CLOSURE/CLOSEOUT PLAN UPDATE

TYRONE MINE CLOSURE/ CLOSEOUT PLAN UPDATE

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Tyrone, New Mexico

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List of Acronyms and Abbreviations

°C	degree Celsius
ABA	acid-base accounting
AST	Above-Ground Storage Tank
AQB	Air Quality Bureau
AQCR	Air Quality Control Regulation
BER	Basic Engineering Report
BLM	Bureau of Land Management
BMI	Borrow Materials Investigation
BMP	Best Management Practices
CCP	Closure/Closeout Plan
CDQA	Construction design quality assurance
CDQAP	Construction Design Quality Assurance Plan
CFR	Code of Federal Regulations
CQA	Construction Quality Assurance
DBS&A	Daniel B. Stephens and Associates, Inc.
DP	Discharge Permit
EC	electrical conductivity
ETS	Evaporative Treatment System
EnviroGroup	EnviroGroup Limited
ft	Feet
Golder	Golder Associates Inc.
Guidelines	Closeout Plan Guidelines
HDPE	high density polyethylene
HDS	high-density sludge
µS/cm	microSiemens per centimeter
msl	mean sea level
M3	M3 Engineering & Technology Corp.
MAP	mean annual precipitation
MMD	Mining and Minerals Division
NMED	New Mexico Environment Department
NMMA	New Mexico Mining Act
NMWQA	New Mexico Water Quality Act
NMWQCC	New Mexico Water Quality Control Commission
NSR	
O&M	Operation and Maintenance
OSE	Office of the State Engineer
OPSDA	Open Pit Surface Drainage Area

List of Acronyms and Abbreviations (Continued)

PDTI	Phelps Dodge Tyrone, Inc.
PLS	pregnant leach solution (economic copper-bearing leach solution)
PMLU	post-mining land use
POPE	Plant Oxidation Pond Effluent
RCRA	Resource Conservation and Recovery Act
RTC	Response to Comments
Rules	New Mexico Mining Rules
SCS	Soil Conservation Service
SPCC	Spill Prevention Control and Countermeasures
SPLP	synthetic precipitation leachate procedure
SSE	self-sustaining ecosystem
SX/EW	solution extraction-electrowinning
SWCZ	surface water catchment zone
SWMP	Stormwater Management Plan
SWPPP	Stormwater Pollution Prevention Plan
t/tk	ton over kiloton
TDS	total dissolved solids
Tyrone	Freeport-McMoRan Tyrone, Inc.
EPA	U.S Environmental Protection Agency
Van Riper	Van Riper Consulting

1.0 INTRODUCTION

Freeport-McMoRan Tyrone, Inc. (Tyrone) is an open pit copper mine located just off State Highway 90, approximately 10 miles southwest of Silver City in Grant County, New Mexico (**Figure 1-1**). This Closure/Closeout Plan (CCP) is an update of the 2003 Tyrone Closure/Closeout Plan and renewal application submitted to the New Mexico Environment Department Groundwater Quality Bureau Mining Environmental Compliance Section (NMED) and the Mining and Minerals Division (MMD) of the Energy of the Minerals, and Natural Resources Department, which was approved by the agencies on April 8, 2003 (NMED, 2003a) and April 12, 2004 (MMD, 2004). This submittal includes the current CCP and associated reclamation cost estimate for the Tyrone Mine.

1.1 Purpose of Plan

The Tyrone Mine CCP has been updated as required by the following permits and agreements. This update incorporates the requirements of the 2010 Settlement Agreement and Stipulated Final Order (NMED and Freeport McMoRan Tyrone, Inc., 2010), 2012 First Amendment to Settlement Agreement and Stipulated Final Order (NMED, 2012, collectively referred to herein as the "Settlement Agreement" and described briefly in Section 1.4 below), and the following two permits:

- Supplemental Discharge Permit (DP) for Closure, DP-1341, which was issued by the NMED on April 8, 2003 (NMED, 2003a); and
- Permit Revision 10-1 to Permit GR010RE (MMD Permit), which was issued by the Director of the MMD on August 31, 2012 (MMD, 2012).

The Settlement Agreement addressed a number of issues regarding site-specific closure requirements at the Tyrone Mine. The Settlement Agreement also sets forth a framework for substantive closure requirements and conditions that shall be included in the DP-1341 renewal. The amended Settlement Agreement incorporated the Copper Mountain Pit within the Open Pit Surface Drainage Area (OPSDA). The OPSDA is defined as the stockpiles (or stockpile areas) and disturbed areas adjacent to the open pits where surface water cannot feasibly be diverted during reclamation out to the perimeter of the Mining Area due to existing topographic constraints, and is contained within the area of open pit hydrologic containment. The OPSDA is depicted on Figure 3R of Revision 10-1 to Permit GR010RE (MMD, 2012). The MMD Permit details general obligations and conditions for mine closure, reclamation, and associated financial assurance requirements. This CCP replaces the Departments approved 2003 CCP and supersedes the Tyrone Mine CCP Update that was submitted to the NMED and MMD in October 2007 (Golder, 2007e).

1.2 Plan Organization

This section describes the purpose and scope of the CCP Update and its overall organization. The main body of the CCP consists of the following sections:

- **Section 1.0** provides an overview of the updated CCP for Tyrone,
- **Section 2.0** describes the existing facilities and current environmental setting at the Tyrone Mine including geology, fauna, flora, mine history, current disturbances, and discharge permits associated with the mine,
- **Section 3.0** describes the ongoing and completed reclamation projects at Tyrone, including reclamation projects planned up through the end of year (EOY) 2014,
- **Section 4.0** describes the proposed reclamation design criteria and performance objectives for surface reclamation and water management and treatment,
- **Section 5.0** provides details on the reclamation plans for each of the three major facility areas at Tyrone,
- **Section 6.0** describes the closure and post-closure monitoring plans for Tyrone along with contingency plans and reporting schedules,
- **Section 7.0** provides details of the proposed post-mining land uses for the Tyrone and the associated requirements for the individual areas,
- **Section 8.0** presents a summary of the capital cost estimate associated with the proposed reclamation and post-closure monitoring plans presented in Sections 5.0 and 6.0, and the operating and maintenance costs associated with the proposed reclamation and post-closure monitoring plans,
- **Section 9.0** presents the proposed reclamation schedule associated with this CCP,
- **Section 10.0** is the signature page for the CCP update, and
- **Section 11.0** lists the references used in preparation of this CCP.

The following appendices are also included in the updated CCP:

- **Appendix A** includes the reclamation design drawings that illustrate the updated CCP,
- **Appendix B** provides the updated facility characteristic forms,
- **Appendix C** includes the updated cost estimates for earthwork, and
- **Appendix D** includes the updated cost estimate for water treatment.

1.3 Regulatory Authority

In 1993, the New Mexico legislature enacted the New Mexico Mining Act (NMMA) requiring that closeout plans be put in place for applicable mines within the state. Rules to implement the requirements of the NMMA were promulgated in 1994. This plan was prepared to comply with applicable regulations and requirements stipulated in the NMMA (NMAC Title 19, Chapter 10, Part 5), New Mexico Water Quality Act (NMWQA), and the New Mexico Water Quality Control Commission (NMWQCC) Regulations (NMAC Title 20, Chapter 6, Part 2). Additional details of the NMMA and closure planning concepts associated with Tyrone are described in the following sections.

1.3.1 The New Mexico Mining Act and Administrative Rules

The NMMA legislature established a goal of promoting responsible utilization and reclamation of lands impacted by mining while also recognizing that mining is vital to New Mexico. The program is administered by the MMD and approved existing mine permits apply for the life of the operation.

Tyrone is regulated as an 'existing mine" under the NMMA because it produced marketable minerals for a total of at least two years between January 1, 1970 and the effective date of the NMMA.

1.3.2 Closeout Planning Constructs

The closeout plan is the core of an existing mine permit. The MMD's New Mexico Mining Rules (Rules) and advisory Closeout Plan Guidelines (Guidelines) provide a foundation for the development of Closeout Plans. Subpart 506.A of the NMMA states that "… closeout plans shall be based on site-specific characteristics and the anticipated life of the mining operation. Site-specific characteristics include, but are not limited to, disturbances from previous mining operations, past and current mining methods utilized, geology, hydrology and climatology of the area." The Guidelines recognize that each site presents a unique set of circumstances and that many of the existing mines subject to closure requirements were largely developed prior to the NMMA without the requirement for reclamation.

The landowner proposes the post-mining land use, which must be approved by the Director of the MMD. Post-mining land uses include, but are not limited to, agricultural (e.g. cropland, grazing land, or forestry), commercial, industrial, or ecological uses that would comply with applicable laws and regulations. Determining future land-use is the first step in developing a closeout plan and establishing financial assurance for the site. The two post-mining land uses applicable to Tyrone are wildlife habitat and industrial. The industrial PMLU is relevant to certain areas that can be used to support industrial uses other than mining after mine closure.

The NMMA allows for the granting of a waiver from the requirement to achieve a self-sustaining ecosystem for specific areas of a mine. Tyrone has applied for and received from MMD a conditional waiver for specific areas of the mine. These areas are primarily the open pits and certain interior stockpile slopes where storm water drains into the open pits and is captured by the mine dewatering system. The waiver does not apply to certain stockpile top surface areas within the mine's interior. This update of the CCP takes into account conditional waivers approved by the MMD.

1.3.3 Closure Planning Constructs

The primary reclamation challenges at Tyrone involve the control of impacted water, stabilization of the mined materials (tailings, rock stockpiles and areas impacted by mine processed materials) to prevent off-site dispersal, and establishment of a self-sustaining ecosystem, where applicable. Tyrone intends to achieve the reclamation goals through a combined approach involving source stabilization, containment and isolation by covering and revegetation complemented by surface and ground water controls and water treatment. In addition to honoring environmental commitments, Tyrone is committed to providing for the economic viability of its mining operations. Thus, the reclamation plans must be rationalized from an economic perspective.

While conceptually simple, the reclamation process is multifaceted in practice and the development of Tyrone's plan has required the coordinated efforts of a diverse group of scientists and engineers. The CCP presented herein relies on the application of standard reclamation principles to the unique set of conditions that characterize the facilities at Tyrone. Consistent with industry practices at large open pit copper mines with long operating histories, Tyrone's plan employs vegetated soil covers and surface and subsurface water management systems to stabilize the facilities and to reduce and control impacted water.

To aid Tyrone in selecting a plan, environmental scientists and engineers have performed extensive, site-specific investigations to develop a comprehensive understanding of the mined material and the surrounding environment. Over the past decade, a broad range of specialized studies (e.g., ground water, cover design, revegetation, and water treatment) have been conducted to evaluate the environmental and economic implications of various closure alternatives.

Results from these, and other, studies were integrated through a comprehensive Feasibility Study to better understand the closure alternatives and financial implications of various closure alternatives (Golder, 2007d). The Tyrone Feasibility Study (Condition 89) involved a collaborative process whereby representatives from Tyrone, NMED, and MMD selected closure alternatives and mechanisms for evaluation (Golder, 2007d). However, the 2010 and 2012 Settlement Agreements previously described has superseded the recommendations of the DP-1341 Condition 89 feasibility study.

From a technical perspective, the overarching conclusions of the Feasibility Study were that there is a point of diminishing return in that increasing levels of source control (cover thickness) will not significantly improve ground water quality. Water quality from impacted stockpile seepage at Tyrone is unlikely to improve significantly, but the volumes of impacted seepage will be significantly reduced over time following cover placement. Thus, there is no expectation for the foreseeable future that any of the closure alternatives analyzed will perform relatively better to decrease the size of the area where ground water currently exceeds the standards of 20.6.2.3103 NMAC. Measured ground water flow in the Mining Area indicates that the open pit areas act as a hydraulic sink (primarily the Main Pit and the Gettysburg Pit) that is maintained by pumping the open pits that intersect ground water. This means that the majority of solutions contained in the stockpiles and ground water within the area of hydrologic containment will flow toward the pit and is contained. Impacted water within the OPSDA will be collected in the pit sumps and treated after cessation of operations. In the case where ground water impacts may occur outside the pit capture zone, stockpile seepage and impacted ground water will be contained by existing and proposed interceptor well systems and seepage collection/cutoff systems and sent to the proposed water treatment system. Treated water may be released to a natural drainage outside of the disturbed area. Concentrated constituents removed from the input stream to the treatment plant will be disposed of in containment cells within the interior of the mine and reclaimed by covering.

The site condition assumptions used for this CCP update are not static. Monitoring well data are regularly collected in accordance with the operational and closure discharge permits, and the site-wide abatement plan is proceeding according to 20.6.2.4106 NMAC, Condition 34 of DP-1341. The Stage 1 Abatement Plan Final Site Investigation Report (FSIR) was submitted as required by DP-1341 (Daniel B. Stephens & Associates, Inc. [DBS&A], 2011), and approval of the FSIR was granted by the NMED in January 2012. The FSIR provided a review of the previous Stage 1 abatement plan submittals, the results of additional field investigations not previously documented, and updated water quality figures and maps of the extent of groundwater impacts based on 2010 monitoring data.

The Stage 2 Abatement Plan Proposal (APP) was submitted to the NMED on February 29, 2012 in accordance with DP-1341 and the regulatory requirements in Section 20.6.2.4106.E NMAC (DBS&A, 2012). The Stage 2 APP discusses groundwater impacts and abatement of impacted groundwater at Tyrone relative to three APP study areas including the: Mangas Valley APP, Mine/Stockpile Area APP, and Brick Kiln Gulch/Oak Grove Wash APP. Also included in the Stage 2 APP is an analysis of background concentrations for selected constituents of interest at Tyrone. The background study proposed elevated background standards for manganese and fluoride, two constituents that are ubiquitous in the Tyrone area and are naturally elevated above NMWQCC standards at some Tyrone monitor wells. Whereas the NMWQCC standards listed in Section 20.6.2.3103 NMAC for fluoride and manganese are 1.6 and 0.2 milligrams per liter (mg/L), respectively, the proposed background standard for fluoride and manganese, based on naturally elevated concentrations at Tyrone, are 2.9 and 3.1 mg/L, respectively.

The Stage 2 APP is currently under review by the NMED. Upon approval of the Stage 2 APP by the NMED, Tyrone plans to submit a petition for alternative abatement standards that meet the criteria of 20.6.2.4103.F NMAC based on the results of groundwater modeling presented in the Stage 2 APP, empirical data, and other information relevant to Tyrone. At closure, groundwater beneath the entire Tyrone Mine site will be subject to either water quality standards set forth in Section 20.6.2.3103 NMAC, background concentrations approved by the NMED, or alternative abatement standards approved by the NMWQCC (referred to herein as "applicable standards").

Tyrone's current mine plan projects that active mining will continue for 5 to 10 years, with the potential to extend the mine life based on the demonstration of additional copper resources in the area, which has occurred in the past. Active mining means the mining, hauling, and leaching of ore for beneficiation on leach stockpiles. Tyrone will continue to leach the stockpiles for a number of years after it has stopped mining and hauling new ore. During this transition period Tyrone's solvent extraction/electrowinning (SX/EW) plant will continue to recover copper-bearing pregnant leach solutions (PLS) and process water from seeps located at the toe of the stockpiles, while closure activities are implemented at other areas of the mine. The SX/EW plant will not close until the last of the economic PLS has been processed. Once the SX/EW plant ceases operation Tyrone will complete implementation of the closure plan.

Tyrone recognizes that the closure plan must be structured to accommodate advancements in science, engineering, and mining technology. Extensive reclamation has been performed to date at this site and the lessons learned from this experience have been applied to this updated plan. Tyrone has employed new reclamation techniques and products during construction and plans to continue this practice for future reclamation. Thus, Tyrone reserves the option to modify the closure plan to adopt developments in reclamation science or improved understanding of the site. The CCP is required to be updated at five year intervals.

1.4 History of Closure/Closeout Plan Submittal

Prior to the legislative activities that led to the establishment of the NMMA, Tyrone submitted various closure plans and implemented tailing test plots for closure as part of operational DP requirements. The following summary focuses on activities that occurred after the implementation of the NMMA.

In 1994 Tyrone submitted a mining operations site assessment and an existing mining operation permit application. The permit application was approved by the MMD on July 10, 1996. The following list provides a chronology of the more recent progress leading to this updated CCP:

- Tyrone submitted a preliminary CCP in December of 1997 (DBS&A, 1997c);
- Tyrone applied for and was granted an extension by the MMD for closeout plan approval until December 31, 1999;
- Tyrone submitted a revised CCP in April 1999 (DBS&A, 1999) and secured an interim financial assurance with the NMED;
- In 1999 Tyrone applied for and was granted an extension for closeout plan approval until December 31, 2001;
- Tyrone submitted the End of Year 2001 Through Year 2008 CCP for the Tyrone Mine in May 2001, which was updated in July 2001 (M3, 2001);
- Supplemental Discharge Permit for Closure DP-1341 was issued by the NMED on April 8, 2003 (NMED, 2003a);
- Permit Revision 01-1 to Permit No. GR010RE was issued by the MMD on April 12, 2004 (MMD, 2004);
- Tyrone submitted a CCP Update in October 2007 (Golder, 2007e);

- In 2010, NMED and Tyrone signed the Settlement Agreement and Stipulated Final Order (NMED and Freeport McMoRan Tyrone, Inc., 2010);
- In December 2012, the Tyrone DP-1341 Settlement Agreement and Stipulated Final Order was amended (NMED, 2012); and
- In August 2012, Permit Revision 10-1 to Permit GR010RE was issued by MMD, which contained a conditional waiver for open pits and interior stockpile slopes (MMD, 2012).

1.5 Description of Updated Plan

The MMD and NMED require that existing mines prepare a CCP and the entity responsible for the mine must put in place financial assurance "sufficient to assure the completion of the performance requirements of the permit, including closure and reclamation, if the work had to be performed by the director or a third party contractor." The CCP is revised on a five year basis throughout the mine's active life to reflect changes in mine operations, site conditions, and adjusted financial assurance estimates.

This 5-year update to the CCP revises the CCP Update submitted in October 2007 (Golder, 2007e) with refined closure/closeout conceptual designs that account for changes in site-specific conditions, ongoing and completed reclamation projects, and recent mine plans. Like the original 2001 CCP (M3, 2001) and 2007 CCP Update (Golder, 2007e), this updated plan is a "snapshot in time" that reflects the most expensive closure scenario within the 5 year period covered by this CCP based on the Tyrone mine plans and site conditions. Details of facility changes that have occurred since the last CCP and those projected in the subsequent planning period are provided in this CCP. It also describes fulfillment of the permit conditions stipulated in Permit GR010RE and DP-1341 (See Section 4.0).

The facility characteristics and reclamation designs presented in this CCP are referenced to conditions at Tyrone at the EOY 2014 as well as the projected status of ongoing and planned reclamation projects prior to the EOY 2014. The proposed reclamation and post-closure monitoring plans for the principal mine facilities and seven operational DP areas (See Section 2.5.7) are described in Sections 5.0 and 6.0.

This updated CCP supports financial assurance cost estimates for closure/closeout based on the EOY 2014 mine plan. Use of the EOY 2014 mine plan is consistent with the snapshot in time philosophy that was adopted by Tyrone and the Agencies early in the closure planning process and represents the year with the greatest volume of regrading and cover placement required between 2012 and 2017. If mining activities were to cease between the years 2012 and 2017, the highest financial assurance requirements would be associated with the EOY 2014 conditions. Thus, the EOY 2014 plan is expected to represent the most onerous condition from a cost perspective.

1.6 Summary of CCP Cost Estimate

For financial assurance purposes, the total cost to implement the CCP presented herein is estimated to be approximately $480,504,000. Capital costs, operating costs, and maintenance costs for post-closure/closeout care have been developed for this updated plan as outlined in Section 8.0 and detailed in Appendices C and D. The EOY 2014 scenario used to develop the reclamation cost estimate reflects the highest reclamation cost scenario for closure/closeout in the time period between 2012 and 2017.

2.0 EXISTING FACILITIES AND CONDITIONS

The following sections describe the Tyrone mining facilities and operations, ownership history, past and current land uses, environmental setting, and mine material characteristics. In addition, pertinent permits and operational DPs are summarized herein.

2.1 Description of Mining Facilities

For the purposes of the updated CCP, the Tyrone Mine was separated into three geographical areas including the; Mining Area, East Mine Area, and Mangas Valley Tailing Area (**Figure 2-1**). The three areas are described as follows:

- The Mining Area includes the Main, Valencia (extension of Main Pit), Savanna, Gettysburg, Copper Mountain, and partially backfilled San Salvador Hill and South Rim Pits; the 1A, 1B, 2A, 2B Leach, 2C, 3A, 4A, 4B, 4C, 6B, 6C, 7B, and future Savanna In Pit leach ore stockpiles; the 2B Waste, 3B, and 8C waste rock stockpiles; reclaimed 1C/7A stockpile units; the 5A and 9A overburden stockpiles; Copper Mountain Reclamation Area, the SX/EW Plant; PLS collection systems and impoundments; seepage interception systems; storm water detention impoundments; maintenance and lubrication shops; process solution pumping stations; former mill and concentrator (reclaimed); and associated facilities (**Figure 2-2**).
- The East Mine Area includes the reclaimed No. 1 Stockpile, acid unloading facility, former precipitation plant area, and reclaimed historic Burro Mountain Tailing Dam (**Figure 2-3**).
- The Mangas Valley Tailing Area includes the reclaimed Dams 1, 1A, 1X, 2, 3 and 3X, reclaimed tailing launder, and associated facilities (**Figure 2-4**).

The general layout of the mine facilities at Tyrone is presented in **Figure 2-1** and **Plate 1**. The principal mine facilities and main mine components are discussed in Sections 2.1.1 through 2.1.10 and include:

- Open pits
- Waste rock, leach ore, and overburden stockpiles
- Mine operation facilities (e.g., warehouse, shop, and office buildings, and power plant)
- SX/EW plant
- Lubrication shop
- Acid-unloading facility and former precipitation plant
- Reclaimed mill and concentrator area
- Reclaimed tailing dams
- Water management system (including wells, tanks, pipelines, process water ponds), and
- Ancillary infrastructure (roads/railway, fuel storage tanks, power lines, storm water controls).

2.1.1 Open Pits

The location of active open pit mining has shifted over time resulting in a number of distinct, but related pits. The open pits are developed in a series of 50-foot benches by blasting, excavation, and hauling of waste rock and ore. To minimize excavation and total land disturbance open pits are developed as steep as possible based on geotechnical and geologic evaluations, therefore the overall slope angle will vary from area to area within the pit(s).

The open pit complex at Tyrone currently encompasses approximately 1,516 acres, including the Main, West Main, Valencia, Gettysburg, Copper Mountain, South Rim, Savanna, and San Salvador Hill pits. Mining is currently focused in the Valencia pit. The Main Pit, near the center of the Mining Area, is about 1,200 feet deep. The West Main and Valencia pits are considered by Tyrone to be part of the Main Pit. The Main, Copper Mountain, and Gettysburg pits are currently being dewatered to maintain mining access, provide process makeup water, and maintain open-pit groundwater capture zones. Where operationally feasible, Tyrone has backfilled portions of the Main Pit and other pits at the mine to facilitate mining and reclamation. On April 12, 2004, the MMD granted a conditional waiver from the requirements to achieve a self-sustaining ecosystem for the Main, Savanna, Gettysburg, and Copper Mountain Pits. A waiver was not granted for the San Salvador Hill and South Rim Pits as part of the current closeout plan approval.

