# Susitna-Watana Hydroelectric Project (FERC No. 14241)

# Technical Memorandum: Adjustments to Middle River Focus Areas

Prepared for

Alaska Energy Authority

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# 1. INTRODUCTION

Since submittal of the Revised Study Plan (AEA 2012), and Focus Area technical memorandum (R2 Resource Consultants 2013a), the Federal Energy Regulatory Commission (FERC) issued a Study Plan Determination (April 1, 2013) which included 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.*

In the March 26-27, 2013 Technical Workgroup (TWG) meetings, a series of technical team meetings were proposed to allow agency and Alaska Energy Authority (AEA) scientists to confer on technical details and address agency comments and concerns regarding planned 2013-2014 sampling and analysis issues. The FERC recommendation above is a planned topic for the first technical team meeting scheduled for April 26, 2013.

This technical memorandum has been developed to evaluate potential responses to the FERC recommendation and to serve as a starting point for the technical team discussion. The intent of this memo was not to propose a specific action; instead this memo provides background information on potential adjustments to Focus Areas (FAs) in the Middle River (MR) Segment. Information on the distribution of habitat types in the affected geomorphic reaches and in potential new study areas may help guide the selection of new areas or adjustments to existing FAs. A description of available fisheries information for potential new areas will also be useful to evaluate the potential adjustments.

## 1.1. Background

Selection criteria for the ten current FAs in the Middle River considered the following:

- All major habitat types (main channel, side channel, side slough, upland slough, tributary delta) will 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) will be studied that is/are representative of other areas.
- A replicate sampling strategy will be used for measuring habitat types within each FA, which will include a random selection process of mesohabitat types.
- 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 current FAs are detailed in Table 1 and displayed in Figure 1.

In the previous FA technical memorandum (R2 Resource Consultants 2013a), 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 TM 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.

The selection of FAs for the Riparian In-Stream Flow (IFS) study was also presented in the FA technical memorandum (R2 Resource Consultants 2013a). The Riparian FAs are a subset of the ten Fish and Aquatics IFS FAs. The FERC determination letter recommended no changes to the Riparian FAs.

## 1.2. Objectives

The overall objective of this technical memorandum is to provide background material in support of planned discussions on the subject of moving one current Focus Area from MR-2 to MR-7. This is not a proposal for a specific change, but an investigation into several options and their corresponding study implications.

Specific objectives include:

- Discuss option for eliminating one of the MR-2 Focus Areas;
- Discuss options for adding a Focus Area to MR-7, including:
    - Modeling an area "near Lower McKenzie Creek" as recommended by agency comments;
    - Modeling an area "below Curry on Old Oxbow II" as recommended by agency comments;
    - 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 (PRM 110.5), Old Oxbow I (PRM 113.7), Little Portage Creek confluence (PRM 121.4), or other areas identified in consultation with the TWG.

## 1.3. Strategy

The selected FA to eliminate from MR-2 should be the one that will have the least 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 new FA to be added to MR-7 should be selected to address agency concerns as outlined in the FERC determination, and to improve the representativeness of Focus Areas in MR-7 in terms of habitat types.

Habitat mapping of the Middle River Segment of the Susitna River was completed 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. Results of the habitat mapping were used to evaluate the "representativeness" of the Focus Areas 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).

## 2. MR-2 FOCUS AREAS

There are currently two Focus Areas within Geomorphic Reach MR-2. 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 on these areas because they were not sampled in the 1980s.

The habitats present in the FA and representativeness and proportionality of the habitats in the two FAs are presented in Table 1.

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 Focus Areas 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 has been selected for intensive riparian investigations that extend into the floodplain associated with the in-channel portion on the FA. Eliminating this FA could affect the overall integrity of the Riparian IFS. 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. 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 for representing this type of habitat include 1) extending the lower boundary of FA-173 to include a stretch of simpler channel type; or 2) use model results from FA-184 in MR-1 to represent the simple channel in geomorphic reach MR-2, or adjusting the weighting of the length of simple channel available in FA-173.

# 3. MR-7 FOCUS AREAS

There is currently one Focus Area within Geomorphic Reach MR-7 (Figure 3). FA-115 includes Slough 6A which, based on the 1980s studies, provides high-use juvenile rearing habitat. It also includes side channel, upland slough, backwater, split main channel, and single main channel habitats that represent MR-7. Habitats within the Slough 6A feature represent areas of known fish use, and were included in the FA to allow comparison to 1980s data.

