

CONCENTRATION OF SELENIUM AND MERCURY IN AMERICAN
AVOCET EGGS AT THE GREAT SALT LAKE, UTAH
2011 REPORT

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INTRODUCTION

The Avian Ecology Laboratory (AEL) located at Weber State University, collected American Avocet (*Recurvirostra Americana*, AMAV) eggs and samples of water, sediment and invertebrates from each study site during June, 2011. Sediment samples were analyzed for total selenium (Se) and all other samples were analyzed for both total mercury (Hg) and Se. All analyses were conducted as part of the Utah Division of Water Quality's ongoing water quality monitoring for the Great Salt Lake (GSL), Utah. Selenium is a target analyte because avian reproduction is the most sensitive ecosystem response identified for Se exposures (UDWQ, 2008). Hg is a target analyte because it biomagnifies through the food web. Shorebirds forage primarily on macroinvertebrates and are expected to be sensitive to exposures of these contaminants. Hg and Se can affect bird populations by reducing egg hatchability, increasing young mortality and the incidence of developmental deformities (Ohlendorf et al., 1989; Burger and Gochfeld, 1997). Gilbert Bay of the GSL has a water quality standard for Se that is based on egg concentrations. No water quality standard for Hg is currently available. These analyses are being conducted to determine if Se concentrations in Gilbert Bay meet the Se water quality standard. In addition, these data will provide information necessary to monitor for trends in Hg and Se concentrations over time.

OBJECTIVE

The objectives of this study were:

1. Collect AMAV and Black-necked Stilt (*Himantopus mexicanus*; BNST) eggs from at least two study sites at the Great Salt Lake (GSL), Utah.
2. Collect water, sediment and invertebrate food items from each site.
3. Examine collected eggs for malpositions and malformations.
4. Determine total Hg and Se levels in collected samples.

The objective of this study was to collect shorebird eggs from Gilbert Bay at the GSL to assess trends in selenium concentrations and determine whether they are approaching or exceeding the established egg-tissue standards. Thresholds of selenium concentrations in the eggs of aquatic-dependent birds were established and "trigger" specific regulatory responses as selenium concentration in eggs increase in the lake. Each trigger value represents a scientifically defensible point. There are two overarching aims of these tiered regulatory responses. First, scientific uncertainties remain regarding the protectiveness of the selenium water quality standard and the triggers are intended to reduce some of these uncertainties as lake concentrations increase and approach the standard. Second, the proactive, adaptive management process established by these procedures allows steps to be taken to avoid selenium related impairments to the Great Salt Lake by preventing the standard from being exceeded. The trigger values and associated regulatory responses were developed using various scientific arguments and by evaluating all existing

data. Due to uncertainty inherent in all scientific inquiry and the desired level of protection, it was difficult to derive a single value from these analyses as a recommended standard. Instead, a range of numbers was generated from different inquiries that were both higher and lower than the standard. The threshold or “trigger” values represent scientifically defensible values that were lower than the standard.

For additional details, see *Developing a Selenium Standard for the Open Waters of the Great Salt Lake* and associated supporting literature at:

http://www.deq.utah.gov/Issues/GSL_WQSC/index.htm.

In addition to determining Se concentrations, Hg concentrations were also determined as well as the physical condition of each embryo.

METHODS

All samples were collected in June 2011.

Study Sites

Targeted sites for this study were within Gilbert Bay and included Ogden Bay, Bridger Bay, and Saltair Beach. Unfortunately, collections could not be made at these sites during the 2011 season. At Ogden Bay, high water levels inundated nesting sites and prevented AMAV and BNST from utilizing the area during the entire breeding season. Bridger Bay as well as all other previous nesting sites at Antelope Island where searched for nesting AMAV but no breeding could be

documented at the sites. Saltair was searched on three different occasions; once in May, June, and July, but no nests were ever found at this site. Due to the lack of nesting at target sites, the collections were made at a site located within Farmington Bay and a site located east of Antelope Island within Gilbert Bay. These sites not only contained nesting AMAV but also were located within the GSL.

Antelope Island Causeway (ANTI)

The Antelope Island site is located west of Syracuse, Utah and north of the 7.2 mile causeway to the island. This study site was located near Howard’s Slough and within Gilbert Bay (41°5’32.13”N, 112°8’30.78”W; Figure 1).

Farmington Bay (FARM)

FARM is located along the eastern shore of the GSL and north of Farmington Bay Waterfowl Management Area (40°58’40.62”N, 111°59’19.44”W; Figure 2).

Species

AMAV and BNST were chosen as the target species for this study by the Great Salt Lake Selenium Science Panel and the Utah Division of Water Quality. The eggs of these species are easily collected and their population sizes are large enough so as not to be affected by egg collections. The modal clutch size of both species is four eggs. Both of these species feed on aquatic invertebrates and are suspected to be the food-chain link in the transfer of Se to shorebirds.

PROCEDURES

Shorebird nests were located by systematic search of areas known to have contained breeding bird colonies over the last few years. A single egg was collected randomly from each of 10 nests. For each nest, eggs were assigned a number and then one egg was collected after consulting a random number table. Every effort was made to minimize disturbance to the nest and any birds in the vicinity.

In the laboratory, measurements of length, width, mass, volume, density and shell thickness were taken. Initial egg mass, (IEM) was calculated by the following formula:

$$\text{IEM} = K_w \cdot L B_2 \text{ (Hoyt, 1979).}$$

K_w : weight coefficient for individual species

L: length

B: breadth

Volumes of the eggs were estimated by the "length-breadth technique" (Hoyt, 1979):

$$\text{Volume} = K_v \cdot L \cdot B_2$$

K_v : volume coefficient for individual species

L: length

B: breadth

Eggs were dissected in the laboratory and examined for malpositions and malformations. Malpositions were characterized as follows:

I. Head between thighs

II. Head in small end of egg

III. Head under left wing

IV. Embryo rotated so that bill is not directed toward the air cell.

V. Feet over head

VI. Bill over right wing

Embryonic age was estimated according to Hamilton (1952). If no embryo was found, the egg was examined for the presence of a blastodisc. For eggs containing embryos, presence or absence of eyes, limbs or limb buds, presence and number of digits on the feet, and length of tarsus and upper mandible were also recorded. Pictures were taken of each egg after removing the egg cap (Appendix 2).

After measurements were taken and eggs dissected, the content of each egg was frozen and shipped with dry ice to an environmental testing laboratory (Brooks Rand Labs, Seattle, Washington; BRL) for total Hg and Se analysis.

Following dissection of each egg, shells were dried at 21 °C for at least 30 days. The mass of the dried shells was then recorded. Thickness was measured to the nearest 0.001mm with a Starrett micrometer. The Ratcliffe index (Ratcliffe, 1967) was calculated with the following formula:

$$\text{Index} = \frac{\text{shell mass (g)}}{\text{length(mm)} \times \text{width (mm)}}$$

All egg data including measurements, coordinates and site locations are presented in Table 1.

Water, Sediment, and Invertebrates

Collection sites for environmental samples were located within AMAV foraging areas. A transect was established within a foraging

area and water and sediment collections were made at random points along this transect. Invertebrates were collected opportunistically within the foraging area.

All water samples were collected following the protocol described in EPA's Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Criteria Levels, EPA-821-R-96-011. Five sediment samples were collected and composited into one sample at both sites. Samples were refrigerated until they were shipped with dry ice to BRL for Se analysis. Mercury was not analyzed in sediment samples.

Invertebrate sweeps were made opportunistically within the foraging area to include the benthos and water column. Invertebrates found in the sweep samples were sorted and their mass recorded at the lab following collection. After weighing, invertebrate samples were immediately frozen until they were shipped with dry ice to BRL for total Se and Hg analysis. All data forms can be found in Appendix 1.

RESULTS AND DISCUSSION

Throughout the nesting season, BNST nests were never found at locations which could be considered study sites. Consequently, only AMAV eggs were collected during the 2011 season. Above normal precipitation and late snow melt, caused water levels to be highly variable during the sampling period. This resulted in considerable difficulty locating successful nesting areas. Every effort was made to locate the target species at all known nesting sites beginning in May.

Five AMAV eggs were collected on June 2, 2011 from ANTI (Figure 1). On June 16,

2011, invertebrate sweeps were collected and on June 30, 2011, 4 water samples and 5 sediment samples were collected from this site. Egg collection coordinates are in Table 1. Coordinates of the remaining sample collecting locations within this site can be found in Appendix 1.

In late May, a colony of AMAV was located at FARM but appeared to have failed as a result of flooding. Therefore, when new nests were located at this site, eggs were collected immediately regardless of stage to ensure adequate samples. Five AMAV eggs, 4 water samples, 5 sediment samples and 1 invertebrate sweep sample were collected from FARM on June 22, 2011. Coordinates of the collecting locations of the eggs can be found in Table 1. All other sample locations can be found in Appendix 1.

Due to the late nesting of the target species and the variable water levels, eggs were occasionally collected from nests even when clutches weren't complete. Four of the 5 eggs collected at ANTI were from nests with less than 4 eggs. This same site was visited again on June 16th to obtain invertebrate samples. At this time, there were no active nests, only foraging adults present.

Egg Breakouts

All eggs were determined to be less than 8 days of age and the stages of development observed were normal. All eggs were determined to be viable. Pictures have been provided in Appendix 2.

Total Egg Selenium and Mercury

Laboratory results for total egg Se showed a mean concentration of 1.56 $\mu\text{g/g dw}$

(standard error = 0.09; median = 1.5) at ANTI and 2.54 $\mu\text{g/g dw}$ (standard error = 0.09; median = 2.57) at FARM. These levels are well below the established Se standard of 12.5 $\mu\text{g/g dw}$. In addition, these results are lower than the 4.43 $\mu\text{g/g dw}$ Se content reported for AMAV in 2010 at Great Salt Lake (Cavitt et al. 2011).

Mean egg Hg concentrations were 0.81 $\mu\text{g/g dw}$ (standard error = 0.1; median = 0.83) at ANTI and 1.17 $\mu\text{g/g dw}$ (standard error = 0.1; median = 1.2) at FARM. Table 2 provides Se and Hg concentrations for each egg sampled. Laboratory results are provided in Appendix 2.

Environmental Samples

Sediment and Water

Selenium analysis for both ANTI and FARM sediment samples resulted in concentrations greater than the method detection limit but less than the method reporting limit. Consequently, these results are considered estimates. Sediments collected at the ANTI site were estimated to contain 0.99 $\mu\text{g/g dw}$ selenium and 1.32 $\mu\text{g/g dw}$ selenium at FARM.

Two water samples were collected from the ANTI site (41°5'32.06"N, 112°8'30.82"W) in containers provided directly from BRL. Samples were collected from water that was approximately 25 cm deep. Water samples for Se analysis resulted in concentrations greater than the method detection limit but less than the method reporting limit. Consequently, these results are considered estimates. The estimated Se content of ANTI water samples were 0.21 $\mu\text{g/L}$ and 0.22 $\mu\text{g/L}$. Total Hg for these samples were 0.0195 $\mu\text{g/L}$ and 0.0187 $\mu\text{g/L}$.

Two water samples were also collected from the FARM site in chemically cleaned jars. One sample was from a sheet-flow area (40°58'33.76"N, 111°59'17.44"W) and the other at an area 30 cm deep (40°58'18.57"N, 111°59'7.59"W). This 2nd sample was to ensure we obtained a viable sample. At the time, we were uncertain if the sheet-flow sample would be enough to process through the chemical analysis. The Se content at the sheet-flow site (sample ID 000533) was 0.303 $\mu\text{g/L}$ and the second sample was 0.21 $\mu\text{g/L}$. FARM Hg concentrations were 0.018 $\mu\text{g/L}$ at the sheet-flow and 0.025 $\mu\text{g/L}$ at the second site. Results of all chemical analyses, including field and equipment blanks are found in Appendix 1 and 2.

All water samples collected were low and within reported average background levels (USDI 1998). At Kesterson National Wildlife Refuge, where Se toxicity produced high egg mortality and deformities within shorebirds and waterfowl, Se levels ranged from 15 – 350 $\mu\text{g/L}$ (Ohlendorf et al. 1986, Ohlendorf et al. 1988).

Invertebrates

Only two species of invertebrates commonly found in the AMAV diet were collected in testable amounts; brine fly larvae (genus *Ephydra*) and midge larvae (family *Chironomidae*). Together these invertebrates represent over 70% of the volume of food items recovered from AMAV digestive tracts at Ogden Bay (Cavitt 2007). Because of difficulty in collecting an adequate sample mass of invertebrates for testing only 2 of 3 samples collected were greater than the method detection limit. Brine fly larvae collected at ANTI had Se concentration of 8.78 $\mu\text{g/g dw}$ and Hg concentration of 1.19 $\mu\text{g/g dw}$. Midge larvae collected at FARM had Se concentration of 5.76 $\mu\text{g/g dw}$ and Hg concentration of 0.426 $\mu\text{g/g dw}$.

