Susitna-Watana Hydroelectric Project
(FERC No. 14241)

Mercury Assessment and Potential for Bioaccumulation Study
Study Plan Section 5.7

Initial Study Report
Part A: Sections 1-6, 8-10

Prepared for

Alaska Energy Authority

SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

Prepared by

URS Corporation/Tetra Tech, Inc.

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Abbreviation	Definition
AEA	Alaska Energy Authority
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
APA	Alaska Power Authority
BrCl	bromine monochloride
BW	body weight
Cm	centimeter
D	daily intake
DO	dissolved oxygen
Dw	dry weight
EFDC	Environmental Fluid Dynamics Code
EPA	U.S. Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
ft.	feet
FL	fish length
G	gram
GAAR	Gates of the Arctic National Park
GPS	global positioning system
HDPE	high density polyethylene
Hg	mercury
ISR	Initial Study Report
K	Kelvin
Kg	kilogram
LNS	longnose suckers
M	million
mm	millimeters
m^2	square meters(s)
MeHg	methylmercury
Ng	nanograms
ng/g	nanograms per gram
ng/m^2/yr	nanograms per square meter per year
NOAA	National Oceanic and Atmospheric Administration
NOAT	Noatak National Preserve
NS	Not sampled
NWIS	National Water Information System
Project	Susitna-Watana Project
PRM	Project River Mile
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
RSP	Revised Study Plan

Abbreviation	Definition
SAP	Sampling and Analysis Plan
SPD	Study Plan Determination
TOC	total organic carbon
Ww	wet weight
µg	microgram
µg/kg	microgram per kilogram
µg/L	micrograms per liter
µm	micrometer
USGS	U.S. Geological Survey
WACAP	Western Airborne Contaminants Assessment Project

1. INTRODUCTION

On December 14, 2012, Alaska Energy Authority (AEA) filed with the Federal Energy Regulatory Commission (FERC or Commission) its Revised Study Plan (RSP), which included 58 individual study plans (AEA 2012). Included in the Study Plan was the Mercury Assessment and Potential for Bioaccumulation Study, Section 5.7. Section 5.7 focuses on determining the current concentrations and methylation rates for mercury in the study area, and what changes could occur with construction of the Susitna-Watana Project (Project) reservoir.

On February 1, 2013, FERC staff issued its study determination (February 1 SPD) for 44 of the 58 studies, approving 31 studies as filed and 13 with modifications. On April 1, 2013 FERC issued its study determination (April 1 SPD) for the remaining 14 studies; approving one study as filed and 13 with modifications. Study Plan Section 5.7 was one of the 13 approved with modifications. In its April 1 SPD, FERC recommended the following:

Use of Harris and Hutchinson and EFDC Models for Mercury Estimation

> *We recommend that AEA use the more sophisticated Phosphorus Release Model to predict peak methylmercury levels in fish tissue, regardless of the outcome of the other two models.*

Mercury Effects on Riverine Receptors

> *We recommend that AEA include likely riverine receptors (i.e., biota living downstream of the reservoir that may be exposed to elevated methyl mercury concentrations produced in the reservoir and discharged to the river) as part of the predictive risk analysis. The additional study element would have a low cost (section 5.9(b)(7)) because AEA would simply add consideration of additional receptors to the existing analysis. This information is necessary to evaluate potential project effects downstream of the reservoir (section 5.9 (b)(5)).*

In accordance with the April 1 SPD, AEA has adopted the FERC requested modifications.

Following the first study season, FERC's regulations for the Integrated Licensing Process (ILP) require AEA to "prepare and file with the Commission an initial study report describing its overall progress in implementing the study plan and schedule and the data collected, including an explanation of any variance from the study plan and schedule." (18 CFR 5.15(c)(1)) This Initial Study Report (ISR) on Mercury Assessment and Potential for Bioaccumulation has been prepared in accordance with FERC's ILP regulations and details AEA's status in implementing the study, as set forth in the FERC-approved RSP as modified by FERC's April 1 SPD and the Quality Assurance Project Plan for Mercury Assessment and Potential for Bioaccumulation Study for the Susitna-Watana Hydroelectric Project (QAPP) (collectively referred to herein as the "Study Plan").

2. STUDY OBJECTIVES

Previous studies have documented increased mercury concentrations in fish and wildlife following the flooding of terrestrial areas to create hydroelectric reservoirs. The purpose of this study is to assess the potential for such an occurrence in the proposed Project area. The study objectives as established in Study Plan (Section 5.7.1) are as follows:

- Summarize available and historic mercury information for the Susitna River basin, including data collection from the 1980s Alaska Power Authority (APA) Susitna Hydroelectric Project.
- Characterize the baseline mercury concentrations of the Susitna River and tributaries. This will include collection and analyses of vegetation, soil, water, sediment pore water, sediment, piscivorous birds and mammals, and fish tissue samples for mercury.
- Utilize available geologic information to determine if a mineralogical source of mercury exists within the inundation area.
- Map mercury concentrations of soils and vegetation within the proposed inundation area. This information will be used to develop maps of where mercury methylation may occur.
- Use the water quality model to predict where in the reservoir conditions (pH, dissolved oxygen [DO], turnover) are likely to be conducive to MeHg formation.
- Use modeling to estimate MeHg concentrations in fish.
- Assess potential pathways for MeHg to migrate to the surrounding environment.
- Coordinate study results with other study areas, including fish, instream flow, and other piscivorous bird and mammal studies.

3. STUDY AREA

As established in Study Plan Section 5.7.3, the study area begins at project river mile (PRM) 19.9 (RM 15.1) and extends upstream from the proposed reservoir to PRM 235.2 (RM 233.4) (Figure 3-1).

4. METHODS AND VARIANCES IN 2013

4.1. Summary of Available Information

AEA implemented the methods as described for this section of the Study Plan with no variances. Existing literature was reviewed to summarize the current understanding of the occurrence of mercury in the environment. A recent and thorough literature review was conducted and included in the Study Plan. Results of that review are provided again here as no additional information is available. Sources included the following:

- APA Susitna Hydroelectric Project
- Alaska Department of Environmental Conservation
- U.S. Geological Survey (Frenzel 2000)
- Western Airborne Contaminants Assessment Project
- Jewett and Duffy (2007)
- Geologic Data in ISR Section 4.5

4.2. Collection and Analyses of Soil, Vegetation, Water, Sediment, Sediment Pore Water, Piscivorous Birds and Mammals, and Fish Tissue Samples for Mercury

AEA implemented the methods as described in the Study Plan with the exception of variances explained below. Mercury and other supporting analytes were collected from vegetation, soil, surface water, sediment, sediment pore water, and fish tissue. (Table 4.2-1). The following sections describe methods used to collect the various matrices and analytical methods to quantify specific parameters (e.g., total mercury, dissolved mercury, methyl mercury, total organic carbon, and sediment size).

4.2.1. Vegetation

AEA implemented the methods as described in this portion of the Study Plan with no variances.

A total of 50 vegetation samples were collected from various plants within the proposed inundation zone in August 2013. Samples were collected from five sites in each of ten locations within reservoir inundation zone. Figure 4.2-1 through 4.2-11 and Table 4.2-2.

The sampling was biased toward vegetative mass, that is to say species that were present in the inundation area at low frequency and size were not be sampled, because even if these plants contain mercury, their contributions to mercury methylation will be low. Only leaves and needles were collected. Samples were from several plant species, including trees and shrubs (alder, willow, spruce, salmonberry) and herbaceous species (fireweed, bush cinquefoil).

Various types of vegetation at each individual sample site were aggregated into large Ziplock® bags. The laboratory homogenized all plant species in each bag and analyzed each as a composite sample. Plant samples were analyzed for total and methyl mercury per EPA Methods 1631 and 1630, respectively.

4.2.2. Soil

AEA implemented the methods as described in this portion of the Study Plan, with the exception of the variances explained below (Section 4.2.2.1).

A total of 50 soil samples were collected at each of the vegetation sampling sites in the inundation zone during August 2013 (Figure 4.2-1 and Table 4.2-2).

The soil samples were collected by advancing a hand dug test pit to the mineral soil. Samples consisted of organic rich material found, including the moss, peat, and mineral soils. This material is most likely to contribute mercury to the proposed reservoir. Up to 20 g of soil were placed into the appropriate laboratory provided sample container and sent for analyses. Samples were analyzed for total mercury and MeHg using EPA Method 1631 and 1630, respectively, and the results reported as both wet (ww) and dry (dw) weight.

4.2.2.1. Variances from the Study Plan

EPA Method 1631 recommends digestion of mineral soil with aqua regia and oxidized with bromine monochloride (BrCl) to extract mercury from samples for analyses. The soil samples collected in 2013 contained a significant fraction of peat and organic material mixed with soil. For these types of organic soils, EPA recommends digestion with HNO_3/H_2SO_4 digestion before using BrCl. Given the soil was a mix of organic and inorganic components, the study team elected to split each sample and analyze them using both digestion methods, giving two analytical results for each sample. This change improved achievement of the study objectives by making sure the maximum amount of mercury was extracted from the samples. No change to the sample methods going forward will be necessary because the soil sampling is complete.

4.2.3. Water

AEA implemented the methods as described in this portion of the Study Plan, with the exception of the variances explained below (Section 4.2.3.4).

There were two types of monitoring programs used to characterize mercury concentrations in surface waters: Baseline Water Quality Monitoring (Study 5.5, RSP Section 5.5.4.4) and Focus Area Monitoring (Study 5.5, RSP Section 5.5.4.5). These programs were distinguished by the frequency of water sampling, the density of sampling effort in a localized area, and parameters analyzed.

4.2.3.1. Baseline Sampling Protocols

For the baseline sampling protocols, water quality data collection occurred on average at 5 mile intervals (Figure 3-1 and Table 4.2-3). Monthly samples were planned for collection from 17 locations from June 2013 to September 2013. An additional sampling location was added to this monitoring effort at PRM 152.2 (Susitna River below Portage Creek) to make a total of 18 locations visited during 2013.

Grab samples were collected along a transect of the stream channel/water body, using methods consistent with ADEC and EPA protocols and regulatory requirements for sampling ambient water and trace metal water quality criteria. Mainstem areas of the river not immediately influenced by a tributary were characterized with a single transect. Areas of the mainstem with an upstream tributary that may influence the nearshore zone or that are well-mixed with the mainstem were characterized by collecting samples at two transect locations: in the tributary and in the mainstem upstream of the tributary confluence. Samples were collected at three equi-distant locations along each transect (i.e. 25 percent from left bank, 50 percent from left bank, and 75 percent from left bank). Samples were collected from a depth of 0.5 meters below the surface as well as 0.5 meters above the bottom.

Surface water grab samples were collected using one of two methods dependent upon field conditions. Field personnel were equipped to perform either method and/or make modifications based on site conditions, water velocity, and flow. Water quality sample containers were filled using a high capacity peristaltic pump and non-reactive high density polyethylene (HDPE) tubing system. The sample tubing was cable tied to a davit cable attached to a 50 to 75 lb. weight and lowered into the water column. Once the tubing was positioned at the right depth the pump was turned on and flushed for three minutes. Samples were collected from the tubing and into the proper sample containers and labeled accordingly. Filtered samples (for dissolved mercury) were collected after a 0.45 μm filter was attached to the tubing and flushed for one minute. Some sample locations were located in water depths less than 3 ft. (<1 m) deep and were not accessible by boat. In this case field personnel collected samples by wading into the river, and using the HDPE tubing and peristaltic pump to collect the sample. The HDPE tubing was secured to an extendable aluminum boat pole and placed along the bottom of the river such that with the tubing opening was facing upstream at approximately mid-water column depth. Water quality profiles at each location on each transect were also conducted for field water quality parameters (e.g., temperature, pH, dissolved oxygen, and conductivity) to determine the extent of vertical and lateral mixing.

All sample collection avoided pools and slack water. Sampling methods also avoided unnecessary collection of sediments in water samples, and touching the inside or lip of the sample container. Samples were delivered to a State-certified laboratory using EPA-approved analytical methods including a separate completed chain of custody sheet. Field duplicates were collected for 10 percent of samples (i.e., one for every 10 water grab samples, which includes other water quality parameters collected for Study 5.5).

Grab samples were analyzed for a suite of parameters (see ISR Study 5.5); however, specific to Study 5.7, samples were analyzed for total and dissolved mercury. Laboratory quality control samples including duplicate, samples between laboratories, spiked, and blank samples were prepared and processed by the laboratory.

4.2.3.2. Focus Area Sampling Protocols

The Focus Areas had a higher density of sampling locations, in contrast to the mainstem network, so that prediction of change in water quality conditions from Project operations could be made with a higher degree of resolution. The resolution expected for predicting conditions were as short as 100-meter (m) longitudinal distances within the Focus Areas. Depending on the length of the Focus Area, transects were spaced every 100 m to 500 m and water quality samples collected at three or more locations along each transect. The collection locations along a transect were in open water areas and had three to six collection points. These were discrete samples taken at each collection point (Figure 4.2-12 and Table 4.2-4).

Grab samples collected from the Focus Areas were analyzed for a suite of parameters (see ISR Study 5.5); however, specific to Study 5.7, samples were analyzed for total mercury and methylmercury.

4.2.3.3. Sample Handling and QA/QC

QA/QC samples included laboratory sample splits, field duplicates, matrix spikes, duplicate matrix spikes, and rinsate blanks for non-dedicated field sampling equipment. The results of the analyses were used in data validation to determine the quality, bias, and usability of the data generated.

Sample numbers were recorded on field data sheets immediately after collection. Samples intended for the laboratory were stored in a dedicated sample refrigerator and kept under the custody of the field team at all times. Samples were transported to the laboratory in coolers with ice the following day by a member of the field team. Chain of custody records and other sampling documentation were kept in sealed plastic bags (Ziploc®) and taped inside the lid of the coolers prior to transport. A temperature blank accompanied each cooler. Packaging, marking, labeling, and shipping of samples was in compliance with all regulations promulgated by the U.S. Department of Transportation in the Code of Federal Regulations, 49 CFR 171-177.

Water quality samples were labeled with the date and time that the sample was collected and filtered/preserved (as appropriate), then stored and delivered to a State-certified water quality laboratory (laboratory) for analyses using EPA-approved methods in accordance with maximum holding periods. A chain of custody record was maintained with the samples at all times.

The laboratory reported data electronically (Excel, Access database, PDF) results for each chemical parameter analyzed with the laboratory method detection limit, reporting limit, and practical quantification limit. The laboratory attained method detection limits specified in the QAPP that were at the applicable regulatory criteria and provided all laboratory QA/QC documentation. However, the method detection limit should be lower for estimating total phosphorus concentrations (MDL $\leq$ 2.0 µg/L) than was achieved for analysis of surface water samples collected during 2013.

The procedures used for collection of water quality samples followed protocols from ADEC and EPA Region 10 (Pacific Northwest).

Additional details of the sampling methods are provided in a combined SAP and the QAPP for this study.

Water samples were analyzed for mercury (total and dissolved) and methylmercury utilizing EPA Methods 1631E and 1630.

4.2.3.4. Variances from the Study Plan

Table 5.7-5 in Study 5.7, RSP Section 5.7.4.2.3 indicated that water samples would be collected for mercury analysis at PRM 225.5 (Susitna near Cantwell). Due to limited site access by helicopter, the site was relocated to PRM 235.2 (Susitna River adjacent to Oshetna Creek). This change is not expected to interfere with the study objectives as concentrations of mercury are not expected to change appreciably between the two areas. No further information needs to be generated with future monitoring from this new site location. One site had minor modifications to the specific monitoring location at least once during the field season due to helicopter accessibility; however, these sites were not appreciably different from those identified in the

Study Plan. During the 2013 field effort, monitoring was required at PRM 225.5 for water quality samples. The collection effort differed from the original monitoring plan by relocating this site from PRM 225.5 (Susitna near Cantwell) to PRM 235.2 (Susitna River adjacent to Oshetna Creek) due to limited site access by helicopter.. The close proximity to the proposed sites in the Study Plan will not result in any effect on study objectives. There are no known influences to water quality between the proposed monitoring sites and those that were sampled.

Study 5.5, RSP Section 5.5.4.4.2 indicated that samples would be collected at three locations along each transect for mainstem samples. Water samples from PRM 235.2 (Susitna River adjacent to Oshetna Creek) and 187.2 (Susitna at Watana Dam) were collected from just one position in the river due to limited access when wading.

4.2.4. Sediment and Sediment Porewater

AEA implemented the methods as described in this portion of the Study Plan, with the exception of the variances explained below (Section 4.2.4.1).

Sediment and sediment porewater samples were collected in the mainstem Susitna River near the mouths of the following tributaries: Jay, Kosina, and Goose creeks, and the Oshetna River. Samples were collected downstream of islands, and in similar riverine locations in which water velocity was slowed, favoring accumulation of finer sediment along the channel bottom. A map of the sediment/porewater sampling locations is shown in Figure 4.2-13. Images of each sampling location can be seen in Figures 4.2-14 and 4.2-15.

Sediment samples were collected using a hand auger or stainless steel spoon. Two field staff collected samples; one handling sampling equipment (dirty hands) while the other received the sediment sample in collection jars and prepared labeling (clean hands). All sediment samples were collected by wading into shallow nearshore areas of each tributary site. Sampling collected from the top 6 inches (15 cm) of sediment. All the sediment samples were photographed. At all locations the sample jar was not overfilled, the sediment was covered by water, and at least the top two inches of sediment was collected. Mercury occurrence is typically associated with fine sediments, rather than with coarse-grained sandy sediment or rocky substrates. Therefore, the sampling obtained sediments with at least 5 percent fines (i.e., particle size <63 µm, or passing through a #230 sieve).

Sediment porewater was collected from the sites listed above and separated from sediments in the field laboratory using a pump apparatus to draw porewater from each of the replicate samples. Filtering of samples utilized a 0.45-µm pore size filter in both the lab apparatus and field apparatus.

Samples were analyzed for total mercury by EPA Method 1631E. In addition, sediment size and total organic carbon (TOC) were also analyzed to evaluate whether these parameters are predictors for elevated mercury concentrations.

4.2.4.1. Variances from the Study Plan

The Study Plan RSP Section 5.7.4.2.4 indicated that sediment and sediment porewater samples would be collected from just above and below the proposed dam site, including Fog, Tsusena, Deadman, Watana, Kosina, Jay, and Goose Creeks, and the Oshetna River. Due to lack of access to CIRWG lands in 2013, samples were not collected from the Susitna River just below and above the proposed dam site, and the mouths of Fog, Deadman, Watana, and Tsusena Creeks. Sediment sampling at these sites is planned for the next year of study. If site access is not possible, alternate sites will be selected. It is not expected that changing the sample locations will affect achievement of the study goals.

The Study Plan Attachment 5-1 indicated that the samples would be collected from a boat using an Ekman dredge or a modified Van Veen grab sampler. This was modified in the QAPP to include possible collection of samples by wading in shallow nearshore areas and using either a hand auger or stainless steel spoon to collect samples. During the 2013 field work, it was found that collection of sediment samples from a boat was impractical in the upper river. The choice of sample collection method should not impact analytical results, and the sampling method used is expected to achieve the study objectives. This change will be implemented for the remaining sediment sampling in 2014 (See Section 7.1.1).

4.2.5. Piscivorous Birds and Mammals

AEA implemented the methods as described in this portion of the Study Plan, with the exception of the variances described in Section 4.2.5.1.

Per the Study Plan, feathers piscivorous birds were sought during the wildlife bird surveys (Study 10.15). When nests of obligate piscivorous waterbirds (e.g., loons, grebes, terns) were observed during the breeding aerial surveys, the locations were recorded as GPS waypoints and marked on field survey maps. The locations of broods of piscivorous waterbirds also were recorded during brood and fall migration surveys. The results of the species identification are presented in Study Section 10.15.

Only one Common Loon nest was found in the inundation zone and no nests of other piscivorous waterbirds were found in 2013. Lack of access to CIRWG lands prevented a visit to look for feather samples at the Common Loon nest. Broods of all piscivorous waterbirds were found in the waterbird study area and nearby lakes. These nests can be targeted during future surveys for nesting birds.

The opportunistic collection of feathers from any Belted Kingfisher nests located during the landbird and shorebird field surveys was proposed for transfer to the mercury study lead for laboratory analysis of methyl-mercury levels. No Belted Kingfisher feathers were collected in 2013, however, because no nests of that species were found during the field surveys.

Feather samples were not obtained from piscivorous raptors for mercury analysis in 2013 (Study 10.14, RSP Section 10.14.4.1). Osprey nests were not documented in the study area and the necessary federal permit for salvage of Bald Eagle feathers could not be obtained in time before the season ended.

