



Pre-Permitting Environmental / Socio-Economic Data Report Series

Report Series L- Iliamna Lake Studies

Report L-2 Sampling Summaries 2005-2007

Submitted to the Alaska Department of Natural Resources October 2009

Preliminary data. Do not cite or quote.

The Pebble Partnership is providing environmental and socio-economic baseline data collected to inform the development of the Pebble Project to state and federal agencies, project stakeholders and the general public prior to project permitting as part of its commitment to full and open disclosure.

A comprehensive Environmental Baseline Document (EBD) will subsequently be prepared and appended to future project permit applications. The EBD will also be made publicly available when complete.

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TABLE L-1															
Summary of Sampling, Iliamna Lake, 2005-2007															
Site Name	Samples Collected during each Sampling Event														
	Field Parameters ^{a, b}			Zooplankton ^b			Surface Water ^b			Sediments ^c			Mussels ^c		
	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007	2005	2006	2007
Bucket Lake	x	x						x		x	x		x	x	
Finn Bay	x	x						x		x	x		x	x	
Flat Island	x	x						x		x	x		x	x	
Knutson Bay	x		x	x		x	x		x	x					
Northeast Bay	x		x	x		x	x		x	x					
Pile Bay	x		x	x		x	x		x	x					
Roadhouse Bay	x		x	x		x	x		x	x					
Upper Talarik ^d	x		x	x		x	x		x						
Whistlewing Bay ^e		x						x			x		x	x	

Notes:

- a. Field measurements of dissolved oxygen, oxidation reduction potential, pH, water clarity, turbidity, temperature, and specific conductance (no samples collected).
- b. Sampling events occurred monthly from May through October.
- c. Sampling events occurred in June and September.
- d. No measurements or samples were collected at Upper Talarik in September 2005 because of weather conditions.
- e. No measurements or samples were collected at Whistlewing Bay in September 2005 - mussels were not located.

Preliminary Data Only - Do Not Cite or Quote

TABLE L-2
Summary of Surface Water Analyses, Iliamna Lake

Analyte	Method	Method Reporting Limit
Aluminum, total and dissolved	E200.8	25 µg/L
Antimony, total and dissolved	E200.8	0.2 µg/L
Arsenic, total and dissolved	E200.8	0.5 µg/L
Barium, total and dissolved	E200.8	0.3 µg/L
Beryllium, total and dissolved	E200.8	0.4 µg/L
Bismuth, total and dissolved	E200.8	5 µg/L
Boron, total and dissolved	E200.7	10 µg/L
Cadmium, total and dissolved	E200.8	0.1 µg/L
Calcium, total and dissolved	200.7	50 µg/L
Chromium, total and dissolved	E200.8	0.2 µg/L
Cobalt, total and dissolved	E200.8	0.1 µg/L
Copper, total and dissolved	E200.8	0.2 µg/L
Iron, total and dissolved	E200.7/200.8	20 µg/L
Lead, total and dissolved	E200.8	0.2 µg/L
Magnesium, total and dissolved	E200.7/200.8	20 µg/L
Manganese, total and dissolved	E200.8	1 µg/L
Molybdenum, total and dissolved	E200.8	1 µg/L
Nickel, total and dissolved	E200.8	0.2 µg/L
Potassium, total and dissolved	E200.7/200.8	50 µg/L
Selenium, total and dissolved	E200.8	1 µg/L
Silicon, dissolved	E200.7	100 µg/L
Silver, total and dissolved	E200.8	0.2 µg/L
Sodium, total and dissolved	E200.7/200.8	100 µg/L
Thallium, total and dissolved	E200.8	0.05 µg/L
Tin, total and dissolved	E200.8	1 µg/L
Vanadium, total and dissolved	E200.8	0.4 µg/L
Zinc, total and dissolved	E200.8	1.5 µg/L
Mercury, total	E1631	0.001 µg/L
pH	E150.1	NA
Specific conductance	E120.1	1 µS/cm
Alkalinity	SM20 2320B	10 mg/L
Acidity	E305.1	NA
Ammonia	E350.2	0.1 mg/L
Chloride	E300.0	0.1 mg/L
Cyanide, total	SM20 4500	0.005 mg/L
Cyanide, weak acid dissociable	SM20 4500	0.005 mg/L
Fluoride	E300.0	0.1 mg/L
Nitrate + nitrite	E300.0	0.1 mg/L
Phosphorus, total	E365.2	0.1 mg/L
Sulfate	E300.0	0.1 mg/L
Total dissolved solids	E160.1	10 mg/L
Total suspended solids	E160.2	0.5 mg/L
Thiocyanate	Laboratory SOP	1 mg/L

Notes:

E = U.S. Environmental Protection Agency (EPA), *Methods for Chemical Analysis of Inorganic Substances in Environmental Samples*, EPA/600/R-93-100, August 1993, and *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91-010, June 1991.

