Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Study of Fish Distribution and Abundance in the Upper Susitna River (Study 9.5)

Proposed 2015 Modifications to Fish Distribution and Abundance Study Plan Implementation Technical Memorandum

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND SCIENTIFIC LABELS

Abbreviation	Definition
ADF&G	Alaska Department of Fish and Game
AEA	Alaska Energy Authority
AWC	Anadromous Waters Catalog
CPUE	Catch per unit effort
CW	Channel width
FDA UP	Study of Fish Distribution and Abundance in the Upper Susitna River
GRTS	Generalized random tessellation stratified sampling
IP	Implementation Plan
ISR	Initial Study Report
km	kilometer
m	meter
PRM	Project river mile
RSP	Revised Study Plan
SPD	Study Plan Determination
SR	Species richness
TSR	True species richness

1. INTRODUCTION

In 2013, AEA's study teams conducted the first year of data collection for the Study 9.5 Fish Distribution and Abundance in the Upper Susitna River. Fish sampling in the Upper River primarily supported Objective 1 of the Study of Fish Distribution and Abundance in the Upper Susitna River: Fish Distribution, Relative Abundance, and Habitat Associations (RSP Section 9.5.4.3.1; AEA 2012). Sampling in 2013 was effective at documenting fish distribution (Task A). Relative abundance estimates were effectively generated for all sampled habitats (Task B). However, analysis of habitat associations (Task C) was limited by the low number of off-channel habitats in the mainstem (see Section 2.1 below) and the low number of rare habitat types in the tributaries (see Section 3.1 below). This technical memorandum describes the proposed modifications to the Study of Fish Distribution and Abundance in the Upper Susitna River (Study 9.5) based on information gathered during the 2013 study year, and limited sampling during the 2014 field season.

Proposed modifications to the Study Plan were presented in Part C, Section 7 of the Initial Study Report (ISR) filed with FERC June 3, 2014 (AEA 2014). AEA implemented the following proposed modifications either in full or on a trial basis in 2014 to gather additional information; to meet study plan objectives; and better inform the 2015 study year:

- Increased sampling of rare habitats (ISR Part C, Section 7.1.2.5.1; AEA 2014) and select Upper River tributaries (ISR Part C, Section 7.1.2.4; AEA 2014) were proposed to better meet the objective of characterizing fish abundance by mesohabitat type (RSP Section 9.5.4.3.1 Task C; AEA 2012), as described in Sections 2 and 3 below.
- Adjustment of the sampling approach for select Upper River tributaries was proposed to obtain useful information about habitat associations (Section 4).
- Low catches in the Kosina Creek rotary screw trap provided limited information on the size, timing, and movements of fishes in the tributary; thus, AEA proposed replacing the rotary screw trap in Kosina Creek with fyke netting near the confluence of Kosina Creek and siting a rotary screw trap in a mainstem Susitna River location near the proposed dam site (ISR Part C, Section 7.1.2.2; 2014) to better meet the objective of describing seasonal movements (described in Section 5).

AEA proposes to continue to implement these modifications during the 2015 study year.

2. SAMPLING DECISION: INCREASED SAMPLING OF RARE HABITATS IN UPPER RIVER MAINSTEM SURVEYS

2.1. Sampling in 2013

Sampling in the mainstem Upper River in 2013 occurred along regularly spaced transects (20 planned, 16 sampled) within the four geomorphic reaches in the inundation zone. Because remote habitat mapping for the Upper River was not available at the time of site selection for the Study 9.5 Implementation Plan (IP Section 5.4; 2013), the transects were widened to 1 km (0.6 mi) in an attempt to intersect rarer, off-channel habitat types. Crews also were asked to look

outside the transects for nearby tributary confluences that were accessible and could be sampled. However, only one off-channel habitat unit was sampled in 2013, limiting the ability to evaluate habitat associations in the mainstem Upper River.

2.2. Rare Habitats

Side-channels, upland sloughs, side sloughs, as well as tributary mouths, clearwater plumes and backwaters all are relatively rare in the Upper River. The original 20 Upper River transect placements resulted in targets of 8 side channels, 3 side sloughs, and 3 tributary mouths. However, a combination of dry habitats and logistical constraints at some transects resulted in sampling 2 side channels, 1 side slough, and 3 tributary mouths (Table 2.2-1). A review of remote line mapping after the 2013 field season indicated that additional habitats of these types were available for sampling as were other unsampled habitat types including upland sloughs, clearwater plumes and backwaters (Table 2.2-2).

The ability to compare data across years is important for collection of baseline data and impact analysis. Thus the modification proposed by AEA for fish sampling was a hybrid approach that would facilitate analysis with 2013 data. This hybrid approach included fish surveys at a subset of 2013 transects for main channel habitats and using generalized random tessellation stratified (GRTS) sampling for rarer habitat types such as side channels, off-channel habitats and special habitat features. Remote line mapping provided the necessary length information for application of a spatially-balanced GRTS sampling approach to these habitats. The advantage of the GRTS approach is that oversamples can be selected and provided to field crews for use in the event that a selected site is not suited for sampling (e.g., dry or inaccessible).

2.3. Sampling Stratification

The ISR for Study 9.5 characterized fish distribution (ISR Section 5.1.1; AEA 2014) and relative abundance (ISR Section 5.1.2; AEA 2014) nested within geomorphic reaches, following the pattern of the Middle River analysis (ISR Study 9.6 Sections 5.1.1 and 5.1.2; AEA 2014). Transect data were aggregated within Geomorphic Reaches for UR-3 through UR-6. Although this geomorphic reach-based approach is helpful in the Middle River where impacts will likely decrease longitudinally downstream from the dam and the impacts of flow changes are dependent on channel form, a reach-based approach is not necessary within the Upper River where the scale of inference will be on the future inundation zone that spans four Geomorphic Reaches from near the upper extent of UR-3 (PRM 234.5) to the downstream extent of UR-6 (PRM 187.1). Therefore, additional sampling sites were not stratified by geomorphic reach. For context, the summed length of habitats in the inundation zone (368,961 ft) is similar to MR-6 (349,877 ft). AEA proposed that it was not necessary to stratify targeted sampling or analysis of fish distribution by Geomorphic Reach in the Upper River. Rather, the hybrid approach that AEA proposed for the next year of sampling included an additional 4 side channel sites and 6 sites of each off-channel and special feature habitat type within the future reservoir inundation zone, as well as repeating 21 mainstem and 2 side channel sites along 10 transects (Table 2.3-1). This would increase the total number of planned sampling sites from 35 to 57 when implemented in the next year of study.

Implementing this modification will maintain the integrity of the data AEA collected in 2013. It will minimize the risk of selecting sites impossible to sample by providing a list of oversample sites to draw upon. It will also increase both the types of habitat as well as the overall area of habitat sampled in the Upper River, and thereby improve AEA's ability to characterize fish-habitat associations in the Upper Susitna River.

2.4. Implementation of Hybrid Mainstem Sampling in 2014

During the 2014 field season and in order to confirm the feasibility of the proposed modification, AEA implemented a modified version of the hybrid GRTS/transect sampling approach in the Upper River. The hybrid approach was modified from that proposed for 2015 so as to provide continuity between years and complement the 2013 dataset. Thus, three of the 16 transects sampled in 2013 (or 10 proposed for 2015) were sampled in 2014 (Table 2.4.-1). A complete set of GRTS sites were selected to fulfill targets of six replicates of the other macrohabitat types (Figures 2.4-1, 2.4-2, 2.4-3, 2.4-4, 2.4-5, 2.4-6). During the early summer sampling event (July 2014), sampling took place at 35 macrohabitat locations (Table 2.4-2). Six replicates of off-channel and side channel habitats were achieved for upland sloughs (6), tributary mouths (7), clearwater plumes (7), and side sloughs (6), but not for side channels (5) or backwaters (2).