Fur samples from river otters and mink from animals harvested by trappers in the study area was attempted but was unsuccessful. Based on a review of ADF&G records it does not appear that there have been appreciable harvests of mink or river otter in this area for the last several years.

In addition, state regulations prevent identification of trappers and harvest locations using ADF&G data.

4.2.5.1. Variances from the Study Plan

The Study Plan required feathers to be collected from nests of raptors (principally bald eagles), loons, grebes, arctic terns, and kingfishers found during the wildlife surveys in 2013. No feather samples were collected for MeHg analysis in 2013. As described above, feather samples were either not available for collection, or as for Bald Eagles, were not obtained for mercury analysis in 2013 (Study 10.14, RSP Section 10.14.4.1) because the necessary federal permit for salvage of Bald Eagle feathers could not be obtained in time before the season ended. Hence, collection of Bald Eagle feathers has been postponed until the nesting season of the next year of study, by which time the eagle salvage permit is expected to be issued. Alternate methods for collecting samples from other piscivorous birds will need to be considered.

It was anticipated that obtaining fur samples could be problematic due to the low level of trapping in the area. No fur samples were collected for MeHg analysis in 2013. Alternate methods for collecting fur samples from piscivorous mammals will need to be considered. These may include targeted trapping or expansion of the proposed study area.

4.2.6. Fish Tissue

AEA implemented the methods as described in this portion of the study plan, with the exception of the variances explained below (Section 4.2.6.1).

Target fish species in the vicinity of the Susitna-Watana Reservoir were Dolly Varden, Arctic grayling, stickleback, longnose sucker, whitefish species, lake trout, burbot, and resident rainbow trout. Sample locations are shown on Figure 4.2-16. When possible, seven individuals from each species were collected, and larger, adult fish were specifically targeted. Given that MeHg accumulates primarily in the muscle tissue, fillets were analyzed. Collection times for fish samples occurred in August through October.

Samples were analyzed for total mercury and MeHg by EPA Methods 1631 and 1630, respectively. Liver samples were also collected from burbot and analyzed for total mercury and MeHg.

Field procedures were consistent with those outlined in applicable ADEC and/or EPA sampling protocols (USEPA 2000). Clean nylon nets and polyethylene gloves were used during fish tissue collection. Species identification, measurement of total length (mm), and weight (g) were recorded, along with sex and sexual maturity when possible (see variances). When possible, efforts were made to determine the age of the fish, including an examination of otoliths or comparisons with established age/length curves for the Susitna River (APA 1984).

4.2.6.1. Variances from the Study Plan

Study Plan RSP Section 5.7.4.6.1 proposed to collect seven to ten fish of each target species. However, additional fish were collected for Arctic grayling (16) and round whitefish (12). Multiple field teams were working at the same time, and a full count of all the fish captured could not occur until the field teams returned to camp. This additional sampling should improve achievement of the study objectives. No change is required in 2014, since no additional specimens of these fish will be captured and analyzed.

The Study Plan required that only adult fish of each species be captured and analyzed. Some juvenile Arctic grayling and whitefish were captured incidentally. While most were released, if a juvenile fish was captured accidentally and died, it was analyzed. This change should enhance achievement of the study objectives since the minimum number (7) of adult fish for each species was captured and analyzed, and this additional data allows for a better evaluation of mercury accumulation rates in target species. No change is required in 2014, since no additional specimens of these fish will be captured and analyzed.

The Study Plan required capture and analyses of a minimum of seven specimens of humpback whitefish. However, only one humpback whitefish was captured after several weeks of effort. These fish appear to be very rare in the study area. The lack of this species in the study area should not impact the study objectives since sufficient round whitefish were captured in the area, and there should be little variation in the feeding habits or mercury accumulation rates between these two species. No change is required in the next year of study, since no additional specimens of these fish will be captured and analyzed.

The Study Plan required that all fish be speciated, however, two whitefish were captured that could not be speciated. The differences between round whitefish and humpback whitefish are generally small. Based on the frequency of the capture of round whitefish in the study area, it appears likely these were also round whitefish. More than sufficient numbers of round whitefish were collected to complete this study. No change is required in the next study year, since no additional specimens of these fish will be captured and analyzed.

The Study Plan called for capture and analyses of rainbow trout or sticklebacks, however, there is no evidence that either of these species reside in the inundation zone. The lack of capture for these species should not impact the study, since these fish do not appear to be present in the inundation zone. No change is required in the next study year, since no specimens of these fish will be captured and analyzed.

Capture and analysis of slimy sculpin was not included in the Study Plan; however, they were found to be present in large numbers in the study area, and were therefore sampled. This sampling effort should enhance the achievement of the study objectives, by adding additional data on mercury for this species. Whole body samples were analyzed due to their small size. No change is required in the next year of study, since no additional specimens of these fish will be captured and analyzed.

Initially, extraction of the otoliths was to occur in the field if possible; however, field conditions were not conducive to this work. To date, 21 fish have had otoliths extracted and analyzed for age as part of this study. Some of the fish, such as slimy sculpin and juvenile specimens, were simply too small to successfully extract otoliths. This change should not impact achievement of the study goals.

The Study Plan required determination of the sex and sexual maturity of the fish, however, determination of gender for the fish proved to be problematic in the field, and the sex of only 12 fish was determined. This was because the gender of most fish could not be easily determined through visual examination, and dissecting the fish in the field introduced the potential for cross contamination of tissue samples. The gender of some fish was determined at the analytical laboratory; however, the laboratory was inconsistent with implementing gender identification. This change is not anticipated effect achievement of the study objectives, since Jewett and Duffy (2007) have shown that sex is not a determining factor in the mercury concentration in fish across several species.

The Study Plan indicated that fish samples would be collected from August to September; however, the sample period was extended into early October to obtain sufficient sample size for targeted species. Bodaly et al (1993) showed that mercury concentrations in fish, when controlled for age and reservoir size, were strongly related to shallow water temperatures. There is little change in shallow water temperature in the Susitna between September and early October. In addition, the alternative was to collect insufficient fish samples to complete the study. No change is required in the next year of study, since additional fish sampling will be limited.

The project QAPP stated that Teflon sheets would be used for the fish when placed in the sample bag. The study team had difficulty sourcing this material, and switched to polyethylene sheets. Given that muscle samples are taken from inside the fish, this material should not have introduced any contamination to the sample and have no effect on achievement of the study objectives. The study plan will be modified to allow use of polyethylene sheets for sampling.

5. RESULTS

5.1. Summary of Available Information

The following sections are a summary of the available mercury information for the Susitna River basin, including data collection from the 1980s APA Susitna Hydroelectric Project, and existing geologic information to determine if a mineralogical source of mercury exists within the inundation area.

5.1.1. APA Susitna Hydroelectric Project/USGS

Limited mercury sampling was performed during efforts to develop hydropower resources on the Susitna River in the 1980s (Alaska Power Authority 1984). This data was summarized in the data gap analyses report prepared for the project (URS 2011) and is currently available on-line from the U.S. Geological Survey (USGS): http://www.usgs.gov/water.

Water and sediment samples were collected from Gold Creek (PRM 140.1), Susitna at Parks Highway East (PRM 87.8), and Susitna Station (PRM 29.9) (Table 5.1-1 to Table 5.1-3). Sampling occurred within the period from January 20, 1975 to June 16, 2013; however, a majority of the samples were collected prior to 1986. The following conclusions can be drawn from this limited data set:

- Most of the water samples were not found to contain detectable concentrations of mercury; however, the older samples had higher detection limits (0.1 µg/L) than current methods, and concentrations of mercury in natural waters would be expected to routinely fall below this limit;

- Many of the detections appeared to occur at or very near the detection limit for the analyses. Such detections are often suspect, given they are close to the theoretical maximum sensitivity of the equipment;

- More modern analyses by the USGS (2012-2013), with lower detection limits, suggest that mercury concentrations in the water range from 0.008 to 0.035 µg/L in unfiltered samples, and is undetectable in filtered samples, suggesting that the majority of the mercury detected is associated with suspended sediment.

- The data from the U.S. Geological Survey (USGS) National Water Information System (NWIS) Web database may include data that is provisional and subject to revision.

5.1.2. Alaska Department of Environmental Conservation

ADEC has been analyzing fish samples in Alaska since 2001 for trace metals (total mercury, selenium, copper, lead, and cadmium) to determine if Alaska fishes are being negatively impacted by environmental pollutants (ADEC 2012). The results are summarized in Table 5.1-4. As expected, concentrations of mercury in piscivorous species such as lake trout and burbot are much higher than concentrations in non-piscivorous species such as grayling and whitefish. Nearly every fish analyzed from Alaska by ADEC has been found to have some mercury present.

ADEC has provided AEA with an additional detailed breakdown of data regarding the number, location, and species of fish collected on the Susitna River Basin. These sample locations are shown on Figure 5.1-1, and the analytical data is shown on Table 5.1-5.

It should be noted that the data presented in this study may be biased high. In many cases the fish selected for analyses by ADEC are collected from locations where mercury accumulation in fish tissues is suspected to be a problem. It should also be noted that the analysis, while believed to be accurate, is not being performed utilizing standard EPA approved QA/QC methods, and should be considered as screening level data only.

5.1.3. USGS (Frenzel 2000)

The purpose of this study was to document the occurrence of organochlorines, SVOCs, and trace elements (including mercury) in streambed sediments and fish tissues at 15 sites in the Cook Inlet Basin in southcentral Alaska. Fish tissue (whole body slimy sculpin) was collected from 12 sites, and mercury in sediment was analyzed from 14 sites (Figure 5.1-2). About half of the sites were located along the road system, but seven sites were located in more remote areas including three national parks. Four of the sites were located on water bodies hydrologically connected to the Susitna River.

The sediment results showed mercury concentrations ranged from 30 ng/g dw in the Kenai River near Soldotna, to as high as 460 ng/g in the Deshka River (Table 5.1-6). Many of the mercury concentrations significantly exceeded the national average of 60 ng/g, and the concentration of mercury in sediments appeared to be correlated with the acres of wetlands associated with each drainage. MeHg has been shown to be positively influenced by wetlands density in other studies (St. Louis et al. 1994).

Mercury concentrations at the Denali National Park (DNP) sites were higher than those typically observed in national parks (Gilliom et al. 1998), but did not exceed the background concentrations found in other areas examined in Alaska. Colorado and Costello Creeks appear to drain a part of DNP that is highly mineralized and the USGS believed that this contributed mercury to streambed sediments.

Partitioning of inorganic mercury and MeHg in unsieved streambed sediment, fish tissue, and water was examined in a variety of environmental settings. Five sites were sampled in the Cook Inlet Basin (Table 5.1-7). The Deshka River, having a greater density of wetlands, was also found to have a much higher concentration of MeHg than other sites.

5.1.4. Western Airborne Contaminants Assessment Project

The Western Airborne Contaminants Assessment Project (WACAP) was initiated to determine the risk from airborne contaminants (including mercury) to ecosystems and food webs in western national parks of the United States (Landers et al. 2008). From 2002 through 2007, WACAP researchers conducted analysis of the concentrations and biological effects of airborne contaminants in air, snow, water, sediments, lichens, conifer needles, and fish in watersheds in each of eight core parks in the western United States. In Alaska these parks included Noatak National Preserve (NOAT), Gates of the Arctic National Park (GAAR), and DNP.

5.1.4.1. Atmospheric Deposition of Mercury

The WACAP project collected numerous air, snow, and precipitation samples from the Wonder Lake area of DNP to analyze precipitation of mercury. This lake is approximately 60 miles from the proposed reservoir.

Much of the mercury found in the snow at Wonder Lake was associated with particulate carbon, and found at higher concentrations in snow samples from forested sites compared with samples from open meadows. It is possible that the mercury and particulate carbon become associated in the atmosphere and are deposited to the snowpack together. Or they could be deposited separately and become associated within the snowpack. Either way, it was theorized that particulate carbon might act to sequester more of the deposited mercury, increasing the net flux of mercury to the watershed when the snowpack melts. The deposition flux of mercury was 336 $ng/m^2/yr$ at Wonder Lake.

5.1.4.2. Vegetation

Samples were collected at multiple sites in GAAR, NOAT, and DNP for lichen (*Masonhalea richardsonii* and *Flavocetraria cucullata)*. The mean concentration of mercury in the vegetation ranged from 12 ng/g ww for DNP to 26 ng/g dw at GAAR (Table 5.1-8).

5.1.4.3. Fish

At NOAT and GAAR fish samples were collected from Burial and Matcharak Lakes, respectively. These lakes have small watersheds, contributing to long hydraulic residence times. Mercury concentrations exceeded thresholds for wildlife health, and the median mercury concentration in Burial Lake and in some fish in Matcharak lake exceeded the human contaminant health threshold of 300 ng/g (Table 5.1-9).

Samples of burbot collected from McLeod Lake in DNP were found to have median concentration of mercury (58.34 ng/g), and lake trout from Wonder Lake DNP were found to have median concentrations of mercury of 112.59 ng/g (Table 5.1-9).

5.1.5. Jewett and Duffy (2007)

Jewett and Duffy (2007) provided a summary of the occurrence and distribution of mercury in fish within Alaska, and while it is not directly related to the proposed study area, it summaries the previous 22 years of studies in the state and provides some insights regarding the occurrence and nature of mercury in Alaskan fish.

The study included data from 17 freshwater fish species (n=775) from Alaska, including juvenile salmon. Much of this data was collected from national wildlife refuges and other otherwise pristine areas. Tissues of the piscivorous northern pike had total mercury concentrations that typically exceeded USEPA and ADEC tissue-based water quality criterion relative to consumption of fish by humans (300 ng/g) and U.S. Food and Drug Administration (USFDA) action level for human consumption (1,000 ng/g). For example, 44 percent of the pike examined from the Nowitna National Wildlife Refuge in 1987 had concentrations in tissues between 1,000 and 2,900 ng/g (Snyder-Conn et al. 1993). A study on subsistence fishes in the Yukon-Kuskokwim Delta area reported 36 percent of the pike examined had total mercury in muscle tissue that exceeded the 1,000 ng/g (Duffy et al. 1999).

Significant regional differences were observed in mercury concentrations. For example, fish from parts of the Yukon were found to have mercury concentrations 2 to 3 times higher than concentrations in the same species from the Kuskokwim River. Overall mercury concentrations in fish were found to be highly variable among collection locations, fluctuating nearly an order of magnitude.

As with other similar studies, Jewett and Duffy found mercury concentrations in fish tended to increase with age, and therefore with the fish size as well (Johnels et al. 1967; Jewett et al. 2003). While age is the preferred parameter of comparison, fish length or body weight can be used for approximation of age (Jewett et al. 2003; Zhang et al. 2001). In general, there was no difference reported in mercury concentrations between sexes of similar sized fish.

5.1.6. Geologic Data

A geologic study is being performed to evaluate the surficial and bedrock geology, geologic structure, mass wasting, and mineral resources in the study area (Study 4.5). Of particular interest to this study is the identification of potential geologic sources for mercury to the reservoir. The survey included identifying mining claims and prospects in the Project area from data sources (e.g., State of Alaska mining claim website); field reconnaissance of selected areas of high mineral potential, mineral licks, and mining claims; and consultations with active miners and geologists familiar with the area (USGS, BLM, Alaska Earth Sciences, CIRI, and claimholders). Additionally, several rock samples were collected and chemically analyzed for a wide range of potentially economic minerals.

In summary, no mining claims appear to be present within the inundation zone of the reservoir. Exposed rock types identified within the inundation zone consist of gneissose granitic rocks, granodiorite, quartz monzonite, amphibolite, argillite, chert, sandstone, and limestone, and other undifferentiated sedimentary rocks. The mineral resources assessment (ISR 4.5) also included the identification and review of potential sources of acid rock drainage (ARD) and mineral licks. Only four such locations were identified in the area, none of which are within the inundation zone.

Based on the information developed to date, there does not appear to be a significant mineralogical source of mercury or sulfate minerals in the inundation zone for the reservoir. Additional geologic mapping and sampling is planned for the next year of study (Study 4.5) and the results of this field work will be reviewed for relevance to this study area.

5.2. Vegetation

The vegetation found at each of the sample sites is shown on Table 5.2-1. In summary, 50 vegetation samples were collected from 10 separate locations within the inundation zone. Only the dominant plant species were sampled at each location. Overall, the vegetation found at each of the sample location was limited in species and volume. Plants were generally found to be in one of four categories:

- Plants common to many sample sites, with a large vegetative mass (alder, willow, bog blueberry, and low bush cranberry).
- Plants present at just a few sample sites, but at large vegetative mass when present (salmonberry, prickly rose, etc.).
- Plants common at many sample sites, but with low vegetative mass (bog birch, horsetail, etc.).
- Rare plants present in small numbers (fireweed, soapberry, etc.).

Only the first two categories of plants were sampled.

The analytical results of the vegetation analyses were received from the contract laboratory too late for inclusion in this ISR and will therefore be provided after QA/QC of the data is completed.

5.3. Soil

All of the planned soil sampling was completed. The soil samples each consisted of a combination of surface moss, peat, and mineral soil (Table 5.3-1). At each sample location there was a significant fraction of organic material (moss and peat) above the mineral soil. This material is the primary potential source or mercury methylation in the reservoir after impoundment.

The results of the soil analyses were received from the contract laboratory too late for inclusion in this ISR and will therefore be provided after QA/QC of the data is completed.

5.4. Water

The results of water quality mercury analyses are provisional, and are not included in the Water Quality ISR Study 5.5.

5.5. Sediment and Sediment Porewater

Sediment samples were collected at four of the ten proposed sample locations at mouths of the following tributaries: Jay, Kosina, and Goose creeks, and the Oshetna River (Figure 4-2.13). The remaining samples will be collected in the next year of study. The collected samples were analyzed for the parameters shown in Table 4.2-1. Sufficient fine grained material was found at each of these sample locations to meet the study objectives listed in Section 4.2.4.

The results of sediment and sediment porewater mercury analyses were received from the contract laboratory too late for inclusion in this ISR and will therefore be provided after QA/QC of the data is completed.

5.6. Piscivorous Birds and Mammals

The Study 10.16 study team completed a scientific literature review on the foraging habits and diets of piscivorous landbirds and shorebirds (primarily Belted Kingfisher, but also American Dipper and Spotted Sandpiper) (see ISR Study 10.16) to inform the mercury risk-assessment study (Study 5.7) and to complement the field data gathered on the distribution and abundance of these species in the study area. The literature review focused on studies conducted in Alaska to the extent possible, but few such studies were available, so literature from elsewhere was included. This literature review will be considered by the mercury risk-assessment study team in 2014.

Piscivorous species where fish are likely to compose 40 percent or more of the diets observed in the reservoir area included Common Loon, Merganser, Red-throated Loon, Red-necked Grebes, Bonaparte’s Gulls, and Arctic Terns. Several broods of these species were observed. Only a single Common Loon nest were found during the waterbird aerial surveys in 2013 (those surveys focused on locating adult birds and broods, rather than nests). One Common Loon nest was found in the Watana Reservoir survey area, but could not be visited because it was located on CIRWG lands. Locations where broods, but not nests, were found in 2013 can visited in the next year of study to look for nests. Plans for sampling nests of piscivorous waterbirds will be discussed further with the TWG.

The study teams were not able to obtain any feather samples of piscivorous raptors for mercury analysis in 2013 because no Osprey nests were found in the study area and the necessary federal permit for salvage of Bald Eagle feathers could not be obtained in time before the season ended. Sampling of Bald Eagle feathers will be pursued during the next year of study.

Fur samples from river otters and mink were sought from animals harvested by trappers in the study area in 2013. However, state regulations prevent identification of trappers and harvest locations using ADF&G data. Therefore the alternate method of placing hair snag "traps" will be utilized in the next year of study (Study 10.11).

5.7. Fish Tissue

The results of fish tissue mercury analyses were received from the contract laboratory too late for inclusion in this ISR and will be provided after QA/QC of the data is completed. To date, 21 otoliths have been extracted and are being analyzed for age as part of this study. Extensive data from the 1980s studies exists on the relationship between fish size and age in the Susitna River. Figures developed as part of previous studies are provided in Figure 5.7-1 through Figure 5.7-4.

The following sections discuss the available data on a species by species basis.

5.7.1. Lake Trout

Two lake trout were collected in 2012 from Sally Lake (Figure 4.2-16). This lake was not accessible this year, however, Cushman Lake and Deadman Lake were accessible, and would be hydrologically connected to the proposed reservoir after filling. Seven lake trout were captured from Deadman Lake in 2013. Otoliths were extracted from all seven of these fish. The otolith data is still being analyzed. While lake trout were present in Cushman Lake, none were caught during the study period.