In the previous Focus Area TM (R2 Resource Consultants 2013a), it was noted that this FA did not capture all mapped habitat types within MR-7 (Table 2). Specifically, there is no side slough habitat, and no tributary mouths or plumes identified by habitat mapping (HDR 2013).

There is approximately 3000 m of side slough habitat 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 Project river mile (PRM) 113.7 (Figure 4).

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.

Below, we review two possibilities for adding a FA in MR-7:

1. Lane Creek area (Figure 5); and
2. Lower McKenzie Creek area (Figure 7).

## 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 in-stream flow modeling, 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). 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, 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 (Table 4). 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, 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. No contractor access is allowed within 100 feet of the railroad property which will inhibit side habitat sampling. The railroad cuts through all tributary habitats in this area, including Lower McKenzie Creek and Little Portage Creek.

## 3.3. Other Middle River Habitats

Instead of the Lane Creek or Lower McKenzie Creek areas, a new FA in MR-7 could be located to encompass other habitats. Old Oxbow 1 is located on the right bank at PRM 113.7 (Figure 4); a Focus Area established to encompass the right bank oxbow habitats could also include the unnamed tributary mouth on the left bank at PRM 113.7. Oxbow 1 was seldom reported as being used for spawning salmon. Barrett et al. (1985) identified a chum spawning area in Oxbow 1 during 1984, but the number of fish observed was not reported.

The Chase Creek confluence located at PRM 110.5 (Figure 4) is another option for an additional MR-7 Focus Area. During the 1980s Chase Creek was identified as a spawning area for coho and pink salmon and a few Chinook salmon. 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). There were a few instances of Chum being seen, but only one fish during each of two years.

Several options are available to identify a new FA in MR-7. The options described in the previous sections are not meant to be exhaustive and combinations of moving boundaries and

adding an FA that could accomplish diverse goals. Possible approaches to identifying a new FA in MR-7 include:

1. Add portions of the Lane Creek area as a FA (Figure 5).
2. Add portions of the McKenzie Creek area as a FA (Figure 6).
3. Consider the area around PRM 113.7 and include the right bank Oxbow I and the unnamed left bank tributary mouth.
4. Consider the area around Chase Creek (approx. PRM 110.5).
5. Extend the upper boundary of FA-115 approximately 0.6 miles to include the Lane Creek tributary mouth, creating a very large FA.

# 4. IMPLICATIONS OF FOCUS AREA ADJUSTMENTS

The effect of eliminating a FA in MR-2 and adding a FA in MR-7 will vary among the various instream flow-related disciplines. Assuming that FA-171 is selected for elimination from MR-2, 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. If a new FA in MR-7 contains 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.

The riparian instream flow study (RSP 8.6) efforts should be minimally impacted by FA adjustments provided FA-173 is not eliminated. If riparian studies are not expanded into the new FA in MR-7, there should be little effect to riparian studies. Assuming that FA-171 is eliminated, it will have little impact to fish distribution and abundance sampling (RSP 9.6) in MR-2 other than a redistribution of selected sampling locations inside and outside of FAs. There will be a reduction in sampling effort in terms of travel and logistics since access to a site in MR-7 will likely involve a greater frequency of boat access compared to helicopter access. 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 efforts for fish emergence. If the decision to move the FA is delayed past early May 2013, fish distribution will not have the same length of study results for the new FA compared to fish distribution and abundance sampling at other locations.

The River Productivity Study (RSP 9.8) will not be impacted by the elimination of FA-171, since 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 in MR-7 below Devils Canyon since there are no study sites within that reach.

Adjustments to the FAs should be determined as soon as possible to ensure necessary measurements are collected during 2013 field study efforts. Measurement of Middle River FAs below Devils Canyon will be conducted as part of an integrated campaign of contractors

specializing in stream gaging and velocity measurements (i.e., Brailey Hydrologic), surveying (i.e., Geovera), stage recorder deployment (i.e., GWS), and fish habitat measurement and modeling (i.e., Miller, Golder, and R2). Field schedules have been developed to measure specific areas under appropriate flow conditions. Delays in determining adjustments to Middle River FAs could disrupt the team schedule and contribute to missed data collections.

