Susitna-Watana Hydroelectric Project (FERC No. 14241)

Technical Memorandum: Characterization and Mapping of Aquatic Habitats

Prepared for

Alaska Energy Authority

Prepared by

HDR

July 2013

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APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
AEA	Alaska Energy Authority
AWC	Anadromous Waters Catalog
FDAIP	Fish Distribution and Abundance Implementation Plan
FERC	Federal Energy Regulatory Commission
HRM	historic river mile
ISR	Initial Study Report
PRM	Project river mile
Project	Susitna-Watana Hydroelectric Project
RSP	Revised Study Plan
TM	Technical memorandum
ZHI	zone of hydraulic influence

1. BACKGROUND

On December 14, 2012, Alaska Energy Authority (AEA) filed with the Federal Energy Regulatory Commission (FERC) its Revised Study Plan (RSP), which included 58 individual study plans (AEA 2012). Included within the RSP was the Characterization of Aquatic Habitats Study, Section 9.09. This study focuses on the characterization and mapping of aquatic habitats with the potential to be altered and/or lost as the result construction and operation of the proposed Susitna-Watana Hydroelectric Project (Project).

On February 1, 2013 FERC issued its Study Plan Determination (February 1 SPD) for 44 of the 58 studies, approving 31 studies as filed and 13 with modifications (FERC 2013a). A decision on the remaining 14 studies was deferred until AEA filed additional information and held meetings with stakeholders to discuss the new information. RSP Section 9.09 was one of the 14 deferred.

On April 1, 2013, FERC issued its SPD (April 1 SPD) for remaining 14 of the 58 proposed individual studies in the RSP (FERC 2013b). When approving the Characterization of Aquatic Habitats Study, RSP Section 9.09, FERC included certain recommendations. This Technical Memorandum addresses one of the FERC recommended modifications to RSP Section 9.09. Specifically, in the April 1 SPD (B-211), FERC stated:

> *We recommend that AEA consult with the TWG and file no later than June 30, 2012, the following information to quantify small and low-order tributaries in the Upper River study area:*
>
> 1. *A detailed description of the specific methods to be used for selecting a representative sample of small and low-order Upper River tributaries for aquatic habitat mapping.*
> 2. *Documentation of consultation with the TWG, including how its comments were addressed.*

This memo provides a detailed description of the methodology for selecting a representative sample of small primary tributaries and low-order (secondary and tertiary) tributaries in the inundation zone of the Upper River.

2. FERC STAFF SPD RECOMMENDATIONS TO RSP SECTION 9.09

In its April 1 SPD, in addition to the above mentioned FERC recommendation, FERC included other recommended changes to RSP Section 9.09, which AEA is implementing.

AEA addressed the other FERC SPD recommendations as follows:

a. *We recommend that AEA remove the level 5 calculation of edge habitat from the habitat classification system. See* April 1 SPD at 208.

AEA Response: AEA will remove the Level 5 edge habitat from the classification system described in RSP Section 9.9.5.4 and Table 9.9-4.

b. *We recommend changing the classification of backwater, beaver complex, and clearwater plume habitats from level 3 (mainstem habitat) to level 4 (mainstem and tributary mesohabitats). See* April 1 SPD at 210.

AEA Response: AEA will revise the classification of mainstem backwater, beaver complex, and clearwater plume habitats in the mainstem as described in RSP Section 9.9.5.4 and Table 9.9-4 from Level 3 to Level 4.

c. *We recommend modifying the study plan to have AEA identify and give specific consideration to backwater habitats, as defined by the agencies (i.e., the confluence of off-channel habitats with main channel habitats), as a unique habitat feature and ensure a representative subsample of these locations when selecting transect locations for one-dimensional or two-dimensional aquatic habitat modeling within Middle River and Lower River instream flow study sites. See* April 1 SPD at 212.

AEA Response: AEA will revise RSP Section 9.9.5.4 and Table 9.9-4 to identify backwater as a unique habitat feature and to ensure modeling of backwater habitat in Focus Areas.

d. *We recommend modifying the study plan to have AEA classify Middle River tributary reaches within the zone of hydrologic influence into geomorphic reaches based on tributary basin drainage area and stream gradient to provide a general understanding of the relative potential value to fish and aquatic resources, and report on these attributes in the initial and updated study reports. See* April 1 SPD at 213.

