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

December 23, 2005

Via Certified Mail #70041160000099652695
Return Receipt Requested

Mr. Clint Marshall
New Mexico Environment Department
Mining Environmental Compliance Section
P.O. Box 26110
Santa Fe, New Mexico 87502

Dear Mr. Marshall:

Re: Phelps Dodge Tyrone, Inc., Discharge Permit 27 Settlement Agreement Paragraph 18, Analysis for Discharge Elimination of Mine Dewatering Water and Main Pit Interceptor Well Water

Phelps Dodge Tyrone, Inc. (Tyrone) submits the attached Analysis for Discharge Elimination of Mine Dewatering Water and Main Pit Interceptor Well Water in partial fulfillment of Paragraph 18 of the Stipulated Final Order, DP 27. Specifically this document addresses article one (1) of Paragraph 18; effluent elimination analysis of mine dewatering water and Main Pit interceptor well water to the No. 1X Tailing Impoundment.

Should you have questions or comments please contact Mr. Michael Jaworski at (505) 538-7181.

Very truly yours,

Ned Hall

E. L. (Ned) Hall, Manager
Environment, Land & Water
New Mexico Operations

ELH:mj
Attachment
20051223-101

cc: Holland Shepherd, MMD
GRIP
CEGEP

ANALYSIS FOR DISCHARGE ELIMINATION OF MINE DEWATERING WATER AND MAIN PIT INTERCEPTOR WELL WATER

DP-27 Settlement Agreement, Paragraph 18

Prepared by:
Phelps Dodge Tyrone Inc.
Tyrone New Mexico

December 23, 2005

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1.0 INTRODUCTION

Phelps Dodge Tyrone, Inc. (Tyrone) is submitting this document in partial fulfillment of the requirements of Paragraph 18 (Elimination of Discharges to Tailing Impoundments) of the Settlement Agreement and Stipulated final Order dated October 11, 2003 for Discharge Permit 27 (DP-27) for the Tyrone Mine tailing area. Specifically, this document addresses item number one (1) of Paragraph 18 of the Final Order, which relates to the discharge of mine dewatering water from the Main Pit at Mine to the No. 1X Tailing Dam. The objective of this document is to present Tyrone's preferred alternative for eliminating the discharges from the Tyrone Main Pit to the No. 1X Tailing Dam. The study reported herein was conducted in accordance with the *Discharge Elimination Work Plan for Mine Dewatering Water and Main Pit Interceptor Well Water to the 1X Tailing Dam* submitted by Tyrone, (January 14, 2004) and subsequent correspondence with the New Mexico Environment Department (NMED).

The selected alternative would need to be implemented before construction (reclamation) begins on Tailing Dam 1X. According to Tyrone's current permit conditions, reclamation is expected to begin in the second quarter of 2008 for this facility. However, Tyrone is currently pursuing a construction schedule that would allow construction for closure to begin in the second quarter of 2007. For the purposes of this report, Tyrone assumed that each option would require that mine dewatering discharges cease by the fourth quarter of 2006.

The anticipated period of operation for the alternatives listed herein is assumed to be from the fourth quarter of 2006 until such time as the surface level of the Tyrone Main Pit Lake has stabilized at an elevation that is at or lower than the mandated maximum level.

1.1 Background

Stripping for mining activities at the Tyrone Main pit commenced in 1967. The mine produced concentrator and leach ore materials from the pit from 1969 until 1992. Concentrator operations ceased in 1992. Mining for leach ore has continued since, and is projected to last into the future.

There is a mandated maximum surface elevation for the Tyrone Main Pit Lake.

2.0 ALTERNATIVE ANALYSIS

Tyrone evaluated five (5) alternatives for eliminating the discharge of mine dewatering water from the Tyrone Main Pit to the No. 1X Tailing Dam. The alternatives are the same as those identified in the work plan dated January 14, 2004. A description of each alternative is provided on the following list.

1. Main Pit Interceptor Well pumping to supplement fresh water requirements. Blend Interceptor Well water with Mimbres Well water at a ratio where the anticipated corrosion to the water distribution system is minimal.

2. Construction and use of a Mine Water Surge Pond to maximize dewatering use to the raffinate system. The construction of a mine dewatering pond would allow water to be added to the SX/EW raffinate system as makeup water at a rate of less than 1,500 gpm.