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# 6. 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 | |
| Focus Area-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* | Focus Area-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. |
| Focus Area-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* | Focus Area-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). |
| Focus Area-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 Focus Area-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). |
| Focus Area-151 | Portage Creek | Single channel area at Portage Creek confluence | MR-5 | 152.3 | 151.8 | 0.5 | X | | | X | | | | X | X | | | | Focus Area-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. |
| Focus Area-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 | | | Focus Area-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. |
| Focus Area-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 | | Focus Area-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. |
| Focus Area-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 Focus Area-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 Focus Area-138 is characteristic of Reach MR-6. IFG modeling was performed in side channel habitats in the 1980s. |
| Focus Area-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 | | Focus Area-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. |
| Focus Area-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 | Focus Area-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. |
| Focus Area-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 | Focus Area-104 contains diverse range of habitat, which is characteristic of the braided, unconfined Reach MR-8. Focus Area-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 compared 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 | Reach Total | FA-115 | Lane | McKenzie | Reach Total |
| Proportion of Main Channel that is Single Main Channel | 100% | 100% | 95% | 13% | 6.8% | 59% | 53% |
| Proportion of Main Channel that is Split Main Channel | 0% | 0% | 5.0% | 87% | 93% | 41% | 47% |
| Side Channel Length/Main Channel Length | 0 | 0.56 | 0.22 | 0.23 | 0.76 | 0.46 | 0.36 |
| Side Slough Length/Main Channel Length | 0.42 | 0.86 | 0.20 | 0 | 0.47 | 0.61[a] | 0.13 |
| Upland Slough Length/Main Channel Length | 0 | 0.26 | 0.19 | 1.1 | 0 | 0.15 | 0.64 |
| Backwaters per River Mile | 0 | 0 | 0.067 | 1.5 | 0 | 0 | 0.20 |
| Tributaries per River Mile | 0.71 | 0.55 | 0.67 | 0.77 | 1.5 | 1.4 | 0.87 |
| Tributary Mouths per River Mile | 0 | 0.55 | 0.80 | 0 | 1.5 | 0[b] | 0.20 |
| Clear Water Plumes per River Mile | 0 | 0 | 0.33 | 0 | 0.77 | 0[b] | 0.067 |
| Proportion of Slough Habitat in Beaver Complex | 0 | 0 | 0 | 42% | 81% | 0%[c] | 16% |
| Proportion of Main Channel in Glide/Run | 100% | 100% | 97% | 70% | 89% | 100% | 84% |
| Proportion of Main Channel in Riffle | 0% | 0% | 3.3% | 30% | 11% | 0% | 16% |

Notes:

[a] Side Slough habitat entirely contained on island complex

[b] Potential unmapped mouths/plumes

[c] 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 | 0 | 31 | 0 | 18 | 4 | 0 | 8 | 0 | | 2 | | 140 | 7 | 127 | 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 | | 11 | 2 |
| Lane Creek | 76 | 5 | 6 | 31 | 1 | 3 | 5 | 2 | 24 | 13 | 291 | 0 | 28 | 1184 | 127 |

