



Environment

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Red Dog Mine Facility Audit Waste Management Plan and Reclamation Plan Approval Final

Executive Summary

Permits and authorizations issued by the Alaska Department of Natural Resources (ADNR), Division of Mining, Land, and Water and Alaska Department of Environmental Conservation (ADEC) include requirements for mining operations to conduct periodic environmental audits. Teck Alaska Incorporated (TAK) contracted AECOM Technical Services, Inc. (AECOM) to conduct an audit of their Red Dog Mine operations consistent with requirements established in ADNR's Final Red Dog Mine Reclamation Plan Approval No. F20099958 (RPA) and ADEC's Waste Management Permit (WMP) 0132-BA002. Both permits specify that TAK will conduct third-party, objective, systematic, and documented audit every 5 years starting in 2013.

The audit was conducted on the Red Dog Mine site August 24- 28, 2014. A desktop review of the closure cost estimate documents was completed subsequent to the site visit. Additionally, the audit included a review of files and interviews with agency representatives at ADNR, ADEC and the Alaska Department of Fish and Game (ADF&G).

A draft report was issued to the ADNR, ADEC and TAK in January 2014. The draft report was modified to respond to agency and TAK comments and issued as a final in May 2014. The audit provides a review of TAK's performance under the current permits and approvals and identifies areas for improvement as TAK prepares to update the Red Dog Mine Closure and Reclamation Plan (CRP) and associated closure cost estimates required in 2014. Additionally, the audit was structured to assist ADNR and ADEC in assessing TAK compliance with the existing authorizations and in evaluating whether modifications are necessary for the upcoming permit/authorization renewals.

The audit focused on on-site features and activities within the audit boundary that are directly related to the RPA, WMP, and existing CRP, including the following:

- Tailings Area
- Inert and camp solid waste landfills
- Waste rock stockpiles
- Ore stockpiles
- Main, Aqqaluk, and Qanaiyaq pits
- Groundwater and surface water – water rights, collection, treatment, monitoring systems
- Hazardous chemical storage and containment
- Closure cost estimate/financial responsibility, which includes all costs associated with closure including demolition, reclamation, and post-closure monitoring
- Characterization of acid rock drainage and seepage collection systems
- Reclamation and closure activities for the tailings, waste rock, and mine pits, including disposal to the mine pits as approved

The audit report includes a detailed table presenting the audit criteria, audit observations, findings and recommendations. Each audit observation was assigned to one of the following four categories:

- Positive/In Conformance – indicates the audit record observations were in accordance/compliance/conformance with the audit criteria.

- Improvement Needed – indicates that while the audit record observations are technically in conformance with the audit criteria, improvement in facility, control, action, and/or documentation is suggested.
- Non-conformance – indicates the audit record observations are not in accordance/compliance/conformance with the audit criteria.
- Update 2014 – indicates that the audit record is in conformance with the requirements laid out by the permits in 2009, but significant changes have been made since the approval of the RPA and issuance of the WMP. Attention to updating the aspect tied to the record number in the 2014 permit renewal process is required.
- No Finding – indicates that the document or aspect was not reviewed during this audit and/or there were no auditable conditions.

The audit report includes sections correlating the audit results to the five audit objectives specified in the WMP and RPA and providing recommendations intended to assist in the document update for the 2014 renewal process. The primary conclusions (presented by audit objective) are as follows:

1. Objective: TAK's Compliance with the Approvals, Permits, and Applicable Environmental Laws and Regulations

The auditors found TAK to be generally compliant with the WMP, RPA, permit supporting documents, laws and regulations that were reviewed within the scope and boundary of this audit. This conclusion was supported by the relatively low incidence of permit violations, compliance issues, missed reporting deadlines, and other non-compliance indicators. Exceptions to this general compliance conclusion are listed below:

- Waste rock from the Aqqaluk Pit has been placed either in the Main Waste Stockpile or waste stockpiles forming a berm around a portion of the Main Pit instead of within the Main Pit as described in the CRP May 2009.
- TAK did not develop and submit to ADNR preliminary plans and cost estimates for eventual "out-of-pit" sludge disposal.
- TAK was unable to supply updated landfill development and land use plans required by the WMP.
- TAK was unable to supply information to verify that an oil water separator exists in the shop as required by the WMP.

2. Objective: Controls Provide Reasonable Assurances and Controls are Functioning

Controls evaluated by the audit team were generally functioning as intended and provide reliable compliance with applicable requirements. These controls, however, have been modified from the WMP and the RPA by TAK. Water and waste rock management are the most significant sources of potential environmental concern at the site. Control-related documents need to be updated during the permit renewal process.

3. Objective: Permit Conditions Provide Environmental Protection as Required

Requirements in the current WMP and RPA provide the necessary environmental protections based on operations in effect at the time of drafting and approval of these permits. However, recent changes in mine operations necessitate these permit conditions be re-examined to ensure adequate environmental protection particularly with respect to water management in the Main Pit, storage and segregation of waste rock, and the cover design being tested on the Oxide Stockpile.

4. Objective: Facility Management and Regulatory Oversight Provide Reasonable Assurances

Facility management and regulatory oversight provide reasonable assurances that the facility and controls are functioning as intended. Employees are intimately familiar with the operations and numerous members of the TAK team have worked at the mine for a significant period of time. Their familiarity with the site and institutional knowledge results in a climate that the audit team perceived to be proactive and solution-oriented. The staff and management demonstrate the qualities necessary to provide reasonable assurance that facility controls are functioning as intended.

The State Large Mining Permitting Team consists of representatives of ADNR, ADEC, and ADF&G that are assigned to specific mining projects. The State team assigned to Red Dog meets regularly and, based on the interviews conducted at their respective offices, communicate regularly in regard to the project. Team members are familiar with their own responsibilities as well as those from other divisions/departments which appears to make an effective and efficient approach to achieve the objective on a programmatic and project-specific basis.

5. Objective: Financial Assurance is Adequate

AECOM reviewed the reports and spreadsheets documenting the closure cost calculations. While the audit did not involve a line by line review of every component in the financial assurance calculations the team did determine that the range of items included, and the underlying assumptions were reasonable and sound. The audit identified a number of items that have changed since the last estimate was established. Those items will need to be revisited with the development of the next financial assurance estimate.

List of Acronyms

AACEI	Association for the Advancement of Cost Engineering International
ABA	Acid-base accounting
ABR	ABR Environmental Research and Services
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AECOM	AECOM Technical Services, Inc.
APDES	Alaska Pollutant Discharge Elimination System
ARD	Acid-rock Drainage
BLM	Bureau of Land Management
BOE	Basis of Estimate
COA	Certificate of Approval
COBC	Compliance Order by Consent
CRP	Closure and Reclamation Plan
CY	Cubic Yards
DD	Diversion Ditch
DES	Denison Environmental Services
DMTS	DeLong Mountain Transportation System
EAP	Emergency Action Plan
EMS	Environmental Management System
FDRMP	Fugitive Dust Risk Management Plan
HDPE	High Density Polyethylene
ISO	International Standards Organization
LMPT	Large Mine Permitting Team
MEND	Mine Environmental Neutral Drainage
MS	Microsoft
MWS	Main Waste Rock Stockpile
NANA	NANA Regional Corporation, Inc.
NPDES	National Pollutant Discharge Elimination System
NPR	Neutralizing potential ratio
NPV	Net Present Value
NSPE	National Society of Professional Estimators
OPMP	Office of Project Management and Permitting
OSC	on-site contact

OSM	Office of Surface Mining
PAC	Personnel Accommodations Complex
ppm	parts per million
QAP	Quality Assurance Plan
ReCLAIM	Reclamation Cost Estimating Model
RFP	Request for Proposal
RPA	Reclamation Plan Approval
SD	Supporting Document
SENES	SENES Consultants Ltd.
SOP	Standard Operating Procedure
SRK	SRK Consulting Engineers and Scientists
TAK	Teck Alaska, Incorporated
TCAK	Teck Cominco Alaska, Inc.
TDS	Total Dissolved Solids
TSF	Tailings Storage Facility
TWUP	temporary water use permit
URS	URS Corporation
USD	U.S. dollar
USEPA	U.S. Environmental Protection Agency
WMP	Waste Management Permit
WTP	Water Treatment Plant

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1.0 Introduction

1.1 Regulatory Purpose of Audit

Permits and authorizations issued by the Alaska Department of Natural Resources (ADNR), Division of Mining, Land, and Water and Alaska Department of Environmental Conservation (ADEC) include requirements for mining operations to conduct periodic environmental audits. Teck Alaska Incorporated (TAK) contracted AECOM Technical Services, Inc. (AECOM) to conduct an audit of their Red Dog Mine operations consistent with requirements established in ADNR's Final Red Dog Mine Reclamation Plan Approval No. F20099958 (RPA) and ADEC's Waste Management Permit (WMP) 0132-BA002. Both permits specify that TAK will conduct third-party environmental audits at TAK's expense every 5 years, prior to the renewal of the permits.

1.2 Audit Objectives

The WMP and RPA require an objective, systematic, and documented audit every 5 years starting in 2013. The audit must be timed so that the auditor's visit occurs during the snow-free season, far enough in advance of the deadline for TAK's submittal of an updated Closure and Reclamation Plan (CRP) and associated required cost estimate documentation, so that the results of the audit can be taken into account in the update and permit renewal process.

The audit objectives specified in the WMP and RPA are to verify that:

1. TAK is in compliance with plan approvals, permits, and applicable environmental laws and regulations;
2. TAK's controls provide reasonable assurances that environmental objectives in the current Red Dog Mine CRP, and relevant permits and approvals are being met;
3. TAK's environmental controls are functioning as intended;
4. State permit conditions provide environmental protection as required;
5. Both TAK's facility management and regulatory oversight provide reasonable assurances that the facility and controls are functioning as intended to protect environmental resources; and
6. The financial assurance to ensure reclamation is adequate.

The audit report is intended to review TAK's performance under the current permits and approvals and to identify areas for improvement as TAK prepares to update the Red Dog Mine CRP and associated closure cost estimates as required in 2014.

The audit report also has been structured to assist ADNR and ADEC in assessing TAK compliance with the existing authorizations and in evaluating whether modifications are necessary for upcoming permit/authorization renewals. ADNR also will use the results of the audit in evaluating the adequacy of the financial assurance.

1.3 Audit Scope, Boundary, Exclusions

The universe of permits, authorizations, and supporting documents – including plans, studies, reports, and designs – to be considered in the audit were identified in TAK's Request for Proposal (RFP) (TAK 2013a). The audit was conducted as an objective, systematic and documented review of the conditions and practices related to environmental requirements, environmental management of wastes related to the extraction and beneficiation of ore (e.g., waste rock and tailings), and plans for reclamation, closure, and post-closure care and maintenance of the Red Dog Mine.

The spatial boundary for the audit was the Red Dog Mine facility as shown in the boundary map provided in **Figure 1-1**. This audit boundary is identical to the Solid Waste Permit Boundary provided in Chapter 5.0 of the WMP.

The audit boundary was limited to the exterior operations located on the mining site and did not include the Delong Mountain Transportation System (DMTS) or the port facility.

As specified in the RFP, the audit did not include compliance related to discharge of treated waste water through Outfall 001 covered under the state of Alaska Pollutant Discharge Elimination System (APDES) Permit. However, the audit did include review of the closure cost estimates for long-term operation and maintenance of the wastewater treatment plants in the closure and post-closure period.

The audit primarily reviewed closure-related activities, reports and documents that have been created since the approval of the RPA and issuance of the WMP, both dated December 2, 2009. The Red Dog Mine Closure and Reclamation Plan May 2009 (SRK Consulting Engineers and Scientists [SRK] 2009), including supporting documents (SDs) (2009 CRP), are incorporated by reference in both the RPA and WMP and, therefore, was a significant document reviewed by the audit team.

The audit focused on on-site features and activities within the audit boundary that are directly related to the RPA, WMP, and 2009 CRP, including the following listed in the RFP:

- Tailings Area
- Inert and camp solid waste landfills
- Waste rock stockpiles
- Ore stockpiles
- Main, Aqqaluk, and Qanaiyaq pits
- Groundwater and surface water – water rights, collection, treatment, monitoring systems
- Hazardous chemical storage and containment
- Closure cost estimate/financial responsibility, which includes all costs associated with closure including demolition, reclamation, and post-closure monitoring
- Characterization of acid rock drainage and seepage collection systems
- Reclamation and closure activities for the tailings, waste rock, and mine pits, including disposal to the mine pits as approved

1.4 Agency File Review

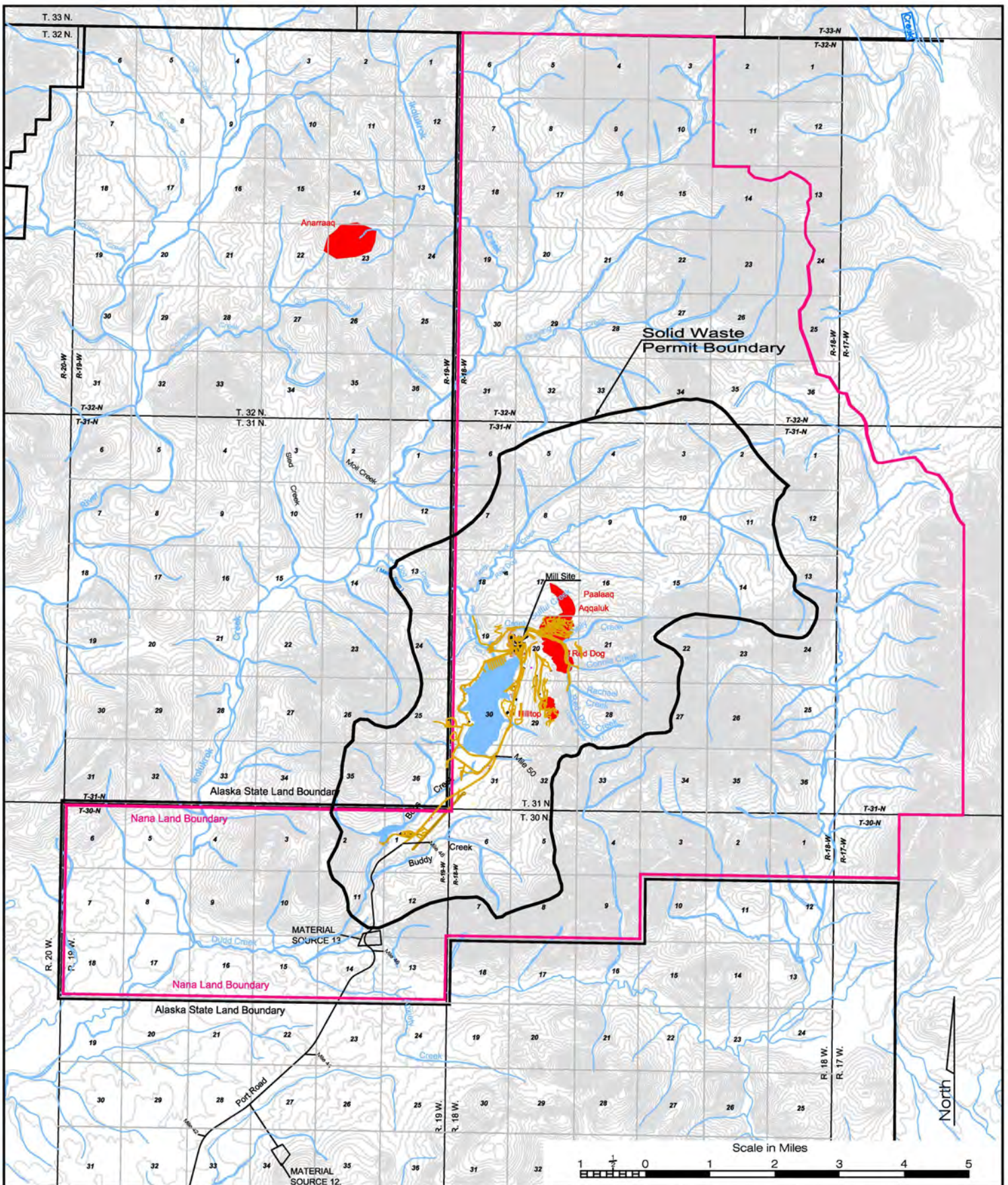
As specified in the RFP, the audit included reviewing files and records at the following State of Alaska agencies, and discussing the departments' respective approaches to assessing Red Dog's compliance with State regulations, permits and authorizations:

- Department of Natural Resources
- Department of Environmental Conservation
- Department of Fish and Game

1.5 Limitations of the Audit

AECOM developed the audit work plan in coordination with TAK to provide the environmental audit required during the 5-year permit term of the RPA and WMP. The audit targeted the overall level of detail needed for TAK, ADEC, and ADNR to effectively begin reviewing and updating approvals and permits

during the renewal of both the WMP and the RPA in 2014. The audit focused on determining the overall effectiveness of the various permits and supporting documents in achieving the six objectives identified above, rather than assessing each potential compliance point line by line. The audit is not intended to be all-inclusive and did not provide for such tasks as detailed engineering assessment of operations or engineering of facilities, data validation, or thorough review of aspects of the monitoring plans, permits, and authorizations that applied to future or closure requirements.



Red Dog Mine Solid Waste Permit Boundary Figure 1-1			Drawn By: SOH	Design Date:	Department	Reviewed By	Date
			Checked By:	Check date:	Mine Engineering		
Revision: 0					Mine Operations		
					Survey		
Scale: 1" = 2 Miles			MWO/Job No:		Geology		
Approved by:					Date: 01/014/04		

2.0 Audit Approach and Methodology

AECOM conducted the audit using an evidence-based approach based on the RFP (TAK 2013a) and description of the audit requirement in the RPA and WPA. The audit carried out the following steps:

- Audit initiation – refining the audit logistics, team, criteria, and definitions
- Document review
- On-site audit activities – Red Dog Mine facility records examination, interviews of selected key personnel; field inspection of the facilities, operations and processes and State of Alaska agency office consultations (interviews and file review)
- Desktop review of the closure cost estimate documents
- State of Alaska file review and consultation
- Audit report preparation

2.1 Audit Initiation

2.1.1 Kick-off Meeting

AECOM held an initial project kick-off session between the AECOM and TAK project managers via teleconference. During this session, the audit scope and audit program expectations were confirmed along with the logistics for the site; the logistics for the state agency office visits were discussed in a separate teleconference with the ADNR Office of Project Management and Permitting lead. Before the kick-off meeting, AECOM identified documents to review for the audit based on professional judgment and experience on prior audits, documents cited in the TAK RFP, and documents available on agency websites. Developing a list of additional documents needed for review and TAK staff to interview during the site visit was a key outcome of the project kickoff session.

2.1.2 AECOM Audit Team

The AECOM audit team consisted of technical specialists with mine waste, mine closure planning, water management, environmental management systems (EMSs), and financial assurance experience. The audit team was composed of senior-level environmental professionals with 20 or more years of experience in their area of technical expertise.

The AECOM audit team members were each assigned specific aspects of the audit commensurate with their experience along with the corresponding permits/authorizations/reports to evaluate for compliance as indicated in **Table 2-1**. These audit assignments assured that all aspects within the scope of the audit were addressed. Due to the senior level of the team members, many members had extensive expertise and experience in areas not specifically assigned to them. The audit team worked in a collaborative manner throughout the process. In many cases, team members not necessarily assigned to a specific area provided significant contributions to the observations and findings outside their assignments.

Table 2-1 AECOM Audit Team Members

Name	Audit Role Description	Site Audit	Agency File Audit	Closure Cost Estimating
Gene Weglinski, Senior Project Manager	Audit project manager, prior experience with the Red Dog Mine facilities, environmental management system, and permits	X	X	X
Jean Decker, CPEA, Senior Project Manger	Lead Auditor, Certified Professional Environmental Auditor	X		
Evelyn Bingham Senior Project Manager	Mine closure planning specialist	X		X
Douglas Yadon, P.E. Senior Geotechnical Engineer	Geotechnical engineer with extensive experience with dam construction and operations, and a familiarity with waste and tailings management	X		
John Claypool, Senior Associate	Cost engineer experienced in estimating costs for mine closure and financial assurance was tasked with evaluating the financial assurance aspects of mine reclamation and closure			X
Robert Berry, PhD, PG, Senior Scientist	Geochemist/hydro-geologist with experience in acid-rock drainage (ARD) assessment, mine water quality and pit lake modeling, focused on geochemical and hydrogeological aspects of the waste management plan and Closure Plan	X		
Brian Kelly, Project Manager	Audit and focused his review on waste management and general environmental compliance	X		

2.1.3 Audit Terminology

2.1.3.1 Audit Criteria

Audit criteria are the basis for determining whether site conditions, including designs, reports, processes and/or activities are being conducted in conformance with the various permits and authorizations. The audit team drafted audit criteria for each specific requirement, stipulation, and condition identified in the documents listed in **Table 2-2**. Audit criteria included compliance with policies, procedures, and legal requirements; adequacy and effectiveness of TAK controls; and/or efficiency and effectiveness of administration as required.

Chapter 4.0 presents the criteria for each of the selected audit record numbers in Section 4.1, **Table 4-1**, by citing the approval/permit that serves as the source of the entry. Additionally, Section 4.1, **Table 4-1**, provides a synopsis of the requirements used as criteria for the audit assessment for reference.

2.1.3.2 Audit Observation and Audit Record Number

Audit observation refers to an item or items of evidence found during an audit related to the compliance status of the product, process, or system. Observations may or may not require corrective action. Audit observations were made visiting the site and observing field conditions, reviewing documents, and/or interviewing TAK or agency staff. Significant or key audit observations were given an audit record number and are presented in Section 4.1, **Table 4-1**.

2.1.3.3 Finding

The team developed audit findings by comparing observations collected during the on-site audit to the audit criteria, and then evaluating whether those observations suggested TAK was in compliance or out of compliance with the audit criteria. Each audit record and its associated audit observation were assessed and assigned a finding category and presented in Section 4.1, **Table 4-1**. For the purposes of this audit, findings are confined to the following four categories:

- Positive/In Conformance – indicates the audit record observations were in accordance/compliance/conformance with the audit criteria.
- Improvement Needed – indicates that while the audit record observations are technically in conformance with the audit criteria, improvement in facility, control, action, and/or documentation is suggested.
- Non-conformance – indicates the audit record observations are not in accordance/compliance/conformance with the audit criteria.
- Update 2014 – indicates that the audit record is in conformance with the requirements laid out by the permits in 2009, but significant changes have been made since the approval of the RPA and issuance of the WMP . Attention to updating the aspect tied to the record number in the 2014 permit renewal process is required.
- No Finding – indicates that the document or aspect was not reviewed during this audit and/or there were no auditable conditions.

2.1.3.4 Recommendation

The audit team also developed recommendations based on their observations. The recommendations were included in this report with the intent of identifying aspects of the permits/authorizations and site activities that could assist TAK, ADNR and ADEC in the 2014 permit renewal process. Recommendations are presented in Section 4.1, **Table 4-1**.

2.2 Document Review

The State's project website (<http://dnr.alaska.gov/mlw/mining/largemine/reddog/>) combined with documents provided by TAK served as the primary sources for the document review process. During the initial review of documents, audit team members were assigned entire documents and/or specific portions of individual documents relevant to their specific expertise. Team members used the review process to identify audit criteria, which were captured in spreadsheets corresponding to the individual documents. Prior to the site visit, team members also used the review process to determine which additional documents would need to be checked during on-site activities. TAK was contacted periodically through the audit preparation/document review process to locate additional documents and asked to either provide them electronically or make them available for on-site audit review.

Table 2-2 provides a list of the permit, authorizations, and SDs reviewed during the audit process. The table provides the abbreviation used to reference the individual document in Section 4.1, **Table 4-1**, and any relevant notes about the documents.

Additional documents reviewed during the audit obtained directly from TAK, such as agency reports, memos, e-mails, and TAK studies, are cited as applicable and included in Chapter 7.0, References, of this report.

2.3 On-site Audit Activities – Red Dog Mine Facility Tour and Interviews with Key Staff

AECOM's audit team arrived at the Red Dog Mine on August 24, 2013, and conducted on-site audit activities from August 25, 2013, through the morning of August 28, 2013. The audit team departed the site on in the afternoon of August 28, 2013.

Upon arrival at the mine facility, the audit team underwent a safety orientation facilitated by the audit team's on-site contact (OSC), Chris Menefee, Environmental Coordinator. TAK provided some of the documents that AECOM had requested previously at this time.

On the morning of August 25, AECOM and the OSC conducted a kick-off meeting prior to initiating the audit. The kick-off meeting attendees are noted in **Table 2-3**. This meeting was used as an introduction to site management and as a forum for the OSC and AECOM to describe the audit process to on-site staff who would be affected by the audit in some way. The TAK representatives present were from various departments on site. An interactive discussion of the audit objectives and process occurred with attendees. Tentative schedules for interviews were set up.

Following the kick-off meeting the OSC and the AECOM team initiated the on-site records examination which augmented the document reviews undertaken during the pre-site audit work. The audit team collected additional documents that included applicable quarterly and annual reports, the current mine plan, environmental procedures and reports. The OSC demonstrated the Red Dog Mine's SiteLine EMS (SiteLine EMS) report and compliance tracking software for the audit team. The SiteLine EMS was the primary tool for retrieving reports and reviewing TAK compliance activities discussed in Section 4.2.7 of this report.

A combination of site tours of facilities and interviews with TAK staff was initiated in the afternoon of August 25 and continued through the morning of August 28. The OSC coordinated interviews and accompanied AECOM audit team personnel for most interviews. **Table 2-3** provides a list of the TAK interviewees with supporting information.

The OSC transported AECOM audit team members around the site for field inspections during the August 25-August 28 on-site audit. AECOM audit team members observed site conditions and operational activities at facilities within the audit boundary described in Section 1.3.1 above. **Appendix 1** provides a log of selected photographs from the site visit.

Prior to departing the mine site in the late morning of August 28, AECOM and the OSC conducted a close-out meeting to discuss the results of the audit with TAK staff. Participants in the close-out meeting are noted in **Table 2-3**. AECOM presented a discussion of observations to date. Some initial findings were discussed, however, AECOM auditors made it clear that the findings were preliminary at the time of the close-out meeting because the visit with agencies, review of the closure cost estimate and document review were incomplete.

Table 2-2 List of Primary Permit /Authorizations/Supplemental Documents Included in Audit Document Review

Document Title	Document Abbreviation in Section 4.1, Table 4-1	Notes
ADNR Certificates of Approvals (COAs) to Operate a Dam (4 certificates)	ADNR -Dam Permits (4)	The dam safety program administered by ADNR and implemented at the Red Dog Mine is structured to ensure that the design, construction, and operation of dams at the site are safe from uncontrolled release of their impounded water or tailings up to design loadings based on the hazard classification of the dam. The hazard classification system provides for protection of both downstream populations and property, and also is protective of the downstream environment. Four dams on site operate under the ADNR COA as discussed in Section 4.2.5 of this report. The audit included review of two <i>Certificates of Approval to Modify a Dam</i> (for the Main and Back Dam raises) and the <i>Certificate of Approval to Repair a Dam</i> (for the Main Dam seepage collection system repair).
ADNR Materials Sales Contracts	Materials Sales	ADNR establishes requirements for the removal of sand and gravel from state lands.
ADEC, Alaska Department of Fish and Game (ADF&G), ADNR file check (performed after site audit)	Agency File Check	Identified in the RFP. Review of agency files was conducted as a parallel activity to the site audit.
Red Dog Closure and Reclamation Plan 2009	CRP May 2009	The Red Dog Mine Closure and Reclamation Plan, includes appendices and supporting documents a subset of which are included as SDs in the RPA and WMP.
Reclamation Plan Approval - ADNR	RPA	ADNR reviewed TAK's closure and reclamation plan for compliance with Alaska reclamation and lands statutes; the RPA documents ADNR's approval of the plan and identifies general and project-specific stipulations.
Waste Management Permit - ADEC	WMP	A major audit objective entailed a detailed review of Red Dog Mine operations in regard to specific requirements of the WMP.
Fugitive Dust Risk Management Plan (FDRMP)	FDRMP	Fugitive dust concerns have been identified at various points through the life of the operation and most recently in the early 2000s. The DMTS Fugitive Dust Risk Assessment (Exponent 2007) assessed risks to human and ecological receptors from metals in soil, water, sediment, plants, and animals in the area surrounding the air/solid waste permit boundary and the DMTS.

Table 2-2 List of Primary Permit /Authorizations/Supplemental Documents Included in Audit Document Review

Document Title	Document Abbreviation in Section 4.1, Table 4-1	Notes
Closure Workshops	SD A1 CIs Workshops	SD A1 documents are listed in the 2009 CRP, but are not officially listed as part of the RPA or WMP. However, a PowerPoint presentation summarizing the results of the workshops was reviewed as background for stakeholder input to the closure plan.
Legal Description of Property	SD A2 Legal Desc	A legal description for the geographical boundary was provided in the 2009 CRP SD A2.
Red Dog Mine Development Plan (Teck Cominco Alaska, Inc. [TCAK] 2004)	SD B1 Mine Dev Plan	The Red Dog Mine Development Plan was written in 2004 and presents a view of the mine plan and site knowledge available during 2003-2004. It provides an overview of known mineral deposits and ARD modeling applicable at the time.
Plan of Operations for Waste Rock Management	SD B2 WR Manage	The Plan of Operations for Waste Rock Management summarizes the commitments made by TAK regarding waste rock in the 2009 CRP. The document groups requirements under the following categories: 1) Stockpile Construction Plan, 2) Stockpile Progressive Reclamation Plan, and 3) Stockpile Classification and Segregation. Commitments are incorporated by reference in the RPA.
Plan of Operations for Tailings and Water Management	SD B3 Tails Water	The Plan of Operations for Tailings and Water Management summarizes the commitments made regarding tailings and water management in the 2009 Closure and Reclamation Plan and provides further details for each of these commitments.
Main Waste Rock Stockpile (MWS) Stability Assessments	SD C1 MWS Stability	Geotechnical reports summarizing work completed through 2005. Reviewed in preparation for the audit but no audit criteria identified.
Drawings from Updated Geotechnical Report (URS Corporation [URS] 2008a)	SD C2 Geotech Drawings	Geotechnical design drawings supporting Stage VIII dam raise and closure. Reviewed in preparation for the audit but no audit criteria identified.
Dam History Report, Red Dog Tailings Main Dam, Future Raises to closure (URS 2007a)	SD C3 Main Dam History	Geotechnical report submitted to support seepage, stability and conceptual designs of future dam raises to closure. Reviewed in preparation for the audit but no audit criteria identified.

Table 2-2 List of Primary Permit /Authorizations/Supplemental Documents Included in Audit Document Review

Document Title	Document Abbreviation in Section 4.1, Table 4-1	Notes
Preliminary Conceptual Design Report, Red Dog Tailings Main Dam, Future Raises to Closure (URS 2007b)	SD C4 Main Dam Raise	Geotechnical design report submitted to support future dam raises to closure (986-foot elevation). Reviewed in preparation for the audit but no audit criteria identified.
Stability Analysis for Future Raises to Closure, Tailings Main Dam, Future Raises to Closure (URS 2007c)	SD C5 Main Dam Stability	Geotechnical stability analyses for dam raises through a final crest height of 986 feet. Reviewed in preparation for the audit but no audit criteria identified.
Seepage Analysis Report, Red Dog Tailings Main Dam, Future Raises to Closure (URS 2007d)	SD C6 Main Dam Seepage	Seepage analysis for dam raises through a final crest height of 986 feet. Reviewed in preparation for the audit but no audit criteria identified.
Drawing from Back Dam Investigation and Design (Golder Associates 2006)	SD C7 Back Dam	Geotechnical drawings in support of slurry wall installation under the Back Dam. Reviewed in preparation for the audit but no audit criteria identified.
Preliminary Spillway Design, Red Dog Tailings Main Dam, Ultimate Closure Configuration (URS 2008b)	SD C8 Spillway	Geotechnical design report for the design of the Main Dam spillway at closure. Reviewed in preparation for the audit but no audit criteria identified.
Consolidation of Studies on Geochemical Characterization of Waste Rock and Tailings	SD D1 Studies Geochem	SD D1 provides a consolidation of studies on the Geochemical characterization of ore and waste rock that was based on static acid-based accounting (ABA) and kinetic humidity cells tests.
Supporting Geochemical Review and Interpretation	SD D2 Geochem Supporting	Appendix D2 represents a supplemental report produced by SRK in 2006 in which the existing database was evaluated for possible geochemical trends in the waste rock seepage including potential long-term trends based on expected geochemical processes operating in the waste rock piles and in the Main Pit. The report relates field data patterns to patterns seen in kinetic humidity cell tests.

Table 2-2 List of Primary Permit /Authorizations/Supplemental Documents Included in Audit Document Review

Document Title	Document Abbreviation in Section 4.1, Table 4-1	Notes
Aqqaluk Geochemistry - Supplemental Testing Program	SD D3 Aqqaluk Geochem	In 2007, SRK completed a supplemental evaluation of the static ABA characteristics of over 1,000 drill core samples from the Aqqaluk deposit to determine if the ARD potential of the main rock types was significantly different from those found in the Main Red Dog deposit being mined in the Main Pit.
Lime Requirements and Predicted Geochemical Changes	SD D4 Lime Geochem	SRK developed an equation to estimate the change in lime demand for water treatment as waste rock seepage chemistry begins to change from primarily a sphalerite oxidation process to a pyrite oxidation process. The change from sphalerite oxidation to pyrite oxidation is due to the galvanic interaction of sphalerite and pyrite; as well as, the consumption of sphalerite.
Red Dog Water and Load Balance	SD E1 Water Balance	The water and load balance model of SRK (2007) in SD E1 was completed using a Microsoft Excel workbook based on data available up to 2006. The SRK modelers assumed that water quality from various sources would not change into the future.
Flood Frequency Update for Middle Fork Red Dog Creek (2002)	SD E2 Flood Middle RDC	The Flood Frequency Update is a modeling report based on stream data collected between 1988 and 2002 to estimate flows in Middle Fork Red Dog Creek, the portion of the creek that passes through the active mining area.
Red Dog Creek Rediversion Design Criteria and Plan (2004)	SD E3 RDC Div Plan	Chanel design considerations to allow Red Dog Creek to bypass the active mining area (Main Pit). Includes an as built discussion of the Red Dog Creek Rediversion.
Assessment of Water Treatment Methods Applicable for Closure	SD E4 Closure WT Meth	The Assessment of Water Treatment Methods for Closure provides a review of water treatment methods and was prepared in 2004 by SENES Consultants Ltd. (SENES). In the assessment, SENES concluded that the addition of lime is the preferred method of water treatment for the Red Dog Mine site both during operations and upon closure.
Assessment of Methods for Managing Post-closure Water Treatment Sludge	SD E5 WT Sludge Post Cls	Report provides an estimate of sludge production and addresses management issues associated with sludge produced while conducting long-term water treatment.
Mine Area closure Options - Summary of the Cover Studies	SD F1 Sum Cls Options	Documentation of a variety of options for consideration in developing designs for the permanent closure of the facility including simple and complex soil covers and geosynthetic covers. Includes results of a field test program.

