



Safer Seward Highway Project
Seward Highway MP 98.5 to 118,
Bird Flats to Rabbit Creek
Project No.: Z566310000/0A31034

Environmental Assessment

Appendix J: Location Hydraulic Study

DRAFT

December 2025

Prepared for:

Alaska Department of Transportation and Public Facilities

Prepared by:

HDR, Inc.
582 E. 36th Avenue, Suite 500
Anchorage, AK 99503-4169
907-644-2000 Phone | 907-644-2022 Fax

This page is intentionally left blank.



Safer Seward Highway Project
Seward Highway MP 98.5 to 118,
Bird Flats to Rabbit Creek
Project No.: Z566310000/0A31034

Location Hydraulic Study

December 2025

Prepared for:

Alaska Department of Transportation and Public Facilities

Prepared by:

HDR, Inc.
582 E. 36th Avenue, Suite 500
Anchorage, AK 99503-4169
907-644-2000 Phone | 907-644-2022 Fax

This page is intentionally left blank.

Table of Contents

1 Introduction1

 1.1 Project Description1

 1.2 Definitions1

2 Regulatory Setting.....2

 2.1 Federal Regulations2

 2.2 Municipality of Anchorage Floodplain Regulations.....2

 2.3 Effective and Preliminary Floodplain Mapping3

3 Floodplain Encroachment.....5

 3.1 Evaluation Method5

 3.2 No Build Alternative6

 3.3 C7T-V1.5 Proposed Action6

 3.3.1 Turnagain Arm Coastal Floodplain6

 3.3.2 Indian Creek Bridge Floodplain.....6

 3.3.3 Bird Creek Bridge Floodplain.....7

 3.3.4 Large Diameter Culvert Floodplains.....8

4 Risks Associated with Implementation11

5 Floodplain Impact Minimization and Mitigation11

6 Conclusions12

7 References12

List of Figures

Figure 1. Overview of the Project Area with FEMA Flood Hazard Areas4

Figure 2. Indian Creek Floodplain Impacts7

Figure 3. Bird Creek Floodplain Impacts8

Figure 4. Potter Creek Impacts and Proposed Realignment10

Figure 5. Birdhouse Creek Impacts and Proposed Realignment.....11

List of Tables

Table 1. FEMA Flood Hazard Zone Codes in the project area and their definitions.....3

Table 2. Stream Crossings and their Flood Zone.....4

Table 3. Impacted Coastal Areas and Flood Zone.....5

Table 4. Project Stream and Floodplain Mapping Method.....5

Table 5. Project Encroachment for Existing Culverts with Proposed Sizes9

List of Appendices

Appendix A. Seward Highway Proposed Action Impacts to Flood Hazard Zones A-1

Appendix B. Safer Seward Hwy Preliminary H&H For Large Pipes – CSRA Tech MemoB-1

Appendix C. LHS Support Tech Memo – 100-year Floodplain MappingC-1

Abbreviations

ADF&G	Alaska Department of Fish and Game
DOT&PF	Alaska Department of Transportation and Public Facilities
AEP	annual exceedance probability
ARRC	Alaska Railroad Corporation
AWC	anadromous waters catalogue
CFR	Code of Federal Regulation
FEMA	Federal Emergency Management Administration
FHP	Flood Hazard Permit
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
HTL	High Tide Line
LHS	Location hydraulics study
MOA	Municipality of Anchorage
MBI	Michael Baker International
MP	Mileposts
NFIP	National Flood Insurance Program
NHS	National Highway System
SFHA	Special Flood Hazard Areas

1 Introduction

This Location Hydraulic Study (LHS) was prepared to determine whether and where the proposed Seward Highway Mileposts (MP) 98.5–118 Project encroaches onto any base (100-year) floodplains and associated floodways.

1.1 Project Description

Originally completed in 1951, the Seward Highway extends north from Seward, Alaska, approximately 130 miles to Anchorage, Alaska. It is the only road corridor between Anchorage and communities to the south along Turnagain Arm, the Kenai Peninsula, and the Alaska Marine Highway System terminals at Whittier, Seward, and Homer. The highway is part of the National Highway System (NHS), designated partially as Interstate A-3, and provides overland travel between local cities, major cities, ports, and airports. The Seward Highway supports commercial, tourist, industrial, and residential traffic, and typical vehicle types range from passenger cars to recreational vehicles to industrial heavy trucks.

The highway segment within the project area is tightly constrained between the tidal waters of the Turnagain Arm, the Alaska Railroad Corporation (ARRC) tracks, and the steep slopes of the Chugach Mountains. At the north terminus, the highway and rail embankments traverse in parallel through the southern end of the Anchorage Coastal Wildlife Refuge, between the mudflats and the constructed wetlands that form Potter Marsh Recreation Area. From MP 115 to the southern project terminus at MP 98.5, the highway and rail corridors are within the boundaries of Chugach State Park, with a few private inholdings, Municipality of Anchorage (MOA), and State-owned lands near the communities of Rainbow (MP 108.5), Indian (MP 105) and Bird (MP 100).

1.2 Definitions

Definitions from the Federal Emergency Management Administration (FEMA), the Alaska Department of Transportation and Public Facilities (DOT&PF), the Code of Federal Regulation (CFR), and MOA Title 21 Code of Ordinances (MOA code) are summarized below to promote consistent terminology throughout the rest of this report.

Base Flood: The area inundated by a flood or tide having a 1 percent (%) annual exceedance probability (AEP), also known as the “100-year flood.” A base flood has a 1% chance of occurring any year.

Flood Zones or Flood Hazard Zones or Flood Hazard Areas: The areas included on *Flood Insurance Rate Maps* and managed as part of the National Flood Insurance Program (NFIP). MOA code includes *stream setbacks* as part of the flood hazard areas within the municipality (MOA Sec. 21.07.20.E.4.b.iv). Flood Zones comprise *Special Flood Hazard Areas* and non-special flood hazard areas.

Flood Insurance Rate Map (FIRM): The official map of a community on which FEMA has delineated the *flood zone* designations, *base flood* elevations, *floodplain* boundaries, and roads and landmarks applicable to the community. The FIRM is the official source for determining flood risk within a community. Currently, the FEMA 2009 Revisions are currently designated as the effective regulatory floodplain.

Floodplain: A floodplain is the area adjacent to a river channel that is inundated with water during floods. Floodplains store, convey, and slow floodwaters. When floodplains are constricted

by structures or fill, their capacity to temper floods is reduced, and flood elevations may rise. All rivers have floodplains, but not all floodplains are legally regulated or mapped by FEMA.

Mapped Floodplain: A regulatory or managed floodplain. FEMA has mapped floodplains on portions of Indian Creek, Bird Creek, Rabbit Creek, Potter Marsh, and Turnagain Arm. Development on a mapped floodplain may be subject to MOA code (Municipal Code, Section 21.07.020) and federal regulatory requirements; development on a floodplain that has not been mapped is not subject to these ordinances and requirements. Mapped floodplains are also sometimes called “Flood Zones” or “Flood Hazard Areas.” FEMA uses a variety of designations to define certain characteristics of floodplains.

Floodway: A regulatory floodway may be established as a portion of the mapped floodplain. A floodway is the river channel and portion of the floodplain that conveys the majority of floodwaters and highest velocities; it is a regulatory tool that helps the community to determine whether a proposed development will increase flood hazards. It is reserved from encroachments to discharge the *base flood* without increasing the water surface elevation (MOA Sec. 21.07.020.E.5.b.i). Encroachments on floodways are not permitted unless the developer can certify that they will not raise the *base flood* elevations by more than a certain amount (typically 1 foot or less). Current FIRM maps do not contain any regulatory floodways in the project area.

Floodway Fringe: The area in a floodplain but outside of a floodway.

Special Flood Hazard Areas (SFHAs): A high-risk *flood zone* that will be inundated by the *base flood*. SFHAs are identified on *FIRMs*. Other non-SFHAs on *FIRMs* are moderate- to low- risk areas that are outside the limits of the base flood, but where a flood risk still exists.

Stream Setback: A minimum setback from the edge of all streams in the municipality that prohibits all disturbances that are not included in a list of exceptions (Sec. 21.07.020.B.9.c.). Stream protections include allowances by federal and state authorization to maintain stream channels and drainageways to move, culvert, and pipe so long as the alterations do not lead to an increase in flooding, erosion, or icing problems (MOA Sec. 21.07.020.B6 through 7).

2 Regulatory Setting

2.1 Federal Regulations

The Federal Highway Administration (FHWA) requires a LHS during the planning of highway improvements where construction might encroach on the base floodplain (Title 23, CFR, Part 650, Subpart A). This study details the floodplain conditions at 11 stream crossings and along Turnagain Arm tide flats, documents and quantifies encroachments of the Proposed Action, and describes risks and potential mitigation measures.

Hydraulic design is a separate task and will take place during the design process. The Alaska Highway Drainage Manual maintains the FHWA regulations in 23 CFR 650 as the design standard for all encroachments, whether or not they are included in the FEMA maps.

2.2 Municipality of Anchorage Floodplain Regulations

MOA has adopted the Title 21 Code of Ordinances that regulate construction and improvements in flood hazard areas, including FEMA’s hazard zones, areas within the highest extreme tide, and stream setbacks. All encroachments on flood hazard areas must obtain a flood hazard permit

(FHP) from MOA. Roads and culverts have exemptions for stream setbacks regulations with applicable state and federal authorizations (MOA Sec. 21.07.020.B6 through 7).

2.3 Effective and Preliminary Floodplain Mapping

The project area runs from MP 98.5 to MP 118 on the Seward Highway. There are flood hazard areas in portions of Turnagain Arm, Rabbit Creek, Indian Creek, Bird Creek, and Potter Marsh in the 1979 FIRM. No regulatory floodways exist in the project area. The FEMA 1979 FIRM has been revised several times since its adoption:

- September 18, 1987: to update map format
- March 5, 1990: to change base flood elevations and SFHAs, reflect updated topographic information and to incorporate previously issued Letters of Map Revision
- July 2, 2002: to add SFHAs and base flood elevations
- September 25, 2009: to update corporate limits, change zone designations and to incorporate previously issued Letters of Map Revision

The 2009 Revision is the effective FIRM. However, there are a couple specific locations in the project area with discrepancies between the FEMA 2009 floodplain mapping and existing conditions, where the elevated roadway infrastructure (which existed prior to any FIRM mapping effort) is included in the flood hazard area boundaries.

- At Bird Creek, approximately 800 feet of the existing roadway and bridge infrastructure are mistakenly mapped as a SFHAs (Zone A) (more details in Section 3.3.3).
- At Indian Creek, the mapped floodplain (Zone AE) overlaps with a portion of the existing roadway and the downstream extents of the floodplain mapping ends upstream of the ARRC railroad tracks (more details in Section 3.3.2).

These two examples are contrary to how the FIRMs delineate other sections of the project area (see Map 1 in Appendix A as an example of how the roadway adjacent to Rabbit Creek floodplain is excluded from the mapped flood hazard zones).

FIRM maps were reviewed for 11 streams in the project, which are all the perennial streams in the project area that are conveyed with a structure 48 inches or larger. Two of these streams are conveyed under bridges; nine pass beneath the existing road and rail corridor through culverts. Culverts are within Flood Zones A, AE, D, and X; see Table 1 for definitions.

Table 1. FEMA Flood Hazard Zone Codes in the project area and their definitions

FIRM Hazard Zone Code	Flood Code Definition
Zone A	Area will be inundated by the base flood (1% AEP, or 100-year flood) and <u>no</u> Base Flood Elevations are determined
Zone AE	Area will be inundated by the base flood (1% AEP) and Base Flood Elevations are determined
Zone D	Flood hazards are undetermined, but possible
Zone X	Area of minimal flood hazard; within the 500-year flood floodplain

Table 2 and Figure 1 identify all bridge and large culverts by their stream name, milepost, and flood zone/FIRM map.

Table 2. Stream Crossings and their Flood Zone

Stream	Milepost	Flood Zone, FIRM Map
Rabbit Creek	117.5	Zone AE, FEMA 2009
Potter Creek	115	Zone D, FEMA 2009
McHugh Creek	111.5	Zone D, FEMA 2009
Rainbow Creek	108.5	Zone D, FEMA 2009
Windy Creek	107	Zone D, FEMA 2009
Falls Creek	105	Zone D, FEMA 2009
Subdivision Creek	104	Zone D, FEMA 2009
Indian Creek (Bridge)	103	Zone AE, FEMA LOMR 99-10-172P
Ballfield Creek	103	Zone D, FEMA 2009
Bird Creek (Bridge)	101.5	Zone A, FEMA 2009
Birdhouse/Bear Creek	100.5	Zone X, FEMA 2009

Figure 1. Overview of the Project Area with FEMA Flood Hazard Areas



In addition to the impacts to streams, there are several areas of impact along the Turnagain Arm tidal floodplain. These areas are summarized by milepost in Table 3 and shown in a map book in Appendix A.

Table 3. Impacted Coastal Areas and Flood Zone

Milepost	Description	Flood Zone and Mapping
117.25 and 116	Arm side of Potter Marsh	Zone A, FEMA 2009
115	Arm side of Potter Cr	Zone D, FEMA 2009
112	Arm side of McHugh Cr	Zone D, FEMA 2009
110	Arm side of Windy Corner	Zone D, FEMA 2009
108.5	Arm side of Rainbow Cr	Zone D, FEMA 2009
106	Arm side, west of Falls Cr	Zone D, FEMA 2009
104 and 103.5	Arm side, west of Indian Cr	Zone D, FEMA 2009

3 Floodplain Encroachment

3.1 Evaluation Method

FIRM maps obtained from the FEMA Map Service Center has limited coverage in the project area; only Rabbit Creek, Indian Creek, and Bird Creek crossing areas have mapped floodplains. Seven stream crossings are drained by large culverts (>48 inches) but fall within undetermined (Zone D) or unmapped areas.