AEA Response: AEA will revise the study to state that Middle River tributary reaches within the zone of hydrologic influence will be classified into geomorphic reaches based on tributary basin drainage area and stream gradient and that these attributes will be reported in the Characterization of Aquatic Habitats Study Initial Study Report (ISR) to be filed with FERC in February 2014.

e. We recommend that AEA provide a detailed description of methods and results of 2012 and 2013 habitat mapping in the initial study report, including a complete set of photographic base maps delineating macrohabitats (level 3) and mesohabitats (level 4) for all mapped locations. See April 1 SPD at 214.

AEA Response: AEA will revise the study plan to state that a detailed description of methods and results of 2012 and 2013 habitat mapping will be provided in the Characterization of Aquatic Habitats Study ISR to be filed with FERC in February 2014.

3. SELECTION OF SMALL AND LOW-ORDER TRIBUTARIES FOR HABITAT MAPPING WITHIN THE RESERVOIR INUNDATION ZONE

The reference of "small and low-order" tributaries are interpreted by AEA to mean small tributaries emptying directly into the mainstem Susitna River and tributaries to tributaries. For the purpose of this technical memorandum a tributary that confluences directly with the Susitna River is referred to as a primary tributary. A tributary that confluences with a primary tributary is referred to as a secondary tributary and a tributary that confluences with a secondary tributary confluences is referred to as a tertiary tributary. Also, for the purposes of this technical memorandum the nomenclature primary, secondary, and tertiary is more definitive than the term "low-order" that generally refers to any tributary ranging from the smallest of headwater stream (first-order) to a tributary emptying directly into the Susitna.

The methodology used for selection of tributaries within the inundation zone that will be habitat mapped incorporates three independent steps. Step 1 describes tributaries selected as proposed in the RSP Section 9.9. These tributaries represent primarily larger primary and secondary tributaries. Steps 2 and 3 described below are in response to Item 3 of FERC's April 1 SPD that recommends the selection of additional small and additional low-order tributaries within the proposed inundation zone.

Step 1: Select all tributaries within the reservoir inundation zone that are proposed for Fish Distribution and Abundance Sampling (Study 9.05 Implementation Plan).

The tributaries that were previously selected as Step 1 and proposed in RSP Section 9.9 are listed in Table 1 and include:

- The largest of the primary tributaries - Jay Creek, Kosina Creek, Watana Creek, and Deadman Creek;
- Four smaller primary tributaries - Unnamed tributaries 206.2, 204.3, 197.6, and 194.8;
- Two large secondary tributaries - Tsisi Creek and Watana Tributary (RB 8.7).

Habitat mapping in tributaries also selected for the Fish Distribution and Abundance Study sampling provides for synergy across studies and allows for more robust characterization of these important aquatic habitats. In addition to habitat mapping at low flow events, fish sampling teams will describe habitats where fish are collected and we will begin to understand how habitat conditions and fish-habitat associations in these tributaries change seasonally.

Step 2: Selection of small primary tributaries within the reservoir inundation zone that are not targeted for fish surveys.

AEA will also habitat map a representative proportion of primary tributaries smaller than those selected in Step 1. As shown in Appendix A, there are approximately 37 small primary tributaries that have some distance of channel length within the inundation zone, none of which have been targeted for fish sampling. Many of these tributaries range in length from 1 to 2 miles with some exceeding 3 miles. Many can be characterized as having a lower gradient reach located within the inundation zone, followed by a high gradient reach within, or beyond, the upstream limit of the inundation zone. For most of these tributaries, less than 25% of the total length of the stream is within the inundation zone. Several of these tributaries may be seasonal streams or have barriers very near their confluences with the Susitna River. A review of the aerial video shows that some tributaries may only have subsurface flow in late summer and fall, as they cross the lateral cobble bars along the Susitna River.

AEA will rely on existing data and GIS analyses to select a subset of these small primary tributaries for habitat mapping. AEA will determine morphological metrics for each tributary and then categorize the tributaries into similar groupings (e.g. larger drainage basin with higher gradient inundation zone; smaller drainage basin with lower gradient inundation zone) based on the results of the GIS analysis and professional judgment. The morphological metrics that may be used in categorization include the following:

- Stream length
  - total stream length
  - reach length in the inundation zone

  - reach length upstream of the inundation zone
- Average gradient
  - for the entire stream length
  - for the reach in the inundation zone
  - for the reach upstream of the inundation zone
- Drainage basin area

AEA will randomly select 25% of the tributaries within each category for a total of approximately 10 additional small primary tributaries to be habitat mapped within the inundation zone. Habitat mapping methods will be consistent with methods described in RSP 9.9 at 9.9.5.3.2.

