phelps dodge Tyrone Inc. P. O. Drawer 571, Tyrone, New Mexico 88065 • (505) 538-5331

July 7, 2003

Via Certified Mail # 7099 3400 0006 4350 9045

Mary Ann Menetrey
Program Manager
New Mexico Environment Department
Mining Environmental Compliance Section
P. O. Box 26110
Santa Fe, New Mexico 87502

Dear Ms. Menetrey:

Re: **Phelps Dodge Tyrone, Inc., Discharge Permit 1341, Condition 34, Abatement Plan**

Attached please find the Phelps Dodge Tyrone, Inc. (PDTI) proposed abatement plan work plan and schedule as required in Condition 34 of Discharge Permit DP-1341. Condition 34 requires PDTI to submit a proposed abatement plan to the New Mexico Environment Department pursuant to Sections 20.6.2.3109.E.1 or 20.6.2.4000 NMAC through 4115 NMAC.

PDTI looks forward to meeting with you to discuss the abatement plan proposal. Please contact Mr. John Gearhart at 505-537-4382 if you have questions or require additional information.

Very truly yours,

Joseph A. Brunner, Manager
Environment, Land & Water
New Mexico Operations

JAB:jg
Attachment
20030707-100

Phelps Dodge Tyrone, Inc.
Stage 1 Abatement Plan Proposal

July 7, 2003

1.0 Introduction and Purpose

This Stage 1 Abatement Plan Proposal for the Tyrone Mine Facility has been prepared by Phelps Dodge Tyrone, Inc. (Tyrone) in accordance with Condition 34 of Discharge Permit (DP) 1341 and 20.6.2.4106.C NMAC. The purpose of a Stage 1 abatement plan is to design and conduct a site investigation that adequately defines site conditions and provides the necessary data to select and design an effective abatement option. Condition 34 of DP-1341 requires the abatement plan or plans to include "a schedule to investigate all known areas of ground water and surface water contamination at the Tyrone Mine Facility, and define the extent and magnitude of ground water contamination in accordance with Sections 20.6.2.3109.E.1 or 20.6.2.4000 NMAC through 4115 NMAC." As summarized below, numerous studies relevant to existing impacts to groundwater and surface water at the Tyrone Mine Facility have already been conducted. Utilization of these existing studies, as well as integration of additional data collection efforts potentially required as part of this plan with those required as part of DP 1341 additional studies, form key components of this proposed Stage 1 plan.

2.0 Description of the Site (20.6.2.4106.C (1) NMAC)

This section provides an overview of the Tyrone Mine Facility, including a site map, the site history, and the nature of historical and current discharges. The discussion includes a description of the Stage 1 Abatement Plan study areas selected for the Tyrone Mine Facility, an explanation of how they were selected based upon known areas of ground water and surface water contamination and potential sources of the ground water and surface water contamination, and an overview of previous investigations.

2.1 Overview of the Tyrone Mine Facility

The Tyrone Mine Facility is located on the northeastern flanks of the Big Burro Mountains about 10 miles south of Silver City, New Mexico. The climate is generally semiarid with annual evaporation exceeding annual precipitation. The natural ground surface elevation at the Tyrone Mine Facility ranges from about 5,300 to 6,500 feet above mean sea level (ft msl). The vegetation is categorized as a desert scrub grassland in the tailing ponds area, transitioning to a mixed-evergreen woodland at the higher elevations around the mine. Modern open pit copper mining involves the excavation of large volumes of overburden, waste rock, and ore. These operations have been conducted at the Tyrone Mine Facility since May of 1967, and the mine area encompasses approximately 9,000 acres. The existing facilities at the Tyrone Mine Facility are shown in Figure 1, and a brief description of the facilities is provided below.

The north portion of the mine area along Mangas Wash contains the currently inactive Nos. 1, 1A, 1X, 2, 3X, and 3 tailing impoundments and associated facilities. The tailing impoundments cover approximately 2,300 acres and contain approximately 304 million tons of tailings. South of the tailing impoundments are the primary mining operations at the Tyrone Mine Facility. This area encompasses several open pits, leach ore stockpiles, waste rock piles, a solution extraction/electrowinning (SX/EW) plant, pregnant leach solution (PLS) collection impoundments, seepage interception systems, stormwater detention impoundments, a maintenance and lubrication area, process solution pumping stations, mill and concentrator facilities, a former precipitation plant area and acid unloading facility, and the Burro Mountain tailing impoundment.

The open pits at the Tyrone Mine Facility encompass approximately 2,000 acres. The open pit areas are the Main, West Main, Valencia, Gettysburg, Copper Mountain, South Rim, Savanna,

and San Salvador Hill pits. The various leach ore stockpiles and waste rock piles at the Tyrone Mine Facility encompass approximately 2,800 acres and contain approximately 1.7 billion tons of rock deposited near and adjacent to the open pits. The leach ore stockpiles are the Nos. 1, 1A, 1B, 2, 2A, 3A, East Main, Gettysburg Out Pit, and Gettysburg In Pit stockpiles. The waste rock piles include the Nos. 1C, 1D, 3B, a portion of the 2B, the Savanna, and the Upper Main. A former leach ore stockpile leached by a previous operator, the Copper Mountain stockpile, was removed from the Deadman Canyon area and placed on the No. 2A leach ore stockpile in 2000.

The SX/EW plant removes copper and acidifies water to produce raffinate for leaching. The SX/EW plant area encompasses approximately 51 acres.

2.2 Abatement Plan Study Areas

For purposes of this Stage 1 Abatement Plan Proposal the Tyrone Mine Facility is divided into three study areas - Mangas Valley, Mine/Stockpile, and Oak Grove Wash/Brick Kiln Gulch (Figure 1). These areas were selected based on known areas of ground water and surface water contamination and potential sources of ground water and surface water contamination as well as similarities in hydrological features and behavior and/or similarity in mine facilities/potential sources. The study areas are reasonable geographic study areas and do not coincide with discharge permit areas. The mine units and facilities included in each study area are briefly described below:

- The Mangas Valley study area includes the Nos. 1, 1A, 1X, 2, 3X, and 3 tailing impoundments and the area of Mangas Wash adjacent to them.

- The Mine/Stockpile study area includes the open pits, the waste rock piles, and all of the leach ore stockpiles except for the No. 1 stockpile. The Mine/Stockpile study area also includes the concentrator and SX/EW plant.

- The Oak Grove Wash/Brick Kiln Gulch study area includes the No. 1 stockpile, the Burro Mountain tailing impoundment, and the area of Brick Kiln Gulch and Oak Grove Wash adjacent to this facility and downgradient of the 1A and 1B seepage interceptor trenches.

2.3 Previous Investigations and Study Area Discussion

Much of the rock material excavated at the Tyrone Mine contains minerals which, when oxidized, may generate acidic solutions. Most of the leach ore stockpiles, waste rock piles, open pits, and tailing impoundments contain rocks with acid-generating minerals or residues of these types of rocks. Where acidic solutions form, they typically react with in situ minerals, leaching some of the contained metals, which produces acid rock drainage and associated metals and sulfate contaminants. The leach ore stockpiles also contain acidic solutions and residual acidity, including metals, from the leaching process that forms acidic leachate.

