

FINAL REPORT

KENNECOTT National Historic Landmark

SOIL SAMPLING SUPPLEMENTAL SERVICES

Prepared for:



On behalf of:

National Park Service



Prepared by:



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Bratslavsky Consulting Engineers, Inc.
500 W. 27th Ave. Suite A
Anchorage, AK 99503

BACKGROUND

White Environmental Consultants (WEC) was contacted by Bratslavsky Consulting Engineers (BCE) on behalf of the National Park Service (NPS) to perform soil and mercury wipe sampling at Kennecott National Historic Landmark in McCarthy, Alaska. There have been recent NPS employee concerns that health effects such as skin rashes, blisters, metallic taste on lips, swollen lymph nodes, and coughing have occurred after working with soil and wood debris at the Mill Building.

WEC was onsite at Kennecott on July 22, 2015 for sample collection. WEC and BCE were guided by the NPS Maintenance Supervisor in and around the Mill Building. NPS suggested specific locations to collect samples and BCE/WEC concurred. Fifteen wipe samples for mercury were collected from Levels 1-10 and the upper deck of the Mill Building, and 19 samples of soil from various areas in and around the building were collected, at an average depth of 2 inches. Mercury wipe samples were submitted to SGS Galson Laboratories in New York. Soil samples were submitted to Test America Laboratories in Seattle and analyzed for the RCRA 8 Metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver) and antimony. WEC was also asked to collect three samples of asphaltic vapor barrier from the debris pile and have it analyzed for asbestos content. This was performed by White Laboratories in Anchorage.

SAMPLE ANALYSIS

Mercury Wipe Samples

Table 1 – Summary of Mercury Wipe Samples – July 22, 2015

Sample #	Location	Concentration (µg/16 in ²)
413-Hg-1	Level 1 – Helmet donning area – shelf	100
413-Hg-2	Level 2 – East of dorr thickener – surface of crib	40
413-Hg-3	Level 3 – Shaker table – north side	9.7
413-Hg-4	Level 3A – North side of dorr thickener – top of crib	6.4
413-Hg-5	Level 4 – North shaker table – surface	5.2
413-Hg-6	Level 5 – High grade collection box – south	5.9
413-Hg-7	Level 6 – Mill support of south shaker table	5.7
413-Hg-8	Level 6A – Hancock jig cross member	3.1
413-Hg-9	Level 7 – North roller crusher	16
413-Hg-10	Level 8 – East ore tipple	1.1
413-Hg-11	Level 9 – Elevator dump site – south side	4.5
413-Hg-12	Level 10 – South elevator – horizontal support	0.82
413-Hg-13	Upper deck – Casing packing tool	4.0
413-Hg-14	Main ore bin – Wood siding	0.26
413-Hg-15	Base of north jaw crusher foundation	92
	NJ DHHS Guidance	< 1

Analysis of the wipes shows that all samples contained detectable amount of mercury in quantities that ranged from 0.26 – 100 microgram (µg) per area wiped.

There are no current regulations or standards available for acceptable levels of mercury on surfaces. A technique that can be utilized to determine if an area of a facility is considered “clean” is to collect wipe samples from areas of the facility that are not known to have any mercury contamination and use those values as a background or baseline value. The New Jersey Department of Health and Senior Services (NJ DHHS) has published a guidance document titled “Controlling Metallic Mercury Exposure in the Workplace” and states that baseline mercury levels of clean areas they have tested are usually less than 1 µg per 16 in² that are wiped. Using this rationale, only 2 of the 15 locations we sampled would be considered clean.

Soil Samples

Analysis of the soils shows widely variable results for all the metals. Most test locations detected a majority of the 9 metals. The following chart is a listing of each metal, the highest concentration found in the analytical results, location of its highest concentration, and a comparison to its State of Alaska cleanup level (based off of a Direct Contact exposure, in an area that receives over 40 inches of precipitation annually). Most test locations contain at least one metal that exceeds the Alaska clean up levels.