2.5. Recommendations for Mainstem Sampling

AEA recommends adopting the hybrid transect/GRTS approach for the 2015 study season. Ten transects have been selected for repeat sampling (Table 2.4-1) and will be supplemented with GRTS-based selection of off-channel and side channel sampling locations.

3. SAMPLING DECISION: INCREASED SAMPLING EFFORT IN SELECT UPPER RIVER TRIBUTARIES

3.1. Sampling in 2013

The April 2013 FERC Study Plan Determination (SPD) recommended scaling sampling in proportion to stream size (p. B-124). To achieve a spatially-balanced and random sample of fish habitats within Upper River tributaries, the length of the tributaries were divided into GRTS panels that were 200, 400, or 800 m long, depending on the tributary drainage area. However, logistical constraints required sub-sampling 100 m (109 yd)-long units within GRTS panels. Specifically, within a selected GRTS panel, fish sampling occurred in either a complete mesohabitat unit or up to 100 m (109 yd) per mesohabitat for each mesohabitat type present. Post-season analysis indicated that the 2013 tributary sampling program was effective at documenting the fish species present and the distribution of these species within Upper River tributaries (Table 3.1-1, Figure 3.1-1). The analysis consisted of comparing the total number of species found in a tributary, referred as observed species richness (SR), and an estimate of true species richness (TSR) in a tributary (Cochran 1977).

However, the 2013 sub-sampling resulted in a sampling effort that was inconsistent with the intent of the April 2013 FERC SPD, with smaller basins receiving proportionally more effort, and larger basins receiving proportionally less (Table 3.1-2). In addition, a post-2013 field

season review of the remote video within each GRTS panel indicated that there were some habitat types (pools, alcoves, percolation channels) that were under-represented in 2013 fish sampling and would benefit from additional replicates. These two findings related to the 2013 fish sampling effort prompted AEA to modify the Upper River study by increasing the number of sub-sampling units within the GRTS panels for the next year of study using an approach that increases sampling proportional to stream width and increases the number of under-represented fish habitats.

3.2. Increased Sampling Effort

Again because of AEA's desire to analyze data across years, the proposed approach involves sampling at all 2013 sampling units while allocating increased effort strategically among tributaries. AEA reviewed a number of sampling sufficiency analyses based on stream size, including a recent publication by ADF&G for sampling in Alaska streams (Kirsch et al. 2014). AEA proposed to apply the recommendation from the ADF&G analysis to Upper River tributaries and will use this approach during the next year of sampling to generate increased total sample lengths by tributary. In applying the ADF&G approach, the sampling effort in most tributaries AEA will be maintained or increased, as determined by sample length, beyond that accomplished in 2013. This will allow for inclusion of additional mesohabitat replicates.

The sole exception to this proposed sampling approach is in Goose Creek. The Implementation Plan incorrectly identified Goose Creek as having documented Chinook salmon presence and being listed in the Anadromous Water Catalog (AWC). Therefore, sampling was intensive, striving towards a goal of sampling up to 25 percent of the 80 GRTS panels generated for this system. AEA proposes to scale back the effort in Goose Creek to sub-sampling in 12 panels to be consistent with the sampling effort in other non-Chinook salmon bearing streams. The stream-specific sample length changes are presented in Table 3.1-2.

3.3. Measures of Sampling Sufficiency

Sampling sufficiency for characterizing fish distribution is often evaluated in relation to channel width (Paller 1995, Patton et al. 2000, Hughes et al. 2002, Maret and Ott 2003, Reynolds et al. 2003, Kirsch et al. 2014). Fish sampling and habitat surveys completed in 2013 provided channel width information that was not available to incorporate into the Implementation Plan (AEA 2013). The AEA study team has reviewed the 2013 sampling effort in the context of field measurements of channel width in order to prioritize additional sampling. Kirsch et al. (2014) recommended sampling lengths of 40 wetted channel widths for wadeable streams, 120 channel widths for nonwadeable streams in basins with a watershed area of 100-300 km^2 (38.6 – 115.8 mi^2), and more than 140 channel widths in nonwadeable streams in larger drainage basins. Applying these recommendations to Upper River tributaries, the study team developed revised distance targets for future sampling (Table 3.1-2). AEA proposed to maintain the spatial configuration of the original GRTS panel sampling and apportioned the additional sampling length within the existing panels by increasing the number of replicates of mesohabitat units sampled per panel.

3.4. Implementation of Increased Tributary Sampling Effort in 2014

During the 2014 study season, AEA implemented the recommended increase in additional sampling length within the existing panels with the aim of increasing the number of replicates of mesohabitat units sampled per panel in the Black River. In 2013, the 100 m (109 yd) sub-sampling approach in six GRTS panels (Panels 01, 02, 04, 06, 07, 09) resulted in sampling of 11 mesohabitat units within 1,050 m (1,148 yd) of sample unit length (Tables 3.4-1 and 3.4-2). In 2014, the same six panels resulted in sampling of 19 mesohabitat units along 2,724 m (2,979 yd) of stream and off-channel unit length (Tables 3.4-1 and 3.4-2). Two additional panels (Panels 03 and 05) were added in to reach the target length (3,178 m [3,476 yd]), resulting in a total of 28 mesohabitat units sampled over a stream length of 3,619 meters (3,958 yd).

3.5. Recommendations for Tributary Sampling

After successfully implementing the increased sampling approach in the Black River, AEA recommends adopting the tributary sampling approach and targets from the Initial Study Report 7.1.2.4 for the 2015 study year.

4. SAMPLING DECISION: PROTOCOL ADJUSTMENT FOR SELECT UPPER RIVER TRIBUTARIES

In 2013, four tributaries that were selected for sampling were not sampled due to land access considerations including Deadman Creek and unnamed tributaries 197.7, 204.5, and 206.3. Deadman was proposed as a direct sample tributary and was partially sampled in 2013. All of these streams are being sampled during the 2014 study season. After reconnaissance of unnamed tributaries 197.7, 204.5, and 206.3 in 2014, it became clear that the proposed GRTS sampling approach was not appropriate because the gradient and forested conditions preclude helicopter landing andaccess to sampleable middle reaches of each of these streams. In addition, the small length targets and number of replicate panels would not yield useful information about habitat associations (Table 3.1-2). Thus, te 2014 sampling efforts used a direct sample approach with two days of sampling effort allotted for each of these tributaries targeting a diversity of the mesohabitats present. AEA recommends that unnamed tributaries 197.7, 204.5, and 206.3 also be sampled with a direct sample approach with two days of effort during the 2015 study season (Table 3.1-2).

5. SAMPLING DECISION: ROTARY SCREW TRAP LOCATIONS

5.1. Sampling in 2013

In 2013, final site selection for Upper River rotary screw traps used the following criteria: 1) position downstream of documented Chinook salmon; 2) landowner permission to access; 3) accessibility by helicopter; 4) a minimum depth of 1.25 m (4.1 ft) during low flow periods; and 5) consistent laminar flow with velocities in the range of 0.6 to 2 m/s (2 to 6.6 ft/s). In 2013, the inability to access areas above ordinary high water mark along Cook Inlet Regional Working Group (CIRWG) land restricted the placement of rotary screw traps (IP Section 5.7.1; AEA

2013) in the Upper River to locations on State of Alaska or Federal land. A third rotary screw trap could not be cited near the proposed dam site as recommend in the April 2013 FERC SPD (B-134). Instead, AEA operated two rotary screw traps near the mouths of the only two known Upper River tributaries that support Chinook salmon, Kosina Creek and the Oshetna River. For the Oshetna River, a location just upstream of the confluence with the Susitna River (PRM 235.1) at Oshetna RM 0.1 was selected. At the time of planning and installation, this location was downstream of the only documented observation of juvenile Chinook salmon in the Oshetna basin at a side channel near Oshetna RM 1.7 (Buckwalter 2011). A second rotary screw trap site was selected on Kosina Creek (PRM 209.1) near RM 2.2 (Figure 5.1-1). This location was the only suitable site in Kosina Creek downstream of the Tsisi and Kosina creeks confluence where Chinook salmon spawning had been documented upstream (HDR 2013). The Kosina trapping site featured a deep, high velocity lateral scour pool next to an undercut vertical rock face with strong eddies and clear water making trap operation difficult.