3. Enhanced leach field Evaporation System to achieve water balance. Replace drip emitters on the leach stockpiles with sprays, causing increased water loss due to evaporation.

4. Pit Lake Management to balance inflow volume with use. Inflow is reduced as the hydraulic gradient is reduced. Significant reductions in inflow could be achieved by maintaining the surface of the Pit Lake at a higher elevation.

5. Treatment and direct discharge of water.

2.1 Assessment Criteria

Tyrone compared the five alternatives for eliminating the discharge of mine dewatering water from the Tyrone Main Pit to the 1X Tailing Dam with respect to five primary criteria. These criteria were:

1. Impact on closure schedule;
2. Environmental considerations;
3. Permitting requirements;
4. Cost of implementation and
5. Operational compatibility.

2.1.1 Impact to Schedule

The impact on closure schedule was evaluated according to anticipated time periods required to:

- Establish a valid project scope

- Develop an effective project design
- Obtain NMED approval
- Procure materials and
- Construct the project.

2.1.2 Environmental Considerations

Environmental considerations included an analysis of performance of each alternative with respect to New Mexico groundwater regulations and other appropriate environmental regulations.

2.1.3 Permitting Requirements

The analysis included a review of the permitting steps, estimated timeline and cost for each alternative at a conceptual level to assess the level of difficulty and potential impacts to the reclamation schedule.

2.1.4 Cost of Implementation

The cost for implementation was developed through the use of a number of sources, including:

- "*Scoping Study, Treatment and Disposal Options for Water in Main Pit, Phelps Dodge Tyrone Inc.*", M3 Engineering & Technology Corp., December 2000.
- "Discharge Elimination Work Plan for Mine Dewatering Water and Main Pit Interceptor Well Water to the 1-X Tailing Dam", Phelps Dodge Tyrone, Inc., January 14, 2004
- "*Building Construction Cost Data 2004*", RS Means.
- "*Heavy Construction Cost Data 1999*", RS Means.
- Recent Tyrone project cost data.
- Recent Engineers Inc. project cost data.

2.1.5 Operational Compatability

As this project must be operated within the framework of the existing SX/EW and mine operations, the advantage to and/or interference with operations was considered.

2.2 Alternative Discussion and Evaluation

In the following sections, each alternative is discussed in the context of the criteria listed above. Table 3 contains the Summary of Alternatives Analysis and provides a side-by-side comparison.

2.2.1 Alternative 1, Main Pit Interceptor Well Pumping for Fresh Process Water

The SX/EW plant requires fresh process water to meet plant process needs such as cathode wash water, electrolyte replacement and pump gland water. Fresh water is also utilized for mobile equipment wash-down prior to maintenance and for dust suppression during mining operations. Fresh water is currently provided by the Mimbres Wells or Gila River systems. The utilization of pit dewatering water from the Main Pit Production (MPP) wells would replace a portion of the process water from the Mimbres Wells and Gila River systems.

In 2002, six (6) Main Pit Production (MPP) wells were drilled within the main pit, intercepting recharge inflow from Deadman Canyon, the Fortuna Aquifer or a combination thereof. Four (4) of the wells, MPP-1, MPP-4, MPP-5 and MPP-6, were equipped as production wells for pit dewatering. A network of observation wells was also developed to allow monitoring of the drawdown from the MPP wells.

The quality of the water produced by the MPP wells meets or exceeds New Mexico Water Quality Control Commission (NMWQCC) water quality standards for discharge of water for all constituents except cobalt (Co), fluorine (F), iron (Fe) and manganese (Mn).

In order for Tyrone to be able to utilize the MPP water in the process circuit, testing was performed to identify any possible, negative impacts to plant environment.

On July 14, 2002, John Shomaker & Associates, Inc. (JSAI) reported their pilot test findings to determine the most suitable and cost effective treatment alternatives for removing elevated concentrations of iron, manganese and fluoride from ground water recovered from MPP wells in the Main pit (*Main Pit Water Management Project Report on Evaluation of Treatment Alternatives)*. As a result of their testing, JSAI recommended that aeration, the addition of lime, coupled with residence time and filtration be utilized to remove iron and manganese from the water. Reverse osmosis would be utilized to remove excessive fluoride. At the time of their report, the estimated operating cost of such treatment was $1.10 per 1,000 gallons.