Previous studies of lake trout from various lakes in the Susitna drainage and in Deadman Lake (Burr 1987) found there to be a good relationship between fish fork length and age (Figure 5.7-1). It should be noted that unlike other fish, the relationship between lake trout length to age may be lake specific, and even small changes in lake conditions can impact growth significantly (Burr 1987). Based on that relationship and the data collected in this study the fish captured for this study ranged from 6 to 26 years old. This data will be confirmed when the analyses of the otoliths collected from these fish is complete.

5.7.2. Longnose Sucker

A total of seven longnose suckers (LNS) were captured from the river (Figure 4.2-16). Five of these fish were captured at the confluence of the Susitna and Oshetna Rivers, the remainder in the mainstem Upper Susitna River. The fish ranged in size from 315 to 430 mm, and in weight from 303 to 500 g. Otoliths were successfully extracted from 5 of these fish.

Previous studies of the LNS in the Susitna Middle River (APA 1984) found there to be a good relationship between fish fork length and age (Figure 5.7-2). Based on that relationship and the data collected in this study, the fish captured ranged from seven to over 13 years old. This data will be confirmed when analyses of the otoliths collected as part of this study are complete.

5.7.3. Dolly Varden

Dolly Varden were found to be rare in the inundation zone, with the only area of their occurrence being the upper Watana Creek (Figure 4.2-16). A total of seven fish were captured from this location. The fish ranged in size from 177 mm to 204 mm, and in weight from 47 g to 70 g. Otoliths were successfully extracted from four of the fish as part of this study. Twenty-eight additional otoliths were extracted as part of the Study of Fish Distribution and Abundance Study (9.5).

5.7.4. Arctic Grayling

A total of 16 Arctic grayling were captured as part of this study. Most were captured from Kosina Creek, where the species appears to be plentiful (Figure 4.2-16). The fish ranged in size from 75 mm to 340 mm, and in weight from 12 g and 385 g. Two fish were also captured in 2012 from Watana Creek, and one was captured from the Oshetna River. Some of the fish captured appeared to be juveniles (<2 years old), however, the field crews were directed to keep any fish accidentally killed during other studies for inclusion in this study. No otoliths were successfully extracted from Arctic grayling.

Previous studies of the Arctic grayling in the Upper Susitna River (APA 1984) found there to be a good relationship between fish fork length and age (Figure 5.7-3). Using this data, it would appear that the fish captured in 2013 ranged from 0.5 to over 8 years old.

5.7.5. Burbot

A total of eight burbot were collected from the mainstem of the Upper Susitna River in the inundation zone, two were captured in 2012, and six in 2013 (Figure 4.2-16). The fish ranged narrowly in size from 390 mm to 467 mm, and in weight from 312 g to 553 g. Two otoliths were successfully extracted from the burbot. For the fish collected in 2013, burbot livers were also analyzed for mercury and other metals.

5.7.6. Slimy Sculpin

A total of seven slimy sculpin were collected from the mainstem of the Upper Susitna River in the inundation zone in 2013 (Figure 4.2-16). Unlike the other species studied here, the analytical results of the slimy sculpin were evaluated for whole fish. The fish ranged narrowly in size from 74 mm to 100 mm, and in weight from 3.6 g to 6.6 g. The fish were not aged due to their small size.

5.7.7. Whitefish

Humpback whitefish were found to be rare in the inundation zone. Only a single fish was positively identified; however, two other unidentified whitefish were also captured. The remaining 10 whitefish captured appeared to be round whitefish. The fish were captured throughout the proposed inundation zone. Otoliths were extracted from three of the fish for analyses.

Three of the whitefish captured appeared to be juveniles, but were analyzed since they had been accidentally killed in rotary screw traps. Including the juveniles, the fish ranged in size from 140 to 450 mm, and in weight from 57.1 to 470 g.

Previous studies of the round whitefish in the Susitna Middle River (APA 1984) found there to be a good relationship between fork length and age (Figure 5.7-4). Based on the data collected in this study the fish captured for this study ranged from 1 to 20 years. This data will be confirmed when the otoliths collected as part of this study are analyzed. It should be noted that the Middle River is more productive than the Upper River, meaning the same size fish may be younger in the Middle River than the Upper River because there is more food available. Therefore using age data from the Middle River could underestimate age for Upper River fish.

6. DISCUSSION

6.1. Current Status of the Study Effort

Most of the necessary data for completion of the study objectives was collected in 2012 and 2013. The following sections summarize the status of the various elements of the study and the findings thus far. Because the laboratory data is still being reviewed, the discussion of this data will be limited.

6.1.1. Summary of Available Information

The summary of the available information has been completed and is presented in this document. If additional data becomes available it will be incorporated. The geologic data is still being reviewed as part of Study 4.5; any additional findings from that study will be incorporated as it becomes available.

6.1.2. Vegetation and Soil

The proposed data collection goals have been met. The adequacy of data collection in 2013 to meet the study objectives will be confirmed following completion of data QA/QC.

There is no data from the previous studies of the dam site in the 1980s on mercury concentrations in vegetation and soils. Understanding the impact of these sources of mercury on reservoirs was just beginning at that time.

The vegetation types at the site do not appear to be variable within the inundation zone, with only three to four species representing the majority of the vegetation mass. However, there was a considerable mass of organic material (moss and peat) at almost all the sample locations. Where soils have developed on uniform parent material vegetation, cover type and cover age are reported to be very important variables affecting concentration of mercury in soils (Grigal et al. 1994). This is certainly true in the Friedli et al. (2007) study (Table 6.1-1) of an upland boreal forest in the Prince Albert National Park, Saskatchewan, Canada. They found that 93 to 97 percent of the mercury resided in the organic soil above the mineral layer. The mercury input to the ecosystem is from wet and dry deposition to the land surface and is trapped in the organic soil layers. They also found that periodic forest fires can "reset" the mercury concentration to a lower level, and that mercury concentrations increase slowly in the soil over time. It is expected that the predominate source of mercury to the newly formed reservoir will be from this source, rather than from the vegetation.

6.1.3. Water

While mercury samples were collected during studies conducted in the 1980s, it appears that the analytical methods utilized at the time were of insufficient sensitivity to detect mercury concentrations in the water (>0.1 µg/L). The few detections found were at or very near the detection limit for the analytical method. Such detections are often suspect, given they are close to the theoretical maximum sensitivity of the equipment. Modern analyses by the USGS (2012-2013), with lower detection limits, suggest that mercury concentrations in the water range from 0.008 to 0.035 µg/L in unfiltered samples, and is undetectable in filtered samples, suggesting that the majority of the mercury detected is associated with suspended sediment.

6.1.4. Sediment and Sediment Porewater

Only a limited amount of sediment and sediment porewater data has been collected from the study area (four of the ten sample locations). Previous studies generally focused on suspended sediment, and suffered from the same elevated detection limits as the water sampling from that period, as discussed above.

6.1.5. Piscivorous Birds and Mammals

Efforts to collect bird specimens have so far been unsuccessful. This potential problem was identified in the Study Plan and discussed with the TWG, in that it is difficult to collect non-lethal samples for animals with very low population densities in rugged terrain. Piscivorous birds have been identified in the area at low numbers; however only one nest was located during the 2013 wildlife surveys. Lack of access to CIRWG lands and a Bald Eagle collection permit further limited the potential for sample collection.

Based on the previously described issues, it is difficult at this time to fully evaluate the potential for success of the proposed feather sampling strategy in the next year of study. Potential alternative methods will be developed and discussed with the TWG. These may include:

- Peregrine falcons are predators of a variety of birds, including waterbirds. Feathers of prey could be collected from Peregrine falcon nests in the study area.
- Expansion of the study area to include nearby areas with larger populations of piscivorous birds.
- Revisiting areas where broods of piscivorous birds were observed, but nests not identified.
- Gaining access to CIRWG lands and obtaining a Bald Eagle collection permit.

The success of proposed winter fur snagging surveys potentially to be conducted during the next year of study is unknown, based on the low population of river otters and mink in the study area. Snagging fur, particularly for small mammals, works best when population density is high, providing more opportunities for success. Depending on the success of collecting adequate samples, alternative methods may be considered.

Absent samples from aquatic mammals from the inundation zone, it might be necessary to expand the collection area to the Middle River. However, this may not be suitable, in that mercury concentrations may be specific to the area where the mammal is feeding, and the farther from the proposed inundation zone the sampling occurs, the less representative it may be of localized conditions.

6.1.6. Fish Tissue

MeHg can be detected in nearly every fish analyzed in Alaska, which is consistent with the primary source of mercury to most aquatic ecosystems being deposition from the atmosphere. Studies around the state provide comparisons of background mercury concentrations for fish collected from the study area. When the results of the fish tissue analyses from this study are completed, the data will be compared to other studies.

The burbot captured seem to be from a narrow size range, and likely represent a limited age range. It is suspected that the burbot captured, while adults, are < 5 years old. While burbot are typically a piscivorous species, they typically do not exhibit this feeding behavior until their 5th to 6th year of life. Prior to becoming piscivorous, burbot have a diet similar to Arctic grayling, longnose sucker, and other fish in the river. It would be expected then that the mercury concentration in burbot would resemble non-piscivorous fish prior to the age of 6, and resemble lake trout after that age. For this reason additional burbot samples (approximately 5) may need to be collected to fully characterize the range of mercury concentration in tissues of this species.

Lake trout sampling was limited to seven fish from Deadman Lake and two fish from Sally Lake. Mercury concentrations in lake trout can be specific to a lake, as shown in the WACAP study. Therefore it is not known if the concentrations of mercury in the trout from Deadman Lake will be fully representative of the concentration in other lakes (Sally Lake, Cushman Lake) in or hydraulically connected to the inundation zone. For this reason it may be necessary to collect approximately 5 additional lake trout from Cushman Lake and/or Sally Lake.

The literature indicates that mercury is exported downstream from reservoirs mainly by water, with the dissolved phase (< 0.45 μm) and suspended solids (0.45 to 50 μm) accounting for 64 percent and 33 percent, respectively, of the total mercury, and plant debris, phytoplankton, zooplankton, benthos and fish contributing only 3 percent (Schetagne et al. 2000). Therefore predictive risk analyses for downstream receptors as requested in the April 1 SPD will incorporate this data.

7. COMPLETING THE STUDY

[Section 7 appears in the Part C section of this ISR.]

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9. TABLES

Table 4.2-1. Sampling Parameters and Media

Parameter	Media							
	Vegetation	Soil	Surfacewater[1]	Sediment	Sediment Porewater	Piscivorous Birds and Mammals	Fish Tissue	
							Filet	Liver
pH			X		X			
Water Temp			X		X			
Hardness			X		X			
Alkalinity			X					
TOC			X	X				
DOC			X		X			
Aluminum			Total, dissolved	Total	Dissolved			
Arsenic			Total, dissolved	Total	Dissolved			X
Cadmium			Total, dissolved	Total	Dissolved			X
Calcium			Total, dissolved		Dissolved			
Copper			Total, dissolved	Total	Dissolved			
Chromium			Total, dissolved	Total				
Iron			Total, dissolved	Total	Dissolved			
Lead			Total, dissolved	Total	Dissolved			
Magnesium			Total, dissolved		Dissolved			
Mercury	Total	Total	Total, dissolved	Total	Dissolved	Total	Total	Total
Methyl Mercury	X			X		X	X	X
Nickel			Total, dissolved	Total	Dissolved			
Selenium				Total	Dissolved			X
Zinc			Total, dissolved	Total	Dissolved			
Sediment Size				X				
Total Solids				X				

[1] See ISR Section 5.5 for additional parameters collected for Baseline Monthly and Focus Area Water Quality Sampling

Table 4.2-2. Vegetation and Soil Sample Locations

Sample Site	Latitude	Longitude	Nearest PRM
Site 1 N1	62.8206	-148.1557	200.3
Site 1 N2	62.8207	-148.1560	200.3
Site 1 N3	62.8206	-148.1553	200.3
Site1 N4	62.8207	-148.1562	200.3
Site1 N5	62.8206	-148.1552	200.3
Site 2 N1	62.7976	-148.0707	203.8
Site 2 N2	62.7975	-148.0706	203.8
Site 2 N3	62.7974	-148.0704	203.8
Site 2 N4	62.7976	-148.0708	203.8
Site 2 N5	62.7973	-148.0703	203.8
Site 2 N6	62.7973	-148.0703	203.8
Site 3 N1	62.7895	-148.0556	208.0
Site 3 N2	62.7895	-148.0561	208.0
Site 3 N3	62.7897	-148.0551	208.0
Site 3 N4	62.7896	-148.0563	208.0
Site 3 N5	62.7898	-148.0552	208.0
Site 3 N6	62.7898	-148.0552	208.0
Site 4S alt1	62.7884	-148.0074	206.2
Site 4S alt2	62.7883	-148.0077	206.2
Site 4S alt3	62.7883	-148.0071	206.2
Site 4S alt4	62.7883	-148.0079	206.2
Site 4S alt5	62.7883	-148.0068	206.2
Site 4S alt6	62.7883	-148.0068	206.2
Site 5S 1	62.7842	-147.9521	208.2
Site 5S 2	62.7845	-147.9521	208.2
Site 5S 3	62.7842	-147.9520	208.2
Site 5S 4	62.7846	-147.9524	208.2
Site 5S 5	62.7840	-147.9519	208.2
Site 6S-1	62.7790	-147.9189	209.8
Site 6S-2	62.7789	-147.9195	209.8
Site 6S-3	62.7790	-147.9185	209.8
Site 6S-4	62.7788	-147.9198	209.8
Site 6S-5	62.7792	-147.9183	209.8
Site 7 N1	62.7784	-147.8787	211.5
Site 7 N2	62.7784	-147.8787	211.5
Site 7 N3	62.7786	-147.8787	211.5
Site 7 N4	62.7782	-147.8789	211.5
Site 7 N5	62.7787	-147.8789	211.5
Site 7 N6	62.7787	-147.8789	211.5
Site 8 S1	62.7728	-147.8483	212.5
Site 8 S2	62.7729	-147.8481	212.5
Site 8 S3	62.7725	-147.8484	212.5

Sample Site	Latitude	Longitude	Nearest PRM
Site 8 S4	62.7731	-147.8480	212.5
Site 8 S5	62.7724	-147.8486	212.5
Site 9 N1	62.8509	-148.2314	NA
Site 9 N2	62.8508	-148.2316	NA
Site 9 N3	62.8509	-148.2311	NA
Site 9 N4	62.8510	-148.2317	NA
Site 9 N5	62.8507	-148.2310	NA
Site 9 N6	62.8507	-148.2310	NA
Site 10 N1	62.8577	-148.2133	NA
Site 10 N2	62.8574	-148.2131	NA
Site 10 N3	62.8572	-148.2134	NA
Site 10 N4	62.8576	-148.2129	NA
Site 10 N5	62.8571	-148.2136	NA

Samples collected from August 6 to 7, 2013.

Table 4.2-3. Baseline Water Quality Monitoring Sites for Total and Dissolved Mercury

Project River Mile (PRM)	Description	Latitude	Longitude	Location Rationale
29.9	Susitna Station	61.544280	-150.515560	Influence of upstream tributary
32.5	Yentna River	61.587604	-150.483017	Major tributary
33.6	Susitna above Yentna	61.575950	-150.427410	Above major tributary
45.1	Deshka River	61.710142	-150.324700	Major tributary
59.9	Susitna	61.862200	-150.184630	Above major tributary
87.8	Susitna at Parks Highway East	62.174531	-150.173677	Mainstem river site
102.8	Talkeetna River	62.342430	-150.112660	Major tributary
118.6	Chulitna River	62.567703	-150.237828	Major tributary
107	Talkeetna	62.397240	-150.137280	Downstream of existing townsite; Historic (1980s) monitoring site
124.2	Curry Fishwheel Camp	62.617830	-150.013730	Important side channel habitat
140.1	Gold Creek	62.767892	-149.689781	Major tributary
142.2	Indian River	62.78635	-149.658780	Major tributary
142.3	Susitna above Indian River	62.785776	-149.648900	Historic (1980s) monitoring site
152.2	Susitna below Portage Creek	62.830397	-149.382743	Downstream of major tributary
152.3	Portage Creek	62.830379	-149.380289	Major tributary
152.7	Susitna above Portage Creek	62.827002	-149. 827002	Historic (1980s) monitoring site
187.2	Susitna at Watana Dam site	62.822600	-148.553000	Boundary condition between the reservoir and riverine models
235.2	Oshetna Creek	62.639610	-147.383109	Uppermost tributary in the Project area

Table 4.2-4. Focus Area Water Monitoring Sites for Total and Methylmercury

Focus Area (FA)
FA-104 (Whiskers Slough)
FA-113 (Oxbow I)
FA-115 (Slough 6A)
FA-128 (Slough 8A)
FA-138 (Gold Creek)
FA-141 (Indian River)
FA-144 (Slough 21)

Table 5.1-1. Historic Mercury Concentrations at Gold Creek (PRM 140.1)

Date	Mercury in water (filtered, µg/L)	Mercury in water (unfiltered, µg/L)	Mercury in suspended sediment (µg/kg)
6/14/77	NS	<0.5	NS
8/10/77	NS	<0.5	NS
10/4/77	NS	0.2	NS
6/23/81	NS	0.4	0.4
7/21/81	0.2	0.3	0.1
3/30/82	<0.1	<0.1	NS
7/1/82	<0.1	0.2	NS
9/16/82	<0.1	0.2	NS
3/18/83	<0.1	<0.1	NS
6/28/83	<0.1	0.1	NS
7/28/83	<0.1	0.3	NS
6/27/84	<0.1	0.1	NS
7/25/84	0.2	3.0	NS
6/27/85	0.2	0.0	NS
7/24/85	<0.1	<0.1	0.1
8/28/85	<0.1	<0.1	NS
3/24/86	<0.1	0.1	NS
6/25/86	<0.1	<0.1	NS
7/30/86	0.2	0.1	NS
8/25/86	0.8	0.5	NS
6/6/12	<0.005	0.007	NS
8/15/12	<0.005	0.008	NS
6/6/13	<0.005	0.023	NS

NS = Not Sampled

Table 5.1-2. Historic Mercury Concentrations at Susitna at Parks Highway East (PRM 87.8)

Date	Mercury in water (filtered, µg/L)	Mercury in water (unfiltered, µg/L)	Mercury in suspended sediment (µg/kg)
6/15/77	NS	<0.5	NS
8/10/77	NS	<0.5	NS
10/4/77	NS	<0.10	NS
3/25/81	0.10	0.1	0.0
6/25/81	0.00	0.6	0.6
7/23/81	0.10	0.3	0.2
7/2/82	<0.10	0.2	NS
9/15/82	0.10	0.2	0.1
10/13/82	0.10	0.1	0.0
1/20/83	<0.10	NS	NS
3/17/83	<0.10	<0.10	NS
6/24/83	<0.10	0.2	NS
7/27/83	<0.10	0.3	NS
6/14/84	<0.10	0.9	NS
7/19/85	<0.10	0.1	NS
1/10/85	<0.10	<0.10	NS
6/25/85	<0.10	0.1	NS
7/23/85	<0.10	<0.10	NS
8/27/85	<0.10	<0.10	NS
3/18/86	<0.10	<0.10	NS
6/25/86	<0.10	<0.10	NS
6/5/12	<0.005	0.015	NS
8/13/12	<0.005	0.023	NS
6/3/13	<0.005	0.035	NS

NS = Not sampled

Table 5.1-3. Historic Mercury at Susitna Station (PRM 29.9)

Date	Mercury in water (filtered, µg/L)	Mercury in water (unfiltered, µg/L)	Mercury in suspended sediment (µg/kg)
1/20/75	<0.5	<0.5	0.0
5/23/75	<0.5	<0.5	0.0
8/27/75	<0.5	<0.5	0.0
10/3/75	<0.5	<0.5	0.0
3/17/76	<0.5	<0.5	0.0
5/28/76	<0.5	<0.5	0.0
7/26/76	<0.5	<0.5	0.3
10/6/76	<0.5	<0.5	0.0
3/9/77	<0.5	<0.5	NS
5/23/77	<0.5	<0.5	0.0
8/19/77	<0.5	<0.5	0.2
12/13/77	<0.1	<0.1	0.0
4/5/78	<0.1	<0.1	0.0
5/24/78	<0.1	<0.1	0.1
7/17/78	<0.1	0.2	0.1
1/15/79	<0.1	<0.1	0.1
5/14/79	<0.1	0.2	0.2
6/19/79	<0.1	<0.1	0.1
9/17/79	<0.1	<0.1	0.1
3/12/80	0.0	0.1	0.1
6/16/80	0.0	0.1	0.1
7/30/80	0.1	0.1	0.0
4/9/81	0.0	0.1	0.1
6/12/81	0.0	0.3	0.3
7/15/81	0.2	0.8	0.6
4/9/82	<0.1	<0.1	NS
5/19/82	<0.1	0.1	NS
7/14/82	0.2	0.2	0.0
10/5/82	0.1	NS	NS
4/5/83	<0.1	NS	NS
6/22/83	0.1	NS	NS
7/27/83	<0.1	NS	NS
9/30/83	<0.1	NS	NS
4/6/84	<0.1	NS	NS
5/18/84	<0.1	NS	NS
7/18/84	<0.1	NS	NS
9/20/84	<0.1	NS	NS
3/27/85	0.1	NS	NS
5/24/85	<0.1	NS	NS
7/18/85	0.2	NS	NS