Rotary screw traps operated in Kosina Creek and the Oshetna River were used to document seasonal fish movements of anadromous salmon and resident fish species out of these Upper River tributaries between mid-June and early October, 2013. During this period, the Kosina Creek trap caught 153 total fish while the Oshetna River trap caught 1,001 total fish (ISR Table 5.2-1). The Kosina Creek trap caught one anadromous fish, a juvenile Chinook salmon, and six species of resident fish including Arctic grayling, Dolly Varden, longnose sucker, sculpin, humpback whitefish, and round whitefish. The Oshetna trap also caught seven total fish species, including juvenile Chinook salmon, Arctic grayling, burbot, longnose sucker, sculpin, humpback whitefish, and round whitefish.

Because of such extremely low catch rates at Kosina Creek in 2013, AEA considered alternatives to gather additional information on the seasonal fish movements of anadromous salmon and resident fish species out of Kosina Creek. In the March 21, 2014 technical team meeting with stakeholders, AEA proposed replacing the rotary screw trap in Kosina Creek with fyke netting near the confluence of Kosina Creek. In addition, newly granted land access permission facilitated siting a rotary screw trap in a mainstem Susitna River location near the proposed dam site. These recommendations were proposed in Section 7 of the Initial Study Report (ISR Section 7.1.2.2; AEA 2014).

5.2. Implementation of Rotary Screw Trap and Fyke Net Sampling in 2014

AEA then implemented these adjustments during 2014 study efforts: setting two fyke nets near the confluence of Kosina Creek and the Susitna River (Figure 5.2-1) and operating a mainstem rotary screw trap at PRM 200.3 (Figure 5.2-2). Fyke nets were fished on the same schedule as rotary screw traps (2 days/nights on/three days off) beginning May 20th, 2014. To evaluate the effectiveness of the fyke trapping, data from the first six weeks of fyke trap sampling are compared to 2013 rotary screw trap data from Kosina Creek.

Preliminary catch numbers and catch-per-unit-effort from May and June, 2014 are higher for fyke netting near the confluence than for the rotary screw trap at Kosina Creek RM 2.2 over the same interval in 2013 (Table 5.2-1). CPUE has increased from 0.06 fish/trap/night to 1.06 fish/trap/night and catch increased from 1 fish to 34. Furthermore, the May-June 2014 fyke

netting efforts have resulted in the capture of nine juvenile Chinook salmon, a species of interest in the Upper River. To provide a perspective on interannual variability between 2013 and 2014 we also evaluated the first six weeks of catch from the Oshetna River rotary screw trap. The Oshetna was fished in the same location in 2013 and 2014 and had similar catch rates, 7.88 fish/night and 8.24 fish/night, respectively (Table 5.2-1).

Preliminary catch data from the mainstem Susitna River rotary screw trap located at PRM 200.3 (Figure 5.2-2) indicate that the selected location is suitable and yielding valuable information on the seasonal fish movements of anadromous salmon and resident fish species in the Upper Susitna River. In May-June 2014, the mainstem Susitna River trap averaged 9.76 fish/night over the same period that the Oshetna trap averaged 8.24 fish/night (Table 5.2-1). The composition of the catch at the mainstem location also included 12 juvenile Chinook salmon.

5.3. Recommendations for Rotary Screw Trap Locations

Based on information collected in 2014, in 2015 AEA recommends operating rotary screw traps at the mouth of the Oshetna River and a mainstem location, likely PRM 200.4, if fish collection and trap operation continues to be reasonable over a range of flow conditions. AEA recommends replacing the Kosina Creek rotary screw trap with fyke netting near the mouth as it has proven to be a more effective technique in the drainage. These recommendations are consistent with those developed in Section 7 of Part C of the Initial Study Report (AEA 2014).

6. LITERATURE CITED

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7. TABLES

Table 2.2-1. Study 9.5 Fish Distribution and Abundance in the Upper Susitna River (FDA UP) sites sampled in 2013 by habitat type.

		Sites per Geomorphic Reach				
Macrohabitat Type	Reach Length	UR-3 (PRM 234.5 - 224.9)	UR-4 (PRM 224.9 - 208.1)	UR-5 (PRM 208.1 - 203.4)	UR-6 (PRM 203.4 – 187.1)	TOTAL
Main Channel Macrohabitats						
Main Channel	500 m	2 (2)	6 (1)	2	6 (1)	16 (4)
Split Main Channel						
Multi-Split Main Channel						
Side Channel		-	-	-	2	2
Off-Channel Macrohabitats						
Side Slough	200 m	-	-	-	1	1
Upland Slough		-	-	-	-	0
Special Habitat Features						
Tributary Mouth	200 m	-	3	-	-	3
Clear Water Plume		-		-	-	0
Backwater						0
Total		*2(2)*	*9(1)*	*2*	*9(1)*	*22 (4)*

(#) indicates number of sites deemed unsafe for sampling

Table 2.2-2. Study 9.5 FDA UP potential generalized random tessellation stratified (GRTS) fish sampling sites based on line mapping of macrohabitats.

		Number of Potential Sites per Geomorphic Reach*				
Macrohabitat Type	Reach Length	UR-3 (PRM 234.5 - 224.9)	UR-4 (PRM 224.9 - 208.1)	UR-5 (PRM 208.1 - 203.4)	UR-6 (PRM 203.4 – 187.1)	TOTAL
Main Channel Macrohabitats						
Main Channel	500 m	101	155	45	169	470
Split Main Channel		-	35	6	11	52
Multi-Split Main Channel		-	-	-	-	-
Side Channel		11	80	15	246	352
Off-Channel Macrohabitats						
Side Slough	200 m	6	70	-	25	101
Upland Slough		-	15	-	3	18
Special Habitat Features						
Tributary Mouth	200 m	3	7	1	4	15
Clearwater Plume		6	27	-	-	33
Backwater		-	6	-	-	6
Total	-	*127*	*395*	*67*	*458*	*1,047*

*Potential sites based on total lengths reported in Upper River line mapping. Total site numbers may be fewer based on habitat configuration.

Table 2.3-1. Study 9.5 FDA UP hybrid sampling recommendations by habitat.

		Sites per Geomorphic Reach				
Macrohabitat Type	Reach Length	UR-3 (PRM 234.5 - 224.9)	UR-4 (PRM 224.9 - 208.1)	UR-5 (PRM 208.1 - 203.4)	UR-6 (PRM 203.4 – 187.1)	TOTAL
Main Channel Macrohabitats						
Main Channel	500 m	2*	3*	2*	3*	10
Split Main Channel						
Multi-Split Main Channel						
Side Channel		6				6
Off-Channel Macrohabitats						
Side Slough	200 m	6				6
Upland Slough		6				6
Special Habitat Features						
Tributary Mouth	200 m	6				6
Clear Water Plume		6				6
Backwater		6				6
					Total	*46*

*Transects may include more than one macrohabitat site, depending on habitat configuration. The ten mainstem transects include 21 mainstem sites.

Table 2.4-1. Study 9.5 FDA UP hybrid transect/GRTS sampling approach recommendations for 2015.

