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SUSITNA-WATANA HYDRO

Susitna-Watana Hydroelectric Project (FERC No. 14241)

Technical Memorandum: Adjustments to Middle River Focus Areas

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

R2 Resource Consultants, Inc.

May 2013

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LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
ADF&G	Alaska Department of Fish and Game
AEA	Alaska Energy Authority
FA	Focus Area
FERC	Federal Energy Regulatory Commission
IFSTT	Instream Flow Study Technical Team
MR	Middle River
PRM	Project river mile
Project	Susitna-Watana Hydroelectric Project, FERC Project No. 14241
RSP	Revised Study Plan
SPD	Study Plan Determination
TWG	Technical Workgroup

1. INTRODUCTION

On April 1, 2013 the Federal Energy Regulatory Commission (FERC) issued its Study Plan Determination (SPD) for 14 of the 58 proposed individual studies in the Alaska Energy Authority's (AEA) Revised Study Plan (RSP) for the Susitna-Watana Hydroelectric Project, FERC Project No. 14241 (Project). When approving the Fish and Aquatics Instream Flow Study (Study 8.5), FERC's April 1 SPD made the following recommendation:

> *We recommend that AEA: (1) consult with the TWG and select an appropriate focus area within MR-2 to eliminate from the study; (2) consult with the TWG and establish an additional focus area in geomorphic reach MR-7 that is sufficient for conducting interdisciplinary studies, possibly near Lower McKenzie Creek or below Curry on old Oxbow II; and (3) file a detailed description of the changes to the proposed focus area locations in MR-2 and MR-7 by May 31, 2013, and include in the filing documentation of consultation with NMFS, FWS, and Alaska DFG, including how the agency comments were addressed.*

AEA has completed these recommended tasks. As recommended, this technical memorandum provides the detailed description of the changes to the proposed focus area locations in MR-2 and MR-7 is provided in the Adjustments to Middle River Focus Areas Technical Memorandum.

In the March 26-27, 2013 Technical Workgroup (TWG) meetings, a series of Instream Flow Study Technical Team (IFSTT) meetings were proposed to allow agency and AEA scientists to confer on technical details and address agency comments and concerns regarding planned 2013-2014 sampling and analysis issues.

During the April 26, 2013 IFSTT meeting, consistent with the FERC recommendation, AEA conferred with the TWG representatives concerning the changes to the Focus Area locations (see Meeting Notes in Appendix 1).

An earlier version of this technical memorandum was developed to evaluate potential responses to the FERC recommendation and to serve as a starting point for the IFSTT discussion on April 26. The earlier version provided background information on potential adjustments to Focus Areas (FAs) in the Middle River (MR) Segment, but did not propose a specific action. The earlier version contained information on the distribution of habitat types and fish species in the affected geomorphic reaches and in potential new study areas to serve as a guide in evaluating alternative FA revisions.

This technical memorandum contains some additional background information that was used in evaluating the candidate FAs, presents the results of the IFSTT meeting, and describes AEA's adjustments to FA locations. Maps of the ten final MR Focus Areas are provided in Appendix 2.

1.1. Background

Preliminary habitat mapping of the Middle River Segment of the Susitna River was completed in 2013 using a combination of geo-rectified aerial imagery (2011 Matsu Ortho Imagery at 1:8000 scale. http://matsu.gina.alaska.edu/wms/imagery) in combination with High Definition aerial videography that was taken of the river in August 2012 (≈ 10,000 cfs) (HDR 2013). The results of the habitat mapping provided a spatial depiction of the distribution of habitat types and

features throughout the entire length of the Middle River Segment. Specific habitat types were digitized using ARC GIS and lineal distances computed of each discrete habitat feature. Selection criteria for the ten original FAs in the Middle River considered the following:

- All major habitat types (main channel, side channel, side slough, upland slough, tributary delta) should be sampled within each geomorphic reach.
- At least one (and up to three) FA(s) per geomorphic reach (excepting geomorphic reaches associated with Devils Canyon – MR-3 and MR-4) that is/are representative of other areas should be studied.
- Areas that are known (based on existing and contemporary data) to be biologically important for salmon spawning and/or rearing will be sampled (i.e., critical areas).
- Some areas for which little or no fish use has been documented, or for which information on fish use is lacking, will also be sampled.

The ten original FAs are detailed in Table 1 and displayed in Figure 1.

In the previous FA technical memorandum (R2 Resource Consultants 2013a), results of the preliminary habitat mapping were used to evaluate the "representativeness" of the proposed FAs with respect to other areas of the river. In this context, representativeness specifically refers to how well habitat units within the FAs represent habitat units outside of these areas within the same geomorphic reach. A suite of scaled metrics were identified and developed that were used in a comparative analysis of the representativeness of habitat types within and outside of FAs (Table 2).

Representativeness was examined by 1) comparing the representation of habitat types within the FAs to the representation of habitat types in the entire geomorphic reach; 2) determining if the habitat types have been proportionately represented (focus vs. non-focus areas); 3) determining if there was a bias in the habitat types that were selected in the FAs; and 4) evaluating whether a random systematic approach in the selection of FAs would yield different results than the selection process and criteria applied to the current FAs.

The technical memorandum concluded that the set of FAs was generally representative, although some habitat types in some geomorphic reaches were not represented. There was no evidence of bias towards specific habitats in the selection of FAs, and a systematic random selection of FAs would not have been perceptibly better in terms of representativeness or bias.

1.2. Objectives

The objective of this technical memorandum is to describe the background material and rationale used to support AEA's decision to move one of the MR-2 FAs proposed in the RSP to Geomorphic Reach MR-7. AEA discussed the implications of several options with the TWG and sought the input of the TWG during the April 26, 2013 meeting.

Specific objectives of this technical memorandum include:

- Describe options for eliminating one of the MR-2 FAs;
- Describe options for adding a FA to MR-7, including:

  - Modeling an area "near Lower McKenzie Creek" as recommended by agency comments (FERC 2013, p B-89);
  - Modeling an area "below Curry on Old Oxbow II" as recommended by agency comments (FERC 2013, p B-89);
  - Modeling an area that includes the Lane Creek confluence, either by establishing a new FA or by expanding FA-115;
  - Modeling other areas such as the Chase Creek confluence (Project river mile [PRM] 110.5), Old Oxbow I (PRM 113.7), or other areas identified in consultation with the TWG.
- Describe the final FA boundaries, including the relocation of one FA from Geomorphic Reach MR-2 to MR-7 and minor revisions to the boundaries of FA138.

1.3. Selection Strategy

The underlying strategy applied in the selection of the FA to eliminate from MR-2 was to minimize the detrimental impact to the quality of the overall study, including considerations of habitat representativeness and impacts to study plans other than Fish and Aquatics IFS.

The strategy for selecting the new FA to be added to MR-7 considered 1) the agency concerns as outlined in the FERC determination (2013), and 2) the representativeness of FAs in MR-7 in terms of habitat types.

2. GEOMORPHIC REACH MR-2 FOCUS AREAS

Two FAs were originally proposed within Geomorphic Reach MR-2, FA-173 and FA-171. These FAs were selected based on their representativeness of the reach and the inclusion of a mix of side channel and slough habitat types. There is no existing fish information within these areas because they were not sampled in the 1980s.

The habitats present in Geomorphic Reach MR-2 and the representativeness and proportionality of the habitats in the two existing FAs are presented in Table 3.

FA-173 is 1.8 miles long and is comprised of single main channel, side channel, side slough, and upland slough habitats, and includes a tributary and tributary mouth (Figure 2, Table 3). It is the more complex of the two FAs in MR-2 in terms of habitat, and based on selected metrics is more representative of MR-2 than the other FA (Table 3). FA-173 is also a planned study area for River Productivity.

FA-171 is 1.4 miles long and is comprised of single main channel and side slough habitat, and contains one tributary (Figure 2, Table 3). Each of these habitat types is also represented in FA-173. Plant communities in FA-171 are represented in other Focus Areas. If FA-171 were the only FA in MR-2, side channel and upland slough habitat in MR-2 would not be represented for the modeling results. Also, there would be no mapped tributary mouths. However, FA-171 was specifically selected for representing the simple mainstem channel type without off-channel habitats prevalent in MR-1 and MR-2. Without FA-171, this type of habitat is underrepresented. Options considered for representing this type of habitat include 1) extending the lower boundary

of FA-173 to include a stretch of simpler channel type; 2) use model results from FA-184 in MR-1 to represent the simple channel in geomorphic reach MR-2; or 3) adjusting the weighting of the length of simple channel available in FA-173.

3. GEOMORPHIC REACH MR-7 POTENTIAL FOCUS AREAS

One FA was originally proposed within Geomorphic Reach MR-7 (Figure 3), FA-115. This FA includes Slough 6A, which, based on the 1980s studies, provides high-use juvenile rearing habitat and also includes side channel, upland slough, backwater, split main channel, and single main channel habitats. Habitats within the Slough 6A feature were included in the FA to allow comparison to 1980s data.

In the previous focus area technical memorandum (R2 Resource Consultants 2013a), it was noted that this FA did not capture all mapped habitat types within MR-7 (Table 3). Specifically, there is no side slough habitat in FA-115, and no tributary mouths or plumes identified by preliminary habitat mapping (HDR 2013).

There is a total of approximately 3,000 meters of habitat classified as side slough in Geomorphic Reach MR-7 (Figure 4). Two of the tributary mouths and the single plume in MR-7 identified by the habitat mapping are associated with the Lane Creek area; the other tributary mouth is associated with an unnamed tributary at PRM 113.7 near Oxbow I.

Two areas were suggested in agency comments and the FERC Determination as potential FAs in MR-7. One area is "*below Curry on old Oxbow II.*" Oxbow II is near PRM 123, and is contained in Geomorphic Reach MR-6. Therefore, creating a new FA containing Oxbow II would not be a choice that is responsive to the FERC recommendations for increasing the proportional length represented by FAs in MR-7.

In this section, AEA reviews three possibilities for adding a FA in MR-7:

- Lane Creek area (Figure 5);
- Lower McKenzie Creek area (Figure 6); and
- Oxbow I area (Figure 7).

AEA also summarizes other alternatives that were considered but rejected.

3.1. Lane Creek and Upstream

The Lane Creek channel bifurcates before entering the main channel of the Susitna River, yielding two tributary mouths and a mapped clearwater plume (Figure 5). There is side slough habitat with (unmapped) beaver complex activity just upstream of Lane Creek.

Lane Creek was utilized by chum, coho, and pink salmon for spawning during the 1980s (Table 4). During 1981, Chinook salmon fry were captured at the mouth of Lane Creek. During 1982, Dolly Varden, longnose sucker, humpback whitefish, round whitefish, burbot, Arctic grayling, and rainbow trout were found in Lane Creek and Side Slough 8. During 1983, juvenile Chinook, juvenile coho, chum, and juvenile sockeye salmon were found in Side Slough 8 (Dugan et al. 1984), and the results of habitat surveys and water quality measurements are available for Lane Creek and Slough 8 from the 1980s studies.

During 2012 field surveys, coho and sockeye fry were observed in the mouth of Lane Creek, and there were many coho fry in Side Slough 8 (R2 Resource Consultants 2013b).

If the Lane Creek area is selected as a new FA in MR-7, there would be substantial improvement in representativeness of mapped habitat types in the reach for instream flow modeling (Table 3), and there appears to be high fish use of the area. However, this area is just 0.5 miles upstream of the existing FA-115, so the two FAs would be spatially co-located.

3.2. Lower McKenzie Creek and Upstream

The Lower McKenzie Creek area was suggested as a potential site in agency comments, and it has mapped side slough habitats (Figure 6, Table 3). It has no mapped tributary mouths or clearwater plumes, but there are several small tributaries that may have currently un-mapped delta areas or plumes. The mapped side slough habitat is all contained in an island complex (Figure 6). Lower McKenzie Creek is mapped as an upland slough at the mouth, but it appears to be a small spring-fed tributary which is affected by beaver activity.

Lower McKenzie Creek was not sampled during the 2012 field season. However, it was utilized by substantial numbers of adult pink and coho salmon for spawning during the 1980s studies, and also by a few chum salmon (Table 4). Upper McKenzie Creek and Little Portage Creek are also used for spawning by these species, but at much lower levels. Very little sampling occurred at the tributary mouths of Little McKenzie, Little Portage, or Upper McKenzie Creek for juvenile salmonids or resident fish. During 1982, resident fish including Arctic grayling, burbot, round whitefish, longnose sucker, and slimy sculpin were captured in the mouth of Upper McKenzie Creek and nearby main channel habitat (Schmidt et al. 1983).

If Lower McKenzie Creek was selected as the new FA in MR-7, it could potentially improve the representativeness of modeled habitat types (Table 3), although this is not assured. For example, the mapped side slough in the island complex may not be representative of other side sloughs. The tributaries are not large and do not have mapped mouths or plumes. There is less information about fish use of this potential FA compared to the Lane Creek area, but resident fish and spawning was observed in this area in the 1980s.

Another concern with the selection of Lower McKenzie Creek is the proximity of the Alaska Railroad to the east bank of the river. Access restrictions would inhibit side habitat sampling. The railroad cuts through all tributary habitats in this area, including Lower McKenzie Creek and Little Portage Creek.

3.3. Oxbow I and Upstream

The feature named Oxbow I is currently mapped as a side channel with an associated upland slough complex at PRM 113.7 (Figure 7). The Oxbow I feature conveys flow during the open-water season but becomes appreciably dewatered during periods of low flow. The Oxbow I channel is characterized by shallow depths, lower velocities, and smaller streambed materials than adjacent main channel habitats. The main channel at the upper end of the Oxbow I feature contains vegetated islands divided by subchannels characterized as main channel splits or side channels depending on the flow volume. A FA established to encompass the right bank oxbow habitats could also include the unnamed tributary mouth on the left bank at PRM 113.7, and the Gash and Slash Creek tributaries.