Table 2 – Summary of Soil Results – July 22, 2015

Metal	Sample # / Location of Highest Concentration	Highest Concentration (mg/kg)	AK Cleanup Level (mg/kg)
Antimony	#5 – West side cover over tram- North side	84	33
Arsenic	#8 – Main ore bin	10,000	3.7
Barium	#3 – West end ore bin- South side	260	16,600
Cadmium	#11 – East of Hancock addition	480	65
Chromium	#3 – West end ore bin- South side #16 – Road at Scalehouse	21	250
Lead	#11 – East of Hancock addition	1500	400
Mercury	#8 – Main ore bin	64	25
Selenium	-----	Not Detected	410
Silver	#11 – East of Hancock addition	110	410

In addition, WEC was asked to interpret arsenic, lead, and mercury wipe and air samples collected by NPS employees. The following tables are a listing of these samples, along with the concentration found in each sample and how that compares to regulations or guidelines.

Table 3 – NPS Wipes – Lead, Arsenic, Mercury

Sample #	Date Sampled	Lead Result Total µg	Arsenic Result Total µg	Mercury Result Total µg
MW #1	7/15/15	1370	4080	
MW #2	7/15/15	2060	1230	
MW #3	7/15/15	5140	1820	
MW #4	7/15/15	7180	3900	
MW #5	7/15/15	3260	1040	
MW #6	7/15/15	7710	2040	
MW #7	7/15/15	4690	920	
MW #8	7/15/15	1280	1070	
MW #9	7/15/15	1950	2300	
MW #10	7/15/15	2090	2140	
MW #11	7/15/15	3520	235	
MW #12	7/15/15	41400	184	
MW #13	7/15/15	178	176	
MW #14	7/15/15	84	83.5	
MW #15	7/15/15	51.8	351	
MW #16	7/15/15	88.9	483	
MW #17	7/15/15	1270	129	
MS #18	7/15/15	1320	1460	
MS #19	7/15/15			1.4
MS #20	7/15/15	183	211	
MS #21	7/15/15			21.8
MW #22	7/15/15	992	1550	
ME #23	7/15/15	13.2	29.4	
NW #24	7/15/15	130	45.6	
BP-1	7/30/15	33.2	33.2	
BP-2	7/30/15	76	40.1	
BP-3	7/30/15			0.56
REGULATION or STANDARD		HUD- Window Troughs 400 µg/ft ²	EPA COPC Committee 36 µg/ft ²	NJDHSS < 1 µg/16 in ² < 9 µg/ft ²

Note: Area Wiped = 1ft²

See References section for regulations/standards citations

In residential buildings, lead wipe levels are generally compared to the U.S. Housing and Urban Development (HUD) Clearance levels to determine acceptable levels of lead-containing dust. There are no standards for an acceptable amount of lead in dust for commercial or industrial facilities. The HUD clearance level for window troughs (400 µg/ft²) is listed solely as a benchmark to compare the NPS results against. Of 24 wipe sample collected by NPS, 15 exceeded the HUD clearance level.

Regulations for arsenic in settled dust do not exist. The USEPA's Contaminants of Potential Concern (COPC) Committee of the World Trade Center Indoor Air Task Force Working Group has given guidance on the matter and uses a value of 36 µg/ft² as an acceptable level. Using this guideline, 22 of the 24 wipe samples exceed the value.

NPS collected three wipes and had them analyzed for mercury. It is important to note that the analytical method for mercury wipes calls for using gauze or Mixed Cellulose Ester media, as well as wiping an area of 16 in². Ghost Wipes™ were used for sampling and an area of 1 square foot was sampled. This does not negate the value of the results; however, the concentration reported may not be entirely accurate. Using the NJ DHHS guidance discussed earlier, two of the three samples exceed the given values.