This leachate from acid rock drainage and the leaching process may move directly or indirectly into ground water. Discharges from these facilities have been permitted under nine Operational Discharge Permits, including the Mangas Valley tailings (DP-27), No. 2 leach system and SX-EW plant (DP-166), No. 3 leach system (DP-286), No. 1A leach system (DP-363), No. 1B leach system (DP-383), No. 1C stockpile (DP-396), No. 2A leach system (DP-435), Gettysburg leach system (DP-455), and the East Main leach system (DP-670). A pending Operational Discharge Permit, DP-896, for the East Mine Area will incorporate the acid unloading facility area, the No. 1 leach ore stockpile, and the historical Burro Mountain tailing impoundment.

Under the Operational Discharge Permits, as well as part of standard mine operations, Tyrone has installed and operates many measures designed to capture and treat or limit the extent of impacts to surface water and ground water. Tyrone has also conducted and continues to conduct corrective actions in certain portions of the Tyrone Mine Facility under some of the Operational Discharge Permits and/or 20.6.2.1203 NMAC. Table 1 summarizes relevant studies, investigation reports, and monitoring reports for the Tyrone Mine Facility. Discussions of the individual study areas, including the nature of the discharges that have caused or can cause water pollution, and pertinent investigations are provided below.

Mangas Valley Study Area

This study area encompasses the six inactive tailing impoundments located along the Mangas Wash. The tailing impoundments received tailing from the Tyrone concentrator from 1969 through 1992, when the concentrator was shut down. Under DP-27 Tyrone has been permitted to discharge to the No. 1X tailing impoundment up to 1.728 million gallons per day (gpd) of excess mine water from the Main Pit and 28,800 gpd of acidic seepage from the Copper Leach stockpile located at the Little Rock Mine. The status of DP-27 is currently under negotiation between Tyrone and NMED. The DP-27 monitoring plan requires that wells and piezometers in the area of the tailing impoundments be monitored. The volume and quality of discharges to the Nos. 1X and 2 tailing impoundments are required to be monitored and recorded.

Tyrone also has been permitted under DP-27 to discharge up to 8.64 million gpd of oxidation pond effluent to the No. 2 tailing impoundment and 100 cubic yards per month of sewage sludge from the town of Silver City to the No. 3 tailing impoundment. As discussed above, the status of DP-27 is currently under negotiation. The mine formerly discharged up to 50,000 tons per day of copper flotation tailing; however, no tailing have been discharged to the tailing impoundments since 1992. Both during operations and after operations, stormwater accumulated on the tailing surfaces and in stormwater collection ponds at the perimeter of the tailing impoundments. Since tailing deposition stopped, the surface of the tailing material oxidized and became a source of acidity and metals for the ponded stormwater.

Groundwater Quality data are submitted on a routine basis to the NMED under the requirements of DP 27 (PDTI, 1979 to present). The data from these routine monitoring reports as well as other studies listed in Table 1 and in the reference section will be compiled and evaluated in the Stage 1 process.

In the late 1980s, water quality results for two monitor wells in the upper Mangas Valley (Monitor Wells 12 and 13) showed an increasing trend in sulfate and TDS concentrations. Tyrone completed a study to evaluate the possible sources and concluded that the source was seepage from the No. 1X tailing impoundment (WCC, 1991). An interceptor well system was constructed 1,300 feet downgradient of the toe of the 1X tailing dam and placed into operation to control the seepage (DBS&A, 1991c). In more recent years the 1X interceptor system has typically not required operation because groundwater standards have been met at the site without operating the system (PDTI, 1979 through present and DBS&A, 1998a).

DBS&A conducted a seepage investigation of the tailing impoundments at the Tyrone Mine Facility (DBS&A, 1999g). Investigation activities focused primarily on evaluating the stratigraphy, geochemistry, and hydrology of the individual tailing impoundments, developing conceptual models of water flow through the Nos. 1A and 2 tailing impoundments, simulating seepage flow within and below the No. 2 tailing impoundment, and extrapolating the seepage

model results to the other tailing impoundments at the mine. The model simulation results indicate that the vast majority of water seeping from the tailing ponds appears to migrate preferentially within the alluvium along the ancestral surface water drainages. Computed residence times for infiltrating water exceeds 100 years for all cases considered and is generally around 200 years. The results of this modeling were incorporated into the hydrogeochemical model prepared by SARB Consulting, Inc (SARB, 1999b). The SARB study concluded that the tailing impoundments have a long-term neutralizing capacity that exceeds the acid-producing potential, as long as the flow within or through the material is very slow.

There are seven surface water sampling points maintained along the lower portion of Mangas Wash between the No. 2 and No. 3 tailing ponds. As this reach of Mangas Wash is ephemeral, water quality data are limited. Available surface water quality information indicates that surface water is not a significant source of existing or potential groundwater contamination. The surface water data will be compiled and evaluated as part of the work outlined in this proposal

Mine/Stockpile Study Area

This study area consists of the area encompassing the Tyrone open pits, waste rock piles, and all of the leach ore stockpiles except for the No. 1 stockpile and leach system. This study area also includes the concentrator, SX/EW Plant and fuel management facilities for the mine, including the diesel tank farm. Therefore this study area will consider impacts in Upper Oak Grove (upgradient of the final interceptor trenches for the 1A and 1B stockpiles), Deadman Canyon, and the Mangas Valley upgradient of the tailing study area.

Open pit mining at Tyrone began in May 1967. Ore and overburden have historically been removed at rates ranging from 50,000 to 400,000 tons per day using traditional blasting, loading, and haulage techniques. Rock is hauled to stockpiles located along the perimeter of the pit areas. Tyrone is permitted under several of the Operational Discharge Permits to discharge up to 98.3 million gpd of acidic leach solution (raffinate) to the top and side slopes of the leach ore stockpiles. The resultant leachate is collected as pregnant leach solution (PLS) at specific permitted collection points at the stockpile toes as well as at other permitted locations in the mine area. The PLS is pumped to the SX/EW plant for copper removal. The SX/EW plant is permitted to discharge up to 43.2 million gpd of raffinate. Raffinate is stored in two above ground stainless steel tanks, with a capacity of 2.4 million gallons, where its pH may be adjusted with sulfuric acid before being discharged to the leach ore stockpiles. Along with the permitted discharge to the leach ore stockpiles, Tyrone is also permitted to discharge 30,000 gpd of acid mine leachate water from the No. 1C waste rock pile that is collected at the toe of this waste rock pile.

Routine discharge permit reports are available for the mine study area for the following discharge permits: DP-27, DP-166, DP-286, DP-363, DP-383, DP-396, DP-435, DP-455, and DP-670. The data will be compiled and evaluated for the Stage 1 abatement plan. There are also several contingency plans in effect to address impacts as described below.