Step 3: Selection of secondary and tertiary tributaries located within the reservoir inundation zone.

In addition to large fish-bearing tributaries selected in Step 1 and smaller primary tributaries selected in Step 2, AEA proposes to habitat map a subset of secondary and tertiary tributaries that have a section of their stream channel located within the inundation zone. Using available topographic maps and Project aerial imagery, AEA has identified 21 secondary and tertiary tributaries having any reach within the proposed inundation zone. Table 2 is a list of these tributaries and Appendix A is a map of their locations.

As can be seen in Appendix A and Table 2, 15 of the 21 secondary and tertiary tributaries are within the watersheds of two primary tributaries; unnamed tributary 194.8 and Watana Creek, both of which fall within the boundaries of geomorphic reach UR-6. The remaining 6 low-order tributaries are contained within the watersheds of 5 other primary tributaries, all in geomorphic reaches UR-6, UR-5, and UR-4.

Table 2 provides relative estimates of gradient and rough calculations of stream length for each of the 21 tributaries. Drainage basin area is unknown at this time. Morphological metrics of all 21 low-order tributaries will be determined using the best available GIS data sets.

A subset of these secondary and tertiary tributaries will be selected for habitat mapping based on physical characteristics of the tributaries using the methods described below.

1) The initial filter of tributaries to be habitat mapped will be based on those with reach lengths in the inundation zone that are equal to or exceed one-half mile and 50% of their total stream length. This minimum stream length is necessary to ensure that there will be adequate stream length to represent the range of habitat types potentially present in non-mapped streams.
2) From among the initial cut of secondary and tertiary tributaries a second filter will be applied to obtain a general representation of steams with similar gradients and drainage areas.

Applying criteria from 1) above, 9 tributaries are filtered out as candidates for habitat mapping of low-order tributaries in the inundation zone. Six of these nine are located in the Watana Creek watershed. Since the other 3 candidates are each in a different watershed, all three of these will be habitat mapped. Applying criteria 2) in Watana Creek watershed, a sub-set of the six

secondary and tertiary tributaries will be selected based on stream typing using similarities in gradient and drainage basin size.

At this time the physical data on stream gradient and drainage area are not available for filtering at the second criteria level. Regardless, we propose that a minimum of 33 percent of the low-order tributaries identified in Watana Creek (or two tributaries) will be selected for habitat mapping.

In summary, AEA will field habitat map at least five secondary and tertiary tributaries from a population of 21 low-order tributaries (24 percent) in the inundation zone. Three of these are 197.6 RB-1, 198.4 LB-1, and 207.4 RB-1 and two will be selected in the Watana watershed as described above. Habitat mapping methods will be consistent with methods described in RSP 9.9 at 9.9.5.3.2.

4. SUMMARY

In this technical memorandum AEA has described a proposed method that will result in the selection of 25 tributaries within the reservoir inundation zone for habitat mapping. Ten of these tributaries are large primary and secondary tributaries known to support fish populations and are targeted for fish sampling under RSP Section 9.5, In addition , AEA provides a systematic approach to grouping smaller primary, secondary, and tertiary tributaries based on physical characteristics and random selection of tributaries within categories. This will result in selection of an additional 10 primary tributaries and at least 5 lower-order tributaries for habitat mapping.

5. REFERENCES

ADF&G (Alaska Department of Fish and Game). 2012. Anadromous Waters Catalog. http://www.sf.adfg.state.ak.us/SARR/AWC/index.cfm. Accessed May 2013.

AEA (Alaska Energy Authority). 2012. Susitna-Watana Hydroelectric Project No 14241-000. Revised Study Plan (RSP) submitted to FERC December 2012.

AEA. 2013. Susitna River Fish Distribution and Abundance Implementation Plan: Susitna-Watana Hydroelectric Project FERC Project No. 14241. March 31, 2013.

FERC (Federal Energy Regulatory Commission). Office of Energy Projects. 2013a. February 1, 2013 Study Plan Determination for the Susitna-Watana Hydroelectric Project No 14241-000. Federal Energy Regulatory Commission.