Table 2-2 List of Primary Permit /Authorizations/Supplemental Documents Included in Audit Document Review

Document Title	Document Abbreviation in Section 4.1, Table 4-1	Notes
Evaluation of Borrow Sources	SD F2 Eval Borrow	Geologic assessment of availability of various materials that may be suitable for cover material at final reclamation.
Revegetation Plan for the Red Dog Mine (ABR Environmental Research and Services [ABR] 2007)	SD F3 Reveg Plan 2007	Assessment of the areas requiring closure/revegetation; available plant growth materials available on site, plant materials potentially available and summary of revegetation studies/research conducted to date.
Demolition Cost Estimates (Denison Environmental Services [DES] 2004)	SD G Demo Cost 2004	Inventory of the structures and facilities that will need to be demolished at closure; assessment of disposal options and spreadsheets of costs associated with itemized list of components/buildings.
Evaluation of Ecological Risk within the Ambient Air/Solid Waste Permit Boundary (Exponent 2008)	SD H Eco Risks 2008	"Risk evaluation" for mine site and DMTS related to fugitive dust with elevated metals concentrations. Report includes problem formulation (conceptual site model), exposure characterizations, toxicity assessments and risk characterizations
Waste Management, Reclamation and Closure Monitoring Plan	SD I Monitor Plan	Monitoring in SD I Waste Management, Reclamation and Closure Monitoring Plan dated May 2009 is adopted by the WRMP and RPA. Monitoring related to the WMP and RPA is done in accordance with SD I.
Quality Assurance Plan (QAP) for Mine Water Monitoring	SD I2 Water QAP	The QAP is the quality assurance and quality control plan for the Red Dog Mine NPDES AK-003865-2 dated January 2009 (Revision 4). It addresses all sampling associated with the NPDES permit in accordance with SD I2. The NPDES permit is outside the scope of the audit.
Methods for Aquatic Life Monitoring	SD I3 Aquatic Life Mon	The document was drafted by the ADF&G to support the 1998 NPDES permit. The NPDES permit is outside the scope of the audit.
Assay Lab Quality Assurance Standard Operating Procedure (SOP)	SD I4 Assay Lab QA SOP	Provides the procedures to save quality control data generated in the routine analysis of the mine, mill and geology samples.

Table 2-2 List of Primary Permit /Authorizations/Supplemental Documents Included in Audit Document Review

Document Title	Document Abbreviation in Section 4.1, Table 4-1	Notes
Closure Cost Estimates J1-Closure, J2-Post-Closure, J3-Suspension Costs	SD J Cost Estimates	SD J is comprised of three documents. SD J1 provides details on the estimate of closure costs for planned closure and premature closure scenarios. SD J2 provides details on the estimates of the long-term average annual post-closure costs for planned closure and premature closure scenarios. SD J3 provides details on estimates on the cost of suspension of mining during a hypothetical 5-year period after mining and milling cease unexpectedly, but before closure is implemented. SD J documents were reviewed as a desktop exercise following completion of the site audit as described in Section 4.3.
Red Dog Creek Fish Weir Construction and Maintenance (WMP-App A)	SEP - FishWeir	The Supplemental Environmental Project included as part of a Consent Decree with the U.S. Environmental Protection Agency required that TAK install a fish weir in Middle Fork Red Dog Creek to exclude fish from the location of the permitted wastewater outfall. A monitoring requirement ensures that TAK maintains the integrity of the "fish protection barrier."
Long-term Permafrost and Groundwater Monitoring Program (WMP-App A)	SEP-Permafrost	The Long-Term Permafrost and Groundwater Monitoring Program resulted from the Groundwater Monitoring Supplemental Environmental Project included as part of a Consent Decree between Cominco and the U.S. Environmental Protection Agency. The program was put in place to monitor potential effects of the tailings impoundment on groundwater and permafrost. The program is intended to demonstrate that the documented "no flow" groundwater system remains in place and therefore demonstrating that a seepage pathway between the tailings impoundment and groundwater does not exist.
Water Use Permits	Water Use	Water use permits and authorizations issued by the ADNR Water Resources Section for withdrawal, diversion, or impoundment of water for domestic, sanitary, and industrial uses.

Table 2-3 TAK Personnel Contacted During Audit

TAK Representative	TAK Role	Audit Participation	AECOM Contact
Wayne Hall	Stakeholder affairs, HR	KO and Closing meetings, interview August 27	Team, Interview: GW, JD, EB
Chris Menefee	Environmental Coordinator	Primary OSC, Kick-off and Closing meetings, interviews throughout the week	Team
Robert Napier	Environmental Coordinator	Closing meeting and interviews throughout the week	Team
Jeffery Clark	Environmental Superintendent	Kick-off and Closing meetings, interviews throughout the week	Team
Todd Smith	Mill Superintendent	Kick-off and Closing meetings	Team
John Egan	Operations Manager	Kick-off meeting	Team
Joe Diehl	Environmental Coordinator	Kick-off meeting; tour lead maintenance shop/landfill/hazmat facilities	Team
Tom Farr	Mine Operations General Foreman	Closing meeting	Team
Ted Garzarlic	Loss Control, historical	Kick-off meeting	Team
Dr. Hui Li	Mine Engineering, Long Term Mine Plan	Interview August 27	EB, BB, JD
Chad Novotny	Engineer	Wastewater treatment / GoldSim	JD
Peter	Mill	Reagent Use	JD, GW
Tom Danielson	Mine	Kick-off meeting	Team
Sonya Adams	Geology Technician, Geology, Short-term Mine Plan, grade control	Interview August 27	EB, BB
Travis Riley	Geology, Short-term Mine Plan, grade control	Interview August 27	EB, BB
Francis "Frankie" Pillifant	Geologist, Short-term Mine Plan, grade control	Interview August 27	EB, BB

2.4 Desktop Closure Cost Estimate Review

The closure cost and related financial assurance/bond review portion of the Red Dog Waste Management audit was performed after the August 2013 on-site audit. The AECOM audit team desktop review included the following:

- Review of the 2009 CRP and key SDs to develop an understanding of the RFP and exclusions, construction means and methods, assumed schedule, and key assumptions that affect the estimated costs.
- A detailed review of the 2009 CRP SD G Demolition Cost Estimates
- A detailed review of the cost estimates for closure, post-closure, and suspension provided in 2009 CRP SD J1, J2, and J3 including:
 - Obtaining and reviewing the cost estimates in their native Excel workbook formats to check estimating logic and mathematical formulas
 - Evaluation of cost estimates against relevant standards and best practices for cost estimating. In particular, Recommended Practices published by ACE International (ACEI)¹ and the National Society of Professional Estimators (NSPE) were used as benchmarks for evaluating the cost estimating methodology. Standards of practice relevant to the cost estimates for the Red Dog Mine are cited in the findings section of this report.
- Review of the Mine Closure and Reclamation Cost Estimation Guidelines issued by the ADNR and the ADEC (Draft dated November 3, 2009). The estimates presented in SD G, J1, J2, and J3 were checked against the state's guidelines to evaluate conformity with the guidelines.
- Review of the bond amount calculations performed by the State of Alaska and a supporting memorandum from Pamela Green, State Comptroller, Alaska Department of Revenue Treasury Division to Rick Frederickson, Natural Resource Manager re: recommended real rate of return for Red Dog Mine Funds (June 9, 2009).

2.5 State of Alaska Consultations

Gene Weglinski met with ADNR, ADEC, and ADF&G representatives in Fairbanks, Alaska, on September 15-16, 2013, to review files and records and discuss the departments' respective approaches to assessing Red Dog's compliance with ADEC and ADNR regulations, permits and authorizations. A meeting in Anchorage between AECOM and the State Dam Safety Engineer occurred on October 9, 2013.

Table 2-4 shows employees who participated in interviews related to the operations of the Red Dog Mine.

2.6 Audit Report Preparation

The audit team prepared the audit report by consolidating their audit criteria, findings, and observations. The summary results are presented in Section 4.1, **Table 4-1**. Points that team members determined warranted additional discussion are presented Section 4.2, Audit Supporting Notes and Comments. The conclusions relate selected observations and findings to the six objectives identified in the RFP. Finally, recommendations are included where audit team members identified items that TAK may want to consider as they move forward with the permit renewal process.

¹ ACEI previously was known as the Association for the Advancement of Cost Engineering.

A draft report was issued to the ADNR, ADEC and TAK in January 2014. Agency comments were received on March 12, 2014 and TAK provided comments on May 2, 2014. The draft report was modified to respond to comments and issued as a final in May 2014. **Appendix 2** presents consolidated agency comments and records how the comments were addressed in the final report. **Appendix 3** presents the comment and response table for comments received from TAK.

Table 2-4 State Personnel and Offices Visited During Audit

Department	Division	Name and Position Title	Office Location
Natural Resources	Mining, Land, and Water	Brent Martellaro, Geologist	Fairbanks
		Stephanie Lovell, Geologist	Fairbanks
		Carolyn Curley, Geologist	Fairbanks
		Kindra Geis, Natural Resources Specialist	Fairbanks
		Jenny Wynne, Natural Resources Specialist	Fairbanks
		Charles Cobb, Dam Safety Engineer	Anchorage
Environmental Conservation	Water Quality, Wastewater Discharge Authorizations Program	Tim Pilon, Engineer II	Fairbanks
		William (Pete) McGee, Engineer II	Fairbanks
Fish and Game	Habitat	Al Ott, Operations Manager	Fairbanks

3.0 Audit Setting

The following description of facilities is based on descriptions presented in the Plan of Operations, which includes SD B3 Plan of Operations for Tailings and Water Management, SD B2 Plan of Operations for Waste Rock Management, and SD B1 Mine Development Plan. These descriptions are based on the facilities as they existed (or were proposed) when the documents were drafted and may not reflect the current configurations. Where updated information is included, specific citations are provided.

3.1 Description of Audited Facilities and Operations

The Red Dog Mine is an open pit zinc/lead mine located in northwestern Alaska, approximately 82 miles north of Kotzebue, and 46 miles inland from the coast of the Chukchi Sea. The mine is located on the Middle Fork of Red Dog Creek in the DeLong Mountains of the western Brooks Range, on private land owned by NANA Regional Corporation, Inc. (NANA). Support facilities are situated on both State and NANA lands. The mine is operated by TAK.

The mine is located on massive sulfide zinc-lead-silver deposits. The majority of the waste rock generated from mining the ore is either acid generating, potentially acid generating, or has potential for metal leaching.

3.1.1 Site Boundary

The Red Dog Mine site is located within the Kateel Meridian spanning parts of Townships 30, 31, and 32 North and Ranges 18 and 19 West. A detailed description of the Red Dog Mine site boundary can be found in SD A2 Red Dog Mine Permit Physical Boundaries in the Closure Plan (also see **Figure 2-1**). This description is used to define the physical boundary of the area covered under both the WMP and the air quality permit.

3.1.2 Mining Operations

Mining operations at the Red Dog Mine consist of an active open pit, a processing mill and support facilities. Construction of the mill began in 1988, with the first ore delivered to the mill in November 1989. The Aqqaluk and Qanaiyaq deposits were discovered adjacent to the Main Pit after operations of the mine had already begun. In 2012, TAK started to blast rock from the Aqqaluk Pit. The Aqqaluk deposit is immediately to the northeast of the Main Pit on the north side of Red Dog Creek. The Qanaiyaq deposit is located south of the Main Pit. At the time of the audit in 2013, only the Aqqaluk Pit was being developed. The Qanaiyaq deposit was under evaluation and being prepared for development in the future.

Conventional drill and blast mining methods are used to extract ore from the pit. Approximately 10,000 tons of ore are extracted and sent to the mill daily from the Aqqaluk Pit. Prior to delivering the ore to the mill, the waste rock is separated from the ore. The ore is temporarily stored in a separate stockpile, while the waste rock is delivered to one of three waste stockpiles along the benches of the Main Pit. Ore feeds to the mineral processing facilities through a jaw or gyratory crusher followed by semi-autogeneous and ball grinding mills to break down the ore into smaller sized material.

Production of lead and zinc concentrates is achieved through sulfide flotation methods that extract (concentrate) lead and zinc from non-valuable materials that become the tailings. These solid tailings are deposited in the Tailings Storage Facility (TSF). Lead and zinc concentrates are sent to a filter press before being delivered to the on mill-site concentrate storage building. The concentrates are then trucked 52 miles along the DMTS to the concentrate storage buildings at the port facility. The transportation system and port were outside the scope of the audit.

3.1.3 Tailings Management

The TSF, which is located in the drainage below the MWS, provides storage for tailings, surface water runoff, and seepage from several locations. Surface water influent to the TSF originates from the mill site, nearby developed areas, and the Main Pit. Surface water runoff from the Main Pit is collected at the mine water diversion dam and pumped to the impoundment. The impoundment also receives pumped-back seepage from the tailings facility itself as well as from the MWS and near-surface seepage from the overburden stockpile. Beginning in 2010, the main dam of the tailings impoundment was raised to an elevation of 970 feet. A minimum of 2 feet of water is maintained over the tailings throughout the impoundment to prevent oxidation of sulfides and release of acidity and metals since the tailings are considered to be potentially acid generating.

The SD B3 Plan of Operations for Tailings and Water Management reports that as of 2006, the tailings impoundment contained an estimated 27,400,000 tons of tailings. At the end of mine life, the tailings impoundment was expected to contain a total of approximately 88,000,000 tons of tailings. These numbers need to be revised with the CRP permit renewal.

The tailings impoundment is a component of the APDES "treatment works" and currently holds approximately about 4 billion gallons of free water. The volume fluctuates seasonally. Inflows occur throughout the year, but are dominated by the spring freshet, which adds roughly one billion gallons to the pond each freshet. Discharge of roughly 1.3 billion gallons per year of treated water is the dominant outflow, which occurs from May to October. The tailings impoundment water is mildly acidic, with a pH of around 5. Total dissolved solids (TDS) and sulfate levels vary seasonally, but average TDS concentrations have risen from about 3,200 to about 4,200 parts per million (ppm) since 1998, and average sulfate concentrations have risen from 2,000 to 3,000 ppm over the same period. Zinc concentrations fluctuate seasonally between 200 and 400 ppm, with 350 ppm a typical average. Iron concentrations are typically less than 10 ppm.

Ditches are currently in place in four locations to route clean water away from the tailings pond. Diversion Ditch (DD)-1 (DD-1) takes water from a drainage on the slope above the west shore of the pond and diverts it into the small catchment immediately west of the South Fork. DD-2 captures water from south of the DD-2 laydown area and routes it to the west end of the Overburden Stockpile. DD-3 extends DD-2 past the south end of the Overburden Stockpile. DD-4 captures additional water from the slope above the west shore of the tailings pond and routes it into DD-1.

3.1.3.1 Main Dam

The Main Dam is at the northern end of the tailings impoundment. The Main Dam currently has a maximum height of 182 feet and a crest length of approximately 2,600 feet. The dam was constructed in eight stages. The Main Dam was raised to an elevation of 970 feet and is expected to be raised an additional 6 feet by the end of 2013. Work to raise the main dam to 970 feet began in 2010 and was completed in 2011. The final design elevation has been increased from 986 feet to 993.3 feet.

The body of the Main Dam is a zoned rockfill structure constructed primarily with material obtained from the mill site, the DD2 borrow pit, and from mining in the Main Pit. The upstream face of the dam is covered with 100-mil high density polyethylene (HDPE) geomembrane. The geomembrane is underlain by a thickness of 1 foot of bedding consisting of rock crushed and processed to less than 1 inch. Along the upstream toe of the dam, the geomembrane continues into a cut-off system. A perforated drain pipe runs along the upstream toe of the dam, below the geomembrane, and collects any water that passes through. The pipe is connected to a gravel drain that runs under the dam along the base of the original valley. The underdrain serves to capture seepage from the Main Dam and transfer it to the seepage collection system. In the winter of 2005-2006, a cofferdam was constructed along the tailings beach to ensure that a minimum 300-foot beach width will be maintained as the pond rises. The water treatment sand filters were relocated from the east abutment to an area near Water Treatment Plant (WTP) 1 and WTP2 to facilitate future extensions of the dam and cutoff wall.

3.1.3.2 Seepage Collection System

A seepage collection and pump-back system is located about 250 feet downstream of the current toe of the Main Dam. The system consists of a pond formed by a lined seepage collection dam, which is less than 20 feet in height. Three pre-cast concrete pump chambers are set into the base of the pond, and each one is fitted with a vertical turbine pump. The pumps are connected via pipes and a manifold system to a 14-inch-diameter HDPE pipe through which the seepage is transferred back to the tailings pond. The pipe includes secondary containment. Below the seepage collection dam is a secondary pumpback system consisting of a small sump and well. The secondary system captures escaped seepage and pumps it back to the primary seepage pond.

Water pumped back from the seepage collection system below the Main Dam reaches up to 0.5 billion gallons per year. Roughly 97 percent of that volume is seepage that originates from the tailings impoundment, and only the remaining 3 percent is a net input from surface runoff. However, the seepage is a net source of contaminants. The pH of the Seepage Collection System has declined over time. In 2000, the pH was measured consistently above 6.0 while being consistently below 6.0 since 2003. Alkalinity decreased from over 100 ppm calcium carbonate to near undetectable during the same time period. Zinc concentrations currently range from 150 to 280 ppm, and iron concentrations from 10 to 100 ppm. Sulfate concentrations range from 1,000 to 4,000 ppm, but are typically 3,000 ppm.

3.1.3.3 Back Dam

When the tailings pond was above the lowest level of the natural divide with the Bons Creek catchment, TAK began to construct a back dam to keep the pond away from the divide. A cofferdam was constructed between 2003 and 2004 to facilitate investigation and future construction along the northern toe of the Overburden Stockpile. A drilling program to further investigate ground and permafrost conditions along the alignment of the proposed Back Dam was completed in 2004. Currently, the back dam is at an elevation of 970 feet. At mine closure, the planned elevation of the back dam is an elevation of 993.3 feet.

3.1.4 Waste Rock Piles

The Red Dog Mine operation includes multiple waste material stockpiles discussed below. Placement of materials within the different stockpiles has historically been driven by the chemical content of the material being handled. Competent reactive material (material that does not pose a stability hazard) is placed in the MWS. Oxidized materials are placed in the Oxide Stockpile in the event that a method to process this material as ore is identified or developed during the life of the operation. The Oxide Stockpile is currently inactive. The Overburden Stockpile also is currently inactive and consists of topsoil and other unconsolidated and incompetent materials removed from the areas underlying the MWS, tailings facility, mill, and Personnel Accommodations Complex (PAC). The Main Pit has been designated as the repository for overburden encountered during the mining of the Aqqaluk and Qanaiyak pits.

3.1.4.1 Main Waste Stockpile

The MWS contains most of the waste rock generated during development of the Main Pit. The Main Pit stockpile identified in the 2012 Annual Report is used for disposal of waste rock from the Aqqaluk Pit. The MWS has an engineered cover which was constructed by compacting and grading the surface of the portions of the facility no longer being used in order to reduce infiltration of rain water and snow melt.

The Closure Plan states that the MWS covers roughly 190 acres and contains 17,000,000 CY or 33,000,000 tons of waste rock. By 2031, TAK anticipates the MWS will ultimately cover 275 acres and contain 31,000,000 CY (62,000,000 tons) of waste rock.

The Closure Plan called for progressive reclamation of the MWS starting in 2009, which would consist of local regrading, construction of a two-layer soil cover, and revegetation. Waste rock deposition was to have continued on the northern half of the MWS until 2012, when progressive reclamation would begin.

However, the current need to store waste rock outside the Main Pit and for continued access to the Qaniyaq deposit has delayed progressive reclamation of the MWS although as of the audit, it had been regraded and an engineered cover had been installed.

3.1.4.2 Oxide Stockpile

The Oxide Stockpile contains approximately 2,200,000 CY (4,200,000 tons) of material, and covers about 30 acres. The oxide material is sometimes referred to as oxide ore, because it has a high metal content. However, it cannot be processed in the current sulfide flotation system.

The Oxide Stockpile was constructed near the crest of the ridge that separates the catchment of the Middle Fork Red Dog Creek from that of the tailings pond. The stockpile was laid out and constructed to remain on the tailings side of the divide. However, a zone of impacted vegetation on the eastern side of the ridge is evidence that some of the runoff from the stockpile construction flowed in that direction.

The Oxide Stockpile is now largely surrounded by other waste rock and is not expected to receive any further material. Progressive reclamation began in 2008 and it is now the subject of cover tests including regrading, construction of a soil cover, and revegetation. The cover construction has been monitored since its construction.

3.1.4.3 Overburden Stockpiles

The Overburden Stockpile straddles the divide between the southern end of the tailings impoundment and Bons Creek. The Closure Plan indicates that the Overburden Stockpile occupies approximately 60 acres, holds 6,600,000 CY of material, and reaches a maximum elevation of 1,020 feet above mean sea level. The total weight of the overburden stockpile ranges between 10,000,000 and 11,000,000 tons. The material in the Overburden Stockpile consists of highly weathered, but relatively non-mineralized waste rock, stripped organic materials, and materials excavated from the tailings and mill site areas during construction.

A system of ditches, sumps and wells on the Bons Creek side of the Overburden Stockpile captures and collects any seepage or runoff from the Overburden Stockpile, and pumps it back to the TSF. The Closure Plan states that a combination of direct runoff and seepage return from the Overburden Stockpile is approximately 50 million gallons per year. Average zinc concentrations are less than 8 ppm, and average iron concentrations are less than 0.4 ppm. Sulfate concentrations of the seepage are typically 1,000 ppm.

3.1.4.4 Main Pit Overburden Stockpile

The Main Pit Overburden Stockpile will result from backfilling the Main Pit and will ultimately contain 5,000,000 CY (104,000,000 tons) of waste rock and cover approximately 150 acres when it is complete in 2031, according to the CRP. The majority of waste rock in the Main Pit Overburden Stockpile will come from the Aqqaluk Pit. The most strongly acid generating rock from the Aqqaluk Pit (approximately 26,000,000 tons of rock with a sulfide sulfur content of greater than 6%) would be placed at the bottom of the Main Pit, below an elevation of 850 feet, where it would eventually be flooded by groundwater thereby limiting oxidation. The remainder of the Main Pit Overburden Stockpile will consist of 63,000,000 tons of less acid generating or neutral overburden material from the Aqqaluk or Qaniyaq pits. The Main Pit Overburden Stockpile area (the inactive Main Pit) is also used as a water management facility as described below in the Section 4.2.1.

3.1.5 Water Treatment and Management

Water from the mine and tailings area is treated in one of the three WTPs located at the mine site. These plants are referred to as WTP1, WTP2, and WTP3. WTP1 treats water that is reclaimed from the tailings pond for use in the mill. Approximately 3 billion gallons of water are treated each year in WTP1. Most of the treated water returns back to the pond with the tailings, but about 1 percent is taken off-site, as

moisture in the concentrate. WTP2 treats water from the tailings pond prior to its discharge during the summer months via Outfall 001, which is located at the Middle Fork of Red Dog Creek. About 60 percent of the water treated by WTP2 is discharged at Outfall 001 or recirculated into the system for water storage or use in the milling process. The discharge is regulated by the National Pollutant Discharge Elimination System (NPDES) Permit AK-003865-2. The remaining water is returned to the tailings impoundment along with the treatment sludge and filter backwash. WTP3 treats water from the mine sump and seepage from the MWS before it enters the tailings pond.

All three plants use a lime treatment process to raise the pH of the water and precipitate metal hydroxides and gypsum (calcium sulfate). WTP2 also includes sulfide addition to precipitate cadmium and a sand filter system to remove suspended solids prior to discharging to Outfall 001.

3.1.6 Bons Reservoir

The Bons Reservoir located in the Bons Creek drainage supplies fresh water to the mill and for domestic uses at the site. The reservoir is filled from snowmelt and precipitation. Fresh water is pumped through heat-traced pipe throughout the year from the reservoir and wells immediately downstream of the dam. The dam is covered by a certificate to operate (FY-2011-8-AK00200); water rights are allocated through an application approved by ADNR (see Section 3.2.1).

3.1.7 Sewage Treatment Plant

A sewage treatment plant operating at the site treats domestic wastewater. The plant is located between the PAC and the mill. The domestic waste water is collected, processed, and discharged to the tailings impoundment. Wastewater treatment consists of solid/liquid separation and disinfection.

3.1.8 Landfills and Waste Disposal

The mine operates an active solid waste landfill, which is used for the disposal of incinerator and burn pit ash, construction waste, and non-putrescible wastes. An incinerator is located along the east side of the tailings impoundment and north of the laydown yard and is used for burning all putrescible wastes, paper and other combustible non-hazardous solid waste.

Hazardous and oily wastes are disposed of offsite at treatment, storage and disposal facilities permitted for handling hazardous wastes. Most liquid wastes are shipped off site for disposal or recycling. Glycols are cleaned and/or recycled on site where possible. Used oil is shipped off-site. Liquid wastes are stored in containers within Conex boxes prior to shipping off-site. Solid waste items that will be shipped off-site, such as batteries, are stored in sealed containers and Conex boxes prior to shipping.

3.1.9 Fuel and Chemical Storage

Fuel is shipped by barge to the port site during the summer and transported to the mine site daily in a 25,000-gallon tanker truck. Diesel fuel is stored in two tanks located on a hill above the mill site. One of the tanks has a storage capacity of 1.1 million gallons while the other tank has a capacity of 1.0 million gallons.

3.1.10 Progressive Reclamation

Progressive reclamation of the waste stockpiles has occurred on a very limited scale. Reclamation activities conducted to date have consisted of constructing an engineered temporary cover for the MWS and seeding a temporary cover on the Oxide Stockpile. The engineered cover on the MWS was installed to reduce infiltration of snow melt and rainfall. According to the Plan of Operations for Waste Rock Management, at mine closure a permanent, engineered cover will be placed over the MWS. A different cover design was placed on the Oxide Stockpile in 2008 to test the effectiveness of overburden material as a growth media and to characterize infiltration characteristics. O'Kane Consultants, who conducted

this evaluations, has submitted annual performance monitoring reports to TAK since 2009; the reports are included as an appendix to the 2010–2012 annual reports.

3.1.11 North Basin Exploration

TAK initiated a natural gas exploration program in 2005; however, the investigation did not yield positive results and the program was discontinued and TAK decided to reclaim the well pads in the North Fork Red Dog Creek drainage (North Basin). The Red Dog Mine Basin Reclamation Plan was included in the list of documents to be evaluated as part of the audit; however, due to time constraints, the plan was not evaluated nor was the site included in the site visit.

3.2 Regulatory Background

3.2.1 Alaska Department of Natural Resources

Statutes in place for environmental protection in Alaska are implemented through regulatory programs managed by multiple departments including ADNR, ADEC, and ADF&G. State law (AS 27.05.010[b]) states that ADNR “is the lead agency for all matters relating to the exploration, development, and management of mining”; furthermore, the law requires that ADNR “coordinate all regulatory matters concerning mineral resource exploration, development, mining, and associated activities.” Coordination on a broad scale is provided in part through ADNR’s Office of Project Management and Permitting (OPMP) while the Large Mine Permitting Team (LMPT) coordinates permit development and review for mining projects. The Red Dog Mine falls under the jurisdiction of both entities.

The ADNR Division of Mining, Land and Water administers land use agreements and leases (e.g., material borrow sites), water rights and temporary use permits, and the dam safety program in permitting. The Division is one of the key regulators of the Red Dog Mine. Within ADNR’s Division of Mining, Land and Water, the Mining Section is responsible for authorizing the Red Dog Mine Closure and Reclamation Plan (F20099958). The ADNR Water Section is responsible for the issuance and management of water rights and temporary water use authorizations in the form of a Water Right Permit to Appropriate, Water Right Certificate of Appropriation, and Temporary Water Use Authorization. The following have been issued to TAK:

- LAS 1453 – for Bons Reservoir (Bons Creek, Main Stem Red Dog Creek and South Fork Red Dog Creek) Certificate of Appropriation (no further action required).
- LAS 25095 – for Mainstem Red Dog Creek (main pit) Permit to Appropriate Water (further action required to bring to Certificate of Appropriation). Permit to Appropriate expires 05-31-2022.
- LAS 25096 – for South Fork Red Dog Creek (tailings impoundment). Permit to Appropriate Water expires 05-31-2022.

The ADNR Water Section also has approved temporary water use authorizations for mine- and exploration-related activities in the vicinity of the project and within the audit boundary. Temporary water use permits (TWUPs) issued to date are as follows: TWUP F2008-07, TWUP F2010-72, TWUP F2012-132, TWUP F2012-133, TWUP F2012-134, TWUP F2012-135 (expired), and TWUP F2012-136. TAK has applied for TWUP F2013-136, TWUP F2013-137, and TWUP F2013-211, which are still under review by ADNR. [Note that TWUP 2013-211 has since been issued.]

The Dam Safety and Construction Unit under the Water Resources Section ensures the protection of public safety and property by reviewing construction and operational plans for dams in Alaska. The unit reviews periodic safety inspection reports, and issues certificates of approval to construct, modify, repair, operate, remove or abandon dams. As noted previously, ADNR authorizes four dams in operation at the Red Dog Mine: Main Dam (tailings), Back Dam (tailings), Bons Reservoir Dam (water supply), and the Red Dog Mine Diversion (mine water management).

3.2.2 Alaska Department of Environmental Conservation

The ADEC issues several environmental permits including WMPs, air quality control permits, and water discharge permits. These permits authorize certain aspects of a facility's operation. The ADEC Division of Water administers the APDES program for wastewater discharges to waters of the state. While the Red Dog Mine is covered under an APDES permit, that permit is outside the defined scope of this audit.

The ADEC Division of Air Quality implements Alaska's air quality control regulations that apply to stationary and mobile sources of air pollution. Under the Alaska air quality control regulations, operators that emit air pollutants above specified thresholds are required to obtain an operating permit for stationary source emissions and a construction permit to modify an existing source or to construct a new source. The ADEC Division of Air Quality regulates fugitive dust emissions as a source of air pollution.

The ADEC Division of Spill Prevention and Response implements the Contaminated Sites Program. The Contaminated Sites Program is engaged at the Red Dog Mine over issues resulting from fugitive dust-related contamination. Fugitive dust concerns have been identified at various points through the life of the Red Dog Mine operation and most recently in the early 2000s. Requirements to minimize fugitive dust have been incorporated into TAK's ecological risk management plan as well as in its air quality operating permit.

3.2.3 Alaska Department of Fish and Game

The ADF&G issues permits for projects in fish-bearing waters that could impair fish passage or affect habitat through water depletions, consistent with Alaska Statutes Title 16. Permits conditions are developed in consideration of the species and life stages present. In a relatively unique relationship, TAK contracts ADF&G to conduct the annual sampling for aquatic bio-monitoring. While the monitoring conducted by ADF&G is part of the monitoring program defined in Appendix I, the biomonitoring activities are specifically required by the APDES permit, which is outside the scope of the audit.

4.0 Audit Results

4.1 Audit Result Summary Table

Table 4-1 presents key audit observations by an assigned audit record number (see Section 2.1.3, Audit Terminology). **Table 4-1** also provides the aspect/facility, approval/permit, finding, and any recommendations associated with each audit record number. The audit team reviewed all of documents presented above in Section 2.2, **Table 2-2**. However, as noted above, not all of those documents contained auditable items.

Table 4-1 assigns an aspect/facility to the audit record number and observation. The term aspect is used to relate audit record numbers that do not pertain to facilities to program areas that were included in the audit.

4.2 Audit Supporting Notes and Comments

The following sections provide additional discussion based on auditor notes for selected audit records presented in **Table 4-1** where additional information may be necessary to understand the audit observation, finding, and/or recommendation.

4.2.1 Aspect: Main Pit Water Management and Main Pit Waste Stockpile for Aqqaluk Waste Rock

Additional detail on the Main Pit use as both a water management facility and final depository for Aqqaluk Pit waste rock is presented in this section. This discussion supports audit records **Nos.15, 53, 54, and 70** presented in **Table 4-1**.

4.2.1.1 Audit Observation Discussion

SD B2 Waste Rock Management Plan summarizes commitments made by TAK regarding waste rock. These commitments are incorporated by reference in the RPA. The document includes a stockpile construction plan, a stockpile progressive reclamation plan, and a plan for waste rock classification and segregation. Section 2 of SD B2 describes the concept of using the Main Pit as a waste rock stockpile for the Aqqaluk Pit mine operations.

2009 CRP Section 2.1.3 describes TAK's plan to backfill the Main Pit with waste rock to create the Main Pit Stockpile. The plan calls for strongly acid-generating waste rock from the Aqqaluk Pit and Qanaiyaq Pit to be placed in the lower levels of the Main Pit. At mine closure, groundwater would fill the voids in the lower portions of the backfilled waste rock slowing the rate of oxidation in the inundated areas. Waste from the Aqqaluk Pit was being placed on the slopes of the Main Pit or side areas of the MWS, but was not being placed in the Pit.