Table 4 – NPS Airs – Lead, Arsenic, Mercury

Sample #	Date Sampled	Lead Results (mg/m ³)	Arsenic Results (mg/m ³)	Mercury Results (mg/m ³)
EBW-01-015	6/25/15	0.005	< 0.00019	
MS-01-015	7/1/15	0.0032	< 0.002	
ML-01-15	6/11/15			< 0.000070
EBW-02-015	7/12/15	0.0026	< 0.00024	
OC-01-015	7/9/15	0.00031	< 0.00024	
MW-02-015	7/16/15	< 0.0013	< 0.001	
EBW-03-015	7/14/15			< 0.000028
OC-02-015	7/9/15			< 0.000049
MW-01-015	7/16/15			< 0.00011
EB-03-015	7/27/15	0.013	< 0.00048	
EB-04-015	7/28/15	0.014	< 0.00025	
ML7-01-015	7/23/15	0.00055	< 0.00022	
ML5-02-015	7/23/15	0.00074	< 0.00025	
CIH-02-015	7/22/15	< 0.002		
REGULATION		OSHA 8 Hour PEL 0.05 mg/m ³	OSHA 8 Hour PEL 0.01 mg/m ³	AKOSH 8 Hour PEL 0.05 mg/m ³

Air monitoring conducted by NPS employees shows no exceedance of any OSHA or Alaska Occupational Safety and Health (AKOSH) regulations for lead, arsenic, or mercury. These values apply to personnel monitoring samples only; they are not applicable for stationary area monitoring samples.

ADDITIONAL INCIDENT INFORMATION

On August 18, 2015, NPS was alerted to the fact that a 12 year old girl that had been on the Mill Building tour experienced itching and rashes on her wrists and arms after handling ore.

DISCUSSION & RECOMMENDATIONS

Determining what has caused skin irritation and other health effects to NPS employees and a guest is an exercise in speculation. An obvious choice is the high concentration of metals in the soil and dust. Many metals can cause skin irritation, rashes, or sensitivity upon contact. Some of these include antimony, arsenic, mercury, and nickel. Although nickel was not tested for, the other three metals listed were found consistently in most soil samples collected.

Beyond metals, there is the possibility that the wood was treated with a highly toxic preservative such as chromated copper arsenate, pentachlorophenol, copper naphthenate, or creosote. Repeated skin contact with arsenicals and chromates can cause redness, itching, swelling, skin rash, and blisters on the hands and forearms. If the wood was treated with a fire retardant, it may have been antimony/bromine/chlorine based; all of which are known to cause skin irritation.

Pesticides and insecticides may have been used at Kennecott in the distant past. The time frame of 1900-1930 saw the use of compounds such as sulfuric acid, copper nitrates, potassium salts, and arsenic/mercury solutions for controlling pests. More recent pesticides include Aldrin, DDT, dieldrin, heptachlor, and dioxin-containing compounds.

Based on the analytical results, WEC feels it is prudent for NPS employees to wear personal protective equipment (PPE) any time they will be disturbing the soil around Kennecott Town or handling any building debris. PPE is discussed in depth in a later section.

Additional sampling is also recommended to determine the scope of chemical hazards that may exist to park employees or visitors. This sampling scheme is discussed in a later section.

The following sections detail procedures and recommendations NPS should follow to ensure its employees and visitors are protected from as many hazards as possible while at Kennecott NHL.

1. VISITOR PROTECTION

Visitors to Kennecott NHL can continue to enjoy the historical aspect and beauty of the area provided they heed the following guidance:

Kennecott Town

- Stay on marked roads and trails.
- Comply with all signage for closed off or restricted areas.

Mill Building Tour

- Keep up with tour guides; no wandering off.
- Stay on the established tour route.
- Keep out of all off-limits areas.

NPS may wish to consider enacting additional rules for visitors to follow. The Mill Building is essentially a museum, and should be treated and respected as such. Standard rules of conduct mandated in various other institutions should be considered for the Mill Building. Rules that would be applicable include:

- All children under the age of 18 must be supervised by a parent or other adult at all times.
- Visitors should avoid open-toed sandals, high-heels, necklaces or other items that can get caught, as well as bags that are too heavy to carry comfortably.
- Shirts and shoes must be worn at all times.
- Guests are prohibited from touching or leaning on any of the exhibits, displays, or contents of the building and must exercise due care when taking close-up photographs of any exhibit or display.
- Visitors are welcome to take pictures for personal use only, with a hand-held camera and electronic flash. "Selfie" sticks are not allowed in the building.
- No eating, drinking, or chewing gum is allowed in the building.
- Running, pushing, and roughhousing are not allowed in the building.