# 7. FIGURES

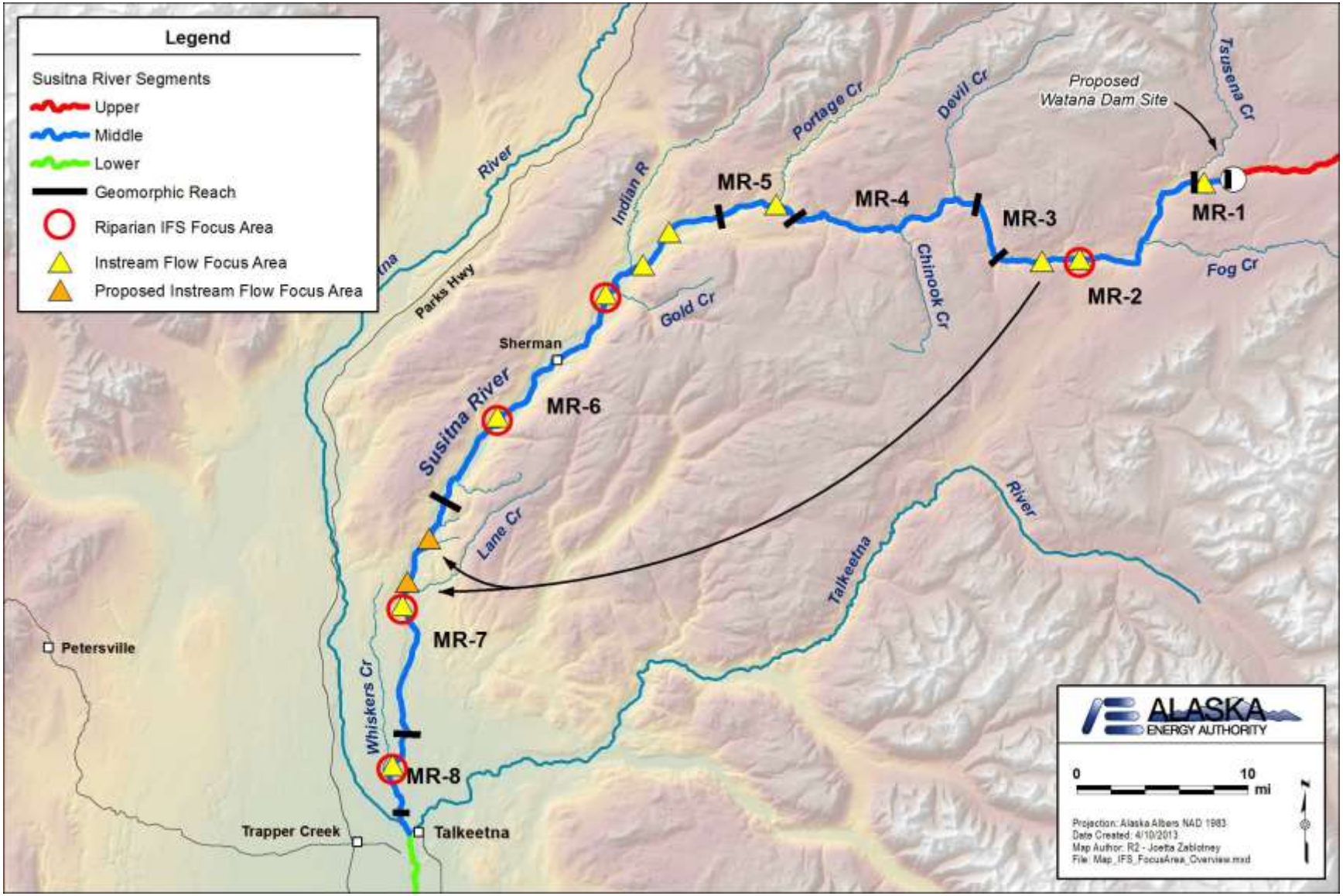


**Figure 1. Map of the Middle Segment of the Susitna River depicting the eight Geomorphic Reaches and locations of proposed Focus Areas. No Focus Areas are proposed in MR-3 and MR-4 due to safety issues related to sampling within or proximal to Devils Canyon.**

