

Appendix E

Preliminary Location Hydraulic Study



Prepared for:



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Department of Transportation and
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February 2014

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Acronyms and Abbreviations

FEMA	Federal Emergency Management Administration
NFIP	National Flood Insurance Program
LHS	<i>Location Hydraulic Study</i>
DOT&PF	Alaska Department of Transportation and Public Facilities
FHWA	Federal Highway Administration
EIS	Environmental Impact Statement
FIRMS	Flood Insurance Rate Maps
USACE	U.S. Army Corps of Engineers
MP	Milepost

1 Introduction

This preliminary *Location Hydraulic Study* (LHS) was prepared to determine whether and where the reasonable alternatives (the four build alternatives) for the proposed Sterling Highway Milepost (MP) 45 to 60 Project encroach onto the mapped 100-year or base floodplain and associated floodways. The study also compares the encroachments of the four build alternatives with those of the existing roadway (the No Build Alternative).

2 Project Description

The Sterling Highway is the only road connection to the western and southern portions of Alaska’s Kenai Peninsula. Because of growing populations in Kenai Peninsula communities and greater recreational pressure in the area, residential, commercial, and tourist vehicle traffic on the Sterling Highway is increasing. In response to these changes, much of the Sterling Highway has been upgraded to current design standards. The portion of the highway between MP 45 and 60 has not seen any substantial upgrade since it was first constructed in the 1950s.

From MP 45 to 60, the Sterling Highway is located in the Kenai Peninsula Borough (Borough) about 100 highway miles south of Anchorage, Alaska. Constrained by rugged mountain topography, this segment of the Sterling Highway is situated in the Kenai River Valley and in many places is immediately adjacent to the Kenai River. Cooper Landing, an unincorporated community of about 300 people, is located along the highway at approximately MP 48.

In order to meet current design standards and reduce traffic congestion along this corridor, the Alaska Department of Transportation and Public Facilities (DOT&PF), in conjunction with the Federal Highway Administration (FHWA), is preparing a supplemental draft environmental impact statement (EIS) for the Sterling Highway MP 45 to 60 Project. The primary goal of this project is to improve the Sterling Highway in the Cooper Landing and Kenai River area so that it meets current “rural principal arterial” standards and thereby reduces congestion and improves safety.

3 Definitions

Base Flood: The base flood is defined as the 1-percent annual chance flood, also known as the “100-year flood.” An event of the magnitude of the base flood or greater has a 1 percent chance of occurring any year.

Flood Hazard Area: Same as “Mapped Floodplain.” The area inundated by the base flood that has been identified by the Federal Emergency Management Administration (FEMA) and is managed as part of the National Flood Insurance Program (NFIP).

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 defined by mapping.

Mapped Floodplain: A regulatory or managed floodplain is called a Mapped Floodplain in this document. FEMA has adopted the 1-percent annual chance flood as the base flood for flood insurance and management purposes. Therefore, the FEMA mapped floodplain corresponds to the area that would be inundated by the base flood. FEMA has mapped floodplains on a portion of the Kenai River. Floodplains are mapped using approximate or detailed methods.

Approximate studies yield floodplains that have no water surface elevations associated with them. Detailed studies provide water surface elevations at intervals along the floodplain. Development on a mapped floodplain is subject to Borough Floodplain Ordinances 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 called “Flood Hazard Areas.” Mapped floodplains can be found on Flood Insurance Rate Maps (FIRMS). At this time, the FEMA 1981 mapped floodplain is the effective regulatory floodplain. The U.S. Army Corps of Engineers (USACE) has conducted studies updating the mapped floodplain in a portion of this area, but until FEMA and the Borough adopt the map, it is considered preliminary. For this document, both the “effective” mapped floodplains and “preliminary” mapped floodplains are considered; see Section 4.3.

Regulatory 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 when the floodplain is unencroached. If the floodplain were completely blocked off up to the floodway margins, the base flood elevation would be increased by no more than 1 foot (some communities allow less of an increase). The floodway is a regulatory tool that helps the community to determine whether a proposed development will increase flood hazards. Typically, encroachments on floodplains are allowed only if the developer can show that it will not cause more than a 1-foot increase in base flood elevations (see Figure 1). Encroachments on floodways are typically not allowed unless the developer can show that they will cause no increase in base flood elevations. An encroachment on a floodplain outside of a floodway by definition can cause less than a 1-foot rise in base flood elevations, as long as the floodway is left clear.