In June, 2005, John Shomaker & Associates, Inc. (JSAI) reported their findings on the suitability of water produced by the MPP wells for industrial supply (*Evaluation of the Suitability of Main Pit Interceptor Well Water for Industrial Supply*). JSAI concluded that, without lime treatment or blending, the long term use of water from the MPP wells would result in severe or extreme corrosion to some metals within the system. JSAI also concluded that, by aerating, settling and decanting Main Pit (pit lake) water and blending it with water from the Mimbres Wells at a ratio of approximately 30:70, short term corrosion effects of the use of the blended water should not be significant.

There are currently eight (8) tailings thickeners located at the Tyrone concentrator site. Water produced by the MPP wells could be pumped into the tailings thickeners to allow contained carbon dioxide gas to escape, iron to precipitate and the water temperature to fall to match ambient conditions. The thickeners could be operated as perimeter or center decants, utilizing the method best suited to tie into the existing tailing thickener plumbing. The decant water would be collected and pumped to the terminal tanks. At the terminal tanks, the conditioned MPP water would be mixed with water from the Mimbres wells at an approximate ratio of 30:70 and utilized as plant process water. See Figure MDW1.

The design of any of this system assumes the following basic elements beyond the existing infrastructure:

- repairs, as required, to seal the thickener tanks;
- construction of an effluent distribution manifold into the thickener tanks;
- 350 gpm effluent booster pump to lift the MPP water out of the pit bottom to the tailing thickeners;
- 15,000 foot long, 6 inch pipeline from the MPP pumps to the tailing thickeners;
- 350 gpm decant water pump
- automatic pump operation and tank level controls and
- 3,000 foot long, 6 inch decant water line to terminal tanks.

Process water is distributed to site demands throughout the mine property from the terminal tanks. The volume of MPP water used as makeup replacement water would depend on the total volume of plant process water required.

This sealing of the thickeners will cost approximately $10,000. The manifold will cost approximately $26,000. The effluent booster pump is estimated at approximately $50,000. The effluent pipeline from the MPP wells would cost approximately $202,000. The cost of the new decant water pump is approximately $30,000. Level controls for automatic pump operation would cost approximately $10,000. The decant water pipeline to the terminal tanks would cost approximately $44,000. Total construction cost is approximately $372,000. Engineering for such a system would be approximately 10% of construction costs, or $37,000. Design and construction costs may total $409,000. Adding GRT @ 7% and contingencies of 15% yields an estimated total project cost of $499,000.

A modification to the existing discharge permit would not be required.

Design time for the pumping facility may be 2 months, after the scope and size of project was determined. Procurement and construction may require 4 months. Effluents to the 1X Tailings Dam must be eliminated early enough to allow the dam to dry prior to reclamation, which is planned to begin during the fourth quarter of 2006.

Because of the moderate construction cost, relatively short project timing and beneficial use of the water into the operating systems, this is viable method for eliminating a portion of the effluent flow from the Main Pit Production Pumps into the 1X tailing dam.

2.2.2 Alternative 2, Construction of a Mine Water Surge Pond to Maximize Dewatering Use

Untreated mine dewatering water (MDW) can be added directly to the raffinate system. In 2001, the Main pit dewatering pump system was upgraded to deliver from 1,500 to 6,000 gpm of pit water to the raffinate booster station as SX/EW makeup water. Makeup water requirements, however, vary from as little as 500 gpm to as much as 5,000 gpm. During the winter months of low evaporation and the summer storm season of high precipitation, the requirement of makeup water was often less than the 1,500 gpm dewatering pump system threshold. Since there is no water storage facility at the raffinate booster station that could be used to manage the large flows from the dewatering pump system, water from the Mimbres Wells and Gila River systems were used instead, especially during periods of relatively low makeup water requirement.

By constructing surge containment adjacent to the raffinate system, MDW could be metered into the raffinate system at flow rates below the threshold flow rate of the Main Pit dewatering system during periods of low raffinate makeup requirement. See Figure MDW2.

The design of this system assumes the following basic elements beyond the existing infrastructure:

- a 1 million gallon (12 hrs @ 1,500 gpm) minimal area lined surge pond in the vicinity of the raffinate booster and

- 500 gpm transfer pump with automatic level controls at the surge pond.