The Oxbow I area was not sampled in 2012, but the Oxbow I feature and Gash and Slash creeks were both sampled in the 1980s studies. Barrett et al. (1985) identified a chum spawning area in Oxbow I during 1984, but the number of fish observed was not reported.

Spawning surveys from the 1980s studies reported pink salmon in both Gash and Slash creeks in small numbers (Table 4). Coho salmon were present in Gash Creek in substantial numbers during 1981 to 1984 (Barrett et al. 1984). Barrett et al. (1984) also reported there is a culvert pipe under the railroad with a 2-foot waterfall near the mouth of the creek. Pink salmon were spawning below the culvert and at the mouth of Gash Creek. A few chum salmon and coho were observed to spawn in Slash Creek during 1985 (Thompson et al. 1986). There were no observations of sockeye salmon or Chinook salmon in either stream during the 1980s. The main channel near Oxbow I was sampled as a Selected Habitat Site during 1982 (Schmidt et al. 1983). Juvenile Dolly Varden and round whitefish were captured at the mouth of Gash Creek, as were Arctic lamprey adults and ammoceotes.

Selecting the Oxbow I area as the new FA in MR-7 would add the Oxbow I feature, several tributary mouths, and divided main channel habitats to improve representativeness of modeled habitat types (Table 3). This FA would also include important chum and coho salmon spawning areas. The railroad property is close to the bank in this area, and it cuts directly across Gash Creek with a small culvert. This potential FA is located immediately downstream of existing FA-115.

3.4. Summary of Rejected Potential MR-7 Focus Area Options

The options described in the previous sections are not meant to be exhaustive, and combinations of moving boundaries and adding a FA could accomplish diverse goals. Three locations that were reviewed and rejected are described below.

The area around Chase Creek (approx. PRM 110.5; Figure 4) was identified as a spawning area for coho and pink salmon and a few Chinook salmon in the 1980s. During the period 1981 through 1985, the highest annual peak spawner counts were 239 coho salmon, 438 pink salmon, and 15 Chinook salmon (Barrett at al. 1985). However, macrohabitat types in the vicinity of Chase Creek are also represented in FA-104, so this area was removed from consideration.

Another reviewed option was adding the Lane Creek area as a FA (Figure 5), or extending the upper boundary of FA-115 approximately 0.6 miles to include the Lane Creek tributary mouth. The Lane Creek area is a documented fish use area, with mapped tributary plumes and a side slough complex (Slough 8). However, after closely reviewing available information, the IFSTT did not think Slough 8 should be currently considered a side slough because the inlet connection appears to have built up in elevation. The vegetation at the inlet area and within this lateral habitat feature suggests that connection to the Susitna River at the upper end of the slough has been lost. This area was considered by the IFSTT to be less critical in terms of fish use when compared to the Oxbow I area.

The final reviewed option was adding the McKenzie Creek area as a FA (Figure 6). This area has documented fish presence, and contains a large island channel complex with crossover channels currently classified as side sloughs. However, there was disagreement within the IFSTT as to how these habitat features should be classified. Some members of the IFSTT suggested that the crossover channels may not provide high-quality fish rearing or spawning habitat. McKenzie Creek and Little Portage creeks are small and do not contain mapped

tributary plumes. In addition, access to the left bank of the area would be difficult because of the close proximity of railroad property.

4. IMPLICATIONS OF FOCUS AREA ADJUSTMENTS

The effect of eliminating a FA in MR-2 and adding a FA in MR-7 will differ among instream flow-related disciplines.

FA-171 represents a simple, single channel area that did not appear to be heavily influenced by tributary inflow, groundwater contributions, or complex riparian habitats. Preliminary evaluations suggest that MR-2 between the proposed dam site and Devils Canyon may remain ice-free during the winter months under post-Project operations, which would reduce the complexity of ice process-related studies.

Because a new FA in MR-7 will contain complex habitats, study efforts may be greater due to higher data needs and modeling requirements associated with tributary deltas, groundwater, ice processes, fish barriers, and water quality considerations.

RSP Section 8.6: The riparian instream flow study efforts will not be impacted by FA adjustments, because the plant communities in FA-171 are represented in other Focus Areas.

RSP Section 9.6: The elimination of FA-171 will have little impact to fish distribution and abundance sampling in MR-2 other than a redistribution of selected sampling locations inside and outside of FAs. While there may be a reduction in cost of travel and logistics at a site in MR-7, the sampling cost will be greater due to the larger, more complex sampling area. Adding a FA to MR-7 will cause a redistribution of sampling effort inside and outside of FAs, and will add to sampling effort in terms of additional habitat types that were not previously available in FAs in MR-7. In addition, if the new FA is also added as a sample site for early life history studies for Fish Distribution and Abundance in the Middle and Lower River (RSP 9.6), it will add considerable effort to sampling for fish emergence.

RSP Section 9.8: The River Productivity Study will not be impacted by the elimination of FA-171 because study efforts in MR-2 are concentrated at FA-173. The addition of a new FA in MR-7 will not affect river productivity study efforts since there are no study sites within that reach.

5. FINAL FOCUS AREA SELECTIONS

The IFSTT meeting held April 26, 2013 included participants from AEA, USFWS, NMFS, USGS, ADF&G, and consultants representing these agencies. The meeting record is included in Appendix 1.

Based upon the input from the IFSTT meeting, AEA has implemented the final FA decisions from that meeting and has also made a minor revision to the boundary of FA-138. Table 5 contains an updated summary description of the final MR Focus Areas. Table 6 summarizes the final FA lengths as proportions of the length of each Geomorphic Reach. Maps of each final FA with preliminary habitat classifications are included in Appendix 2.

5.1. Focus Area Removed from Geomorphic Reach MR-2

AEA will eliminate FA-171 as a FA, leaving FA-173 as the sole Focus Area in Geomorphic Reach MR-2. AEA will adjust the weighting of the length of simple channel available in FA-173. This adjustment should be sufficient for capturing the simple habitat features available in MR-2. The IFSTT participants supported this change.

5.2. Focus Area Added to Geomorphic Reach MR-7

After considering the merits of each potential new FA for MR-7, AEA supports the IFSTT recommendation to select the Oxbow I area as the new, additional MR-7 Focus Area, henceforth labeled FA-113 (Figure 7). FA-113 will encompass 1.7 miles of MR-7 extending from PRM 113.6 to PRM 115.3. The downstream boundary of FA-113 will be located immediately below the confluence of the left bank tributary (PRM 113.7) and below the right bank confluence of the Oxbow 1 feature. FA-113 will extend upstream to encompass the entire Oxbow 1 feature and the mouths of left bank Slash and Gash creeks.

Selecting FA-113 to represent MR-7 habitat provides additional examples of macrohabitat types present in MR-7 including a side channel, upland slough, divided main channel islands, and multiple small tributary mouths. When considered together, the two MR-7 Focus Areas will encompass the variety of habitats found in MR-7. The proportion of Geomorphic Reach MR-7 that will be included in FAs and 2-D modeled will increase from 8 percent to 19 percent (Table 6).

The IFSTT participants supported this change. The IFSTT participants expressed interest in the Oxbow I area from a fish perspective. The new FA contains habitats that supported salmon spawning and rearing habitats in the 1980s. Both Gash Creek and Slash Creek are recognized as anadromous fish waters in the ADF&G catalog. Gash Creek was identified in the 1980s as a primary coho spawning tributary. Oxbow I is thought to be a critical chum salmon rearing ground. Although the upper boundary of this new FA (FA-113) is effectively the lower boundary of the existing FA-115, the two FAs will be considered as separate units for reporting purposes.

5.3. Focus Area FA-138 Boundary Revision

The downstream boundary of FA-138 (Gold Creek Area, Figure 2-6) has been modified and moved downstream from PRM 138.7 to PRM 138.5. For 2-D hydraulic modeling, a Focus Area boundary perpendicular to flow with consistent water surface elevation across each channel is preferred. The previous downstream boundary for FA-138 was cut along a cross-over channel where flow could be moving laterally and the water surface elevation dropping along the channel. The new boundary cuts across three distinct channel types which could have different water surface elevations among channels, but a similar water surface elevation within each channel.

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7. TABLES

Table 1. Locations, descriptions and selection rationale of 10 Proposed Focus Areas identified for detailed study in the Revised Study Plan, Middle River Segment of the Susitna River (AEA 2012). Focus Area identification numbers (e.g., Focus Area 184) represent the truncated Project River Mile (PRM) at the downstream end of each Focus Area.

Focus Area ID	Common Name	Description	Geomorphic Reach	Location (PRM)		Area Length (mi)	Habitat Types Present							Fish use in 1980s		Instream Flow Studies in 1980s			Rationale for Selection
				Upstream	Downstream		Main Channel, Single	Main Channel, Split	Side Channel	Tributary Mouth	Side Slough	Upland Slough	Beaver Complex	Spawning	Rearing	IFG	DIHAB	RJHAB	
FA-184	Watana Dam	Area approximately 1.4 miles downstream of dam site	MR-1	185.7	184.7	1.0	X	X	X					*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	FA-184 length comprises 50% of MR-1 reach length (2 miles long) and contains split main channel and side channel habitat present in this reach.
FA-173	Stephan Lake, Complex Channel	Wide channel near Stephan Lake with complex of side channels	MR-2	175.4	173.6	1.8	X		X	X	X			*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	FA-173 contains a complex of main channel and off-channel habitats within wide floodplain. Represents greatest channel complexity within MR-2. Reach MR-2 is 15.5 miles long and channel is generally straight with few side channels and moderate floodplain width (2-3 main channel widths).
FA-171	Stephan Lake, Simple Channel	Area with single side channel and vegetated island near Stephan Lake	MR-2	173.0	171.6	1.4	X		X	X				*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	The single main channel with wide bars, single side channel and moderate floodplain channel width in FA-171 are characteristic of MR-2. Reach MR-2 channel morphology is generally straight with few side channels and moderate floodplain width (2-3 main channel widths).
FA-151	Portage Creek	Single channel area at Portage Creek confluence	MR-5	152.3	151.8	0.5	X			X				X	X				FA-151 is a single main channel and thus representative of the confined Reach MR-5. Portage Creek is a primary tributary of the Middle Segment and the confluence supports high fish use.
FA-144	Side Channel 21	Side channel and side slough complex approximately 2.3 miles upstream Indian River	MR-6	145.7	144.4	1.3	X	X	X	X	X		X	X	X	X			FA-144 contains a wide range of main channel and off-channel habitats, which are common features of Reach MR-6. Side Channel 21 is a primary salmon spawning area. Reach MR-6 is 26 miles long (30% of Middle Segment length) and is characterized by a wide floodplain and complex channel morphology with frequent channel splits and side channels.
FA-141	Indian River	Area covering Indian River and upstream channel complex	MR-6	143.4	141.8	1.6	X	X	X	X		X	X	X	X		X		FA-141 includes the Indian River confluence and a range of main channel and off-channel habitats. High fish use of the Indian River mouth has been documented and DIHAB modeling was performed in main channel areas in the 1980s. Studies in the 1980s did not document high fish use of lateral habitats on the right bank upstream of the Indian River confluence.
FA-138	Gold Creek	Channel complex including Side Channel 11 and Slough 11	MR-6	140.0	138.7	1.3	X	X	X		X	X	X	X	X	X			The FA-138 primary feature is a complex of side channel, side slough and upland slough habitats, each of which support high adult and juvenile fish use. Complex channel structure of FA-138 is characteristic of Reach MR-6. IFG modeling was performed in side channel habitats in the 1980s.
FA-128	Skull Creek Complex	Channel complex including Slough 8A and Skull Creek side channel	MR-6	129.7	128.1	1.6	X	X	X	X	X			X	X	X	X		FA-128 consists of side channel, side slough and tributary confluence habitat features that are characteristic of the braided MR-6 reach. Side channel and side slough habitats support high juvenile and adult fish use and habitat modeling was completed in side channel and side slough habitats.
FA-115	Lane Creek	Area 0.6 miles downstream of Lane Creek, including Upland Slough 6A	MR-7	116.5	115.3	1.2	X	X	X			X	X		X	X		X	FA-115 contains side channel and upland slough habitats that are representative of MR-7. Reach MR-7 is a narrow reach with few braided channel habitats. Upland Slough 6A is a primary habitat for juvenile fish and habitat modeling was done in side channel and upland slough areas.
FA-104	Whiskers Slough	Whiskers Slough Complex	MR-8	106.0	104.8	1.2	X	X	X	X	X	X		X	X	X	X	X	FA-104 contains diverse range of habitat, which is characteristic of the braided, unconfined Reach MR-8. FA-104 habitats support juvenile and adult fish use and a range of habitat modeling methods were used in side channel and side slough areas.

Table 2. Metrics used to compare the representation and proportionality of habitat types for Focus Areas within each geomorphic reach.