Invertebrate Se concentrations are slightly above reported background concentrations. Cavitt (2007) reported concentrations of Se

within brine fly larvae at Great Salt Lake from 0.8 to 3.8 $\mu\text{g/g dw}$. Maier and Knight (1994) reported a range of ambient selenium concentrations of 0.5 to 2.0 $\mu\text{g/g dw}$ in invertebrates. Lemly (1996a, 1996b) suggests that Se concentrations in bird diets that are greater than 3 $\mu\text{g/g dw}$ are above the toxicity threshold for sensitive species. Because of the difficulty in obtaining a sufficient sample mass of invertebrates for this current study, the results should only be treated as estimates. Future samples should develop better collection techniques to obtain sufficient samples of invertebrates (between 3 – 5 g mass) for analysis.

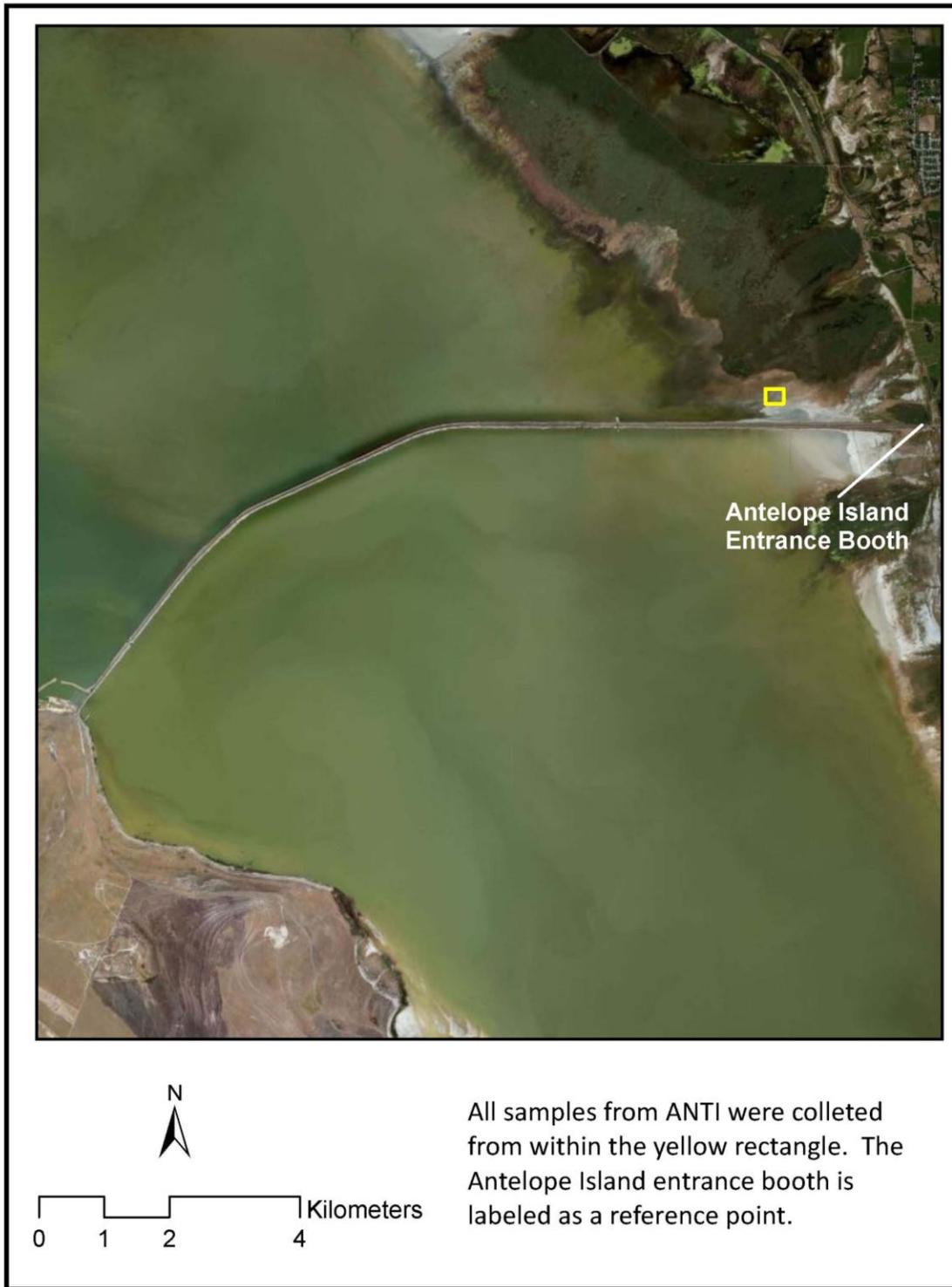


Figure 1. Map showing the Antelope Island study site in relation to the causeway (ArcGIS Desktop 10, 2010).



Figure 2. Map showing the Farmington Bay study site in relation to Farmington Bay Waterfowl Management Area (ArcGIS Desktop 10, 2010).

Table 1. Egg breakout datasheet for collected AMAV eggs including lab ID, site name, coordinates, date collected, number of eggs in the clutch, initial egg mass, egg weight, length and width (breadth), fresh egg mass, egg volume, density, Ratcliff index, shell thickness, dry shell weight, stage of development, and sample weight.

Laboratory ID #	Site Name	LAT (N) DMS	LONG (W) DMS	Date Collected	#of Eggs Clutch	IEM HOYT	Egg Wt (g)	Measurements L & W (mm)	FEM Calc	Egg Vol	Density	Ratcliff Index	Shell (mm)	Dry Shell Wt (g)	Embryo Stage ^a	Sample wt. (g)
NW-500-11	ANTI	41°05'32"	-112°08'27"	6/2/2011	4	37.411	35.34	49.84 37.01	31.80	34.82	1.0150	0.001176	0.256	2.17	D6-7	34.38
NW-501-11	ANTI	GPS failed		6/2/2011	2	34.381	32.46	48.98 35.79	29.22	32.00	1.0145	0.001101	0.232	1.93	D1	28.86
NW-502-11	ANTI	GPS failed		6/2/2011	3	31.599	30.83	49.94 33.98	26.86	29.41	1.0484	0.001131	0.230	1.92	D1	27.55
NW-503-11	ANTI	GPS failed		6/2/2011	2	30.552	28.78	48.57 33.88	25.97	28.43	1.0122	0.001343	0.238	2.21	D1	25.83
NW-504-11	ANTI	GPS failed		6/2/2011	2	33.392	31.08	52.28 34.14	28.38	31.08	1.0001	0.001059	0.234	1.89	D1	27.47
NW-700-11	FARM	40°58'39.87"	-111°59'23.18"	6/22/2011	4	29.440	28.12	47.22 33.73	25.02	27.40	1.0263	0.001136	0.250	1.81	D5	25.33
NW-701-11	FARM	40°58'40.62"	-111°59'22.59"	6/22/2011	4	32.549	30.10	47.13 35.50	27.67	30.29	0.9937	0.001160	0.274	1.94	D3	26.74
NW-702-11	FARM	40°58'40.82"	-111°59'22.38"	6/22/2011	4	33.010	29.65	50.20 34.64	28.06	30.72	0.9652	0.001121	0.256	1.95	D4	26.52
NW-703-11	FARM	40°58'42.01"	-111°59'19.53"	6/22/2011	4	34.488	32.13	50.85 35.18	29.31	32.10	1.0011	0.001269	0.292	2.27	D6	28.59
NW-704-10	FARM	40°58'44.09"	-111°59'19.44"	6/22/2011	4	31.018	28.85	49.08 33.96	26.37	28.87	0.9994	0.001176	0.278	1.96	D4	25.78

Table 2. Selenium and mercury analysis for American Avocet egg samples collected in 2011.

Laboratory ID #	Site Name	Se dry (ug/g)	Hg dry (ug/g)	Date Collected	Sample wt. (g)
NW-500-11	ANTI	1.42	1.15	6/2/2011	34.38
NW-501-11	ANTI	1.38	0.675	6/2/2011	28.86
NW-502-11	ANTI	1.5	0.825	6/2/2011	27.55
NW-503-11	ANTI	1.84	0.853	6/2/2011	25.83
NW-504-11	ANTI	1.67	0.528	6/2/2011	27.47
NW-700-11	FARM	2.4	1.2	6/22/2011	25.33
NW-701-11	FARM	2.63	1.35	6/22/2011	26.74
NW-702-11	FARM	2.57	1.07	6/22/2011	26.52
NW-703-11	FARM	2.28	1.39	6/22/2011	28.59
NW-704-10	FARM	2.83	0.815	6/22/2011	25.78

LITERATURE CITED

- ArcGIS Desktop 10. 2010 Redlands, CA: ESRI, Inc. [February, 2012].
- Burger, J. and M. Gochfeld. 1997. Risk, mercury levels, and birds: Relating adverse laboratory effects to field biomonitoring. *Environmental Research* 75:160-172.
- Cavitt, J.F. 2006. Productivity and foraging ecology of two-coexisting shorebird species breeding at Great Salt Lake, UT: 2005 - 2006 Report. Avian Ecology Laboratory Technical Report to Utah Division of Water Quality. Weber State University, Ogden, UT. 38pp.
- Cavitt, J.F. 2007. Concentration and effects of selenium on breeding shorebirds at Great Salt Lake. In: *Development of a Selenium Standard for the Open Waters of the Great Salt Lake*, 30pp. State of Utah Department of Environmental Quality, Division of Water Quality, Salt Lake City, UT.
- Cavitt, J., M. Linford, and N. Wilson. 2011. Selenium concentration of shorebird eggs at Great Salt Lake Utah. Report to State of Utah Department of Environmental Quality, Division of Water Quality, Salt Lake City, UT.
- Hamilton, H.L. 1952. Lillie's development of the chick. Henry Holt and Co., Inc., New York.
- Hoyt, D.F. 1979. Practical methods of estimating volume and fresh weight of bird eggs. *Auk* 96:73-77.
- Lemly, A.D. 1996a. Assessing the Toxic Threat of Selenium to Fish and Aquatic Birds. *Environmental Monitoring. Assessments*, 43:19-35.
- Lemly, A.D. 1996b. Selenium in Aquatic Organisms. Pages 427-445 In W.N.Beyer, G.H. Heinz, and A.W. Redmon, (Eds.), *Interpreting Environmental Contaminants in Animal Tissues*. Lewis Publishers, Boca Raton, Florida.
- Maier, K.J., and A.W. Knight. 1994. Ecotoxicology of Selenium in Freshwater Systems. *Reviews of Environmental Contamination and Toxicology*, 134:31-48.
- Ohlendorf, H.M., R. L. Hothem, and D. Welsh. 1989. Nest success, cause-specific nest failure, and hatchability of aquatic birds at selenium-contaminated Kesterson reservoir and a reference site. *Condor* 91:787-796.
- Ratcliffe, D.A. 1967. Decrease in eggshell weight in certain birds of prey. *Nature* 215:208-210.
- UDWQ. *Development of a Selenium Program for the Open Waters of Great Salt Lake*. May 2008. Web. 04 Jan. 2011 < <http://www.deq.utah.gov> >
- U.S. Department of the Interior (USDI). 1998. Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment. USDI (Bureau of Reclamation, U.S. Fish and

Wildlife Service, U.S. Geological Survey, Bureau of Indian Affairs), National Irrigation Water Quality Program Information Report No. 3. Bureau of Reclamation, Denver, CO.

U.S. Environmental Protection Agency (EPA). 1995. Method 1669: Sampling Ambient Water for Trace Metals at EPA Water Criteria Levels. EPA-821-R-95-034 (April 1995 Draft). EPA, Office of Water, Washington, DC.

Appendix 1a Datasheet for water samples collected at FARM and ANTI including lab ID, coordinates and notes.