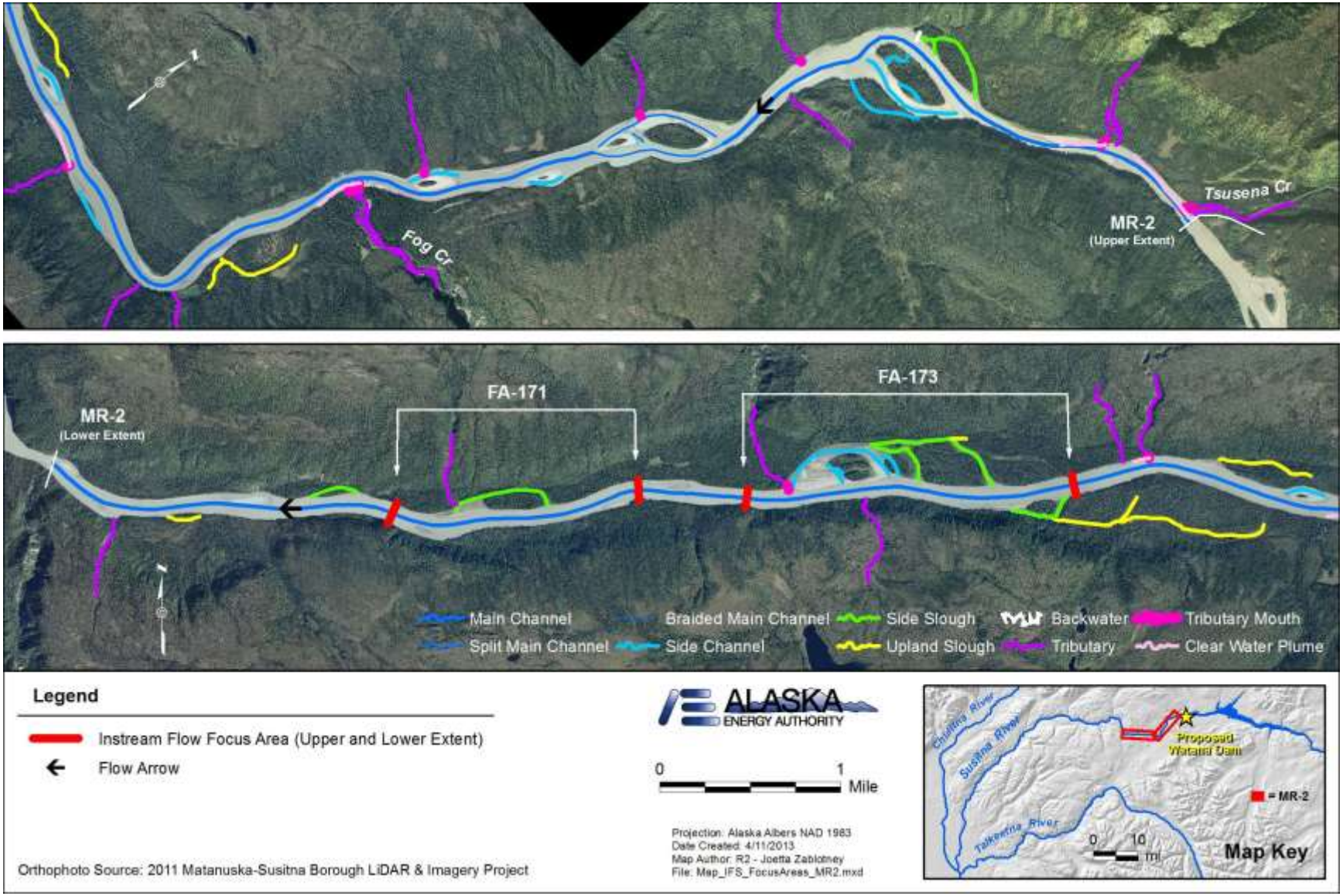


**Figure 2. Map showing habitat mapping for geomorphic reach MR-2 ( HDR 2013).**

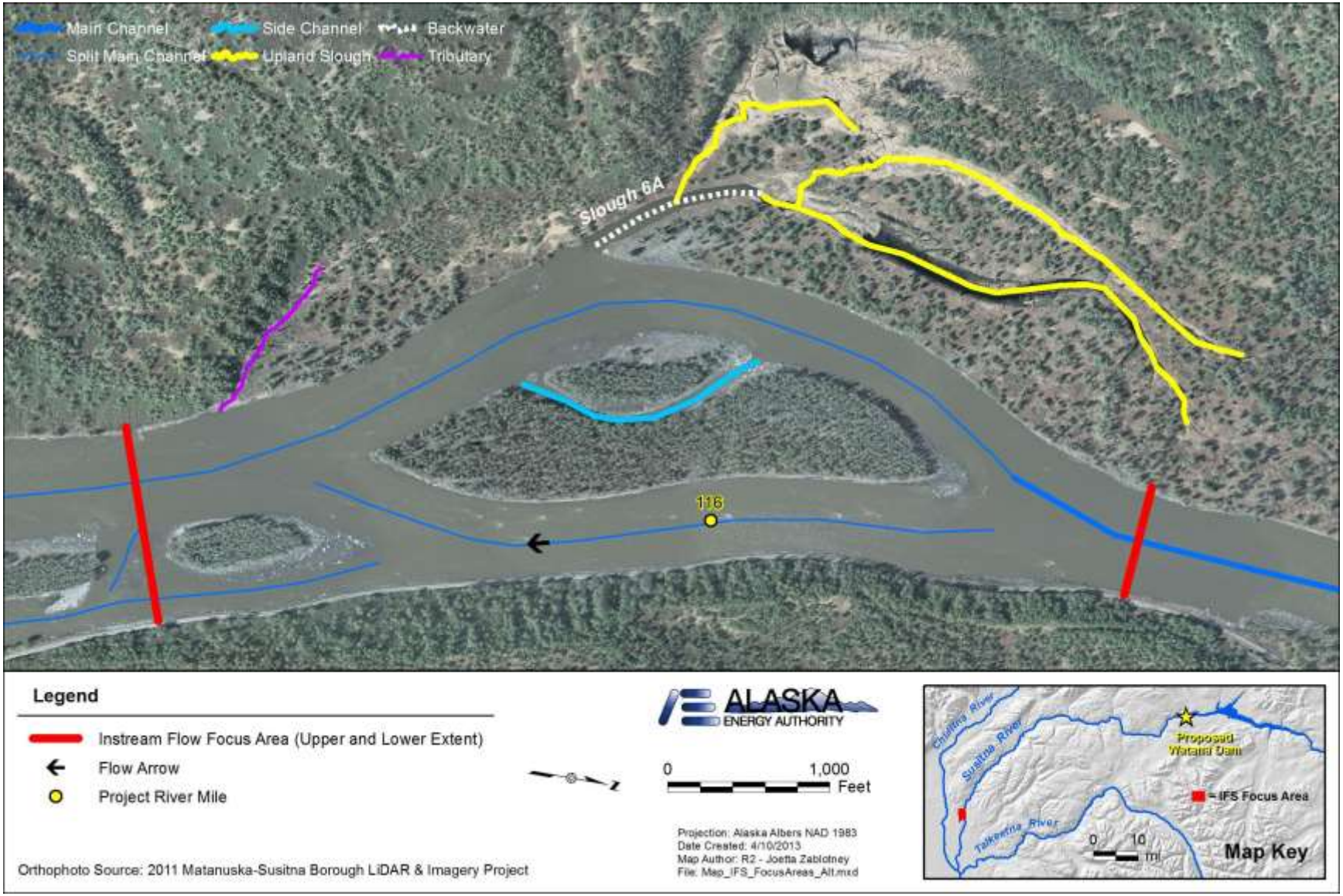


**Figure 3. Map showing Focus Area 115 beginning at Project River Mile 115.3 and extending upstream to PRM 116.5. This Focus Area is located about 0.6 miles downstream of Lane Creek and consists of side channel and upland slough habitats including Slough 6A.**