Level	Habitat Type	Comparison Metric	Numerator	Denominator
Macro-Habitat	Main Channel	Percent of main channel that is single unsplit main channel	Length of main channel habitat (HDR)	Total length of main channel (thalweg, R2)
	Split Main Channel	Percent of main channel that is in split main channel	Length of main channel that is in split main channel (R2 calculated)	Total length of main channel (thalweg, R2)
	Braided Main Channel	Percent of main channel that is in braided main channel	Length of main channel that is in braided main channel (R2 calculated)	Total length of main channel (thalweg, R2)
	Side Channel	Side channel length per river mile	Total length of side channels (HDR)	Total length of main channel (thalweg, R2)
	Upland Slough	Upland slough length per river mile	Total length of upland slough habitat (HDR)	Total length of main channel (thalweg, R2)
	Side Slough	Side slough length per river mile	Total length of side channel habitat (HDR)	Total length of main channel (thalweg, R2)
	Backwater	density of backwaters (#/mile)	# backwaters (HDR)	Total length of main channel (thalweg, R2)
	Tributary	density of tributaries (#/mile)	# tributaries (HDR)	Total length of main channel (thalweg, R2)
	Tributary Mouth	density of tributary mouths (#/mile)	# Tributary Mouths (HDR)	Total length of main channel (thalweg, R2)
	Clear Water Plume	density of plumes (#/mile)	# plumes (HDR)	Total length of main channel (thalweg, R2)
Mesohabitat	Glide or Run	Percent of main/side channel habitat in glide/run	Total length of Glide or Run (HDR)	Total Length of Main + Side Channel Habitat (HDR)
	Riffle	Percent of main/side channel habitat in riffle	Total length of Riffle (HDR)	Total Length of Main + Side Channel Habitat (HDR)
	Beaver Complex	Percent of slough habitat that is beaver complex	Total length of Beaver Complex Habitat (HDR)	Total length of slough habitat (HDR)

Table 3. Proportionality metrics for existing and alternate Focus Area options in comparison to total geomorphic reach values in MR-2 and MR-7 based on 2012 habitat mapping (HDR 2013).

	MR-2			MR-7				
	FA-171	FA-173	Total	FA-115	LANE	McKenzie	Oxbow I	Total
Proportion of Main Channel that is Single Main Channel	100%	100%	95%	13%	6.8%	59%	34%	53%
Proportion of Main Channel that is Split Main Channel	0%	0%	5.0%	87%	93%	41%	66%	47%
Side Channel Length/Main Channel Length	0	0.56	0.22	0.23	0.76	0.46	0.45	0.36
Side Slough Length/Main Channel Length	0.42	0.86	0.20	0	0.47	0.61	0.00	0.13
Upland Slough Length/Main Channel Length	0	0.26	0.19	1.1	0	0.15	0.45	0.64
Backwaters per River Mile	0	0	0.067	1.5	0	0	0	0.20
Tributaries per River Mile	0.71	0.55	0.67	0.77	1.5	1.4	1.2	0.87
Tributary Mouths per River Mile	0	0.55	0.80	0	1.5	0	1	0.20
Clear Water Plumes per River Mile	0	0	0.33	0	0.77	0	0	0.067
Proportion of Slough Habitat in Beaver Complex	0	0	0	42%	81%	0%	0%	16%
Proportion of Main Channel in Glide/Run	100%	100%	97%	70%	89%	100%	82%	84%
Proportion of Main Channel in Riffle	0%	0%	3.3%	30%	11%	0%	18%	16%

Notes:
1 Side Slough habitat entirely contained on island complex
2 Potential unmapped mouths/plumes
3 Unmapped beaver complex likely available

Table 4. 1980s peak spawner counts. Source: ADF&G 1981, ADF&G 1983, Barrett et al. 1984, Barrett et al. 1985, Thompson et al. 1986.

	Chum					Coho					Pink				
	81	82	83	84	85	81	82	83	84	85	81	82	83	84	85
Little Portage		31	0	18	4		8	0	0	2		140	7	162	7
Lower McKenzie	14	0	1	23	0	0	133	18	24	50	56	23	28	585	3
Upper McKenzie	0	0	0	0	1	0	0	0	0	0	0	17	0	11	2
Lane Creek	76	5	6	31	1	3	5	2	24	13	291	0	28	1184	127
Gash Creek	0	0	0	0	0	141	74	19	234	71	0	0	0	6	2
Slash Creek		0	0	0	5		6	2	5	8		0	0	3	0

Table 5. Locations, descriptions and selection rationale of 10 Final Focus Areas identified for detailed study in the Middle River Segment of the Susitna River. Focus Area identification numbers (e.g., Focus Area 184) represent the truncated Project River Mile (PRM) at the downstream end of each Focus Area.

Focus Area ID	Common Name	Description	Geomorphic Reach	Location (PRM)		Area Length (mi)	Habitat Types Present							Fish Use in 1980s		Instream Flow Studies in 1980s			Rationale for Selection
				Upstream	Downstream		Main Channel, Single	Main Channel, Split	Main Channel, Multiple Split	Side Channel	Side Slough	Upland Slough	Tributary	Spawning	Rearing	IFG	DIHAB	RJHAB	
FA-184	Watana Dam	Area approximately 1.4 miles downstream of dam site	MR-1	185.7	184.7	1.0	X			X				N/A	N/A	N/A	N/A	N/A	FA-184 length comprises 50% of MR-1 reach length (2 miles long) and contains split main channel and side channel habitat present in this reach.
FA-173	Stephan Lake, Complex Channel	Wide channel near Stephan Lake with complex of side channels	MR-2	175.4	173.6	1.8	X			X	X	X	X	N/A	N/A	N/A	N/A	N/A	FA-173 contains a complex of main channel and off-channel habitats within wide floodplain. Represents greatest channel complexity within MR-2. Reach MR-2 is 15.5 miles long and channel is generally straight with few side channels and moderate floodplain width (2-3 main channel widths).
FA-151	Portage Creek	Single channel area at Portage Creek confluence	MR-5	152.3	151.8	0.5	X						X	X	X				FA-151 is a single main channel and thus representative of the confined Reach MR-5. Portage Creek is a primary tributary of the Middle Segment and the confluence supports high fish use.
FA-144	Side Channel 21	Side channel and side slough complex approximately 2.3 miles upstream Indian River	MR-6	145.7	144.4	1.3	X			X	X	X	X	X	X	X			FA-144 contains a wide range of main channel and off-channel habitats, which are common features of Reach MR-6. Side Channel 21 is a primary salmon spawning area. Reach MR-6 is 26 miles long (30% of Middle Segment length) and is characterized by a wide floodplain and complex channel morphology with frequent channel splits and side channels.
FA-141	Indian River	Area covering Indian River and upstream channel complex	MR-6	143.4	141.8	1.6	X		X	X		X	X	X	X		X		FA-141 includes the Indian River confluence and a range of main channel and off-channel habitats. High fish use of the Indian River mouth has been documented and DIHAB modeling was performed in main channel areas in the 1980s. Studies in the 1980s did not document high fish use of lateral habitats on the right bank upstream of the Indian River confluence.
FA-138	Gold Creek	Channel complex including Side Channel 11 and Slough 11	MR-6	140	138.5	1.5	X		X	X	X	X		X	X	X			The FA-138 primary feature is a complex of side channel, side slough and upland slough habitats, each of which support high adult and juvenile fish use. Complex channel structure of FA-138 is characteristic of Reach MR-6. IFG modeling was performed in side channel habitats in the 1980s.
FA-128	Skull Creek Complex	Channel complex including Slough 8A and Skull Creek side channel	MR-6	129.7	128.1	1.6	X			X	X	X	X	X	X	X	X		FA-128 consists of side channel, side slough and tributary confluence habitat features that are characteristic of the braided MR-6 reach. Side channel and side slough habitats support high juvenile and adult fish use and habitat modeling was completed in side channel and side slough habitats.
FA-115	Lane Creek	Area 0.6 miles downstream of Lane Creek, including Upland Slough 6A	MR-7	116.5	115.3	1.2	X	X		X		X	X		X	X		X	FA-115 contains side channel and upland slough habitats that are representative of MR-7. Reach MR-7 is a narrow reach with few braided channel habitats. Upland Slough 6A is a primary habitat for juvenile fish and habitat modeling was done in side channel and upland slough areas.
FA-113	Oxbow I	Oxbow I Complex and Upstream Area	MR-7	115.3	113.6	1.7	X	X		X		X	X	X	X				FA-113 was added in response to Agency comments that important fish habitat area was underrepresented in MR-7. Oxbow I is an important chum salmon rearing area.
FA-104	Whiskers Slough	Whiskers Slough Complex	MR-8	106	104.8	1.2	X			X	X	X	X	X	X	X	X	X	FA-104 contains diverse range of habitat, which is characteristic of the braided, unconfined Reach MR-8. FA-104 habitats support juvenile and adult fish use and a range of habitat modeling methods were used in side channel and side slough areas.

Table 6. Lengths of final Focus Areas as proportion of each Geomorphic Reach.

Geomorphic Reach	Geomorphic Reach			Current Focus Area				Revised Focus Area Length as % of Geomorphic Reach
	Start	End	Length	ID	Start	End	Length	
MR-1	187.1	184.6	2.5	184	185.7	184.7	1	40%
MR-2	184.6	169.6	15	173	175.4	173.6	1.8	12%
MR-5	153.9	148.4	5.5	151	152.3	151.8	0.5	9.1%
MR-6	148.4	122.7	25.7	144	145.7	144.4	1.3	23%
				141	143.4	141.8	1.6	
				138	140	138.5	1.5	
				128	129.7	128.1	1.6	
MR-7	122.7	107.8	14.9	115	116.5	115.3	1.2	19%
				113	115.3	113.6	1.7	
MR-8	107.8	102.4	5.4	104	106	104.8	1.2	22%

8. FIGURES

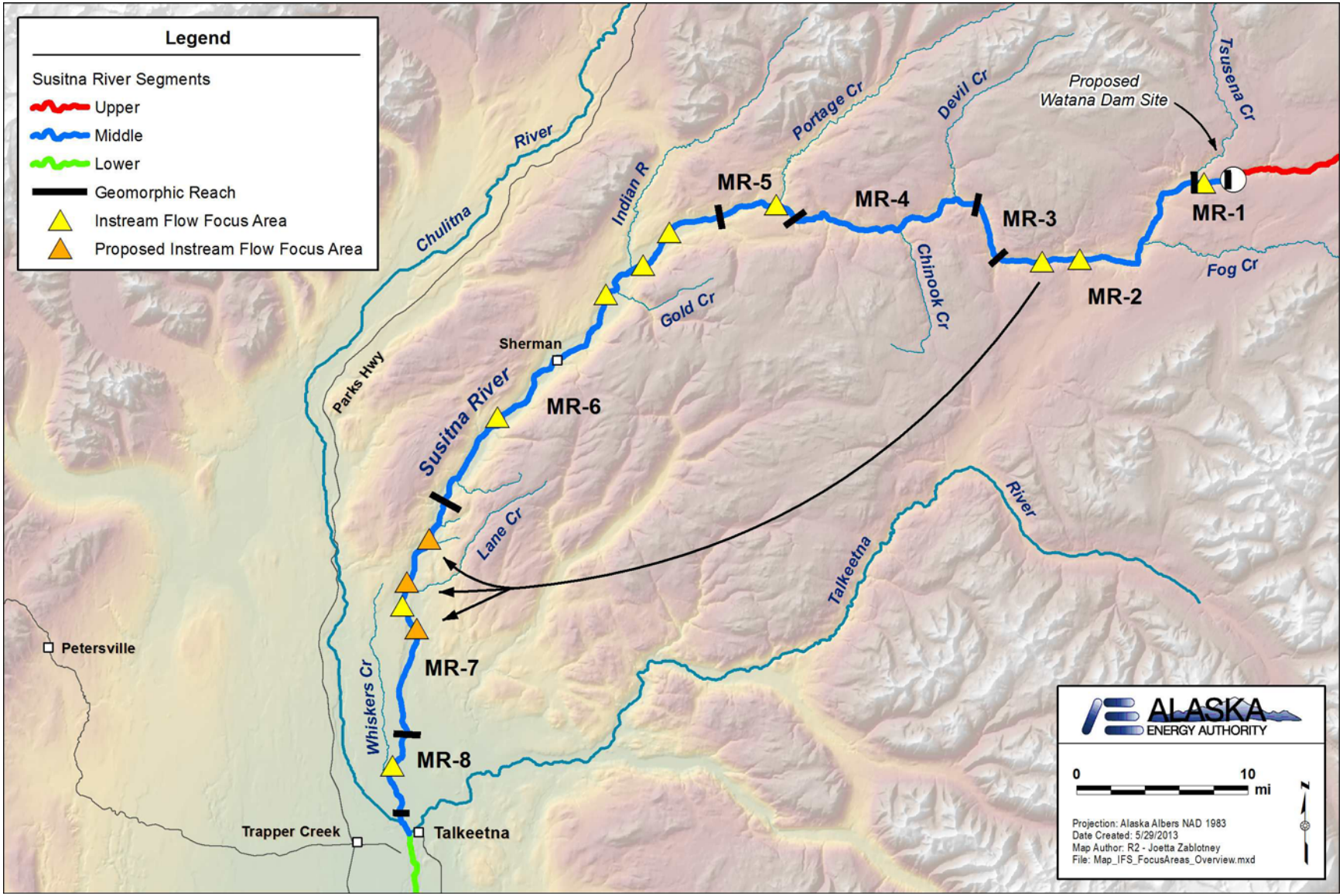

Figure 1. Map of the Middle Segment of the Susitna River depicting the eight Geomorphic Reaches and original locations of and potential changes to Focus Areas. No Focus Areas have been proposed in MR-3 and MR-4 due to safety issues related to sampling within or proximal to Devils Canyon.

