

**Red Dog Mine
Closure and Reclamation Plan**

SD B2: Plan of Operations for Waste Rock Management

Plan of Operations for Waste Rock Management

September 2007

Plan of Operations for Waste Rock Management

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1 Introduction

The Closure and Reclamation Plan for the Red Dog Mine makes several commitments related to waste rock management during operations. This document collects these commitments and provides further details. The topics are grouped into three categories, as follows:

- Construction of waste rock stockpiles in a geometry that is compatible with the closure plan;
- Progressive reclamation of completed stockpile sections;
- Segregation of waste rock to obtain clean material suitable for dam and cover construction and, where possible, to place material with the highest leaching potential below the ultimate water level in the Main Pit stockpile.

Other waste rock management procedures are documented in:

- Red Dog Development Plan (TCAK 2004);
- Main Waste Dump Design Criteria SOP; and
- Main Waste Dump Construction SOP.

2 Stockpile Construction Plan

The waste rock stockpiles have been designed to accommodate the projected waste volumes and to minimize re-sloping requirements for closure. The ultimate height of the Main Waste stockpile is constrained by navigational requirements for the airstrip, and the southernmost extent by a small creek at the south end of the dump.

Where possible, the stockpiles will be constructed so that the final surfaces will have slopes of approximately 3:1 to facilitate cover placement and other reclamation activities. Additionally, there will be sufficient space at the toe of the Main Waste stockpile to allow construction of the seepage collection system, and sufficient clearance between the toe of the Main Pit stockpile and the Red Dog Creek Diversion to prevent material from reaching the creek during operations.

The current dumping sequence for the Main Waste stockpile specifies final construction of the southern half of the waste rock pile by 2009 and completion of the north half by 2012. Completion of the southern half of the pile will allow final re-sloping, cover placement and re-vegetation activities to be initiated as early as 2009, without the need for haul trucks to cross through this area.

Once mining of the Main Pit is close to completion, waste rock will be placed in the Main Pit stockpile. Long-range plans for the Main Pit stockpile are described in the Red Dog Development Plan (TCAK 2004). The dumping sequence has been designed to allow high sulfide material from the Aqqaluk Pit to be placed below the ultimate water level in the Main Pit. This will be accomplished by working from three separate dumping platforms. The long-range plans indicate

that the Qanaiyaq waste rock would be placed in the upper lift of the Main Pit stockpile, where it will cover about half of the upper dump surface. However, further characterization of the Qanaiyaq waste may indicate that it would be preferable to encapsulate it in less reactive Aqqaluk material.

The low-grade stockpile will be expanded to accommodate material that may be economic to process once overhead costs from the pit are removed. It has been designed to accommodate 7.1 Mt of low-grade ore from Aqqaluk and 0.6 Mt of low-grade ore from Qanaiyaq.

3 Stockpile Progressive Reclamation Plan

The waste rock stockpiles will be progressively reclaimed during operations. The primary objective of progressive reclamation is to reduce loads to the tailings impoundment and subsequently to the water treatment plant. In addition, progressive reclamation will allow more efficient utilization of the existing equipment, and will allow less stockpiling of cover materials from the mining operations.

A schedule for implementation is provided in Figure 1, and described as follows:

- Cover trials will be constructed on the existing waste rock test cells located on the Main Waste stockpile in 2008. These tests will be fully instrumented to collect the data that will be needed for final design of the covers.
- A large scale cover trial will also be constructed on the Oxide stockpile in 2008 and 2009. These covers will also be instrumented to collect data for final design.
- The southern end of the Main Waste stockpile will be completed in 2009. At that time, it will be re-sloped in preparation for cover placement. The exact timing of cover placement will depend on the availability of suitable cover materials, equipment and manpower. Cover construction could start as early as 2009, and would continue over a period of several years. It is expected that the southern half of the stockpile would be completed no later than 2017. Once the covers are complete, this area would be seeded and fertilized over a 2 year period.
- The northern half of the Main Waste stockpile will be largely completed by 2011. Access to the low grade stockpile and the Qanaiyaq deposit will need to cross through this area. However, depending on material availability, equipment and manpower, it should be possible to re-slope and cover at least half of this area starting as early as 2014. Cover construction would likely be spread out over several years. However, it is expected that covers over the inactive areas could be completed no later than 2020, and then seeded and fertilized over a two year period.
- The Main Pit stockpile will be in use until the end of the mine life. However, it may be possible to cover portions of this stockpile in 2026, and the remainder within two years of cessation of mining.
- Depending on the economics at the time of closure, it may be possible to process ore in the Low Grade stockpile. This would most likely occur in the last year of mining when overhead from

the pit operations is reduced. If it is not economic to process this material, it will be re-sloped and covered along with any remaining areas on the Main Waste stockpile.

- The Overburden stockpile is a potential source of borrow material for the first lift of the Main Waste and Main Pit stockpile covers. For this reason, final re-vegetation activities on the Overburden stockpile would not be implemented until at least 2013, and possibly not until the end of mining.
- Suitable material will be required to cover the exposed tailings beaches at the end of the mine life. Some stockpiling of material will be required for this purpose.

4 Waste Rock Classification and Segregation

The most reactive waste rock from the Aqqaluk Pit will be segregated and selectively placed below the flood level in the Main Pit stockpile.

Rock or overburden with a low potential for ARD and metal leaching will be required for raises of the tailings Main Dam and construction of the waste rock covers. Siksikuk Shale from the mining operations will be used for tailings dam construction, and Okpikruak Shale and portions of the Kivalina Shale are expected to be used for cover construction. (Cover trials and further assessment of the distribution of zinc in the Kivalina shale are needed to confirm this part of the plan).

Segregation of these materials will require implementation of a waste rock classification plan as well as planning of deposition locations to minimize the need for re-handling. The main elements are as follows:

- Segregation criteria were defined for the dam construction materials, cover materials and most reactive waste rock as summarized in Table 1.
- ARD and resource models will be used to identify the general areas where these materials will be found and to update materials handling schedules. It is anticipated that additional data generated in the routine pit operations will be used to regularly update the block model and scheduling.
- Samples will be collected from the production blast holes by means of an automatic drill cutting sampler and analyzed to determine the iron, lead and zinc content. The exposed rock will be identified by a qualified geologist.
- The assay data and rock type will be used to classify the material in terms of its suitability for dam construction, cover construction or underwater disposal requirements according to the criteria in Table 1. Haul trucks drivers will be directed to haul these materials to a designated cover stockpile or area within the waste rock stockpile, as appropriate.
- Temporary stockpiles will be required for the dam construction and cover materials. Where possible, stockpiles for the cover material will be located on areas of the dump that have already been re-sloped in preparation for cover placement. Based on the current block model, it is

estimated that the maximum temporary stockpile size would be about 1,300,000 tonnes, which could easily be accommodated on the south end of the Main Waste stockpile.

Elements of the above may need to be revised as more experience is gained. In particular, procedures for the sampling, analysis and handling of “unmineralized” cover material will need to be tested by monitoring of the rock quality in cover material stockpiles.

The production schedules for the Okpikruak, Kivalina and Siksikpuk Shales are summarized in Table 2. These are based on the current block models of the deposits, and are periodically updated as additional data become available from delineation drilling programs and mining. At this time, it is anticipated that most of the Okpikruak, large portions of the Kivalina, and some of the Siksikpuk rock would meet the analytical criteria for construction.

Table 2 also shows the construction tonnage requirements for dams and covers. Based on this schedule, it is likely that there would be sufficient quantities of material for both the dam raises and cover construction, although the availability of Kivalina Shale will be limited prior to 2010. It is also likely that there would be periods of time when the amount of construction material exceeds the requirements for the projected construction activities, particularly for the Siksikpuk shales. During those periods, the excess material will be handled as unclassified waste rock and will be placed directly in the waste rock stockpiles.