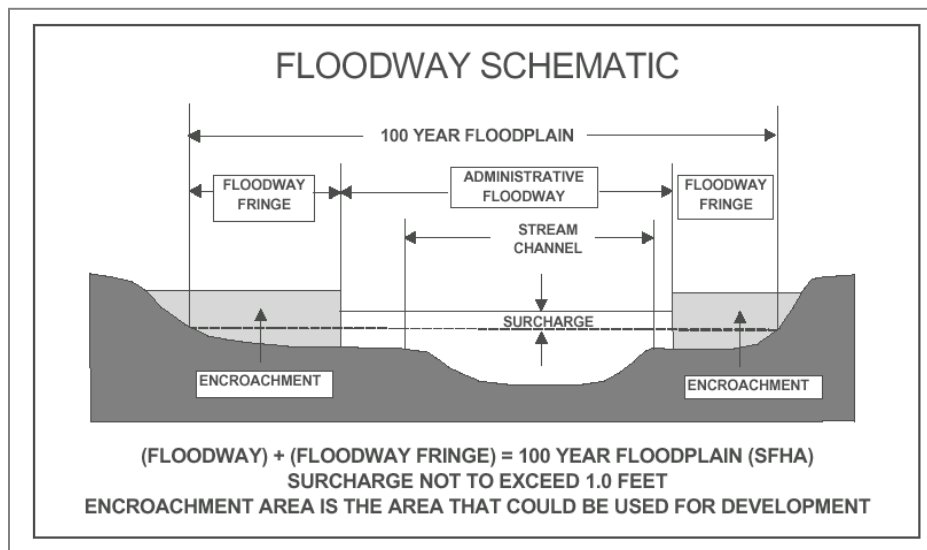


Figure 1. Illustration of a floodplain with a floodway

The FEMA 1981 mapping does not identify a regulatory floodway within the study area. The USACE preliminary mapping does identify a floodway in the area they studied in the upper Kenai River. See Figure 2.

4 Regulatory Setting

4.1 Federal Regulations

The FHWA requires an LHS during the planning of highway improvements where construction may encroach on mapped floodplains or regulatory floodways (Title 23, Code of Federal Regulations, Part 650, Subpart A). The purpose of the LHS is to determine whether a highway location alternative encroaches on a regulatory floodplain/floodway, whether there are practicable alternatives to this encroachment, and mitigation measures to minimize environmental impacts of encroachments on floodplains. The studies necessary where a proposed highway encroaches on a regulatory floodway or mapped floodplain include hydraulic design, right-of-way, and flood insurance studies. This document is a preliminary LHS, documenting the potential encroachments of all alternatives. Hydraulic design and flood insurance studies will take place during the design process after an alternative has been selected. Where the highway would encroach on an unidentified floodplain, the *Alaska Highway Drainage Manual* states that design standards outlined in 23 CFR 650 A should be followed. This document does not take into account unidentified floodplains that may be impacted by the project, especially the segment west of MP 55 which abuts the Kenai River.

4.2 Kenai Peninsula Borough Floodplain Regulations

The Kenai Peninsula Borough Floodplain Administration has adopted codes and ordinances that regulate construction and improvements in mapped floodplains and regulatory floodways within the Borough. For all encroachments on mapped floodplains, the agency must obtain a floodplain permit from the Borough. Encroachments on regulatory floodways are typically prohibited unless it is shown that the encroachment would not increase base flood elevations (Borough Code, Section 21.06.030).

4.3 Effective and Preliminary Floodplain Mapping

The project area runs approximately from MP 45 to MP 60. There are mapped floodplains on portions of the Kenai River, Russian River, and Cooper Creek within the project area but not throughout the project area. The boxed area shown on Figure 2 illustrates the area in which floodplains have been mapped (FIRM Panels 2125A and 2150A), and this is the study area for the preliminary LHS. These floodplains were mapped by approximate methods and adopted in 1981. This mapping is referred to as FEMA 1981 mapped floodplains within this report. No regulatory floodways have been adopted in the project area.

It is important to note that there are some discrepancies between the FEMA 1981 mapped floodplain and the existing Kenai River channel at Schooner Bend and downstream for approximately three miles. Also, mapped floodplains are updated on occasion, and any segments of alternatives located near the river but currently outside the mapped floodplain may in the future be considered floodplain encroachments. Finally, the project would encroach on the Kenai River floodplain in areas where there is no official “mapped floodplain;” these areas are not addressed in this document, but all culverts, bridges, and longitudinal fill in floodplains are designed to accommodate the base flood and to avoid the rise in water surface elevation during storm events.

The USACE completed a detailed study of a portion of the Kenai River in the Cooper Landing Area in 2010, updated the floodplain boundaries, calculated base flood elevations, and delineated

a floodway. The USACE study area includes only the east half of the FEMA 1981 mapped area and only the Kenai River (see Figure 2). This study has not yet been accepted by FEMA and thus has not been adopted by the Borough, but it likely will be adopted in the near future. This preliminary LHS considers both the effective FEMA 1981 floodplain mapping and the preliminary USACE 2010 floodplain update mapping for the Cooper Landing area.