Date Collected	Lab ID	Site	Lat (N) DMS	Long (W) DMS	Se ($\mu\text{g} / \text{L}$)	Hg ($\mu\text{g}/\text{L}$)	Notes
6/22/2011	000533	FARM	40°58'33.76"	111°59'17.44"	0.303	0.0176	Sample 1 from sheet flow
6/22/2011	000536	FARM	40°58'33.76"	111°59'17.44"	0.343	0.0267	duplicate of sample 1
6/22/2011	000514	FARM	40°58'33.76"	111°59'17.44"	0.1	0.00039	field blank
6/22/2011	000517	FARM	40°58'18.57"	-111°59' 7.59"	0.21	0.025	Sample 2 from deeper water closer to GSL
6/22/2011	000528	FARM	40°58'18.57"	-111°59' 7.59"	0.23	0.025	duplicate of sample 2
6/22/2011	000513				0.07	0.00027	equipment blank
6/30/2011	ANTI-01-11	ANTI	41°5'32.06"	-112°8'30.82"	0.21		Se submerged sampled from water column
6/30/2011	ANTI-02-11	ANTI	41°5'32.06"	-112°8'30.82"	0.113		field blank
6/30/2011	ANTI-03-11	ANTI	41°5'32.06"	-112°8'30.82"	0.222		Se duplicate of sample ANTI-01-11
6/30/2011	ANTI-04-11	ANTI	41°5'32.06"	-112°8'30.82"		0.0195	Hg submerged sample w/o air contact
6/30/2011	ANTI-05-11	ANTI	41°5'32.06"	-112°8'30.82"		0.00019	field blank
6/30/2011	ANTI-06-11	ANTI	41°5'32.06"	-112°8'30.82"		0.0187	duplicate of sample ANTI-04-11

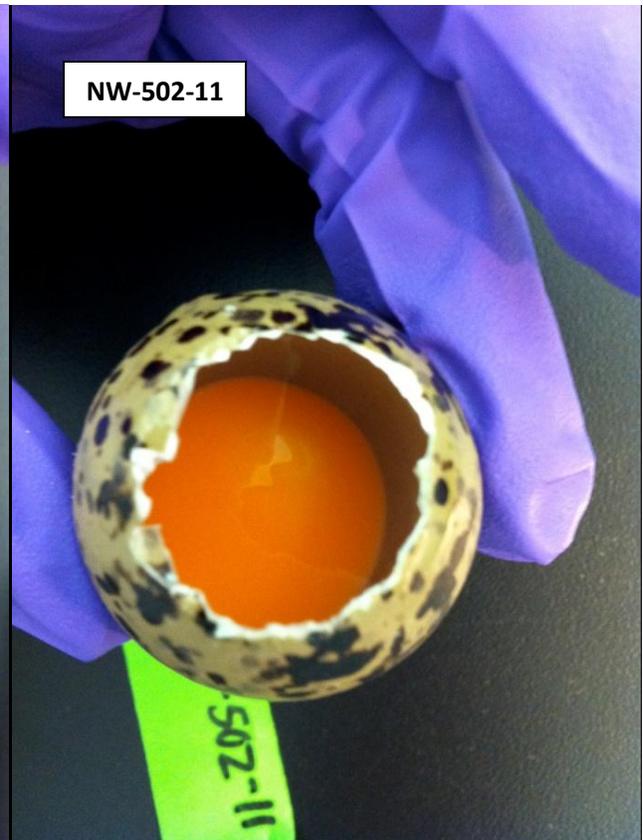
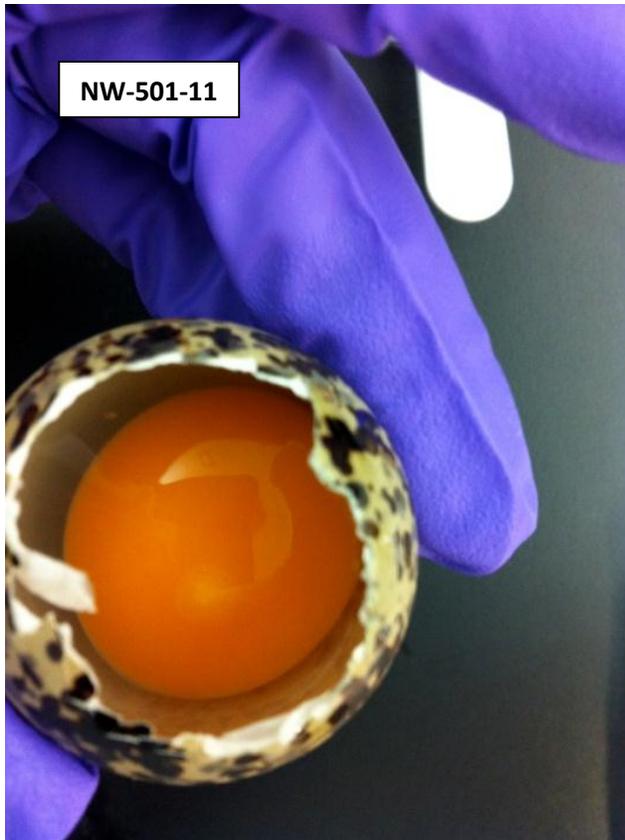
Appendix 1b Datasheet for sediment samples collected from both FARM and ANTI including

Date Collected	Lab ID	Site	UTM E	UTM N	Lat (N) DMS	Long (W) DMS	Notes
6/22/2011	Farm-1a	FARM	416869	4536565	40°58'33.66"	-111°59'17.14"	All five samples from FARM were composited into one sample to be sent to BRL
6/22/2011	Farm-1b	FARM	416864	4536561	40°58'33.53"	-111°59'17.35"	
6/22/2011	Farm-1c	FARM	416858	4536560	40°58'33.49"	-111°59'17.61"	
6/22/2011	Farm-1d	FARM	416848	4536555	40°58'33.33"	-111°59'18.04"	
6/22/2011	Farm-1e	FARM	416835	4536551	40°58'33.19"	-111°59'18.59"	
6/30/2011	ANTI-1a	ANTI	404099	4549627	41°5'32.13"	-112°8'30.78"	All five samples from FARM were composited into one sample to be sent to BRL
7/1/2011	ANTI-1b	ANTI	404109	4549632	41°5'32.29"	-122°8'30.35"	
7/1/2011	ANTI-1c	ANTI	404116	4549636	41°5.32.43"	-112°8'30.06"	
7/1/2011	ANTI-1d	ANTI	404129	4549643	41°5'32.66"	-112°8'29.50"	
7/1/2011	ANTI-1e	ANTI	404139	4549645	41°5'32.73"	-112°8'29.08"	

Appendix 1c Datasheet for Invertebrate species sorted from sweep samples and sent to BRL for total Hg and Se analysis.

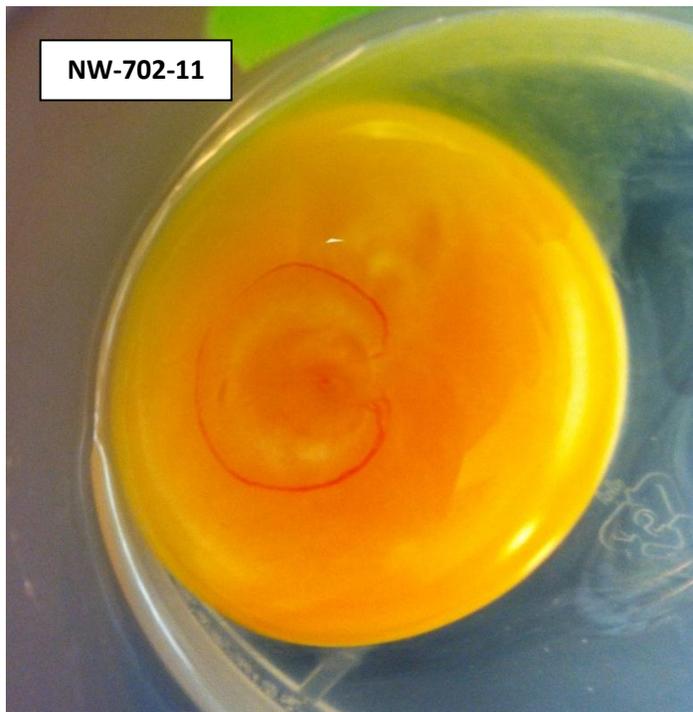
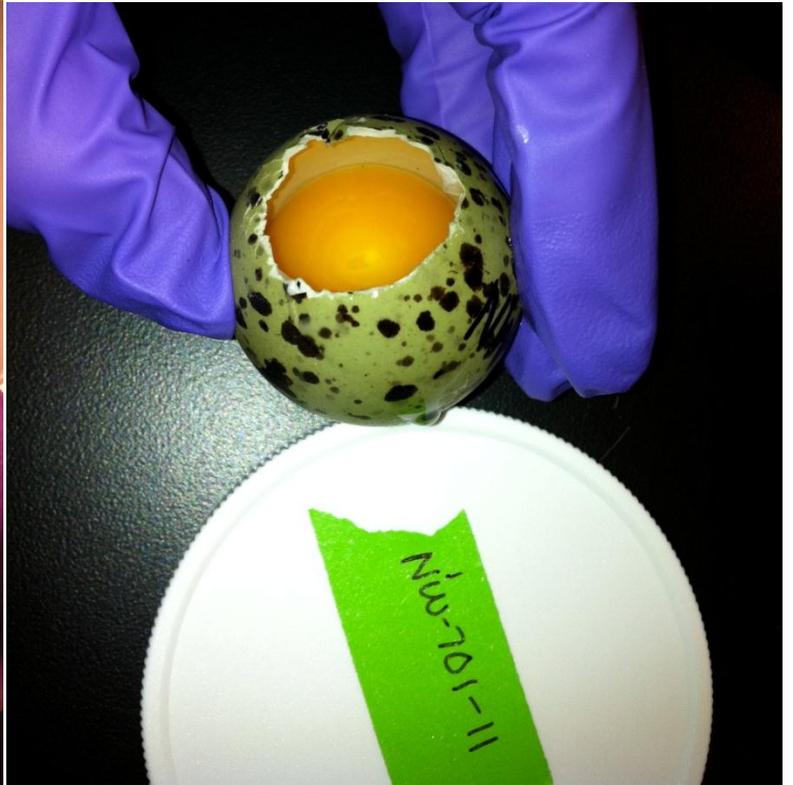
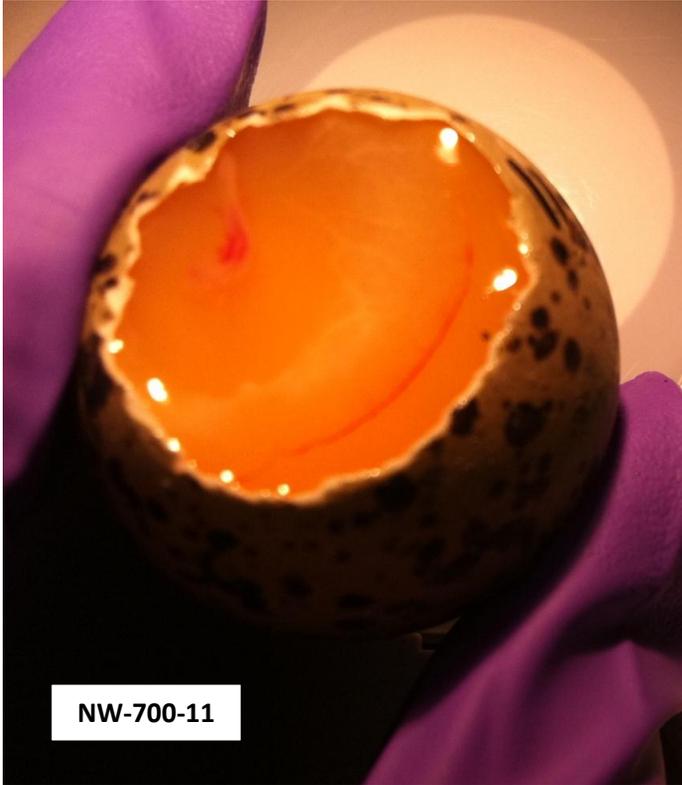
Date Collected	Lab ID	Site	Content	Se dry wght ($\mu\text{g/g}$)	Hg dry wght ($\mu\text{g/g}$)	Mass (wet) g
6/16/2011	ANTI-Invert1	ANTI	Brine Fly larvae	8.77	1.19	0.86
	ANTI-Invert2	ANTI	Midge larvae	0.69*	0.017	0.1
6/22/2011	FARM-Invert1	FARM	Midge larvae	5.76	0.426	2.3

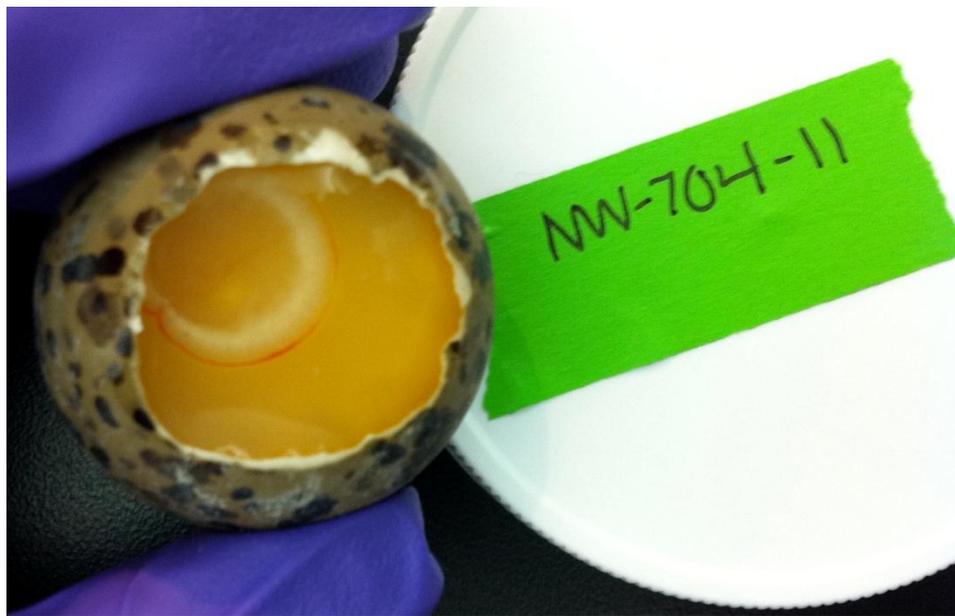
Appendix 2a Egg breakout pictures of the eggs collected from the ANTI study site.





