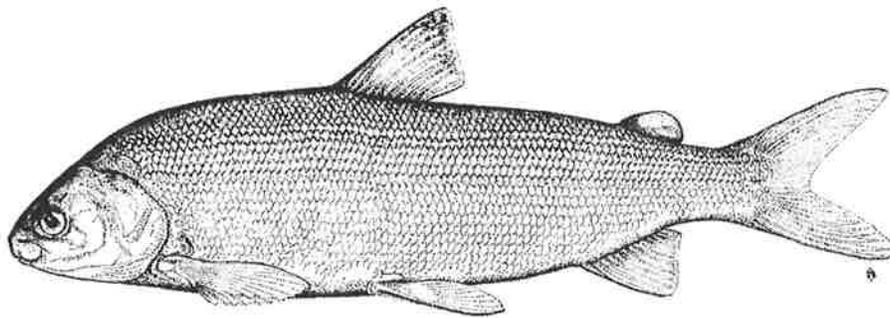


**COMPILATION OF REPORTS ON
FISH MOLD AND CONTAMINANTS IN
NUIQSUT FISH (2000-2016)**

North Slope Borough
Department of Wildlife Management
Barrow, Alaska



DWM Science Staff (alphabetically)
B. Adams, C. George, C. Hanns,
T. O'Hara, T. Sformo, R. Stimmelmayer

November 2016

Tab 1. Mold Concerns Regarding Nuiqsut Aanaaktiq (2013-2014) and Water Sample Analysis

Tab 2. A Summary of Water Quality Analysis from the Colville River and other high latitude Alaskan and Canadian Rivers

Tab 3. Petroleum Hydrocarbons in the Fish and Sediments of NPRA Teshekpuk Lake and the Colville and Ikpikpuk Rivers. April 2007

Tab 4. Petroleum Hydrocarbons in Fish and Sediments of NPRA: Teshekpuk Lake Area and the Colville, Ikpikpuk, Meade, and Kuk Rivers. June 2012

Tab 5. Trophic transfer of persistent organochlorine contaminants (OCs) within an Arctic marine food web from the southern Beaufort-Chukchi Seas

Tab 6. Concentrations of persistent and organochlorine contaminants in bowhead whale tissues and other biota from northern Alaska: implications for human exposure from a subsistence diet

Tab 7. Update on PCB and DDT Concentrations in Broad whitefish and Burbot Livers Harvested in 2001 near Nuiqsut

Executive Summary:
Compilation of Reports on Fish Mold and Contaminants in Nuiqsut Fish (2000-2016)

Fishing is an important cultural activity for the Inupiaq people on the North Slope of Alaska as well as providing a significant contribution to their annual nutritional needs. For instance, in the village of Nuiqsut, Alaska nearly one-third of the subsistence diet of residents on average comes from fish¹ (Braund, 2013). Fishing activities occur every month of the year with the highest catches occurring from June through October.

This report summarizes Nuiqsut-specific North Slope Borough- Department of Wildlife Management (NSB-DWM) work related to the newly emerging fish mold issue (2013 to 2016) and contains reports and published work on contaminants (2000-2012). It should be noted that these two topics are not linked in time. Contaminate work was mostly conducted in the first decade, while the mold issue arose more recently in October 2013; however, we decided to include both topics into a single compilation due to the overlap as well as overwhelming local concern regarding the former Naval Petroleum Reserve Camp, Umiat, a known contaminated site downstream of Nuiqsut.

In response to the recent fish-mold health concerns, the NSB-DWM has set up an investigation team. This report contains a brief summary of fish mold, fish pathology reports, efforts to identify the mold by molecular methods (Tab 1), and a recently commissioned NSB-

¹ Braund, Stephen R. & Associates (SRB&A). 2013. Greater Mooses Tooth 1 Development Supplemental Environmental Impact Statement Subsistence APPENDIX G: Overview of Nuiqsut Subsistence Uses. Prepared for SLR International Corporation, Anchorage, Alaska. *In* Alpine Satellite Development Plan GMT1 Development Project Final Supplemental Environmental Impact Statement Volume 4: Appendices. Prepared by U.S. Department of the Interior Bureau of Land Management Anchorage, Alaska. October 2014.

DWM report (conducted by ABR, Inc.) that gathers historical reports and compares water quality on the Colville River to Alaska Department of Environmental Conservation standards (Tab 2).

Recent reports by Nuiqsut residence regarding the presence of 55 gallon drums of unknown origin along the Colville river drainage prompted us to include earlier contaminate work conducted in the Nuiqsut area (Tabs 3-6). The former military and oil exploration activities at Umiat have resulted in documented environmental contamination of the Umiat area by various organochlorines (OCs) that are also known as persistent organic pollutants (POPs). These chemicals are well known to be persistent and to accumulate as they “travel up” the food chain.

The chemical analyses were performed in various laboratories: Mote Marine Laboratory (Tabs 3-4) and the Environment Canada laboratory (Tabs 5, two published studies), and finally a memorandum from the NSB-DWM (Dr. Todd O’Hara) to the Mayor of the NSB (George Ahmaogak, Sr., in 2002) that summarizes the two published works in Tab 5.

Therefore, this compilation arises out of **local concern of a historically contaminated site at Umiat**, and a **more recent pervasive mold condition** affecting important subsistence fish. Thanks to the on-going efforts of local citizens, elected officials, Corporations and Native organizations in Nuiqsut, the NSB-DWM continues to obtain and analyze environmental data and specimens (mold, fish, and water samples) to address the Colville fish-mold issue.

We hope you find this report is useful and helpful,

Todd Sformo and Craig George
Utqiagvik, Alaska

**MOLD CONCERNS REGARDING NUIQSUT AANAAKLIQ
(BROAD WHITEFISH): 2013-2014 AND WATER SAMPLE
ANALYSIS 2015**

Prepared by
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October 26, 2016



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Brief History

The North Slope Borough-Department of Wildlife Management (NSB-DWM) has been investigating the fish-mold issue in Nuiqsut. Sformo has researched this mold and has found only one other reference to it on the North Slope. A local fisherman submitted a "Barrow white fish" to the NSB Environmental Protection Office in 1980 to the Alaska Department of Fish and Game (See documents 81-0094 Barrow white fish and Fish/Shellfish Disease record from ADF&G). The fish is reported to have been found at the bottom of the Inaru River. These documents to our knowledge are the only evidence of an earlier mold incident on the North Slope.

In contrast, the latest mold events were detected by fishermen from Nuiqsut. They sent broad whitefish over the weekend of 12 October 2013 to Barrow. They were examined by Todd Sformo on 14 October, and Sformo began sampling tissues to be sent to the State of Alaska Fish Pathology Lab. Before sending samples to State of Alaska lab, Sformo also took measurements and photos to send to the lab. Sformo notes that "I have been talking to the state fish pathologist, too, who said that it could be a fungus. He would like to have a few samples as soon as possible."

On 15 October, the State of Alaska Fish Pathologist in Anchorage Jayde Ferguson looked at the photos and noted: "This looks like an external infection, possibly involving a fungus. Please send fresh and formalin-fixed pieces of the lesion to our lab and we will work this up." Samples were sent and the fish pathology report can be read below, entitled Official fish pathology report
ACCESSION NO: 2014-0053. Sformo also sent samples to the USGS Western Fisheries Research Center (Seattle, WA) since the Alaska Fish Pathology Lab's work does not examine the mold at a molecular level. The USGS lab, however, does identification through DNA. The USGS report is also included, entitled USGS Identification of Saprolegnia-like fungus or mold.

On two occasion (17-18 and 25-27 October 2013), Billy Adams and Sformo traveled to Nuiqsut to collect samples (both fish and water) and to discuss the mold with local fishers. On 21 October, the NSB-DWM released the following announcement: "As of today [October 21 2013], the State of Alaska Fish Pathology Lab (Anchorage) has initially identified the broad whitefish illness as a Saprolegnia-like water mold. This mold has been found commonly in other areas of Alaska and can infect fish under a variety of conditions. The DWM has advised fishermen to follow customary practices regarding consumption of traditional foods and avoid affected fish. While we have an initial identification, we do not know the reason(s) for its occurrence. We are continuing to investigate and monitor the fishery. If fishermen catch fish that have been affected, we encourage them to contact the NSB Department of Wildlife Management to provide the following information: number of fish affected, number of normal-looking fish, location, date, and photos."

81-0094 Barrow white fish and Fish/Shellfish (this document continues for three pages)

Alaska Department of Fish & Game
Division of F.S.E.D.

FISH/SHELLFISH DISEASE RECORD

81-0094

Disease Data

Locality Inaru River

Fiscal Year 81 Disease Exam No. 1 Page No. 1 Using Division FRED

Date Sampled 10/20/80 Disease Suprolegnia

Clinical course chronic

Affected Areas of Host external - general

white fish, Inaru River

BROOD YEAR, SPECIES, ORIGIN

Stage adult Certification Code _____

Weight (gm. ea.) 600

Length (cm.) 30

Total Wt. of Diseased Stock in Facility (kg) 0

Number Examined one Mortality one

Condition: Alive (G)
 Dead, on ice or frozen (F)
 Dead, less than optimal for exam. (P)

Temp. (°C) max _____ min _____

Dissolved Oxygen (mg/l) max _____ min _____

Treatment(s)

Terramycin (T) Diquat (D) Potassium p (P)
 Sodium chl (C) Formalin (F) Malachite gr (A)
 Destroy & Disinfect (S) Sulmac (S)
 Other _____ (O)

Pathology Log Number 81-0094 History

Diagnosis reported by A. H. Hauck

Individual Requesting Service _____

Services desired: Bacti. _____ Virol. _____

Parasit. _____ Histo. _____ Water Qual. _____

Reason for sample: Determine cause of death

Order's Use Only

[1:1:N] [2] [:::]:]

[8:1:9:0:1] [0:1] [E]

[1:0:2:0:8:0] [1:0:6:1:4:2]

[E] (Lot No.) [:::]:]

[K] [W:0] [N:0] [:::]

[0:0:6:0:0:0:0:0]

[3:0:0]

[0:0:0:0:0:0]

[0:0:0:0:0:0] [0:0:0:0:0:0]

[P]

[:::] [:::]

[:::] [:::]

[0::::]:] (Update) [A]

[8:1:0:0:9:4] [:::]:]

Results and Recommendations:

See page 2.

FISH/SHELLFISH DISEASE RECORD

Disease Data				Parasitology	
Eccubary _____				Sample number <u>one</u>	
Fiscal Year _____	Disease Exam No. _____	Page No. _____	Using Division _____	Clinical signs and lesions:	
Data Sampled _____ Disease _____				Areas examined	
Clinical course _____				<input checked="" type="checkbox"/> skin <i>covered with ice and fungal growth</i>	
Affected Areas of Host _____				<input checked="" type="checkbox"/> fins	
BROOD YEAR, SPECIES, ORIGIN _____				<input type="checkbox"/> gills	
Stage _____ Certification Code _____				<input type="checkbox"/> eyes	
Weight (gm. ea.) _____				<input checked="" type="checkbox"/> GI tract <i>badly decomposed</i>	
Length (cm.) _____				<input type="checkbox"/> gall bladder	
Total Wt. of Diseased Stock in Facility (kg) _____				<input type="checkbox"/> body cavity	
Number Examined _____ Mortality _____				<input type="checkbox"/> other	
Condition: <input type="checkbox"/> Alive (G)				Special techniques <i>none</i>	
<input type="checkbox"/> Dead, on ice or frozen (F)				Diagnostician's signature/date	
<input type="checkbox"/> Dead, less than optimal for exam. (P)				<i>A.C.C. Sance 10/21/80</i>	
Temp. (°C) max _____ min _____					
Dissolved Oxygen (mg/l) max _____ min _____					
Treatment(s)					
<input type="checkbox"/> Terramycin (T) <input type="checkbox"/> Diquat (D) <input type="checkbox"/> Potassium p (P)					
<input type="checkbox"/> Sodium chl (C) <input type="checkbox"/> Formalin (F) <input type="checkbox"/> Malachite gr (A)					
<input type="checkbox"/> Destroy & Disinfect (B) <input type="checkbox"/> Sulnac (S)					
<input type="checkbox"/> Other _____ (O)					
Pathology Log Number <u>81-0094</u> History <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>					
Diagnosis reported by <u>ACC</u>					

Results:

Fish interior organs were badly decomposed. Surface of body had mycotic infection which was poorly defined because of frozen + decomposed nature of the specimen. Cause of death was not determined because of advanced state of decomposition; slime covering fish surface was *Saprolegnia*, a facultative fungal parasite, which will commonly be found on dead fish and decaying organic matter in the aquatic environment.

81-0074 Burrow creek fish -

Inara River

Fish had been dead for

considerable time before found.

It had undergone internal decomposition

& the surface was covered with

Sarcophaga sp. Cause of death

undeterminable - white

Lester Suvlu - director for
 Fish Analyzed ^{Cousins E. P.} at North Slope
 Barrow

Red sample of
 substance fish.

Four miles - covered as
 slime

Inara River

30 miles from Barrow

floating at bottom of ice &
 covered as jelly-like
 substance. Only 1 fish
 frozen now.

Will send ESP - on this trip

With flight # for

West arrive here 2:30-3pm.

34 **FINAL REPORT DATE:** 12/5/13; addendum with virology results will be issued at a later date.

35 **CLINICAL FINDINGS**

36 **NECROPSY:** 5 fish necropsied at Fish Pathology Lab; 6 fish partially necropsied at NSB

37 **MORIBUND:** Mean fork length of 52.2 cm (range: 44.2-56.5 cm; n = 11);

38 Mean weight of 1.7 kg (range: 1.2-2.5; n = 6);

39 7 males and 4 females – appeared in spawning or post-spawning condition

40 11/11 with small to large brown/green cottony fungal plaques on various external locations,
41 mostly on head/snout but also on the ventrolateral surface and fins (Figure 1). The
42 majority of plaques could be manually removed from scales, leaving a reddened
43 (hyperemic) area of tissue, but a few extended deeper and formed ulcerations.

44 4/11 hyperemic and eroded fins

45 3/11 with several net marks on exterior surface

46 1/11 with detached upper mandible and brown/green fungal plaques in mouth

47 11/11 with mature gonads appearing in spawning or post-spawning condition; 1 female with
48 egg reabsorption and 2 with partial skeins. 1 male with spent testes.

49 11/11 with no food in gastrointestinal tract; 1 fish had a struvite crystal in gut

50 5/5 with little or no visceral adipose tissue

51 1/5 with congested airbladder (likely post-mortem change)

52 2/6 with congested peritoneum (likely post-mortem change)

53 5/5 plaque wet mounts contained innumerable fungal hyphae that were branched and
54 aseptate with distinct club shaped sporangium, characteristic of *Saprolegnia* species

55 5/5 plaque wet mounts contained few to many pennate diatoms with various morphology

56 1/5 plaque wet mounts with innumerable motile and non-motile bacilli; Gram-negative

57 0/4 abnormal spleen and airbladder squashes

58 0/3 abnormal kidney squashes

59 0/2 abnormal liver and gut squashes

60 **FAT:** 0/1 positive for *Aeromonas salmonicida*

61 0/1 positive for *Yersinia ruckeri* Type I

62 0/1 positive for *Yersinia ruckeri* Type II

63 **BACTERIOLOGY:** 0/2 kidneys struck on TSA and TYES at 20°C for 4 days had bacterial growth

64 **MYCOLOGY:** Skin lesions explanted on oatmeal agar (OA), potato agar (PA) and cornmeal agar (CMA)

65 at 20°C for up to 30 days. Explants on OA and PA from one fish (#37) sent from NSB.

66 3/6 skin lesion explants had fungal growth on OA and PA; 3/5 with growth on CMA.

67 Luxurious growth of white, cottony aerial mycelia occurred on OA within 4 days and on PA after 7 days.

68 Mycelia contained branching and mostly aseptate hyphae. Germinating gemma-like structures were

69 observed in mycelia at day 14 and an oogonium-like structure was detected at day 21. Less growth

70 occurred on CMA, which spread across the agar in non-aerial formation. This contained branching and

71 rarely septate hyphae.

72 **HISTOPATHOLOGY:** Formalin fixed tissues processed into 6µ sections and stained with hematoxylin

73 and eosin, included (# of fish in parentheses): margin of skin lesion (8), spleen (7),

74 liver (6), heart (6), kidney (4), congested airbladder (1), congested peritoneum (1)

75 and egg mass (1).

76 **MORIBUND:** There were varying degrees of post-mortem autolysis in all samples. The sectioned

77 peritoneum had processing artifacts.

78 All internal organs appeared normal. Congestion was confirmed in the airbladder and additionally found

79 in the spleen of 1 fish. This was interpreted as a post-mortem change. The egg mass contained viable eggs

80 in various developmental stages.

81 No fungal hyphae were found in Fish #36, which was likely due to the plane of section. All other fish had

82 branched, aseptate fungal hyphae in the epidermis and dermis (Figure 2). Occasionally hyphae were

83 observed deeper in skeletal musculature and the perichondrium of fin rays. A gemma-like structure was

84 detected in one specimen (Figure 3). A few pennate diatoms and several bacilli were present in the lesions

85 of 2 fish. The mycotic infection was associated with necrotic cells containing pyknotic nuclei and mixed

86 inflammatory infiltrates.

87 **VIROLOGY:** To be determined; an addendum with virology results will be issued at a later date.

88 **DIAGNOSIS:** Saprolegniasis

89 **COMMENTS/RECOMMENDATIONS:**

90 All of these fish had an external mycotic infection caused by the common water mold, *Saprolegnia*. Wet

91 mounts of lesions contained clubbed shaped sporangium, which is a hallmark feature of this group of

92 organisms. Genetic testing by the USGS lab confirmed this identification. No bacteria were isolated from

93 kidneys struck on general purpose media. Kidney was also FAT-negative for targeted Gram-negative

94 pathogens. Internal organs appeared histologically normal with no evidence of bacteremia or viral
95 cytopathology. Virology is still pending and an addendum with these results will be issued at a later date.

96 *Saprolegnia* is ubiquitous in nature, as it is an important saprophyte facilitating the breakdown of organic
97 matter. It is not exotic to Alaska or the North Slope. The Fish Pathology Section has records of this organism
98 occurring in whitefish from Barrow Alaska as far back as 1980 (Acc. No. 81-0094). Other records from the
99 North Slope region include: whitefish from Elim (Acc. No. 00-0042), Koyukuk (Acc. No. 02-0530), and
100 Selawik (Acc. No. 06-0021); sheefish from Kotzebue (Acc. No. 02-0026); chum from Noatak (Acc. No. 84-
101 0234), Nome (Acc. No. 13-0055), and Kotzebue (Acc. No. 02-0027); Dolly Varden from Wulik River (Acc.
102 No. 03-0041); and Arctic grayling from Nome (Acc. No. 06-0005).

103 *Saprolegnia* is also generally regarded as an opportunistic pathogen that affects only stressed or
104 immunocompromised fish. There are many potential stressors for wild fish. Common stressors include
105 sexual maturation, physical activity on spawning beds, trauma from predation and fishing gear, changes in
106 water quality and temperature, pathogens and parasites, and pollution. These fish were caught during
107 spawning season and all necropsied fish appeared in spawning or post-spawning condition. This alone
108 could be the predisposing factor. Many of the fish also had net marks on their body, which is a source of
109 physical trauma that exposes fish to organisms in the environment. So far (virology pending) there have
110 been no primary pathogens or parasites associated with predisposing these fish to this external mycotic
111 infection. There are inadequate water quality data for this system, so no inference can be made on
112 changes that may have occurred. As mentioned above, there is much speculation about pollution from
113 the oil industry as the primary source of stress and possible immunosuppression. As previously
114 recommended, fish tissue samples should be sent to an analytical laboratory for hydrocarbon testing if
115 this issue continues to be a primary concern. Initial results were emailed to the NSB Wildlife Biologist on
116 10/17/13 and subsequently several updates have been provided.

117 **FISH HEALTH INVESTIGATOR:** C. Bentz, J. Ferguson

118



119 **TECHNICAL ASSISTANCE:** I. Dickson

120 **COPIES TO:** FY14, Miscellaneous, Itta (Native Village), Skaugstad, Behr, Borba, Rabung, Rozen, Davis,

121 Meyers

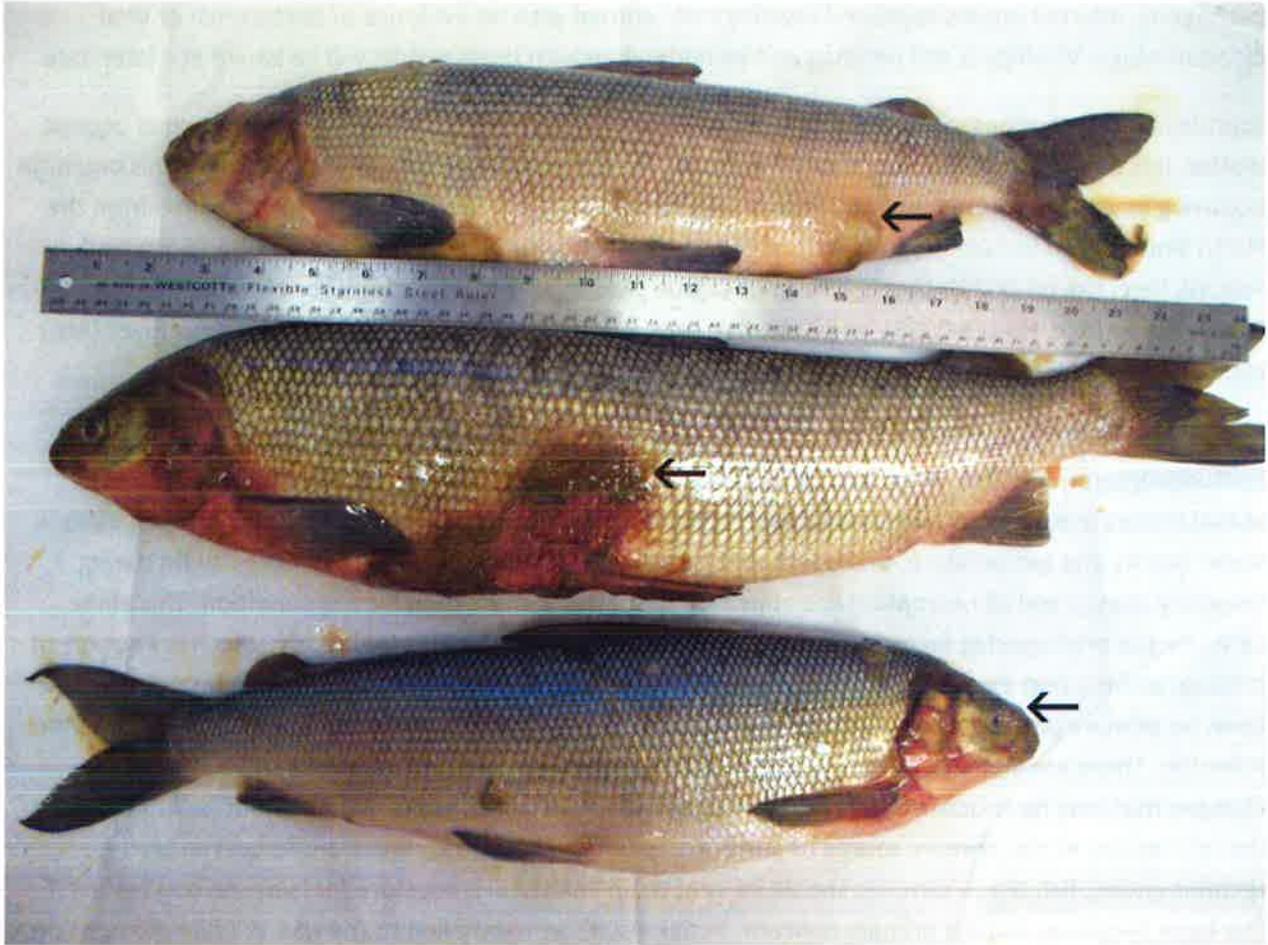


Figure 1. Gross pathology of broad whitefish in present case. Note the brown/green cottony fungal plaques on head/snout and ventrolateral surface and fins. Photograph provided by Todd Sformo, North Slope Borough.

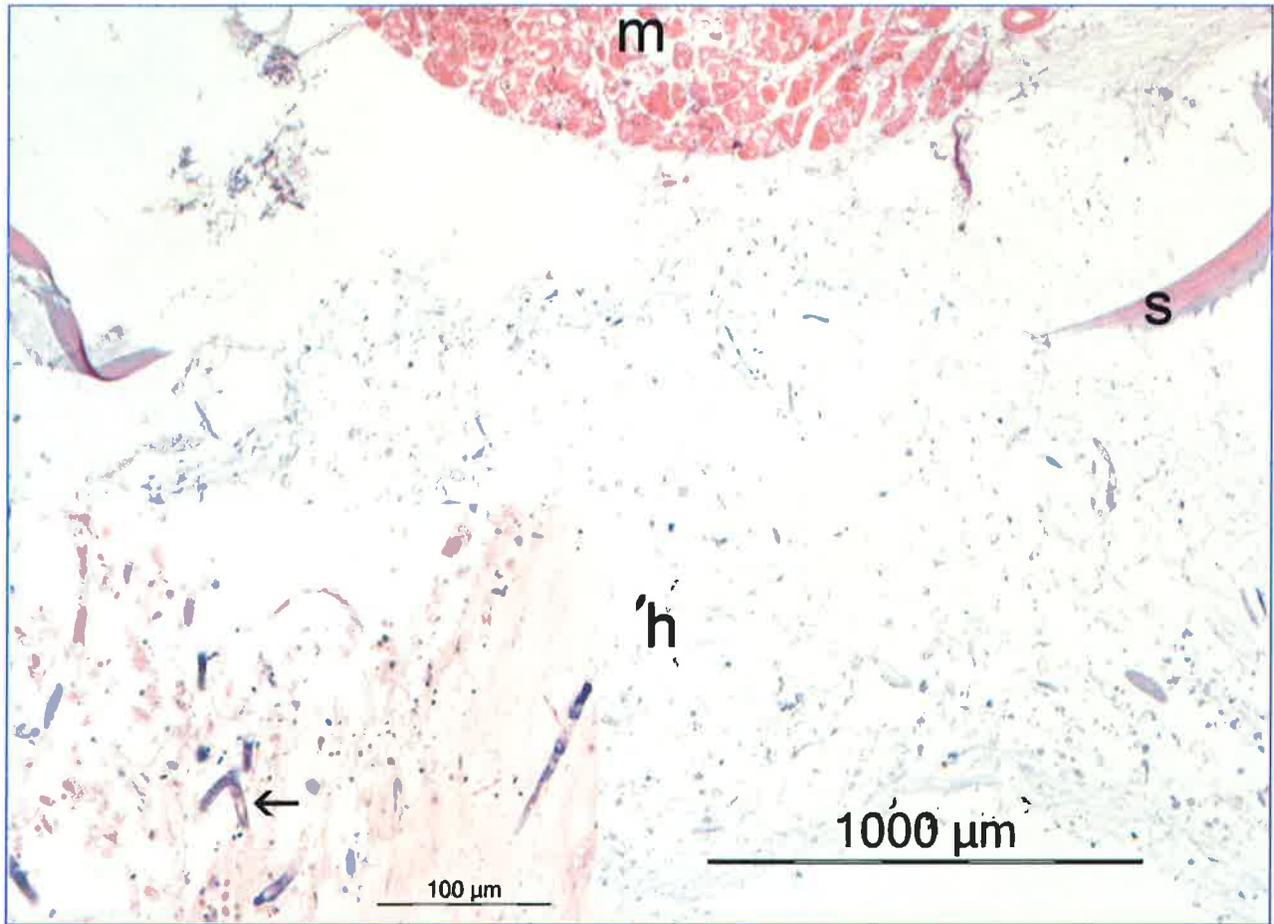


Figure 2. Histopathology of broad whitefish in present case. Note the abundance of fungal hyphae (h) in the dermis, which extends past the scales (s) to the skeletal musculature (m). Inset shows branched, aseptate hyphae (arrow).

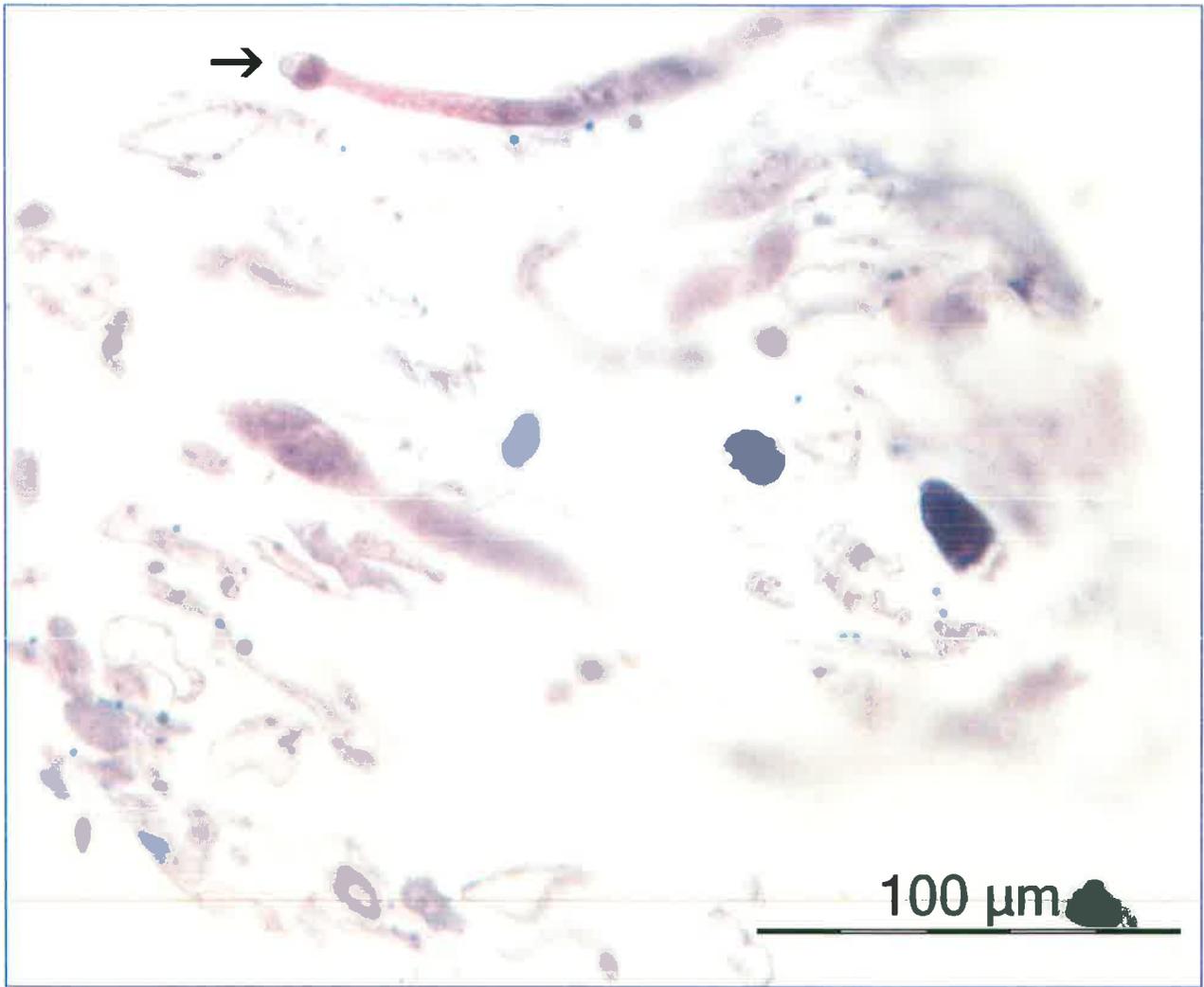


Figure 3. Histopathology of broad whitefish in present case. Note the aseptate hyphae and gemma-like reproductive structure (arrow).

Running commentary to accompany the official fish pathology report (ACCESSION NO: 2014-0053) by Sformo

Line # 37: “MORIBUND” is used in this case because this lab typically examines “hatchery fish when there are obvious clinical signs of dying.” Some of the broad whitefish were alive at capture in the net; a few were dead. The better term would be “morbid,” indicating diseased or abnormal

Line # 40: “11/11” indicates that all eleven specimens displayed these features

Line # 40: “plaque” is used to indicate the gross-level features of the water mold, a superficial, solid, elevated skin lesion

Line # 44: "hyperemic" is a term for increased, abnormal, or unusual amount of blood in area, a pooling effect, although the blood can be in small volumes. The term can even be used to describe blushing

Line # 50: "5/5" had little to no internal fat

Line # 53: "fungal hyphae" are normal growth extensions of the mold—the way the mold grows and matures

Line # 54: "aseptate" indicates the hyphae are not divided into distinct sections and "sporangium" is a structure of the mold that releases spores (important for reproduction of the fungus)

Line # 55: "pennate diatoms" indicates that a particular classification of diatoms (algae) were found on the mold/ fish (an expected finding)

Lines # 57-59: Indicates that no fish out of the ones examined showed abnormalities in these tissues

Line # 60: "FAT" stands for a technique called Fluorescent Antibody Test that was used to examine one specimen for the presence of three species of bacteria: *Aeromonas salmonicida*, *Yersinia ruckeri* Type I, *Yersinia ruckeri* Type II. See cover sheet for more information

Lines # 63: These abbreviations stand for types of media that grow bacteria to aid with diagnostics. TSA, for instance, stands for Trypticase Soy Agar

Line # 68: "gemma-like" is a structure in asexual reproduction that detaches and develops into a new individual fungal organism (clone)

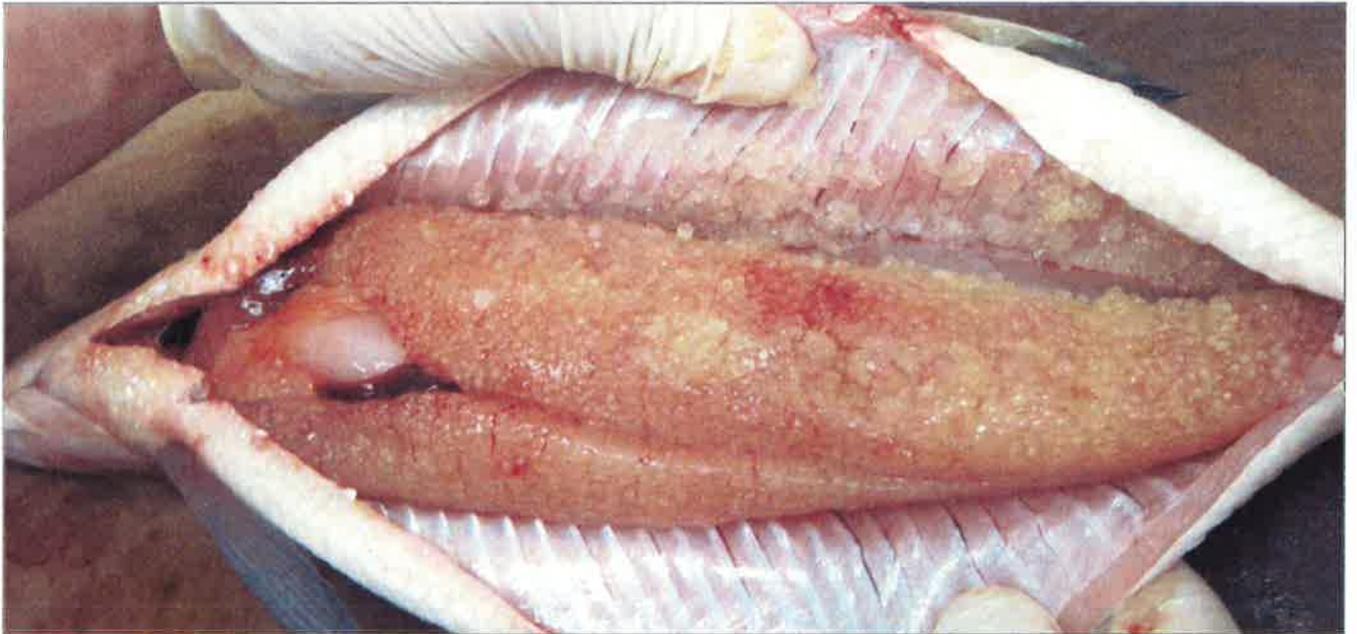
Line # 69: "oogonium" indicates female reproductive structure

Line # 85: "pyknotic" indicates condensed DNA that is formed in a dead or dying cell (necrotic).