To evaluate floodplain encroachment for these crossings, a combination of methods including 1-D HEC-RAS modeling, culvert hydraulics assessment (HY-8), and normal depth analysis were used to calculate the headwater elevation for the 100-year flood (or the base flood elevation, BFE) which were mapped onto the Project DEM (MBI 2024a). The floodplain mapping methods used for each crossing are summarized in Table 4 below; the memo regarding these analyses is in Appendix C.

Table 4. Project Stream and Floodplain Mapping Method

Stream/Water Body	Milepost	Base Flood Elevation Analysis Method
Rabbit Creek	117.5	FEMA 1979 model
Potter Creek	115	HECRAS 1D with USGS Stream Stats and MHHW
McHugh Creek	111.5	HY-8 with USGS Stream Stats and MHHW
Rainbow Creek	108.5	HY-8 with USGS Stream Stats and MHHW
Windy Creek	107	HECRAS 1D with USGS Stream Stats and MHHW
Falls Creek	105	HECRAS 1D with USGS Stream Stats and MHHW
Subdivision Creek	104	HY-8 with USGS Stream Stats and MHHW
Indian Creek (Bridge)	103	FEMA model
Ballfield Creek	103	HECRAS 1D with USGS Stream Stats and MHHW
Bird Creek (Bridge)	101.5	Supplemented FEMA Zone A using HECRAS 1D with USGS Stream Stats and MHHW
Birdhouse/Bear Creek	100.5	HECRAS 1D with USGS Stream Stats and MHHW

Note: USGS = U.S. Geological Survey

With the BFEs established, encroachment extents were quantified from the area of overlap between the C7T- V1.5 project footprint and the FEMA and Michael Baker International (MBI) mapped base floodplains.

Coastal floodplain areas were not modeled at this time, but the High Tide Line (HTL) was used to overlay the Project Footprint to provide a high-level assessment of the coastal floodplain

encroachment. HTL is the highest astronomical tide based on the Anchorage and Bird Creek tidal stations.

3.2 No Build Alternative

The No Build Alternative maintains existing infrastructure at all stream crossings. Crossings at Indian, Bird, and Bear Creeks were upgraded in 2022 to meet current design standards as part of the Seward Highway MP 100–105 Improvements project. However, culverts at Rabbit Creek, Potter Creek, and Rainbow Creek are still fish passage impediments and likely undersized for current conditions, especially when considering future climate projections. Climate models predict an overall rise in precipitation for the region combined with sea level rise and increasing storm intensities. These factors likely lead to more frequent and intense flooding in tidally influenced drainages in the project area. Even without expanding the transportation infrastructure within the project area, it is likely that existing culverts designed for historic flows will need to be replaced in most locations along the highway to accommodate climate driven changes.

3.3 C7T-V1.5 Proposed Action

The Proposed Action widens the existing road and rail corridor throughout the project area, requiring both blasting of the steep hillsides and placement of fill into Turnagain Arm and at numerous stream crossings. The proposed footprint runs perpendicular to the direction of river flow and crosses mapped and unmapped areas (by FEMA) of coastal and riverine floodplains. The project has preliminary floodplain modeling for the project crossings (MBI 2024a), which can be used to fill the data gaps for the unmapped areas as well as update FEMA maps where discrepancies exist (as noted in Section 2.3). It should be noted that the project footprint is preliminary and all quantitative values described below will need to be updated in final design.

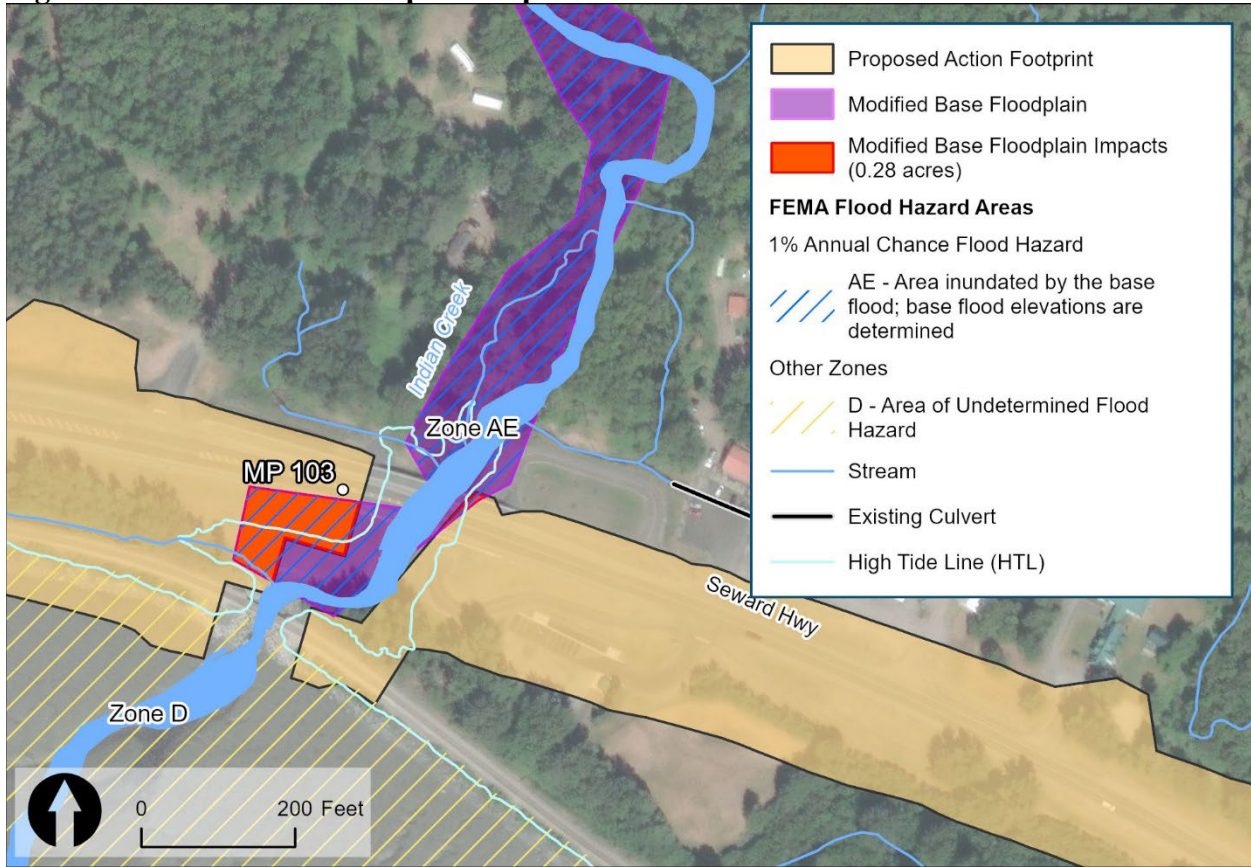
3.3.1 Turnagain Arm Coastal Floodplain

Fill would be placed into the waters of Turnagain Arm in 10 areas between MP 103 and 117.5 to support the widening of the transportation corridor. DOT&PF would need to obtain a MOA FHP for encroachments on 11.5 acres between MP 115.5 and 117.5, which is within a SFHA (Zone A). All other instances of marine fill placement, totaling 106.5 acres, are outside of SFHAs (Zone D) and, therefore, are not considered encroachments and do not require a MOA FHP (personal communication with Steve Ellis, MOA).

3.3.2 Indian Creek Bridge Floodplain

The Proposed Action maintains the existing two-lane bridge over Indian Creek to act as a frontage road and adds a new bridge between the existing highway bridge and railroad bridge to incorporate the 4-lane divided highway and a separated bike path. To the west of Indian Creek, the railroad would be realigned onto fill placed into Turnagain Arm with a new, longer bridge spanning the creek. There are 0.28 acres of FEMA Zone AE floodplain that would be encroached upon; however, as noted in Section 2.3, the existing highway is included in that flood hazard area (Figure 2). Additionally, the flood zone ends uphill of the ARRC crossing, approximately 80 feet upstream of the creek's outlet. Determining the amount of actual encroachment from highway construction upon Indian Creek's floodplain will require a final bridge design and updated mapping. The project footprint does show the widening of the floodplain at the ARRC crossing of approximately 80 feet which would increase flood conveyance capacity over existing conditions.

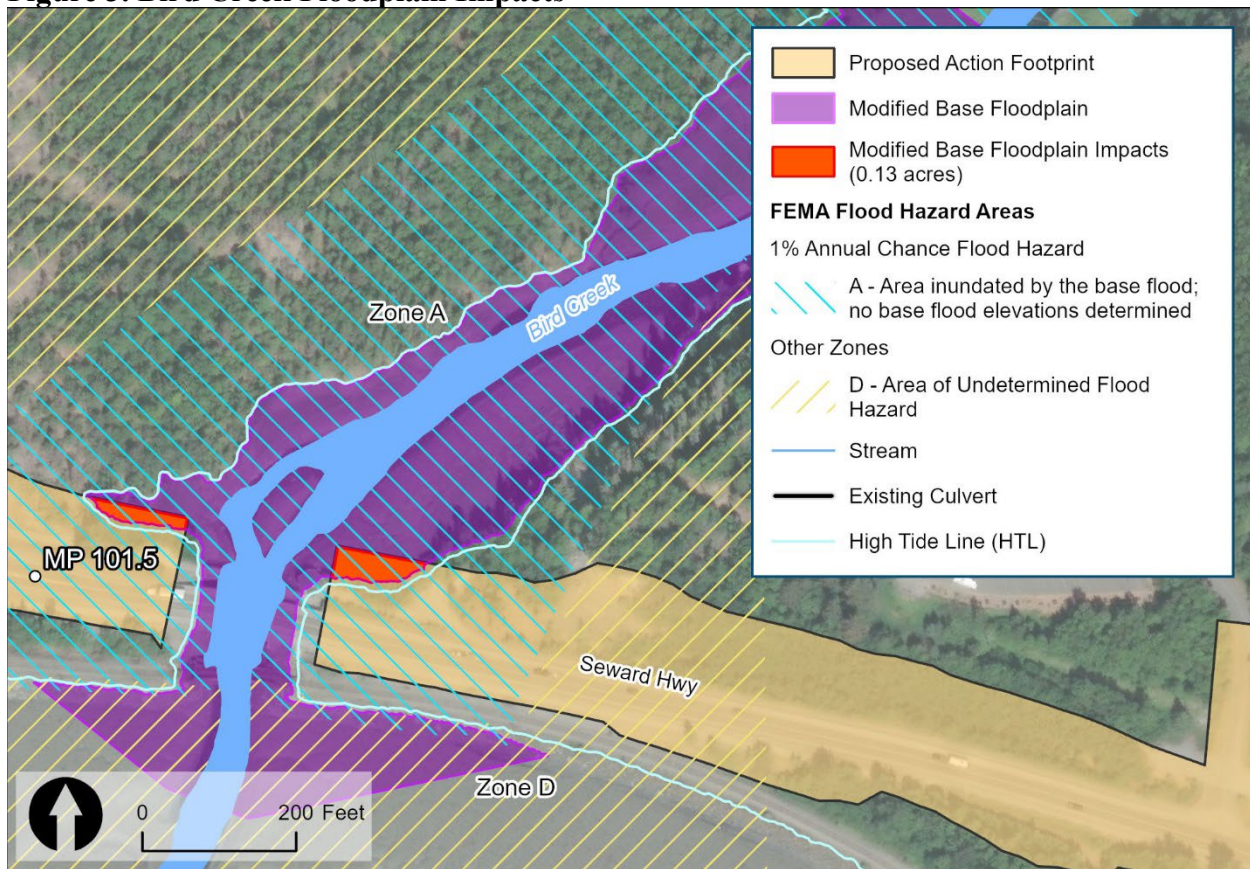
Figure 2. Indian Creek Floodplain Impacts



3.3.3 Bird Creek Bridge Floodplain

At Bird Creek, the proposed action would replace the existing two-lane bridge with a 4-lane divided highway bridge but would not change the existing railroad alignment. Though the project footprint overlaps with 2.5 acres of FEMA 1979 floodplain, approximately 800 feet of existing highway and railroad is incorrectly identified within the Zone A flood hazard area and the mapping deviates drastically from existing topography upstream of the highway. As such, updated floodplain mapping to FEMA's boundaries is needed to accurately assess any project encroachments. MBI provided preliminary floodplain mapping updates using a 1D HEC-RAS model, 2015 LiDAR, and 100-year flow estimates from USGS Stream Stats (documented in Appendix C). Based upon this modified floodplain mapping (shaded in purple in Figure 3), the project footprint encroaches 0.13 acres on the upstream side of the Bird Creek bridge (red shading).

Figure 3. Bird Creek Floodplain Impacts



3.3.4 Large Diameter Culvert Floodplains

Within the project area are nine stream crossings drained by large culverts (>48 inches) all of which would need to be replaced with longer culverts to accommodate the additional width of the Proposed Action. All replacement culverts require design for the 2% AEP flow, but DOT&PF may choose to design to a higher capacity using the 1% AEP flows. Culvert design will incorporate fish passage considerations for streams registered in the Alaska Department of Fish and Game (ADF&G) anadromous waters catalogue (AWC).

Most proposed culvert diameters would either remain the same or increase in size to increase flood conveyance capacity (Table 5). There are two exceptions, Windy and Birdhouse, which may decrease in size but still meet design conveyance capacities. Flood zones for each large culvert were determined using methods listed in Table 4. The total area of encroachment for each culvert is calculated from the project's floodplain analysis (MBI 2024a) and summarized in Table 5 with the existing and proposed diameters of the crossing. Maps of each crossing are in Appendix A.