Date	Mercury in water (filtered, µg/L)	Mercury in water (unfiltered, µg/L)	Mercury in suspended sediment (µg/kg)
9/19/85	<0.1	NS	NS
12/4/85	0.1	NS	NS
7/29/86	0.1	NS	NS
9/25/86	3.0	NS	NS
5/30/13	<0.005	NS	NS

NS= No sample

Table 5.1-4. ADEC Mercury Statewide Data (ng/g ww)

Species	Tissue	Number	Mean and Std. Dev. (ng/g ww)	Median (ng/g ww)	Range (ng/g ww)
Lake trout	Fillet whole	53 31	360 ± 180 280 ± 130	320 310	64 -740 59 -540
Grayling	Fillet juvenile	48 1	87 ± 34 NA	82 48	33 -180 NA
Dolly Varden	Fillet	22	120 ± 160	58	11 -550
Humpback whitefish	Fillet whole	98 24	67 ± 32 48 ± 25	66 44	8 -18 12 -120
Round whitefish	Fillet	12	75 ± 56	68	8 -200
Burbot	Fillet	27	330 ± 280	250	ND– 850
Longnose sucker	Fillet	3	71 ± 12	73	59 -82

Table 5.1-5. ADEC Mercury Data from Susitna Watershed

Species	Site Name	Fish Length (FL mm)	Fish Weight (g)	Age	Sex	Hg (ng/g dw)
Lake trout	Lakes near Tyone Creek	600	2939	NM	M	130
	Lakes near Tyone Creek	610	3089	NM	M	270
	Lakes near Tyone Creek	730	5294	NM	F	740
Arctic grayling	Lake Louise	288	200	4.5	M	110
	Lake Louise	290	230	4	M	110
	Lakes near Tyone Creek	200	NM	2	NM	95
	Lakes near Tyone Creek	201	NM	2	NM	91
	Lakes near Tyone Creek	330	340	5	F	180
	Lakes near Tyone Creek	278	200	<1	F	160
	Lakes near Tyone Creek	220	110	2	M	110
	Lakes near Tyone Creek	270	190	3.5	F	80
	Lakes near Tyone Creek	290	230	4	NM	80
	Finger Lake	370	460	7	M	67
	Fishook Lake	310	310	4	F	77
	Fishook Lake	370	160	7	F	100
	Fishook Lake	320	350	5	M	130
	Upper Talkeetna River	360	420	6.5	NM	93
	Upper Talkeetna River	370	430	7	M	51
	Christianson Lake	260	160	3.5	F	120
	Christianson Lake	204	10	2.5	NM	130
	Christianson Lake	272	190	3.5	F	59
Burbot	Big Lake	579	1038	9	NM	94
Round whitefish	Knob Lake	390	490	20	F	120
	Knob Lake	360	310	7	F	200
	Knob Lake	340	220	8	F	78
	Knob Lake	320	230	6	M	58
	Knob Lake	280	150	1	M	90
	Coal Creek Lake	330	290	12	M	140
	Coal Creek Lake	310	220	13	F	79

Table 5.1-6. Mercury in Cook Inlet Sediments and Slimy Sculpin (Frenzel 2000)

Site Name	Sediment Hg (ng/g dw)	Slimy Sculpin Hg (ng/g dw)
Ninilchik River	50	150
Kenai River at Soldotna	30	200
South Fork Campbell Creek	30	210
Chester Creek	180	100
Talkeetna River	40	80
Deshka River	460	110
Moose Creek	200	160
Kamishak River	40	90
Johnson River	130	NS
Kenai River Below Russian	70	120
Kenai River at Jim's Landing	90	140
Kenai River below Skilak Lake Outlet	70	150
Colorado Creek	180	NS
Costelllo Creek	230	80
National mean	60	NA

National mean is derived from Gilliom et al (1998)

Table 5.1-7. Mercury Partitioning in Cook Inlet Sediments and Slimy Sculpin (Frenzel 2000)

Site Name	Total Hg in Sediment (ng/gdw)	MeHg in Sediment (ng/g dw)	Total Hg in Fish (ng/g dw)	Total Hg in Water (ng/g)	MeHg in water (ng/g)
South Fork Campbell Creek	200	0.67	292/429	2.50	0.02
Chester Creek	109	0.38	152/0	2.96	0.02
Deshka River	21	5.10	246	NS	NS
Johnson River	50	0.01	NS	9.78	0.02
Costelllo Creek	169	0.04	0/101	4.97	0.02

Fish concentrations are for slimy sculpin/Dolly Varden

Table 5.1-8. WACAP Data for Lichen Samples

Site Name	Species	Number	Median Hg (ng/g ww)
NOAT	*Masonhalea richardsonii*	3	17
NOAT	*Flavocetraria cucullata*	2	23
GAAR	*Masonhalea richardsonii*	2	22
GAAR	*Flavocetraria cucullata*	4	26
DNP	*Masonhalea richardsonii*	6	12
DNP	*Flavocetraria cucullata*	6	21

NOAT = Noatak National Preserve; GAAR = Gates of the Arctic National Park; and DNP = Denali National Park

Table 5.1-9. WACAP Data for Alaska Fish

Site Name	Species	Number	Mean Age	Median Hg (ng/g ww)
NOAT Burial Lake	Lake trout	10	19.7	129.71
GAAR Matcharak Lake	Lake trout	10	17.9	217.54
DNP McLeod Lake	Burbot	4	4	58.34
DNP Wonder Lake	Lake trout	10	17	112.59

Results are for whole body samples.

NOAT = Noatak National Preserve; GAAR = Gates of the Arctic National Park; and DNP = Denali National Park

Table 5.2-1. Plant Species Observed and Collected at Each Sample Site

Species	Site-1	Site-2	Site-3	Site-4	Site-5	Site-6	Site-7	Site-8	Site-9	Site-10
Alder (*Alnus* spp.)	X	X	X	X	X			X	X	X
Willow (*Salix* spp.)	X	X	O	X	X	X	X	X	X	X
Bog Blueberry (*Vaccinium uliginosum*)	X	X	X	X	X	X	X	X	X	X
Low-bush Cranberry (*Vaccinium vitus-idaea*)	X	X	X	X	X		X	O	X	X
Salmonberry (*Rubus spectabilis*)	X		X							
Prickly Rose (*Rosa acicularis*)		X	O		X		O		X	X
Crowberry (*Empetrum nigrum*)		X	X	O				O	X	O
American Red Currant (*Ribes triste*)					X					
Clover (*Trifolium* sp.)					X					
Spruce (*Picea* sp.)					X	O	O			
Sweet Gale (*Myrica gale*)						X	O			
Arctic Coltsfoot (*Petasites frigidus*)	O	O		O			X		X	X
Horsetail (*Equisetum* sp.)	O	O		O	O	O		O	O	O
Bog Birch (*Betula glandulosa*)	O	O	O	O	O	O	O	O	O	
Bush Cinquefoil (*Dasiphora fruticosa*)	O		O	O		O		O	O	
Common Labrador Tea (*Ledum groenlandicum*)	O	O	O	O	O		O	O	O	O
Cloudberry (*Rubus chamaemorus*)	O						O		O	
Wintergreen (*Pyrola* sp.)		O	O		O					
Dwarf Dogwood (*Cornus canadensis*)			O		O					O
Soapberry (*Shepherdia canadensis*)			O							
Twisted Stalk (*Streptopus amplexifolius*)					O					
Fireweed (*Chamerion angustifolium*)					O					
Marsh Five-finger (*Comarum palustre*)						O				
Red Bearberry (*Arctostaphylos rubra*)	O		O	O					O	O

X are plants included in the sampling. O are plants observed, but not included due to low vegetative mass.

Table 5.3-1. Results of General Soil Characteristics

Location	Sample number	Lat.	Long.	River Mile	Soil Fraction Description	Moss (cm)	Peat (cm)	Total	percent Total Solids
Site-1	N-1	62.8206	-148.1557	200.3	Silt with clay	4.50	9.5	14.0	25.05
Site-1	N-2	62.8207	-148.1560	200.3	Silt with clay	6.50	18.0	24.5	19.59
Site-1	N-3	62.8206	-148.1553	200.3	Silt with clay	5.00	13.0	18.0	20.68
Site-1	N-4	62.8207	-148.1562	200.3	Silt with clay	3.50	6.5	10.0	21.23
Site-1	N-5	62.8206	-148.1552	200.3	Silt with Clay	4.00	14.5	18.5	41.76
Site-2	N-1	62.7976	-148.0707	203.8	Silt	4.50	8.9	13.4	27.19
Site-2	N-2	62.7975	-148.0706	203.8	Silt	3.60	15.0	18.6	23.69
Site-2	N-3	62.7974	-148.0704	203.8	Clayey silt	8.50	13.0	21.5	27.93
Site-2	N-4	62.7976	-148.0708	203.8	Silt	4.80	19.0	23.8	31.25
Site-2	N-5	62.7973	-148.0703	203.8	Clayey silt	3.80	9.2	13.0	23.55
Site-2	N-6	62.7973	-148.0703	203.8	Clayey silt	3.80	9.2	13.0	19.65
Site-3	N-1	62.7895	-148.0556	208.0	Clayey silt	4.50	28.5	33.0	26.12
Site-3	N-2	62.7895	-148.0561	208.0	Clayey silt	4.50	20.5	25.0	26.02
Site-3	N-3	62.7897	-148.0551	208.0	Clayey silt	4.50	15.3	19.8	28.30
Site-3	N-4	62.7896	-148.0563	208.0	Clayey silt	3.50	9.0	12.5	28.01
Site-3	N-5	62.7898	-148.0552	208.0	Clayey silt	7.00	5.0	12.0	27.28
Site-3	N-6	62.7898	-148.0552	208.0	Clayey silt	7.00	5.0	12.0	25.91
Site-4S	alt 1	62.7884	-148.0074	206.2	Silt	3.80	6.2	10.0	19.25
Site-4S	alt 2	62.7883	-148.0077	206.2	Silt	12.50	4.2	16.7	22.44
Site-4S	alt 3	62.7883	-148.0071	206.2	Silt	4.20	8.2	12.4	26.26
Site-4S	alt 4	62.7883	-148.0079	206.2	Silt	1.90	0.0	1.9	20.32
Site-4S	alt 5	62.7883	-148.0068	206.2	Silt	8.20	6.2	14.4	25.60
Site-4S	alt 6	62.7883	-148.0068	206.2	Silt	8.20	6.2	14.4	26.42
Site-5S	1	62.7842	-147.9521	208.2	Silty sand	4.00	4.0	8.0	38.09
Site-5S	2	62.7845	-147.9521	208.2	Clayey silt sand	5.00	8.0	13.0	33.27
Site-5S	3	62.7842	-147.9520	208.2	Silty sand	4.50	15.0	19.5	35.95
Site-5S	4	62.7846	-147.9524	208.2	Clayey silty sand	3.80	8.1	11.9	44.67
Site-5S	5	62.7840	-147.9519	208.2	Clayey silt	4.30	2.5	6.8	23.48
Site-6S	1	62.7790	-147.9189	209.8	Silty sand	3.50	1.0	4.5	30.25
Site-6S	2	62.7789	-147.9195	209.8	Silty sand	2.50	0.0	2.5	54.53
Site-6S	3	62.7790	-147.9185	209.8	Silt	5.50	2.0	7.5	28.91
Site-6S	4	62.7788	-147.9198	209.8	Silty sand	2.00	0.0	2.0	29.87
Site-6S	5	62.7792	-147.9183	209.8	Clayey silt	6.00	10.0	16.0	23.90
Site-7	N-1	62.7784	-147.8787	211.5	Silt	4.30	0.0	4.3	18.44
Site-7	N-2	62.7784	-147.8787	211.5	Silt	3.50	0.0	3.5	19.47
Site-7	N-3	62.7786	-147.8787	211.5	Silt	6.00	0.0	6.0	20.71
Site-7	N-4	62.7782	-147.8789	211.5	Silt	4.50	5.0	9.5	23.41

Location	Sample number	Lat.	Long.	River Mile	Soil Fraction Description	Moss (cm)	Peat (cm)	Total	percent Total Solids
Site-7	N-5	62.7787	-147.8789	211.5	Silt	3.80	0.0	3.8	23.61
Site-7	N-6	62.7787	-147.8789	211.5	Silt	3.80	0.0	3.8	19.50
Site-8	S-1	62.7728	-147.8483	212.5	Silt	3.50	0.0	3.5	37.62
Site-8	S-2	62.7729	-147.8481	212.5	Silt	4.00	0.0	4.0	26.54
Site-8	S-3	62.7725	-147.8484	212.5	Silt	4.00	0.0	4.0	42.70
Site-8	S-4	62.7731	-147.8480	212.5	Clayey Silt	3.80	0.0	3.8	28.67
Site-8	S-5	62.7724	-147.8486	212.5	Clayey silt	3.50	0.0	3.5	35.36
Site-9	N-1	62.85085	-148.2314	NA	Clayey silt	3.50	7.5	11.0	27.66
Site-9	N-2	62.85083	-148.2316	NA	Silt	3.00	6.5	9.5	32.48
Site-9	N-3	62.85089	-148.2311	NA	Silt	3.50	11.5	15.0	17.51
Site-9	N-4	62.85104	-148.2317	NA	Clayey silt	4.00	9.5	13.5	25.17
Site-9	N-5	62.85074	-148.2310	NA	Clayey silt	6.00	7.5	13.5	30.99
Site-9	N-6	62.85074	-148.2310	NA	Clayey Silt	6.00	7.5	13.5	26.73
Site-10	N-1	62.8577	-148.2133	NA	Clayey Silt	7.00	6.5	13.5	27.14
Site-10	N-2	62.8574	-148.2131	NA	Clayey Silt	5.50	7.5	13.0	27.85
Site-10	N-3	62.8572	-148.2134	NA	Clayey Silt	4.50	6.8	11.3	29.75
Site-10	N-4	62.8576	-148.2129	NA	Clayey Silt	4.50	6.5	11.0	25.24
Site-10	N-5	62.8571	-148.2136	NA	Clayey Silt	2.5	1.5	4.0	23.98

Table 6.1-1 Mercury in Soil and Vegetation (Friedli et al. 2007)

Media	Hg (ng/g, dw) 39 year old stand	Hg (ng/g, dw) 133 year old stand	Hg (ng/g dw) 180 year old stand
Moss	94.5	108	90.6
Aspen leaves	NS	8	NS
Spruce needles	9.9	NS	NS
Aspen bark	NS	15.9	NS
Jack pine bark	38.6	NS	NS
Lichen	30.6	74	227.1
Leaf litter	68.3	NS	127.1
Aspen wood	NS	2.08	NS
White spruce wood	1.86	NS	NS
Organic soil	100-160	120 - 300	160-250
Mineral soil	9.2	8.8	25.2