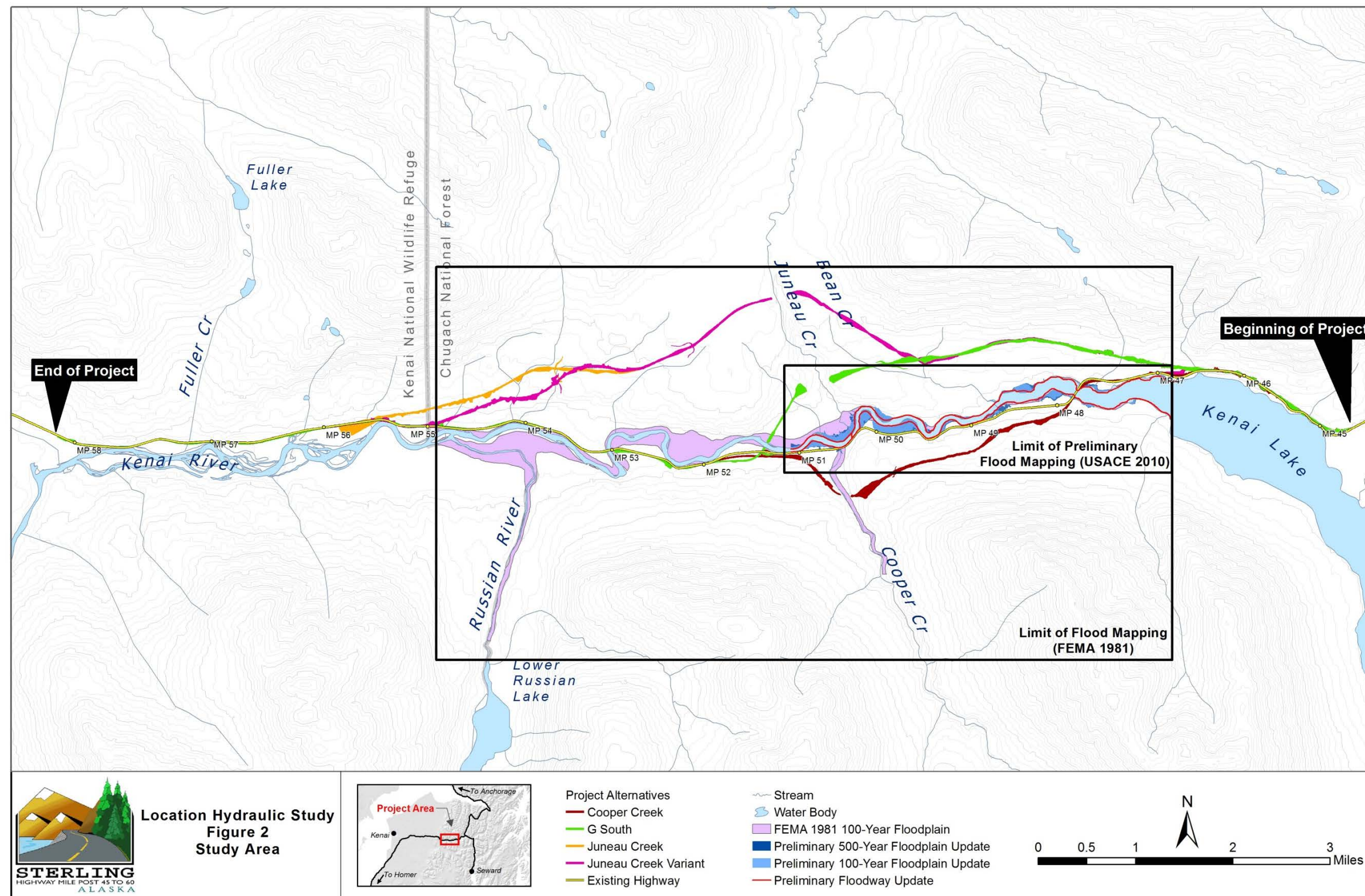


Figure 2. Location Hydraulic Study – study area

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5 Floodplain Encroachment

5.1 Floodplain Encroachment Evaluation Method

Existing NFIP mapping obtained from the FEMA map Service Center and preliminary mapping produced by the USACE and obtained from the Borough’s Kenai River Center were used to determine whether a proposed alternative would encroach on a mapped floodplain. Total acres of mapped floodplain encroachments for each alternative are listed in Table 1, as well as preliminary USACE floodplain and floodway encroachments.

Each of the build alternatives would have varied impacts to floodplains within the project area. Both the Cooper Creek Alternative and the G South Alternative propose new bridges to be constructed within the official and preliminary mapped floodplains and floodway. For the Cooper Landing Bridge under the Cooper Creek Alternative, construction would occur within the preliminary floodway. The fill embankment required for these bridges is accounted for in the encroachment calculations; however, the area of impact for bridge piers is not. Preliminary engineering conducted to date does not include that level of detail. The additional area of impact from bridge piers would have a negligible additional effect and would ultimately be accounted for during final design and permitting. The new bridges over Juneau Creek required for the Juneau Creek or Juneau Creek Variant alternative would not affect mapped floodplains.