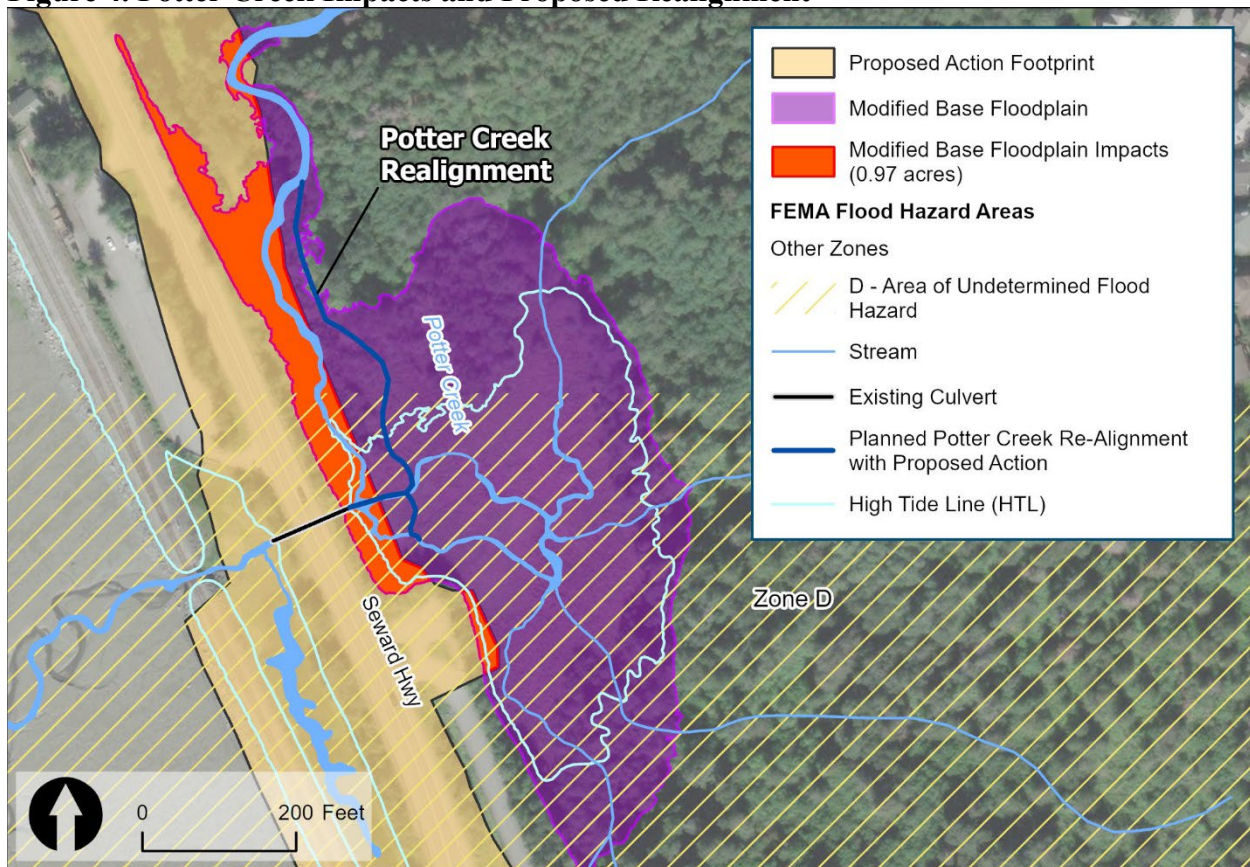
Table 5. Project Encroachment for Existing Culverts with Proposed Sizes

Stream/Water Body	Milepost	Existing Diameter (Inches)	Existing BFE Encroachment (Acre)	Proposed Diameter (Inches)
Rabbit Creek	117.5	(3) 60	0	141 wide x 86 tall, or 120 with (4) 60-inch flood relief culverts
Potter Creek	115	84	0.97	120
McHugh Creek	111.5	84	0	96
Rainbow Creek	108.5	84	0.18	96
Windy Creek	107	(2) 36	0.05	54
Falls Creek	105	84	0.01	96
Subdivision Creek	104	54	0.08	54
Ballfield Creek	103	54	0.34	54
Birdhouse/Bear Creek	100.5	108	0.37	54 (if no fish pass); 108 if fish passage required

Of these crossings, only the Rabbit Creek culvert replacements require a FHP as they drain FEMA mapped floodplains (Zone AE upstream of the road within Potter Marsh and Zone A downstream at the outlet). The Proposed Action would replace the existing three side-by-side 60-inch culverts at Rabbit Creek with either a single larger fish passage, pipe arch culvert 141 by 86 inches, or 120-inches diameter culvert with four 60-inch flood relief pipes (MBI 2024b). Guidance from ADF&G during project scoping stated that water in Potter Marsh would need to be maintained at its current level, which will need to be addressed during the design phase. There will be no encroachment into Potter Marsh.

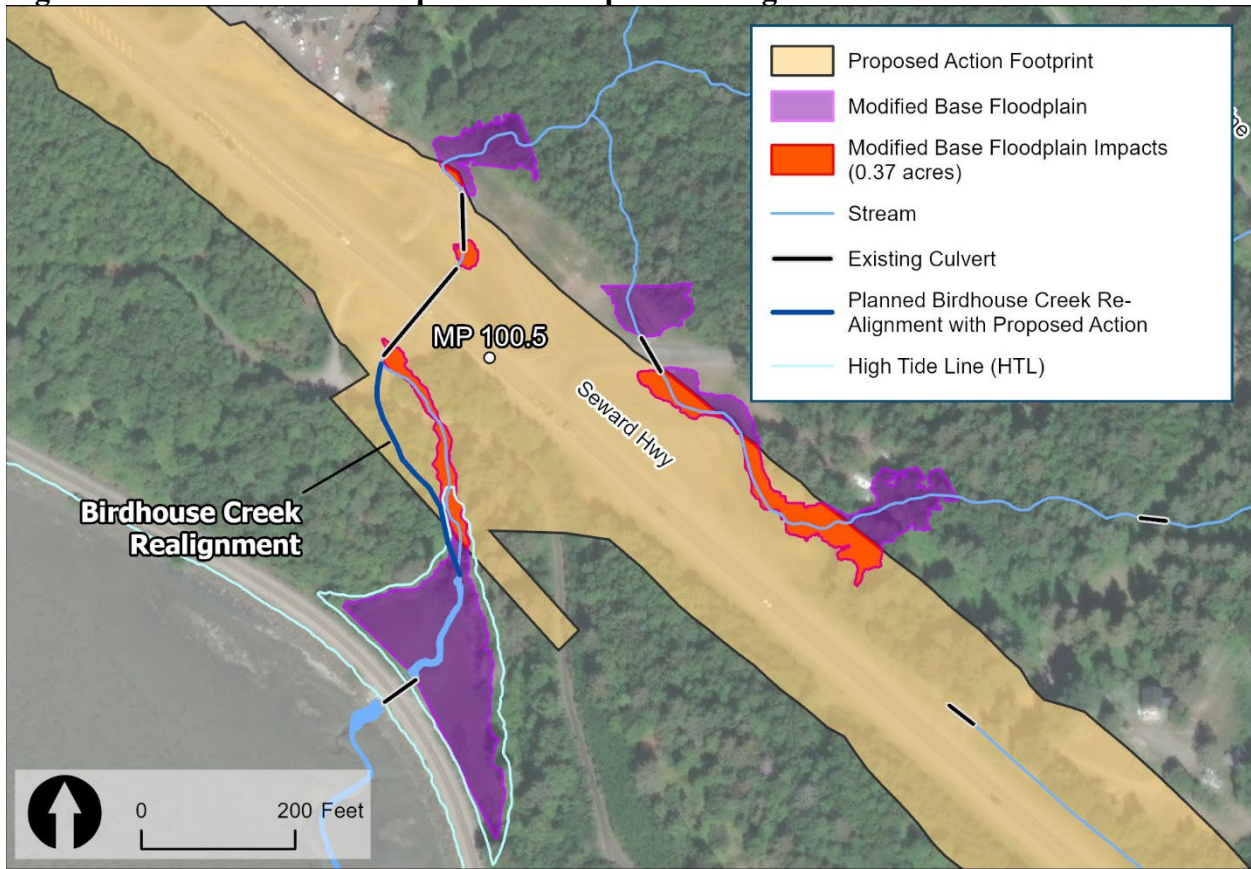
Fill to support the widened transportation corridor would encroach upon 0.97 acres of the Potter Creek floodplain including approximately 400 feet of stream channel. As part of the Proposed Action, Potter Creek would be realigned, shifting the impacted channel to the east and then directing the stream through a new 120-inch fish passage culvert, as shown below in Figure 4.

Figure 4. Potter Creek Impacts and Proposed Realignment



The proposed culvert for Birdhouse Creek (formerly Bear Creek) was upgraded to a 108-inch fish passage culvert as part of the Seward Highway MP 100–105 Improvements completed in 2022. However, field observations by ADF&G indicate that there is a natural series of cascades that act as a fish passage barrier approximately 120 feet downstream of the fish passage culvert. As a consequence, the AWC nomination for Birdhouse Creek only includes the section between tidewater and the existing bike path bridge. The Proposed Action would fill in the section of Birdhouse from approximately 160 feet downstream of the existing bike path bridge up to the existing highway drainage culvert (Figure 5). As part of this process this section of Birdhouse Creek would be realigned to the west to avoid the fill. If this realignment is determined by ADF&G to remove barriers to fish passage, the replacement culvert beneath the highway could be required to stay at the existing 108 inches for fish passage requirements. If not, the proposed culvert replacement could be downsized to 54 inches to only meet hydraulic design standards.

Figure 5. Birdhouse Creek Impacts and Proposed Realignment



4 Risks Associated with Implementation

Risks associated with floodplain encroachment generally increase with the area impacted by construction and include the possibility of increased flood elevations and velocity. Additionally, structures and portions of the highway that encroach upon a floodplain are more likely to sustain damage or fail during overtopping events. The location of the project area adjacent to Turnagain Arm means that all encroachments have the potential to constrict flow at the stream outlet.

The project is still in preliminary stages and detailed hydrologic and hydraulic analyses will be completed during the design phase to correctly size the structures within the floodplain.

5 Floodplain Impact Minimization and Mitigation

The Proposed Action broadly aligns with the existing transportation corridor. Measures to minimize floodplain impacts are and will continue to be incorporated into the design and construction of this project and will be based upon additional modeling to be completed during the design phase. They include:

- Maintaining or improving flood conveyance by sizing culverts to 1% or 2% AEP flows and accounting for projected increases in precipitation due to climate change impacts.
- Extending bridge lengths to avoid constrictions at stream outlets.
- Maintaining current water levels within Potter Marsh through the design of the fish passage and flood relief culverts.

- Maintaining or improving fish passage for anadromous waters.
- Implementing cross-drainage through drainage culvert placement.
- Implementing erosion and sediment control measures during construction.
- Preserving or re-establishing riparian vegetation to aid in maintaining stable stream banks and roadway drainages.

6 Conclusions

There are no regulatory floodways within the project area, but the preliminary footprint does include encroachments into mapped coastal and riverine flood hazard zones. As currently proposed, these encroachments do not meet the criteria of “significant encroachments” and should not support incompatible floodplain development. The *Alaska Highway Drainage Manual* describes the necessary steps if mapped floodplain encroachments, such as those in the Proposed Action, are to be accepted. DOT&PF would need to determine the impacts of the proposed encroachments on the floodplain, determine any hazards to property, and coordinate with FEMA and MOA to update flood maps if an increase to base flood elevations were anticipated. A Title 16 Fish Habitat permit from ADF&G would be required for the work in or crossing anadromous streams within the project area.

7 References

DOT&PF (Alaska Department of Transportation and Public Facilities)

2006 *Alaska Highway Drainage Manual*. June 15, 2006. Accessed at https://dot.alaska.gov/stwddes/desbridge/hwy_drainage_manual.shtml

Ellis, Steve

2024 Personal Communication with Steve Ellis, MOA Flood Hazard Administrator.

FHWA (Federal Highway Administration)

1979 23 CFR Part 650 Subpart A. November 26, 1979. Accessed at <https://www.ecfr.gov/current/title-23/part-650/subpart-A>

MOA (Municipality of Anchorage)

No Date Municipality of Anchorage Code, Chapter 21.07.020 Natural Resource Protection Subsection E. Accessed at

https://library.municode.com/ak/anchorage/codes/code_of_ordinances?nodeId=TIT21_LAUSPLNECOFFJA12014_CH21.07DEDESTNECOFFJA12014_21.07.020NAREP

MBI (Michael Baker International)

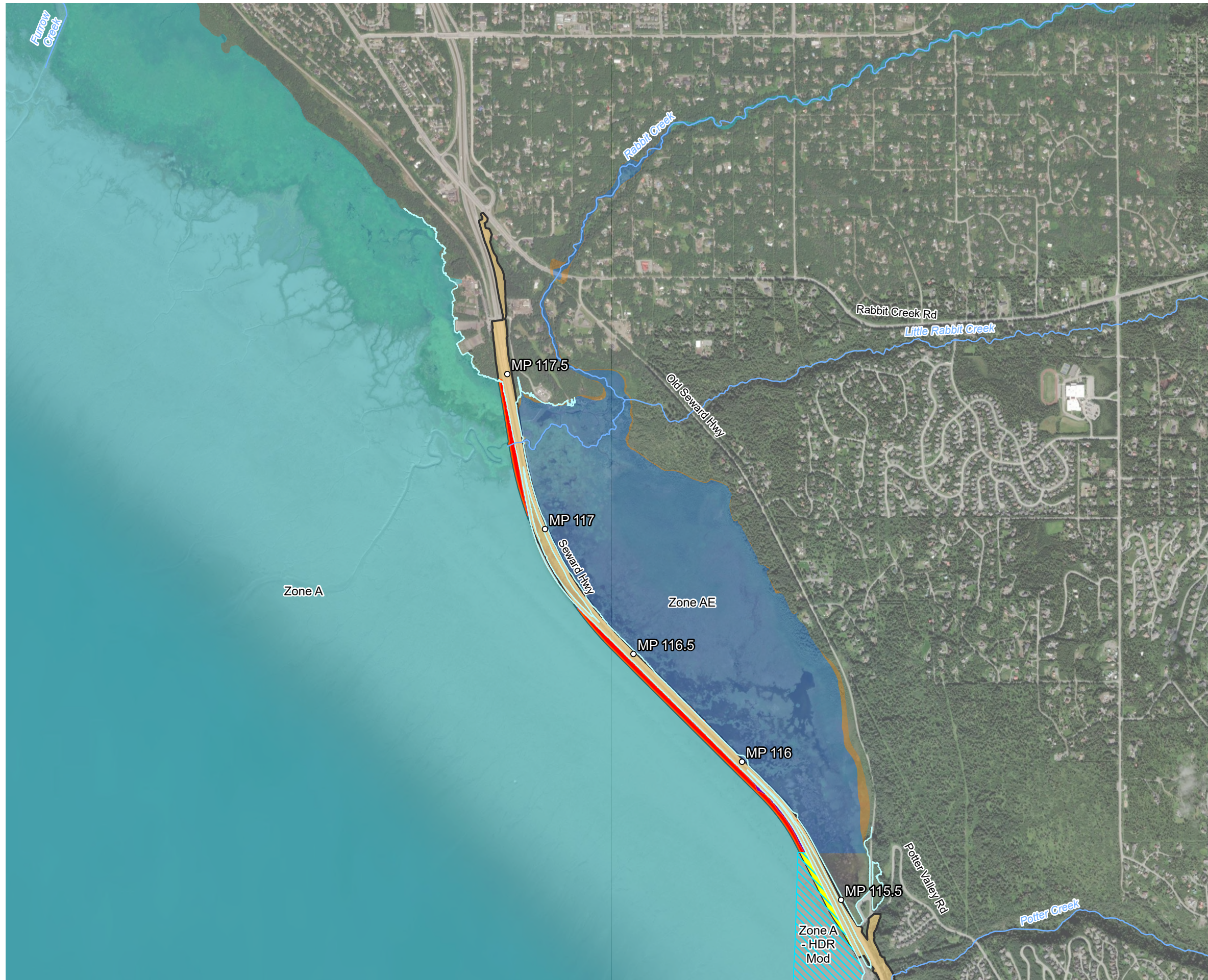
2024a Safer Seward Hwy MP 98.5-118 LHS Analysis Update Tech Memo.

