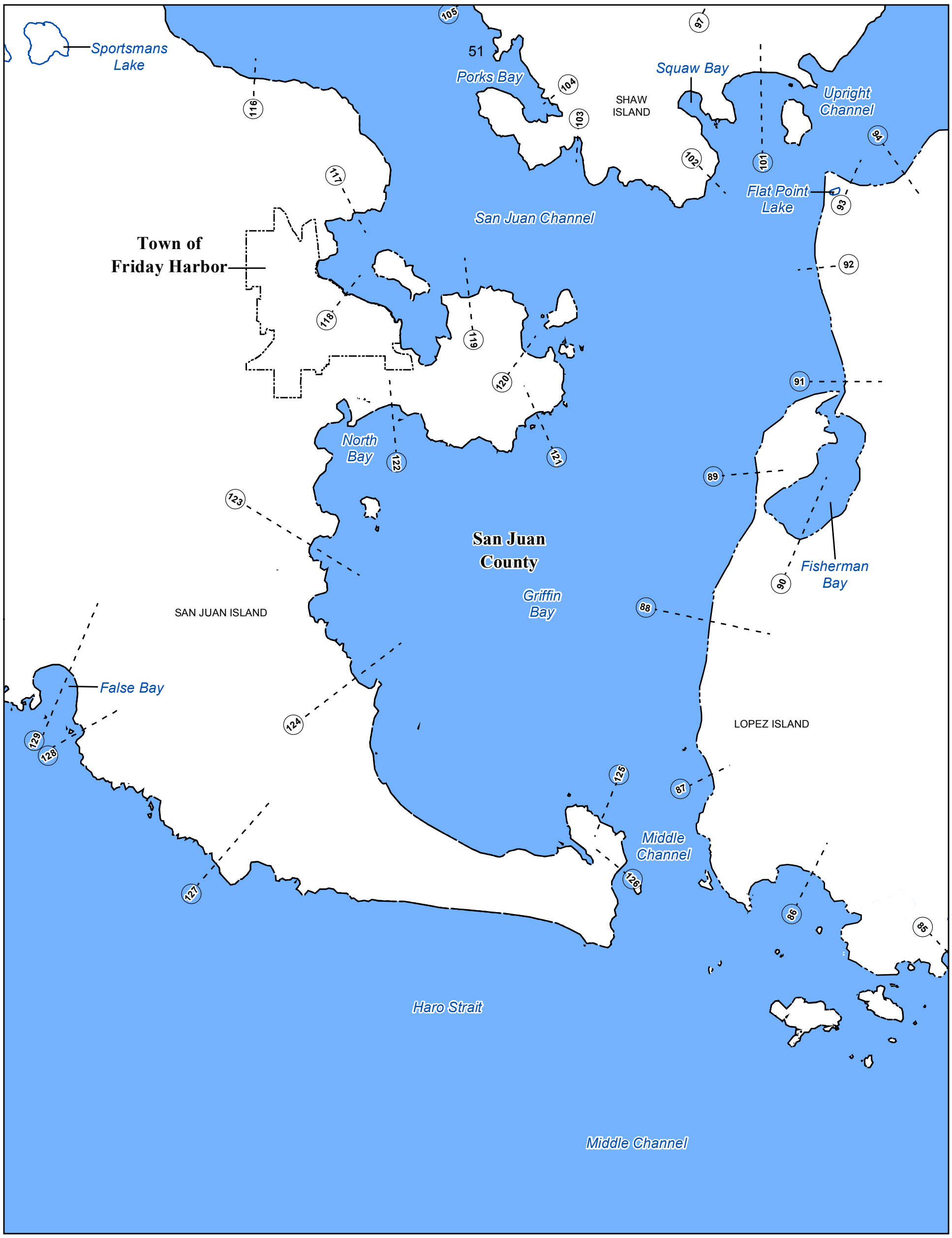
Transect Locator Map

PANELS WITH TRANSECTS:

0115, 0120, 0135, 0145, 0155, 0160, 0165, 0170, 0180, 0190, 0195, 0230, 0235, 0245, 0255, 0260, 0270, 0280, 0285, 0290, 0305, 0310, 0315, 0320, 0360, 0380, 0385, 0405, 0410, 0420, 0430, 0435, 0440, 0445

FEMA

Figure 9: Transect Location Map (continued)



1 inch equals 0.9 miles

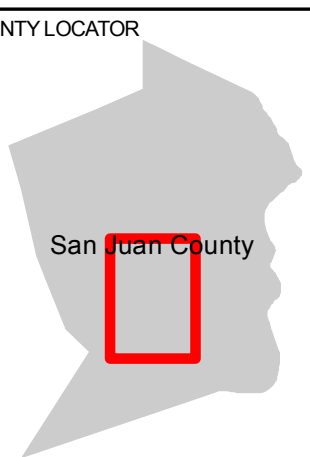
N

Miles

0 0.75 1.5

Map Projection:
Universal Transverse Mercator Zone 10 North
North American Datum 1983