The ongoing DP investigation reports contain important results of seepage investigations at the No. 3A stockpile and No. 1A, 1B, and 1C stockpile areas (beginning in 1990 and 1996, respectively), and describe the present extent of known groundwater impacts in this study area. The most relevant groundwater impacts identified by these investigations are PLS seepage sources below active stockpile leach systems, which result in perched seepage migration in alluvium-filled drainage channels beyond the stockpile boundaries. In addition, acidic seeps (non-process water) emanating from the Nos. 2 and 2A stockpiles were historical sources of

impacted water to the perched zone in the Deadman Canyon area in addition to seeps from historic mine facilities operated by companies other than Tyrone.

At the No. 3 stockpile, seepage from perched zones has reached the water table in the Mangas Valley. Water quality impacts from PLS seepage to the groundwater outside of perched zones in the No. 1A, 1B, and 1C stockpile area is confined to the region west of the Sprouse-Copeland fault (Figure 1), which occurs immediately east of the toe of these stockpiles. Elevated levels of sulfate and total dissolved solids (TDS) have been observed in one well near the 1A stockpile, and elevated levels of sulfate, TDS, manganese, copper and cadmium have been observed in several wells immediately adjacent to the No. 1C stockpile.

At each of these locations where impacted water has been found, remedial pumping systems and PLS collection structures (interceptor well systems, interceptor/barrier trenches, and high-density polyethylene [HDPE]-lined ponds) have been constructed and are operating to capture and remove the vast majority of perched seepage and prevent and abate potential impacts to groundwater in accordance with discharge permit requirements and 20.6.2.1203 NMAC.

A number of studies have evaluated groundwater flow beneath the stockpiles and in the vicinity of the open pits. The preliminary and supplemental groundwater studies (DBS&A 1997f and 1997j) identified the nature and extent of the open pit capture zone for several time periods and provided some preliminary estimates of groundwater flow volumes. The Tyrone groundwater flow model was developed primarily to evaluate groundwater flow conditions within the Mine/Stockpile unit (DBS&A 1999a, 1999f, 2000b, 2002a). Estimates of surface water runon to the open pits, an analysis and summary of historical pumping, and a water balance for the Main Pit are provided in DBS&A 2002b. Because the majority of the stockpiles and all of the open pits lie within the pit capture zone, much of the impacted groundwater associated with stockpiles and pits in the Mine/Stockpile study area reports to the open pits, which are periodically dewatered for mining purposes and are proposed to continue to be dewatered in the closure plan.

Two incidents of groundwater contamination by diesel fuel have occurred within the Mine/Stockpile study area. The first incident occurred in 1994 in Canyon 1 of the No. 3 leach stockpile (DP-286). The second incident occurred in 1997 near the Tyrone Power Plant (DP-27). Remediation systems have been installed at both locations, and each location has ongoing corrective action under the terms of the respective discharge permits and 20.6.2.1203 NMAC (DBS&A, 1994 and 1999e).

Data on surface water flow and quality is very limited for this study area. Available surface water data will be compiled and evaluated as part of the work outlined in this proposal. Some relevant data may be available in BLM (1997) and Dames & Moore (1996).

Oak Grove Wash/Brick Kiln Gulch Study Area

This study area consists of the area of Oak Grove and Brick Kiln Gulch down-gradient of the final PLS interceptor trenches associated with the Nos. 1A and 1B stockpiles. This study area also includes the area of the No. 1 leach stockpile and associated PLS collection facilities where groundwater impacts have been observed.

The Burro Mountain tailing impoundment is within this study area. As a matter of background, the Burro Mountain tailing impoundment received tailing from the concentrator from 1916 to 1921. The tailing was capped with a dust cap in 2002, and since that time, acidic water has not

accumulated on the top surface of the tailing nor in the stormwater catchment pond at the toe of the dam.

Tyrone began constructing the No. 1 stockpile in 1969 and operated the facility as a leach system from 1972 until January 1998. Tyrone requested Discharge Permit 896 in 1992 to address discharges associated with the No. 1 stockpile leach system. To approve the permit, NMED required several studies, including installation of several groundwater wells near the stockpile, as additional data gathering efforts. These data were collected and submitted to NMED as recorded in the DP 896 files. Investigations in the vicinity of the No. 1 stockpile indicated that PLS from the No. 1 stockpile leach system had impacted perched water. In response, perched zone collection wells were installed below the No. 1 stockpile and in Oak Grove Wash, and these wells continue to operate to capture and remove historical perched seepage and prevent potential impacts to the underlying groundwater.

The Discharge Permit monitoring reports for the Nos. 1, 1A, 1B, and a portion of the 1C stockpile areas (DPs 363 and 383, known as the "East Side reports") and the routine discharge permit monitoring reports for DPs 363, 383 and 396 describe the past and present extent of known groundwater impacts in the Oak Grove Wash/Brick Kiln Gulch study area (DBS&A, 1997-2000, TtEMI 2000-2003). The permit file for pending DP 896 also contains correspondence including well and monitoring information relevant to this study area.

In 1996, it was discovered that PLS had migrated within alluvium-filled channels down Brick Kiln Gulch and Oak Grove Wash to a point about 3.4 miles east of the No. 1A stockpile. Seepage from the Nos. 1 and 1B stockpiles flowed into Brick Kiln Gulch, and seepage from the Nos. 1A and 1C stockpiles flowed into Upper Oak Grove Wash. These two washes join about 1 mile east of the No. 1A stockpile to form Oak Grove Wash. Corrective actions were initiated in January 1999. Actions taken consisted of (1) installation of interceptor/barrier trenches and wells to intercept the sources of seepage near the stockpiles, and (2) installation of wells and trenches in Oak Grove Wash to stop the migration of PLS and remove it from the alluvium. Since 1999, the terminus of the perched zone has receded westward to about 2 miles east of the No. 1A stockpile, and much of the PLS that had flowed down Oak Grove Wash has been removed, even to the extent that portions of the alluvium have been drained or pumped entirely dry. A number of monitor wells are completed in the Gila Conglomerate that underlies the Oak Grove Wash alluvium. Water quality sampling results from these wells indicate that impacts from PLS seepage to underlying groundwater in the Oak Grove Wash/Brick Kiln Gulch study area have not been confirmed.

3.0 Site Investigation Work Plan (20.6.2.4106.C (2) NMAC)

This section provides a brief overview of groundwater and surface water at the Tyrone Mine Facility, a work plan for assessment of contamination and other items as required under 20.6.2.4106.C(2) NMAC, and some study area specific considerations. In accordance with the cited regulations, the abatement plan will evaluate areas of known ground water and surface water contamination. This will be done as outlined below based on existing site data.

Due to the extensive amount of information already available for the Tyrone Mine Facility, the first step in this work plan is an assessment of the existing information and identification of data gaps for purposes of an abatement plan. Following the gap analysis, the next stage is the collection and evaluation of additional data, to be coordinated with studies already required under DP-1341 and other ongoing studies. Following data collection, a site investigation report will be prepared.