Where encroachment would occur, the steps necessary to comply with Federal and local regulations are briefly described.

Table 1. Area of Mapped Floodplain Encroachment for Each Build Alternative

Alternative	Approximate Encroachment Area in FEMA 1981 Mapped Floodplains (acres)	Approximate Encroachment Area in Preliminary USACE Floodplains (acres)	Approximate Encroachment Area in Preliminary USACE Floodway (acres)
Cooper Creek	5.1	0.5	0.06
G South	6.2	0	0
Juneau Creek	0	0	0
Juneau Creek Variant	<0.01	0	0

Source: Geographic Information System (GIS) analysis by HDR, 2013.

5.1.1 No Build Alternative

Construction of the existing Sterling Highway in the project area predated current regulatory floodplain maps. Therefore, comparative floodplain encroachment data are not applicable to the No Build Alternative and are not included in this evaluation. Also, the as-built footprint of the existing highway is not available. However, Figure 3 is provided to illustrate the overlap of the existing highway right-of-way (not footprint) with the Kenai River floodplain.

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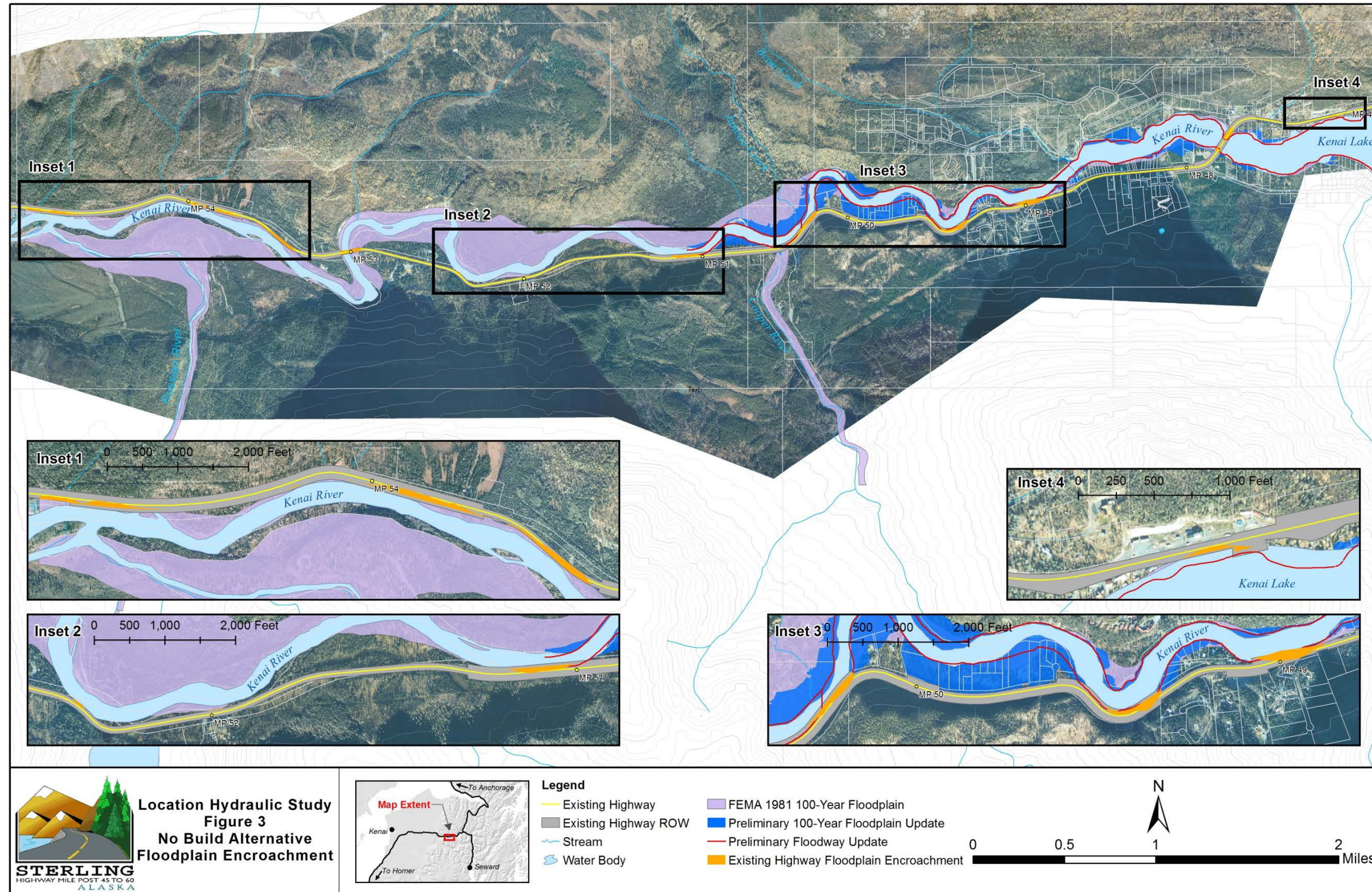