Appendix 2b Egg breakout pictures for eggs collected from the FARM study site.





Appendix 2 Report from Brooks Rand Labs.

July 29, 2011

Weber State University
ATTN: Nacole Wilson
Department of Zoology
2505 University Circle
Ogden, UT 84408
nacolewilson@weber.edu

RE: Project WSU-OG1101

Client Project: Great Salt Lake Sampling

Dear Ms. Wilson,

On July 6, 2011, Brooks Rand Labs (BRL) received six (6) water samples. The samples were logged-in for the contracted analyses of total mercury (Hg) and selenium (Se) according to the chain-of-custody (COC) form. The samples were received, prepared, analyzed, and stored according to BRL SOPs and EPA methodology.

The results were blank-corrected as described in the calculations section of the relevant SOP(s) and may have been evaluated using reporting limits that have been adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details.

Sample *ANTI-05-11* (1128010-05) was identified as a field blank and produced a detectable Hg concentration of 0.19 ng/L. The result was less than the method reporting limit of 0.40 ng/L and not considered a significant source of contamination.

Aside from concentration qualifiers, all data was reported without qualification and all associated quality control sample results met the acceptance criteria.

BRL, an accredited laboratory, certifies that the reported results of all analyses for which BRL is NELAP accredited meet all NELAP requirements. For more information please see the *Report Information* page in your report. Please feel free to contact us if you have any questions regarding this report.

Sincerely,



Lydia Greaves
Jr. Project Manager
lydia@brooksrands.com



Amanda Royal
Project Manager
amanda@brooksrands.com

Report Information

Laboratory Accreditation

BRL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BRL is also certified by many other states to perform environmental analyses. For a current list of our accreditations/certifications, please visit our website at <http://www.brooksrand.com/default.asp?contentID=586>. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

BLK	method blank	MS	matrix spike
BRL	Brooks Rand Labs	MSD	matrix spike duplicate
BS	laboratory fortified blank	ND	non-detect
CAL	calibration standard	NR	non-reportable
CCV	continuing calibration verification	PS	post preparation spike
COC	chain of custody record	REC	percent recovery
CRM	certified reference material	RPD	relative percent difference
D	dissolved fraction	RSD	relative standard deviation
DUP	duplicate	SCV	secondary calibration verification
ICV	initial calibration verification	SOP	standard operating procedure
MDL	method detection limit	SRM	standard reference material
MRL	method reporting limit	T	total recoverable fraction

Definition of Data Qualifiers

(Effective 9/23/09)

B	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Result is estimated.
J	Estimated value. A full explanation is presented in the narrative.
J-M	Duplicate precision (RPD) for associated QC sample was not within acceptance criteria. Result is estimated.
J-N	Spike recovery for associated QC sample was not within acceptance criteria. Result is estimated.
M	Duplicate precision (RPD) was not within acceptance criteria. Result is estimated.
N	Spike recovery was not within acceptance criteria. Result is estimated.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.

These qualifiers are based on those previously utilized by Brooks Rand, Ltd., those found in the EPA [SOW_ILM03.0](#), Exhibit B, Section III, pg. B-18, and the [USEPA Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses](#); USEPA; July 2002. These supersede all previous qualifiers ever employed by BRL.



Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
ANTI-01-11	1128010-01	Water	Sample	06/30/2011	07/06/2011
ANTI-02-11	1128010-02	DIW	Field Blank	06/30/2011	07/06/2011
ANTI-03-11	1128010-03	Water	Field Duplicate	06/30/2011	07/06/2011
ANTI-04-11	1128010-04	Water	Sample	06/30/2011	07/06/2011
ANTI-05-11	1128010-05	DIW	Field Blank	06/30/2011	07/06/2011
ANTI-06-11	1128010-06	Water	Field Duplicate	06/30/2011	07/06/2011

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
Hg	Water	EPA 1631	07/12/2011	07/15/2011	B111001	1100485
Se	Water	EPA 1640 RP	07/12/2011	07/18/2011	B110974	1100488



Sample Results

Sample	Analyte	Report Matrix	Fraction	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
ANTI-01-11 1128010-01	Se	Water	T	0.210	B	0.108	0.308	µg/L	B110974	1100488
ANTI-02-11 1128010-02	Se	DIW	T	0.113	U	0.113	0.323	µg/L	B110974	1100488
ANTI-03-11 1128010-03	Se	Water	T	0.222	B	0.105	0.301	µg/L	B110974	1100488
ANTI-04-11 1128010-04	Hg	Water	T	19.5		1.49	3.98	ng/L	B111001	1100485
ANTI-05-11 1128010-05	Hg	DIW	T	0.19	B	0.15	0.40	ng/L	B111001	1100485
ANTI-06-11 1128010-06	Hg	Water	T	18.7		1.58	4.21	ng/L	B111001	1100485



Accuracy & Precision Summary

Batch: B110974
 Lab Matrix: Water
 Method: EPA 1640 RP

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B110974-BS2	Laboratory Fortified Blank (1129018) Se		1.000	0.920	µg/L	92% 70-130	
B110974-MS3	Matrix Spike (0944029-44) Se	ND	1.000	1.004	µg/L	95% 70-130	
B110974-DUP1	Duplicate (1126021-01) Se	0.181		0.226	µg/L		22% 30
B110974-MS1	Matrix Spike (1126021-01) Se	0.181	1.000	1.165	µg/L	98% 70-130	
B110974-MSD1	Matrix Spike Duplicate (1126021-01) Se	0.181	1.000	1.128	µg/L	95% 70-130	3% 30



Accuracy & Precision Summary

Batch: B111001
Lab Matrix: Water
Method: EPA 1631

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B111001-SRM1	Certified Reference Material (1128004, THg ICV 1641d) Hg		15.68	15.50	ng/L	99% 85-115	
B111001-MS3	Matrix Spike (1128010-04) Hg	19.53	105.3	130.1	ng/L	105% 71-125	
B111001-MSD3	Matrix Spike Duplicate (1128010-04) Hg	19.53	105.3	118.3	ng/L	94% 71-125	9% 24



Method Blanks & Reporting Limits

Batch: B110974
Matrix: Water
Method: EPA 1640 RP
Analyte: Se 77

Sample	Result	Units			
B110974-BLK1	0.002	µg/L			
B110974-BLK2	0.010	µg/L			
B110974-BLK3	0.016	µg/L			
B110974-BLK4	0.008	µg/L			
Average:	0.009		Standard Deviation:	0.006	MDL: 0.070
Limit:	0.200		Limit:	0.070	MRL: 0.200



Method Blanks & Reporting Limits

Batch: B111001
Matrix: Water
Method: EPA 1631
Analyte: Hg

Sample	Result	Units			
B111001-BLK1	0.10	ng/L			
B111001-BLK2	0.12	ng/L			
B111001-BLK3	0.10	ng/L			
B111001-BLK4	0.13	ng/L			
	Average: 0.11		Standard Deviation: 0.02	MDL: 0.15	
	Limit: 0.50		Limit: 0.10	MRL: 0.40	



Sample Containers

Lab ID: 1128010-01 Sample: ANTI-01-11	Report Matrix: Water Sample Type: Sample	Collected: 06/30/2011 Received: 07/06/2011					
Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle HDPE ICP-RP	125 mL	1043809	0.2% HNO3 (BRL)	1112089	<2	Cardboard Box w/ Styro Cooler
Lab ID: 1128010-02 Sample: ANTI-02-11	Report Matrix: DIW Sample Type: Field Blank	Collected: 06/30/2011 Received: 07/06/2011					
Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle HDPE ICP-RP	125 mL	1043809	0.2% HNO3 (BRL)	1112089	<2	Cardboard Box w/ Styro Cooler
Lab ID: 1128010-03 Sample: ANTI-03-11	Report Matrix: Water Sample Type: Field Duplicate	Collected: 06/30/2011 Received: 07/06/2011					
Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle HDPE ICP-RP	125 mL	1043809	0.2% HNO3 (BRL)	1112089	<2	Cardboard Box w/ Styro Cooler
Lab ID: 1128010-04 Sample: ANTI-04-11	Report Matrix: Water Sample Type: Sample	Collected: 06/30/2011 Received: 07/06/2011					
Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250 mL	71313080 60	none	n/a		Cardboard Box w/ Styro Cooler
Lab ID: 1128010-05 Sample: ANTI-05-11	Report Matrix: DIW Sample Type: Field Blank	Collected: 06/30/2011 Received: 07/06/2011					
Des	Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A	Bottle FLPE Hg-T	250 mL	71313080 60	none	n/a		Cardboard Box w/ Styro Cooler

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1128010
Client PM: Nacole Wilson

Sample Containers

Lab ID: 1128010-06	Report Matrix: Water	Collected: 06/30/2011				
Sample: ANTI-06-11	Sample Type: Field Duplicate	Received: 07/06/2011				
Des Container	Size	Lot	Preservation	P-Lot	pH	Ship. Cont.
A Bottle FLPE Hg-T	250 mL	71313080 60	none	n/a		Cardboard Box w/ Styro Cooler

Shipping Containers

Cardboard Box w/ Styro Cooler

Received: July 6, 2011 8:45
Tracking No: (9612019) 3381615 30019068 via Fed
Coolant Type: None
Temperature: ambient

Description: Cardboard Box w/ Styro Coo
Damaged in transit? No
Returned to client? No

Custody seals present? No
Custody seals intact? No
COC present? Yes

Chain of Custody Record

1128010

White: LAB COPY
Yellow: CUSTOMER COPY

Client: <u>Weber State University</u>	Address: <u>2505 University Circle</u> <u>Cody, UT 84408-2505</u>	COC receipt confirmation? Y / N
Contact: <u>Nacole Wilson</u>		If so, by: email / fax (circle one)
Client project ID: <u>Great Salt Lake Sampling</u>		Email:
PO #:	Phone #: <u>801-626-8634</u>	Fax #:

Sample ID	Collection		Miscellaneous				Field Preservation			Analyses required						Comments	
	Date	Time (AM) MST.	Sampler (initials)	Matrix type	# of containers	Field filtered? (Y/N)	Unpreserved / ice only	HCl / HNO ₃ (circle one)	Other (specify)	Total Hg, EPA 1631	Methyl Hg, EPA 1630	ICP-MS Metals (specify)	As / Se species (specify)	% Solids	Filtration		Other (specify) <u>Total Se</u>
1	ANTI-01-11	6/30/11 9:23	AH	W	1	N	N/A									✓	
2	ANTI-02-11	6/30/11 9:27	AH	W	1	N	N/A									✓	Field blank
3	ANTI-03-11	6/30/11 9:30	AH	W	1	N	N/A									✓	duplicate
4	ANTI-04-11	6/30/11 9:33A	AH	W	1	N	N/A		✓								
5	ANTI-05-11	6/30/11 4:35	AH	W	1	N	N/A		✓								Field blank
6	ANTI-06-11	6/30/11 9:38	AH	W	1	N	N/A		✓								duplicate
7																	
8																	
9																	
10																	

Relinquished by: <u>Nacole Wilson</u>	Date: <u>7/1/11</u>	Time: <u>12:37 PM</u>	Relinquished by:	Date:	Time:
Received by: <u>[Signature]</u>	Date: <u>7/1/11</u>	Time: <u>12:37 PM</u>	Received at BRL by: <u>[Signature]</u>	Date: <u>7/6/2011</u>	Time: <u>0845</u>
Shipping carrier: <u>Fed Ex</u>	# of coolers: <u>1</u>	BRL work order ID:	BRL project ID:		

[Signature] 1 JUL 11 15:35 [Signature] 7/1/11 [Signature] 1624

July 29, 2011

Weber State University
ATTN: Nacole Wilson
Department of Zoology
2505 University Circle
Ogden, UT 84408
nacolewilson@weber.edu

RE: Project WSU-OG1101

Client Project: Great Salt Lake Sampling

Dear Ms. Wilson,

On June 23, 2011, Brooks Rand Labs (BRL) received six (6) water samples. The samples were logged-in for the contracted analyses of total mercury (Hg) and selenium (Se) according to the chain-of-custody (COC) form. Samples were received in one 500mL glass container. The containers were preserved with nitric acid and then an aliquot was taken and put into a HDPE bottle for Se analysis, while the original container was used for Hg analysis. The samples were received, prepared, analyzed, and stored according to BRL SOPs and EPA methodology.