3.1 Overview of Tyrone Mine Facility Hydrology

3.1.1 Groundwater Flow The geology and hydrology of the Tyrone Mine Facility has been extensively investigated and documented (Table 1). For the majority of the mine site, mechanisms, directions, and approximate rates of groundwater flow are known. The general direction of groundwater flow within each study area is illustrated in Figure 2. Within the Mangas Valley study area, groundwater flow is focused toward the axis of the valley and ultimately travels northwest down the valley toward the Gila-San Francisco Groundwater Basin. Within the Mine/Stockpile study area, the majority of groundwater flow is toward the Main Pit, where it is pumped and used as process water. In the Oak Grove Wash/Brick Kiln Gulch study area, groundwater flow is generally to the southeast toward the Mimbres Groundwater Basin and, near the mine, is focused beneath Oak Grove Wash.

Groundwater flow generally occurs in Quaternary alluvium and Gila Conglomerate within the Mangas Valley and Oak Grove Wash/Brick Kiln Gulch study areas, and within igneous rocks (Tertiary quartz monzonite and Precambrian granite) in the Mine/Stockpile study area. Average hydraulic parameters for these hydrogeologic units were estimated for previous groundwater modeling studies conducted at the mine from aquifer tests documented in DBS&A (1997f,j), and are provided in Table 2.

Table 2. Average Aquifer Properties of Hydrogeologic Units at the Tyrone Mine Facility.

	Hydraulic Conductivity		Storativity		Specific Yield	
Hydrogeologic Unit	No. of Tests	Mean (ft/d)	No. of Tests	Mean	No. of Tests	Mean
Quaternary alluvium	31	98	17	0.01	1	0.27
Gila Conglomerate	31	7.3	9	0.003	1	0.08
Igneous rocks	8	2.5	4	0.0095	4	0.015

As indicated in Table 2, the Quaternary alluvium has the highest hydraulic conductivity and storage properties, the Gila Conglomerate is intermediate, and the igneous rocks are the lowest.

Groundwater also exists in perched zones in each of the study areas. These perched zones occur along alluvial channels that have been covered by, or are near, stockpiles and that are generally not considered a useful source of water supply. Groundwater flow in the perched zones (where it exists) is parallel to and is contained within the alluvium channels illustrated in Figure 2. The alluvium channels are aligned along the drainages of the pre-mining topographic surface. Capture of the perched groundwater is accomplished at numerous locations at the Tyrone Mine Facility (Figure 3).

In the Mangas Valley study area, downgradient (northwest) of the No. 3A leach stockpile, perched groundwater in the alluvial channels that emanate from the No. 3 stockpile area joins and intermingles with underlying groundwater. In the Oak Grove Wash/Brick Kiln Gulch study area, perched groundwater in the alluvium remains perched several hundred feet above underlying groundwater until it is extracted. Perched groundwater in the Mine/Stockpile study area appears to be limited to the Deadman Canyon area along the southwest side of the study area, which ultimately drains into the No. 1X tailing area.

3.1.2 Groundwater Quality. Outside of the perched zones, most groundwater at the Tyrone Mine Facility generally meets the numerical standards of 20.6.2.3103 NMAC except for some areas within the Mine/Stockpile study area and immediately downgradient of the No. 3 leach stockpile in the Mangas Valley. Most groundwater within the Mine/Stockpile study area is located underneath mine stockpiles or inside the perimeter of the open pits and flows to the Main Pit. Impacted groundwater north of the No. 3 leach stockpile is captured at a series of extraction wells. The areas where groundwater contaminants have been detected at levels above the 20.6.2.3103 NMAC numerical standards are very limited in the tailing area of the Mangas Valley based on a significant data set. Groundwater contaminants have been measured at levels above the 20.6.2.3103 NMAC numerical standards for several constituents at one well downgradient of the No. 1 stockpile in the Oak Grove Wash/Brick Kiln Gulch study area. Groundwater in this area may be influenced by the No. 1 leach system.

3.1.3 Nearby Wells Currently identified wells within 1 mile of the Tyrone Mine Permit Boundary are shown on Figure 4. The vast majority of wells near the mine boundary are owned by Phelps Dodge. As part of the Stage 1 Abatement Plan investigations, wells affected by or potentially affected by groundwater contamination will be identified.

3.1.4 Surface Water Streams and washes in the vicinity of the Tyrone Mine Facility are ephemeral - they flow only after significant precipitation events. Interaction of surface water and groundwater occurs in three ways:

- Infiltration of surface water to groundwater during and after storm events large enough to cause flows in the washes
- Discharge of groundwater to the surface at springs
- Discharge of groundwater to the Main, Gettysburg and Copper Mountain Pits, which have been excavated to depths such that they intersect groundwater

Because streams at the Tyrone Mine Facility are ephemeral, it is not anticipated that biological assessments will be used to assist with definition of the extent and magnitude of impacts to surface water.

3.2 General Work Plan and Technical Approach

Our general approach to assessing the geology, hydrology, and vertical and horizontal extent of groundwater contamination will be similar for each abatement plan study area. The general approach for assessing (1) impacts to groundwater and (2) surface water will be as follows:

Groundwater Impacts

Task A-1 - Compile and evaluate all existing information concerning study area geology, hydrology, and water quality, including

- The nature and extent of geologic and hydrogeologic units
- Aquifer properties such as hydraulic conductivity and storage coefficients
- Water quality information

Task A-2 - Identify data gaps that preclude a reasonable assessment of the horizontal and vertical extent of groundwater contamination.

Task A-3 - Propose and obtain approval from the NMED for additional data collection and analysis activities to fill identified data gaps. Additional data collection efforts will be coordinated with additional studies required by DP 1341 to the extent possible. Additional data collection efforts, if required, would likely include

- Installation and sampling of additional soil borings and/or monitor wells
- Hydraulic testing of monitor wells to determine aquifer hydraulic properties

Task A-4 - Conduct additional data collection activities proposed and approved as part of Task 3 and provide progress and final reports of such activities to the NMED.

Task A-5 - Incorporate the results of the data collection into existing databases and conceptual models of the Tyrone Mine Facility, and define the vertical and horizontal extent of groundwater contamination at the site. Contamination will be defined by measured contaminant levels in excess of standards referenced in 20.6.2.4103.B NMAC. The site investigation report will identify three-dimensional bodies within the Tyrone Mine Facility where standards are exceeded. These three-dimensional bodies will be presented in the report without regard to whether these areas are "places of withdrawal for present or reasonably foreseeable future use" as specified in 20.6.2.4103.B, but Tyrone reserves all rights with regard to this issue.

In addition, all water wells inside and within 1 mile of the perimeter of the three-dimensional body of water where contaminants are measured in excess of the numerical standards of 20.6.2.3103, and all water wells actually or potentially affected by water contaminants from this area will be identified. This evaluation will be conducted using the Office of the State Engineer WATERS database with subsequent field verification, as well as information in Tyrone files and personal knowledge of Tyrone staff.

