



memorandum

to: Mr. Robert Carreau, Corporate Manager, Environmental Affairs,
Breakwater Resources Limited
From: Arlene Laudrum, P.Geol., Senior Environmental Geologist
Date: February 5, 2004
ref: 23635
re: Nanisivik Mine, Predicted Volumes of Contaminated Soil

Introduction

A three phased Environmental Site Assessment has been undertaken at CanZinco Ltd.'s Nanisivik Mine in preparation for closure activities. Gartner Lee Limited (GLL) performed the work with field assistance being provided by local residents of Arctic Bay. Based on the results of these investigations, and incorporating GLL's current experience¹ at the Polaris Mine, the in-situ volume of contaminated soil present in the various areas of the mine site has been estimated. Figure 7 of our report, *Phase 3 Environmental Site Assessment Nanisivik Mine*, February 2004 (the Phase 3 Report) provides a visual representation of the areas of contamination targeted for remediation during closure.

Nanisivik Mine Soil Quality Remediation Objectives

The areas of contamination targeted for remediation during closure have metal concentrations that exceed the site-specific Soil Quality Remediation Objectives (SQROs) and/or hydrocarbon concentrations greater than the generic federal guidelines presented in the *Canada Wide Standards for Petroleum Hydrocarbons in Soil*² (PHC CWS). For a more detailed description of the soil quality remedial objective being applied, please refer to the Remedial Guidelines section of the Phase 3 Report. In areas where both metal and hydrocarbon contamination is present the soil has been listed as hydrocarbon contaminated on the following table.

Estimated Volume of Contaminated Soil

The volume estimates provided here are based on the information available, our knowledge of the Nanisivik mine site and our general experience with remediation of northern mine sites. The volume estimates are exclusive of the waste rock piles. The waste rock piles at the mine portals are included as areas of concern for metals on Figure 7 of the Phase 3 Report and the remediation of these areas is addressed in our report, *Nanisivik Mine Rock Piles and Open Pits Closure Plan*, February 2004. These areas include waste rock present at the East Adit, Oceanview, K-Baseline, Area 14, West Adit, 09 South Portal, and along the road joining the West Adit and the 09 South Portal. It is estimated that the waste rock in these areas represents an additional 70,000 m³ (plus) of material to be dealt with during site remediation.

¹ Arlene Laudrum, P.Geol. is the on-site remediation supervisor managing the excavation of contaminated soils at Polaris Mine, Nunavut. Arlene Laudrum P.Geol. conducted both the Phase 2 and Phase 3 ESA investigations at Nanisivik, Nunavut.

² *Canada Wide Standards for Petroleum Hydrocarbons in Soil (PHC CWS)*, Canadian Council of Ministers of the Environment (CCME), Winnipeg, MB, 2001 05 01.



The volumes of soil presented on the following table represent “banked” or in-situ volumes prior to excavation. For those areas where excavation is the preferred remedial plan, GLL suggests that a swell factor of 20% be used to plan for the storage volume required for placement of the material once excavated. In addition, covering of the contaminated soils may be a more appropriate remedial plan in some of the targeted areas as opposed to excavating and relocating this material.