Additionally, tour group size should be kept to a number of guests (as determined by NPS and tour vendor) that allows tour leader to supervise guest actions. Alternatively, consider having 2 tour leaders; one to lead and one to observe and follow after the guests.

2. EMPLOYEE TRAINING, HAZCOM, JOB HAZARD ANALYSIS

All employees should be trained for known site-specific hazards they may encounter. At the present time, this includes, but is not limited to: asbestos, lead, mercury, petroleum contaminated soil, electrical hazards, slipping and falling hazards.

NPS shall ensure that all workers and trades performing work on this site are trained in accordance with OSHA standards for asbestos awareness (29 CFR 1926.1101), lead awareness (29 CFR 1926.62), hazard communication (29 CFR 1910.1200) and respiratory protection (29 CFR 1910.134), as well as engineering controls and work methods required to prevent exposure to regulated air contaminants that might be generated or encountered as a results of their work.

A Job Hazard Analysis (JHA) can be an important tool in a work environment such as Kennecott NHL. This is a technique that focuses on job tasks as a way to identify hazards before they occur. After identifying uncontrolled hazards, steps are taken to eliminate or reduce them to an acceptable risk level. The analysis is also a valuable tool for training new employees in the steps required to perform their jobs safely.

The following is a NPS-provided list of routine tasks performed by employees. A JHA should be prepared for each task.

Table 5 – Work Tasks Performed at Kennecott NHL

Task
Conduct archeological survey and testing of ground around building to mitigate potential impact from building stabilization; locate and manage artifacts.
Construct foundation / footing concrete and pressure treated wood and cribbing. Excavate with backhoe and by hand.
Construct timber retaining wall.
Cut back vegetation against or near building.
Make repairs to painted wood siding, skirt, and trim; re nail.
Realign wood frame walls
Reattach loose corrugated metal roofing
Reconstruct timber retaining wall
Reestablish landscape elements
Remove building debris around perimeter of building
Remove earth in contact with building - Provide drainage around building

Task
Wet scrape painted wood siding; repaint exterior and interior surfaces
Repair existing foundation / footing; wood and concrete
Repair / rebuild / repaint wood windows and doors including removing window casing and wooden molding, removing the window sash, heating the glazing, scraping and removing the softened
Replace roof covering; wood shingles, galvanized metal, rolled asphalt roofing
Roof Repair – Stripping Old Roofing, Installing New Roofing (Rolled, Shingles, Metal)
Re-support foundation posts and sills; install additional bracing, partial excavation
Secure building: Installing locks, hasps, steel screening, and boarding doors
Backhoe/Loader Operation – Excavation, Stripping
Hand Excavation – Foundations
Window and Door Repair – Removal, Repair, Replacement Removal of hinge pins or painted door hinges. Removal of lock hardware, closers, or other hardware accessories from a painted door.
Sanding floor with “stand-behind” power disc sander, scraping floor near corner, clean-up of debris and placing debris in container.
Erect scaffolding on exterior and interior of building
Erect support scaffolding for structural support
HEPA vacuuming interior
Pressure washing exterior walls
Removing exterior and interior wood siding
Removal of nails, screws, picture hangers, or other fasteners, etc. from a painted wall surface.
Jacking and leveling buildings
Repair and replacement of deteriorated wall studs, posts, and truss members
Installing electrical wiring, receptacles, lighting, load centers, meter base, and generators
Installing fiberglass insulation
Maintaining water treatment (filters, chlorination, lines, tanks)
Garbage collection and custodial for visitors
Transporting materials to site
Fueling vehicles and generators
Transporting lead waste from site
Transporting hazardous waste from site (oils, asbestos)
ATV transportation

3. WORKER PROTECTION

The following PPE will be utilized during work at Kennecott that involves contact with soil or wood debris:

- Respiratory Protection – All work will be performed utilizing ½ face negative pressure respirators equipped with HEPA cartridges, until a Negative Exposure Assessment shows respiratory protection may be downgraded.
- Protective Clothing – Disposable coveralls will be worn during each project. Shoe coverings or rubber boots will also be provided. If rubber boots are used these will be left in the work area or decontaminated prior to leaving the work area.
- Skin protection – Disposable or work gloves will be worn at all times.
- Hygiene Facilities:
 - Change area will be established immediately adjacent to the work area. Change areas will typically consist of a separate drop cloth, disposal bags for disposable clothing and a wash station to wash face and hands and to decontaminate respirators.
 - At a minimum a wash station will consist of a 5-gallon bucket with a mild detergent and a 5-gallon bucket of clean rinse water. A separate 5-gallon bucket will be provided for decontaminating respirators.