Under the Settlement Agreement between Tyrone and NMED, the Supplemental Discharge Permit for Closure (DP-1341), as renewed, will not require Tyrone to regrade and cover the side slopes of leach stockpiles and waste rock piles within the approved OPSDA. This aspect of the Settlement Agreement was contingent, in part, on MMD granting a waiver for the areas identified within the OPSDA. As part of Permit Revision 10-1 to MMD Permit GR010RE, the MMD granted a conditional waiver from the requirements to achieve a self-sustaining ecosystem for: (1) an additional 135 acres of pit disturbance at the Main and Copper Mountain open pits; and (2) the interior (pit facing) slopes of the 1A, 1B, 2B, 2C, 3B, 4A, 6B, 6C, and Copper Mountain stockpiles. A waiver was not granted for the interior slopes of the 2A stockpile and part(s) of the 5A and 7B stockpiles. The final revised conditional waiver area is depicted on Figure 3R in Permit Revision 10-1 to MMD Permit GR010RE (MMD, 2012) and is shown on **Plate 1** herein.

2.1.2 Waste Rock, Leach and Overburden Stockpiles

The Tyrone permit area contains a number of stockpiles in the Mining Area and East Mine Area. The stockpiles generally fall into three types: 1) leach stockpiles, which apply a low concentration of acid solution to extract copper from ore; 2) waste rock stockpiles, which store excavated rock moved to access the ore body and that may contain copper, but are currently not economic to process; and 3) overburden stockpiles, which contain materials suitable for future reclamation purposes. Combined, the stockpiles encompass approximately 3,480 acres.

The leach stockpiles include the 1A, 1B, 2A, 2B Leach, 2C, 3A, 4A, 4B, 4C, 6B, 6C, and 7B. A former leach ore stockpile leached by a previous operator, the Copper Mountain Stockpile, is located along the northwest perimeter of the Copper Mountain Pit. This area is referred to as the Copper Mountain Reclamation Area. Note, although the 7B Stockpile has historically been considered a leach stockpile, the facility is currently only receiving waste rock material.

Waste rock stockpiles include the 1C, 2B Waste, 3B, 7A, 8C, and portions of the Savanna stockpile. The 5A and 9A stockpiles contain overburden material that may be used for cover material at closure. The 5A is comprised primarily of Gila Conglomerate and the 9A is comprised of leach cap excavated from the Little Rock mine.

Several stockpiles have been fully reclaimed including the No. 1 and 1C/7A stockpiles. Pullback of the 1A leach stockpile and placement of the pullback material along the toe of the 1B leach stockpile is currently ongoing and is projected to be completed prior to the EOY 2014. Additional reclamation work required at the Copper Mountain Reclamation Area is also projected to be completed by the EOY 2014.

2.1.3 Main Mine Facilities

The main mine operations facilities area is located along the north ends of the 3A and 5A stockpiles along the upper reach of Mangas Wash (**Figure 2-5**). Facilities and structures located in the main mine operations area include:

- MM-01 General Office
- MM-02 Mine Operations Office
- MM-03 Security
- MM-04 Safety Building
- MM-05 Human Resources/Training
- MM-06 Jerome Building
- MM-07 Plant Warehouse
- MM-08 Truck Shop/Machine Shop/Welding Shop
- MM-09 Electric Shop
- MM-10 Pipe Shop
- MM-11 Carpenter Shop
- MM-12 Lumber Storage
- MM-13 Shovel Repair
- MM-14 Environmental Lab (Environmental field office)
- MM-15 Chapel
- MM-16 Electrical Building & Chlorine Shack
- MM-18 Analytical Lab (training building)
- MM-19 Car Wash

- MM-20 Diesel Tank Farm
- MM-21 Electrical Power Substation
- MM-24 Fire Truck Barn
- MM-25 Ambulance Barn

2.1.4 SX/EW Plant

The SX/EW plant is located northwest of the Main Pit, between the 3B and 2A stockpiles (**Figure 2-6**). PLS from the leach stockpiles is sent to the SX/EW plant where the copper is extracted. After copper extraction, the remaining solution is recycled by adding a low concentration of acid to produce raffinate, which is then re-circulated through the leach stockpiles to collect additional copper. Facilities and structures located in the SX/EW plant area include:

- Tankhouse
- SX/EW Plant Area Shop
- Leach Crew Office
- SX/EW Warehouse
- Substation
- Raffinate Storage Tanks (2)
- Gonzales Cells
- Jamison Cells
- Organic Tanks (4)
- Mixer/Settler Tanks (8)
- Tank Farm (5)
- Water Tank
- PLS Feed Pond
- Acid Tanks (2)
- MCC Building
- Tool Room and Storage
- Chlorinator Room
- 2A West Raff Tank
- Rectifiers
- Workroom
- Pump Mixer Control Room
- Cobalt Sulfate Tank
- Reagent Tanks
- Tool Room
- Diluent Storage Tank
- Pacesetter Filters (2)
- Wash Pad, and
- Other miscellaneous (e.g., tanks and pipelines)

2.1.5 Former Mill and Concentrator

The former mill and concentrator area is east of the 3A stockpile (**Figure 2-7**). Demolition activities at the site began in August 2004, and reclamation of the mill and concentrator area was completed in 2007. The buildings and facilities that remain in the vicinity of the Mill include:

- MC-01 Tailing Thickeners (8)
- MC-02 Reclaim Water Storage Tanks (3)
- MC-04 Reclaim Water Pump House
- MC-05 Terminal Tanks (3)
- MC-15 Mill Warehouse (Warehouse and Core Storage)
- MC-17 Radiators/Power Plant (Power House)
- MC-20 Reagent Building
- MC-21 Fuel Station
- MC-22 Tire Shop
- MC-24 Spigot Underflow Pump House
- MC-25 Tailing Pump House, and
- MC-27 Inactive Diesel Storage Tanks (2) – these tanks have been decommissioned and are rendered inoperable as tanks

The buildings and facilities presented below were demolished, removed, and/or buried according to an approved building removal plan. Further details on the mill and concentrator reclamation project are provided in Section 3.2.

- MC-06 Flotation Units (3)
- MC-07 Secondary Crusher
- MC-08 Mill Pumphouse
- MC-09 SX/EW Change room
- MC-10 Intermediate Ore Storage
- MC-11 Primary Crusher
- MC-12 Process Water Tanks
- MC-13 Concentrator-Filter Plant & Dryer
- MC-14 Lime Storage
- MC-16 Warehouse/Concentrate Unloading
- MC-19 Concentrator Building

2.1.6 Lubrication Shop

The lubrication shop (Lube Shop) area is located east/southeast of the Main Pit area, between the 1B and 5A stockpiles (**Figure 2-8**). An undisturbed cemetery is located east of the lube shop. Other facilities in this area include the Southwest Energy building and electrical substation. A storm water collection pond (Lube Shop Pond) is located north and northwest of the Southwest Energy building. Explosives and blasting supplies are stored at secured, isolated facilities in this area, including the prill tanks, which contain powdered ammonium nitrate, and the powder magazines, which contain primers, blasting caps, cord, and delays. One prill tank has since been moved adjacent to the 9A Stockpile.

2.1.7 Acid-Unloading Facility and Former Precipitation Plant

The acid unloading facility and former precipitation plant are located within the East Mine Area, southeast of the main mine facilities area, and west of and adjacent to Highway 90 in the upper reach of Brick Kiln Gulch (**Figure 2-9**). In the past, the area was used to produce copper precipitate, but the precipitation plant was decommissioned in 1996. Presently, the north end of the area is used to unload train cars of sulfuric acid used in the leaching process. Ancillary facilities in the area include the railroad tracks, a small permitted solid-waste landfill, and various pump stations for process water and storm water handling.

2.1.8 Reclaimed Tailing Dams

The reclaimed tailing dams at the Tyrone Mine consist of the historic Burro Mountain Tailing Dam located in the East Mine Area and six tailing dams in the Mangas Valley Tailing Area referred to herein as the Mangas Valley Tailing Dams.

The Burro Mountain Tailing Dam received tailing from the Burro Chief Mill that operated from 1916 to 1921. Reclamation of the Burro Mountain Tailing Dam began in 2004 and was completed in 2005.

The Mangas Valley Tailing Area contains the reclaimed Mangas Valley Tailing Dams (Dams 1, 1A, 1X, 2, 3X, and 3) (**Figure 2-4**). The reclaimed tailing dams cover about 2,300 acres. Additional facilities that have been reclaimed within the Mangas Valley Tailing Area include the tailing launder and approximately 72 storm water catchments. Reclamation of the Mangas Valley Tailing Dams began in 2004 with the initial grading of Dam 3X. Reclamation of Dam 3X was completed in 2005, and Dam 3 was completed in 2006. Dams 1, 1A, and 1X were completed in 2008. Dam 2 was completed in 2007.

2.1.9 Water Management System and Ponds

Figure 2-10 presents a generalized schematic of the water supply and use cycle at the mine. Various surface impoundments are used during current operations for temporary storage of both impacted and non-impacted process waters, surface waters, and seep water. Surface impoundments at Tyrone were originally identified in Table 5.6 of the End of Year 2001 through 2008 CCP (M3, 2001) and subsequently updated as part of the Condition 87 Surface Impoundment Study Work Plan (DBS&A, 2006) and 2007 CCP Update (Golder, 2007e). The locations of the existing surface impoundments at Tyrone have been further updated based on information within the Stage 2 APP (DBS&A, 2012) and more current information provided by Tyrone Mine personnel. The locations of the surface impoundments at the mine are shown on **Figures 2-11 and 2-12**. **Table 2-1** summarizes the type and operational status of the surface impoundments at the mine.

2.1.10 Other Ancillary Facilities, Structures, and Systems

In addition to the major mine components identified above, there are a number of key ancillary facilities dispersed across the mine or that cross facility boundaries that support the operations at Tyrone. Some of the more important ancillary facilities that require consideration at closure are listed below:

- Haul and access roads,
- No. 1 fuel dock, No. 2 fuel dock, tire shop area,
- Electrical power transmission lines and substations,
- Storm water structures for drainage, diversion, and sediment control,
- Fencing and security systems, and
- Miscellaneous pipelines.

2.2 Past and Current Land Uses

Surface lands in and adjacent to the mine have historically been used for mining, livestock grazing, timber and fuel wood harvesting, recreation, and wildlife habitat. Ponderosa pine was logged in the Big Burro Mountains south of the Tyrone Mine, and fuel wood has been cut from woodlands in this area for at least a century. Recreation in the area includes camping, picnicking, hunting, off-road vehicle use, hiking, horseback riding, and bicycling.

Current surrounding land uses include private residences, grazing, mining, and recreation. Grazing is the predominant land use surrounding the mine.

2.3 Environmental Setting

The following sections present various aspects of the mine site, including its topography, geology, climate, hydrology, soils and vegetation, wildlife, and material characteristics.

2.3.1 Topography

The Tyrone Mine area straddles the Continental Divide between the Big Burro and Little Burro Mountains. The mine is located on the northeastern slopes of the east end of the Big Burro Mountains, a northwest-southeast trending range approximately 22 miles long and 4 to 12 miles wide. The Little Burro Mountains are situated northeast of the Big Burro Mountains and are separated from the Big Burro Mountains by the mine and the Mangas Valley (**Figures 2-13 and 2-14**). The Mangas Valley and the Little Burro Mountains are located within a structurally controlled regional topographic feature that trends northwest to southeast. The Little Burro Mountains have a steep southwestern front and gentle northeastern slopes.

The topography in the vicinity of the Tyrone Mine reflects the relatively gentle northeastern slopes of the Big Burro Mountains (**Figures 2-13 and 2-14**). Burro Peak, on the Continental Divide, rises to an elevation of 8,035 feet above mean sea level (msl). The trace of the Continental Divide is to the northeast through the Tyrone Mine, crossing the Mangas Valley at an elevation of 5,825 feet above msl. The Divide separates Mangas Wash from the southeasterly-draining Brick Kiln Gulch and Oak Grove Wash. The Continental Divide crosses the Little Burro Mountains northwest of Tyrone Peak at a maximum elevation of 6,439 feet above msl.

2.3.2 Geology

The geology of the Tyrone copper deposit and surrounding area has been summarized by DuHamel and others (1993), Kolessar (1982), and Paige (1922), and geologic maps were prepared by Hedlund (1978a, 1978b, 1978c, 1978d). Data from these sources, as well as from ongoing Tyrone operation and exploration activities, were used to develop the geologic map of the pre-mining surface and mine permit area shown in **Figure 2-15**.

It should be noted that the fault systems illustrated in **Figure 2-15** are based on results of geologic mapping conducted by Tyrone geologists. Consequently, the fault systems differ somewhat from those presented in previous reports. One of the most notable differences is the division of the Burro Chief fault into two separate faults: the West Main Fault, which trends 45 degrees northeast, and the Burro Chief fault, which splays off the West Main at an orientation of 15 degrees northeast. Two additional northwest-southeast trending faults have also been identified, one that extends from the vicinity of the Gettysburg Pit to the northeast corner of the Main Pit, and a second that extends from the northeast corner of the Gettysburg Pit to the northeast corner of the Main Pit (Townsite Fault).

The Tyrone copper deposit is a porphyry copper deposit. The Tyrone deposit is generally confined to a triangular area at the southeast end of the Big Burro Mountains and is bounded by the Burro Chief and West Main Fault systems on the west, the Sprouse-Copeland Fault on the east, and the San Salvador fault system on the south.

Rock Units

The rocks that crop out in the Big Burro Mountains, the Mangas Valley, and the Little Burro Mountains range in age from Precambrian to Quaternary and are shown in generalized cross sections in **Figure 2-16**. The Big Burro Mountains are dominantly composed of the Precambrian Burro Mountain granite; this batholith was subsequently intruded by the Tyrone stock nearly 56 million years ago. The Tyrone laccolith consists of a Tertiary quartz monzonite that is composed of four stages of porphyry intrusions, each of which differs in composition, texture, and age.

Exposures of Cretaceous rocks are limited to the Little Burro Mountains. The Cretaceous units are predominantly sedimentary rocks that include the Beartooth quartzite and the Colorado Formation. The Beartooth quartzite is a thin-bedded to massive fine-grained sandstone that unconformably overlies Precambrian granite. The Colorado Formation is a sandy shale that conformably overlies the Beartooth quartzite. Cretaceous and Tertiary volcanic rocks, primarily andesites and rhyolites, overlie the Cretaceous sedimentary units.

The youngest rocks in the area are of late Tertiary and Quaternary age and consist mostly of consolidated and weakly lithified sands, gravels, and conglomerates. The Gila Conglomerate Formation, the oldest of the younger sedimentary rocks, is a semi-consolidated unit that was deposited as basin fill and fan sediments derived from late Tertiary and earlier uplifts. The youngest sedimentary units are unconsolidated and were deposited unconformably on Gila Conglomerate and as valley fill along present-day drainages.

Geologic Structures

The main geologic structures in the Big Burro Mountains, the Mangas Valley, and the Little Burro Mountains are northeast- and northwest-trending faults. Within the Mining Area, numerous intrusions or vein swarms have contributed to the development of a complex jointing and fracture network. The main regional faults include, but are not limited to: the Sprouse-Copeland, Austin-Amazon, West Main, Burro Chief, Southern Star, and Mangas Fault systems (**Figures 2-17 and 2-18**). The traces of two of these regional faults, the Mangas Fault and the Sprouse-Copeland Fault, are shown in **Figures 2-15 and 2-16**. The Mangas Fault strikes northwest-southeast with a dip of about 60 degrees southwest forming a prominent scarp on the Little Burro Mountains. Along the fault trace, Gila Conglomerate and bolson fill deposits have been juxtaposed against the older rocks of the Little Burro Mountains. Near Oak Grove Wash, the Sprouse-Copeland Fault strikes north along the eastern boundary of the Mining Area and is nearly vertical, with displacement on the order of hundreds of feet. This fault has juxtaposed the Gila Conglomerate, downthrown to the east, and the Precambrian Burro Mountain granite.

The Mangas Fault is a high-angle fault that separates the Little Burro Mountains from the Big Burro Mountains. Rotation of the down-dropped block has tilted the Tyrone ore body about 8 degrees toward the plane of the fault. This rotation has also preserved a wedge of the Gila Conglomerate and possibly Cretaceous rocks in the down-dropped block. The Gila Conglomerate section in the down-dropped block is thickest on the northeastern side of the Mangas Valley and thins to a few feet thick on the southwest side.

Tyrone continues to refine the geologic understanding at the Tyrone Mine. The fracture density and vein mineralogy has recently been measured in connection with mine operations located just north of the Copper Mountain pit area. The results of these measurements show that the majority of the fractures in the area are filled with supergene kaolinite and are expected to have relatively low hydraulic conductivity.

2.3.3 Climate

The Tyrone Mine is located in a semiarid region in southwestern New Mexico, with elevations ranging from about 5,100 to 8,000 feet above msl. The climate at Tyrone is warm and dry, with mean annual precipitation of about 16 inches (400 mm) and a mean annual temperature near 50°F (10°C). Precipitation falls mainly as rain, but snow may occur from November to March. Most of the precipitation in the area falls during July through October in the form of rain during short, intense, thunderstorms. About 60 percent of the precipitation falls during the summer months. Precipitation is characterized mostly by small magnitude events ranging from less than 0.1 to 0.25 inches (2.5 to 6.4 mm) per day. Larger magnitude rainfall events (greater than one inch) also occur in the summer months, but at a much lower frequency. For example, the probability of exceeding one-inch of rainfall in a 24-hour period is less than one percent. Monthly precipitation is generally less than an inch per month from November through June, peaks in July, August, and September with between 2 and 3 inches per month, and generally falls to about 1 inch in October. Evaporative demand in this region is high and annual evaporation far exceeds annual precipitation.

Seven weather stations are located at the Tyrone Mine each with varying periods of record. Of those stations, the Tyrone Mine General Office station has the longest period of record (i.e., 1954 to the present), while shorter records (7 to 15 years) are available for the other Tyrone Mine stations.

Longer term records (more than 40 years) are available from five weather stations located near the mine. The five stations with the longest periods of record are:

- The Tyrone Mine General Office station, located at the mine at an elevation of 5,960 feet above msl,
- The White Signal station, located approximately 7 miles south at an elevation of 6,066 feet above msl,
- The Santa Rita station, located approximately 20 miles east-northeast at an elevation of 6,312 feet above msl,
- The Hurley station, located approximately 15 miles east at an elevation of 5,700 feet above msl, and
- The Fort Bayard station, located approximately 20 miles northeast at an elevation of 6,149 feet above msl.

These stations are considered fairly representative of the range of climate conditions at Tyrone. Long-term climatic records (spanning more than 100 years) are available for Fort Bayard. Weather stations installed at the Tyrone test plots (Dam 3X and No. 1 Stockpile) in 2005 provide a wider range of meteorological data (e.g., wind speed and direction, relative humidity, solar radiation, air temperature, and rainfall) than those previously measured at the mine. These two stations along with automated rain fall measurement stations at Dam 1A and Laney Canyon are the defined measurement points used for erosion monitoring purposes.

2.3.4 Hydrology

The surface-water and ground water hydrologic setting at the Tyrone Mine are presented below.

Surface-Water Hydrology

The Tyrone Mine occupies only a portion of two large watersheds: Mangas Wash and Oak Grove Wash. A key feature of the Tyrone property is that the continental divide segments the facility into the two watersheds. Mangas Wash drains to the northwest and Oak Grove Wash drains to the southeast. For purposes of discussion, the four major drainage basins in the area of Tyrone include Mangas Wash, Deadman Canyon, Brick Kiln Gulch, and Oak Grove Wash (**Figure 2-14**). Deadman Canyon is a tributary to Mangas Wash and was diverted by Tyrone around Dam 1X into the Whitewater Canyon tributary of Mangas Wash. Mangas Wash is ephemeral at the mine site and drains to the Gila River. Brick Kiln Gulch is a tributary to Oak Grove Wash, which is also ephemeral and drains to the San Vicente Arroyo and then to the Mimbres River.

Ground Water Hydrology

Groundwater in the Tyrone Mine area is present in both regional and perched systems. A single regional aquifer, which is predominantly unconfined, exists throughout the site. In addition, perched zones occur in several areas. The nature and extent of impacts to regional and perched groundwater are documented in detail in the Tyrone Mine Stage 1 Abatement Plan FSIR (DBS&A, 2011) and the Stage 2 APP (DBS&A, 2012). This section provides a brief summary based on those documents.

The primary water-bearing units at the Tyrone Mine include the Precambrian Burro Mountain granite, the Tertiary quartz monzonite, the Gila Conglomerate, and the Quaternary alluvium. The Quaternary alluvium occurs along surface drainages and lies above regional groundwater at most locations around Tyrone, with the exception of the Mangas Valley. The alluvium along most parts of the major axis of the Mangas Valley contains regional groundwater. Regional groundwater occurs within the igneous rocks throughout most of the Mining Area and East Mine Area.

The regional groundwater flow regime in the area of the Tyrone Mine prior to surface mining was characterized by the presence of a regional groundwater flow divide, which was nearly coincident with the Continental Divide (Trauger, 1972). Groundwater flowed northwest into the Gila-San Francisco underground basin or to the southeast into the Mimbres Valley underground basin. While regional groundwater still flows to both basins from some portions of the mine area today, surface mining and ground water pumping over the past 35 years have substantially altered the original groundwater flow direction.

Regional aquifer water-level elevations for the northern and southern portions of the mine, compiled from data collected in the second quarter of 2012, are shown on **Figures 2-17** and **2-18**, respectively. The arrows on the figures show the general direction of groundwater flow. Groundwater in the Mangas Valley Tailing Area flows predominately toward the northwest (**Figure 2-17**). Groundwater in the Mangas Valley Tailing Area occurs in Gila Conglomerate or in alluvium that is contiguous with groundwater in the underlying Gila Conglomerate. Most monitor wells in this study area meet Section 20.6.2.3103 NMAC standards. Groundwater standards for sulfate and total dissolved solids (TDS) are exceeded within limited areas at or immediately adjacent to the toe of several reclaimed tailing dams.

Within the Mining Area groundwater occurs primarily in fractured igneous rock (either quartz monzonite or granite). In some limited areas, such as the northern portion of the No. 3A Stockpile, the former concentrator area, and the No. 5A Stockpile, groundwater occurs in Gila Conglomerate that overlies igneous rock. Groundwater in the Mining Area flows predominately from the southwest to the northeast, until it is intercepted at one of the open pits (Copper Mountain, Gettysburg, and Main) from which groundwater is extracted (**Figure 2-18**). Each of these open-pits has a capture zone associated with it, but the largest capture zone is associated with the Main Pit. Due to pumping from the open pits, the majority of groundwater within the Mining Area is captured and utilized as part of mine operations. Within the East Mine Area, regional groundwater flows to the north/northeast on the west side of the Sprouse-Copeland Fault, but turns to the southeast once it reaches the thick section of Gila Conglomerate that adjoins the Mangas Fault. On the east side of the Sprouse-Copeland Fault, groundwater flows predominately east-southeast (**Figure 2-18**).