10. FIGURES

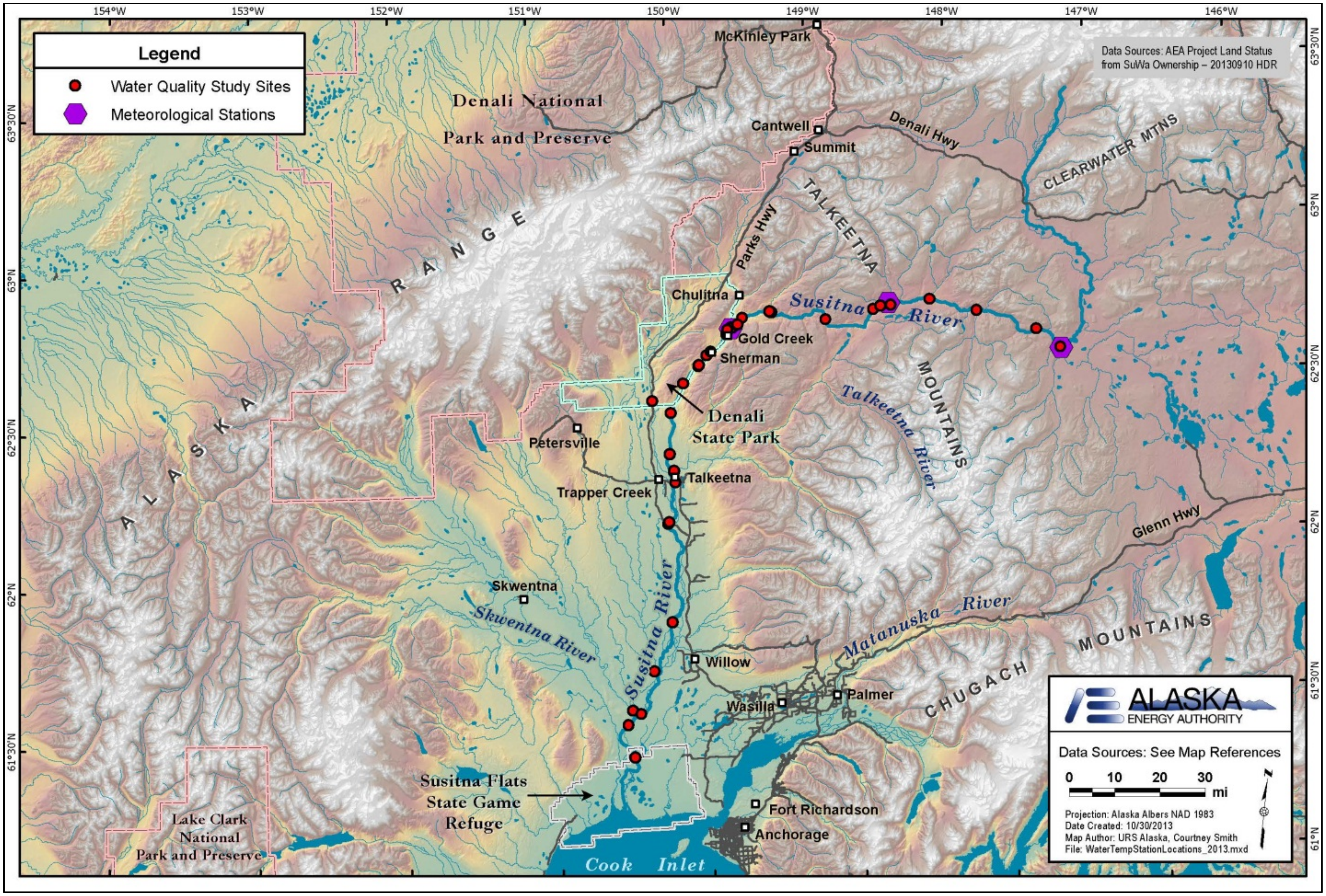


Figure 3-1. Water Quality Sample Locations

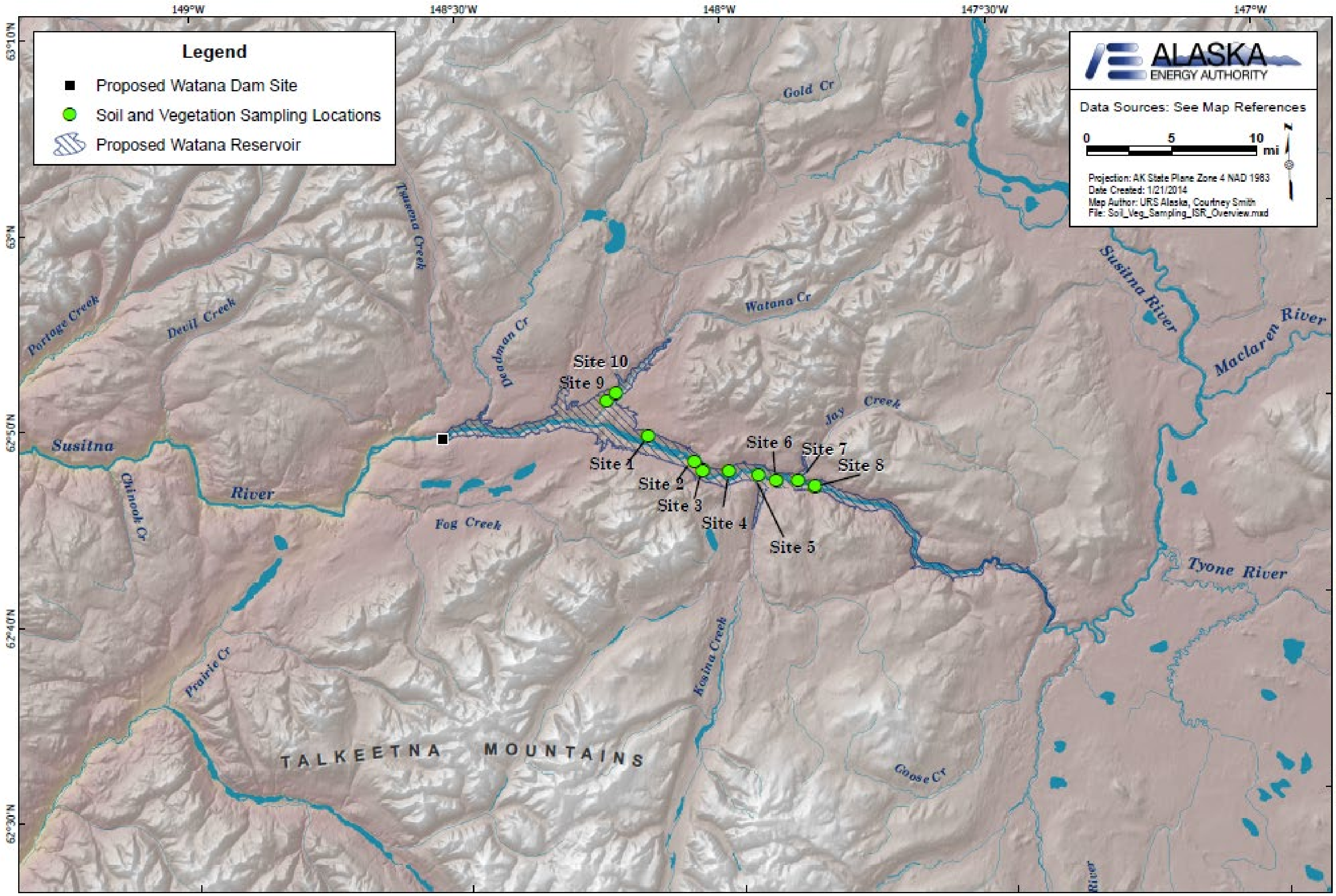


Figure 4.2-1. Vegetation and Soil Sampling Locations

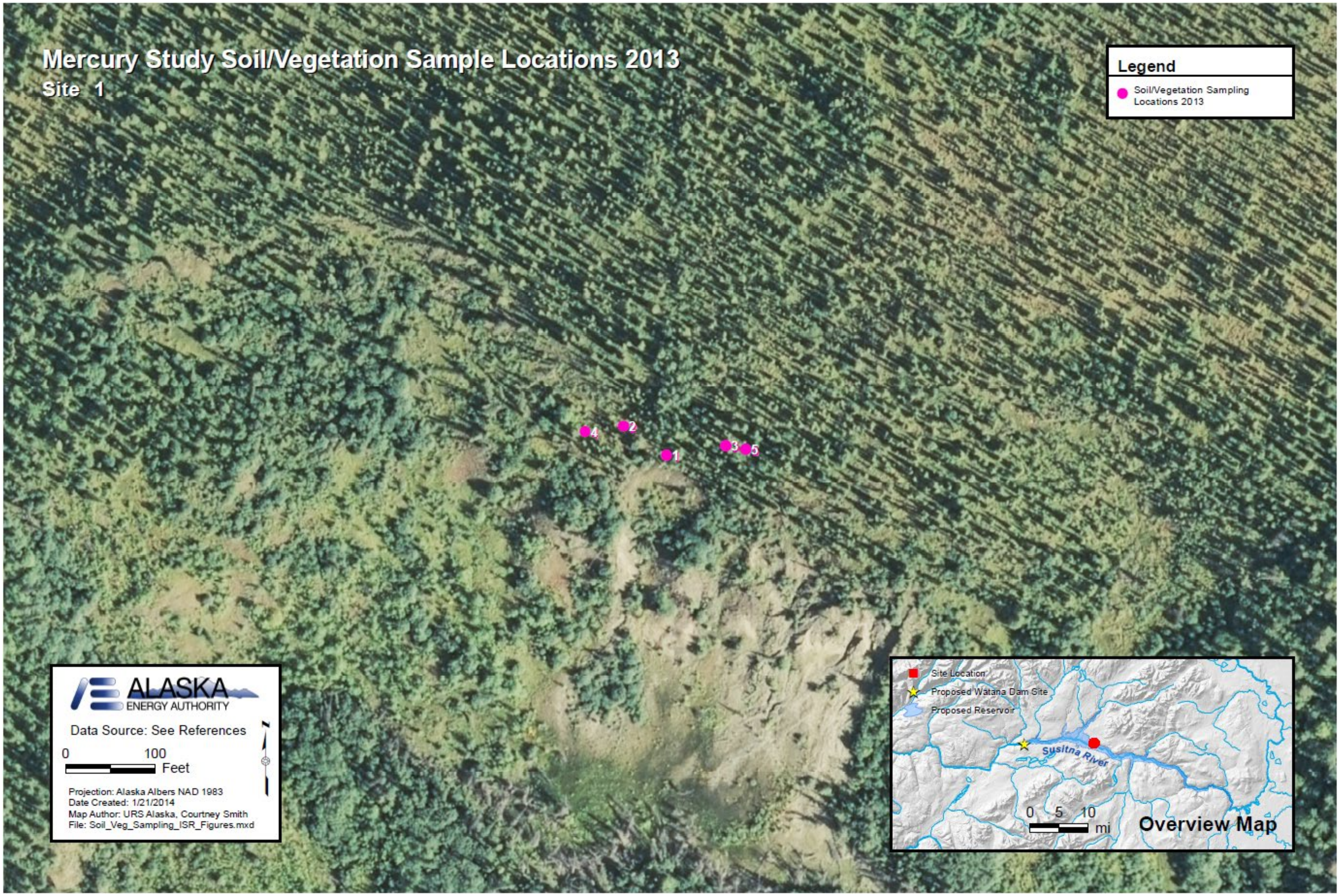


Figure 4.2-2. Vegetation and Soil Sample Location: Site 1

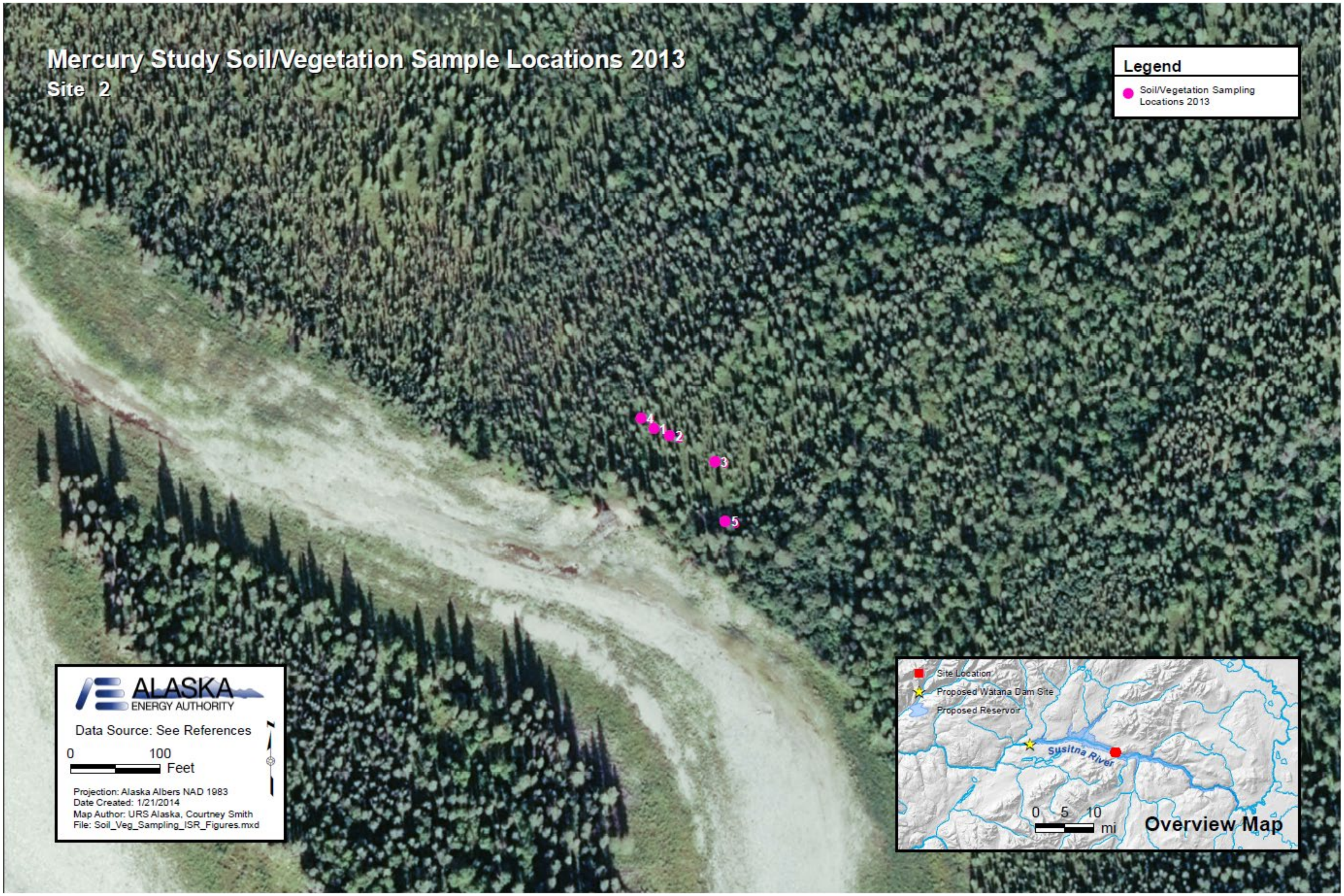


Figure 4.2-3. Vegetation and Soil Sample Location: Site 2

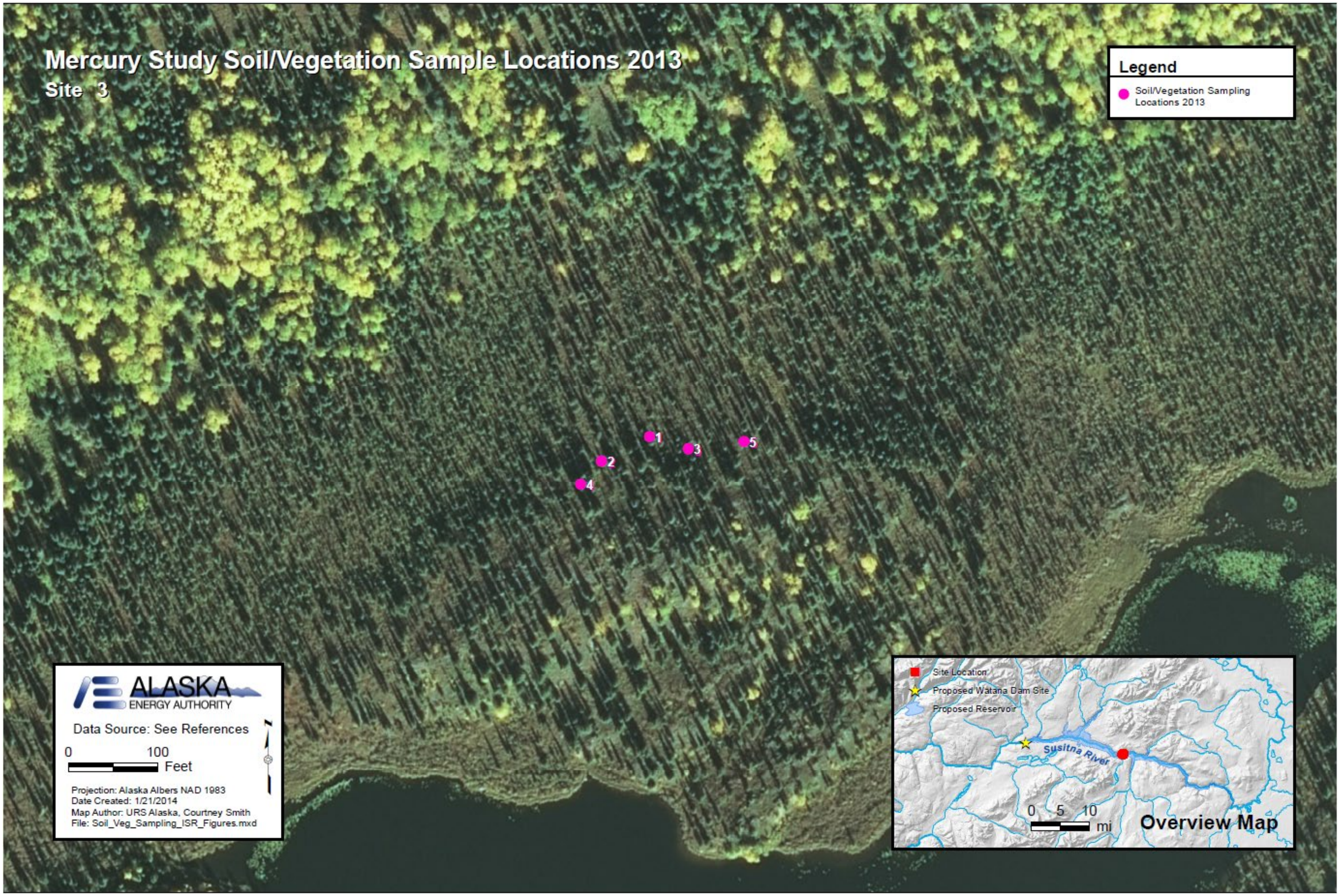


Figure 4.2-4. Vegetation and Soil Sample Location: Site 3

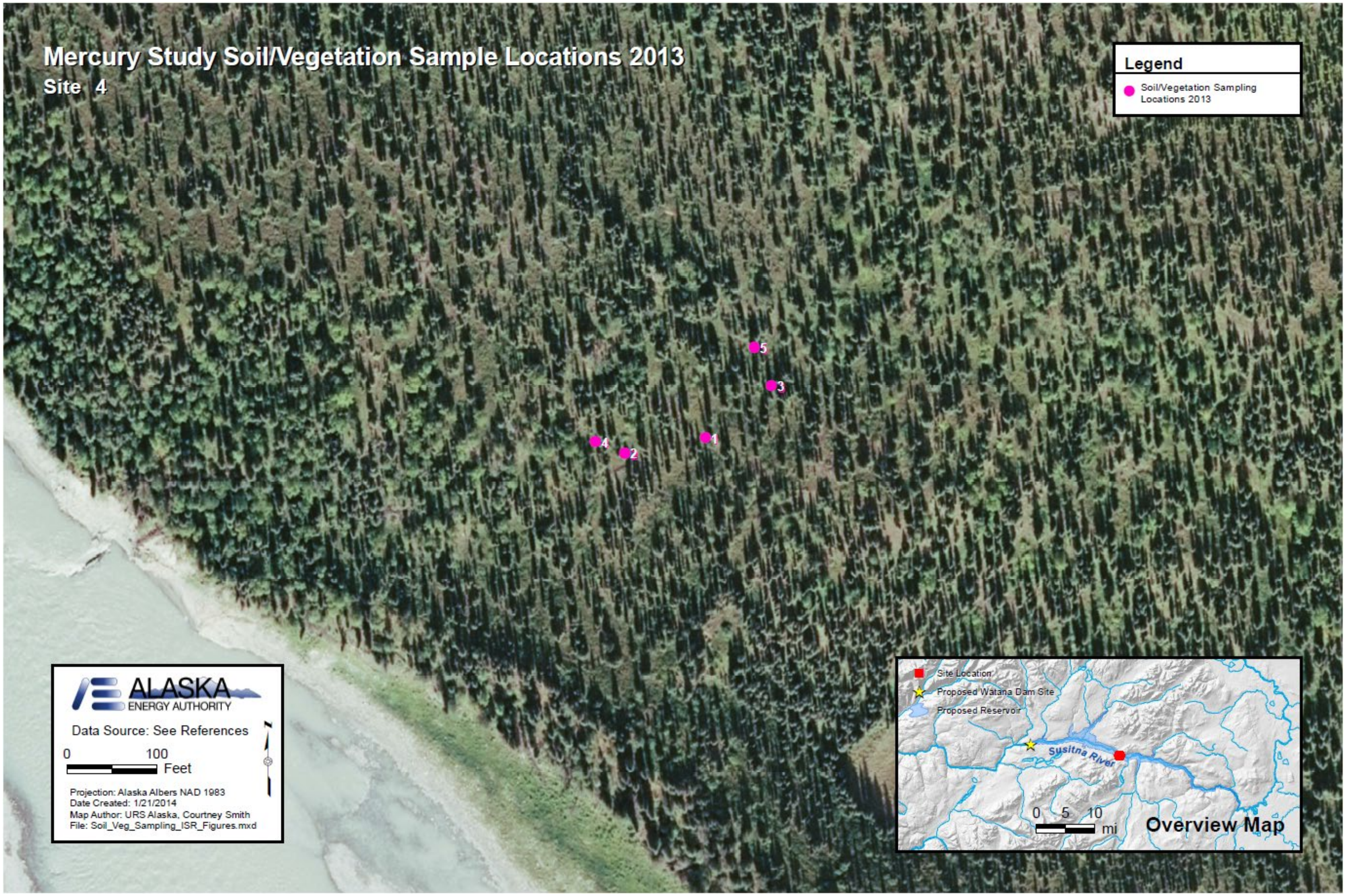


Figure 4.2-5. Vegetation and Soil Sample Location: Site 4