2024b Safer Seward Hwy 98.5-118 Preliminary H&H Analysis for Large Culverts.

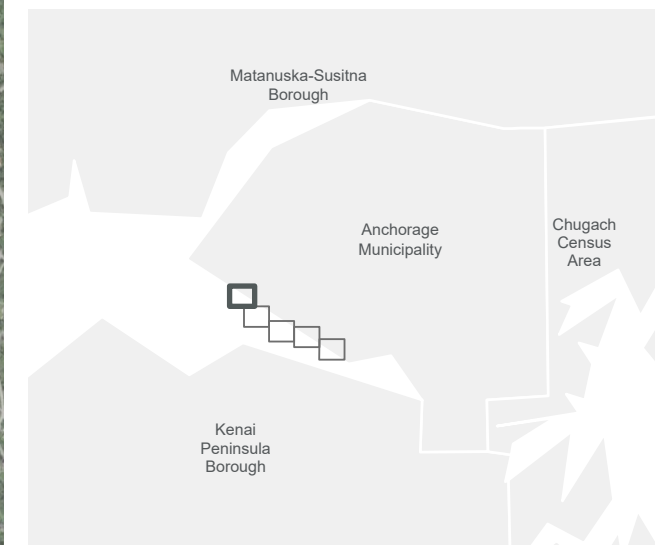
Appendix A. Seward Highway Proposed Action Impacts to Flood Hazard Zones

This page is intentionally left blank.

**Seward Highway Proposed Action
Impacts to Flood Hazard Zones**
Page 1 of 5



- Mileposts
- ▭ Proposed Action Footprint
- Flood Hazard Areas**
- 1% Annual Chance Flood Hazard
 - ▭ A
 - ▭ AE
- Other Zones
 - ▭ X, 0.2% Annual Chance Flood Hazard
 - ▨ HDR Modified Flood Zone
 - Streams
 - High Tide Line (HTL)
- Footprint Impact**
- ▭ FEMA Flood Zone Impact
- ▭ Footprint Below HTL
- ▭ HDR Modified Flood Zone Impact

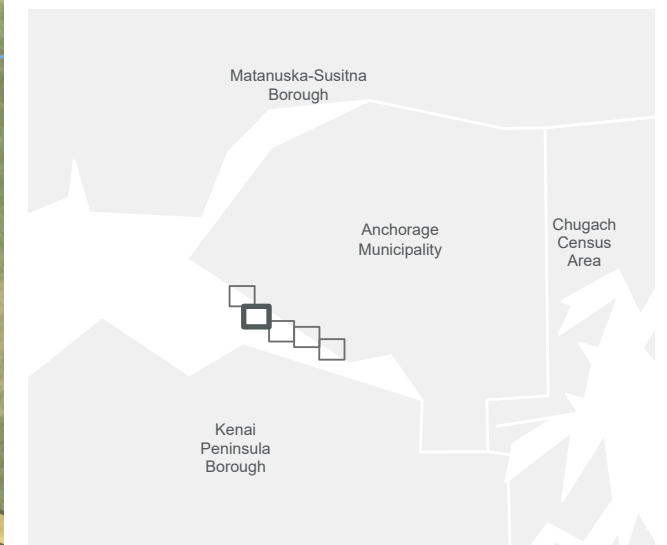


0 1,000 Feet



**Seward Highway Proposed Action
Impacts to Flood Hazard Zones**
Page 2 of 5

- Mileposts
- ▭ Proposed Action Footprint
- Flood Hazard Areas**
- 1% Annual Chance Flood Hazard
- ▭ A
- Other Zones**
- ▭ D, Area of Undetermined Flood Hazard
- ▨ HDR Modified Flood Zone
- Streams
- High Tide Line (HTL)
- Footprint Impact**
- ▭ Footprint Below HTL

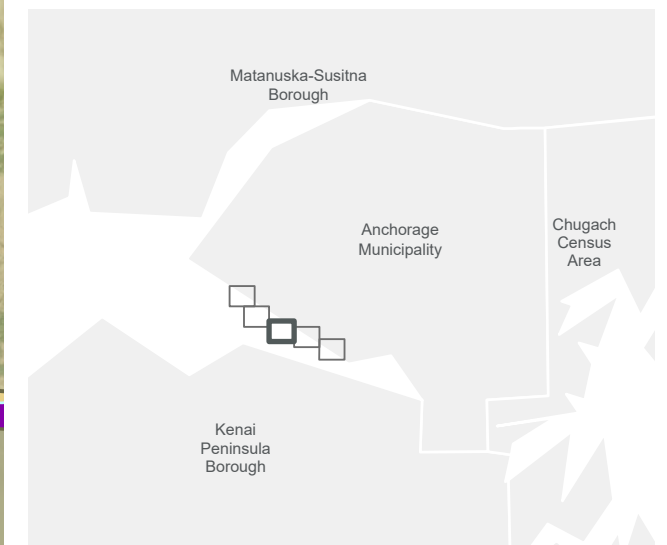


0 1,000 Feet





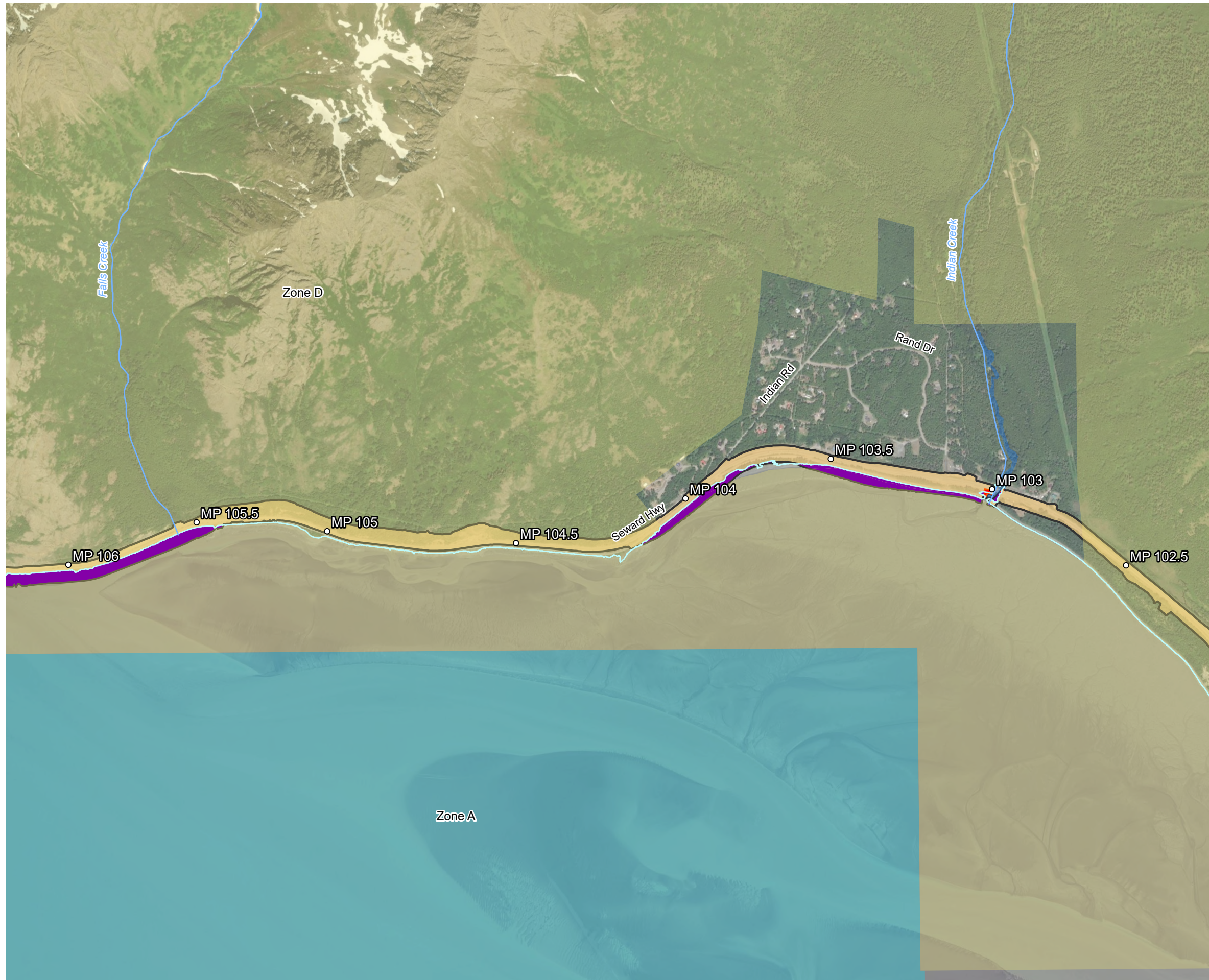
- Mileposts
- ▭ Proposed Action Footprint
- Flood Hazard Areas**
- 1% Annual Chance Flood Hazard
- ▭ A
- Other Zones**
- ▭ D, Area of Undetermined Flood Hazard
- Streams
- High Tide Line (HTL)
- Footprint Impact**
- ▭ Footprint Below HTL



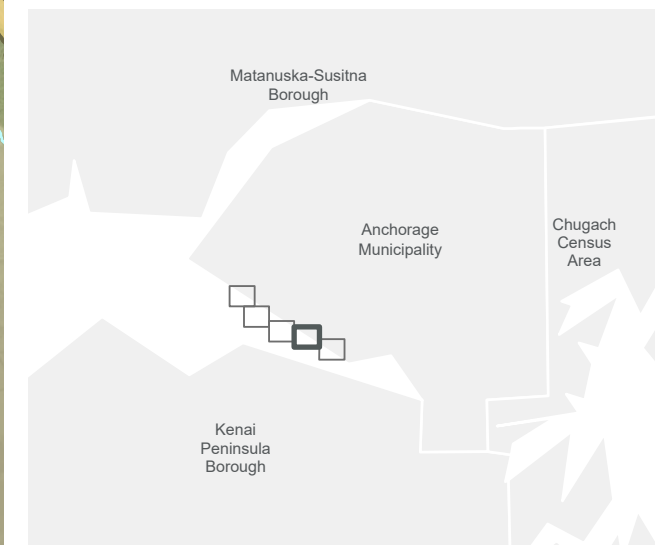
0 1,000 Feet



**Seward Highway Proposed Action
Impacts to Flood Hazard Zones**
Page 4 of 5



- Mileposts
- ▭ Proposed Action Footprint
- Flood Hazard Areas**
- 1% Annual Chance Flood Hazard
 - ▭ A
 - ▭ AE
- Other Zones
 - ▭ D, Area of Undetermined Flood Hazard
- Streams
- High Tide Line (HTL)
- Footprint Impact**
- ▭ FEMA Flood Zone Impact
- ▭ Footprint Below HTL