Transect ID	PRM	Sampled in 2013	Main Channel	Side Channel	Side Slough	Tributary Mouth/Plume	Total	Sampled in 2014	Sample in 2015
Proposed Dam Site PRM 187.1									
1	188.3	No	0	0	0	0	0	No	No
2	190.7	Yes	1	0	0	0	1	No	Yes
3	193.1	Yes	1	0	0	0	1	No	No
4	195.5	Yes	1	0	1	0	2	No	Yes
5	197.9	Yes	1	0	0	0	1	No	No
6	200.3	Yes	1	1	0	0	2	Yes	Yes
7	202.7	Yes	1	1	0	0	2	No	No
8	205.1	Yes	1	0	0	0	1	No	Yes
9	207.5	Yes	1	0	0	0	1	No	No
10	209.9	Yes	1	0	0	0	1	Yes	Yes
11	212.3	Yes	1	0	0	1	2	No	No
12	214.7	Yes	1	0	0	0	1	No	Yes
13	217.1	Yes	1	0	0	1	2	No	No
14	219.5	Yes	1	0	0	1	2	Yes	Yes
15	221.9	No	0	0	0	0	0	No	No
Proposed Reservoir Inundation Zone at Low Pool 222.5									
16	224.3	Yes	1	0	0	0	1	No	Yes
17	226.7	No	0	0	0	0	0	No	No
18	229.1	No	0	0	0	0	0	No	No
19	231.5	Yes	1	0	0	0	1	No	Yes
Proposed Reservoir Inundation Zone at Maximum Pool 232.5									
20	233.9	Yes	1	0	0	0	1	No	Yes
Total		16	16	1	1	3	22	3	10

Table 2.4-2. Study 9.5 FDA UP sampling approach implemented in Event 1 (July), 2014. 2014 sampling included all of the GRTS sites and a subset of the transect sites that will be completed in 2015.

Site ID	Transect/ GRTS	Project River Mile	Mainstem Habitat	Macrohabitat/ Special Mesohabitat	Site Length (m)
Proposed Dam Site PRM 187.1					
FDA-UR6-189.4-68-CWP	GRTS	189.4	Main Channel	Clearwater Plume- Deadman Creek	200
FDA-UR6-189.4-68-TM	GRTS	189.4	Main Channel	Tributary Mouth- Deadman Creek	38
FDA-UR6-193.1-72-CWP	GRTS	193.1	Main Channel	Clearwater Plume- Unnamed Tributary	16
FDA-UR6-193.1-72-TM	GRTS	193.1	Main Channel	Tributary Mouth- Unnamed Tributary	14
FDA-UR6-P48-SS	GRTS	194.5	Off-Channel	Side Slough	200
FDA-UR6-P51-SS	GRTS	197.1	Off-Channel	Side Slough-Backwater	200
FDA-UR6-200.3-SC	Transect	200.3	Main Channel	Side Channel	270
FDA-UR6-200.3-MC	Transect	200.3	Main Channel	Split Main Channel	500
FDA-UR6-P4-SC	GRTS	202.1	Main Channel	Side Channel	200
FDA-UR6-203.4-71-CWP	GRTS	203.4	Main Channel	Clearwater Plume- Unnamed Tributary	91
FDA-UR6-203.4-71-TM	GRTS	203.4	Main Channel	Tributary Mouth- Unnamed Tributary	25
FDA-UR5-204.5-67-CWP	GRTS	204.5	Main Channel	Clearwater Plume- Unnamed Tributary	35
FDA-UR5-204.5-67-TM	GRTS	204.5	Main Channel	Tributary Mouth-Unnamed Tributary	19
FDA-UR5-P2-SC	GRTS	206.4	Main Channel	Side Channel	500
FDA-UR4-P46-SS	GRTS	208.1	Off-Channel	Side Slough	200
FDA-UR4-209-69-CWP	GRTS	209	Main Channel	Clearwater Plume- Kosina Creek	262
FDA-UR4-209-69-TM	GRTS	209	Main Channel	Tributary Mouth- Kosina Creek	50
FDA-UR4-P50-SS	GRTS	209.7	Off-Channel	Side Slough Backwater	70
FDA-UR4-P50-SS	GRTS	209.7	Off-Channel	Side Slough	129
FDA-UR4-209.9-MC	Transect	209.9	Main Channel	Single Main Channel	500
FDA-UR4-P47-SS	GRTS	210	Off-Channel	Side Slough	200
FDA-UR4-210.5-93-US	GRTS	210.5	Off-Channel	Upland Slough	160
FDA-UR4-099-US	GRTS	211.2	Off-Channel	Upland Slough	120
FDA-UR4-214-90-US	GRTS	214	Off-Channel	Upland Slough	120
FDA-UR4-214-94-US	GRTS	214	Off-Channel	Upland Slough	120
FDA-UR4-214.4-91-US	GRTS	214.4	Off-Channel	Upland Slough	200
FDA-UR4-098-US	GRTS	214.4	Off-Channel	Upland Slough	160
FDA-UR4-O6-SC	GRTS	215.9	Main Channel	Side Channel	200
FDA-UR4-P49-SS	GRTS	216.9	Off-Channel	Side Slough	145
FDA-UR4-219.9-CWP	Transect	219.9	Main Channel	Clearwater Plume- Unnamed Tributary	112
FDA-UR4-219.9-MC	Transect	219.9	Main Channel	Single Main Channel	500
FDA-UR4-219.9-TM	Transect	219.9	Main Channel	Tributary Mouth- Unnamed Tributary	87
Proposed Reservoir Inundation Zone at Low Pool 222.5					
FDA-UR3-P1-SC	GRTS	231	Main Channel	Side Channel	200
FDA-UR3-P70-CWP	GRTS	232	Main Channel	Clearwater Plume- Goose Creek	200
FDA-UR3-P70-TM	GRTS	232	Main Channel	Tributary Mouth- Goose Creek	61
Proposed Reservoir Inundation Zone at Maximum Pool 232.5					
Total					6,104

Table 3.1-1. Summary of sampling sufficiency measures for tributaries with at least six GRTS sampling sites in the Upper River in 2013.

Upper River Tributary	Number of 2013 Sample Sites	SR[a]	Site when SR first observed	TSR_{H-T}[b]	Site when TSR_{H-T} -1 first observed	TSR_{H-T} minus SR
Oshetna River (PRM 235.1)	13	6	7	6.81	7	0.81
Black River	6	6	3	6.60	3	0.60
Goose Creek (PRM 232.8)	20	4	1	4.003	1	0.003
Kosina Creek (PRM 209.1)	6	4	2	4.10	1	0.10
Tsisi Creek	6	4	4	4.52	4	0.52
Watana Creek (PRM 196.9)	15	5	9	5.55	9	0.55
Watana Creek Tributary	13	4	7	4.58	7	0.58

[a] Observed species richness (SR) - the total number of species found in a Tributary
[b] Horvitz-Thompson estimate (Cochran 1977) of the true species richness (TSR) in a tributary

Table 3.1-2. 2013-2014 tributary sampling summary and proposed future Upper River tributary sampling length targets.