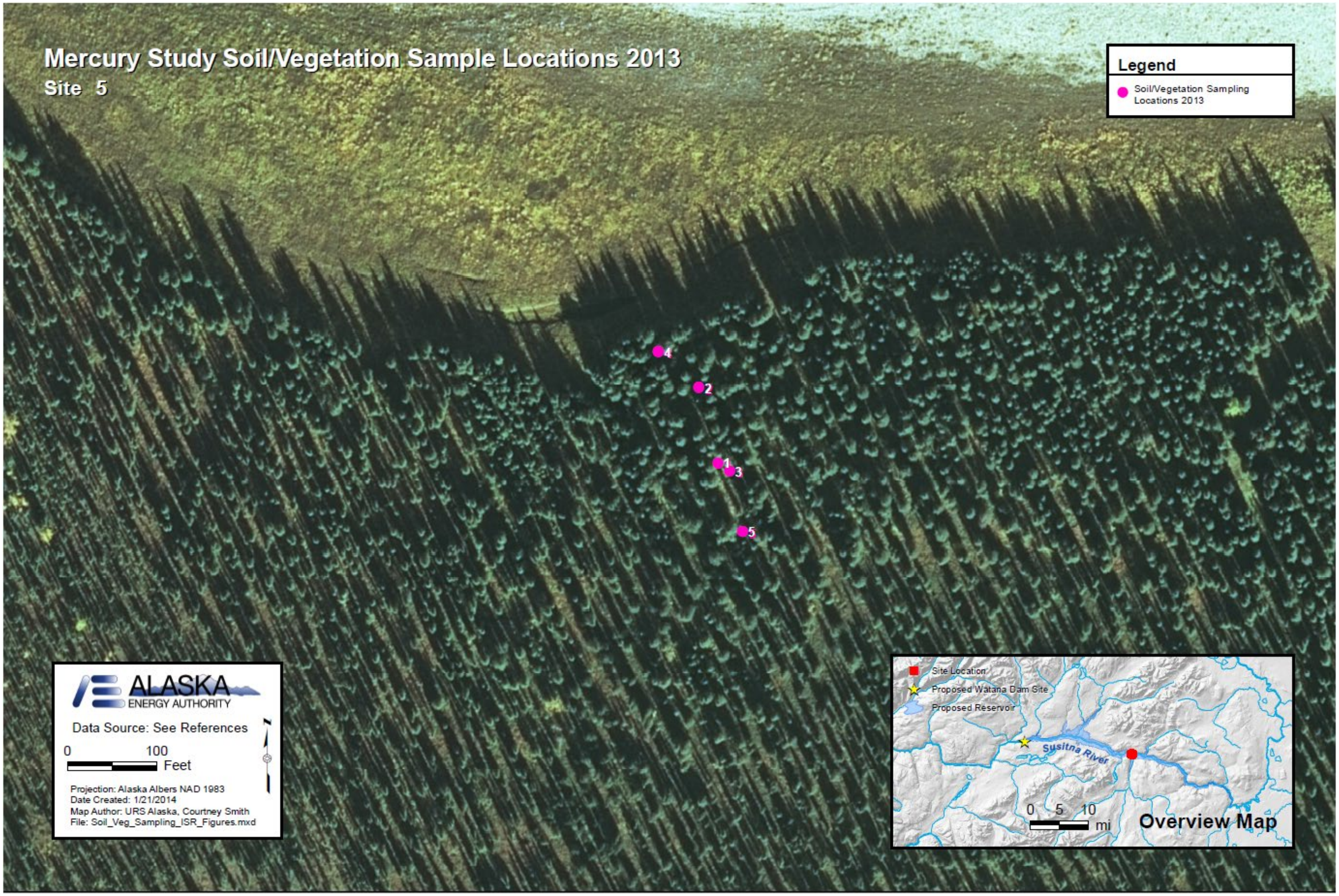


Figure 4.2-6. Vegetation and Soil Sample Location: Site 5

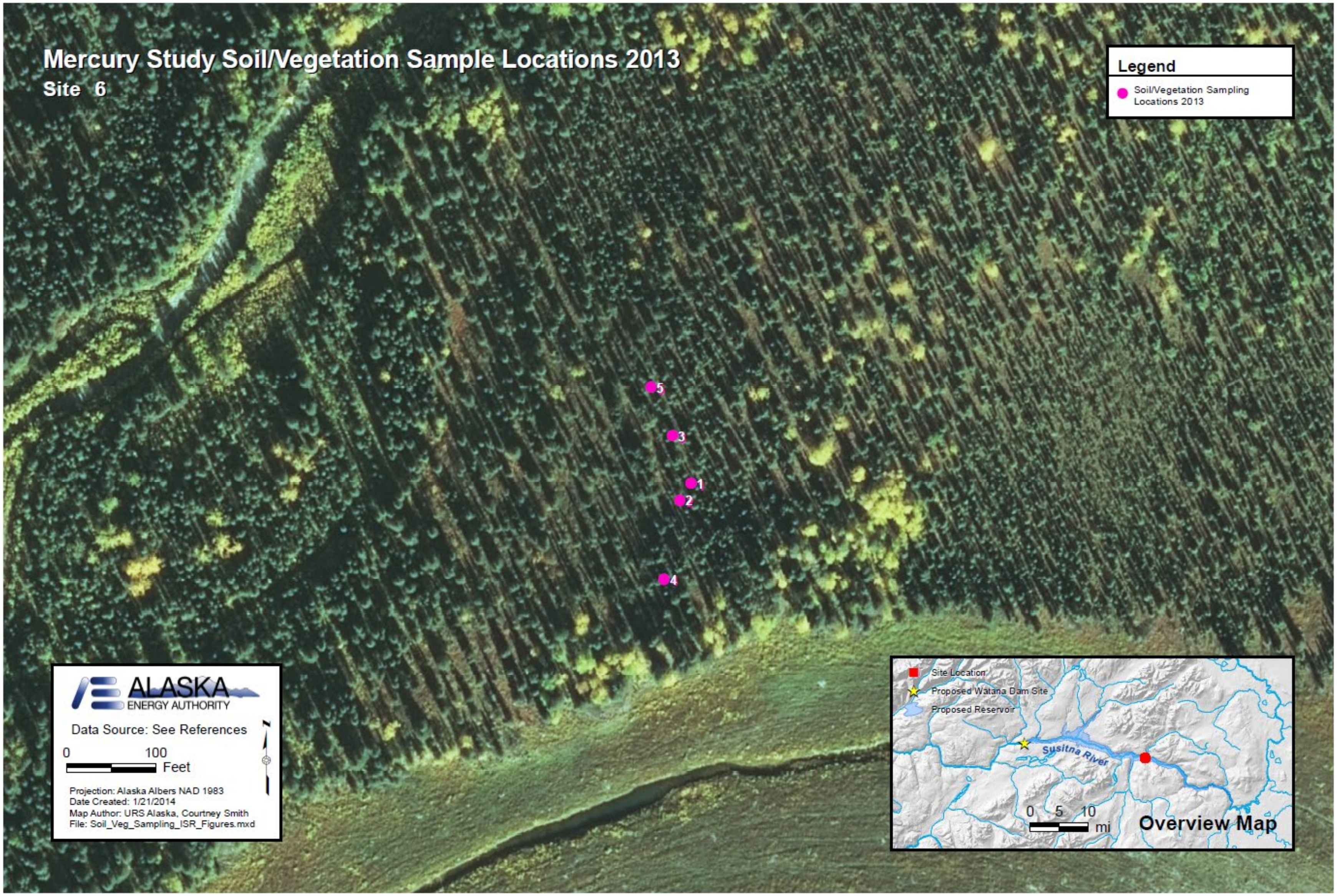


Figure 4.2-7. Vegetation and Soil Sample Location: Site 6

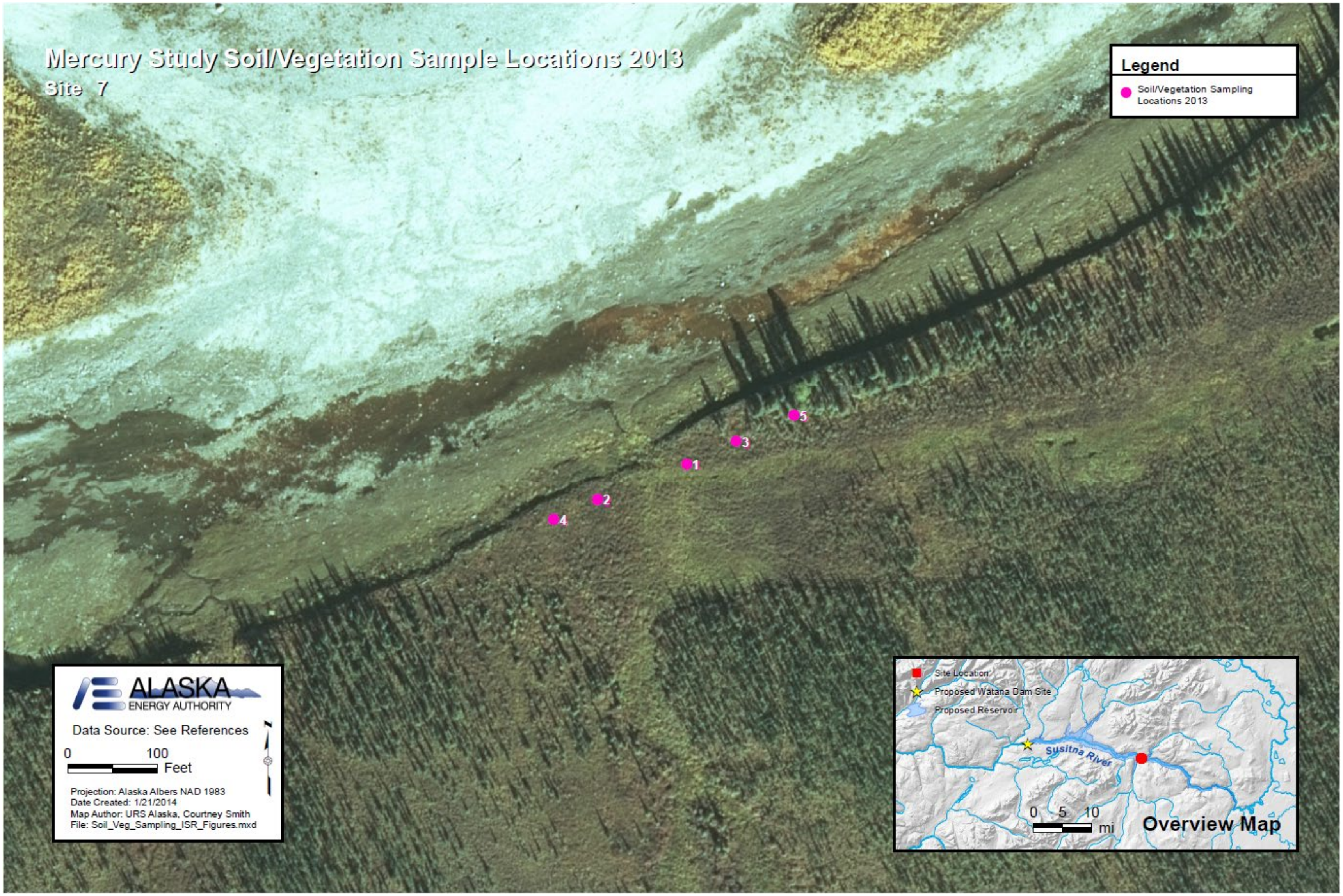


Figure 4.2-8. Vegetation and Soil Sample Location: Site 7

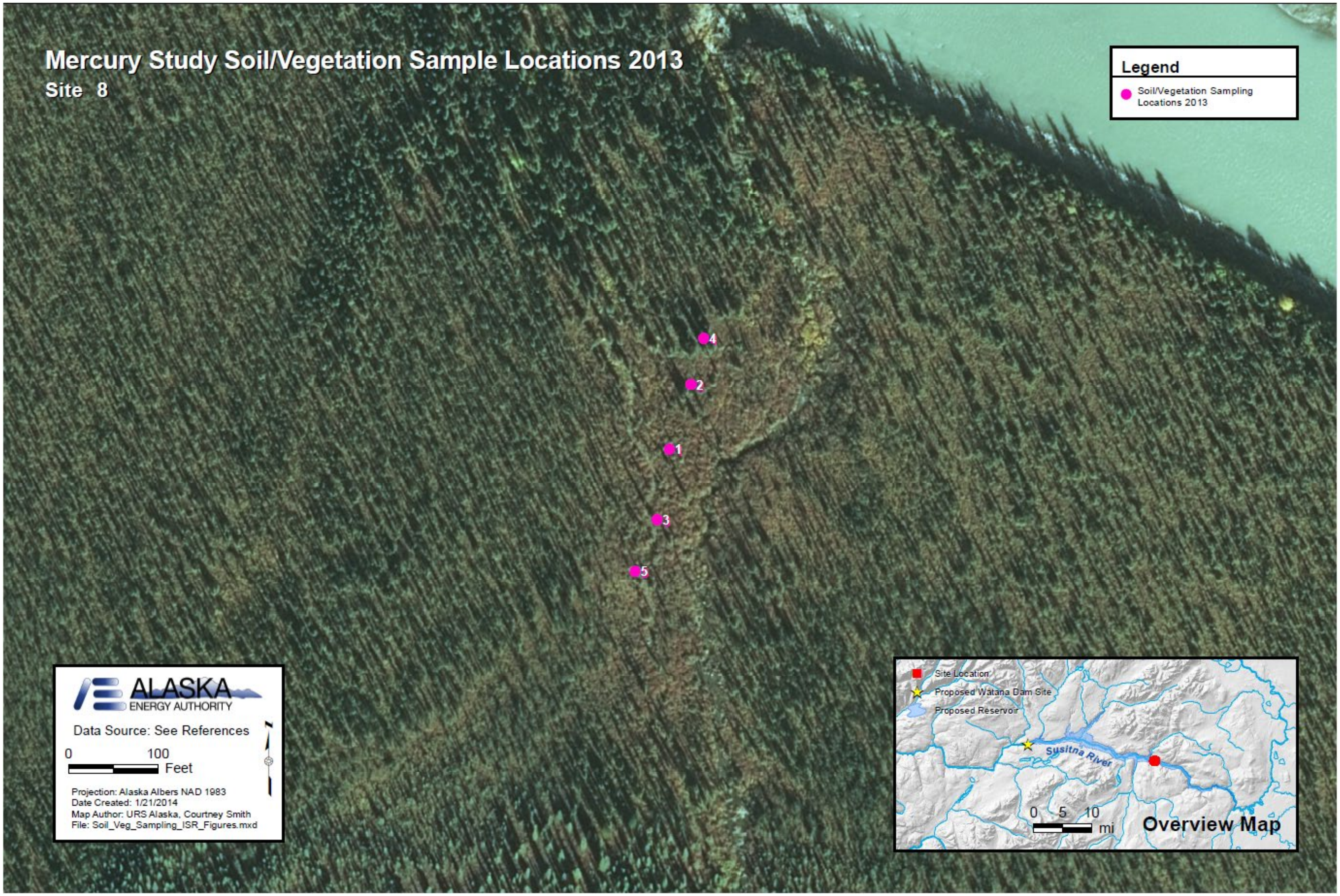


Figure 4.2-9. Vegetation and Soil Sample Location: Site 8

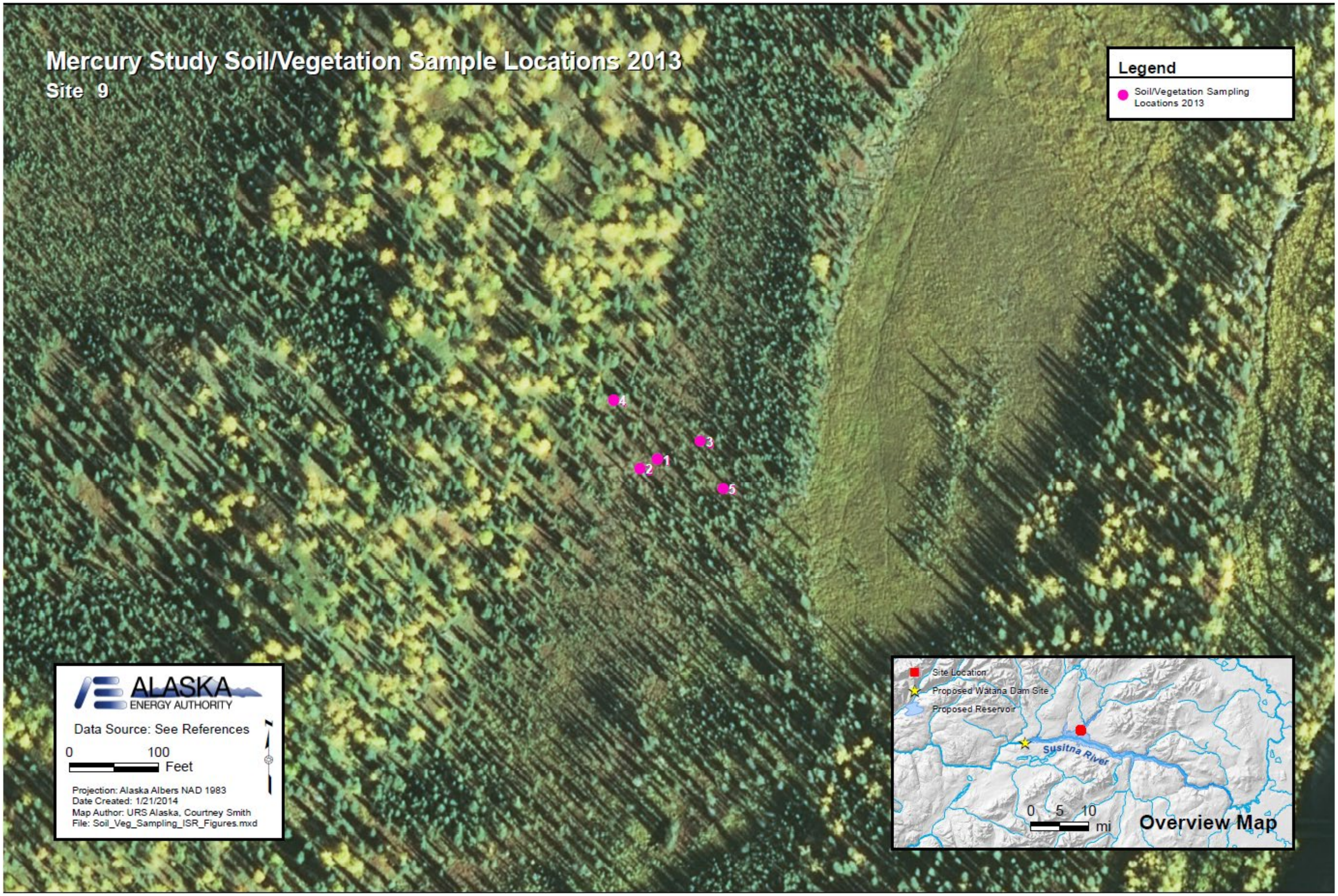


Figure 4.2-10. Vegetation and Soil Sample Location: Site 9

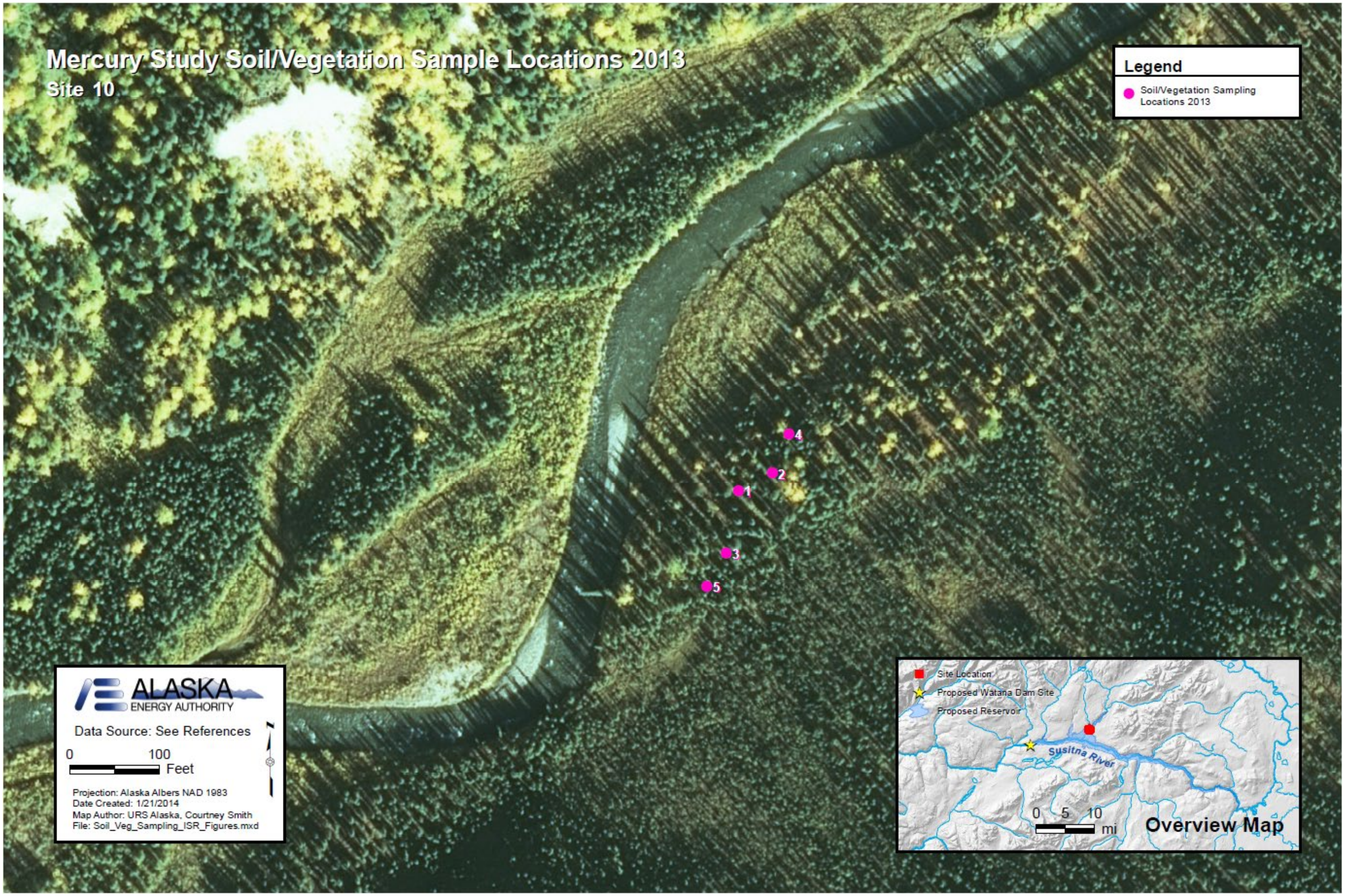