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

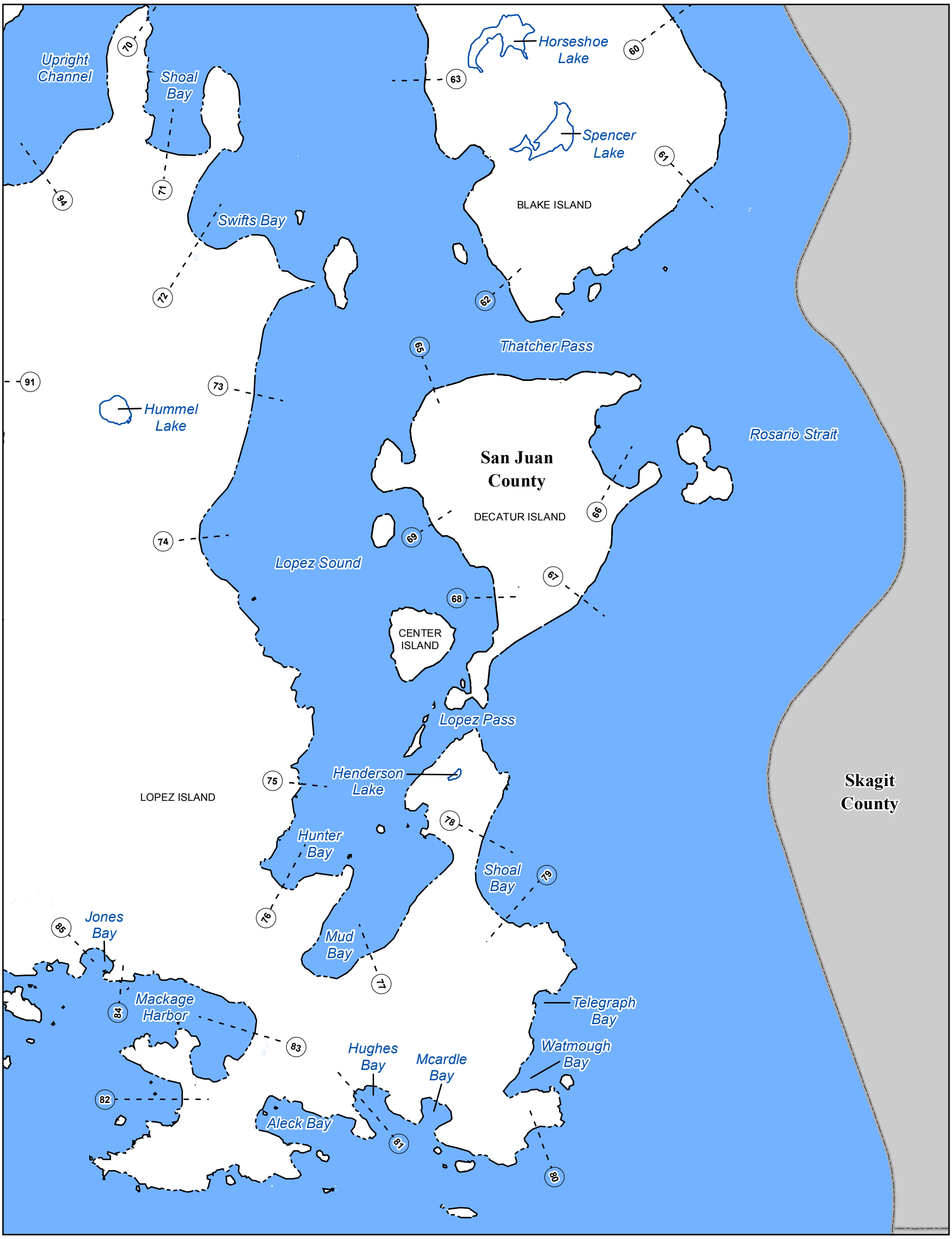
Transect Locator Map

PANELS WITH TRANSECTS:

0115, 0120, 0135, 0145, 0155, 0160, 0165, 0170, 0180, 0190, 0195, 0230, 0235, 0245, 0255, 0260, 0270, 0280, 0285, 0290, 0305, 0310, 0315, 0320, 0360, 0380, 0385, 0405, 0410, 0420, 0430, 0435, 0440, 0445

FEMA

Figure 9: Transect Location Map (continued)



1 inch equals 0.9 miles

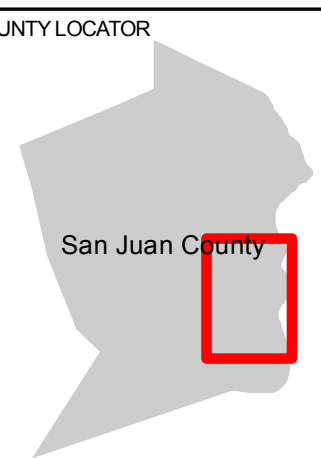
N

Miles

0 0.75 1.5

Map Projection:
Universal Transverse Mercator Zone 10 North
North American Datum 1983

COUNTY LOCATOR



NATIONAL FLOOD INSURANCE PROGRAM

Transect Locator Map

PANELS WITH TRANSECTS:

0115, 0120, 0135, 0145, 0155, 0160, 0165, 0170, 0180, 0190, 0195, 0230, 0235, 0245, 0255, 0260, 0270, 0280, 0285, 0290, 0305, 0310, 0315, 0320, 0360, 0380, 0385, 0405, 0410, 0420, 0430, 0435, 0440, 0445

FEMA

5.4 Alluvial Fan Analyses

This section is not applicable to this Flood Risk Project.