Figure 3. No Build Alternative, floodplain encroachment by the existing right-of-way

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5.1.2 Cooper Creek Alternative

The proposed footprint of the Cooper Creek Alternative intersects FEMA 1981 mapped floodplains of the Kenai River in seven places: two bridge crossings and five longitudinal encroachments where the cut and fill footprint of the alignment intersects the floodplain (Figure 4). Should this alternative be chosen, DOT&PF would need to obtain a floodplain permit and perform hydraulic calculations to show that floodplain encroachments on all affected water bodies would not increase base flood elevations over existing conditions.

The Cooper Creek Alternative would replace the existing Cooper Landing Bridge with a longer bridge immediately adjacent the existing structure. The new Cooper Landing Bridge would involve approximately 0.6 acre of fill within the FEMA 1981 floodplain. Based on the preliminary USACE 2010 floodplain mapping, the area would be approximately 0.5 acre. The bridge approaches would also encroach upon approximately 0.06 acre of the preliminary floodway; however, because its spans would be longer than the existing bridge spans, flood conveyance capacity would be increased over existing conditions, resulting in a net benefit to the floodplain function. Floodway encroachments would be developed pursuant to Borough Code, Chapter 21.06.050, and therefore would not result in any increase in flood levels during the occurrence of a base flood discharge.

South of the Kenai River, the proposed alignment would cross Cooper Creek and its mapped (FEMA 1981) floodplain upstream of the existing Cooper Creek Bridge. The new Cooper Creek Bridge abutments and associated fill would be placed outside of the mapped floodplain, leaving only bridge piers within the floodplain, but outside of the active stream channel.

The crossing of the Kenai River and replacement of Schooner Bend Bridge at MP 53 would be located approximately 80 feet downstream of the existing bridge. The new Schooner Bend Bridge would be slightly longer than the existing bridge. Fill associated with the abutment of the new bridge would encroach on approximately 0.5 acre of the FEMA 1981 floodplain. The old bridge and piers would be removed.

Longitudinal encroachments on floodplains would occur on the floodplain fringe where the alternative's footprint is wider than the existing footprint. Floodplain encroachment would result from placement of fill and riprap, and installation of culverts to accommodate road widening. Five encroachments would occur within the official floodplain (at MPs 47.2, 52, 53.5, 53.9, and 54.7), with a total area of impact of approximately 4 acres.

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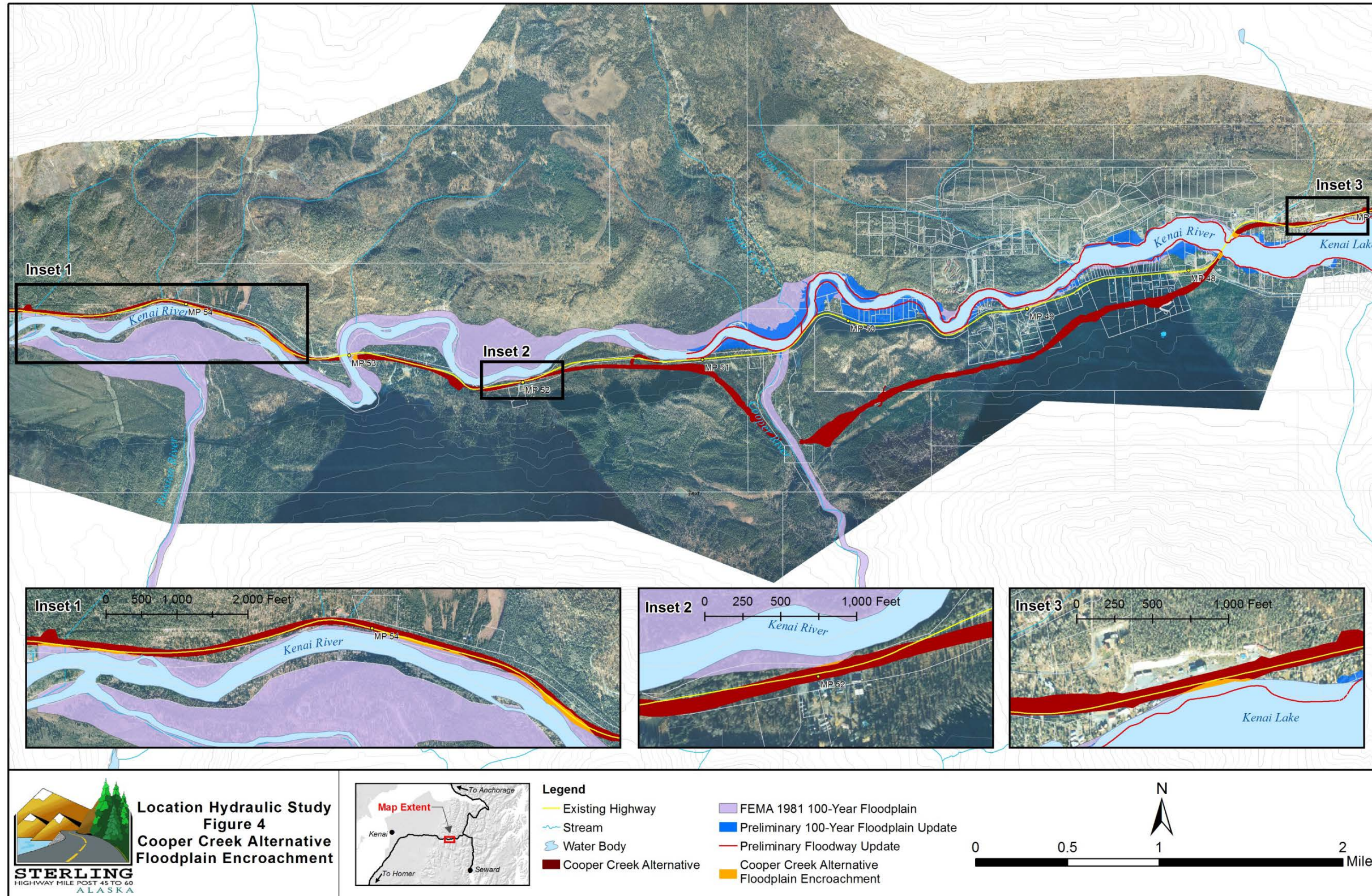