Observation wells in the Mining Area often exceed Section 20.6.2.3103 NMAC standards for sulfate and TDS near mine facilities, and wells near leach stockpiles often exceed Section 20.6.2.3103 NMAC standards for multiple other constituents such as aluminum, cadmium, cobalt, copper, fluoride, iron, manganese, pH, and zinc. In the far southwest corner of the mine, regional water quality generally meets all Section 20.6.2.3103 NMAC standards or exceeds only a single standard, such as that for fluoride or manganese, due to natural background conditions. Immediately south of the mine, several wells adjacent to waste rock stockpiles exceed standards for TDS and sulfate, and farther to the east, in a limited area near the former corner of the No. 1C waste stockpile, regional groundwater exceeds Section 20.6.2.3103 NMAC standards for TDS, sulfate, aluminum, cadmium, cobalt, copper, fluoride, manganese, pH, and zinc. Regional groundwater within the East Mine Area, on the east side of the Sprouse-Copeland Fault, generally meets Section 20.6.2.3103 NMAC standards, but several monitor wells exceed standards for sulfate and TDS.

Perched water occurs within alluvium-filled channels incised into the Gila Conglomerate or igneous bedrock in the upper Mangas Wash, Deadman Canyon, Brick Kiln Gulch and Oak Grove drainages. In various areas adjacent to mine facilities, the perched zone water quality has been impacted by mine solutions. Impacted water within these alluvium-filled channels is collected by various seepage collection and interceptor systems installed along the toes of individual stockpiles. Additional perched water zones occur beneath the major drainages at the mine and flows are generally located along the major axes of the drainages.

Deadman Canyon perched groundwater refers to shallow water in the alluvium (about 10 feet deep or less) of Deadman Canyon, which borders the western side of the Mining Area. The alluvium overlies quartz monzonite, which is saturated below the base of the alluvium. Perched zone water level elevations and associated groundwater flow directions for the Deadman Canyon area based on second quarter 2012 data are shown on **Figure 2-19.** Perched water in Deadman Canyon, from about the location of well TWS-36 and points south (upstream for alluvial groundwater), meets Section 20.6.2.3103 NMAC standards for sulfate and TDS.

Perched water occurs in the southeastern portion of the Mining Area and East Mine Area in Oak Grove Wash or Brick Kiln Gulch alluvium within about 30 to 90 feet of land surface; the alluvium gets thicker moving downstream along these drainages. Regional groundwater occurs in Gila Conglomerate, and the regional aquifer water table is about 400 to more than 500 feet below the base of the perched water in the alluvium. Perched zone water level elevations and associated ground water flow directions for the Oak Grove Wash/Brick Kiln Gulch areas, compiled from data collected in in the second quarter of 2012, are shown on **Figure 2-20**. Where perched water occurs in Oak Grove Wash and Brick Kiln Gulch, it is generally impacted by multiple constituents that exceed Section 20.6.2.3103 NMAC standards (DBS&A, 2011and 2012).

Perched and regional groundwater in the No.3A Stockpile area, north of the Main Pit, has been impacted by seepage of leach solutions. In this area, Quaternary alluvium has filled drainage channels eroded into the Gila Conglomerate. The channels are referred to as “canyons” at the No. 3A Stockpile because the stockpile was built on top of the pre-existing drainage pattern and the canyons (drainages) are the mechanism used to channel and collect leach solutions at the base of the stockpile. Perched fluids exist in the alluvium; most of these fluids appear to be leach solutions, although there is some limited mixing with meteoric water. Impacted perched seepage zones have been identified in alluvial sediments beneath 10 of the 11 PLS surface catchments. Regional groundwater occurs about 100 to 200 feet below the base of the alluvial channels in Gila Conglomerate. Impacted perched groundwater in this area is captured by existing pumping wells and seepage collection trenches. Impacted regional groundwater in this area is captured by existing regional aquifer pumping systems located near the toe of the No. 3A Stockpile, in Mangas Wash, and North of Canyons 7 through 11. **Figure 2-21** shows the first quarter 2012 water level elevations for the perched zones adjacent to the No. 3A Stockpile. **Figure 2-18** shows the second quarter 2012 regional groundwater elevations in the vicinity of the No. 3A Stockpile.

2.3.5 Soils and Vegetation

The soils in Grant County were previously mapped by the Forest Service and Soil Conservation Service (Parnham et. al., 1983). Site-specific soil and vegetation surveys were conducted at Tyrone in 1997 as part of the closure/closeout studies (DBS&A 1997c). The distribution of soils at the Tyrone Mine is controlled by the climate, geology, age of the land surfaces, and physiography of the area. The vegetation is indicative of the regional climate modified by soil and topographic factors. The distribution of the existing vegetation is locally complex and reflects the influence of both environmental gradients and land management practices. The vegetation in the permit area is not unique relative to the surrounding area and represents a minor fraction of plant communities that are locally and regionally extensive. No threatened or endangered plant species are recognized as occurring in the permit area.

Four soil-vegetation associations have been identified within the mine permit area as shown on **Figure 2-22.** These include the: (1) alluvial grassland association; (2) piedmont scrub savanna association; (3) mountain slope scrub savanna association; and (4) mountain slope mixed evergreen woodland association. The individual associations are described below.

Alluvial Grassland Association

The dominant soils in the alluvial grassland association include coarse-loamy and sandy families of Haplustolls. The soils are very deep, nonsaline, nonsodic, and coarse-textured and were formed in thick, stratified alluvial deposits composed predominantly of mixed igneous rocks. This association includes two consociations that occupy the nearly level to gently sloping floodplains and alluvial terraces of the major drainages in the permit area. The vegetation in this map unit is representative of an alluvial grassland with a minor riparian component.

The potential plant community at the site would probably be dominated by warm season grama grasses *(Bouteloua spp.)* with a minor shrub component of soaptree yucca *(Yucca elata)* and honey mesquite *(Prosopis glandulosa).* Important cool season grasses likely include lovegrasses *(Era grostis spp.),* junegrass *(Koeleria cristata),* muttongrass *(Poa fendleriana),* New Mexico needlegrass *(Stipa neomexicana),* and bottlebrush squirreltail *(Sitanion hystrix).* Desert willow *(Chilopsis linearis)* was presumably the dominant tree in the riparian corridor along the active floodplain.

The existing vegetation is dominated by a variety of annual and perennial grasses and forbs. Sideoats grama *(Bouteloua curtipendula)* and purple three-awn *(Aristida purpurea)* are the dominant perennial grasses, while honey mesquite, Apache plume *(Fallugia paradoxa),* and California bricklebush *(Brickellia californica)* are important shrubs. Mat muhly *(Muhlenbergia torreyi),* cholla *(Opuntia spp)* and Russian thistle *(Salsola kali)* are locally prevalent in disturbed areas. Desert willow is primarily restricted to the Wind Canyon drainage upstream of its confluence with Mangas Wash.

Piedmont Scrub Savanna Association

The soils in the piedmont scrub savanna association are included in loamy-skeletal, clayey-skeletal, and fine families of Aridic Haplustalfs. The soils are very deep, nonsaline, nonsodic, medium- to fine-textured, and calcareous in the lower solum and substratum. These soils were formed in residuum composed of regionally derived Gila Conglomerate and local fan terrace deposits from the Little Burro Mountains. This association includes three consociations that occur on the gently sloping to steep pediments and fan terrace remnants north and east of the mine pits and stockpiles.

The scrub savanna vegetative community at the Tyrone Mine is characteristic of the transition between an open grassland and mixed evergreen woodland. The potential plant community was probably dominated by mixed graina and associated grasses with a moderate component of honey mesquite and gray oak *(Quercus grisea).* Pinyon pine *(Pinus edulis)* one-seed *(Juniperus monosperma)* and alligator juniper *(J. deppeana),* and Emory oak *(Q. emoryi)* were probably important minor elements in the community.

Currently, the dominant perennial grasses are sideoats grama, hairy grama *(B. hirsuta)* rough bentgrass *(Agrostis scabra),* and tobosa *(Hilaria mutica)* Honey mesquite, gray oak, beargrass *(Nolina microcarpa),* broom snakeweed *(Gutierrezia sarothrrae),* and catclaw mimosa *(Mimosa biuncifera)* constitute the primary shrub species. Pinyon pine, one-seed and alligator juniper, and Emory oak are important woody species on slopes with north- and east-facing aspects.

Mountain Slope Scrub Savanna

The soils in the mountain slope scrub savanna association are comprised largely of loamy-skeletal Haplustalfs. The soils are shallow, medium-textured, and contain relatively high amounts of coarse fragments. These soils formed in residuum and colluvium from quartzite and mixed igneous rocks. This association includes a single consociation that is restricted to the steep and very steep western slope of the Little Burro Mountains.

The vegetation in this map unit represents the kinds of vegetation found on high-gradient west-facing slopes. The potential plant community was probably dominated by mixed grama grasses with a moderate component of beargrass, gray oak, mountain mahogany *(Cercocarpus montanus),* and sotol *(Dasyflrion wheeleri).* One-seed and alligator juniper were probably important minor elements in the community.

Because of the steep slopes, the vegetation in this association has probably been only minimally influenced by management. The existing vegetation is characterized by a relatively open shrub canopy. Rough bentgrass, sideoats grama, and blue grama *(B. gracilis)* are the dominant perennial understory grasses. The overstory is dominated by Emory and gray oak, beargrass, sotol, and one-seed juniper, with a minor representation of honey mesquite and pinyon pine.

Mountain Slope Mixed Evergreen Woodland

The soils in the mountain slope mixed evergreen woodland association are mostly loamy-skeletal Haplustolls. These soils are shallow, noncalcareous, and medium- to coarse-textured with moderate to high amounts of coarse fragments. These soils formed in residuum and colluvium from competent igneous rocks composed of quartz monzonite and granite. Minor areas of bedrock are exposed at the surface in this map unit. This association corresponds to a single consociation map unit that occupies the strongly sloping to very steep backslopes and ridges of the Big Burro Mountains.

Vegetation within the mountain slope mixed evergreen woodland association represents the lower elevation ranges of this community regionally. The potential plant community in this zone was probably dominated by a relatively open stand of pinyon pine and evergreen oaks with one-seed and alligator juniper occurring as locally important representatives. Mixed grama and associated grasses probably dominated the sparsely vegetated understory with mountain mahogany, point-leaf manzanita *(Arctostaphylos pun gens),* and squawberry *(Rhus trilobata)* occurring as important shrub components. Ponderosa pine *(Pinus ponderosa)* and Gambel oak *(Quercus gambelii)* are locally important subordinates in this community that may dominate in minor sheltered topographic positions. The riparian corridor associated with the upper reaches of Deadman Canyon is included in this association; thus, Fremont cottonwood *(Populus fremontii)* may occur as an incidental species.

2.3.6 Wildlife

The habitat near the Tyrone Mine supports a diversity of wildlife species. Previous studies in the Tyrone Mine Area have recorded at least 18 mammals, 79 bird species, and 5 reptiles (DBS&A 1997c; Metric Corporation 1993 and 1996; and Dames & Moore 1994). Metric Corporation (1993 and 1996) conducted surveys to identify federal and state threatened, endangered, and special status wildlife species in the Tyrone Mine area, and none were detected.

The habitat around the mine is composed predominantly of pinon-juniper woodland with a substantial oak component. Within this major habitat type are patches of riparian vegetation, ponderosa pine woodland, and rock outcrop. Large grassland areas are absent from the project area, but several grass species are prevalent providing ground cover within the woodland and in forest openings. The mine stockpiles are currently characterized by sparsely vegetated seral communities of volunteer vegetation. The reclaimed area will be dominated by grasses, forbs, and shrubs, and will increase the diversity of the area.

The main goals for reclamation at the Tyrone Mine are to stabilize the tailing dams and stockpile areas from erosion, reduce water entry into the underlying wastes, and support the development of a self-sustaining ecosystem. The entire area of tailing and selected areas of the mine and stockpiles are, or will be, covered with suitable soils and seeded with native and adapted grasses, shrubs, and forbs. During the bond-release period, the vegetation on the reclaimed areas is expected to represent a grass-shrub plant community. Initially, the contrast in vegetation between the reclaimed lands and surrounding undisturbed lands will provide edge habitat. Over time, the vegetation on the reclaimed areas will become more complex, both structurally and compositionally, which may increase habitat diversity for wildlife.

Limited wildlife features have been constructed of locally available materials (e.g., rock or slash) on the tailing and stockpile reclamation areas to provide additional cover and vertical diversity for wildlife. These wildlife features will continue to be constructed on the remaining stockpile areas to be reclaimed and are expected to provide cover and nest sites for wildlife in the reclaimed areas.

2.3.7 Material Characteristics

Stockpile, tailing, and borrow materials found at the Tyrone mine site have been characterized with respect to their chemical composition and physical properties. The characteristics of the mineral assemblages identified at Tyrone as well as the stockpiles, tailing dams, and potential cover materials are described below.

Mineral Assemblages

The Tyrone ore, waste rock, and overburden have been thoroughly characterized for acid-base accounting (ABA) (Sobek,1978), synthetic precipitation leachate procedure (SPLP), whole rock constituent concentrations, soil pH, mineralogy, and kinetic testing of sulfide oxidation using humidity cells (DBS&A 1997a and 1997b; SARB, 1999) according to procedures recommended by the NMED (1996). Tyrone developed a mineralogical classification that groups copper-and iron-bearing minerals into distinct mineral assemblages. The mineral assemblage approach was developed to characterize ore deposits because of the implications mineralogy has for copper extraction and environmental issues. The most frequent copper ore types identified at Tyrone include one or a combination of oxide, chalcocite, or chalcopyrite mineral assemblages.

Results of the geochemical analyses were used to further categorize the waste rock and leach ore into two broad groups, A and B, through statistical analysis of variability (DBS&A 1997a and 1997b). Group A consists primarily of sulfide-bearing mineral assemblages having significant acid-generation potential, and Group B comprises leached cap and oxide mineral assemblages that are near neutral with respect to acid generating potential. Whole rock composition data show that copper, iron, cobalt, lead, cadmium, and zinc are significantly more concentrated in the Group A mineral assemblages than in the Group B assemblages.

Stockpile Material Characteristics

The Tyrone mine materials characterization data was reported in three principal reports as part of the End of Year 2001 through 2008 CCP (M3, 2001), and in four additional reports prepared to satisfy the *Supplemental Materials Characterization Study* which was required by Condition 80 of DP-1341 (Greystone, 2004a and 2004b; and EnviroGroup, 2005a and 2005b). Information from these studies show that waste rock stockpiles contain a significant proportion of materials designated as leach cap, but also may contain some copper and sulfide minerals, which have a wide range of ABA characteristics. The ore in the leach stockpiles generally have consistently negative ABAs (DBS&A 1997a and 1997b; SARB 1999).

Comparisons of data from newly mined materials with those of older stockpiled materials conducted as part of the *Supplemental Materials Characterization Study* showed that the materials properties are highly variable and that the variability of stockpile material properties is similar to that of the fresh mine materials. The sulfate content in the stockpiled materials was significantly higher than that of fresh mine materials owing to the effects of pyrite oxidation and the application of raffinate on the leach stockpiles. The leach ore stockpiles appear to be more reactive and release higher concentrations of constituents than waste rock stockpiles.

The stockpile materials at Tyrone are geochemically stable with respect to silicate matrix mineral reaction with water, air and acidity. The levels of acidity produced in the stockpiles are relatively low and most paste pH results are 4 and above. These conditions do not result in pervasive weathering and leaching of the primary minerals at Tyrone. The geologic materials were subjected to hypogene and supergene alteration as part of the ore forming processes that occurred over the course of millions of years and significant alteration from their present state in the stockpiles will take very long periods of time.

Tailing Material Characteristics

The long-term geochemical behavior of Tyrone's tailing dams has been evaluated using drill core and mineral assemblage data. The tailing dams contain stratified layers of sands to silts (slimes). The degree of saturation varies between layers, but the fine-grained layers appear to be generally wetter, which may inhibit oxygen flow, acid generation, and the rate of contaminant migration within the tailing dams. The tailing dams are composed of Group A mineral assemblage material, originally derived from high-grade sulfide ore. Gangue minerals dominate the mineralogy, but sulfides are also found throughout the tailing dams. Tailing layers near the surface are oxidized and generally acidic. The pH becomes near neutral to alkaline with depth. The tailing dams have an overall acid generation potential with limited acid neutralization potential.

Borrow Materials

The characteristics and suitability of the cover materials at Tyrone have been previously evaluated in the *Borrow Materials Investigation* (BMI) (DBS&A, 1997c), *Soil and Rock Suitability Assessment* (DBS&A, 1997a), *Preliminary Materials Characterization* (DBS&A, 1997a), *Supplemental Materials Characterization* (DBS&A, 1997b), *Little Rock Mine Cover Design Report and Test Plot Work Plan* (Golder, 2004), *Copper Mountain Pit Expansion Leached Cap and Waste Rock Management Plan* (PDTI, 2005a), and *Leached Cap Analysis and Vegetation Summary* (Golder, 2005c). The most recent evaluation of the borrow materials at Tyrone was completed in 2005 as part of Condition 79 of DP-1341, the borrow source materials investigation, and Condition L.5 of the Revision 01-1 to MMD Permit No. GR010RE (Golder 2005d and 2006a).

Potential cover materials identified at Tyrone include native soils, alluvium, in-situ Gila Conglomerate, mined Gila Conglomerate in the 5A Stockpile, and leach cap overburden from the Little Rock Mine and the Copper Mountain Pit. The Gila Conglomerate and associated soils and leach cap are the principal cover materials identified for use at the Tyrone Mine. The Gila Conglomerate Formation is a mid-Miocene and mid-Pleistocene continental deposit that is widespread in southern New Mexico and Arizona. The composition of the Gila Conglomerate Formation varies locally depending on the source area lithology at the time of stripping and deposition. The Gila Conglomerate in the Mining Area consists largely of igneous intrusive rocks originating from the ancestral Big Burro Mountains, while the Gila Conglomerate in the Mangas Valley Tailing Area reflects the influence of volcanic and meta-sedimentary rocks from the Little Burro Mountains.

Physically, the fine-earth fraction (i.e., <2mm) of the Gila Conglomerate and associated soils is dominantly moderately coarse-textured and mainly represented by loamy sand and sandy loam textures. Fine-, moderately fine- and coarse-textured soils occur locally. In general, the coarse textured soils are more prevalent in and around the mine area, and the somewhat finer textured soils tend to occur on the flanks of the Little Burro Mountains east of the tailing dams. The soils around Tyrone typically contain about 30 to 50 percent rock fragments (>2 mm diameter) by volume. Saturation percentages for the soils generally range from 18 to 75 percent.

Chemically, the Gila Conglomerate and associated soils have few inherent limitations. The pH of the soils range from about 5.0 to 7.8 and the salinity levels are low (0.2 to 3.8 dS/m). These materials are universally nonsodic and have favorable calcium to magnesium ratios. Soluble selenium and boron levels are low. The materials range from noncalcareous to calcareous and contain 0.5 to 9.2 percent calcium carbonate equivalent. The highest levels of $CaCO_3$ are found in the subsurface of the soils in the Mangas Valley.

In the Tyrone Mine Area, leach cap is altered igneous intrusive rock (hypogene mineralization) that generally has low copper values and is considered waste rock from a mining perspective. The chemical and physical characteristics of this leached cap make it potentially suitable for use as a cover material. Leach cap from the Copper Mountain Pit Expansion and Little Rock Mine areas have been extensively characterized and were tentatively approved (with conditions) for use as cover in some portions of the mine (PDTI, 2005a and Golder, 2005c). Besides the Copper Mountain and Little Rock Areas, leach cap occurs in the West Main and Valencia Pit Areas and on the Savanna Stockpile.

Overall, the materials from the Copper Mountain Area and Little Rock Mine are net-neutralizing and non-acid generating. Laboratory analyses indicate that the overburden from the Copper Mountain and Little Rock areas is relatively uniform and has few apparent limitations as a plant growth media when compared to the surrounding native soils. There are no apparent chemical limitations with respect to salinity in either the overburden or the native soils and the pH and extractable nitrate concentrations occur at similar levels in both materials. The overburden is moderately coarse textured and contains moderate volumes of rock fragments. The native soils exhibited similar characteristics and are moderately coarse textured with moderate amounts of rock fragments (PDTI, 2000 and 2005a). Thus, the overburden from the Copper Mountain and Little Rock Mine areas is considered to be a reasonable substitute for native soils.

The cover requirement for the Tyrone mine is approximately 12.8 million yd^3 based on the current permit requirements. More than 20 million yd^3 of Gila Conglomerate and leach cap cover materials have been conservatively identified in the Mining Area (Golder, 2005a). Additional materials may be available from alternative leach cap sources and from the deposits of residual Gila Conglomerate. Thus, the total volume of cover materials designated for the Mining Area is more than that needed to cover these facilities.

2.4 Permits and Discharge Plans

Tyrone currently conducts its mining operations pursuant to numerous state and federal regulations covering ground water, surface water, air, solid and hazardous wastes. **Table 2-2** lists the closure/close-out related permits held by Tyrone for current mining activities. Information regarding those permits is summarized in the following sections.

2.4.1 Mining Act Permit

To meet requirements of the NMMA, Tyrone obtained approval of its existing mining operation by issuance of an existing mine permit (GR010RE) from the MMD in July 1996.

2.4.2 National Pollutant Discharge Elimination System (NPDES) Permit

Tyrone is currently operating under NPDES permit NMR05GB76. Additionally, Tyrone has developed a Spill Prevention Control and Countermeasure Plan (SPCC) (Freeport McMoRan Tyrone, Inc., 2010) for its oil storage facilities as required by the Clean Water Act and has also developed a Storm Water Pollution

Prevention Plan (SWPPP) with Best Management Practices (BMPs) (Freeport McMoRan Tyrone, Inc., 2012) in accordance with the requirements of the U.S. EPA, NPDES, Multi-Sector General Storm Water Permit (MSGP-2008) for Sector G – Metal Mining (Ore Mining and Dressing) facilities. Both of these documents are on file at Tyrone, as required by applicable regulations.

2.4.3 Water Rights

Tyrone has water rights licenses under the New Mexico Office of the State Engineer (NMOSE) File Nos. GSF02260, GSF85, GSF85S, M02680, M04978, M04979, and M04980. Water is pumped from the Gila River to either Bill Evans Lake or to various farms and ranches for irrigation under NMOSE License No. 02260. The annual permitted water right under NMOSE License No. 02260 is 9,425.34 acre-ft. There are a series of four water supply wells comprising the Mimbres well field that supply fresh water to the mine under NMOSE License No’s M02680, M04978, M04979, and M04980. The annual permitted water right under NMOSE License No’s M2680, M4978, M4979, and M4980 is 2,090 acre-ft. The Fortuna well system, located in the Gila-San Francisco groundwater basin, provides fresh water for non-potable domestic and other uses at the mine. There are two water supply wells comprising the Fortuna well system that supply fresh water to the mine under NMOSE License No’s GSF-85 and GSF-85-S.