FERC. Office of Energy Projects. 2013b. April 01, 2013 Study Plan Determination for the Susitna-Watana Hydroelectric Project No 14241-000. Federal Energy Regulatory Commission.

Table 1. List of primary and secondary tributaries proposed for fish population sampling and habitat mapping in the inundation zone.

Primary Tributary	Secondary Tributary	Geomorphic Reach	Project River Mile	Total Stream Length	Drainage Area Mi	Approximate Elevation and River Mile of Anadromous Barrier	Habitat Mapping Study Area[1]	Documented Chinook in Watershed	Tributary Proposed for FDA Sampling	Mapping Method	Species Known to be Present in Tributary or Plume[2]													
											Chinook	Dolly Varden	Lake Trout	Arctic Grayling	Round Whitefish	Humpback Whitefish	Whitefish spp.	Salmonid spp.	Burbot	Longnose Sucker	Slimy Sculpin	Sculpin spp.	Rainbow Trout	Sampled [NO FISH]
Jay Creek - RB		UR-4	211.0	19.6	61.8	None	PRM 0.0 to 2,200 ft	NI	Yes	Aerial and Ground		X		X	X			X	X	X	X	X		
Kosina Creek - LB		UR-4	206.8	39.5	400.2	None	PRM 0.0 to 3,000 ft	Yes	Yes	Aerial and Ground	X			X	X		X	X	X	X	X	X		
	Tsisi Creek1 - LB	UR-4	7.4 (LB)	NI	NI	None	PRM 0.0 to 3,000 ft	Yes	Yes	Aerial and Ground														
Unnamed Tributary - LB		UR-5	206.2	7.43	<31	None	PRM 0.0 to 2,200 ft	NI	Yes	Ground only				X							X			
Unnamed Tributary - LB		UR-5	204.3	6.2	<31	Possible – PRM 0.5	PRM 0.0 to 2,200 ft	NI	Yes	Ground only				X					X			X		
Unnamed Tributary - LB		UR-6	197.6	5.4	<31	PRM 1.3	PRM 0.0 to 2,200 ft	NI	Yes	Ground only					X			X			X	X		
Watana Creek - RB		UR-6	196.8	26.9	174.8	None	PRM 0.0 to 3,000 ft	Yes	Yes	Aerial and Ground		X		X	X			X	X	X	X	X		
	Watana Tributary – RB	UR-6	8.7 (RB)	UNI	NI	None	PRM 0.0 to 3,000 ft	Yes	Yes	Aerial and Ground														
Unnamed Tributary - RB		UR-6	194.8	7.1	124	None	PRM 0.0 to 2,200 ft	NI	Yes	Ground only		X		X	X			X		X	X	X		
Deadman Creek - RB		UR-6	189.3	41.9	175.1	≈1,700 ft - PRM 0.4	PRM 0.0 to 2,200 ft	NI	Yes	Aerial and Ground		X		X					X	X		X		

[1] For streams in watersheds known to support Chinook salmon, the habitat mapping study area will extend to 3,000 feet unless there is a confirmed Chinook barrier between 2,200 and 3,000 feet elevation; in which case the study area will terminate at the impassable barrier. For streams in watersheds not known to support Chinook salmon, the habitat mapping study area will terminate at 2,200 feet elevation..

[2] Fish species presence based on historical and current surveys. Streams between the low the proposed dam

NI: No information available at this time.

Table 2. Inventory of low-order (secondary or tertiary) tributaries in the reservoir inundation zone.
(Green shading indicates preliminary selection for habitat mapping consideration based on Criteria 1, above.)