Construction of the surge pond would cost approximately $130,000. The cost of the transfer pump from the surge pond to the raffinate booster station, with controls, would cost approximately $50,000. Total construction cost is approximately $180,000. Permitting of the modification to the discharge plan may cost $20,000. Engineering for such a system would be approximately 10% of construction costs, or $18,000. Design and construction costs may total $218,000. Adding GRT @ 7% and contingencies of 15% yields an estimated total project cost of $266,000.

A modification to the existing discharge permit to allow for the construction and operation of a new storage and pumping facility would be required. Design time for the surge water pond facility may be 4 months, after the scope and size of project was determined. Permitting would occur after design is complete. The preparation, submittal and approval of a modification to the discharge permit may require 12 months.

Procurement and construction may require 8 months. Effluents to the 1X Tailings Dam must be eliminated early enough to allow the dam to dry prior to reclamation, which is planned to begin during the fourth quarter of 2006.

Because of the potential reclamation schedule conflicts, this alternative was eliminated from consideration.

2.2.3 Alternative 3, Evaporation System to Dewater the Pit for Mining

The main pit was dewatered in 1992, 1994, 1996 and 2001 to allow mining at the pit bottom. In each of these occasions, the dewatering water was pumped to the 1X tailing dam for evaporation. Instead of depending on passive evaporation of the 1X dam, an active evaporation system could be constructed and operated in an area approved for disposal of excess Mine Dewatering Water (MDW). It is anticipated that an active system could evaporate between 10% and 30% of the leach system circulating flow rate. An example of an evaporation system was presented in the Tyrone Closure/Closeout Plan in which process water inventories are circulated through an approved stockpile for evaporation.

Prior to 1997, the SX/EW leach stockpiles were irrigated with sprinklers that caused an average evaporation loss of approximately 10% of the circulating raffinate flow. In 1997, the sprinkler systems in the leach fields were replaced with drip emitters. Irrigation utilizing drip emitters resulted in evaporation losses of approximately 7.5%, reducing the raffinate makeup water requirement. By replacing the drip emitters with sprinklers, evaporation losses should increase to at least previous levels. This increased evaporation loss will increase the makeup requirement for raffinate in all weather conditions and provide a tool to assist in restoring the balance between Main Pit water inflow and consumption.

Mine dewatering water (MDW) can be added to the raffinate system without treatment. No detrimental effects would be anticipated from the utilization of MDW as raffinate makeup. As the demand for raffinate makeup water increases, it will become easier to provide makeup water to the raffinate system directly through the mine dewatering system.

The drip emitter systems have a single-use application, and are buried by over dumping. As the leach system on a new lift is piped, it will be laid out and plumbed for sprayers. The additional costs to change the center to center distances of distribution headers and leach trunk lines, and to install sprinklers, are estimated to be approximately $300,000.

As raffinate flow volumes increase due to enhanced evaporation, pump horsepower and power consumption will increase. Pumping heads should not increase from the change to sprinklers. Increased power costs due to the change to sprinklers have not been quantified.

- No change in the raffinate pumping system is required to utilize sprinklers;
- Some modifications to the leach stockpile irrigation system will be required to adjust the spacing of header and smaller distribution pipes;
- No modification to the existing discharge permit is required.

Though loss of water to the atmosphere through evaporation does no provide a direct beneficial use, this method of increasing water consumption should be used to help manage the water balance at the property.

2.2.4 Alternative 4, Pit Lake Management to Balance Inflow with Use

Based on the current mine plans at Tyrone, it will not be necessary to dewater the Main pit for mining, prior to reclamation work on the 1X tailing dam. As the mine discharge permit contains a mandated maximum pond surface elevation, management of the water volume of the pit lake must continue.

The rate of groundwater inflow could be affected by allowing the water level in the main pit to rise, reducing the hydraulic gradient and subsequent inflow. A balance between inflow and make up water consumption while maintaining the hydraulic sink at the Main Pit could possibly be achieved.

The depth of the surrounding water table is dependant on seasonal, annual and long-term precipitation trends, transpiration from the ground surface, groundwater pumping of the aquifer around the perimeter of the pit and changes in near-surface infiltration features.