Figure 4.2-11. Vegetation and Soil Sample Location: Site 10

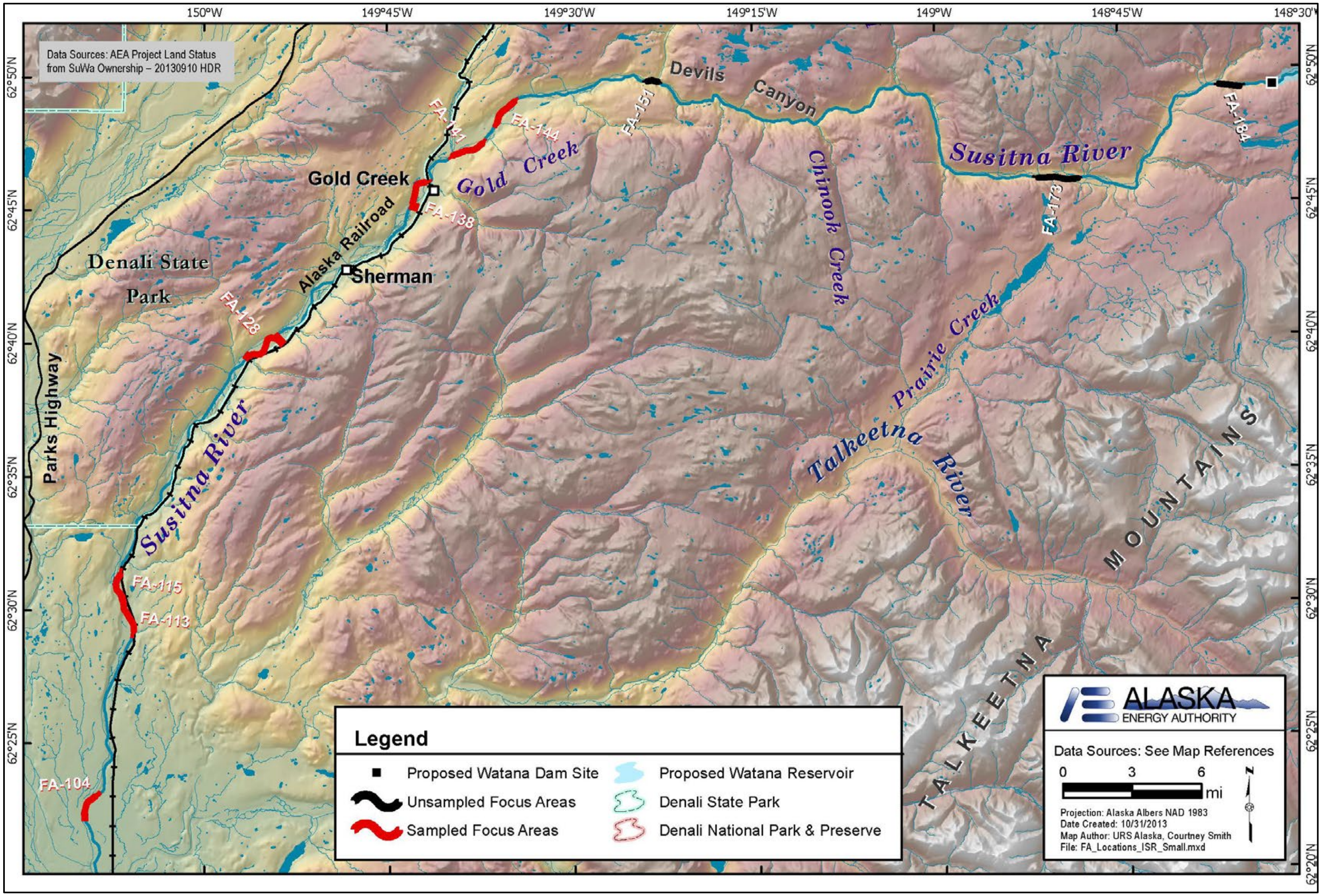


Figure 4.2-12. Overview of Focus Area Sampling Locations

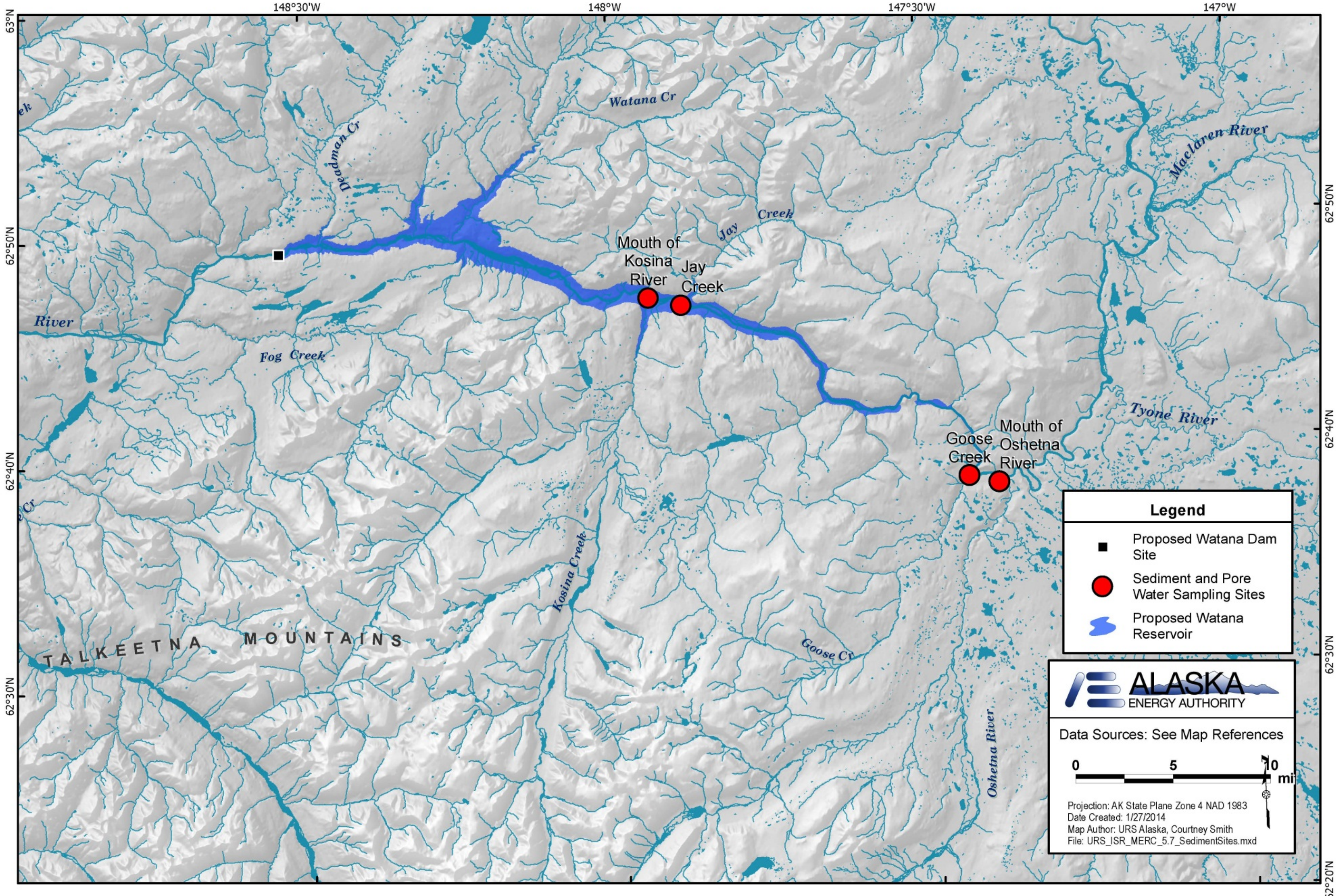
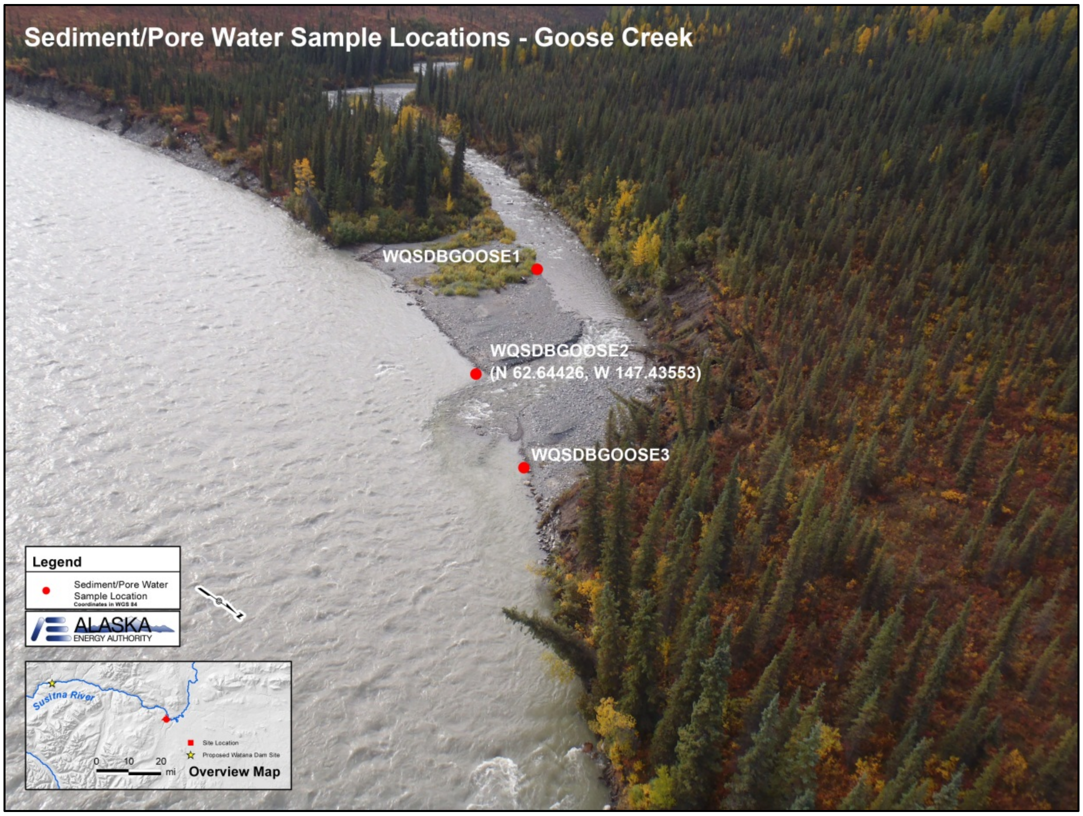


Figure 4.2-13. Map of sediment/porewater sampling locations



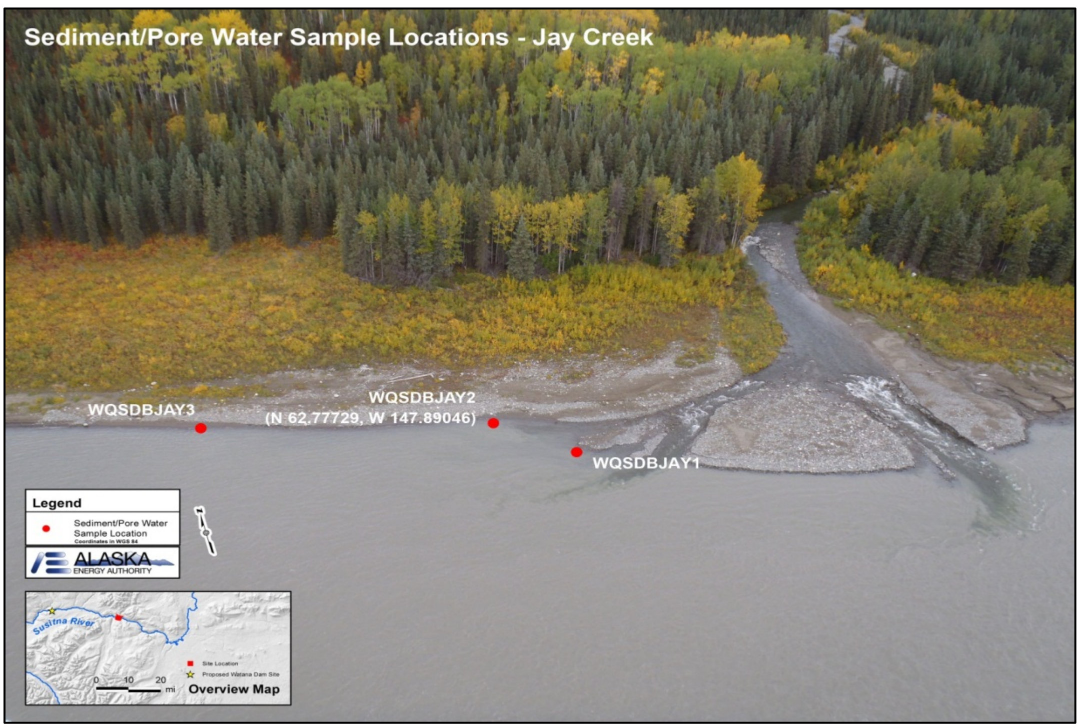
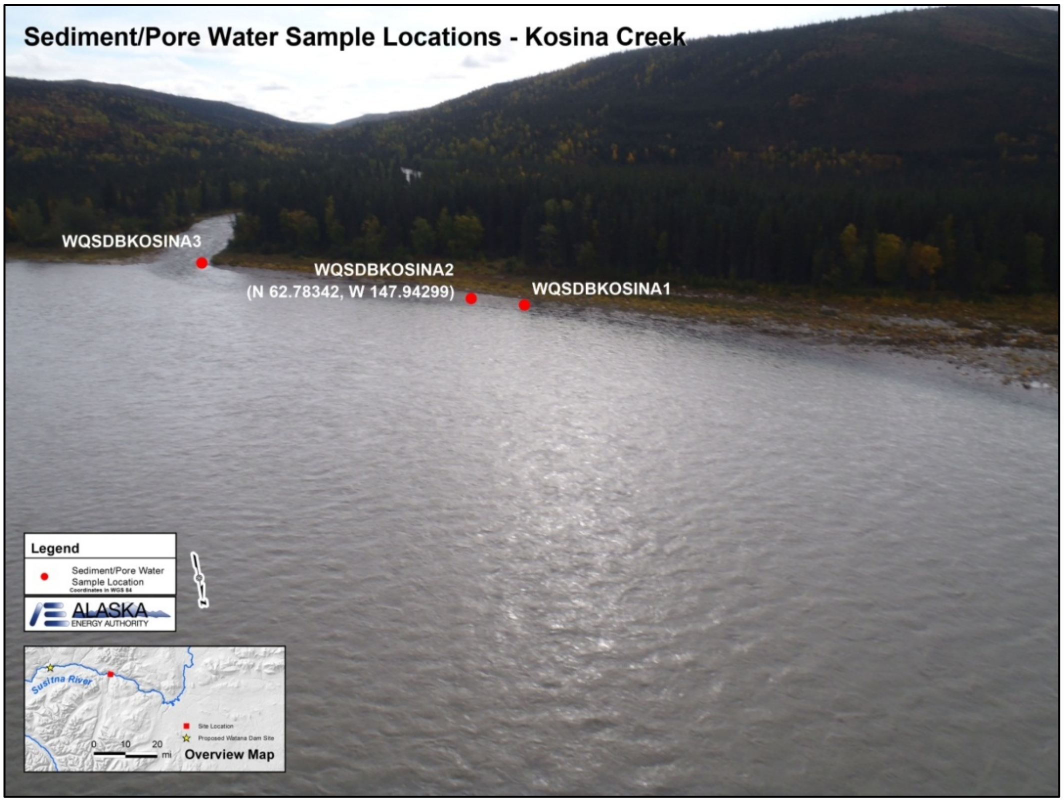


Figure 4.2-14. Sediment and Porewater Sample Locations for Goose and Jay Creeks



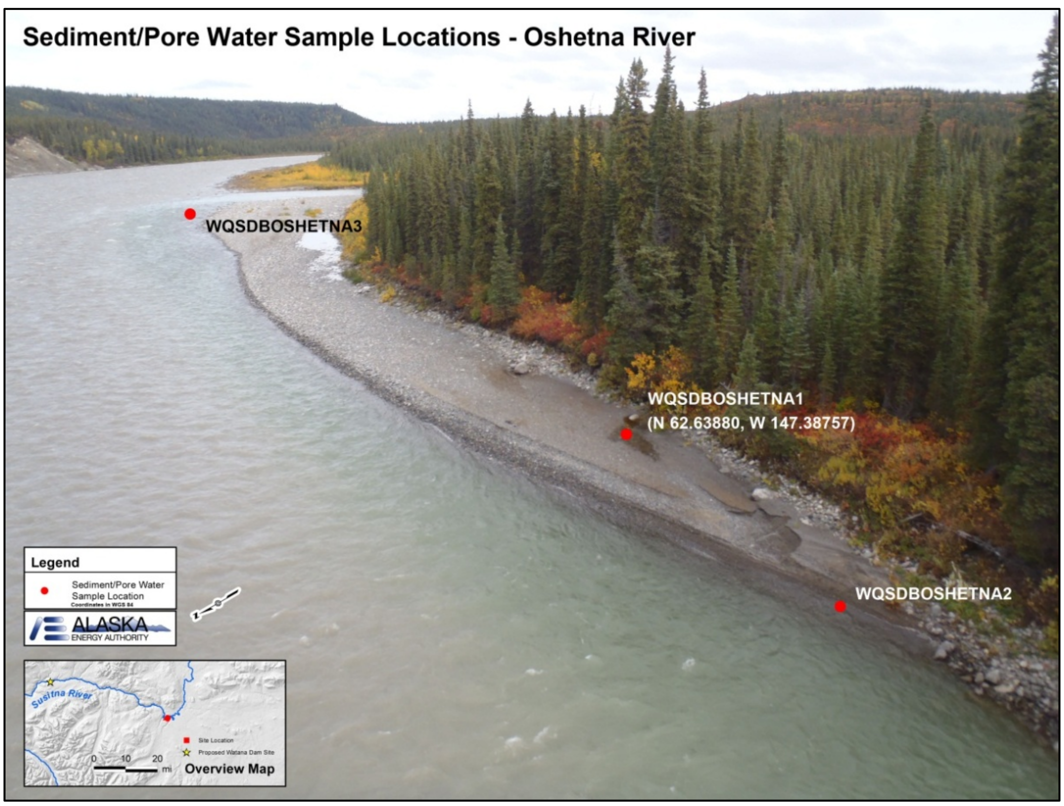


Figure 4.2-15. Sediment and Porewater Sample Locations for Kosina Creek and Oshetna River