GRTS Sampled Tributaries	Drainage Basin Area (km^2)	Chinook salmon presence	GRTS Sampling Unit Size (m)	Number of GRTS Population Sample Units	Number of 2013 Sample Sites	Number of mesohabitats sampled 2013	Meters Sampled 2013	% Sampled 2013	Number of mesohabitats sampled 2014	Meters sampled 2014	Average Wetted width (m)	Channel Widths Sampled 2013	Kirsch et al. 2014 target (CW)	Kirsch et al. 2014 target (m)	Kirsch et al. 2014 target (%)	Proposed Change (m)
Oshetna River (PRM 235.1)	1424.5	yes	800	52	13	28	2,604	6%	--	--	36	73	140	5,026	12%	2,422
Black River	NA	no	400	24	6	11	1,050	11%	28	3619	23	46	140	3,178	33%	2,128
Goose Creek (PRM 232.8)	269.1	no	200	81	20	38	3,107	19%	--	--	14	219	120	1,704	11%	-1,403
Kosina Creek (PRM 209.1)	1036.5	yes	800	24	6	10	1,000	5%	--	--	32	31	120	4,522	24%	3,522
Tsisi Creek	NA	no	400	23	6	10	980	11%	--	--	14	69	140	1,988	22%	1,008
Watana Creek (PRM 196.9)	452.7	yes	400	60	15	30	2,561	11%	--	--	11	231	140	1,554	6%	--
Watana Creek Tributary	NA	no	200	67	13	18	1,459	11%	--	--	10	154	140	1,330	10%	--
Unnamed Tributary (PRM 194.8)	321.2	no	400	32	2	4	300	2%	--	--	3	88	140	476	4%	176
GRTS Total	--	--	--	454	81	149	13,061	8%	--	--	--	--		19,778	12%	7,853
Direct sample Tributaries																
Jay Creek (PRM 211)	160.1	no	NA	--	NA	8	324	--			14	--	--	--	--	--
Unnamed Tributary (PRM 206.3)	<80.3	no	NA	--	NA	--	--	--	3	263	6.9	--	--	--	--	Direct
Unnamed Tributary (PRM 204.5)	<80.3	no	NA	--	NA	--	--	--	2	330	4.5	--	--	--	--	Direct
Unnamed Tributary (PRM 197.7)	<80.3	no	NA	--	NA	--	--	--	5	358	7.1	--	--	--	--	Direct
Deadman Creek (PRM 189.4)	453.5	no	NA	--	NA	--	--	--	5	357	28.4	--	--	--	--	--
Direct Sample Total	--	--	--	--	--	8	324	--	15	1,308	--	--	--	--	--	--

Table 3.4-1. Black River sample unit length (meters) by tributary channel /macrohabitat and mesohabitat type for GRTS sampling approach 2013 and 2014.

Year	Trib Hab Type	Single Channel			Single Total	Split Channel				Split Total	Complex Channel				Complex Total	Off-Channel Habitat				OCH Total	Grand Total
	Trib MC/OC HabType	Main Channel				Primary			Secondary		Primary		Secondary	Tertiary		Tributary		Upland Slough			
	Mesohabitat	Boulder riffle	Rapid	Run/Glide		Boulder riffle	Riffle	Run/Glide	Run/Glide		Boulder riffle	Run/Glide	Riffle			Run/Glide	Boulder Riffle	Pool	Run/Glide		
2013	Black River: Panel 01			100	100													100		100	200
	Black River: Panel 02											100	100		200				100	100	300
	Black River: Panel 04	100			100																100
	Black River: Panel 06					100		100	50	250											250
	Black River: Panel 07	100			100																100
	Black River: Panel 09	100			100																100
2013 Total		300	-	100	400	100	-	100	50	250	-	100	100	-	200	-	-	100	100	200	1,050
2014	Black River: Panel 01	104		296	400													127		127	527
	Black River: Panel 02						100	245		345			55		55				140	140	540
	Black River: Panel 03	43	282	75	400											51	44			95	495
	Black River: Panel 04		90		90			310		310									40	40	440
	Black River: Panel 05										400				400						400
	Black River: Panel 06	150		100	250	100				100		50			50						400
	Black River: Panel 07	210	190		400				17	17											417
	Black River: Panel 09	280			280						120				120						400
2014 Total		787	562	471	1,820	100	100	555	17	772	520	50	55	-	625	51	44	127	180	402	3,619

Table 3.4-2. Black River mesohabitat unit count (number of replicate mesohabitat units) by tributary channel /macrohabitat and mesohabitat type for GRTS sampling approach 2013 and 2014.

	Tributary Habitat Type	Single Channel				Split Channel					Complex Channel					Off-Channel Habitat					
	Trib MC/OC HabType	Main Channel				Primary			Secondary		Primary		Secondary	Tertiary		Tributary		Upland Slough			
Year	Mesohabitat	Boulder riffle	Rapid	Run/Glide	Single Total	Boulder riffle	Riffle	Run/Glide	Run/Glide	Split Total	Boulder riffle	Run/Glide	Riffle		Complex Total	Run/Glide	Boulder Riffle	Pool	Run/Glide	OCH Total	Grand Total
2013	Black River: Panel 01			1	1													1		1	2
	Black River: Panel 02											1	1		2				1	1	3
	Black River: Panel 04	1			1																1
	Black River: Panel 06					1		1	1	3											3
	Black River: Panel 07	1			1																1
	Black River: Panel 09	1			1																1
2013 Total		3	-	1	4	1	-	1	1	3	-	1	1	-	2	-	-	1	1	2	11
2014	Black River: Panel 01	1		1	2													1		1	3
	Black River: Panel 02						1	1		2			1		1				1	1	4
	Black River: Panel 03	1	2	2	5											2	1			3	8
	Black River: Panel 04		1		1			1		1									1	1	3
	Black River: Panel 05										1				1						1
	Black River: Panel 06	1		1	2	1				1		1			1						4
	Black River: Panel 07	1	1		2				1	1											3
	Black River: Panel 09	1			1						1				1						2
2014 Total		5	4	4	13	1	1	2	1	5	2	1	1	-	4	2	1	1	2	6	28

Table 5.2-1. May-June rotary screw trap catch at Oshetna River (2013-14), Kosina Creek (2013), Susitna River at PRM 200.3 (2014), and Fyke netting catch at Kosina Creek mouth/Clearwater plume (2014). Data are preliminary.

Location		Susitna River			Kosina Creek						Oshetna River					
Geomorphic Reach		UR-4			UR-4						UR-2					
Project River Mile		200.3			209.1						235.1					
Collection Method		Rotary Screw Trap			Rotary Screw Trap			Fyke Net			Rotary Screw Trap			Rotary Screw Trap		
Year		2014			2013			2014			2013			2014		
Month		May	June	Total	May	June	Total	May	June	Total	May	June	Total	May	June	Total
Effort (trap-nights)		6	11	17	0	16	16	10	22	32	0	16	16	6	11	17
Species	Life Stage															
Chinook Salmon	Fry								1	1						
	Parr	1	1	2				1		1				1		1
	Smolt		10	10					7	7					2	2
	Adult															
Arctic Grayling	Juvenile	1	21	22				1	3	4		9	9	38	6	44
	Juvenile/Adult	5	20	25				1		1		48	48	1	7	8
	Adult	3	4	7		1	1	1		1		6	6	1	3	4
	Unknown														1	1
Burbot	Juvenile								1	1						
	Juvenile/Adult							1		1		1	1			
Dolly Varden	Juvenile/Adult															
Longnose Sucker	Juvenile	7	48	55				1	8	9		1	1	13	62	75
	Juvenile/Adult											3	3			
	Adult											26	26		1	1
Sculpin	Juvenile								2	2						
	Juvenile/Adult		2	2								3	3			
	Adult								4	4		8	8	2		2
Whitefish, humpback	Juvenile											3	3			
	Juvenile/Adult		1	1												
Whitefish, undifferentiated	Juvenile	29	7	36				1		1		2	2			
	Juvenile/Adult											4	4		1	1
Whitefish, round	Juvenile		3	3								3	3			
	Juvenile/Adult	2	1	3								5	5	1		1
	Adult											4	4			
Unknown	Juvenile							1		1						
Total		48	118	166	0	1	1	8	26	34	0	126	126	57	83	140
CPUE Fish per Trap/Night		8.00	10.73	9.76	NAP	0.06	0.06	0.80	1.18	1.06	NAP	7.88	7.88	9.50	7.55	8.24