4. MEDICAL SURVEILLANCE

NPS shall establish a respiratory protection program as required by 29 CFR 1910.134. All workers required to wear a respirator will receive a respiratory physical exam prior to starting the work. Annual medical evaluations and fit tests are also required.

Employees should have their blood levels assessed for metals at the beginning of every work season, and upon the onset of any skin contact response or other health effects similar to those noted recently by NPS employees.

5. ENGINEERING CONTROLS

As it is not currently known what the extent of airborne hazardous constituents are at Kennecott, engineering controls consist of the following measures:

- Outdoor Dust Control: Spray water with a hose or water truck during any excavation activities. Consider the use of a palliative agent to keep dust down on roadways.

- Utilize hand tools as often as possible. The use of mechanical grinders or sanders should be kept to a minimum.
- Negative air machines to minimize airborne particulates should be used when feasible during work inside buildings.
- All vacuums used for cleaning should be equipped with HEPA filters.

6. SITE CONTROL

Before any activities occur within the project site, NPS should deploy temporary barriers surrounding the immediate work area. Appropriate signage will be placed on the temporary barriers indicating the specific hazards. The temporary barriers will delineate the immediate work area from the rest of the project site and provide a first line dust and access barrier. This area should be set up such that there is limited entry and exit points in and out of it. Specific operations may occur within this area that will limit the personnel being allowed entrance into the area based on the work being performed.

7. ADDITIONAL SAMPLING & EXPOSURE ASSESSMENT

WEC recommends a variety of additional testing be performed in order to gauge if a hazard exists to NPS employees and visitors.

Soil Testing

Baseline soil samples should be collected from areas away from the Mill Building and Kennecott Town to determine background concentrations of metals, pesticides, and organic compounds such as pentachlorophenol in the soil. These samples should be analyzed for at least the same nine metals as were previously tested; it would be preferable to complete a more detailed metals profile, such as a 17 metal scan. This will also provide useful information in regards to the use of PPE in areas other than in the vicinity of the Mill Building.

Soil samples from around the Mill Building should be collected and analyzed for pesticides and organic compounds.

Bulk Materials Testing

Samples of wood debris should be analyzed for wood preservatives and pesticides.

Air Testing

Stationary air monitoring should be performed at various areas in Kennecott Town and the samples should be analyzed for at least a 9 metals scan; 17 metals is preferable. This monitoring should be performed for several days and ideally, during times of heavy visitor traffic.

A mercury direct-read meter should be used in and around the Mill Building and any other areas NPS personnel feel may contain elevated areas of mercury. This instrument gives real-time readings of concentrations of mercury in the air.

Air monitoring for organic wood preservatives and pesticides should occur in and around the Mill Building; other buildings can be added if/when NPS anticipates work on or around those buildings.

Mill Building Tour Air Monitoring

Air monitoring should be performed on Mill Building tours or simulated Mill tours utilizing NPS personnel to determine a representative exposure level. Air monitoring during actual Mill tours could be accomplished by having a second tour guide wearing the air pump. A method to dampen the noise of the air pump will be necessary, as it will surely interfere with guests' ability to hear the tour. A suggested way to mitigate the noise is to wrap the pump in foam and place in a small box inside a backpack.

If simulated Mill tours are used for air monitoring, they should consist of a similar number of participants to actual tours, follow the same route, and spend the same amount of time in each part of the building as actual tours. Participants in a simulated tour should, at a minimum, wear long sleeves, long pants, boots, and rubber gloves.

To approximate an exposure level for a tour guide, ideally, a guide would wear the monitor all day, even when not guiding. This would give the most accurate representation of total exposure for a guide's 8 hour day. If this is not feasible, air monitoring should occur for the number of tours a typical guide gives during a routine day.

