BUREAU OF MINING REGULATION AND RECLAMATION

GUIDELINES AND PROCEDURES FOR THE PERMANENT CLOSURE OF BIOREACTORS, EVAPORATION AND EVAPOTRANSPIRATION CELLS

The permanent closure of bioreactors, evaporation (E) and evapotranspiration (ET) cells provides a unique set of challenges. It may be assumed that cell matrix will, over time, contain elevated source solution dissolved solids concentrations. These dissolved solids may contain contaminants capable of degrading waters of the State. As such, the permanent closure of these types of components deserves additional detail.

This guidance document provides the Nevada Division of Environmental Protection (NDEP) overall cell permanent closure regulatory framework incorporating detailed guidelines and procedures. In particular, the Cell Matrix Characterization and Stabilization Procedures have been developed in cooperation with the U.S. Bureau of Land Management (BLM) and the U.S. Forest Service (USFS). This guidance document describes a conservative cell permanent closure approach, the application of which will clearly demonstrate that all cell matrix contaminants are permanently "stabilized" (Nevada Administrative Code [NAC] 445A.379) thereby preventing degradation of waters of the State.

BACKGROUND

It is common for permanently closed heap leach pads, tailings impoundments, and occasionally waste rock storage facilities to discharge a continuous, low flow solution. This solution is generally meteoric water that has infiltrated through the mine component and, in doing so, has mobilized a mass of dissolved solids that may include one or more contaminants. Specific site conditions may preclude an allowable/permitted discharge of this solution, more specifically the contaminants mobilized by the solution, into the environment.

Bioreactors, E, and ET cells have been proven to be effective tools for the management of these continuous, low flow solutions. E and ET cells remove or minimize the volume of source solution through passive evaporation or evapotranspiration. This source solution may be considered the 'vehicle' responsible for mobilizing and potentially disseminating contaminants into the environment. The lack of a 'vehicle' will immobilize potential contaminants within the cell matrix. Bioreactor cells treat/reduce/immobilize within the cell matrix identified draindown solution contaminants, thereby allowing for an acceptable discharge of the modified source solution into the environment.

Cells are generally constructed in existing double-lined process ponds or in another suitable location. The complexity of any cell design is dependent on the goal. However, all cells will include a matrix of solid materials necessary for successful cooperation. This matrix solid material may be a simple borrow source, spent ore, waste rock, or an engineered product.

One determination of a cell's effective lifespan can be linked to successful cell matrix function. Over time, problems associated with excessive salt concentrations, ecological toxicity issues, or preferential pathways will eventually reduce cell matrix effectiveness, thereby requiring actions that may include the permanent closure of the cell matrix and/or the entire cell itself. The permanent closure of an existing cell may not alleviate the Permittee's responsibility for the continued management or treatment of future source solution.

STATE REGULATORY OVERSIGHT

The NDEP, Bureau of Mining Regulation and Reclamation (BMRR), issues Water Pollution Control Permits (WPCPs) to construct, operate and close mining facilities pursuant to Nevada Revised Statutes

(NRS) 445A.300 through 445A.730, inclusive (commonly cited as the Nevada Water Pollution Control Law). Chapter 445A.350 through 445A.447 of the NAC entitled 'Mining Facilities', contains the applicable mining regulations. These regulations apply to all statewide mining operations, with exceptions as provided for within NAC 445A.387, regardless of land ownership. A cell, and its matrix if relocated, shall be considered a potential "Source" (NAC 445A.378).

FEDERAL REGULATORY OVERSIGHT

Federal agencies may have additional regulations and/or requirements.

CELL MATRIX BEVILL AMENDMENT APPLICABILITY

As provided for in the U.S. Code of Federal Regulations (CFR), Title 40, Chapter 1, Part 261, **is** commonly referred to as the Bevill Amendment. Heap leach pads, tailings impoundments, waste rock and solution solid materials (as are contained within the E or ET cell matrix) are excluded from the definition of 'hazardous waste' and are not subject to Federal Resource Conservation and Recovery Act (RCRA) requirements. The Bevill Amendment exclusion from RCRA requirements does not provide any cell matrix permanent closure "benefits", nor in any way precludes or lessens regulatory agency mine Permittee responsibilities with regard to the permanent stabilization of these wastes.