SD B3 Tails Water Plan of Operations for Tailings and Water Management summarizes the commitments made regarding tailings and water management in the 2009 CRP and provides further details for each of these commitments. The audit team observed the Main Pit was in use as a water storage facility in August 2013, which is not envisioned by SD B3. A new pump station was being constructed in the Main Pit for future water management in the Main Pit. Discussions with TAK representatives indicated that the Main Pit had been used as a primary water management facility since the summer of 2012. TAK indicated restrictions on off-site discharge at the APDES Permit Outfall 001 due to high selenium concentrations during the rainy season resulted in the requirement to store more water on site than is normally anticipated.

Table 4-1 Red Dog Mine Facility Audit Waste Management Plan and Reclamation Plan Approval
 Prepared by AECOM January 2014
 Report Section 4.1, Table 4-1 Audit Observations, Findings and Recommendations

No.	Aspect/ Facility	Approval/ Permit	Permit Section	Requirement	Audit Objective/ Criteria	Finding	Observation	Recommendation	Auditor	Additional Report Info
1	Dam Permit	ADNR -Dam Permits (4)	All	TAK must operate dams meeting ANDR requirements in accordance with ADNR certificates of approval (COAs).	1-TAK Reg Compliance	Positive/ In Conformance	Bons Creek Freshwater Dam (AK00200); the Red Dog Tailings Dam (also referred to as the Main Tailings Dam; AK00201); Red Dog Back Dam (AK00303); and Mine Water Diversion Dam (also referred to as the Red Dog Creek Dam; AK00260). Refer to text Section 4.2.5 for audit observations regarding the four ADNR permitted dam COAs at the Red Dog site.	None	DY	Report Section 4.2.5
2	Dam Permit	ADNR -Dam Permits (4)	11 AAC 93	Annual Inspection.	2-TAK Controls Env Obj	Positive/ In Conformance	The audit team reviewed the 2012 WMP/RPA Annual Report and verified that visual annual inspections were performed for mine water systems and tailings facilities.	None	DY	Report Section 4.2.5
3	Dam Permit	ADNR -Dam Permits (4)	11 AAC 93	Instrumentation Monitoring.	2-TAK Controls Env Obj	No Finding	Not reviewed during audit	None	DY	Report Section 4.2.5
4	Dam Permit	ADNR -Dam Permits (4)	11 AAC 93	Periodic Safety Inspections (PSI).	2-TAK Controls Env Obj	Positive/ In Conformance	The audit team examined TAK's PSI Report No. 4 dated October 15, 2010 for the Main Tailings Dam. The next PSI for the Main Tailings Dam and the first PSI for the Back Dam will be due June 28, 2014.	None	DY	Report Section 4.2.5
5	Dam Permit	ADNR -Dam Permits (4)	11 AAC 93	Inspections After Significant Events.	2-TAK Controls Env Obj	Positive/ In Conformance	The audit team reviewed forms and confirmed TAK was completing inspections of facilities after significant events. For example, daily, weekly, quarterly and annual inspections were made during and after the high precipitation experienced during 2012.	None	DY	Report Section 4.2.5
6	Dam Permit	ADNR -Dam Permits (4)	11 AAC 93	Annual Emergency Action Plan (EAP) Internal Review and Orientation Exercise with Staff.	2-TAK Controls Env Obj	No Finding	TAK stated that the site holds EAP Drills annually. Records are held with engineering, but were not immediately available for review. Reference: e-mail from C. Menefee to G. Weglinski, October 31, 2013. However, records of annual EAP internal review and orientation with staff were not discussed or reviewed.	TAK to ensure EAP internal review and staff orientation is in compliance with regulation. Consider entering EAP review records in Siteline for access by Environmental Department for compliance review.	DY	Report Section 4.2.5
7	Dam Permit	ADNR -Dam Permits (4)	11 AAC 93	Biannual EAP Drill or Table Top Exercise.	2-TAK Controls Env Obj	Improvement Needed	The TAK OSC stated that the site holds EAP Drills annually. Records are held with engineering, but were not immediately available for review. Reference: e-mail from C. Menefee to G. Weglinski, October 31, 2013.	Assure EAP drills meet biannual requirement and consider entering records into Siteline EMS to enable access by Environmental Department for compliance review.	DY	Report Section 4.2.5
8	Dam Permit	ADNR -Dam Permits (4)	11 AAC 93	Revise EAP Every 3 Years as Needed and Redistribute.	1-TAK Reg Compliance	No Finding	The current EAP was not reviewed during the audit. TAK indicated an approved EAP was being used for periodic drills.	Update EAP as needed and submit to agencies during the 2014 permit renewal process.	DY	Report Section 4.2.5
9	Dam Permit	ADNR -Dam Permits (4)	ADNR Approved O&Mplan	Daily Inspection.	2-TAK Controls Env Obj	Positive/ In Conformance	The audit team reviewed inspection forms and confirmed that TAK is completing daily, weekly and quarterly inspections as required.	None	DY	Report Section 4.2.5
10	Dam Permit	ADNR -Dam Permits (4)	ADNR Approved O&Mplan	Weekly and Quarterly Inspections.	2-TAK Controls Env Obj	Positive/ In Conformance	The audit team reviewed inspection forms and confirmed that TAK is completing daily, weekly and quarterly inspections as required.	None	DY	Report Section 4.2.5
11	Dam Permit	ADNR -Dam Permits (4)	NA	Red Dog (Main) Tailings Dam: Implement the recommendations of the engineer contained in "Periodic Safety Inspection Report #4, Tailings Main Dam, NID#AK00201" dated October 15, 2010."	1-TAK Reg Compliance	Positive/ In Conformance	Compliance with this requirement was evidenced in part by interviews with TAK staff and on-site observations of work to address precipitation of ferracrete at the seepage ponds at the downstream toe of the main dam. Conversations by audit team with ADNR dam safety staff confirmed that work to address this and related issues at the Main Tailings Dam was being pursued by TAK under the review and approval of ADNR.	None	DY	Report Section 4.2.5
12	Dam Permit	ADNR -Dam Permits (4)	Attachment A - Special Conditions	Red Dog (Main) Tailings Dam: By March 31 of each year, provide an updated water balance model based on actual data collected during the previous year that includes the historic and projected water levels in the TSF, and a comparison to the remaining stages of the dam and the current estimated construction schedule for those stages."	1-TAK Reg Compliance	Positive/ In Conformance	The audit team reviewed procedures for the site water balance update and reporting. GoldSim software is being used by Mill Operations to track and predict the site water balance for facilities including the certified dams. The water balance is reported in the annual reports for the WMP and RPA. ADNR receives a copy of the annual report.	None	GW	Report Section 4.2.5
13	Dam Permit	ADNR -Dam Permits (4)	Attachment A - Special Conditions	Red Dog Back Dam: No later than March 30, 2013, submit a revised detailed design report for the Red Dog Back Dam to update and replace previous design reports dated August 26, 2008 and April 17, 2007. The revised detailed design report must include current seepage and stability analyses based on information collected during the recently completed construction.	1-TAK Reg Compliance	Positive/ In Conformance	The audit team reviewed the report containing the updated design of the Red Dog Back Dam that was prepared and submitted to TAK by Golder Associates, Inc. by cover letter dated July 19, 2013. TAK is in communication with agencies regarding the Back Dam report.	None	DY	Report Section 4.2.5
14	General Permit	ADNR Mat Sales	All	The ADNR Lands Section has issued a number of land use authorizations including the following: ADL 418654 for material site DD2 authorizing the removal of 25,000 cubic yards per year through 2014, ADL 419795 for material site MS9 through 2018, ADL 419895 for material site DD2 through 2018 for removal of 250,000 cubic yards of material.	2-TAK Controls Env Obj	Positive/ In Conformance	The presence of valid permits was confirmed during the visit to ADNR offices in Fairbanks, AK on 9/10/2013. Conditions of the material sales/land use permits require submittal of a completion report if the permit is used. Completion reports were not reviewed as part of the audit.	None	GW	None
15	Aqq Waste Rock	CRP May 2009	3.1.3 WR&OSP	Waste rock from the Aqqaluk Pit will be placed in the Main Pit to create the Main Pit Stockpile. Strongly acid-generating waste rock from the Aqqaluk Pit will be placed in the lower levels of the Main Pit for ARD management as described in the CRP 2009.	2-TAK Controls Env Obj	Non-Conformance	Waste rock from the Aqqaluk Pit has been placed either in the Main Waste Stockpile or waste stockpiles forming a berm around a portion of the Main Pit instead of the Main Pit as described in the CRP May 2009.	Update CRP and mine operating plan in 2014. TAK should work with agencies to determine need for additional geochemical studies and which SDs need to be updated to support CRP update. Management plans for water and reactive waste rock in the Main Pit need to be updated in the 2014 process to reflect current site conditions.	BB	Report Section 4.2.1
16	Cover Design/Shale	CRP May 2009	3.1.3 WR&OSP	CRP May 2009 Section 3.1.3 describes a planned reclamation cover for waste rock and ore stockpiles with 18 inches of compacted shale covered by 18 inches of lightly compacted shale for all areas where cover is being constructed. The upper layer of the cover will then be seeded and fertilized to promote vegetations. (CRP page 34). Also see SD F3 Revegetation Plan by ABR.	4-PermitEnvProtection	Update 2014	Cover on the Oxide Stockpile has been evaluated by site staff and consultants (e.g., O'Kane 2012) since 2009. TAK staff indicated various discussions on potential cover design have been held internally with the Main Waste Stockpile grading in 2012. Information is available on the Main Waste Stockpile run off and infiltration characteristics in its current uncovered condition. Cover design requirements in the 2009 documents are out of date with TAK site information gained during the permit period.	TAK should summarize information on cover design gathered during the past permit period (e.g., Oxide Stockpile performance, Main Waste Stockpile regrade without final cover) and provide agencies with updated cover design for discussion and inclusion in the 2014 CRP update.	GW	Report Section 4.2.3
17	Water-Bal & WT	CRP May 2009	2.3.2	2.3.2 ... SD E4... "concluded that lime addition is the preferred method of water treatment for the Red Dog site, and that water treatment efficiency could be improved by collecting higher strength water from the mine sump or Main Waste Seepage and treating it prior to discharge into the tailings pond. The latter is now being implemented through WTP3."	2-TAK Controls Env Obj	Update 2014	Contaminant balance consists of series of calculations tracking contaminant loadings from respective sources to treatment works (tailings pond and water treatment plant). Three water treatment plants: #1 - water reclaimed from tailings pond, used in mill; #2 - treats water from pond for summer discharge to outfall 001; #3 - treats water from mine sump and waste rock seepage before entering tailings pond. Gold Sim software is being updated and will eventually provide updated flow/loading analysis for current and future scenarios. The last detailed water balance and contaminant loading calculations were conducted in 2007 (SRK report). Treated water from WTP#1 could be routed to the sand filters and discharged to outfall 001.	The water treatment section of the 2014 closure plan and closure cost estimate needs to be updated with the information and water treatment upgrades that have been completed during the permit period.	BB	Report Section 4.2.6
18	Closure Cost Estimate	RPA	GEN	General Stipulation: Financial Assurance. Total approved initial financial assurance amount is \$ 305,150,000 for the 2009 RPA based on the Red Dog Mine Closure and Reclamation Plan (SRK 2009 and supporting documents listed in the permit).	4-PermitEnvProtection	Update 2014	TAK plans to revise the reclamation plan and associated cost estimate in 2014 to address changes into the mine plan and site conditions that have been made since the SRK 2009 reclamation plan was developed. See cost estimating section in this report for detailed audit observations.	See recommendations in report Section 4.3.	JC	Report Section 4.3
19	Closure Cost Estimate	RPA	5.1.4 Premature Closure	5.1.4 Project Suspension or Premature Closure - Within the next 5-year renewal of the Red Dog Mine closure and Reclamation Plan, Teck Alaska Inc. shall develop a plan and cost estimate for the premature closure at the point of maximum reclamation liability that is expected to occur during the next 5-year period of operations.	6-Financial Assurance	Update 2014	Future requirement: TAK confirmed they will develop a cost estimate for the premature closure at the point of maximum reclamation liability that is expected to occur during the next five-year period of operations during the 2014 closure plan update.	TAK to develop maximum premature closure cost in accordance with updated mine plan and closure plan in 2014.	JC	None
20	Cover /Vegetation	RPA	3.1.3 WR&OSP	Project Specific Stipulation: Section 3.1.3 Waste and Ore Stockpiles – Unless changes are approved by ADNR, the fertilizer application rate shall be 400 - 450 lbs per acre of 20N-20P-10K and the seed application rate and species shall be as listed in Table 3.1 (Revegetation Species for Stockpile Covers) or other native species that have proven successful at the site, including transplants...A self-sustaining vegetative cover shall be achieved a minimum of five years after the last application of cover material, soil amendment, seed or fertilizer before full financial assurance will be released for reclaimed areas.	4-PermitEnvProtection	Update 2014	Stipulation applicable to a future condition. None of the disturbances have been subject to final grading and placement of covers; therefore, the use of fertilizer has not been required. TAK has conducted some revegetation test work, including fertilizer application on the Oxide Waste Stockpile.	Update this stipulation based on Oxide cover experience. TAK may benefit from revisiting the Revegetation Plan to present a more comprehensive approach to investigating the effectiveness of various cover materials, growth material, and fertilizer application.	GW	None
21	Cover Design/Shale	RPA	3.1.3 WR&OSP	Project Specific Stipulation: Section 3.1.3 Waste and Ore Stockpiles - Prior to the placement of covers on additional stockpile areas, including any test covers, Teck Alaska Incorporated shall submit to ADNR plans that are developed to minimize infiltration into the waste rock material and metal loading in surface runoff.	4-PermitEnvProtection	Update 2014	Future requirement, TAK verified cover design, including test covers would be submitted to agency prior to placement. TAK indicated final cover design for the Main Waste Stockpile (MWS) may be some years off while recent regrading completed under the EPA Compliance Order by Consent (COBC) is evaluated.	TAK and agencies should review the effect of leaving the recently regraded MWS without an engineered cover for a number of years (i.e., infiltration and metal loading to water treatment). Update requirements for cover plans and cover performance monitoring to reflect recent regrading of MWS and the data collection opportunity it presents.	GW	Report Section 4.2.3

Table 4-1 Red Dog Mine Facility Audit Waste Management Plan and Reclamation Plan Approval
 Prepared by AECOM January 2014
 Report Section 4.1, Table 4-1 Audit Observations, Findings and Recommendations

No.	Aspect/ Facility	Approval/ Permit	Permit Section	Requirement	Audit Objective/ Criteria	Finding	Observation	Recommendation	Auditor	Additional Report Info
22	Cover Design/Shale	RPA	3.1.3 WR&OSP	Project Specific Stipulation: Section 3.1.3 Waste and Ore Stockpiles ...Final facility closure plans shall document the construction and performance of the cover on the Oxide Stockpile.		Positive/ In Conformance	The annual reports to the State of Alaska (2010, 2011, 2012) for the WMP/RPA include appendices presenting results and updates on the Oxide Stockpile Cover System and the TDS Management Plan. The pilot reclamation cover on the Oxide Stockpile was evaluated after the 2012 wet summer season by O'Kane (2012). The results of this evaluation showed that the cover design of 18 inches of compacted non-reactive shale and 18 inches of lightly compacted non-reactive shale did not keep infiltration to less than 15% of precipitation during the heavy August rains. Infiltration rates were 25% or greater.	Incorporate new information from existing Oxide Stockpile and develop a cover plan for the Main Waste Rock Dump that was recontoured 2013.	GW	Report Section 4.2.3
23	Cover Design/Shale	RPA	3.1.3 WR&OSP	Future test covers should evaluate the difference in infiltration rates and runoff quality between covers constructed from Kivalina Shale (No Suggestions) Shale vs. material removed from the overburden stockpile.		Improvement Needed	Shale as Cover Material: Discussion with TAK staff indicated that no segregation and stockpiling of different types of shale occurred during this permit period. The 2009 permit anticipated that shale type distinction would be apparent and significant quantities could be separated and stockpiled, which has not been the case.	Review goals for shale/cover characterization program and revise during permit renewal. The permit reissued for the next term should consider adding a stipulation to study the type and quantity of shale suitable as a cover material. Further defining shale characteristics and calibration of XRF instruments to read shale characteristics rather than ore should be part of the plan.	GW	Report Section 4.2.3
24	Cover Design/Shale	RPA	SD B2 page 10 of 13	...Okpikruak Shale and Kivalina Shale shall be segregated where practicable, and stockpiled separately unless otherwise approved by ADNDR, until cover trials and further assessment of the distribution of zinc in the Kivalina Shale are completed and demonstrate the acceptability of Kivalina Shale as a cover material.	3-TAK Control Function	Improvement Needed	TAK stated that Okpikruak and Kivalina shales have not been segregated during the past permit period because they have not been encountered in developing the Aqqaluk Pit. During the audit, TAK operations personnel questioned whether adequate storage capacity is available to segregate growth media. In the event that an adequate volume of these cover materials are not salvaged during mining the next RPA should consider alternative material sources.	Align permit required shale segregation practices with current site conditions and mining practices in 2014 permitting update process. TAK should document agency discussions regarding exceptions to permit requirements during permit period for review during next 5-year audit.	BB	Report Section 4.2.3
25	Cover Design/Shale	RPA	RecStip a.	Standard Stipulations: Reclamation Stipulations: a. Topsoil and overburden, not promptly redistributed to an area being reclaimed, shall be separated and stockpiled for future use. This material shall be protected from erosion and contamination by acidic or toxic materials and shall not be buried by development rock or surface construction activities.		Positive/ In Conformance	The acreages of areas disturbed and the location of "topsoil" stockpiles are presented in the annual reports (figures presented in Appendix E). Also see record numbers 11 and 27.	None	GW	Report Section 4.2.3
26	Exploration	RPA	RecStip b.	Standard Stipulations: Reclamation Stipulations: b. All surface drill holes for the purpose of subsurface exploration or sampling that enter into a water source (other than those holes within the ore to be mined) shall be plugged with a minimum of 7 feet of bentonite hole-plug, a benseal mud, or equivalent slurry immediately above the static water level in the drill hole. A bentonite hole-plug, a benseal mud, or equivalent slurry, shall also be placed for a minimum of 10 feet within the top 20 feet of the drill hole in competent material. The remainder of the hole will be backfilled to the surface with drill cuttings. Complete filling of the drill holes, from bottom to top, with a bentonite hole-plug, benseal mud, or equivalent slurry is also permitted and is considered to be the preferred method of drill-hole closure.	1-TAK Reg Compliance	Improvement Needed	Interviews with TAK exploration geologists indicate exploration drill hole closure procedures are in compliance with ADNDR drilling permit but not necessarily with this requirement to backfill "remainder of the hole with drill cuttings". The ADNDR drilling permit does not specify that "the remainder of the hole will be backfilled to the surface with drill cuttings" as stated in this requirement. TAK has more stringent drill hole closure procedures in mineralized areas where underground mining may occur to address future safety concerns. In mineralized areas, the general practice is complete filling of the drill holes is stated as the preferred method of closure in this requirement.	TAK should review drill closure practices for compliance with requirements. Align various permit requirements through review and discussion with agencies. Update permit language as needed in 2014 to assure TAK practices are in compliance with permits.	EB	None
27	General Permit	RPA	GEN	General Stipulation: Terms and conditions contained in Red Dog Mine Closure and Reclamation Plan and Supporting Documents A2, B1-B3, E1, F3, G, I, J1-J3, closure cost estimate, post closure cost estimate, and suspension cost estimate are incorporated by reference as stipulations of approval.		Update 2014	Conditions at the mine facility have changed since the 2009 permit approval process. Permits protect the environment by providing for periodic audit, update and subsequent approval. TAK is in compliance with the update process.	TAK updating to reflect current site conditions through permit renewal process scheduled in 2014.	GW	None
28	General Permit	RPA	GEN	General Stipulation: A third-party audit must be completed beginning 2013 and every 5 years thereafter to verify TAK Alaska's compliance with plan approvals, permits, and applicable environmental laws and regulations.		Positive/ In Conformance	Third-party audit requirement fulfilled through this audit effort and report.	None	GW	None
29	General Permit	RPA	SD B1 page 9 of 13	Project Specific Stipulation: SD B1- Red Dog Mine Development Plan: ADNDR shall be provided any updates to the Red Dog Mine Development Plan that occur prior to the next 5-year Reclamation Plan Approval Renewal.	4- PermitEnvProtection	Positive/ In Conformance	Audit team Reviewed 2011 and 2012 annual reports and verified that the reports provide an updated forecast of the mine plan.	None	GW	None
30	General Permit	RPA	SS Historic Prev	Standard Stipulations-AK Historic Preservation Act- notification of State Historic Preservation Officer and State Troopers if burials or humans remains are discovered.	1-TAK Reg Compliance	Positive/ In Conformance	Interviews with TAK staff, including environmental department, mine operations department and exploration department confirmed this requirement is part of training and systems. Awareness of staff is such that this requirement would be fulfilled if burial or human remains were discovered in the course of operations.	None	GW	None
31	General Permit	RPA	RecStip c.	Artesian conditions.		Positive/ In Conformance	Interviews with TAK staff indicated sufficient awareness of this requirement. No artesian conditions found to date.	None	GW	None
32	Geochem Charact	RPA	2.1.3 WR&OSP	Project Specific Stipulation: Section 2.1.3 Waste Rock and Ore Stockpiles - Further waste characterization of the Qanaiyaq deposit is required.	2-TAK Controls Env Obj	Update 2014	The expected waste rock from Qanaiyaq has been evaluated by a report by SRK entitled "Results of Static Geochemical Testing on Qanaiyaq Samples, Red Dog Mine - Draft Report", August 2012 (SRK 2012). SRK 2012 completed the evaluation of expected waste rock from Qanaiyaq which showed Qanaiyaq waste rock more likely to be acid generating and to leach metals than current waste rock from the Main Pit or Aqqaluk. The evaluation recommended kinetic tests to supplement the results from the Static Acid Base Accounting tests. The OSC showed that the Sitaline EMS assigned Principal Geologist Reserves Tom Krolak Sitaline responsibility for further action. It was noted that the way Sitaline is currently configured, the Environmental Department would not be notified if the assigned task was missed or completed.	Update the waste characterization plan with results and recommendations of SRK 2012 report on Qanaiyaq waste.	BB	Report Section 4.2.2
33	Geochem Charact	RPA	SD B2 page 10 of 13	Project Specific Stipulation: SD B2 - Plan of Operations for Waste Rock Management Plan: Within 90 days of the issuance of this Reclamation Plan Approval, Teck Alaska Incorporated shall develop and submit to ADNDR for review and approval a Waste Rock Management QA/QC Plan that will demonstrate compliance with Waste Rock Management Plan and Segregation Criteria specified in Table 1...	1-TAK Reg Compliance	Improvement Needed	Audit team reviewed a waste rock management QA/QC plan (TAK Red Dog Mine Waste Rock Management Procedures, Geology Department 2012) that was provided from Sitaline. Sitaline indicated the plan had been issued to ADNDR and approved. The QA/QC plan document reviewed is referenced as Document ID No. 2231, Revision 2 in the footer of the document; however, the document was not set up to indicate a date of the last revision (only a print date is in the footer). The Geology Department reports data collected using this QA/QC procedure to the Environmental Department, which in turn, reports the data to agencies in the quarterly and annual reports as required by WMP and RPA (e.g., 2012 Annual Report, Feb 28, 2013 Appendix C). There is no reference to the QA/QC procedure in the quarterly or annual reports to the agencies to indicate the data reported is collected under the approved QA/QC procedure.	Modify formatting of waste rock management document procedures to clearly indicate date of revision and add the date the document was approved by agencies. Verify that data collected by the Geology Department is using the approved QA/QC and make a statement in the quarterly/annual reports that the data presented has been collected under the most recent, agency approved QA/QC procedures.	BB	Report Section 4.2.2
34	Geochem Charact	RPA	SD B2 page 10 of 13	...Monitoring results associated with the (Waste Rock Management) QA/QC plan shall be reported in quarterly and annual reports...	1-TAK Reg Compliance	Positive/ In Conformance	Audit team Reviewed 2011 and 2012 annual reports and verified that the reports provide monitoring results associated with the Waste Rock Management QA/QC plan.		BB	Report Section 4.2.2
35	Pit-Aqq	RPA	2.1.2 Pits	Project Specific Stipulation: Section 2.1.2 Pits - A geotechnical investigation report shall be provided to ADNDR that demonstrates the static and dynamic stability and performance of the Aqqaluk Pit Wall located between the Aqqaluk and Main Pits where slope failure could result in disruption of the Red Dog Creek Diversion. This evaluation should consider both the long-term stability and stability during the time frame when the Main Pit is backfilled and saturated and the Aqqaluk Pit is dry. This report should be provided to ADNDR no later than May 2013.	2-TAK Controls Env Obj	Update 2014	The TAK OSC retrieved a Quick Strip plan from Sitaline EMS that had been entered in Sitaline EMS by TAK's Mike Harvie dated April 2012 that appeared to meet the requirement, although it was not entirely clear when the report had been submitted to ADNDR.	Improve Sitaline EMS entry clarity on the specific document that was intended to fulfill this requirement and include transmittal letter or other documentation that the report was provided to ADNDR. [ADNDR/DMW/DAM Safety indicated that it had received the letter dated June 7, 2011.]	DY	None
36	Pit-Aqq	RPA	3.1.2 Pits	Project Specific Stipulation: Section 3.1.2 Pits - Submit to ADNDR final facility closure plans for review and approval prior to initiation of reclamation of the waste rock that would be exposed by the blasting back of the eastern limit of the Aqqaluk Pit to a 4:1 slope...ARD	4- PermitEnvProtection	No Finding	Future requirement, not evaluated	None	GW	None
37	RD Creek Diversion	RPA	3.1.4 Red Dog Creek Diversion	Project Specific Stipulation: Section 3.1.4 Red Dog Creek Diversion - Prior to initiation of construction of the post-closure configuration of the Red Dog Creek Diversion, TAK shall submit to ADNDR for review and approval final facility design plans.	4- PermitEnvProtection	Update 2014	Future requirement: TAK confirmed Red Dog Creek post-closure design will be submitted for agency approval prior to initiation of construction. The audit team observed that the diversion system has been impacted by Aqqaluk Pit blasting. A section of a culvert has been temporarily replaced with Conex containers while repairs are being made. Facility management is aware of the importance of the diversion.	Agency to retain requirement in 2014 update for future action.	GW	None
38	Reporting	RPA	GEN	General Stipulation: Reporting: Submit quarterly reports no later than 60 days after last day of the first through the third calendar quarter in hard copy and electronic format. Submit annual report by March 1. Conduct annual meeting with ADNDR and ADEC. See RPA for Data List.		Positive/ In Conformance	Review of report files at the site and at agency determined that TAK reporting and communication with agencies is in conformance with the RPA	None	GW	None
39	Reporting	RPA	GEN	General Stipulation: Submit as-built maps with annual report. 1"-200' (1:2400) or appropriate scale. Maps should show cleared and grubbed areas, topsoil and growth medium, cover material, waste rock stockpiles, roads, tailings facility, mine pits, facility construction, and or unreclaimed exploration disturbance.		Positive/ In Conformance	Drawings of new activities related to disturbance, stockpiles, and construction are provided as an attachment (Maps) in the annual reports. Drawings from the 2010 and 2011 annual reports were reviewed as obtained from the ADNDR website; the 2012 posting on the ADNDR site did not include the maps.	None	GW	None

Table 4-1 Red Dog Mine Facility Audit Waste Management Plan and Reclamation Plan Approval
 Prepared by AECOM January 2014
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No.	Aspect/ Facility	Approval/ Permit	Permit Section	Requirement	Audit Objective/ Criteria	Finding	Observation	Recommendation	Auditor	Additional Report Info
40	TSF	RPA	3.2.4 Main Dam	Project Specific Stipulation: 3.2.4 Main Dam - Prior to the next five-year renewal of the Red Dog Mine Closure and Reclamation Plan, TAK shall increase the width of the tailings beach from the current 300-feet to 600-feet (or as otherwise required by ADNR Dam Safety Authorizations) or provide a plan, cost estimate, and financial assurance with the next five-year renewal of the Red Dog Mine Closure and Reclamation Plan for the construction of this beach in the event of premature mine closure.	1-TAK Reg Compliance	Update 2014	The milestone was not met; however, TAK has made significant changes to the Main Dam beach width during the permit period and is in communication with agency to resolve this issue.	TAK should update the CRP and supporting documents with the current information on beach width goals integrated with current site conditions and updated Main Dam and Back Dam lift designs. Update this requirement in 2014 permit to reflect current conditions and current TSF operating plan.	DY	Report Section 4.2.5
41	Water - Monitoring	RPA	GEN	General Stipulation: Monitoring: Monitoring shall be conducted in accordance with the SD 1 - Red Dog Mine Waste Management, Reclamation and Closure Monitoring Plan (TAK 2009).	4-PermitEnvProtection	Positive/ In Conformance	CRP May 2009 Supporting Document I (SD 1) was reviewed during the audit process. Observations and findings of note appear as unique entries in this table under "SD 1 - Monitor Plan" in Approval/Permit Column. The Quarterly and Annual reports submitted by TAK to the agencies indicate compliance with the monitoring and reporting requirements.	None	GW	None
42	Water-Bal & WT	RPA	4.2.2 Water Treat	Project Specific Stipulation: 4.2.2 Water Treatment - Prior to May 2013, Teck Alaska, Incorporated shall develop and submit to ADNR preliminary plans and cost estimates for eventual "out-of-pit" sludge disposal.	2-TAK Controls Env Obj	Non-Conformance	The milestone was not met; however, TAK is in communication with agency to resolve this issue. The audit team reviewed an e-mail from TAK to Brent Martello (ADNR) dated August 27, 2013 requesting modification to RPA Stipulation 4.2.2 to allow submission of an out-of-pit sludge plan during permit renewal in 2014. TAK representative believes agency will grant request. A task has been entered in the Siltline EMS data base and assigned to the Red Dog Long Range Planner who will be electronically notified by March 14, 2014 (which will provide sufficient time for TAK to complete task for submission of RPA renewal submittal). [NOTE: Post-audit, ADNR indicated that it granted TAK's request for an extension in an email dated 9/27/2013. Sludge disposal will be addressed in the upcoming permit renewal process.]		GW	Report Section 4.2.6
43	General Permit	WMP	All	Review of WMP permit conditions - overall.	4-PermitEnvProtection	Update 2014	Conditions at the mine facility have changed since the 2009 permit approval process. Permits protect the environment by providing for periodic audit, update and subsequent approval. TAK is in compliance with the update process.	TAK updating to reflect current site conditions through permit renewal process scheduled in 2014.	GW	None
44	Haz Chem Materials	WMP	1.15	1.15 Pollution Prevention Strategy...the permittee is encouraged to implement pollution prevention practices at the facility...	2-TAK Controls Env Obj	Update 2014	TAK has not implemented a pollution prevention strategy (Stipulation 1.15). This stipulation is a recommendation rather than a permit requirement. It is noted that TAK has not implemented the WMP recommendation to develop and implement a formal pollution prevention strategy. TAK currently ships much of its hazardous wastes to approved off-site disposal sites through an air cargo service. It should be noted that the cost associated with shipping hazardous wastes via air cargo provides economic incentive beyond the WMP's recommendations for TAK to pursue strategies for reducing the type and volume of wastes generated.	TAK should consider developing a formal pollution prevention strategy as recommended in the WRP and in keeping with generally accepted best practices.	BK	None
45	Waste -Inert	WMP	1.6.7.1	1.6.1.7.1 Visually monitor the site each month for signs of damage or potential damage from settlement, ponding, leakage, erosion, or operations at the site to ensure the active landfills are being operated according to the most recent department-approved landfill standard operating procedures. Record the inspection results and maintain them in the facility's operating record for review by department staff during inspections.		Positive/ In Conformance	The 2010-2012 Annual Reports contain a section that documented sites are visually monitored on a weekly basis. A hard copy file containing the results of weekly visual monitoring observations was included in the site audit. A random sample of the data sheets was reviewed. The auditors were able to infer from the review that TAK completed the visual inspections and that datasheets were reviewed by supervisors.	None	DY	None
46	Waste -Inert	WMP	1.6.1.7.2	1.6.1.7.2 Maintain a set of site development and use plans and submit an updated copy to the department showing current status before the permit anniversary date each year.	2-TAK Controls Env Obj	Non-Conformance	Updated landfill site development and use plans were not available during the audit. Siltline records indicate that development plans had been completed beyond 2008; however, in the absence of these plans, this could not be verified by the team. Siltline also had no records of updated plans since 2008.	TAK should locate or develop the required landfill site development and use plans and ensure Siltline EMS has appropriate entry. Ensure copy is submitted annually.	BK	None
47	Water - Monitoring	WMP	1.6.1.3	1.6.1.3 Monitoring of surface and groundwater, as required, near the site to ensure that Alaska Water Quality Standards are not exceeded and that sample results are valid.	4-PermitEnvProtection	Improvement Needed	TAK is monitoring water in accordance with all current permits. The audit team notes that the permits do not specifically require groundwater quality monitoring and therefore, the water monitoring plan may not be protective of the environment as intended by the WMP. While ground water levels are monitored as part of the "Long-Term Permafrost and Groundwater Monitoring Program for the Tailings Impoundment", this program does not include monitoring water quality to ensure that State Water Quality Standards are not exceeded.	Agencies and TAK to review and consider defining the conditions under which groundwater quality sampling would be added to the monitoring plan.	BK	None
48	Water-Bal & WT	WMP	1.2.3	1.2.3 Wash water from the maintenance shops and truck wash may go into the tailings area. Oily water must go through an oil/water separator and the treated water may not have a visible sheen prior to entering the tailings area. Dry methods of cleanup shall be used for initial cleanup of oil spills in the maintenance shops.	2-TAK Controls Env Obj	Non-Conformance	The audit team found that shop personnel were unsure if flow from the shop floor drain passed through an oil water separator prior to discharge to the TDF. Shop personnel also could not provide the current site development plan records to determine if the wash water is being treated prior to discharge. Siltline records indicate that these plans had been completed as of 2008; however, in the absence of the plans, this could not be verified. A schematic drawing of the drainage system provided after the audit was inconclusive.	TAK to ensure shop has an oil water separator, that it is documented in files, and that staff using the system are trained in the requirements and how the system works.	BK	Report Section 4.2.7
49	Air Quality	FDRMP	All	Fugitive dust concerns have been identified at various points through the life of the operation and most recently in the early 2000s. The DMTS Fugitive Dust Risk Assessment (Exponent, 2007) assessed risks to human and ecological receptors from metals in soil, water, sediment, plants, and animals in the area surrounding the air/solid waste permit boundary and the DeLong Mountain Transportation System. The risk assessment resulted in the development of the Fugitive Dust Risk Management Plan (FDRMP), which in turn gave rise to a series of studies and plans including the following: Communication Plan, Worker Dust Protection Plan, Monitoring Plan, Remediation Plan, Dust Emissions Reduction Plan, Uncertainty Reduction Plan. All of these plans, with the exception of the Dust Emissions Reduction Plan have been approved by ADEC.	4-PermitEnvProtection	Update 2014	The focus of studies related to fugitive dust management is on areas outside of the "facility boundary" (i.e., the air/solid waste permit boundary) which is the area covered by this audit. However, since these plans are related to and include fugitive dust considerations within the facility boundary, the audit includes a cursory review of the documents. Consistent with commitments established in the FDRMP, TAK submitted the first Fugitive Dust Risk Management Plan Annual Report in 2011 and the second in 2012. The Uncertainty Reduction Plan includes the expansion of a reclamation and recovery database to track aspects of reclamation in the mine and port areas. The use of the database is encouraged as a method to ensure information gathered on growth media materials testing, fertilizer performance, and vegetation establishment success criteria/evaluation is integrated in future decision-making processes. The 2012 Fugitive Dust Risk Management Plan Annual Report states that a significant increase in lead and zinc concentrations were observed in TEOM monitoring locations at the personnel accommodations complex (PAC TEOM) and the west side of the Main Tailings Dam (T-Dam TEOM). The report further states that if significant increases are noted at the mine areas in 2013, additional dust control measures will need to be implemented. The report also notes that dustfall jar monitoring between 2009 and 2012 showed statistically significant increases in lead concentrations at the mine.	Incorporate most recent information on fugitive dust related to the Red Dog Mine into the 2014 permit renewal process. The 2014 CRP should include a discussion of how current information developed under the FDRMP (or is not) included in the updated 2014 closure plan and closure cost.	GW	None
50	Stakeholder Engage	SD A1 Cls Workshops	All	NA	5-TAK EMS Oversight	Positive/ In Conformance	Plan supporting documents A1 are not defined as a RPA SD and a review of A1 documents was not within the scope of this audit. The audit team, however, reviewed a power point presentation that summarized information concerning TAK's community engagement activities that were conducted in support of the 2009 Reclamation and Closure Plan. The power point presentation was prepared by Jack DiMarchi, Large Mine Project Coordinator, Alaska Department of Natural Resources entitled "Reclamation & Closure Red Dog Zinc-Lead Mine, DeLong Mountains, Alaska, May 2011." Members of the audit team interviewed TAK employee Wayne Hall, (Manager of Community and Public Relations), on current community engagement programs and their relation to mine closure and reclamation planning as well. TAK has continued to implement a comprehensive community relations program over the past four years following the Reclamation and Closure Plan Workshops. This community engagement effort has included regular visits to local villages, local hiring, training programs, and providing scholarships to assist students with training (W. Hall interview, 2013).	Continuation of existing program.	GW	None
51	General Permit	SD A2 Legal Desc	All	NA	1-TAK Reg Compliance	No Finding	A legal description for the geographical boundary was provided in the SD A2. A detailed review of the legal description was not completed.	None	GW	None
52	General Permit	SD B1 Mine Dev Plan	All	NA	5-TAK EMS Oversight	Update 2014	The Red Dog Mine Development Plan was written in 2004 and presents a view of the mine plan and site knowledge available during 2003-2004. It provides an overview of known mineral deposits and ARD modeling applicable at the time. A discussion of proven, probable, indicated and inferred ore reserves was provided in the development plan as well. The plan contains a schedule based on 2003 pit shell modeling, which was based on operating costs, capital costs, and an economic analysis. This mine plan was written in a manner that was intended to optimize the net present value of the current Red Dog open pit reserves. The audit team noted that details of the 2004 Red Dog Mine Development Plan such as the specific pit shell modeling, cost analysis, and capital expenditure plan, which are typically updated on a quarterly or annual basis, might have been outdated when the 2009 Reclamation and Closure Plan was written.	Update the mine development plan in 2014. Update the CRP, including supporting closure plans and cost estimates in accordance with 2014 mine development plan.	GW	None
53	Aqq Waste Rock	SD B2 WR Manage	Section 2	High sulfide material from Aqqualuk Pit will be placed below the ultimate water level in the Main Pit.	1-TAK Reg Compliance	Non-Conformance	Water management in the Main Pit and sequencing in the Aqqualuk mine plan have changed. Interviews with the mine planning engineering staff (Dr. Hui Li) confirmed submersion or other appropriate isolation of high sulfide material remains an objective of current mine plan. Waste rock from the Aqqualuk Pit has been placed either in the Main Waste Stockpile or new waste stockpiles forming a berm around a portion of the Main Pit instead of the Main Pit as described in the CRP May 2009.	Update CRP and mine operating plan in 2014. TAK should work with agencies to determine need for additional geochemical studies and which SDs need to be updated to support CRP update. Management plans for water and reactive waste rock in the Main Pit need to be updated in the 2014 process to reflect current site conditions. The 2014 plan update should discuss current plan for mining high sulfide material and address any timing and volume issues.	BB	Report Section 4.2.1