2.4.4 Air Quality

In December 1995, Tyrone submitted a Title V air quality permit application to meet its initial requirement as defined by the State of New Mexico operating permits programs (AQCR 770 and 771) pursuant to Title V of the Clean Air Act and Title 40 Code of Federal Regulations (CFR) 70. NMED subsequently issued Operating Permit Number P147, which was last renewed in October 2010 (NMED Air Quality Bureau [AQB], 2005a). This permit authorizes the operation of the open pit copper mine and associated process activities such as drilling, blasting, loading, hauling, and unloading of ore and overburden.

Tyrone applied for and received a Part 72 permit (Permit No. 2448) for modification and operation of the SX/EW plant in January 2001. Tyrone also applied for and received a Part 72 permit (Permit No. 2448A) for modification and operation of the Tyrone Power Plant in May 2002.

2.4.5 Hazardous Waste

The Tyrone Mine is currently classified as a small-quantity hazardous waste generator under the Resource Conservation and Recovery Act (RCRA). Tyrone generates hazardous waste under EPA identification number NMD035806405 in compliance with the requirements for hazardous waste generators set forth in 40 CFR 262 and the applicable portions of 40 CFR 265.

2.4.6 Discharge Plans

NMWQCC regulations require a DP for any discharge of effluent or leachate that has the potential to move directly or indirectly into ground water. Tyrone operates pursuant to seven operational DPs which are listed in **Table 2-3** and shown on **Figures 2-2 through 2-4**. The facilities located within the Mangas Valley Tailing Area were previously covered under operational DP-27. They are now covered under the DP-27 Settlement Agreement and Stipulated Final Order (DP-27SA) (NMED, 2003b), DP-1341 (NMED, 2003a), and Permit Revision 10-1 to MMD Permit GR010RE (MMD, 2012).

Mining Area

The Mining Area is the most complex administrative area at the Tyrone Mine. Its system of mine pits, stockpile areas, and production and maintenance facilities make up the majority of Tyrone's current operations. Six of the seven operational DPs are located within this area and are described below.

DP-166: No. 2 Leach System, SX/EX Plant, Open Pits

The DP-166 area covers a large part of the Mining Area and includes the Main, Valencia, San Salvador Hill, and Copper Mountain Pits; SX/EW Plant and associated facilities; lube shop area which includes the fuel dock, explosives storage building and prill tanks; No. 2 leach system, 4A leach, 4B leach, 4C leach (including former Copper Mountain leach), and 8C waste rock stockpiles; unlined PLS and storm water collection pond at the base of the Copper Mountain Pit, North Racket HDPE-lined PLS Pond; No. 2 HDPE-lined PLS pond located south of the Main Pit; PLS collection wells 2L3 and 2L5; five Main Pit production wells; SX/EW HDPE-lined PLS feed pond; miscellaneous pipelines, 5E seepage collection pond; additional surface impoundments (see **Table 2-1**); and seepage interceptor trenches and collection ponds located in Deadman Canyon.

DP-286: No. 3 Leach System

DP-286 includes the 3A stockpile and leaching system; 3B waste rock stockpile; 5A waste rock and overburden stockpile; eleven concrete-lined surface PLS catchments located along the toe of the 3A stockpile, No. 3 HDPE-lined PLS Pond, No. 3 HDPE-lined PLS Overflow Pond, Plant Oxidation Pond Effluent (POPE) ponds, HDPE-lined SPCC Pond, reclaimed mill and concentrator site, Old Fuel Dock No. 1, regional aquifer collection systems, existing seepage interceptor/barrier trenches located around the perimeter of the 3A/3B stockpile, and ancillary pipelines and pumps.

DP-363: 1A and 1B Leach Systems, and East-Side Seepage Collection System

DP-363 includes the 1A and 1B leach stockpiles and leaching systems, HDPE-lined 1A PLS Overflow Pond, HDPE-lined 1B PLS Overflow Pond, clay-lined 1A Storm Water Pond, 1A stainless steel PLS tank, 1B stainless steel PLS tank, two gravity-flow seepage collection trenches at the 1A Stockpile, four interceptor/barrier seepage collection trenches (two at the 1A Stockpile and two at the 1B Stockpile), and seepage pumpback wells.

DP-396: 1C Waste Rock Stockpile

DP-396 includes the 1C, 7A, and South Rim Pit waste rock stockpiles, three interceptor/barrier trenches and associated shallow toe collection systems located along the toe of the 1C stockpile, six shallow HDPE-lined seepage collection trenches located along the toe of the 7A stockpile, HDPE-lined Oak Grove Pond, and associated pumps and pipelines. The 1C/7A Stockpile Unit has been reclaimed as described in Section 3.2.

DP-435: 2A and 2B Leach Systems, 2B Waste Rock Stockpile, and Proposed 9A Overburden Stockpile

DP-435 includes the 2A, 2B, and 2C leach stockpiles, 2B waste rock stockpile, 9A overburden stockpile; 2A West and 2A East PLS collection stations (tanks), 2A West and No. 2 raffinate booster pump stations, HDPE-lined 2A East PLS Overflow Pond, HDPE-lined Seep 5E Discharge/Collection Ponds, HDPE-lined 2A Surge Pond, McCain Spring and Deadman Canyon Springs (Seeps 6 and 31), and associated tanks, pumps, and piping.

DP-455: Gettysburg Pit and Leach System, Savanna Pit and East Main Leach System

DP-455 includes: the Gettysburg Pit; Savanna Pit; 6B, 6C and 7B leach stockpiles; future Savanna leach stockpile; Gettysburg Pit Collection Pond; HDPE-lined 6C-2 PLS Collection Pond and booster station; HDPE-lined 7B PLS Collection Pond and booster station (to be replaced by new HDPE-lined 6150 collection pond); HDPE-lined East Main Booster Pond; HDPE-lined Savanna Sediment Collection Pond; Savanna North Sump; and associated tanks, pumps, and piping.

East Mine Area

Operational DP-896 is the only discharge permit associated with the East Mine Area.

DP-896: No. 1 Stockpile

DP-896 includes the reclaimed No. 1 Stockpile, reclaimed B Sump (former No. 1 PLS Pond), acid-unloading facility at the former precipitation plant, five seepage collection/barrier trenches and five gravity-fed shallow toe collection systems located along the toe of the No. 1 Stockpile, fiberglass above-ground storage tank (AST) and HDPE-lined Overflow Pond and associated booster station, pumps and piping.

2.4.7 Supplemental Discharge Permit for Closure, DP-1341

Supplemental DP for Closure (DP-1341) was issued by the NMED on April 8, 2003 (NMED, 2003a). This DP contains the closure requirements addressing Tyrone's discharges that may move directly or indirectly into groundwater from the various open pits, tailing dams, leach stockpiles, waste rock piles, and associated facilities at the mine. DP-1341 supplements each of the operational DP's for Tyrone and contains conditions necessary to limit, contain, or prevent the exceedance of standards of Section

20.6.2.3103 NMAC or the presence of a toxic pollutant in groundwater after the cessation of operation and conditions necessary to ensure abatement of groundwater contamination. Abatement of groundwater contamination is covered in Conditions 32 through 35 of DP-1341.

3.0 DESCRIPTION OF COMPLETED, ONGOING AND PLANNED RECLAMATION PROJECTS

As previously noted, a substantial amount of reclamation work has been conducted at the Tyrone Mine since the issuance of DP-1341 and MMD Permit Revision 01-1 to Permit No. GR010RE. Reclamation activities have primarily been focused on the tailing dams in the Mangas Valley Tailing Area, but a substantial amount of reclamation work has also occurred in the Mining Area and East Mine Area. The following sections describe the ongoing and completed reclamation activities that have occurred since the issuance of DP-1341 and MMD Permit Revision 01-1 to Permit No. GR010RE, and planned reclamation projects scheduled to be initiated prior to the EOY 2014.

Facilities where reclamation is complete include: the No. 1, 1C, and 7A series stockpiles; Mangas Valley Tailing Dams; Burro Mountain Tailing Dam; former mill and concentrator area located east of the No. 3A Stockpile; and impacted soils along Brick Kiln Gulch. Areas projected to be completed prior to the EOY 2014 include the Copper Mountain Stockpile Reclamation Area, the remaining launder line earthwork, a short run of tailings pipeline and associated features located northwest of tailing thickeners, and impacted soils in and around the tailing thickeners. Pullback of the 1A Stockpile and placement of the excavated material as a buttress along the toe of the 1B Stockpile is also projected to be complete prior to the EOY 2014. A summary of the completed and ongoing reclamation projects conducted at the Tyrone Mine is provided in **Table 3-1** and detailed in the following sections.

3.1 Reclamation Projects Within the Mangas Valley Tailing Area

Reclamation work has been completed on the Mangas Valley Tailing Dams. A minimum two-foot thick Gila Conglomerate cover was placed on the Mangas Valley Tailing Dams in accordance with DP-27SA (NMED, 2003b), although thicker covers exist in many areas. The following sections provide details of the planned and completed reclamation activities at the individual facilities in the Mangas Valley Tailing Area.

3.1.1 Dam 3X

A Basic Engineering Report (BER) for Dam 3X was submitted to NMED and MMD in June 2004 (M3, 2004d) prior to the initiation of reclamation activities at the site. Reclamation activities commenced at Dam 3X in September 2004 and included: outslope and top surface grading, construction of storm water diversions, top surface drainages, outslope drainage conveyances, and placement of suitable cover sub-base on both top and outslope surfaces. Rip-rap placement began on the top and outslope drainage conveyances. Starting in the fourth quarter of 2006, corrective actions were implemented on the primary storm water conveyance channel on the top surface of Dam 3X. Seeding of Dam 3X was completed in December 2005. Reclamation of Dam 3X was completed in the fourth quarter of 2005, and the corrective actions conducted on the primary storm water conveyance channel on the top surface were completed during the first quarter of 2007. The Construction Quality Assurance Report (CQAR) for the facility was submitted in August 2008 (M3, 2008a).

3.1.2 Dam 3

A site-wide BER for Dam 1, 1A, 1X, 2, and 3 was submitted in May 2005 (PDTI, 2005b/M3, 2005a), and regrading activities began on Dam 3 shortly thereafter. In December 2005, PDTI submitted Amendments to the BER for the Top Surface Overland Flow Requirements for the Tyrone Mine's Dam 3, 2, 1A, 1, and 1X (PDTI, 2005c). Cover placement, seeding and mulching activities began during the first quarter of 2006 and cover placement was completed during the fourth quarter of 2006. Seeding of Dam 3 was completed in 2006. Reclamation of Dam 3 was completed 2006, and the CQAR for the facility was submitted in December 2008 (M3, 2008b).

3.1.3 Dam 2

Reclamation activities commenced at Dam 2 during the first quarter of 2006 and included rough grading of the outslopes and the top surfaces. Grading of the tailing outslope and top surface were completed during the third and fourth quarters of 2006, respectively. During the first quarter 2007, all regrading activities were completed; placement of the top surface sub-base material was completed; seeding and mulching activities were initiated; and placement of the cover material was initiated. By September 2007, all cover had been placed on the top surface and outslopes, and the top surface and side slope channels had been completed. Seeding of Dam 2 was completed in April 2009. Reclamation of Dam 2 was completed during the third quarter of 2007, and the CQAR for the facility was submitted in July 2009 (M3, 2009a).

3.1.4 1 Series Dams

Reclamation activities commenced at the 1 series tailing dams in June 2006 with the construction of access roads and storm water controls on the tailing dams. In the fourth quarter of 2006, regrading of the Dam 1A outslope was initiated, and the construction access road was completed. During the first quarter of 2007, regrading activities along the crest perimeters of Dams 1 and 1X and regrading of the 1A rock dam were completed. Also, placement of a limited thickness of Gila conglomerate was completed along the northwest side of Dam 1X. In April 2007, the Final CDQAP was submitted for Agency approval (MWH, 2007). By December 2008, all cover had been placed on the top surfaces and outslopes of the 1 series tailing dams, and the top surface and side slope channels had been completed. Reclamation of the 1 series tailing dams was completed by the end of 2008, and seeding was completed in July 2009. The CQAR for Dam 1A was submitted in January 2009 (MWH, 2009a), and the CQAR for Dams 1 and 1X was submitted in April 2009 (MWH, 2009b).

3.1.5 Tailing Launder

Demolition of the launder was initiated in the fourth quarter of 2004 as part of pre-cover reclamation activities on Dam 3X (M3, 2008a). Closure of the launder and pipeline included crushing the concrete structure, removal of buried Ameron pipe and concrete from the embankment sections, and burial of demolition materials in trenches and repositories. Golder (2008b) conducted a post-demolition field investigation of the launder corridor that included digging test pits, establishing surface transects, and a comprehensive foot survey to identify impacted areas and any tasks needed to complete closure. Based on that investigation, the total area impacted by tailing along the launder corridor south of Dam 2 was determined to cover about 6 acres including the catch basins (Golder, 2008b). A closure plan and associated CDAQP for the additional impacted areas and demolition and removal of approximately 800 feet of concrete launder and Ameron pipe was submitted for agency approval in June 2008 (Golder, 2008c). The reclamation design project for the remaining portions of the launder area to be reclaimed was recently awarded and the areas are projected to be reclaimed by the EOY 2014.

3.2 Reclamation Activities Within the Mining Area

Reclamation work has been completed for the 1C and 7A waste rock stockpiles (1C/7A Stockpile Unit) portions of the 3A Stockpile, and the Mill/Concentrator area within the Mining Area. Additional areas projected to be completed by the EOY 2014 include the Copper Mountain Stockpile Reclamation Area, portions of the 1A and 1B leach stockpiles, a short run of tailings pipeline and associated features located northwest of tailing thickeners, and impacted soils in and around the tailing thickeners. The following sections provide details of the planned and completed reclamation activities at the individual facilities in the Mining Area.

3.2.1 Mill/Concentrator Reclamation Activities

The original Tyrone Mill Demolition Plan was submitted to the NMED and MMD in June 2004 (PDTI, 2004c), and demolition activities at the site began in August 2004. The BER for reclamation of the site was submitted to the NMED and MMD in January 2005 (Golder, 2005b). Grading and cover placement activities began during the second quarter of 2006 and were completed during the fourth quarter of 2006. Construction of the drainage channels were initiated upon completion of grading and cover placement at the site. Reclamation of the Mill/Concentrator area was completed during the fourth quarter of 2007 along with cover thickness quality control (QC) testing performed by the NMED. Seeding and mulching of the site was completed in April 2007. The as-built design set and CQAR were submitted to the NMED and MMD in January 2008 (Golder, 2008a).

3.2.2 1C Waste Stockpile

Removal of 1C Stockpile material from Oak Grove Wash was initiated in March 2004. The original CDQAP for the Oak Grove Stockpiles (1C, 7A and 7A Far West stockpiles) was submitted in July 2006

(PDTI, 2006), and on December 14, 2006, Tyrone received from NMED and MMD conditional approval of the CDQAP (NMED and MMD, 2006). Removal of the 1C Stockpile material from Oak Grove Wash was completed during the first quarter of 2005. Construction of seepage collection and cutoff trenches within three ancestral drainages located along the toe of the 1C Stockpile began in the second quarter of 2005, and they were operational by the end of the fourth quarter. During that same quarter, regrading and shaping of the ridge and valley outslope design was initiated. Regrading activities were completed during the first quarter of 2007 and placement of Copper Mountain Leach Cap cover material on the outslope began. During the second quarter of 2006 Gila Conglomerate from the 5A Stockpile started to be loaded to the top of 1C Stockpile for future placement on the stockpile outslope. Hauling and loading of Gila Conglomerate material from the 5A Stockpile was completed during the fourth quarter 2006. The placement of additional cover material on the outslope was completed in July 2007, and placement of rip-rap within the valley outslopes was completed in 2011. Four additional seepage collection systems were constructed along the regraded stockpile toe between May 2008 and October 2012 and are fully operational. Reclamation of the 1C Stockpile was completed in November 2012 and the draft CQAR was submitted to the agencies for review in March 2013 (M3, 2013).

3.2.3 7A Waste Stockpiles

Reclamation activities at the 7A stockpiles began in the fourth quarter of 2005 with the construction of storm water best management practices (BMPs) along the toe of the stockpiles (surface dikes). Additionally during the fourth quarter of 2005, the 3H:1V and 2.5H:1V test plots on the 7A stockpiles were completed, with the exception of the vadose zone monitoring instrumentation installations. Regrading of the 7A Far West stockpile began during the first quarter of 2006 and outslope grading was completed during the second quarter. Also during the second quarter of 2006, a series of six seepage collection systems were installed along the toe of the 7A stockpiles. Placement of Gila Conglomerate cover material also began on the outslope of the 7A Far West Stockpile during the second quarter of 2006. Placement of cover material on the outslope of the 7A Far West Stockpile was completed during the third quarter of 2006. Loading and hauling of Gila Conglomerate cover material to the crest of the 7A West/East Wing segment was conducted during the fourth quarter of 2006 to provide an additional one-foot of cover on the stockpile. Placement of the additional one-foot of Gila Conglomerate cover over the 7A West/East Wings was completed in the second quarter of 2009. Channel armoring commenced during the third quarter of 2009. Three additional shallow seepage collection systems were constructed in the spring of 2009 as replacements to existing collection systems. Reclamation of the 7A stockpiles was completed in November 2012 and the draft CQAR was submitted to the agencies for review in March 2013 (M3, 2013).

3.2.4 1A/1B Leach Stockpiles

Mining of the 1A Stockpile outslope began in the first quarter of 2006 as part of the stockpile pull-back, and was temporarily halted in the fourth quarter of 2006 with the shovel moving back into production in the West Main Pit. Mining of waste rock and leach ore material from the outslope of the 1A Stockpile resumed in the first quarter of 2012. Leach material from the 1A Stockpile outslope is currently being placed along the toe of the 1B stockpile. The outslope of the 1B Stockpile will then be regraded to a 3H:1V slope, and the entire existing PLS collection system will be covered with waste rock. The existing 1B PLS collection system was modified in 2006, 2007, and 2011 to ensure that the system continues to operate effectively following placement of the waste rock in the area. All existing piezometers, monitor wells, and extraction wells located within the regrade footprint of the 1B Stockpile were plugged and abandoned between August and September 2006 in accordance with NMED Monitor Well Completion and Abandonment guidelines. Construction of the modified PLS collection system began in September 2006 and was completed in February 2007. The 1B Stockpile PLS Collection System Relocation As-Built design set was completed in May 2007 and submitted to the NMED in July 2007 (PDTI, 2007).

3.2.5 3A Leach Stockpile

The current reclamation plan for the 3A leach stockpile is based on an overall outslope slope gradient of 3.5H:1V, 32-foot wide terrace benches, and 200-foot inter-bench slope lengths to allow for flexibility in the final design of the terrace benches and associated surface water conveyance channels. With these designs, several of the existing collection systems and a significant number of monitor wells located near the existing toe of the stockpile will be covered. Well abandonment and installation activities were initiated during the first quarter of 2007 for the wells that would be impacted by stockpile regrading. A total of 49 wells have been plugged and abandoned in accordance with NMED Monitor Well Completion and Abandonment guidelines, including 23 perched zone and 26 regional ground water monitor wells. A total of 25 5-inch-diameter extraction wells and 34 4-inch-diameter monitor wells were also installed. The new wells were placed immediately north of the projected reclaimed stockpile footprint. The 3A Stockpile well program activities were conducted between November 2006 and May 2007. The new seepage collection system installations and remaining well abandonment and installation activities will be conducted in the future.

3.2.6 Copper Mountain Reclamation Area

The Copper Mountain Reclamation Area includes the former Copper Mountain Stockpile and the southern-most portion of the Copper Mountain Pit. The leach stockpile and underlying asphalt liner were removed in 2000. The area was regraded, partially covered and seeded to test various reclamation methods in July 2001. Benches were graded into the hillsides to reduce storm water runoff. Below the benches the former stockpile footprint was covered with 0 to 12 inches of cover from the adjacent haul road. The cover was installed to act as a growth medium for vegetation and the underlying material would act as a secondary root zone medium. The stockpile materials in this area will be further reclaimed by grading, covering, and seeding. The Copper Mountain Stockpile reclamation design project was recently awarded and the facility is projected to be reclaimed by the EOY 2014.

The Copper Mountain Stockpile Reclamation Area to be reclaimed includes the southern-most portion of the Copper Mountain Pit that is partially administered by the BLM (a.k.a., Copper Mountain Pit South Expansion area). The exposed bedrock and stockpile materials in this area will be reclaimed by grading, selective covering, and seeding. Highwalls within the reclamation areas will remain and will not be regraded or covered. The Copper Mountain Pit South Expansion area reclamation design project was recently awarded and the area is projected to be reclaimed by the EOY 2014.

3.2.7 Impacted Soils and Tailings Pipeline In and Around the Tailing Thickeners

A closure plan and associated CDAQP for the additional impacted areas and demolition and removal of approximately 800 feet of concrete launder and Ameron pipe was submitted for agency approval in June 2008 (Golder, 2008c). Reclamation in this area will include consolidation of all tailing and other mining impacted materials in the vicinity of the thickeners, grading the surface for drainage, development of stormwater control structures, and covering and revegetating the surface. The remaining tailing pipeline and launder will be closed and the launder crossing flowing across the tributary near the thickeners will be removed to re-establish natural flow in the tributary channel. The tailing pipeline and launder will be closed in a manner similar to the methods used for the reclaimed portions of the launder line. The reclamation design project for the impacted soils and tailings pipeline in and around the tailing thickeners and remaining portions of the launder area to be reclaimed was recently awarded and the areas are projected to be reclaimed by the EOY 2014.

3.3 Reclamation Activities Within the East Mine Area

Reclamation work has been completed for the No. 1 Stockpile, Burro Mountain Tailing Dam, and impacted soils located along Brick Kiln Gulch within the East Mine Area. The following sections provide details of the completed reclamation activities at the individual facilities in the East Mine Area.

3.3.1 Burro Mountain Tailing Dam

Design work for closure/closeout activities began during the second quarter of 2004; and regrading, cover placement, and fencing of the Burro Mountain Tailing Dam was initiated in the third quarter. Regrading, cover placement, and fencing were completed during the fourth quarter of 2004. Seeding of the Burro Mountain Tailing Dam was completed in December 2004. Reclamation of the Burro Mountain Tailing Dam was completed in February 2005. The CQAR for the Burro Mountain Tailing Dam was submitted in September 2005 (M3, 2005b).

3.3.2 No. 1 Leach Stockpile

The CDQA plan for the No. 1 Stockpile was submitted in April 2006 (M3, 2006). Reclamation activities at the No. 1 Stockpile began in February 2005 with the construction of the test plots on the west side of the stockpile. The existing seepage collection systems and monitor wells located within the projected regraded footprint of the stockpile were plugged and abandoned in May 2005 in accordance with NMED

Monitor Well Completion and Abandonment guidelines. Removal of the existing non-functional pipelines in the No. 1 Stockpile area was completed in June 2006, and relocation of the existing functional pipelines was completed in July 2006. The C Sump Pond closure and seepage collection system installations were completed during the fourth quarter of 2006. Rough grading on the top surface was initiated in the second quarter of 2006 and regrading activities on the stockpile outslope were initiated in July 2007. Regrading activities on both the top surface and outslope were completed in the second quarter of 2008. Reclamation of the former PLS Pond (B Sump) was completed in February 2009. Cover placement was completed in the second quarter of 2009. Armoring of all on-site and off-site channels and seeding of all reclaimed areas was completed in the third quarter of 2009. Reclamation of the No. 1 Stockpile was completed in July 2009. The CQAR for the No. 1 Stockpile was submitted in December 2009 (M3, 2009b).

