



ENVIRONMENTAL BASELINE STUDIES

PRELIMINARY SUMMARY STUDIES PERFORMED BY SHAW ALASKA, INC. ANALYTICAL QUALITY ASSURANCE/QUALITY CONTROL

Shaw Alaska, Inc. (Shaw), a division of The Shaw Group, provides analytical quality assurance (QA)/quality control (QC) management services. The analytical QA/QC management services for Pebble Project include the following:

- Independent validation of analytical chemistry data.
- Development of data quality objectives.
- Development of quality assurance project plans.
- Development and management of laboratory services.
- Analytical QA/QC program development.
- Auditing of field sampling and laboratory activities.
- Chemistry consultation.
- Analytical methods evaluation and development.
- Chemistry data management from sample collection to database.
- Compliance with analytical regulatory requirements.
- Management of multi-disciplinary studies.

For the Pebble Project, Shaw has developed an innovative quality program to govern chemistry data quality. This quality program was built in at the planning stages of the project in the spring of 2004. The program is assessed through field and laboratory audits and extensive data validation and is apparent in the final product.

1. PROGRAM OBJECTIVES

Shaw's role in the Pebble Project is critical to ensure that field procedures, laboratory analyses, and data deliverables meet technical and quality requirements stipulated by regulatory agencies and Northern Dynasty Mines Inc. (NDM). The primary objective is to ensure that analytical data quality is consistent among consultants collecting samples in the field, meets specified data quality objectives, and is legally defensible.

Shaw is responsible for ensuring that analytical QA/QC requirements are met for the water-quality, trace-elements, and marine-chemistry data for the environmental baseline studies. Shaw reviews all plans and reports related to these studies for the Pebble Project. To ensure a quality product, Shaw also conducts field training and field sampling audits and advises the field sampling teams on collection of representative samples for the environmental baseline studies.

Another large component of the program is management of laboratory services and laboratory data. Shaw receives all laboratory data and performs extensive review and validation of the data. The data are then uploaded into a secure database and made accessible to NDM and consultants through a web-based application that permits viewing and downloading of the chemistry data. The data are managed by electronic means from sample collection through laboratory reporting and database upload. There is no manual entry of chemistry data to Shaw's systems or the final database. This greatly reduces the potential for error in the final product. The data management design and process are crucial for protecting and maintaining the environmental baseline chemistry data for current and long-term use.

2. PROJECT SCOPE

Shaw developed the analytical QA/QC program prior to the initiation of collection of field samples. This program includes extensive field QA/QC tasks related to sample collection. All field sampling plans are reviewed by Shaw to ensure that sampling methods and handling will meet requirements for defensibility of data and permitting. The review also ensures consistency of methods among the many field teams collecting samples from the study areas. The number of parameters (or analytes) tested per sample and the numbers of samples collected is very extensive. Sample collection occurs at least 10 months of the year. In view of the magnitude and need for high-quality data, each field team is audited two times each year, once in the winter and once in the summer.

A summary of the number of field samples collected and parameters analyzed over the last three years is presented in Table 1. A summary of parameters analyzed for each sample type is presented in Table 2.

TABLE 1
Number of Environmental Samples Collected and Parameters Analyzed

Sample Type	Samples Analyzed per Year			Total Samples Analyzed	Total Parameters Analyzed
	2004	2005	2006		
<i>Mine Study Area</i>					
Surface Water Streams	344	504	332	1180	87,320
Surface Water Seeps	23	60	168	83	6,142
Soil	163	115	54	332	11,288
Sediment	85	77	39	201	6,834
Terrestrial Plant Tissue	302	250	192	744	20,832
Aquatic Plant Tissue	0	3	68	71	1,988
Groundwater	35	151	160	346	25,604
<i>Mine Study Area and Lake</i>					
Freshwater Fish Tissue	314	362	50	726	10,164
Freshwater Lake Mussels	0	6	4	10	140
<i>Transportation Corridor and Port</i>					
Surface Water	87	140	4	231	17,094
Groundwater	16	18	0	34	2,516
Sediment	51	63	5	119	4,046
Vegetation	100	0	42	142	3,976
Soil	41	0	8	49	1,666
<i>Marine</i>					
Water	4	0	0	4	296
Sediment	72	9	0	81	2,754
Fish	4	14	0	18	252
Mussels, Bivalves, Crabs, Snails	16	0	0	16	224
Totals	1,657	1,772	958	4,387	203,136

TABLE 2
Summary of Parameters Analyzed for Each Sample Type

Parameter	Surface Water	Ground-water	Surface Soil	Sediment	Vegetation	Fish Tissue	Bivalve Tissue
<i>Inorganics</i>							
pH	X	X					
Specific Conductance	X	X					
Acidity	X	X					
Alkalinity	X	X					
Ammonia	X	X	X	X			
AVS-SEM ¹				X			
Chloride	X	X	X	X			
Cyanide	X	X	X	X	X		
Fluoride	X	X	X	X			
Nitrite and Nitrate	X	X					
Orthophosphate	X	X					
Phosphorus	X	X					
Sulfate	X	X	X	X			
Sulfur				X			
Thiocyanate	X	X					
Total Dissolved Solids	X	X					
Total Suspended Solids	X	X					
<i>Trace Elements</i>							
Mercury	X	X	X	X	X		
Metals ²	X	X	X	X	X	X	X
<i>Organics</i>							
Total Organic Carbon			X				
Fuels			X				

1. AVS-SEM = acid volatile sulfides-simultaneously extracted metals (Cd, Cu, Pb, Hg, Ni, Zn)

2. Al, Sb, As, Ba, Be, Bi, B, Ca, Cd, Co, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Si, Ag, Na, Tl, Sn, V, Zn.
Sb, As, Be, Cd, Cr, Cu, Pb, Hg, Mo, Ni, Se, Ag, Tl, and Zn are planned for fish and bivalve tissue.

3. PROJECT ACCOMPLISHMENTS

Development and implementation of a well-defined field and analytical quality program have resulted in several noteworthy accomplishments for the Pebble Project. The Shaw team has accomplished the following over the course of the last two and a half years on the project.

- Completion of a high-quality database of validated chemistry data for all sample types and parameters presented in the tables above.
- Continuous improvement of field sample-collection methods.

- Continuous improvement of laboratory analytical methods.
- Expert technical direction for field sampling teams and analytical laboratories.
- Archiving of all laboratory reports, data quality assurance reports, and sample documentation.
- Transfer of field data collected by several field teams to the Pebble Project database.
- Real-time sample tracking from collection of samples in the field to laboratory reports.
- Receipt of all samples in the field and delivery to laboratories (four) with excellent sample documentation and custody throughout.
- Provision of a seasoned technical resource for all consultants and NDM staff involved in the water-quality, trace-elements, and marine studies.

All of these accomplishments have been achieved through extensive planning, sound technical procedures, and attention to detail. The objective of generating high-quality, defensible chemistry data that are secure and easily accessible by users has been met and will continue through the life of the Pebble Project.