µg/L = micrograms per liter.

µS/cm = microSiemens per centimeter.

mg/L = milligrams per liter.

NA = not applicable.

SM = American Public Health Association, *Standard Methods for the Examination of Water and Wastewater*, 20th edition, 1998.

SOP = standard operating procedure.

TABLE L-3
Summary of Sediment Analyses, Iliamna Lake

Analyte	Method
Total metals ^a	SW6010B/6020
Mercury	SW7471 (CVAA)
Total cyanide	SM20 4500
Chloride	E300.0
Fluoride	E300.0
Sulfate	E300.0
Ammonia-N	E350.3
Polynuclear aromatic hydrocarbons ^b	SW8270CSIM

Notes:

- a. Aluminum through zinc in Table L-2.
 - b. Polynuclear aromatic hydrocarbons are made up of 10 parameters and individual MRLs are located in the 2005 QAPP.
- E = U.S. Environmental Protection Agency (EPA), *Methods for Chemical Analysis of Inorganic Substances in Environmental Samples*, EPA/600/R-93-100, August 1993, and *Methods for the Determination of Metals in Environmental Samples*, EPA/600/4-91-010, June 1991.
- SIM = selective ion monitoring.
- SM = American Public Health Association, *Standard Methods for the Examination of Water and Wastewater*, 20th edition, 1998.
- SW = EPA, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, 3rd edition, September 1986.

TABLE L-4

Summary of Tissue Analyses, Iliamna Lake

Analyte	Method
Total metals ^a	PSEP/E200.8
Pesticides ^b	SW8081
Polychlorinated biphenyls ^b	SW8082
Polynuclear aromatic hydrocarbons ^b	SW8270CSIM

Notes:

a. Aluminum through zinc in Table L-2.

b. Pesticides, polynuclear aromatic hydrocarbons and polychlorinated biphenyls are made up of several parameters and individual MRLs are located in the 2005 QAPP.

E = U.S. Environmental Protection Agency (EPA), Methods for Chemical Analysis of Inorganic Substances in Environmental Samples, EPA/600/R-93-100, August 1993, and Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91-010, June 1991.

PSEP = Puget Sound Estuary Program.

SIM = selective ion monitoring.

SW = EPA, Test Methods for Evaluating Solid Waste Physical/Chemical Methods, 3rd edition, September 1986.

