APPENDIX I
TAILINGS DEWATERING PLAN

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1.0 INTRODUCTION

This appendix outlines the tailings dewatering plan for the Primary and Secondary Impoundments at the Cotter Corporation Canon City milling facility. This plan has been prepared as an appendix to the 2011 Tailings Reclamation Plan, associated with Radioactive Materials License 369-01. This appendix is an update of the plan included in the 2005 Decommissioning and Reclamation Plan (MFG, 2005), incorporating concepts for water management prior to tailings dewatering.

Since no additional tailings are to be placed in the Primary or Secondary Impoundments, the purpose of tailings dewatering is to enhance tailings consolidation from subsequent random fill or contaminated soil placement, prior to reclamation cover construction. The specific objectives of the tailings dewatering plan are to (1) reduce pore water pressures in the tailings, and (2) remove extractable pore water from the tailings (where achievable) in both the Primary and Secondary Impoundments. These objectives differ between the Primary and Secondary Impoundments, due to their differing placement conditions and densities (described in the following section).

2.0 TAILINGS AND IMPOUNDMENT SETTING

The tailings dewatering plan differs between the Primary and Secondary Impoundments. This is due to the thickness, stratigraphy, physical characteristics, loading history, and density of the tailings in each impoundment. These properties are summarized below. Note that both impoundments were treated by discharge of lime slurry for pH control and that this practice continues in the Primary Impoundment.

2.1 Primary Impoundment

The Primary Impoundment is partially filled with slurried tailings. Most of these tailings were generated from acid-leach processing of uranium ore, primarily from the Schwartzwalder Mine near Golden, Colorado. Approximately 26 percent of the milled ore came from mines near Nucla, Colorado (western slope ore). The particle-size distribution of Primary Impoundment tailings is summarized in Figure I.1.

The thickness of the slurried tailings has been evaluated from surveyed and sounded tailings surfaces (measured by Cotter) and the original constructed liner system surface (outlined Wahler, 1980). The elevation difference between these surfaces indicates that the maximum tailings thickness in the Primary Impoundment is approximately 30 feet. The tailings have been mostly submerged since their discharge in the impoundment, with some of the exposed tailings on the west and north side covered with soils for environmental control.

Investigation of the physical characteristics of tailings above the drainage layer of the liner system was conducted for Cotter Corporation by SMI in 1999. The investigation was conducted in two areas of the Primary Impoundment that were accessible with a drilling rig. The results of this investigation (presented in Appendix A of MFG, 2005) showed that the tailings in the areas investigated range in particle size from silty fine-grained sand to silt (illustrated in Figure I.1). The saturated hydraulic conductivity of the tailings is relatively low (10^{-6} to 10^{-7} cm/sec or 1.0 to 0.1 ft/yr), as are the values of coefficient of consolidation (0.003 to 0.3 cm^2/sec or 100 to 10,000 ft^2/yr). This means that porewater drainage from the tailings is limited by the low permeability of the tailings, and extractable porewater yield from the tailings is expected to be low.

2.2 Secondary Impoundment

The Secondary Impoundment is filled with tailings from the Old Ponds area. These tailings were generated primarily from alkaline-leach processing of various ores, primarily from the Schwartzwalder Mine. The particle-size distribution of Old Ponds area tailings is summarized in Figure I.1. These tailings were excavated as unsaturated materials and placed in lifts in the Secondary Impoundment with conventional earthmoving equipment. Since placement, these tailings have been covered with water from groundwater remediation for dust control and evaporation operations.

The physical characteristics of these tailings were not measured in 1999, since the Secondary Impoundment was covered with water. As shown in Figure I.1, these tailings range in particle size from silty sands to sandy silts, like the tailings in the Primary Impoundment. Due to their method placement, these tailings are at a significantly higher density than the tailings in the Primary Impoundment.