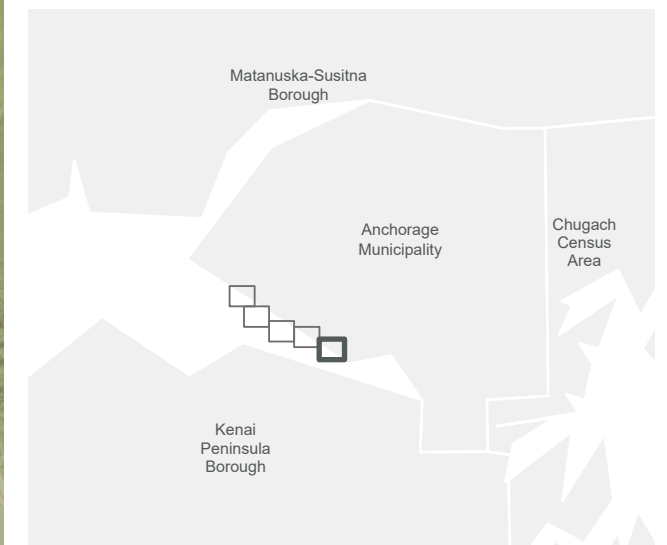
0 1,000 Feet



**Seward Highway Proposed Action
Impacts to Flood Hazard Zones**
Page 5 of 5



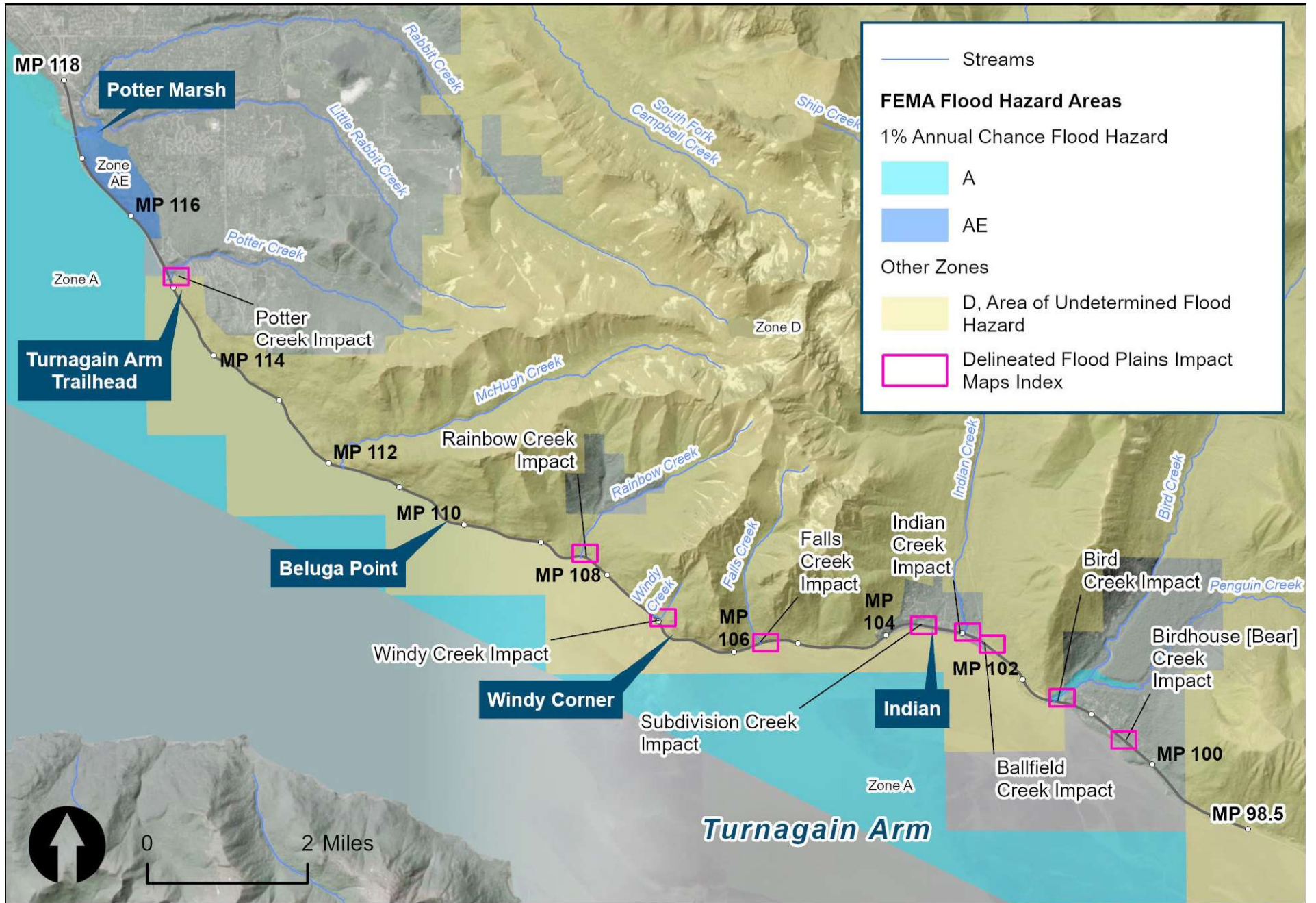
- Mileposts
- ▭ Proposed Action Footprint
- Flood Hazard Areas**
- 1% Annual Chance Flood Hazard
- A
- Other Zones**
- D, Area of Undetermined Flood Hazard
- HDR Modified Flood Zone
- Streams
- High Tide Line (HTL)
- Footprint Impact**
- FEMA Flood Zone Impact
- HDR Modified Flood Zone Impact