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No.	Aspect/ Facility	Approval/ Permit	Permit Section	Requirement	Audit Objective/ Criteria	Finding	Observation	Recommendation	Auditor	Additional Report Info
54	Aqq Waste Rock	SD B2 WR Manage	Section 2	The most reactive waste from the Aqqaluk Pit will be segregated and placed below flood level in the Main Pit Stockpile.	1-TAK Reg Compliance	Update 2014	Water management in the Main Pit and sequencing in the Aqqaluk mine plan have changed. Interviews with the mine planning engineering staff (Dr. Hui Li) confirmed submersion or other appropriate isolation of high sulfide material remains an objective of current mine plan.	Update CRP and mine operating plan in 2014. TAK should work with agencies to determine need for additional geochemical studies and which SDs need to be updated to support CRP update. Management plans for water and reactive waste rock in the Main Pit need to be updated in the 2014 process to reflect current site conditions. The 2014 plan update should discuss current plan for mining high sulfide material and address any timing and volume issues.	GW	Report Section 4.2.1
55	Cover Design/Shale	SD B2 WR Manage	Section 4	Okpikruak Shale and portions of the Kivalina Shale are expected to be used for cover construction.	1-TAK Reg Compliance	Update 2014	The audit team reviewed SD B2 including related documents and plans and interviewed TAK staff on segregation of non-ore shales for use as dam construction material, closure cover material and/or disposal as waste rock. SD B2 provides for allowance for changes in waste management procedures in accordance with information gained over time. TAK has been in communication with agencies regarding waste rock segregation and plans to update waste management procedures (including segregation for final cover or facility construction) during the 2014 permit update process.	Update waste rock segregation criteria and schedule of waste, rock production and material requirements presented in the Waste Rock Management Plan with current site information and data in 2014 permit renewal process.	BB	Report Section 4.2.3
56	Cover Design/Shale	SD B2 WR Manage	Section 4	Segregate waste rock for use as dam construction cover materials and most reactive rock.	1-TAK Reg Compliance	Update 2014	The audit team reviewed SD B2 including related documents and plans and interviewed TAK staff on segregation of non-ore shales for use as dam construction material, closure cover material and/or disposal as waste rock. SD B2 provides for allowance for changes in waste management procedures in accordance with information gained over time. TAK has been in communication with agencies regarding waste rock segregation and plans to update waste management procedures (including segregation for final cover or facility construction) during the 2014 permit update process.	Update waste rock segregation criteria and schedule of waste, rock production and material requirements presented in the Waste Rock Management Plan with current site information and data in 2014 permit renewal process.	BB	Report Section 4.2.3
57	Geochem Charact	SD B2 WR Manage	Section 4	Samples will be collected from production blast holes to determine iron, lead, and zinc content.	1-TAK Reg Compliance	Update 2014	The audit team reviewed SD B2 including related documents and plans and interviewed TAK staff on segregation of non-ore shales for use as dam construction material, closure cover material and/or disposal as waste rock. SD B2 provides for allowance for changes in waste management procedures in accordance with information gained over time. TAK has been in communication with agencies regarding waste rock segregation and plans to update waste management procedures (including segregation for final cover or facility construction) during the 2014 permit update process.	Update waste rock segregation criteria and schedule of waste, rock production and material requirements presented in the Waste Rock Management Plan with current site information and data in 2014 permit renewal process.	BB	Report Section 4.2.2
58	Stpl - Main WR	SD B2 WR Manage	Section 3	Main Pit Stockpile reclamation may be possible in 2026.	1-TAK Reg Compliance	No Finding	Future Event, not audited.	Update CRP and SD B2 with current mine plan.	GW	Section 4.2.1
59	Stpl - Main WR	SD B2 WR Manage	Section 2	Construct stockpiles with 3:1 slopes.	1-TAK Reg Compliance	Positive/ In Conformance	Site observation and interviews conducted by the audit team confirmed that the general construction of stockpiles were completed with a 3:1 slope or in a manner that regrade can be accomplished without complications	Update CRP and SD B2 with current mine plan including results of MWS regrading and water management efforts in 2012-2013.	GW	Report Section 4.2.4
60	Stpl - Main WR	SD B2 WR Manage	Section 2	Main Waste stockpile constructed with room for seepage collection and buffer with creek.	1-TAK Reg Compliance	Update 2014	Observed recently constructed seepage collection facilities in the field.	Update CRP and SD B2 with current mine plan including results of MWS regrading and water management efforts in 2012-2013.	GW	Report Section 4.2.4
61	Stpl - Main WR	SD B2 WR Manage	Section 2	Main Waste stockpile resloping, cover placement, and re-vegetation to begin by 2009.	1-TAK Reg Compliance	Update 2014	The audit team observed the MWS regrading completed in 2013. Cover placement and re-vegetation plans are being revised and TAK plans to update the CRP and supporting documents to reflect current conditions and plans in 2014.	Update CRP and SD B2 with current mine plan including results of MWS regrading and water management efforts in 2012-2013.	EB	Report Section 4.2.4
62	Stpl - Main WR	SD B2 WR Manage	Section 3	Cover trials will be continued on Main Waste Stockpile in 2008. Monitoring instrumentation will be installed.	1-TAK Reg Compliance	Update 2014	The audit team observed the MWS regrading completed in 2013. Cover placement and re-vegetation plans are being revised and TAK plans to update the CRP and supporting documents to reflect current conditions and plans in 2014.	Update CRP and SD B2 with current mine plan including results of MWS regrading and water management efforts in 2012-2013.	GW	Report Section 4.2.4
63	Stpl - Main WR	SD B2 WR Manage	Section 3	Progressive reclamation is scheduled on the Main Waste Stockpile.	1-TAK Reg Compliance	Update 2014	The audit team observed the MWS regrading completed in 2013. Cover placement and re-vegetation plans are being revised and TAK plans to update the CRP and supporting documents to reflect current conditions and plans in 2014.	Update CRP and SD B2 with current mine plan including results of MWS regrading and water management efforts in 2012-2013.	GW	Report Section 4.2.4
64	Stpl - Ore	SD B2 WR Manage	Section 2	Low grade ore stockpile is designed to be expanded with mining of Aqqaluk and Qanaiyaq pits.	1-TAK Reg Compliance	No Finding	The design for expansion of the low grade ore stockpile was not evaluated during the audit.	Update CRP and SD B2 with current mine plan including Main WR Stockpile regrading effort completed in 2012-2013.	GW	
65	Stpl - Ore	SD B2 WR Manage	Section 3	Depending on conditions at closure, it may be possible to process ore in the Low Grade Stockpile.	1-TAK Reg Compliance	Update 2014	Discussions with TAK indicated that this is still under consideration and statement will be reviewed and updated accordingly during the 2014 permit renewal process	Update CRP and SD B2 with current mine plan including Main WR Stockpile regrading effort completed in 2012-2013.	GW	None
66	Stpl - Overburden	SD B2 WR Manage	Section 3	Overburden Stockpile may be used as cover material and therefore, revegetation of the Overburden Stockpile may not be implemented until the end of mining.	1-TAK Reg Compliance	Update 2014	Field observations and discussion with TAK staff indicated the Overburden Stockpile is still under consideration for cover material. TAK plans to update the CRP and related documents with any additional information during the 2014 permit renewal process.	Update CRP and SD B2 with current mine plan including Main WR Stockpile regrading effort completed in 2012-2013.	GW	None
67	Stpl - Oxide	SD B2 WR Manage	Section 3	Cover trials will be constructed on the Oxide stockpile in 2008. Monitoring instrumentation will be installed.	1-TAK Reg Compliance	Positive/ In Conformance	O'Kane Consultants Inc. was retained by TAK Alaska - Red Dog Mine to design and install a performance monitoring system for the Oxide Stockpile cover system around 2008. Two automated monitoring stations were installed on the west-facing slopes and plateau of the Oxide Stockpile. Data collected in the field included in situ matric suction, temperature, and water content, rainfall, net radiation, snowpack thickness, and net percolation. Monitoring results are reported in the annual WMP/RPA annual reports (2010, 2011, and 2012).	Update during 2014 permit process.	GW	None
68	TSF	SD B2 WR Manage	Section 3	Stockpiling material for tailings beaches cover at end of mine life.	1-TAK Reg Compliance	No Finding	Stockpiling of shales from developing the Aqqaluk Pit has not occurred to date. (See related items #24 and #71.)	Update CRP and SD B2 with current mine plan including actions to increase the stockpiling/storage of growth/cover materials.	GW	Report Section 4.2.5
69	TSF	SD B2 WR Manage	Section 4	Siksipuk Shale will be used for tailings dam construction.	1-TAK Reg Compliance	Update 2014	The audit team reviewed SD B2 including related documents and plans and interviewed TAK staff on segregation of non-ore shales for use as dam construction material, closure cover material and/or disposal as waste rock. SD B2 provides for allowance for changes in waste management procedures in accordance with information gained over time. TAK has been in communication with agencies regarding waste rock segregation and plans to update waste management procedures (including segregation for final cover or facility construction) during the 2014 permit update process.	Update waste rock segregation criteria and schedule of waste, rock production and material requirements presented in the Waste Rock Management Plan with current site information and data in 2014 permit renewal process.	BB	Report Section 4.2.3
70	Aqq Waste Rock	SD B2 - WR Manage	Sec 4. WR Class and Seg	The most reactive waste rock from the Aqqaluk Pit will be segregated and selectively placed below the flood level in the Main Pit Stockpile.		Non-Conformance	Waste rock from the Aqqaluk Pit has been placed either in the Main Waste Stockpile or other waste stockpiles forming a berm around a portion of the Main Pit instead of the Main Pit as described in the CRP May 2009.	Update CRP and mine operating plan in 2014. TAK should work with agencies to determine need for additional geochemical studies and which SDs need to be updated to support CRP update. Management plans for water and reactive waste rock in the Main Pit need to be updated in the 2014 process to reflect current site conditions.	BB	Report Section 4.2.1
71	Cover Design/Shale	SD B3 Tails Water	Sec 3.1.2	Segregation of Construction and Cover Materials.	1-TAK Reg Compliance	Improvement Needed	Shale as Cover Material: Discussion with Teck staff indicated that no segregation and stockpiling of different types of shale occurred during this permit period. The 2009 permit anticipated that shale type distinction would be apparent and significant quantities could be separated and stockpiled, which has not been the case.	Review goals for shale/cover characterization program and revise during permit renewal. The permit reissued for the next term should consider adding a stipulation to study the type and quantity of shale suitable as a cover material. Further defining shale characteristics and calibration of XRF instruments to read shale characteristics rather than ore should be part of the plan.	DY	Report Section 4.2.3
72	Stpl - Main WR	SD B3 Tails Water		Construction of improved MWS seepage collection system between dates of 2010 and 2026, timed with closure of the MWS.	1-TAK Reg Compliance	Update 2014	The changes to the MWS in 2013 included installation of seepage collection systems along the toe of the MWS. Field observation and interviews with TAK staff indicated a great deal of engineering and construction work had been done during the permit period to improve MWS seepage collections. The seepage collection sump at the southwest corner of the MWS was inspected in the field. The audit team suggested some improvement could be made to the system to ensure as much seepage from the MWS as possible is collected and sent to pre-treatment prior to entering the tailings pond. TAK staff indicated that the system was functioning as intended.	Update CRP and SD B3 with current mine plan including results of MWS regrading and water management efforts in 2012-2013.	GW	Report Section 4.2.4
73	TSF	SD B3 Tails Water	Sec 2.1	Closure design, no requirements. Conceptual spillway design for tailings at closure.	6-Financial Assurance	Update 2014	Audit team reviewed preliminary plans for an emergency spillway on Main Dam for water management and dam safety at closure.	Update CRP and cost estimate with current plans for an emergency spillway on the TSF dams for long-term closure management.	Eve	Report Section 4.2.5
74	TSF	SD B3 Tails Water	Sec 2.4	Tailings beach requirements to reduce seepage in conjunction with dust management.	1-TAK Reg Compliance	Update 2014	Improvements have been made to tailings deposition facilities that are supportive of the goal maintaining a tailings beach against the Main Dam during operations, along with controlling dust in the beach area.	Update tailings water management objectives and criteria during the 2014 permit renewal process to reflect current facility improvements and engineering information obtained since the last permit cycle.	DY	Report Section 4.2.5
75	TSF	SD B3 Tails Water	Sec 2.5	TSF water cover maintained at 2-foot depth.	1-TAK Reg Compliance	Update 2014	Improvements have been made to tailings deposition facilities that are supportive of the goal maintaining a two foot minimum water cover on the tailings facility.	Update tailings water management objectives and criteria during the 2014 permit renewal process to reflect current facility improvements and engineering information obtained since the last permit cycle.	DY	Report Section 4.2.5
76	TSF	SD B3 Tails Water	Sec 2.6	Tailings subaqueous deposition.	1-TAK Reg Compliance	Update 2014	Improvements have been made to tailings deposition facilities that are supportive of the goal of a wet closure cover for the facility.	Update tailings water management objectives and criteria during the 2014 permit renewal process to reflect current facility improvements and engineering information obtained since the last permit cycle.	DY	Report Section 4.2.5

Table 4-1 Red Dog Mine Facility Audit Waste Management Plan and Reclamation Plan Approval
 Prepared by AECOM January 2014
 Report Section 4.1, Table 4-1 Audit Observations, Findings and Recommendations

No.	Aspect/ Facility	Approval/ Permit	Permit Section	Requirement	Audit Objective/ Criteria	Finding	Observation	Recommendation	Auditor	Additional Report Info
77	TSF	SD B3 Tails Water	Sec 3.1	Pond volume reduction by 2025.	1-TAK Reg Compliance	Update 2014	Field observations and discussion with TAK staff indicated a focused effort is underway to reduce water on site to meet the objectives of the closure plan. Updates to the water monitoring tools (GoldSim, Pi) and improvements to the Main Pit pumping facilities were observed and discussed during the audit. During the on-site audit, the team observed that heavy rains that occurred in August 2012 resulted in an approximately 50 percent increase in the water volume stored in the tailings impoundment. When use of the Main Pit for water storage was taken into consideration, this overall increase in stored water volume for the entire mine site increased to 65 percent. Section II.10 of the 2013 COBC served as audit evidence of this increase in water storage at the tailings impoundment and Main Pit.	Update tailings water management objectives and criteria during the 2014 permit renewal process to reflect current facility improvements and engineering information obtained since the last permit cycle.	DY	Report Section 4.2.5
78	TSF	SD B3 Tails Water	Sec 3.1.1 & 3.1.2	Pre-treatment of largest sources of loadings.	1-TAK Reg Compliance	Update 2014	Pre-treatment of high TDS water is ongoing, with improvements having been made to the water treatment plan system during the permit period. The 2013 regrading of the MWS and improvements to the MWS seepage collection system were completed to capture and pre-treat largest sources of loadings.	Update tailings water management objectives and criteria during the 2014 permit renewal process to reflect current facility improvements and engineering information obtained since the last permit cycle.	DY	Report Section 4.2.5
79	TSF	SD B3 Tails Water	Sec 3.2	Re-alignment and final construction of Red Dog Creek Diversion.	1-TAK Reg Compliance	Positive/ In Conformance	Interviews with TAK environmental staff indicated that the upgrades required (96-inch conversion, heat-traced upgrade) were completed in a timely manner. Field observations: diversion has been undergoing changes with the start of mining of the Aqqaq Pit.	None	DY	None
80	TSF	SD B3 Tails Water	Sec 2	Required Dam Raises.	1-TAK Reg Compliance	Update 2014	TAK has accelerated the schedule for dam raises by at least 10 years. TAK is in the process of raising both the Main and Back Dams. Engineering design and construction was ongoing during the audit.	Permit applications and supporting materials for the next 5-year cycle need to reflect the current design of the Main Dam and Back Dam (final elevations of 993 feet).	BB	Report Section 4.2.5
81	Stpl - Main WR	SD C1 MWS Stability	All	Summary. No requirements.	5-TAK EMS Oversight	No Finding	The audit team reviewed this document and determined that the document contained no auditable conditions.	None	DY	None
82	TSF	SD C2 Geotech Drawings	All	Drawings. No requirements.	5-TAK EMS Oversight	No Finding	The audit team reviewed this document and determined that the document contained no auditable conditions.	None	DY	None
83	TSF	SD C3 Main Dam History	All	Summary. No requirements.	5-TAK EMS Oversight	No Finding	The audit team reviewed this document and determined that the document contained no auditable conditions.	The dam history and design reports cover the dam through a final crest elevation of 986 feet, which was the plan at the time of permit issuance. The current final crest elevation of the Main Dam is 993 feet. The design document history should be revised to reflect the current conditions.	DY	None
84	TSF	SD C4 Main Dam Raise	All	Study. No requirements.	5-TAK EMS Oversight	No Finding	The audit team reviewed this document and determined that the document contained no auditable conditions.	The Preliminary Conceptual Design Report covers the dam through a final crest elevation of 986 feet, which was the plan at the time of permit issuance. The current plan calls for a final crest elevation of the Main Dam at 993 feet. The report should be revised to reflect the current conditions.	DY	None
85	TSF	SD C5 Main Dam Stability	All	Design study. No requirements.	5-TAK EMS Oversight	No Finding	The audit team reviewed this document and determined that the document contained no auditable conditions.	The dam stability report covers the dam through a final crest elevation of 986 feet, which was the plan at the time of permit issuance. The current plan calls for a final crest elevation of the Main Dam at 993 feet. The report should be revised to reflect the current conditions.	DY	None
86	TSF	SD C6 Main Dam Seepage	All	Study. No requirements.	5-TAK EMS Oversight	No Finding	The audit team reviewed this document and determined that the document contained no auditable conditions.	The seepage report considers the Main Dam with a final crest elevation of 986 feet, which was the plan at the time of permit issuance. The current plan calls for a final crest elevation of the Main Dam at 993 feet. The report should be revised to reflect the current conditions.	DY	None
87	TSF	SD C7 Back Dam	All	Drawings. No requirements.	5-TAK EMS Oversight	No Finding	The audit team reviewed this document and determined that the document contained no auditable conditions.	None	DY	None
88	TSF	SD C8 Spillway	All	Design study. No requirements.	5-TAK EMS Oversight	No Finding	The audit team reviewed this document and determined that the document contained no auditable conditions.	The Spillway Design Report needs to be updated with the other engineering reports to reflect the current design target (final crest elevation 993 feet).	DY	None
89	Geochem Charact	SD D1 Studies Geochem	NA	Study. No auditable elements identified.	4-PermitEnvProtection	Update 2014	Geochemical characterization of ore and waste rock that was based on static acid-based accounting (ABA) and kinetic humidity cells tests. The audit revealed the testing followed standard protocols for geochemical characterization and were conducted by consulting firms familiar with the methodology of geochemical testing required by TAK for the Red Dog Mine waste rock and tailings.	Update geochemistry discussion in CRP with past 5 years' data results in 2014 permit renewal.	BB	Report Section 4.2.2
90	Geochem Charact	SD D2 Geochem Supporting		Study. No auditable elements identified.	4-PermitEnvProtection	Update 2014	Appendix D2 represents a supplemental report produced by SRK in 2006 in which the existing database was evaluated for possible geochemical trends in the waste rock seepage. SRK evaluated potential long-term trends based on expected geochemical processes operating in the waste rock piles and in the Main Pit. The report attempted to relate field data patterns to patterns seen in kinetic humidity cell tests.	Update geochemistry discussion in WMP and CRP to reflect anticipated changes in water treatment that will be required as oxidation products in the MWS change from sphalerite (zinc source) to pyrite (iron source).	BB	Report Section 4.2.2
91	Geochem Charact	SD D3 Aqqaq Geochem		Study. No auditable elements identified.	4-PermitEnvProtection	Update 2014	Audit reviewed the document where, in 2007, SRK completed a supplemental evaluation of the static ABA characteristics of over 1,000 drill core samples from the Aqqaq deposit to determine if the ARD potential of the main rock types was significantly different from those found in the Main Red Dog deposit being mined in the Main Pit. Based on this evaluation, SRK determined that the Kivalina Shale and the Okpikruak Shale were non-acid generating, while the Ikalukruk and Siksikpuk formations were potentially acid generating similar to the formations in the Main Pit. The latter two units comprise 58 percent of the rock units to be mined at Aqqaq. The Basal Mélange unit was observed to have static ABA results in the uncertain range; however, SRK concluded that this unit was not expected to be acid generating. The general conclusion drawn from the supplemental static ABA testing of Aqqaq drill core samples was that Aqqaq waste rock can be managed the same as waste rock from the Main Pit.	Update geochemistry discussion in CRP with past 5 years' data results in 2014 permit renewal.	BB	Report Section 4.2.2
92	Geochem Charact	SD D4 Lime Geochem		Study. No auditable elements identified.	4-PermitEnvProtection	Update 2014	Audit reviewed the document where SRK developed an equation to estimate the change in lime demand for water treatment as waste rock seepage chemistry begins to change from primarily a sphalerite oxidation process to a pyrite oxidation process. The lime demand calculations in Supporting Document D4 of the Closure and Reclamation Plan need to be expanded and supported with more detailed calculations, supporting documentation for the equation for lime requirement used in the calculations, and a calculation of acidity generated by sphalerite oxidation.	SD D4 does not support conclusion that the lime requirement for treating seepage from the MWS due to pyrite oxidation will be the same as the current lime requirement for sphalerite oxidation. In addition to updating with the most recent water treatment information, this study methodology should be improved.	BB	Report Section 4.2.2
93	Water-Bal & WT	SD E1 Water Balance	All	Study. No auditable elements identified.	4-PermitEnvProtection	Update 2014	The water and load balance model of SRK (2007) in Supporting Document SDE1 was completed using a Microsoft Excel workbook based on data available up to 2006 and is out-of-date. In the SRK water and load balance model, the modelers assumed that water quality from various sources would not change into the future. The audit team observed that TAK is no longer using the deterministic model entered into MS Excel to calculate water balance and loading. TAK is now using GoldSim instead. An examination of the MS Excel Model was acknowledged by TAK to be out of date. The audit team determined this MS Excel model for water loading and balance had several incorrect assumptions associated with it. The water balance and mass load program currently in use by TAK at the Red Dog Mine is the GoldSim software program managed by Mill Operations..	TAK to continue to develop Gold Sim model. Update 2014 CRP and permit documents to reflect improvement.	BB	Report Section 4.3.6
94	RD Creek Diversion	SD E2 Flood Middle RDC	All	Study. No auditable elements identified.	4-PermitEnvProtection	Update 2014	The Reclamation Plan for Red Dog Mine (including this E2 Flood Frequency Update) stated that it should be considered an interim document and that changes in mine operations and construction activities may warrant revisions. The previous analyses were conducted in 2000 and 2002 using data from that time period.	Considering the activities that have occurred at the site since the previous flood frequency analyses, including development of the Aqqaq Pit, regrading of the MWS and covering and seeding the Oxide Ore Stockpile, the analyses should be updated. The flood frequency model should be updated with 10 additional years of data.	GW	None
95	RD Creek Diversion	SD E3 RDC Div Plan	All	Design study. No requirements.	4-PermitEnvProtection	No Finding	Design document - no findings	None	DY	None
96	Water-Bal & WT	SD E4 Closure WT Meth	All	Study. No auditable elements identified.	1-TAK Reg Compliance	Update 2014	The Assessment of Water Treatment Methods for Closure provides a review of water treatment methods and was prepared in 2004 by SENES Consultants Ltd. In the assessment, SENES concluded that the addition of lime is the preferred method of water treatment for the Red Dog mine site both during operations and upon closure. The auditors determined that there have been several changes to the water treatment system since the 2009 Closure and Reclamation Plan was approved.	Update 2014 CRP and permit documents to reflect improvement in water treatment facilities and current monitoring data.	JD	Report Section 4.2.6
97	Water-Bal & WT	SD E5 WT Sludge Post Cls	All	Study. No auditable elements identified.	4-PermitEnvProtection	Update 2014	SD E5 projects annual sludge volume, puts forward the idea of using freezing to dewater sludge in the future, anticipates sludge density with opportunity for improvement if source controls are applied, and suggests practical repositories for sludge storage and disposal long term. Sludge disposal is an important aspect of the closure plan and closure cost because long-term water treatment is expected during the post-closure period.	SD E5 uses assumptions and information that is close to 10 years old. During the 2014 update process, this memo should be updated with current site water treatment studies and information to improve the 2014 closure plan and cost estimate with respect to long-term sludge disposal quantity, method and location.	EB	Report Section 4.2.6