Primary Tributary	Secondary or Tertiary Tributary[1]	Geomorphic Reach	Estimated Total Tributary Length[2] (mi)	Estimated Stream Length in Inundation [2] Zone (mi)	Percent of Estimated Total Stream Length in Inundation Zone	Relative Estimated Gradient in Inundation Zone[3]	Total Drainage Basin Area[4]	Perennial[5]	Anadromous Barrier Downstream	Documented Chinook in Watershed	Aerial Video Available	Primary Tributary Proposed for Habitat Mapping or FDA
194.8	RB-1	UR 6	3.1	1.2	40.0	M-H	UK	UK	No	No	No	Yes
	RB-2		3.7	0.8	21.7	M-H		UK				
	RB-3		1.2	0.2	12.5	L		UK				
	LB-1		0.9	0.2	20.0	M-H		UK				
	LB-2		1.6	0.2	12.0	L		UK				
	LB-3		1.6	0.1	4.0	L		UK				
Sub-total	*6*		*12.1*	*2.6*	21.8							
Watana Creek	RB-1	UR-6	0.6	0.6	100.0	H	UK	UK	No	Yes	No	Yes
	RB-2		1.2	1.2	100.0	L		UK				
	RB-3		6.2	2.2	35.0	L-M		Likely				
	RB-4		7.5	0.6	8.3	H		Likely				
	LB-1		5.0	3.7	75.0	L-H		Likely				
	LB-1.1		2.2	1.6	71.4	M-H		UK	UK			
	LB-1.1.1		1.1	1.1	100	M-H		UK	UK			
	LB-2		2.5	1.2	50.0	M		UK	No			
	LB-2.1		4.3	0.3	7.1	M-H		UK	UK			
	LB-3		5.0	0.9	18.8	M		Likely	No			
Sub-total	9		34.5	13.5	*38.0*							
197.6	RB-1	UR 6	3.1	1.9	60.0	H	UK	UK	No	No	No	Yes
Sub-total	*1*											
198.4	LB-1	UR 6	0.9	0.6	66.7	M-H	UK	UK	No	NI	No	No
Sub-total	*1*											
207.4	RB-1	UR 5	0.8	0.6	77.7	M-H	UK	UK	No	NI	No	No
Sub-total	*1*											
Kosina	RB-1	UR 4	5.0	0.2	3.8	M	UK	Likely	No	Yes	No	Yes
Sub-total	*1*											
Jay	RB-1	UR 4	2.2	0.2	7.1	M-H	UK	UK	No	No	No	Yes
	RB-2		2.5	0.3	12.5	M-H		UK				
Sub-total	2		*4.7*	*0.5*	*10.0*							
Total	***21***		***62***	***19.9***	***32***							

[1] Unnamed secondary and tertiary tributaries in the Upper River have not been assigned a Project name at this time. The alpha-numeric naming system applied in this TM is for the purposes of this TM only.
[2] Digitized GIS lengths not yet available.
[3] Relative gradients are: H = high, M= moderate, L=low. Digitized GIS gradient data not yet available.
[4] Digitized GIS drainage basin area not yet available.
[5] Likelihood of tributary being perennial is attributed to any tributary greater than 5 miles in length. There is no other basis for this determination. Field reconnaissance in later summer required.
UK = Unknown,
NI = No information available; UK= Unknown

APPENDIX A

MAP OF TRIBUTARIES IN THE UPPER SUSITNA RIVER INUNDATION ZONE

148.55° W 148.5° W 148.45° W 148.4° W 148.35° W 148.3° W 148.25° W 148.2° W 148.15° W 148.1° W 148.05° W

62.925° N 62.9° N 62.875° N 62.85° N 62.825° N 62.8° N

Tsusena Butte

Tsusena Creek

Deadman Creek

Unnamed - 194.3

Watana RB-4

Watana RB-3

Watana LB-3

Watana LB-2

Watana LB-2.1

194.8 RB-3

194.8 RB-2

194.8 LB-3

194.8 LB-2

194.8 LB-1

194.8 RB-1

Watana RB-2

Watana RB-1

Watana LB-1

Watana LB-1.1

Watana LB-1.1.1

Unnamed - 194.4

Unnamed (R) - 189.7

Unnamed - 193.1

Unnamed (L) - 188.6

Unnamed (L) - 189.7

Unnamed - 197.1

Unnamed - 198.4

Unnamed - 199.1

Unnamed - 199.3

Unnamed - 200.4

Unnamed - 201.2

Unnamed - 201.3

Unnamed - 203.4

198.4 LB-1

197.6 RB-1

SUSITNA RIVER

FOG LAKES

185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204

148.6° W 148.55° W 148.5° W 148.45° W 148.4° W 148.35° W 148.3° W 148.25° W 148.2° W 148.15° W 148.1° W

Susitna - Watana Hydroelectric Project

Aquatic Habitat - Reservoir Stream Analysis

1:72,223

0 3,000 6,000 Feet

0 1,000 2,000 Meters

Map Projection: NAD83 State Plane Zone 4 (Feet)

- Fish Barriers
- Susitna Project River Miles
- Tributary River Miles
- SCK Chinook Salmon Observed
- Fish Barrier and Aquatic Habitat Permit Study Areas
- 2050ft Reservoir
- Contour 2200ft
- Contour 3000ft

Streams in Reservoir

- PRIMARY
- SECONDARY
- TERTIARY

Streams Outside Reservoir

- PRIMARY
- SECONDARY
- TERTIARY

ALASKA ENERGY AUTHORITY

Projection: Alaska Albers NAD 1983
Map Author: HDR Alaska Inc.