2.3 Impoundment Liner System

The liner system in both the Primary and Secondary Impoundments includes a synthetic liner constructed over a compacted clay layer (Wahler, 1980). A drainage system was installed above the synthetic liner in both impoundments to protect the synthetic liner as well as provide lateral drainage to remove tailings pore water. The drainage system consists of a series of finger drains (comprised of geofabric-wrapped sand and gravel conduits) that drain by gravity to a low area of each impoundment. The remaining liner surface (between the finger drains) is covered with on-site soils (sandy to clayey silt). This drainage system was not constructed as a high-capacity water extraction system, but provides a means for reduction of porewater pressures and removal of tailings porewater along the base of the tailings in both the Primary and Secondary Impoundments.

3.0 TESTING OF THE DRAINAGE SYSTEM

In addition to the studies of tailings drainage characteristics conducted by SMI in 1999, Cotter Corporation has conducted qualitative tests of the drainage system above the synthetic liner. These tests were implemented to determine if the installed drainage system was functioning. The tests were conducted in both the Primary and Secondary Impoundments, as described below.

3.1 Primary Impoundment Test

In the Primary Impoundment, a pump was placed in the collection sump for the lateral finger drain system. The finger drain extraction laterals that are below the water level in the impoundment are within the horizon of deposited tailings. After sufficient liquid volume had been pumped to achieve stable pH values, the pH of the pumped solution was monitored to determine whether the recovered solution was tailings porewater (being drawn from the tailings matrix) or from the standing free liquid from the tailings pond. Because the pH of the tailings porewater was acidic due to the acid-leach operations generating the tailings, a pH significantly lower than the impounded solution above the tailings would be a reliable, qualitative indicator that interstitial solutions were being withdrawn from the tailings.

The observed results of the test were that (1) liquid could be withdrawn from the lateral drains, and (2) the recovered fluid was significantly acidic. These observations support a qualitative finding of a functional drain system in the Primary Impoundment.

3.2 Secondary Impoundment Test

The test of the Secondary Impoundment was also designed to evaluate the functional operability of the lateral and finger drain system, and was accessed from the central collection point for the entire drain system. A pump was lowered into the central collection point riser. This riser extends deeper than the Primary Impoundment riser and therefore required sealing by means of an inflatable isolation bladder placed at a position just above the pump location. This device was then inflated to ensure that solution incursions from the upper pipe joints of the riser extensions were not being collected, and that recovered solutions were from the tailings matrix. Because of the alkaline pH of interstitial tailings fluid (from the alkaline tailings transferred from the Old Ponds area), a pH significantly higher than the acidic solution stored at the surface would be a reliable qualitative indicator that interstitial solutions were being withdrawn from the tailings.

The observed results of the test were that (1) liquid could be withdrawn from the lateral drains, and (2) the recovered fluid was significantly alkaline. These observations support a qualitative finding of a functional drain system in the secondary impoundment.

3.3 Implications for Reclamation

The tests conducted by Cotter Corporation indicate that the drain systems between the tailings and synthetic liner in both the Primary and Secondary Impoundments are operable and can be pumped to remove extractable pore water from the tailings. From the 1999 tailings hydraulic testing, the rate of water extraction from the drain system may be low, due to the relatively low hydraulic conductivity of the tailings above the drainage layer. However, the fact that tailings pore water can be removed by the drain system provides significant benefit for impoundment reclamation. Pumping of water from the drain system will reduce the hydraulic head on the synthetic liner and reduce the pore water pressures in the tailings, thereby aiding in consolidation of the tailings.

4.0 DEWATERING ALTERNATIVES FOR TAILINGS CONSOLIDATION

4.1 Secondary Impoundment

Due to the method used to excavate and place tailings in the Secondary Impoundment as well as monitoring of the interim cover surface by Cotter Corporation after completion of evaporation operations, minimal additional consolidation and settlement of tailings in the Secondary Impoundment has been measured to date. Minimal additional settlement is anticipated in the future. Operation of the drain system between the tailings and synthetic liner would be for removal of extractable porewater to minimize head on the liner system.