Line # 96-102: the regions noted in this list are not all North Slope Borough (see enclosed report: 81-0094 Barrow white fish and Fish/Shellfish)

Additional photos by Todd Sformo and Billy Adams of mold-affected Aanaakliq from Nuiqsut to accompany fish pathology report



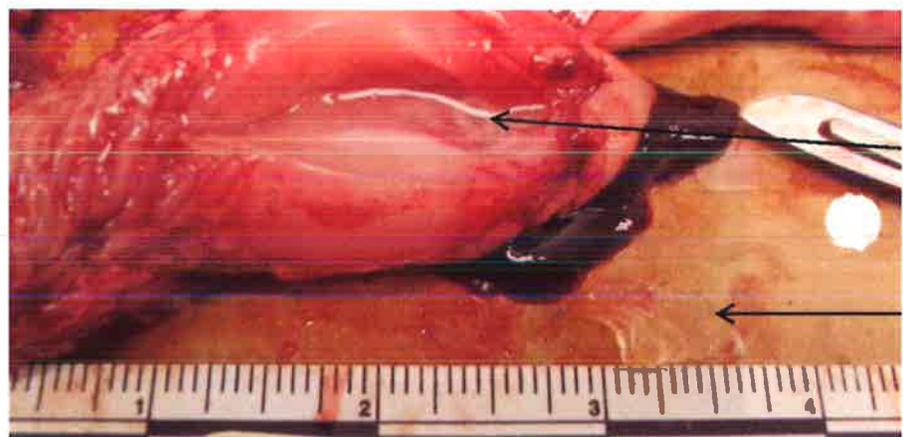
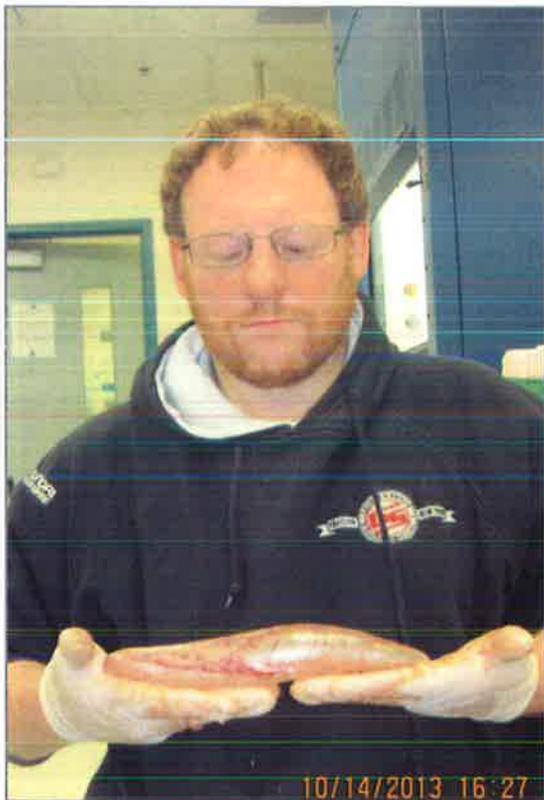
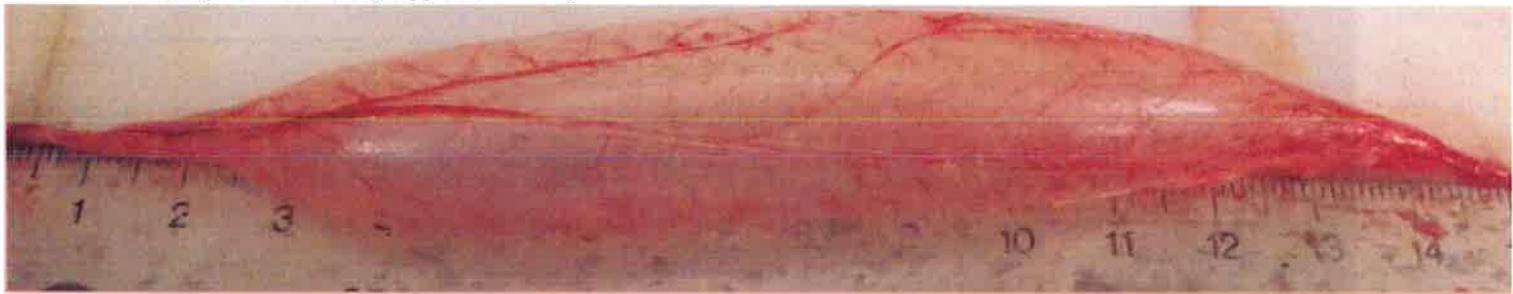


Suvak (eggs) appear healthy



Taqtu (kidney) appears healthy

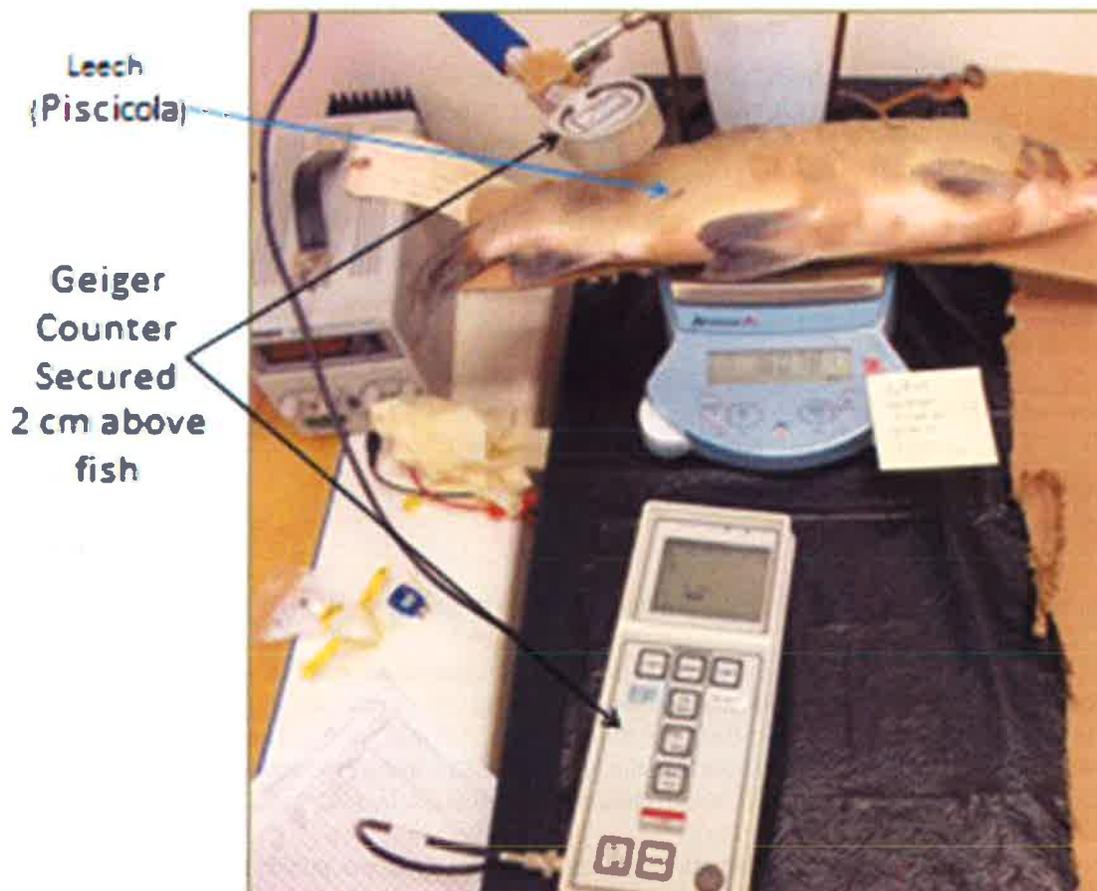
Puktan (swim bladder) appears healthy



Sformo holding inflated swim bladder. Stomach with scale bar on right.

Opened stomach (above right) top arrow. Only unusual "object" found internally was a struvite crystal (small arrow near bottom on photo) found in the stomach that immediately dissolved in ethanol.

Radiological Assessment



Background radiation in lab during Nuiqsut fish assessment including instruments, room, tools ranged from 3-101 Counts/minute (C/min.) as recorded by the Geiger Counter (two black arrows). Ten fish from Nuiqsut were measured (including three qaaktaq) indicating 1-94 C/min., and over the mold itself 4-44 C/min. Radiation measurement conducted on two *Aanaaktiq* from a gill net on 2 October 2013 near Iviksuk area on the Inaru River. These fish were given to Sformo prior to mold being reported in the Nuiqsut area. The room for this analysis was between 6-64 C/min. = background. Fish 1 ranged between 1-38 C/min., and fish 2 ranged between 2-42 C/min.



USGS Identification of *Saprolegnia* – like fungus or mold
United States Department of the Interior

WESTERN FISHERIES RESEARCH CENTER
DIVISION OF BIOLOGICAL RESOURCES
US GEOLOGICAL SURVEY
6505 NE 65th St
Seattle, WA 98115
(206) 526-6591

Draft Do Not Cite

Date: December 22, 2014

Preliminary Report: Identification of *Saprolegnia* – Revised Report

Prepared by: Maureen K. Purcell, Ph.D., Western Fisheries Research Center

Prepared for: Todd Sformo, Barrow, AK

USGS Fundamental Science Practices: Non-Disclosure Policy Prior to Publication

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In being provided this courtesy copy of the information product prior to peer review, publication and release, such parties are bound by the Bureau's disclaimer as included on each page of the report.

Summary

Previously, we used 18s ribosomal DNA sequencing on an unknown Alaskan mold / fungus and the results suggested that the isolate was most likely *Saprolegnia parasitica*. In this revised report, we sequenced the internal transcribed spacer (ITS) regions of the ribosomal gene complex and conclude that the isolate is within *Saprolegnia* Clade I. Clade I comprises all parasitic *Saprolegnia* and the proposed species name for Clade I is *Saprolegnia parasitica*.

Sample History

Case #	14-01
Samples	Fish #44 two samples
Date received	Received at the WFRC-Seattle October 29, 2013

Submitted by	Todd Sfomo, POB 69, Barrow AK 99723 Todd.sfomo@north-slope.org 907-852-0350
Received by	Maureen Purcell, Ph.D.
Processed by	Rachel Thompson
Report by	Maureen Purcell, Ph.D.
Report	November 7, 2013, Revised Report 12/22/14

Case History

In October 2013, Nuiqsut fishermen observed a mold/fungus on Aanaaqliq (broad whitefish) which had not been previously observed. The fishermen were concerned about the health of the fish and the health risk to people consuming the affected fish. Initial identification of the mold was *Saprolegnia* spp. (Alaska Fish Pathology Laboratory). This type of mold occurs in freshwater bodies across the globe from Alaska to Antarctica. Although the mold has probably been resident on the North Slope, there are no previous reports, and fishermen in Nuiqsut have not seen it before.

Methods

Extraction of DNA was performed using the DNeasy Minikit (Qiagen Inc.; Valencia, California) following the manufacturer's instruction for animal tissues. The DNA concentrations were determined using a Nanodrop 1000 (Thermo Fisher Scientific Inc.; Wilmington, Delaware). The DNA was stored at 4°C until used. PCR amplification was performed using 1x buffer containing 1.5 mM of MgCl₂, 100 μM each dNTPs, 100 pmol each primer, 2 U of *Taq* polymerase (Qiagen, Inc.) and 10-20 ng of template DNA. Cycling parameters were 94°C for 2 min., followed by 35 cycles of 94°C for 1 min, 55°C for 1 min, and 72°C for 2 min, followed by a final extension at 72°C for 10 min. Six combinations of primers were used for PCR amplification of the 18s [1, 2]. These primer combinations included: nu-SSU-0817-5' / nu-SSU-1196-3', nu-SSU-0817-5' / nu-SSU-1536-3', 18s-42F / 18S-1498R, 18s-42F / 18S-1520R, 18S-82F / 18S-1498R, and 18S-82F / 18S-1520R. The ITS region was amplified using the ITS1 F and ITS 4 R. See Table 1 for complete list of primers. Products were visualized by electrophoresis in a 1.5% agarose gel in 0.5x Tris-acetate-EDTA (TAE) buffer. PCR products were purified using the Qiagen PCR Clean-up Kit (Qiagen, Inc.). Sequencing of the PCR products was performed on an ABI PRISM 310 Genetic Analyzer with an ABI Big Dye Terminator Cycle Sequencing Kit v1.1 in 10 μL volume reactions following the manufacturer's instructions (Applied Biosystems Inc.). Sequences were visually inspected with Sequencher V.4.5 software (Gene Codes Corp., Ann Arbor, Michigan). Phylogenetic relationships were inferred using MEGA 5 [3].

Results

Sequencing of 18s. Amplicons were observed using four out of the six primer combinations for both samples: 18s-42F / 18S-1498R, 18s-42F / 18S-1520R, 18S-82F / 18S-1498R, and 18S-82F / 18S-1520R (all amplicons approximately 1500 bp). The amplicons derived from two of the primer combinations (18S-42 F / 18S-1498 R and 18S-82 F / 18S-1520 R) were sequenced (sample 1 only). A 1666 bp consensus sequence was obtained (Fig. 1). BLAST analysis [4] indicated 99% identity to publicly available 18s rDNA sequences representing *Saprolegnia parasitica*. Additional *Saprolegnia* spp. 18s sequences were

obtained from GenBank and used for phylogenetic reconstruction. A total of 1571 nucleotides were used in the final multiple sequence alignment analysis. The Alaskan sample clustered mostly closely with *Saprolegnia parasitica* strain NJM8604 from Japanese coho salmon (Fig. 2), with no nucleotide differences observed across the 1571 bp region.

Sequencing of ITS. An approximate 750 bp amplicon was observed following PCR. A 705 bp consensus sequence was obtained by sequencing (Fig. 1). BLAST analysis [4] indicated 100% identity to publicly available ITS sequences representing *Saprolegnia parasitica*. An additional 124 sequences of *Saprolegnia* sp. were obtained from GenBank and used for phylogenetic reconstruction; these 124 sequences were listed in publication by Dieguez-Urbeondo et al. [5]. A total of 624 nucleotides were used in the final multiple sequence alignment analysis. The tree topology was highly similar to the tree reported in [5]. The Alaskan sample clustered within Clade I, which includes the *Saprolegnia parasitica* isolates (Fig. 3).

Conclusions

Sequencing of the 18s ribosomal gene confirmed the fungal isolate was within the Genus *Saprolegnia*. Further sequencing of the ITS ribosomal DNA regions indicated that it is within the Clade I defined by Dieguez-Urbeondo et al. (2007) [5]. The majority of all fish parasitic *Saprolegnia* isolates group into ITS Clade I and it is proposed that all Clade I isolates be assigned the name *Saprolegnia parasitica* [5].

Disclaimers

The sequence reported here will be kept confidential until we receive permission from Todd Sfomo to release the sequences to GenBank. The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute endorsement or approval by the U.S. Department of Interior or the U.S. Geological Survey of any product or service to the exclusion of others that may be suitable.

Figure 1. Partial 18s small subunit ribosomal DNA and internal transcribed spacer (ITS) region.