The results were blank-corrected as described in the calculations section of the relevant SOP(s) and may have been evaluated using reporting limits that have been adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details.

Samples 00514 (1128009-05) and 00513 (1128009-11) were identified as a field blank and an equipment blank, respectively, and produced detectable Hg concentrations of 0.27 ng/L and 0.39 ng/L, respectively. The results were less than the method reporting limit of 0.40 ng/L and not considered a significant source of contamination.

The sample 000536 (1128009-03) was identified as a field duplicate. The relative percent difference (RPD) between the field duplicate and the native sample 000533 (1128009-01) was 41%. The sample results were confirmed by re-analysis.

Aside from concentration qualifiers, all data was reported without qualification and all associated quality control sample results met the acceptance criteria.

BRL, an accredited laboratory, certifies that the reported results of all analyses for which BRL is NELAP accredited meet all NELAP requirements. For more information please see the *Report Information* page in your report. Please feel free to contact us if you have any questions regarding this report.

Sincerely,



Lydia Greaves
Jr. Project Manager
lydia@brooksrands.com



Amanda Royal
Project Manager
amanda@brooksrands.com

Report Information

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Common Abbreviations

BLK	method blank	MS	matrix spike
BRL	Brooks Rand Labs	MSD	matrix spike duplicate
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CAL	calibration standard	NR	non-reportable
CCV	continuing calibration verification	PS	post preparation spike
COC	chain of custody record	REC	percent recovery
CRM	certified reference material	RPD	relative percent difference
D	dissolved fraction	RSD	relative standard deviation
DUP	duplicate	SCV	secondary calibration verification
ICV	initial calibration verification	SOP	standard operating procedure
MDL	method detection limit	SRM	standard reference material
MRL	method reporting limit	T	total recoverable fraction

Definition of Data Qualifiers

(Effective 9/23/09)

B	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Result is estimated.
J	Estimated value. A full explanation is presented in the narrative.
J-M	Duplicate precision (RPD) for associated QC sample was not within acceptance criteria. Result is estimated.
J-N	Spike recovery for associated QC sample was not within acceptance criteria. Result is estimated.
M	Duplicate precision (RPD) was not within acceptance criteria. Result is estimated.
N	Spike recovery was not within acceptance criteria. Result is estimated.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.

These qualifiers are based on those previously utilized by Brooks Rand, Ltd., those found in the EPA SOW_ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses; USEPA; July 2002. These supersede all previous qualifiers ever employed by BRL.



Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
000533	1128009-01	Water	Sample	06/22/2011	06/23/2011
000533	1128009-02	Water	Sample	06/22/2011	06/23/2011
000536	1128009-03	Water	Field Duplicate	06/22/2011	06/23/2011
000536	1128009-04	Water	Field Duplicate	06/22/2011	06/23/2011
000514	1128009-05	DIW	Field Blank	06/22/2011	06/23/2011
000514	1128009-06	DIW	Field Blank	06/22/2011	06/23/2011
000517	1128009-07	Water	Sample	06/22/2011	06/23/2011
000517	1128009-08	Water	Sample	06/22/2011	06/23/2011
000528	1128009-09	Water	Field Duplicate	06/22/2011	06/23/2011
000528	1128009-10	Water	Field Duplicate	06/22/2011	06/23/2011
000513	1128009-11	DIW	Equip. Blank	06/22/2011	06/23/2011
000513	1128009-12	DIW	Equip. Blank	06/22/2011	06/23/2011

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
Hg	Water	EPA 1631	07/12/2011	07/15/2011	B111001	1100485
Se	Water	EPA 1640 RP	07/12/2011	07/18/2011	B110974	1100488



Sample Results

Sample	Analyte	Report Matrix	Fraction	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
000513										
1128009-11	Hg	DIW	T	0.27	B	0.15	0.40	ng/L	B111001	1100485
1128009-12	Se	DIW	T	0.070	U	0.070	0.200	µg/L	B110974	1100488
000514										
1128009-05	Hg	DIW	T	0.39	B	0.17	0.44	ng/L	B111001	1100485
1128009-06	Se	DIW	T	0.101	U	0.101	0.288	µg/L	B110974	1100488
000517										
1128009-07	Hg	Water	T	25.0		0.59	1.57	ng/L	B111001	1100485
1128009-08	Se	Water	T	0.207		0.070	0.200	µg/L	B110974	1100488
000528										
1128009-09	Hg	Water	T	25.0		0.57	1.53	ng/L	B111001	1100485
1128009-10	Se	Water	T	0.230		0.070	0.200	µg/L	B110974	1100488
000533										
1128009-01	Hg	Water	T	17.6		0.15	0.40	ng/L	B111001	1100485
1128009-02	Se	Water	T	0.303		0.088	0.252	µg/L	B110974	1100488
000536										
1128009-03	Hg	Water	T	26.7		0.15	0.40	ng/L	B111001	1100485
1128009-04	Se	Water	T	0.343		0.083	0.238	µg/L	B110974	1100488



Accuracy & Precision Summary

Batch: B110974
Lab Matrix: Water
Method: EPA 1640 RP

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B110974-BS2	Laboratory Fortified Blank (1129018) Se		1.000	0.920	µg/L	92% 70-130	
B110974-MS3	Matrix Spike (0944029-44) Se	ND	1.000	1.004	µg/L	95% 70-130	
B110974-DUP1	Duplicate (1126021-01) Se	0.181		0.226	µg/L		22% 30
B110974-MS1	Matrix Spike (1126021-01) Se	0.181	1.000	1.165	µg/L	98% 70-130	
B110974-MSD1	Matrix Spike Duplicate (1126021-01) Se	0.181	1.000	1.128	µg/L	95% 70-130	3% 30



Accuracy & Precision Summary

Batch: B111001
Lab Matrix: Water
Method: EPA 1631

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B111001-SRM1	Certified Reference Material (1128004, THg ICV 1641d) Hg		15.68	15.50	ng/L	99% 85-115	
B111001-MS3	Matrix Spike (1128010-04) Hg	19.53	105.3	130.1	ng/L	105% 71-125	
B111001-MSD3	Matrix Spike Duplicate (1128010-04) Hg	19.53	105.3	118.3	ng/L	94% 71-125	9% 24

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1128009
Client PM: Nacole Wilson
Client PO: P0036620

Method Blanks & Reporting Limits

Batch: B110974
Matrix: Water
Method: EPA 1640 RP
Analyte: Se 77

Sample	Result	Units			
B110974-BLK1	0.002	µg/L			
B110974-BLK2	0.010	µg/L			
B110974-BLK3	0.016	µg/L			
B110974-BLK4	0.008	µg/L			
Average:	0.009		Standard Deviation:	0.006	MDL: 0.070
Limit:	0.200		Limit:	0.070	MRL: 0.200

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1128009
Client PM: Nacole Wilson
Client PO: P0036620

Method Blanks & Reporting Limits

Batch: B111001
Matrix: Water
Method: EPA 1631
Analyte: Hg

Sample	Result	Units
B111001-BLK1	0.10	ng/L
B111001-BLK2	0.12	ng/L
B111001-BLK3	0.10	ng/L
B111001-BLK4	0.13	ng/L

Average: 0.11	Standard Deviation: 0.02	MDL: 0.15
Limit: 0.50	Limit: 0.10	MRL: 0.40

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1128009
Client PM: Nacole Wilson
Client PO: P0036620

Sample Containers

Lab ID: 1128009-01
Sample: 000533
Des Container Size Lot Preservation P-Lot pH Ship. Cont.
A Bottle Glass 500 mL No Lot # 0.2% HNO3 (BRL) 1112089 <2 Cardboard Box w/ Styro Cooler

Comments: Original Container 000533-Glass Jar

Lab ID: 1128009-02
Sample: 000533
Des Container Size Lot Preservation P-Lot pH Ship. Cont.
A Bottle HDPE ICP-RP 500 mL 627404 0.2% HNO3 (BRL) 1112089 <2 Cardboard Box w/ Styro Cooler

Comments: Split from original container 000533

Lab ID: 1128009-03
Sample: 000536
Comments: DUP of Sample -01
Des Container Size Lot Preservation P-Lot pH Ship. Cont.
A Bottle Glass 500 mL No Lot # 0.2% HNO3 (BRL) 1112089 <2 Cardboard Box w/ Styro Cooler

Comments: Original Container 000536-Glass Jar

Lab ID: 1128009-04
Sample: 000536
Comments: DUP of Sample -02
Des Container Size Lot Preservation P-Lot pH Ship. Cont.
A Bottle HDPE ICP-RP 500 mL 627404 0.2% HNO3 (BRL) 1112089 <2 Cardboard Box w/ Styro Cooler

Comments: Split from original container 000536

Lab ID: 1128009-05
Sample: 000514
Des Container Size Lot Preservation P-Lot pH Ship. Cont.
A Bottle Glass 500 mL No Lot # 0.2% HNO3 (BRL) 1112089 <2 Cardboard Box w/ Styro Cooler

Comments: Original Container 000514-Glass Jar

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1128009
Client PM: Nacole Wilson
Client PO: P0036620

Sample Containers

Lab ID: 1128009-06

Sample: 000514

Report Matrix: DIW

Sample Type: Field Blank

Collected: 06/22/2011

Received: 06/23/2011

Des	Container	Size	Lot	Preservation	P-Lot
A	Bottle HDPE ICP-RP	500 mL	627404	0.2% HNO3 (BRL)	1112089

pH	Ship. Cont.
<2	Cardboard Box w/ Styro Cooler

Comments: Split from original container 000514

Lab ID: 1128009-07

Sample: 000517

Report Matrix: Water

Sample Type: Sample

Collected: 06/22/2011

Received: 06/23/2011

Des	Container	Size	Lot	Preservation	P-Lot
A	Bottle Glass	500 mL	No Lot #	0.2% HNO3 (BRL)	1112089

pH	Ship. Cont.
<2	Cardboard Box w/ Styro Cooler

Comments: Original Container 000517-Glass Jar

Lab ID: 1128009-08

Sample: 000517

Report Matrix: Water

Sample Type: Sample

Collected: 06/22/2011

Received: 06/23/2011

Des	Container	Size	Lot	Preservation	P-Lot
A	Bottle HDPE ICP-RP	500 mL	627404	0.2% HNO3 (BRL)	1112089

pH	Ship. Cont.
<2	Cardboard Box w/ Styro Cooler

Comments: Split from original container 000517

Lab ID: 1128009-09

Sample: 000528

Report Matrix: Water

Sample Type: Field Duplicate

Collected: 06/22/2011

Received: 06/23/2011

Comments: DUP of sample -07

Des	Container	Size	Lot	Preservation	P-Lot
A	Bottle Glass	500 mL	No Lot #	0.2% HNO3 (BRL)	1112089

pH	Ship. Cont.
<2	Cardboard Box w/ Styro Cooler

Comments: Original Container 000528-Glass Jar

Lab ID: 1128009-10

Sample: 000528

Report Matrix: Water

Sample Type: Field Duplicate

Collected: 06/22/2011

Received: 06/23/2011

Comments: DUP of Sample -08

Des	Container	Size	Lot	Preservation	P-Lot
A	Bottle HDPE ICP-RP	500 mL	627404	0.2% HNO3 (BRL)	1112089

pH	Ship. Cont.
<2	Cardboard Box w/ Styro Cooler

Comments: Split from original container 000528

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1128009
Client PM: Nacole Wilson
Client PO: P0036620

Sample Containers

Lab ID: 1128009-11

Sample: 000513

Des Container

A Bottle Glass

Size

500 mL

Lot

No Lot #

Preservation

0.2% HNO3 (BRL)