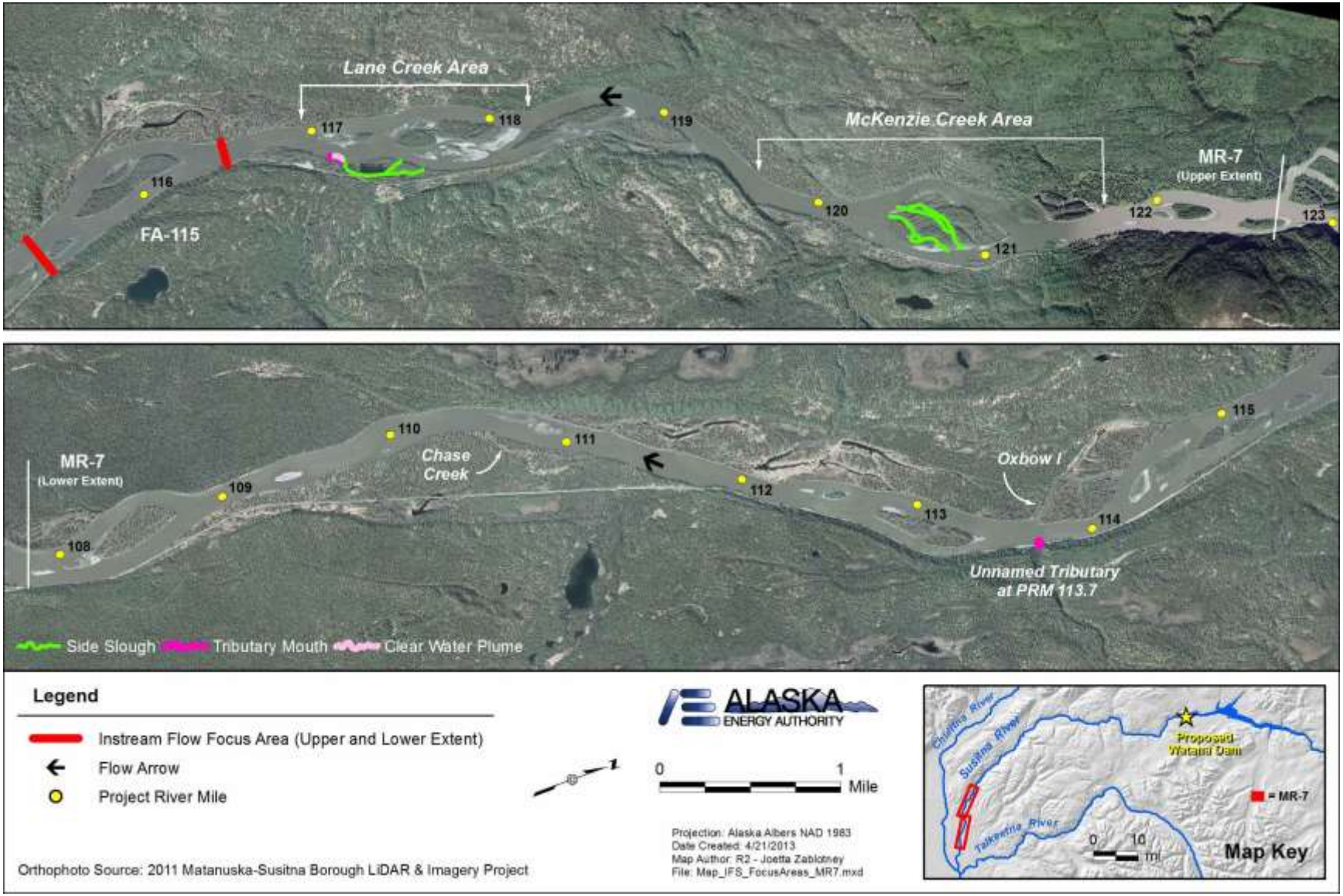


**Figure 4. Map of geomorphic reach MR-7 highlighting side sloughs and tributary features not captured by existing FA-115.**