Task A-6 - Develop and submit a draft final report for NMED review. Submit a final report after NMED has provided written comments on the draft report.

Surface Water Impacts

Task B-1 - Compile and evaluate all existing information concerning study area surface water hydrology and water quality, including

- The nature and extent of surface water within the study area
- Seasonal stream-flow characteristics
- Surface water-groundwater interactions

Task B-2 - Identify data gaps that preclude a reasonable assessment of the horizontal and vertical extent of contaminated surface water.

Task B-3 - Propose and obtain approval from the NMED for additional data collection and analysis activities to fill identified data gaps. Additional data collection efforts will be coordinated with additional studies required by DP 1341 to the extent possible. Additional data collection efforts, if required, would likely include

- Sampling of storm water and ephemeral flows
- Sampling at springs

Task B-4 - Conduct additional data collection activities proposed and approved as part of Task 3 and provide progress and final reports of such activities to the NMED.

Task B-5 - Incorporate the results of the data collection into existing databases and conceptual models of the Tyrone Mine Facility, and define the vertical and horizontal extent of surface water contamination at the site. Contamination will be defined by measured contaminant levels in excess of standards referenced in 20.6.2.4103.C NMAC for surface waters of the state.

Task B-6 - Develop and submit a draft final report for NMED review. Submit a final report after NMED has provided written comments on the draft report.

Application of the general tasks outlined above to each of the three study areas will be customized as required to suit the unique hydrologic, geologic, and site conditions within each area, particularly as part of Tasks A-2, A-3, B-2 and B-3, the additional field work and analysis tasks. Unique features identified for each of the three study areas are summarized below.

Mangas Valley study area

- Existing impacts from the No. 3 stockpile are currently contained by remediation wells.
- Excluding the No. 3 leach stockpile, potential sources of contamination are tailing ponds that historically have caused only limited impacts to groundwater.
- Groundwater exists in Quaternary alluvium and Gila Conglomerate along much of the Mangas Valley, and high hydraulic conductivities are therefore prevalent.

Mine/Stockpile study area

- Groundwater flow is predominantly within fractured igneous rocks.
- Some faults in the area have a significant influence on groundwater flow directions and rates.
- Most of the area is covered by stockpiles, making drilling activities and data collection at depth difficult to impossible at places.
- Most groundwater flows to one of three pits (the largest being the Main Pit) where it is extracted and used for process water.
- Active mining occurs throughout much of the area.

Oak Grove Wash/Brick Kiln Gulch study area

- Groundwater occurs at significant depth beneath some areas of impacted (although contained) perched water in alluvial channels.
- The Sprouse-Copeland fault along the western boundary of this study area acts as a barrier to horizontal groundwater flow and has a significant influence on water levels and groundwater flow.
- The No. 1 stockpile lies primarily east of the Mangas Fault outside of Brick Kiln Gulch on top of relatively low-permeability aquifer materials.

4.0 Monitoring Program (20.6.2.4106.C (3) NMAC)

For the monitoring program of the Stage 1 Abatement Plan, Tyrone proposes to continue monitoring according to existing DP requirements. If additional key sampling points are installed as additional data are collected, the monitoring plan will be updated and submitted to the NMED for approval.

5.0 Quality Assurance Plan (20.6.2.4106.C (4) NMAC)

The same quality assurance plan (QAP) will be applied for all three study areas. Tyrone proposes to use the QAP that has been applied for the Phelps Dodge Chino Mine for several years as part of DP 526 (Chino Mines Company, 1998).

6.0 Site Health and Safety Plan (20.6.2.4106.C (5) NMAC)

A site health and safety plan sufficient to cover all expected activities at the Tyrone Mine Facility related to the abatement plan will be developed and submitted to NMED prior to the commencement of any field investigations conducted under this Stage 1 Abatement Plan.

7.0 Schedule (20.6.2.4106.C (6) NMAC)

The proposed schedule for completion of the Stage 1 Abatement Plan is outlined in Table 3. Additional data collection required under this work plan will be coordinated with additional studies required under DP 1341 to the extent possible. The DP 1341 additional studies expected to be most closely integrated with the Stage 1 plan are listed in the DP as conditions 80 (supplemental materials characterization study), 81 (revised seepage investigation), and 82 (supplemental groundwater studies). Each of these studies involves additional field work and data collection pertinent to the Stage 1 Abatement Plan, and efficient coordination of activities is therefore essential.

Tyrone will submit quarterly progress reports covering each calendar quarter beginning with the first full calendar quarter after NMED approves this work plan. The quarterly report will be submitted by the last day of the month following the end of each calendar quarter.

Table 3. Schedule for Stage 1 Abatement Plan Activities

Task	Description	Completion Date
Groundwater Impacts		
A-1	Compile and evaluate existing information	90 days from approval of work plan by NMED
A-2	Identify data gaps	90 days from approval of work plan by NMED
A-3	Propose additional data collection activities	90 days from approval of work plan by NMED
A-4	Conduct additional data collection	12 months from NMED approval of Task A-3
A-5	Define vertical and horizontal extent of contamination, and identify wells affected by contamination	30 days from completion of Task A-4
A-6	Submit final report draft Submit final report	60 days from completion of Task A-4 60 days from receipt of NMED comments on draft report
Surface Water Impacts		
B-1	Compile and evaluate existing information	90 days from approval of work plan by NMED

Task	Description	Completion Date
B-2	Identify data gaps	90 days from approval of work plan by NMED
B-3	Propose additional data collection activities	90 days from approval of work plan by NMED
B-4	Conduct additional data collection	12 months from NMED approval of Task B-3
B-5	Define vertical and horizontal extent of contamination	30 days from completion of Task B-4
B-6	Submit final report draft Submit final report	60 days from completion of Task B-4 60 days from receipt of NMED comments on draft report

For reference purposes, the proposed schedule for completion of the Tyrone DP 1341 additional studies required under permit conditions 80, 81 and 82 is provided in Table 4.