Date Created: 6/28/2013
File: SUWA_Stream_Analysis_11x17.mxd

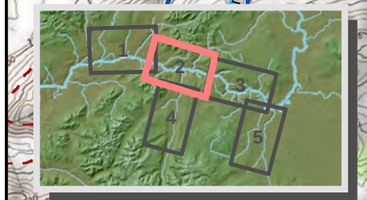
148.15° W 62.9° N 148.1° W 148.05° W 148° W 147.95° W 147.9° W 147.85° W 147.8° W 147.75° W 62.825° N 147.7° W 147.65° W

62.9° N 62.875° N 62.85° N 62.825° N 62.8° N 62.775° N

62.8° N 62.775° N 62.75° N 62.725° N 62.7° N 147.75° W

148.25° W 148.2° W 148.15° W 148.1° W 148.05° W 62.725° N 148° W 147.95° W 147.9° W 62.7° N 147.85° W 147.8° W

Watana LB-3
Watana LB-2
Watana LB-2.1
Watana LB-1
Watana LB-1.1
Watana LB-1.1.1
198.4 LB-1
207.4 RB-1
Jay RB-1
Jay LB-1
Kosina RB-1
Jay creek
Kosina Creek
Unnamed - 198.4
Unnamed - 199.8
Unnamed - 200.4
Unnamed - 201.3
Unnamed - 201.2
Unnamed - 203.4
Unnamed - 203.5
Unnamed - 204.3
Unnamed - 205.3
Unnamed - 205.9
Unnamed - 207.2
Unnamed - 207.4
Unnamed - 208.7
Unnamed - 209.3
Unnamed - 212.5
Unnamed - 213.3
Unnamed - 214.4
Unnamed - 215.1
Unnamed - 215.2
Unnamed - 221.2
Unnamed - 223.4
198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218
DIVER
RIVER



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ALASKA ENERGY AUTHORITY

Projection: Alaska Albers NAD 1983
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Date Created: 6/28/2013
File: SUWA_Stream_Analysis_11x17.mxd

62.825° N 147.75° W 147.7° W 147.65° W 147.6° W 147.55° W 147.5° W 147.45° W 147.4° W 147.35° W 147.3° W

62.825° N 147.8° W 62.8° N 62.775° N 62.75° N 62.725° N 62.7° N

62.725° N 62.7° N 62.675° N 62.65° N 62.625° N

Jay Creek
Unnamed - 213.8
Unnamed - 215.4
Unnamed - 223.4
Unnamed - 223.5
Unnamed - 214.4
Unnamed - 215.2
Unnamed - 219.6
Unnamed - 226.2
Unnamed - 226.3
Unnamed - 229.1
Unnamed - 230.1
Unnamed - 230.7
Unnamed - 230.2
Unnamed - 234.1
Unnamed - 234.5
Unnamed - 232.8
Unnamed - 221.2
Unnamed - 221.3
Unnamed - 222.1
Unnamed - 223.1
Susitna River
RIVER
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147.85° W 147.8° W 62.675° N 147.75° W 147.7° W 147.65° W 62.65° N 147.6° W 147.55° W 147.5° W 62.625° N 147.45° W 147.4° W