P-Lot

1112089

Report Matrix: DIW

Sample Type: Equip. Blank

Collected: 06/22/2011

Received: 06/23/2011

pH **Ship. Cont.**

<2

Cardboard
Box w/ Styro
Cooler

Comments: Original Container 000513-Glass Jar

Lab ID: 1128009-12

Sample: 000513

Des Container

A Bottle HDPE ICP-RP

Size

500 mL

Lot

627404

Preservation

0.2% HNO3 (BRL)

P-Lot

1112089

Report Matrix: DIW

Sample Type: Equip. Blank

Collected: 06/22/2011

Received: 06/23/2011

pH **Ship. Cont.**

<2

Cardboard
Box w/ Styro
Cooler

Comments: Split from original container 000513

Shipping Containers

Cardboard Box w/ Styro Cooler

Received: June 23, 2011 8:40

Tracking No: 9541 5827 6183 via FedEx

Coolant Type: None

Temperature: ambient

Description: Cardboard Box w/ Styro Coo

Damaged in transit? No

Returned to client? No

Custody seals present? No

Custody seals intact? No

COC present? Yes

CHAIN-OF-CUSTODY RECORD

1128009

BRL Report 1128009

Avant Ecology Lab, 2505 University Circle, Weber State University, Ogden, UT 84408-2505, 801-626-8634 Contact: J. Cavitt

NOTE: USE BLACK INK ONLY TO FILL IN THIS FORM

Analytical Schedules:

Project name: Great Salt Lake Sampling

Sample Identification Number:

Sampler's Name: John Cavitt

Sample number (Field ID)	Date sampled (DDMMYY)	Time sampled (HHMM)	Lab ID (lab use only)	Sample matrix, (W, water; S, soil; B, Biota)	Number of containers	ASR Form Enclosed
000533	06/22/11	AM		W	1	
000536	06/22/11	AM		W	1	
000514	06/22/11	AM		W	1	
000517	06/22/11	AM		W	1	
000528	06/22/11	AM		W	1	
000513	06/22/11	AM		equipment blank	1	

CHAIN-OF-CUSTODY RECORD

SHIPPING DETAILS

Relinquished by (signature)	Date (DDMMYY)	Time (HHMM)	Received by (signature)	Seal number	Delivered to shipper by:
Nicole Wilson	06/22/11	1405	C. Allen	Method of shipment:	Airbill number:
C. Allen	06/22/11	14:22	R. R. Hooper	LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
				Lab:	Cooler seal intact upon receipt Yes ___ No ___
					Conditions of contents:
Additional comments: Samples sent to Brooks Rand Labs, LLC 3958 6th Ave NW Seattle, WA 98107				Received for laboratory by: Print: Tyler Rankin Sign: <i>Tyler Rankin</i> Date: 6/23/11 Time: 0840	Contents temp. (°C) on delivery: Laboratory Project Number:.

2011 Water Samples

Date	ID	Site	UTM E	UTM N	Notes
6/22/11	000533	FARM	416862	4536568	sample
"	000536	FARM	416862	4536568	duplicate
"	000514	"	"	"	000514 field blank
"	000517	"	417087	4536097	sample
"	000528	"	"	"	duplicate
"	000513	—————	—————	—————	equip. blank

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October 7, 2011

Weber State University
ATTN: Nacole Wilson
Department of Zoology
2505 University Circle
Ogden, UT 84408
nacolewilson@weber.edu

RE: Project WSU-OG1101

Client Project: Great Salt Lake Sampling

Dear Ms. Wilson,

On August 26, 2011, Brooks Rand Labs (BRL) received three (3) invertebrate samples, two (2) sediment samples, and ten (10) egg samples. The samples were logged-in for the contracted analyses of total mercury (Hg) and selenium (Se) according to the chain-of-custody (COC) form. The samples were received, prepared, analyzed, and stored according to BRL SOPs and EPA methodology.

The results were blank-corrected as described in the calculations section of the relevant SOP(s) and may have been evaluated using reporting limits that have been adjusted to account for sample aliquot size. Please refer to the *Sample Results* page for sample-specific MDLs, MRLs, and other details. Sample results were reported on both a wet-weight and dry-weight basis.

In Se batch B111345, the analysis of the laboratory fortified blank produced a recovery of 60%. All sample results were qualified **J** as estimates due to potential low bias.

Furthermore in batch B111345, all matrix spike/matrix spike duplicate (MS/MSD) sets were spiked with Se concentrations greater than 20x. All recoveries meet the acceptance criteria. Samples were limited in volume and re-preparation was not possible in most cases.

In soil/sediment Hg batch B111392, the MS/MSD set performed on an unrelated client sample was spiked with an Hg concentration less than the native sample result. Therefore, the recoveries were not considered valid indications of overall data quality. Ideally a post preparation spike would have been analyzed but was inadvertently not performed. No further corrective action was necessary.

Due to limited sample mass an MS/MSD set could not be prepared in biota batch B111462. Individual method duplicate and post preparation spike were analyzed instead. Two certified reference materials were prepared alongside samples and produced excellent recoveries as well.

Aside from concentration qualifiers, all data was reported without further qualification and all associated quality control sample results met the acceptance criteria.

BRL, an accredited laboratory, certifies that the reported results of all analyses for which BRL is NELAP accredited meet all NELAP requirements. For more information please see the *Report Information* page in your report.

Please feel free to contact me if you have any questions regarding this report.

Sincerely,

A handwritten signature in black ink that reads "Tiffany Stilwater". The signature is written in a cursive style with a large, looped initial "T".

Tiffany Stilwater
Project Manager
tiffany@brooksrand.com



Report Information

Laboratory Accreditation

BRL is accredited by the *National Environmental Laboratory Accreditation Program* (NELAP) through the State of Florida Department of Health, Bureau of Laboratories (E87982) and is certified to perform many environmental analyses. BRL is also certified by many other states to perform environmental analyses. For a current list of our accreditations/certifications, please visit our website at <http://www.brooksrand.com/default.asp?contentID=586>. Results reported relate only to the samples listed in the report.

Field Quality Control Samples

Please be notified that certain EPA methods require the collection of field quality control samples of an appropriate type and frequency; failure to do so is considered a deviation from some methods and for compliance purposes should only be done with the approval of regulatory authorities. Please see the specific EPA methods for details regarding required field quality control samples.

Common Abbreviations

BLK	method blank	MS	matrix spike
BRL	Brooks Rand Labs	MSD	matrix spike duplicate
BS	laboratory fortified blank	ND	non-detect
CAL	calibration standard	NR	non-reportable
CCV	continuing calibration verification	PS	post preparation spike
COC	chain of custody record	REC	percent recovery
CRM	certified reference material	RPD	relative percent difference
D	dissolved fraction	RSD	relative standard deviation
DUP	duplicate	SCV	secondary calibration verification
ICV	initial calibration verification	SOP	standard operating procedure
MDL	method detection limit	SRM	standard reference material
MRL	method reporting limit	T	total recoverable fraction

Definition of Data Qualifiers

(Effective 9/23/09)

B	Detected by the instrument, the result is > the MDL but ≤ the MRL. Result is reported and considered an estimate.
E	An estimated value due to the presence of interferences. A full explanation is presented in the narrative.
H	Holding time and/or preservation requirements not met. Result is estimated.
J	Estimated value. A full explanation is presented in the narrative.
J-M	Duplicate precision (RPD) for associated QC sample was not within acceptance criteria. Result is estimated.
J-N	Spike recovery for associated QC sample was not within acceptance criteria. Result is estimated.
M	Duplicate precision (RPD) was not within acceptance criteria. Result is estimated.
N	Spike recovery was not within acceptance criteria. Result is estimated.
R	Rejected, unusable value. A full explanation is presented in the narrative.
U	Result is ≤ the MDL or client requested reporting limit (CRRL). Result reported as the MDL or CRRL.
X	Result is not BLK-corrected and is within 10x the absolute value of the highest detectable BLK in the batch. Result is estimated.

These qualifiers are based on those previously utilized by Brooks Rand, Ltd., those found in the EPA SOW_ILM03.0, Exhibit B, Section III, pg. B-18, and the USEPA Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses; USEPA; July 2002. These supersede all previous qualifiers ever employed by BRL.



Sample Information

Sample	Lab ID	Report Matrix	Type	Sampled	Received
ANTI - Invert 1	1135049-01	Invertebrate	Sample	06/16/2011	08/26/2011
ANTI - Invert 2	1135049-02	Invertebrate	Sample	06/16/2011	08/26/2011
FARM - Invert 1	1135049-03	Invertebrate	Sample	06/22/2011	08/26/2011
FARM	1135049-04	Soil/Sediment	Sample	06/22/2011	08/26/2011
ANTI	1135049-05	Soil/Sediment	Sample	07/01/2011	08/26/2011
NW-500-11	1135049-06	Egg	Sample	06/10/2011	08/26/2011
NW-501-11	1135049-07	Egg	Sample	06/10/2011	08/26/2011
NW-502-11	1135049-08	Egg	Sample	06/10/2011	08/26/2011
NW-503-11	1135049-09	Egg	Sample	06/10/2011	08/26/2011
NW-504-11	1135049-10	Egg	Sample	06/10/2011	08/26/2011
NW-700-11	1135049-11	Egg	Sample	06/28/2011	08/26/2011
NW-701-11	1135049-12	Egg	Sample	06/28/2011	08/26/2011
NW-702-11	1135049-13	Egg	Sample	06/28/2011	08/26/2011
NW-703-11	1135049-14	Egg	Sample	06/28/2011	08/26/2011
NW-704-11	1135049-15	Egg	Sample	06/28/2011	08/26/2011

Batch Summary

Analyte	Lab Matrix	Method	Prepared	Analyzed	Batch	Sequence
%TS	Biota	SM 2540G	09/13/2011	09/19/2011	B111391	N/A
%TS	Biota	SM 2540G	09/28/2011	09/29/2011	B111535	N/A
Hg	Biota	EPA 1631 Appendix	09/15/2011	09/20/2011	B111294	1100645
Hg	Biota	EPA 1631 Appendix	09/15/2011	09/21/2011	B111294	1100649
Hg	Biota	EPA 1631 Appendix	09/20/2011	09/21/2011	B111462	1100650
Se	Biota	EPA 1638 DRC	09/09/2011	09/16/2011	B111345	1100642
%TS	Soil/Sediment	SM 2540G	09/15/2011	09/19/2011	B111393	N/A
Hg	Soil/Sediment	EPA 1631 Appendix	09/15/2011	09/22/2011	B111392	1100649
Se	Soil/Sediment	EPA 1638 DRC	09/14/2011	09/16/2011	B111340	1100642



Sample Results

Sample	Analyte	Report Matrix	Fraction	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
ANTI										
1135049-05	%TS	Soil/Sediment	N/A	61.85		0.30	1.00	%	B111393	N/A
1135049-05	Hg	Soil/Sediment	N/A	70.6		3.19	9.56	ng/g dry	B111392	1100649
1135049-05	Hg	Soil/Sediment	N/A	43.6		1.97	5.91	ng/g	B111392	1100649
1135049-05	Se	Soil/Sediment	N/A	0.99	B	0.26	1.61	mg/kg dry	B111340	1100642
1135049-05	Se	Soil/Sediment	N/A	0.61	B	0.16	0.99	mg/kg	B111340	1100642
ANTI - Invert 1										
1135049-01	%TS	Invertebrate	N/A	1.52		0.14	0.47	%	B111535	N/A
1135049-01	Hg	Invertebrate	N/A	1190		63.0	158	ng/g dry	B111462	1100650
1135049-01	Hg	Invertebrate	N/A	18.1		0.96	2.40	ng/g	B111462	1100650
1135049-01	Se	Invertebrate	N/A	8.77	J, B	4.92	14.8	mg/kg dry	B111345	1100642
1135049-01	Se	Invertebrate	N/A	0.13	J, B	0.07	0.22	mg/kg	B111345	1100642
ANTI - Invert 2										
1135049-02	Hg	Invertebrate	N/A	17.3		2.25	5.62	ng/g dry	B111462	1100650
1135049-02	Hg	Invertebrate	N/A	17.3		2.25	5.62	ng/g	B111462	1100650
1135049-02	Se	Invertebrate	N/A	0.69	J, U	0.69	2.08	mg/kg dry	B111345	1100642
1135049-02	Se	Invertebrate	N/A	0.69	J, U	0.69	2.08	mg/kg	B111345	1100642
FARM										
1135049-04	%TS	Soil/Sediment	N/A	58.88		0.30	1.00	%	B111393	N/A
1135049-04	Hg	Soil/Sediment	N/A	138		8.05	24.1	ng/g dry	B111392	1100649
1135049-04	Hg	Soil/Sediment	N/A	81.2		4.74	14.2	ng/g	B111392	1100649
1135049-04	Se	Soil/Sediment	N/A	1.32	B	0.27	1.68	mg/kg dry	B111340	1100642
1135049-04	Se	Soil/Sediment	N/A	0.78	B	0.16	0.99	mg/kg	B111340	1100642
FARM - Invert 1										
1135049-03	%TS	Invertebrate	N/A	5.52		0.14	0.47	%	B111535	N/A
1135049-03	Hg	Invertebrate	N/A	426		11.7	29.4	ng/g dry	B111462	1100650
1135049-03	Hg	Invertebrate	N/A	23.5		0.65	1.62	ng/g	B111462	1100650
1135049-03	Se	Invertebrate	N/A	5.76	J	0.92	2.75	mg/kg dry	B111345	1100642
1135049-03	Se	Invertebrate	N/A	0.32	J	0.05	0.15	mg/kg	B111345	1100642
NW-500-11										
1135049-06	%TS	Egg	N/A	28.91		0.30	1.00	%	B111391	N/A
1135049-06	Hg	Egg	N/A	1150		1.38	3.44	ng/g dry	B111294	1100645
1135049-06	Hg	Egg	N/A	331		0.40	0.99	ng/g	B111294	1100645
1135049-06	Se	Egg	N/A	1.42	J	0.16	0.47	mg/kg dry	B111345	1100642
1135049-06	Se	Egg	N/A	0.41	J	0.05	0.14	mg/kg	B111345	1100642