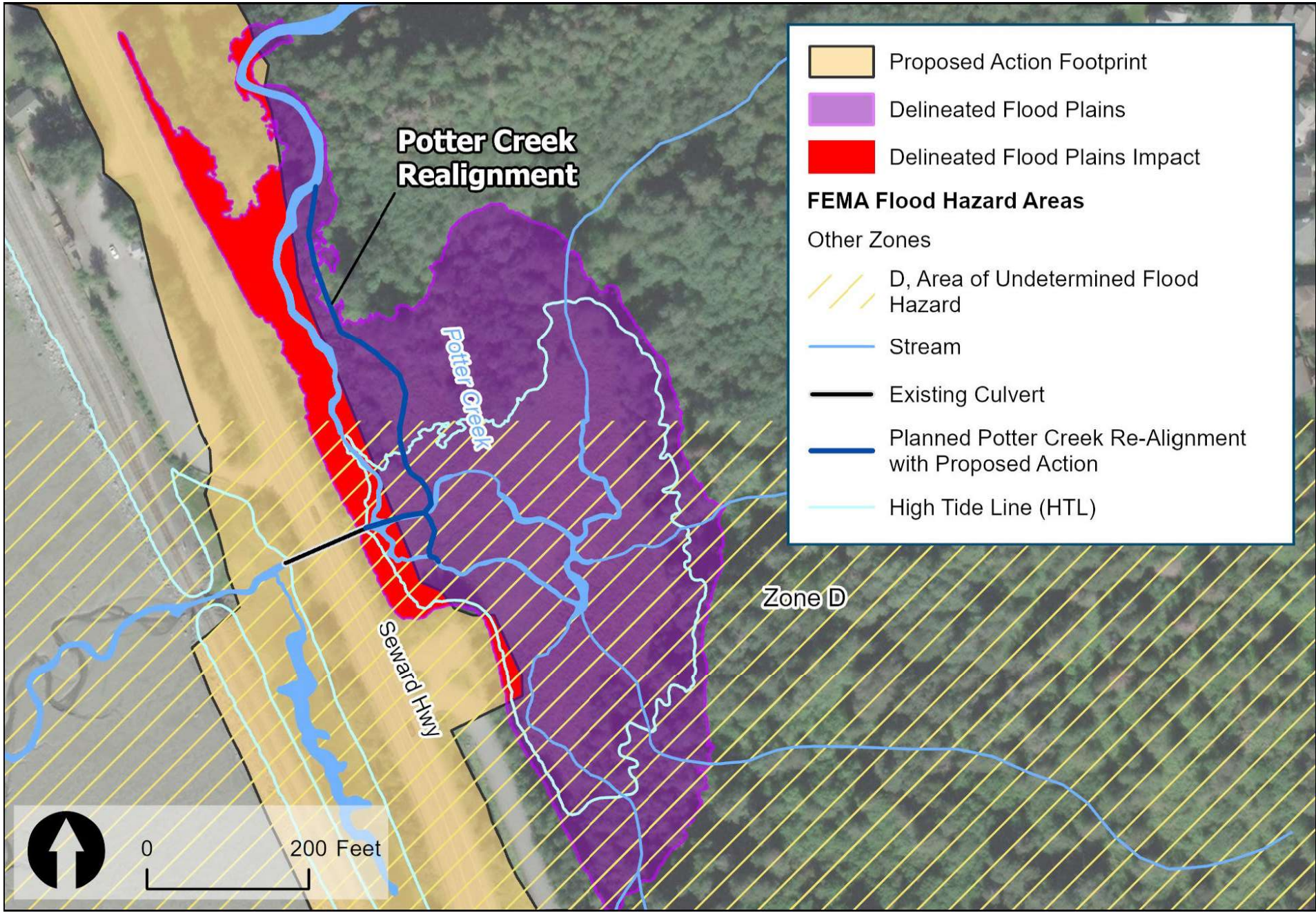


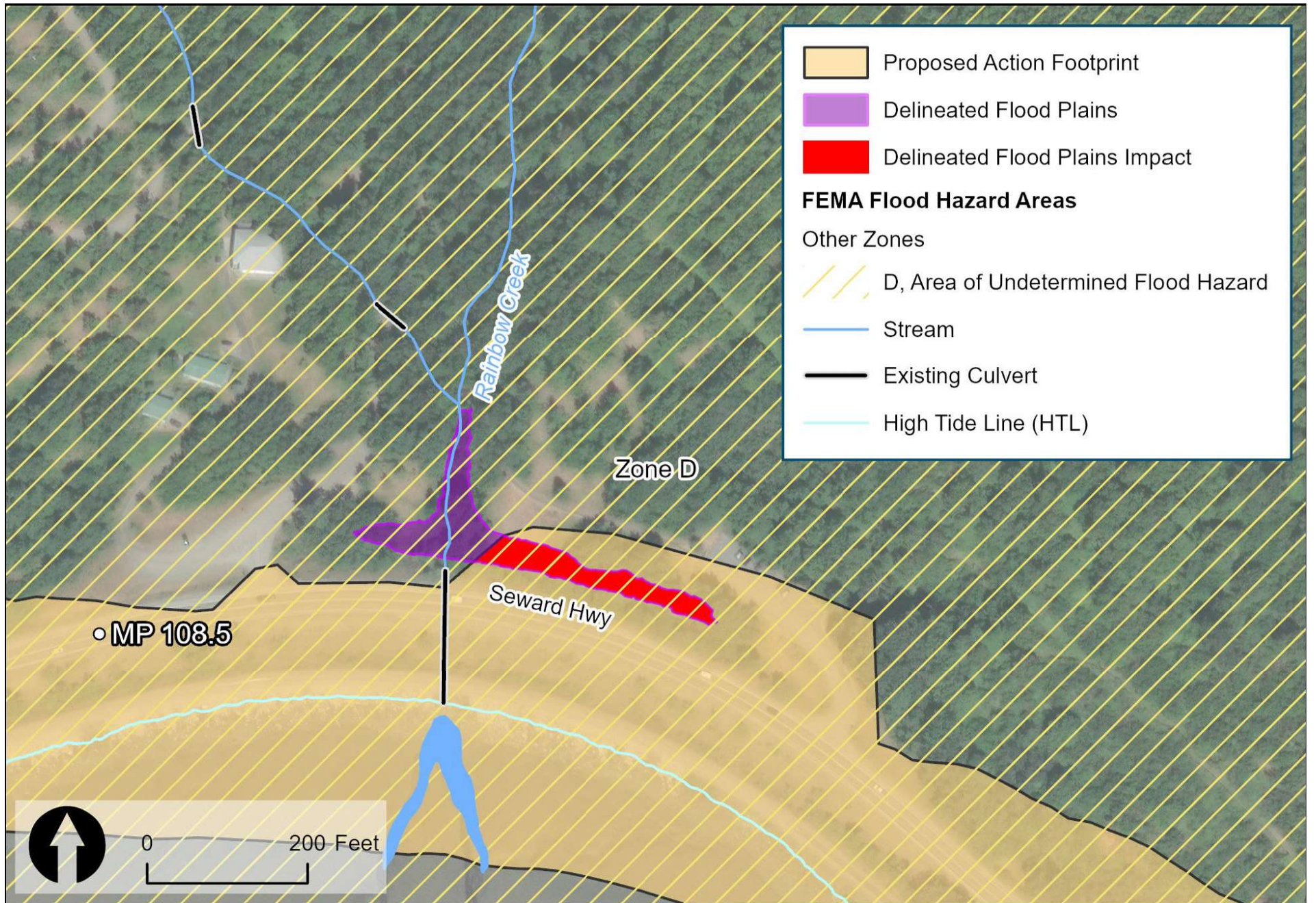
0 1,000 Feet

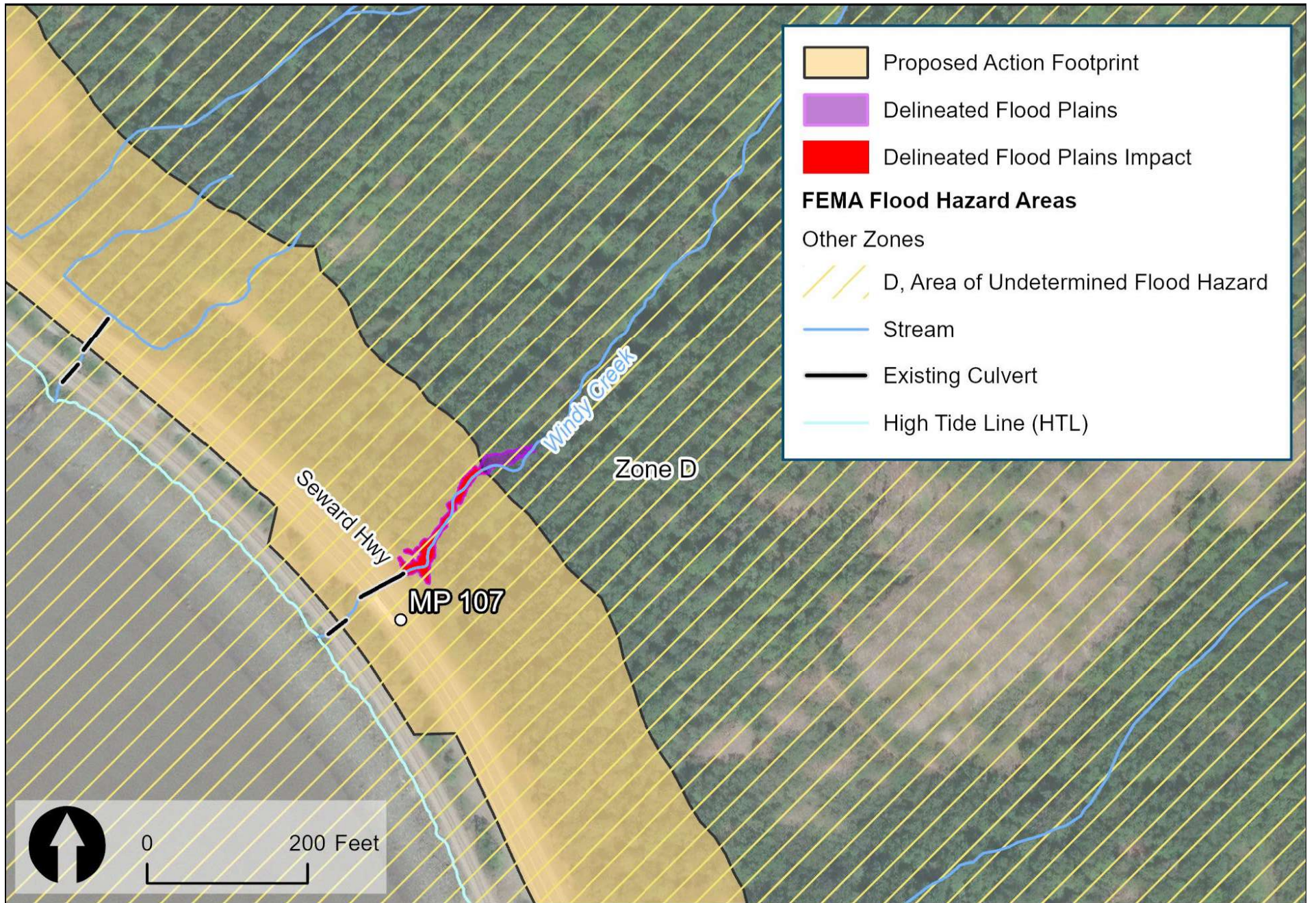


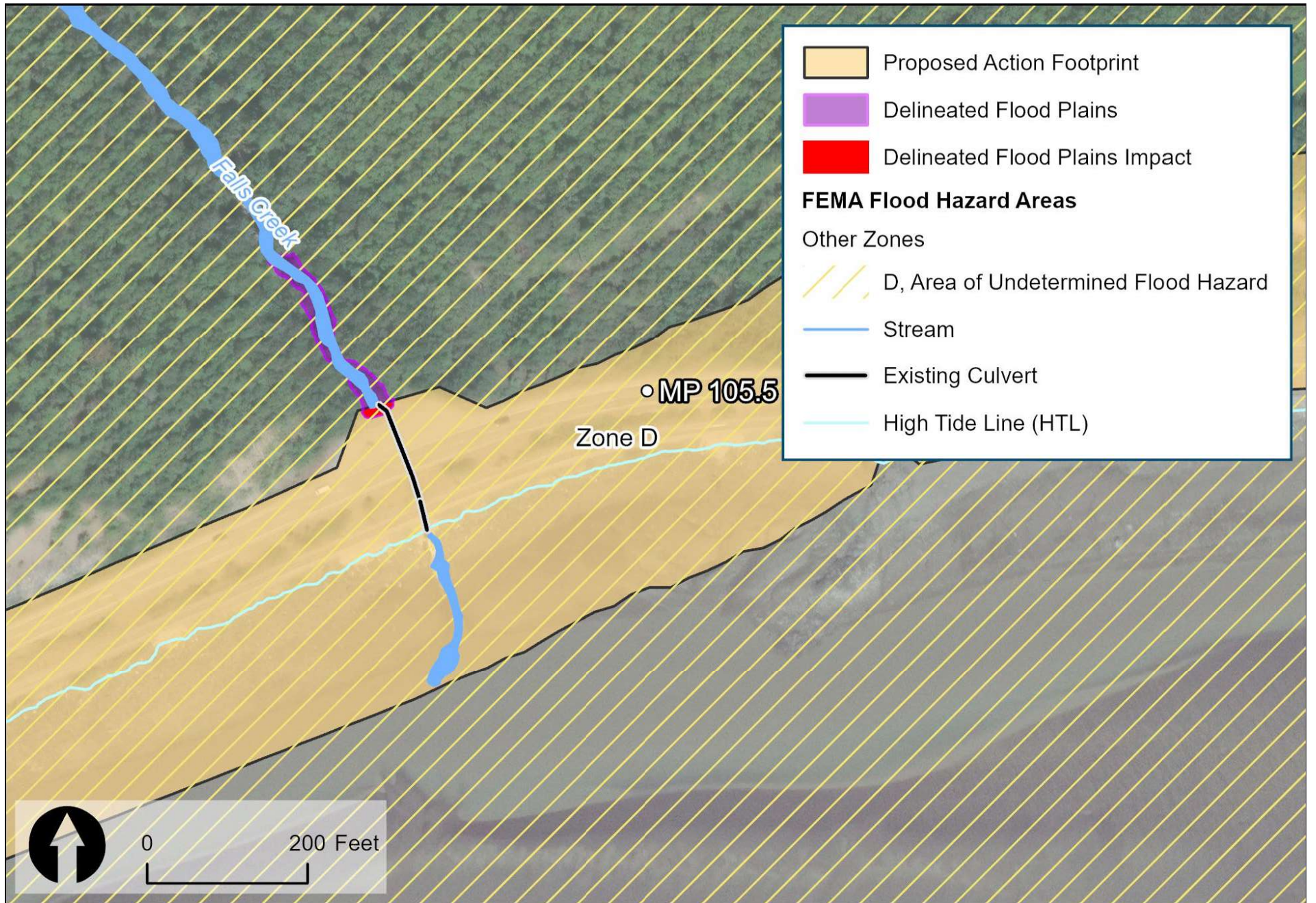
This page is intentionally left blank.