Table 4. Schedule for Tyrone DP 1341 Additional Studies

NMED Condition No.	Study Description	Work Plan Submittal Date	Study Completion Date
80	Supplemental materials characterization study of the leach ore stockpiles and waste rock piles	3-Oct-03	10-Oct-05
81	Revised seepage investigation report for the leach ore stockpiles and waste rock piles	30-Apr-04	8-Apr-06
82	Supplement existing groundwater studies and evaluate the hydrologic conditions beneath the Tyrone Mine Facility.	25-Oct-03	30-Nov-05

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Table 1. Summary of Relevant Studies and Data Usage
Page 1 of 2

Report	Reference	Status [a]	Data Categories									
			Site Background	Hydrogeology	Hydraulic Parameters	Extent of Stockpiles	Stockpile Compositions	Geochemical Parameters	Groundwater Geochemistry	Predictive Modeling (Hydrology/ Geochemistry)	Existing Impacts	Containment Measures
CCP Supporting Studies												
Revised closure closeout plan	DBS&A, 1999c	√	X	X		X					X	X
Preliminary site-wide groundwater study	DBS&A, 1997f	√	X	X					X		X	
Supplemental groundwater study	DBS&A, 1997j	√		X	X				X	X		X
Preliminary materials characterization	DBS&A, 1997e	√	X			X	X	X				
Supplemental materials characterization	DBS&A, 1997i	√				X	X	X				
Cover design study	DBS&A, 1999b	—			X			X		X		
Stockpile and tailing pond seepage investigation	DBS&A, 1999f	√		X	X			X		X		
Prediction of impact on water quality	DBS&A, 2000b	√			X		X	X	X	X		X
Geochemical evaluation of tailings and stockpiles	SARB, 1999b	√					X	X		X		
Pit lake water quality study	SARB, 1999a, 2000	√						X	X	X		
Pit Lake modeling reports	DBS&A, 1999a, 1999f	√		X	X					X		
Stockpile outslope evaluation	DBS&A, 2001	√				X	X	X		X		
Closure/closeout plan	M3, 2001	√	X	X		X				X	X	X

[a] √ = Complete; — = In progress; --- = Ongoing monitoring effort
[b] DBS&A, 1991a, 1991b, 1992a, 1992b, 1997b, 2000a, 2003
[c] DBS&A, 1996a, 1996b, 1997a, 1997c
[d] DBS&A, 1997g, 1997h, 1997k, 1998b, 1999d, 1999h
[e] TtEMI, 2000, 2001a, 2001b, 2001c, 2002a, 2002b, 2003

CCP = Closure/Closeout plan
DP = Discharge plan.
DBS&A = Daniel B. Stephens & Associates, Inc
HAI = Harlan and Associates, Inc.
SARB = SARB Consulting, Inc.
TtEMI = Tetra Tech EM Inc.

Table 1. Summary of Relevant Studies and Data Usage
Page 2 of 2

Report	Reference	Status [a]	Data Categories									
			Site Background	Hydrogeology	Hydraulic Parameters	Extent of Stockpiles	Stockpile Compositions	Geochemical Parameters	Groundwater Geochemistry	Predictive Modeling (Hydrology/ Geochemistry)	Existing Impacts	Containment Measures
Pit runon	DBS&A, 2002b	√		X						X		
DP Supporting Documents												
Phase I Canyon 6 seepage study	DBS&A, 1990	---	X	X	X						X	
Selected No. 3 stockpile progress reports	DBS&A, 1991-2003 [b]	---	X	X					X		X	X
Selected No. 3 stockpile progress reports	DBS&A, 1991b, 1995	---	X	X	X				X		X	X
No. 1A seepage investigation	DBS&A, 1996a, 1996b	---	X	X	X						X	
Selected Nos. 1, 1A, 1B stockpile reports	DBS&A, 1996-1997 [c]	---	X	X					X		X	
Selected east side progress reports	DBS&A, 1997-2000 [d] TtEMI, 2000-2003[e]	---	X	X					X		X	X
No. 1A stockpile progress report	DBS&A, 1997d	---	X	X	X				X		X	X
No. 2 leach dump monitoring reports - Deadman Canyon	HAI, 1988-2001	---	X	X					X		X	X

[a] √ = Complete; — = In progress; --- = Ongoing monitoring effort
[b] DBS&A, 1991a, 1991b, 1992a, 1992b, 1997b, 2000a, 2003
[c] DBS&A, 1996a, 1996b, 1997a, 1997c
[d] DBS&A, 1997g, 1997h, 1997k, 1998b, 1999d, 1999h
[e] TtEMI, 2000, 2001a, 2001b, 2001c, 2002a, 2002b, 2003

CCP = Closure/Closeout plan
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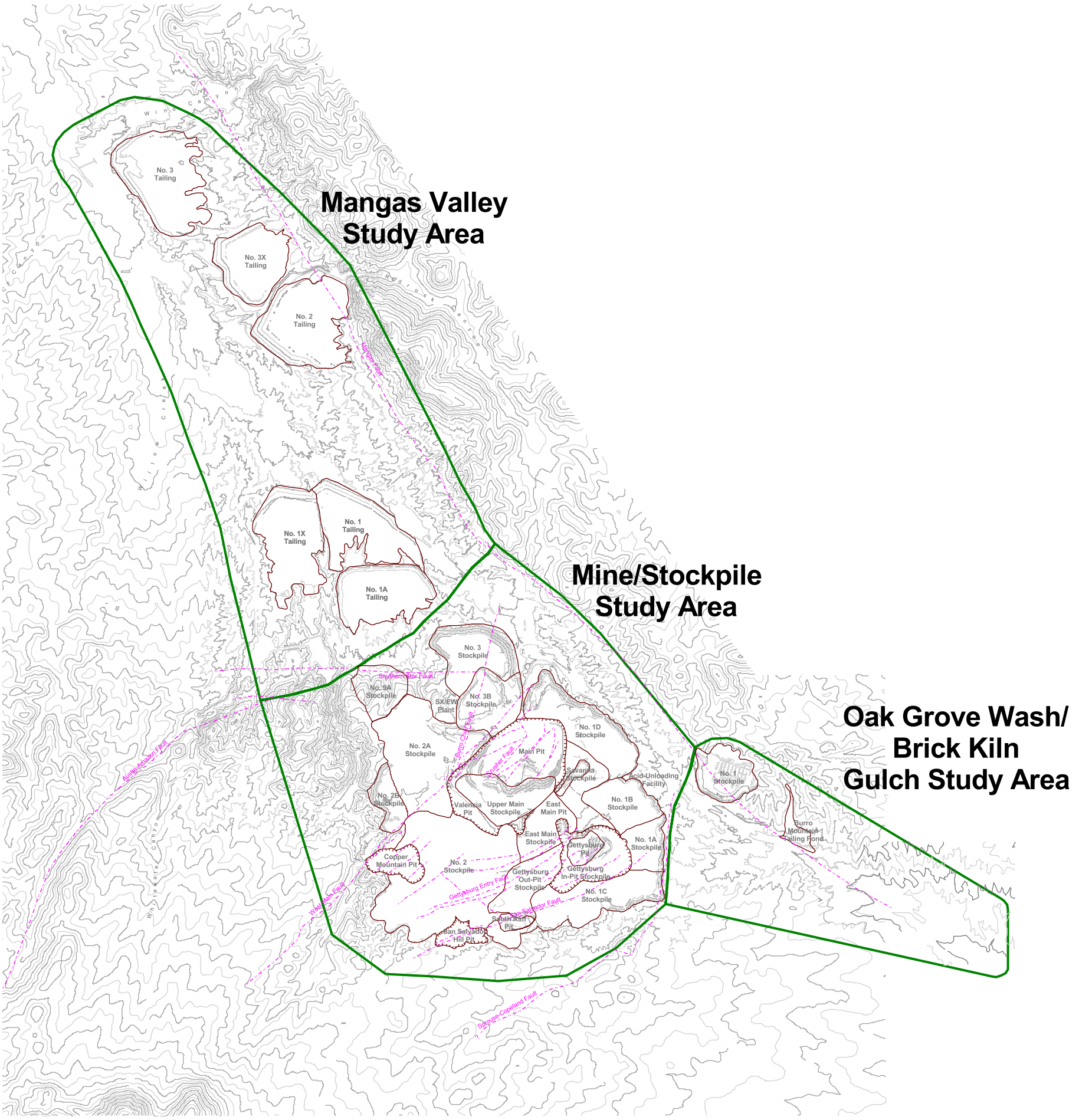