8. FIGURES

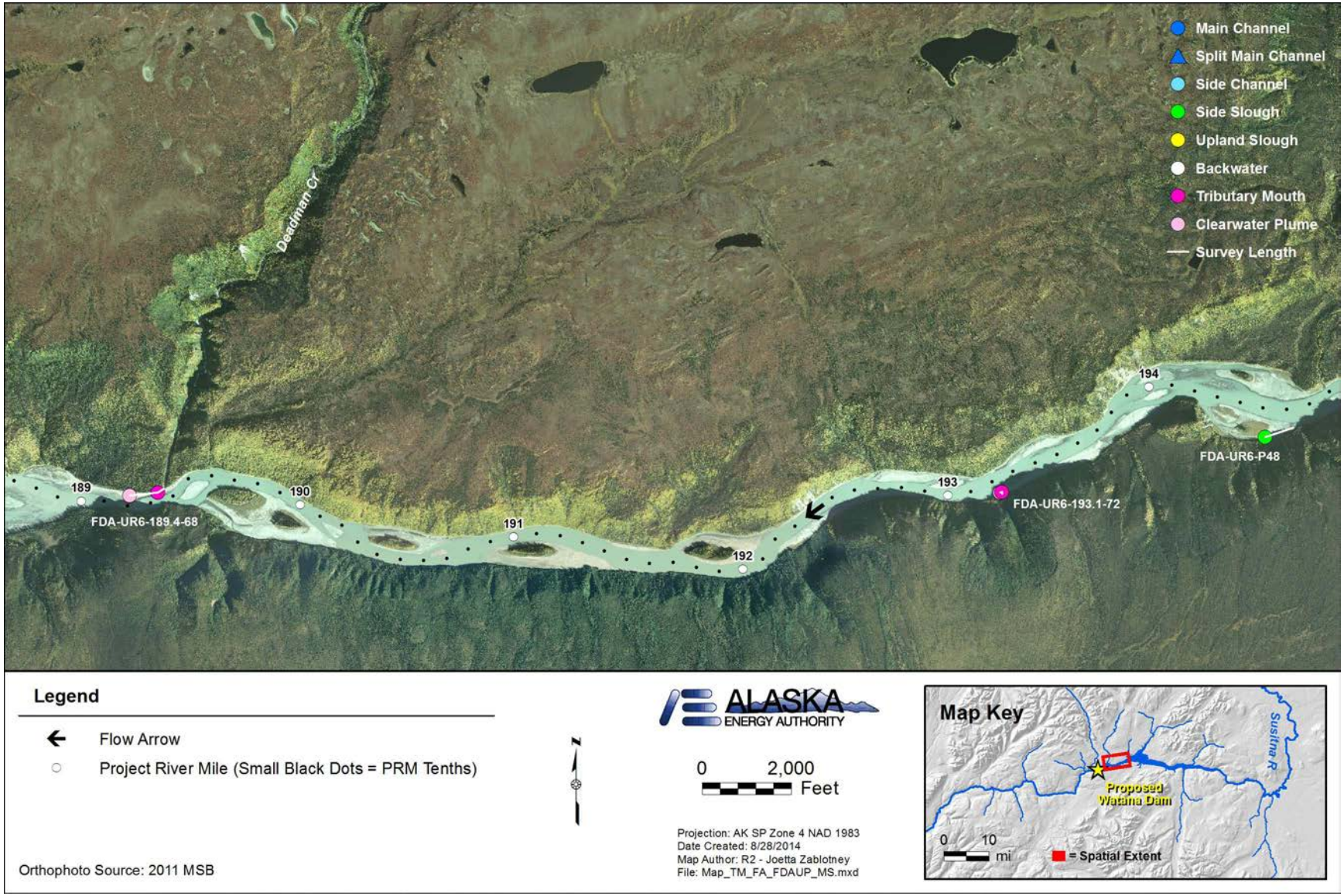

Figure 2.4-1. Upper River mainstem sampling PRM 188.7 to 194.8 in 2014 using the GRTS/transect hybrid approach.

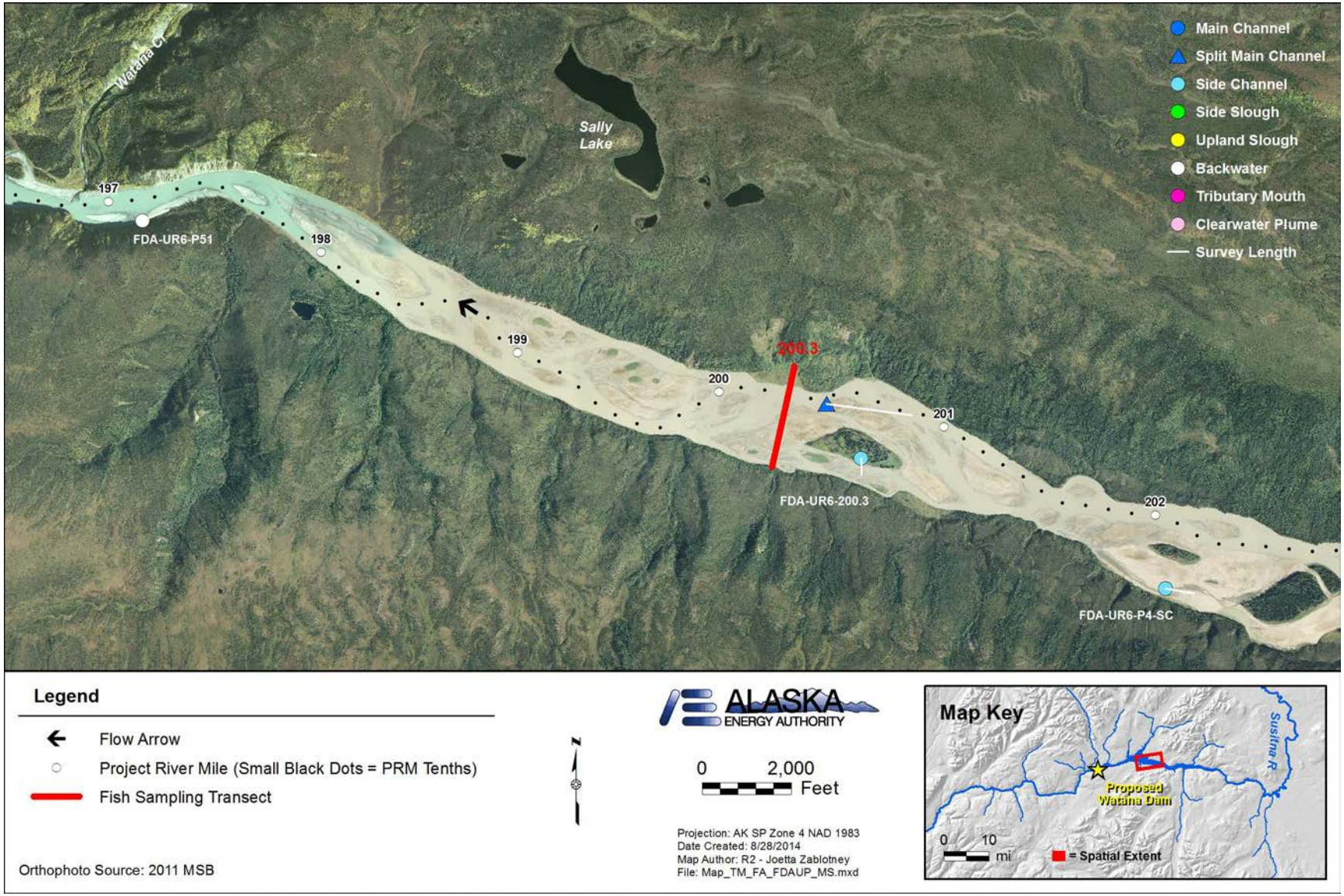

Figure 2.4-2. Upper River mainstem sampling PRM 196.6 to 202.8 in 2014 using the GRTS/transect hybrid approach.