3.3.3 Impacted Soils Along Brick Kiln Gulch

Stained soils that generally lacked vegetation were identified in 2007 along the county road that parallels Brick Kiln Gulch. The stained soils were generally characterized by impacted acidic soils with little to no vegetation. An investigation of the identified areas was conducted by Golder in 2007 and reclamation plans for impacted soil areas along Brick Kiln Gulch were submitted to the agencies in December 27, 2007 (Golder, 2007f). The stained soils areas were reclaimed between February and April 2008 by covering the areas with a minimum of 3 feet of clean cover, grading them to create positive drainage from the covered areas, and seeding the reclaimed areas. The CQAR for the impacted soil areas along Brick Kiln Gulch was included as part of the No. 1 Stockpile CQAR that was submitted in December 2009 (M3, 2009b).

4.0 RECLAMATION DESIGN CRITERIA

This section presents the reclamation design criteria for closure/closeout of the Tyrone Mine facilities. The reclamation practices proposed herein are intended to limit future environmental impacts and, to the extent practicable, provide protection of air and water resources consistent with state and federal laws. Reclamation design criteria were developed in consideration of the site-specific conditions that exist at Tyrone including soil, ecological, operational, and economic constraints. The reclamation designs criteria conform to the closure requirements described in Section III of DP-1341 and Section 9 of MMD Permit GR010RE (MMD, 2004; 2009; 2012).

Open pit mining and recovery of copper is projected to continue at Tyrone for many years, therefore, the size and topography of the mining area will change. Leaching and SX/EW recovery of copper is projected to continue beyond open pit mining. Therefore, the conceptual reclamation design approach for closure/closeout has been prepared to consider current disturbance and completed and ongoing reclamation for the next five years. The 5-year update to the CCP revises the approved End of Year 2001 Through 2008 CCP (M3, 2001) and the CCP Update included in the DP-1341 renewal application (Golder, 2007e). Like the original 2001 CCP and financial assurance (M3, 2001) and the 2007 CCP Update (Golder, 2007e), this plan is a “snapshot in time” that reflects the most expensive closure scenario based on the Tyrone mine plans and site conditions. The basic conceptual design criteria should be applicable to any time period even though quantities and unit costs may change with time. Final designs, technical specifications, and construction quality assurance plans for each facility will be prepared when mining and SX/EW recovery of copper ceases or as part of accelerated reclamation activities.

Descriptions of the facilities covered by the reclamation designs and their design criteria are included in Section 4.1. The performance objectives and reclamation designs for closure/closeout of the facilities are included in Section 4.2, and the water treatment methodology is outlined in Section 4.3. The existing and planned closure/closeout activities for Tyrone are presented in association with each of the three main mine facility areas in Section 5.0.

4.1 Facility Characteristics and Classification

To standardize the development of the financial assurance cost estimate associated with this CCP, facilities with common characteristics and mine function have been grouped together in this section. The reclamation plans and facilities are also grouped by the three main mine facility areas in Section 5.0. Thus, the tailing dams, stockpiles, open pits, surface impoundments, disturbed areas, and water treatment are identified as the primary reclamation facility groups. Sections 4.1.1 through 4.1.7 provide general descriptions of these facility groups.

The characteristics of individual tailing dams, stockpiles, open pits, surface impoundments, and other disturbed areas at Tyrone are summarized on facility characteristics forms (**Appendix B**). The general areas of disturbance and associated major facilities to be reclaimed at Tyrone are summarized in the following sections.

4.1.1 Tailing Dams

As described in Section 3.1, the tailing dams at Tyrone have been fully reclaimed. Portions of Mangas Valley Tailing Dams have two feet of cover, which was consistent with DP-27SA but less than the 3-feet required by later Agreements. Pending demonstration of the effective of the 2-foot thick covers, additional financial assurance is accounted for in the reclamation cost estimate provided in Section 8 for the areas with less than three feet of cover.

4.1.2 Stockpiles

A total of approximately 2,505 acres of stockpile surfaces are targeted for reclamation under this plan. Reclamation has been completed for several stockpiles, including the No. 1 Stockpile and 1C and 7A stockpiles. Stockpile surfaces targeted for reclamation under this plan include all top surfaces and outslopes of leach and waste stockpiles that are located outside the OPSDA. Additionally, as part of this CCP update, Tyrone has included a new leach stockpile that will be constructed within the Savanna Pit by the EOY 2014. This facility, referred to herein as the “Savanna Pit Stockpile”, is projected to cover an area of approximately 172 acres and is identified as a conditionally waived facility in this CCP. The top surfaces of leach stockpiles, waste rock piles, and other level areas of significant size within the OPSDA will be regraded to a slope of between 1 and 5 percent and covered. The outslopes within the OPSDA will not be reclaimed. Impacted surface water runoff from the stockpiles located within the OPSDA will be collected in the pit sumps and PLS collection sumps located within the OPSDA and conveyed to the proposed water treatment plant. Impacted stockpile seepage will be collected from the existing seepage collections, pit sumps, and PLS collection systems and conveyed to the proposed water treatment plant.

The leach stockpiles located inside the OPSDA include the future Savanna Pit Stockpile; and the interior slopes of the 1A, 1B, 2B, 2C, 4A, 6B, 6C, and Copper Mountain stockpiles. The waste rock stockpiles located inside the OPSDA include the 8C, and the interior slopes of the 3B Stockpile. The leach stockpiles located outside the OPSDA include: the No. 1 (reclaimed), 2A, 3A, 4B, 4C, and 7B stockpiles; and all but the interior slopes of the 1A, 1B, 2B, 2C, 4A, 6B, 6C, and Copper Mountain stockpiles. The waste rock stockpiles located outside the OPSDA include the 1C (reclaimed), 2B, 5A, 7A (reclaimed), and 9A stockpiles; and all but the interior slopes of the 3B stockpile.

4.1.3 Open Pits

The open pits at the Tyrone Mine Facility encompass approximately 1,516 acres. The open pit areas include the Main, West Main, Valencia, Gettysburg, Copper Mountain, South Rim, Savanna and San Salvador Hill pits. Of the existing open pits at the mine, the Main, West Main, Valencia, Savanna, and Gettysburg Pits are contiguous. The West Main and Valencia pits are part of the Main open pit. These pits, which by the EOY 2014 will cover an area of about 1,240 acres, have been granted a conditional waiver (see **Plate 3**) from the requirement of achieving a self-sustaining ecosystem, and will not be covered during mine closure. The Copper Mountain Pit (excluding the Copper Mountain Pit South Expansion area), covering approximately 132 acres by the EOY 2014, has also been granted a conditional waiver from the requirement of achieving a self-sustaining ecosystem, and will not be regarded and covered during mine closure. The water that accumulates in the conditionally waived pits will be managed through combined processes of evaporation and pumping. The pits form a hydrologic sink capturing ground water flowing from all directions. Surface water conveyed from the stockpiles located within the OPSDA will be directed to the individual pit sumps and/or PLS sump collections for incorporation into the mine process water circuit while the mine is still operational, and to the water treatment system circuit during closure and post-closure.

The two remaining pits (the South Rim Pit and the San Salvador Hill Pit) do not qualify for waiver consideration. These two pits cover areas of approximately 22 and 123 acres, respectively (see **Plate 3**). The San Salvador Pit is projected to be partially backfilled at the EOY 2014 and the South Rim Pit is projected to be fully backfilled. During reclamation, these areas will be regraded such that drainage is directed toward the Oak Grove Drainage and any surface ponding is minimized, and then covered and revegetated in accordance with Appendix C of MMD Permit GR010RE.

4.1.4 Surface Impoundments, Tanks, and Catchments

A survey of the surface impoundments, tanks, and storm water catchments at the Tyrone Mine was compiled as part of the Final Surface Impoundment Study Work Plan (DBS&A, 2006). This list has been updated as part of this CCP to include more recent information on the status of the surface impoundments, tanks, and storm water catchments associated with the ongoing reclamation efforts at the mine. **Table 2-1** in this plan presents an updated summary of the existing and planned surface impoundments that will be in place by the EOY 2014. This table includes information from the surface impoundment list in the 2006 study, additional information from the Stage 2 APP (DBS&A, 2012), and more current information from Tyrone personnel. According to this summary, there will be 67 surface impoundments, tanks, and catchments present at Tyrone at the EOY 2014. Two impoundments that are currently present at the mine (7B PLS Pond and Savanna Pit Sediment Collection Pond) will be reclaimed by the EOY 2014.

4.1.5 Disturbed Areas

A miscellaneous group of disturbed areas such as haul roads and operational roads, existing borrow areas, facilities such as the SX/EW, Acid Unloading, Lube Shop, equipment storage areas, and pipeline and utility corridors are present at the Tyrone Mine. Performance objectives for disturbed areas include creation of a self-sustaining ecosystem and erosion control for all areas located outside the OPSDA.

Reclamation of the disturbed areas located outside the OPSDA or regrade footprint of stockpiles will be accomplished by removing or burying utility and structure foundations, pipelines, power lines, and buildings and providing erosion and drainage control and revegetation. Compacted soils in areas such as haul roads and mine access roads not covered by stockpile regarding, and not used for post-closure purposes will be loosened by ripping on an as needed basis. Where possible, the ripping and grading of compacted areas will be accomplished during near-closure operational phases. Disturbed sites located outside the OPSDA or regrade footprint of stockpiles and on non-acid generating material will be ripped to a depth of 24 inches and revegetated. Disturbed sites located outside the OPSDA or regrade footprint of stockpiles and on acid generating material will be covered with 36 inches of Gila Conglomerate (or other suitable material) and revegetated. Revegetation will be achieved by seeding with a variety of grasses, shrubs, and forbs in accordance with Appendix C of MMD Permit GR010RE.

Examples of temporary erosion and drainage control practices may include rough grading and installation of water bars, minor diversions, sediment containment structures, mulching, straw bales, and silt fences. The need for these practices will be evaluated on a site-specific basis at closure.

4.1.6 Facility Demolition

Those facilities not designated for industrial PMLU will be demolished, removed, and/or buried or otherwise closed in accordance with an approved construction design and quality assurance plan. A total of approximately 69 buildings/tanks/structures containing approximately 8.72 million cubic feet will be demolished and removed under this plan. The list of facilities that are scheduled to be removed is provided in **Table 4-1**. Where footings, slabs, walls, pavement, manholes, vaults, storm water controls, and other foundations are abandoned in place over native material (not demolished), they will be covered with topdressing to a depth of 36 inches and revegetated in accordance with Appendix C of MMD Permit GR010RE. All structures to be removed and visually affected soil in unpaved areas will be disposed of in an approved manner or covered with 36 inches of suitable cover material, and revegetated in accordance with Appendix C of MMD Permit GR010RE.

4.1.7 Industrial Facilities

The infrastructure (shops, buildings, roads and utilities) associated with the Industrial PMLU areas will be adapted for non-mining industrial applications. NMED requires abatement of contaminated soils that are potential source areas for ground water and surface water contamination in accordance with NMAC Sections 20.6.2.1203, 20.6.2.3109.E.1, and 20.6.2.4103 in and around all facilities and structures approved by MMD to be left for an Industrial PMLU. Abatement of contaminated soils in and around all structures necessary for post-closure treatment and disposal of ground water and/or surface water is also required. Tyrone will maintain erosion controls, structures, equipment, and utilities within the Industrial PMLU areas until they are occupied by tenants. Tyrone proposes to cover impacted areas located within the Industrial PMLU areas with 36-inches of cover material and revegetate the areas in accordance with Appendix C of MMD Permit GR010RE.

4.2 Performance Objectives/Reclamation Design

Performance objectives and design criteria were developed with the intent of meeting rules and requirements associated with the WQA, WQCC Regulations and NMMA. This section presents the reclamation design criteria in accordance with these objectives. The closure or reclamation designs are depicted in the drawing set provided in **Appendix A**. The designs were developed to provide enough information to calculate the financial assurance cost estimate. The following sections present the performance objectives and reclamation design criteria for the major facilities at the mine. A summary of the key design criteria for the facilities to be closed is presented in **Table 4-2**.

4.2.1 Tailing Dams

The tailing dams at the Tyrone Mine have been fully reclaimed. The performance objectives for the top surface and exterior outslopes of the reclaimed tailing dams include establishment of a self- sustaining ecosystem, control of fugitive dust, control of run-on and runoff and erosion, prevention of overtopping, and the reduction of infiltration of meteoric water.

4.2.2 Stockpiles

The performance objectives for closure/closeout of the stockpile facilities and interior stockpile slopes located within the OPSDA include: limit future access to the conditionally waived stockpile areas to authorized personnel only, minimize adverse impacts to waterfowl and other wildlife resulting from ponding or water impounded in the conditionally waived stockpile areas, prevent stormwater from running onto reclaimed areas from the conditionally waived areas, establishment of a self- sustaining ecosystem on the covered top surfaces, and construction of water collection ponds as needed for water treatment.

The performance objectives for closure/closeout of the stockpile areas located outside the OPSDA include: re-establishment of a self-sustaining ecosystem; stabilize the reclaimed areas to minimize future impacts to the environment and to protect air and water resources; limit ponding on the final cover surfaces; reduction of infiltration; containment of seeps and sediment transport; and control of run-on, runoff, and releases to perched and regional ground water.

A summary of the key design criteria for the stockpile facilities to be closed is presented in **Table 4-2**. It should be noted that the conceptual designs and associated earthwork cost estimate presented in this CCP for the stockpiles located outside the OPSDA are based on an inter-bench slope of 3H:1V, 32-foot wide terrace benches, and 200-foot inter-bench slope lengths to allow for flexibility in the final design of the terrace benches and associated surface water conveyance channels. With these designs, the overall outslope gradient from the crest to toe is generally 3.5H:1V. Precise designs for each reclamation unit will be prepared and submitted to the agencies at final design and may alter the 3.5H:1V overall slope in this conceptual design.

Structural Stability

The existing stockpiles at Tyrone are composed of blasted rock placed on 30-to-50-foot high lifts through end-dumping at angle of repose that results in overall slopes that are flatter than angle of repose. The gross stability of the stockpiles has been determined to be adequate and is expected to remain stable under post-closure conditions (Golder 2006b, 2006c, 2006d, 2007a, 2007b, and 2007c).

Stockpile Erosion and Drainage Control

For the stockpile top surfaces located outside the OPSDA, the surfaces will be graded and covered to direct non-impacted water to designated discharge areas. The stockpile top surfaces will be graded to slopes of between 1 and 5 percent. The slopes will be graded to armored storm water conveyance structures. Armored channels, perimeter berms, and hydraulic structures will be designed to control erosion on the top surfaces and outslopes and safely convey storm water for release. The existing berms on the stockpile top perimeters will be improved, where necessary, and maintained to prevent the concentration of flow to the outslopes.

For the stockpile outslopes located outside the OPSDA, inter-bench outslopes will be graded to 3H:1V with uninterrupted slope lengths of no greater than 200 feet. Storm water will be controlled using conventional terrace channels integrated to downdrains for facilities to be reclaimed. For the reclaimed No. 1, 1C, and 7A stockpiles, the outslopes were primarily constructed with the ridge-valley design and generally no benches are present (with the exception of portions of the No. 1 and 7A stockpiles that were constructed with benches). Run-off drainage and erosion control for the stockpiles will be achieved by storm water conveyance channels, stable outslopes, suitable cover material and revegetation.

For the stockpiles located inside the OPSDA, the outslopes will remain at/near angle-of-repose. The top surfaces of the stockpiles located inside the OPSDA will be regraded to a slope of between 1 and 5 percent and covered. Storm water within the OPSDA will be controlled using constructed downdrains and/or existing surface conveyance channels that will direct storm water to existing surface impoundments or mine pit sumps where water can be collected for treatment.

Energy dissipation structures will be constructed at channel outlets to reduce erosive velocities where necessary. Where possible, channels will be constructed to incorporate existing topography, grade controls, and exposed inert bedrock thus, promoting long-term integrity of the structures. The final design will be adjusted for local conditions.

With the exception of in-pit stockpiles, run-on is not expected to be a post-closure concern for the stockpiles because they are constructed above the surrounding terrain. The need for run-on protection for the in-pit stockpiles will be fully evaluated in the final design process.

Temporary erosion control measures may be provided during the construction and early vegetation establishment periods for the stockpiles located outside the OPSDA and the top surfaces of the stockpiles located within the OPSDA. These measures may include, but are not limited to, berms, mulch, straw bales, silt fences, and minor corrective regrading. All construction will be in compliance with state regulations for temporary storm water control.

Stockpile Cover and Revegetation

Finish grading of the stockpile subgrade will be performed based on pre-construction surveys. Earth moving equipment such as bulldozers and motor graders will be used to smooth the surfaces and facilitate access for supplemental cover placement and mulching/seeding. Stockpile covers will be placed according to the following criteria:

Inside Open Pit Surface Drainage Area	
Top Surface Cover Thickness	36 inches
Outslope Cover Thickness	0 inches
Top Surface Grade	1.0 to 5%
Slope (overall)	Existing (approx. angle of repose)
Outside Open Pit Surface Drainage Area	
Top Surface Cover Thickness	36 inches
Outslope Cover Thickness	36 inches
Top Surface Grade	1.0 to 5%
Slope (Inter-Bench Slope)	3H:1V max.

The recently completed reclamation designs presented in **Appendix A** and the associated Earthwork Cost Estimate presented in **Appendix C** indicate that the cover requirement for the Mining Area at Tyrone is approximately 12.8 million yd^3 based on the current permit requirements. More than 20 million yd^3 of Gila Conglomerate and leached cap cover materials have been conservatively identified at Tyrone (Golder, 2005d and 2006a). Under this CCP, the borrow sources for stockpile cover are assumed to be in-situ Gila Conglomerate in the Lube Shop area and Gila Conglomerate from the 5A overburden stockpile.

Ongoing regrading and ripping during mining operations will result in top surfaces with minor irregularities. Thus, only finish grading to achieve 1 to 5 percent slopes is planned on the top surfaces to facilitate cover placement and/or storm water run-off controls. Substantial grading is planned for the stockpile outslopes located outside the OPSDA. Terraced benches will be constructed to control erosion from run-off. These benches will be constructed on inter-bench outslope angles of 3H:1V at slope lengths no greater than about 200 feet.

Revegetation of the stockpile top surfaces, and stockpile outslopes located outside the OPSDA will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit. The planned seed mix is discussed in Section 7.0.

Stockpile Surface Water, Ground Water, and Sediment Containment

The existing and planned surface impoundments, berms, sumps, collector pipes, seepage and PLS collection systems, and ground water pump-back systems will be integrated into a new overall system to control releases to surface water, perched water, and ground water. Impacted waters will be directed to the proposed water treatment plant described in Section 4.3.

4.2.3 Open Pits

Tyrone received a conditional waiver from the requirements of achieving a self-sustaining ecosystem pursuant to Section F of the MMD Permit (MMD, 2010; 2012). Based on this waiver, the pits at Tyrone are divided into two categories: conditionally waived and non-waived pits. The conditionally waived pits at Tyrone are the Main, Savanna, Gettysburg, and Copper Mountain Pits. The non-waived pits are the San Salvador Hill and South Rim Pits. The San Salvador Pit is projected to be partially backfilled at the EOY 2014 and the South Rim Pit is projected to be fully backfilled as part of mine operations.

The performance objectives for the conditionally waived pits are to control run-on and public access, maintain operational access, and minimize adverse impacts to waterfowl and other wildlife resulting from ponding or water impounded in the pit areas, seepage and ground water control. Site access will be controlled by new 6-foot high chain link fences installed around the perimeter of the pits. Signs will be posted on the fencing at 500·foot intervals and at all access points, and warnings of potential hazards present.

The performance objectives for the conditionally waived pit floor areas are to provide a hydraulic sink for capture and removal of impacted water. Pit walls are sufficiently stable that a specific conceptual design is not needed. Any materials eroded from these slopes will be contained within the pit. Impacted water will be captured in pit floor treatment sumps then pumped to the proposed water treatment facility.

The performance objectives for closure/closeout of the non-waived open pit facilities include establishment of a self-sustaining ecosystem; reduction of infiltration; containment of seeps and sediment; and control of run-on, runoff, and releases to perched and regional ground water. The South Rim and San Salvador Hill pits will be graded in a manner that ensures positive drainage from the areas to be covered and revegetated and to eliminate, to the extent practicable, ponding on final cover surfaces.

Top surfaces of the South Rim and San Salvador Hill pits will be graded to a slope of between 1 and 5 percent to direct non-affected water to designated discharge areas. Armored channels, perimeter berms, and hydraulic structures will be designed to control erosion on the top surfaces and convey storm water for release. The existing berms on the backfilled portions of the pits will be improved, where necessary, and maintained to prevent the concentration of flow onto the top surfaces from the pit slopes.

Energy dissipation structures will be constructed at channel outlets to reduce erosive velocities where necessary. Where possible, channels will be constructed to incorporate existing topography, grade controls, and exposed inert bedrock thus, promoting long-term integrity of the structures. The final design will be adjusted for local conditions. Temporary erosion control measures will be provided during the construction and early vegetation establishment periods. These measures include, but are not limited to, berms, mulch, straw bales, silt fences, and minor corrective regrading. All construction will be in compliance with state regulations for temporary storm water control.

Revegetation of the non-waived pit top surfaces will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit. The planned seed mix is discussed in Section 7.0.

4.2.4 Surface Impoundments

The performance objectives for surface impoundments facilities are to retain, evaporate, or convey process waters, seepage collection waters, extracted ground water and pit water, and surface water. For the purposes of this plan, surface impoundments include: storage tanks for process waters, seepage collection waters, and extracted ground water/pit water; storm water catchments; and lined and unlined surface impoundments. The surface impoundment facilities are planned to be the last features to be closed following the establishment of vegetation and site stabilization on the other facilities. Impoundments that serve PMLU functions or are associated with the stockpile toe perimeter and ground water control systems are planned to be permanent parts of the reclamation system and will be maintained throughout the post-closure period. The disposition of specific facilities with respect to closure/closeout is discussed in Section 5.0.

The impoundments to be closed will be characterized sequentially, by facility and will include the definition of the drainage of the surface impoundment, characterization and abatement of sediments that could potentially impact ground water quality, and characterization of ground water to determine if abatement is necessary. Closure and reclamation of surface impoundments not designated for PMLU may involve removal of contaminated material if present and/or grading to achieve drainage, followed by capping with 36 inches of suitable cover material and revegetation. Cover will be applied only where contamination is present and for impoundment areas located outside the regrade toe of stockpile facilities. Synthetic liners (if present and outside the regrade toe of stockpile facilities) will either be removed and disposed of, or ripped, and completely covered with 36-inches of suitable material. Revegetation will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit.