Figure 4. Cooper Creek Alternative floodplain encroachment

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5.1.3 G South Alternative

The proposed footprint of the G South Alternative would encroach on approximately 6.2 acres of the Kenai River effective (FEMA 1981) floodplain in six locations: two new bridges and four longitudinal encroachments where the cut and fill footprint of the upgraded alignment is wider than the current highway (Figure 5). The G South Alternative alignment does not approach the Kenai River in the section the USACE studied in 2010, therefore there would be no change to estimated impacts should FEMA adopt the preliminary mapping.

The 0.5 acre of floodplain impacts from the proposed Schooner Bend Bridge are identical to those described for the Cooper Creek Alternative (see Section 5.1.2). There are four locations of longitudinal encroachments to the Kenai River (at MPs 52, 53.5, 53.9, and 54.7) totaling 3.74 acres of impact to Kenai River floodplain.

The G South Alternative includes a new bridge over Juneau Creek, which does not have a mapped floodplain, and a new bridge over the Kenai River. Fill placed into the floodplain to construct the Kenai River Bridge abutments would affect approximately 1.9 acres of the mapped floodplain.

If this alternative were chosen, DOT&PF would need to obtain a floodplain permit and determine the impact of the proposed bridge and fill on base flood elevations.

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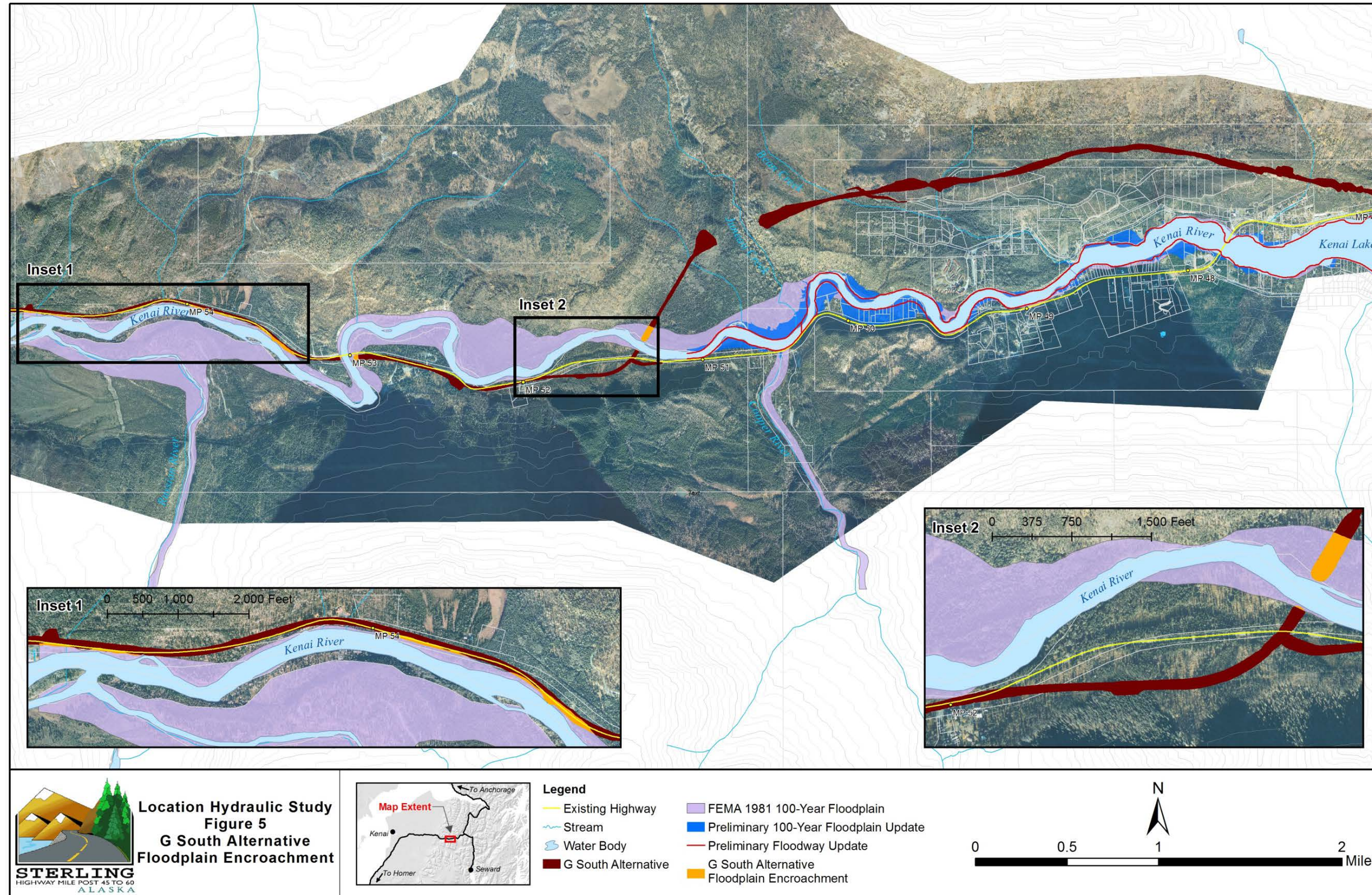


Figure 5. G South Alternative floodplain encroachment

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5.1.4 Juneau Creek Alternative

The proposed footprint of the Juneau Creek Alternative would not encroach on the Kenai River or other mapped floodplains, including both the FEMA 1981 mapped floodplains and or the USACE preliminary floodplain or floodway (Figure 6).

5.1.5 Juneau Creek Variant Alternative

The proposed footprint of the Juneau Creek Variant Alternative includes a <0.01-acre longitudinal encroachment on the effective (FEMA 1981) Kenai River mapped floodplain at approximately MP 54.9 (Figure 6). This alternative would not require bridge crossings of any regulatory floodplains. If the Juneau Creek Variant Alternative were selected as mapped, the DOT&PF would need to obtain a floodplain permit for the fill encroachments. Alternatively, because the impact area is so small, it may be possible to alter the design to avoid any floodplain impacts.