Sample Results

Sample	Analyte	Report Matrix	Fraction	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
NW-501-11										
1135049-07	%TS	Egg	N/A	29.58		0.30	1.00	%	B111391	N/A
1135049-07	Hg	Egg	N/A	675		1.29	3.22	ng/g dry	B111294	1100645
1135049-07	Hg	Egg	N/A	200		0.38	0.95	ng/g	B111294	1100645
1135049-07	Se	Egg	N/A	1.38	J	0.17	0.50	mg/kg dry	B111345	1100642
1135049-07	Se	Egg	N/A	0.41	J	0.05	0.15	mg/kg	B111345	1100642
NW-502-11										
1135049-08	%TS	Egg	N/A	27.14		0.30	1.00	%	B111391	N/A
1135049-08	Hg	Egg	N/A	825		2.84	7.11	ng/g dry	B111294	1100645
1135049-08	Hg	Egg	N/A	224		0.77	1.93	ng/g	B111294	1100645
1135049-08	Se	Egg	N/A	1.50	J	0.17	0.50	mg/kg dry	B111345	1100642
1135049-08	Se	Egg	N/A	0.41	J	0.04	0.13	mg/kg	B111345	1100642
NW-503-11										
1135049-09	%TS	Egg	N/A	26.96		0.30	1.00	%	B111391	N/A
1135049-09	Hg	Egg	N/A	853		1.41	3.52	ng/g dry	B111294	1100645
1135049-09	Hg	Egg	N/A	230		0.38	0.95	ng/g	B111294	1100645
1135049-09	Se	Egg	N/A	1.84	J	0.17	0.50	mg/kg dry	B111345	1100642
1135049-09	Se	Egg	N/A	0.49	J	0.04	0.13	mg/kg	B111345	1100642
NW-504-11										
1135049-10	%TS	Egg	N/A	27.51		0.30	1.00	%	B111391	N/A
1135049-10	Hg	Egg	N/A	528		1.35	3.39	ng/g dry	B111294	1100645
1135049-10	Hg	Egg	N/A	145		0.37	0.93	ng/g	B111294	1100645
1135049-10	Se	Egg	N/A	1.67	J	0.17	0.52	mg/kg dry	B111345	1100642
1135049-10	Se	Egg	N/A	0.46	J	0.05	0.14	mg/kg	B111345	1100642
NW-700-11										
1135049-11	%TS	Egg	N/A	28.96		0.30	1.00	%	B111391	N/A
1135049-11	Hg	Egg	N/A	1200		1.27	3.19	ng/g dry	B111294	1100645
1135049-11	Hg	Egg	N/A	347		0.37	0.92	ng/g	B111294	1100645
1135049-11	Se	Egg	N/A	2.40	J	0.17	0.51	mg/kg dry	B111345	1100642
1135049-11	Se	Egg	N/A	0.70	J	0.05	0.15	mg/kg	B111345	1100642
NW-701-11										
1135049-12	%TS	Egg	N/A	29.45		0.30	1.00	%	B111391	N/A
1135049-12	Hg	Egg	N/A	1350		1.34	3.34	ng/g dry	B111294	1100645
1135049-12	Hg	Egg	N/A	397		0.39	0.98	ng/g	B111294	1100645
1135049-12	Se	Egg	N/A	2.63	J	0.16	0.47	mg/kg dry	B111345	1100642
1135049-12	Se	Egg	N/A	0.77	J	0.05	0.14	mg/kg	B111345	1100642
NW-702-11										
1135049-13	%TS	Egg	N/A	29.06		0.30	1.00	%	B111391	N/A
1135049-13	Hg	Egg	N/A	1070		1.34	3.36	ng/g dry	B111294	1100645
1135049-13	Hg	Egg	N/A	312		0.39	0.98	ng/g	B111294	1100645
1135049-13	Se	Egg	N/A	2.57	J	0.17	0.52	mg/kg dry	B111345	1100642
1135049-13	Se	Egg	N/A	0.75	J	0.05	0.15	mg/kg	B111345	1100642



Sample Results

Sample	Analyte	Report Matrix	Fraction	Result	Qualifier	MDL	MRL	Unit	Batch	Sequence
NW-703-11										
1135049-14	%TS	Egg	N/A	29.88		0.30	1.00	%	B111391	N/A
1135049-14	Hg	Egg	N/A	1390		26.5	66.4	ng/g dry	B111294	1100649
1135049-14	Hg	Egg	N/A	415		7.93	19.8	ng/g	B111294	1100649
1135049-14	Se	Egg	N/A	2.28	J	0.17	0.50	mg/kg dry	B111345	1100642
1135049-14	Se	Egg	N/A	0.68	J	0.05	0.15	mg/kg	B111345	1100642
NW-704-11										
1135049-15	%TS	Egg	N/A	25.78		0.30	1.00	%	B111391	N/A
1135049-15	Hg	Egg	N/A	815		30.7	76.8	ng/g dry	B111294	1100649
1135049-15	Hg	Egg	N/A	210		7.92	19.8	ng/g	B111294	1100649
1135049-15	Se	Egg	N/A	2.83	J	0.19	0.57	mg/kg dry	B111345	1100642
1135049-15	Se	Egg	N/A	0.73	J	0.05	0.15	mg/kg	B111345	1100642



Accuracy & Precision Summary

Batch: B111294
Lab Matrix: Biota
Method: EPA 1631 Appendix

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B111294-SRM1	Certified Reference Material (0951025, DORM-3) Hg		382.0	431.3	ng/g	113% 75-125	
B111294-SRM2	Certified Reference Material (1051005, TORT-2) Hg		270.0	320.2	ng/g	119% 75-125	
B111294-DUP3	Duplicate (1133023-10) Hg	48.06		50.00	ng/g dry		4% 30
B111294-MS3	Matrix Spike (1133023-10) Hg	48.06	248.2	311.7	ng/g dry	106% 70-130	
B111294-MSD3	Matrix Spike Duplicate (1133023-10) Hg	48.06	248.3	313.2	ng/g dry	107% 70-130	0.5% 30
B111294-DUP2	Duplicate (1135049-08) Hg	824.9		837.7	ng/g dry		2% 30
B111294-MS2	Matrix Spike (1135049-08) Hg	824.9	1833	2834	ng/g dry	110% 70-130	
B111294-MSD2	Matrix Spike Duplicate (1135049-08) Hg	824.9	1742	2730	ng/g dry	109% 70-130	4% 30



Accuracy & Precision Summary

Batch: B111340
Lab Matrix: Soil/Sediment
Method: EPA 1638 DRC

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B111340-BS2	Laboratory Fortified Blank (1138026) Se		20.00	17.41	mg/kg	87% 75-125	
B111340-DUP1	Duplicate (1135049-04) Se	1.32		1.14	mg/kg dry		15% 30
B111340-MS1	Matrix Spike (1135049-04) Se	1.32	10.59	13.18	mg/kg dry	112% 70-130	
B111340-MSD1	Matrix Spike Duplicate (1135049-04) Se	1.32	10.38	10.55	mg/kg dry	89% 70-130	22% 30



Accuracy & Precision Summary

Batch: B111345
 Lab Matrix: Biota
 Method: EPA 1638 DRC

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B111345-BS2	Laboratory Fortified Blank (1137026) Se		3.000	1.81	mg/kg	60% 75-125	
B111345-SRM1	Certified Reference Material (1051006, DORM-3) Se		3.300	2.69	mg/kg	81% N/A	
B111345-SRM2	Certified Reference Material (1051005, TORT-2) Se		5.630	5.00	mg/kg	89% 75-125	
B111345-DUP1	Duplicate (1135048-01) Se	0.86		0.79	mg/kg dry		9% 30
B111345-MS1	Matrix Spike (1135048-01) Se	0.86	97.28	88.23	mg/kg dry	90% 70-130	
B111345-MSD1	Matrix Spike Duplicate (1135048-01) Se	0.86	100.8	82.32	mg/kg dry	81% 70-130	7% 30
B111345-DUP3	Duplicate (1135049-06) Se	1.42		1.36	mg/kg dry		4% 30
B111345-MS3	Matrix Spike (1135049-06) Se	1.42	348.7	304.3	mg/kg dry	87% 70-130	
B111345-MSD3	Matrix Spike Duplicate (1135049-06) Se	1.42	342.5	275.6	mg/kg dry	80% 70-130	10% 30

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1135049
Client PM: Nacole Wilson
Client PO: P0036620

Accuracy & Precision Summary

Batch: B111391
Lab Matrix: Biota
Method: SM 2540G

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B111391-DUP2	Duplicate (1135049-06) %TS	28.91		28.87	%		0.1% 15



Accuracy & Precision Summary

Batch: B111392
 Lab Matrix: Soil/Sediment
 Method: EPA 1631 Appendix

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B111392-SRM1	Certified Reference Material (1103012, MESS-3) Hg		91.00	85.85	ng/g	94% 75-125	
B111392-SRM2	Certified Reference Material (1103012, MESS-3) Hg		91.00	87.45	ng/g	96% 75-125	
B111392-DUP1	Duplicate (1135046-03) Hg	4057		4595	ng/g dry		12% 30
B111392-MS1	Matrix Spike (1135046-03) Hg	4057	1412	6848	ng/g dry	198% 70-130	
B111392-MSD1	Matrix Spike Duplicate (1135046-03) Hg	4057	1389	7191	ng/g dry	226% 70-130	5% 30
B111392-DUP4	Duplicate (1135049-04) Hg	137.9		143.2	ng/g dry		4% 30
B111392-MS4	Matrix Spike (1135049-04) Hg	137.9	1636	1603	ng/g dry	90% 70-130	
B111392-MSD4	Matrix Spike Duplicate (1135049-04) Hg	137.9	1605	1596	ng/g dry	91% 70-130	0.5% 30

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1135049
Client PM: Nacole Wilson
Client PO: P0036620

Accuracy & Precision Summary

Batch: B111393
Lab Matrix: Soil/Sediment
Method: SM 2540G

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B111393-DUP2	Duplicate (1135049-05) %TS	61.85		57.16	%		8% 15



Accuracy & Precision Summary

Batch: B111462
Lab Matrix: Biota
Method: EPA 1631 Appendix

Sample	Analyte	Native	Spike	Result	Units	REC & Limits	RPD & Limits
B111462-SRM1	Certified Reference Material (1051006, DORM-3) Hg		382.0	433.0	ng/g	113% 75-125	
B111462-SRM2	Certified Reference Material (1051005, TORT-2) Hg		270.0	317.4	ng/g	118% 75-125	
B111462-DUP1	Duplicate (1135049-01) Hg	1193		1248	ng/g dry		4% 30
B111462-PS1	Post Spike (1135049-03) Hg	426.4	1849	2516	ng/g dry	113% 75-125	



Method Blanks & Reporting Limits

Batch: B111294
Matrix: Biota
Method: EPA 1631 Appendix
Analyte: Hg

Sample	Result	Units		
B111294-BLK1	0.02	ng/g		
B111294-BLK2	0.04	ng/g		
B111294-BLK3	0.02	ng/g		
B111294-BLK4	0.03	ng/g		
	Average: 0.03		Standard Deviation: 0.01	MDL: 0.04
	Limit: 0.08		Limit: 0.03	MRL: 0.10

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1135049
Client PM: Nacole Wilson
Client PO: P0036620