>Whitefish *Saprolegnia*-like 14-01 18s Gene

```
GAAACTGCGAATGGCTCATTATATCAGTTATAGTCTACTTGGCAGTACCTTACTACTTGGATACCCGTAGTAATTCTAGAGCTAA
TACATGCGTAAATACCCAACCTGCTTGTGCGACGGGTAGCATTATTAGATTGAAACCAATGCGGCCTCGGTCGGTATTGTGTTG
AATCATAATAACTGTGCGGATCGCTTACAGCGATAAGTCAATTGAGTTTCTGCCCTATCAGCTTTGGATGGTAGGATATGGGC
CTACCATGGCGTTAACGGGTAACGGGGAATTAGGGTTTATTCCGGAGAGGGAGCCTTAGAAACGGCTACCACATCCAAGGA
AGGCAGCAGGCGCGTAAATTACCCAATCCTGACACAGGGAGGTAGTGACAATAAATAACAATGCCGGGCTTTTCAAGTCTGG
CAATTGGAATGAGAACAATTTAAATCCCTAACGAGGATCAATTGGAGGGCAAGTCTGGTGCCAGCAGCCGCGGTAATTCCAG
CTCCAATAGCGTATATTAAGTTGTTGCAGTTAAAAAGCTCGTAGTTGGATTTCTGGTTTGAGCGTCCGGTCGAGTTTATCTCT
GTAATATGGATGCTTGGGCCATTTTTGTGAGGGGGCGCTTCTGCCATTAGTTGGTGGTTGTGTCGACTTGCATCGTTTACTG
TGAAAAAATTAGAGTGTTTAAAGCAGGCGTTTGTCTATTTGAATACATTAGCATGGAATAATAAGATACGACCTTGGTGGTCTA
TTTTGTTGGTTTGCACACCGAGGTAATGATTAATAGGGACAGTTGGGGGTATTCATATTTCAACGTCAGAGGTGAAATCTTGG
ATCGTTGAAAGATGAGCTTAGGCGAAAGCATTTACCAAGGATGTTTTCATTAATCAAGAACGAAAGTTAGGGGATCGAAGAT
GATTAGATACCATCGTAGTCTTAACCATAAACTATGCCGACTCGGGATTGGCAGTCGTTTATTTGAATGACCTTGCAGCACC
GTATGAGAAATCAAAGTCTTTGGGTTCCGGGGGAGTATGGTCGCAAGGCTGAAACTTAAAGGAATTGACGGAAGGGCACC
ACCAGGAGTGGAGCCTGCGGCTTAATTTGACTCAACACGGGGAAACTTACCAGGTCAGACATAGTAAGGATTGACAGATTG
AGAGCTCTTTCTGATTCTATGGGTGGTGGTGCATGGCCGTTCTTAGTTGGTGGAGTGATTTGTCTGGTTAATTCGGTTAACGA
ACGAGACCTCCGCGTGCTAAATAGTTCTGCTTACCAATTTGGTAGGTATGGACTTCTTAGAGGGACTTTCAGTGACTAACTGAA
GGAAGTTGGAGGCAATAACAGGTCTGTGATGCCCTTAGATGTTCTGGGCCGACGCGCTACACTGATACGCTCAACGAGTA
TATAACCTTGATCGATAGGTCTGGGTAATCTTTGAATACGTATCGTGCTAGGATAGATTATGCAATTATTAATCTTGAACGA
GGAATTCCTAGTAAACGCAAGTCATCAGCTTGCAATTGATTACGTCCCTGCCCTTTGTACACACCCCGCGTCCGACCTACCGATTG
AATGACTCGGTGAAGTATTGGGACTGGAATTTGTGTGCTTCAATTGCATGCAAGTTTGTGGAACTTTCCTTAACCTCGCC
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>Whitefish *Saprolegnia* – like 14-01 ITS region

AAGGATCATTACCACACCAAAAAACACCCACGTGAATGTA CTCTTTATGAGGCTTTGCGCTGCCCTTGTGGCAGCTAGCCGAA
GGTTTCGCAAGAAGCCGATGTCAATTTGAATCCTTTTTAAAATACGACTGATCAAACTGCAGATAGAAATATCTGCATGCAAT
TGAAATACAACCTTTCAACAGTGGATGTCTAGGCTCGCACACCGATGAAGAACGCTGCGAACTGCGATACGTAATGCGAATTGC
AGAATTCAGTGAGTCATCAAAATTTGAACGCATATTGCACTTCCGGGTTAGTCCTGGGAGTATGTTTGTATCAGTGTCCTGGA
ACACAACTTGTTTCATTTCTTGATTGGGATGGAGCAGACTGTGAAGGTCTTGTAAATTACAAGTCCTTTTAAACGACGGTACCT
ATGCGTCCTAGTGAGATGTATTATTTAAAGGTATGCCTGCGCTCCTTTGAAAGTCTTGTGTGGCGGCACACAGCACTCAAAGA
GAGAGCAAATCGCGGTAGTTTTGCTTGTACTTCGGTACGAGTGGACACATATTGCTTTTTGTGATTTCTGCGAGTCTGTTGTCA
AAGTACAAGGCACGTAAGGAGAGTTGGTATGCTGGTGCAATTTCTGGCGTATGGAGGCAAATTGGGAATTCAATCCAATTTGG
ACCTGATATCAAACAAGACTACCCGCTGAACTTAA

Figure 2. Phylogenetic analysis of the Alaskan unknown fungal / mold isolate based on the 18S gene. Evolutionary relationships were inferred using the Maximum Likelihood method. The tree is drawn to scale, with branch lengths measured in the number of substitutions per site. All positions containing gaps and missing data were eliminated. There were a total of 1571 positions in the final dataset. Evolutionary analyses were conducted in MEGA5.

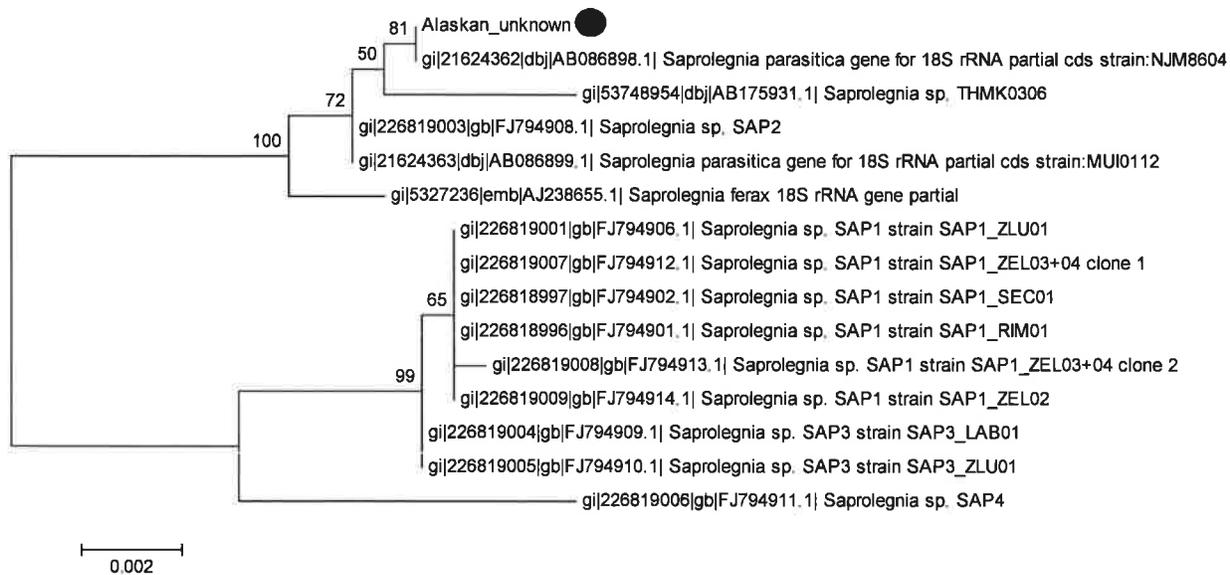


Figure 2. Phylogenetic analysis of the Alaskan unknown fungal / mold isolate based on ITS sequences. Evolutionary relationships were inferred using the Maximum Likelihood method. The tree is drawn to scale, with branch lengths measured in the number of substitutions per site. All positions containing gaps and missing data were eliminated. There were a total of 654 positions in the final dataset. Analysis included 125 different sequences. Evolutionary analyses were conducted in MEGA5.

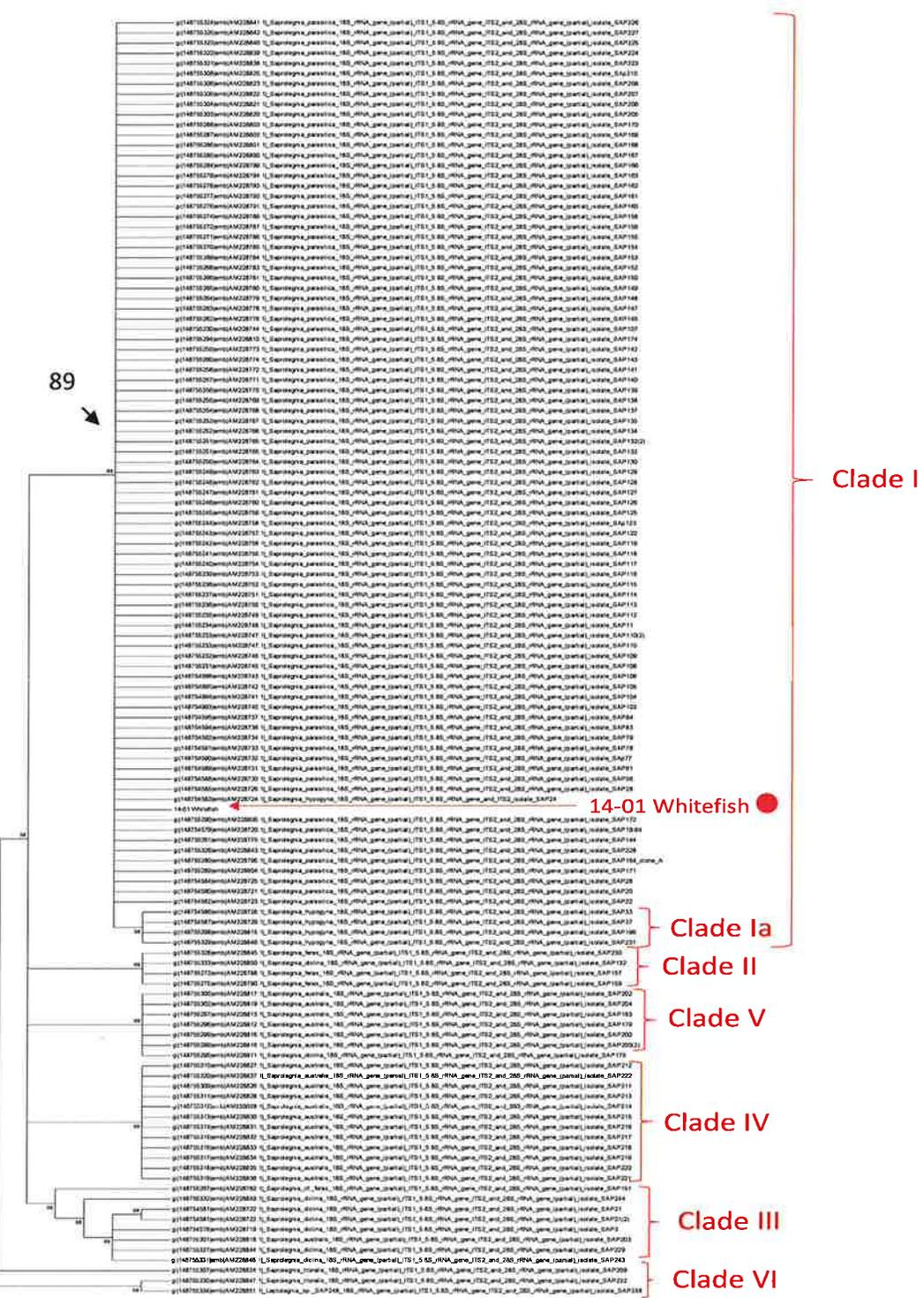


Table 1. Primer name, sequence and source

Primer Name	Sequence (5' → 3')	Source
nu-SSU-0817-5'	TTAGCATGGAATAATRRRAATAGGA	[1]
nu-SSU-1196-3'	TCTGGACCTGGTGAGTTTCC	[1]
nu-SSU-1536-3'	ATTGCAATGCYCTATCCCCA	[1]
18s-42F	CTCAARGAYTAAGCCATGCA	[2]
18S-82F	GAAACTGCGAATGGCTC	[2]
18S-1498R	CACCTACGGAAACCTTGTTA	[2]
18S-1520R	CYGCAGGTTACCTAC	[2]
ITS1 F	TCCGTAGGTGAACCTGCGG	[6]
ITS1 R	TCCTCCGCTTATTGATATGC	[6]

References

1. Borneman J, Hartin RJ. PCR primers that amplify fungal rRNA genes from environmental samples. *Applied Environmental Microbiology* 2000; 66:4356-60.
2. Takishita K, Miyake H, Kawato M, Maruyama T. Genetic diversity of microbial eukaryotes in anoxic sediment around fumaroles on a submarine caldera floor based on the small-subunit rDNA phylogeny. *Extremophiles* 2005; 9:185-96.
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4. Altschul SF, Gish W, Miller W, Myers EW, Lipman DJ. Basic Local Alignment Search Tool. *Journal of Molecular Biology* 1990; 215:403-10.
5. Dieguez-Urbeondo J, Fregeneda-Grandes JM, Cerenius L, Perez-Iniesta E, Aller-Gancedo JM, Telleria MT, et al. Re-evaluation of the enigmatic species complex *Saprolegnia diclina*-*Saprolegnia parasitica* based on morphological, physiological and molecular data. *Fungal Genet Biol* 2007; 44:585-601.
6. Eissa, A.E, M. Abdelsalam, N. Tharwat, and M. Zaki. Detection of *Saprolegnia parasitica* in eggs of angelfish *Pterophyllum scalare* (Cuvier–Valenciennes) with a history of decreased hatchability. *International Journal of Veterinary Science and Medicine* 2013; 1: 7–14

2014-0053 Fish Pathology Report addendum with virology results issued on 2/24/14

This is the same report as above, except for the addition of the virology findings in red.

ACCESSION NO: 2014-0053_addendum

ALASKA DEPARTMENT OF FISH AND GAME

DIVISION OF COMMERCIAL FISHERIES - FISH PATHOLOGY SECTION

333 RASPBERRY ROAD, ANCHORAGE, AK 99518-1599 - Phone (907) 267-2244/Fax 267-2194

REPORT OF LABORATORY EXAMINATION

LOT (YEAR, STOCK, SPECIES): Colville River broad whitefish, *Coregonus nasus*

FACILITY: North Slope Borough, Dept. of Wildlife Management

CONTACT PERSON/ADDRESS: Todd Sformo, P.O. Box 69, Barrow, AK 99723

SAMPLE DATE: 10/15/13 or 10/16/13; 10/18/13 **DATE SAMPLE RECEIVED:** 10/17/13; 10/24/13

SPECIMEN TYPE: Whole fish; formalin fixed tissues, fungal isolate and viral swabs **LIFE STAGE:**
Adult

STATE: Slightly frozen; formalin fixed **NUMBER OF SAMPLES:** 11 **WILD:** Yes

HISTORY/SIGNS: Subsistence fishers have noticed that "some" broad whitefish from the Coleville River and Nigliq Channel near Nuiqsut have a patchy fungal-like mass on the exterior surface. A number of fish have been caught, but there is no estimate as to how many of the catch were affected. Likewise, no summary of reported observations was provided. This was first noticed on 10/12/13 when 3 fish were submitted to the North Slope Borough (NSB). Subsequently, the Fish Pathology Lab received 5 partially frozen fish sampled on 10/15/16 and formalin fixed tissues from 6 fish collected on 10/18/13. Swabs for viral testing and a fungal isolate from one fish were also included in the latter submission. No mortality has been associated with this condition; affected fish are detected in gill nets along with apparently healthy fish. The NSB Wildlife Biologist measured the amount of ionizing radiation in these fish with a Geiger-Müller counter, which was found to be the same as background levels.

On 10/21/13, the Fish Pathology Lab sent the NSB Wildlife Biologist preliminary results that this condition is caused by the common water mold, *Saprolegnia* sp. We also sent him fungal agar plates to use for isolating the organism per his request. He then sent an isolate to the USGS Western Fisheries Research Lab for genetic confirmation, where it was also identified as *Saprolegnia*. There is a growing concern

that this mold is exotic (which it is not) and will lead to a food shortage at a subsistence level. This has further been fueled by speculation of its occurrence being due to climate change, industrial development or other anthropogenic activities.

REASON FOR SUBMISSION: Diagnostic evaluation.

FINAL REPORT DATE: 12/5/13; addendum with virology results issued on 2/24/14.

CLINICAL FINDINGS

NECROPSY: 5 fish necropsied at Fish Pathology Lab; 6 fish partially necropsied at NSB

MORIBUND: Mean fork length of 52.2 cm (range: 44.2-56.5 cm; n = 11);

Mean weight of 1.7 kg (range: 1.2-2.5; n = 6);

7 males and 4 females – appeared in spawning or post-spawning condition

- 11/11 with small to large brown/green cottony fungal plaques on various external locations, mostly on head/snout but also on the ventrolateral surface and fins (Figure 1). The majority of plaques could be manually removed from scales, leaving a reddened (hyperemic) area of tissue, but a few extended deeper and formed ulcerations.
- 4/11 hyperemic and eroded fins
- 3/11 with several net marks on exterior surface
- 1/11 with detached upper mandible and brown/green fungal plaques in mouth
- 11/11 with mature gonads appearing in spawning or post-spawning condition; 1 female with egg reabsorption and 2 with partial skeins. 1 male with spent testes.
- 11/11 with no food in gastrointestinal tract; 1 fish had a struvite crystal in gut
- 5/5 with little or no visceral adipose tissue
- 1/5 with congested airbladder (likely post-mortem change)
- 2/6 with congested peritoneum (likely post-mortem change)
- 5/5 plaque wet mounts contained innumerable fungal hyphae that were branched and aseptate with distinct club shaped sporangium, characteristic of *Saprolegnia* species
- 5/5 plaque wet mounts contained few to many pennate diatoms with various morphology
- 1/5 plaque wet mounts with innumerable motile and non-motile bacilli; Gram-negative
- 0/4 abnormal spleen and airbladder squashes

0/3 abnormal kidney squashes

0/2 abnormal liver and gut squashes

FAT: 0/1 positive for *Aeromonas salmonicida*

0/1 positive for *Yersinia ruckeri* Type I

0/1 positive for *Yersinia ruckeri* Type II

BACTERIOLOGY: 0/2 kidneys struck on TSA and TYES at 20°C for 4 days had bacterial growth

MYCOLOGY: Skin lesions explanted on oatmeal agar (OA), potato agar (PA) and cornmeal agar (CMA) at 20°C for up to 30 days. Explants on OA and PA from one fish (#37) sent from NSB.

3/6 skin lesion explants had fungal growth on OA and PA; 3/5 with growth on CMA.

Luxurious growth of white, cottony aerial mycelia occurred on OA within 4 days and on PA after 7 days. Mycelia contained branching and mostly aseptate hyphae. Germinating gemma-like structures were observed in mycelia at day 14 and an oogonium-like structure was detected at day 21. Less growth occurred on CMA, which spread across the agar in non-aerial formation. This contained branching and rarely septate hyphae.

HISTOPATHOLOGY: Formalin fixed tissues processed into 6 μ sections and stained with hematoxylin and eosin, included (# of fish in parentheses): margin of skin lesion (8), spleen (7), liver (6), heart (6), kidney (4), congested airbladder (1), congested peritoneum (1) and egg mass (1).

MORIBUND: There were varying degrees of post-mortem autolysis in all samples. The sectioned peritoneum had processing artifacts.

All internal organs appeared normal. Congestion was confirmed in the airbladder and additionally found in the spleen of 1 fish. This was interpreted as a post-mortem change. The egg mass contained viable eggs in various developmental stages.

No fungal hyphae were found in Fish #36, which was likely due to the plane of section. All other fish had branched, aseptate fungal hyphae in the epidermis and dermis (Figure 2). Occasionally hyphae were observed deeper in skeletal musculature and the perichondrium of fin rays. A gemma-like structure was detected in one specimen (Figure 3). A few pennate diatoms and several bacilli were present in the

lesions of 2 fish. The mycotic infection was associated with necrotic cells containing pyknotic nuclei and mixed inflammatory infiltrates.

VIROLOGY: 0/1 fish positive for virus. Kidney and spleen from fish #5 processed by quantal assay on

EPC, BF-2 and INEM-1 cell lines at 14°C for 14 days and blind-passaged for an additional 14 days. Minimum level of detection was 50 infectious particles/g of sample.

Cells were pretreated with PEG to enhance viral infectivity. The viral swabs that were submitted were of insufficient quantity for testing and were several months past their expiration dates.

DIAGNOSIS: Saprolegniasis

COMMENTS/RECOMMENDATIONS:

All of these fish had an external mycotic infection caused by the common water mold, *Saprolegnia*. Wet mounts of lesions contained clubbed shaped sporangium, which is a hallmark feature of this group of organisms. Genetic testing by the USGS lab confirmed this identification. No bacteria were isolated from kidneys struck on general purpose media. Kidney was also FAT-negative for targeted Gram-negative pathogens. Internal organs appeared histologically normal with no evidence of bacteremia or viral cytopathology. Virology is still pending and an addendum with these results will be issued at a later date.

Saprolegnia is ubiquitous in nature, as it is an important saprophyte facilitating the breakdown of organic matter. It is not exotic to Alaska or the North Slope. The Fish Pathology Section has records of this organism occurring in whitefish from Barrow Alaska as far back as 1980 (Acc. No. 81-0094). Other records from the North Slope region include: whitefish from Elim (Acc. No. 00-0042), Koyukuk (Acc. No. 02-0530), and Selawik (Acc. No. 06-0021); sheefish from Kotzebue (Acc. No. 02-0026); chum from Noatak (Acc. No. 84-0234), Nome (Acc. No. 13-0055), and Kotzebue (Acc. No. 02-0027); Dolly Varden from Wulik River (Acc. No. 03-0041); and Arctic grayling from Nome (Acc. No. 06-0005).

Saprolegnia is also generally regarded as an opportunistic pathogen that affects only stressed or immunocompromised fish. There are many potential stressors for wild fish. Common stressors include sexual maturation, physical activity on spawning beds, trauma from predation and fishing gear, changes in water quality and temperature, pathogens and parasites, and pollution. These fish were caught during spawning season and all necropsied fish appeared in spawning or post-spawning condition. This alone could be the predisposing factor. Many of the fish also had net marks on their body, which is a source of physical trauma that exposes fish to organisms in the environment. So far (virology pending) there have been no primary pathogens or parasites associated with predisposing these fish to this external mycotic infection. There are inadequate water quality data for this system, so no inference can be made on changes that may have occurred. As mentioned above, there is much speculation about pollution from the oil industry as the primary source of stress and possible immunosuppression. As previously recommended, fish tissue samples should be sent to an analytical laboratory for hydrocarbon testing if

this issue continues to be a primary concern. Initial results were emailed to the NSB Wildlife Biologist on 10/17/13 and subsequently several updates have been provided.

The appended virology results showed that there were no viruses detected in the kidney and spleen tested with standard cell lines and the phylogenetically closer inconnu cell line. The viral swabs that were submitted were of insufficient quantity for testing and were several months past their expiration dates. Likewise, several of the fish submitted for necropsy were partially frozen upon arrival, so only the freshest material was tested.

Recent discussion of this issue at the North Slope Subsistence Regional Advisory Council meeting indicated that the NSB has plans to investigate this further, which includes a survey for mortalities in the spring and monitoring for re-occurrence of this condition during harvest next fall. Burbot will also be evaluated to determine if this species is affected. Some water quality testing has been performed, which will continue. My understanding is that molecular diagnostics will be employed to identify *Saprolegnia* infestations. However, a wet mount evaluating morphology should be sufficient, which would also be less expensive and provide quicker results considering that this work would need to be out-sourced. The overview of my presentation that I provided at this meeting is attached. One specific recommendation I provided was that juvenile fish should be evaluated in order to rule out sexual maturation/spawning as the sole cause, as this is a well-established paradigm.

FISH HEALTH INVESTIGATOR: C. Bentz, J. Ferguson



TECHNICAL ASSISTANCE: I. Dickson

COPIES TO: FY14, Miscellaneous, Itta (Native Village), Patton (USFWS), Hyer (USFWS), Skaugstad, Behr, Borba, Rabung, Rozen, Davis, Meyers

Water samples collected by Sformo, Adams, and John Siegel (ABR) on 10/18/2013. Entire water report not included in this fish report.



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**Analytical Services Order
 and Chain of Custody Form**

84509

1013-1083

Client Name and Address: A/SB-DWH PO BOX 69 Barrow, AK 99723				Account Number: #2504		Preservative ←	
Contact Person: Todd Sformo 907 852 6584				P.O. or Contract Number:		Number of Containers 020/000	
Phone Number: 907 852 0350 Fax Number:				Authorization Number:		Matrix H2O/Water	
E-mail: todd.sformo@north-slope.org				Sampled By: T.S.		Matrix H2O/Water	
Project Name: Colville Fish Study				PWS Number:		Matrix H2O/Water	
Data Deliverables: Level I <input type="checkbox"/> Level II <input type="checkbox"/> Level III <input type="checkbox"/> EDD/Format:				Send Results to ADEC: <input type="checkbox"/> YES <input type="checkbox"/> No		Matrix H2O/Water	
Requested Turnaround Time and Special Instructions: rapid turnaround						Matrix H2O/Water	
Client Sample ID	Date Sampled	Time Sampled	Matrix	AF Sample ID			Remarks
Colville Fish Study ST4 H2O ^B	10/18/13	10:30 AM		AF48972	1	X	X
ST4 H2O ^C	10/18/13	10:30 AM		AF48973	1	X	X
ST4 H2O ^A	10/18/13	10:30 AM		AF48974	1		X
Colville Fish Study ST4 H2O ^E	10/18/13	10:30 AM		AF48975	1	X	X
" " ST4 " F	10/18/13	10:30 AM		AF48976	1	X	X
ST4 " D	10/18/13	10:30 AM		AF48977	1		X
Relinquished By (1): Todd Sformo				Date: 10/18/13 Time: 11:00 AM		Received By:	
Relinquished By (2):				Date: 10/18/13 Time: 11:30		Received By: [Signature]	
Relinquished By (3):				Date: Time:		Received for lab by:	
				TO BE COMPLETED BY LABORATORY			
				Location Received/ ANC <input type="checkbox"/> 6.4 °C FBK <input type="checkbox"/> °C PB <input type="checkbox"/> °C			
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				Chain of Custody Seal <input type="checkbox"/> INTACT <input type="checkbox"/> BROKEN <input type="checkbox"/> ABSENT			
				Shipping Bill Number:			

Sformo-25

MycoLogic Water Sample Analysis for Sformo



October 27th, 2016

Paul de la Bastide
Department of Biology
Petch Building room 168
University of Victoria
3800 Finnerty Road
Victoria BC V8P 5C2 CANADA

Subject: Water sample analysis for the detection of *Saprolegnia parasitica*

Dear Dr. Sformo,

We are a biotechnology company located at the University of Victoria, in Victoria, BC Canada. We have extensive experience studying the water mold *Saprolegnia parasitica* and we have been directly involved in research on this species for a number of years. This species is an opportunistic fish pathogen that may be found in fresh water across North America, and it can infect a wide range of fish species in natural environments, fish hatcheries and in aquaculture systems. Fish that are already stressed for other reasons (e.g., high water temperature, other infections) may become more susceptible to infection by this pathogen.

As part of this research project, we have developed DNA-based methods of detecting this species (and closely related species) in both water samples and fish tissue samples. In 2015, we processed three separate groups of water samples provided by your lab. The water samples included the following:

1. Samples collected on June 22nd, 2015 included 3 water samples collected from the Nuiqsut region (specific sample location not indicated). Samples #1 and #3 were both positive for the presence of *Saprolegnia parasitica*.
2. Samples collected July 30th (2 samples) and August 27th, 2015 (one sample) included water samples collected from the Nuiqsut region (specific sample locations not indicated). The sample from August 27th was positive for the presence of *S. parasitica*.
3. Samples collected on October 29th, 2015 (three samples) included water samples from Lake Tesikvoak. None of these samples were positive for *S. parasitica*. However, these water samples had a high level of other contaminants, which made it difficult to detect the target species.

Although we have conducted only a limited sample analysis to date, we have been able to detect *S. parasitica* in water samples collected from rivers in this region. It would be useful to conduct more extensive analysis of water samples collected in different watersheds over time, as well as obtain tissue samples from affected fish, in order to confirm that *S. parasitica* is in fact the species infecting fish in this region. It would be helpful to obtain fresh tissue, so we can isolate pure cultures of the water mold from an infected fish. Samples of infected fish tissue can also be preserved by freezing, or by storage in 95% ethanol, for the purpose of identification.

I would be happy to discuss your priorities further, so we may develop an appropriate study and sampling approach to address your questions and concerns regarding this pathogen of freshwater fish.

Best regards,

Dr. Paul de la Bastide
(pdelabas@uvic.ca)

MycoLogic Inc., University of Victoria, P.O. Box 3020, Victoria, B.C., Canada V8W 3N5

From: Paul De La Bastide [pdelabas@uvic.ca]
Sent: Saturday, July 04, 2015 8:29 PM
To: Todd Sformo
Subject: Re: Saprolegnia issues

Hi Todd,

Sorry for the delay. For two of the three samples, we did detect *Saprolegnia parasitica*. There were a lot of other contaminants present, but we did have positive amplification for the species-specific marker that identifies *S. parasitica*, in samples #1 and #3. It is likely that the antibiotics we added were degraded due to the delay, allowing many other things to grow as well. In the future, we can sort out a shorter time-line for sampling and analysis. If you would like to discuss a plan for further sampling, we can certainly do that.

Regards,

Paul

From: Todd Sformo <Todd.Sformo@north-slope.org>
Sent: July 5, 2015 9:03 AM
To: Paul De La Bastide
Subject: RE: Saprolegnia issues

Only question: when you say, "there were a lot of other contaminants present," you mean non-*Saprolegnia parasitica* elements and not things like mercury, pesticides, crude oil . . . ?

Thanks, again.

-Todd

Sun 7/5/2015 8:55 AM
Hi Todd,

By other contaminants I mean there were other fungi and bacteria in the samples, which is not a surprise for water samples from the environment. We only look at the microbial life, not chemical contaminants. I am not at the office this week, but let me know if you want to discuss by phone and we can arrange a time to talk. Thanks,

Paul

Supplementary document:

Givens Statistical Solutions
Data Analysis and Modeling for Scientists

4913 Hinsdale Dr., Fort Collins, CO 80526
www.geofgivens.wix.com/home
geof@geofgivens.com
(970) 282-3482



May 6, 2016

Todd,

Thanks for the opportunity to review the "Assessment of PCBs and DDTs in Fish Populations of the Colville River Near the Former Umiat Air Force Station, Umiat, Alaska" report prepared for Linc Energy Operations, Inc. by Travis/Peterson Environmental Consulting, Inc., and Fisheye Consulting.

This document summarizes three earlier studies:

- 1997: 20 grayling from two locations
- 1998: 15 broad whitefish and 7 burbot from three locations
- 2001: 70 burbot from 7 locations

These are total fish counts, not per location. The document also introduces new data for 10 grayling and 1 burbot from 3 locations. The burbot was caught 3 miles downstream from the Unit C Slough, and would not be expected to have particularly high contaminant levels, given the results of the earlier surveys.

Overall, the data used in this report are wholly inadequate for drawing any reliable conclusions about contaminant levels and human health. I will discuss this more below, but let me first identify an exception. The data for 2001 are sufficient for analyzing how contaminant levels vary with distance upstream/downstream/at the Unit C Slough, but these data alone obviously are not informative about time trends. In this report, there is only a brief mention of the 2001 statistical analysis ("developing correlation coefficients"). This is not suggestive to me of any standard or appropriate analysis that could be done with these 2001 data, but without more information I'm unable to fully evaluate the question.

The results of the current analysis are summarized in Figs. 4-9. In most of these, linear regression has been used to estimate time trends in contaminant levels. There are several problems with this.

First, there are too few fish. For burbot, there is only a single fish in 2015. It is impossible to understand the potential contaminant variability in 2015 from a single sample. In 1998, there are only 2 downstream burbot (Fig. 5). Similar poor sample sizes are evident elsewhere. It is ludicrous to assert that there is a downward trend in contaminant levels when comparing a single 2015 fish to a small set of past fish. Are researchers actually willing to give health assurances to native Alaskans based on a single fish?

Second, there are too few years. If there were more fish per year, this wouldn't be so much of a problem. However, with many of these plots showing only one or two fish in some years, these points become extremely influential in the (inappropriate) regression analyses. There are standard statistical methods for assessing whether data points have excessive influence in regression. The 2015 datum surely does. If we are to have any confidence in analyses with only a few fish per year, then we must have more years of data so that contaminant levels and variability can be estimated reliably.

Third, the regression analyses in these figures are generally not appropriate. Contaminant levels appear to be skewed (heavy right tail—take logs?), and clearly they are constrained to be non-negative. Since the analysis devices have detection limits, the data are left censored in the technical statistical sense. Since there are only 2 or 3 years, I think that year-against-year comparisons would be simpler and more appropriate than trying to fit a linear time trend. Figs. 5 and 7 display data where a linear fit is inappropriate: if anything, the data have a curvilinear pattern. (Fig. 8 shows another appalling fit: the projection for 2015 is drastically off target.) Given the non-normality, skewness, censoring, and extremely low sample sizes, I would suggest a different inferential method (permutation tests?), different models (comparisons of annual groups rather than linear trends), and possibly different data treatment (rank tests?).

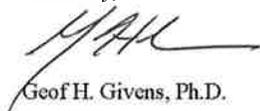
Broadly speaking, the level of statistical sophistication and skill shown in this report is quite amateur and not adequate for the importance of the topic being studied.

The conclusions from these analyses are far too ambitious and don't adequately account for the data deficiencies. One particularly troubling sentence is on p. 27: "The 2015 PCB concentrations in burbot livers are much lower than those from the 2001 study, especially compared to those of similar locations." Remember that there is only a single 2015 burbot—exactly how many livers did it have?! Fig. 9 cannot be used to make a valid statistical test comparing 2015 to 2001. The following sentence is also very troubling: "While only one data point is available for the 2015 study, TPECI/Fisheye find that if additional downstream sampling were conducted, a similar trend, but at further decreased concentrations would be observed." Exactly how do they "find" that? So far as I can tell, there is no basis for this statement. The next sentence states: "The significant decrease in PCB concentrations in burbot livers downstream of the Unit C slough can likely be attributed to the removal of the contaminant source..." Beware of this language: it cannot mean *statistically significant*, and a claim that it means *significant in magnitude* (i.e., substantial) would be remarkably adventurous. This sentence is at best unfounded, at worst deceptive.

I find no convincing evidence that contaminants have decreased in any species. Better data and more appropriate analysis, fully accounting for the massive uncertainties, sampling variability, and data deficiencies are needed. Until then, I would advise dismissing this analysis as unreliable.

If you have any questions, please feel free to ask.

Sincerely,



Geoff H. Givens, Ph.D.

**ASSESSMENT OF PCBs AND DDTs IN
FISH POPULATIONS OF THE COLVILLE RIVER NEAR THE
FORMER UMIAT AIR FORCE STATION
UMIAT, ALASKA**

Prepared for:



LINC ENERGY OPERATIONS, INC.
3000 C Street
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Prepared by



TRAVIS/PETERSON ENVIRONMENTAL CONSULTING, INC.

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&



FISHEYE CONSULTING

P.O. Box 100506
Anchorage, AK 99510

1554-01

November, 2015

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Acronyms and Abbreviations

ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ATSDR	Agency for Toxic Substances and Disease Registry
BLM	Bureau of Land Management
CFS	Cubic Feet per Second
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DINAC	The Department of Indian and Northern Affairs Canada
DoD	Department of Defense
EPA	Environmental Protection Agency
Linc	Linc Energy Operations, Inc.
PCB	Polychlorinated Biphenyl
ppb	Parts per Billion
ppm	Parts per Million
QA/QC	Quality Assurance/Quality Control
SOP	Standard Operating Procedure
TPECI	Travis/Peterson Environmental Consulting, Inc.
USACE	U.S. Army Corps of Engineers

S. T. GRABACKI, page 2 of 2

Awards:

- * **Antarctic Service Medal of the USA**, National Science Foundation
- * **Eagle Scout**, Boy Scouts of America

Affiliations:

- * **American Fisheries Society**
- * **Pacific Fisheries Technologists**

Services:

- * **Chairman, Board of Directors**, since 2011
ALASKA SEALIFE CENTER, Seward
- * **Chairman**, since 2010
ALASKA MINERS ASSOCIATION, Fisheries Committee
- * **Adjunct Faculty**, since 1998
UNIVERSITY OF ALASKA, Anchorage
courses in: **Seafood Supply Chain Management and Fisheries Management**
- * **Board of Directors**, since 2014
RESOURCE DEVELOPMENT COUNCIL FOR ALASKA, Anchorage

Recent Communications:

Grabacki, S.T. 2011 Environmental Limitations and General Impact on Properties of the Catch and Onboard Quality Systems (2 chapters) in: Daczowska-Kozon, E.G. & B. Sun Pan (eds.) Environmental effects on seafood availability, safety and quality issues. CRC Press

Grabacki, S.T. 2010 Mining And Fisheries; coordinator of a 2-day short course for the annual convention of the Alaska Miners Association, Anchorage

Grabacki, S.T., & P.T. Hanley 2008 The Oil / Fisheries Group Of Alaska -- An Early Example Of Inter-Industry Collaboration in: Allee, B.J. (editor) North Aleutian Basin Energy-Fisheries: workshop proceedings. Alaska Sea Grant, University of Alaska Fairbanks

Grabacki S.T. 2008 Sustainable Management Of Alaska's Fisheries: A Primer, A Checklist For Fisheries Resource Management Issues Seen From The Perspective Of The FAO Code Of Conduct For Responsible Fisheries, and several other documents on sustainable Alaska fisheries, available at -- www.alaskaseafood.org/sustainability

Grabacki, S.T., M. Ronchetti, T. Humphrey, & O. Hedgepeth 2006 RFID -- How It Will Transform Packaging, Distribution, and Handling of Alaska Seafood Pacific Fisheries Technologists, Anchorage

Grabacki, S.T. 2005 Fishery Management Regulations and Practices: How They Affect Seafood Quality Collaborative Insights, Global Food Collaborative

Quoter since 1995 Weekly Seafoc Market Information and Price Quotes, KSKA Public Radio

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phone: +1-907-272-5600 ✦ fishyecon@gmail.com

1.0 INTRODUCTION

Linc Energy Operations, Inc. (Linc) contracted Travis/Peterson Environmental Consulting, Inc. (TPECI) and Fisheye Consulting (Fisheye) to investigate organochlorine contaminants, specifically polychlorinated biphenyls (PCBs) and dichlorodiphenyltrichloroethane (DDTs), in the Colville River near the former Umiat Air Force Station in northern Alaska. This investigation included a literature review of all historical studies conducted at the facility and regarding these contaminants in fisheries populations in the Colville River and their potential impacts on subsistence harvests and use in the region. TPECI and Fisheye also conducted a field study at the Umiat facility to assess current PCB and DDT concentrations in various fish species. The field study was conducted in August, 2015.

2.0 SITE DESCRIPTION LOCATION AND DESCRIPTION

2.1 Former Umiat Air Force Station

The former Umiat Air Force Station is an approximately 8,000-acre facility located adjacent to the Colville River, 120 miles south of Prudhoe Bay in northern Alaska (Figure 1). The facility is located at 69.3706° North latitude, -152.1399° West longitude. The facility is located in Sections 9 and 10, Township 1 South, Range 1 West, Umiat Meridian, United States Geological Survey (USGS) Quadrangle.

Around 1944, the site was developed by the United States Department of Defense (DoD). It included the airstrip complex, the main gravel pad, and 11 historical oil well test sites. In 1960, the DoD transferred the site to the U.S. Bureau of Land Management (BLM). Currently, ownership of the developed facilities is divided amongst public entities including Alaska Department of Transportation and Public Facilities, BLM, as well as private ownership by UIC Umiat.

The facility does not house any year-round residents. Temporary workers and site visitors are present at the property occasionally throughout the year. The camp facility is utilized as a staging area for oil and gas exploration and the airfield is often used as a base for hunting in the region.