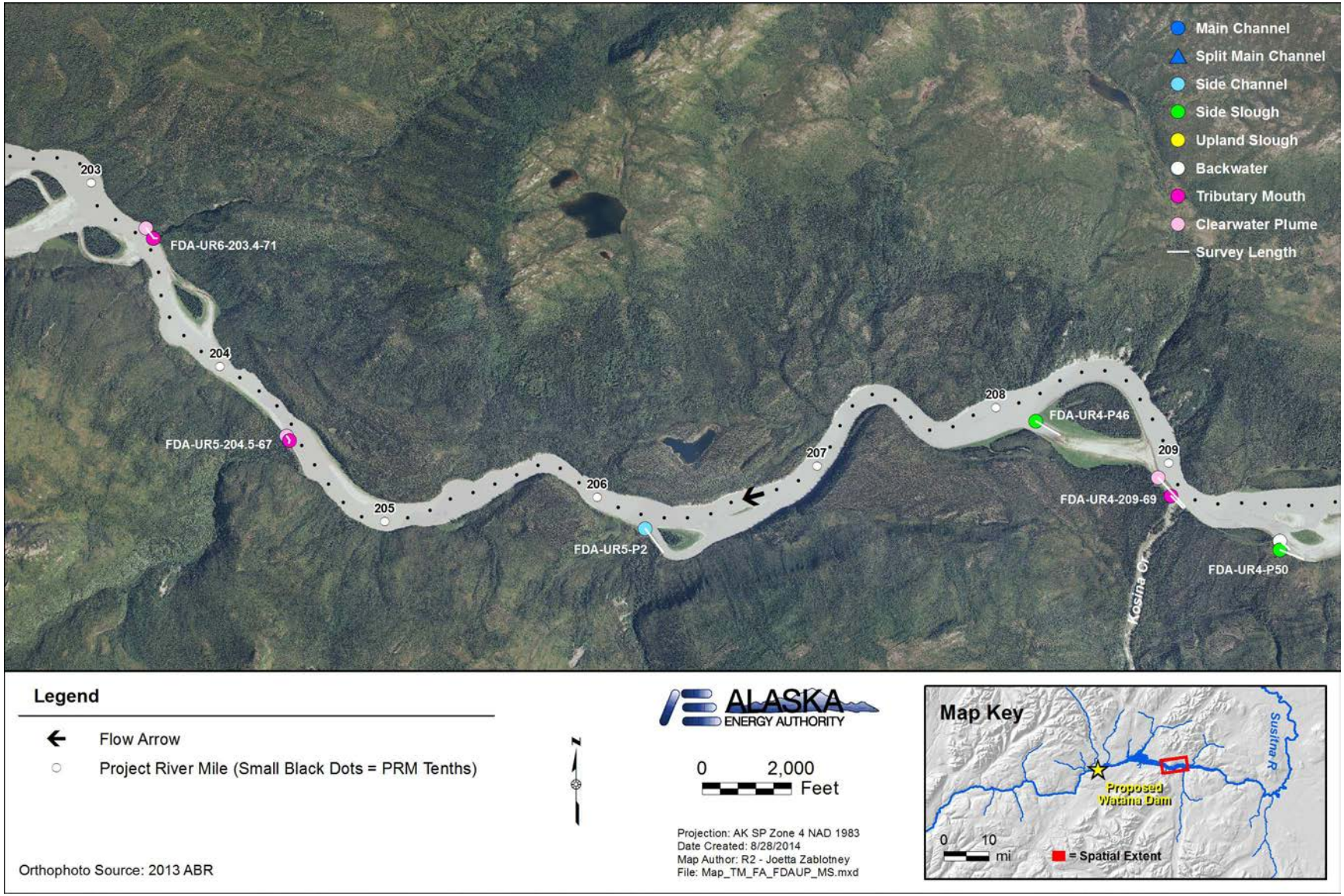

Figure 2.4-3. Upper River mainstem sampling PRM 202.6 to 209.8 in 2014 using the GRTS/transect hybrid approach.

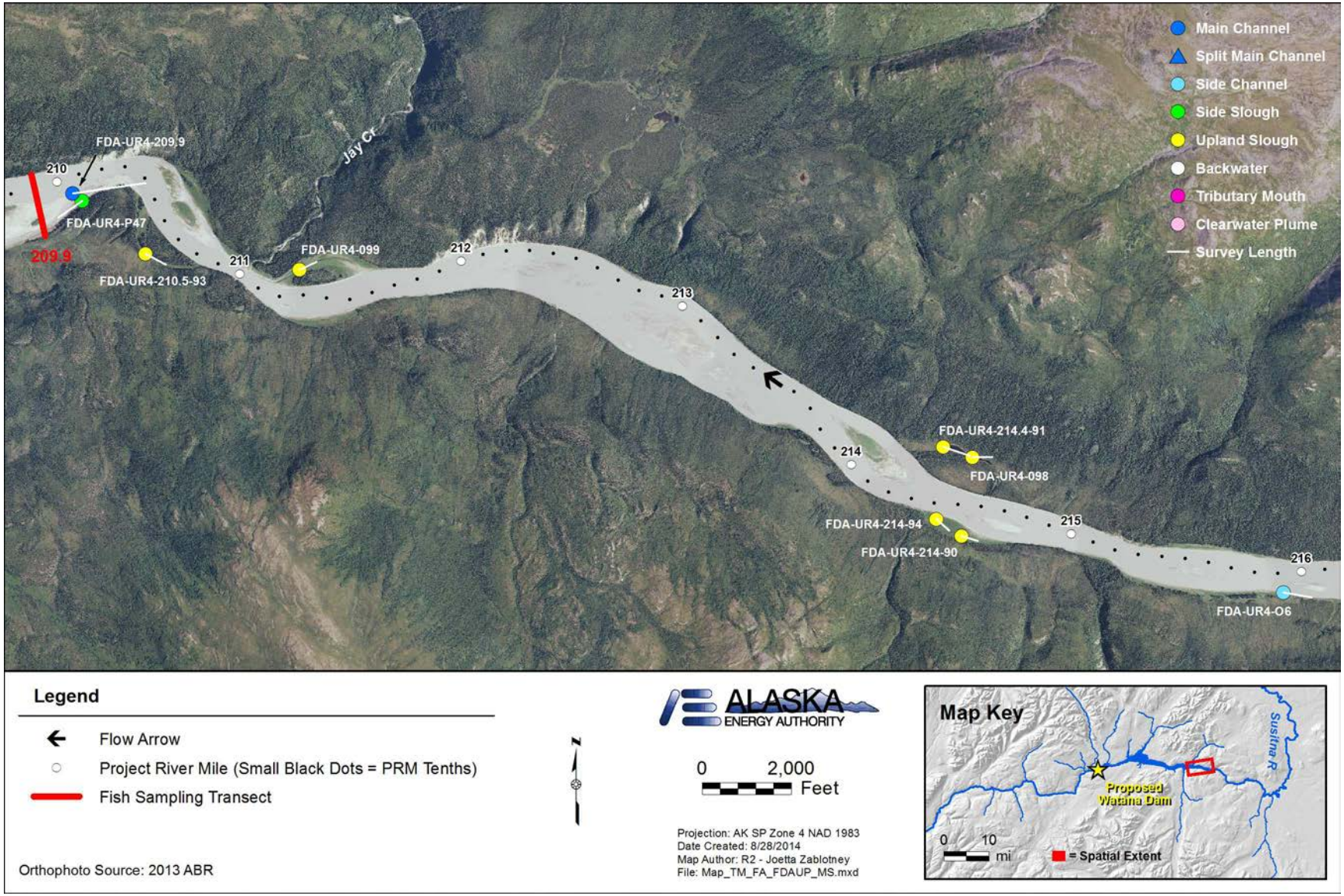

Figure 2.4-4. Upper River mainstem sampling PRM 209.8 to 216.1 in 2014 using the GRTS/transect hybrid approach.