Method Blanks & Reporting Limits

Batch: B111340
Matrix: Soil/Sediment
Method: EPA 1638 DRC
Analyte: Se 78

Sample	Result	Units			
B111340-BLK1	-0.07	mg/kg			
B111340-BLK2	-0.08	mg/kg			
B111340-BLK3	-0.10	mg/kg			
B111340-BLK4	-0.09	mg/kg			
Average:	-0.09		Standard Deviation:	0.01	MDL: 0.16
Limit:	1.00		Limit:	0.16	MRL: 1.00

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1135049
Client PM: Nacole Wilson
Client PO: P0036620

Method Blanks & Reporting Limits

Batch: B111345
Matrix: Biota
Method: EPA 1638 DRC
Analyte: Se 78

Sample	Result	Units			
B111345-BLK1	-0.02	mg/kg			
B111345-BLK2	-0.02	mg/kg			
B111345-BLK3	-0.02	mg/kg			
B111345-BLK4	-0.02	mg/kg			
Average:	-0.02		Standard Deviation:	0.00	MDL: 0.05
Limit:	0.15		Limit:	0.05	MRL: 0.15

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1135049
Client PM: Nacole Wilson
Client PO: P0036620

Method Blanks & Reporting Limits

Batch: B111391
Matrix: Biota
Method: SM 2540G
Analyte: %TS

Sample	Result	Units	
B111391-BLK1	-0.01	%	
B111391-BLK2	-0.01	%	
Average:	-0.01		MDL: 0.30
Limit:	1.00		MRL: 1.00

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1135049
Client PM: Nacole Wilson
Client PO: P0036620

Method Blanks & Reporting Limits

Batch: B111392
Matrix: Soil/Sediment
Method: EPA 1631 Appendix
Analyte: Hg

Sample	Result	Units			
B111392-BLK1	0.009	ng/g			
B111392-BLK2	0.006	ng/g			
B111392-BLK3	0.005	ng/g			
B111392-BLK4	0.01	ng/g			
	Average: 0.01		Standard Deviation: 0.00	MDL: 0.05	
	Limit: 0.10		Limit: 0.03	MRL: 0.15	

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1135049
Client PM: Nacole Wilson
Client PO: P0036620

Method Blanks & Reporting Limits

Batch: B111393
Matrix: Soil/Sediment
Method: SM 2540G
Analyte: %TS

Sample	Result	Units
B111393-BLK1	-0.26	%
B111393-BLK2	0.24	%
B111393-BLK3	0.00	%

Average: -0.01
Limit: 1.00

MDL: 0.30
MRL: 1.00

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1135049
Client PM: Nacole Wilson
Client PO: P0036620

Method Blanks & Reporting Limits

Batch: B111462
Matrix: Biota
Method: EPA 1631 Appendix
Analyte: Hg

Sample	Result	Units		
B111462-BLK1	0.11	ng/g		
B111462-BLK2	0.15	ng/g		
B111462-BLK3	0.16	ng/g		
B111462-BLK4	0.16	ng/g		
	Average: 0.15		Standard Deviation: 0.02	MDL: 0.16
	Limit: 0.32		Limit: 0.11	MRL: 0.40

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1135049
Client PM: Nacole Wilson
Client PO: P0036620

Method Blanks & Reporting Limits

Batch: B111535
Matrix: Biota
Method: SM 2540G
Analyte: %TS

Sample	Result	Units
B111535-BLK1	0.00	%
B111535-BLK2	0.00	%

Average: 0.00
Limit: 0.47

MDL: 0.14
MRL: 0.47



Sample Containers

Lab ID: 1135049-01				Report Matrix: Invertebrate		Collected: 06/16/2011
Sample: ANTI - Invert 1				Sample Type: Sample		Received: 08/26/2011
Des	Container	Size	Lot	Preservation	P-Lot	pH
A	Client-Provided			none	n/a	Ship. Cont. Cooler
Lab ID: 1135049-02				Report Matrix: Invertebrate		Collected: 06/16/2011
Sample: ANTI - Invert 2				Sample Type: Sample		Received: 08/26/2011
Comments: Insufficient Volume for analysis						
Des	Container	Size	Lot	Preservation	P-Lot	pH
A	Client-Provided			none	n/a	Ship. Cont. Cooler
Lab ID: 1135049-03				Report Matrix: Invertebrate		Collected: 06/22/2011
Sample: FARM - Invert 1				Sample Type: Sample		Received: 08/26/2011
Des	Container	Size	Lot	Preservation	P-Lot	pH
A	Client-Provided			none	n/a	Ship. Cont. Cooler
Lab ID: 1135049-04				Report Matrix: Soil/Sediment		Collected: 06/22/2011
Sample: FARM				Sample Type: Sample		Received: 08/26/2011
Des	Container	Size	Lot	Preservation	P-Lot	pH
A	Client-Provided			none	n/a	Ship. Cont. Cooler
Lab ID: 1135049-05				Report Matrix: Soil/Sediment		Collected: 07/01/2011
Sample: ANTI				Sample Type: Sample		Received: 08/26/2011
Des	Container	Size	Lot	Preservation	P-Lot	pH
A	Client-Provided			none	n/a	Ship. Cont. Cooler
Lab ID: 1135049-06				Report Matrix: Egg		Collected: 06/10/2011
Sample: NW-500-11				Sample Type: Sample		Received: 08/26/2011
Des	Container	Size	Lot	Preservation	P-Lot	pH
A	Jar HDPE			none	n/a	Ship. Cont. Cooler
Lab ID: 1135049-07				Report Matrix: Egg		Collected: 06/10/2011
Sample: NW-501-11				Sample Type: Sample		Received: 08/26/2011
Des	Container	Size	Lot	Preservation	P-Lot	pH
A	Jar HDPE			none	n/a	Ship. Cont. Cooler



Sample Containers

Lab ID: 1135049-08 Sample: NW-502-11			Report Matrix: Egg Sample Type: Sample		Collected: 06/10/2011 Received: 08/26/2011
Des Container	Size	Lot	Preservation	P-Lot	pH Ship. Cont.
A Jar HDPE			none	n/a	Cooler
Lab ID: 1135049-09 Sample: NW-503-11			Report Matrix: Egg Sample Type: Sample		Collected: 06/10/2011 Received: 08/26/2011
Des Container	Size	Lot	Preservation	P-Lot	pH Ship. Cont.
A Jar HDPE			none	n/a	Cooler
Lab ID: 1135049-10 Sample: NW-504-11			Report Matrix: Egg Sample Type: Sample		Collected: 06/10/2011 Received: 08/26/2011
Des Container	Size	Lot	Preservation	P-Lot	pH Ship. Cont.
A Jar HDPE			none	n/a	Cooler
Lab ID: 1135049-11 Sample: NW-700-11			Report Matrix: Egg Sample Type: Sample		Collected: 06/28/2011 Received: 08/26/2011
Des Container	Size	Lot	Preservation	P-Lot	pH Ship. Cont.
A Jar HDPE			none	n/a	Cooler
Lab ID: 1135049-12 Sample: NW-701-11			Report Matrix: Egg Sample Type: Sample		Collected: 06/28/2011 Received: 08/26/2011
Des Container	Size	Lot	Preservation	P-Lot	pH Ship. Cont.
A Jar HDPE			none	n/a	Cooler
Lab ID: 1135049-13 Sample: NW-702-11			Report Matrix: Egg Sample Type: Sample		Collected: 06/28/2011 Received: 08/26/2011
Des Container	Size	Lot	Preservation	P-Lot	pH Ship. Cont.
A Jar HDPE			none	n/a	Cooler
Lab ID: 1135049-14 Sample: NW-703-11			Report Matrix: Egg Sample Type: Sample		Collected: 06/28/2011 Received: 08/26/2011
Des Container	Size	Lot	Preservation	P-Lot	pH Ship. Cont.
A Jar HDPE			none	n/a	Cooler

Project ID: WSU-OG1101
PM: Tiffany Stilwater



BRL Report 1135049
Client PM: Nacole Wilson
Client PO: P0036620

Sample Containers

Lab ID: 1135049-15
Sample: NW-704-11

Report Matrix: Egg
Sample Type: Sample

Collected: 06/28/2011
Received: 08/26/2011

Des Container

Size

Lot

Preservation

P-Lot

pH Ship. Cont.

A Jar HDPE

none

n/a

Cooler

Shipping Containers

Cooler

Received: August 26, 2011 9:00
Tracking No: 503364309659 via FedEx
Coolant Type: Dry Ice
Temperature: 2.6 °C

Description: Styro Cooler, Cardboard Box
Damaged in transit? No
Returned to client? No

Custody seals present? No
Custody seals intact? No
COC present? Yes

CHAIN-OF-CUSTODY RECORD

Avian Ecology Lab, 2505 University Circle, Weber State University, Ogden, UT 84408-2505, 801-626-8634 Contact: J. Cavitt port 1135049

NOTE: USE BLACK INK ONLY TO FILL IN THIS FORM

Analytical Schedules:

Project name: Great Salt Lake Sampling

Sample Identification Number:
Macroinvertebrates, soil, and embryos

Sampler's Name: John Cavitt

Sample number (Field ID)		Date sampled (DDMMYY)	Time sampled (HHMM)	Lab ID (lab use only)	Sample matrix, (W, water; S, soil; B, Biota)	Number of containers	ASR Form Enclosed
ANTI-Invert 1	NW	16/06/11			B	1	
ANTI-Invert 2	NW	16/06/11			B	1	
FARM-Invert 1	NW	22/06/11			B	1	
FARM	NW	22/06/11			S	1	
ANTI	NW	01/07/11			S	1	
NW-500-11	egg NW	10/06/11			B	1	
NW-501-11	egg NW	10/06/11			B	1	
NW-502-11	egg NW	10/06/11			B	1	
NW-503-11	egg NW	10/06/11*			B	1	

CHAIN-OF-CUSTODY RECORD

SHIPPING DETAILS

Relinquished by (signature)	Date (DDMMYY)	Time (HHMM)	Received by (signature)	Seal number	Delivered to shipper by:
<u>Nicole Wilson</u>	25/08/11	1:45	<u>[Signature]</u>	Method of shipment: <u>FedEx</u>	Airbill number: <u>5033 64309659</u>
<u>Zach Hansen</u>	25/08/11	3:30 pm	<u>[Signature]</u>	LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
				Lab: <u>Brooks Rand Labs</u>	Cooler seal intact upon receipt Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Additional comments: <u>Samples sent to Brooks Rand Labs, LLC 3958 6th Ave NW Seattle, WA 98107</u>				Received for laboratory by: Print: <u>Katie Jahanmir</u>	Conditions of contents: <u>Excellent</u> <u>No custody seal present</u>
				Sign: <u>[Signature] for KS</u> Date: <u>8/26/11</u> Time: <u>0900</u>	Contents temp. (°C) on delivery: <u>2.6 °C</u>
				Laboratory Project Number: <u>WSU-061101</u>	

CHAIN-OF-CUSTODY RECORD

1135049

Pg 2 of 2

Avian Ecology Lab, 2505 University Circle, Weber State University, Ogden, UT 84408-2505, 801-626-8634 Contact: J. Cavitt

NOTE: USE BLACK INK ONLY TO FILL IN THIS FORM	Analytical Schedules:
Project name: Great Salt Lake Sampling	
Sample Identification Number: Embryos	
Sampler's Name: John Cavitt	

Sample number (Field ID)	Date sampled (DDMMYY)	Time sampled (HHMM)	Lab ID (lab use only)	Sample matrix, (W, water; S, soil; B, Biota)	Number of containers	ASR Form Enclosed
NW-504-11 egg NW	10 06 11			B	1	
NW-700-11 egg NW	28 06 11			B	1	
NW-701-11 egg NW	28 06 11			B	1	
NW-702-11 egg NW	28 06 11			B	1	
NW-703-11 egg NW	28 06 11			B	1	
NW-704-11 egg NW	28 06 11			B	1	

CHAIN-OF-CUSTODY RECORD				SHIPPING DETAILS	
Relinquished by (signature)	Date (DDMMYY)	Time (HHMM)	Received by (signature)	Seal number	Delivered to shipper by:
<i>Marcus Wilson</i>	250811	1451	<i>Marcus Wilson</i>	Method of shipment:	Airbill number:
Zach Hansen	250811	3:30 pm	<i>Zach Hansen</i>	LABORATORY LOG-IN OF SAMPLE SHIPPING CONTAINER	
				Lab: See Page 1	Cooler seal intact upon receipt Yes ___ No ___
Additional comments: Samples sent to Brooks Rand Labs, LLC 3958 6th Ave NW Seattle, WA 98107				Received for laboratory by: Print:	Contents temp. (°C) on delivery:
				Sign:	
Date: _____	Time: _____				