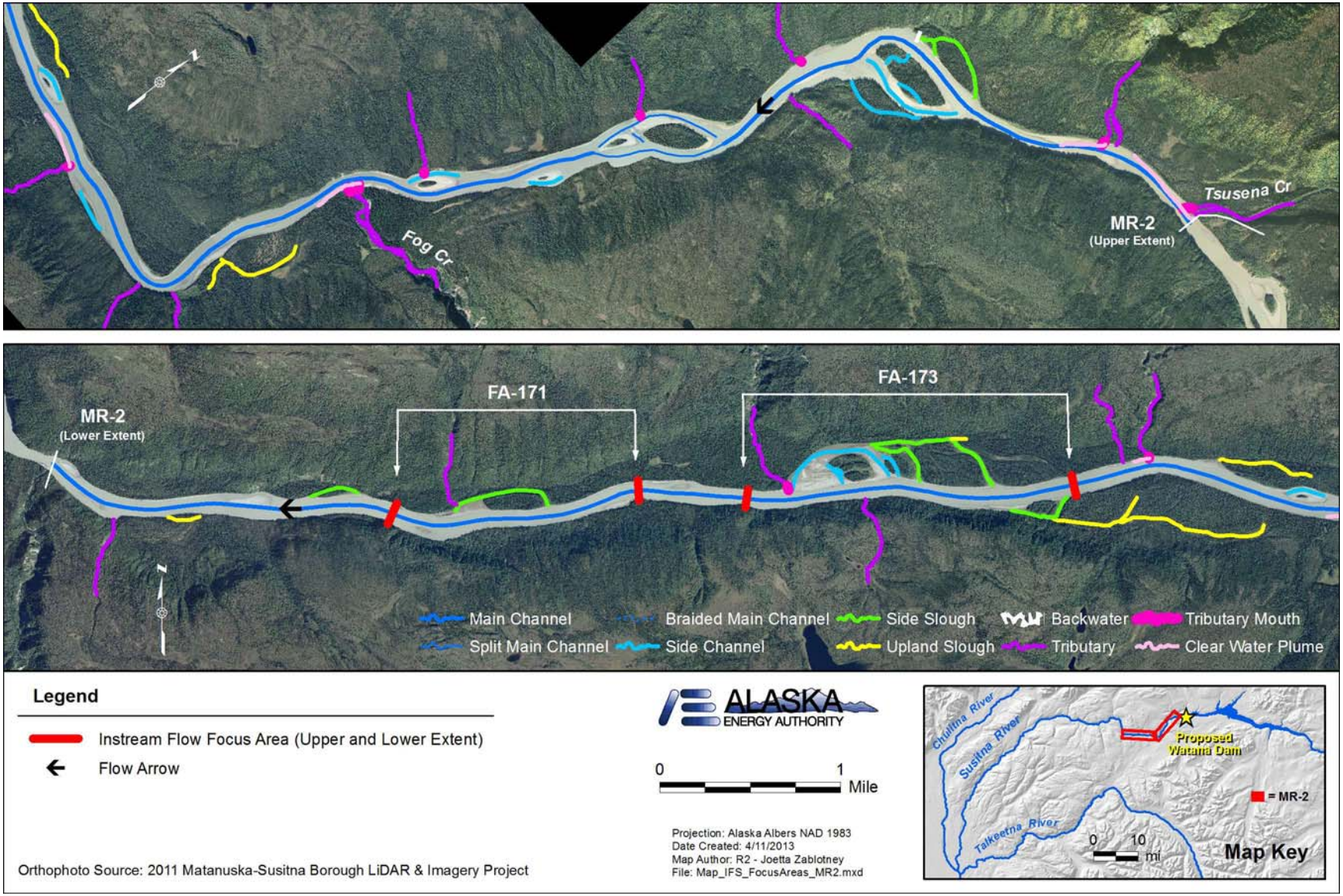

Figure 2. Map showing habitat mapping for geomorphic reach MR-2 (HDR 2013).

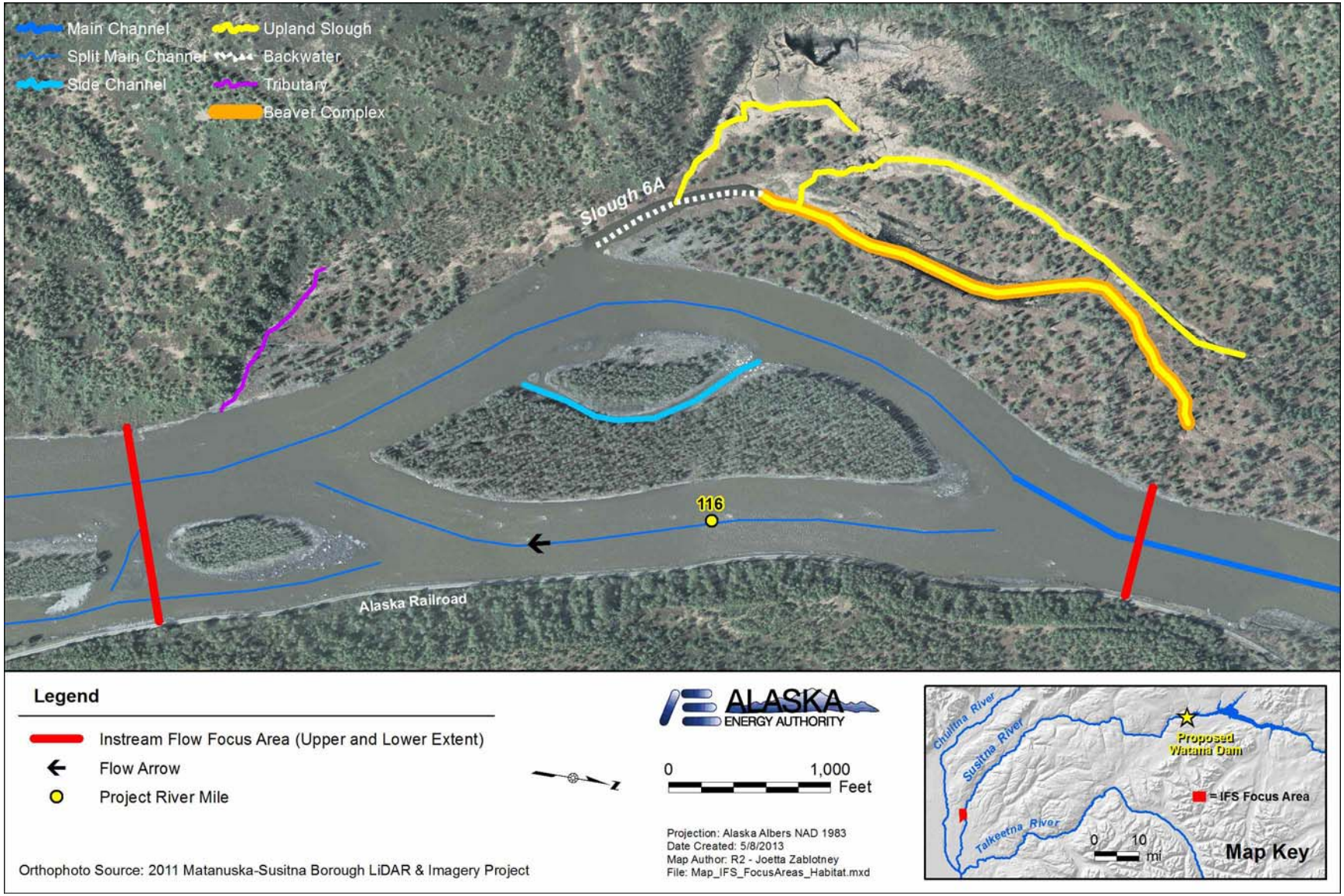

Figure 3. Map showing Focus Area 115 beginning at Project River Mile 115.3 and extending upstream to PRM 116.5. This Focus Area is located about 0.6 miles downstream of Lane Creek and consists of side channel and upland slough habitats including Slough 6A.

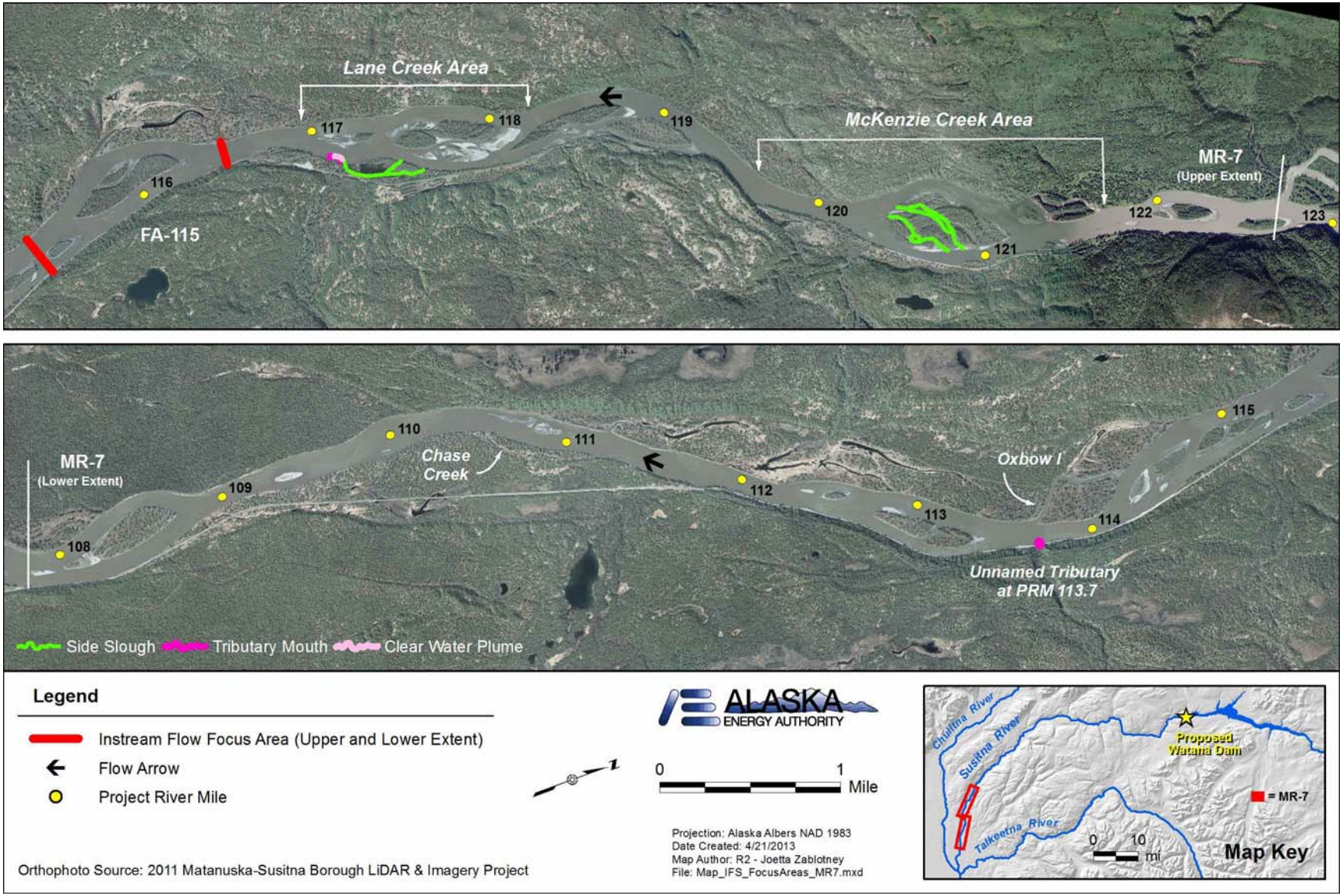

Figure 4. Map of geomorphic reach MR-7 highlighting side sloughs and tributary features not captured by existing FA-115.

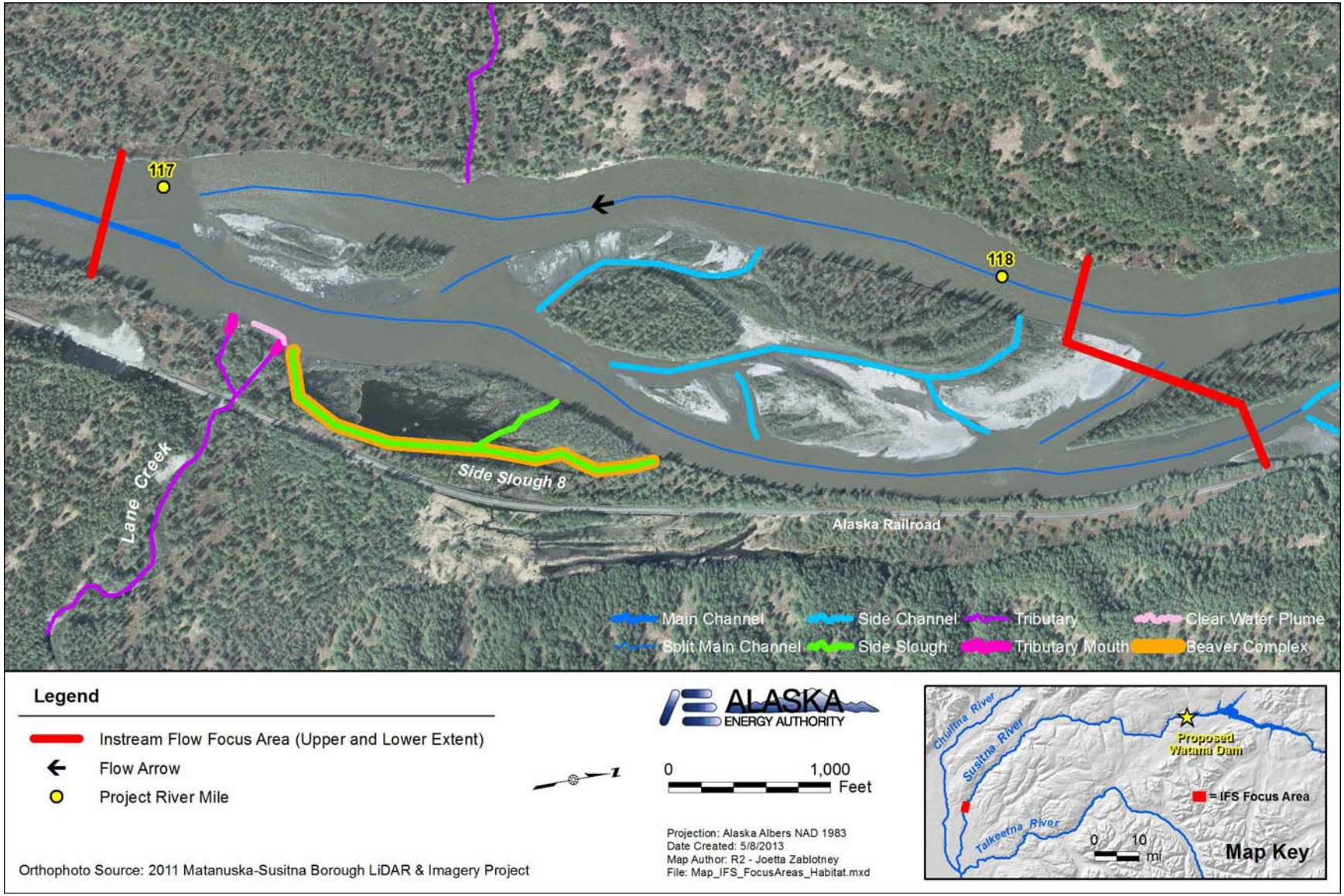

Figure 5. Map showing habitats mapped in the Lane Creek area.