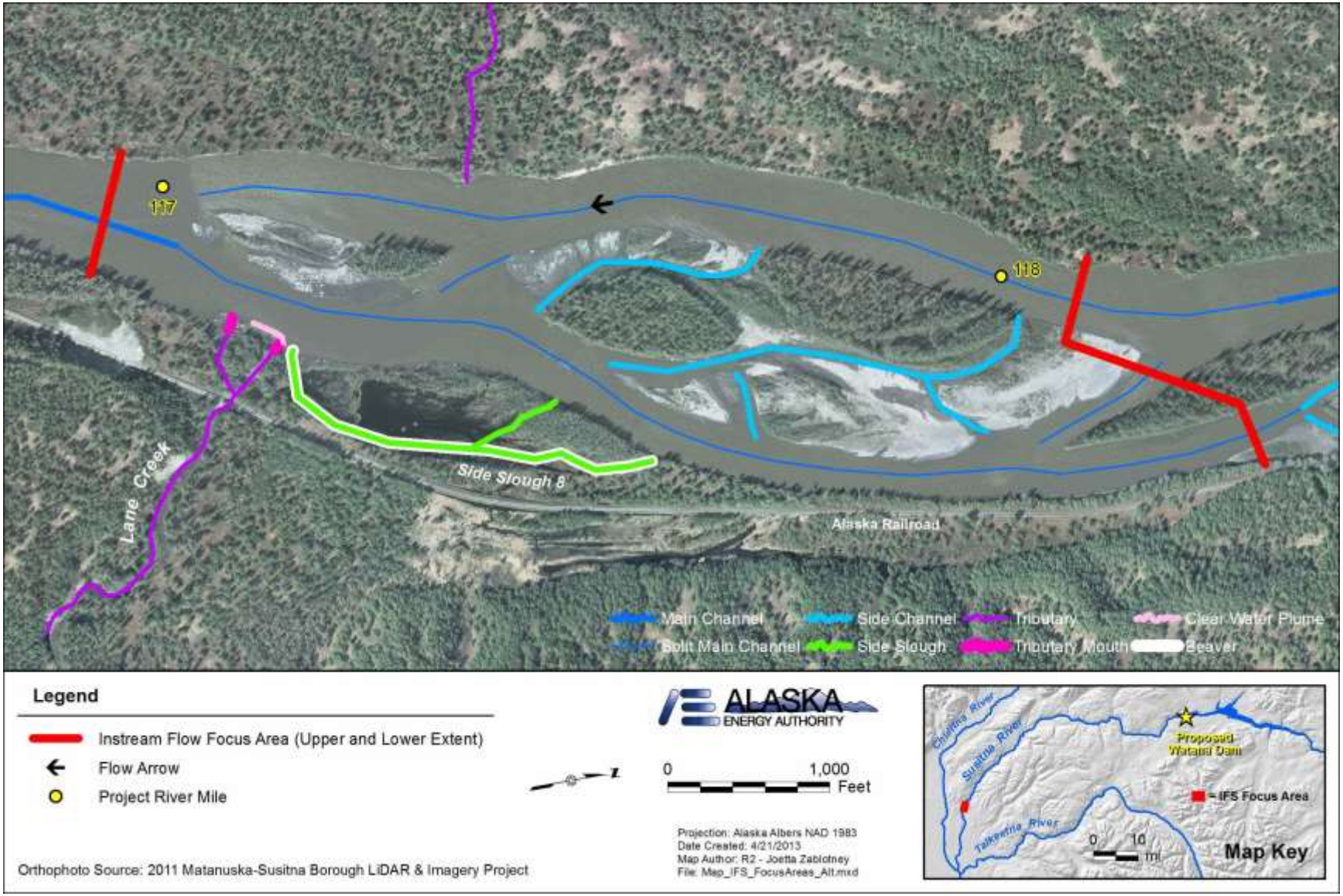


**Figure 5. Map showing habitats mapped in the Lane Creek area.**

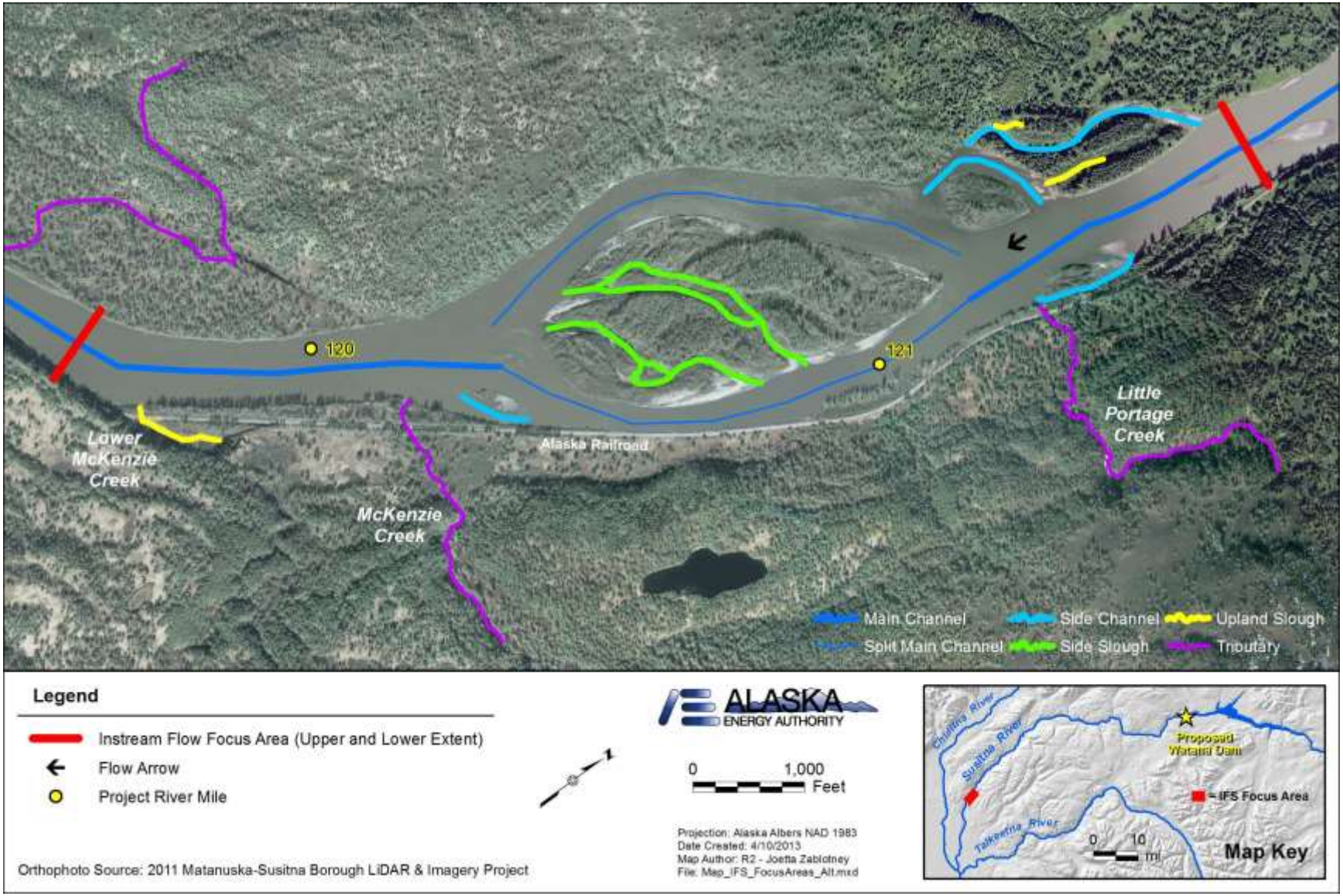


**Figure 6. Map showing habitats mapped in the McKenzie Creek area.**