TABLE L-5
Ambient Water Parameters, Iliamna Lake, 2005 and 2007

Site Name	Month	Total Depth		Secchi Median ^a (depth in meters)		Turbidity ^{b,c}		Temp. ^c (°C)		Specific Conductance ^c (mS/cm)		Dissolved Oxygen (%)		Dissolved Oxygen ^c (mg/L)		pH ^c		Oxidation Reduction Potential ^c (mV)		
		2005	2007	2005	2007	2005	2007	2005	2007	2005	2007	2005	2007	2005	2007	2005	2007	2005	2007	
Knutson Bay	May	8.0	17.5	6.0	12.3	0.40 ^d	0.00	4.26	3.82	0.035	0.041	108.5	101.2	14.13	13.31	6.62	6.45	38.25	256.00	
	Jun	15.0	15.0	12.5	15.0	0.25	0.42	7.90	5.50	0.038	0.034	111.1	106.0	13.22	13.39	6.79	6.68	25.40	148.45	
	Jul	16.0	13.0	—	12.8	0.29	0.26	12.46	12.50	0.046	0.042	105.7	76.5	11.29	8.19	7.67	7.18	30.00	116.55	
	Aug	19.0	20.0	9.0	12.8	0.31	0.32	14.36	10.87	0.032	0.043	93.1	68.4	9.32	7.56	6.97	6.95	244.20	232.30	
	Sept	15.0	16.0	11.5	13.3	0.57	0.36	10.21	9.41	0.042	0.043	111.9	85.1	12.56	9.73	6.72	7.06	195.30	149.10	
	Oct	19.0	10.0	13.5	—	0.29	0.24	8.86	8.14	1.416	0.044	90.5	64.3	10.45	7.59	—	7.12	-163.50	73.75	
	Median		15.5	15.5	11.5	12.8	0.29	0.28	10.20	9.41	0.042	0.042	105.7	82.8	11.29	9.48	6.87	6.96	34.60	159.10
Northeast Bay	May	11.0	11.0	—	8.0	0.35 ^e	1.00	7.48	6.01	0.044	0.047	114.0	90.3	13.63	11.27	6.82	6.58	41.20	272.35	
	Jun	11.0	12.0	8.7	9.5	0.25	0.37	7.97	7.36	0.043	0.045	115.6	109.6	13.83	13.20	6.83	7.28	9.60	145.80	
	Jul	11.0	11.0	9.8	10.8	0.32	0.32	13.44	12.29	0.043	0.048	83.9	103.7	8.75	11.09	6.75	7.12	228.10	157.00	
	Aug	12.0	11.0	9.5	11.0	0.66	0.43	14.32	12.16	0.038	0.047	99.4	68.1	10.21	7.31	7.36	6.75	210.30	230.35	
	Sept	12.0	11.0	8.3	6.5	0.85 ^d	1.02	10.32	10.81	0.045	0.050	109.2	84.2	12.23	9.32	6.93	7.00	142.70	126.35	
	Oct	12.0	13.0	9.3	9.5	0.61	0.58	8.30	7.61	0.045	0.048	86.4	64.6	10.16	7.73	—	6.89	247.10	72.70	
	Median		11.5	11.0	9.3	9.5	0.52	0.59	10.32	8.87	0.044	0.047	100.3	87.1	10.53	10.01	6.90	6.99	153.60	149.95
Pile Bay	May	16.0	20.0	—	11.3	0.34	1.00	4.10	4.15	0.040	0.043	106.9	101.8	13.99	13.30	6.32	5.86	69.75	134.40	
	Jun	17.0	20.0	8.1	13.0	0.72	0.31	4.98	4.39	0.037	0.042	105.5	101.9	13.49	13.23	6.49	6.69	-44.75	269.30	
	Jul	20.0	17.0	—	11.3	0.54	0.45	10.51	11.62	0.043	0.043	106.7	76.2	11.90	8.31	5.30	7.07	195.50	113.40	
	Aug	20.0	17.0	8.8	17.0	0.39	0.58	13.84	5.30	0.034	0.045	92.7	67.4	9.57	8.53	7.29	6.41	228.15	252.80	
	Sept	19.0	20.0	9.5	12.1	0.76	0.36	10.06	9.93	0.042	0.045	111.3	78.3	12.56	8.85	7.11	6.87	220.80	64.10	
	Oct	14.0	20.0	12.5	12.3	0.49	0.42	8.81	8.78	—	0.044	89.3	63.6	10.31	7.39	—	6.91	-109.85	85.25	
	Median		18.0	20.0	9.1	12.2	0.54	0.44	9.85	6.62	0.040	0.043	106.2	77.8	12.42	8.77	6.62	6.82	168.55	131.10
Roadhouse Bay	May	10.0	11.0	9.5	8.5	0.31	1.00	8.15	5.31	0.043	0.047	114.6	89.8	13.53	11.31	6.90	6.67	123.20	272.80	
	Jun	12.0	11.0	9.3	10.3	0.32	0.38	10.60	6.54	0.043	0.046	114.2	109.8	12.53	13.48	7.10	7.25	12.80	173.25	
	Jul	10.0	10.0	11.3	9.5	0.30	0.36	12.32	10.74	0.043	0.047	84.0	106.4	8.99	11.87	6.77	6.49	201.50	20.70	
	Aug	10.0	10.0	8.5	10.5	0.61	0.39	14.88	12.30	0.037	0.047	95.7	67.6	9.71	7.24	7.36	6.68	214.50	237.10	
	Sept	13.0	11.0	7.6	6.5	0.74	0.91	10.17	10.76	0.088	0.050	108.1	83.0	12.15	9.21	7.06	7.00	159.40	160.45	
	Oct	12.0	11.0	9.0	9.0	0.56	0.65	7.42	6.78	0.046	0.046	87.1	65.2	10.48	7.97	—	6.80	191.20	79.20	
	Median		11.0	11.0	9.1	9.3	0.47	0.62	10.17	7.89	0.044	0.047	106.2	88.5	11.90	10.75	7.00	6.94	161.80	168.70
Upper Talarik	May	13.0	14.0	10.2	10.8	0.35	0.00	6.96	4.01	0.044	0.046	113.0	89.4	13.72	11.72	6.96	6.47	115.60	319.00	
	Jun	14.0	11.0	7.9	8.5	0.76	0.40	7.30	6.47	0.044	0.048	112.1	60.2	13.50	7.38	7.04	7.07	16.50	224.95	
	Jul*	13.0	9.0	10.8	—	0.31	0.26	10.81	—	0.038	—	80.4	—	8.88	—	6.78	—	170.70	—	
	Aug	14.0	13.0	11.5	9.0	0.35	1.44	13.42	12.35	0.034	0.048	95.3	67.5	9.94	7.22	7.11	6.08	260.75	43.15	
	Sept**	—	11.0	—	—	—	—	—	10.64	—	0.046	—	—	79.6	—	8.86	—	6.60	—	71.95
	Oct	15.0	14.0	9.0	10.3	0.50	0.46	8.12	8.33	0.045	0.047	87.3	64.7	10.35	7.62	—	6.91	203.20	83.50	
	Median		14.0	12.0	10.2	9.6	0.35	0.40	8.12	8.33	0.044	0.046	94.8	67.5	10.34	7.62	7.02	6.64	170.45	136.75