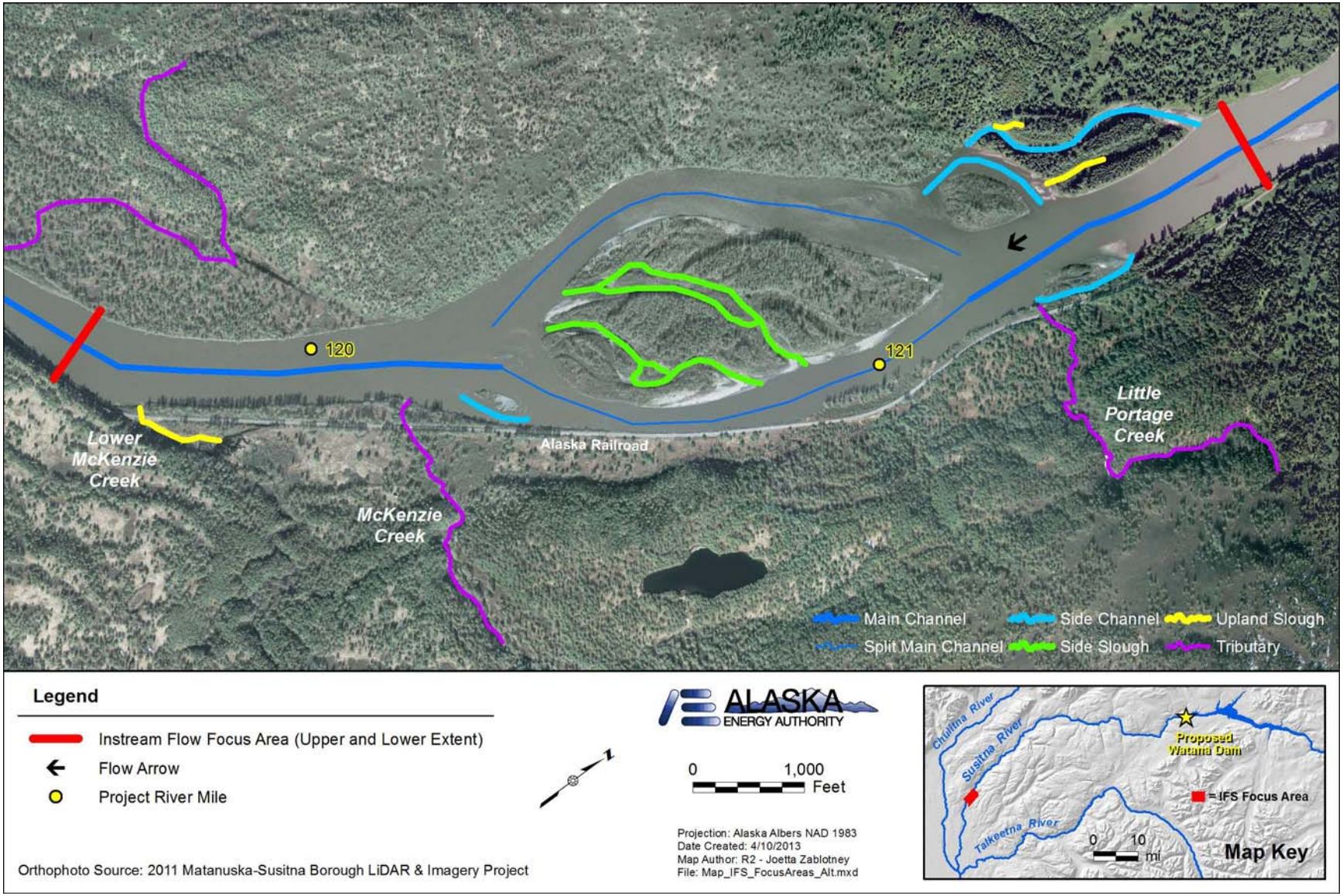

Figure 6. Map showing habitats mapped in the McKenzie Creek area.

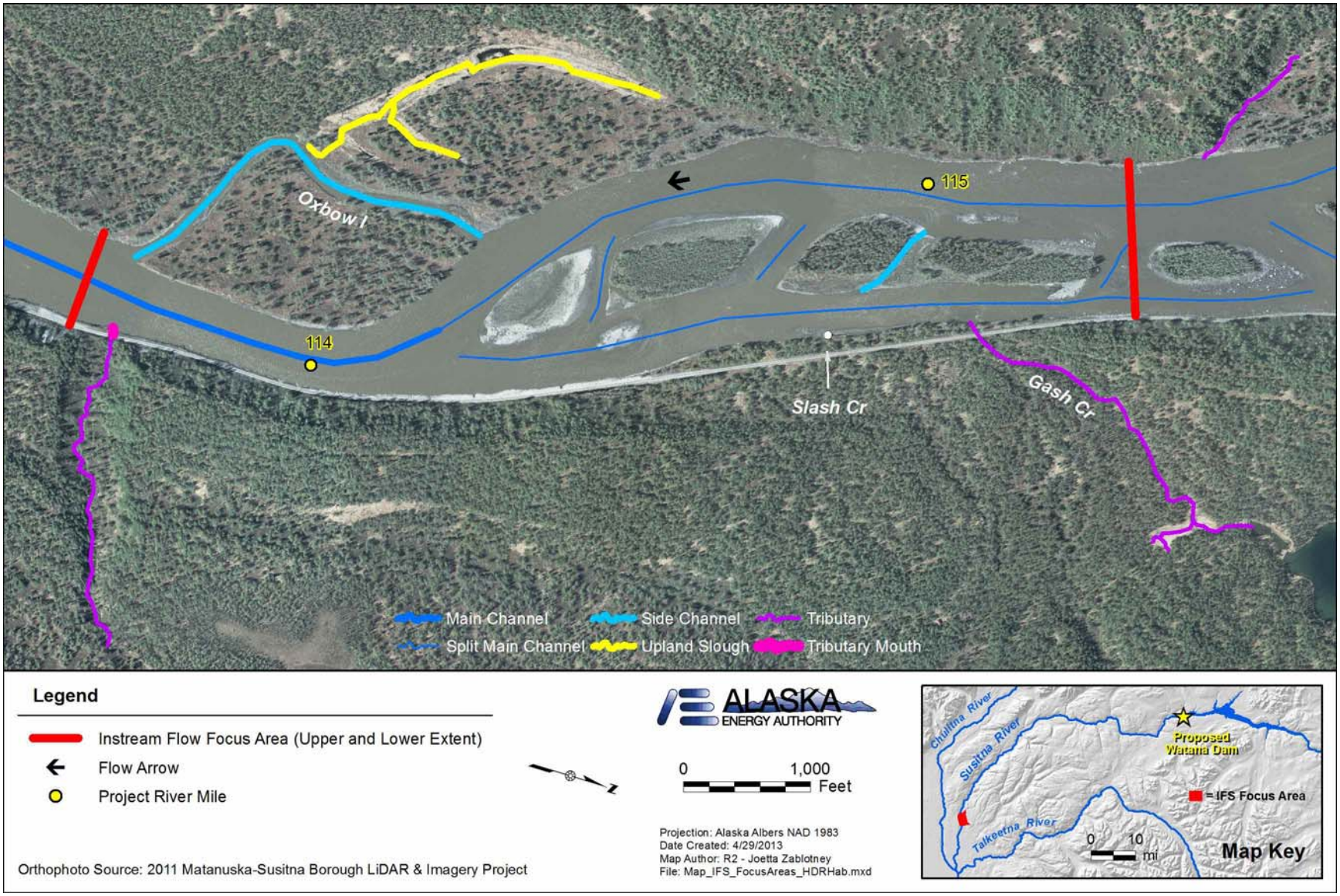

Figure 7. Map showing habitats mapped in the Oxbow I area.

9. APPENDIX 1. IFSTT MEETING NOTES, APRIL 26, 2013

SUSITNA-WATANA HYDRO

Meeting Notes
Instream Flow Study Technical Team (IFSTT)
Conference Call
April 26, 2013

LOCATION: **Teleconference**

TIME: **9:00 am to 1:00 pm (AKDT)**

SUBJECT: **Middle River Focus Areas and Lower River IFS Modeling**

GOAL: **To discuss adjustments to Middle River Focus Areas, review Lower River IFS modeling approach and identify topics for next IFS technical team meeting**

PARTICIPANTS: **Alice Shelly** (R2)**, Becky Long** (Coalition for Susitna Dam Alternatives)**, Betsy McGregor** (AEA)**, Bill Fullerton** (TT)**, Bill Miller** (MEC)**, Catherine Berg** (USFWS)**, Chris Holmquist-Johnson** (USGS)**, Dana Schmidt** (GAI)**, Dudley Reiser** (R2)**, Eric Rothwell** (NMFS)**, Greg Auble** (USGS)**, Jeff Davis** (ARRI)**, Joe Klein** (ADF&G)**, Kasey Clipperton** (GAI)**, Kate Knox** (R2)**, Kim Sager** (DNR)**, Laura Arendall** (R2)**, Leanne Hanson** (USGS)**, Leslie Jensen** (ARRI)**, Lyle Zevenbergen** (TT)**, MaryLou Keefe** (R2)**, Michael Barclay** (HDR)**, Michael Lilly** (GWS)**, Mike Buntjer** (USFWS)**, Phil Hilgert** (R2)**, Sandie Hayes** (AEA)**, Steve Padula** (McMillen)**, Sue Walker** (NMFS)

This was the first of what will be several meetings of the Instream Flow Study Technical Team (IFSTT), that are designed to allow more detailed discussion of technical topics than could otherwise be achieved during normal Technical Work Group meetings. The IFSTT meetings are intended to vet, discuss and, where possible, reach agreement on technical issues and questions regarding the implementation of various elements of the IFS for the Susitna-Watana Hydroelectric Project. This first meeting was focused primarily on two issues – potential adjustments to Middle River Focus Areas, and a discussion of the Lower River Instream Flow sampling approach (see Meeting Agenda below). Some discussion also occurred early on in the meeting regarding the habitat classification scheme and potential differences of opinion concerning the interpretation of specific habitat types that were used in the habitat mapping exercise. A summary of the discussion related to each of these topics is presented below.

MAJOR TOPICS AND DISCUSSION POINTS

- Reviewed general concerns of USFWS/NMFS about elements of the habitat classification system that will be used on the Project. This included a discussion of McKenzie Creek island "side slough" habitat types that might instead be designated as "cross-over channels." It was noted that the need for any modifications to the specific habitat types would be realized as part

of the more detailed habitat mapping that would occur in 2013 field studies. Adjustments could then be made. As a preliminary step, it was agreed that the habitat types of each FA be delineated and provided to agencies for review, with the objective of identifying any habitat type "calls" that they consider questionable. These will be noted and briefly discussed during the next IFSTT meeting, and further evaluated as part of the field studies.

- Discussed portions of the Susitna River near Lane Creek, McKenzie Creek, and Oxbow 1 as potential Focus Areas that could be studied in MR- 7, instead of FA-171 located in MR-2. This was a follow-up to the FERC determination of February 1, 2013 (page B-92) indicating a move of Focus Area from MR-2 to MR-7 should be discussed with agencies. This was the major topic discussed during the meeting and included reviews of each potential candidate site (i.e., pros and cons including railroad restrictions). The Thermal Infrared Imagery (TIR) completed by Watershed Sciences was reviewed for each of the candidate sites noting areas of apparent groundwater influence; meeting attendees generally acknowledged the value of the TIR. The discussion resulted in agreement of the selection of a new FA located near Oxbow 1 (FA-113), and dropping FA-171.
- Discussed Lower River modeling approach, noting that the complexity of the habitats will require development of a series of individual habitat specific models that can be used for evaluating habitat-flow relationships within areas considered biologically important to fish. Question was raised regarding selection criteria for the tributaries proposed for study in 2013. It was noted the tributaries were selected based on studying a subset of those considered biologically important to fish based in part on 1980s studies as well as current information. Additional tributaries may be studied in 2014 based on results in 2013.
- Response to the FERC determination concerning the fish barrier studies was discussed and it was noted that the revised plan would be delivered on May15; and will follow with a 15-day comment period; the technical memorandum for this is due on June 30.
- Topics for the next IFSTT were discussed with emphasis placed on a series of potential topics related to HSC and HSI data collection.