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98	General Permit	SD F1 Sum CIs Options	All	Study. No auditable elements identified.	4- PermitEnvProtection	Update 2014	This document reports on the process that TAK used to develop the closure and reclamation plan.	Closure options should be reviewed and updated in accordance with current site conditions and changed assumptions during the 2014 CRP update process. Documenting the process is useful.	EB	None
99	Cover Design/Shale	SD F2 Eval Borrow	All	Study. No auditable elements identified.	2-TAK Controls Env Obj	Update 2014	The Evaluation of Borrow Resources is a memo dated 11/28/2005 that assesses the availability of materials potentially available to use as cover material for reclamation. The document includes projections on the volume materials that were anticipated to be generated by mining the main pit, an assessment of the geochemistry as the materials weather, and estimates of cover materials needed at closure. Audit observed that little material has been stockpiled for use at closure.	Revise this document in 2014 to reflect current conditions and knowledge. The revision should include any new information on the availability of materials suitable for reclamation and tie to any further chemical leaching work conducted in support of waste rock management.	GW	Report Section 4.2.3
100	Cover /Vegetation	SD F3 Reveg Plan 2007	All	No auditable requirements identified.	2-TAK Controls Env Obj	Update 2014	SD F3, the revegetation plan developed in 2007, was reviewed. SD F3 is clearly intended be revised through time. Numerous activities have taken place at the site that will assist in updating the plan. The costs presented in the Revegetation Plan were found to be out of date. The plan references a previous demonstration plot and a study of natural revegetation, both of which could be revisited to gain additional insight into long-term revegetation success.	The revegetation plan document should be revised to reflect the current state of knowledge and the unknowns that need to be investigated during the next authorization cycle. The revised revegetation plan should take into account the activities that have occurred at the site since the plan was developed in June 2007, including development of the Aqqualuk Pit, regrading of the Main Waste Stockpile and covering and seeding the Oxide Ore Stockpile. Costs associated with revegetation will need to be updated as part of the 2014 Closure and Reclamation Plan revision. An updated document should consider integrating the methodologies being used to monitor natural revegetation in areas impacted by fugitive dust (see Fugitive Dust Management Plan). An updated Revegetation Plan should address the identification of alternative cover materials in the event that adequate volumes of Kivalina and Okpikruak shales are not identified and segregated while removing waste rock from the Aqqualuk Pit. Once vegetation has been established on reclaimed areas, monitoring could be similar to that being used to monitor vegetation re-establishment in areas impacted by fugitive dust.	GW	None
101	Closure Cost Estimate	SD F3 Reveg Plan 2008	All	Study. No auditable requirements identified.	6-Financial Assurance	Update 2014	The costs presented in SD F3 Revegetation Plan are out of date.	Update closure cost estimate with revised revegetation plan and updated costs.	JC	Report Section 4.3
102	Closure Cost Estimate	SD G Demo Cost 2004	All	No auditable requirements identified.	6-Financial Assurance	Update 2014	Based on interviews with TAK personnel, evidence suggests that the demolition cost estimates developed in 2004 need to be updated.	Review and update demolition closure costs.	JC	Report Section 4.3
103	General Permit	SD H Eco Risks 2008	All	Study. No auditable requirements identified.	4- PermitEnvProtection	Update 2014	TAK contracted Exponent in 2007 to conduct an ecological risk assessment for fugitive dust originating from operations at the mine and the DeLong Mountain Transportation System (Exponent 2007). SD H specifically addresses the evaluation of ecological risk within the air/solid waste permit boundary. The document was intended to support the previous permitting process; findings and observations to related ongoing efforts regarding ecological risk are captured in the Fugitive Dust Management. The document is now out of date; for example, a report dated July 2006 is the most recent date presented in the document's Appendix D, Chronology of Dust Control Improvements to the Red Dog Mine Operation.	Update SD H. The appendix was current with the last CRP 2009; however, it is now out of date.	GW	None
104	Geochem Charact	SD I - Monitor Plan	2.4.3 Geochem,	Supporting Document I - Red Dog Mine Waste Management, Reclamation and Closure Monitoring Plan, Section 2.4.3 Geochemical Monitoring, Table 2-6: Waste Rock Segregation Criteria.	1-TAK Reg Compliance	Update 2014	TAK has modified the criteria for waste rock segregation and no longer uses the calculated sulfur content of 6% or greater for definition of "most reactive waste rock". This is evident in their 2012 annual report. This modification of the segregation criteria is in response to a waste rock fire due to high levels of zinc and iron in close proximity and the fact that waste rock from Aqqualuk is predominately acid generating and thus reactive.	The modified waste rock segregation currently being used by TAK and discussed in their 2012 annual report should be submitted for approval and included in the 2014 updated CRP.	BB	Report Section 4.2.2
105	Water - Monitoring	SD I Monitor Plan	All	Monitoring in SD I Waste Management, Reclamation and Closure Monitoring Plan dated May 2009 is adopted by the WRMP and RPA. Monitoring related to the WMP and RPA is done in accordance with SD I.	4- PermitEnvProtection	Update 2014	The Waste Management, Reclamation and Closure Monitoring Plan prepared in May 2009 provides sufficient detail to create a roadmap for monitoring and reporting in compliance with the WMP/RPA. The Quarterly and Annual reports submitted by TAK to the agencies indicate compliance with the monitoring and reporting requirements. A comprehensive review of whether monitoring results are sufficiently analyzed, trends are established and appropriate adaptive management response measures were taken are outside the scope of this audit.	The Monitoring Plan will need to be reviewed and updated with current site information and monitoring results collected during the permit period. Table 2-6 in Supporting Document I (Monitoring Plans) to the RPA needs to be updated to reflect current waste segregation practices at the Red Dog Mine.	JD	None
106	Water - Monitoring	SD I Monitor Plan	2.1	Biomonitoring Program - aquatic life monitoring at defined locations within Bons and Red Dog Creek drainages.	4- PermitEnvProtection	Positive/ In Conformance	The aquatic life aspect of biomonitoring is conducted by the Alaska Department of Fish and Game and reported annually in stand alone reports published by ADFG. The 2010 - 2012 annual reports include sample results from the water quality aspect of the sampling program for the preceding year (included as Appendix A).	Continuation of existing program.	GW	None
107	Water - Monitoring	SD I Monitor Plan	2.2	Monitoring of permafrost and sub-permafrost temperatures (thermistors) and sub-permafrost groundwater levels (piezometers) quarterly at locations defined in Tables 2-3 and 2-4.	4- PermitEnvProtection	Improvement Needed	Data are collected and reported as required on a quarterly basis. The Quarterly and Annual reports submitted by TAK to the agencies indicate compliance with the monitoring and reporting requirements.	Continuation and potential refinement of monitoring program. See item 47 above.	GW	None
108	Water - Monitoring	SD I Monitor Plan	2.3	Mine Water Management - requires reporting of flows collected from mining areas, stockpiles, and diversion systems. Includes aspects of flow, quality, water and load balances (compared to modeled flows and chemical loadings), visual monitoring of water management facilities weekly and of the fish weir twice per year.	4- PermitEnvProtection	Update 2014	Water quality data are collected and reported as required on a quarterly basis. The annual reports include revised GoldSim models, which are used to model the water balance at the site. The recording of weekly inspections was verified during the audit. Inspection reports included the fish weir.	Continuation of existing program.	GW	None
109	Water - Monitoring	SD I Monitor Plan	2.4	Waste Rock Management - requires reporting quantities and location of materials placement, geochemical testing, weekly visual monitoring.	4- PermitEnvProtection	Positive/ In Conformance	Water quality data are collected and reported as required on a quarterly basis. The annual reports include revised GoldSim models, which are used to model the water balance at the site. The recording of weekly inspections was verified during the audit. Inspection reports included the fish weir.	Continuation of existing program.	GW	None
110	Water - Monitoring	SD I Monitor Plan	2.5	Tailings Management - requires reporting quantities and location of materials placement, geochemical testing, weekly visual monitoring.	4- PermitEnvProtection	Positive/ In Conformance	The annual reports (years 2010, 2011 and 2012 reviewed) report quantities of tailings produced monthly for the previous quarter including an analysis of percent zinc, lead, and iron. The report includes water elevations within the tailings pond for the previous quarter, reported on a weekly basis.	Continuation of existing program.	GW	None
111	Water - Monitoring	SD I Monitor Plan	2.6	Inert Solid Waste Landfills - requires reporting calculations of volumes of materials placed; visual inspections of facility and loads; report site development plans annually.	4- PermitEnvProtection	Positive/ In Conformance	The annual reports (years 2010, 2011 and 2012 reviewed) report quantities of inert solid waste placed in the solid waste landfills. See Item 46 above as it relates to the submittal of site development and use plans.	Continuation of existing program. See Item 46 above as it relates to the submittal of site development and use plans.	GW	None
112	Water - Monitoring	SD I Monitor Plan	2.7	Mining and Milling Activities - requires reporting to ore removed and processed and volumes waste rock and tailings generated.	4- PermitEnvProtection	Positive/ In Conformance	The annual reports (years 2010, 2011 and 2012 reviewed) report tones of ore mined and tones of ore milled by month for the previous quarter.	Continuation of existing program.	GW	None
113	Water - Monitoring	SD I Monitor Plan	2.8	Reclamation - requires reporting of areas disturbed/reclaimed; research related to reclamation and monitoring activities associated with reclamation.	4- PermitEnvProtection	Positive/ In Conformance	The annual reports (years 2010, 2011 and 2012 reviewed) report areas disturbed and describe research and monitoring activities for the preceding year.	Continuation of existing program.	GW	None
114	Water - Monitoring	SD I Monitor Plan	2.9	Dust Monitoring - ties requirements from the Fugitive Dust Risk Management Plan to the overall monitoring program.	4- PermitEnvProtection	Positive/ In Conformance	The annual reports (years 2010, 2011 and 2012 reviewed) report the monitoring activities for the previous quarter and studies conducted at the site (or in effect) during the preceding year.	Continuation of existing program.	GW	None
115	Water - Monitoring	SD I Monitor Plan	2.10	Wildlife Monitoring - established reporting requirements for wildlife interactions stating monitoring is conducted as part of the weekly visual monitoring process.	4- PermitEnvProtection	Improvement Needed	The 2010 Annual Report indicated that no wildlife interactions or casualties were reported during the previous quarter; the 2011 and 2012 Annual reports indicated that no wildlife interactions or casualties were reported during the previous reporting period.	The shift in the language for reporting from "previous quarter" to "reporting period" is a minor issue but since the monitoring plan does not state a reporting frequency (only that TAK "has procedures in place") the plan should be clarified in regards to reporting periods as part of upcoming permit renewal process.	GW	None
116	Water - Monitoring	SD I Monitor Plan	2.11	Defines the water quality parameters related to the sampling required as part of the biomonitoring and water management monitoring requirements.	4- PermitEnvProtection	No Finding	None - water quality sample parameters tied to items 106 and 108 above.	Continuation of existing program.	GW	None
117	Water - Monitoring	SD I2 Water QAP	All	Quality assurance/quality control protocols.	5-TAK EMS Oversight	Update 2014	The detailed information about sample collection and analyses and associated QA/QC procedures appeared appropriate to the audit team. Based on evidence reviewed on-site, the QAP appeared to be implemented as described.	The QAPP should be updated to reflect any changes to permit requirements, including the renewal of APDES Permit No. AK003865-2 in 2013.	JD	None
118	General Permit	SD I3 Aquatic Life Mon	All	Defines methodology and QA/QC procedures for biomonitoring program.	5-TAK EMS Oversight	Update 2014	Drafted by ADF&G in support of the 1998 NPDES permit. Aquatic sampling is conducted by ADF&G and documented in annual ADF&G biomonitoring reports. Audit verified submission of reports but did not verify QA/QC procedures were being observed.	Continuation of existing program.	GW	None
119	Water - Monitoring	SD I4 Assay Lab QA SOP	All	Assay Lab Quality Assurance Practices.	5-TAK EMS Oversight	No Finding	Auditing the QA/QC procedures at the assay lab was outside the scope of the audit	None	JD	None
120	Fish Weir	SEP - FishWeir	All	Inspect integrity of fish weir twice annually. Also tied to EPA's Special Environmental Project requirements.	2-TAK Controls Env Obj	Positive/ In Conformance	Fish weir inspections are submitted to ADNR as part of the quarterly reports as verified in the 3rd quarter report July 1, 2011 through September 31, 2011 during the ADNR File Review .	None	GW	None

No.	Aspect/ Facility	Approval/ Permit	Permit Section	Requirement	Audit Objective/ Criteria	Finding	Observation	Recommendation	Auditor	Additional Report Info
121	Water-Indust WT	WaterUse		TAK water use is confined to ADNR water use permit authorization.	1-TAK Reg Compliance	Positive/ In Conformance	The TAK water use permits were reviewed. TAK staff was interviewed and confirmed that water use at the site is confined to the ADNR permits. TAK has obtained the following water rights: LAS 1453 - for Bons Reservoir (Bons Creek, Main Stem Red Dog Creek and South Fork Red Dog Creek), LAS 25095 – for Mainstem Red Dog Creek (main pit), LAS 25096 – for South Fork Red Dog Creek (tailings impoundment). The ADNR water section has also approved temporary water use authorizations for mine- and exploration-related activities in the vicinity of the project. Temporary water use permits issued to date are as follows: TWUP F2008-07, TWUP F2010-72, TWUP F2012-132, TWUP F2012-133, TWUP F2012-134, TWUP F2012-135, and TWUP F2012-136. TAK has applied for temporary water use permits TWUP F2013-136, TWUP F2013-137, and TWUP F2013-211, which are still under review by ADNR.	TAK should update the status of water rights for the 2014 CRP update.	GW	None

4.2.1.2 Audit Finding Discussion

The disposal of waste rock from the Aqqaluk Pit is not entirely consistent with the 2009 CRP and, therefore, the RPA. Waste rock from the Aqqaluk Pit is being placed either in the MWS or waste stockpiles forming a berm north of the MWS and west of the Main Pit. Waste placement in these areas is consistent with the 2009 CRP. The use of the Main Pit for water management eliminated the opportunity to dispose of the most strongly acid-generating waste rock in that location, is not consistent with the 2009 CRP. Auditors did not find TAK reports to agencies clearly made agencies aware of the change to waste rock management with regard to the Aqqaluk Pit waste rock resulting in a finding of non-conformance.

4.2.2 Aspect: Geochemistry

Additional detail on the aspect of geochemistry is presented in this section. SD B2 Plan of Operations for Waste Rock Management, SD D1-SD D4 regarding geochemistry, and SD I Monitoring Plan are all documents that support the aspect of site geochemistry for the 2009 CRP. Additionally, the RPA contains a requirement for a Waste Rock Management QA/QC Plan that is related to geochemistry. This discussion supports audit records **Nos. 32, 33, 34, 57, 89, 90, 91, 92, and 104** presented in **Table 4-1**.

4.2.2.1 Audit Observation Discussion

Geochemical Waste Rock Segregation Methodology

The geochemical method of determining how waste rock is segregated described in the 2009 CRP documents differs from what is currently being done at the site. SD B2 and SD I Table 2-6, state that the method to be used to segregate waste rock involves calculating sulfur percentage from zinc, iron, and lead minerals to determine if the waste rock is classified as reactive waste or non-reactive waste. If the total calculated sulfur is greater than 6.0 percent, the waste rock is segregated as reactive waste. Reactive waste is unsuitable for construction or for use in raising the level of the dams. According to the 2012 Annual Report and a review of quarterly waste rock sampling data sheets, TAK has modified its approach to identify the waste to be segregated and currently uses the zinc and iron contents of waste rock rather than the calculated sulfur percentage.

Interviews with the TAK Environmental Department indicated that the change in methodology was done for two main reasons: 1) zinc and iron control the amount of calculated sulfur because lead is minor in abundance in most waste rock samples and 2) the waste rock fire² of 2012 showed that high concentrations of zinc and iron can lead to a galvanic reaction not unlike the galvanic process noted in the kinetic humidity cell tests (see SD D1). Thus, identifying waste for segregation based on zinc and iron content provides the same ability to segregate waste based on its ARD "reactive" nature and allows TAK to prevent waste rock with high concentrations of iron and zinc from being placed in close proximity to incompatible waste rock within the stockpiles. TAK modified its waste rock segregation practices to address these issues, and presented the revised practices in the 2012 Red Dog Mine Annual Report. This revised segregation practice uses the iron and zinc contents of the waste rock, as determined from blast hole and drill hole sample analyses, to more definitively separate waste rock appropriate for construction use from the waste rock considered reactive waste.

² During 2012, a waste rock fire occurred in the MWS. TAK stated the waste rock fire was caused by a combination of meteoric water infiltrating the MWS during the summer of 2012 causing local chemical reactions in the dump. A large enough volume of waste rock with particularly high concentrations of zinc and iron was sufficient to support combustion in the presence of an adequate volume of aquatic infiltration.

Geochemical Trends and Long Term Lime Water Treatment

SD D2 Supporting Geochemical Review and Interpretation, represents a supplemental report produced by SRK in 2006 in which the existing database was evaluated for possible geochemical trends in the waste rock seepage. SRK evaluated potential long-term trends based on expected geochemical processes operating in the waste rock piles and in the Main Pit. SD D2 reports decreasing oxidation of sulfides over the same time as the depletion of carbonate buffering in pit walls and waste rock and solubility product effects for lead and zinc sulfates.

Based on the site's geochemistry, TAK anticipates long-term geochemical changes in seepage water for the MWS as a result of the galvanic interaction of sphalerite and pyrite; as well as the consumption of sphalerite over the long term. The change from sphalerite oxidation (zinc source) to pyrite oxidation (iron source) would result in an acceleration of pyrite oxidation, an increase in iron and sulfate in the seepage water, and a decrease in pH. The early loss of buffering materials results in the pH declining and then remaining relatively stable at low values. As a result, TAK will need to be prepared to adjust its treatment of MWS seepage water in order to accommodate the changes in seepage water chemistry beginning around 2016 to 2020.

The information on changing seepage geochemistry over time developed in SD D2 supports SD D4 Lime Requirements and Predicted Geochemical Changes. SD D4 develops an equation to estimate the change in lime demand for water treatment over time. Lime use in water treatment is a significant closure cost component and the audit team's observation on review of SD D4 is that this report lacked sufficient detail for full evaluation of the assumptions related to the calculation of the lime demand.

Analyses presented in the SD D documents anticipate that the lime demand for water treatment of sphalerite-dominated oxidation was approximately the same lime demand for water treatment of pyrite-dominated oxidation products. Currently, sphalerite oxidation controls the chemistry of the MWS. A review of the evidence provided in the analysis led the auditors to conclude that the reason SRK determined that the lime demand did not differ significantly based on the type of oxidation resulted from the assumption that the molar masses of zinc and iron would be approximately the same. Therefore, when zinc was replaced by iron in the lime demand equation, the amount of lime demanded in each oxidation scenario did not vary. Acidity in sphalerite oxidation does not appear to have been calculated in the same manner as that for pyrite oxidation, based on the audit review of SD D documents. Further, the auditors could not find details regarding how SRK developed its equation for lime demand. The auditors found that other constituents; such as, aluminum, manganese, and magnesium were not discussed or considered as part of the lime demand calculations.

In the equation for lime demand presented in SD D4, pH has a dramatic effect on lime demand because it is an exponential function. The change from sphalerite oxidation from pyrite oxidation could result in a decrease in pH of one to three standard units in the MWS seepage. This was not discussed in the SD D documents.

Waste Rock Management QA/QC Plan

The RPA contains a project-specific stipulation under the title SD B2 - Plan of Operations for Waste Rock Management Plan that requires TAK to develop a Waste Rock Management QA/QC Plan within 90-days of the issuance of RPA approval for ADNR for review and approval. The audit team reviewed the Red Dog Mine Waste Rock Management Procedures QA/QC plan (TAK 2012a) that was retrieved from the SiteLine EMS by the TAK OSC. The SiteLine EMS entry indicated the plan had been issued to ADNR and approved. The QA/QC plan reviewed is referenced with a document ID and revision number in the footer of the document; however, the document was not set up to indicate a date of the last revision or indicate if it was approved by ADNR. Data presented to agencies in the quarterly and annual reports as required by WMP and RPA (e.g., 2012 Annual Report, Feb 28, 2013 Appendix C) is collected by the Geology Department purportedly using this QA/QC procedure. The audit team could

find no reference to the QA/QC procedure in the quarterly or annual reports to the agencies or other related documents to indicate the data reported is collected under the approved QA/QC procedure.

4.2.2.2 Audit Finding Discussion

The audit team reviewed the reports related to geochemistry and, based on professional experience with similar reports; found that the studies were adequate for the time they were written. All documents related to geochemistry and waste rock characterization should be updated with the most current information during the 2014 permitting process. Attention should be given to adequately documenting assumptions in the updated reports in sufficient detail for review.

During the 2014 update process, particular attention should be given to assuring the geochemical method of segregation of waste rock in approved documentation reflects what is being done on site. The changes in methodology since the 2009 approval of the RPA and issuance of the WMP have likely improved waste rock handling at the site and should be incorporated into a revision to the 2014 CRP.

The lime demand calculations in SD D4 need to be expanded and supported with more detailed calculations, supporting documentation for the equation for lime requirement used in the calculations, and a calculation of acidity generated by sphalerite oxidation. The presentation does not support the conclusion that the lime requirement for treating seepage from the MWS due to pyrite oxidation will be the same as the current lime requirement for sphalerite oxidation.

TAK should improve its documentation (and procedures, if necessary) to assure the QA/QC procedure being used on site for waste management segregation has been approved by ADNR as required by the RPA. The QA/QC procedure in use by the Geology Department (TAK 2012a) should be the version of the document that has been approved by the ADNR. Entry in the SiteLine EMS entry indicating compliance with the RPA stipulation should clearly indicate the date of QA/QC procedure approval by ADNR. The QA/QC procedure document should be formatted to clearly indicate date of revision and add the date the document was approved by agencies. TAK should make a statement in the quarterly/annual reports that the data presented has been collected under the most recent, agency approved QA/QC procedure in accordance with the RPA.

4.2.3 Aspect: Final Cover Design for Stockpiles – Oxide Stockpile, Main Waste Stockpile, Overburden Stockpile, Shale Segregation

Additional detail on the subject of final cover design and shale segregation (for use in final cover) is presented in this section. This discussion supports audit records **Nos. 16, 21, 22, 23, 24, 25, 55, 56, 71, and 99** as presented in **Table 4-1**.

4.2.3.1 Audit Observation Discussion

2009 CRP, Section 3.1.3 specifies a cover design based on previous investigations provided in SD F1 and SD F2. The 2009 CRP cover plan is to construct the final reclamation cover for the waste rock and ore stockpiles using 18 inches of compacted non-reactive shale and 18 inches of lightly compacted non-reactive shale. The plan calls for using Okpikruak and Kivalina shales with less than 0.1 percent zinc and non-acid generating qualities as cover material. The cover infiltration rate was designed to be 15 percent or less. The pilot reclamation cover on the Oxide Stockpile was evaluated by O'Kane (2013) and found to be saturated after the 2012 summer rainy season. The estimated infiltration rate for the saturated pilot cover was in excess of the design rate of less than 15 percent. The evaluation of the pilot test cover on the Oxide Stockpile by O'Kane (2013) suggests a need for the State and TAK to reevaluate the design to determine whether any changes may be necessary to ensure that during post-closure, TAK will not face water management problems from waste rock drainage due to excessive infiltration and drainage.

Segregation and evaluation of final cover material is specified in a number of the permits and documents audited as noted in audit records **Nos. 24, 25, 55, 56, and 71**. Segregation of shale for cover is a

requirement in the RPA under the section entitled SD B2 on page 10 of 13 that states: "...Okpikruak Shale and Kivalina Shale shall be segregated where practicable, and stockpiled separately unless otherwise approved by ADNR..." (see audit record No. 24). TAK stated that no segregation of shale materials occurred during this permit period. Shale materials suitable for cover were not stockpiled during the permit period. TAK indicated that Okpikruak and Kivalina shale have not been encountered in developing the Aqqaluk Pit. However, TAK indicated that an inability to distinguish shale types was a significant reason for not segregating shale material for cover. When the 2009 CRP and permit conditions were developed, TAK anticipated that it would have the ability to distinguish between shale types suitable for cover from those unsuitable for cover. TAK also assumed an adequate quantity could be separated and stockpiled. To date, these assumptions proved to be incorrect. TAK indicated during the audit that re-calibration of field instruments set to delineate the ore during mining could be done to assist in segregating shale types for cover in the future.

TAK indicated in conversation that there may be a lack of adequate storage capacity to segregate growth media contributing to the lack of cover stockpile. The auditors note that reclamation costs could be impacted if an adequate volume of shale cover materials are not salvaged during mining and cover material needs to be acquired from a borrow source during the closure period.

The RPA Project-specific Stipulation, Section 3.1.3, Waste and Ore Stockpiles (page 8 of 13) states "Prior to the placement of covers on additional stockpile areas, including any test covers, Teck Alaska Incorporated shall submit to ADNR plans that are developed to minimize infiltration into the waste rock material and metal loading in surface runoff." The auditors observed that while TAK has re-graded, covered, and re-seeded the Oxide Ore Stockpile, it is not necessarily the final configuration for that facility. TAK has evaluated the runoff water quality of Kivalina and Okpikruak shale in barrel tests conducted in association with the Oxide Ore Stockpile reclamation. Zinc and iron observed in runoff water quality tests warrant additional monitoring. TAK provided a memo for review indicating that Kivalina shale barrel tests have been initiated. An ACZ Laboratories, Inc. memo dated September 11, 2012, documented results of the barrel tests and TAK indicated that additional tests would be done in the future based on these results.

4.2.3.2 Audit Finding Discussion

The performance of the cover design on the Oxide Stockpile as assessed in O'Kane 2012 is not consistent with the infiltration design criteria presented in 2009 CRP 3.1.3 and supporting documents. Finding: update plans in 2014 in accordance with recent studies.

TAK is not segregating shale for cover in accordance with the RPA for a number of reasons noted above. TAK did not indicate that agencies had been advised of the lack of shale segregation and stockpiling during the permit period. TAK should discuss the current operational conditions regarding cover segregation and evaluation with agencies and update stockpiling plans, cover material design plans and reclamation costs accordingly. Finding: Improvement needed.

4.2.4 Main Waste Stockpile Recontouring and Water Management

Additional detail on the subject MWS recontouring and water management is presented in this section. This discussion supports audit records **Nos. 59, 60, 61, 63, and 81** as presented in **Table 4-1**.

4.2.4.1 Audit Observation Discussion

Efforts to reduce infiltration of precipitation and air into the MWS were initiated in late 2012. Recontouring the MWS for proper drainage and compacting the MWS material were completed in mid-2013 shortly before the audit. The MWS regraded slope, surface drainage, seepage collection and associated facilities were observed in the field by the audit team.

Discussions with TAK indicated that the MWS regrading and recently updated seepage collection system was primarily driven by the Source Control (Pre-ARD) program under the APDES Permit and the associated ADEC Compliance Order by Consent (COBC) (ADEC 2013). While compliance with the APDES Permit and the COBC were outside the scope of this audit, the regrading and surface water and seepage management system changes recently completed on the MWS potentially affect the site closure plan, 2009 CRP and supporting documents (including closure cost estimates) and audit observations are made on the MWS in that context.

The SD B2 Waste Rock Management Plan, Section 2 Stockpile Construction Plan and Section 3 Stockpile Progressive Management Plan contain a number of specific dates and plans for the MWS cover trials and progressive reclamation. The site conditions and permit requirements (including requirements under the APDES Permit discussed above) have changed significantly. The schedules and requirements in SD B2 are either partially met or entirely out of date.

The design and implementation of the recent recontouring of the MWS were done within the intent of SD 1. Discussions with TAK indicated that the current re-grade of the final MWS is not necessarily the final closure re-grade profile. Additionally, final covering and revegetation of the newly regraded MWS is currently in the planning stage. A document entitled the 2012 TDS Management Plan submitted to agencies in the 2012 Annual Report describes the concept of 3 feet of cover material and revegetation on the MWS. This cover has not been scheduled pending evaluation of the recent work completed.

Surface water drainage systems have been constructed on the MWS as part of the regrading effort. TAK indicated some uncertainty around the long-term performance of the synthetic liners on some of the drainage channels. Slopes have been regraded to 3:1 or better as specified in SD B2, to limit surface water erosion. The audit team observed that the Oxide Stockpile was experiencing some rilling at a 3:1 slope.

An updated seepage collection system on the MWS has been installed in conjunction with the 2013 recontouring project and the work completed under the COBC including a related memo regarding selenium management (TAK 2013c). A document associated with the APDES permit entitled TDS Management Plan Source Control (TAK 2013d) includes discussion of the MWS infiltration reduction project and seepage control system and was reviewed. Changes to the MWS of seepage collection systems along the toe of the MWS were discussed with TAK. Field observations and interviews with TAK staff indicated a great deal of engineering and construction work had been done during the permit period to improve MWS seepage collections. Further, the COBC was signed during the permit period and TAK has been in the process of meeting the related requirements of selenium source control contained in the COBC. The seepage collection sump at the southwest corner of the MWS was inspected in the field. The audit team suggested some improvement could be made to the system to ensure as much seepage from the MWS is collected and sent to pre-treatment prior to entering the tailings pond. TAK staff indicated that the system was functioning as intended.

4.2.4.2 Audit Finding Discussion

The 2012-2013 MWS recontour and water management changes (including seepage collection upgrades) have been completed in general compliance with the 2009 CRP and supporting document SD B2. Design criteria to prevent surface erosion for final reclamation of stockpiles (e.g., slope, contour, vegetation) should be reviewed during the 2014 permit renewal process to incorporate rilling observed on the Oxide Stockpile. Finding: update closure plan and cost estimates in the 2014 process to reflect the significant work that has been done on the MWS since the last permitting.

4.2.5 Aspect: Tailings Storage Facility and Certificates of Approval to Operate a Dam

Additional detail on the Tailings Storage Facility (TSF) and the certificates of approval (COAs) to operate the dams related to the TSF and two other certified dams is presented in this section. This discussion supports audit records **Nos. 2-13, 40, 82-88, 68, 69, and 73-80** as presented in **Table 4-1**.

4.2.5.1 Audit Observation Discussion

TAK holds COAs from ADNR to operate a dam for the following four facilities on the site:

- Bons Creek Freshwater Dam – ADNR No. AK00200
- Red Dog Tailings Dam (also referred to as the Main Tailings Dam) – ADNR No. AK00201
- Red Dog Back Dam (also referred to as the Back Tailings Dam) – ADNR No. AK00303
- Mine Water Diversion Dam (also referred to as the Red Dog Creek Dam) – ADNR No. AK00260

TAK obtains separate certificates of approval from ADNR for any modifications, major repairs, removal or abandonment of any of the dams. The authority for these requirements is per statutory provisions in AS 46.17 and administrative regulations in 11 ACC 93.

The audit team made on-site observation of all four dams. Active construction projects were observed at the Main Tailings Dam and Back Dam including repairs/upgrades to the Main Tailings Dam seepage collection system and ongoing raises to the Main Tailings Dam and Back Dam. All four dams appeared to be well maintained.

The audit team made a brief examination of numerous representative documents regarding the dam raises including safety analyses, designs and reports and determined that requirements of the COAs are generally being met. Specifically, the auditors found that TAK is performing periodic safety inspections and has operation and maintenance plans in place for the Main Tailings Dam, the Back Dam, Freshwater Dam, and Diversion Dam.

A spot-check of SiteLine EMS showed that it contains the required dam safety-related inspection and emergency planning reports and documentation; however, records did not include documentation of Emergency Action Plan (EAP) requirements. TAK verbally indicated EAP requirements, such as annual training, were being met. The URS Periodic Safety Inspection Report No. 4, NID#AK00201, dated October 15, 2010, for the Main Tailings Dam, reviewed during the audit, makes detailed reference to all of the inspection forms and data collection and reporting as being up to date and submitted to ADNR when required and otherwise available in TAK files on-site. The URS does not address the EAP activities.

SD B3 Plan of Operations for Tailings and Water Management found within the 2009 CRP includes the following key elements related to the long-term operational integrity and safety of the TSF (specifically Main Tailings Dam) that are relevant to assuring that key environmental objectives are met:

- The existing tailings beach along the upstream face of the Main Tailings Dam will be expanded to at least 600 feet (or more if required by ADNR or determined beneficial by TAK) to reduce seepage through and under the dam. This measure will promote stability of the main dam by reducing piezometric pressures within the dam and its foundation, and extend longevity of the seepage pumpback system by reducing the required pumping rate and quantity (see Audit Record No. 74).
- Preliminary plans have been developed for an emergency spillway to be constructed at the Main Tailings Dam upon completion of production. The auditor found that the criteria currently planned for the emergency spillway were extremely conservative and should provide a high level of protection against overtopping of the dam and uncontrolled releases under the most severe hydrologic events (see Audit Record No. 73).

Both of these elements are important to ensuring the operational life and safety of the tailings facility meet the objective of permanent containment of the tailings on-site, and maintaining the ability to retain a pool over the tailings over the long-term. The audit team reviewed documents and interviewed TAK staff as to the status of documents and plans pertaining to both the tailings beach and emergency spillway.

Engineering and construction plans have been developed over the since approval of the 2009 CRP and WMP and the TAK Environmental Department representative stated that TAK plans to include updates in the 2014 permit process.

4.2.5.2 Audit Finding Discussion

The audit team concluded that the overall intent and key elements of the dam safety, operation and maintenance requirements in the COAs are being met. Significant engineering and construction has been completed or in progress during the permit period, particularly activities that affect the closure plan for the Main Tailings Dam, and Back Dam, including long-term water management, emergency spillways, tailings beach and seepage collection below the Main Tailings Dam. TAK stated that they will update closure plan documents to reflect these changes in the 2014 permit renewal process.

4.2.6 Aspect: Water Balance, Water Contaminate Loading, GoldSim Software, Water Treatment

Additional detail on audit observations regarding water management is presented in this section. The following discussion focuses on water balance, water contaminant loading, GoldSim software, and water treatment and supports audit records **Nos. 17, 42, 93, and 97**, as presented in **Table 4-1**.

4.2.6.1 Audit Observation Discussion

Water management, including water balance, contaminant loading, water treatment and release is an important aspect of operations and closure planning at the Red Dog site. As noted in Section 1.3, Audit Area Boundary, Focus and Exclusions, the audit scope did not include compliance related to discharge of treated wastewater through Outfall 001 covered under the state of Alaska APDES Permit.

SD E1- E5 (Water Management), dealing with water management, were reviewed in preparation for and during the audit. Interviews with TAK, review of recent annual reports to agencies, and review of studies and other documents supporting the COBC process confirmed that TAK has and continues to focus a significant amount of work on tracking and managing the water balance, water quality and water treatment processes on site. The water treatment plants have been upgraded during the term of the existing permits. A project to use Goldsim software to track and forecast water balance and contaminant loading site wide has been initiated by the site water team³ to replace or augment older spreadsheet methods. The Mill Operations Department is the manager of the Goldsim water management model. All of the SD E documents (E1-E5) are out of date because of the progress TAK has made in understanding water management issues during the permit period. During the 2014 permit process, the water management SDs should all be reviewed and updated to reflect current knowledge and conditions.

SD E1 Red Dog Water and Load Balance is a memo from SRK dated March 15, 2007, presenting an annual water and load balance model for the Red Dog tailings impoundment and water treatment requirements in support of developing the 2009 CRP. **SD E1** was completed using a Microsoft Excel workbook based on data available up to 2006. The modelers assumed that water quality from various sources would not change into the future. The modelers included flow estimates and water quality in the event of a mine shutdown in 2012, as well as for mine closure in 2031. The model is deterministic based on assumptions that involve a constant water quality over time. It does not consider the expected change in MWS drainage water quality due to the switch from sphalerite to pyrite-driven oxidation and leaching anticipated around 2016 to 2020. The audit team observed that TAK is no longer using the deterministic model entered into MS Excel to calculate water balance and loading. TAK has replaced the MS Excel model with GoldSim, a probabilistic modeling software package. TAK is currently updating the hydraulic

³ The “water team” consists of representatives from different departments to ensure that operations, environmental, and management personnel are regularly engaged to identify and resolve issues related to water management.

and loading input data fed into GoldSim. GoldSim can easily be adapted to changes in the water balance and can perform Monte Carlo simulations for evaluating the statistical variations in water balance and mass balance due to engineering and environmental changes. TAK should document how they are using this approach to water and mass loading balance for the Red Dog Mine into the next revision of the CRP.

SD E4 Assessment of Water Treatment Methods for Closure is a report prepared by SENES Consultants in November 2004. **SD E4** provides a review of water treatment methods used in support of the 2009 CRP. In the assessment, SENES concluded that the addition of lime is the preferred method of water treatment for the Red Dog mine site both during operations and upon closure. In SD E4, SENES concludes that water treatment efficiency could be improved by collecting higher strength water from the mine sump or Main Waste seepage and treating it prior to discharge into the tailings pond. SENES anticipated that all of the current treatment plants will be available for use, and various configurations are possible at closure. SENES left open the possibility to either modify one of the three plants or construct entirely new components at closure. The water treatment reagent requirements in the document reflect the final water and load balance anticipated in 2009. As discussed above, these 2004 assumptions are now out of date. A document similar to the SENES report should be prepared to support the permit renewals using updated information available.