Table 18: Summary of Alluvial Fan Analyses
[Not Applicable to this Flood Risk Project]

Table 19: Results of Alluvial Fan Analyses
[Not Applicable to this Flood Risk Project]

SECTION 6.0 – MAPPING METHODS

6.1 Vertical and Horizontal Control

All FIS Reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS Reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the completion of the North American Vertical Datum of 1988 (NAVD88), many FIS Reports and FIRMs are now prepared using NAVD88 as the referenced vertical datum.

Flood elevations shown in this FIS Report and on the FIRMs are referenced to NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between NGVD29 and NAVD88 or other datum conversion, visit the National Geodetic Survey website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the archived project documentation associated with the FIS Report and the FIRMs for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description, and/or location information for benchmarks in the area, please contact information services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

The datum conversion locations and values that were calculated for San Juan County are provided in Table 20.

Table 20: Countywide Vertical Datum Conversion

Quadrangle Name	Quadrangle Corner	Latitude	Longitude	Conversion from NGVD29 to NAVD88 (feet)
Sucia Island	SE	48.750	-122.875	3.900
Stuart Island	SE	48.625	-123.125	3.820
Waldron Island	SE	48.625	-123.000	3.830
Eastsound	SE	48.625	-122.875	3.840
Mount Constitution	SE	48.625	-122.750	3.850
Roche Harbor	SE	48.500	-123.125	3.750
Shaw Island	SE	48.500	-122.875	3.780
Blakely Island	SE	48.500	-122.750	3.790
Friday Harbor	SE	48.500	-123.000	3.770
Waldron Island	NE	48.750	-123.000	3.880
Average Conversion from NGVD29 to NAVD88 = 3.821 (Feet)				

Table 21: Stream-by-Stream Vertical Datum Conversion

[Not Applicable to this Flood Risk Project]

6.2 Base Map

The FIRMs and FIS Report for this project have been produced in a digital format. The flood hazard information was converted to a Geographic Information System (GIS) format that meets FEMA's FIRM database specifications and geographic information standards. This information is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community. The FIRM Database includes most of the tabular information contained in the FIS Report in such a way that the data can be associated with pertinent spatial features. For example, the information contained in the Floodway Data table and Flood Profiles can be linked to the cross sections that are shown on the FIRMs. Additional information about the FIRM Database and its contents can be found in FEMA's *Guidelines and Standards for Mapping Partners*, Appendix L.

Base map information shown on the FIRM was derived from the sources described in Table 22.

Table 22: Base Map Sources

Data Type	Data Provider	Data Date	Data Scale	Data Description
Airports	U.S. Geological Survey	1981	1:24,000	Airports locations were provided by the USGS and verified online
Base Map Index	USDA-FSA Aerial Photography Field Office	2013	1:12,000	Digital Orthoimagery was provided as a countywide mosaic dataset
County Boundary	San Juan County GIS Department	2006	1:24,000	County boundary
Datum Conversion Points	National Oceanic and Atmospheric Administration	2003	1:24,000	Datum Conversion Points used to convert effective elevation data from NGVD29 to NAVD88.
FIRM Panel Layout	U.S. Geological Survey	2004	1:24,000	FIRM Panel Layout was derived from the USGS Quadrangle Index
HUC8 Subbasins	U.S. Geological Survey	1994	1:24,000	San Juan County Islands
Municipal Boundary	San Juan County GIS Department	2011	1:24,000	Boundaries for incorporated areas
Public Land Survey System	San Juan County GIS Department	2011	1:24,000	Townships, Ranges, and Sections
Roads	U.S. Census Bureau, 2013	2013	1:24,000	Roads centerlines
Submittal Info	Atkins	2013	1:24,000	Submittal Info was determined using the extents of the FIRM Panel Index
Water Areas	U.S. Geological Survey	2014	1:24,000	Lakes, Ponds, and other inland water areas
Water Lines	U.S. Geological Survey	2014	1:24,000	Streams, Rivers, and other inland water features

6.3 Floodplain and Floodway Delineation

The FIRM shows tints, screens, and symbols to indicate floodplains and floodways as well as the locations of selected cross sections used in the hydraulic analyses and floodway computations.

For riverine flooding sources, the mapped floodplain boundaries shown on the FIRM have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using the topographic elevation data described in Table 24. For each coastal flooding source studied as part of this FIS Report, the mapped floodplain boundaries on the FIRM have been delineated using the flood and wave elevations determined at each transect; between transects, boundaries were delineated using land use and land cover data, the topographic elevation data described in Table 23, and knowledge of coastal flood processes. In ponding areas, flood elevations were determined at each junction of the model; between junctions, boundaries were interpolated using the topographic elevation data described in Table 24.

In cases where the 1% and 0.2% annual chance floodplain boundaries are close together, only the 1% annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

The floodway widths presented in this FIS Report and on the FIRM were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. Table 2 indicates the flooding sources for which floodways have been determined. The results of the floodway computations for those flooding sources have been tabulated for selected cross sections and are shown in Table 24, "Floodway Data."