DoD constructed a 13-acre landfill and closed it in 1973. It was located approximately one-half mile east of the main gravel pad, in a slough of the Colville River (Figure 2). Past activities at the facility, particularly those centered around the old landfill, have resulted in PCB and DDT contamination at the facility. Previous studies have located the source of this contamination at the "Unit C" slough, the location of the old landfill (Ecology & Environment, 2003). Unit C slough is roughly one-half mile long. The slough is fed by Sea Bee Creek and runs into the Colville River. Fish are present in the slough during non-freezing months (Ecology & Environment, 2003).

SUMMARY

An experienced professional with thorough grounding in fisheries biology, environmental studies & documents, and fisheries management.

PRESIDENT (since 1985)

FISHEYE Consulting / GRAYSTAR Pacific Seafood, Ltd., Anchorage
A wide variety of fisheries biology & ecology, baseline & impact studies, and environmental permits & documents. Clients are in the public and private sectors. *Representative projects* –

- * ASM's Responsible Fisheries Management program
- * Fisheries baseline study: Iniskin oil/gas exploration
- * Strategic fisheries-related consultation, Chuitna coal, Pebble LP
- * Third-party FAO-based certification of Alaska fisheries management
- * Fisheries baseline study: Yerrick Creek and Bradley Lake hydroelectric
- * Fisheries baseline study: Lik base metals mine and Pogo Gold
- * EIS coordination, including marine fishes: Chukchi Sea OCS exploration
- * EIS coordination: Endicott causeway
- * Consultation on settlement of EVOS claims by harvesters and processors
- * Plans for Fishery-Based Community Development (SWAMC & CRWP)

SENIOR BIOLOGIST (1981-1985)

DAMES & MOORE, Anchorage
Consulting in commercial fisheries, and economic and environmental impact studies. *Representative projects* –

- * Fisheries biology baselines: Slate Creek asbestos, Quartz Hill molybdenum
- * Environmental baseline & permitting: Unalaska geothermal exploration
- * Bering Sea Commercial Fishing Industry Impact Analysis (MMS)
- * EIS: Wasilla Bypass (New Parks Highway)
- * Bristol Bay Underdeveloped Commercial Fisheries Potential (ADCRA)
- * Fisheries Research Alternatives for the State of Alaska (AVTEC & FITC)

VICE PRESIDENT, OPERATIONS (1976-1978)

GENERAL PRESS COLORS, Ltd., Addison, Illinois
All phases of production, research, & quality assurance operations for a start-up manufacturer of printing-ink pigment dispersions.

RESEARCH ASSISTANT (1974-1976)

SCRIPPS INSTITUTION OF OCEANOGRAPHY
and DEPAUL UNIVERSITY, at McMurdo Station, Antarctica
Basic research in marine biology, including winter-over.

Education:

* **Master of Science, University of Alaska**, Fairbanks, 1981
Major: Fisheries Biology *Minor:* Business Management
Research Topic: Effects of Exploitation on Fish Population Dynamics

* **Bachelor of Science, DePaul University**, Chicago, 1973
Major: Biology *Minor:* Chemistry

Certifications:

* **Certified Fisheries Professional, American Fisheries Society**

-- continued →

2.2 Colville River

The Colville River has its headwaters in the Brooks Range and flows for approximately 450 miles across the coastal plain of Alaska before emptying into the Beaufort Sea. The Colville River is the largest waterway on the North Slope of Alaska and discharges near the mouth of the river has been estimated to be 16,000 cubic feet per second (CFS) (Roguski et al., 1971, cited in Ecology & Environment, 2003). Fish species found within the Colville River include round whitefish, broad whitefish, arctic grayling, ciscos, char, stickleback, salmon, and burbot. Fish populations within the Colville River are a major food source of the local Inupiat Eskimo population in the downstream village of Nuiqsut, Alaska. In 1993, a 33.8% of the total Nuiqsut community resource harvest was fish from the Colville River watershed (ATSDR, 2003). Burbot, specifically their livers, are a favored species within the subsistence harvests for local populations.

3.0 FISH SPECIES OF CONCERN

Freshwater fishes make up more than one-third of all subsistence harvests for the community of Nuiqsut, Alaska, located on the Colville River (ATSDR, 2003). These harvests include salmon, smelt, burbot, char, grayling, and whitefish. Several species, including salmon, smelt, some char, and some whitefish are anadromous (ADF&G, 2015). These species will not be present within the Colville River watershed for the entirety of their life cycle, thus limiting their contact to potential contaminants and minimizing the effects of bioaccumulation of persistent organic contaminants.

Predatory species such as Arctic grayling (*Thymallus arcticus*) and burbot (*Lota lota*) are both high on the food chain and stay within a watershed for their entire lifecycle. These characteristics result in the strong potential for bioaccumulation of persistent organic contaminants and their suitability as indicators of the presence of these contaminants within an aquatic ecosystem. Additionally, these species are part of a regular subsistence diet for the regional population, with burbot livers considered to be a primary food source in Nuiqsut (ATSDR, 2003). Previous studies of the Umiat site and Colville River and the research conducted in 2015 focused on these two species as well as broad whitefish.

3.1 Broad Whitefish (*Coregonus nasus*)

Broad whitefish (*Coregonus nasus*) are an anadromous species. However, extended ocean migrations are not well studied or documented. The majority of adults remain in brackish waters in river delta regions (Morrow, 1980). An upstream spawning migration will occur in northern Alaska over a period of several months, typically August through October (ADF&G, 2015). Spawning typically takes place in small streams with gravel bottoms. Adults will move downstream after spawning and overwinter in deep pools or river delta estuaries (Morrow, 1980).

The species is the largest of the Alaskan whitefishes; mature fish weigh between two and five kilograms (four to 12 lbs) (ADF&G, 2015). The maximum age of fish collected during previous studies in the Umiat area is roughly 14 years old. Growth of this species in arctic regions is

Erik D. Mundahl, P.E.

Environmental Engineer

Employer: Travis/Peterson Environmental Consulting, Inc.
Discipline: Environmental Engineer, State of Alaska Registered Professional Engineer EV14420
Residency: Alaska
Education: B.S. Environmental Engineering, Michigan Technological University - 2009

Biological Science Experience:

General tasks/skills:

- Backpack electrofishing
- Fish collection, identification
- Stream habitat assessment (depth, velocity, substrate assessment, embeddedness, fish cover, riparian buffer assessments, soil compaction, pebble counts, cross section construction, longitudinal stream profiles)
- GPS based wildlife monitoring
- Data management, analyses (spreadsheet, IBI calculations)
- Aquatic invertebrate collection, sorting, identification
- Lab fish maintenance

Research Project Experience:

- Fish population and distribution surveys in streams and rivers of the Inupiat Peninsula, Alaska
- Habitat use and selection by slimy sculpin (*Cottus cognatus*) in coldwater streams of southeastern Minnesota
- Stream habitat assessment for slimy sculpin reintroduction
- Diet assessment of slimy sculpin in coldwater streams
- Feeding rates of slimy sculpin: influence of water temperatures
- Fish communities and stream habitats along a warmwater to coldwater longitudinal stream gradient: South Branch Whitewater
- Long-term monitoring of stream fish communities in southeastern Minnesota trout streams: application of a coldwater index of biotic integrity
- Fish communities in warmwater streams in an agricultural landscape: upper South Branch Root River
- Habitat assessments for stream fish communities: warmwater and coldwater streams (Whitewater River watershed, South Branch Root River)
- Deterioration of stream fish habitats: loss of pool volume to fine sediment deposition
- Effects of livestock grazing management (conventional, rotational) on stream fish communities and stream habitats

Appendix D: Qualifications of the Environmental Professionals

particularly slow. The broad whitefish is primarily a bottom feeder and subsists mostly on chironomids, snails, small mollusks, mosquito larvae, and crustaceans (Morrow, 1980).

3.2 Arctic Grayling (*Thymallus arcticus*)

Arctic grayling (*Thymallus arcticus*) have the largest natural range of any sport fish within the State of Alaska, being found in nearly the entire state with the exception of Kodiak Island, the Aleutian Islands, and portions of Southeast Alaska. Arctic grayling are found throughout the northern latitudes of North America, though their range continues to move northward due to overfishing, competition from introduced species, and habitat loss (ADF&G, 2015).

In Alaska, Arctic grayling will typically reach a length of 10 to 20 inches. The largest recorded Arctic grayling in the State was recorded to be 24 inches (ADF&G, 2015). The fish are particularly long-lived and individuals have been found in Alaska over 32 years old. Grayling will first spawn between the ages of four and seven years old and will continue to spawn regularly throughout their life span.

During summer months, Arctic grayling are voracious feeders. They will strike and consume any potential food source. Their diet consists of primarily aquatic insects including blackflies, caddisflies, stoneflies, as well as small fish and the eggs of other fish species (ADF&G, 2015). Arctic grayling feed minimally during the winter months, conserving energy by occupying lakes or deep, slow moving river pools.

Arctic grayling are known to be highly migratory, utilizing different streams, rivers, and lakes for spawning, juvenile growth, summer feeding, and overwintering. Grayling typically undertake a spring, upstream migration for spawning. Then migrate again for summer feeding. Distances traveled during times of migration can be as little as one kilometer, or up to 100 miles. Arctic grayling populations are found in all reaches of the Colville River and its tributaries (ADF&G, 2015). Their abundance in addition to their aggressive feeding behaviors results in the grayling being a popular and accessible subsistence food source.

3.3 Burbot (*Lota lota*)

Burbot (*Lota lota*) can also be referred to as cusk, lingcod, eel pout, loache, ling, lawyer, lush, or mud shark. The burbot is the only member of the cod family (*Gadidae*) in North America that lives entirely in fresh water (ADF&G, 2015).

In Alaska, burbot will typically reach a length of 15 to 22 inches, but are known to grow as long as 46 inches (ADF&G, 2015). Burbot spawn under the late winter ice of February and March. They are a long-lived species, and burbot older than 20 years are not uncommon in Alaska (ADF&G, 2015). Burbot are extremely predatory, by the age of five years old, they will typically feed entirely on fish, including whitefish, sculpin, lamprey, and other burbot (ADF&G, 2015).

Burbot are a somewhat sedentary species, often resting near the bottom of the stream or river, in deep, slow moving pools or back eddies (Morrow, 1980). Despite the sedentary behavior, burbot

may travel significant distances, upwards of 78 miles, during spawning season (Breaser, et al., 1988). A 2003 study of the seasonal movements of burbot within the Colville River delta showed that burbot frequently moved in and out of shallow, ephemeral streams and backwater of larger rivers and streams, overwintering in deeper lakes or river channels (Moris, 2003). These seasonal migrations for both spawning and overwintering sites results in a changing population distribution and indicates the presence of burbot migration throughout the Colville River system.

4.0 CONTAMINANT CHARACTERISTICS

Polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT) and its breakdown products, dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE), are all persistent, lipophilic organochlorine compounds. The DDT compounds are naturally degraded into DDD and DDE in the environment. However, these chemicals do not fully deteriorate. PCBs, DDTs, as well as DDE and DDD do not break down readily within the environment and due to their lipophilic nature, they tend to bioaccumulate in aquatic food chains. Animals at the upper ends of the food chains, such as predatory fish, fish consuming birds and mammals, often contain the highest concentrations of these contaminants, when present. In fish, these organochlorine compounds are more likely to be found in predatory fish such as burbot or char than in fish whose diet is comprised of primary aquatic invertebrates, lower on the food chain. In an organism, the concentrations of the organochlorine compounds will likely be higher in fatty tissues, including adipose tissue or liver. The high specific gravity of the contaminants also results in their transport through sediments in aquatic environments.

5.0 POINT AND NON-POINT CONTAMINANT SOURCES

5.1 Unit C Slough at Umiat Point Source

The former landfill located at Unit C Slough at Umiat has been identified in previous studies as a point source for both PCB and DDT contamination. Specific information regarding the design, construction, and materials within the former landfill are not readily available. However, the United States Army Corps of Engineers (USACE) has been aware of the presence of these contaminants and the site since the early 1990s and has conducted numerous investigations and cleanup operations.

PCBs were utilized by the DoD for numerous applications until 1979, when their manufacture and use was banned in the United States. Uses included fire retardants, in transformers and capacitors, in motor oil and other lubricants, in caulking, sealants, and other coatings, in fluorescent light ballasts, and for many other industrial purposes. The U.S. Navy noted that PCB compounds, Aroclors 1254 and 1260, were among the most frequently produced and used (Battelle Memorial Institute et al., 2012). Therefore, it is logical that these compounds (1254 and 1260) have been noted in previous studies to have been the most prevalent in water, sediments, and fish tissues in the area of the Unit C Slough at Umiat.

Beginning during the second half of World War II, around the time that the Umiat facility was established, the DoD began using DDT as an insecticide for the control of malaria. Shortly

Confirmation Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015
 Date Extracted: 09/04/2015

Polychlorinated Biphenyls (PCBs)

Sample Name: DB1_Liver
 Lab Code: K1509159-012
 Extraction Method: EPA 3541
 Analysis Method: 8082A

Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	MRL	MDL	Primary Result	Confirmation Result	RPD	Q	Dilution Factor	Date Analyzed
Aroclor 1260	8.0	2.8	15	23	42.1	P	1	09/16/15

Confirmation Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015
 Date Extracted: 09/04/2015

Linc Energy Operations, Inc., 1554-01
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11/15/2015
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Polychlorinated Biphenyls (PCBs)

Sample Name: SG2
 Lab Code: K1509159-005
 Extraction Method: EPA 3541
 Analysis Method: 8082A

Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	MRL	MDL	Primary Result	Confirmation Result	RPD	Q	Dilution Factor	Date Analyzed
Aroclor 1254	9.8	2.8	9.2	11	17.8	J	1	09/15/15
Aroclor 1260	9.8	2.8	5.3	6.2	15.7	J	1	09/15/15

thereafter and until the early 1970s, it was used heavily as a commercial insecticide (Bates, 2007).

Mosquitoes are found in extreme abundance on the Alaska Coastal Plain and in the Umiat area due to optimal climatic conditions during the summer months (Gjullin, C.M. et al., 1961). To control the mosquito populations, the DoD and subsequent users of the facility likely used DDT extensively to control mosquito populations at the site. Previous studies have found varying concentrations of DDT and its breakdown products DDE and DDD in the soils, water, and fish tissues around Umiat.

5.2 Non-Point Sources

Many studies have documented the presence of persistent organic contaminants such as PCBs or organochloride pesticides in the surface waters, sediments and fish tissues in arctic ecosystems (Muir and Lockhart, 1994a, 1994b, 1997; Palmer, 1994; McCarthy et al., 1997; Ewald et al., 1998). Very few point sources for these persistent organic contaminants exist within these arctic ecosystems. As a result, many researchers have sought to determine the source for this contamination or otherwise explain its continued presence. Prevailing theories indicate that the presence of the persistent organic contaminants in aquatic arctic ecosystems may be attributed to the deposition of pollutant through atmospheric transport (McCarthy et al., 1997; Ewald et al., 1998).

The mechanism for this deposition occurs when contaminants originating in warmer climates are volatilized and transported in water vapor form by upper atmospheric winds. The direction of contaminant transport is typically believed to be toward the Polar Regions. Contaminant laden vapors condense and are deposited in colder climates. Condensation temperatures vary for different contaminants and the condensation characteristics for contaminant species may result in a global fractioning of contaminant deposition. This process is referred to as global distillation. As these persistent organic contaminants are deposited in arctic aquatic or terrestrial ecosystems, they have the potential to bio-accumulate due to their lipophilic nature. The fractionation of contaminants into subspecies can alter the original contaminant's identifying signature, potentially allowing a foreign chemical or contaminant to be distinguished from a local, point source.

Theories into the biotransport of contaminants have been established within the past several decades as studies have sought to explain the process by which contaminants accumulate in fish tissues and how these contaminants move among different ecosystems (Ewald et al., 1998). Numerous species of anadromous fish potentially accumulate contaminants through their diet, contact with contaminated water, and contact with contaminated sediments during their time in the ocean as well as migratory periods within freshwater environments. These anadromous fishes accumulate lipid stores for energy needed during spawning migration. As a result, a concomitant accumulation of lipophilic pollutants occurs. When spawning fish die, their carcasses become a source of nutrients and organic matter to the freshwater ecosystem. It is evident then, that migrating fish can act as vectors of organic contaminants between ecosystems. As an example, organic pollutants have been transported to inland Alaska lakes by sockeye

salmon (Ewald et al., 1998). This biotransport process has also been documented in the Great Lakes with anadromous Steelhead and Atlantic Salmon.

The Unit C Slough at Umiat is a likely point source contributor of organic contaminants within the Colville River. However, it is equally likely that both atmospheric transport and biotransport also contribute PCBs and DDTs to the biota of the Colville River system. The Colville River watershed is located entirely within arctic latitudes. As such, atmospheric transported contaminants are more likely to condense and be deposited in this region. Additionally, the Colville River has numerous anadromous fish runs, including several species of whitefish (*Coregonus* spp.), Chum salmon (*Oncorhynchus keta*), Pink salmon (*O. gorbuscha*), and Dolly Varden (*Salvelinus malma*) (Burr, 1999). Anecdotally, Inupiat Eskimo residents of the region have also reported a Chinook salmon (*O. tshawytscha*) run in the Colville River. All of these species, with the exception of Pink Salmon, have been found upstream past Umiat (Burr, 1999).

The Department of Indian and Northern Affairs Canada (DINAC) published data on contaminant levels in biota, water, and sediments of freshwater and marine ecosystems in northern Canada (Muir and Lockhart, 1994, DINAC, 1997). In their research, whole fish, fish muscle, and fish livers were analyzed for 130 individual organochlorine compounds, including PCB congeners and DDT and its breakdown products.

A 1998 Ecology & Environment study for the USACE (described in detail in subsequent Sections) found that total PCB mean concentrations detected in burbot livers of fish collected from the upstream reaches of the Colville River (123.70 ppb) were similar to the lower ranges of total PCB concentrations found in the DINAC studies (26.9 ppb to 136 ppb). Burbot livers results from fish samples collected in the Unit C slough at Umiat and downstream reaches of the Colville were significantly higher (468.05 ppb and 665.00 ppb, respectively) and were similar to higher PCB concentrations found in the DINAC studies in Lake Laberge, Canada (836 ppb to 1,300 ppb). DINAC studies note Lake Laberge's proximity to Whitehorse, Yukon, and the potential for point source contributions in addition to both atmospheric depositions. Additionally, the burbot in Lake Laberge likely feed at a higher trophic level than top predator fish in other reference waters. Higher trophic levels would result in the potential for greater biomagnification and bioaccumulation of contaminants.

A similar comparison of the 1998 Ecology & Environment and the DINAC studies found that DDT concentration detected in burbot livers of fish collected in the main channel of the Colville River (86.47 ppb to 448.40 ppb) were similar to the lower values of DDT mean concentrations detected in burbot from lakes and rivers in northern Canada. The DDT concentrations detected in burbot livers of fish collected from the Unit C Slough at Umiat (1,029.80 ppb) were more closely similar to the higher ranges in the DINAC study data from Lake Laberge (1,578 ppb to 4,000 ppb). Again, DDT concentrations in Lake Laberge were likely associated with nearby point sources.

Numerous studies have determined that atmospheric transport and biotransport of contaminants is likely impacting arctic ecosystems. The role that these transport mechanisms play in the total contaminant concentrations within the biota is not insignificant as shown in the 1998 Ecology & Environment study and the DINAC studies. These previous studies, as well as other published

CA/QC Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal tissue
Service Request: K1509159
Date Extracted: 09/04/2015

Extraction Prep Log
Polychlorinated Biphenyls (PCBs)

Extraction Method: EPA 3541
Analysis Method: 8082A
Extraction Lot: KWG1508475
Level: Low

Sample Name	Lab Code	Date Collected	Date Received	Sample Amount	Final Volume	% Solids	Note
UG1	K1509159-001	08/08/15	08/20/15	22.714g	4ml	NA	
UG2	K1509159-002	08/08/15	08/20/15	20.011g	4ml	NA	
UG3	K1509159-003	08/08/15	08/20/15	20.991g	4ml	NA	
SG1	K1509159-004	08/08/15	08/20/15	20.976g	4ml	NA	
SG2	K1509159-005	08/08/15	08/20/15	20.547g	4ml	NA	
SG3	K1509159-006	08/08/15	08/20/15	20.587g	4ml	NA	
SG4	K1509159-007	08/08/15	08/20/15	20.755g	4ml	NA	
DG1	K1509159-008	08/08/15	08/20/15	20.641g	4ml	NA	
DG2	K1509159-009	08/08/15	08/20/15	20.357g	4ml	NA	
DG3	K1509159-010	08/08/15	08/20/15	20.956g	4ml	NA	
DB1_Fillet	K1509159-011	08/08/15	08/20/15	20.694g	4ml	NA	
DB1_Liver	K1509159-012	08/08/15	08/20/15	12.577g	2ml	NA	
Method Blank	KWG1508475-7	NA	NA	23.745g	4ml	NA	
UG1MS	KWG1508475-4	08/08/15	08/20/15	20.486g	4ml	NA	
UG1DMS	KWG1508475-5	08/08/15	08/20/15	20.843g	4ml	NA	
Lab Control Sample	KWG1508475-6	NA	NA	20.000g	4ml	NA	

Results flagged with an asterisk (*) indicate the holding time was exceeded for the analysis

QA/QC Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001

Service Request: K1509159

Line Energy Operations, Inc., 1554-01
Assessment of PCBs and DDTs in Fish Populations of the Colville River Near Umiat, AK

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Analysis Run Log
Polychlorinated Biphenyls (PCBs)

Analysis Method: 8082A

Analysis Lot: KWG1509033
Instrument ID: GC27.i
Column: DB-35MS

File ID	Sample Name	Lab Code	Date Analysis Started	Start Time	Q	Date Analysis Finished	Finish Time
0915F003.D	Continuing Calibration Verification	KWG1509033-1	9/15/2015	15:25		9/15/2015	15:25
0915F004.D	Instrument Blank	KWG1509033-2	9/15/2015	15:49		9/15/2015	15:49
0915F005.D	ZZZZZ	ZZZZZ	9/15/2015	16:13		9/15/2015	16:13
0915F006.D	ZZZZZ	ZZZZZ	9/15/2015	16:37		9/15/2015	16:37
0915F007.D	ZZZZZ	ZZZZZ	9/15/2015	17:01		9/15/2015	17:01
0915F008.D	ZZZZZ	ZZZZZ	9/15/2015	17:24		9/15/2015	17:24
0915F009.D	Continuing Calibration Verification	KWG1509033-3	9/15/2015	17:48		9/15/2015	17:48
0915F010.D	Instrument Blank	KWG1509033-4	9/15/2015	18:12		9/15/2015	18:12
0915F011.D	UG1	K1509159-001	9/15/2015	18:36		9/15/2015	18:36
0915F012.D	UGIMS	KWG1508475-4	9/15/2015	18:59		9/15/2015	18:59
0915F013.D	UG1DMS	KWG1508475-5	9/15/2015	19:23		9/15/2015	19:23
0915F014.D	UG2	K1509159-002	9/15/2015	19:46		9/15/2015	19:46
0915F015.D	UG3	K1509159-003	9/15/2015	20:10		9/15/2015	20:10
0915F016.D	SG1	K1509159-004	9/15/2015	20:33		9/15/2015	20:33
0915F017.D	SG2	K1509159-005	9/15/2015	20:57		9/15/2015	20:57
0915F018.D	SG3	K1509159-006	9/15/2015	21:20		9/15/2015	21:20
0915F019.D	SG4	K1509159-007	9/15/2015	21:44		9/15/2015	21:44
0915F020.D	DG1	K1509159-008	9/15/2015	22:07		9/15/2015	22:07
0915F021.D	Continuing Calibration Verification	KWG1509033-5	9/15/2015	22:31		9/15/2015	22:31
0915F022.D	Instrument Blank	KWG1509033-6	9/15/2015	22:54		9/15/2015	22:54
0915F023.D	DG2	K1509159-009	9/15/2015	23:18		9/15/2015	23:18
0915F024.D	DG3	K1509159-010	9/15/2015	23:41		9/15/2015	23:41
0915F025.D	DB1_Filter	K1509159-011	9/16/2015	00:05		9/16/2015	00:05
0915F026.D	Lab Control Sample	KWG1508475-6	9/16/2015	00:28		9/16/2015	00:28
0915F027.D	Method Blank	KWG1508475-7	9/16/2015	00:52		9/16/2015	00:52
0915F028.D	Continuing Calibration Verification	KWG1509033-7	9/16/2015	01:15		9/16/2015	01:15
0915F029.D	Instrument Blank	KWG1509033-8	9/16/2015	01:39		9/16/2015	01:39
0915F030.D	DB1_Liver	K1509159-012	9/16/2015	02:02		9/16/2015	02:02
0915F031.D	Continuing Calibration Verification	KWG1509033-9	9/16/2015	02:26		9/16/2015	02:26
0915F032.D	Instrument Blank	KWG1509033-10	9/16/2015	02:49		9/16/2015	02:49

Results flagged with an asterisk (*) indicate the holding time was exceeded for the analysis

research, find that atmospheric transport and biotransport are likely contributing to contaminant concentrations in fish populations in the Colville River. They also indicated that at one point in time, a point source of both PCB and organochlorine (DDT) contaminants were present in the Unit C Slough at Umiat.

6.0 PREVIOUS STUDIES

Numerous previous studies have been conducted regarding PCB and DDT contamination in the Colville River, the effects of point-source contamination from the Unit C Slough at Umiat, and the impact on the utilization of subsistence food sources by the regional population. These studies have been primarily funded by U.S. federal agencies including the USACE, The U.S. Department of Health and Human Services, and the National Science Foundation. The scope of the studies varies widely, but all focus on the impacts of these contaminants pointing towards the source at Umiat as a primary concern.

The first studies of the PCB and DDT contamination in fish tissues in the Colville River at the Umiat site were conducted in August, 1997 by the private consulting firm Ecology & Environment. This study was contracted by the USACE. A follow-up study was conducted in August, 1998, also by Ecology & Environment under contract again by the USACE. The initial focus of these studies was a broad assessment of contamination throughout the entire Former Air Force Station at Umiat and included soil, groundwater, sediment, fish tissue, and other investigations.

In 2001, The U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry (ATSDR) conducted a review of the 1997 and 1998 Ecology & Environment studies for the completion of a Health Consultation and evaluation of the impacts of these contaminants on subsistence food sources.

In August, 2001, Ecology & Environment conducted a third study, focusing exclusively on fish tissues and included multiple reaches of the Colville River system. This study was also contracted by the USACE and was more in depth than any previous investigation into PCBs and DDTs within the river biota. The study also compared the data from the Colville River to background data from northern Canada identifying both point and non-point source inputs.

ATSDR conducted a review of the 2001 Ecology & Environment study and prepared a Health Consultation in 2003. This Health Consultation, similar to the one published by ATSDR in 2001 looked at the findings of the Ecology & Environment study and determined potential impacts on subsistence food sources and risk to the regional population. During their 2001 and 2003 reviews and reports, ATSDR did not collect any original data, but relied solely on data available from the Ecology & Environment findings.

One additional study was conducted in July, 2004 by Dr. Jesse Ford of Oregon State University Department of Fisheries and Wildlife. The findings and data of this study were never published or made publicly available. No report or other information regarding the scope of this study, fish species collected, or any other data is available and as a result it has not been included within this assessment.

6.1 Study Sampling Ranges

6.1.1 1997 Ecology & Environment Study

The August, 1997 Ecology & Environment study was focused exclusively at the Former Umiat Air Force Station and the development within the immediate vicinity of the facility. The fish collected as part of this study were only obtained for the Unit C Slough and from the main channel of the Colville River nearby.

6.1.2 1998 Ecology & Environment Study

Based on the findings of the 1997 study, Ecology & Environment expanded the sample collection range for the 1998 investigation. Fish for this study were collected in the Unit C Slough at Umiat, approximately four miles downstream from the Former Umiat Air Force Station, and approximately four miles upstream of the facility.

6.1.3 2001 Ecology & Environment Study

The August, 2001 Ecology & Environment study was designed as a comprehensive assessment of PCBs and DDTs in burbot throughout a significant length of the Colville River system. A total of seven reaches were established to serve as sampling segments. The length of the individual reaches varied significantly.

Reaches one through five were located downstream of the Former Umiat Air Force Station. These reaches stretched a total downstream distance of approximately 90 miles. These reaches included areas of the river in close proximity to the Village of Nuiqsut, where subsistence use occurs. Many of these reaches were established in an effort to isolate potential impacts from major tributary rivers. Reach six was established entirely within the Unit C slough at Umiat to determine if drainage from the landfill site was contributing to contamination in the slough and the Colville River as a whole. The seventh and final reach was established approximately 20 miles upriver from the Former Umiat Air Force Station. This distance was selected as it was assumed that it would be far enough upriver to limit any direct impacts from the Umiat facility.

6.2 Study Fish Species, Sample Methodology, and Sample Quantities

The sample size and speciation of the studies changed from 1997 through 2001 as each subsequent study became more focused on both impacts to fish and the broader concern of impacts to subsistent uses through consumption of preferred species.

6.2.1 1997 Ecology & Environment Study

The 1997 Ecology & Environment study collected a total of 20 Arctic grayling (*Thymallus arcticus*) for sampling analysis for PCBs. Fourteen fish were collected entirely within the Unit C slough at the Former Umiat Air Force Station. An additional six fish were collected approximately one mile upstream of the confluence of the Unit C slough and the Colville River.

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001

QA/QC Results

Service Request: K1509159
 Date Analyzed: 09/16/2015

Continuing Calibration Verification Summary Polychlorinated Biphenyls (PCBs)

Calibration Type: External Standard
 Analysis Method: 8082A

Calibration Date: 10/18/2014
 Calibration ID: CAL13624
 Analysis Lot: KWG1509033
 Units: ng/mL
 Column ID: DB-XLB

File ID: \\ALKLSWS002\INSTDATA\GC27\DATA\091515_RB\0915F031.D

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
Decachlorobiphenyl	50	52	82400	85700	4	NA	± 20	AverageRF
Aroclor 1016 {1}	500	45C	1840	1650	-10	NA	± 100	AverageRF
Aroclor 1016 {2}	500	46C	2430	2220	-9	NA	± 100	AverageRF
Aroclor 1016 {3}	500	42C	3000	2540	-15	NA	± 100	AverageRF
Aroclor 1016 {4}	500	4C	2200	1930	-12	NA	± 100	AverageRF
Aroclor 1016 {5}	500	4C	2160	1890	-13	NA	± 100	AverageRF
Aroclor 1016	500	4C	NA	NA	NA	-12	± 20	NA
Aroclor 1260 {1}	500	49C	2210	2150	-3	NA	± 100	AverageRF
Aroclor 1260 {2}	500	51C	3780	3880	3	NA	± 100	AverageRF
Aroclor 1260 {3}	500	51C	3610	3700	2	NA	± 100	AverageRF
Aroclor 1260 {4}	500	51C	8630	8860	3	NA	± 100	AverageRF
Aroclor 1260 {5}	500	50C	5590	5630	1	NA	± 100	AverageRF
Aroclor 1260	500	51C	NA	NA	NA	1	± 20	NA

Results flagged with an asterisk (*) indicate values outside control criteria.

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001

Service Request: K1509159
Date Analyzed: 09/16/2015

Linc Energy Operations, Inc., 1554-01
Assessment of PCBs and DDTs in Fish Populations of the Colville River Near Umiat, AK

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Continuing Calibration Verification Summary
Polychlorinated Biphenyls (PCBs)

Calibration Type: External Standard
Analysis Method: 8082A

Calibration Date: 10/18/2014
Calibration ID: CAL13624
Analysis Lot: KWG1509033
Units: ng/mL
Column ID: DB-35MS

File ID: \\ALKLSWS002\INSTDATA\GC27\DATA\091515_B\0915F031.D

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
Decachlorobiphenyl	50	55	158000	174000	10	NA	± 20	AverageRF
Aroclor 1016 {1}	500	500	3590	3570	-1	NA	± 100	AverageRF
Aroclor 1016 {2}	500	480	3000	2900	-3	NA	± 100	AverageRF
Aroclor 1016 {3}	500	430	9890	8490	-14	NA	± 100	AverageRF
Aroclor 1016 {4}	500	460	4960	4530	-9	NA	± 100	AverageRF
Aroclor 1016 {5}	500	450	5180	4620	-11	NA	± 100	AverageRF