4.2.5 Disturbed Areas

Performance objectives for disturbed areas located outside the OPSDA include creation of a self-sustaining ecosystem, erosion and stormwater control, and reduction of infiltration of incident precipitation. Reclamation of the disturbed areas outside the OPSDA or regrade footprint of stockpiles will be accomplished by removing or burying utility and structure foundations, power lines, and buildings and providing erosion and drainage control and revegetation. Pipeline corridors located outside the regrade footprint of stockpiles and outside the OPSDA will be inspected and characterized for evidence of past spills that could potentially cause exceedances of water quality standards of Section 20.6.1 NMAC and Section 20.6.2.3103 NMAC. If they do not constitute a source of contamination (defined as exceedances of standards), they can be left in place and buried, after they have been rinsed and capped if they contain contaminated materials. If soils have been impacted, the material will be removed or covered with 36-inches of suitable material. Where pipelines are removed or buried, the pipeline corridor will be revegetated in accordance with Appendix C of the MMD Permit.

Haul roads and access roads not needed for closure and pose closure access will be reclaimed if not located within the OPSDA or regrade footprint of stockpiles. If the roads are located on non-acid generating material, compacted road material will be loosened by ripping to a depth of 24 inches and revegetated. For haul roads located on acid-generating material, the roads will be ripped, covered with 36 inches of the suitable cover material and revegetated. All culverts will be removed unless they serve a post-closure purpose.

The necessity for removing utility structures will be determined on a site-specific basis. Buildings will be demolished or converted to an alternative industrial use. Footings, slabs, walls, pavement, manholes, vaults, storm water controls and other foundations located outside the OPSDA that are not included in the Industrial PMLU, and are located on non-acid generating materials will be abandoned in place and covered with 36 inches of topdressing. For footings, slabs, walls, pavement, manholes, vaults, storm water controls and other foundations located outside the OPSDA that are not included in the Industrial PMLU and are located on impacted soils that could potentially cause exceedances of water quality standards of Sections 20.6.1 NMAC and Section 20.6.2.3103 NMAC, the structures and impacted soils will be removed or covered in place with 36 inches of Gila Conglomerate (or other suitable cover material).

Temporary erosion and drainage control practices may include but are not be limited to rough grading and installation of water bars, minor diversions, sediment containment structures, mulching, straw bales, and silt fences. The need for these practices will be evaluated on a site-specific basis at closure. The seed mix to be used is presented in Section 7.0. Revegetation will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit.

4.2.6 Borrow Areas

Tyrone's experience with cover excavation and placement on the tailing dams, No. 1 Stockpile, 1C Stockpile, and 7A series stockpiles revealed that flexibility in materials handling is critical to achieving quality control objectives and efficient management of cover soil resources. The exact location and configuration of the borrow areas will ultimately be determined during the final design and construction phases of the reclamation.

The top surface and outslopes of the 5A stockpile, which will be only partially consumed, will be reclaimed using methods similar to those described for the other stockpiles located outside the OPSDA (Section 4.2.2). The remaining borrow pits will have low-angle side slopes as a result of the specified excavation plan. Borrow pit side slopes and bottoms will be ripped where required and revegetated with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit.

4.3 Water Management and Treatment

There are five sources of water that are likely to be sent to the proposed water treatment system and include the following:

- Residual process solutions from the leach operation;
- Meteoric water that infiltrates through the acid-generating stockpiles to seepage collection;
- Storm water runoff that comes into contact with un-reclaimed stockpiles;
- Dewatering water from the existing open pits; and
- Impacted groundwater captured in seepage collection and interceptor well systems.

These sources will be managed and or treated throughout site reclamation activities and for a duration of 100 years following cessation of mining operations. The following methods are proposed for management and treatment of impacted surface water and ground water.

4.3.1 Performance Objectives

The primary performance objectives for water management and treatment are to collect impacted waters associated with mine operations and to treat these waters to meet the applicable NMWQCC criteria for discharge. To meet the performance objectives the following strategy will be utilized:

- A process solution elimination (PSE) system for treatment of highly concentrated process water, seepage and runoff water, and pit dewatering water during the first six years after closure;

- Minimization of impacted surface runoff requiring treatment. Diversion of non-impacted meteoric water and storm water surface runoff away from potentially impacted sources, which will allow for discharge to an approved surface discharge area in accordance with state regulations. Non-impacted water sources will not require treatment prior to discharge;
- Storage of stockpile seep water and groundwater from interceptor systems in open top tanks or HDPE-lined impoundments will allow for sampling and analysis prior to final disposition. Water that is shown to be in compliance with NMWQCC water quality standards (Title 20, Chapter 6, Part 2, Subpart III, Section 3103),will be discharged. Impacted water will be conveyed to the proposed water treatment plant;
- Impacted ground water from interceptor systems and seepage collection systems will be sent to the proposed water treatment plant.; and
- Pit water will be pumped to the proposed water treatment plant.

This strategy will maximize the quantity of non-impacted water and minimize the quantity of impacted water that must be treated prior to release. Treatment of impacted waters is discussed in the following sections.

4.3.2 Closure/Closeout Plan Objectives

To meet the performance objectives, elements have been designed to segregate affected and non-affected waters as close to the source as possible. Non-impacted waters are to be released at approved points of discharge, and impacted waters are treated to meet NMWQCC water quality standards (Title 20, Chapter 6, Part 2, Subpart III, Section 3103, Standards for Groundwater of 10,000 mg/L TDS concentrations or less). The basis of the design of water management and treatment operations considers the following:

- Quantity and quality of water to be managed through segregation from impact areas allowing for direct discharge;
- Quantity and quality of water to be treated (design basis influent);
- Water quality requirements for managed waters (direct discharge) and treated waters (treatment plant effluent);
- Water treatment unit process configuration;
- Treatment facility performance;
- Treatment facility location(s); and
- Sludge management.

4.3.3 Management and Treatment Processes

The five sources of water requiring management and or treatment through the 100-year period following cessation of mining operations will be handled as follows:

- Process solutions will be eliminated through the use of a process solution elimination (PSE) system during the first 6 years following closure of the leach circuit. Residual process solutions will be fully treated at the beginning of the sixth year after cessation of mining operations. The PSE system and the water treatment system will operate concurrently in year 6, and the PSE system will be shut down at the end of the sixth year.

- Stockpile seepage will be treated through the time period from year 6 to year 100 for removal of metals, sulfate and TDS. Treatment will involve a combination of membrane filtration and lime-high density sludge (HDS) process. The lime HDS process will produce a treated effluent that will be compliant with discharge or beneficial use requirements and a sludge waste stream. Between years 1 and 5, stockpile seepage will be handled in the PSE system.
- Storm water runoff will be managed through surface reclamation to preclude potential for contact with stockpiles and tailing. All stockpile top surfaces and outslopes located outside the OPSDA, and the stockpile top surfaces within the OPSDA will be coved with 36 inches of suitable borrow material. Impacted storm water runoff will be collected and treated at the proposed treatment facility through the time period from year 6 to year 100. Between years 1 and 5, impacted storm water runoff will be handled in the PSE system.
- Impacted ground water and pit water will be pumped to the proposed treatment facility through the time period from year 6 to year 100. Between years 1 and 5, impacted ground water and pit water will be handled in the PSE system.

The PSE system and proposed water treatment facility are described in more detail in the following sections and could change when implemented.

Process Solution Elimination System

Integral with the water treatment system is development and operation of the PSE system. The PSE system will collect and evaporate residual process solutions from all the existing PLS collection systems, pit dewatering wells, groundwater interceptor wells, seepage collection systems, and surface impoundments. For the first year, all collected solutions will be distributed through the existing drip irrigation network and into the existing lined surface impoundments and open-top process solution storage tanks, where the solutions will be exposed to surface evaporation. In addition, during this initial year, a series of spray evaporator systems will be installed on top of the 6B and Savanna Pit stockpiles. For years 2 through 6, solution evaporation will be accomplished through a combination of drip irrigation on the stockpile surfaces, spray evaporators on the 6B and Savanna Pit stockpiles, and within the existing lined surface impoundments and tanks. The flow rate will be controlled such that evaporation will occur at the wetted surface of the stockpiles, immediately above the 6B and Savanna Pit stockpiles, and from the lined surface impoundments and process water tanks. The PSE system is designed to handle approximately 1.5 billion gallons of residual process leach solution that is assumed to be present at the end of mining operations plus:

- Stockpile seepage;
- Ground water inflows into the pit sumps;
- Residual PLS that enters the pit sumps;
- Ground water inflows from interceptor wells; and
- Impacted runoff from uncovered stockpiles and pit walls.

Water Treatment Facility

The design basis for the proposed water treatment facility was derived from implementation of a conceptual mathematical dynamic system model (DSM) using the GoldSim simulation software platform for runoff estimates, projected groundwater in-flows into the open pits from the Tyrone groundwater flow model (DBS&A, 2012), projected flows from the existing seepage collection systems and groundwater remediation systems, and the proposed reclamation plan presented in this updated CCP. The estimates that are used as “inputs” for water treatment design include the predicted flow rates and sulfate concentrations of waters collected for treatment.

The DSM segregates runoff into impacted and non-impacted flows. Runoff from covered and vegetated stockpile surfaces is assumed to be non-impacted and will not be sent to the water treatment system. Water quality has a defining role in in determining which water treatment technology can effectively meet established limits. Water quality is also critical in determining operating costs of the technologies, with high concentration waters being more expensive to treat. By separating the transient, process-related waters from the longer-term, better quality waters, specific technologies can be applied to each of the waters. Therefore, one of the objectives of the water treatment system for Tyrone is to separate the process-related impacts, which are transient and represent poorer quality water, from the longer-term, steady-state background conditions, and to treat them separately.

The projected rate and quality of the influent to the water treatment plant over a 100-year simulation period was based on projected groundwater in-flows into the open pits from the Tyrone groundwater flow model (DBS&A, 2012), projected flows from the existing seepage collection systems and groundwater remediation systems, and the CCP reclamation drawings and associated areas presented in **Appendix A** that were subsequently used as input into the DSM for the runoff component into the water treatment plant.

Based on these estimates, the proposed water treatment facility will involve membrane filtration and lime precipitation high density sludge (lime/HDS) processes as follows:

- A membrane system for treatment of the majority of collected water at low to moderate sulfate levels.
- A lime precipitation high density sludge (lime/HDS) process for treatment of high sulfate seeps and reject from the membrane system.
- Discharge of a combined permeate from the membrane system and lime treated water from the lime/HDS system to provide a final discharge stream with sulfate values less than 600 mg/l.

Sludge Management

The sludge disposal facility will be developed within the OPSDA at the 8C Stockpile (**Figure 2-2**). The sludge facility costs developed in the Preliminary Sludge Handling Plan and Cost Estimate (Van Riper, 2004b) were used as the basis for this CCP with scaling to account for the sludge volumes projected based on updated flow and sulfate concentrations developed as part of the Tyrone CCP Update. The capacity of the disposal facility will be adequate for sludge produced for 95 years of operation of the lime/HDS treatment plant. It is designed to have a final footprint of approximately 48 acres and will be functionally divided into four sludge disposal cells of approximately the same footprint area. An evaporation pond will be located on the southern end of the facility to collect sludge cell stormwater runoff, along with any potential seepage from the sludge disposal cells. Grade control will be maintained to ensure that all seepage flows south toward the evaporation pond. All sides of the facility will be constructed with an interbench slope of 3.0H:1.0V.

The sludge disposal cells will be operated in a sequential fashion. The first cell will be filled to a prescribed height before sludge is disposed of in the second cell. Once a cell is filled to capacity, the top surface of the cell will be regraded to a slope of between 1 and 5 percent and covered with 36 inches of suitable material. The sludge disposal facility will be constructed with runoff collection channels at its perimeters to carry storm runoff from the sludge cell surfaces during the operational period to the evaporation pond located at the southern end of the facility. The channels will be cut into the existing terrain and will be sized to safely convey the collected runoff to the evaporation pond. Run-on is not expected to be a post-closure concern since the facility will be constructed above the surrounding terrain. An access road will be extended across the closed cells to transport sludge to the next disposal cell. This fill/close sequence will continue until the conclusion of the water treatment operations. It is expected that the sludge disposal cells will be filled to a nominal height of 65 feet at the conclusion of the water treatment sludge production based on the planned surface area of the disposal facility and the projected sludge volume.

The top surfaces of the closed cells will be covered with 36 inches of Gila Conglomerate (or other suitable cover material) and revegetated. Revegetation of the sludge disposal facility cell top surfaces will be achieved by seeding with a variety of native and adapted grasses, shrubs, and forbs in accordance with Appendix C of the MMD Permit. The planned seed mix is discussed in Section 7.0.

5.0 RECLAMATION PLAN

This section summarizes the planned closure/closeout activities for Tyrone associated with each of the three main mine facility areas. Several facilities have been fully reclaimed and additional facilities are projected to be reclaimed by the EOY 2014. These facilities are described in Section 3.0.

5.1 Mangas Valley Tailing Area

The facilities located within the Mangas Valley Tailing Area are regulated under the DP-27SA (NMED, 2003b), DP-1341 (NMED, 2003a), and Revision 01-1 to MMD Permit GR010RE (MMD, 2004). As previously noted, reclamation work has been completed for the Mangas Valley Tailing Dams and the majority of the tailing launder. Portions of the 1, 1A, 2, 3 and 3X tailing dams have a 2 foot thick cover. Cover maintenance financial assurance for these areas is described in Section 8.3. A closure plan and associated CDAQP for additional tailing impacted areas in the vicinity of the tailing thickeners and along the launder corridor, and demolition and removal of approximately 800 feet of concrete launder and Ameron pipe was submitted for agency approval in June 2008 (Golder, 2008c). Reclamation of the remaining portions of the tailing launder and thickener area is projected to be completed by the EOY 2014. The 1X tailing interceptor system, 1A tailing seepage collection system, No. 1X Tailing Seepage Collection Pond (1X-1), and associated pumps and pipelines will continue to be operated until applicable groundwater standards are met at each system. The general setting of the Mangas Valley Tailing Area is shown on **Plate 2**.

5.2 Mining Area

The primary facilities to be closed and/or maintained in the Mining Area include: 1) leach stockpiles; 2) waste rock stockpiles; 3) the Main, West Main, Valencia, Gettysburg, Copper Mountain, South Rim, Savanna, and San Salvador Hill pits; 4) the SX/EW Plant and associated facilities; 5) the main mine facilities; 6) the lubrication shop area which includes the fuel dock, explosives storage building and prill (ammonium nitrate) tanks; 7) various lined and unlined surface impoundments; 8) various seepage and PLS collection/interceptor systems; 9) various tanks; 10) regional and perched ground water extraction systems, and; 11) booster pump stations.

Reclamation has been completed for the 1C and 7A stockpiles, and a substantial amount of reclamation work is currently being conducted in the area. The Copper Mountain Reclamation Area design project was recently awarded and the facility is also projected to be reclaimed by the EOY 2014. As such, the following CCP applies only to those facility components that will not be fully reclaimed by the EOY 2014. The general setting of the Mining Area is shown on **Plates 3 and 4** and the reclamation areas are presented on the facility characteristic forms in **Appendix B**. The following sections describe the specific facilities that will still have components to be closed at the EOY 2014 and the components that will be retained for further use during the closure/post-closure period.

5.2.1 Stockpiles Located Outside the OPSDA

Stockpile Facilities to Be Closed

Stockpile facilities located outside the OPSDA to be closed are shown on **Plate 3** and include the:

- 2A, 3A, 4B, 4C, and 7B leach stockpiles;
- 1A, 1B, 2B, 2C, 4A, 6B, and 6C leach stockpiles, except for the waived interior slopes;
- 2B, 5A, and 9A waste rock stockpiles; and
- 3B waste rock stockpile, except for the waived interior slopes.

Existing Components That Will Be Used for Post-Closure Purposes

The existing closure components and related engineering controls associated with the stockpiles and stockpile areas located outside the OPSDA that will be used for post-closure purposes include:

- Maintenance of existing stockpile top surface perimeter berms;
- Maintenance of existing berms at the toes of the stockpiles;
- Operation and maintenance of six existing seepage collection systems (seep collection systems 2, 3 replacement, 4 replacement, 5E replacement, 8, and DC2-1 replacement and new collection system within Deadman Canyon) and associated pipelines in the Deadman Canyon area (note replacement systems and new collection system within Deadman Canyon are projected to be installed by the EOY 2014);
- Operation and maintenance of eight existing seepage collection systems (original 7R1A, new 7R1A, original 7R1B, new 7R1B, 7R2A, 7R2B, 7R3A, and 7R4A) and associated pipelines along the 7A waste rock stockpile;
- Operation and maintenance of three existing seepage collection/cutoff systems (collections 1C-1, 1C-2, 1C-3), eight existing shallow toe seepage collection systems (1C-1, 1C-2, 1C-3A, 1C-3B, 1C-3C, 1C-3D, 1C-3E, #4), and associated pumps and pipelines located along the toe of the 1C waste rock stockpile;
- Operation and maintenance of three existing seepage collection/cutoff systems (1AGFT-1, 1AGFT-2, and OGTU-1) and associated pumps and pipelines located around the 1A leach stockpile;
- Operation and maintenance of two existing seepage collection/cutoff systems (1BU-1 and 1BU-2) and associated pumps and pipelines located down gradient of the 1B leach stockpile;
- Operation and maintenance of existing perched seepage zone collection well systems and associated pumps and pipelines located in Oak Grove Wash;
- Operation and maintenance of nine existing seepage collection/cutoff systems (canyon 4, canyon 5, canyon 6, canyon 7, upper canyon 8, lower canyon 8, upper canyon 10, lower canyon 10, canyon 11) and associated pumps and pipelines located down gradient of the 3A leach stockpile;
- Operation and maintenance of existing perched seepage and regional aquifer collection systems and associated pumps and pipelines located down gradient of the 3A stockpile;
- Operation and maintenance of existing PLS collection systems and associated pumps, pipelines and impoundments associated with the leach stockpiles;

- Construction and maintenance of storm water controls in the Copper Mountain stockpile area;
- Placement of waste material from the 1A leach stockpile pullback as a buttress along the exterior toe of the No.1B leach stockpile;
- Abandonment of non-essential wells located within the regrade footprint of the 3A stockpile; and
- Installation of replacement monitor wells located outside the projected footprint of the 3A stockpile.

Planned Closure/Closeout Activities

The design criteria for the stockpiles and stockpile areas located outside the OPSDA are summarized in **Table 4-2** and the planned approaches for closure of these facilities are described below. Reclamation design drawings for the facilities are presented in **Appendix A**. The planned approaches for closure of the stockpiles located outside the OPSDA include:

- Flushing of process water, PLS and raffinate pipelines located outside the regrade footprint of the stockpiles that will not be part of the post-closure water management and water treatment system to remove residual solutions and dispose of them (or cap and cover) in an approved manner;
- Process water, PLS and raffinate pipelines located within the regraded footprint of the stockpiles that will not be part of the post-closure water management and water treatment system will be crushed and covered as part of the stockpile regrading and cover placement of these facilities;
- Removal of all aboveground electrical systems and infrastructure, including outdoor lighting and transmission lines, not used in the industrial PMLU or not necessary for site operations and maintenance, including water treatment;
- Grading of the stockpile top surfaces to a final grade of between 1 and 5% to direct storm water to slope drainage channels;
- Grading of the stockpile outslopes down to interbench slopes of 3.0H:1V;
- Construction of 32 foot wide terrace benches on the outslopes at maximum slope lengths of 200 feet;
- Covering of the top surfaces and outslopes of the stockpiles with 36 inches of Gila Conglomerate (or other suitable material);
- Construction of surface water conveyance channels on the top surfaces (where required) and terrace benches to direct surface water off the covered stockpile surfaces;
- Grading of the disturbed areas associated with the stockpiles to provide positive drainage;
- Seeding of covered and disturbed areas to reestablish vegetation in accordance with Appendix C of the MMD Permit;
- Plugging and abandonment of any unneeded monitor wells;
- Replacement of monitor wells that are abandoned that are required to be monitored as part of operation DPs;

- Breaching of existing seepage collection systems that will be covered by stockpile regarding and replacing these systems outside the regrade footprint of the facility (as needed);
- Providing additional channels, sumps, wells, pumps, and pipelines to direct impacted water to a site-wide water treatment facility; channels to have energy dissipaters as required; and
- Providing facilities to discharge non-impacted stockpile runoff.

5.2.2 Stockpiles Located Inside the OPSDA

As previously described, the OPSDA is defined as the stockpiles and disturbed areas adjacent to the open pits where surface water cannot feasibly flow out to the perimeter of the Mining Area due to existing topographic constraints, and hydrologic containment is maintained as a result of pumping from the open pits. The OPSDA is depicted on Figure 3R of Revision 10-1 to Permit GR010RE (MMD, 2012). Additionally, as part of this CCP, Tyrone has included a new leach stockpile that will be constructed within the Savanna Pit by the EOY 2014 and the 8C waste stockpile that will function as the post-closure sludge disposal facility within the OPSDA.

Stockpile Facilities to Be Closed

Stockpile facilities located inside the OPSDA are shown on **Plate 3** and include the:

- Future Savanna Pit leach stockpile;
- Interior slopes of the 1A, 1B, 2B, 2C, 4A, 6B, and 6C leach stockpiles;
- 8C waste rock stockpile; and
- Interior slopes of the 3B waste rock stockpile.

Existing Components to be used for Post-Closure Purposes

The existing closure components and related engineering controls associated with the stockpiles and stockpile areas located inside the OPSDA that will be used for post-closure purposes include:

- Maintenance of existing stockpile top surface perimeter berms;
- Maintenance of existing berms at the toes of the stockpiles;
- Operation and maintenance of existing PLS collection systems and associated pumps, pipelines, and impoundments associated with the leach stockpiles; and
- Maintenance of existing storm water controls in the area.

Planned Closure/Closeout Activities

The design criteria for the stockpiles located inside the OPSDA are summarized in **Table 4-2** and the planned approaches for closure of these facilities are described below. The planned approaches for closure of the stockpiles and stockpile areas located inside the OPSDA include:

- Flushing of process water, PLS and raffinate pipelines that will not be part of the post-closure water management and water treatment system to remove residual solutions and dispose of them (or cap in place) in an approved manner;
- Process water, PLS and raffinate pipelines located within the regrade footprint of the stockpiles that will not be part of the post-closure water management and water treatment system will be crushed and covered as part of the stockpile regrading and cover placement of these facilities;
- Removal of all aboveground electrical systems and infrastructure, including outdoor lighting and transmission lines, not used in the industrial PMLU or not necessary for site operations and maintenance, including water treatment;
- Grading of the stockpile top surfaces to a final grade of between 1 and 5% to direct storm water to slope drainage channels;
- Covering of the top surfaces of the stockpiles with 36 inches of Gila Conglomerate (or other suitable material);
- Construction of surface water conveyance channels on the top surfaces and outslopes (where required) to direct surface water off the stockpile surfaces and to the nearest open pit sump;
- Seeding of covered top surfaces to reestablish vegetation in accordance with Appendix C of the MMD Permit;
- Stockpile outslopes to remain at approximate angle of repose;
- Plugging and abandonment of any unneeded monitor wells; and
- Providing additional channels, sumps, wells, pumps, and pipelines to direct impacted water to a site-wide water treatment facility; channels to have energy dissipaters as required.