Through discussion with TAK, the audit confirmed that there have been a number of changes to the water treatment system since preparation of the 2009 CRP. These changes were either anticipated in the CRP and supporting documents or otherwise discussed with appropriate agencies and reported in required reports. Selected observations concerning site water treatment follow:

- WTP#1 was modified to have the capability to work in parallel with WTP#2, to treat water for discharge through APDES Outfall 001. The impetus for this modification is understood to be an increase in TDS concentrations in site water. TAK does not expect that the volume of water to be treated or discharged will increase significantly on an annual basis. However, an increase in sludge is expected due to the higher TDS concentration.
- WTP#1 was also modified to treat seepage water from the MWS during the term of the permit. WTP#1 has been operational treating MWS seepage since October 2012 (2012 TDS Management Plan Progress Report and Updated Management Plan).
- Modifications to WTP#1 allowed the site to treat MWS seepage on a year-round basis, negating the need for changes to WTP#3 for winter operation.
- WTP#2 continued to be the primary treatment plant for treating water for discharge through APDES Outfall 001 during the permit period. The audit team toured the WTP#2 facility with TAK operators and the field observation of the overall system, including the clarifier and sand filter, indicated that WTP#2 is operated and maintained to a high standard.
- WTP#3 continued to be used during the permit period to pre-treat high TDS/impacted water on site prior to holding in the TSF pond for further treatment by WTP #1 or #2. Pre-treatment in this manner follows recommendations in **SD E4** in 2004. The SD E4 recommendations served as a basis for the upgrades to WTP#2, WTP#3 and the associated MWS seepage capture system function.

SD E5 Assessment of Methods for Managing Post-Closure Water Treatment Sludge is a memo prepared by SRK in November 2004 in support of developing the 2009 CRP. The memo projects annual sludge volume, puts forward the idea of using freezing to dewater sludge in the future, anticipates sludge density with opportunity for improvement if source controls are applied, and suggests practical repositories for sludge storage and disposal long term. Sludge disposal is an important aspect of the closure plan and closure cost because long-term water treatment is expected during the post-closure period. The SD E5 uses assumptions and information that are close to 10 years old. During 2014, this

memo should be updated with current site water treatment studies and information to improve the 2014 closure plan and cost estimate with respect to long-term sludge disposal quantity, method and location.

Water Balance Audit Team Field Observations: The team noted that the seepage pump system at southwest corner of MWS has recently been upgraded as part of the MWS regrading and seepage collection system project in 2012/2013. The audit team observed that some minor upgrades to the pump collection basins and pump configurations would ensure the maximum quantity of seepage is collected for pre-treatment prior to management on the TSF. Additionally, installing a flow meter at the southwest corner of the MWS seepage collection facility would provide a means to collect valuable baseline data on quantity of MWS seepage that occurs both over time and in response to particular weather events. Periodic sampling of seepage water quality should also be considered. Seepage water quality and quantity data collected now could serve to calibrate and refine the water balance model for the closure plan and closure plan cost estimate.

4.2.6.2 Audit Finding Discussion

The **SD E1-E4 Water Management** documents are out of date because of the progress TAK has made in understanding water management issues and upgrading facilities during the permit period. During the 2014 permit process, the water management SDs should all be reviewed and updated to reflect current knowledge and conditions. The 2014 closure plan and closure cost estimate should then be updated based on the updated water management studies.

4.2.7 SiteLine Environmental Management System (SiteLine EMS), On-site Facility Condition Observations

Additional detail on audit observations regarding the SiteLine EMS is presented in this section. This discussion supports audit records **Nos. 32** and **48** as presented in **Table 4-1**.

4.2.7.1 Audit Observations Discussion

TAK's SiteLine EMS is the primary compliance monitoring software tool for ensuring environmental responsibilities are met at the Red Dog Mine. The SiteLine EMS is a centralized database where Environmental Department compliance files are stored and where future compliance tasks are scheduled, assigned and tracked to completion. The searchable data base provides a "one-stop" file system for finding completed compliance documents including agency reports, technical studies, facility inspections, project files and environmental facility maintenance. While the SiteLine EMS is overseen by the Environmental Department, the system is accessible by any department on site. The SiteLine EMS can be set to send reminders to the person assigned to a task, thereby providing a mechanism to avoid tasks being forgotten or inadvertently delayed.

The OSC used the SiteLine EMS to retrieve numerous documents at the audit team's request. The audit team observed the OSC reviewing key tasks related to the audit and it was apparent the system has been in use for several years with success in tracking compliance tasks to completion.

The SiteLine EMS is periodically reviewed and frequently updated. The system is easily updated and some minor changes were made by the OSC during the audit. During the audit process, an improvement to modify the SiteLine EMS to provide notification to both the responsible party (the mine operations department) as well as the "owner" of the task was identified and discussed with the OSC. SiteLine is currently configured so that a single person within a specific department is assigned task responsibility. The system, as presently configured, has no mechanism to assign secondary, or backup, personnel to the task. This creates a situation where critical tasks may be overlooked or may not be addressed in a timely manner.

Due to time constraints, it was not possible for the audit team to make a detailed inspection of all on-site facilities supporting compliance with the permits within audit scope. However, the OSC gave the audit

team a drive by tour of the major facilities subject to the permits as well as those supporting permit compliance. The general impression of the audit team is that TAK is operating and maintaining mining and environmental control facilities effectively.

The audit team took the opportunity to make some detailed observations on the SiteLine EMS system. The team identified two items as follows:

1. In reviewing the SiteLine EMS, it was noted that operations personnel were assigned a specific task that fed into preparation of the closure and reclamation plan required for the WMP. While Mine Operations was the appropriate department to complete the task, the Environmental Department was directly responsible for assuring the task was completed on time. In its present configuration, SiteLine EMS only notifies Mine Operations of the task status. In the event that Mine Operations was unable to complete the task by the assigned deadline, the Environmental Department could potentially be unaware, which in turn could lead to missed permitting deadlines. Improving the SiteLine EMS to provide feedback to the Environmental Department (task "owner"), if the task was not completed by the Mine Operations Department (task "doer") would be a better control, since the item and its timing is ultimately a compliance issue "owned" by the environmental department.
2. The audit team audited the Red Dog Mine Water Diversion Dam with a site representative and noted that the main ditch intercepting runoff from the waste dumps was in need of a clean out. It appeared that the buildup of sediment in the ditch could result in impacted runoff jumping the ditch berm and entering Red Dog Creek, rather than being channeled to the pump station per the facility design. The audit team used this opportunity to observe the effectiveness of the SiteLine EMS and other procedures that provide for maintenance tasks to be completed for permit compliance. The team verified with TAK that regular inspections of the condition of environmental facilities were being made and documented on the Red Dog Mine Site Monthly/Semi-annual Pollution Prevention Inspection Form. Additionally, the team established through this sampling exercise that corrective actions are entered and tracked to completion through the SiteLine EMS. However, the particular need for clean-out of the particular ditch at the Final Red Dog Diversion Dam was not noted on the inspection form or entered into the SiteLine EMS. The need for a related improvement on a different protective berm was noted on the inspection form and scheduled in the SiteLine EMS; however, it appeared the task had not been completed at the time of the audit.

4.2.7.2 Audit Finding Discussion

The Site Line EMS system was found to be robust, well maintained tool, and used system allowing TAK to successfully facilitate compliance monitoring, recordkeeping, and reporting. The system has been used for many years to assign responsibilities and track whether the assignments within the system were being completed. Conversations with the OCS indicated regular improvements to the Site Line EMS will continue to be made, including a large upgrade to occur in the immediate future. The system is effective and, combined with regular ongoing monitoring activities, provides reasonable assurances that the environmental objectives are being met.

TAK should continue improvement of the EMS.

4.3 Closure Cost Estimate Document Review

AECOM performed a desktop review of the closure cost estimate and financial assurance documents following the on-site portion of the audit, as described in Section 2.5. This section presents the results from that desktop exercise.

4.3.1 Consistency with State of Alaska Cost Estimating Guidelines Observations, Findings, and Recommendations

The closure cost estimates and their basis are presented in SD J1 (closure), SD J2 (post-closure) and SD J3 (suspension). Each of these documents reference state guidelines for estimating costs as the basis for financial assurance. The closure cost estimates were prepared for TAK by SRK Consulting in May 2009 and describe the scope, quantities, unit costs and indirect costs for both planned closure and premature closure. The closure cost estimate is tied to the 2009 CRP, also prepared by SRK Consulting in May 2009. SD G is a demolition cost estimate prepared by Denison Environmental Services in 2004 that feeds into the SD J1 cost estimate.

To ensure the audit addresses all relevant requirements established by the State, the audit team requested the State of Alaska Financial Assurance Guidelines from ADNR, which are referenced in SD J1, J2, and J3. ADNR provided a document titled, "DRAFT Mine Closure and Reclamation Cost Estimation Guidelines" (ADNR.2009). The audit team noted that Supporting Documents J1, J2, and J3 are dated May 2009, which pre-dates the November 2009 guidelines supplied by the ADNR. For purposes of the audit, AECOM assumed that the November 2009 guidelines supplied by ADNR are similar to any guidelines that were in effect in May 2009 as referenced in the Supporting Documents.

The State's cost estimating guidelines constitute "...a broad list of provisions that might apply at mines; all provisions are not meant to apply to all mines." Given this statement about applicability, the audit team considered any deviations between the ADNR's guidelines and the cost estimates in SD G, SD J1, SD J2, and SD J3 as reflective of specific conditions and requirements for the Red Dog mine.

Key elements in the State's cost estimating guidelines and a comparison to the cost estimates for the Red Dog mine are summarized in **Table 4-2**:

Table 4-2 Closure Cost Estimate Consistency with State of Alaska Guidelines

ADNR Cost Estimating Requirements	Cost Estimates for Red Dog Mine Audit Observation	Finding	Recommendation
<p>Cost estimating tools/platforms – Step 2 of the State’s guidelines mention the use of Cross-Linked Spreadsheets as the platform for developing cost estimates.</p>	<ul style="list-style-type: none"> The cost estimates for suspension, closure, and post-closure care and maintenance for Red Dog mine were developed as three separate workbooks, each of which contains “cross linked” worksheets. Within each workbook, the links between spreadsheets was spot checked for accuracy; no errors were identified. 	<p>Positive/ In Conformance</p>	<p>None</p>
	<ul style="list-style-type: none"> While the State’s guidelines specifically mention the use of spreadsheet-based estimates, they do not include or exclude other available tools that have been developed for estimating costs of mine closure and post-closure care and maintenance. Standardized mine reclamation cost calculating spreadsheets in other jurisdictions have advanced during the permit period such as 1) the Department of the Interior Office of Surface Mining (DOI OSM) Mine Bond Calculator; (2) the Nevada Standardized Reclamation Cost Model (SRCE); and (3) the Reclamation Cost Estimating Model (ReCLAIM) developed by SRK and Brodie Consulting. Use of standardized cost estimating tools allow for more effective reviews and comparison to like projects. 	<p>Positive/In Conformance</p>	<p>The State should consider revising the estimating guidelines to a more standard mine cost estimating tool for mine closure.</p> <p>[Note: The State is in the process of updating and revising its cost estimating guidelines which includes linkage to the SRCE cost model.]</p>

Table 4-2 Closure Cost Estimate Consistency with State of Alaska Guidelines

ADNR Cost Estimating Requirements	Cost Estimates for Red Dog Mine Audit Observation	Finding	Recommendation
<p>Labor rates - Labor rates for equipment operators should be obtained from the most current issue of the "Laborers' and Mechanics' Minimum Rates of Pay" published by the State of Alaska, Department of Labor and Workforce Development, Wage and Hour Administration.</p> <ul style="list-style-type: none"> • Base hourly rates should be adjusted to reflect assumed overtime schedule for closure activities. • Labor rates should be compared to 'industry standard wage rates' and the higher rates should be used in the reclamation cost estimate. 	<ul style="list-style-type: none"> • Supporting documents J1, J2, and J3 state that "...labor rates for an independent contractor were built up from base hourly rates presented in Issue 15 (effective September 1, 2008) of the Laborers' and Mechanics Minimum Rates of Pay. • The Unit Costs worksheet references a file named "Red Dog Wage Analysis 3-3-09.xls". This worksheet was not included within the cost estimate files; as such, the labor rate calculations were not verified as part of this audit effort. • The Unit Costs worksheet provides a single value for Fringes + Burden + OT Adjustment. The formulas were not provided in the worksheet, and the detailed calculations were not verified as part of this audit. • The Unit Costs worksheet shows hourly rates for contractor and TAK workforces. It is not clear whether this data is intended to satisfy the comparison to industry standard wage rates. 	<p>Positive/In Conformance</p>	<p>Include detailed back up worksheets as appendix in 2014 update to closure cost estimates for completeness.</p>

Table 4-2 Closure Cost Estimate Consistency with State of Alaska Guidelines

ADNR Cost Estimating Requirements	Cost Estimates for Red Dog Mine Audit Observation	Finding	Recommendation
<p>Equipment rates – hourly operating costs are to be based on <u>average</u> fuel, lubrication and wear items, and maintenance costs. The costs must be adjusted to account for higher costs in Alaska and particularly at remote sites.</p>	<ul style="list-style-type: none"> Supporting documents J1, J2, and J3 state that "...Equipment rates were based on ...2009 monthly rental rates provided by NC Machinery. The base NC Machinery rates were reduced by 5% to account for a fleet discount". Documentation supporting the equipment rental rates was not included in the Basis of Estimate reports or the Excel workbooks. Reference is made to a memorandum to the Red Dog file from Steve J. McGroarty, PE dated March 19, 2009 that was not verified as part of this audit. Fuel factors for each type of equipment represent the average fuel consumed per hour per horsepower. It is unclear whether fuel consumption was adjusted to reflect more severe operating conditions in northern Alaska. 	<p>Positive/In Conformance</p>	<p>Include detailed back up worksheets as appendix in 2014 update to closure cost estimates for completeness.</p>

Table 4-2 Closure Cost Estimate Consistency with State of Alaska Guidelines

ADNR Cost Estimating Requirements	Cost Estimates for Red Dog Mine Audit Observation	Finding	Recommendation
<p>Fuel and materials – prices for fuel and materials should be based on project-specific vendor quotes. Fuel costs should be inclusive of all costs for handling and shipment of the fuel from the point of purchase to the final point of use.</p>	<ul style="list-style-type: none"> • The unit price for fuel is based on the “average of the price paid for fuel delivered to Red Dog port over the five-year period from 2004 to 2008.” The calculations underlying the fuel price were not provided in the Basis of Estimate reports or the Excel workbooks and were not reviewed as part of this audit. • Unit prices for materials are provided along with references in the Unit Cost Inputs worksheet. <ul style="list-style-type: none"> ○ Various items are referenced to RS Means 2005; the worksheets do not indicate whether the 2005 prices were escalated to 2009 dollars. ○ Various items are referenced to quotes from suppliers & vendors. Copies of the quotes were not included in the Basis of Estimate reports and were not reviewed as part of this audit. • The closure cost estimate is presented in United States dollar (USD). Unit prices for materials are denominated in both USD and Canadian (CAD). It is unclear why currency exchange rates are applied to prices taken from sources that are expressed in USD (for example, RS Means prices are in USD, but has the currency exchange rate factor applied as if it were a CAD unit price). 	<p>Positive/In Conformance</p>	<p>Include detailed back up worksheets as appendix in 2014 update to closure cost estimates for completeness.</p>

Table 4-2 Closure Cost Estimate Consistency with State of Alaska Guidelines

ADNR Cost Estimating Requirements	Cost Estimates for Red Dog Mine Audit Observation	Finding	Recommendation
<p>Demolition – "...it is recommended that operators obtain site-specific quotes for the demolition of structures from a contractor that has mine/mill demolition experience in the arctic and sub-arctic." Salvage values are not to be considered as a credit in closure cost estimates.</p>	<ul style="list-style-type: none"> The demolition cost estimates presented in Supporting Document G were prepared by Denison Environmental Services (DES), a firm that specializes in mine closure work. Salvage values were not included as a credit in the closure cost estimates. It appears that the cost estimate developed by DES was incorporated into the Ore Processing & Infrastructure worksheet in the closure cost estimate. However, it was not clear how this was done and why the costs in the Supporting Document J1 differ from the costs in Supporting Document G (e.g., the total estimated cost for Water Treatment Plant #1 Area is \$34,328 in SD J1, and \$37,860 in SD G). 	Positive/In Conformance	Include detailed back up worksheets as appendix in 2014 update to closure cost estimates for completeness.
<p>Contractor Profit – reasonable profit margins range from 10% of total direct costs for larger reclamation projects to 20% for smaller projects.</p>	<ul style="list-style-type: none"> The demolition, closure, and post-closure cost estimates include a profit allowance of 10%, which appears to be appropriate given the magnitude of the respective work. 	Positive/In Conformance	None

Table 4-2 Closure Cost Estimate Consistency with State of Alaska Guidelines

ADNR Cost Estimating Requirements	Cost Estimates for Red Dog Mine Audit Observation	Finding	Recommendation
<p>Performance and Payment Bond – usually estimated at 1.5% of total direct costs (including mobilization, demobilization, profit and overhead).</p>	<ul style="list-style-type: none"> • The demolition estimate includes an allowance of \$50,000 for bonding. This amount equates to 0.4%, which is approximately 73% less than the 1.5% allowance suggested by the State’s guidelines. • The closure cost estimate includes an allowance of 3% of the direct and some of the indirect cost elements. This allowance is twice the allowance suggested in the State’s guidelines. • The post-closure cost estimate does not indicate whether an allowance for bonding is included. If it is excluded, the rationale should be provided in the Basis of Estimate report. 	Improvement Needed	Review performance and payment bond allowances during 2014 update and conform to State guidelines or provide rationale for exceptions
<p>Liability Insurance – should be included as an allowance of 1.5% of the total estimated labor costs for the project.</p>	<ul style="list-style-type: none"> • The demolition cost estimate does not indicate whether insurance is included. • The closure cost estimate includes insurance at 1.6% of labor. The rationale for a slightly higher insurance allowance than the value specified in the state’s guidelines is not provided in the Basis of Estimate report. • The post-closure estimate includes insurance at 1.6% of “manpower and mobile equipment”. The rationale for a slightly higher insurance allowance and the rationale for including mobile equipment in the calculation are not provided in the Basis of Estimate report. 	Improvement Needed	Review liability insurance allowances during 2014 update and conform to State guidelines or provide rationale for exceptions

Table 4-2 Closure Cost Estimate Consistency with State of Alaska Guidelines

ADNR Cost Estimating Requirements	Cost Estimates for Red Dog Mine Audit Observation	Finding	Recommendation
<p>Contract Administration – may range from 2% to 7% of total direct costs depending on the size of the overall bond, the level of complexity of the work, and the anticipated duration of active reclamation.</p>	<ul style="list-style-type: none"> • The demolition estimate includes an allowance of \$200,000 for contract admin. It was not possible to check this amount as a percent of total direct costs. The amount is 1.6% of the total estimated demolition contract amount; as such the contract admin allowance appears to be adequate. • The closure cost estimate includes an allowance of 1% of direct and select indirect costs for “state management and oversight costs.” It is not clear whether these costs are the same as “contract administration. • The Basis of Estimate report for post-closure estimate includes \$90,000 per year for “state contract management”. The Summary worksheet shows an allowance of \$140,000. It is unclear which amount is correct. The \$140,000 shown in the worksheets equates to 1.3% of the annual cost; this allowance likely is appropriate given the long-term nature of the post-closure work. 	<p>Positive/In Conformance</p>	<p>None</p>

Table 4-2 Closure Cost Estimate Consistency with State of Alaska Guidelines

ADNR Cost Estimating Requirements	Cost Estimates for Red Dog Mine Audit Observation	Finding	Recommendation
<p>Contingency – "...the project must include a contingency allowance to cover unanticipated costs..."</p> <ul style="list-style-type: none"> The contingency allowance should only cover non-catastrophic unexpected and unforeseeable events." Contingency should be separated into "scope" and "bid" contingencies. Scope contingency should address uncertainty inherent in producing a closure design. Bid contingency addresses the cost uncertainty inherent in actual construction or implementation. 	<ul style="list-style-type: none"> The demolition cost estimate in Supporting Document G includes a 15% contingency allowance. The Mine, Tailings, and Ore Processing & Infrastructure worksheets include a 20% allowance. The estimates for Water Treatment include a 10% contingency allowance. A contingency allowance is included on the Summer Power Consumption worksheet of the post-closure estimate. It is unclear whether a contingency is applied elsewhere in the post-closure estimate. The rationale for selecting the contingency allowance is not provided in the Basis of Estimate reports. The cost estimates do not separate contingency into the scope and bid categories as suggested by the State's guidelines. While the State's guidelines delineate between scope and bid contingency, they do not provide mine operators with instructions or guidelines for setting appropriate contingency allowances. 	<p>Improvement Needed</p>	<p>Review contingency allowances during 2014 update and conform to State guidelines or provide rationale for exceptions</p> <p>The State should consider whether additional guidelines for contingency allowances would add value in the State's determination of the level of financial assurance required for mining projects (in general). If so, resources such as AACE International Recommended Practice No. 40R-08, Contingency Estimating – General Principles may be an appropriate resource to consult.</p>

Table 4-2 Closure Cost Estimate Consistency with State of Alaska Guidelines

ADNR Cost Estimating Requirements	Cost Estimates for Red Dog Mine Audit Observation	Finding	Recommendation
<p>Inflation – to ensure that the bond amount stays current in terms of real dollars, an inflation factor over the five year period should be applied to the sum of the direct, indirect, interim care and maintenance, and site care and maintenance costs. The inflation factor is to be based on the average consumer price index for Anchorage over the preceding five years.</p>	<ul style="list-style-type: none"> • SD G does not indicate whether inflation was included in the demolition cost estimate. • The Unit Cost Inputs worksheet indicates that “inflation” was included in indexing labor rates to 2008 dollars. This use of the term “inflation” is more correctly characterized as “escalation” or “indexing” in which historical costs are increased to reflect prices at the time of estimate preparation. Since the estimate was prepared in 2009, it is unclear why the labor rates were indexed to 2008 and not to 2009 dollars. • Cell B99 of the Maintenance Materials worksheet in SD J3 includes an “inflation” adjustment of 1.218. This adjustment also should be considered indexing and not future inflation. Also, it was noted that the formulas in SD J3 do not appear to use the inflation factor in cell B99. • According to the State’s guidelines, inflation should be included to the mid-point of the five year permit period. Since the permit was issued in 2009, the mid-point would be 30 months later (approx. May 2012). Inflation should be prospective (i.e., current year (CY) dollars increased to CY+2.5 dollars). Inflation to CY+2.5 dollars should be additional to any indexing of historical unit prices to current year dollars. 	<p>Improvement Needed</p>	<p>Review inflation calculations during 2014 update and assure terminology is accurate; conform to State guidelines or provide rationale for exceptions</p>

Table 4-2 Closure Cost Estimate Consistency with State of Alaska Guidelines

ADNR Cost Estimating Requirements	Cost Estimates for Red Dog Mine Audit Observation	Finding	Recommendation
<p>The permit applicant or mine operator is responsible for providing all information necessary to validate and support the reclamation plan and closure cost estimates.</p>	<ul style="list-style-type: none"> • Documentation supporting the equipment rental rates was not included in the Basis of Estimate reports or the Excel workbooks. Reference is made to a memorandum to the Red Dog file from Steve J. McGroarty, PE dated March 19, 2009 that was not reviewed as part of this audit. • The calculations underlying the fuel cost were not provided in the SDs or the Excel workbooks. As such, it was not possible to verify the value used in the estimates for this key consumable. • Quotes for materials were not provided in an appendix to the SD reports. 	<p>Improvement Needed</p>	<p>Include detailed back up worksheets as appendix in 2014 update to closure cost estimates for completeness.</p>
<p>References and data sources used in the estimation of the closure bond should be specifically cited in the appropriate section of the closure cost estimate.</p>	<ul style="list-style-type: none"> • The SD reports and the Excel workbooks are annotated with key references 	<p>Positive/In Conformance</p>	<p>None</p>

Table 4-2 Closure Cost Estimate Consistency with State of Alaska Guidelines

ADNR Cost Estimating Requirements	Cost Estimates for Red Dog Mine Audit Observation	Finding	Recommendation
<p>Basis of Estimate Report – should cover the 1-year site holding period, closure costs during the period of active reclamation, and any post-closure costs associated with long-term water treatment or site management and monitoring requirements. The content should include the elements specified in the guidelines.</p>	<ul style="list-style-type: none"> SD G, SD J1, SD J2, and SD J3 constitute the Basis of Estimate (BOE) reports for the Red Dog mine. Each of the reports is organized according to the content items listed in the State’s guidelines. The State’s guidelines do not encompass all of the items commonly included in a BOE report. AACE International Recommended Practice No. 34R-05, Basis of Estimate, includes a number of elements not addressed in the State’s guidelines such as: Exclusions, Exceptions, Risks and Opportunities, Management Reserve, Reconciliation, Estimating Team, and Quality Assurance. 	<p>Positive/In Conformance</p>	<p>The State should consider whether additional topics noted in the observation would add value in the State’s determination of the level of financial assurance required for mining projects (in general).</p>

4.3.2 Bond Amount Calculations Observations, Findings and Recommendations

The amount of financial assurance required for the Red Dog mine was calculated by the State of Alaska based on the cost estimates for suspension, closure and post-closure presented in SD J1, SD SD J2, and SD J3. The State's calculations are contained in an Excel workbook titled "Red Dog NPV Calc 2009-5-15.xlsx", which is reproduced in **Table 4-3**.

Table 4-3 Red Dog Mine Financial Assurance 5/15/2009

Years <i>(after suspension of mining)</i>	Suspension <i>(site maintenance and ongoing water treatment)</i>	Closure Earthwork and other Reclamation	Closure Water Treatment	Post-Closure <i>(perpetual annual water treatment)</i>	Cash Flows	Net Present Value <i>(at a 4.3% estimated real rate of return)</i>
1	\$13,290,000				\$13,290,000	\$305,150,000
2	\$13,290,000				\$13,290,000	
3	\$13,290,000				\$13,290,000	
4	\$13,290,000				\$13,290,000	
5	\$13,290,000				\$13,290,000	
6		\$25,900,000	\$7,850,000		\$33,750,000	
7		\$25,900,000	\$7,850,000		\$33,750,000	
8 and beyond				\$10,540,000	\$255,656,279	

Source: SD J.

Cash flow for year 8 equals the present value of an account that earns \$10,540,000 annually in perpetuity plus first year post-closure expenses of \$10,540,000.

The annual amounts for Suspension and for Closure Water Treatment presented in **Table 4-3** agree with the annual costs in SD J3. However, the total for Closure Earthwork and other Reclamation in **Table 4-3** is \$51.8 million; this amount does not tie to the total amount of \$47.0 million for Planned Closure or the \$51.0 Million for Premature Closure shown in SD J1. An explanation of the difference between the amounts presented in Supporting Document J1 was not provided in the available documents. The annual cost for Post-closure (i.e. water treatment) presented in **Table 4-3** agrees with the \$10.54 million for Premature Closure shown in SD J2. The State used the annual cash flows shown in the table above to calculate the Net Present Value (NPV) of the amount of the required financial assurance.

Recommendation: TAK should assure the cost estimate documents developed during the 2014 permit renewal process are consistent, or provide an explanation as to why they differ.

A key input to the NPV calculations is the discount rate or rate of return. In calculating the NPV, the State used a real rate of return (i.e., net of inflation) rather than a nominal rate of return (i.e., exclusive of inflation). Using a real rate of return is appropriate when cash flows are expressed in current year dollars. In June 2009, the ADNR requested that the Department of Revenue Treasury Division provide an estimated real rate of return to determine the funding needed to cover the total treatment and monitoring costs. The State Comptroller recommended a real rate of return of 4.3%, which "targets a nominal rate of return of 8%, using an asset allocation of 43% fixed income, 41% domestic equity, 15% international

equity and 1% cash equivalents.”⁴ The nominal rate of return assumes 3.5% inflation and estimated management and treasury fees of 0.2% as recommended by actuaries, Buck Consultants.

The methodology used by the State appears to be specific to the Red Dog mine; as such, the methodology is not a general determination that would apply across the mining industry. Since the audit was focused on the Red Dog mine, comparing the rate of return for the Red Dog mine with the rate of return determinations for other mines was outside the scope of the audit. **Recommendation:** Rather than setting rates of return on a mine-specific or project-specific basis, the State should consider establishing a uniform process for determining the real rate of return for financial assurance that would apply across the mining industry.

The real rate of return recommended by the Department of Revenue is based on an asset allocation that includes 56% exposure to equity markets (41% domestic and 15% international). Some financial assurance programs (e.g., hazardous waste facility closure under the Resource Conservation & Recovery Act) typically assume a risk free rate of return based on appropriate duration US Treasuries. As a general matter, the State should consider whether inclusion of market risk is appropriate when determining the rate of return for financial assurance calculations for mine closure cost estimates.

The NPV calculations include two major components. The first component is the annual cash flows in the first seven years after suspension of mining. The NPV for the first seven years were calculated by discounting the annual cash flow using the 4.3% real rate of return. Since \$13.29 million of cash will be expended in the first year following suspension of mining, that cash will not be available for long-term investing (or it would be invested in very short duration instruments with reduced rates of return).

Recommendation: The State should consider revising the NPV calculation methodology to begin discounting at an appropriate point and using an appropriate discount rate after suspension of mining.

The second major component of the NPV calculation addresses perpetual cost for water treatment beginning in the eighth year after suspension of mining. The funding for water treatment was calculated by capitalizing the \$10.54 million annual cost using the 4.3% real rate of return. The capitalized amount was then discounted to the beginning of the cash flow model using the 4.3% real rate of return.

The finding of “Positive/In Conformance” is made in general for the bond amount and calculations. The audit team recommends that the observations above be considered and addressed during the 2014 audit update.

4.3.3 Financial Assurance Documentation Observations

The audit included review of the Mining Reclamation Bond documentation. The bond documentation provided by the State indicates that financial assurance in an aggregate amount of \$305,150,000.00 was secured via three letters of credit. The aggregate amount of the letters of credit agrees with the total NPV calculated by the State. The letters of credit were not reviewed, however, the bond documents appear to be properly executed and accompanied by a resolution passed by the Directors of Teck Alaska Incorporated.

The finding of “Positive/In Conformance” is made in general for financial assurance documentation. The audit team had no specific recommendation for this aspect.

⁴ Memorandum to Rick Fredericksen, Natural Resource Manager, from Pamela Green State Comptroller dated June 9, 2009.

4.3.4 Observations on the Impact of the 2013 Audit Results Financial Cost of Closure

A number of the findings presented in this report could affect the estimated costs for closure and/or post-closure care and maintenance of the Red Dog mine. The items described below should be re-examined during the 2014 closure plan permit renewal cycle to determine the magnitude and mathematical sign (positive or negative) of the impacts on the estimates and the amount of financial assurance required for the mine.

- TAK will need to develop an alternative approach for managing waste rock generated by development of the Aqaluk and Qanaiyaq pits if the Main Pit will continue to be used for water management in the long term. A cost estimate for the alternative waste rock management approach will need to be developed. See Section 4.2.1 for discussion on water management.
- The amount of lime consumed by the water treatment plant needs to be re-evaluated to consider pyrite oxidation versus sphalerite oxidation. Lime is one of the key drivers in the annual operating cost for the water treatments plant. Changes in the lime consumption could affect the estimated annual operating costs for the water treatment plants during the closure and post-closure periods. See Section 4.2.2 for discussion on geochemistry.
- Final cover design for stockpiles at the site will need to be updated during the 2014 permit renewal process based on current information. The design, source and availability of cover material will affect the closure cost estimate for 2014. See Section 4.2.3 for discussion on cover design.
- The MWS has undergone a significant investment in recontouring and seepage collection during the permit period. TAK is in the process of evaluating how the work completed in 2013 fits with the final closure plan design. The amount of additional work on the MWS required to achieve final grades at closure will affect the closure cost estimate for 2014. See Section 4.2.4 for discussion on the MWS recontouring.
- The water and mass balance tracking has undergone changes since the 2009 cost estimate was prepared. The results may change the volumes of water and the mass loadings in the influents to the water treatment plants. The revised volumes and loadings may impact the treatment schema and key assumptions for water treatment during both the closure and post-closure periods. See Section 4.2.6 for discussion on water balance.
- WTP#1 was modified to have the capability to work in parallel with WTP#2 due to an increase in TDS concentrations in influent water. The increase in TDS concentrations are expected to increase the volume of sludge generated by the treatment plants. The costs for sludge handling, dewatering, loading, hauling, and placement during the closure and post-closure periods could be affected by this change. See Section 4.2.6 for discussion on water treatment.

5.0 Conclusions Presented by Audit Objective

This section correlates the audit results to the six objectives defined in the WMP and the RPA (see Section 1.2). Specific details are presented below.

5.1 Objective: TAK's Compliance with the Approvals, Permits, and Applicable Environmental Laws and Regulations

As reflected in Chapter 4.0, Audit Results, including **Table 4-1**, the auditors found TAK to be generally compliant with the WMP, RPA, permit supporting documents, laws and regulations that were reviewed within the scope and boundary of this audit. This conclusion was supported by the relatively low incidence of permit violations, compliance issues, missed reporting deadlines, and other non-compliance indicators. Exceptions to this general compliance conclusion are listed below:

- A. Waste rock from the Aqqaluk Pit has been placed either in the MWS or waste stockpiles forming a berm around a portion of the Main Pit instead of within the Main Pit as described in the CRP May 2009 (see Audit Record Nos. 15, 53, and 70).
- B. TAK did not develop and submit to ADNR preliminary plans and cost estimates for eventual "out-of-pit" sludge disposal (see Audit Record No. 42).
- C. TAK was unable to supply updated landfill development and land use plans required by the WMP (see Audit Record No. 46).
- D. TAK was unable to supply information to verify that an oil water separator exists in the shop as required by the WMP (see Audit Record No. 48).