Aroclor 1016	500	460	NA	NA	NA	-7	± 20	NA
Aroclor 1260 {1}	500	460	9850	9160	-7	NA	± 100	AverageRF
Aroclor 1260 {2}	500	500	8110	8150	0	NA	± 100	AverageRF
Aroclor 1260 {3}	500	500	8230	8300	1	NA	± 100	AverageRF
Aroclor 1260 {4}	500	510	18800	19000	1	NA	± 100	AverageRF
Aroclor 1260 {5}	500	520	14200	14800	4	NA	± 100	AverageRF
Aroclor 1260	500	500	NA	NA	NA	0	± 20	NA

Results flagged with an asterisk (*) indicate values outside control criteria.

These fish were intended to be collected as background samples. All Arctic grayling were collected by fly fishing. Despite the study design and intentions, no whitefish or burbot were caught or collected in 1997. This is likely because the fly fishing sample collection methods were not conducive to attracting whitefish or burbot.

6.2.2 1998 Ecology & Environment Study

The 1998 Ecology & Environment study was designed to expand on the 1997 research. As the 1997 results yielded indications of contaminants present in the fish populations, further work was necessary to determine if the point source at the Unit C slough at Umiat was a significant cause and whether other species were also impacted.

During this study, five broad whitefish (*Coregonus nasus*) and three burbot (*Lota lota*) were captured and submitted for laboratory analysis at the upstream site, approximately four miles upriver of the Former Umiat Air Force Station. Five broad whitefish and two burbot were captured in the Unit C slough at the Umiat facility. Five broad whitefish and two burbot were captured at the downstream site, approximately four miles downriver from the Former Umiat Air Force Station.

Ecology & Environment utilized baited hoop nets for the capture of burbot. Hoop nets were 10 feet in length with a two foot diameter opening. Hoops were held rigid with lengths of PVC piping. The nets were baited with locally caught Arctic grayling, char, and whitefish. Two hoop nets were fished at each of the three locations for eight days. Due to poor success rates, an additional hoop net was placed at the downstream site for six days.

Gill nets were used for the collection of broad whitefish. Gill nets were 125 feet in length, and six feet deep. One gill net was set at each sampling site and was fished until the required number of whitefish was collected. The gill nets were fished for five days at the upstream site, and two days each at the Unit C slough site and the downstream site. Due to the traveling distance between sites, the gill nets were not attended and were checked once daily.

Due to poor success rates of burbot capture, the use of a baited long line was also attempted for a five day period. However, no fish were captured using this method. While the original study planned for the collection of Arctic grayling, Ecology & Environment determined that it was not necessary based on the number of broad whitefish collected.

6.2.3 2001 Ecology & Environment Study

Based on the data from the 1998 study, Ecology & Environment determined that low sample numbers from captured burbot resulted in inconclusive research outcomes. However, it did indicate a possible trend of elevated PCB and DDT concentrations in burbot downstream of the Unit C slough at Umiat. Burbot are the most abundant resident predatory fish in the Colville River watershed, and as persistent organic contaminants such as PCBs and DDTs are known to bioaccumulate at higher trophic levels, the burbot was selected as the target species for evaluating risk factors to subsistence users.

Baited hoop nets were again used for the capture of burbot during this study. Hoop net construction was identical to those used in 1998, consisting of 10-foot long hoops with a two foot diameter opening. Hoop nets were baited with locally captured whitefish. Hoop nets were primarily set in pools that were formed on downstream ends of alder and willow lined embankments. The river currents tended to undercut these soil embankments, causing shoreline vegetation to collapse into the river channel, forming underwater habitat. Hoop nets were typically set by wading into the channel, but were deployed by boat and anchored to the river bank where depth limited access.

Baited long lines, both shore based and temporary buoy based, were also initially used. Hooks were baited using pieces of a locally captured whitefish. The long lines were found to not be successful for the capture of burbot and were phased out after five days with the capture of only a single burbot.

Three hoop nets were initially deployed in each of the seven reaches. Once 10 burbot were captured in a reach, the hoop nets were reallocated to the remaining reaches until 10 burbot were captured in all seven reaches. The total time (in days) of nets actively fishing each reach was not listed within the Ecology & Environment report. However, it is stated that a period of greater than 13 days was spent fishing some reaches.

Once preferred burbot habitat was identified, capture success of the hoop nets was found to be a function of river stage. Rising water levels led to greater catch rates (Ecology & Environment, 2001). Within one reach, after fishing for 13 days using up to eight hoop nets, only two fish had been captured. Heavy precipitation and flood conditions then occurred, forcing burbot to move towards vegetative shelter along the river banks, increasing catch rates significantly (up to 12 fish in a single net per day).

During the study, the majority of the fish captured within the hoop nets were burbot. No numbers or other information were recorded on incidentally captured fish, but species caught included (in order of abundance) Arctic grayling, longnose sucker (*Catostomus catostomus*), broad whitefish, arctic char (*Salvelinus alpinus*), sculpin (*Myoxocephalus quadricornis*), lake trout (*Salvelinus namaycush*), and northern pike (*Esox Lucius*).

6.3 Study Results and Conclusions

6.3.1 1997 Ecology & Environment Study

The 1997 Ecology & Environment study focused on Arctic grayling captured within the Unit C slough at the Former Umiat Air Force Station. A total of 14 fish were collected at the site. All fish were submitted for laboratory analysis. Of these 14, seven fish were analyzed for PCBs looking at whole body content, and the other seven were analyzed for PCBs for just the fillets.

PCB Aroclor 1254 was detected in three of the seven whole body samples, ranging in concentrations from 48 µg/Kg to 1,400 µg/kg. Four of the seven analyzed fillets detected PCBs (Aroclor 1254) in concentrations ranging from 19 µg/Kg to 460 µg/kg. PCBs were not detected in the six Arctic grayling (three whole body samples and three fillets) collected approximately

QA/QC Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001

Service Request: K1509159
Date Analyzed: 09/16/2015

**Continuing Calibration Verification Summary
 Polychlorinated Biphenyls (PCBs)**

Calibration Type: External Standard
Analysis Method: 8082A

Calibration Date: 10/18/2014
Calibration ID: CAL13624
Analysis Lot: KWG1509033
Units: ng/mL
Column ID: DB-XLB

File ID: \\ALKLSWS002\INSTRDATA\GC27\DATA\091515_RB\0915F028.D

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
Decachlorobiphenyl	50	52	82400	85800	4	NA	± 20	AverageRF
Aroclor 1216 {1}	500	430	1840	1590	-14	NA	± 100	AverageRF
Aroclor 1216 {2}	500	430	2430	2100	-14	NA	± 100	AverageRF
Aroclor 1216 {3}	500	420	3000	2530	-16	NA	± 100	AverageRF
Aroclor 1216 {4}	500	430	2200	1870	-15	NA	± 100	AverageRF
Aroclor 1216 {5}	500	430	2160	1830	-15	NA	± 100	AverageRF
Aroclor 1216	500	430	NA	NA	NA	-15	± 20	NA
Aroclor 1260 {1}	500	470	2210	2090	-5	NA	± 100	AverageRF
Aroclor 1260 {2}	500	500	3780	3820	1	NA	± 100	AverageRF
Aroclor 1260 {3}	500	510	3610	3690	2	NA	± 100	AverageRF
Aroclor 1260 {4}	500	510	8630	8870	3	NA	± 100	AverageRF
Aroclor 1260 {5}	500	520	5590	5840	5	NA	± 100	AverageRF
Aroclor 1260	500	510	NA	NA	NA	1	± 20	NA

Results flagged with an asterisk (*) indicate values outside control criteria.

ALS Group USA, Corp. dba ALS Environmental

QA/QC Results

Client: GRAYSTAR Pacific Seafood, Ltd,
Project: Umiat Fish/30118-001

Service Request: K1509159
Date Analyzed: 09/16/2015

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Continuing Calibration Verification Summary
Polychlorinated Biphenyls (PCBs)

Calibration Type: External Standard
Analysis Method: 8082A

Calibration Date: 10/18/2014
Calibration ID: CAL13624
Analysis Lot: KWG1509033
Units: ng/mL
Column ID: DB-35MS

File ID: \\ALKLSWS002\INSTDATA\GC27\DATA\091515.B\0915F028.D

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
Decachlorobiphenyl	50	54	158000	172000	9	NA	± 20	AverageRF
Aroclor 1016 {1}	500	540	3590	3890	8	NA	± 100	AverageRF
Aroclor 1016 {2}	500	510	3000	3060	2	NA	± 100	AverageRF
Aroclor 1016 {3}	500	440	9890	8650	-13	NA	± 100	AverageRF
Aroclor 1016 {4}	500	480	4960	4780	-4	NA	± 100	AverageRF
Aroclor 1016 {5}	500	470	5180	4880	-6	NA	± 100	AverageRF
Aroclor 1016	500	490	NA	NA	NA	-2	± 20	NA
Aroclor 1260 {1}	500	480	9850	9470	-4	NA	± 100	AverageRF
Aroclor 1260 {2}	500	510	8110	8300	2	NA	± 100	AverageRF
Aroclor 1260 {3}	500	520	8230	8530	4	NA	± 100	AverageRF
Aroclor 1260 {4}	500	520	18800	19500	4	NA	± 100	AverageRF
Aroclor 1260 {5}	500	530	14200	15200	7	NA	± 100	AverageRF
Aroclor 1260	500	510	NA	NA	NA	3	± 20	NA

one mile upriver of the confluence of the Unit C slough and the main channel of the Colville River. Mean concentrations for PCBs captured in the slough were calculated to be 25 µg-PCB/Kg and 18 µg-PCB/Kg for fillet and whole body tissues samples, respectively.

While the primary focus of the analysis was on PCBs, DDT and its breakdown products DDD and DDE were also identified, but not quantified in the fish tissues. The scope of the study did not originally intend to include an investigation of DDT or its breakdown products, and as such, detailed laboratory analysis was not conducted. The presence of DDT, DDD, and DDE within the grayling may indicate a point source of these contaminants within the Unit C slough at Umiat. However, the extent or probability of this source could not be determined, due to the lack of quantifiable data.

6.3.2 1998 Ecology & Environment Study

The 1998 Ecology & Environment study included PCB and DDT analysis for fish collected from the Unit C slough at the Former Umiat Air Force Station as well as sampling sites located four miles upstream and four miles downstream of the facility. A total of 15 broad whitefish and seven burbot were collected from the three sampling locations.

Five broad whitefish were collected from each of the three sampling sites. All 15 fish samples were found to have detectable levels of PCBs and DDTs. PCB compounds, Aroclors 1242/1016, 1254, and 1260 were all detected. Whitefish samples at the upstream location had PCB concentrations ranging from 2.2 to 8.3 µg/Kg. DDT concentrations in the whitefish at this site ranged from 0.5 to 1.3 µg/Kg. Whitefish collected from the Unit C slough were found to have PCB concentrations ranging from 4.1 to 39.1 µg/Kg and DDT concentrations from 0.5 to 2.2 µg/Kg. Whitefish collected from the downstream sampling site had PCB concentrations ranging from 2.4 to 6.0 µg/Kg and DD concentrations from 0.7 to 1.0 µg/Kg.

Seven whole body burbot samples were collected from the three sampling sites. Three samples were collected from the upstream location, two of which were found to have detectable concentrations of PCBs (1.2 to 1.3 µg/Kg). DDTs were detected in all three samples with concentrations ranging from 0.3 to 0.6 µg/Kg. Two whole body burbot samples were collected from the Unit C slough site. Both samples were found to contain detectable concentrations of PCBs and DDTs ranging from 3.3 to 18.2 µg/Kg and 4.1 to 34.9 µg/Kg, respectively. The two whole body burbot samples collected from the downstream site were found to have PCB concentrations ranging from 1.2 to 8.1 µg/Kg and DDT concentrations from 0.7 to 4.4 µg/Kg.

A total of seven burbot livers were collected for analysis from the three sampling sites. Three samples were collected from the upstream location, all were found to have PCB concentrations ranging from 119.1 to 126 µg/Kg. DDT concentrations in these samples ranged from 71.1 to 106.9 µg/Kg. The two burbot liver samples from the Unit C slough sampling location were found to have PCB concentrations of 270 µg/Kg and 1,060 µg/Kg and DDT concentrations of 704.6 µg/Kg and 1,355 µg/Kg. The two burbot liver samples collected from the downstream site were found to contain PCB concentrations ranging from 256.1 to 680 µg/Kg and DDTC concentrations from 174.3 to 722.5 µg/Kg.

Results flagged with an asterisk (*) indicate values outside control criteria.

During their investigation, Ecology & Environment reviewed both their data collected during August, 1998 as well as the findings of other investigators and determined that atmospheric transport and biotransport are likely contributing to persistent organic contaminant concentrations in the fish tissues of several species in the Colville River.

The findings note that a point source of contaminants, both PCBs and DDTs is likely located at the Unit C slough at Umiat. The Ecology & Environment statistical analysis found that the source does not appear to be significantly affecting the whitefish population in the remainder of the Colville River. However, despite weak supporting data due to small sample size, Ecology & Environment found that the burbot population of the Colville River downstream of the Unit C slough may have elevated concentrations of persistent organic contaminants including PCBs and DDTs. Ecology & Environment recommended that an additional study be conducted with larger burbot population sampling size to confirm these findings.

6.3.3 2001 Ecology & Environment Study

The 2001 Ecology & Environment study collected a total of 70 burbot from seven sampling reaches (10 burbot per reach) on the Colville River. The liver of each fish was removed by the laboratory prior to sample analysis. Both whole body fish and liver analysis was done for each fish collected. Samples were analyzed for PCBs, DDT, and its breakdown products.

The analytical data for PCBs, individual Aroclors, and DDTs were evaluated by Ecology & Environment for any potential flood bias as a portion of their sample collection period was divided by a river flood event. The data from all seven reaches were pooled for each of the analyte groups. Ecology & Environment determined that no statistically significant differences were found comparing results from fish collected before and after the flooding began. A similar assessment was made within the data for each individual reach. All burbot from Reaches 1, 2, and 7 were collected prior to flooding. Ecology & Environment found no statistical differences for the sample results from the remaining reaches (Reaches 3, 4, 5, and 6) where burbot were collected both before and during the flood event.

Ecology & Environment found that livers contained higher concentrations of persistent organic contaminants than whole body samples, as was anticipated. However, the results of both liver and whole body sampling displayed the same general trends throughout the various analyses.

Reviewing the data, the seven samples with the highest PCB concentrations within the study were all collected from Reach 6, contained fully within the Unit C slough at Umiat. Those sample concentrations ranged from 896 µg/Kg to 3,389 µg/Kg. Average concentrations for PCBs in each of the seven study reaches ranged from a maximum of 887 µg/Kg in Reach 6 to a minimum of 106 µg/Kg in Reach 5, near the village of Nuiqsut. While Reaches 1 and 2 are located closer to the Unit C slough, the upstream sampling reach (Reach 7) had the second highest average PCB concentrations (449 µg/Kg). Reach 4 (445 µg/Kg) also was found to have higher average concentrations than Reach 1 (200 µg/Kg) and 2 (297 µg/Kg), the reaches located immediately downstream of the slough.

QA/QC Results

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Project: Umiat Fish/30118-001

Service Request: K1509159
Date Analyzed: 09/15/2015

Continuing Calibration Verification Summary
Polychlorinated Biphenyls (PCBs)

Calibration Type: External Standard
Analysis Method: 8082A

Calibration Date: 10/18/2014
Calibration ID: CAL13624
Analysis Lot: KWG1509033
Units: ng/mL
Column ID: DB-XLB

File ID: \\ALKLSWS002\UNSTDATA\GC27\DATA\091515_R_B\0915FC21.D

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
Decachlorobiphenyl	50	51	82400	84500	3	NA	± 20	AverageRF
Aroclor 1016 {1}	500	430	1840	1580	-14	NA	± 100	AverageRF
Aroclor 1016 {2}	500	430	2430	2080	-14	NA	± 100	AverageRF
Aroclor 1016 {3}	500	420	3000	2520	-16	NA	± 100	AverageRF
Aroclor 1016 {4}	500	420	2200	1840	-16	NA	± 100	AverageRF
Aroclor 1016 {5}	500	420	2160	1810	-16	NA	± 100	AverageRF
Aroclor 1016	500	420	NA	NA	NA	-15	± 20	NA
Aroclor 1260 {1}	500	460	2210	2040	-8	NA	± 100	AverageRF
Aroclor 1260 {2}	500	500	3780	3750	-1	NA	± 100	AverageRF
Aroclor 1260 {3}	500	500	3610	3620	0	NA	± 100	AverageRF
Aroclor 1260 {4}	500	500	8630	8710	1	NA	± 100	AverageRF
Aroclor 1260 {5}	500	510	5590	5750	3	NA	± 100	AverageRF
Aroclor 1260	500	500	NA	NA	NA	-1	± 20	NA

Results flagged with an asterisk (*) indicate values outside control criteria.

Colville River are very similar to those found in the Yukon lake and river samples from the DIAND report, indicating that the majority of the Colville River concentrations are the result atmospheric deposition. Ecology & Environment concluded then that only individual samples that are exposed to the Unit C slough at Umiat may contain concentrations higher than might be expected from typical atmospheric deposition of contaminants in arctic regions, and while these individuals may migrate, they likely do not reach the lower reaches of the Colville River near Nuiqsut.

6.4 Study Determinations of Consumption Risks

A primary focus of many of these studies was an assessment and determination of risk to subsistence users based on the presence of persistent organic contaminants in the Colville River ecosystem, specifically the tissues of target harvest species such as burbot.

6.4.1 1997 Ecology & Environment Study

In the 1997 study, Ecology & Environment determined that the potential excess lifetime cancer risks for current Umiat residents and subsistence users association with consumption of fish caught from the Colville River near Umiat were within acceptable regulatory criteria. They determined that there were no human health risks associated with eating fish from the Colville River for current Umiat residents and subsistence users. Any human health risks related to the consumption of fish contaminated with PCB Aroclor 1254 would be limited to the Unit C slough and do not extend to fish collected from the Colville River.

The study scope was limited to PCBs, so while DDT and its breakdown products were identified in fish tissue, the human health risks due to these contaminants in fish tissue were unknown.

6.4.2 1998 Ecology & Environment Study

The 1998 Ecology & Environment study did not make a determination of potential human health impacts of persistent organic contaminants on the consumption or subsistence harvests of fish in the Colville River watershed. Ecology & Environment recommend that a risk evaluation to determine these impacts be conducted in a future study.

6.4.3 2001 Ecology & Environment Study

The 2001 Ecology & Environment study did not make a determination of potential human health impacts of persistent organic contaminants on the consumption or subsistence harvests of fish in the Colville River watershed. Ecology & Environment made all raw data publicly available so that independent health professionals could evaluate potential risks to subsistence users.

6.4.4 2001 ATSDR Health Consultation

In 2001, ATSDR conducted its review of the 1997 and 1998 Ecology & Environment studies and produced its Health Consultation. The Consultation determined that there is a point source of

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**Continuing Calibration Verification Summary
 Polychlorinated Biphenyls (PCBs)**

Calibration Type: External Standard
 Analysis Method: 8082A

Calibration Date: 10/18/2014
 Calibration ID: CAL13624
 Analysis Lot: KWG1509033
 Units: ng/mL
 Column ID: DB-XLB

File ID: \\ALKLSWS002\INSTDATA\GC27\DATA\091515_RB\0915F009.D

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
Decachlorobiphenyl	50	50	82400	82700	0	NA	± 20	AverageRF
Aroclor 1016 {1}	500	430	1840	1590	-14	NA	± 100	AverageRF
Aroclor 1016 {2}	500	430	2430	2110	-13	NA	± 100	AverageRF
Aroclor 1016 {3}	500	400	3000	2410	-20	NA	± 100	AverageRF
Aroclor 1016 {4}	500	410	2200	1800	-18	NA	± 100	AverageRF
Aroclor 1016 {5}	500	410	2160	1770	-18	NA	± 100	AverageRF
Aroclor 1016	500	420	NA	NA	NA	-17	± 20	NA
Aroclor 1260 {1}	500	450	2210	2000	-10	NA	± 100	AverageRF
Aroclor 1260 {2}	500	480	3780	3630	-4	NA	± 100	AverageRF
Aroclor 1260 {3}	500	480	3610	3470	-4	NA	± 100	AverageRF
Aroclor 1260 {4}	500	490	8630	8390	-3	NA	± 100	AverageRF
Aroclor 1260 {5}	500	500	5590	5550	-1	NA	± 100	AverageRF
Aroclor 1260	500	480	NA	NA	NA	-4	± 20	NA

Results flagged with an asterisk (*) indicate values outside control criteria.

ALS Group USA, Corp. dba ALS Environmental

QA/QC Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001

Service Request: K1509159
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Continuing Calibration Verification Summary
Polychlorinated Biphenyls (PCBs)

Calibration Type: External Standard
Analysis Method: 8082A

Calibration Date: 10/18/2014
Calibration ID: CAL13624
Analysis Lot: KWG1509033
Units: ng/mL
Column ID: DB-35MS

File ID: \\ALKLSWS002\INSTDATA\GC27\DATA\091515_B\0915F009.D

Analyte Name	Expected	Result	Average RF	CCV RF	%D	%Drift	Criteria	Curve Fit
Decachlorobiphenyl	50	51	158000	161000	2	NA	± 20	AverageRF
Aroclor 1016 (1)	500	480	3590	3430	-5	NA	± 100	AverageRF
Aroclor 1016 (2)	500	470	3000	2810	-6	NA	± 100	AverageRF
Aroclor 1016 (3)	500	450	9890	8810	-11	NA	± 100	AverageRF
Aroclor 1016 (4)	500	440	4960	4380	-12	NA	± 100	AverageRF
Aroclor 1016 (5)	500	430	5180	4490	-13	NA	± 100	AverageRF
Aroclor 1016	500	450	NA	NA	NA	NA	± 20	NA
Aroclor 1260 (1)	500	440	9850	8740	-11	NA	± 100	AverageRF
Aroclor 1260 (2)	500	480	8110	7750	-5	NA	± 100	AverageRF
Aroclor 1260 (3)	500	480	8230	7880	-4	NA	± 100	AverageRF
Aroclor 1260 (4)	500	480	18800	18200	-3	NA	± 100	AverageRF
Aroclor 1260 (5)	500	500	14200	14200	0	NA	± 100	AverageRF
Aroclor 1260	500	480	NA	NA	NA	NA	± 20	NA

Results flagged with an asterisk (*) indicate values outside control criteria.

PCB and DDT contamination in the Unit C slough, and resident fish in the slough are exposed to the contaminants. However, any human exposure to contaminants in fish tissue at the site is likely limited, and as a result, it was not identified as a current public health problem. This is due to the small population of fish in the slough and lack of active harvesting of those fish.

ATSDR also determined that the current Colville River fish data did not indicate a need for a public health concern. Minimal data was available on PCBs and DDTs in burbot downstream in the Colville River. Broad whitefish sampled in the river near Umiat were not affected by persistent organic contaminants.

The extent of the downstream contamination of fish had not yet been well characterized. Some evidence suggested that PCB and DDT contamination were present in burbot collected four miles downstream of the Unit C slough at Umiat. The presence of these contaminants further downstream towards the village of Nuiqsut was unknown.

Minimal data was available regarding the dietary information, including fish consumption and harvest locations, was available at the time of the review. This data would be necessary to provide an accurate assessment of potential human health risks.

6.4.5 2003 ATSDR Health Consultation

In 2003, ATSDR conducted its review of the 2001 Ecology & Environment and produced its Health Consultation. The consultation made the following conclusions. PCBs and DDTs were detected in burbot collected during the August, 2001 Ecology & Environment study. However, contaminant concentrations observed were too low to cause harmful health effects for the subsistence users in Nuiqsut.

ATSDR evaluated whether eating up to almost one pound of fish from the river every day for 70 years would result in harmful health effects. This extremely conservative evaluation was based on the information available on the subsistence harvests for Nuiqsut and contaminant concentrations found in burbot in the Colville River. In this scenario, the estimated exposure doses for both adults and children were found to be well below health effect levels. ATSDR concluded that it was safe to consume fish from the river.

The address Nuiqsut community concerns, ATSDR evaluated whether eating large amounts of burbot during the seasonal subsistence harvest would result in harmful health effects. Based on harvest data, ATSDR assumed people at two pounds per week for four months. Again, the estimated exposure was found to be below health effect levels. ATSDR concluded that it was safe to eat large amounts of burbot during the harvest period.

Nuiqsut community members also expressed concerns regarding the consumption of burbot livers. In both scenarios where community members consumed six livers in one week and six livers in one day, exposure doses remained below health effect levels. ATSDR concluded that it is safe to eat several burbot livers in a short time period.

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Initial Calibration Summary
Polychlorinated Biphenyls (PCBs)

Calibration ID: CAL13624
Instrument ID: GC27.i

Column: DB-XLB

Analyte Name	Compound Type	Calibration Evaluation				Control Criteria
		Fit Type	Eval.	Eval. Result	Q	
Decachlorobiphenyl	SURR	AverageRF	% RSD	14.3		≤20
Aroclor 1016 {1}	MULTI	AverageRF	% RSD	9.0		≤20
Aroclor 1016 {2}	MULTI	AverageRF	% RSD	10.1		≤20
Aroclor 1016 {3}	MULTI	AverageRF	% RSD	9.5		≤20
Aroclor 1016 {4}	MULTI	AverageRF	% RSD	9.8		≤20
Aroclor 1016 {5}	MULTI	AverageRF	% RSD	9.8		≤20
Aroclor 1260 {1}	MULTI	AverageRF	% RSD	12.5		≤20
Aroclor 1260 {2}	MULTI	AverageRF	% RSD	13.6		≤20
Aroclor 1260 {3}	MULTI	AverageRF	% RSD	14.9		≤20
Aroclor 1260 {4}	MULTI	AverageRF	% RSD	11.6		≤20
Aroclor 1260 {5}	MULTI	AverageRF	% RSD	13.5		≤20

Results flagged with an asterisk (*) indicate values outside control criteria.

the Colville River. The slough itself comprised the third sampling location (Station "S"). Figure 3 in Appendix A shows the specific locations of the sampling sites as well as those locations sampled in previous studies.

Unfortunately, low water levels resulted in river access issues and Station U was moved to approximately 1.5 miles upstream of the slough.

Station	Description	Approximate River Miles From Slough
U	Upstream of slough	1.5
S	Unit C slough	0
D	Downstream of slough	3.0

Sample collection was conducted in August, 2015. The sampling sites were accessed via the Colville River and flat-bottom jet-boat, traveling from the Umiat Camp. The summer of 2015 was unusually dry with river water levels being extremely low. As a result, the pools favored by burbot were unusually shallow or frequently non-existent. River travel by boat was not possible upstream of Station U at the time of sample collection due to low water levels and braided river channels.

8.2 Fish Collection

Fish collection and sampling was conducted utilizing hoop nets, set lines, gills nets, and hook and line angling. All sampling methodology and collection was in accordance with the ADF&G FRP. All sampling techniques were used at each of the three sampling locations with the exception of gill nets.

Weighted, varied-mesh monofilament gill nets were initially deployed from shore at the slough sampling location and continually monitored and observed during a period of several hours. Unfortunately the gill nets did not prove effective and were found to be difficult to manage and use in areas of woody debris. Their use was abandoned for the other sampling sites.

Two hoop nets were used at each sampling location. Each hoop net was 12-feet long and four feet in diameter, with two throats. The netting was heavy twine woven in 3-inch stretch mesh. The nets were held open using four, 12-foot long PVC pipes secured to the net hoops using zip ties. Due to the weight of the fiberglass hoops, no additional weights were required to sink the nets, so long as current velocity was not excessive. Each net was baited with fresh bait prior to deployment. TPEC1 and Fisheye used commercially frozen herring bait, in two fine-mesh bags. Bait bags were secured in the second (deeper) chamber of each net. The nets sunk to the riverbed, and were anchored to shore in deep pools and near shoreline vegetation (locations where Ecology & Environment successfully captured burbot).

The baited set lines (commonly referred to as trot lines) were anchored from shore and deployed into the river. The lines were weighted to sink. Each line had six hooks spaced approximately eight feet apart, attached to the set line by steel gangions (leaders). The hooks were single (not treble) circle-type hooks, of legal size for recreational burbot fishing with a gap between the point and shank larger than 20 mm (as required by ADFG regulation). Each hook was baited

using commercially frozen herring bait, as was used in the hoop nets. Fresh bait was used for each deployment.

At each sampling location, the passive gear (two hoop nets and three set lines) was allowed to soak overnight (for a period of approximately 16 hours). As required by the FRP, each piece of sampling gear (nets and lines) was tagged with the investigators contact information and the FRP number.

Hook and line angling was performed using spinning rods and reels, with a variety of terminal tackle. All personnel conducting hook and line angling were holders of valid State of Alaska sport fishing licenses. The total duration of hook and line angling at each sampling location varied based on fish landing frequency and study species requirements. Number and species of fish captured and released during hook and line angling was not recorded. Species caught by angling included Arctic grayling, northern pike, and lake trout.

8.3 Sample Processing

Captured fish retention at each site was based on individual species retention limits of the ADF&G FRP. All retained fishes were sacrificed and temporarily stored for transport back to the Umiat camp for processing.

Sampled fish were measured and weighed, noting the condition of the fish and any indicators of stress, disease, or trauma. Fish were subsequently photographed. No assessment of gender or age was made at the time of collection.

Each fish was rinsed in river water to remove any dirt or other potential inadvertent contaminants that they may have come in contact with during handling. Collected fish were handled in a manner to ensure no cross contamination occurred. Each retained fish was placed in a sealed zip-close plastic bag, which were individually labeled with a unique sample identification number. Collected fish were kept fully intact throughout the handling and storage process.

Collected samples were held for approximately two days at the Umiat Camp at a temperature less than 40 degrees Fahrenheit, but above freezing. Upon completion of field activities, all samples were packed in wax coated cardboard fish boxes with gel ice, and transported to Anchorage for further processing and shipment to the analytical laboratory. In Anchorage, samples were flash frozen by a commercial seafood processing company and shipped in insulated containers with dry ice to the analytical laboratory.

8.4 Laboratory Analysis

Laboratory analysis of the fish tissue samples was conducted by ALS Environmental laboratory located in Kelso, Washington. Arctic grayling samples were randomly apportioned into whole body and fillet subsets. The burbot was dissected to allow for analyses of the two edible tissues, body meat (fillet) and the liver. The results of the two were reported separately.

ALS Group USA, Corp. dba ALS Environmental

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001

QA/QC Results

Service Request: K1509159
 Calibration Date: 10/18/2014

Initial Calibration Summary Polychlorinated Biphenyls (PCBs)

Calibration ID: CAL13624
 Instrument ID: GC27.i

Column: DB-XLB

Analyte Name	Level			Level			Level			Level					
	ID	Amt	RF	ID	Amt	RF	ID	Amt	RF	ID	Amt	RF			
Aroclor 1260 {5}	Z	500	5450	AA	1000	5410	AB	2000	5150	AC	5000	4630	Y	50	6810
													AD	25	6020

Results flagged with an asterisk (*) indicate values outside control criteria.

ALS Group USA, Corp. dba ALS Environmental

QA/QC Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001

Service Request: K1509159
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Initial Calibration Summary
Polychlorinated Biphenyls (PCBs)

Calibration ID: CAL13624
Instrument ID: GC27.j

Column: DB-XLB

Level ID	File ID	Level ID	File ID
A	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F011.D	Q	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F027.D
B	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F012.D	R	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F028.D
C	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F013.D	S	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F029.D
D	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F014.D	T	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F030.D
E	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F015.D	U	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F031.D
F	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F016.D	V	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F032.D
G	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F017.D	W	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F033.D
H	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F018.D	X	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F034.D
I	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F019.D	Y	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F046.D