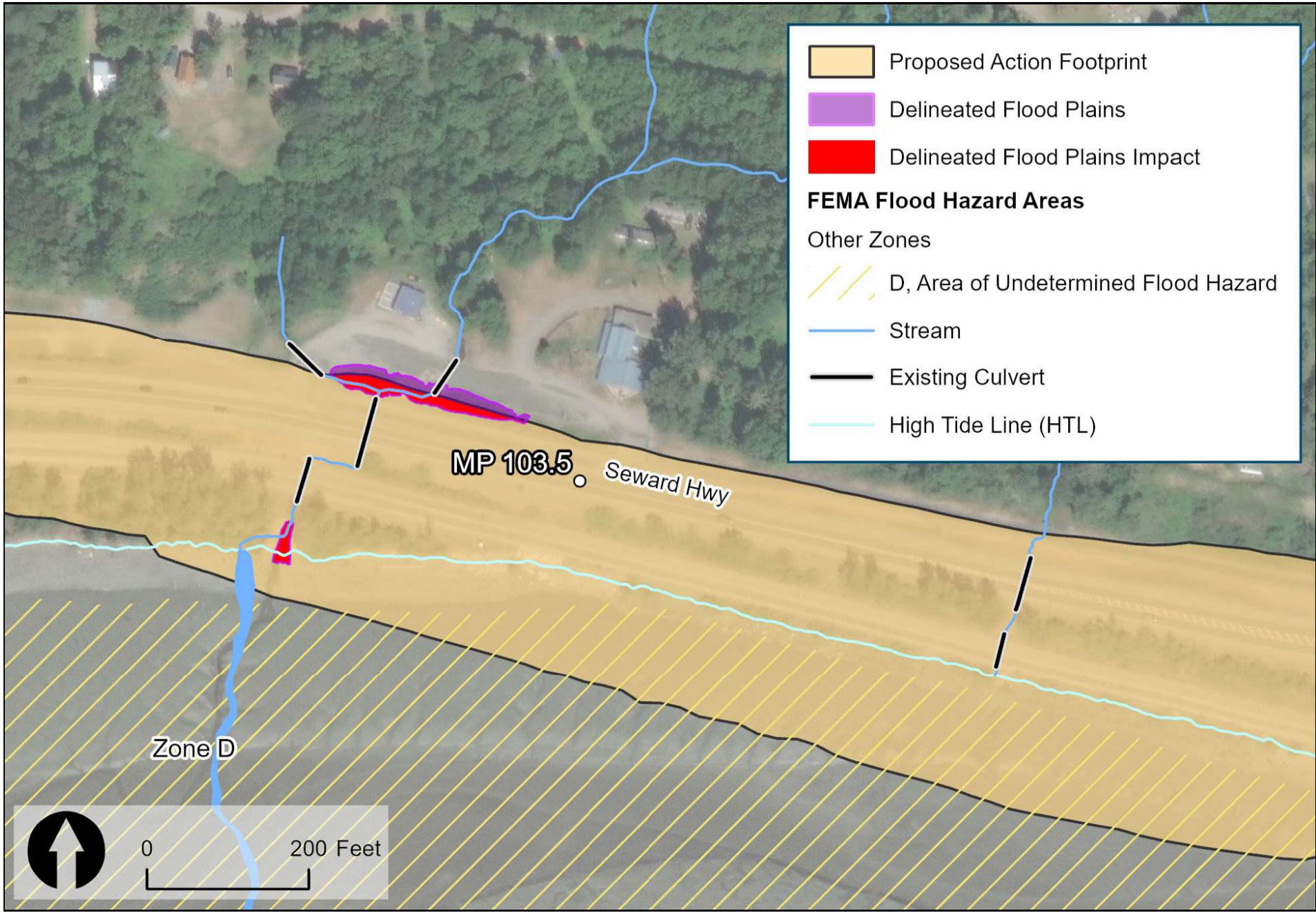


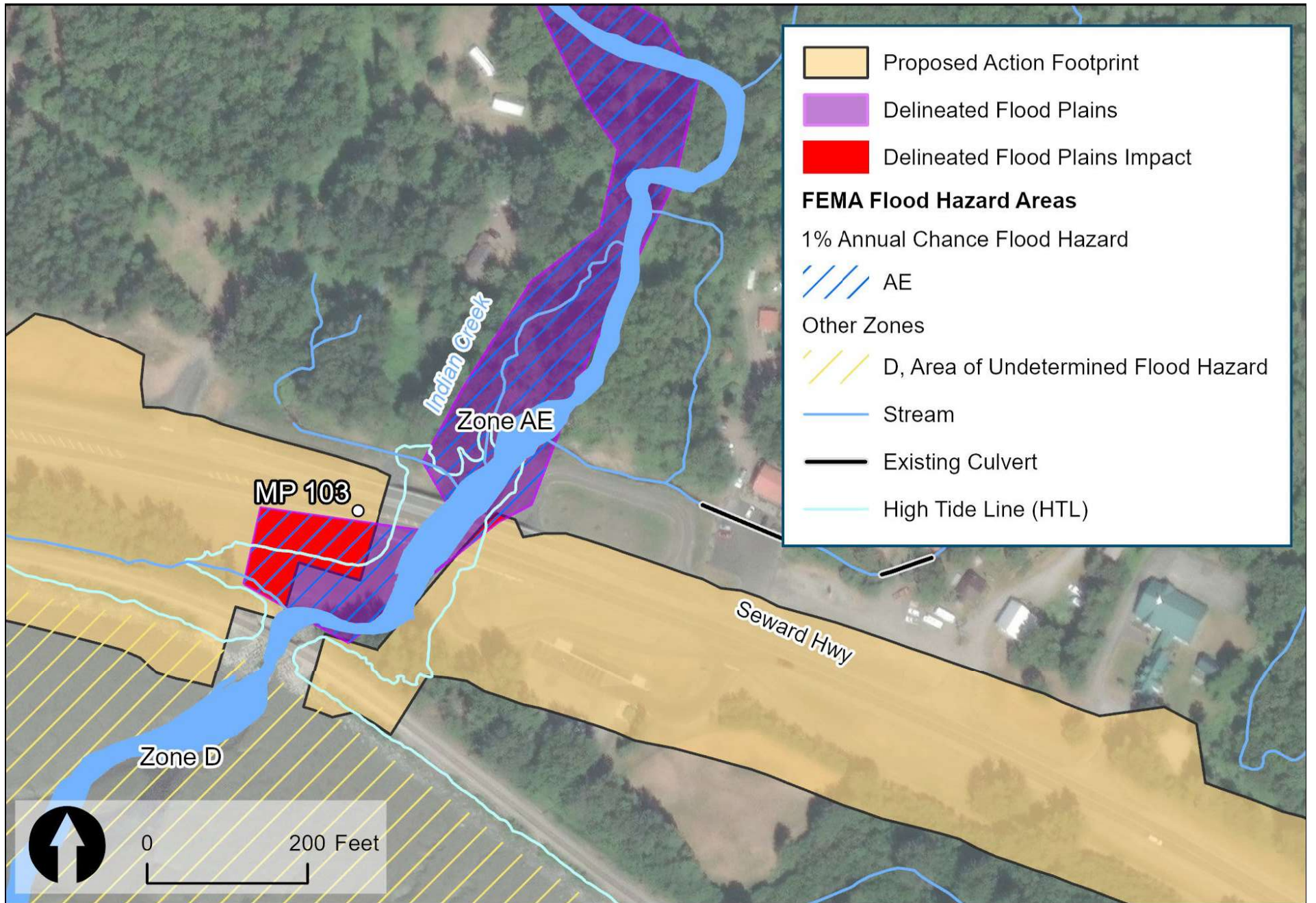


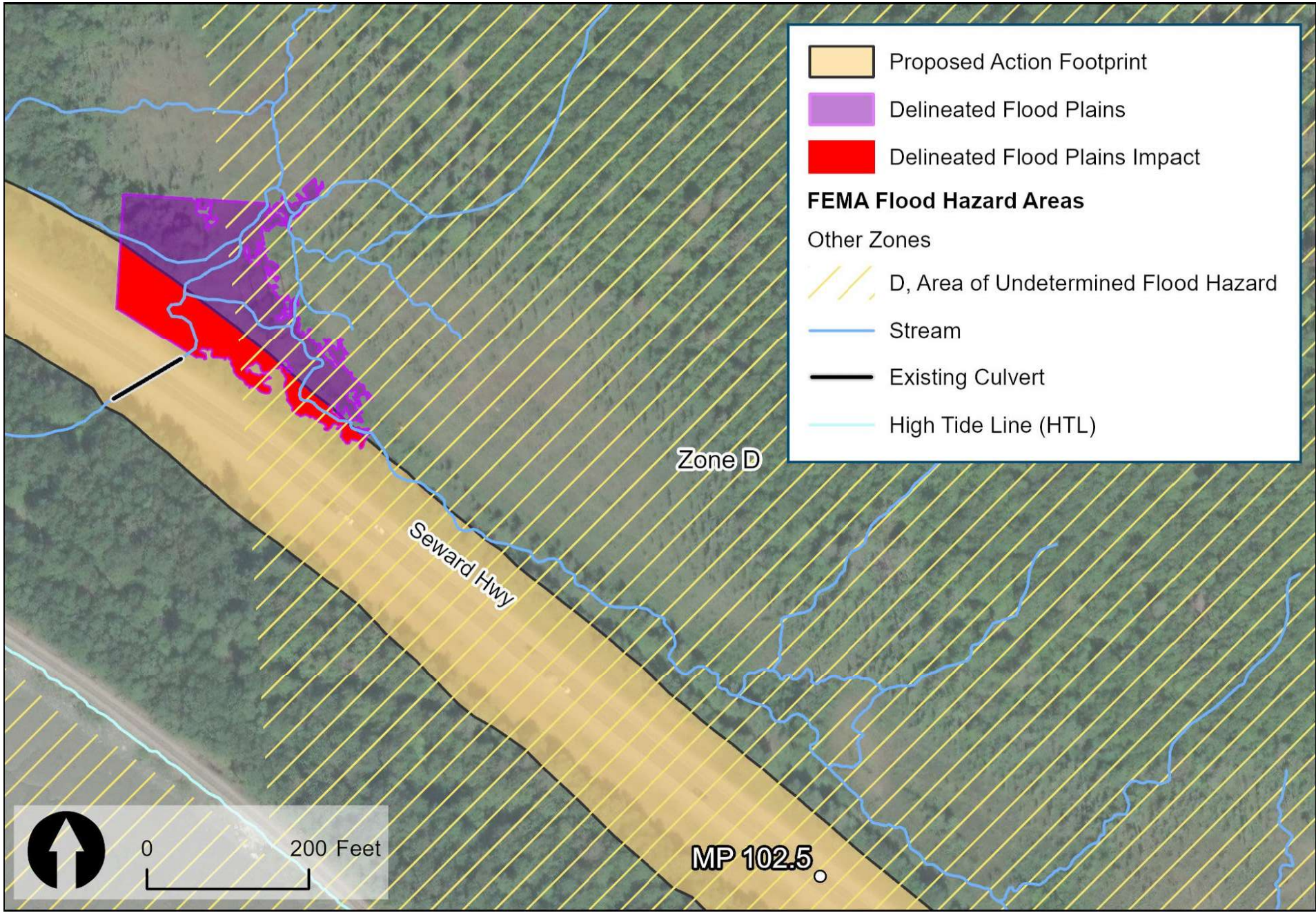


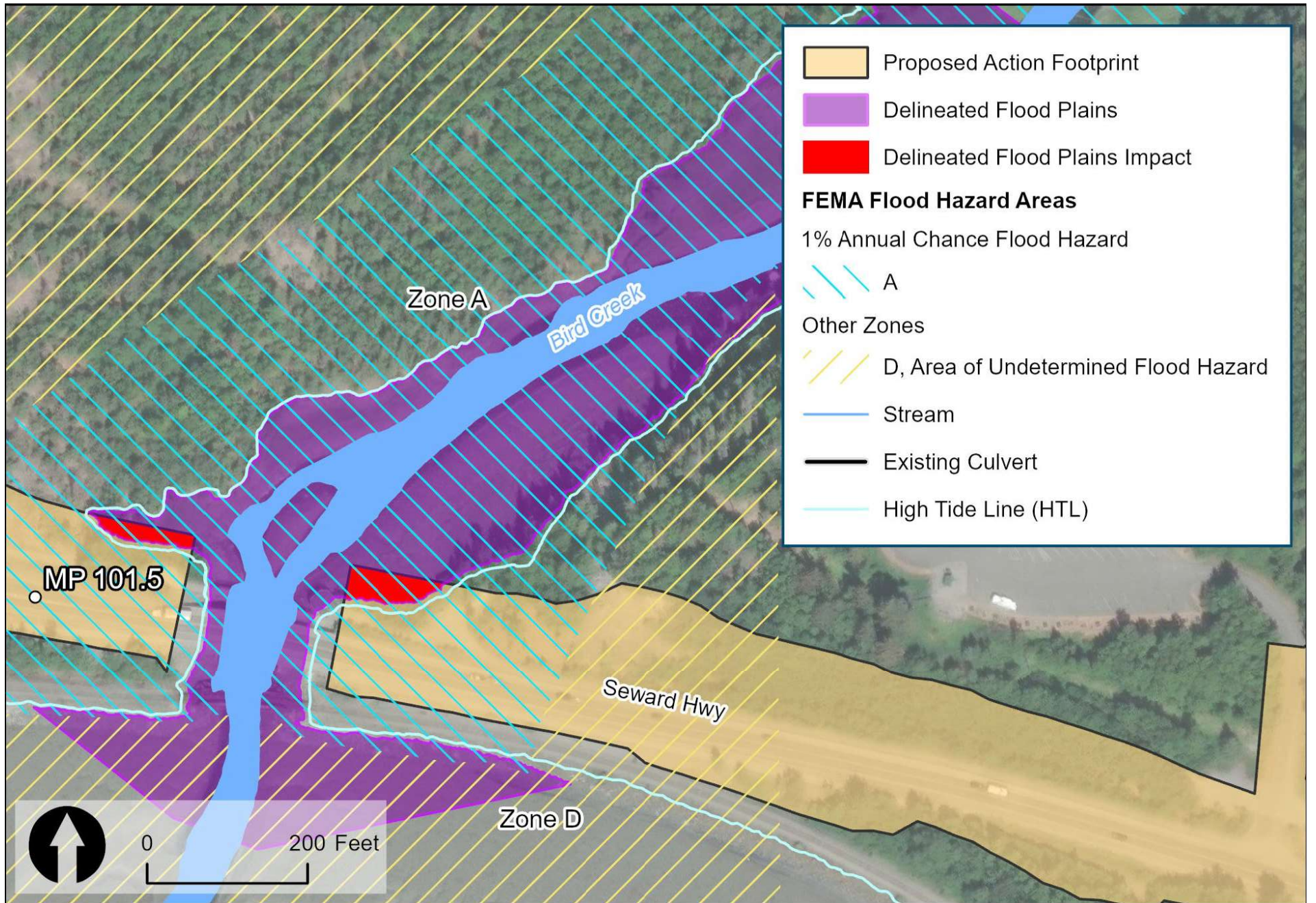


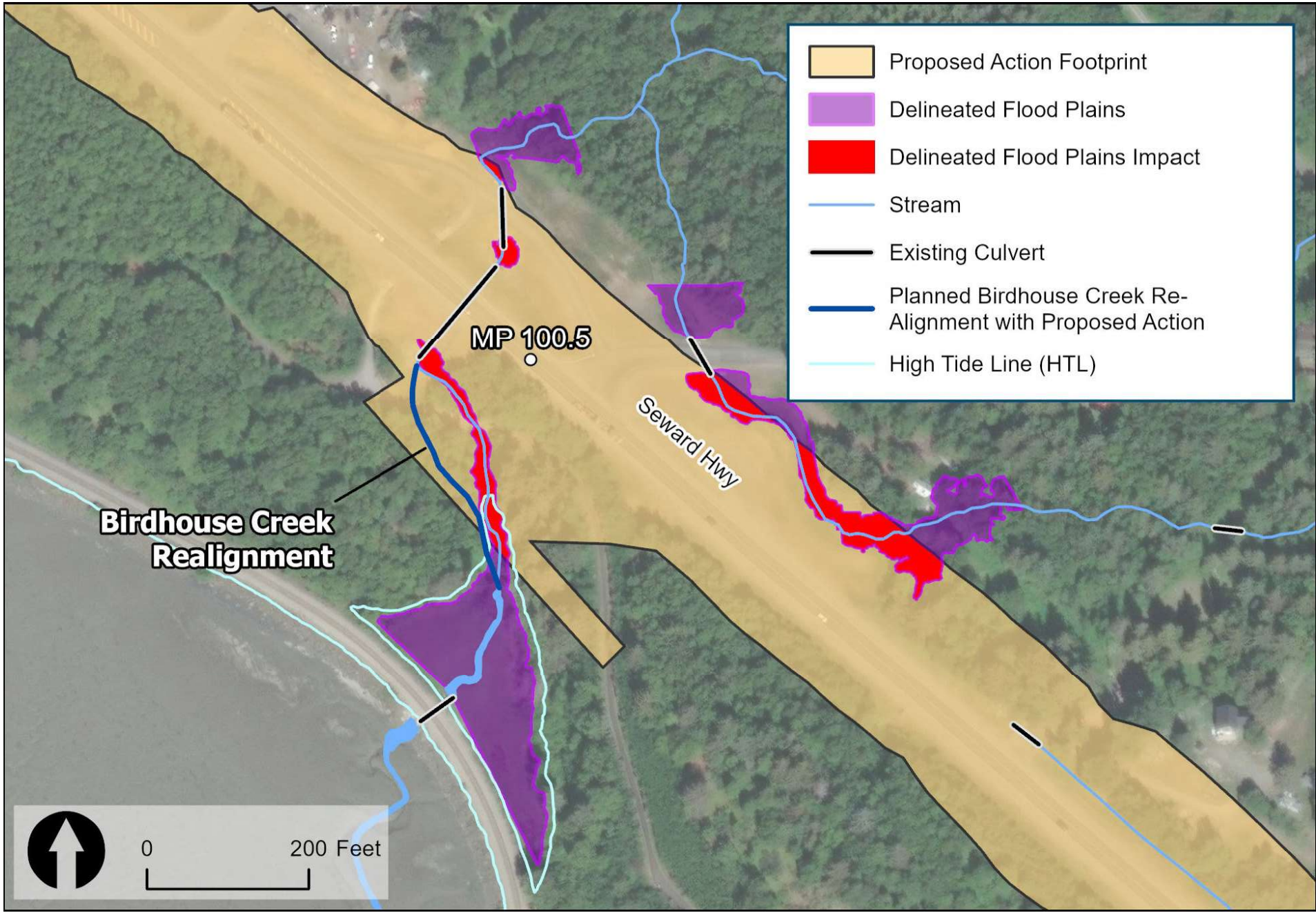












Appendix B. Safer Seward Hwy Preliminary H&H For Large Pipes – CSRA Tech Memo

This page is intentionally left blank.

Project Memo

Safer Seward Hwy 98.5-118 Preliminary H&H Analysis for Large Culverts

To: Edith McKee

Date: 2/7/2024

From: Michael Baker International (Michael Baker)

Subject: CSRA H&H Support

Overview:

Michael Baker International (Michael Baker) completed an initial review of the project's large culverts (>48") for preliminary sizing and fish passage requirements to support the February 2023 CSRA workshop. Nine crossing locations were identified fitting the large pipe selection criteria, and three were also cataloged anadromous streams requiring aquatic organism passage (AOP) design considerations.

Pipe sizes range from 54" to 120" with pipe lengths from 130' to 470' to accommodate the C7 concept (65mph four-lane) provided by HDR, See [Figure 1 on page 3](#) for an example cross section. Pipe lengths were also examined for the C8, C2M, and C2 concepts and are presented in [Table 1 on page 2](#). The proposed lengths pass water through the combined road and railroad embankments or drain to existing railroad culverts except at Potter Creek. The Existing Potter Creek railroad bridge can remain in C2 and C2M concepts but will need to be rebuilt in the C7 and C8 concepts.

Methods and Results:

- Existing site and culvert condition review was performed using the Safer Seward Highway Hub 98.5-118 Sandbox. Existing culvert locations, sizes and conditions were noted from DOT inspections forms available between MP 105-118 and Asbuilt plans for MP 100-105 and MP 99-100 were reviewed for MP 98.5-104.
- Culvert diameters were selected based on each site's design flood event and were standardized where possible for constructability. Site hydrology characteristics were collected with the USGS Stream Stats tool, and the design flood events were calculated with regional regression-based flood frequency estimates for the associated prediction intervals for Alaska and conterminous basins in Canada based on peak-flow data through water year 2012.
 - Pipes were sized to pass the 2% annual exceedance probability flow or 50-year flood with HW/D (headwater over diameter) ratio of ~1.0 and are summarized for each site in [Table 2 on page 2](#).
 - At streams registered in the ADF&G Anadromous waters catalog, there were additional sizing considerations for meeting Tier 1 stream simulation.
 - HDS nomograph procedures were used for preliminary pipe sizing and confirmation of HY-8 pipe sizing and headwater modeling, see [Figure 2 on page 3](#).
- All large pipes sized 60" and greater are expected to be aluminum 9" x 2.5" corrugated structural plate pipe with aluminum bolts to tolerate saltwater exposure. Current pipe cover estimates require a minimum metal thickness of 0.15". The 54" corrugated metal pipes will also require marine tolerant materials and should be gauge 10 or thicker.

Project Memo

- Rabbit creek poses a unique challenge of pipe selection for aquatic organism passage, preventing overtopping during design flood events, and meeting the minimum/maximum pipe cover restrictions. For this exercise flanker or flood relief pipes were evaluated.

LOCATION ^{'FISH PASS'}	MP	C2M STA	Ex. Diam.	Prop. Diam.	Concept Lengths LF			
					C7	C8	C2M	C2
RABBIT CREEK^{AOP}	117.5	1068+50	(3) 60"	141"-86" or 120"	230	250	220	215
RABBIT CREEK FLOOD RELIEF PIPES	117.5	1068+50	-	(4) 60"	230	250	220	215
POTTER CREEK^{AOP}	115	954+60	84"	120"	260*	250*	195	160
MCHUGH CREEK^{AOP}	111.5	778+60	84"	96"	325	305	300	280
RAINBOW CREEK	108.5	605+80	84"	96"	470	510	470	430
WINDY CORNER	107	540+75	(2) 36"	54"	300	260	280	250
FALLS CREEK	105	463+30	84"	96"	210	260	230	220
SUBDIVISION CREEK	104	354+75	54"	54"	320	300	315	190
BALL FIELD CREEK	103	312+70	54"	54"	140	150	145	110
BEAR CREEK	100.5	194+55	108"	54"	325	350	325	270

*NOTE: POTTER CREEK C7 AND C8 LENGTHS DO NOT INCLUDE NEW RAILROAD BRIDGE.