Air monitoring to simulate visitor exposure can be accomplished by placing a monitor on a NPS employee for one actual or simulated tour of the Mill.

Constituents monitored for during an actual or simulated tour would, at a minimum, consist of the following:

- Metals: antimony, arsenic, cadmium, lead, mercury, nickel.

If bulk testing of soils and wood debris confirms the presence of wood preservatives or pesticides, these constituents should be monitored for also.

Personnel Air Monitoring for Routine Tasks

Air monitoring should be performed for a minimum of 3 shifts for each discrete task that is most likely to disturb soil or wood debris on NPS employees (and subcontractors as needed) doing the work and in the immediate work area. An Initial Exposure Assessment (IEA) for the job task will be obtained from this sampling endeavor. This IEA will serve to determine if the employees' PPE is adequate or if it may be downgraded and to ensure workers are not being exposed above the permissible exposure limits (PEL) established by 29 CFR 1926 and 8 AAC 61.1100. Samples should be analyzed for a 17 metals profile. Soil disturbance activities should also include air monitoring for pesticides.

Initial Exposure Assessment

1. If the IEAs indicate that the work methods employed for each task result in airborne exposures below the various PELs, air monitoring will be reduced. Use of respirators can be made optional to the workers, at the discretion of NPS supervisors. Engineering controls and methods will remain unchanged. If the work requires new methods or new engineering controls, these changes will be re-assessed to accurately measure airborne metals concentrations.
2. If the initial exposure assessments indicate that the work methods cannot consistently maintain airborne metals concentrations below the PELs, the use of all PPE will remain mandatory. Work methods and engineering controls will be reevaluated and modified as needed to control airborne metal concentrations.
3. If it is determined that it is not feasible to complete the work while maintaining airborne concentrations of metals below the various PELs, extensive pre-cleaning of the work areas will be performed by appropriately trained and licensed sub-contractors.

8. CONCLUSION

WEC feels that the sampling effort to date does not contain enough information for a conclusive determination as to why NPS employees and a guest were afflicted with skin irritation and other health effects. WEC-collected data is limited to nine metals in soils and wipes and air monitoring provided by NPS is restricted to three metals. We do not believe the limited sampling performed to date shows an immediate danger to employees provided they wear proper PPE or visitors, provided they stay on the roads, trails, and tour paths already in place, and if they follow the additional recommended requirements. Additional sampling for airborne contaminants would be necessary to attempt to make a definitive conclusion.

Moving forward, WEC recommends the following actions:

- Baseline testing of soil away from Kennecott Town for background levels of metals, pesticides, wood preservatives.
- Additional soil testing around Mill Building for wood preservatives and pesticides.
- Bulk testing of wood debris for preservatives and pesticides.
- Use of a mercury direct-read meter in and around Mill Building and any other areas NPS suspects may contain elevated areas of mercury.
- Air monitoring at areas throughout Kennecott Town for metals.
- Air monitoring in and around Mill Building for wood preservatives and pesticides.
- Air monitoring for employees doing routine tasks that disturb soil or wood debris. Soil disturbance work should include air sampling for metals and pesticides; wood debris disturbance should include air sampling for preservatives and select metals such as antimony and arsenic.
- Ensure workers wear protective coveralls and respirators until an Initial Exposure Assessment determines if PPE may be downgraded.
- Ensure engineering controls are always used.
- Consider the Mill Building a museum and enact standard codes of museum conduct and rules for all visitors to follow on the tour.

9. REFERENCES

New Jersey Department of Health and Senior Services. Controlling Metallic Mercury Exposure in the Workplace. 2004. <http://www.state.nj.us/health/surv/documents/mercemp.pdf>

U.S. Department of Housing and Urban Development (HUD), Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing (2012 Edition) – Chapter 15, Table 15-2. http://portal.hud.gov/hudportal/HUD?src=/program_offices/healthy_homes/lbp/hudguidelines

USEPA's Contaminants of Potential Concern (COPC) Committee of the World Trade Center Indoor Air Task Force Working Group. 2003. World Trade Center Indoor Environment Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks. http://www.epa.gov/wtc/reports/contaminants_of_concern_benchmark_study.pdf