Table 23: Summary of Topographic Elevation Data used in Mapping

Community	Flooding Source	Source for Topographic Elevation Data					
		Description	Scale	Contour Interval	$RMSE_z$	$Accuracy_z$	Citation
Town of Friday Harbor	Salish Sea	Light Detection and Ranging data (LiDAR)		1 ft			Pictometry International Corp; 2013 San Juan County Bare Earth , 2013
San Juan County	Salish Sea	Light Detection and Ranging data (LiDAR)		1 ft			Pictometry International Corp, 2013; San Juan County Bare Earth , 2013

BFEs shown at cross sections on the FIRM represent the 1% annual chance water surface elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding,

and other areas with static base flood elevations.

Table 24: Floodway Data

[Not Applicable to this Flood Risk Project]

Table 25: Flood Hazard and Non-Encroachment Data for Selected Streams [Not Applicable to this Flood Risk Project]

6.4 Coastal Flood Hazard Mapping

Flood insurance zones and BFEs including the wave effects were identified on each transect based on the results from the onshore wave hazard analyses. Between transects, elevations were interpolated using topographic maps, land-use and land-cover data, and knowledge of coastal flood processes to determine the aerial extent of flooding. Sources for topographic data are shown in Table 23.

Zone VE is subdivided into elevation zones and BFEs are provided on the FIRM.

The limit of Zone VE shown on the FIRM is defined as the farthest inland extent of any of these criteria (determined for the 1% annual chance flood condition):

- The *primary frontal dune zone* is defined in 44 CFR Section 59.1 of the NFIP regulations. The primary frontal dune represents a continuous or nearly continuous mound or ridge of sand with relatively steep seaward and landward slopes that occur immediately landward and adjacent to the beach. The primary frontal dune zone is subject to erosion and overtopping from high tides and waves during major coastal storms. The inland limit of the primary frontal dune zone occurs at the point where there is a distinct change from a relatively steep slope to a relatively mild slope.

- The *wave runup zone* occurs where the (eroded) ground profile is 3.0 feet or more below the 2-percent wave runup elevation.

- The *wave overtopping splash zone* is the area landward of the crest of an overtopped barrier, in cases where the potential 2-percent wave runup exceeds the barrier crest elevation by 3.0 feet or more.

- The *breaking wave height zone* occurs where 3-foot or greater wave heights could occur (this is the area where the wave crest profile is 2.1 feet or more above the total stillwater elevation).

- The *high-velocity flow zone* is landward of the overtopping splash zone (or area on a sloping beach or other shore type), where the product of depth of flow times the flow velocity squared (hv^2) is greater than or equal to 200 ft^3/sec^2. This zone may only be used on the Pacific Coast.

The SFHA boundary indicates the limit of SFHAs shown on the FIRM as either “V” zones or “A” zones.

Table 26 indicates the coastal analyses used for floodplain mapping and the criteria used to determine the inland limit of the open-coast Zone VE and the SFHA boundary at each transect.

Table 26: Summary of Coastal Transect Mapping Considerations

Coastal Transect Number	Wave Runup Analysis	Wave Height Analysis	Zone VE Limit	SFHA Boundary
	Zone Designation and BFE (ft NAVD88)	Zone Designation and BFE (ft NAVD88)		
SJ-001	AE 13	AE 12	N/A	
SJ-002	VE 13 AE 13	N/A	Runup	Runup
SJ-003	VE 17	N/A	Runup	Runup
SJ-004	VE 16	N/A	Runup	Runup
SJ-005	VE 16	N/A	Runup	Runup
SJ-006	VE 14 AE 14	AE 12	Runup	Runup, SWEL
SJ-007	AE 13	VE14 AE 12-13	Wave Height	Wave Height, SWEL
SJ-008	VE 15	N/A	Runup	Runup
SJ-009	VE 13 AE 13	AE 12-13	Runup	Runup, SWEL
SJ-010	VE 15	N/A	Runup	Runup
SJ-011	VE 16 AE 16	N/A	Runup	Runup
SJ-012	VE 16	N/A	Runup	Runup
SJ-013	VE 19	N/A	Runup	Runup
SJ-014	VE 18	N/A	Runup	Runup
SJ-015	VE 16	N/A	Runup	Runup
SJ-016	VE 21	N/A	Runup	Runup
SJ-017	VE 21	N/A	Runup	Runup
SJ-018	VE 19 AE 19	N/A	Runup	Runup
SJ-019	VE 18	N/A	Runup	Runup
SJ-020	VE 18 AE 18	N/A	Runup	Runup
SJ-021	VE 20	N/A	Runup	Runup
SJ-022	AE 13	N/A	N/A	Runup
SJ-023	VE 16 AE 16	N/A	Runup	Runup
SJ-024	VE 16 AE 16	AE 12	Runup	Runup, SWEL
SJ-025	VE 17	N/A	Runup	Runup
SJ-026	VE 15 AE 15	N/A	Runup	Runup
SJ-027	VE 17	N/A	Runup	Runup
SJ-028	VE 15	N/A	Runup	Runup
SJ-029	VE 15	N/A	Runup	Runup
SJ-030	AE 12	AE 12	N/A	Runup, SWEL

Table 26: Summary of Coastal Transect Mapping Considerations (continued)