5.2 Objective: Controls that Provide Reasonable Assurances and Controls are Functioning

The following discussion applies to both the 2nd and 3rd objective bullets (controls provide reasonable assurances and controls are functioning).

TAK employs engineering controls and operational controls to provide reasonable assurances that environmental objectives are being met. Engineering controls include dams, diversion channels, collection ditches, and the pump-back system at the toe of the Main Tailings Dam. TAK's first line of operational controls includes the myriad standard operating procedures which standardize practices and procedures over time and throughout the organization. As a second line of operational control, TAK employs the SiteLine EMS to ensure that monitoring practices and procedures are being implemented. The SiteLine EMS assists employees in all departments comply with regulatory requirements by identifying compliance triggers, and reporting requirements, and generating "to do" lists, the results of which are entered back into Site Line for monitoring by supervisors and management. These controls provide reasonable assurances that environmental objectives in the 2009 CRP and relevant permits and approvals are being met.

Controls evaluated by the audit team were generally functioning as intended and provide reliable compliance with applicable requirements. These controls, however, have been modified from the WMP and the RPA by TAK in terms of managing water and waste rock. While these issues have been discussed in Chapter 4.0, water management is the most significant source of potential environmental concern at the site. The fact that the Main Pit was available for water storage was fortunate but speaks to the significance and scale of the water management challenges at the site. The use of the Main Pit for water management and the subsequent changes related to waste rock disposal, in addition to the changes in how reactivity of the waste rock is determined need to be updated for the upcoming revisions

of the CRP and WMP permit application. Both TAK and the State have been and need to remain vigilant in identifying methods to improve the efficiency of water management at the site.

As discussed in Section 4.2.5, the audit team found that dam-safety controls, as required under the COAs and related documents, are functioning as intended to ensure dams are operating as designed and safely maintained. This compliance also serves to support the environmental protection objective.

5.3 Objective: Permit Conditions Provide Environmental Protection as Required

Requirements in the current WMP and RPA provide the necessary environmental protections based on operations in effect at the time of drafting and approval of these permits. However, recent changes in mine operations necessitate these permit conditions be re-examined to ensure adequate environmental protection. The following discussion highlights the changes that should be considered in developing conditions in support of the reissuance of the WMP and RPA.

Both permits need to be updated to reflect that TAK currently stores contaminated water in the Main Pit. The use of the Main Pit for water management forced a change in the storage of Aqqaluk Pit waste rock; TAK now stores waste rock from the Aqqaluk Pit along benches created in the Main Pit.

The manner in which waste rock segregation was described in Table 2-6 of the SD I Monitoring Plan, which supplements the RPA, differs from current practice. The manner in which waste rock is now segregated is inconsistent with the practices currently described in Table 2-6.

The segregation of waste rock for cover material (SD B2 page 10 of 13) is not a “permit condition” per se. However, the effectiveness of covers installed at closure will have a substantial effect on ensuring environmental protection over the long-term. The lack of success in identifying and segregating suitable cover material (Okpikruak and Kivalina shales) under the existing RPA and WMP warrants further consideration by TAK and the State under the upcoming permit renewal process.

The use of the Main Pit for water management is tied to a project-specific RPA stipulation (reference to Red Dog Mine Closure Plan Section 3.1.3 Waste Rock and Overburden Stockpile) among others. The need to manage loading from seepage in the MWS and other locations is directly related to the geochemistry of the waste materials. As noted in Sections 4.2.2.1 and 6.3 of this report, the supporting documentation and management plans need to be updated to reflect the change in waste rock seepage water quality from the MWS as pyrite oxidation replaces sphalerite oxidation. The RPA stipulation referred to as 4.2.2. Water Treatment also relates to this issue since the volume of sludge disposal is tied directly to the amount of lime required by the process which in turn is driven by the geochemistry.

The cover design for the MWS being tested on the Oxide Stockpile has been monitored on an annual basis to assess its performance. The cover experienced two consecutive years of precipitation events significantly higher than average and the summary reports available indicate that the cover performed as expected. However, the extended period of saturation did result in higher infiltration rates than may be desired from a long-term cover.

5.4 Objective: Facility Management and Regulatory Oversight Provide Reasonable Assurances

Facility management and regulatory oversight provide reasonable assurances that the facility and controls are functioning as intended. TAK’s approach to facility management has been discussed previously and centers around the SiteLine EMS. Personnel at Red Dog work extended shifts and their “tours” extend for at least 2 weeks at a time. Employees are intimately familiar with the operations and numerous members of the TAK team have worked at the mine for a significant period of time. Their familiarity with the site and institutional knowledge results in a climate that the audit team perceived to be proactive and solution-oriented. The staff and management demonstrate the qualities necessary to provide reasonable assurance that facility controls are functioning as intended.

The State Large Mining Permitting Team consists of representatives of ADNR, ADEC, and ADF&G that are assigned to specific mining projects. The State team assigned to Red Dog meets regularly and, based on the interviews conducted at their respective offices, communicate regularly in regard to the project. Team members are familiar with their own responsibilities as well as those from other divisions/departments which appears to make an effective and efficient approach to achieving the objective on a programmatic and project-specific basis.

5.5 Objective: Financial Assurance is Adequate

AECOM reviewed the reports and spreadsheets documenting the closure cost calculations. While the audit did not involve a line by line review of every component in the financial assurance calculations the team did determine that the range of items included, and the underlying assumptions were reasonable and sound. The audit identified a number of items that have changed since the last estimate was established; those items (discussed above in Chapter 4.0) will need to be revisited with the development of the next financial assurance estimate.

6.0 Recommendations

Recommendations tied to specific audit observations are presented in Section 4.1, **Table 4-1**. Recommendations regarding the SD J cost estimate documents are presented in Section 4.3.

The following discussion provides high level recommendations regarding selected key documents intended to assist in the document update for the 2014 permit renewal process.

6.1 Waste Management Plan

The audit team recommends TAK develop a plan for managing Aqqaluk and Qanaiyaq waste if it intends to continue to use the Main Pit for contaminated water storage. TAK will need to explain in detail how the water currently being stored in the Main Pit will be managed if TAK decides to drain the water. Based on evidence and observations made during the audit, the team recommends TAK more effectively account for high precipitation events during future operations and post-closure as part of a revised waste management plan. Similar provisions should be incorporated into the water management plans for operation and post-closure.

6.2 Reclamation Plan Approval

TAK should assure requirements in both the RPA and ADNR drilling permit are in sync for the 2014 permit renewal effort. TAK is recommended to consider using the preferred practice of complete sealing of all exploration drill holes as described in the RPA Reclamation Stipulations.

6.3 Closure and Reclamation Plan

TAK will need to incorporate provisions in its water management load calculations for post-closure to account for the change in MWS seepage water quality expected to occur around 2016-2020 as pyrite oxidation replaces sphalerite oxidation.

The audit team recommends revising Table 2-6 in the Monitoring Plan to reflect current waste segregation practices and to incorporate these changes into a revision of the WMP.

6.4 Other State of Alaska Authorizations

No specific recommendations are provided as a result of the audit on “other” State of Alaska authorizations, which include the Fish Weir Maintenance Plan, Water Use Permits, Certificates of Approval to Operate a Dam, Fugitive Dust Management, and ADNR Material Sale Contract.

6.5 Supporting Documentation to Closure and Reclamation Plan

The audit team developed several recommendations from the supporting documentation associated with the Closure and Reclamation Plan. These recommendations are provided in the subsequent subsections and are organized by appendix.

6.5.1 SD A Consultation and Property Description

The audit team recommends that TAK seek input from local stakeholders, building on the current community engagement program, as they develop the 2014 Closure and Reclamation Plan. The approach would be similar to workshops conducted in 2009 for the Closure and Reclamation Plan. Stakeholders should be notified of changes to the mine plan and mine site that will affect the closure plan update. Stakeholder input on closure and reclamation objectives and alternatives should be requested and considered.

Another recommendation concerns the property description. The property description and permit boundary should be reviewed for consistency with current and expected future site conditions as the closure and reclamation plan is revised in 2014.

6.5.2 SD B Plan of Operations

TAK should consider working with agencies and stakeholders to refine the content of the mine development plan to target information relevant to aspects of the closure and reclamation plan such as the mine operation and closure schedule, waste facility capacity, and waste rock characterization.

TAK also should consider formalizing how it will update, prior to the next 5-year plan renewal, information that is subject to change during the permit term. TAK should develop criteria for determining which changes or updates are critical enough to warrant submission to agencies prior to the next permit renewal cycle.

The Plan of Operations Waste Rock Management should be updated with current site and mine plan information during the 2014 closure and reclamation plan. The audit team recommends TAK revise Plan of Operations for Waste Rock Management concurrent with updating the Closure and Reclamation Plan, which is schedule for 2014. TAK should consider relevant plans and schedules outlined in the 2013 COBC when updating the Plan of Operations for Waste Rock Management. The Plan of Operations for Waste Rock Management should be updated to monitor sulfur, as required, rather than iron.

The audit team recommends that the Plan of Operations for Tailings and Water Management be updated with current site and mine plan information during the 2014 Closure and Reclamation Plan update process. TAK should take the 2013 COBC into consideration when updating the Plan of Operations for Tailings and Water Management.

The audit team recommends that the 2014 CRP document the most current and long term closure water model. The water models should be updated to reflect changes in conditions that have occurred over the last permit period. In order to meet closure plan objectives, adjustments will need to be made to average discharge volumes required to retain two-foot cover on the tailings impoundment. The audit team observed several changes to the mine facility and mine plan, including regrading of the MWS, and the use of the Main Pit for water storage, that will need to be incorporated into the development of the 2014 Closure and Reclamation Plan.

The audit team recommends TAK continue the improvements it has made to the MWS seepage collection system, including improving the operation and maintenance of the southwest seepage collection sump in accordance with best management practices. Requirements enumerated in the 2013 COBC that relate to the seepage collection systems also should be included in the Plan of Operations for Tailings and Water Management.

6.5.3 SD C Geotechnical

The performance of the Main and Back dams is critical to the functioning of the operation during the active mining period and at closure. The audit team recommends that for the 2014 CRP, the Supporting Documents "C - Geotechnical" be updated to support the existing conditions at the site (e.g., the dams being raised beyond that envisioned in the 2009 CRP). The update process should clearly support additional changes anticipated during the term of the 2014 CRP or as part of the ultimate site closure planning. The reports should also document the objectives and results of the work conducted on the secondary seepage control system.

6.5.4 SD D Geochemistry

The audit team recommends that TAK revise and expand the lime demand calculations to document how the equation for lime demand was developed, and to provide more details on the calculation

methods used to support the conclusions about lime demands for current and post-closure conditions. In particular, the audit team recommends a detailed justification for how SRK came to the conclusion that lime demand would not change appreciable under sphalerite oxidation conditions and pyrite oxidation conditions.

6.5.5 SD E Water Management

The audit team recommends that TAK update the water balance and water modeling information in the 2014 CRP to reflect to reflect current water and load management outputs created with GoldSim software by the mine's water management team. The audit team recommends TAK more effectively account for high precipitation events during future operations and post-closure as part of a revised water management plan as well.

6.5.6 SD F Reclamation and Revegetation

The audit team recommends TAK review the work documented in SD F3 (Revegetation Plan) and subsequent investigations including the Oxide Stockpile Full-Scale Cover System 2011-2012 Annual Performance Monitoring Report (Final) prepared by O'Kane Consultants (2013), the Reclamation and Recovery Study discussed in the Uncertainty Reduction Plan (Exponent 2012) and any additional studies related to the cover placed on the MWS. These documents should be used to develop a forward-looking description of the reclamation and revegetation aspects of closure when developing the 2014 CRP.

6.5.7 SD H1 Evaluation of Ecological Risk

The audit team recommends that if this SD is maintained as part of the permit renewal package, it should directly reference the FDRMP, or be updated to reflect the current status of ecological risk within the mine site (air/solid waste permit boundary).

6.5.8 SD I Monitoring Plans

The audit team recommends that TAK review and update the monitoring plan during 2014 closure plan update and the WMP/RPA renewal process.

6.5.9 Closure Cost Estimate Document Review

The audit team provides the following recommendations in response to review of the closure cost estimates:

- TAK should assure the cost estimate documents developed during the 2014 permit renewal process are consistent, or provide an explanation as to why they differ.
- Rather than setting rates of return on a mine-specific or project-specific basis, the State should consider establishing a uniform process for determining the real rate of return for financial assurance that would apply across the mining industry.
- The State should consider revising the NPV calculation methodology to begin discounting at an appropriate point and using an appropriate discount rate after suspension of mining.

7.0 References

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- Teck Alaska, Incorporated (TAK). 2013d. 2012 TDS Management Plan Progress Report & Updated Management Plan for APDES Permit AK-003865-2. February 2013
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Appendix 1

Photo Log

PHOTOGRAPHIC LOG – Selected Photos

Project: Red Dog Facility Audit – WMP and RPA – site visit August 2013	Site Location: Red Dog Mine	Final Report May 2014
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Photo No. <div style="text-align: center; font-size: 24pt; font-weight: bold;">1</div>	Date: August 25-28, 2013
Direction Photo Taken: NA	
Description: Entrance to Red Dog facilities	



Photo No. <div style="text-align: center; font-size: 24pt; font-weight: bold;">2</div>	Date: August 25-28, 2013
Direction Photo Taken: Northeast	
Description: Red Dog plant facilities across tailings impoundment pond	



PHOTOGRAPHIC LOG

Project: Red Dog Facility Audit – WMP and RPA – site visit August 2013	Site Location: Red Dog Mine	Final Report May 2014
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Photo No. <div style="text-align: center; font-size: 1.2em; font-weight: bold;">3</div>	Date: August 25-28, 2013
Direction Photo Taken: Southwest from Main Waste Stockpile	
Description: view of airstrip and portion of Back Dam	



Photo No. <div style="text-align: center; font-size: 1.2em; font-weight: bold;">4</div>	Date: August 25-28, 2014
Direction Photo Taken: Northeast from near Low Grade Ore Stockpile	
Description: view of Aqqaluk Pit, Main Pit, water storage in Main Pit, new water pump station under construction in Main Pit (left side of photo, center)	



PHOTOGRAPHIC LOG

Project: Red Dog Facility Audit – WMP and RPA – site visit August 2013

Site Location: Red Dog Mine

Final Report May 2014

Photo No.
5

Date:
August 25-28,
2013

Direction Photo Taken: East from near Low Grade Ore Stockpile

Description: Main Pit, water storage in Main Pit, active waste dumps on side of Main Pit for waste from Aqqualuk Pit



Photo No.
6

Date:
August 25-28,
2013

Direction Photo Taken: Northeast from near Low Grade Ore Stockpile

Description: Red Dog Creek Diversion (center) w/ Aqqualuk Pit in background



PHOTOGRAPHIC LOG

Project: Red Dog Facility Audit – WMP and RPA – site visit August 2013	Site Location: Red Dog Mine	Final Report May 2014
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Photo No. 7	Date: August 25-28, 2013	
Direction Photo Taken: East across tailings impoundment pond		
Description: Main Waste Stockpile south west corner – recently regraded		

Photo No. 8	Date: August 25-28, 2013	
Direction Photo Taken: East across tailings impoundment pond		
Description: Main Waste Stockpile southwest corner – recently regraded		

PHOTOGRAPHIC LOG

Project: Red Dog Facility Audit – WMP and RPA – site visit August 2013

Site Location: Red Dog Mine

Final Report May 2014

Photo No.
9

Date:
August 25-28,
2013

Direction Photo Taken: East

Description: Main Waste Stockpile southwest corner – showing seepage water flowing to collection facilities



Photo No.
10

Date:
August 25-28,
2013

Direction Photo Taken: Southwest, looking toward road

Description: Main Waste Stockpile south west corner seepage collection facilities



PHOTOGRAPHIC LOG

Project: Red Dog Facility Audit – WMP and RPA – site visit August 2013	Site Location: Red Dog Mine	Final Report May 2014
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Photo No. 11	Date: August 25-28, 2013	
Direction Photo Taken: West looking toward road		
Description: Main Waste Stockpile south west corner seepage collection facilities –, noted crushed culvert and general housekeeping		

Photo No. 12	Date: August 25-28, 2013	
Direction Photo Taken: West		
Description: Main Dam and tailings beach		

PHOTOGRAPHIC LOG

Project: Red Dog Facility Audit – WMP and RPA – site visit August 2013

Site Location: Red Dog Mine

Final Report May 2014

Photo No.
13

Date:
August 25-28,
2013

Direction Photo Taken: Northwest

Description: Main Dam, beach, Red Dog Creek



Photo No.
14

Date:
August 25-28,
2013

Direction Photo Taken: South from toe of Main Dam

Description: Main Dam face with heavy equipment working



PHOTOGRAPHIC LOG

Project: Red Dog Facility Audit – WMP and RPA – site visit August 2013

Site Location: Red Dog Mine

Final Report May 2014

Photo No.
15

Date:
August 25-28,
2013

Direction Photo Taken: Northwest

Description: Back Dam and tailings pond



Photo No.
16

Date:
August 25-28,
2013

Direction Photo Taken: East

Description: Revegetation on Oxide Stockpile; erosion control netting was installed to rectify gullying.



Appendix 2

Agency Consolidated Comments and Response Table

State of Alaska Consolidated Agency Comments - 2014 DRAFT Environmental Audit - Red Dog Mine

Department/Division/ Section	Section # (i.e. 2.1.4)	Page #	Figure # / Table #	Comment	AECOM Status to Comment
DEC	General Comment			As a general comment, this is a high quality audit, i.e. well focused on renewal of permits, comprehensive, and detailed, compared to others we have seen.	Thank you for your comment.
DEC	4.2.2.1	4-10		In <u>Geochemical Trends and Long Term Water Treatment</u> , the second paragraph states that around 2016-2020 oxidation of waste rock will shift from sphalerite to pyrite dominated, pH of seepage water will drop, and lime demands will increase. However, the last paragraph in the section states that the change from pyrite oxidation to sphalerite oxidation could result in a pH drop. These statements are contradictory. It appears that the last paragraph should state that the change from sphalerite oxidation to pyrite oxidation would result in a pH drop.	Correct. Edit made per comment
DEC	4.2.6	4-15		Revise the first sentence according to the bold text as follows, "Additional detail on audit observations regarding the water management is presented..."	Edit made per comment
DEC			Table 4-1	Please provide this seven page table in Excel format. This would make them easier to use and organize.	Excel table to be provided with the final report
DNR/Mining	General Comment			Overall, the audit report is fair and well developed. The format of this report aids in identifying key areas for consideration during the upcoming renewal process. We did not find any glaring inconsistencies, unsupported observations or unnecessary recommendations	Thank you for your comment.
DNR/Mining		AA-1		ADEC is known as Alaska Department of Environmental Conservation, please edit the term "Compliance" in the title.	Edit made per comment
DNR/Mining		AA-1		DNR is known as Alaska Department of Natural Resources; please remove the term "Management" from the title.	Edit made per comment
DNR/Mining	4.1		Table 4-1 (42)	Update: DNR has granted TAK's request in an email dated September 17, 2013. TAK has approval to extend the stipulation and submit the "out-of-pit" sludge disposal plan and cost estimate during this upcoming permit renewal process.	The update has been noted in the table. The finding has not been changed since the table and report reflect the status as of the date of the audit.
DNR/Mining	4.2.1.1	4-1		The discussion in the second paragraph describing the plan to create the Main Pit Stockpile references 2009 CRP Section 3.1.3 . Although this referenced section of the CRP does mention the Main Pit stockpile, it refers mainly to placement of covers. This discussion seems to speak of those procedures described in the 2009 CRP Section 2.1.3. There may be an incorrect reference.	Agreed. The reference in the text has been changed to Section 2.1.3.
DNR/Mining	4.2.1.2	4-9		The findings discuss the current placement of the Aqqaluk Pit waste rock. Please describe the location of the temporary stockpile berms relative to the main pit and whether the runoff from the berms is flowing into or away from the main pit. Also please indicate whether these storage sites for the Aqqaluk waste rock have been correctly reported in the Quarterly Monitoring Reports for the WMP and RPA.	<p>The text was modified to note that audit team observed waste stockpiles being created west of the Main Pit extending north from the northern end of the Main Waste Stockpile. It appeared that runoff from the observed stockpiles would flow toward the pit.</p> <p>The 2012 Annual Report Appendix E (January 2013) states: "2) <i>Water issues have required the dumping sequence be modified to delay waste dumping into the flooded Main Pit. There is uncertainty about where waste dump locations will be for Q2 to Q4 2013. All options will increase the cycle time for haul trucks.</i>"</p> <p>As noted in Audit records No. 15, 53, 54, and 70, the audit team recommends that TAK work with agencies to update the CRP and mine operating plan during the 2014 renewal process. Management plans for water and reactive waste rock in the Main Pit need to be updated to reflect current site conditions.</p>

State of Alaska Consolidated Agency Comments - 2014 DRAFT Environmental Audit - Red Dog Mine

Department/Division/ Section	Section # (i.e. 2.1.4)	Page #	Figure # / Table #	Comment	AECOM Status to Comment
DNR/Mining	4.2.3.2	4-12		The lack of shale segregation was conveyed to ADNR Mining during a site inspection. This was documented in the review memorandum, Red Dog Mine Waste Rock Management Procedures dated August 9, 2010 (and March 11, 2011), which was an attachment to ADNR's Red Dog Mine Waste Rock Management QA/QC Plan Approval dated March 18, 2011 and submitted to Jeff Clark.	Comment noted. The audit team reviewed the Red Dog Mine Waste Rock Management Procedures QA/QC plan in a different context (see Section 4.2.2.1).
DNR/Mining	4.3	4-20	Table 4-2	The State is currently in the process of updating and revising our cost estimate guidelines, and including links to the Standardized Reclamation Cost Estimating Model (SRCE).	The table has been revised to note the State's revision of the cost estimating guidelines.
DNR/Mining	4.3.2	4-32		DNR appreciates and will consider the auditors recommendations.	Comment noted.
DFG/HAB	2.3		2-2	DFG Fish Habitat Permits appear to be missing, several water withdrawal related permits missing, fish weir permit	ADF&G fish habitat permits were not identified in the original request for proposal (RFP) which defined the scope of work. The Fish Weir Maintenance Plan was included although the need for a fish weir permit was not identified during the audit. Water use permits were identified in the RFP and discussed in Section 3.2.1.
DFG/HAB	3.1.4.3	3-4		Discusses average zinc (and iron) concentrations in overburden stockpile seepage/run-off. What about other components of the water? Peak concentrations may be of significance in identifying periods of higher concentrations/periods when the collection system may be challenged.	As noted in Section 3.0, Section 3.1.4.3 reflects TAK's description of the overburden stockpile presented in the Plan of Operations. The audit did not include a detailed review of water quality monitoring data collected from the overburden stockpile.
DFG/HAB	3.1.6	3-5		3 drainages (including Bons Creek) flow directly into Bons Reservoir and a third is tributary to Bons Creek. Bons Creek is located immediately downstream from the Overburden stockpile. Presently no other waste dumps or stockpile material exist in the Bons Creek watershed. In the past there have been tentative plans to extend the main waste rock dump to the south, into Bons Creek drainage. ADF&G discouraged this concept in the past and maintains that perspective presently.	Comment noted. The descriptions in Section 3 are summarized from TAK's Plan of Operations.
DFG/HAB	3.1.11	3-5		Should be evaluated, at this point the infrastructure should be removed and the area rehabilitated.	Comment noted. As stated in the text, the North Basin Exploration facilities were not evaluated in the audit. The removal and rehabilitation of the area is (was) outside the scope of the audit.
DFG/HAB	3.1.6	3-5		Freshwater is pumped from the reservoir and from wells immediately downstream of the dam	Text was added to Section 3.1.6 to refer to the wells downstream of the dam.
DFG/HAB	3.2.1	3-6		ADF&G also has permitting responsibilities associated with water withdrawal from fish bearing waters. Permit conditions are issued consistent with fish species and life stages present in water body. Multiple Fish Habitat Permits issued for water and intake structures.	Comment noted. Section 3.2.3 acknowledges that ADF&G issues permits for water depletions. The text has been expanded to note that permit conditions are consistent with fish species and life stages present.
DFG/HAB	3.2.3	3-7		Even though ADF&G permits were excluded from the audit – the Regulatory Background section and audit more generally would be more informative and accurate if this section was developed a bit further so it more accurately reflected the regulatory authority, permits (Title 16 - fish passage, water withdrawals) and monitoring activities that ADF&G have at Red Dog.	Comment noted. A reference to Title 16 has been included. Also see additions per comment above. The regulatory background is intended to describe the programs covered under the audit process rather than capture the entirety of the State of Alaska's permitting program.
DFG/HAB	4.1		4-1	Annual biomonitoring reports produced by ADF&G	Item Number 118 of Table 4-1 has been revised to state that Aquatic sampling is conducted by ADF&G "and documented in annual ADF&G biomonitoring reports."
DFG/HAB	4.1		4.1 (31)	Artesian conditions have been observed on the south facing slope adjacent to North Fork Red Creek	Comment noted. The statement reflects the observations by the audit team and the information provided by TAK staff during the audit. Agencies should follow-up with TAK to reconcile discrepancies during the 2014 CRP update process.
DNR/OPMP	5.0	5.2		Second paragraph makes reference to section 4.1.3.3 that does not exist in the report – It should probably refer to section 4.2.5	Correct. Reference changed per comment.
DNR/Water Resources	1.3	1-2	Bullet #6	Include water rights. For groundwater and surface water it is stated that collection, treatment, and monitoring systems were reviewed. AECOM also reviewed water rights for surface and groundwater.	Edit made per comment.

State of Alaska Consolidated Agency Comments - 2014 DRAFT Environmental Audit - Red Dog Mine

Department/Division/ Section	Section # (i.e. 2.1.4)	Page #	Figure # / Table #	Comment	AECOM Status to Comment
DNR/Water Resources	2.3	2-10	Table 2-2	Change sentence to read: Water Use Permits. Water use permits and authorizations issued by the DNR Water Resources Section for withdrawal, diversion, or impoundment of water for domestic, sanitary, and industrial uses.	Edit made per comment.
DNR/Water Resources	2.5	2-12	Table 2-4	Just a suggestion - Do they want to include our contact information in this table? Or at a minimum our phone numbers?	Comment noted. In the name of maintaining consistency between the TAK contacts and State of Alaska contacts, the text is unchanged.
DNR/Water Resources	3.2.1	3-6	Paragraph	The last couple of sentences of paragraph 2 it should be clarified to read the following: The DNR Water Resources Section is responsible for the issuance and management of water rights and temporary water use authorizations. These include Water Right Permit to Appropriate, Water Right Certificate of Appropriation, and Temporary Water Use Authorization. The following have been issued toTAK.	Edit made per comment.
DNR/Water Resources	3.2.1	3-6	Bullets	LAS 1453 – for Bons Reservoir (Bons Creek, Main Stem Red Dog Creek and South Fork Red Dog Creek). Certificate of Appropriation (no further action required) LAS 25095 – for Mainstem Red Dog Creek (main pit) – Permit to Appropriate Water (further action required to bring to Certificate of Appropriation. Permit to Appropriate expires 05-31-2022. LAS 25096 – for South Fork Red Dog Creek (tailings impoundment). Permit to Appropriate Water expires 05-31-2022.	Edit made per comment.
DNR/Water Resources	3.2.1	3-6	Paragraph	Paragraph after bullets. TWUP F2012-135 is expired. TWUP F2013-211 has been issued.	Text has been revised to reflect these clarifications.
DNR/Water Resources	General Comment			Perhaps in the Recommendations section state that all non-emergency use of a significant amount of water (as defined in 11 AAC 93.035) must be previously applied for, adjudicated, and permitted through the DNR Water Resources Section prior to use. This includes water use, withdrawal, diversion, and impoundment. Currently the DNR Water Resources Section is reviewing water use activities to ensure all such activities are properly permitted. Conditions contained within the Permits to Appropriate require that Red Dog establish a metering system acceptable to the DNR Water Resources Section and submit records to the DNR Water Resources Section on an annual basis.	Comment noted. The audit report captures a snapshot in time. While correspondence with the State was reviewed during the audit, this issue was not identified at the time and therefore is not included in the report.
DNR/WATER/Alaska Hydrological Survey	General Comment			We reviewed the draft environmental audit and found it to be a good document with a good structure. The auditors seemed thorough and had some very good recommendations.	Thank you for your comment.
DNR/WATER/Alaska Hydrological Survey	3.1.3	3-2		The current amount of tailings (as of 2012) is given in cubic yards, whereas for the end of mine life the amount is given in tons.	The volumes in the audit report have been revised to reflect the numbers (tons) as provided in the 2006 <i>SD B3 Plan of Operations for Tailings and Water Management</i> . The text has been revised to state that these numbers need to be revised with the CRP permit reissuance. The tailings numbers are presented as they were reported in the source reports to avoid the need for developing, refining or defending conversion factors.
DNR/WATER/Alaska Hydrological Survey	4.1	4-6	4-1	Item #79: "Field observations: diversion has been undergoing changes..." Please expand on what changes you are referring to.	Field notes indicate that during the site tour, TAK staff pointed out that the Red Dog Creek diversion culvert near the Aqqaluk Pit had been replaced or patched following initial blasting in the pit. TAK indicated the functionality of the diversion was not compromised; the statement appeared reasonable based on field observations (note that the audit team did not make a detailed inspection of the diversion culvert due to time constraints). Diversion culvert and patching can be seen in Photo No. 6. To fully answer the agency comment, the audit team suggests TAK provide additional, specific information on timing and type of repairs that were made to the Red Dog Diversion and include any significant changes in the 2014 CRP update.

State of Alaska Consolidated Agency Comments - 2014 DRAFT Environmental Audit - Red Dog Mine

Department/Division/ Section	Section # (i.e. 2.1.4)	Page #	Figure # / Table #	Comment	AECOM Status to Comment
DNR/WATER/Alaska Hydrological Survey	4.2.4.1	4-13		Referring to the seepage collection sump at the southwest corner of the MWS: "The audit team suggested some improvement could be made to the system...TAK staff indicated that the system was functioning as intended" Please expand on these suggestions further.	The audit team observed in the field that the general appearance of the collection basin/sump, culverts, and electrical connections did not seem consistent with other work recently conducted at the site (e.g., the SmartDitch installation across the MWS). At least one of the culverts appeared to have been crushed during installation allowing stagnate water to accumulate in a portion of the sump. The sump appeared to segregate drainage from lower portion of the MWS from the upper portion of the MWS which would allow flexibility in managing different flows in the future. The TAK representatives stated both flows were currently being directed to the tailings impoundment. The team suggested that improvement in housekeeping for this important seepage collection point could improve the ability of observers, auditors, agency inspectors, and possibly TAK maintenance personnel to assure the sump was working properly. Photo Nos. 10 and 11 give some indication of conditions with a crushed culvert, electrical cords and sediment buildup around the sump. Photo No. 9 shows the seepage from the MWS reporting to the sump. TAK asserted that the system was functioning properly and did not agree improvements were necessary.
ADNR/DMLW/Water/D am Safety	2.1.3	2-5	Table 2-2	Recommendation: List the two <i>Certificates of Approval to Modify a Dam</i> (for the Main and Back Dam raises) and the <i>Certificate of Approval to Repair a Dam</i> (for the Main Dam seepage collection system repair) because these certificates include important special conditions pertinent to the audit, as described later in these comments.	The list of documents listed in Table 2-2 audit was structured to be responsive to the requirements (and documents) identified in the RFP. The referenced additional certificates have been noted in the Notes section of the table.
ADNR/DMLW/Water/D am Safety	2.1.3	2-5	Table 2-2	Note that SDs C4, C5, C6, C7, and C8 are stale and superseded by more current technical reports published within the "permit period". Table 4-1 correctly notes that these documents are stale in audit items 84 through 88. See comment on Table 4-1, audit items 82, 85, & 86.	The text has been revised throughout the report eliminating "permit period" and inserting "since the 2009 approval of the RPA and issuance of the WMP..."
ADNR/DMLW/Water/D am Safety	2.1.3.3	2-3		The fourth bullet includes an ambiguous reference to the "permit period." This term is then used repeatedly throughout the document. This may refer to the "5 year permit term of the RPA and WMP" mentioned in Section 1.5 of the Audit. A specific definition of the "permit period" and its significance to the Audit would be enlightening. For example, are the observations of the Audit limited to the permit period?	The text has been revised throughout the report eliminating "permit period" and inserting "since the 2009 approval of the RPA and issuance of the WMP..." Observations of the audit are limited to the time frame of the audit itself.
ADNR/DMLW/Water/D am Safety	3.2	3-1		A history of the CRP, RPA and WMP may be useful for context of the Audit; e.g., explain that this is the first review of the first authorizations of those permits issued in 2009 for a mine whose production began 20 years prior.	We agree that the history leading to the first audit of a facility in operation for 20 years would be beneficial but developing such is outside the scope of the assignment.
ADNR/DMLW/Water/D am Safety	3.1.3 3.1.3.1	3-2		Correct inaccuracy in first paragraph of each section: the raise to elevation 970 began in 2008 (not 2010) per Stage VIII Construction Completion Report, URS, 2011.	No change. We would prefer that the audit report reflect accurate information however, the information presented in the report accurately reflects the information available to the auditors during the audit.
ADNR/DMLW/Water/D am Safety	3.1.3	3-2		Tailings quantities are first referred to in cubic yards, then in tons, obfuscating the comparison between 2012 and end of mine life values.	The numbers in the final report reflect the information provided in the SD B3 Plan of Operations for Tailings and Water Management, which while outdated, presents a comparable set of numbers (in tons).
ADNR/DMLW/Water/D am Safety	3.1.3.1	3-2		The last sentence in the first paragraph correctly notes that the final design elevation of the crest of the Main Dam is increased to elevation 993.3 feet. However, the reference for this information is not included in the audit report. This information was presented to ADNR in two recent URS reports: "Report, Water Management Plan, Red Dog Mine, Alaska" dated March 31, 2013 and "Preliminary Design Report, Revision 1, Ultimate Closure Configuration, Tailings Main Dam, Red Dog Mine, Alaska" dated July 2, 2013. Both of these documents are contemporary to the audit, but neither are mentioned specifically or referenced.	The 993.3-foot elevation is a reflection of the AECOM's meeting with ADNR/DMLW/Water/Dam Safety and not as a result of a review of the noted reports. The referenced documents were not reviewed as part of the audit since they were not made available during pre-audit preparations.