LOCATION	MP	C2M STA	Drainage Area (sqmi)	Mean Annual Precip (in)	1% Chance Exceedance (cfs)	2% Chance Exceedance (cfs)
RABBIT CREEK^{AOP}	117.5	1068+50	21.3	27	1,330	1,140
POTTER CREEK^{AOP}	115	954+60	3.4	24	317	266
MCHUGH CREEK^{AOP}	111.5	778+60	6.0	34	626	534
RAINBOW CREEK	108.5	605+80	4.8	32	508	431
WINDY CORNER	107	540+75	0.2*	27*	43.5	35.6
FALLS CREEK	105	463+30	2.4	35	327	276
SUBDIVISION CREEK	104	354+75	0.7	29	115	95.5
BALL FIELD CREEK	103	312+70	0.5	29	89.9	74.3
BEAR CREEK	100.5	194+55	0.6	31	108	89.7

Project Memo

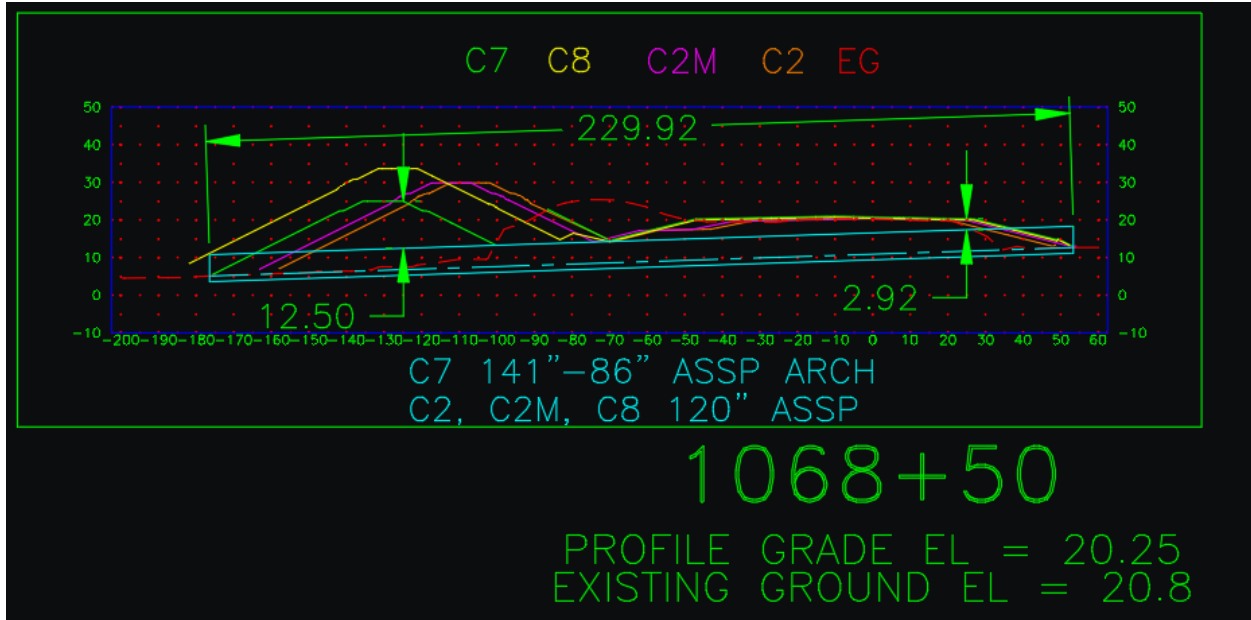


Figure 1. Sample Cross Section view for Rabbit Creek showing all concept surfaces and sizing for C7.

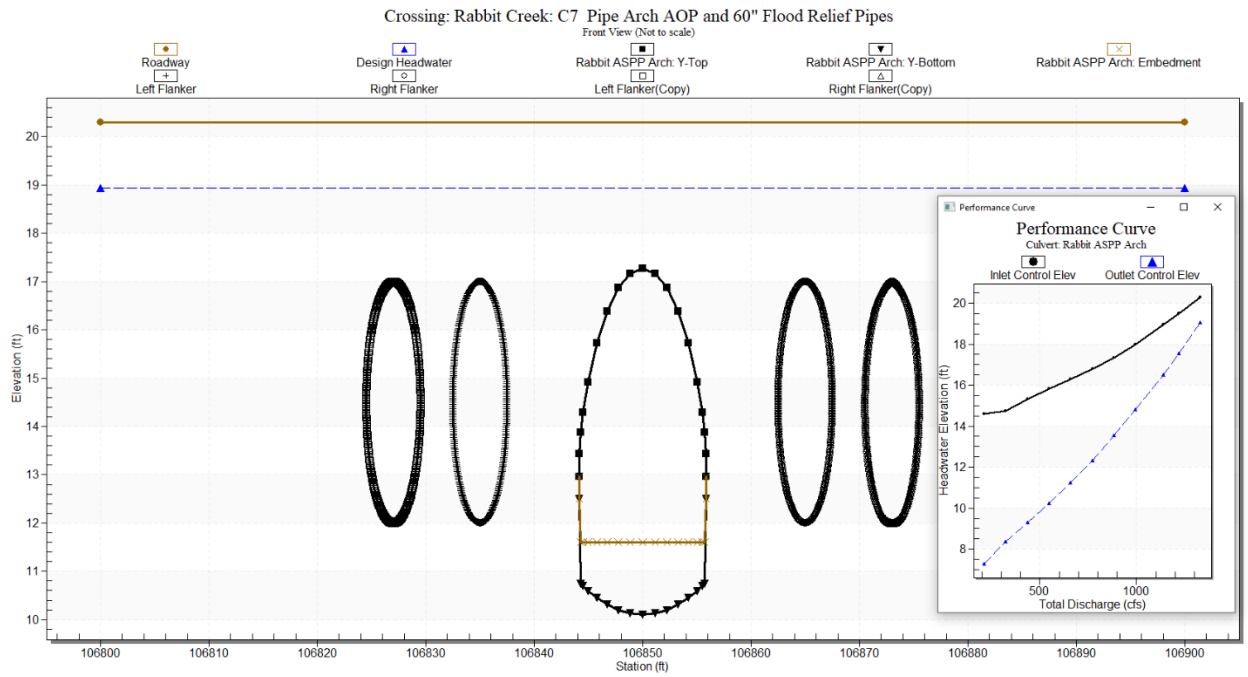


Figure 2. Pipe end View for HY-8 modeling at Rabbit Creek Culvert Crossing and Performance Curve

This page is intentionally left blank.

Appendix C. LHS Support Tech Memo – 100-year Floodplain Mapping

This page is intentionally left blank.

Safer Seward Hwy MP 98.5-118 LHS Analysis Update Tech Memo

To: Edith McKee and Irene Turletes

Deliverable Date: 12/24/2024

From: Michael Baker International (Michael Baker)

Subject: LHS H&H Support

Overview:

Michael Baker has performed preliminary floodplain mapping analysis to support the Safer Seward Highway (SSH) MP 98.5-118 Location Hydraulic Study required for the Environmental Assessment. The following summary outlines the approaches used and provides tables detailing data sources, modeling methods, and controlling elevations for use alongside the georeferenced linework mapping the 100yr flood extent boundaries. The extent of the boundaries upstream and downstream of the existing Seward Highway were selected based on reviewing the C7T V1.5 footprint and noting where it would encroach within the 100-yr floodplain boundaries of stream crossings designated as bridges or large diameter culverts (greater than 48-inch diameter). This floodplain mapping is provisional for use in the project's early development phase.

Table 1 documents the primary method of flood boundary determination using existing FEMA flood mapping data, 1D HEC-RAS modeling of the river reach near the roadway, a culvert hydraulics assessment (HY-8), and/or normal depth analysis. Table 1 also notes the data sourced from the SSH sandbox and relevant tidal water values used for determining the 100-year flood extent. Table 2 summarizes the key values at each site for the HY-8 analysis and resulting Headwater elevation.

Conflicting adjustments to go between the project vertical datum ("NGVD 1929 - 1967/1968 NGS Tentative Adjustment") and the NAVD88 vertical datum have been observed from previous work. DOT Plans and the MOA 2015 LiDAR study show elevations for vertical control points in the Anchorage 72 Datum that match the project's "NGVD29 - 1967/1968 NGS Tentative Adjustment" and show the adjustment from NAVD88 to the project datum as -6.52 feet. The 2017 Tidal Elevations in Turnagain Arm Study reports the adjustment from NAVD88 to the project datum as -5.98 feet. For the calculations in the preliminary exercise -6.5 feet was used as the adjustment. For example, if the MHW elevation in the Sandbox was at 18 feet, the converted value in the project's datum used for flood mapping was 11.5 feet.

For this analysis, MHW elevations were extracted from the SSH Sandbox at each and increased by 0.74 feet to approximate MHHW. The value 0.74 feet was selected based on the results of the Windy Corner DOWL study for Seward Highway Milepost 105-107 Project: Tidal Observation Data at Windy Corner. Values were rounded to the nearest quarter foot for presenting data in the following tables.

TABLE 1: METHODS AND TIDE VALUES FOR CROSSINGS >4FT

LOCATION 'FISH PASS'	MP	Modelling Approach and NAVD88 Elevations from SSH Sandbox
RABBIT CREEK^{FP}	117.5	FEMA model, zone AE study focused on upper sections of Rabbit Creek with BFE extending into Potter's Marsh, completed in the 1970s. 100-year floodplain from DFIRM. No additional modeling.
POTTER CREEK^{FP}	115	Culvert Hydraulic Analysis and 1D HEC-RAS model with 100yr flow estimates from USGS Stream Stats to establish headwater at existing highway culverts and MHHW tailwater conditions of 18.5 feet NAVD88, upstream of railroad bridge. HECRAS 1D modeling for reaches upstream of existing highway with downstream boundary condition set to headwater elevation.
MCHUGH CREEK	111.5	Culvert Hydraulic Analysis on 2024 As-built lower pipe and CIPP overflow pipe with 100yr flow estimates from USGS Stream Stats and MHHW tailwater conditions of 19.25 feet NAVD88.
RAINBOW CREEK	108.5	Culvert Hydraulic Analysis with 100yr flow estimates from USGS Stream Stats and MHHW tailwater conditions of 20.25 feet NAVD88
WINDY CORNER	107	Culvert Hydraulic Analysis and 1D HEC-RAS model with 100yr flow estimates from USGS Stream Stats and MHHW tailwater conditions of 21.5 feet NAVD88.
FALLS CREEK	105	Culvert Hydraulic Analysis and 1D HEC-RAS model with 100yr flow estimates from USGS Stream Stats and MHHW tailwater conditions of 21.5 feet NAVD88.
SUBDIVISION CREEK	104	Culvert Hydraulic Analysis with 100yr flow estimates from USGS Stream Stats and MHHW tailwater conditions of 22.5 feet NAVD88.
INDIAN CREEK BRIDGE	103	FEMA Model, Zone AE study LOMR 99-10-172P, shared by DOT. No additional modeling.
BALL FIELD CREEK	103	Culvert Hydraulic Analysis and 1D HEC-RAS model with 100yr flow estimates from USGS Stream Stats. Culvert outlets at ~62 feet, and MHHW tailwater conditions of 22.5 feet NAVD88, no tidal influence on culvert HW.
BIRD CREEK BRIDGE	101.5	Supplemented FEMA zone A study with 1D HEC-RAS model. Upstream terrain from the ANC 2015 Lidar, MHHW downstream boundary condition of 23.25 feet NAVD88, and 100yr flow estimates from USGS Stream Stats.
BIRDHOUSE CR^{FP} A.K.A. BEAR CR^{FP}	100.5	Culvert Hydraulic Analysis and 1D HEC-RAS model with 100yr flow estimates from USGS Stream Stats. Roadway culvert outlets at ~50', and MHHW tailwater conditions of 23.25 feet NAVD88, no tidal influence on culvert HW, but influences flood boundary downstream.

LHS Support Memo- Draft

TABLE 2: SITE HYDROLOGY AND EXISTING CULVERT HY-8 HEADWATER MODELING

LOCATION	MP	1% AEP Discharge (cfs)	D/S El. Control	Culvert Condition	Project's Vertical Datum		NAVD88 Approx. HW El. ft (PD+6.5')
					D/S Water El. ft	1% Discharge HW El. ft	
<i>RABBIT CREEK</i>	117.5	1,330	MHHW	Overtops Road	12	> 20.3	>26.8
<i>POTTER CREEK</i>	115	317	MHHW	Inlet Control	12	21.1	27.6
<i>MCHUGH CREEK</i>	111.5	626	MHHW	Outlet Control	12.75	25.2	31.7
<i>RAINBOW CREEK</i>	108.5	508	MHHW	Inlet Control	13.75	35.3	41.8
<i>WINDY CORNER</i>	107	43.5	MHHW	Inlet Control	15	50.4	56.9
<i>FALLS CREEK</i>	105	327	MHHW	Inlet Control	15	40.5	47.0
<i>SUBDIVISION CREEK</i>	104	115	MHHW	Inlet Control	16	39.9	46.4
<i>BALL FIELD CREEK</i>	103	90	Normal Depth	Inlet Control	NA	60.2	66.8
<i>BIRDHOUSE CR - HWY</i>	103	108	Normal Depth	Inlet Control	NA	51.3	57.8
<i>BIRDHOUSE CR - BIKE PATH</i>	101.5	108	Hwy Culvert	Inlet Control	51.3	56.2	62.7
<i>BIRDHOUSE CR - DRIVEWAY</i>	100.5	108	Normal Depth	Inlet Control	NA	64.5	71.0

This page is intentionally left blank.