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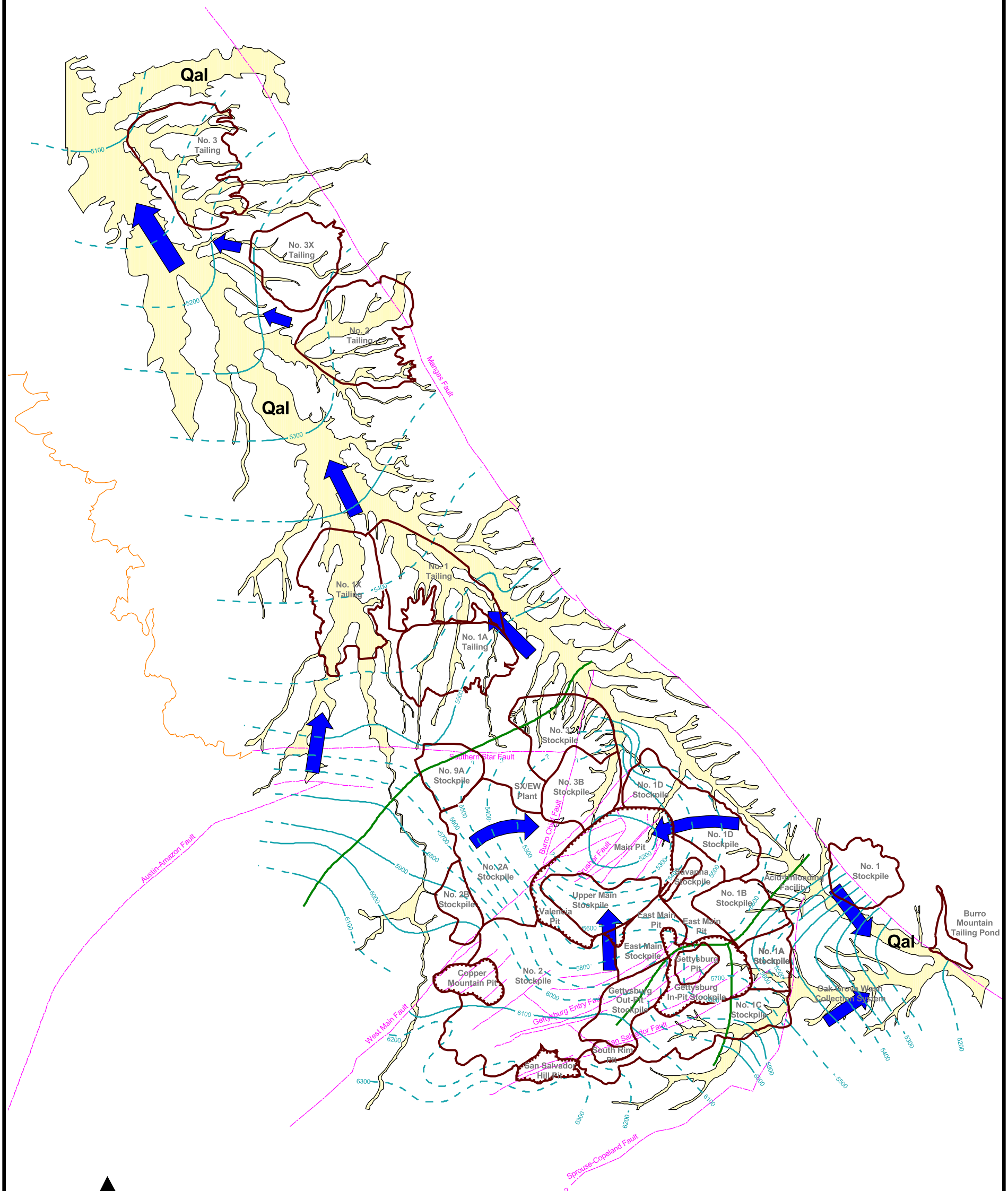
TYRONE MINE SITE

Abatement Plan Study Areas

Figure 1



N

0 2250 4500 Feet

Explanation

- Fault
- Contact between Upper Gila Conglomerate and Igneous Rock
- Facility outlines
- Water level elevation contour (ft msl), dashed where approximate (contour interval 100 ft in Mine/ Stockpile Unit, 50 ft elsewhere)
- Groundwater flow direction
- Approximate groundwater divide
- Qal — Alluvium (Holocene); unconsolidated poorly sorted gravel, sand, and silt

Notes:

1. Water level elevation data are from the third quarter of 2001, except wells LRW-4, LRW-7, 6-2R, GLD-2A, MPWM-1, MPWM-2, MPWM-3, P-8A (May - June 2001), and MPWM-6 (Oct 2001).