5.2.3 Open Pits (Non Waiver Areas)

The South Rim and San Salvador Hill pits have been partially backfilled with waste rock as part of mine operations. The San Salvador Pit is projected to be partially backfilled at the EOY 2014 and the South Rim Pit is projected to be fully backfilled. During reclamation, these areas will be regraded such that drainage is directed toward the Oak Grove Drainage and any surface ponding is minimized, and then covered and revegetated. The South Rim and San Salvador Hill pits are shown on **Plate 3**, and their reclamation areas are presented on the facility characteristic forms in **Appendix B**. The existing closure components and the planned closure activities for the non-waiver pits are described below.

Existing Components to be used for Post-Closure Purposes

The existing closure components and related engineering controls associated with the non-waiver pits that will be used for post-closure purposes include:

- Construction and maintenance of pit perimeter berms;
- Partial backfilling of the San Salvador Hill pit with waste rock; and
- Complete backfilling of the South Rim pit with waste rock by the EOY 2014.

Planned Closure/Closeout Activities

The design criteria for the non-waiver pits are summarized in **Table 4-2** and the planned approaches for closure of these facilities are described below. Reclamation design drawings for the facilities are presented in **Appendix A**. The planned approaches for closure of the non-waiver pits include:

- Flushing of process water, PLS and raffinate pipelines that will not be part of the post-closure water management and water treatment system to remove residual solutions and dispose of them (or cap and cover) in an approved manner;
- Process water, PLS and raffinate pipelines located within the regrade footprint of the non-waived pits that will not be part of the post-closure water management and water treatment system will be crushed and covered as part of the regrading and cover placement of these facilities;
- Removal of all aboveground electrical systems and infrastructure, including outdoor lighting and transmission lines, not used in the industrial PMLU or not necessary for site operations and maintenance, including water treatment;
- Completion of backfilling of the San Salvador Hill pit with available waste rock to a point that will allow for surface water flows to be directed to the Oak Grove Wash drainage;
- Grading of the backfill over the pit walls to maximum inter-bench slopes of 3.0H:1V;
- Construction of 32 foot wide terrace benches on the pit slopes at maximum slope lengths of 200 feet;
- Grading of the top surfaces of the backfill material to a final grade of between 1 and 5% to direct storm water to drainage channels;
- Covering of the top surfaces of the backfill and the remaining pit slopes with 36 inches of Gila Conglomerate (or other suitable material);
- Construction of surface water conveyance channels on the top surfaces of the covered backfill and terrace benches (where required) to direct surface water off the covered surfaces;
- Construction of spillways and down chutes to divert excess water off the covered top surfaces and into natural drainages;
- Seeding of covered and disturbed areas to reestablish vegetation in accordance with Appendix C of the MMD Permit; and
- Providing facilities to discharge non-impacted runoff into natural drainages

5.2.4 Open Pits (Conditionally Waiver Areas)

The Main, West Main, Valencia, Savanna, Gettysburg, and Copper Mountain pits have been granted a conditional waiver from the requirement of achieving a self-sustaining ecosystem, so closure/closeout activities will focus on safety measures, water management and some limited reclamation of accessible flat areas. These pits are shown on **Plate 3**, and the existing closure components and the planned closure activities for the conditionally waiver pits are described below.

Existing Components to be used for Post-Closure Purposes

The existing closure components and related engineering controls associated with the conditionally waived pits that will be used for post-closure purposes include:

- Maintenance of existing pit perimeter berms;
- Operation and maintenance of existing Main Pit dewatering system and No. 2A decant ponds (five main pit production wells, decant ponds, and associated electrical distribution and piping systems);
- Operation and maintenance of existing Gettysburg Pit dewatering system (pit production wells and associated electrical distribution and piping systems);
- Operation and maintenance of existing Savanna Pit dewatering system (pit production wells and associated electrical distribution and piping systems);
- Operation and maintenance of existing Copper Mountain Pit dewatering system (pit production wells and associated electrical distribution and piping systems);
- Operation and maintenance of HDPE-lined East Main Booster Pond; and
- Operation and maintenance of HDPE-lined North Racket Sump and decant ponds located on the south side of the Copper Mountain Pit.

The existing pit dewatering and stormwater management systems (sumps, pumps, electrical distribution and pipeline systems) will continue to be operated and maintained to reduce surface water impacts, to the maximum extent practicable, and capture and transfer impacted groundwater and surface water to the site-wide water treatment facility.

Planned Closure/Closeout Activities

The design criteria for the waiver pits are summarized in **Table 4-2** and the planned approaches for closure of these facilities are described below. The planned approaches for closure of the conditionally waived pits include:

- Construction of a 6-foot high continuous chain-link security fence around the perimeter of the open pits to control access. Vehicle gates installed at 1-mile intervals and warning signs posted every 500 feet;
- Removal of all aboveground electrical systems and infrastructure, including outdoor lighting and transmission lines, not used in the industrial PMLU or not necessary for site operations and maintenance, including water treatment.
- Reclamation of certain flat stockpile surface areas within the open pit surface drainage area as described in Section 4.2.2.

5.2.5 Surface Impoundments and Tanks

Table 2-1 presents an updated summary of the surface impoundment list and shows the surface impoundments grouped by the operational DP areas. According to this summary, there will be 67 surface impoundments, tanks, and catchments present at Tyrone at the EOY 2014. Two impoundments that are currently present at the mine (7B PLS Pond and Savanna Pit Sediment Collection Pond) will be reclaimed by the EOY 2014. Three of the existing impoundments will be replaced with new impoundments by the EOY 2014, and a new PLS pond (6150 Pond) is projected to be installed as a replacement to the 7B PLS Pond by the EOY 2014. For the purposes of this plan, surface impoundments include: open-top storage tanks for process waters, seepage collection waters, and extracted ground water/pit water; storm water catchments; and lined and unlined surface impoundments. The surface impoundment facilities and tanks that contain impacted water are planned to be the last features to be closed following the establishment of vegetation and site stabilization on the other facilities. Impoundments that serve PMLU functions or are associated with the stockpile toe perimeter and ground water control systems are planned to be permanent parts of the reclamation system and will be maintained throughout the post-closure period. A summary of the surface impoundments and tanks to be utilized throughout the post-closure period are presented in **Table 5-1**. All remaining surface impoundments and tanks listed in **Table 2-1** that are not included in **Table 5-1** will be closed during the post closure period, and the surface impoundments listed in **Table 5-1** will be closed at the end of the post-closure period. The existing closure components and the planned closure activities for the surface impoundments and tanks are described below.

Existing Components to be used for Post-Closure Purposes

The existing closure components and related engineering controls associated with the surface impoundments and tanks that will be used for post-closure purposes include:

- Operation, and maintenance of the HDPE-lined No. 2 PLS Pond, 6150 Pond, North Racket PLS Pond, East Main Booster Pond, SX/EW PLS Feed Pond and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of the HDPE-lined No. 2A Surge Pond and No. 2A East PLS Overflow Pond and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of the HDPE-lined No. 3A PLS Pond and No. 3A PLS Overflow Pond and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of the 1A stainless steel PLS tank and 6-million-gallon HDPE-lined 1A PLS Overflow Pond and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of various stormwater ponds (Crusher Pond, Land Farm and Stage Pond, Plant Oxidation Ponds A and B, and SPCC Pond) and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of the 1B stainless steel PLS tank and 4-million-gallon HDPE-lined 1B PLS Overflow Pond and associated pumps, electrical distribution and pipeline systems;
- Operation, and maintenance of the No. 1 Stockpile Seepage fiberglass tank and HDPE-lined No. 1 Overflow Pond and associated pumps, electrical distribution and pipeline systems;
- Operation and maintenance of various seepage collection system impoundments (DC2-1, 5E Pond 2, No. 1X Tailing Seepage Collection Pond, Oak Grove Pond) and associated pumps, electrical distribution and pipeline systems; and

- Operation and maintenance of the six tailing thickeners and associated pumps, electrical distribution, and pipeline systems.

These surface impoundments and associated tanks will be an integral part of the post-closure sediment, seepage, groundwater, and surface water management system at the mine. The few auxiliary structures not needed to operate these systems (unused power lines and pipelines) will be removed and salvaged or buried upon closure. The remaining surface impoundments will be closed at the end of the post-closure period.

Planned Closure/Closeout Activities

All surface impoundments and tanks that will not be used for post-closure purposes will be closed during the post closure period. These facilities include the Lube Shop Pond, Seep 5E collection, 5E Pond 1, Niagara Stormwater, No. 1A Stormwater Pond, and the No. 2A (Seep 5E Pond Discharge). All of these impoundments will be covered over by stockpile regrading during closure or removed as part of borrow source excavations (Lube Shop Pond). The closure/closeout activities planned for the remaining surface impoundments used for post-closure purposes consist of:

- Flushing of pipelines to remove residual solutions and disposing of them in an approved manner at a nearby construction and debris landfill;
- Capping all non-functional buried process water, PLS and raffinate pipelines;
- Pumping of remaining water in the impoundments and tanks to an approved discharge point, water treatment plant, or allowed to evaporate;
- Ripping HDPE liners (if present);
- Grading area to drain;
- Covering of impoundments with 36-inches of suitable cover material where impacted materials remain beyond the regrade toe or unsuitable growth media exists after grading;
- Removal of all aboveground electrical systems and infrastructure, including outdoor lighting and transmission lines, not used in the industrial PMLU or not necessary for site operations and maintenance, including water treatment; and
- Seeding of covered and disturbed areas to reestablish vegetation in accordance with Appendix C of the MMD Permit (note, seeding will be conducted as part of stockpile closure).

5.2.6 Buildings and Structures

Those facilities not designated for industrial PMLU will be demolished, removed, and/or buried. A total of approximately 69 buildings/tanks/structures covering approximately 8.72 million cubic feet will be demolished and removed under this plan. The list of facilities that are scheduled to be removed is provided in **Table 4-1**. The existing closure components and the planned closure activities for the buildings and structures are described below.

Existing Components to be used for Post-Closure Purposes

The existing closure activities and related engineering controls associated with the mine buildings and structures that are not part of the Industrial PMLU that will be used for post-closure purposes include diversion of storm water runoff from paved areas and along access roads at the Mine Maintenance Facilities area, SX/EW plant, lubrication shop area, and Mill and Concentrator area through ditches and culverts to existing sediment/storm water control ponds

Planned Closure/Closeout Activities

All buildings and structures that will not be used for post-closure purposes will be closed. The closure/closeout activities planned for these buildings and structures consist of:

- Salvaging and demolition of the buildings, tanks and structures listed in **Table 4-1**;
- Removal of all debris and visually affected soil at or near the surface in unpaved areas, disposal of debris or affected soil in an approved manner, and covering impacted areas with 36 inches of suitable cover material;
- Collection of confirmation samples from areas where soils were removed, as necessary;
- Where footings, slabs, walls, pavement, manholes, vaults, storm water controls, and other foundations are abandoned in place over non-acid-generating material, and not demolished, they will be covered with topdressing to a depth of 36 inches minimum;
- Flushing of process water, PLS and raffinate pipelines (if they contained contaminated materials) that will not be part of the post-closure water management and water treatment system to remove residual solutions and dispose of them in an approved manner at a nearby construction and debris landfill;
- Capping all non-functional buried process water, PLS and raffinate pipelines;
- Removal of all aboveground electrical systems and infrastructure, including outdoor lighting and transmission lines, not used in the industrial PMLU or not necessary for site operations and maintenance, including water treatment;
- Maintaining and improving existing culverts and surface water conveyance structures (if required);
- Placement of 24 inches of suitable cover material over disturbed areas on non-acid-generating material (unless suitable cover material already exists in the case of a buried pipe approved to remain in place); and
- Seeding of covered and disturbed areas to reestablish vegetation in accordance with Appendix C of the MMD Permit.

5.3 East Mine Area

The facilities located within the East Mine Area are regulated under operation DP-896. A substantial amount of reclamation work has been completed in the area. As such, the following CCP applies only to those facility components that will not be fully reclaimed by the EOY 2014. The facilities that have been reclaimed in the area include the No. 1 Stockpile, B Sump (former No. 1 PLS Pond), C-Sump Pond, Burro Mountain Tailing Dam, and impacted soils along Brick Kiln Gulch. The primary facilities to be closed in the

East Mine Area include the acid-unloading and former precipitation plant area. The general setting of the East Mine Area is shown on **Plate 3**. The following section describes planned closure activities for the acid-unloading and former precipitation plant area, and the components within the East Mine Area that will be retained for further use during the closure/post-closure period.

Existing Components to be used for Post-Closure Purposes

The existing closure components and related engineering controls associated with the East Mine Area that will be used for post-closure purposes include:

- Maintenance of existing berms and stormwater conveyance channels at the No. 1 Stockpile and Burro Mountain Tailing Dam;
- Operation and maintenance of existing seepage collection/cutoff systems around the perimeter of the No. 1 Stockpile;
- Maintenance of existing above-ground fiberglass storage tank, booster pumps/station, and HDPE-lined overflow pond to handle all seepage waters and convey them to the No. 1B PLS tank;
- Diversion of storm water runoff from parking areas and along access roads through existing ditches and culverts to existing sediment/storm water control structures in the acid-unloading facility area.

Planned Closure/Closeout Activities

The planned approaches for closure of the acid-unloading and former precipitation plant area will support a self-sustaining ecosystem in the post-mining era. All buildings and structures that will not be used for post-closure purposes will be closed. The closure/closeout activities planned for this area consists of:

- Flushing of the above-ground acid or process water pipelines and tanks and former precipitation plant cells with water to remove residual solutions and dispose of them in an approved manner;
- Salvaging and demolition of the acid-unloading and former precipitation plant buildings/structures (**Table 4-1**);
- Removal of all debris and visually affected soil at or near the surface in unpaved areas, disposal of debris or affected soil in an approved manner, and covering with 36 inches of suitable cover material;
- Collection of confirmation samples from areas where soils were removed, as necessary;
- Flushing of above-ground process water, PLS and raffinate pipelines (if they contained contaminated materials) that will not be part of the post-closure water management and water treatment system to remove residual solutions and dispose of them in an approved manner at a nearby construction and debris landfill;
- Capping all non-functional buried process water, PLS and raffinate pipelines;
- Filling and grading the acid-unloading and former precipitation plant area to promote positive drainage;

- Where footings, slabs, walls, pavement, manholes, vaults, storm water controls, and other foundations are abandoned in place over non-acid-generating material, and not demolished, they will be covered with topdressing to a depth of 36 inches minimum;
- Removal of all aboveground electrical systems and infrastructure, including outdoor lighting and transmission lines, not used in the industrial PMLU or not necessary for site operations and maintenance, including water treatment;
- Maintaining and improving existing culverts and surface water conveyance structures (if required);
- Placement of 24 inches of suitable cover material over disturbed areas on non-acid-generating material (unless suitable cover material already exists in the case of a buried pipe approved to remain in place); and
- Seeding covered and disturbed areas to reestablish vegetation in accordance with Appendix C of the MMD Permit.

5.4 Borrow Areas

Gila Conglomerate within the 5A stockpile and residual Gila Conglomerate on the east side of the Main Pit are considered the two primary sources of cover material for this CCP. Additional borrow areas include leach cap overburden from the Little Rock Mine and the Copper Mountain Pit. These borrow areas, with the exception of the east side of the Main Pit, will have low-angle side slopes as a result of the specified excavation plans. The closure/closeout activities planned for these areas consist of:

- Grading of borrow areas to create positive drainage from them;
- Installation of storm water controls with slopes not steeper than 3H:1V;
- Ripping of the borrow area bottoms and slopes to a depth of 24 inches, when necessary;
- Seeding of covered and disturbed areas to reestablish vegetation in accordance with Appendix C of the MMD Permit; and
- If practical, incorporation of the borrow pits into the post-closure water management system.

6.0 CLOSURE & POST- CLOSURE MONITORING, REPORTING, AND CONTINGENCY PLANS

It is assumed that all closure and post-closure monitoring, reporting, and contingency plans required under Tyrone's current DP's will continue to take place post-closure. The costs associated with these DP Conditions were included in the CCP cost estimate using an assumed third party to complete all DP Conditions listed in Sections 6.0 through 6.8.

All the closure and post-closure ground water, surface water, seep, spring, interceptor system, tailing draindown, and piezometer monitoring data will be reported under the applicable Tyrone Operational DPs and in accordance with Condition 58 of the Supplemental Discharge Permit DP-1341 (NMED, 2003a). Additionally, as specified under Condition 59 of DP-1341, Tyrone will submit to NMED quarterly reports summarizing reclamation and post-closure activities on or before January 15, April 15, July 15, and October 15 of each year. Tyrone will also prepare two potentiometric maps annually that include data from all monitoring wells, extraction wells, piezometers, seeps, and springs.

Tyrone has also submitted annual reports to MMD beginning in year two of the test plot study in accordance with Condition L.1.d of the MMD Permit (MMD, 2004). The MMD guidelines require monitoring of revegetation during the bonding period to evaluate revegetation success, and NMWQCC Regulation 3107.A.11 requires the development of post-closure monitoring and contingency plans that are consistent with the terms and conditions of the applicable DP. Additional monitoring and reporting requirements associated with public health and safety, conditionally waived areas, and construction quality assurance plans are specified in Revision 10-1 of the MMD Permit (MMD, 2012). The following sections summarize the general approach that will used to meet these requirements.

6.1 Erosion and Drainage Control Structures

The reclaimed lands, including those in the Industrial PMLU areas will be visually inspected for signs of excessive erosion and significant erosion features will be mitigated to prevent future degradation of the site in accordance with Conditions 53, 54 and 62 of DP-1341 and Section 9.N.1 of Revision 01-1 of the MMD Permit.

Tyrone will accomplish these inspections in accordance with professionally recognized standards such as Natural Resources Conservation Service and NMOSE. Post construction/reclamation inspection schedules will be developed to include provisions for periodic (monthly for the first year following completion of reclamation construction activities, and quarterly thereafter) and extreme event monitoring as appropriate for individual facilities. Tyrone will report evidence of excessive erosion and/or structural failures to the appropriate agencies (MMD, NMED, or NMOSE) in a timely manner. A written report detailing the nature and extent of the problem and a corrective action plan will be developed within 30 days after the problem is identified.

6.2 Ground Water and Surface Water Control Facilities

In accordance with Conditions 61 and 63 of DP-1341 (NMED, 2003a), Tyrone will perform quarterly inspections and annual evaluations of all ground water abatement systems, including the seepage interceptor systems, and perform maintenance as necessary to ensure that all water contaminants are managed in a manner that is protective of ground water quality. Monitoring of site water quality will be accomplished through sampling and analysis of potentially impacted water at site locations. Ground water quality will be monitored throughout the post-closure period. The intent of the ground water monitoring is to evaluate the effectiveness of the ground water containment systems and demonstrate compliance with applicable regulations and standards. The monitoring schedule, analytical requirements, location, and construction specifications for the monitoring wells will be determined in consultation with NMED. The analytical results will be reported to the NMED on a semi-annual basis.

Contingency Plans and Emergency Response Plans were submitted in December 2003 and April 2004 (PDTI, 2003c; 2004) that presents details for addressing potential failures of individual components of the Tyrone Mine closure plan, including an increase in the extent or magnitude of ground water and/or surface water contamination, potential failures associated with interceptor systems and impoundments, and potential failures of various components of closed lands. The emergency response plan outlines operational parameters and contingencies to address operation failures at Tyrone associated with pumping water from the open pits, sumps, and other impoundments that may contain affected water. Accordingly, Tyrone will verify any potential discharges not approved in DP-1341 or an operational discharge permit. If an unapproved discharge is identified, Tyrone will perform appropriate corrective actions to contain and remove or mitigate the condition, provide verbal notification to the NMED within 24 hours after discovery of the condition, provide written notification to the NMED within one week after discovery of the condition, prepare a corrective action report within 15 days after discovery of the condition, and submit an abatement plan in accordance with Section 20.6.2.1203.A.9 NMAC or, if required by NMED, in accordance with Conditions 32 through 35 of DP-1341.

Surface water quality around the perimeter of closed facilities will be monitored according to the Tyrone Mine Storm Water Pollution Prevention Plan (Freeport McMoRan Tyrone, Inc., 2012) and any other applicable closure permit requirements. These data will be reported according to the Tyrone NPDES permit and DP 1341.

Samples will be collected quarterly in all monitoring wells required to be monitored in the Operational DPs, and in all new monitoring wells installed after closure for compliance monitoring purposes. Tyrone reserves the right to modify the sampling frequency based on water quality trends observed during the closure period. Sample collection will be done in-house or under contract by an independent environmental engineering firm. Collected samples will be shipped to an independent analytical laboratory for analysis. A report will be prepared to document the sampling and analysis for review and recording by site management and review by regulatory authorities.

The water treatment plant will be on a continuous schedule of sampling and recording for operational control. Automatic samplers will be employed to collect composite samples of influent and effluent streams. Each month, one composite sample of water treatment plant influent and one composite sample of water treatment plant effluent will be shipped to an independent analytical laboratory for analysis of COCs. A report will be prepared to document the sampling and analysis for review and recording by site management and review by regulatory authorities.

6.3 Revegetation Success Monitoring

The reclaimed areas will be monitored according to Section 9.N.2 of Revision 01-1 of the MMD Permit after the final grading and the initial establishment of vegetation on the reclaimed lands. Tyrone will conduct vegetation monitoring of both volunteer revegetation and re-seeded areas during the third year after seeding. Tyrone will inter-seed or reseed those areas that have volunteer vegetation as well as other areas, if necessary. Revegetation monitoring will be performed at the sixth year after planting and for two consecutive years prior to bond release. The revegetation monitoring will be conducted to meet statistical adequacy for the monitoring conducted during the two consecutive years prior to bond release. Revegetation monitoring will include canopy cover, plant diversity, and woody stem density as specified in Section N.2 of the Revision 01-1 to Permit GR010RE (MMD, 2004).

6.4 Wildlife Monitoring

Pursuant to Section 9.N.3 of Revision 01-1 of the MMD Permit, Tyrone submitted a wildlife monitoring plan for post closure in December 2005 (Golder, 2005e). This plan was approved by the MMD and New Mexico Department of Game and Fish February 15, 2006. The monitoring plan provides a description of the proposed reclamation plan as it applies to wildlife and wildlife habitat, an overview of the existing species and wildlife habitat within the vicinity of the Tyrone Mine, and the proposed methods for deer pellet group counts and bird surveys.

Semi-annual wildlife monitoring has been conducted at the reclaimed facilities at the Tyrone Mine since 2009 in accordance with the approved wildlife monitoring plan. Results of the monitoring will be evaluated to determine wildlife use trends during re-establishment of a self-sustaining ecosystem. The results of the surveys will not be a condition of, or given consideration with regard to financial assurance release.

6.5 Public Health and Safety

Pursuant to Sections 9.E.1.2 and 9.F.2 of Revision 10-1 of the MMD Permit (MMD, 2012), Tyrone will submit written details and maps showing the locations of berms and fences that will be placed at the interface of the conditionally waived stockpile areas and the non-waived stockpile areas; and around the pits to restrict access by unauthorized personnel and provide for public safety within 180 days of cessation of operations. Annual visual inspections of the interface of the conditionally waived stockpile areas and the non-waived stockpile areas, and quarterly visual inspections of the stability of the pit walls will be conducted to identify potential failure areas which may adversely impact the environment and public health or safety. If failure areas are identified, Tyrone will propose measures to mitigate the hazard within 30 days of identification for MMD approval.

