Pebble Project Environmental Baseline Studies
2004-2008
Technical Summary

APPENDIX A.
Analytical Quality Assurance/Quality Control Review

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ACRONYMS AND ABBREVIATIONS

DQO	data-quality objective
QA	quality assurance
QC	quality control

APPENDIX A. ANALYTICAL QUALITY ASSURANCE/QUALITY CONTROL REVIEW

A.1 Introduction

The analytical quality assurance (QA)/quality control (QC) program was developed to ensure that field procedures, laboratory analyses, and data deliverables for the Pebble Project met technical and quality requirements stipulated by regulatory agencies and the Pebble Partnership. The primary objective of the program is to ensure that the quality of the analytical data is consistent among consultants collecting samples in the field and among laboratories performing the testing and that the data meet specified data-quality objectives (DQOs) and are legally defensible. The program accomplishes this objective by providing sample-collection oversight, laboratory-services management, data verification, data validation, and data management. These services were performed for the data collected from the April 2004 through December 2008 for the surface water quality (including seeps), groundwater quality, trace elements, and marine studies. The study areas for the Pebble Project studies are depicted on Figure 1-4 in Chapter 1 of the technical summary for the environmental baseline studies.

Oversight of sample collection involved reviewing field sampling plans for adherence to industry-accepted standards and the quality assurance project plans, and consistency between sampling teams for select aspects of the sampling process common in similar studies. Compliance to the field sampling plans was monitored through field audits performed at least once each year during the summer and, for studies for which samples were collected in winter, a second time during a winter month.

Oversight continued with receiving samples from the field teams and executing documentation and chain-of-custody protocols for controlled transfer of samples to the laboratories for testing. Post-collection procedures (e.g., filtering water for dissolved metals, dissecting fish), when required, also were monitored for compliance to the field sampling plans.

Management of the laboratories and monitoring of their testing and reporting regimens was also within the purview of the QA/QC program.

A.2 Results and Discussion

The usability of data was assessed by data validation using the key indicators of precision, accuracy, representativeness, comparability, completeness, and sensitivity compared against specified DQOs. Total versus dissolved metals and cation/anion balance also have specific DQOs for surface water and groundwater. Table A-1 explains how each key indicator is assessed and to which studies they apply.

A.2.1 Surface Water Quality

The surface water quality program study includes samples from streams, ponds, and lakes in the mine study area, the transportation-corridor study area, and the Cook Inlet drainages study area, and from Iliamna Lake as well. Overall, the precision for this program was excellent. The most variability was seen in manganese, nickel, silver, thallium, and tin in terms of laboratory testing and field sampling. Improvements for nickel were observed during the 2007 field season. Accuracy controls within the laboratory were stable. Sulfate showed variability in precision and accuracy measurements. Seasonal variations were observed in the sulfate concentrations and should be considered when using the data. Performance-evaluation sample results in 2006 and 2007 showed high biases for a small number of analytes, but these outliers are not considered to be a significant cause for concern in terms of data usability. Improvement was seen in the 2008 performance-evaluation samples with no biases observed. The data set for the surface water quality program was considered representative and comparable. The completeness goal for surface water was met. Sensitivity goals were met for a majority of the data, with sensitivity improving over time and most exceedences being minor and including only a few metals. Comparisons of total versus dissolved metals results that did not meet data-validation criteria largely involved the metals barium, chromium, cobalt, copper, nickel, and zinc. Investigations into the sample procedures and data and a subsequent elevation of laboratory method reporting limits reduced total versus dissolved metals failures. The cation/anion balances for a vast majority of surface water data met the criteria.

The surface water quality program also includes surface water samples from seeps. Excellent precision was demonstrated in the seeps data. Exceptions existed, for example, in the cases of mercury and selenium where a limited number of detections resulted in a limited number of pairs for field duplicates and triplicates. Data assessment for accuracy demonstrated that the accuracy controls were stable within the laboratory. The data set for the seeps program was considered representative and comparable. The completeness goal for seeps was met. Sensitivity goals were met for a majority of the data with exceedences being minor and including only a few metals.

A.2.2 Groundwater

The groundwater quality program includes samples from monitoring wells in the mine study area and from drinking water wells in the transportation-corridor study area.

Data quality indicators reflected a high level of data acceptance and usability. The intra- and inter-laboratory statistics demonstrated variability for alkalinity, chloride, lead, molybdenum, nickel, and sulfate. Concentrations for those parameters should be used with some measure of uncertainty. Laboratory results for sulfate showed seasonal variability. The data set for the groundwater quality program was considered representative and comparable. The completeness goal for groundwater was met. Sensitivity goals were met for a majority of the data, with sensitivity improving over time and most exceedences being minor and including only a few metals. Comparisons of total versus dissolved metals results that did not meet data-validation criteria largely involved lead, molybdenum, and nickel. The raised laboratory reporting limits affecting surface water metals were applied to all terrestrial water quality programs,

including groundwater. The cation/anion balances for a vast majority of groundwater data met the criteria.

A.2.3 Trace Elements

The trace elements study includes sediment, vegetation, soil, fish tissue, and bivalve tissue samples from streams, ponds, and lakes including Iliamna Lake. All study areas are included.

The data quality for sediment, vegetation, soil, fish and bivalve tissue was excellent, as indicated by the assessment of the key data quality indicators. Aluminum and potassium results for sediments and nitrogen results for soils in 2007 may have had a high bias, indicated by the high result reported by the primary lab for the performance-evaluation sample that year. All trace elements data were considered valid as qualified and are acceptable for use.

A.2.4 Marine

The marine program includes samples of marine water, marine sediment, and marine fish and bivalve tissue from Cook Inlet and incorporates water quality and trace elements studies.

The data quality for marine sediment, marine water, and marine tissues was acceptable as indicated by the assessment of the key data quality indicators of precision, accuracy, completeness, and sensitivity; however, marine water data for 2004 from the primary laboratory were considered not representative of ambient concentrations of select metals (arsenic, copper, nickel, and selenium). Marine water data for 2008, all marine sediment data, and all marine tissue data were considered valid as qualified (as applicable) and are acceptable for use.

TABLE A-1
Key Indicators of Data Usability

Key Indicator	Assessed By	Applies To
Precision	Relative standard deviation calculated from results for laboratory control, laboratory duplicate, and field duplicate samples.	All studies
Accuracy	Percent recovery calculated from results for laboratory control and performance evaluation samples.	All studies
Representativeness	Use of field blanks, field duplicates, and laboratory blanks to monitor potential transport contamination and variation in sampling techniques.	All studies
Comparability	Use of field sampling methods and laboratory analytical methods that are comparable and consistent throughout the baseline environmental studies.	All studies
Completeness	The amount of data determined valid divided by the total amount of data acquired.	All studies
Sensitivity	Comparison of laboratory detection and reporting limits to baseline goals established in the quality assurance project plans.	All studies
Total vs. dissolved metals	Comparison of total metals to dissolved metals, specifically drawing attention to situations where the dissolved metal result is greater than the total metal result and whether subsequent qualification is warranted.	Surface water and groundwater
Cation/anion balance	Separately summing the total cations and the total anions and comparing the sums to method criteria.	Surface water and groundwater

Field auditors, along with a seeps sampler and a bear guard.

Fish are dissected following protocols documented in the sampling plan.