CELL FINAL PLAN FOR PERMANENT CLOSURE (FPPC)

The responsible party shall submit to all applicable agencies a proposed cell FPPC prior to initiating any cell permanent closure activities. These activities are coordinated through the BMRR Mine Closure Branch. For NDEP purposes, the permanent closure of cells shall follow facility permanent closure standard operating procedures as provided within the BMRR document *Preparation Requirements and Guidelines for Permanent Closure Plans and Final Closure Reports*. This document may be accessed on the BMRR website: Preparing Closure Plans and Final Closure Reports. The cell FPPC will be incorporated into the overall site Final Plan for Permanent Closure, Final Closure Report, and Request for Final Closure documents.

CELL FPPC CONTENTS:

1. Facility location and background information.
2. Cell location, description and operational history.
   A. Describe cell operational goals, assumptions, and design criteria;
   B. Describe cell engineering specifications to include liners, leak detection systems, matrix source; and all associated conveyance devices;
   C. Provide a detailed cell schematic drawing;
   D. Describe why cell permanent closure actions are now necessary;
   E. Present and discuss source solution quality, flows, and trends observed during cell operational timeline;
   F. Present and discuss cell outflow solution quality, flows, and trends observed during cell operational timeline;
   G. Discuss potential impacts to receptors exposed to cell matrix environmental media (e.g., metal uptake through matrix soil or vegetation ingestion);
   H. Summarize in detail overall cell effectiveness with respect to initial goals, assumptions, and design criteria, and
   I. Present predicted future long term source solution quality and flow. Will source solution require future management/treatment?
3. Cell matrix permanent closure location.

Cell matrix may be permanently closed either onsite or offsite. In general, the permanent closure of the cell matrix located on federally administered (BLM or USFS) lands will be site specific.

A. Onsite locations include:

   a. In-situ, or

   b. Onsite relocation remaining on approved containment (e.g., heap leach pad, process pond, or tailings impoundment).

If the cell matrix is to be permanently stabilized onsite, BMRR will be the NDEP coordinating bureau.

B. Offsite locations include:

   a. Hazardous Waste Disposal Facility, or

   b. Relocation to another permitted mine facility component remaining on containment (e.g., heap leach pad, process pond, or tailings impoundment).

Should the Permittee propose an off-site permanent stabilization scenario, the Bevill 'exclusion' will still apply although cell matrix would be managed as if a hazardous waste. The NDEP Bureau of Sustainable Materials Management and BMRR will then act as coordinating bureaus.

4. Cell matrix characterization and stabilization programs

Actions are required for all cell matrices proposed to be permanently stabilized onsite or be relocated to a similar mining facility component for permanent stabilization.

A. Cell matrix Characterization Program

The Characterization Program consists of a matrix sampling rationale, matrix sampling protocols, and laboratory analysis. Currently, spent cell matrix solids are not required to meet a regulatory numerical standard.

   a. The Characterization Program data collection requirements are designed to:

      i. Provide an average or baseline matrix solids numerical constituent concentration

      ii. Document the ability of the meteoric water to mobilize matrix solids constituents, and

      iii. Assist in providing cell matrix stabilization program direction.

   b. The Characterization Program data, when evaluated in conjunction with future monitoring data, may be of assistance in:

      i. Identifying a potential source of contaminants degrading waters of the State

      ii. Confirming that meteoric waters are not mobilizing potential matrix contaminants, and

      iii. Validating that the cell matrix stabilization program has stabilization matrix contaminants.