6.6 Adjustment of OPSDA

In accordance with Sections 9.E.1.5 and 9.F.4 of Revision 10-1 of the MMD Permit (MMD, 2012), and Section III.B.23 of the Settlement Agreement and Stipulated Final Order (NMED, 2010; 2012), Tyrone will submit updated maps of the OPSDA (NMED) and associated conditionally waived areas (MMD). The maps will be presented annually, and will show any incremental increases or decreases in the extent of the OPSDA/conditional waiver area resulting from mine activities, including increases in existing stockpile elevations and any expansion of existing open pits. The maps will be submitted to the agencies by August 30th of each year, beginning in 2013.

6.7 Construction Quality Assurance Plan

Pursuant to Section 9.G.3a of Revision 10-1 of the MMD Permit, Tyrone will submit a Construction Quality Assurance Plan (CQAP) to MMD for approval no less than 180 days prior to regrading of a facility and placement of any cover material for final closure. The CQAP will be supplemented with a Construction Quality Assurance Report (CQAR) to be submitted to the MMD within 180 days after completion of construction.

6.8 Alternative Abatement Standards

In accordance with DP-1341, Tyrone will submit a petition for alternative abatement standards following the NMED’s approval of the Stage 2 APP. The petition will be prepared in accordance with Section 20.6.2.4103.F(2) NMAC based upon the Stage 2 APP and the analysis conducted therein, and any additional analyses that Tyrone may have conducted in support of the petition. Tyrone’s petition will identify proposed alternative abatement standards for constituents that are predicted to exceed Section 20.6.2.3103 NMAC standards after implementation of approved closure measures and schedules, and any background concentrations approved by NMED. The Tyrone Stage 1 Abatement Plan (DBS&A, 2011) that delineates the magnitude and extent of contamination was approved by the NMED on January 20, 2012 and the Tyrone Site Wide Stage 2 Abatement Plan Proposal (20.6.2.4106.D NMAC) was submitted to NMED on February 29, 2012 (DBS&A, 2012) for review and approval.

7.0 POST-MINING LAND USE DESIGNATION

This section provides the post-mining land use (PMLU) for the permit area as a whole and for specific facilities at Tyrone based upon the requirements of the MMD Permit, NMMA Section 69-36-11.6, and Subparts 507.A and 507.B of the NMMA Rules (MMD, 1996). PMLUs are specified in Section 3.G. of the MMD Permit.

7.1 Post-Mining Land Use Overview

The NMMA Rules define the PMLU as "a beneficial use or multiple uses which will be established on a permit area after completion of a mining project. The PMLU may involve active management of the land. The use shall be selected by the owner of the land and approved by the Director (of MMD). The uses, which may be approved as PMLUs, may include agriculture, commercial or ecological uses that would ensure compliance with Federal, State or local laws, regulations and standards and which are feasible." The proposed PMLUs for each facility are presented in **Figure 7-1** and were selected on the basis of the site characteristics and the following guidelines:

- Make the PMLU compatible with the surrounding ecosystem and land use;
- Use the existing infrastructure and land resources to the extent possible; and
- Maintain economic viability for Tyrone and the surrounding community.

The approved PMLUs for Tyrone are wildlife habitat and industrial in accordance with MMD Permit Conditions D.4, E.4, G.5, and I.1 (MMD, 2004, 2012). Tyrone was granted a conditional waiver from the MMD from achieving a post mine land use or self-sustaining ecosystem for: 1) the Main, Gettysburg, Savanna, and Copper Mountain Pits; 2) interior slopes of the 1A, 1B, 2B, 2C, 4A, 6B, 6C, and Copper Mountain leach stockpiles; and 3) the interior slopes of the 3B waste stockpile (MMD, 2012). The approved waiver areas are identified in **Figure 7-1** and in the MMD Permit (MMD, 2010; 2012). Additionally, as part of this CCP, Tyrone has included a new leach stockpile that will be constructed within the Savanna Pit by the EOY 2014 and the 8C waste stockpile that will function as the post-closure sludge disposal facility. The Savanna Pit Stockpile, projected to cover an area of approximately 172 acres, and the 8C waste stockpile (sludge management facility), projected to cover an area of 48 acres, are identified as conditionally waived facilities in this CCP. Because surface water from the conditionally waived areas will not drain to the exterior of the mine without a substantial amount of regrading, runoff from these areas will be commingled with pit water, collected with the existing pit sump collections systems, and incorporated into the proposed water treatment influent circuit for treatment.

Wildlife habitat is the primary PMLU for the majority of the permit area, with an industrial PMLU designated for the Main Mine Facilities Area, including the SX/EW Plant Area, and several of the remaining buildings located within the Mill and Concentrator Area. The selection of the wildlife habitat PMLU is discussed in Section 7.2. Section 7.3 presents the rationale Tyrone used for designating an industrial PMLU for some of the facilities and provides details regarding the efforts to achieve the PMLU. Section 7.4 details the vegetation success guidelines that will be applied to demonstrate reclamation of the mine.

7.2 Wildlife Habitat Post-Mining Land Use

Of the MMD-approved PMLUs, grazing land and wildlife habitat are the designations most consistent with the surrounding land uses and ecological potential of the Tyrone site, excluding the areas designated as industrial/commercial. Tyrone proposed the wildlife PMLU as a practical target use for the reclaimed lands at the site and the MMD has approved this PMLU for the reclaimed lands.

Reclamation will result in the development of an early-stage grass/shrub community that will provide a locally important increase in community-level diversity. Some infrastructure may have a post-mining wildlife use such as power poles for raptor perches, main roads for land management, and modified mine openings for use by ringtail cats, bats, and other wildlife.

Native vegetation will be established on the reclaimed areas at Tyrone resulting in increased erosion protection, direct habitat improvement, and reduced percolation of water into the underlying materials relative to current conditions. Proposed reclamation seed mixes and seeding rates for Tyrone are presented in **Table 7-1**. These species have broad ecological amplitudes and provide structural diversity.

The proposed seed mix was selected to provide early establishment of ground cover, erosion control, and diversity in growth forms. The species selected for Tyrone have been successfully used in mine reclamation and range improvement projects in many parts of New Mexico, including the Tyrone Mine. The primary reclamation seed mix proposed for the wildlife habitat PMLU areas at Tyrone includes cool and warm season grasses, perennial shrubs, and forbs. Depending on availability, alternate species may be substituted for the primary species. The seed mix was designed for application prior to the summer rains. However, it has proved successful under fall seeding conditions.

Table 7-2 lists some of the major attributes of the vegetation selected for use at the Tyrone Mine. The selected vegetation will provide erosion control, promote soil development, and provide forage, seeds, and cover for small mammals and birds. The seed mix includes a number of valuable, nutritious forage and browse species that could be used by wildlife.

7.3 Industrial Post-Mining Land use

The industrial PMLU designation of buildings and facilities are summarized in **Table 7-3**. This table includes buildings and facilities approved for industrial PMLU in the MMD Permit (listed in Appendix F of the MMD Permit), with the exception of certain buildings that have since been removed as part of the mill and concentrator demolition and reclamation project. NMED requires abatement of contaminated soils that are potential source areas for ground water and surface water contamination in accordance with NMAC Sections 20.6.2.1203, 20.6.2.3109.E.1, and 20.6.2.4103 in and around all facilities and structures approved by MMD to be left for an industrial PMLU or structures necessary for post-closure treatment and disposal of ground water and/or surface water. Those facilities not designated for industrial PMLU will be removed or demolished. Demolition, removal, and/or burial will be accomplished by the following:

1. Where footings, slabs, walls, pavement, manholes, vaults, storm water controls, and other foundations are not included in the industrial PMLU, abandoned in place over non-acid-generating material, and not demolished, they will be covered with topdressing to a depth of 36 inches minimum:
2. Covered footings, slabs, walls, pavement, manholes, vaults, storm water controls and other foundations not included in the industrial PMLU will be revegetated in accordance with Appendix C of the MMD Permit: and
3. A structural removal plan will be submitted to the NMED at least 60 days prior to any structure removal or demolition; the plan will address any potential discharges of leachate and contaminated soils that could cause and exceedance of applicable ground water standards.

The industrial PMLU will continue the existing type of use; however, the specific industry will change. The areas proposed for industrial PMLU have the infrastructure necessary to support a variety of future industrial uses. The buildings are currently being used and are well maintained and most of the areas have significant shop facilities and warehouse storage capacity. All the sites have access to a major state highway (Highway 90), and there is railroad access up to the acid unloading facility. Electrical power is available in each area. Storm water runoff from the areas is contained within the on-site surface impoundment system. Finally, ample water rights are available due to the water rights that Tyrone controls.

Tyrone will maintain erosion controls, structures, equipment, and utilities within the industrial PMLU areas until they are occupied by tenants in accordance with the current industrial PMLU erosion control plan (PDTI, 2004c). The areas identified for the industrial PMLU are currently used for industrial purposes such as warehousing, heavy equipment repairs, electrical distribution and repairs, welding, machining, plumbing, and training. Although the industrial PMLU will continue the existing type of use, the specific industry will change. Possible industrial uses that may be recruited were described in previous justifications for the industrial PMLU for these sites.

7.4 Site-Specific Revegetation Success Guidelines

Section 507.A of the NMMA rules (MMD, 1996) requires that the permit area of an existing mine be reclaimed to a condition that allows the establishment of a self-sustaining ecosystem appropriate for the life zone of the surrounding area unless it conflicts with the approved PMLU. Demonstration of the establishment of a self-sustaining ecosystem is made by comparison of the vegetation on the reclaimed areas to vegetation attributes on a reference area and/or technical standards (MMD, 1996).

The MMD recognizes that replication of the pre-mining plant communities after mining is not practical (MMD, 1996). The intent of the reference area characterization is to provide a site-specific, quantitative basis for determining revegetation success. More importantly, the reference area provides an “ecological barometer” that integrates normal climatic variations to aid in the evaluation of temporal changes or trends in the reclaimed ecosystem. Thus, the reference areas do not represent model plant communities that will be replicated in detail, but rather local indications of the ecological potential of the reclaimed plant communities.

The reclamation success guidelines required by the MMD vary depending on the PMLU. Canopy cover, shrub density, and vegetation diversity are the revegetation success guidelines that are typically used to judge revegetation success on lands designated as wildlife habitat. The vegetation success guidelines include numerical standards to address the canopy cover and shrub density requirements of the NMMA.

The plant diversity guidelines are addressed through a technical standard and are complemented by a qualitative assessment of plant colonization and regeneration to corroborate the establishment of a self-sustaining ecosystem. A detailed description of the vegetation success guidelines is included in DBS&A (1999). The approved guidelines for revegetation success that apply to Tyrone are discussed in sections 7.4.1 through 7.4.3.

7.4.1 Canopy Cover

Because of its broad implications for erosion control and ecologically based PMLUs, canopy cover is one of the primary criteria for determining reclamation success. Tyrone has a proportional success guideline for total canopy cover equal to 70 percent of the measured reference area value. The proportional standard was determined based on the interpretation of the community structure and ecological conditions in the reference area. The proportional standard reflects the view that the typical 12-year bond release period does not allow enough time for full maturation of the reclaimed plant community relative to the native sites. The numerical standard derived from the proportional standard will vary over time to account for temporal differences in canopy cover associated with climatic variations. Thus, the numerical standard may increase or decrease based on reference area measurements, but the proportional standard will remain fixed.

7.4.2 Shrub Density

Shrubs are important components of many reclaimed landscapes. A proportional success guideline of 60 percent (of the reference area) has been accepted by the MMD for shrub density in the reclaimed areas.

As with canopy cover, the shrub density standard was determined based on the interpretation of the ecological conditions of the reference areas.

Plant Diversity

Species diversity is commonly thought to increase the stability of plant communities. The perceived enhancement of ecological stability is related to the buffering effect that species with different ecological amplitudes provide in response to environmental stresses. A technical, rather than proportional, standard will be proposed for plant diversity.

The plant diversity guidelines for Tyrone are based on the assumption that site stability is improved by establishing plants with different ecological amplitudes to buffer seasonal and annual fluctuations in climate. Tyrone understands that creating a monoculture on the reclaimed lands is not desirable, while at the same time, recognizing that the benefits of increased diversity diminish beyond subjective threshold levels that are defined by the reclamation objectives. Thus, the diversity guideline for Tyrone was developed from a functional perspective, whereby site stability and erosion control are primary performance objectives. In addition, these guidelines were developed in recognition of the limitations associated with the sampling and statistical evaluation of plant communities whereby minor components are often not represented in the monitoring data.

The numerical diversity guidelines for Tyrone mines are listed in **Table 7-4**. To summarize, the diversity guideline would be met if the reclaimed area contains at least three warm season grasses and two shrubs, with individual cover levels of at least 1 percent, and one perennial, cool season grass with a minimum cover level of 0.5 percent. For the purposes of this guideline, intermediate-season grasses such as plains lovegrass are considered the functional equivalent of the more traditionally defined cool season grasses. In addition, one non-weedy forb species should occur at a minimum cover level of at least 0.1 percent to meet the proposed diversity guideline. The forb guideline is unqualified with respect to seasonality and could include a perennial, biannual, or annual species.

Species diversity on the reclaimed areas is expected to increase with time; however, this process is likely to be slow. Successful colonization depends on the convergence of a seed source and the proper weather conditions; however, even with such an ideal convergence, inter-specific competition, predation, and dispersion mechanisms may limit the establishment of new plants on the reclaimed area. Because of the strong climatic influence on seed production and plant establishment, the rate of colonization is expected to be erratic and potentially slow for many species, with the highest rates of colonization expected to be concentrated in the reclaimed/undisturbed ecotone. Evidence of colonization will complement the numerical diversity guidelines listed in **Table 7-4**. No numerical guideline is proposed for colonization, which would be demonstrated by increases in the number of species recognized in the reclaimed area. Information on colonization will be collected and reported to provide evidence of the ability of the reclaimed landscape to support native plants from the surrounding communities. Secondarily, observations of colonization provide evidence of regeneration and thus help demonstrate the establishment of a self-sustaining ecosystem required in the NMMA.

The intent of the colonization standard is to provide evidence of the ability of the reclaimed landscape to support plants from the surrounding communities. In addition, observations of colonization provide evidence of regeneration and thus support the demonstration of the establishment of a self-sustaining ecosystem. No numerical standard is proposed for colonization, which will instead be demonstrated by increases in the number of species recognized in the reclaimed area. This information will be obtained from the relative cover data or documented observations along the margins of the reclaimed areas.

8.0 CAPTIAL AND OPERATION AND MAINTENANCE COST ESTIMATES

This section provides a brief description of the capital cost estimate portion of the financial assurance. Cost estimates are budgetary and for the purpose of determining the value of the financial assurance performance bond.

8.1 Capital Cost Estimates

The cost estimate has been prepared in accordance with standard engineering practice and is supported with data from various references and is fully documented in **Appendices C (Earthwork) and D (Water Treatment)**. The capital costs for closure are presented in detail in **Appendices C and D** and are summarized as follows:

Capital Cost Summary			
Item	**Subtotal Direct Costs**	**Subtotal Indirect Costs[1]**	**Total (Current Cost)**
Earthwork			
Tailing Dams	$0	$0	$0
Stockpiles	$93,370,000	$21,008,000	$114,378,000
Open Pits	$8,931,000	$2,009,000	$10,941,000
Other Disturbed Areas	$2,703,000	$608,000	$3,311,000
Abandonment of Monitor Wells, Extraction Wells, and Exploration Holes/Replacement of Necessary Wells	$892,000	$201,000	$1,093,000
Building Demolition and Soil Removal	$3,402,000	$765,000	$4,167,000
Earthwork Subtotal	**$109,297,000**	**$24,592,000**	**$133,889,000**
Water Treatment			
Water Treatment Facility (Including Water Collection and Conveyance)	$8,727,000	$1,964,000	$10,691,000
Process Solution Elimination System	$2,400,000	$540,000	$2,940,000
Sludge Disposal Facility	$1,524,000	$343,000	$1,867,000
Water Treatment Subtotal	**$12,651,000**	**$2,846,000**	**$15,497,000**
TOTAL CAPITAL COST	**$121,948,000**	**$27,438,000**	**$149,386,000**

Note:
[1] – Total indirect costs of 22.5% were applied to the earthwork and water treatment capital direct costs per MMD (1996) and OSM (2000) guidance.

8.2 Basis of Capital Cost Estimates

Capital cost estimate details for earthwork, including quantity takeoffs, calculations, and supporting documentation are provided in **Appendix C**. The capital cost estimate details associated with water management and treatment are provided in **Appendix D**.

8.3 Operation and Maintenance Cost Estimates

The operations and maintenance (O&M) cost estimate details and supporting documentation are provided for earthwork in **Appendix C** and water treatment in **Appendix D.** A summary of these details are provided below.

8.3.1 Earthwork

O&M estimated costs relate to periodic erosion control, road maintenance, and vegetation maintenance have been included in a standalone calculation sheet in **Appendix C**. O&M costs are assumed to diminish with time and are allocated over time periods of years 0 to 19, years 20 to 39, and years 40 to 99 as follows:.

- **Years 1 to 19**: erosion control work will be required 30 days per year; road maintenance will be required monthly during the monsoon season; and vegetation maintenance is based on an assumed 2% failure every year for a total of 12 years, starting the year reclamation is completed.
- **Years 20 to 39**: erosion control work will be required 24 days per year; road maintenance will be required monthly during the monsoon season; and vegetation maintenance is assumed to not be required.
- **Years 40 to 99**: erosion control work will be required 15 days per year; road maintenance will be required monthly during the monsoon season; and vegetation maintenance is assumed to not be required.

Also included are tailing cover maintenance costs for tailing dams with areas of less than three feet of cover (portions of Dams 1, 1A, 2, 3 and 3X). The tailing cover maintenance O&M costs for these tailing dams are based on the following assumptions:

- **Tailing Cover Maintenance:** 90 days per year for Years 0 and 1, and 60 days per year for Years 2 to 6.

Appendix C provides the supporting documentation for the O&M cost estimate. O&M costs for closure are summarized as follows:

Earthwork O&M Cost Summary			
Item	**Subtotal Direct Costs**	**Subtotal Indirect Costs[1]**	**Total (Current Cost)**
Road Maintenance	$4,677,000	$818,000	$5,495,000
Erosion Control	$9,111,000	$1,594,000	$10,705,000
Vegetation Maintenance	$1,330,000	$233,000	$1,562,000
Tailing Cover Maintenance	$1,739,000	$304,000	$2,043,000
Earthwork O&M Subtotal	**$16,856,000**	**$2,950,000**	**$19,806,000**

Note:
[1] – Total indirect costs of 17.5% were applied to the earthwork O&M costs per MMD (1996) and OSM (2000) guidance and comprise the same values and factors as the capital indirect costs with exception of contractor profit and overhead.

8.3.2 Water Treatment

Annual O&M costs for water treatment are estimated annually for the 100 year post-closure period. O&M estimated costs for the major components of the water treatment system over the 100 year period are as follows:

Water Treatment O&M Cost Summary			
Item	**Subtotal Direct Costs**	**Subtotal Indirect Costs[1]**	**Total (Current Cost)**
Process Solution Elimination System	$9,259,000	$250,000	$9,509,000
Water Treatment Facility (Including Water Collection and Conveyance)	$273,598,000	$12,596,000	$286,194,000
Sludge Disposal	$13,692,000	$1,917,000	$15,609,000
Water Treatment O&M Subtotal	**$296,549,000**	**$14,763,000**	**$311,312,000**

Note:
[1] - Total indirect O&M costs were calculated at 14% of the direct O&M cost, excluding electrical power and reagent costs.

O&M costs for operation of the PSE system are included for years 1 through 6 only. The PSE system will be shut down when process solutions are substantially eliminated, which is projected to occur at the end of year 6. The O&M of the water treatment plant includes costs for labor, capital for equipment replacement, routine maintenance parts costs, utilities (power costs), chemical reagents, sludge disposal, water treatment and handling, and sampling and analysis. Further details on the water treatment system and the associated cost estimates are provided in **Appendix D**.

9.0 CLOSURE SCHEDULE

An update to the reclamation schedule is required pursuant to DP-1341 and the MMD Permit. **Table 9-1** presents the anticipated schedule for implementation of closure activities based on best available information and forecasts based on the progress of ongoing reclamation efforts at the mine. The proposed schedule summarizes Tyrone's understanding of the existing near-term mine operation and reclamation commitments and longer-term projections. More specifically, the schedule is based on the following considerations:

- Ongoing reclamation projects and previous schedule commitments;
- Practical phasing of the reclamation projects to account for water management, water treatment and the anticipated labor, equipment and other resources that would be necessary to complete these projects based on current conditions;
- Sequential closure of facilities in a phased cost efficient manner (i.e., closure of select leach and waste rock piles as mining operations cease followed by closure of the leach stockpiles utilized as part of the process solution elimination system); and
- Total annual acreages that would be reclaimed over this period.

The anticipated durations specified in **Table 9-1** are based upon cessation of operation for the various facilities occurring at different times under a forfeiture scenario. If cessation of operation occurs for more than one facility at or near the same time, then reclamation of those facilities will occur within a time period that will be less than the sum of the total anticipated durations listed for those facilities. Ultimately, Tyrone reserves the right to modify the proposed reclamation schedule to respond to unforeseen changes in mine operations and ongoing mine reclamation efforts, and advancements in reclamation practices. The anticipated durations for reclamation presented in **Table 9-1** include earthwork and reseeding, but do not include vegetation success/O&M/monitoring.

For clarity, the financial assurance cost estimate and the proposed reclamation schedule are explicitly linked. Tyrone expects that the planned closure of the facilities represented by the proposed schedule will be conducted in a more cost efficient manner than that reflected in the financial assurance cost estimate, which is predicated on the unlikely condition of forfeiture. As indicated earlier, implementation of the mine-for-closure concepts are expected to result in more efficient reclamation than might be considered in a forfeiture scenario.

10.0 USE OF THIS REPORT

Golder has compiled this CCP Update to present Tyrone Mine's 5-year update of the CCP to the NMED and the MMD of the New Mexico Energy, Minerals and Natural Resources Department. In the compilation of this plan, Golder collaborated with MWH, who designed the closure/closeout configuration of the mine facilities, and Telesto Solutions, Inc., who prepared the earthwork cost estimate. The Tyrone Mine CCP has been updated to fulfill the requirements of the following permits:

- **Supplemental Discharge Plan DP-1341, Phelps Dodge Tyrone, Inc., Tyrone Mine Facility,** (DP-1341), issued by the NMED on April 8, 2003 (NMED, 2003a); and
- **Permit Revisions 01-1 and 10-1 to Permit GR010RE** (MMD Permit), issued by the MMD of the New Mexico Energy, Minerals and Natural Resources Department on April 4, 2004 (MMD, 2004) and August 31, 2012 (MMD, 2012), respectively.

Tyrone has completed numerous other studies required by DP-1341 and Mining Act Permit GR010RE. Information from these various studies has also been considered in preparing this CCP Update.

Please contact the undersigned with any questions or comments on the information contained in this report.

Respectfully submitted,

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