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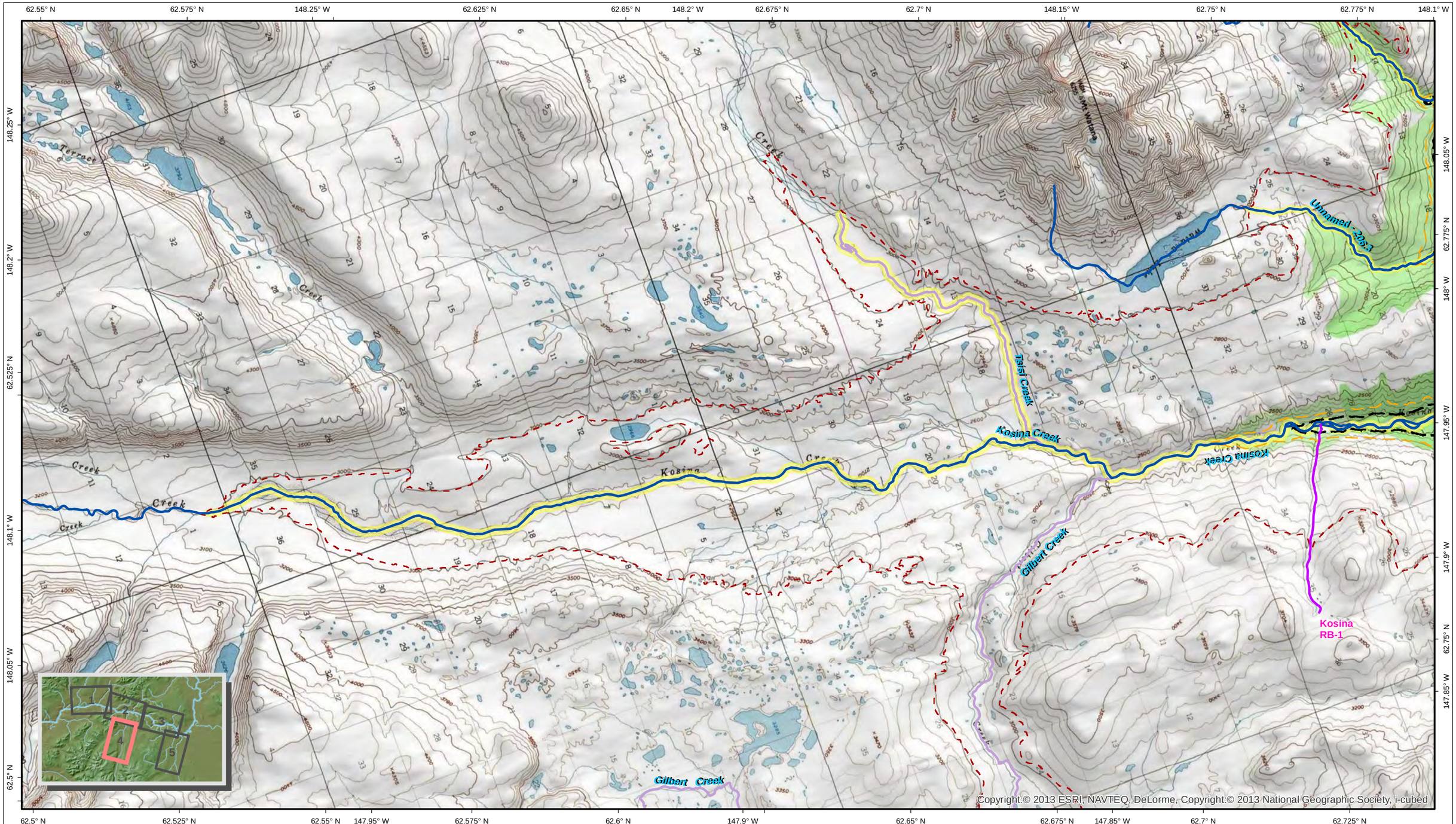

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- TERTIARY

Streams Outside Reservoir

- PRIMARY
- SECONDARY
- TERTIARY

ALASKA ENERGY AUTHORITY

Projection: Alaska Albers NAD 1983
Map Author: HDR Alaska Inc.

Date Created: 6/28/2013
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Susitna - Watana Hydroelectric Project

Aquatic Habitat - Reservoir Stream Analysis

1:72,223

0 3,000 6,000 Feet

0 1,000 2,000 Meters

Map Projection: NAD83 State Plane Zone 4 (Feet)

- Fish Barriers
- Susitna Project River Miles
- Tributary River Miles
- Chinook Salmon Observed
- Fish Barrier and Aquatic Habitat Permit Study Areas
- 2050ft Reservoir
- Contour 2200ft
- Contour 3000ft

Streams in Reservoir

- PRIMARY
- SECONDARY
- TERTIARY

Streams Outside Reservoir

- PRIMARY
- SECONDARY
- TERTIARY

ALASKA ENERGY AUTHORITY

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