   c. The Characterization Program lab sample results are not required prior to initiating approved matrix stabilization actions. However, agency approval for stabilization actions will require a clearly conservative stabilization approach. All sampling and analysis requirements, as provided within the NDEP *Water Pollution Control Permit* under Part *II. General Facility Conditions and Limitations*; Section *E. Sampling and Analysis Requirements*, will be followed.

      i. Matrix sampling procedures

         1. The cell matrix must be sampled representatively, both laterally and vertically.

2. For E and ET cells, as a minimum one solids sample composited from five sub-samples taken from the four corners and the center of the cell will be required.
3. Samples must be taken from a depth consistently below the cell's saturation zone. The sampling procedure for bioreactor matrix and any unusual configuration will be specific to that cell. The matrix sub-samples may be collected when 'wet' but composite samples must be dry (air dry only) prior to laboratory analysis.
4. Sample location mapping and photographs shall also be submitted.

ii. Matrix analytical methods

1. ASTM E2242-02: Standard test method for column percolation extraction of mine rock by the meteoric water mobility procedure, and
2. EPA METHOD 3051A: Microwave assisted acid digestion of sediment, sludge, soil, and oil (SW-846), or
3. EPA METHOD 3050B: Acid digestion of sediment, sludge, and soil (SW-846).

B. Cell Matrix Stabilization Program contents

a. Matrix stabilization actions

i. The NDEP will only approve of a Matrix Stabilization Program that will, with a high degree of confidence, ensure a long term, stable matrix permanent closure configuration resulting in a zero discharge of contaminants into the environment.

ii. Requirements as specified by NAC 445A.427 may be applicable.

iii. Depending on site characteristics (e.g., shallow depth to groundwater), a risk assessment may be an option (see NAC 445A.227).

b. Matrix permanent closure configuration and physical stability into the long term.

i. The Permittee shall inspect or review the upgradient watershed to ensure that the ultimate matrix deposition location is not subject to meteoric run-on events that may damage the facility. Long term physical stability actions may include upgrading existing stormwater diversions or the construction of new structures. These diversions shall be designed to withstand a 500-year, 24-hour storm event, and require little to no maintenance. Maintenance may be a bondable item.

ii. One potential matrix stabilization action may include the installation of a cover. Because of the potentially high concentrations of matrix contaminants, a cover, if a significant component of the Matrix Stabilization Program, shall be impermeable or relatively impermeable to meteoric water infiltration. Synthetic cover materials may be required depending on the anticipated chemistry. Prior to cover installation, the cell matrix should be dried and then compacted to avoid cover related settling problems.

iii. Another potential matrix stabilization action may include chemically binding matrix contaminants into a material resistant to meteoric water mobilization.

C. Matrix Post-Closure Monitoring Plan

Site characteristics and the cell's operational history and performance will help determine post-closure monitoring locations, parameters and frequency (to include down-gradient monitoring wells). These monitoring requirements will be incorporated into the facility's Water Pollution Control Permit.

a. Facility location and background information

i. Geographic location and site climatology,

ii. Water Pollution Control Permit status,

iii. Background aquifer depth and quality, and

iv. Background surface water location and quality, to include springs (if applicable).

b. Monitoring Plan

i. Post closure monitoring and data collection efforts will be required to validate matrix stabilization.

ii. Final matrix location GPS coordinates (UTM in meters NAD 83) will be required unless a Hazardous Waste Disposal Facility is utilized.

iii. The potential for receptors to access stabilized matrix, to include the potential impacts to receptors exposed to cell matrix environmental media, will be evaluated with respect to a selected stabilization action.

iv. A monitoring well designed to validate the lack of meteoric water infiltration into the matrix, or the lack of matrix contaminant mobility if meteoric water is available, will be required.

D. Cells permanent closure surety bonding

a. In general, a surety bond will be required to support some aspects of the overall cells. On Federal lands a long-term trust fund may be required.

b. The BMRR's Reclamation Branch will be the surety 'lead' and should be provided a copy of the cell’s FPPC (as well as applicable Federal land managers) for review and comments.

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