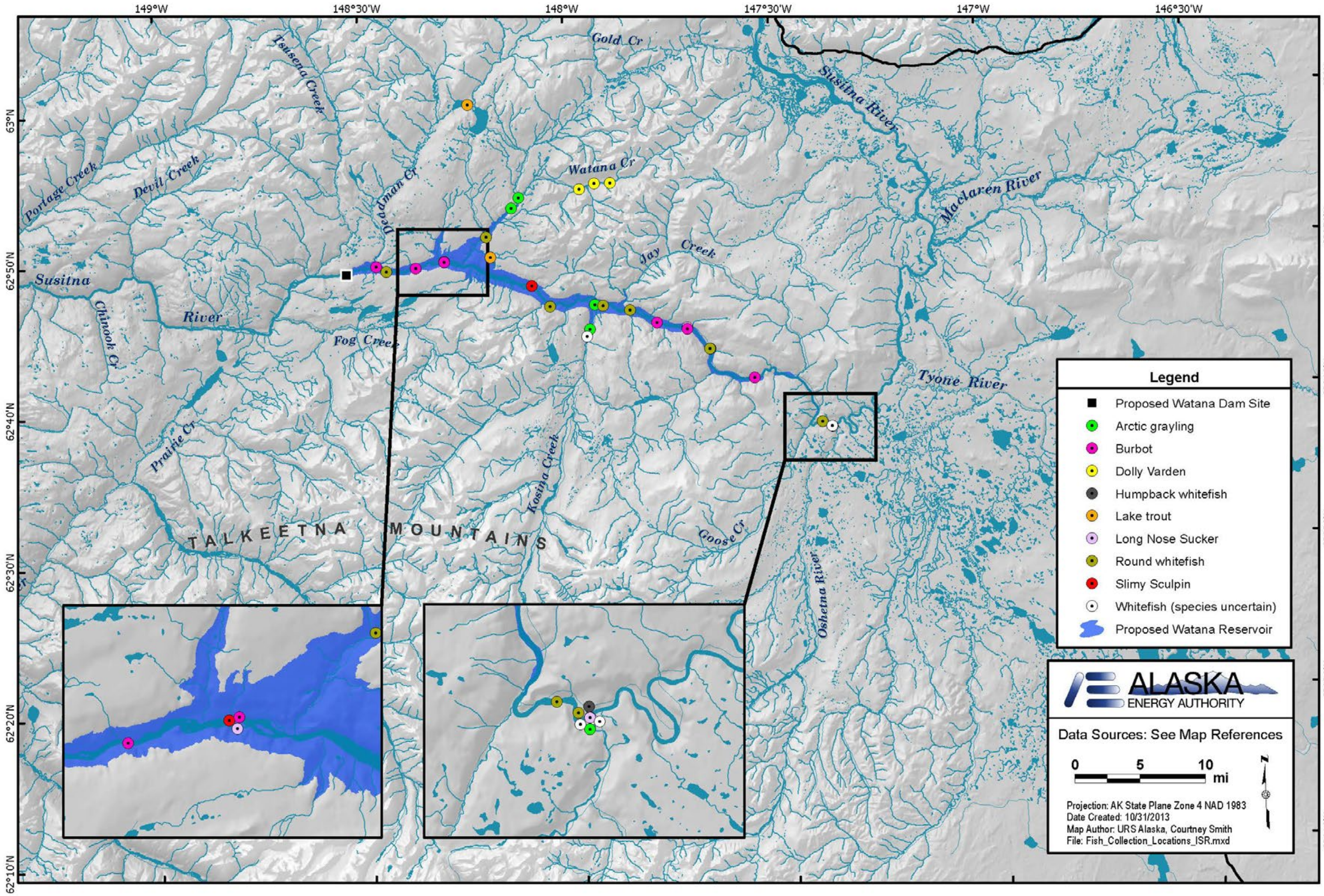


Figure 4.2-16. Fish Tissue Sample Collection Locations

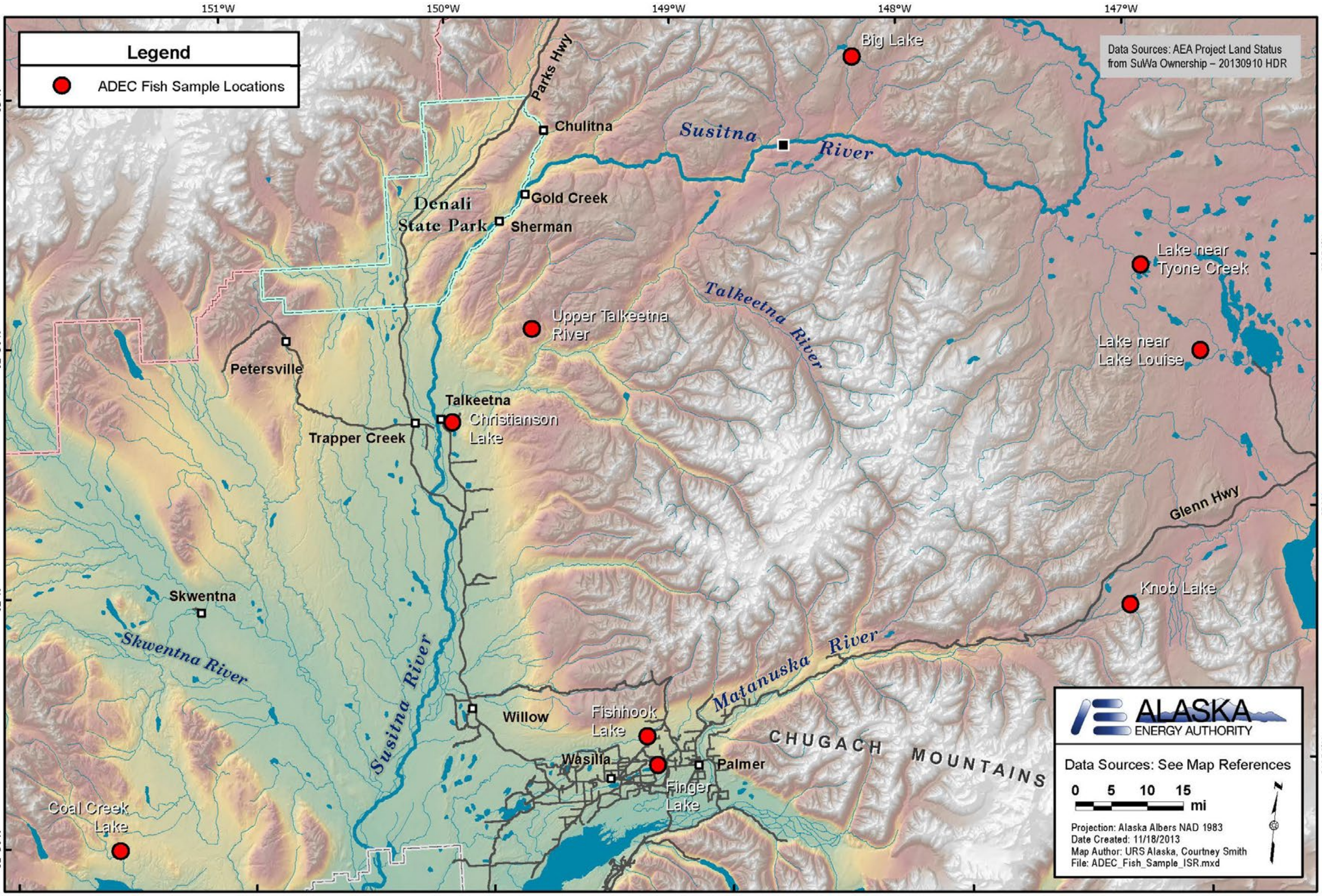


Figure 5.1-1. ADEC Fish Tissue Sample Collection Locations

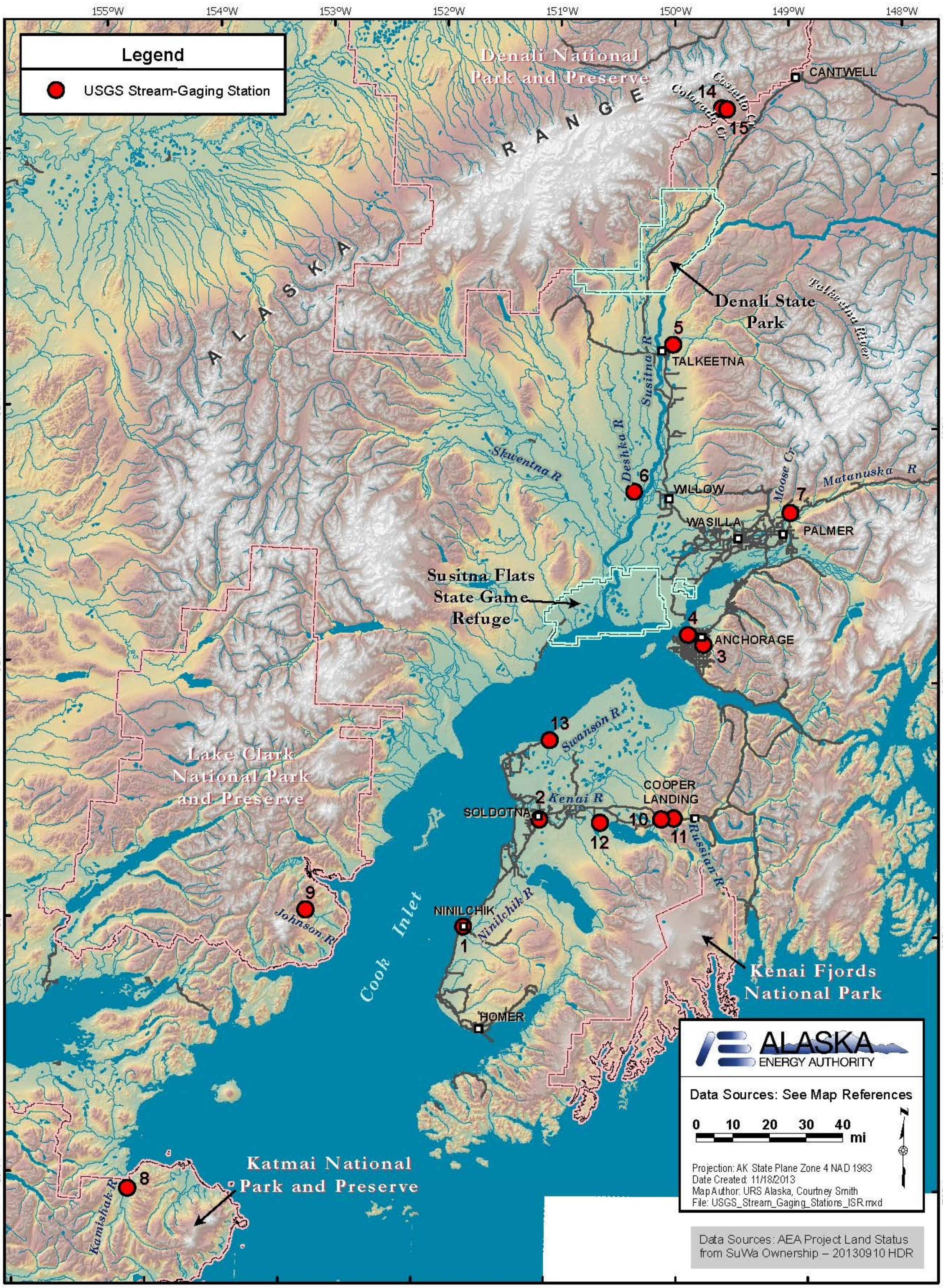


Figure 5.1-2. USGS (Frenzel 2000) Sample Locations

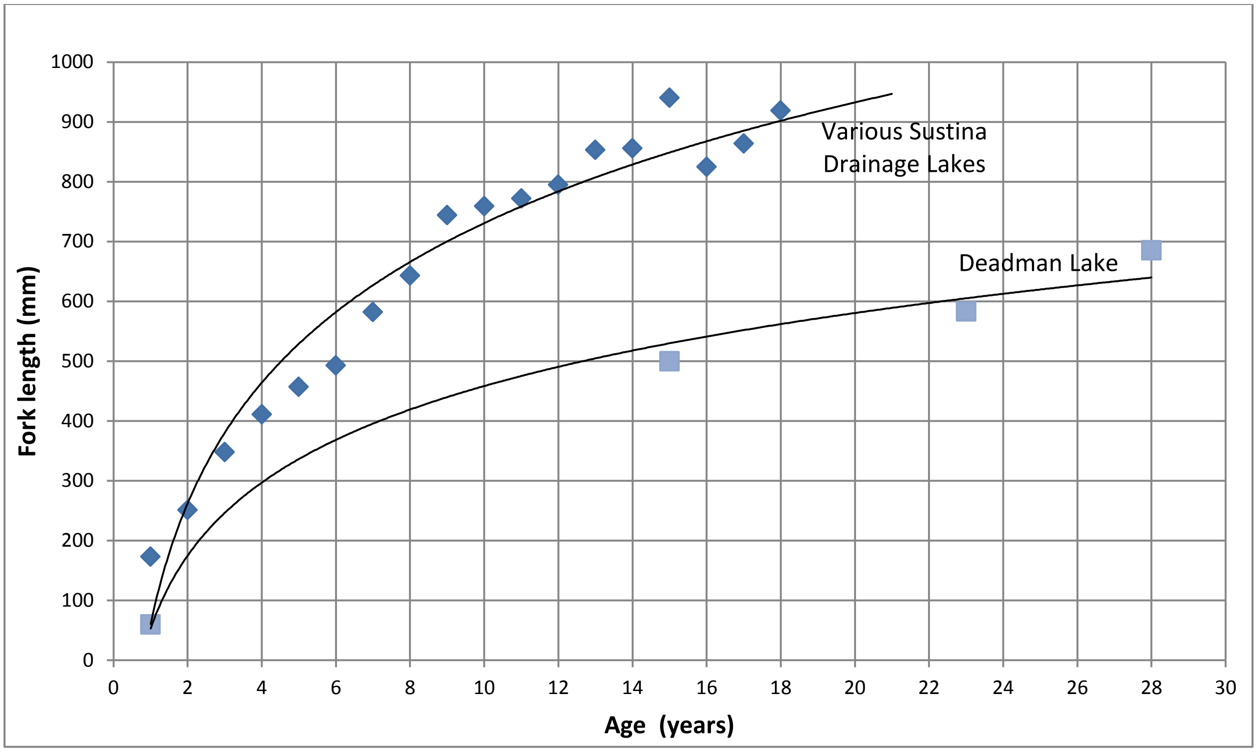


Figure 5.7-1. Lake Trout Fork Length and Age (Burr 1987)

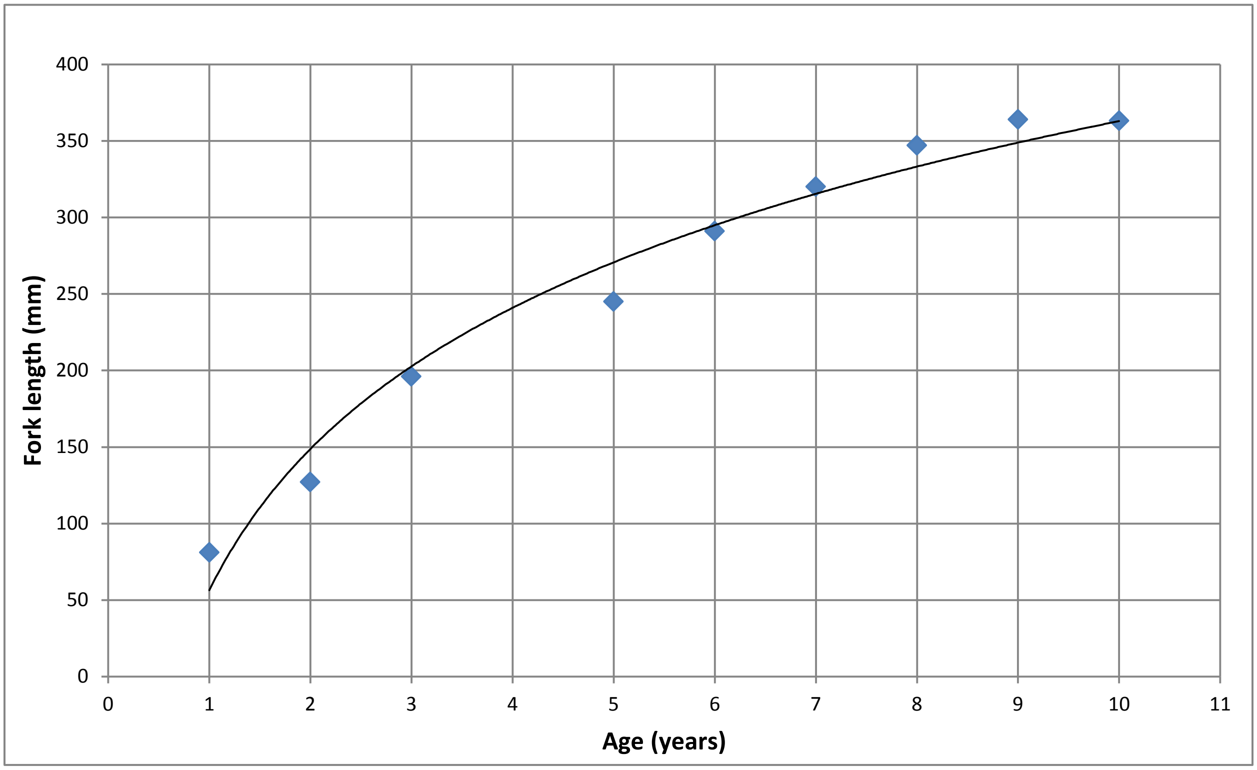


Figure 5.7-2. LNS Fork Length and Age in the Upper Susitna (APA 1984)

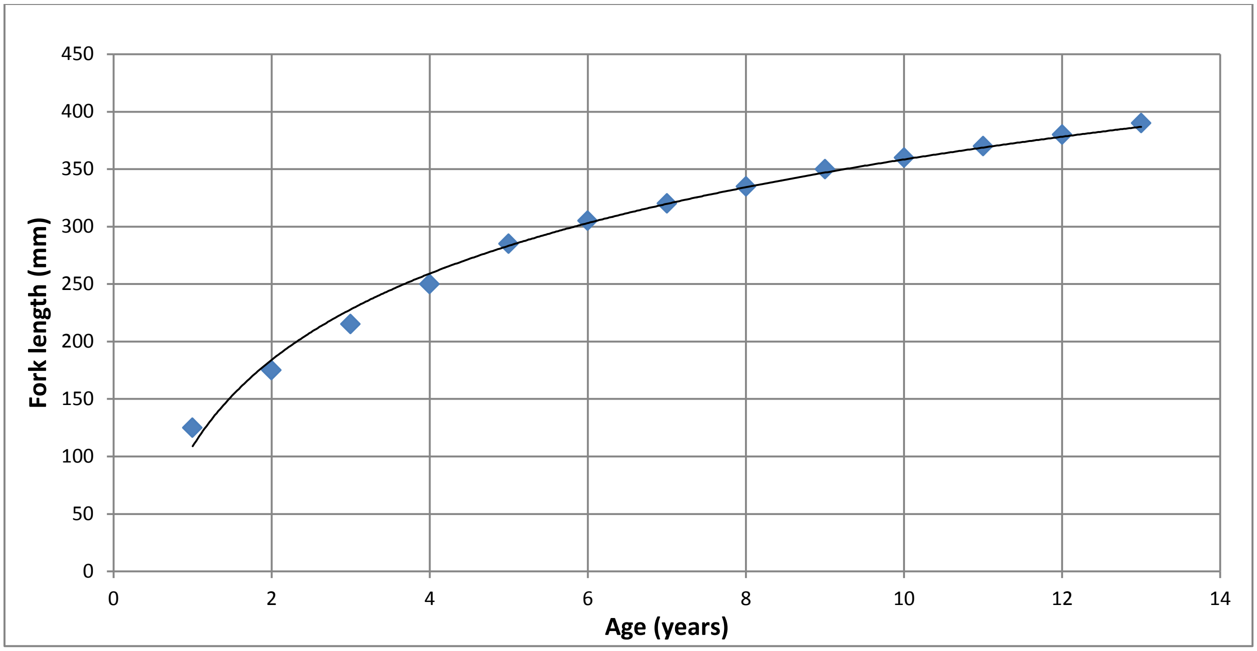


Figure 5.7-3. Arctic Grayling Fork Length and Age in the Upper Susitna (APA 1984)

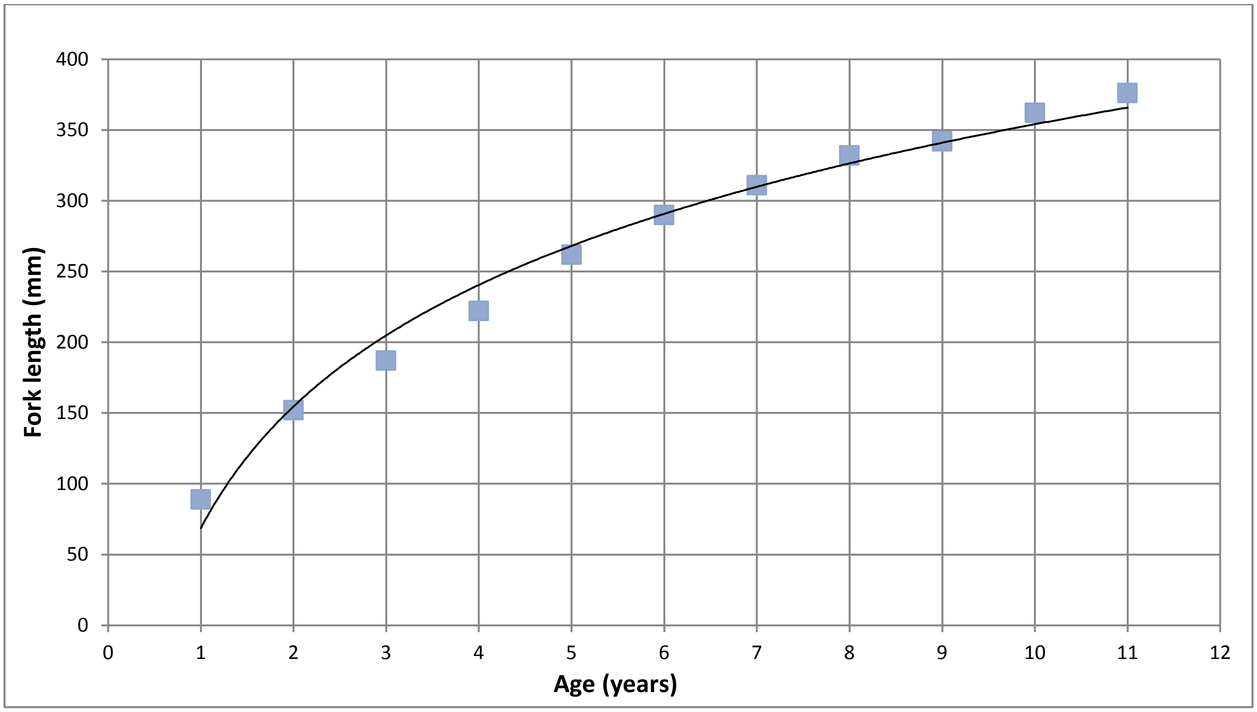


Figure 5.7-4. Round Whitefish Fork Length and Age in Middle Susitna (APA 1984)