J	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F020.D	Z	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F047.D
K	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F021.D	AA	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F048.D
L	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F022.D	AB	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F049.D
M	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F023.D	AC	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F050.D
N	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F024.D	AD	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F052.D
O	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F025.D		
P	\\alkslsws002\insdata\GC27\Data\101714CAL_r_b\1017F026.D		

DDT, DDE, and DDD (pesticides) analysis was conducted using EPA Method 8081A. PCB analysis was conducted using EPA Method 8082A. Specific PCB Aroclors assessed include 1016, 1221, 1232, 1242, 1248, 1254, and 1260. The analytical methods differed from those used by Ecology & Environment in their previous studies. A discussion of these differences and potential impacts on results is included in Section 10.0.

9.0 RESULTS

Ten Arctic grayling and one burbot were collected during the 2015 study among the three sampling locations. Three Arctic grayling were captured at the upstream site, four Arctic grayling were captured at the Unit C slough, and three Arctic grayling, as well as a single (one) burbot were collected at the downstream site. Arctic grayling were captured primarily by hook and line angling, though several were captured within the hoop nets. The single burbot was captured within a hoop net. No Broad whitefish were captured during the study, despite their inclusion as a target species.

All grayling were adults, and generally similar in size (Table 1). While grayling were found to be similar in length, weights varied greatly.

Table 1 – Lengths and Weights of Fishes Captured in the Colville River Near Umiat

Species	Grayling										Burbot
	Upstream			Slough				Downstream			
ID	UG1	UG2	UG3	SG1	SG2	SG3	SG4	DG1	DG2	DG3	DB1
Length*	324	315	327	334	312	320	327	318	323	356	580
Weight*	320	300	300	340	280	320	360	390	290	400	420

*Grayling length reported in mm fork length; burbot length reported in mm total length.
*Weight reported as live weight in grams.

In general, DDT and its breakdown products DDE, and DDD (pesticides) were not detected in Arctic grayling captured upstream of the Unit C slough, with one exception as 2,4' – DDT was observed in sample UG3 at 0.17 µg/Kg (Table 2). The complete ALS Environmental Laboratory report is in Appendix C. Observable concentrations were noted in Arctic grayling collected from within the Unit C slough ranging from 0.83 to 11.0 µg/Kg. Pesticide concentrations in Arctic grayling collected at the downstream sampling location were higher than concentrations observed at the upstream sites, though less than those within the Unit C slough (Ranging from 0.58 to 5.4 µg/Kg). Pesticides were not detected in the burbot fillet (DB1F), but three compounds (4,4' – DDE, 4,4' – DDT, and 2,4' – DDT) were detected in the liver (DB1L) (16.0 µg/Kg, 13.0 µg/Kg, and 4.9 µg/Kg, respectively).

Analyte Name	Level ID			Level ID			Level ID			Level ID			Level ID		
	Level ID	Amt	RF	Level ID	Amt	RF	Level ID	Amt	RF	Level ID	Amt	RF	Level ID	Amt	RF
Decachlorobiphenyl	Z	50	81000	AA	100	79500	AB	200	74900	AC	500	66600	Y	5.0	97700
Aroclor 1016 {1}	Z	500	1810	AA	1000	1770	AB	2000	1610				Y	50	2030
Aroclor 1016 {2}	Z	500	2380	AA	1000	2310	AB	2000	2120				Y	50	2670
Aroclor 1016 {3}	Z	500	2970	AA	1000	2890	AB	2000	2620				Y	50	3400
Aroclor 1016 {4}	Z	500	2160	AA	1000	2110	AB	2000	1930				Y	50	2520
Aroclor 1016 {5}	Z	500	2130	AA	1000	2080	AB	2000	1930				Y	50	2500
Aroclor 1260 {1}	Z	500	2230	AA	1000	2200	AB	2000	2070	AC	5000	1760	Y	50	2520
Aroclor 1260 {2}	Z	500	3740	AA	1000	3690	AB	2000	3490	AC	5000	3090	Y	50	4610
Aroclor 1260 {3}	Z	500	3540	AA	1000	3470	AB	2000	3290	AC	5000	2920	Y	50	4460
Aroclor 1260 {4}	Z	500	8380	AA	1000	8380	AB	2000	8090	AC	5000	7460	Y	50	10300

Results flagged with an asterisk (*) indicate values outside control criteria.

Table 2 – Organochlorine Pesticides in Fishes Captured in the Colville River Near Umiat (ppb, wet weight)

Species Station	Grayling										Burbot			
	Upstream			Slough				Downstream					DB1F	DB1L
	UG1	UG2	UG3	SG1	SG2	SG3	SG4	DG1	DG2	DG3	Whole	Fillet		
Sample ID	UG1	UG2	UG3	SG1	SG2	SG3	SG4	DG1	DG2	DG3	DB1F	DB1L		
Tissue	Whole	Whole	Fillet	Whole	Whole	Fillet	Fillet	Whole	Whole	Fillet	Fillet	Liver		
4,4'-DDE	ND	ND	ND	11	6.6	0.99	4.0	0.58	1.9	5.4	ND	16		
4,4'-DDD	ND	ND	ND	5.2	3.6	1.4	1.3	ND	ND	3.4	ND	ND		
4,4'-DDT	ND	ND	ND	3.0	3.5	0.83	0.64	ND	0.94	1.3	ND	13		
2,4'-DDE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
2,4'-DDD	ND	ND	ND	ND	0.83	ND	ND	ND	ND	ND	ND	ND		
2,4'-DDT	ND	ND	0.17	1.3	2.4	ND	ND	ND	ND	ND	ND	4.9		

ND – Analyte not detected in the sample.
 A 1 data in parts per billion (ppb), wet weight

PCB concentrations in all Arctic grayling captured at both the upstream and downstream sampling locations were found to be non-detect for all Aroclors (Table 3). A single sample, SG2, collected at the Unit C slough was found to have a (PCB) Aroclor 1254 concentration of 9.2 µg/Kg and an Aroclor 1260 concentration of 5.3 µg/Kg. No other PCBs were detected in any Arctic grayling from any of the three sampling locations.

PCBs were not detected in burbot fillet. PCB Aroclor 1260 was detected in the burbot liver from the downstream sampling location (Sample ID DB1L) at 15.0 µg/Kg. No other PCB Aroclors were detected in the burbot sample.

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001

QA/QC Results

Service Request: K1509159
 Calibration Date: 10/18/2014
 Date Analyzed: 10/19/2014

Second Source Calibration Verification
 Polychlorinated Biphenyls (PCBs)

Calibration Type: External Standard
 Analysis Method: 8082A

Calibration ID: CAL13624
 Units: ng/mL

File ID: \\alklsws002\instdata\GC27\Data\101714\CAL_b\1017F036.D
 \\alklsws002\instdata\GC27\Data\101714\CAL_b\1017F037.D
 \\alklsws002\instdata\GC27\Data\101714\CAL_b\1017F038.D
 \\alklsws002\instdata\GC27\Data\101714\CAL_b\1017F039.D
 \\alklsws002\instdata\GC27\Data\101714\CAL_b\1017F040.D
 \\alklsws002\instdata\GC27\Data\101714\CAL_b\1017F042.D
 \\alklsws002\instdata\GC27\Data\101714\CAL_b\1017F043.D
 \\alklsws002\instdata\GC27\Data\101714\CAL_b\1017F053.D
 \\alklsws002\instdata\GC27\Data\101714\CAL_b\1017F054.D

Column ID: DB-35MS

Analyte Name	Expected	Result	Average RF	SSV RF	%D	%Drift	Criteria	Curve Fit
Aroclor 1016 {1}	1000	1300	3590	4530	26	NA	± 100 %	AverageRF
Aroclor 1016 {2}	1000	1200	3000	3720	24	NA	± 100 %	AverageRF
Aroclor 1016 {3}	1000	1200	9890	11900	20	NA	± 100 %	AverageRF
Aroclor 1016 {4}	1000	1100	4960	5570	12	NA	± 100 %	AverageRF
Aroclor 1016 {5}	1000	1200	5180	6170	19	NA	± 100 %	AverageRF
Aroclor 1016	1000	1200	NA	NA	20	NA	± 20 %	NA
Aroclor 1260 {1}	1000	1100	9850	10300	5	NA	± 100 %	AverageRF
Aroclor 1260 {2}	1000	1300	8110	10300	27	NA	± 100 %	AverageRF
Aroclor 1260 {3}	1000	1200	8230	10200	24	NA	± 100 %	AverageRF
Aroclor 1260 {4}	1000	1200	18800	22900	22	NA	± 100 %	AverageRF
Aroclor 1260 {5}	1000	1200	14200	17200	21	NA	± 100 %	AverageRF
Aroclor 1260	1000	1200	NA	NA	NA	20	± 20 %	NA

Results flagged with an asterisk (*) indicate values outside control criteria.

† SPCC Compound

‡ CCC Compound

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001

Service Request: K1509159
 Calibration Date: 10/18/2014

Line Energy Operations, Inc., 1554-01
 Assessment of PCBs and DDTs in Fish Populations of the Colville River Near Umiat, AK

11/15/2015
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Initial Calibration Summary
 Polychlorinated Biphenyls (PCBs)

Calibration ID: CAL13624
 Instrument ID: GC27.i

Column: DB-35MS

Analyte Name	Compound Type	Calibration Evaluation				
		Fit Type	Eval.	Eval. Result	Q	Control Criteria
Decachlorobiphenyl	SURR	AverageRF	% RSD	11.7		≤20
Aroclor 1016 {1}	MULTI	AverageRF	% RSD	13.4		≤20
Aroclor 1016 {2}	MULTI	AverageRF	% RSD	12.5		≤20
Aroclor 1016 {3}	MULTI	AverageRF	% RSD	11.5		≤20
Aroclor 1016 {4}	MULTI	AverageRF	% RSD	13.6		≤20
Aroclor 1016 {5}	MULTI	AverageRF	% RSD	12.0		≤20
Aroclor 1260 {1}	MULTI	AverageRF	% RSD	14.3		≤20
Aroclor 1260 {2}	MULTI	AverageRF	% RSD	12.4		≤20
Aroclor 1260 {3}	MULTI	AverageRF	% RSD	12.5		≤20
Aroclor 1260 {4}	MULTI	AverageRF	% RSD	10.6		≤20
Aroclor 1260 {5}	MULTI	AverageRF	% RSD	11.0		≤20

Table 3 – Polychlorinated Biphenyls (PCBs) in Fishes Captured in the Colville River Near Umiat (ppb, wet weight)

Species	Grayling										Burbot	
	Upstream			Slough				Downstream			F	L
Station	UG1	UG2	UG3	SG1	SG2	SG3	SG4	DG1	DG2	DG3	DB1	DB1
Sample ID	UG1	UG2	UG3	SG1	SG2	SG3	SG4	DG1	DG2	DG3	DB1	DB1
Tissue	Whole	Whole	Fillet	Whole	Whole	Fillet	Fillet	Whole	Whole	Fillet	Fillet	Liver
Aroclor 1016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1221	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1232	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1242	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1248	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Aroclor 1254	ND	ND	ND	ND	9.2	ND	ND	ND	ND	ND	ND	ND
Aroclor 1260	ND	ND	ND	ND	5.3	ND	ND	ND	ND	ND	ND	15

ND – Analyte not detected in the sample.
 All data in parts per billion (ppb), wet weight

10.0 DISCUSSION

10.1 Analysis Methodology

DDT, DDE, and DDD (pesticides) analysis was conducted using EPA Method 8081A. PCB analysis was conducted using EPA Method 8082A. Specific PCB Aroclors assessed include 1016, 1221, 1232, 1242, 1248, 1254, and 1260. The analytical methods differed from those used by Ecology & Environment in their previous studies. Ecology & Environment used EPA Method 1668, Revision A for their analysis of PCBs and Isotope dilution analysis using the New York Department of Environmental Conservation Method HRMS-2 (a modified EPA Method 1668) for pesticide analysis (DDT, DDE, and DDD).

A comparison of the two separate methodologies (8082A and 8081A vs. 1668) finds that EPA Method 1668 is a more sensitive analysis capable of a greater degree of accuracy and generally lower detection limits. EPA Method 1668 also is capable of reducing potential interferences within the analyzed samples. At the concentration levels observed within this study and the observed detection limits, both methods were comparable and either would have been suitable for the analysis of these samples.

The ALS Environmental laboratory report case narrative makes use of several descriptive terms in regards to potential impacts to data usability and quality. Matrix interference, or the potential

Results flagged with an asterisk (*) indicate values outside control criteria.

impact to sample analysis based on a sample matrix other than pure water, was noted as a possible flag within the report. The matrix for the samples for this study was animal (fish) tissue, which is composed of numerous constituents in varying quantities including proteins, polypeptides, lipids, and other compounds. It is possible, although unlikely that these constituents could have interfered with the analyses for PCBs and DDTs. The potential matrix interference is noted for the lab's reference control samples, and is not considered to affect the analytical results of the collected samples or the interpretation of the results.

The case narrative also notes elevated detection limits for some samples. An elevated detection limit refers to a decrease in statistical precision when an analyte is detected at concentrations close to its lower detection limit. All samples analyzed for this study were detected at concentrations close to or below their lower detection limits. However, all results in which an analyte was reported as ND (Not Detected) can be confidently interpreted as having an extremely low (likely zero) concentration for the specific analyte.

10.2 Burbot Capture Success

The TPECI/Fisheye study deployed two hoop nets at each of the three sites for one day each. During this time, one burbot was captured at the downstream location, and no burbot were captured at the slough or at the upstream site. The 2015 TPECI/Fisheye study conducted fishing at each site for a short duration compared to the previous Ecology & Environment studies.

In the 1998 Ecology & Environment study, two hoop nets were fished at each of the three locations for eight days. Due to poor success rates, an additional hoop net was placed at the downstream site for six days. During the 14 days of fishing, a total of seven burbot were captured among the three sampling sites.

In the 2001 Ecology & Environment study, three hoop nets were initially deployed in each of the seven reaches. Once 10 burbot were captured in a reach, the hoop nets were reallocated to the remaining reaches until 10 burbot were captured in all seven reaches. The total time (in days) of nets actively fishing each reach was not listed within the Ecology & Environment report. However, it is stated that a period of greater than 13 days was spent fishing some reaches.

Ecology & Environment found that capture success of the hoop nets was largely a function of river stage. During their 2001 study, flooding conditions forced burbot to move towards vegetative shelter along the river banks, increasing their catch rates significantly. Water levels and the river stage during the 2015 study were extremely low, likely limiting potential for burbot capture.

Given the short duration of fishing and the low water levels of the Colville River at the time of sampling, the capture of one burbot during the 2015 TPECI/Fisheye study can be viewed as successful compared to the capture success rates of the previous studies. However, to allow for greater sampling populations, additional burbot, and therefore, longer fishing periods may have been beneficial.

Client: GRAYSTAR Pacific Seafood, Ltd. Service Request: K1509159
 Project: Umiat Fish/30118-001 Calibration Date: 10/18/2014

QA/QC Results
 Initial Calibration Summary
 Polychlorinated Biphenyls (PCBs)

Calibration ID: CAL13624 Column: DB-35MS
 Instrument ID: GC27.i

Analyte Name	Level ID			Level ID			Level ID			Level ID					
	Amt	RF		Amt	RF		Amt	RF		Amt	RF				
Aroclor 1260 (5)	Z	50C	1620	AA	1000	14000	AB	2000	12400	AC	5000	12600	AD	25	14300

Results flagged with an asterisk (*) indicate values outside control criteria.

Client: GRAYSTAR Pacific Scafood, Ltd.
Project: Umiat Fish/30118-001

Service Request: K1509159
Calibration Date: 10/18/2014

Line Energy Operations, Inc., 1554-01
Assessment of PCBs and DDTs in Fish Populations of the Colville River Near Umiat, AK

11/15/2015
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Initial Calibration Summary
Polychlorinated Biphenyls (PCBs)

Calibration ID: CAL13624
Instrument ID: GC27.i
Column: DB-35MS

Level ID	File ID	Level ID	File ID
A	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F011.D	Q	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F027.D
B	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F012.D	R	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F028.D
C	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F013.D	S	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F029.D
D	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F014.D	T	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F030.D
E	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F015.D	U	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F031.D
F	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F016.D	V	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F032.D
G	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F017.D	W	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F033.D
H	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F018.D	X	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F034.D
I	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F019.D	Y	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F046.D
J	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F020.D	Z	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F047.D
K	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F021.D	AA	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F048.D
L	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F022.D	AB	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F049.D
M	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F023.D	AC	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F050.D
N	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F024.D	AD	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F052.D
O	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F025.D		
P	\\alklsws002\instdata\GC27\Data\101714CAL_b\1017F026.D		

Analyte Name	Level ID			Level ID			Level ID			Level ID		
	ID	Amt	RF	ID	Amt	RF	ID	Amt	RF	ID	Amt	RF
Decachlorobiphenyl	Z	50 1.80E+5	*	AA	100 1.55E+5	*	AB	200 1.37E+5	*	AC	500 1.37E+5	*
Aroclor 1016 {1}	Z	500 4060		AA	1000 3530		AB	2000 3160		AC	5000 2890	
Aroclor 1016 {2}	Z	500 3510		AA	1000 3090		AB	2000 2640		AC	5000 2480	
Aroclor 1016 {3}	Z	500 11000		AA	1000 9830		AB	2000 8070		AC	5000 9210	
Aroclor 1016 {4}	Z	500 5650		AA	1000 4880		AB	2000 4330		AC	5000 4070	
Aroclor 1016 {5}	Z	500 5900		AA	1000 5120		AB	2000 4550		AC	5000 4370	
Aroclor 1260 {1}	Z	500 11100		AA	1000 9570		AB	2000 8330		AC	5000 8190	
Aroclor 1260 {2}	Z	500 9340		AA	1000 8030		AB	2000 6990		AC	5000 6900	
Aroclor 1260 {3}	Z	500 9530		AA	1000 8190		AB	2000 7130		AC	5000 7020	
Aroclor 1260 {4}	Z	500 21000		AA	1000 18200		AB	2000 16300		AC	5000 16800	

Results flagged with an asterisk (*) indicate values outside control criteria.

10.3 Long-Term Trends

The 2015 TPECI/Fisheye data can be combined with data collected during the 1997, 1998, and 2001 Ecology & Environment studies to assess concentrations of persistent organic contaminants in fish tissue and determine if any long term trends are present. Direct comparisons of these data are difficult due to variability in sampling location, species sampled, and the contaminant analyzed among the four separate studies. Ideally, the more sampling years (studies) included in any comparison would yield greater potential for observable trends. However, limited data prevented detailed analysis for all analytes, all fish species, in all locations.

In the 1997 Ecology & Environment study, a total of 14 Arctic grayling were collected from the Unit C slough. Four Arctic grayling were collected in the slough during the 2015 TPECI/Fisheye study. PCBs were analyzed for whole body or fillet for grayling for both studies. The results of these analyses were plotted as shown in Figure 4 below. A decreasing trend in PCB concentrations in grayling tissue within the slough was observed. However, this trend is not significant (P > 0.05), likely due to the numerous "zero" concentration values during both the 1997 Ecology & Environment study and the 2015 TPECI/Fisheye study. However, in 1997, fewer than half of the total fish exhibited zero (0.0 µg/Kg) PCB concentrations. In 2015, three quarters of the sampled fish were found to be non-detect (0.0 µg/Kg) for PCBs. The only non-zero concentration from the 2015 study (14.5 µg/Kg) was lower than the lowest non-zero concentration from the 1997 study (19.0 µg/Kg). Based on this data, it is likely that PCB concentrations in grayling at the Unit slough are decreasing. Additional data would be necessary to prove that this trend is occurring.

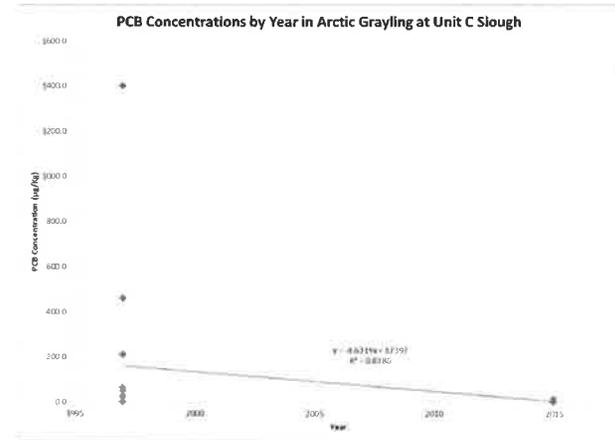


Figure 4. PCB Concentrations by Year in Arctic Grayling at Unit C Slough.

A single burbot was captured during the 2015 TPECI/Fisheye study. While the capture success rate was comparable with previous studies (on a catch-per-unit-effort basis), the single data point made analysis of long term trends challenging.

PCB concentrations in whole burbot were compared among the 1998 Ecology & Environment study, the 2001 Ecology & Environment study, and the 2015 TPECI/Fisheye study at the "downstream" location. The sampling locations varied only slightly among the three studies, all were located downstream of the Unit C slough at Umiat. The 1998 site was located approximately four miles downstream of Umiat, the 2001 site was referred to as Reach 1, and was began approximately two to three miles downstream of the slough, and the 2015 site was located approximately three miles downstream of the slough. Figures XX and XX all use data obtained from "this" location.

Figure 5 shows that a slight, decreasing trend in whole body PCB concentration; in burbot in the Colville River downstream of the Unit C slough may exist, though it is not statistically significant ($P > 0.05$). Data analysis and the presence of any statistically significant trend is limited by the single data point from 2015. Had additional burbot been collected at this site, identifiable, and proven trends may have been identified. Additional data would be required to make these determinations.

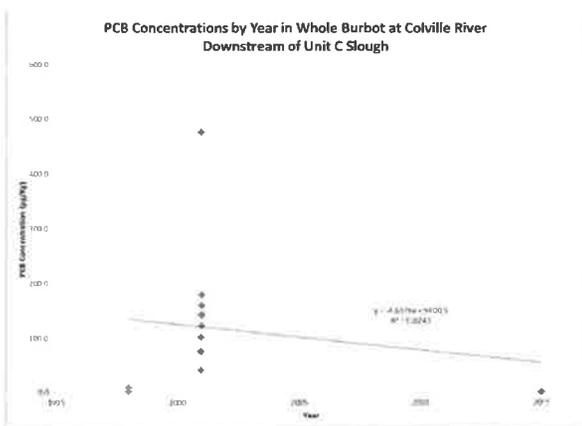


Figure 5. PCB Concentrations by Year in Whole Burbot at Colville River Downstream of Unit C Slough.

Figure 6 shows a significant decrease in PCB concentrations in Burbot livers in the Colville River at the site downstream of the Unit C slough. A regression analysis found this decreasing trend to be significant ($P=0.049$). Had additional burbot been captured at this site during the 2015 study, a stronger correlation may have been produced. However, the available data does show that PCB concentrations in these tissues are generally on the decline in the area.

QA/QC Report

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal tissue

Service Request: K1509159
Date Extracted: 09/04/2015
Date Analyzed: 09/16/2015
Time Analyzed: 00:28

Lab Control Sample Summary
 Polychlorinated Biphenyls (PCBs)

Sample Name: Lab Control Sample **Instrument ID:** GC27.i
Lab Code: KWG1508475-6 **File ID:** J:\GC27\DATA\091515.B\0915F026.D
Extraction Method: EPA 3541 **Level:** Low
Analysis Method: 8082A **Extraction Lot:** KWG1508475

This Lab Control Sample applies to the following analyses:

Sample Name	Lab Code	File ID	Date Analyzed	Time Analyzed
UG1	K1509159-001	J:\GC27\DATA\091515.B\0915F011.D	09/15/15	18:36
UGIMS	KWG1508475-4	J:\GC27\DATA\091515.B\0915F012.D	09/15/15	18:59
UGIDMS	KWG1508475-5	J:\GC27\DATA\091515.B\0915F013.D	09/15/15	19:23
UG2	K1509159-002	J:\GC27\DATA\091515.B\0915F014.D	09/15/15	19:46
UG3	K1509159-003	J:\GC27\DATA\091515.B\0915F015.D	09/15/15	20:10
SG1	K1509159-004	J:\GC27\DATA\091515.B\0915F016.D	09/15/15	20:33
SG2	K1509159-005	J:\GC27\DATA\091515.B\0915F017.D	09/15/15	20:57
SG3	K1509159-006	J:\GC27\DATA\091515.B\0915F018.D	09/15/15	21:20
SG4	K1509159-007	J:\GC27\DATA\091515.B\0915F019.D	09/15/15	21:44
DG1	K1509159-008	J:\GC27\DATA\091515.B\0915F020.D	09/15/15	22:07
DG2	K1509159-009	J:\GC27\DATA\091515.B\0915F023.D	09/15/15	23:18
DG3	K1509159-010	J:\GC27\DATA\091515.B\0915F024.D	09/15/15	23:41
DB1_Fillet	K1509159-011	J:\GC27\DATA\091515.B\0915F025.D	09/16/15	00:05
Method Blank	KWG1508475-7	J:\GC27\DATA\091515.B\0915F027.D	09/16/15	00:52
DB1_Liver	K1509159-012	J:\GC27\DATA\091515.B\0915F030.D	09/16/15	02:02

QA/QC Report

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Extracted: 09/04/2015
 Date Analyzed: 09/16/2015
 Time Analyzed: 00:52

Linc Energy Operations, Inc., 1554-01
 Assessment of PCBs and DDTs in Fish Populations of the Colville River Near Umiat, AK

Method Blank Summary
 Polychlorinated Biphenyls (PCBs)

Sample Name: Method Blank
 Lab Code: KWG1508475-7
 Extraction Method: EPA 3541
 Analysis Method: 8082A

Instrument ID: GC27.i
 File ID: J:\GC27\DATA\091515.B\0915F027.D
 Level: Low
 Extraction Lot: KWG1508475

This Method Blank applies to the following analyses:

Sample Name	Lab Code	File ID	Date Analyzed	Time Analyzed
UG1	K1509159-001	J:\GC27\DATA\091515.B\0915F011.D	09/15/15	18:36
UG1MS	KWG1508475-4	J:\GC27\DATA\091515.B\0915F012.D	09/15/15	18:59
UG1DMS	KWG1508475-5	J:\GC27\DATA\091515.B\0915F013.D	09/15/15	19:23
UG2	K1509159-002	J:\GC27\DATA\091515.B\0915F014.D	09/15/15	19:46
UG3	K1509159-003	J:\GC27\DATA\091515.B\0915F015.D	09/15/15	20:10
SG1	K1509159-004	J:\GC27\DATA\091515.B\0915F016.D	09/15/15	20:33
SG2	K1509159-005	J:\GC27\DATA\091515.B\0915F017.D	09/15/15	20:57
SG3	K1509159-006	J:\GC27\DATA\091515.B\0915F018.D	09/15/15	21:20
SG4	K1509159-007	J:\GC27\DATA\091515.B\0915F019.D	09/15/15	21:44
DG1	K1509159-008	J:\GC27\DATA\091515.B\0915F020.D	09/15/15	22:07
DG2	K1509159-009	J:\GC27\DATA\091515.B\0915F023.D	09/15/15	23:18
DG3	K1509159-010	J:\GC27\DATA\091515.B\0915F024.D	09/15/15	23:41
DB1_Fillet	K1509159-011	J:\GC27\DATA\091515.B\0915F025.D	09/16/15	00:05
Lab Control Sample	KWG1508475-6	J:\GC27\DATA\091515.B\0915F026.D	09/16/15	00:28
DB1_Liver	K1509159-012	J:\GC27\DATA\091515.B\0915F030.D	09/16/15	02:02

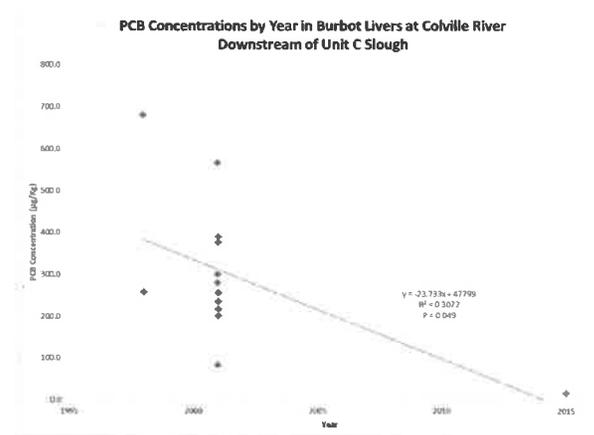


Figure 6. PCB Concentrations by Year in Burbot Livers at Colville River Downstream of Unit C Slough

DDT (including DDD, and DDE) concentrations in whole burbot at the downstream location were low in the 1998 Ecology & Environment Study, were generally low in the 2001 Ecology & Environment Study, and remained low in the 2015 TPECI/Fisheye study. No significant trend or decrease in contaminant concentrations was observed during this time period. Low sample numbers for burbot in the 2015 study may have impacted this analysis, or DDT concentrations are not a major issue in whole body burbot tissues at this site.

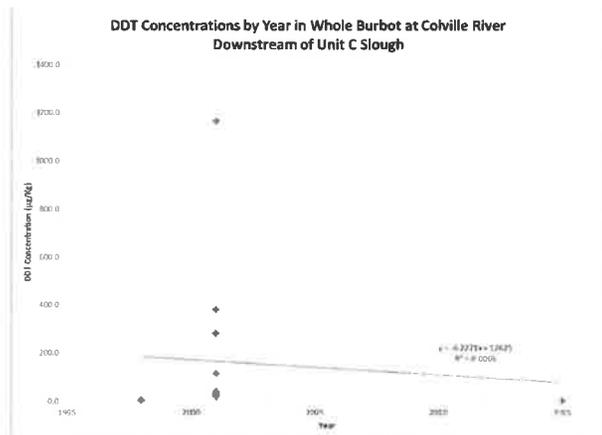


Figure 7. DDT Concentrations by Year in Whole Burbot at Colville River Downstream of Unit C Slough.

DDT (included DDD, and DDE) concentrations in burbot livers at the downstream location were found to have a slight decreasing trend (Figure 8). However, no significant decrease was noted from 1998 to 2015. As with DDT concentrations in whole burbot, low sample numbers for the species in 2015 may have impacted the analysis. A larger sample population likely would show stronger long term contaminant trends.

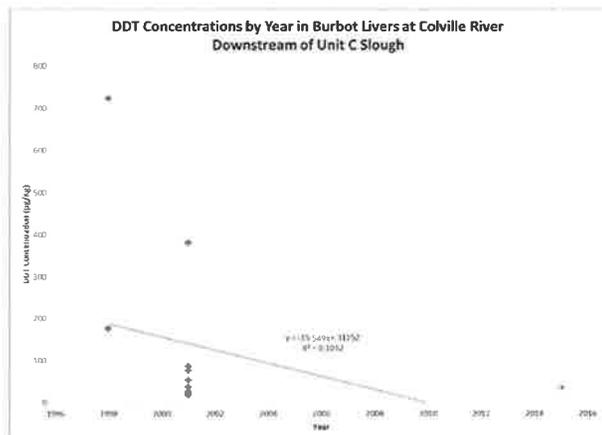


Figure 8. DDT Concentrations by Year in Whole Burbot at Colville River Downstream of Unit C Slough.

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Extracted: 09/04/2015
 Date Analyzed: 09/16/2015

Lab Control Spike Summary
 Polychlorinated Biphenyls (PCBs)

Extraction Method: EPA 3541
 Analysis Method: 8082A

Units: ug/Kg
 Basis: Wet
 Level: Low
 Extraction Lot: KWG1508475

Lab Control Sample
 KWG15C8475-6
 Lab Control Spike

Analyte Name	Result	Spike Amount	%Rec	%Rec Limits
Aroclor 1016	125	200	62	46-128
Aroclor 1260	167	200	84	46-128

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal tissue

Service Request: K1509159
Date Extracted: 09/04/2015
Date Analyzed: 09/15/2015

Line Energy Operations, Inc., 1554-01
 Assessment of PCBs and DDTs in Fish Populations of the Colville River Near Umiat, AK

Matrix Spike/Duplicate Matrix Spike Summary
 Polychlorinated Biphenyls (PCBs)

Sample Name: UG1
Lab Code: K1509159-001
Extraction Method: EPA 3541
Analysis Method: 8082A

Units: ug/Kg
Basis: Wet
Level: Low
Extraction Lot: KWG1508475

Analyte Name	Sample Result	UG1MS KWG1508475-4 Matrix Spike			UG1DMS KWG1508475-5 Duplicate Matrix Spike			%Rec Limits	RPD	RPD Limit
		Result	Spike Amount	% Rec	Result	Spike Amount	% Rec			
Aroclor 1016	ND	99.4	195	51	98.5	192	51	46-128	1	40
Aroclor 1260	ND	108	195	55	113	192	59	46-128	4	40

The migration of persistent organic contaminants, including PCBs downstream towards the village of Nuiqsut is a major concern of the regional communities and subsistence users. Specifically, PCB concentrations in burbot livers have been noted as an issue. Figure 8 shows a figure of both the 2001 Ecology & Environment data and the 2015 TPECI/Fisheye data for PCB concentrations in burbot livers relative to river location.

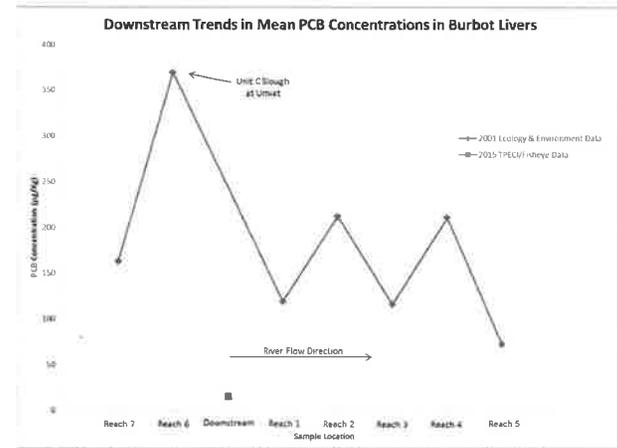


Figure 9. Downstream Trends in Mean PCB Concentrations in Burbot Livers.

The 2015 PCB concentrations in burbot livers are much lower than those from the 2001 study, especially compared to those of similar locations. Figure 9 shows that PCB concentrations in burbot livers decreased from upstream to downstream relative to distance from the Unit C slough at Umiat. While only one data point is available for the 2015 study, TPECI/Fisheye find that if additional downstream sampling were conducted, a similar trend, but at further decreased concentrations would be observed.

The significant decrease in PCB concentrations in burbot livers downstream of the Unit C slough can likely be attributed to the removal of the contaminant source and a generational change in the burbot population of the Colville River. The former landfill was mostly remediated during the early 1990s, though areas of PCB contamination within the soil are still noted as part of the Ecology & Environment studies. Given a lifespan nearing a maximum of 20 years, the generation of burbot exposed to the contaminant source at the landfill has largely died off and have been replaced by a new generation, lacking the contaminant source. Additionally, fish on lower trophic levels, which the burbot feed upon, have similarly undergone a generational shift.

Results flagged with an asterisk (*) indicate values outside control criteria.
 Results flagged with a pound (#) indicate the control criteria is not applicable.
 Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

16.4 Current Background Concentrations and Atmospheric Deposition

DINAC published data on contaminant levels in biota, water, and sediments of freshwater and marine ecosystems in northern Canada (Muir and Lockhart, 1994, DINAC, 1997). In their research, whole fish, fish muscle, and fish livers were analyzed for 130 individual organochlorine compounds, including PCB congeners and DDT and its breakdown products.

The 2015 TPECI/Fisheye study found that total PCB mean concentrations detected in burbot livers of fish collected from the downstream sampling site on the Colville River (15.0 ppb) were similar to the lower ranges of total PCB concentrations found in the DINAC studies (26.9 ppb to 136 ppb). In the previous Ecology & Environment studies, burbot livers results from fish samples collected in the Unit C slough at Umiat and downstream reaches of the Colville were significantly higher (468.05 ppb and 665.00 ppb, respectively) and were similar to higher PCB concentrations found in the DINAC studies in Lake Laberge, Canada (836 ppb to 1,300 ppb). DINAC studies note Lake Laberge's proximity to Whitehorse, Yukon, and the potential for point source contributions in addition to both atmospheric depositions.

The PCB concentrations observed in burbot liver in the 2015 TPECI/Fisheye study were similar to background levels observed in the DINAC studies. These observations may indicate that the primary current source of PCBs in the Colville River ecosystem may be from atmospheric deposition.

Numerous studies have determined that atmospheric transport and biotransport of contaminants is likely impacting arctic ecosystems. The role that these transport mechanisms play in the total contaminant concentrations within the biota is not insignificant as shown in the 1998 Ecology & Environment study and the DINAC studies. These previous studies, as well as other published research, find that atmospheric transport and biotransport are likely contributing to contaminant concentrations in fish populations in the Colville River. The findings of the 2015 TPECI/Fisheye study also indicate that the a point source of PCB contaminants at the Unit C Slough at Umiat may no longer be impacting burbot populations in the Colville River, as contaminant levels observed have decreased to within background ranges.

11.0 CONCLUSIONS

The weathering of the primary contaminant point source (Umiat landfill) and a new burbot population generation that no longer is exposed to a concentrated point source of persistent organic contaminants is likely the primary cause in the decreased concentrations seen during the 2C15 sampling. Similar trends observed in other species, including Arctic grayling likely are due to these same circumstances. As burbot livers and fish in general comprise a significant portion of the subsistence harvests in the region, the decrease in persistent organic contaminant concentrations is beneficial to the human health of the region, despite findings of the previous studies that existing contaminant concentrations at the time did not pose any significant health risks.

Long-term trends in contaminant concentrations in both burbot and Arctic grayling were not generally statistically significant. Poor correlations were likely due to low numbers of fish

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

QA/QC Report

Service Request: K1509159

Surrogate Recovery Summary Polychlorinated Biphenyls (PCBs)

Extraction Method: EPA 3541
 Analysis Method: 8082A

Units: Percent
 Level: Low

Sample Name	Lab Code	Sur1
UG1	K1509159-001	83
UG2	K1509159-002	79
UG3	K1509159-003	76
SG1	K1509159-004	71
SG2	K1509159-005	70
SG3	K1509159-006	79
SG4	K1509159-007	83
DG1	K1509159-008	59
DG2	K1509159-009	73
DG3	K1509159-010	71
DB1_Fillet	K1509159-011	77
DB1_Liver	K1509159-012	50
Method Blank	KWG1508475-7	89
UG1MS	KWG1508475-4	58
UG1DMS	KWG1508475-5	58
Lab Control Sample	KWG1508475-6	80

Surrogate Recovery Control Limits (%)

Sur1 = Decachlorobiphenyl 37-139

Results flagged with an asterisk (*) indicate values outside control criteria.
 Results flagged with a pound (#) indicate the control criteria is not applicable.

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: NA
 Date Received: NA

Linc Energy Operations, Inc., 1554-01
 Assessment of PCBs and DDTs in Fish Populations of the Colville River Near Umiat, AK

Polychlorinated Biphenyls (PCBs)

Sample Name: Method Blank
 Lab Code: KWG1508475-7
 Extraction Method: EPA 3541
 Analysis Method: 8082A

Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	8.5	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1221	ND	U	17	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1232	ND	U	8.5	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1242	ND	U	8.5	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1248	ND	U	8.5	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1254	ND	U	8.5	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1260	ND	U	8.5	2.8	1	09/04/15	09/16/15	KWG1508475	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	89	37-139	09/16/15	Acceptable