4.2 Primary Impoundment

Due to loose and saturated condition of tailings in the Primary Impoundment, dewatering to promote consolidation and settlement of the tailings prior to cover placement is necessary. The alternatives available for dewatering of tailings in the Primary Impoundment to promote consolidation and settlement of the tailings (from MFG, 2005) are listed below.

1. Allowing sufficient time for tailings consolidation, drainage, and settlement to occur.
2. Preloading the tailings, or placing additional fill over the tailings to enhance the rate of consolidation, then moving the additional fill elsewhere.
3. Enhancing the rate of consolidation by installing vertical band drains (wick drains) in the tailings.
4. Allowing downward drainage in the tailings through the existing drain system above the liner (described in Section 3).

4.3 Discussion of Dewatering Alternatives

The dewatering alternatives listed above were compared for effectiveness and rough cost in MFG (2005). This comparison indicated that providing drainage at the base of the tailings is as effective for tailings consolidation and drainage as other enhancement alternatives such as wick drains and preloading. This is the alternative for tailings dewatering included in the current 2011 tailings reclamation plan.

5.0 TAILINGS WATER MANAGEMENT

In order to meet the objectives of the tailings dewatering plan (reducing pore water pressures in the tailings and removing extractable pore water from the tailings), ponded water in the impoundments must be removed. This removal of process water and treatment by evaporation has been in progress for some time, with sufficient progress that use of the Secondary Impoundment for storage and evaporation of process water is no longer needed. The remaining volume of process water is contained in the lower portions of the Primary Impoundment.

The remaining water in the Primary Impoundment includes residual process water, lime slurry water added for ongoing pH control, and water collected from the SCS Dam and other various surface and groundwater collection areas on site. In order to continue evaporation of this water while proceeding with tailings reclamation activity, an overall site water management plan is included as a component of the tailings reclamation plan. This water management plan is outlined below.

5.1 Short-Term Conditions

In the short term, use of the Primary Impoundment for evaporation of water will be continued. There is sufficient area within the Primary Impoundment for evaporation, such that use of the surface of the Secondary Impoundment for evaporation is not necessary. Placement of demolition debris and contaminated soils has been limited to the north side of the Primary Impoundment, so as to not affect the lower areas of the impoundment for water storage and evaporation use.

5.2 Interim Conditions

In order to promote tailings consolidation in the Primary Impoundment, the water in the Primary Impoundment must eventually be removed. However, ongoing evaporation will still be required. Therefore an evaporation pond external to the Primary Impoundment will be necessary. The location and size of the pond (in terms of both evaporation surface area and storage capacity) is under evaluation by Cotter Corporation.

5.3 Long-Term Conditions

After covering and reclamation of the Primary and Secondary Impoundments, the external evaporation pond (constructed under the interim conditions described above) will remain in place as long as treatment of water by evaporation is necessary. Diversion of unaffected runoff on site for discharge as stormwater will be developed where possible.

6.0 REFERENCES

MFG Inc., (MFG), 2005. “2005 Update of the Mill Decommissioning and Tailings Reclamation Plan for the Cotter Corporation Milling Facility,” prepared for Cotter Corporation, August.

Wahler, W.A. and Associates (Wahler), 1980. “First Stage Construction Report, Cotter Corporation, Uranium-Vanadium Tailings Impoundment,” July.