SJ-031	VE 16	N/A	Runup	Runup
SJ-032	VE 16 AE 16	N/A	Runup	Runup
SJ-033	VE 17	N/A	Runup	Runup
SJ-034	VE 16	N/A	Runup	Runup
SJ-035	VE 16	N/A	Runup	Runup
SJ-036	VE 17	N/A	Runup	Runup
SJ-037	VE 16	N/A	Runup	Runup
SJ-038	VE 19	N/A	Runup	Runup
SJ-039	VE 16 AE 16	N/A	Runup	Runup
SJ-040	VE 17	N/A	Runup	Runup
SJ-041	VE 15 AE 15	AE 12	Runup	Runup, SWEL
SJ-042	AE 14	N/A	N/A	Runup
SJ-043	VE 15 AE 15	AE 12	Runup	Runup, SWEL
SJ-044	VE 15 AE 15	N/A	Runup	Runup
SJ-045	VE 15	N/A	Runup	Runup
SJ-046	VE 15 AE 15	N/A	Runup	Runup
SJ-047	VE 17 AE 17	AE 12	Runup	Runup, SWEL
SJ-048	VE 15 AE 15	N/A	Runup	Runup
SJ-049	AE 13	N/A	N/A	Runup
SJ-050	AE 14	N/A	N/A	Runup
SJ-051	VE 15 AE 15	AE 12	Runup	Runup, SWEL
SJ-052	VE 15	N/A	Runup	Runup
SJ-053	VE 17 AE 17	N/A	Runup	Runup
SJ-054	VE 16	N/A	Runup	Runup
SJ-055	VE 16 AE 16	N/A	Runup	Runup
SJ-056	VE 15 AE 15	N/A	Runup	Runup
SJ-057	VE 16	N/A	Runup	Runup
SJ-058	VE 16 AE 16	N/A	Runup	Runup
SJ-059	VE 14	AE 12	Runup	Runup, SWEL
SJ-060	VE 19	N/A	Runup	Runup
SJ-061	VE 21	N/A	Runup	Runup
SJ-062	AE 14	N/A	N/A	Runup
SJ-063	VE 16	N/A	Runup	Runup
SJ-064	AE 12	AE 12	N/A	Runup, SWEL

Table 26: Summary of Coastal Transect Mapping Considerations (continued)

SJ-065	VE 15	N/A	Runup	Runup
SJ-066	AE 12	N/A	N/A	Runup
SJ-067	VE 20	N/A	Runup	Runup
SJ-068	AE 12	AE 12-13	N/A	Wave Height, SWEL
SJ-069	VE 15 AE 15	N/A	Runup	Runup
SJ-070	VE 14 AE 14	N/A	Runup	Runup
SJ-071	AE 14	N/A	N/A	Runup
SJ-072	AE 12	AE 12	N/A	Runup, SWEL
SJ-073	VE 17 AE 17	N/A	Runup	Runup
SJ-074	VE 17	N/A	Runup	Runup
SJ-075	AE 14	N/A	N/A	Runup
SJ-076	AE 13	AE 12-13	N/A	Wave Height, SWEL
SJ-077	AE 14	N/A	N/A	Runup
SJ-078	VE 13 AE 13	N/A	Runup	Runup
SJ-079	VE 19	N/A	Runup	Runup
SJ-080	VE 16 AE 16	AE 11	Runup	Runup, SWEL
SJ-081	VE 15 AE 15	AE 11	Runup	Runup, SWEL
SJ-082	VE 14 AE 14	N/A	Runup	Runup
SJ-083	AE 12	AE 11	N/A	Runup, SWEL
SJ-084	VE 18 AE 18	N/A	Runup	Runup
SJ-085	VE 16 AE 16	AE 11	Runup	Runup, SWEL
SJ-086	VE 16 AE 16	N/A	Runup	Runup
SJ-087	VE 17	N/A	Runup	Runup
SJ-088	AE 13	N/A	N/A	Runup
SJ-089	AE 14	VE 14 AE 12-13	Wave Height	Wave Height, SWEL
SJ-090	AE 13	N/A	N/A	Runup
SJ-091	VE 13 AE 13	N/A	Runup	Runup
SJ-092	VE 14	N/A	Runup	Runup
SJ-093	AE 12	AE 12-13	N/A	Wave Height, SWEL
SJ-094	AE 14	N/A	N/A	Runup
SJ-095	AE 13	N/A	N/A	Runup

Table 26: Summary of Coastal Transect Mapping Considerations (continued)