DECISIONS REACHED

- Agencies and AEA were in agreement that FA-171 (located in MR-2) will be dropped leaving a single FA (FA-173) in MR-2 for investigation.
- Agencies and AEA were in agreement that a new FA would be located in MR-7 (FA-113), and that it would be located in a reach of the Susitna River that includes the Oxbow 1 area (including unnamed tributary PRM 113.7 and Slash and Gash Creeks). This area is immediately adjacent to FA-115, so the hydraulic modeling will encompass both areas together. However, the two Focus Areas will be considered separately for reporting purposes. The lower boundary of the area will be below the unnamed tributary (~PRM 113.6) and the upper boundary at ~PRM 115.3.
- Agencies and AEA were in agreement that the IFS work in the Lower River Reach should proceed as described during the meeting; some further discussion of tributaries is needed relative to 2014 studies but will depend on results of 2013 studies.
- Topics for the next IFSTT meeting were reviewed, and it was agreed that the primary focus would be to discuss target species and HSC/HSI data collection techniques; HSC/HSI topics of stranding/trapping modeling, varial zone modeling, effective spawning were considered lower priority topics at this time.

ACTION ITEMS

The following ACTION ITEMS were identified:

tion Items	Date	Responsibility
1) Update Post FERC SPD Recommendations Tech Memo and file with FERC by 5/31/13. Include a map of each FA depicting the habitat types and an updated table from the RSP indicating the proportion of each reach included within the FAs. Provide the maps if available sooner than the technical memorandum.	05/31/13	R2
2) Post a map of each Focus Area (including new FA-113) showing the preliminary habitat types identified by HDR.	As soon as available	R2
3) Develop meeting agenda and meeting materials for the next meeting scheduled to occur 5/17/13, to cover the following topics: ▫ Target Species and Life stages ▫ HSC – 2013 sampling effort, target locations, microhabitat data to be collected ▫ Habitat Classification System – provide clarified set of definitions from RSP and approach for moving forward without changing the classification system	05/13	R2
4) Discuss 2-D/1-D modeling (development of digital terrain model, transect selection, calibration flows, data aggregation, etc.) off-line with Joe Klein-ADF&G.	05/13	R2 and ADF&G
5) As field schedules become established, coordinate with agencies to allow them to participate on an opportunist basis.	As soon as available	R2
6) Develop summary of April 26, 2013 conference call and identify decisions and action items.	05/13	R2

10. APPENDIX 2. FOCUS AREA MAPS WITH PRELIMINARY MACROHABITAT CLASSIFICATION TYPES

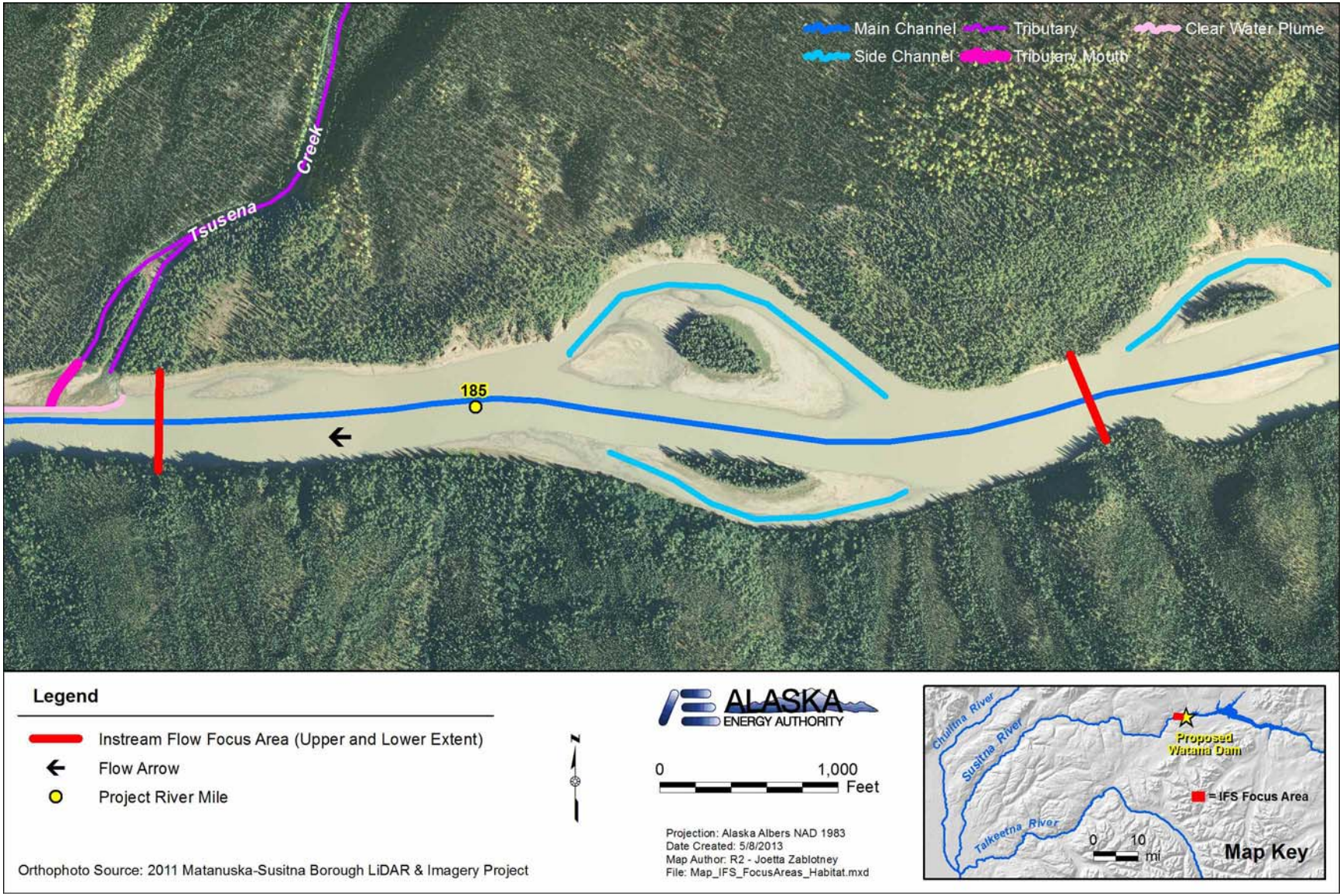

Figure 2-1. Map showing boundaries of FA-184 in Geomorphic Reach MR-1, along with associated mapped macrohabitat units (HDR 2013).

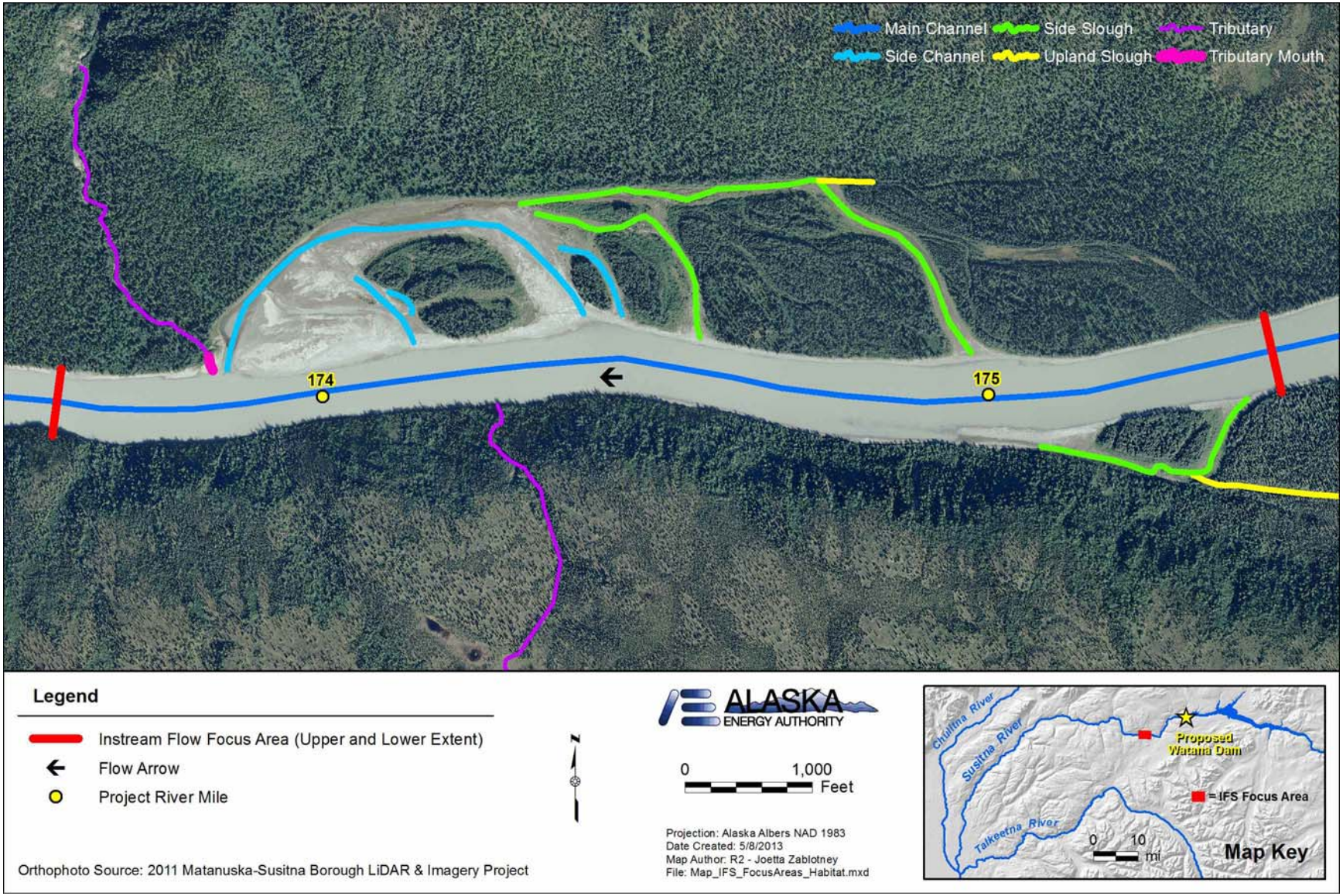

Figure 2-2. Map showing boundaries of FA-173 in Geomorphic Reach MR-2, along with associated mapped macrohabitat units (HDR 2013).

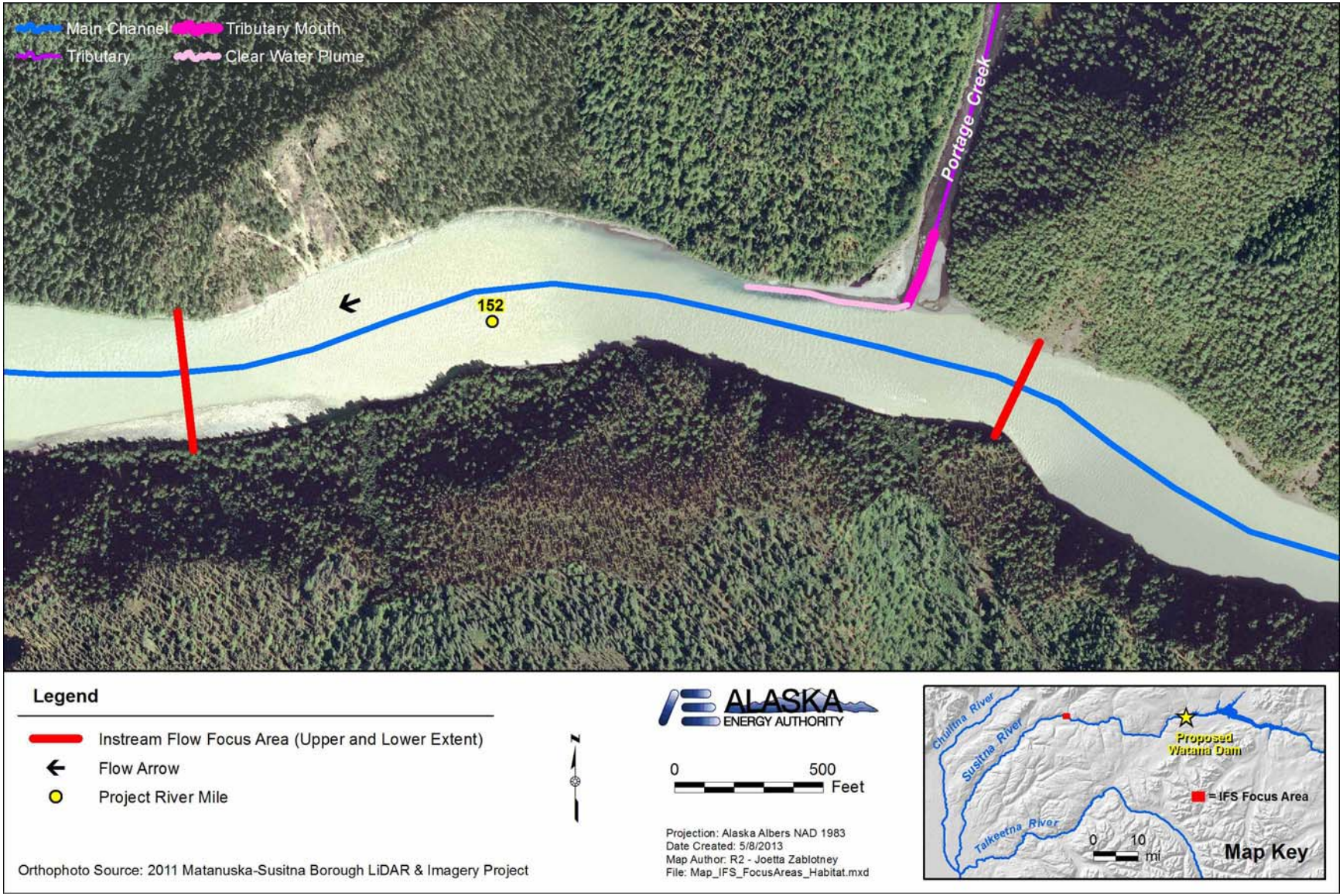

Figure 2-3. Map showing boundaries of FA-151 in Geomorphic Reach MR-5, along with associated mapped macrohabitat units (HDR 2013).