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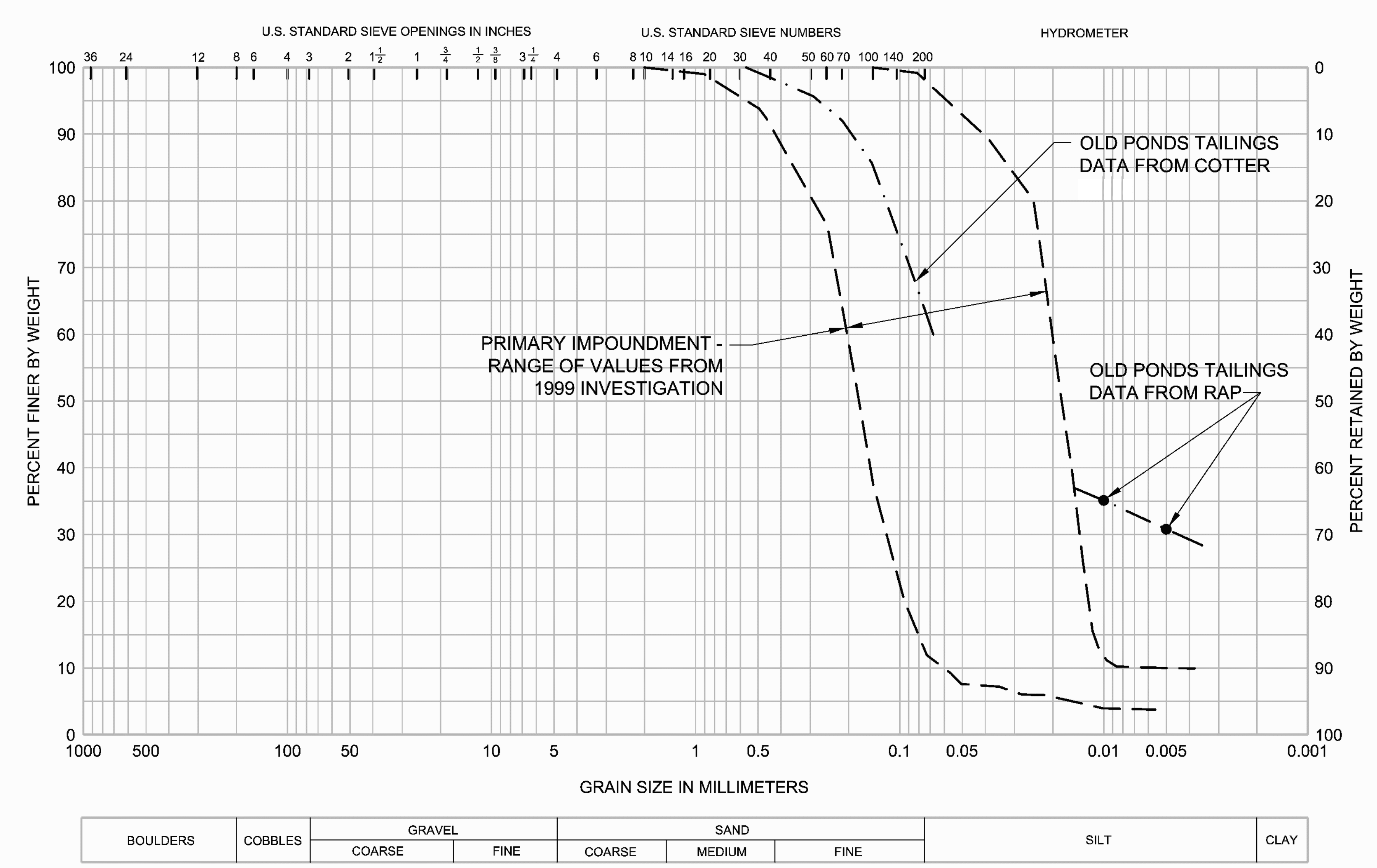

COTTER CORPORATION (N.S.L.)

PROJECT: CANYON CITY MILLING FACILITY

TITLE: PRIMARY IMPOUNDMENT TAILINGS PARTICLE-SIZE DISTRIBUTION SUMMARY

MWH

DATE: MAY 2011

FIGURE I.1

FILE NAME: 1007533-GSD

NOTE: FIGURE ADAPTED FROM FIGURE K.1 OF MFG (2005).