Notes:

- a. Each value is the median of two Secchi readings. If substrate was visible, this depth represents the substrate depth at this site.
- b. Only three turbidity readings were taken at each site at the same depths from which samples were collected.
- c. Each value represents the median of values for all depths.
- d. Median of only two readings.
- e. Only one reading.
- * Water quality samples were taken, but field parameters not taken due to weather conditions; **Field parameters taken, but water quality samples not taken due to weather conditions.
- = no measurements taken; mV = millivolts; NTU = nephelometric turbidity unit(s)

TABLE L-6
Zooplankton Primary Taxa Abundance, Iliamna Lake, 2005 and 2007

Site ID	Sample Month	Vertical depth sampled (m)		Total Abundance		Copepoda		Rotifera		Cladocera		Ostracoda		Laevicaudata		Anostroca	
		2005	2007	2005	2007	2005	2007	2005	2007	2005	2007	2005	2007	2005	2007	2005	2007
Knutson Bay	May	8	17.5	312	304	236	250	66	48	4	3	0	3	0	0	0	0
	Jun	15	15	314	323	106	204	46	93	4	10	1	0	0	3	0	0
	Jul	16	13	790	429	223	53	394	227	7	2	0	0	0	1	0	0
	Aug	19	20	353	1141	2	503	5	438	10	200	0	0	0	0	0	0
	Sept	15	16	738	745	323	246	315	413	74	78	0	1	0	6	0	0
	Oct	19	10	121	339	8	150	0	154	7	25	0	7	0	0	0	0
Northeast Bay	May	11	11	391	400	241	63	103	304	3	3	0	7	0	0	0	0
	Jun	11	12	384	391	125	145	152	215	1	12	3	0	0	0	0	0
	Jul	11	11	656	301	164	36	246	216	31	13	0	0	0	1	0	0
	Aug	12	11	951	342	33	123	111	170	4	48	0	0	0	0	0	0
	Sept	12	11	317	351	153	213	83	37	52	101	0	0	0	0	0	0
	Oct	12	13	145	429	11	256	2	50	5	123	1	0	0	0	0	0
Pile Bay	May	16	20	458	446	306	382	41	56	3	3	0	2	0	0	0	0
	Jun	16	20	313	484	288	429	14	0	8	55	0	0	0	0	0	0
	Jul	20	17	698	551	520	80	136	459	6	2	0	0	0	0	0	0
	Aug	20	17	735	414	26	293	516	25	2	96	0	0	0	0	0	0
	Sept	19	20	476	821	171	641	296	78	5	85	0	0	0	0	0	0
	Oct	12	20	310	550	22	440	153	93	8	17	0	0	0	0	0	0
Roadhouse Bay	May	10	11	430	500	204	80	106	296	9	2	2	3	0	0	0	0
	Jun	11	11	336	329	81	197	143	106	0	16	0	0	0	0	2	1
	Jul	10	10	581	561	186	105	238	428	119	16	2	0	0	1	0	0
	Aug	10	10	803	371	27	187	84	126	2	55	0	1	0	0	0	0
	Sept	13	11	315	412	91	268	149	20	46	71	0	11	0	0	0	0
	Oct	12	11	126	353	12	161	0	39	3	153	0	0	0	0	0	0
Upper Talarik	May	13	14	420	323	155	91	214	216	4	6	0	2	0	0	0	0
	Jun	13	11	302	302	108	153	179	110	2	25	0	1	0	0	0	1
	Jul ^a	13	9	822	0	181	0	547	0	34	0	1	0	0	0	0	0
	Aug	14	13	1055	325	288	156	83	52	49	117	0	0	0	0	0	0
	Sept ^b	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Oct	15	14	138	461	33	333	0	33	29	75	0	0	0	0	0	0
TOTAL ABUNDANCE:				13790	12698	4324	6238	4422	4502	531	1412	10	38	0	12	2	2

Notes:

a. July 2005 sample collected August 1.

b. No samples collected in September because of weather.