Figure 2.4-5. Upper River mainstem sampling PRM 216.3 to 222.7 in 2014 using the GRTS/transect hybrid approach.

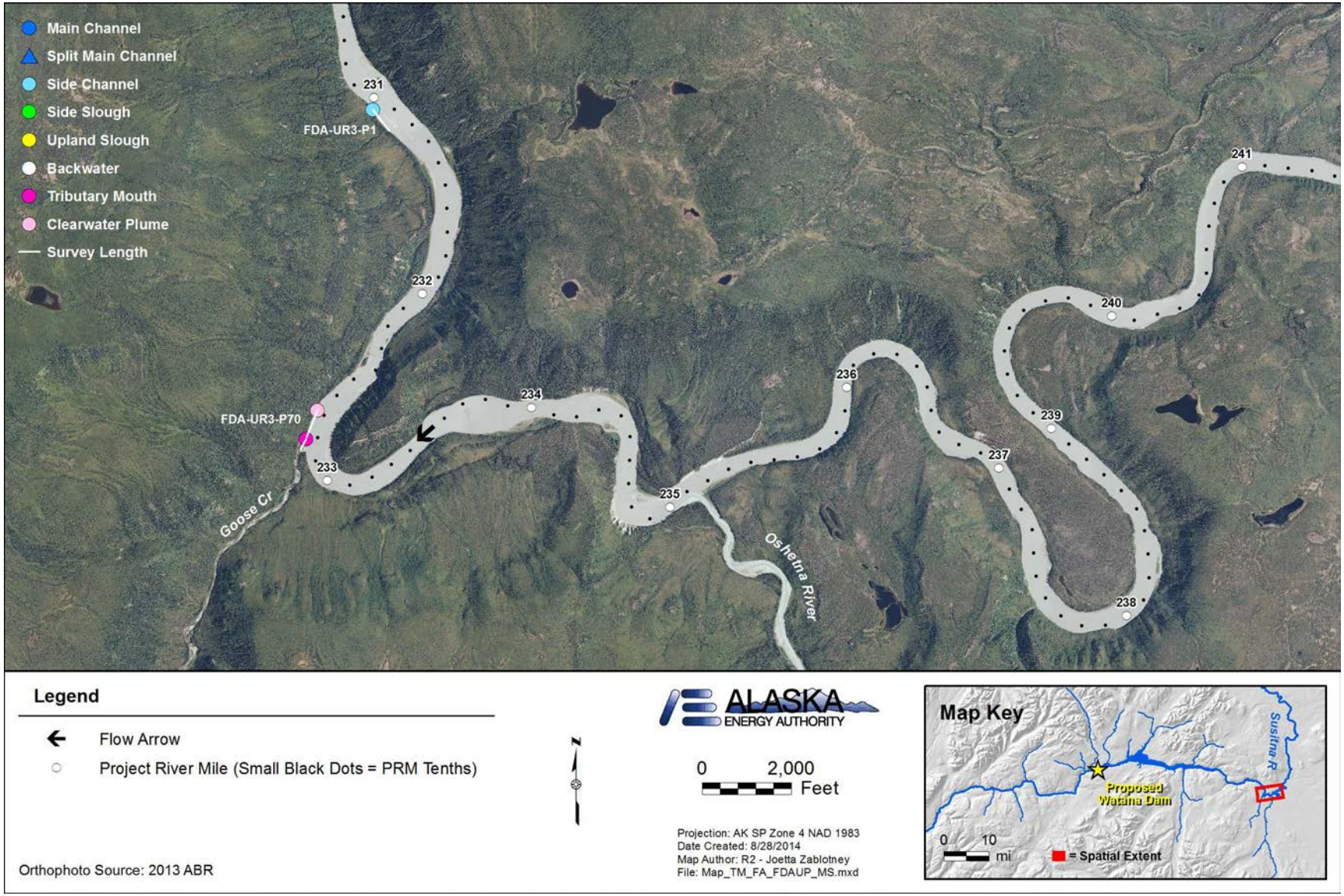

Figure 2.4-6. Upper River mainstem sampling PRM 230.6 to 241.4 in 2014 using the GRTS/transect hybrid approach.

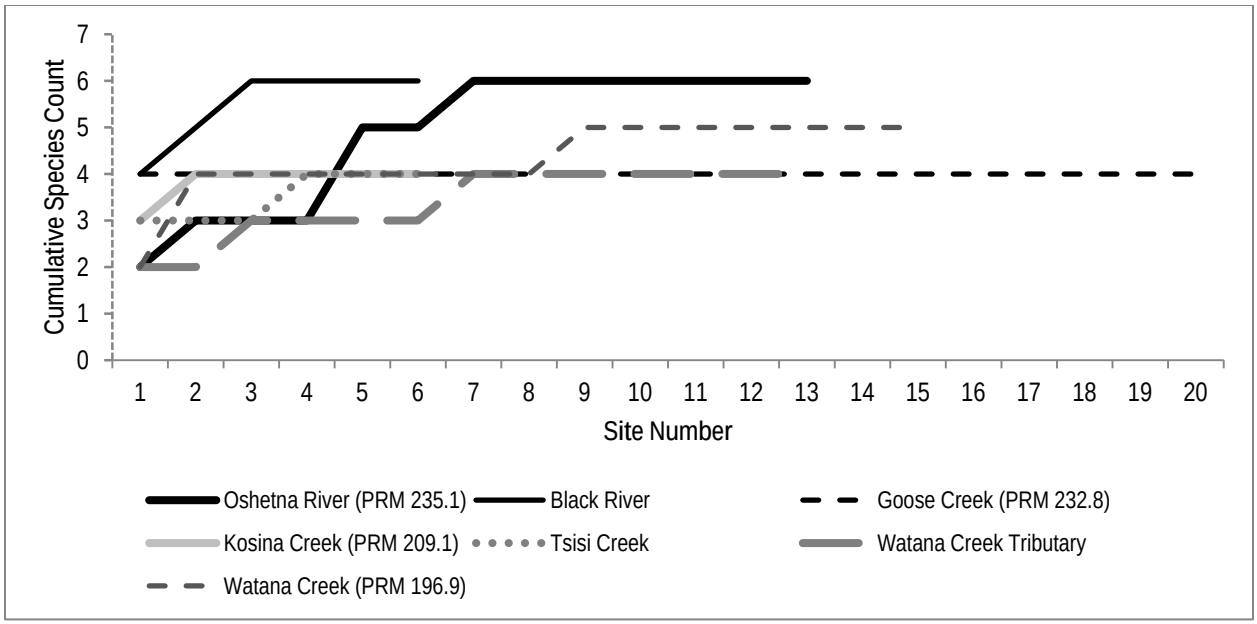

Figure 3.1-1. Species accumulation among Upper River tributary GRTS sampling sites in 2013.

Figure 5.1-1. Rotary screw trap installed and operating in a pool at Kosina Creek RM 2.2 on June 14, 2013.

Figure 5.2-1. Kosina Creek mouth and clearwater plume fyke net locations May 20, 2014.

Figure 5.2-2. Rotary screw trap on the Upper Susitna River, PRM 200.3.