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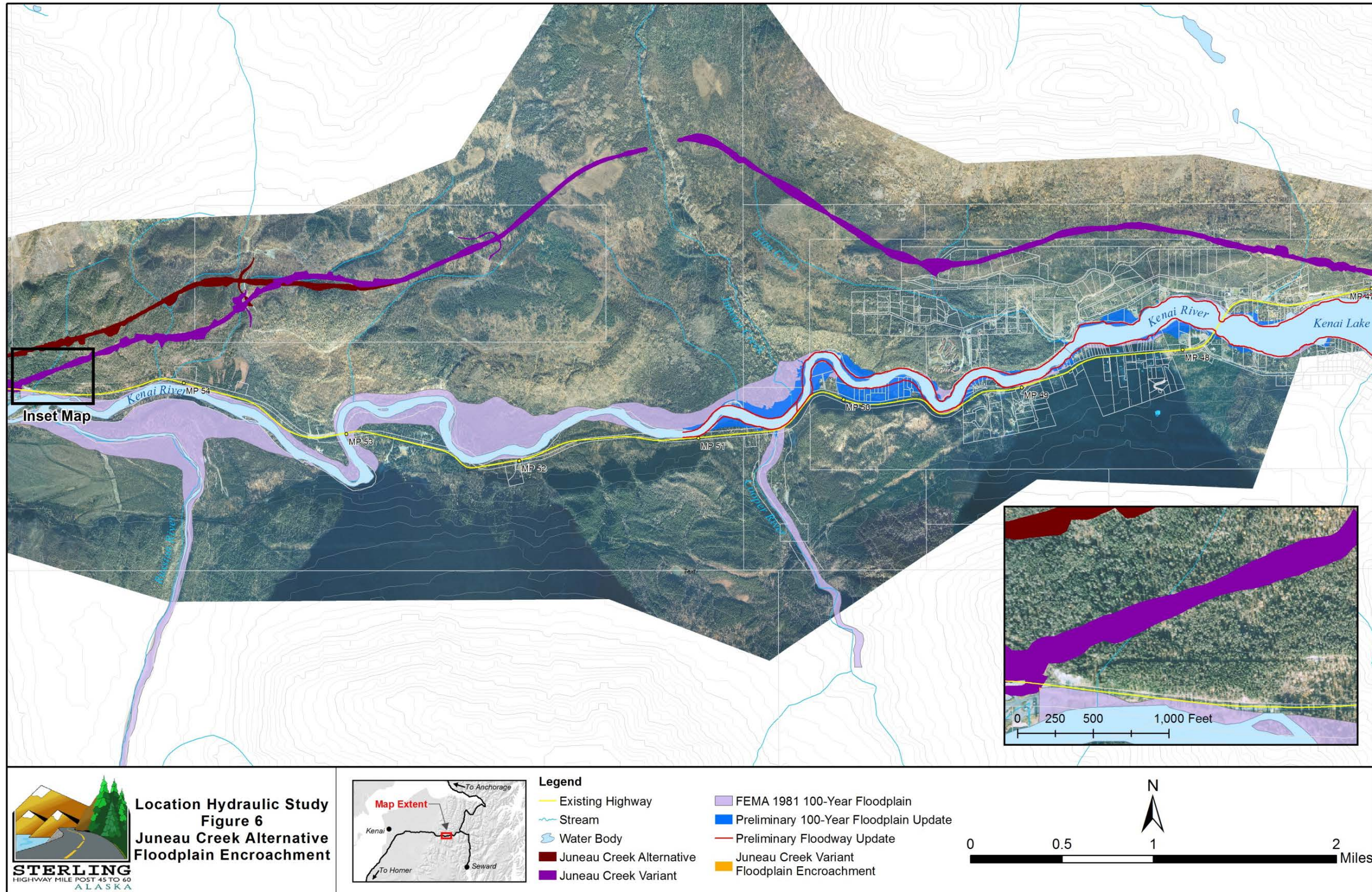


Figure 6. Juneau Creek Alternatives floodplain encroachment

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5.2 Risks Associated with Implementation

In general, risks associated with floodplain encroachment increase with increased encroachment. Where these encroachments do occur, they have the potential to increase flood elevations and velocities during flood events. Structures and portions of the highway that encroach on floodplains are also more likely to sustain damage or fail during overtopping events.

Longitudinal encroachments are minimal for each alternative. The risk of flows overtopping the highway is somewhat less for the Cooper Creek and G South alternatives than for the No Build Alternative, as each of these includes segments that leave the river corridor. Risks associated with encroachment are least for the Juneau Creek alternatives, which do not cross the Kenai River. A detailed analysis of the potential for increased flood hazards and mitigation will be necessary when an alternative has been selected.

5.3 Floodplain Impact Minimization and Mitigation

Measures to minimize negative effects to floodplains, mapped or unmapped, are incorporated in the alternatives. These include locating alignments away from floodplains, increasing bridge lengths at new crossings, and upgrading cross-drainage through culvert placement. Additional measures will be implemented during the design phase when an alternative is selected.

Little or no change to historic drainage patterns is expected within or downstream of the project area. Impacts to the floodplain are minimized by following standard stream crossing design criteria and avoiding direct impacts on stream channels.