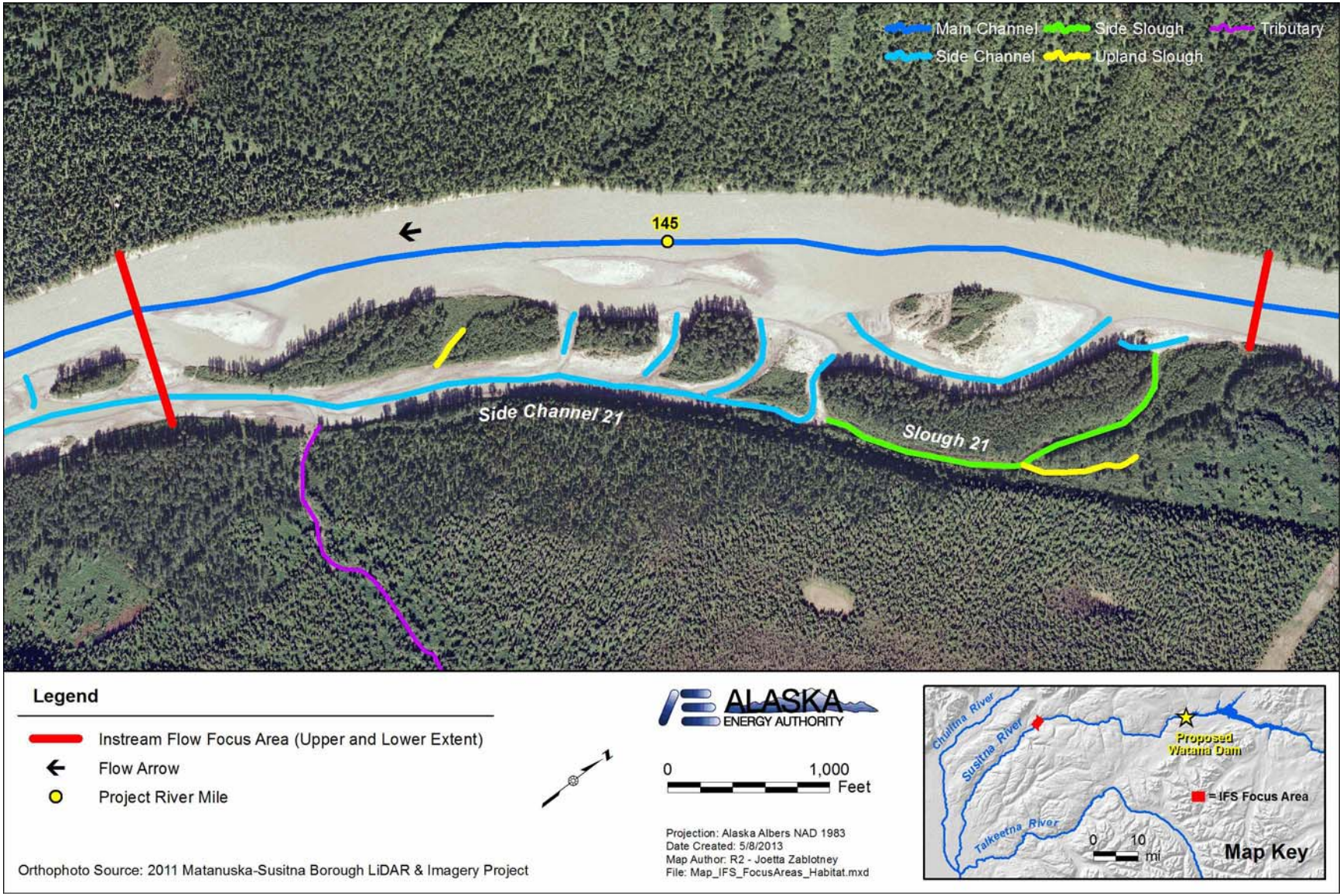

Figure 2-4. Map showing boundaries of FA-144 in Geomorphic Reach MR-6, along with associated mapped macrohabitat units (HDR 2013).

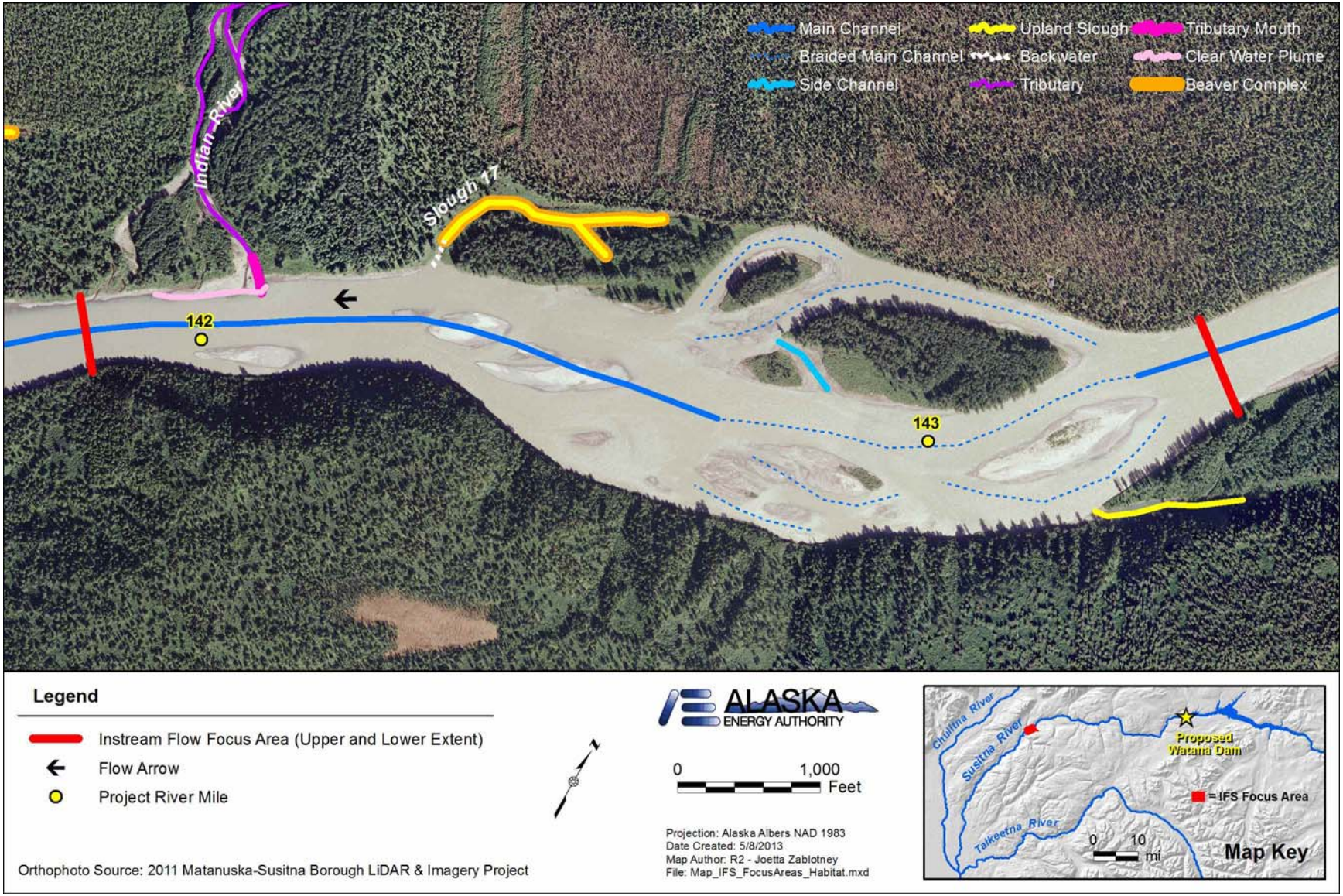

Figure 2-5. Map showing boundaries of FA-141 in Geomorphic Reach MR-6, along with associated mapped macrohabitat units (HDR 2013).

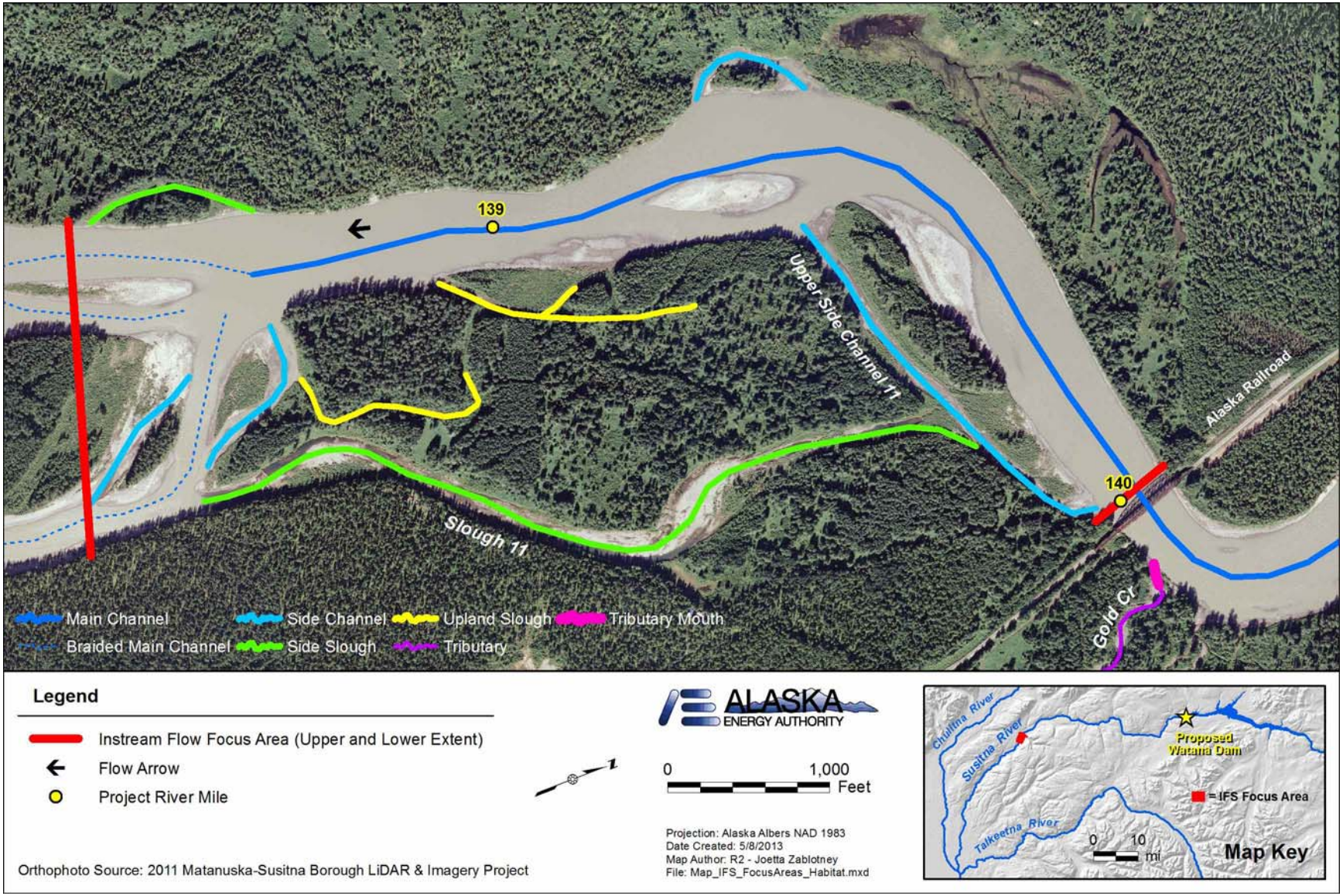

Figure 2-6. Map showing boundaries of FA-138 in Geomorphic Reach MR-6, along with associated mapped macrohabitat units (HDR 2013).