captured during the 2015 study. Additional data would be required to further define the findings of this study.

11.1 Recommendations for Future Work

The purpose of the TPECI/Fisheye study was to investigate contaminant concentrations in fish within the Unit C slough at Umiat as well as fish in the Colville River at distances of approximately three miles upstream and downstream of Umiat. Fish capture numbers and the relatively small study area, as compared to the 2001 Ecology & Environment study, resulted in few statistically significant findings.

To confirm the general trends observed during this study, and to make a complete assessment of the contaminant concentrations in burbot populations in downstream areas of the Colville River, near the village of Nuiqsut, TPECI/Fisheye recommend that additional field work be conducted allowing for a larger sample population and the addition of more sampling locations throughout the river system. Additionally, sediment sampling within the Unit C slough may aid in determining if a point source for persistent organic contaminants remains present at the site. Any future studies would allow for a more direct comparison to previous work and an ultimate determination in ecosystem health.

Comments: _____

12.0 LITERATURE CITED

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ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal tissue

Service Request: K1509159
Date Collected: 08/08/2015
Date Received: 08/20/2015

Polychlorinated Biphenyls (PCBs)

Sample Name: DB1_Liver
Lab Code: K1509159-012
Extraction Method: EPA 3541
Analysis Method: 8082A

Units: ug/Kg
Basis: Wet
Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1316	ND	C	8.0	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1221	ND	C	16	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1232	ND	U	8.0	5.9	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1242	ND	Li	8.0	7.7	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1248	ND	C	8.0	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1254	ND	Li	28	28	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1260	15	P	8.0	2.8	1	09/04/15	09/16/15	KWG1508475	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	50	37-139	09/16/15	Acceptable

Comments: _____

ALS Group USA, Corp. dba ALS Environmental

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Analytical Results

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

Linc Energy Operations, Inc., 1554-01
 Assessment of PCBs and DDTs in Fish Populations of the Colville River Near Umiat, AK

11/15/2015
 Page 31

Polychlorinated Biphenyls (PCBs)

Sample Name: DB1 Fillet
 Lab Code: K1509159-011
 Extraction Method: EPA 3541
 Analysis Method: 8082A

Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	9.7	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1221	ND	U	20	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1232	ND	U	9.7	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1242	ND	U	9.7	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1248	ND	U	9.7	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1254	ND	U	9.7	2.8	1	09/04/15	09/16/15	KWG1508475	
Aroclor 1260	ND	U	9.7	2.8	1	09/04/15	09/16/15	KWG1508475	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	77	37-139	09/16/15	Acceptable

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Comments: _____

Appendix A:
Figures

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal tissue

Service Request: K1509159
Date Collected: 08/08/2015
Date Received: 08/20/2015

Polychlorinated Biphenyls (PCBs)

Sample Name: DG3
Lab Code: K1509159-010
Extraction Method: EPA 3541
Analysis Method: 8082A

Units: ug/Kg
Basis: Wet
Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1221	ND	U	20	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1232	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1242	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1248	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1254	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1260	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	71	37-139	09/15/15	Acceptable

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

Polychlorinated Biphenyls (PCBs)

Sample Name: DG2 Units: ug/Kg
 Lab Code: K1509159-009 Basis: Wet
 Extraction Method: EPA 3541 Level: Low
 Analysis Method: 8082A

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	9.9	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1221	ND	U	20	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1232	ND	U	9.9	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1242	ND	U	9.9	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1248	ND	U	9.9	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1254	ND	U	9.9	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1260	ND	U	9.9	2.8	1	09/04/15	09/15/15	KWG1508475	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	73	37-139	09/15/15	Acceptable



Travis/Peterson Environmental Consulting, Inc. 3305 Arctic Boulevard, Suite 102 Anchorage, AK 99503 907-522-4337	Assessment of PCBs and DDTs in Fish Populations of the Colville River Near the Former Umiat Air Force Station Umiat, Alaska	General Location Map Figure #1
Project No: 1554-01	File: Jupiter/backup/Erik/1554-01\Figures	Date: 11/10/2015
		Scale: None

Comments: _____

ALS Group USA, Corp. dba ALS Environmental

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Analytical Results

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

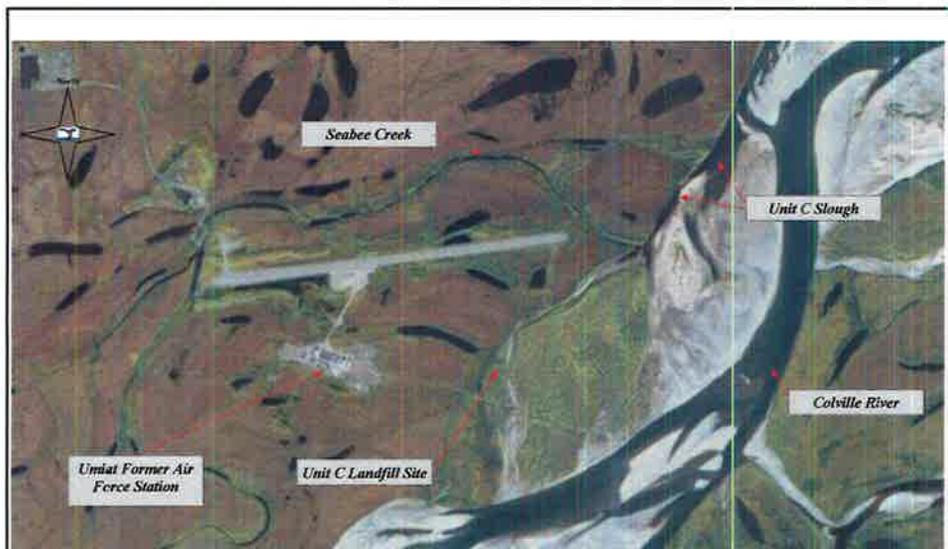
Polychlorinated Biphenyls (PCBs)

Sample Name: DG1
 Lab Code: K1509159-008
 Extraction Method: EPA 3541
 Analysis Method: 8082A

Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1221	ND	U	20	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1232	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1242	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1248	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1254	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1260	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	59	37-139	09/15/15	Acceptable



Travis/Peterson Environmental Consulting, Inc. 3305 Arctic Boulevard, Suite 102 Anchorage, AK 99503 907-522-4337	Assessment of PCBs and DDTs in Fish Populations of the Colville River Near the Former Umiat Air Force Station Umiat, Alaska	Umiat Map Figure #1
Project No: 1554-01	File: Jupiter\backup\Erik\1554-01\Figures	Date: 11/10/2015
		Scale: None

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

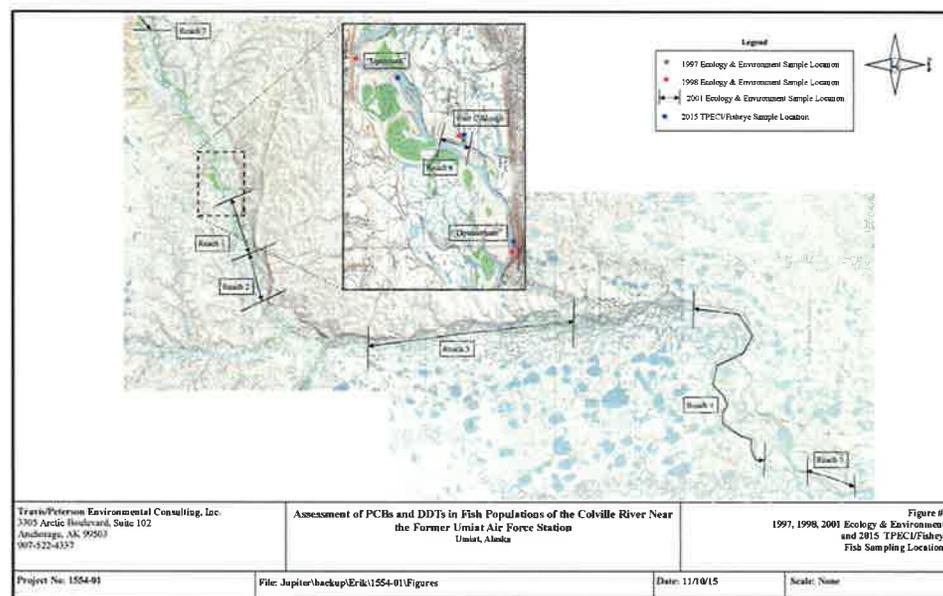
Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

Polychlorinated Biphenyls (PCBs)

Sample Name: SG4 Units: ug/Kg
 Lab Code: K1509159-007 Basis: Wet
 Extraction Method: EPA 3541 Level: Low
 Analysis Method: 8082A

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1221	ND	U	20	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1232	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1242	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1248	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1254	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1260	ND	U	9.7	2.8	1	09/04/15	09/15/15	KWG1508475	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	83	37-139	09/15/15	Acceptable



Comments:

Appendix B:
Photographic Log

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal tissue

Service Request: K1509159
Date Collected: 08/08/2015
Date Received: 08/20/2015

Polychlorinated Biphenyls (PCBs)

Sample Name: SG3
Lab Code: K1509159-006
Extraction Method: EPA 3541
Analysis Method: 8082A

Units: ug/Kg
Basis: Wet
Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1221	ND	U	20	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1232	ND	U	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1242	ND	U	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1248	ND	U	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1254	ND	U	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1260	ND	U	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	79	37-139	09/15/15	Acceptable

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Scafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015



Polychlorinated Biphenyls (PCBs)

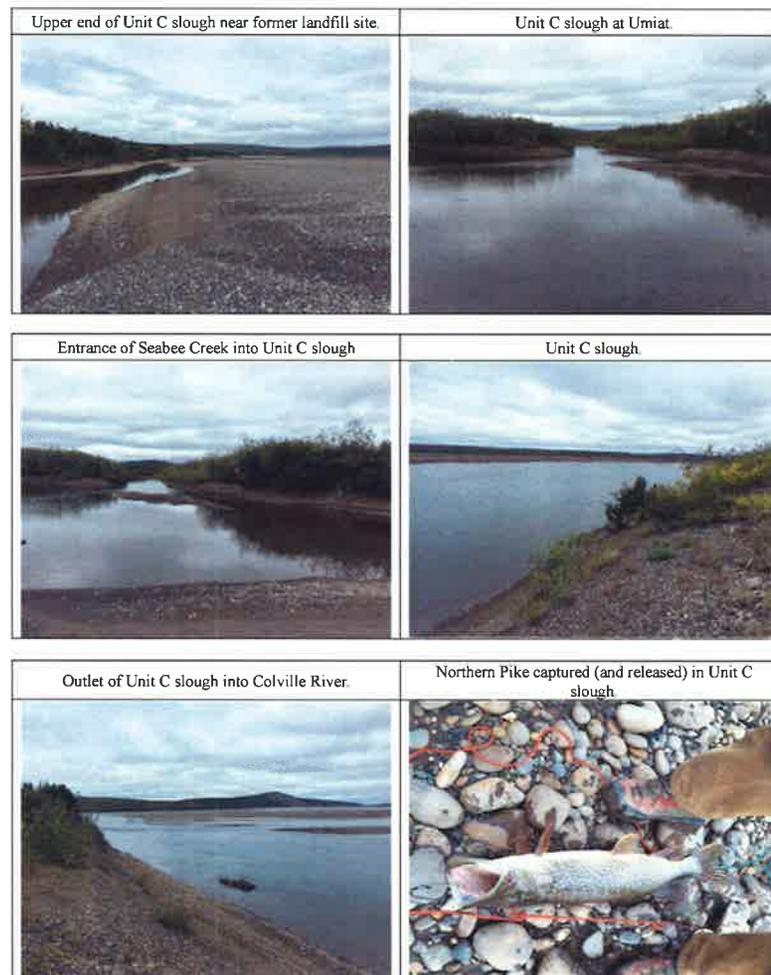
Sample Name: SG2 Units: ug/Kg
 Lab Code: K1509159-005 Basis: Wet
 Extraction Method: EPA 3541 Level: Low
 Analysis Method: 8082A

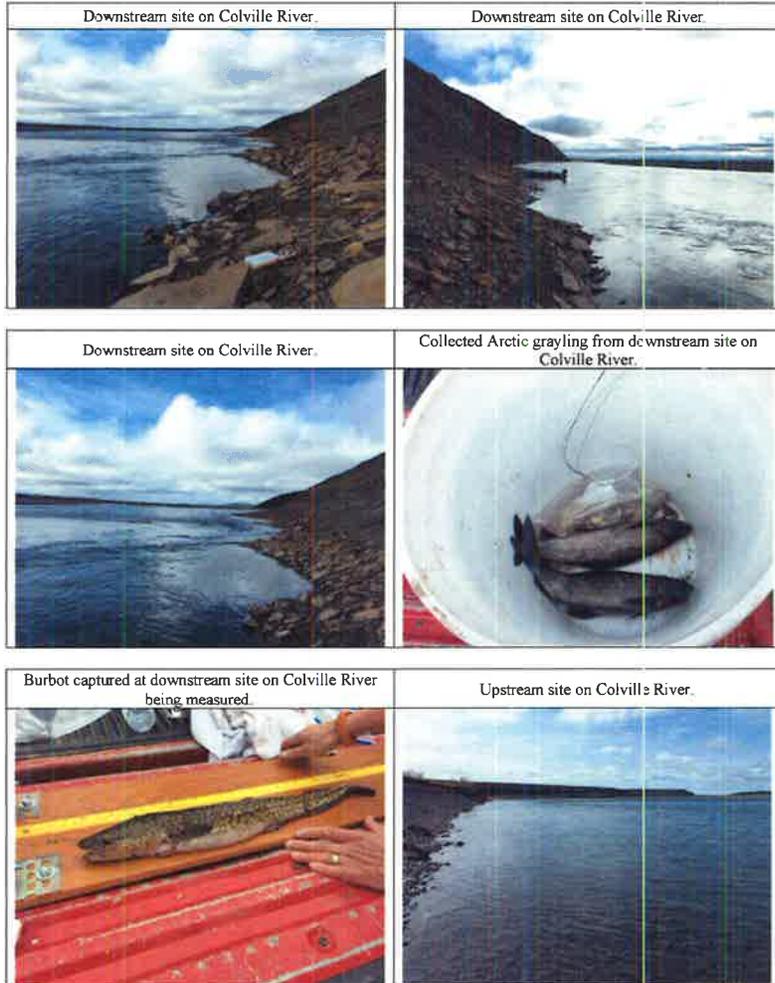
Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1221	ND	U	20	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1232	ND	U	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1242	ND	U	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1248	ND	U	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1254	9.2	J	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1260	5.3	J	9.8	2.8	1	09/04/15	09/15/15	KWG1508475	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	70	37-139	09/15/15	Acceptable

Comments: _____

Assessment of PCBs and DDTs in Fish Populations of the Colville River Near the Former Umiat Air Force Station: Photo Log – August, 2015





ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal tissue

Service Request: K1509159
Date Collected: 08/08/2015
Date Received: 08/20/2015

Polychlorinated Biphenyls (PCBs)

Sample Name: SG1 **Units:** ug/Kg
Lab Code: K1509159-004 **Basis:** Wet
Extraction Method: EPA 3541 **Level:** Low
Analysis Method: 8082A

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1221	ND	U	20	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1232	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1242	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1248	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1254	ND	Ui	9.6	5.0	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1260	ND	Ui	9.6	3.3	1	09/04/15	09/15/15	KWG1508475	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	71	37-139	09/15/15	Acceptable

Comments:

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

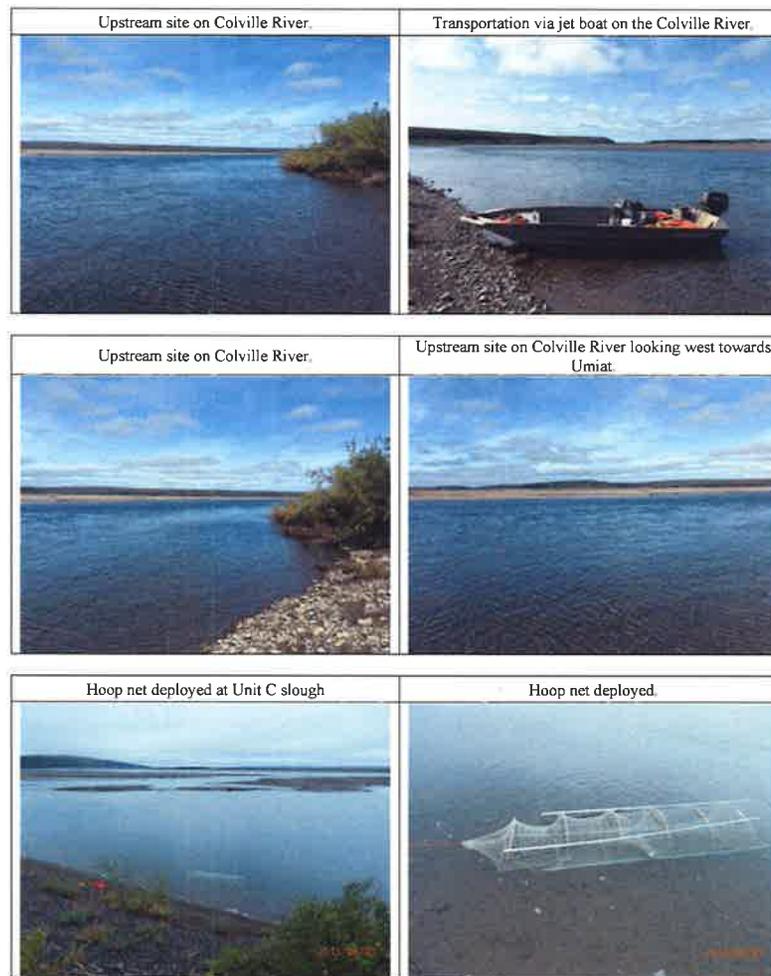


Polychlorinated Biphenyls (PCBs)

Sample Name: UG3 Units: ug/Kg
 Lab Code: K1509159-003 Basis: Wet
 Extraction Method: EPA 3541 Level: Low
 Analysis Method: 8082A

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1221	ND	U	20	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1232	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1242	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1248	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1254	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1260	ND	U	9.6	2.8	1	09/04/15	09/15/15	KWG1508475	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	76	37-139	09/15/15	Acceptable



Comments: _____

Appendix C:
ALS Environmental Laboratory Report

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal tissue

Service Request: K1509159
Date Collected: 08/08/2015
Date Received: 08/20/2015

Polychlorinated Biphenyls (PCBs)

Sample Name: UG2
Lab Code: K1509159-002
Extraction Method: EPA 3541
Analysis Method: 8082A

Units: ug/Kg
Basis: Wet
Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	10	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1221	ND	U	20	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1232	ND	U	10	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1242	ND	U	10	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1248	ND	U	10	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1254	ND	U	10	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1260	ND	U	10	2.8	1	09/04/15	09/15/15	KWG1508475	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	79	37-139	09/15/15	Acceptable

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

Polychlorinated Biphenyls (PCBs)

Sample Name: UG1
 Lab Code: K1509159-001
 Extraction Method: EPA 3541
 Analysis Method: 8082A

Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
Aroclor 1016	ND	U	8.9	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1221	ND	U	18	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1232	ND	U	8.9	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1242	ND	U	8.9	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1248	ND	U	8.9	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1254	ND	U	8.9	2.8	1	09/04/15	09/15/15	KWG1508475	
Aroclor 1260	ND	U	8.9	2.8	1	09/04/15	09/15/15	KWG1508475	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Decachlorobiphenyl	83	37-139	09/15/15	Acceptable



ALS Environmental
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 www.alsglobal.com

September 28, 2015

Analytical Report for Service Request No: K1509159

Stephen Grabacki
 GRAYSTAR Pacific Seafood, Ltd.
 P.O. Box 100506
 Anchorage, AK 99510-0506

RE: Umiat Fish / 30118-001

Dear Stephen,

Enclosed are the results of the sample(s) submitted to our laboratory August 20, 2015
 For your reference, these analyses have been assigned our service request number **K1509159**.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please contact me if you have any questions. My extension is 3293. You may also contact me via email at Shar.Samy@alsglobal.com.

Respectfully submitted,

ALS Group USA, Corp. dba ALS Environmental

Shar Samy, Ph.D.
 Project Manager

Comments: _____



ALS Environmental
 ALS Group USA, Corp
 1317 South 13th Avenue
 Kelso, WA 98626
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- LIPIDS
- Organochlorine Pesticides
- Polychlorinated B phenyls (PCBs)

ALS Group USA, Corp. dba ALS Environmental

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001

Service Request: K1509159

Cover Page - Organic Analysis Data Package Polychlorinated Biphenyls (PCBs)

Sample Name	Lab Code	Date Collected	Date Received
UG1	K1509159-001	08/08/2015	08/20/2015
UG2	K1509159-002	08/08/2015	08/20/2015
UG3	K1509159-003	08/08/2015	08/20/2015
SG1	K1509159-004	08/08/2015	08/20/2015
SG2	K1509159-005	08/08/2015	08/20/2015
SG3	K1509159-006	08/08/2015	08/20/2015
SG4	K1509159-007	08/08/2015	08/20/2015
DG1	K1509159-008	08/08/2015	08/20/2015
DG2	K1509159-009	08/08/2015	08/20/2015
DG3	K1509159-010	08/08/2015	08/20/2015
DB1_Fillet	K1509159-011	08/08/2015	08/20/2015
DB1_Liver	K1509159-012	08/08/2015	08/20/2015
UG1MS	KWG1508475-4	08/08/2015	08/20/2015
UG1DMS	KWG1508475-5	08/08/2015	08/20/2015

ALS Environmental



Polychlorinated Biphenyls (PCBs)

ALS Environmental—Kelso Laboratory
1317 South 13th Avenue, Kelso, WA 98626
Phone (360)577-7222 Fax (360)636-1068
www.alsglobal.com

Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LOD	Limit of Detection
LOQ	Limit of Quantitation
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

Inorganic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- E The result is an estimate amount because the value exceeded the instrument calibration range.
- J The result is an estimated value.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.
- H The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

- # The control limit criteria is not applicable. See case narrative.
- J The result is an estimated value.
- E The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
- M The duplicate injection precision was not met.
- N The Matrix Spike sample recovery is not within control limits. See case narrative.
- S The reported value was determined by the Method of Standard Additions (MSA).
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- W The post-digestion spike for Larnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
- i The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
- X See case narrative.
- + The correlation coefficient for the MSA is less than 0.995.
- Q See case narrative. One or more quality control criteria was outside the limits.

Organic Data Qualifiers

- * The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- A A tentatively identified compound, a suspected aldol-condensation product.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result as defined by the DOD or NELAC standards.
- C The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
- D The reported result is from a dilution.
- E The result is an estimated value.
- J The result is an estimated value.
- N The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
- p The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results.
- U The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
DOD-QSM 4.2 definition : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
- i The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
- X See case narrative.
- Q See case narrative. One or more quality control criteria was outside the limits.

Additional Petroleum Hydrocarbon Specific Qualifiers

- F The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
- L The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
- H The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
- O The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
- Y The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
- Z The chromatographic fingerprint does not resemble a petroleum product.

ALS Group USA, Corp. dba ALS Environmental

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

QA/QC Report

Service Request: K1509159
 Date Extracted: 09/04/2015
 Date Analyzed: 09/19/2015

**Lab Control Spike Summary
 Organochlorine Pesticides**

Extraction Method: EPA 3541
 Analysis Method: 8081B

Units: ug/Kg
 Basis: Wet
 Level: Low
 Extraction Lot: KWG1508474

Lab Control Sample
 KWG1508474-7
 Lab Control Spike

Analyte Name	Result	Spike Amount	% Rec	% Rec Limits
4,4'-DDE	14.3	20.0	71	36-139
4,4'-DDD	15.3	20.0	77	33-138
4,4'-DDT	17.4	20.0	87	49-136
2,4'-DDE	13.1	20.0	65	44-115
2,4'-DDD	13.5	20.0	68	43-117
2,4'-DDT	13.9	20.0	69	42-118

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp. dba ALS Environmental

QA/QC Report

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Extracted: 09/04/2015
 Date Analyzed: 09/19/2015

Matrix Spike/Duplicate Matrix Spike Summary
 Organochlorine Pesticides

Sample Name: UG1
 Lab Code: K1509159-001
 Extraction Method: EPA 3541
 Analysis Method: 8081B

Units: ug/Kg
 Basis: Wet
 Level: Low
 Extraction Lot: KWG1508474

Analyte Name	Sample Result	UGIMS KWG1508474-5 Matrix Spike			UG1DMS KWG1508474-6 Duplicate Matrix Spike			%Rec Limits	RPD	RPD Limit
		Result	Spike Amount	%Rec	Result	Spike Amount	%Rec			
4,4'-DDE	ND	7.80	18.8	41	8.09	16.8	48	33-134	4	40
4,4'-DDD	ND	8.27	18.8	44	8.48	16.8	50	35-126	2	40
4,4'-DDT	ND	8.67	18.8	46	8.85	16.8	53	26-133	2	40
2,4'-DDE	ND	7.02	18.8	37 *	7.49	16.8	44	44-115	6	40
2,4'-DDD	ND	7.37	18.8	39 *	7.70	16.8	46	43-117	4	40
2,4'-DDT	ND	7.69	18.8	41 *	8.12	16.8	48	42-118	5	40

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
 State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certific/labs/Pages/ELAP.aspx	2795
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L14-51
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Hawaii DOH	Not available	-
Idaho DHW	http://www.healthandwelfare.idaho.gov/Health/Labs/CertificationDrinkingWaterLabs/tabid/1833/Default.aspx	-
ISO 17025	http://www.pjlabs.com/	L14-50
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	03016
Maine DHS	Not available	WA01276
Michigan DEQ	http://www.michigan.gov/deq/0,1607,7-135-3307_4131_4156---,00.html	9949
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-457
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdwlabservice.htm	WA01276
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
North Carolina DWQ	http://www.dwqlab.org/	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon - DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA100010
South Carolina DHEC	http://www.scdhec.gov/environment/envserv/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	T104704427
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C544
Wisconsin DNR	http://dnr.wi.gov/	998386840
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.ALSGlobal.com or at the accreditation bodies web site.
 Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/analyte is offered by that state.

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.



Case Narrative

ALS Environmental—Kelso Laboratory
 1317 South 13th Avenue, Kelso, WA 98626
 Phone (360)577- 7222 Fax (360)636- 1068
 www.alsglobal.com

ALS Group USA, Corp. dba ALS Environmental

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

QA/QC Report

Service Request: K1509159

Surrogate Recovery Summary Organochlorine Pesticides

Extraction Method: EPA 3541
 Analysis Method: 3081B

Units: Percent
 Level: Low

Sample Name	Lab Code	Sur1	Sur2
UG1	K1509159-001	77	78
UG2	K1509159-002	73	72
UG3	K1509159-003	68	70
SG1	K1509159-004	66	66
SG2	K1509159-005	65	67
SG3	K1509159-006	71	73
SG4	K1509159-007	77	83
DG1	K1509159-008	54	58
DG2	K1509159-009	68	69
DG3	K1509159-010	62	65
DB1_Fillet	K1509159-011	65	69
DB1_Liver	K1509159-012	60 D	68 D
Method Blank	KWG1508474-8	76	88
UG1MS	KWG1508474-5	36	35
UG1DMS	KWG1508474-6	40	40
Lab Control Sample	KWG1508474-7	65	68

Surrogate Recovery Control Limits (%)

Sur1	* Tetrachloro-m-xylene	29-117
Sur2	* Decachlorobiphenyl	22-121

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd,
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: NA
 Date Received: NA

ALS ENVIRONMENTAL

Organochlorine Pesticides

Sample Name: Method Blank
 Lab Code: KWG1508474-8
 Extraction Method: EPA 3541
 Analysis Method: 8081B

Units: ug/Kg
 Basis: Wet
 Level: Low

Client: GRAYSTAR Pacific Seafood, Ltd
 Project: Umiat Fish/ 30118-001
 Sample Matrix: Animal Tissue

Service Request No.: K1509159
 Date Received: 08/20/15

Case Narrative

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	ND	U	0.85	0.45		09/04/15	09/17/15	KWG1508474	
4,4'-DDD	ND	U	0.85	0.55		09/04/15	09/17/15	KWG1508474	
4,4'-DDT	ND	U	0.85	0.49		09/04/15	09/17/15	KWG1508474	
2,4'-DDE	ND	U	1.0	0.37		09/04/15	09/17/15	KWG1508474	
2,4'-DDD	ND	U	1.0	0.73		09/04/15	09/17/15	KWG1508474	
2,4'-DDT	ND	U	0.85	0.16		09/04/15	09/17/15	KWG1508474	

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Surrogate recoveries have been reported for all applicable organic analyses. Additional quality control analyses reported herein include: Laboratory Control Sample (LCS), and Laboratory/Duplicate Laboratory Control Sample (LCS/DLCS).

Sample Receipt

Twelve animal tissue samples were received for analysis at ALS Environmental on 08/20/15. The samples were received in good condition and consistent with the accompanying chain of custody form, except where noted on the cooler receipt and preservation form included in this report. The samples were stored frozen at -20°C upon receipt at the laboratory.

Lipids

No anomalies associated with the analysis of these samples were observed.

Organochlorine Pesticides by EPA Method 8081

Calibration Verification Exceptions:

The upper control criterion was exceeded for the following analytes in Continuing Calibration Verification (CCV) KWG1508959-3: 4,4'-DDD and 4,4'-DDT. The field samples analyzed in this sequence did not contain the analytes in question above the reporting limit. Since the apparent problem equates to a potential high bias, the data quality is not affected. No further corrective action was required.

The analysis of Chlorinated Pesticides by EPA 8081 requires the use of dual column confirmation. When the Continuing Calibration Verification (CCV) criterion is met for both columns, the lower of the two sample results is generally reported. The primary evaluation criteria were not met on the confirmation column for Tetrachloro-m-xylene. The results were reported from the column with an acceptable CCV. The data quality was not affected. No further corrective action was necessary.

Second Source Exceptions:

The analysis of Chlorinated Pesticides by EPA 8081 requires the use of dual column confirmation. When the Initial Calibration Verification (ICV) criteria are met for both columns, the lower of the two sample results is generally reported. The criteria were not met for 4,4'-DDE and 2,4'-DDD in CAL 14272. The data quality was not affected. No further corrective action was necessary.

Comments: _____

Approved by: 

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal tissue

Service Request: K1509159
Date Collected: 08/08/2015
Date Received: 08/20/2015

Organochlorine Pesticides

Sample Name: DB1_Liver
Lab Code: K1509159-012
Extraction Method: EPA 3541
Analysis Method: 8081B

Units: ug/Kg
Basis: Wet
Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	16	D	4.0	2.3	.5	09/04/15	09/17/15	KWG1508474	
4,4'-DDD	ND	U	4.0	2.8	.5	09/04/15	09/17/15	KWG1508474	
4,4'-DDT	13	D	4.0	2.5	.5	09/04/15	09/22/15	KWG1508474	
2,4'-DDE	ND	U	5.0	1.9	.5	09/04/15	09/17/15	KWG1508474	
2,4'-DDD	ND	U	5.0	3.7	.5	09/04/15	09/17/15	KWG1508474	
2,4'-DDT	4.9	PD	4.0	0.80	.5	09/04/15	09/17/15	KWG1508474	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Tetrachloro-m-xylene	60	29-117	09/17/15	Acceptable
Decachlorobiphenyl	68	22-121	09/17/15	Acceptable

Sample Confirmation Notes:

The confirmation comparison criterion of 40% difference for 2,4'-DDT was exceeded in DB1-Liver. The lower of the two values was reported when both peaks were within the expected retention time window for this analysis and Gaussian in shape or the higher of the two values was reported when there was an apparent interference on the alternate column that produced the lower value.

Elevated Detection Limits:

The reporting limit is elevated for 2,4'-DDT in samples DG1 and DG3. The chromatogram indicated the presence of non-target background components. The matrix interference prevented adequate resolution of the target compound at the reporting limit. The results are flagged to indicate the matrix interference.

The reporting limit is elevated for all analytes in sample DB1-Liver. The sample extract was diluted prior to instrumental analysis due to sample matrix. The extract contained visible lipids and was viscous, which indicated the need to perform a dilution prior to injection into the instrument. Clean-up of the extract was performed within the scope of the method, but did not eliminate enough of the background components to prevent dilution. The results are flagged to indicate the matrix interference.

Sample Notes and Discussion:

Organochlorine Pesticides (O-C Pesticides) determined by EPA Method 8081B or equivalent gas chromatography-electron capture detector (GC/ECD) procedures are subject to interference from polychlorinated biphenyls (PCBs). The interference stems from the inability of the GC/ECD to differentiate selected PCB congeners from certain O-C Pesticides. This method limitation can result in false positive detections and/or high bias to pesticide values.

The magnitude of the interference is directly proportional to the concentration of PCBs in the sample. In addition, the affect on selected O-C Pesticides is complicated by the type PCB Aroclor(s) present in the sample. The presence of multiple Aroclors can result in contribution to the apparent concentration of O-C Pesticides by PCB congeners common to two or more Aroclors.

DB1_Liver and SG2 in this delivery group contained PCB Aroclors at concentrations high enough to impact the O-C Pesticide results. Note that the results for the O-C Pesticides were reported as per the protocol defined in SW-846 regarding dual column confirmation. In some instances, certain PCB congeners were suspected of being detected on both columns simultaneously within the retention time window of the target pesticide. When the resulting chromatographic peaks met the criteria of a detection as defined in the method, the values were reported.

Results for 4,4'-DDT have contribution from confirmed PCB interferences on both columns within the established retention time window, resulting in reported values with a significant high bias.

Matrix Spike Recovery Exceptions:

The matrix spike recovery of a few analytes for sample UG1 was outside control criteria. Recoveries in the Laboratory Control Sample (LCS) and Duplicate Matrix Spike were acceptable, which indicated the analytical batch was in control. The matrix spike outlier suggested a potential low bias in this matrix. No further corrective action was appropriate.

No other anomalies associated with the analysis of these samples were observed.

PCB Aroclors by EPA Method 8082

Second Source Exceptions:

The analysis of PCB Aroclors by EPA 8082A requires the use of dual column confirmation. The Initial Calibration Verification (ICV) evaluation criteria were not met on the confirmation column for Aroclor 1260 in CAL13624. The ICV criteria were met on the alternate column. The data quality was not affected. No further corrective action was necessary.

Approved by _____



Comments _____

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

Organochlorine Pesticides

Sample Name: DB1_Fillet
 Lab Code: K1509159-011
 Extraction Method: EPA 3541
 Analysis Method: 8081B

Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	ND	U	0.97	0.45	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDD	ND	U	0.97	0.55	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDT	ND	U	0.97	0.49	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDE	ND	U	1.0	0.37	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDD	ND	U	1.0	0.73	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDT	ND	U	0.97	0.16	1	09/04/15	09/17/15	KWG1508474	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Tetrachloro-m-xylene	65	29-117	09/17/15	Acceptable
Decachlorobiphenyl	69	22-121	09/17/15	Acceptable

Comments: _____

Elevated Detection Limits:

The detection limit was elevated for at least a few Aroclors in samples SG2 and DB1-Liver. The chromatogram indicated the presence of non-target background components. The matrix interference prevented adequate resolution of the target compounds at the normal limit. The results were flagged to indicate the matrix interference.

Sample Notes and Discussion:

Two Aroclors were identified in SG2: Aroclor 1254 and Aroclor 1260. When mixtures of PCB Aroclors are present in a sample, correct identification and quantitative analysis of the individual Aroclors can be subjective.

When Aroclor mixtures are present in a sample, care is taken to minimize the possibility of double-counting PCBs. Analytical peaks are selected based on the best resolution possible for that particular sample. However, when a mixture of Aroclors 1254 and 1260 are present in a sample, the potential exists for a high bias from contribution of one Aroclor to another due to common peaks or peaks that cannot be completely resolved.

Sample Confirmation Notes:

The confirmation comparison criteria of 40% difference for Aroclor 1260 was exceeded in sample DB1_Liver. The lower of the two values was reported because no evidence of a matrix interference was observed.

No other anomalies associated with the analysis of these samples were observed.

Approved by: _____





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 Phone (360)577- 7222 Fax (360)636- 1068
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ALS Group USA, Corp. dba ALS Environmental

Analytical Results
 Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue
 Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

Organochlorine Pesticides

Sample Name: DG3
 Lab Code: K1509159-010
 Extraction Method: EPA 3541
 Analysis Method: 8081B
 Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	5.4		0.98	0.45	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDD	3.4		0.98	0.55	1	09/04/15	09/22/15	KWG1508474	
4,4'-DDT	1.3		0.98	0.49	1	09/04/15	09/22/15	KWG1508474	
2,4'-DDE	ND	U	1.0	0.37	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDD	ND	U	1.0	0.73	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDT	ND	U	0.98	0.23	1	09/04/15	09/17/15	KWG1508474	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Tetrachloro-m-xylene	62	29-117	09/17/15	Acceptable
Decachlorobiphenyl	65	22-121	09/17/15	Acceptable

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

Organochlorine Pesticides

Sample Name: DG2
 Lab Code: K1509159-009
 Extraction Method: EPA 3541
 Analysis Method: 8081B

Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	1.9		0.99	0.45	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDD	ND	U	0.99	0.55	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDT	0.94	J	0.99	0.49	1	09/04/15	09/22/15	KWG1508474	
2,4'-DDE	ND	U	1.0	0.37	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDD	ND	U	1.0	0.73	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDT	ND	U	0.99	0.16	1	09/04/15	09/17/15	KWG1508474	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Tetrachloro-m-xylene	68	29-117	09/17/15	Acceptable
Decachlorobiphenyl	69	22-121	09/17/15	Acceptable

Chain of Custody

Work Order No: K1509159

ADDRESS 1317 South 13th Ave, Kelso, WA 98626
 PHONE 1 360 577 7222 FAX 1 360 636 1068
 Columbia Analytical Services, Inc.
 Part of the ALS Group - A Campbell Brothers Limited Company

Project Manager: Stephen Grabacki	Bill to: Michael Travis
Client Name: GRAYSTAR Pacific Seafood, Ltd.	Company: Travis Peterson Environmental Consulting
Address: P.O. Box 100506	Address: 3305 Arctic Blvd, Suite 102
City, State Zip: Anchorage, Alaska 99510-0506	City, State Zip: Anchorage, Alaska 99503
Email: graystarpacific@gmail.com	Email: mtravis@tpecc.com
Phone: 907-272-5600	Phone: 907-522-4337

Project Name: Umiat Fish
 Project Number: 30118-001
 P.O. Number:
 Sample's Name: Stephen Grabacki

REQUESTED ANALYSIS										TAT	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> Routine <input type="checkbox"/> Same Day *** <input type="checkbox"/> Next Day *** <input type="checkbox"/> 5 Day <input type="checkbox"/> 7 Day										
*** Please call for availability											
Due Date:											
Comments											

Sample Identification	Matrix	Date Sampled	Time Sampled	Lab ID	No. of Containers	MC# 8082A	Precludes 8081B
UG1	fish	8/8/2015		1	1	X	X
UG2	fish	8/8/2015		2	1	X	X
UG3	fish	8/8/2015		3	1	X	X
UG4	fish	8/8/2015		4	1	X	X
UG5	fish	8/8/2015		5	1	X	X
UG6	fish	8/8/2015		6	1	X	X
UG7	fish	8/8/2015		7	1	X	X
UG8	fish	8/8/2015		8	1	X	X
UG9	fish	8/8/2015		9	1	X	X
UG10	fish	8/8/2015		10	1	X	X
UG11	fish	8/8/2015		11	1	X	X

Dissolved	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Si, Sn, Sr, Ti, V, Zn, Zr	Additional Methods Available Upon Request
Total	Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Si, Sn, Sr, Ti, V, Zn, Zr	