Volume of Contaminated Soil Identified during ESA Investigations

TARGETED AREA	Hydrocarbon			Metal >SQROs		
	Area (m ²)	Depth ^a (m)	Volume ^b (m ³)	Area (m ²)	Depth ^a (m)	Volume ^b (m ³)
Dock ^c	600	3.0	1,800	2,000	0.5	1,000
Concentrate Shed	1,000	1.0	1,000	20,000	0.4	8,000
Tank Farm and Chemical Storage Area	5,000	1.5	7,500	-		
STOL	1,500	1.5	2,250	1,500	0.3	450
Townsite, Homes	5,000	0.3	1,500	1,500 ^d	0.3	450
Townsite, Dome day tank	2,000	1.5	3,000	-		
Townsite, Carpenter Shop	2,000	1.5	3,000	-		
Industrial Complex, North Yard	8,500	2.0	17,000	^e		
Industrial Complex, Adjacent Boneyard	2,800	1.5	4,200	^e		
Industrial Complex, Waste Oil Tank	750	0.6	450	-		
Industrial Complex, Assumed to be Under Building	2,500	1.0	2,500	-		
Industrial Complex, Warehouse Yard	2,000	1.0	2,000	-		
Road from Town to Dock	-			52,500	0.3	15,750
East Adit Treatment Facility ^f	-			2,000	0.3	600
Landfarm Cell ^g	1,000	0.75	750	-		
Landfill	-			-		
Day Tanks on Mine Roads	6,000	0.3	1,800	-		
Industrial Complex, West Side ^h	-			10,000	0.5	5,000
Industrial Complex, Lower Adit Yard ^h	-			2,800	0.5	1,400
Industrial Complex, Compressor ^h	1,000	0.5	500	1,500	0.5	750
K Baseline	3,700	2.0	7,400	ⁱ		
Area 14	1,000	0.3	300	ⁱ		
TOTAL VOLUMES			56,950			33,400^j

^a Minimum practical depth of soil excavation is 0.3 m.

^b Banked Volume.

^c Includes hydrocarbon contamination in dock cell and metal contamination under conveyor.

^d Does not include natural mineralization northeast of town site.

^e Soil is co-contaminated with both metals and hydrocarbons.

^f Shallow surface contamination identified at toe of retention pond.

^g Approximately 25% of the soil in the landfarm cell now meets the remedial objectives and it is possible to distinguish it by field-testing methods.

^h An application of a soil cover may be an appropriate remedial method for metal contaminated soil.

ⁱ Being addressed in the remediation of the waste rock piles.

^j An additional **70,000 m³ (plus)** is to be addressed under the remediation of the waste rock piles.



Assumptions Incorporated into the Volume Estimate

- The minimum depth to which soils can be effectively excavated at Nanisivik is 0.3 m.
- The residual concentrate in concentrated storage shed is less than 0.3 m deep.
- A small amount of hydrocarbon contamination is present at each above ground storage tank in the townsite and at the refuge station day tanks along the mine roads.
- The extent of hydrocarbon contamination was not delineated at the Dome and at the north side of the Industrial Complex due to presence of live underground utilities.
- The volume estimate assumes that residual hydrocarbon contamination is present under the carpenter shop, and the warm storage shed.
- The presence of hydrocarbon contamination under the footprint of the Industrial Complex was not investigated because of inaccessibility. For predicting the volume of hydrocarbon contaminated soil at Nanisivik it is assumed that it is present under the footprint of shop and powerhouse.
- Only one area with visible hydrocarbon surface staining in the warehouse yard was investigated. The volume estimate assumes that there will be five small similar areas of hydrocarbon contamination requiring remediation in the warehouse yard.

Confirmation that Remediation Objectives Have Been Met

A soil quality control procedure is to be implemented to ensure that the remedial objectives for contaminant concentrations are achieved in an efficient and timely manner. The objective will be to capture at least 95% of soils containing contaminants in excess of the SQROs in each remediation area. Contaminant concentrations in any residual soils will not exceed twice the SQRO's. These objectives are currently being applied at Polaris Nunavut.

The Confirmatory Sampling Plan is addressed in our report, *Nanisivik Mine Closure and Reclamation Monitoring Plan*, February 2004. The plan was developed so that the excavation of contaminated soils would proceed until the on-site screening procedures indicate that the excavation objectives have been achieved. At that time, a suite of confirmatory soil samples will be collected and analyzed at an accredited off-site laboratory. Backfilling of excavated areas or other similar work in the areas of excavation would proceed only subsequent to the receipt of results from the off-site laboratory confirming that the SQROs have been met.

Please do not hesitate to contact the undersigned or Eric Denholm if you have any questions or wish further clarification of this letter.

Yours truly,
GARTNER LEE LIMITED

Original Signed by

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c.c.: E. Denholm, P.Eng., Project Manager, GLL