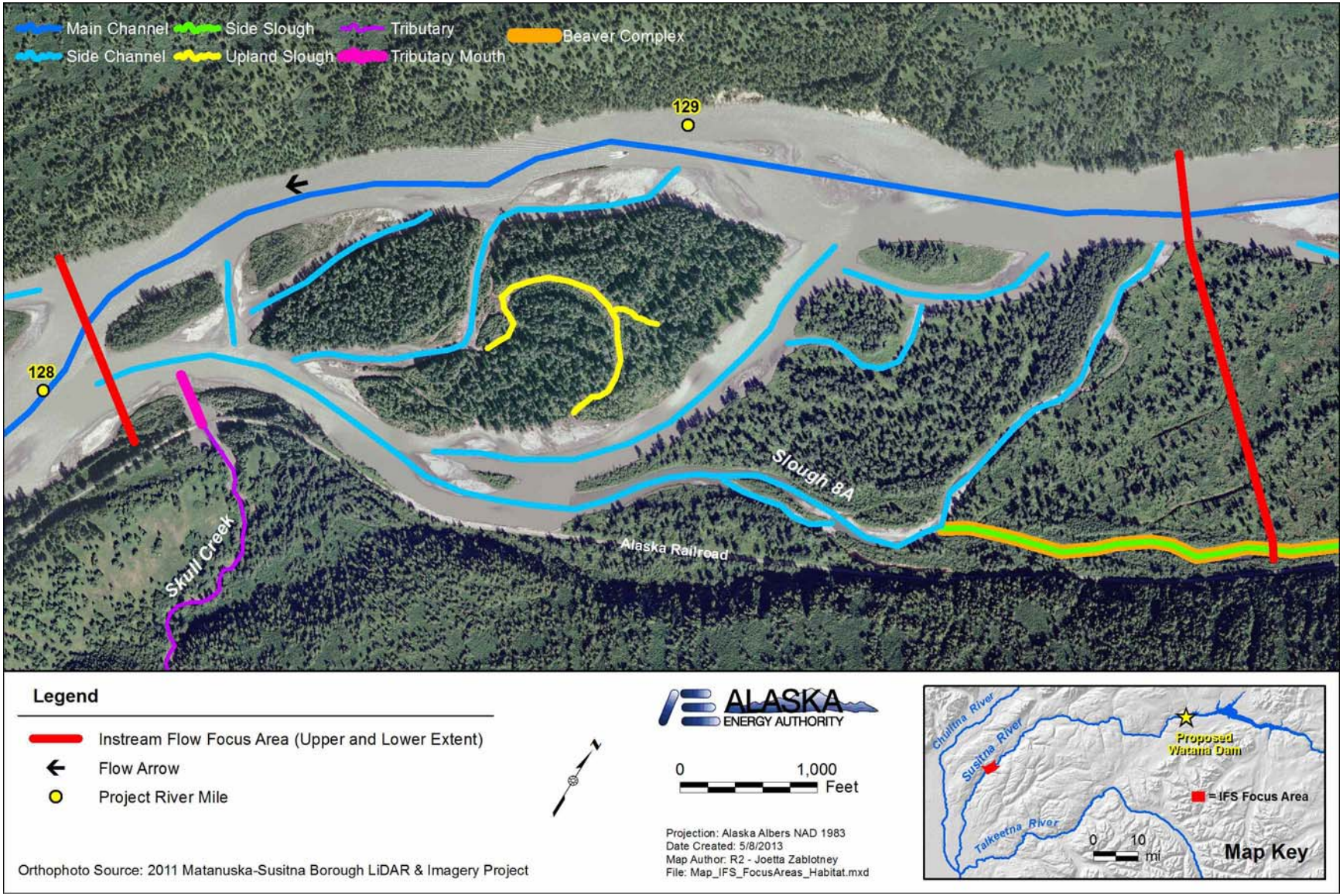

Figure 2-7. Map showing boundaries of FA-128 in Geomorphic Reach MR-6, along with associated mapped macrohabitat units (HDR 2013).

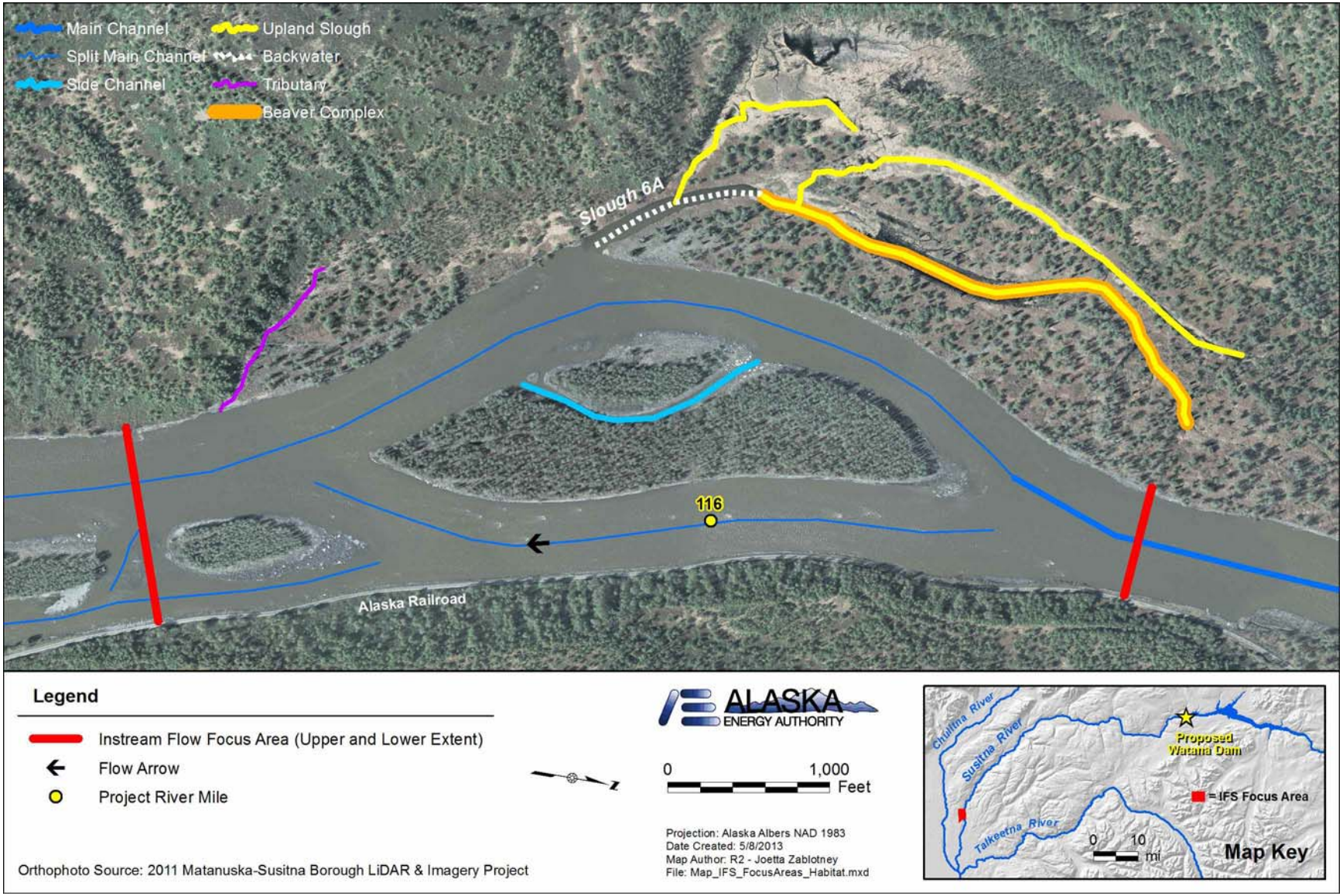

Figure 2-8. Map showing boundaries of FA-115 in Geomorphic Reach MR-7, along with associated mapped macrohabitat units (HDR 2013).

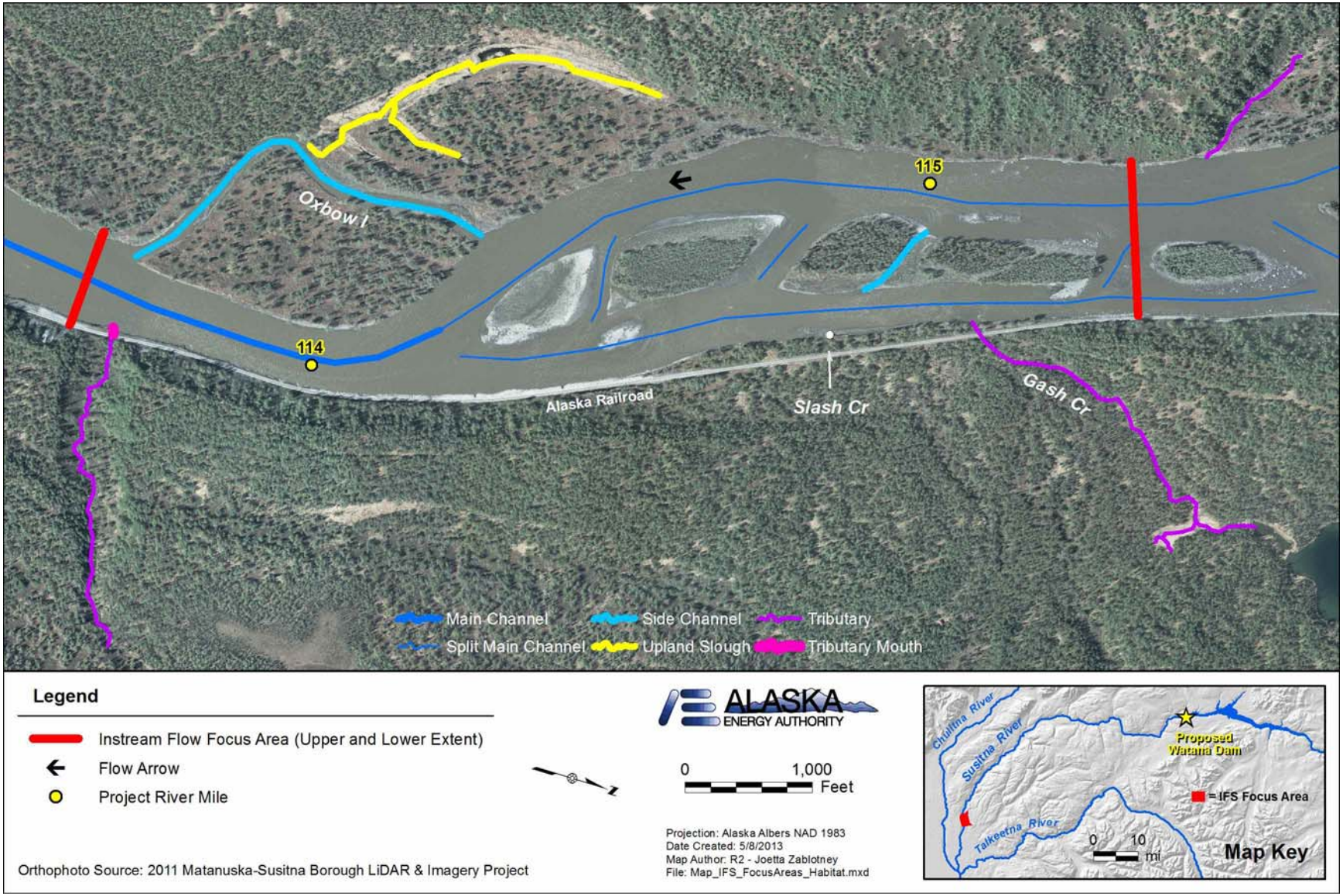

Figure 2-9. Map showing boundaries of FA-113 in Geomorphic Reach MR-7, along with associated mapped macrohabitat units (HDR 2013).

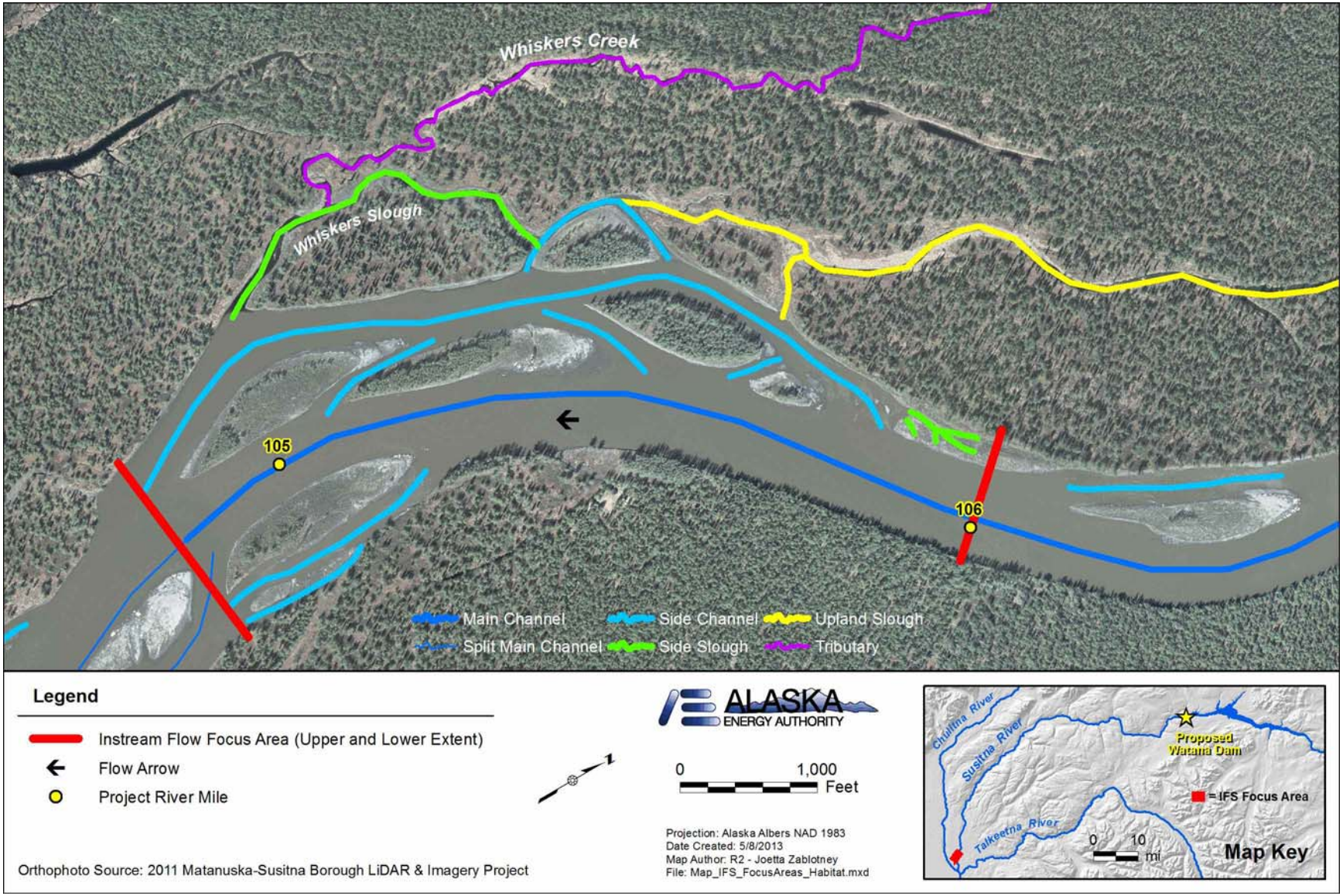

Figure 2-10. Map showing boundaries of FA-104 in Geomorphic Reach MR-8, along with associated mapped macrohabitat units (HDR 2013).