RELINQUISHED BY			RECEIVED BY		
Print Name	Signature	Date/Time	Print Name	Signature	Date/Time
Stephen Grabacki	<i>[Signature]</i>	18 AUG 2015 @ 17:4	JWOLF	<i>[Signature]</i>	8/20/15 09:20

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Comments:



Cooler Receipt and Preservation Form

PC Shar

Client / Project: FAVEO Inc. Service Request #15 09159
Received: 8/20/15 Opened: 8/20/15 By: [Signature] Unloaded: 8/20/15 By: [Signature]

- 1. Samples were received via? Mail Fed Ex UPS DHL PDX Courier Hand Delivered
2. Samples were received in: (circle) Cooler Box Envelope Other NA
3. Were custody seals on coolers? NA Y N If yes, how many and where?
If present, were custody seals intact? Y N If present, were they signed and dated? Y N

Table with columns: Raw Cooler Temp, Corrected Cooler Temp, Raw Temp Blank, Corrected Temp Blank, Corr. Factor, Thermometer ID, Cooler/COC ID, Tracking Number, NA, Filed.

- 4. Packing material: Inserts Baggies Bubble Wrap Gel Packs Wet Ice Dry Ice Sleeves
5. Were custody papers properly filled out (ink, signed, etc.)? NA Y N
6. Did all bottles arrive in good condition (unbroken)? Indicate in the table below. NA Y N
7. Were all sample labels complete (i.e. analysis, preservation, etc.)? NA Y N
8. Did all sample labels and tags agree with custody papers? Indicate major discrepancies in the table on page 2. NA Y N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA Y N
10. Were the pH-preserved bottles (see SMO GEN SOP) received at the appropriate pH? Indicate in the table below. NA Y N
11. Were VOA vials received without headspace? Indicate in the table below. NA Y N
12. Was C12/Fes negative? NA Y N

Table with columns: Sample ID on Bottle, Sample ID on COC, Identified by:

Table with columns: Sample ID, Bottle Count, Bottle Type, Out of Head-Temp space, Broke, pH, Reagent, Volume added, Reagent Lot Number, Initials, Time

Notes, Discrepancies, & Resolutions:

No COC rec'd.

ALS Group USA, Corp. dba ALS Environmental

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal tissue

Analytical Results

Service Request: K1509159
Date Collected: 08/08/2015
Date Received: 08/20/2015

Organochlorine Pesticides

Sample Name: DGI
Lab Code: K1509159-008
Extraction Method: EPA 3541
Analysis Method: 8081B

Units: ug/Kg
Basis: Wet
Level: Low

Table with columns: Analyte Name, Result, Q, MRL, MDL, Dilution Factor, Date Extracted, Date Analyzed, Extraction Lot, Note

Table with columns: Surrogate Name, %Rec, Control Limits, Date Analyzed, Note

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015



Organochlorine Pesticides

Sample Name: SG4
 Lab Code: K1509159-007
 Extraction Method: EPA 3541
 Analysis Method: 8081B

Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	4.0		0.97	0.45		09/04/15	09/17/15	KWG1508474	
4,4'-DDD	1.3		0.97	0.55		09/04/15	09/22/15	KWG1508474	
4,4'-DDT	0.64	JP	0.97	0.49		09/04/15	09/17/15	KWG1508474	
2,4'-DDE	ND	U	1.0	0.37		09/04/15	09/17/15	KWG1508474	
2,4'-DDD	ND	U	1.0	0.73		09/04/15	09/17/15	KWG1508474	
2,4'-DDT	ND	U	0.97	0.16		09/04/15	09/17/15	KWG1508474	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Tetrachloro-m-xylene	77	29-117	09/17/15	Acceptable
Decachlorobiphenyl	83	22-121	09/17/15	Acceptable



Comments: _____

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ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal Tissue
Analysis Method: Calculation
Prep Method: None

Service Request: K1509159
Date Collected: 08/8/15
Date Received: 08/20/15
Units: Percent
Basis: Wet

Moisture

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Q
UG1	K1509159-001	76.9	-	-	1	09/04/15 14:45	
UG2	K1509159-002	76.3	-	-	1	09/04/15 14:45	
UG3	K1509159-003	79.2	-	-	1	09/04/15 14:45	
SG1	K1509159-004	77.9	-	-	1	09/04/15 14:45	
SG2	K1509159-005	76.3	-	-	1	09/04/15 14:45	
SG3	K1509159-006	79.5	-	-	1	09/04/15 14:45	
SG4	K1509159-007	79.3	-	-	1	09/04/15 14:45	
DG1	K1509159-008	75.0	-	-	1	09/04/15 00:00	
DG2	K1509159-009	75.6	-	-	1	09/04/15 14:45	
DG3	K1509159-010	80.1	-	-	1	09/04/15 14:45	
DB1_Fillet	K1509159-011	80.6	-	-	1	09/04/15 14:45	
DB1_Liver	K1509159-012	58.3	-	-	1	09/04/15 14:45	

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Sample Matrix: Animal tissue

Service Request: K1509159
Date Collected: 08/08/2015
Date Received: 08/20/2015

Organochlorine Pesticides

Sample Name: SG3
Lab Code: K1509159-006
Extraction Method: EPA 3541
Analysis Method: 8081B

Units: ug/Kg
Basis: Wet
Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	0.99		0.98	0.45	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDD	1.4		0.98	0.55	1	09/04/15	09/22/15	KWG1508474	
4,4'-DDT	0.83	JP	0.98	0.49	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDE	ND	U	1.0	0.37	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDD	ND	U	1.0	0.73	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDT	ND	U	0.98	0.16	1	09/04/15	09/17/15	KWG1508474	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Tetrachloro-m-xylene	71	29-117	09/17/15	Acceptable
Decachlorobiphenyl	73	22-121	09/17/15	Acceptable

Comments:

ALS Group USA, Corp. dba ALS Environmental

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiaf Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

Analytical Results

Organochlorine Pesticides

Sample Name: SG2
 Lab Code: K1509159-005
 Extraction Method: EPA 3541
 Analysis Method: 8081B

Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	6.6		0.98	0.45	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDD	3.6		0.98	0.55	1	09/04/15	09/22/15	KWG1508474	
4,4'-DDT	3.5		0.98	0.49	1	09/04/15	09/22/15	KWG1508474	
2,4'-DDE	ND	U	1.0	0.37	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDD	0.83	JP	1.0	0.73	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDT	2.4		0.98	0.16	1	09/04/15	09/17/15	KWG1508474	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Tetrachloro-m-xylene	65	29-117	09/17/15	Acceptable
Decachlorobiphenyl	67	22-121	09/17/15	Acceptable

Comments: _____

ALS Group USA, Corp.
 dba ALS Environmental

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiaf Fish/30118-001
 Sample Matrix: Animal Tissue
 Analysis Method: Freeze Dry
 Prep Method: None

Analytical Report

Service Request: K1509159
 Date Collected: 08/8/15
 Date Received: 08/20/15

Units: Percent
 Basis: Wet

Total Solids

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Q
UG1	K1509159-001	23.1	-	-	1	09/04/15 14:45	
UG2	K1509159-002	23.7	-	-	1	09/04/15 14:45	
UG3	K1509159-003	20.8	-	-	1	09/04/15 14:45	
SG1	K1509159-004	22.1	-	-	1	09/04/15 14:45	
SG2	K1509159-005	23.7	-	-	1	09/04/15 14:45	
SG3	K1509159-006	20.5	-	-	1	09/04/15 14:45	
SG4	K1509159-007	20.7	-	-	1	09/04/15 14:45	
DG1	K1509159-008	25.0	-	-	1	09/04/15 00:00	?
DG2	K1509159-009	24.4	-	-	1	09/04/15 14:45	
DG3	K1509159-010	19.9	-	-	1	09/04/15 14:45	
DB1_Fillet	K1509159-011	19.4	-	-	1	09/04/15 14:45	
DB1_Liver	K1509159-012	41.7	-	-	1	09/04/15 14:45	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umat Fish/30118-001
Sample Matrix: Animal Tissue

Service Request: K1509159
Date Collected: 08/08/15
Date Received: 08/20/15
Date Analyzed: 09/04/15

Replicate Sample Summary
Inorganic Parameters

Sample Name: UG1 **Units:** Percent
Lab Code: K1509159-001 **Basis:** Wet

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample	Average	RPD	RPD Limit
					K1509159-001DUP			
Total Solids	Freeze Dry	-	-	23.1	23.1	23.1	<1	20

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umat Fish/30118-001
Sample Matrix: Animal tissue

Service Request: K1509159
Date Collected: 08/08/2015
Date Received: 08/20/2015

Organochlorine Pesticides

Sample Name: SG1 **Units:** ug/Kg
Lab Code: K1509159-004 **Basis:** Wet
Extraction Method: EPA 3541 **Level:** Low
Analysis Method: 8081B

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	11		0.96	0.45	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDD	5.2		0.96	0.55	1	09/04/15	09/22/15	KWG1508474	
4,4'-DDT	3.0		0.96	0.49	1	09/04/15	09/22/15	KWG1508474	
2,4'-DDE	ND	U	1.0	0.37	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDD	ND	U	1.0	0.73	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDT	1.3		0.96	0.16	1	09/04/15	09/17/15	KWG1508474	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Tetrachloro-m-xylene	66	29-117	09/17/15	Acceptable
Decachlorobiphenyl	66	22-121	09/17/15	Acceptable

Comments:

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015



Organochlorine Pesticides

Sample Name: UG3 Units: ug/Kg
 Lab Code: K1509159-003 Basis: Wet
 Extraction Method: EPA 3541 Level: Low
 Analysis Method: 8081B

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	ND	U	0.96	0.45	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDD	ND	U	0.96	0.55	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDT	ND	U	0.96	0.49	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDE	ND	U	1.0	0.37	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDD	ND	U	1.0	0.73	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDT	0.17	JP	0.96	0.16	1	09/04/15	09/17/15	KWG1508474	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Tetrachloro-m-xylenc	68	29-117	09/17/15	Acceptable
Decachlorobiphenyl	70	22-121	09/17/15	Acceptable



Comments: _____

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ALS ENVIRONMENTAL

Analytical Report

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 8/8/2015
 Date Received: 8/20/2015

Lipids, Total

Prep Method: EPA 3541
 Analysis Method: NOAA
 Test Notes:
 Units: PERCENT
 Basis: Wet Weight

Sample Name	Lab Code	MRL	Date Extracted	Date Analyzed	Result	Result Notes
UG1	K1509159-001	0.004	9/4/2015	9/9/2015	1.6	
UG2	K1509159-002	0.005	9/4/2015	9/9/2015	1.9	
UG3	K1509159-003	0.005	9/4/2015	9/9/2015	1.2	
SG1	K1509159-004	0.005	9/4/2015	9/9/2015	1.3	
SG2	K1509159-005	0.005	9/4/2015	9/9/2015	1.5	
SG3	K1509159-006	0.005	9/4/2015	9/9/2015	1.0	
SG4	K1509159-007	0.005	9/4/2015	9/9/2015	1.0	
DG1	K1509159-008	0.005	9/4/2015	9/9/2015	2.3	
DG2	K1509159-009	0.005	9/4/2015	9/9/2015	0.97	
DG3	K1509159-010	0.005	9/4/2015	9/9/2015	1.4	
DB1_Filler:	K1509159-011	0.005	9/4/2015	9/9/2015	0.46	
DB1_Liver:	K1509159-012	0.008	9/4/2015	9/9/2015	25	
Method Blank	KWG1508474-8 MB	0.004	9/4/2015	9/9/2015	0.004	U

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

Organochlorine Pesticides

Sample Name: UG2
 Lab Code: K1509159-002
 Extraction Method: EPA 3541
 Analysis Method: 8081B
 Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	ND	U	1.0	0.45	I	09/04/15	09/17/15	KWG1508474	
4,4'-DDD	ND	U	1.0	0.55	I	09/04/15	09/17/15	KWG1508474	
4,4'-DDT	ND	U	1.0	0.49	I	09/04/15	09/17/15	KWG1508474	
2,4'-DDE	ND	U	1.0	0.37	I	09/04/15	09/17/15	KWG1508474	
2,4'-DDD	ND	U	1.0	0.73	I	09/04/15	09/17/15	KWG1508474	
2,4'-DDT	ND	U	1.0	0.16	I	09/04/15	09/17/15	KWG1508474	

Surrogate Name	% Rec	Control Limits	Date Analyzed	Note
Tetrachloro-m-xylene	73	29-117	09/17/15	Acceptable
Decachlorobiphenyl	72	22-121	09/17/15	Acceptable

Comments:

ALS Group USA, Corp. dba ALS Environmental

Analytical Results

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 08/08/2015
 Date Received: 08/20/2015

Organochlorine Pesticides

Sample Name: UG1
 Lab Code: K1509159-001
 Extraction Method: EPA 3541
 Analysis Method: 8081B

Units: ug/Kg
 Basis: Wet
 Level: Low

Analyte Name	Result	Q	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Extraction Lot	Note
4,4'-DDE	ND	U	0.89	0.45	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDD	ND	U	0.89	0.55	1	09/04/15	09/17/15	KWG1508474	
4,4'-DDT	ND	U	0.89	0.49	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDE	ND	U	1.0	0.37	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDD	ND	U	1.0	0.73	1	09/04/15	09/17/15	KWG1508474	
2,4'-DDT	ND	U	0.89	0.16	1	09/04/15	09/17/15	KWG1508474	

Surrogate Name	%Rec	Control Limits	Date Analyzed	Note
Tetrachloro-m-xylene	77	29-117	09/17/15	Acceptable
Decachlorobiphenyl	78	22-121	09/17/15	Acceptable

Comments: _____

ALS ENVIRONMENTAL

QA/QC Report

Client: GRAYSTAR Pacific Seafood, Ltd.
 Project: Umiat Fish/30118-001
 Sample Matrix: Animal tissue

Service Request: K1509159
 Date Collected: 8/8/2015
 Date Received: 8/20/2015
 Date Extracted: 9/4/2015
 Date Analyzed: 9/9/2015

Triplicate Summary
 Lipids, Total

Sample Name: KWG1508474-9 LCS
 Lab Code: K1509459-001 TRP
 Test Notes:

Units: PERCENT
 Basis: Wet Weight

Analyte	Prep Method	Analysis Method	MRL	Sample Result	Duplicate Sample Result	Triplicate Sample Result	Average	Percent Relative Standard Deviation	Result Notes
Lipids, Total	EPA 3541	NOAA	0.005	1.6	1.3	1.4	1.5	9	

ALS ENVIRONMENTAL

QA/QC Report

Client: GRAYSTAR Pacific Seafood, Ltd.
Project: Umiat Fish/30118-001
Matrix: Tissue

Service Request: K1509159
Date Collected: NA
Date Received: NA
Date Extracted: 9/4/2015
Date Analyzed: 9/9/2015



Laboratory Control Sample
Lipids, Total

Sample Name: KWG1508474-9 LCS

Units: PERCENT
Basis: Wet Weight

Test Notes:

Analyte	Prep Method	Analysis Method	Spike Level Percent	Result	CAS Advisory Limits	Result Notes
Lipids, Total	EPA 3541	NOAA	100	108	70-130	

Organochlorine Pesticides

ALS Environmental—Kelso Laboratory
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Arctic Fox Environmental, Inc.

Pouch 340043 / Prudhoe Bay, AK 99734
Phone: (907) 659-2145 / Fax: (907) 659-2146
arcticfox@astacalaska.com / www.arcticfoxenv.com

Analytical Services Order and Chain of Custody Form

84509

1013-1083

Client Name and Address: WSB-DWM PO BOX 69 Barrow, AK 99723				Account Number: 42804		Preservative ←	
Contact Person: Todd Sformo 907.852.6584				P.O. or Contract Number:			
Phone Number: 907 852-0350 Fax Number:				Authorization Number:			
E-mail: todd.sformo@north-slope.org				Sampled By: T.S.			
Project Name: Colville Fish Study				PWS Number:			
Data Deliverables: Level I <input type="checkbox"/> Level II <input type="checkbox"/> Level III <input type="checkbox"/> EDD/Format:				Send Results to ADEC: <input type="checkbox"/> YES <input type="checkbox"/> No			
Requested Turnaround Time and Special Instructions: rapid turnaround							
Client Sample ID	Date Sampled	Time Sampled	Matrix	AF Sample ID	Number of Containers		Remarks
Colville fish study st4 H2O ^B	10/18/13	10:30 AM		AF48972	1	X	X
st4 H2O ^C	10/18/13	10:30 AM		AF48973	1	X	X ^{with}
st4 H2O ^A	10/18/13	10:30 AM		AF48974	1		X
Colville Fish study st4 H2O ^E	10/18/13	10:30 AM		AF48975	1	X	X
" " st4 " ^F	10/18/13	10:30 AM		AF48976	1	X	X ^{with}
st4 " ^D	10/18/13	10:30 AM		AF48977	1		X
Relinquished By (1): Todd Sformo				Date: 10/18/13	Time: 11:10 AM	Received By:	
Relinquished By (2):				Date: 10/18/13	Time: 11:30	Received By: [Signature]	
Relinquished By (3):				Date:	Time:	Received for lab by:	
				TO BE COMPLETED BY LABORATORY			
				Location Received/ ANC <input type="checkbox"/> 6.4 °C FBK <input type="checkbox"/> °C PB <input type="checkbox"/> °C			
				Temp on Arrival: 8178			
				Chain of Custody Seal <input type="checkbox"/> INTACT <input type="checkbox"/> BROKEN <input type="checkbox"/> ABSENT			
				Shipping Bill Number:			

Arctic Fox Environmental, Inc.

Pouch 340043 - Prudhoe Bay, AK 99734
Phone: (907) 659-2145 / Fax: (907) 659-2146 / arcticfox@astacalaska.com

North Slope Borough
Pouch 340044
Prudhoe Bay, Alaska 99734

Report Date: 10/25/2013
Date Arrived: 10/18/2013
Date Sampled: 10/18/2013
Time Sampled: see below
Collected By: TS

Attn: Todd Sformo
Phone: (907) 852-0350
Fax: (907) 659-9061
Email: todd.sformo@north.slope.org

AF Lab #: AF48972-48977
Client Sample ID: see below
Location/Project: Colville Fish Study
COC#: 84509
Sample Matrix: Water

Comments: Attached are the results for analysis of your water samples.
These samples were analyzed by Test America in Beaverton, OR.
Tracking information is as follows:

NSB Sample ID: Colville fish study ST 4 H2O B
Analysis Requested: Total Metals
Time Sampled: 1030
Arctic Fox ID: AF48972
Test America Lab ID: 250-14963-1

NSB Sample ID: Colville fish study ST 4 H2O C
Analysis Requested: DRO/RRO
Time Sampled: 1030
Arctic Fox ID: AF48973
Test America Lab ID: 250-14963-2

NSB Sample ID: Colville fish study ST 4 H2O A
Analysis Requested: Nitrate/Nitrite
Time Sampled: 1030
Arctic Fox ID: AF48974
Test America Lab ID: 250-14963-3

NSB Sample ID: Colville fish study ST 4 H2O E
Analysis Requested: Total Metals
Time Sampled: 1030
Arctic Fox ID: AF48975
Test America Lab ID: 250-14963-4

NSB Sample ID: Colville fish study ST 4 H2O F
Analysis Requested: DRO/RRO
Time Sampled: 1030
Arctic Fox ID: AF48976
Test America Lab ID: 250-14963-5

NSB Sample ID: Colville fish study ST 4 H2O D
Analysis Requested: Nitrate/Nitrite
Time Sampled: 1030
Arctic Fox ID: AF48977
Test America Lab ID: 250-14963-6



Reported By: Ralph E. Allphin/Michael Hawley/Max Greene

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING



ANALYTICAL REPORT

TestAmerica Laboratories, Inc.

TestAmerica Portland
9405 SW Nimbus Ave.
Beaverton, OR 97008
Tel: (503)906-9200

TestAmerica Job ID: 250-14963-1

Client Project/Site: 1013-1083/Colville Fish Study

For:

Arctic Fox Environmental, Inc
Pouch 340043
Prudhoe Bay, Alaska 99734

Attn: Max Greene

Authorized for release by:
10/24/2013 3:24:42 PM

Erica Fot, Project Mgmt. Assistant
erica.fot@testamericainc.com

Designee for

Vanessa Berry, Project Manager I
(503)906-9233
vanessa.frahs@testamericainc.com

LINKS

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The test results in this report meet all 2003 NELAC and 2009 TNI requirements for accredited parameters, exceptions are noted in this report. This report may not be reproduced except in full, and with written approval from the laboratory. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.



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Sample Summary

Client: Arctic Fox Environmental, Inc
Project/Site: 1013-1083/Colville Fish Study

TestAmerica Job ID: 250-14963-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
250-14963-1	AF48972 ST4 B	Water	10/18/13 10:30	10/21/13 08:35
250-14963-2	AF48973 ST4 C	Water	10/18/13 10:30	10/21/13 08:35
250-14963-3	AF48974 ST4 A	Water	10/18/13 10:30	10/21/13 08:35
250-14963-4	AF48975 ST4 E	Water	10/18/13 10:30	10/21/13 08:35
250-14963-5	AF48976 ST4 F	Water	10/18/13 10:30	10/21/13 08:35
250-14963-6	AF48977 ST4 D	Water	10/18/13 10:30	10/21/13 08:35



Case Narrative

Client: Arctic Fox Environmental, Inc
Project/Site: 1013-1083/Colville Fish Study

TestAmerica Job ID: 250-14963-1

Job ID: 250-14963-1

Laboratory: TestAmerica Portland

Narrative

Job Narrative
250-14963-1

Comments

No additional comments.

Receipt

The samples were received on 10/21/2013 8:35 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 3.8° C.

Except:

The following samples were received unpreserved and were preserved upon receipt to the laboratory: AF48972 ST4 B (250-14963-1), AF48975 ST4 E (250-14963-4). Regulatory documents require a 24-hour waiting period from the time of the addition of the acid preservative to the time of digestion.

M030 10/22/13@0930 by PSS

GC Semi VOA

No analytical or quality issues were noted.

Metals

No analytical or quality issues were noted.

General Chemistry

Method 353.2: The matrix spike (MS/MSD) recoveries associated with batch 197495 were outside control limits for NOXT: (280-47683-2 MS), (280-47683-2 MSD). Matrix interference is suspected. The parent sample was negative, with an absolute value greater than the reporting limit (RL), indicating a matrix interference. The associated laboratory control samples (LCS/LCSD) recoveries met acceptance criteria.

No other analytical or quality issues were noted.

Organic Prep

No analytical or quality issues were noted.



Client Sample Results

Client: Arctic Fox Environmental, Inc
Project/Site: 1013-1083/Colville Fish Study

TestAmerica Job ID: 250-14963-1

Client Sample ID: AF48972 ST4 B

Date Collected: 10/18/13 10:30

Date Received: 10/21/13 08:35

Lab Sample ID: 250-14963-1

Matrix: Water

Method: 6020 - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 15:59	1
Barium	0.080		0.0010		mg/L		10/23/13 08:35	10/23/13 15:59	1
Chromium	ND		0.0020		mg/L		10/23/13 08:35	10/23/13 15:59	1
Lead	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 15:59	1
Silver	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 15:59	1
Selenium	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 15:59	1
Cadmium	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 15:59	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	ND		0.00020		mg/L		10/22/13 14:45	10/22/13 21:35	1

Client Sample ID: AF48973 ST4 C

Date Collected: 10/18/13 10:30

Date Received: 10/21/13 08:35

Lab Sample ID: 250-14963-2

Matrix: Water

Method: AK102 & 103 - Alaska - Diesel Range Organics & Residual Range Organics (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C25)	ND		0.11		mg/L		10/21/13 10:15	10/22/13 16:09	1
RRO (nC25-nC36)	ND		0.56		mg/L		10/21/13 10:15	10/22/13 16:09	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
Triacontane	89		50 - 150				10/21/13 10:15	10/22/13 16:09	1
1-Chlorooctadecane	99		50 - 150				10/21/13 10:15	10/22/13 16:09	1

Client Sample ID: AF48974 ST4 A

Date Collected: 10/18/13 10:30

Date Received: 10/21/13 08:35

Lab Sample ID: 250-14963-3

Matrix: Water

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate Nitrite as N	ND		0.10		mg/L			10/23/13 20:36	1

Client Sample ID: AF48975 ST4 E

Date Collected: 10/18/13 10:30

Date Received: 10/21/13 08:35

Lab Sample ID: 250-14963-4

Matrix: Water

Method: 6020 - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Arsenic	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 16:02	1
Barium	0.087		0.0010		mg/L		10/23/13 08:35	10/23/13 16:02	1
Chromium	ND		0.0020		mg/L		10/23/13 08:35	10/23/13 16:02	1
Lead	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 16:02	1
Silver	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 16:02	1
Selenium	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 16:02	1
Cadmium	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 16:02	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.00020		0.00020		mg/L		10/22/13 14:45	10/22/13 21:37	1

TestAmerica Portland

Client Sample Results

Client: Arctic Fox Environmental, Inc
 Project/Site: 1013-1083/Colville Fish Study

TestAmerica Job ID: 250-14963-1

Client Sample ID: AF48976 ST4 F

Date Collected: 10/18/13 10:30

Date Received: 10/21/13 08:35

Lab Sample ID: 250-14963-5

Matrix: Water

Method: AK102 & 103 - Alaska - Diesel Range Organics & Residual Range Organics (GC)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
DRO (C10-C25)	ND		0.11		mg/L		10/21/13 10:15	10/22/13 16:28	1
RRO (nC25-nC36)	ND		0.56		mg/L		10/21/13 10:15	10/22/13 16:28	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
<i>Triacontane</i>	89		50 - 150				10/21/13 10:15	10/22/13 16:28	1
<i>1-Chlorooctadecane</i>	98		50 - 150				10/21/13 10:15	10/22/13 16:28	1

Client Sample ID: AF48977 ST4 D

Date Collected: 10/18/13 10:30

Date Received: 10/21/13 08:35

Lab Sample ID: 250-14963-6

Matrix: Water

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate Nitrite as N	ND		0.10		mg/L			10/23/13 20:35	1



QC Sample Results

Client: Arctic Fox Environmental, Inc
Project/Site: 1013-1083/Colville Fish Study

TestAmerica Job ID: 250-14963-1

Method: AK102 & 103 - Alaska - Diesel Range Organics & Residual Range Organics (GC)

Lab Sample ID: MB 250-21328/1-A

Matrix: Water

Analysis Batch: 21381

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 21328

Analyte	MB MB		RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
DRO (C10-C25)	ND		0.10		mg/L		10/21/13 10:15	10/22/13 14:53	1
RRO (nC25-nC36)	ND		0.50		mg/L		10/21/13 10:15	10/22/13 14:53	1

Surrogate	MB MB		Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
Triacotane	94		50 - 150	10/21/13 10:15	10/22/13 14:53	1
1-Chlorooctadecane	99		50 - 150	10/21/13 10:15	10/22/13 14:53	1

Lab Sample ID: LCS 250-21328/2-A

Matrix: Water

Analysis Batch: 21381

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 21328

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	Limits
RRO (nC25-nC36)	1.50	1.32		mg/L		88	60 - 120

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
Triacotane	97		50 - 150
1-Chlorooctadecane	99		50 - 150

Lab Sample ID: LCSD 250-21328/3-A

Matrix: Water

Analysis Batch: 21381

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Prep Batch: 21328

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	Limits	RPD	Limit
RRO (nC25-nC36)	1.50	1.31		mg/L		87	60 - 120	1	20

Surrogate	LCSD LCSD		Limits
	%Recovery	Qualifier	
Triacotane	97		50 - 150
1-Chlorooctadecane	100		50 - 150

Method: 6020 - Metals (ICP/MS)

Lab Sample ID: MB 250-21397/1-A

Matrix: Water

Analysis Batch: 21438

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 21397

Analyte	MB MB		RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Arsenic	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 15:32	1
Barium	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 15:32	1
Chromium	ND		0.0020		mg/L		10/23/13 08:35	10/23/13 15:32	1
Lead	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 15:32	1
Silver	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 15:32	1
Selenium	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 15:32	1
Cadmium	ND		0.0010		mg/L		10/23/13 08:35	10/23/13 15:32	1

TestAmerica Portland

QC Sample Results

Client: Arctic Fox Environmental, Inc
 Project/Site: 1013-1083/Colville Fish Study

TestAmerica Job ID: 250-14963-1

Method: 6020 - Metals (ICP/MS) (Continued)

Lab Sample ID: LCS 250-21397/2-A
Matrix: Water
Analysis Batch: 21438

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 21397

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec.	
							Limits	
Arsenic	0.100	0.106		mg/L		106	80 - 120	
Barium	0.100	0.102		mg/L		102	80 - 120	
Chromium	0.100	0.106		mg/L		106	80 - 120	
Lead	0.100	0.103		mg/L		103	80 - 120	
Silver	0.0500	0.0517		mg/L		103	80 - 120	
Selenium	0.100	0.103		mg/L		103	80 - 120	
Cadmium	0.100	0.102		mg/L		102	80 - 120	

Lab Sample ID: 250-14999-I-2-B MS
Matrix: Water
Analysis Batch: 21438

Client Sample ID: Matrix Spike
Prep Type: Total/NA
Prep Batch: 21397

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec.	
									Limits	
Arsenic	0.0021		0.100	0.109		mg/L		107	75 - 125	
Barium	0.029		0.100	0.130		mg/L		101	75 - 125	
Chromium	ND		0.100	0.105		mg/L		105	75 - 125	
Lead	0.0028		0.100	0.108		mg/L		103	75 - 125	
Silver	ND		0.0500	0.0512		mg/L		102	75 - 125	
Selenium	ND		0.100	0.108		mg/L		106	75 - 125	
Cadmium	ND		0.100	0.103		mg/L		103	75 - 125	

Lab Sample ID: 250-14999-H-1-B DU
Matrix: Water
Analysis Batch: 21438

Client Sample ID: Duplicate
Prep Type: Total/NA
Prep Batch: 21397

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD	
								Limit	
Arsenic	0.0020		0.00211		mg/L		5	20	
Barium	0.030		0.0290		mg/L		2	20	
Chromium	ND		ND		mg/L		NC	20	
Lead	0.0027		0.00270		mg/L		1	20	
Silver	ND		ND		mg/L		NC	20	
Selenium	ND		ND		mg/L		NC	20	
Cadmium	ND		ND		mg/L		NC	20	

Method: 7470A - Mercury (CVAA)

Lab Sample ID: MB 250-21383/1-A
Matrix: Water
Analysis Batch: 21392

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 21383

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac

Lab Sample ID: LCS 250-21383/2-A
Matrix: Water
Analysis Batch: 21392

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 21383

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec.	
							Limits	
Mercury	0.00500	0.00471		mg/L		94	85 - 115	

TestAmerica Portland

QC Sample Results

Client: Arctic Fox Environmental, Inc
 Project/Site: 1013-1083/Colville Fish Study

TestAmerica Job ID: 250-14963-1

Method: 7470A - Mercury (CVAA) (Continued)

Lab Sample ID: 250-14963-4 MS
 Matrix: Water
 Analysis Batch: 21392

Client Sample ID: AF48975 ST4 E
 Prep Type: Total/NA
 Prep Batch: 21383

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Mercury	0.00020		0.00500	0.00492		mg/L		98	75 - 125

Lab Sample ID: 250-14963-4 MSD
 Matrix: Water
 Analysis Batch: 21392

Client Sample ID: AF48975 ST4 E
 Prep Type: Total/NA
 Prep Batch: 21383

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	Limit
Mercury	0.00020		0.00500	0.00493		mg/L		99	75 - 125	0	20

Method: 353.2 - Nitrogen, Nitrate-Nitrite

Lab Sample ID: MB 280-197495/40
 Matrix: Water
 Analysis Batch: 197495

Client Sample ID: Method Blank
 Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate Nitrite as N	ND		0.10		mg/L			10/23/13 20:15	1

Lab Sample ID: LCS 280-197495/41
 Matrix: Water
 Analysis Batch: 197495

Client Sample ID: Lab Control Sample
 Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Nitrate Nitrite as N	5.00	4.99		mg/L		100	90 - 110

Lab Sample ID: LCSD 280-197495/42
 Matrix: Water
 Analysis Batch: 197495

Client Sample ID: Lab Control Sample Dup
 Prep Type: Total/NA

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	Limit
Nitrate Nitrite as N	5.00	5.15		mg/L		103	90 - 110	3	10

Lab Sample ID: MRL 280-197495/18 MRL
 Matrix: Water
 Analysis Batch: 197495

Client Sample ID: Lab Control Sample
 Prep Type: Total/NA

Analyte	Spike Added	MRL Result	MRL Qualifier	Unit	D	%Rec	%Rec. Limits
Nitrate Nitrite as N	0.100	ND		mg/L		86	50 - 150

Lab Sample ID: 280-47683-D-2 MS
 Matrix: Water
 Analysis Batch: 197495

Client Sample ID: Matrix Spike
 Prep Type: Dissolved

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Nitrate Nitrite as N	ND		4.00	3.48	F	mg/L		87	90 - 110

TestAmerica Portland

QC Sample Results

Client: Arctic Fox Environmental, Inc
 Project/Site: 1013-1083/Colville Fish Study

TestAmerica Job ID: 250-14963-1

Method: 353.2 - Nitrogen, Nitrate-Nitrite (Continued)

Lab Sample ID: 280-47683-D-2 MSD
Matrix: Water
Analysis Batch: 197495

Client Sample ID: Matrix Spike Duplicate
Prep Type: Dissolved

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec. Limits	RPD	RPD Limit
Nitrate Nitrite as N	ND		4.00	3.51	F	mg/L		88	90 - 110	1	10



Definitions/Glossary

Client: Arctic Fox Environmental, Inc
Project/Site: 1013-1083/Colville Fish Study

TestAmerica Job ID: 250-14963-1

Qualifiers

General Chemistry

Qualifier	Qualifier Description
F	MS/MSD Recovery and/or RPD exceeds the control limits

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
□	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Certification Summary

Client: Arctic Fox Environmental, Inc
 Project/Site: 1013-1083/Colville Fish Study

TestAmerica Job ID: 250-14963-1

Laboratory: TestAmerica Portland

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
Alaska (UST)	State Program	10	UST-012	12-26-13
California	State Program	9	2597	09-30-15
Oregon	NELAP	10	OR100021	01-09-14
USDA	Federal		P330-11-00092	02-17-14
Washington	State Program	10	C586	06-23-14

Laboratory: TestAmerica Denver

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
A2LA	DoD ELAP		2907.01	10-31-13
A2LA	ISO/IEC 17025		2907.01	10-31-13
Alabama	State Program	4	40730	09-30-12 *
Alaska (UST)	State Program	10	UST-30	04-05-14
Arizona	State Program	9	AZ0713	12-19-13
Arkansas DEQ	State Program	6	88-0687	06-01-14
California	ELAP	9	2513	08-31-14
Colorado	State Program	8	N/A	09-30-14
Connecticut	State Program	1	PH-0686	09-30-14
Florida	NELAP	4	E87667	06-30-14
Illinois	NELAP	5	200017	04-30-14
Iowa	State Program	7	370	12-01-14
Kansas	NELAP	7	E-10166	04-30-14
Louisiana	NELAP	6	30785	06-30-14 *
Maine	State Program	1	CO0002	03-03-15
Maryland	State Program	3	268	03-31-14
Minnesota	NELAP	5	8-999-405	12-31-13
Nevada	State Program	9	CO0026	09-01-14
New Hampshire	NELAP	1	205310	04-28-14
New Jersey	NELAP	2	CO004	06-30-14
New Mexico	State Program	6	CO00026	06-30-14 *
New York	NELAP	2	11964	04-01-14
North Carolina DENR	State Program	4	358	12-31-13
North Dakota	State Program	8	R-034	06-30-14 *
Oklahoma	State Program	6	8614	08-31-14
Oregon	NELAP	10	CO200001	01-16-14
Pennsylvania	NELAP	3	68-00664	07-30-14
South Carolina	State Program	4	72002	06-30-14 *
Texas	NELAP	6	T104704183-08-TX	10-01-14
USDA	Federal		P330-13-00202	07-02-16
Utah	NELAP	8	CO000262012-4	07-31-14
Virginia	NELAP	3	460232	06-14-14
Washington	State Program	10	C583	08-03-14
West Virginia DEP	State Program	3	354	11-30-13
Wisconsin	State Program	5	999615430	08-31-14
Wyoming (UST)	A2LA	8		10-31-13

* Expired certification is currently pending renewal and is considered valid.



CHAIN OF CUSTODY REPORT

Work Order #: 84509

CLIENT: Arctic Fox Environmental, Inc. REPORT TO: Pouch 340043 ADDRESS: Prudhoe Bay, AK 99734 attn. Ralph E. Allphin / Michael Hawley PHONE: (907) 659-2145 FAX: (907) 659-2146		INVOICE TO: Arctic Fox Environmental, Inc. Pouch 340043 Prudhoe Bay, AK 99734 attn. Ralph E. Allphin/arcticfox@astacalaska.com P.O. NUMBER: 1013-1083		TURNAROUND REQUEST in Business Days * Organic & Inorganic Analyses STD. 10 7 5 4 3 2 1 <1 Petroleum Hydrocarbon Analyses STD. 5 4 3 2 1 <1 OTHER Specify: RUSH * Turnaround Requests less than standard may incur Rush Charges.			
PROJECT NAME: Colville Fish study		PRESERVATIVE		REQUESTED ANALYSES			
PROJECT NUMBER:		Nitrate					
SAMPLED BY: T.S.		Nitrite					
CLIENT SAMPLE IDENTIFICATION		DRO/PRO					
SAMPLING DATE/TIME		Total Metals					
AF48972	10/18/13 @ 1030		X				
AF48973		X					
AF48974		X					
AF48975			X				
AF48976		X					
AF48977		X					
RELEASED BY: Michael Hawley		DATE: 10/20/13		RECEIVED BY: Phil Stabit		DATE: 10/21/13	
PRINT NAME: Michael Hawley		TIME: 1400		PRINT NAME: Phil Stabit		TIME: 0835	
FIRM: Arctic Fox				FIRM: TAP			
ADDITIONAL REMARKS:							

Login Sample Receipt Checklist

Client: Arctic Fox Environmental, Inc

Job Number: 250-14963-1

Login Number: 14963

List Source: TestAmerica Portland

List Number: 1

Creator: Svabik-Seror, Philip M

Question	Answer	Comment
Radioactivity wasn't checked or is \neq background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	False	AF48972 and AF48975 HNO3 preserved in lab 10/21/13@0930.
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <math><6\text{mm}</math> (1/4").	N/A	
Multiphasic samples are not present.	N/A	
Samples do not require splitting or compositing.	N/A	
Residual Chlorine Checked.	N/A	



Login Sample Receipt Checklist

Client: Arctic Fox Environmental, Inc

Job Number: 250-14963-1

Login Number: 14963

List Number: 1

Creator: Roman, Alex F

List Source: TestAmerica Denver

List Creation: 10/22/13 03:47 PM

Question	Answer	Comment
Radioactivity wasn't checked or is \leq background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	N/A	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	N/A	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is $<6\text{mm}$ (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