5.4 Steps to Completing an LHS if an Alternative with Encroachment is Selected

The *Alaska Highway Drainage Manual* describes the necessary steps if a mapped floodplain or regulatory floodway encroachment, such as that proposed under the Cooper Creek Alternative, is to be accepted. For a regulatory floodway, DOT&PF would first need to show that there is no practicable alternative to placing abutment fill within the floodway, and that the floodway could not be modified to accommodate the fill without causing more than a 1-foot increase in water surface elevations. DOT&PF would then need to work with affected property owners and the community to mitigate any flooding risks associated with encroaching on the floodway, and would need to update flood maps and flood profiles for the area. These studies would be performed at a later stage of design if the Cooper Creek Alternative were chosen and if floodway encroachment could not be avoided. For encroachments to mapped floodplains that do not have a regulatory floodway, DOT&PF would need to determine the impacts of the proposed encroachment on the floodplain, determine any hazards to property, and coordinate with FEMA and the Borough to update flood maps if increased base flood elevations were anticipated.

6 Conclusions

Each alternative, with the exception of the Juneau Creek and No Build alternatives, would encroach on mapped floodplains and thus would require detailed hydraulic analysis, floodplain permits, and coordination with FEMA during the design phase of the project. No significant longitudinal encroachments are proposed in the four build alternatives.

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