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ADNR/DMLW/Water/D am Safety	3.1.3.1	3-2		The description of the Main Dam is not accurate. For example, in the second paragraph, the geomembrane “cut-off system” and “perforated drain pipe” are not consistent or continuous along the upstream toe of the dam, and the perforated pipe is not directly connected to the “gravel drain”. The design of the “cut-off system” changed after the starter dam was constructed, so Stage 2 and above are different (referred to now as the “cut-off wall”). The perforated pipe under the upstream toe does not extend up through all stages (it is definitely not included under Stage 5 and above). A 36 inch pipe runs from the perforated pipe under the starter dam, but was grouted closed before Stage 2 of the dam was constructed. This eliminated any direct connection with the coarse rockfill “underdrain” below the remaining stages of the dam. The underdrain is a blanket drain (approximately 50 feet wide by 6 feet thick by 750 feet long) of coarse rock fill, reported to be similar to Soil Type 5 (100% < 24 inches, 15% < 6 inches) that runs from the downstream toe of the starter dam, under the downstream fill of Stage 2 and above, connecting to the seepage collection system at the downstream toe of the Main Dam.	Comment noted. The audit report reflects AECOM’s understanding of the facility at the time of the audit based on the materials available from the State of Alaska and TAK.
ADNR/DMLW/Water/D am Safety	3.1.3.1	3-2		The comment, “The gravel drain acts to keep the phreatic surface in the dam low” is subjective and implies some evaluation of the performance of the underdrain. Suggested edit: “The underdrain serves to capture seepage from the Main Dam and transfer it to the seepage collection system.”	Edit made per comment.
ADNR/DMLW/Water/D am Safety	3.1.3.2	3-3		What is a “seepage dam”? Term does not provide any descriptive information and appears to be interchanged as a dam name. ADNR Dam Safety typically refers to that component as the seepage collection system dam, and regulates it as an appurtenant feature to the Red Dog Tailings Main Dam. Suggested edits: Delete first reference to “Seepage Dam” in second sentence and insert “embankment dam, referred to as the seepage collection system dam”. Replace other references to “Seepage Dam” with “seepage collection system dam.”	The reference in question is to the seepage collection dam. Edit made per comment.
ADNR/DMLW/Water/D am Safety	3.1.3.3	3-3		Some historical information is provided, but the paragraph does not include a description of the Red Dog Tailings Back Dam. The final closure elevation of the Back Dam is currently undefined and may include up to 17 feet of additional fill above the proposed final seal zone elevation (986 ft) for insulation purposes per “Revised Detailed Design Report for Tailings Impoundment Back Dam Cut-off Wall” by Golder Associates, March 2013.	Comment noted. As stated in the introduction, the descriptions presented in Section 3 reflect TAK’s descriptions in the Plan of Operations. The referenced document was not included in AECOM’s review since it was not made available during pre-audit preparations.
ADNR/DMLW/Water/D am Safety	3.1.4.1	3-3		This subsection appears to mention parenthetically the “Main Pit stockpile” (intended for Aqqaluk waste rock) with the discussion on the Main Waste Stockpile, which was constructed of waste rock from the Main Pit. Perhaps another sub-section for the Main Pit Stockpile under Section 3.1.4 would benefit the audit, given the change in purpose and impact on storage of waste rock from the Aqqaluk pit. This would help clarify the succeeding related observations of the audit.	This appears to have been an oversight in the draft report. The report has been revised to include Section 3.1.4.4 Main Pit Stockpile.
ADNR/DMLW/Water/D am Safety	3.1.4.2	3-4		Is this stockpile the subject of “small scale cover tests” or a “full scale test of cover construction”? What is the difference?	The text has been revised to eliminate any reference to scale.
ADNR/DMLW/Water/D am Safety	3.1.4.3	3-4		The second paragraph should include the active-zone cutoff wall in the description of design features and clearly indicate that the system is dependent on permafrost to collect seepage.	Comment noted. The description of the Overburden stockpile in the CRP (Section 2.2.6, page 21) does not describe the cutoff wall and permafrost dependency of the system. The audit team recommends that TAK include these as-built features in the 2014 CRP update.
ADNR/DMLW/Water/D am Safety	3.1.6	3-5		The reference to “certificate to operate (AK00200) [sic]” is not accurate and along with the reference to water rights, seems out of context. Section 3.1.5 is the only other subsection in section 3.1 that refers to an associated permit number. The Red Dog Water Supply Dam is listed on the Alaska Dam Inventory and the National inventory of Dams with the unique identification number AK00200; the current <i>Certificate of Approval to Operate a Dam</i> number is FY2011-8-AK00200. The design of the dam is similar to the Red Dog Tailings Main Dam (NID#AK00201).	The reference in Section 3.1.6 has been revised to FY-2011-8-AK00200.

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ADNR/DMLW/Water/D am Safety	3.2.1	3-6		In fourth paragraph, the Dam Safety and Construction Unit is referred to as a section, when it is actually under the Water Resources Section of DMLW. The unit issues "certificates of approval" for various activities, rather than "permits."	Edits made per comment.
ADNR/DMLW/Water/D am Safety	4.1		4-1	Recommendations are included under the observation column heading. For examples, see audit items 53 and 54.	Text with recommendations has been moved from Observations to Recommendations.
ADNR/DMLW/Water/D am Safety	4.1		4-1 1-13	The table lists requirements for <i>Certificates of Approval to Operate a Dam</i> , but misses <i>Certificates of Approval to Modify or Repair a Dam</i> for the active construction observed during the audit. Please include a row with the requirements for financial assurance for post closure operation of the dams listed in Special Condition 14 of <i>Certificate of Approval to Modify a Dam</i> No. FY2013-14-AK00201 and Special Condition 8 of <i>Certificate of Approval to Modify a Dam</i> No. FY2013-15-AK00303. The finding should be "Update 2014" with a recommendation to identify and include those costs as appropriate in the pending update.	No change. Dam modifications and repairs were not included in the RFP and were not specifically addressed as part of the audit. It would be inappropriate for AECOM to make recommendations on items not included in the audit.
ADNR/DMLW/Water/D am Safety	4.1		4-1 #2—13	At least for audit items 2 through 13, the fourth column, Permit Section, incorrectly references documents other than the respective permits. For example, most of the requirements listed are special conditions to certificates of approval, whereas items 2 through 8 incorrectly reference Alaska dam safety regulations for qualified engineers. The general reference to Alaska dam safety regulations is Article 3 of 11 AAC 93.	The Permit Section reference for items 2 through 8 has been revised to 11 AAC 93. Under items 12 and 13 the Permit Section has been revised to "Attachment A – Special Conditions."
ADNR/DMLW/Water/D am Safety	4.1		4-1 #13	Under audit item 13, the audit observation references the wrong report submitted in accordance with the requirement. The correct report is titled, "Revised Detailed Design Report for Tailings Impoundment Back Dam Cut-off Wall, Red Dog Mine, Alaska" by Golder Associates dated March 28, 2013. Note that the July 19, 2013 report does not supersede this report; the July 19, 2013 report is focused on the 2013 construction work.	No change. The information presented in the report accurately reflects the information available to the auditors at the time of the audit.
ADNR/DMLW/Water/D am Safety	4.1		4-1 #35	ADNR is in receipt of the geotechnical letter report, "Aqqaluk South Wall Stability Assessment" by Golder Associates dated June 7, 2011. The audit item finding is "improvement needed", but this appears to be based on observations describing TAK's inability to demonstrate that the required information was transmitted to ADNR and recommendations to improve such recordkeeping. Because the development of the Aqqaluk pit could affect the stability of the subject area during both operations (which could affect the Red Dog Creek diversion) and in closure (which could affect reclamation), the finding should be "Update 2014" and the recommendation should be to update the stipulation based on the results of the study, as appropriate.	Edits made per comment.
ADNR/DMLW/Water/D am Safety	4.1		4-1 #40	This item is related to the tailings deposition plan, which is not specifically addressed at any other location in the audit. This appears to be a deficiency in the audit, since the tailings deposition plan affects both the operations and closure of the TSF. See comments on items 74, 75, & 76.	Comment noted. The tailings deposition plan was not specifically identified in the RFP and was not reviewed as part of the audit.
ADNR/DMLW/Water/D am Safety	4.1		4-1 #53 & 54	Item 53 includes a finding of "non-conformance" while item 54 includes a finding of "Update 2014." However, both include similar observations and recommendations, including updates to the water management plan. Both also reference Section 4.2.1 for discussion; see comment on Section 4.2.1.	High sulfide material from Aqqaluk Pit has not been placed below the ultimate water level in the Main Pit hence the non-conformance. It is not clear that the "most reactive" waste has been handled to date, resulting in the "Update 2014" finding.
ADNR/DMLW/Water/D am Safety	4.1		4-1 #58	Requirement refers to Main Pit Stockpile and the observation and recommendation applies to the Main Waste Stockpile.	The Finding has been revised to "No Finding" and the Observation has been revised to note "Future event, not evaluated."
ADNR/DMLW/Water/D am Safety	4.1		4-1 #68	The requirement, the observation and the recommendation seem unrelated. Note that the requirement is regarding cover material for the tailings beach with TSF in a closed configuration. This is a similar issue to the requirement for stockpiling cover material for the MWS. See comment on Section 4.2.3.2 and audit item #71.	The finding, observation, and recommendation have been revised.

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ADNR/DMLW/Water/D am Safety	4.1		4-1 #69	The observation and recommendations are related to the issue discussed in Section 4.2.3, but the table directs the reader to section 4.2.5, which does not discuss this subject. The issue of identifying suitable construction materials for the dam contributed to a change in the Waste Rock Segregation Criteria, as described in the "Red Dog Mine 4 th Quarter Annual Report 2010 for State of Alaska [WMP and RPA]" by Teck dated February 21, 2011, which eliminated Siksikpuk shale as an exclusive identifier for dam construction materials. Subsequently, a refinement of the construction specifications for the dams restricted the source of construction materials to the Siksikpuk formation of the DD-2 quarry, exclusive of the Aqqaluk waste rock stream, as well as the requirement in the construction quality assurance plan for geologic descriptions of fill. See Part 2 of Section 02200 of the "Technical Specifications, Revision 1, Stage IX Raise, Red Dog Tailings Main Dam" by URS dated February 18, 2013, and Section 4.0 of "Construction Quality Assurance Plan, Revision 1, Stage IX Raise, Red Dog Tailings Main Dam" by URS dated February 18, 2013 for specific requirements.	Comment noted. The reference in the table has been revised to refer to Section 4.2.3. Neither the URS references nor the need to review construction specifications were identified by the RFP and therefore were not reviewed as part of the audit. The recommendation addresses the need for revisions to the supporting documentation.
ADNR/DMLW/Water/D am Safety	4.1		4-1 #73	It is not clear that audit team reviewed the most current spillway design. See comment on Section 4.2.5.1.	Comment noted. The team reviewed the documentation referenced in the RFP that was either publically available or specifically provided by the State and TAK.
ADNR/DMLW/Water/D am Safety	4.1		4-1 #74, 75, 76	Observations include "improvements...to tailings deposition facilities" that are supportive of the respective requirements, but Section 4.2.5 (referenced in Table 4-1) does not include any description of such improvements. The auditors have not discussed the effect of the tailings deposition plan on other aspects of the TSF, such as the height of the dam, the schedule of raises, the storage capacity of the TSF or the water balance.	Comment noted. As stated in Section 4.2.5.1 of the audit report, the audit team made a brief examination of numerous documents regarding the tailings dam raises, including safety analysis, designs, and reports. As stated in Section 4.2.5.2 of the audit report, significant engineering and construction on the tailings dams has been completed (or is in progress) since the CRP was approved. The audit team was satisfied that the overall intent and key elements of the dam safety, operation and maintenance requirements have been met. However, the scope of this audit did not allow for a detailed review of all aspects of tailings deposition and how that has changed in the period since the 2009 CRP. As indicated in Audit Records No. 74, 75, and 76, the audit team recommends TAK update the tailings water management objectives and criteria during the 2014 permit renewal process to reflect current facility improvements and engineering information obtained since the last permit cycle.
ADNR/DMLW/Water/D am Safety	4.1		4-1 #75	The auditors should be advised that this requirement is part of the reason that the ultimate elevation of the dam is increased by 7 feet to elevation 993 ft. In other words, because the final elevation of the top of tailings deposit increased, the requirement for 2 foot of water cover pushes the revised hydrologic design of the dam up in elevation.	Comment noted.
ADNR/DMLW/Water/D am Safety	4.1		4-1 #77	Given that SD B3 assumed an average annual discharge of 1.5 billion gallons per year, and the actual historical discharge average is approximately 1.1 billion gallons per year, what is the effect of a 65% increase in storage in a single year? The accumulation of excess water described in Table 4-1 is not discussed in Section 4.2.5, as referenced, even though this problem has contributed to the accelerated dam raise construction schedule over the life of the mine, or in Section 4.2.6, which discusses the water balance. Additional elaboration on this topic in Section 4 seems warranted, considering the comments in the last paragraph on p. 5-1: "...water management is the most significant source of potential environmental concern at the site. The fact that the Main Pit was available for storage was fortunate, but speaks to the significance and scale of the issue". See comment on Section 4.2.1	Comment noted. The scope of the audit did not include development or detailed analysis of the site water balance. The water balance and related issues are discussed at a high level in Section 4.2.5 and Section 4.2.6 with the intention of providing a basis for the recommendation that TAK update the long term water balance in the 2014 renewal process. The agency comment raises important specific issues that TAK should fully address in the 2014 update to the CRP and supports the audit team recommendations.
ADNR/DMLW/Water/D am Safety	4.1		4-1 #79	Reference to Section 4.2.5; however, there is no discussion of the creek diversion in this section.	The Additional Report Info column has been revised to "None"
ADNR/DMLW/Water/D am Safety	4.1		4-1 #80	Note that the schedule for dam raises in SD B3 is stale and Stage IX construction (to elevation 976 feet) was mostly completed in 2013 and the Stage X raise is pending. What are the cause and effects of these accelerated raises? Are they significant to the audit? This issue may be more noteworthy than TAK compliance with state dam safety regulations and more accurately represents non-conformance with the schedule in SD B3.	The schedule in SD B3 is indeed stale and the Finding has been changed to "Update 2014" since indeed the raises were accelerated. While water management is a major driver for decisions at the site, determining the cause and effect of dam raises was outside the scope defined in the RFP and therefore not addressed in the audit report.

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ADNR/DMLW/Water/D am Safety	4.1		4-1 83	One of the primary purposes of the SD C3 was to document gaps in the construction record (i.e. as-built record). It is not clear why the auditors recommend updating a historical record with "design targets."	The text has been revised to indicate the dam history document should be updated to include "current conditions." (Applies to items 83 – 86.)
ADNR/DMLW/Water/D am Safety	4.1		4-1 84	Please note that SD C4 was superseded by "Preliminary Design Report, Revision 1, Ultimate Closure Configuration, Tailings Main Dam, Red Dog Mine, Alaska" dated July 2, 2013.	Noted. The referenced document was not identified in the RFP and was either not publically available or specifically provided by the State and TAK in preparation for the audit.
ADNR/DMLW/Water/D am Safety	4.1		4-1 82, 85 & 86	See Special Condition 4 of <i>Certificate of Approval to Modify a Dam</i> No. FY2013-14-AK00201, and Special Conditions 14 and 15 of <i>Certificate of Approval to Repair a Dam</i> No. FY2014-2-AK00201 for requirements to complete additional geotechnical investigations, and seepage, internal erosion and stability analyses. Revise findings as appropriate.	No change. The referenced documents were not identified in the RFP and were either not publically available or specifically provided by the State and TAK in preparation for the audit.
ADNR/DMLW/Water/D am Safety	4.1		4-1 88	Please note that revised spillway design was included in Appendix E of "Report, Water Management Plan, Red Dog Mine, Alaska" dated March 31, 2013.	The referenced document was not identified in the RFP and was either not publically available or specifically provided by the State and TAK in preparation for the audit.
ADNR/DMLW/Water/D am Safety	4.1		4-1 121	While TAK may be in compliance with existing water use authorizations, it is not clear that all water uses on site are specifically authorized. The auditor's recommendation to update the status of water rights for the 2014 CRP update is not consistent with the finding of "positive/in conformance".	The auditors' understanding in regard to water rights is that some changes would be occurring (e.g., expiration of TWUP F2012-135 and applications for TWUP F2013-136 / TWUP F2013-137) in the immediate future, hence the recommendation for the update.
ADNR/DMLW/Water/D am Safety	4.2			This section fails to follow the outline presented in Section 2.1.3. The recommendations based on the audit observation and finding that merit additional discussion remain buried in Table 4-1, leaving the reader to search for respective recommendations.	The content of Section 4.2 had been clarified to state it provides "additional discussion" rather than "detailed auditor notes." Note that Section 2.1.3 is not an outline, it presents definitions for the terminology used in the report since it is not standardized language. The section clearly states that the details are presented in Table 4-1. AECOM hopes that providing Table 4-1 in Excel format along with the Final Report will facilitate its use.
ADNR/DMLW/Water/D am Safety	4.2.1.	4-1		Water storage in Main Pit is a significant operational change that should be addressed by the audit in more detail. The final paragraph of Section 4.2.1.1 states that the Main Pit was converted to a "primary water management facility" in 2012 but does not provide enough detail to accurately understand the underlying factors driving the conversion. For example, the audit states, "high selenium concentrations during the rainy season resulted in the requirement to store more water than is normally anticipated. The auditors do not mention a letter from TAK to ADNR dated February 23, 2012 which indicates that the "main purpose" of flooding the pit was to submerge reactive waste rock up to elevation 840 ft MSL "faster than would occur if precipitation alone was filling the Main Pit." In the letter, Teck asked specifically if additional authorizations from ADNR were required. In an email dated February 27, 2012 from S. Stambaugh of ADNR OPMP, TAK was informed that ADNR Water Resources Section needed additional information. In a letter dated April 20, 2013, TAK submitted a TWUP application to pump water from the Main Pit to the TSF in order to maintain the pit water level "between 830 and 840 feet with a surge capacity to the 850 foot elevation." In an email dated May 21, 2013 from J. Clark of TAK, ADNR Dam Safety was informed that the water level in the TSF was expected to exceed the freeboard limits during the spring freshet, and that water would be removed from the TSF, treated, and both discharged to Red Dog Creek and diverted to the Main Pit, as soon as weather conditions allowed. Subsequently, TAK began reporting discharge and diversion quantities. In summary, the purpose and volume of water currently being stored in the Main Pit may be inconsistent with the initially stated purposes, and apparently contributes to the inability to utilize the pit for waste rock storage. Section 4.2.1.2 of the audit points out that the effect of the water storage on the waste rock storage plan as a "finding of non-conformance," but the change in the water management plan appears to be a "non-conformance", "improvement needed" or "Update 2014". See related comments on Items 53 and 54 of Table 4-1 and Section 5.0.	Comment noted. The referenced documents were not identified in the RFP and were either not publically available or specifically provided by the State and TAK in preparation for the audit. To this end, the audit team was unaware of the water being stored in the Main Pit until it was observed during the site visit. Once the team ascertained that the State was aware of the change in plans, the auditors assessed water storage in the Main Pit along with the myriad other audit items that needed to be covered in the brief time allotted for the site visit. The team stands by the findings and discussions presented in the report as a reflection of our observations and review of the materials and documentation made available for review. The agency comment raises important specific issues that TAK should fully address in the 2014 update to the CRP and supports the audit team recommendations.

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ADNR/DMLW/Water/D am Safety	4.2.5.1	4-14		The section refers to <i>Certificates of Approval to Operate a Dam</i> for the four dams at the mine and correctly notes that a separate certificate of approval is required for modifications, etc. The audit team observed active construction projects, but does not refer to the respective <i>Certificates of Approval to Modify a Dam</i> for the current construction. The audit team states that the requirements of the COAs are "generally being met", but fails to list outstanding requirements included with the modification approvals, in a manner consistent with operations approval requirements listed in Table 4-1. The outstanding requirements not listed clearly indicate that many of the SD C series are stale and require updating to meet state dam safety regulations.	As noted previously, AECOM was not provided with any Certificates of Approval to Modify in advance of the audit and therefore did not specifically include them in the audit plan.
ADNR/DMLW/Water/D am Safety	4.2.5.1	4-14		In fourth paragraph, please note that TAK is performing periodic safety inspections and has operation and maintenance plans in place for all four dams.	Edit made per comment.
ADNR/DMLW/Water/D am Safety	4.2.5.1	4-15		It is not clear why the auditor is endorsing design criteria in a stale document rather than deferring to regulatory agency approval. Such endorsements appear to conflict with the limitations described in Section 1.5 of the Audit. SD C8, presumably used as basis of the auditors opinion, is outdated and specifically superseded by "Report, Water Management Plan, Red Dog Mine, Alaska" by URS dated March 31, 2013, as well as "Preliminary Design Report, Revision 1, Ultimate Closure Configuration, Tailings Main Dam, Red Dog Mine, Alaska" by URS dated July 2, 2013.	AECOM is unable to specifically identify the subject of this comment. The referenced documents by URS were not identified in the RFP and were either not publically available or specifically provided by the State and TAK in preparation for the audit.
ADNR/DMLW/Water/D am Safety	4.2.5.2	4-15		The auditors correctly indicate that "significant engineering" has occurred during the "permit period" but fails to provide any correlation with the stale supporting documents listed in Table 2-2.	Significant engineering refers in general to the completed and ongoing work done on the Main and Back dams at the time of the audit. The observation is independent of the supporting documents listed in Table 2-2.
ADNR/DMLW/Water/D am Safety	4.2.6.1	4-17		Under the paragraph heading, "Water Balance Audit Team Field Observations" the auditors suggest some benefit for water quality testing of seepage from the MWS. See Special Condition 5 of <i>Certificate of Approval to Repair a Dam</i> No. FY2014-2-AK00201 for seepage water quality monitoring requirements for the Main Dam. Would this data provide similar benefits?	Unknown. The referenced document has not been made available to the audit team.
ADNR/DMLW/Water/D am Safety	4.2.7.1	4-18		In paragraph 5, item 2, the "Final Red Dog Diversion Dam" is not a formal dam name for a currently approved dam on site, so the subject of the paragraph is not clear. Please clarify that this refers to the Red Dog Mine Water Diversion Dam (NID#AK00260), currently approved to operate under <i>Certificate of Approval to Operate a Dam</i> number FY2011-10-AK00260, or some other structure.	Edit made per comment (Red Dog Mine Water Diversion Dam)
ADNR/DMLW/Water/D am Safety	4.3.2	4-32		It is not clear why the finding of "positive/in conformance" was made in light of the significant potential impacts of the related observations, as described. At face value, the finding should be "Update 2014."	The finding of positive/in conformance reflects TAK's conformance with current conditions required by the State in the 2009 CRP and RPA. The text suggests that the bond calculations be revisited as part of the next CRP / WMP permitting cycle, addressing the future condition.
ADNR/DMLW/Water/D am Safety	4.3.4	4-33		Appears to reflect confusion began in section 3.1.4.1 by questioning if the MWS "will be used for water management in the long term." The correct question should refer to the Main Pit.	Edit made per comment.
ADNR/DMLW/Water/D am Safety	5.0	5-1		Add second level heading format or number to objectives in order to provide numerical identifier to subsections. Paraphrased subsection titles do not track clearly with objectives as listed in Section 1.2. Only five objectives are listed here, whereas six are referenced and listed in Section 1.2. Instead of ordering the observations into objective based headings, consider listing the observations, and indicating the related objectives, since more than one objective may be pertinent to the observation.	The final report includes second level heading numbers. Section 5.3 Objective: Permit Conditions are Being Met was renamed to "Permit Conditions Provide Environmental Protection as Required" to more closely track the objectives presented in Section 1.2. The fact that 5 objectives are presented in Section 5 versus 6 in Section 1 is discussed in the text. AECOM felt the discussion of objectives as presented was more effective in presenting the evaluation.
ADNR/DMLW/Water/D am Safety	5.0	5-1		Under first objective, the issue described in item A is a consequence of the diversion of water from TSF to Main Pit to relieve the TSF storage requirement. This is a significant operational change that was not specifically authorized by ADNR TWUP and appears to be an exception to general compliance. See comment on Section 4.2.1.	The audit did not go into the level of detail to assess the diversion of water from the TSF to the Main Pit from the standpoint of the TWUP.

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Department/Division/ Section	Section # (i.e. 2.1.4)	Page #	Figure # / Table #	Comment	AECOM Status to Comment
ADNR/DMLW/Water/D am Safety	5.0	5-1		Under second objective, the first paragraph indicates a break from the correlation described in the first paragraph of Section 5.0 and contributes to the confusion stemming from the format and organization of this section.	Comment noted.
ADNR/DMLW/Water/D am Safety	5.0	5-1		Under second objective, in the second paragraph, dams are a significant engineering control that should be included in the list. They are not incidental to the operation and should not be deemphasized.	Dams have been added to the list in the final report.
ADNR/DMLW/Water/D am Safety	5.0	5-1		Under second objective, the third paragraph indicates that Teck modified water management and waste rock controls, which resulted in the Main Pit being utilized for water storage. However, the audit does not accurately describe any background information leading up to such a significant change, including root causes, decision events, or potential consequences of the action or the no-action corollary. See comment on Section 4.2.1.	See previous responses. The focus of audit was not an investigation into the Main Pit being used for storage. Rather, water in the Main Pit was a condition observed during the audit and investigated at a level of detail commensurate with the priorities identified in the RFP.
ADNR/DMLW/Water/D am Safety	5.0	5-2		Under second objective of the section, in the final paragraph (near the top of p. 5-2), please add note that compliance with "dam safety controls" supports environmental objectives. Suggested edit: Insert at the end of the paragraph, "This compliance also serves to support the environmental objectives."	Edit made per comment.
ADNR/DMLW/Water/D am Safety	5.0	5-2		Under third objective, the fourth paragraph is confusing. First, the passive reference to "the water management issue" leaves the reader hungry. Which water management issue is being discussed: storage in the Main Pit or seepage from the MWS? The paragraph then appears to reference sections in both the RPA and the audit; both the RPA and the Audit appear to include the number 4.2.2, and the callout adds to the confusion. How the discussion in this paragraph fits the objective "Permit conditions are being met" is unclear.	The discussion has been rephrased to clarify the references. The discussion provides suggestions for either changes to or continuation of permit conditions, which was the overall focus of the subsection. text states that the objective is being met but in relation to the state "the significance and scale of the challenges associated with water management."
ADNR/DMLW/Water/D am Safety	6.0	6-1		Recommendations are scattered throughout the Audit report in other areas than indicated in the first paragraph. For example, recommendations are included in audit observation and finding discussions in subsections of Section 4.2, as well as in the conclusions in Section 5.0. It is not clear that the "high level" recommendations of Section 6.0 are inclusive of Table 4-1 and the other misplaced or incidental recommendations throughout the audit report.	The occurrence of recommendations has been tightened up. For example, they have been eliminated from the Section 5 (Conclusions), and section 4.2. Recommendations discussed in Section 4.3 and presented in Table 4-2 are consistent with the way in which they are presented in Table 4-1, forming an intrinsic part of the report. Recommendations provided elsewhere in the document are repeated in Section 6.0 (Recommendations).
ADNR/DMLW/Water/D am Safety	6.0	6-1		Several of the recommendations are worded awkwardly, puzzling or fractured. For example: <ul style="list-style-type: none"> the fourth paragraph of Section 6.5.2 recommends updating the Plan of Operations for Tailings and Water Management "during the 2014 Closure and Reclamation Plan update process" with consideration of "relevant plans and schedules outlined in Reclamation Plan scheduled for 2014 [sic]." The two sentences appear to be redundant, In section 6.5.4, the audit team recommends updating "water and load balance calculations to reflect current water and load management outputs created with Goldsim" However, in Section 4.2.6.1, in the first paragraph on p.4-16, the audit team indicates that TAK is no longer using the stale, deterministic spreadsheet based models. Recommendations for updating the water management plan are included in Sections 4.2.6, 5.0, 6.5.2, and 6.5.4, in addition to Table 4-1. Recommendations for closure cost estimates are included in Table 4-2, and within paragraphs in Section 4.3.2, but apparently do not rise to a "high level" recommendation for discussion in Section 6.0. 	The recommendations have been reworded based on the comment. See changes to Section 6.5.2 to take out redundant wording and clarify that recommendation is that TAK update the CRP in the 2014 renewal process with the water management information developed in Goldsim. Additionally, Section 6.5.8 was added summarize the closure cost estimate recommendations.

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Department/Division/ Section	Section # (i.e. 2.1.4)	Page #	Figure # / Table #	Comment	AECOM Status to Comment
ADNR/DMLW/Water/D am Safety	6.5	6-2		The audit report makes recommendations on supporting document series A, B, D, E, F, G, H, and I, but does not provide any "high level" recommendations for the C series. As previously noted, several of the C series documents are stale as a result of the "significant engineering" during the permit period and must be revisited. The audit should recommend that all related engineering documents are revised and advanced to detailed design in order to support the increased height of the dam. In addition, the 2014 CRP update should reflect the increased elevation of the TSF dams.	Section 6.5.3 has been added to recommend the C series documents be updated.

Appendix 3

TAK Comments and Response Table

TAK – Chris Menefee Comments - 2014 DRAFT Environmental Audit - Red Dog Mine

Comment Number	Section # (i.e., 2.1.4)	Page #	Figure # / Table #	Comment	AECOM Status to Comment
1	4.0	PDF pg. 33	Table 4.1 Item 15	I don't think that placing waste rock around the edge of the main pit is a non-conformance with the CRP. The waste that has been placed around the perimeter of the main pit would have been placed there by the time mine closure occurs. The waste material was just placed in the current location (the edges of the main pit) earlier than was originally anticipated. Any runoff or infiltration from the waste is captured within the Red Dog Mine Treatment Works.	The final report includes some additional clarification and focuses the finding on the fact that the 2009 CRP includes the possibility for placing the most reactive rock in the Main Pit below the groundwater level. Because of the Main Pit being used for water management, that option was unavailable at the time of the audit and wasn't consistent with the 2009 CRP.
2	4.0	PDF pg. 35	Table 4.1 Item 35	Typo - Harvie	Edit made per comment
3	4.0	PDF pg. 35	Table 4.1 Item 47	Consider rewording; the primary objective of the current Groundwater Monitoring Plan is demonstrate that there is no possible connection between the water from the tailings pond and subpermafrost GW or between tailings pond water and the "temporary" GW that is present in the active layer during the summer. This is accomplished by demonstrating that the permafrost continues to be frozen and that impacted water is neither hydraulically connected or the hydraulic gradient of impacted water is lower than water that is flowing through the active layer in the summer. Because the goal of the plan has been to show that we the tailings pond is not impacting groundwater because impacted water is not connected to local or regional groundwater. I think Red Dog is in conformance with this requirement. However in the next permit we should be more explicit in how our plan protects groundwater.	AECOM agrees with the premise of the response and that TAK is compliant with the SEP and the Long-Term Permafrost and Groundwater Monitoring Plan for the Tailings Impoundment. The WMP references the consent decree between Cominco and EPA and the Supplemental Environmental Project which requires permafrost and sub-permafrost groundwater monitoring. The WMP requires "monitoring of surface and groundwater, as required, near the site to ensure that Alaska Water Quality Standards are not exceeded..." The audit observation is based on the fact that water quality data is not collected, which is a direct measure that Alaska Water Quality Standards are not being exceeded. The monitoring program accomplishes the objective indirectly by demonstrating the lack of hydrologic connection between the tailings impoundment and groundwater. The corresponding recommendation has been reworded to suggest that TAK and the State consider defining the conditions under which groundwater quality sampling would be added to the monitoring program.
4	4.0	PDF pg. 35	Table 4.1 Item 49	After further reflection and discussion among the folks up here, we've got one non-conformance that we disagree with. This one is in relation to the oil/water separator in the HE shop. Red Dog does not think that the Waste Management Permit explicitly require treatment of water resulting from the HE Shop with an oil/water separator. Red Dog thinks that the permit only requires treatment of oily water from the HE shop with an oil/water separator. Red Dog does not think that the HE shop generates oily water because we have adequate processes to prevent oily water from being generated and that we have adequate monitoring to detect a problem with oily water in the event that the HE shop generates oily water.	The following is from Tim Pilon (ADEC) in response to the email comment: "The intention of the permit condition is this: water that flows into the floor drains in the heavy equipment shop must go through an oil/water separator before it's discharged to the TSF. If there is no flow of water to a floor drain, then there is no problem. If there is flow to a flow drain, it needs to go through an oil/water separator." Per ADEC's response, the finding stands as presented in the draft report.
5	4.0	PDF pg. 36	Table 4.1 Item 53	Waste stockpiles are not temporary; the wastes will be incorporated into the final Main Pit Waste Dump design at closure.	Edit made per comment
6	4.0	PDF pg. 37	Table 4.1 Item 70	I don't think we have not conformed with the CRP by stacking waste around the edge of the main pit. The CRP anticipates that we will be placing waste above and outside of the Red Dog Mine pit shell. Waste was just placed above and outside of the Red Dog Mine Pit shell earlier than anticipated.	Response to Comment No. 1 above
7	4.0	PDF pg. 39	Table 4.1 Item 107	In conformance, see thoughts in condition 47 above.	Response to Comment No. 1 above
8	5.0	5-1	Item A	See my discussion about this in the findings table. I think we are in conformance with this part of the permit because all of the waste that we have placed outside of the pit is still within the permitted boundaries for waste management at closure.	Response to Comment No. 1 above