Table 1: Segregation Criteria

Intended Use/Disposal Location	Allowable Rock Types	Analytical Criteria*
Dam Construction	Siksikpuk Shale	Single blast hole assays not to exceed: 1% Zn 1% Pb 3.5% Fe Average blast hole assays not to exceed 0.5% Zn 0.5% Pb 2.5% Fe
Cover Material	Kivalina Shale Okpikruak Shale	As above except Single blast hole assays not to exceed: Zn = 0.2% Average blast hole assays not to exceed: Zn = 0.1%
Most Reactive Waste Rock (where possible placed below the minimum water level, otherwise placed above the maximum water level in the backfilled Main Pit)	All Mineralized rock units, particularly the Ikalukrok Formation	>6% sulphide S**
Other Waste Rock (for placement in unsaturated portions of the waste rock stockpiles)	All other units.	Unclassified

Notes: *Analytical criteria are only to be applied to the allowable rock type (*i.e.* rock type has precedence)

**Calculated as follows:

$$\text{Sulfur from sulfide minerals} = (\%Zn * 0.516079) + (\%Pb * 0.154734) + (\%Fe * 1.148228)$$

Table 2: Schedule of Waste Rock Production and Material Requirements

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	>2019
Cumulative Production – Potential Construction Materials (Mtonnes/year)														
Okpikruak	0.74	1.5	2.7	3.2	3.6	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Kivalina	0.03	0.23	0.65	1.1	1.6	2.2	2.3	2.4	2.5	3.3	4.2	5.0	5.8	6.7
Siksikpuk	0.31	0.70	1.8	3.7	5.5	8.3	10.5	12.7	14.9	17.4	19.9	22.4	24.9	27.4
Construction Requirements (Mtonnes/year)														
Dam Raises*			0.54									0.74		0.5
Covers**														
Oxide stockpile		0.24												
South End of MWS			1.1											
North End of MWS								1.1						
Main Pit stockpile														1.2
Low Grade Ore														0.13
Tailings Beaches														0.5

Activity	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Production																												
Main Pit Mining																												
Aqqaluk Pit Stripping and Mining																												
Qanaiyak Pit Mining																												
Main Waste Stockpile Active																												
Main Pit Stockpile Active																												
Mine Area																												
Stockpile Cover Material																												
From Main Pit																												
From Aqqaluk Pit																												
Reslope and Cover Oxide Stockpile (requires 0.24 Mtonnes)				E	L																							
Reslope South End of Main Waste Stockpile				E								L																
Cover South End of Main Waste Stockpile (requires 1.1 Mtonnes)																												
Place First Cover Layer on Top of Dump				E																								
Place First Cover Layer on Sideslopes					E																							
Complete Cover on Top						E						L																
Complete Cover on Sideslopes							E	E				L	L															
Seed and Fertilize							E					L	L															
Reslope North End of Main Waste Stockpile								E				L																
Cover North End of Main Waste Stockpile (requires 1.1 Mtonnes)																												
Place First Cover Layer on Top of Dump									E																		L	L
Place First Cover Layer on Sideslopes										E																	L	L
Complete Cover on Top											E																L	L
Complete Cover on Sideslopes												E	E														L	L
Seed and Fertilize												E	E														L	L
Cover Main Pit Stockpile (requires 1.2 Mtonnes)																												
Reslope and Cover Qanaiyaq portion																												
Reslope and Cover Remainder																												
Seed and Fertilize																												
Re-Slope and Cover Low Grade Ore (requires 0.13 Mtonnes)																												
Cover Tailings Beaches																												
Reslope and Revegetate Overburden Stockpile														E													L	

E = Earliest
L = Latest



Closure and Reclamation Plan

Schedule for Progressive Reclamation

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RED DOG MINE

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Figure: 1