SJ-096	AE 15	N/A	Runup	Runup
SJ-097	AE 14	N/A	N/A	Runup
SJ-098	AE 13	N/A	N/A	Runup
SJ-099	AE 13	N/A	N/A	Runup
SJ-100	VE 16	N/A	Runup	Runup
SJ-101	VE 13 AE 13	N/A	Runup	Runup
SJ-102	VE 17 AE 17	N/A	Runup	Runup
SJ-103	VE 16 AE 16	N/A	Runup	Runup
SJ-104	AE 13	N/A	N/A	Runup
SJ-105	VE 15	N/A	Runup	Runup
SJ-106	VE 15 AE 15	N/A	Runup	Runup
SJ-107	AE 12	AE 12-13	N/A	Wave Height, SWEL
SJ-108	AE 13	N/A	N/A	Runup
SJ-109	VE 14	N/A	Runup	Runup
SJ-110	VE 13 AE 13	N/A	Runup	Runup
SJ-111	VE 16	N/A	Runup	Runup
SJ-112	VE 16 AE 16	N/A	Runup	Runup
SJ-113	VE 15 AE 15	N/A	Runup	Runup
SJ-114	VE 16	N/A	Runup	Runup
SJ-115	VE 18	N/A	Runup	Runup
SJ-116	VE 15	N/A	Runup	Runup
SJ-117	VE 16	N/A	Runup	Runup
SJ-118	AE 13	N/A	N/A	Runup
SJ-119	AE 14	N/A	N/A	Runup
SJ-120	AE 13	N/A	N/A	Runup
SJ-121	VE 20	N/A	Runup	Runup
SJ-122	VE 16 AE 16	AE 12	Runup	Runup, SWEL
SJ-123	VE 16 AE 16	N/A	Runup	Runup
SJ-124	VE 17	N/A	Runup	Runup
SJ-125	VE 17	N/A	Runup	Runup
SJ-126	VE 13 AE 13	N/A	Runup	Runup
SJ-127	VE 17	N/A	Runup	Runup
SJ-128	VE 17	N/A	Runup	Runup
SJ-129	VE 17 AE 17	AE 11	Runup	Runup, SWEL
SJ-130	VE 21	N/A	Runup	Runup

Table 26: Summary of Coastal Transect Mapping Considerations (continued)

SJ-131	VE 21	N/A	Runup	Runup
SJ-132	VE 25	N/A	Runup	Runup
SJ-133	VE 19 AE 19	N/A	Runup	Runup
SJ-134	VE 16	N/A	Runup	Runup
SJ-135	VE 16 AE 16	N/A	Runup	Runup
SJ-136	AE 12	N/A	N/A	Runup
SJ-137	AE 13	N/A	N/A	Runup
SJ-138	AE 13	N/A	N/A	Runup
SJ-139	AE 14	N/A	N/A	Runup
SJ-140	VE 15 AE 15	N/A	Runup	Runup
SJ-141	VE 19	N/A	Runup	Runup
SJ-142	VE 15 AE 15	N/A	Runup	Runup
SJ-143	AE 13	N/A	N/A	Runup
SJ-144	AE 13	N/A	N/A	Runup
SJ-145	AE 12	N/A	N/A	Runup
SJ-146	AE 13	N/A	N/A	Runup
SJ-147	AE 12	AE 12-14	N/A	Wave Height, SWEL
SJ-148	VE 15 AE 15	N/A	Runup	Runup
SJ-149	VE 17 AE 17	N/A	Runup	Runup
SJ-150	VE 19	N/A	Runup	Runup

6.5 FIRM Revisions

This FIS Report and the FIRM are based on the most up-to-date information available to FEMA at the time of its publication; however, flood hazard conditions change over time. Communities or private parties may request flood map revisions at any time. Certain types of requests require submission of supporting data. FEMA may also initiate a revision. Revisions to FIS projects may take several forms, including Letters of Map Amendment (LOMAs), Letters of Map Revision Based on Fill (LOMR-Fs), Letters of Map Revision (LOMRs) (referred to collectively as Letters of Map Change (LOMCs)), Physical Map Revisions (PMRs), and FEMA-contracted restudies. These types of revisions are further described below. Some of these types of revisions do not result in the republishing of the FIS Report. To assure that any user is aware of all revisions, it is advisable to contact the community repository of flood-hazard data (shown in Table 31, "Map Repositories").

6.5.1 Letters of Map Amendment

A LOMA is an official revision by letter to an effective NFIP map. A LOMA results from an administrative process that involves the review of scientific or technical data submitted by the owner or lessee of property who believes the property has incorrectly been included in a designated SFHA. A LOMA amends the currently effective FEMA map and establishes that a specific property is not located in a SFHA. A LOMA cannot be issued for properties located on the PFD (primary frontal dune).

To obtain an application for a LOMA, visit http://www.fema.gov and download the form "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill". Visit the "Flood Map-Related Fees" section to determine the cost, if any, of applying for a LOMA.

FEMA offers a tutorial on how to apply for a LOMA. The LOMA Tutorial Series can be accessed at http://www.fema.gov/plan/prevent/fhm/ot_lmreq.shtm.

For more information about how to apply for a LOMA, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627).

6.5.2 Letters of Map Revision Based on Fill

A LOMR-F is an official revision by letter to an effective NFIP map. A LOMR-F states FEMA's determination concerning whether a structure or parcel has been elevated on fill above the base flood elevation and is, therefore, excluded from the SFHA.

Information about obtaining an application for a LOMR-F can be obtained in the same manner as that for a LOMA, by visiting http://www.fema.gov for the "MT-1 Application Forms and Instructions for Conditional and Final Letters of Map Amendment and Letters of Map Revision Based on Fill" or by calling the FEMA Map Information eXchange, toll free, at 1-877-FEMA MAP (1-877-336-2627). Fees for applying for a LOMR-F, if any, are listed in the "Flood Map-Related Fees" section.

A tutorial for LOMR-F is available at http://www.fema.gov/plan/prevent/fhm/ot_lmreq.shtm.