2. The water level elevation within the Main Pit was approximately 5,142 feet msl during the third quarter of 2001.

TYRONE MINE SITE

Water Level Elevations and Groundwater Flow Direction

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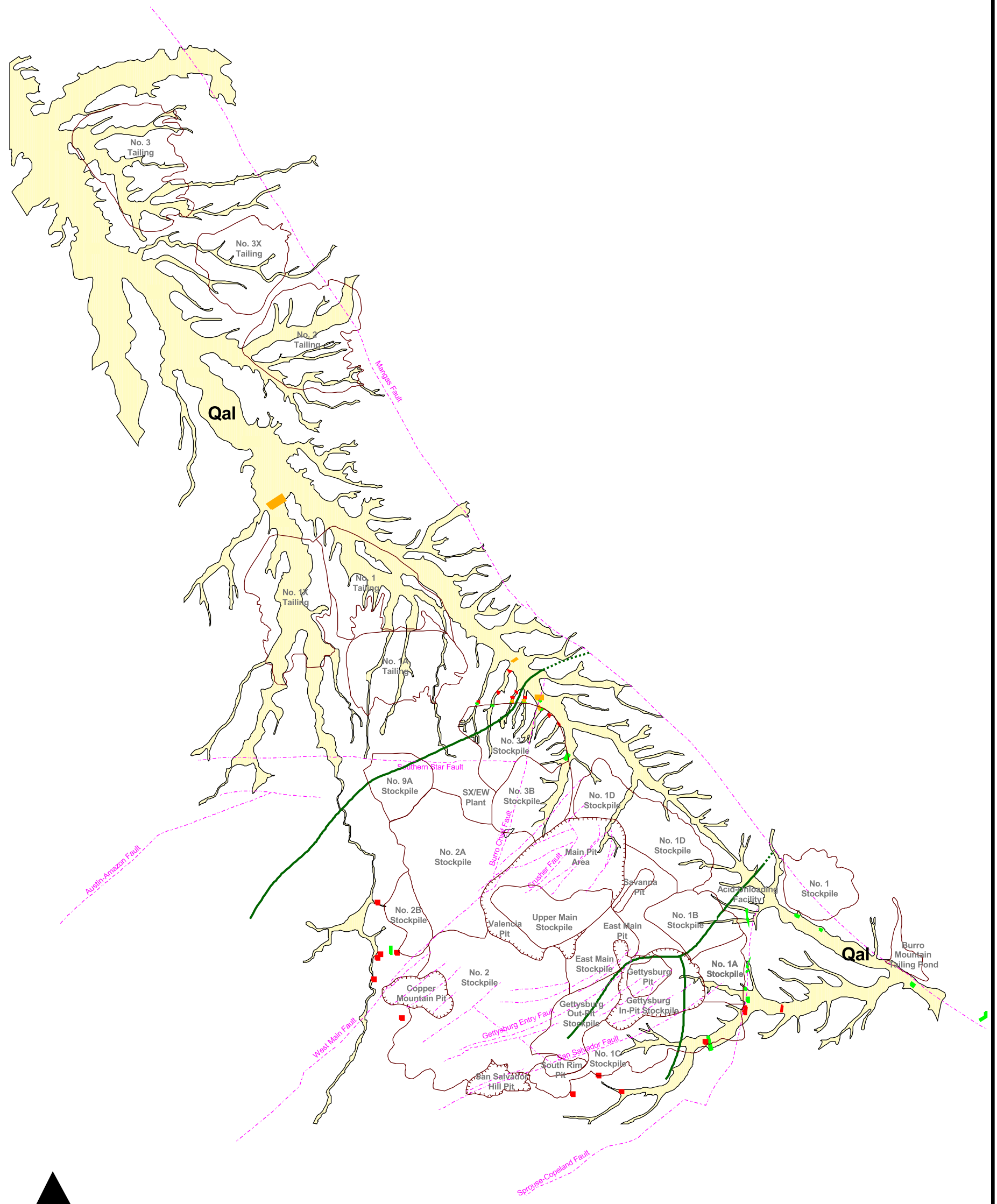
Figure 2



N

0 2250 4500 Feet

Explanation

- Fault
- Facility outlines
- Study area boundary
- Perched seepage zone interceptor trench
- Perched seepage zone collection well system
- Aquifer collection well system
- Qal — Alluvium (Holocene); unconsolidated poorly sorted gravel, sand and silt

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TYRONE MINE SITE

Groundwater Collection Systems

Figure 3

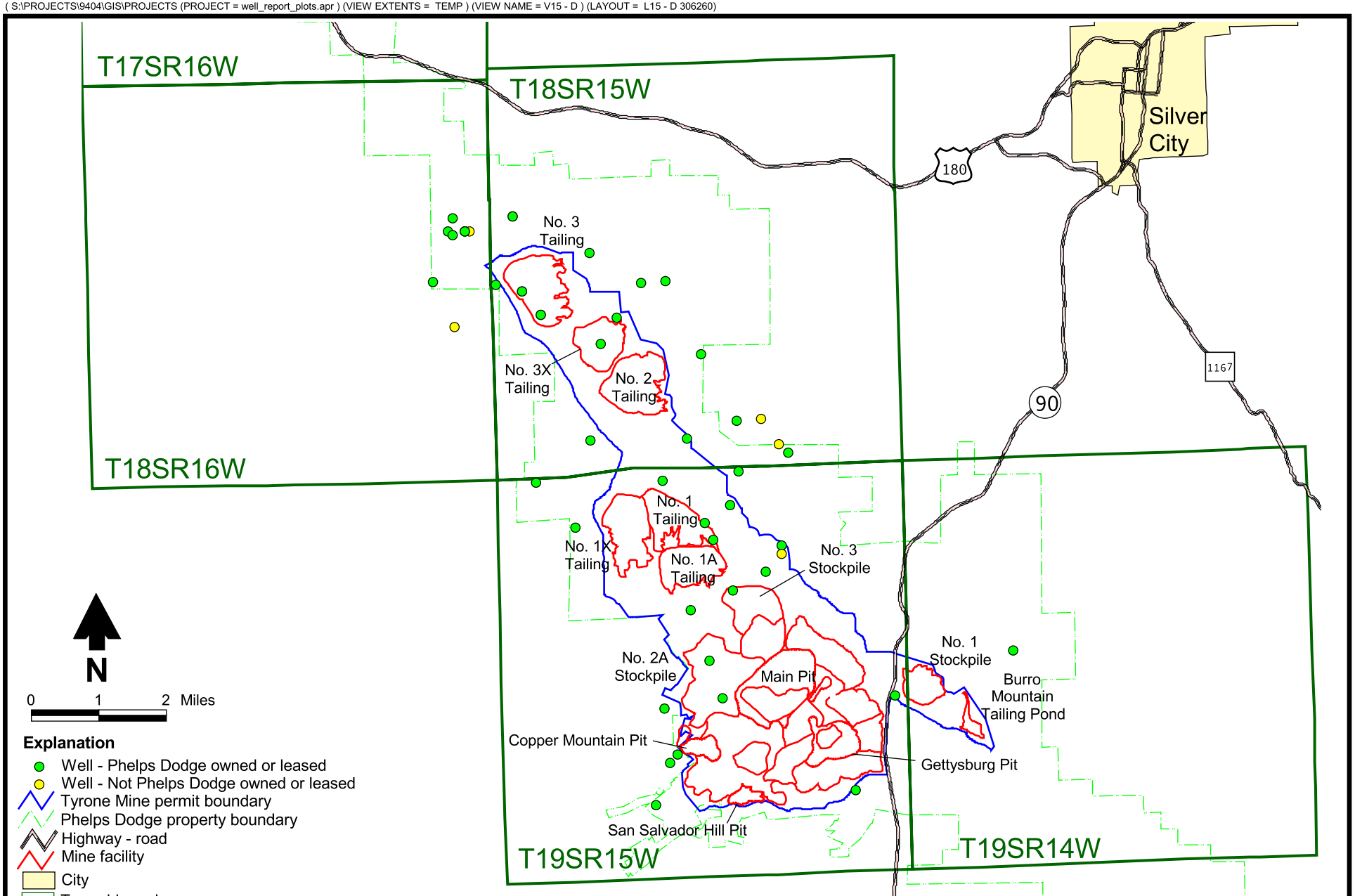

Figure 4

Tyrone Mine

Wells Within 1 Mile of Tyrone Mine Boundary

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