6.5.3 Letters of Map Revision

A LOMR is an official revision to the currently effective FEMA map. It is used to change flood zones, floodplain and floodway delineations, flood elevations and planimetric features. All

requests for LOMRs should be made to FEMA through the chief executive officer of the community, since it is the community that must adopt any changes and revisions to the map. If the request for a LOMR is not submitted through the chief executive officer of the community, evidence must be submitted that the community has been notified of the request.

To obtain an application for a LOMR, visit http://www.fema.gov and download the form "MT-2 Application Forms and Instructions for Conditional Letters of Map Revision and Letters of Map Revision". Visit the "Flood Map-Related Fees" section to determine the cost of applying for a LOMR. For more information about how to apply for a LOMR, call the FEMA Map Information eXchange; toll free, at 1-877-FEMA MAP (1-877-336-2627) to speak to a Map Specialist.

Previously issued mappable LOMCs (including LOMRs) that have been incorporated into the San Juan County FIRM are listed in Table 27.

Table 27: Incorporated Letters of Map Change

[Not Applicable to this Flood Risk Project]

6.5.4 Physical Map Revisions

PMRs are an official republication of a community's NFIP map to effect changes to base flood elevations, floodplain boundary delineations, regulatory floodways and planimetric features. These changes typically occur as a result of structural works or improvements, annexations resulting in additional flood hazard areas or correction to base flood elevations or SFHAs.

The community's chief executive officer must submit scientific and technical data to FEMA to support the request for a PMR. The data will be analyzed and the map will be revised if warranted. The community is provided with copies of the revised information and is afforded a review period. When the base flood elevations are changed, a 90-day appeal period is provided. A 6-month adoption period for formal approval of the revised map(s) is also provided.

For more information about the PMR process, please visit http://www.fema.gov and visit the "Flood Map Revision Processes" section.

6.5.5 Contracted Restudies

The NFIP provides for a periodic review and restudy of flood hazards within a given community. FEMA accomplishes this through a national watershed-based mapping needs assessment strategy, known as the Coordinated Needs Management Strategy (CNMS). The CNMS is used by FEMA to assign priorities and allocate funding for new flood hazard analyses used to update the FIS Report and FIRM. The goal of CNMS is to define the validity of the engineering study data within a mapped inventory. The CNMS is used to track the assessment process, document engineering gaps and their resolution, and aid in prioritization for using flood risk as a key factor for areas identified for flood map updates. Visit www.fema.gov to learn more about the CNMS or contact the FEMA Regional Office listed in Section 8 of this FIS Report.

6.5.6 Community Map History

The current FIRM presents flooding information for the entire geographic area of San Juan County. Previously, separate FIRMs, Flood Hazard Boundary Maps (FHBMs) and/or Flood Boundary and Floodway Maps (FBFMs) may have been prepared for the incorporated communities and the unincorporated areas in the county that had identified SFHAs. Current and historical data relating to the maps prepared for the project area are presented in Table 29,

"Community Map History." A description of each of the column headings and the source of the date is also listed below.

- *Community Name* includes communities falling within the geographic area shown on the FIRM, including those that fall on the boundary line, nonparticipating communities, and communities with maps that have been rescinded. Communities with No Special Flood Hazards are indicated by a footnote. If all maps (FHBM, FBFM, and FIRM) were rescinded for a community, it is not listed in this table unless SFHAs have been identified in this community.

- *Initial Identification Date (First NFIP Map Published)* is the date of the first NFIP map that identified flood hazards in the community. If the FHBM has been converted to a FIRM, the initial FHBM date is shown. If the community has never been mapped, the upcoming effective date or "pending" (for Preliminary FIS Reports) is shown. If the community is listed in Table 28 but not identified on the map, the community is treated as if it were unmapped.

- *Initial FHBM Effective Date* is the effective date of the first Flood Hazard Boundary Map (FHBM). This date may be the same date as the Initial NFIP Map Date.

- *FHBM Revision Date(s)* is the date(s) that the FHBM was revised, if applicable.

- *Initial FIRM Effective Date* is the date of the first effective FIRM for the community. This is the first effective date that is shown on the FIRM panel.

- *FIRM Revision Date(s)* is the date(s) the FIRM was revised, if applicable. This is the revised date that is shown on the FIRM panel, if applicable. As countywide studies are completed or revised, each community listed should have its FIRM dates updated accordingly to reflect the date of the countywide study. Once the FIRMs exist in countywide format, as Physical Map Revisions (PMR) of FIRM panels within the county are completed, the FIRM Revision Dates in the table for each community affected by the PMR are updated with the date of the PMR, even if the PMR did not revise all the panels within that community.

The initial effective date for the San Juan County FIRMs in countywide format was 03/01/1991.

Table 28: Community Map History

Community Name	Initial Identification Date (First NFIP Map Published)	Initial FHBM Effective Date	FHBM Revision Date(s)	Initial FIRM Effective Date	FIRM Revision Date(s)
Town of Friday Harbor	11/29/1974	11/29/1974	12/5/1975	TBD	TBD
San Juan County	6/7/1977	6/7/1977	TBD	03/01/1991	TBD

SECTION 7.0 – CONTRACTED STUDIES AND COMMUNITY COORDINATION

7.1 Contracted Studies

Table 29 provides a summary of the contracted studies, by flooding source, that are included in this FIS Report.

Table 29: Summary of Contracted Studies Included in this FIS Report

Flooding Source	FIS Report Dated	Contractor	Number	Work Completed Date	Affected Communities
Pacific Ocean (Salish Sea)	TBD	STARR II	HSFE60-15-D-0005	TBD	Town of Friday Harbor, San Juan County (Unincorporated Areas)

7.2 Community Meetings

The dates of the community meetings held for this FIS project and any previous FIS projects are shown in Table 30. These meetings may have previously been referred to by a variety of names (Community Coordination Officer (CCO), Scoping, Discovery, etc.), but all meetings represent opportunities for FEMA, community officials, study contractors, and other invited guests to discuss the planning for and results of the project.

Table 30: Community Meetings

Community	FIS Report Dated	Date of Meeting	Meeting Type	Attended By
San Juan County	N/A	04/06/2011	Discovery	FEMA, the community, and the study contractor
San Juan County	N/A	12/16/2015	Flood Study Review	FEMA, the community, the study contractor, and the DNR

SECTION 8.0 – ADDITIONAL INFORMATION

Information concerning the pertinent data used in the preparation of this FIS Report can be obtained by submitting an order with any required payment to the FEMA Engineering Library. For more information on this process, see http://www.fema.gov.

The additional data that was used for this project includes the FIRM panels that were previously prepared for San Juan County, (FEMA 1977, converted by letter in 1991).

Table 31 is a list of the locations where FIRMs for San Juan County can be viewed. Please note that the maps at these locations are for reference only and are not for distribution. Also, please note that only the maps for the community listed in the table are available at that particular

repository. A user may need to visit another repository to view maps from an adjacent community.

Table 31: Map Repositories

Community	Address	City	State	Zip Code
Friday Harbor, Town of	135 Rhone Street	Friday Harbor	WA	98250
San Juan County, Unincorporated Areas	135 Rhone Street	Friday Harbor	WA	98250

The National Flood Hazard Layer (NFHL) dataset is a compilation of effective FIRM databases and LOMCs. Together they create a GIS data layer for a State or Territory. The NFHL is updated as studies become effective and extracts are made available to the public monthly. NFHL data can be viewed or ordered from the website shown in Table 32.

Table 32 contains useful contact information regarding the FIS Report, the FIRM, and other relevant flood hazard and GIS data. In addition, information about the state NFIP Coordinator and GIS Coordinator is shown in this table. At the request of FEMA, each Governor has designated an agency of State or territorial government to coordinate that State's or territory's NFIP activities. These agencies often assist communities in developing and adopting necessary floodplain management measures. State GIS Coordinators are knowledgeable about the availability and location of state and local GIS data in their state.

Table 32: Additional Information

FEMA and the NFIP	
FEMA and FEMA Engineering Library website	http://www.fema.gov
NFIP website	http://www.fema.gov/business/nfip
NFHL Dataset	http://msc.fema.gov
FEMA Region X	Federal Regional Center, 130 228th Street SW. Bothell, WA 98021-9796 (425) 487-4657
Other Federal Agencies	
USGS website	http://www.usgs.gov
Hydraulic Engineering Center website	http://www.hec.usace.army.mil
State Agencies and Organizations	
State NFIP Coordinator	State National Floodplain Insurance Program (NFIP) Coordinator Daniel Sokol Washington Department of Ecology P.O. Box 47775 Olympia, WA 98504-7775 (360) 407-7253 FAX (360) 407-2305 dsok461@ecy.wa.gov

Table 32: Additional Information *(continued)*

State GIS Coordinator	State GIS Coordinator Joy Paulus Department of Information Services 1110 Jefferson St. SE Olympia, WA 98504-2445 Phone: 360.902.3447 Cell: 360.628.2621 joyp@dis.wa.gov

SECTION 9.0 – BIBLIOGRAPHY AND REFERENCES

Table 33 includes sources used in the preparation of and cited in this FIS Report as well as additional studies that have been conducted in the study area.

Table 33: Bibliography and References

Citation in this FIS	Publisher/ Issuer	*Publication Title,* "Article," Volume, Number, etc.	Author/Editor	Place of Publication	Publication Date/ Date of Issuance	Link
	WHAFIS 4.0	Supplementary WHAFIS Documentation	David Divoky		2007	
	Federal Emergency Management Agency	Final Draft Guidelines for Coastal Flood Hazard Analysis and Mapping for the Pacific Coast of the United States.			2005	
	Federal Emergency Management Agency	Guidance for Coastal Flood Hazard Analyses and Mapping in Sheltered Waters, Technical Memorandum			2008	
	Federal Emergency Management Agency	Wave Height Analysis for Flood Insurance Studies, Technical Documentation for WAHFIS Program Version 3.0. Technical Memorandum			1988	
	U.S. Army Corps of Engineers (USACE)	Coastal Engineering Manual.			2003	
	U.S. Army Corps of Engineers (USACE)	Shore Protection Manual.			1984	

Table 33: Bibliography and References (continued)

	Technical Advisory Committee for Water Retaining Structures (TAW)	Wave Run-up and Wave Overtopping at Dikes, Technical Report	J.W. Meer	Delft, The Netherlands	2002	