The depth of the pit lake is dependant on seasonal and annual precipitation amounts and the dewatering effort. Inflow rates are based on mine history. Lake volumes can be calculated if the surface elevation is known, and factoring in a dewatering rate.

No modification of the existing discharge permit is required to manage pit lake inflow, unless there is a requirement to exceed the maximum pit lake surface elevation.

There would be a reduction of pit inflow as a result of managing the pit lake at high levels. Even if inflow could be reduced by 10% by pit lake management, however, that reduction would be only a small portion of volume required to achieve a water balance. Active pit lake dewatering would still be required to maintain the pit lake elevation below mandated levels.

Operationally, high or fluctuating pit lake levels may also weaken the rock mass at the toe of the pit wall and increase the possibility of a slope failure.

Because of these reasons, we do not believe that pit lake level management is a viable tool in achieving a water balance.

2.2.5 Alternative 5, Water Treatment

Options to treat the water not required for make up and process water flows will be evaluated. Due to the significant differences in quality between the water in the Pit Lake and the water from the Main Pit Production wells, treatment methods may differ and they will be evaluated separately.

2.2.5.1 Alternative 5A, Water Treatment of Main Pit Production (MPP) Well Water

Treatment is the general heading for processing the effluent in such a way as to lower the concentrations of contaminants within the water to the levels that allow discharge or use in other applications. Two methods of water treatment were evaluated: dilution and contaminant removal.

As a result of sampling of the MPP wells performed from November 20-23, 2002, it was determined that composite results of the water from the MPP wells exceeded the maximum allowable concentrations for four (4) contaminants when compared to groundwater and surface water quality standards as published in the *New Mexico Water Quality Control Commission Regulations* Title 20.6.2.3103.A, B and C.

The assumed dewater/treatment rate for the MPP wells for this exercise is approximately 350 gallons per minute, as stated in the *Evaluation of the Suitability of Main Pit Interceptor Well Water for Industrial Supply, Tyrone, New Mexico, June 2005*.

Dilution

Dilution would be accomplished by mixing the impacted MPP water with Tyrone's fresh water sources to allow the effluent to comply with surface and groundwater standards prior to its direct discharge.

For the purpose of this analysis, a suitable location for a dilution plant was assumed to be in the area below and north of the primary concentrator (see Figure MDW3).

The requirement for treatment by dilution of the composite product of the MPP wells by blending with process water from the Mimbres Wells system may range from 0.3:1 for cobalt to 160:1 for iron, as evidenced by the water quality monitoring data from water samples collected on November 20-23, 2002, as included in Appendix A of the *Evaluation of the Suitability of Main Pit Interceptor Well Water for Industrial Supply, Tyrone, New Mexico, June 2005*. The dilution requirement was established by comparing concentrations of contaminants in a calculated composite sample from the MPP wells (November 20-23, 2002) and a sample from the Mimbres well system (March 18, 2005) to the maximum allowable concentrations as published in the *New Mexico Water Quality Control Commission Regulations Title 20.6.2.3103.A, B and C.* Table 1 attached.

Testing performed as part of the Main Pit Water Management Project report on Evaluation of Treatment Alternatives, John Shomaker & Associates, Inc., July 14, 2002 showed that from 30% to 50% of the dissolved iron and from 20% to 30% of the dissolved manganese in the MPP well water could be removed from the water through aeration and settling. If 40% of the iron and 25% of the manganese in the MPP water could be eliminated through aeration, the dilution requirement for iron would fall to 92:1. See Table 2, attached.

The dilution requirement for the contaminant of greatest concentration was 92:1 after pretreatment. Because of the large impractical flow requirement of makeup or fresh water required to perform this level of dilution, this alternative is considered unrealistic and will be dropped from further consideration.

Removal of Contaminants

Contaminants can be removed from the effluent through filtering, chemical reaction and electrostatic precipitation. The "*Scoping Study: Treatment and Disposal Options for Water in Main Pit*" for Tyrone by M3 Engineering & Technology Corporation (December 2000) was used as a source for a portion of the data.

- Chemical Reaction: Metals can be precipitated from the effluent by increasing the pH through the use of lime or other alkaline chemicals. The resultant sludge may be difficult to dewater, greatly increasing disposal cost. It would also likely require an additional polishing or dilution step to remove sulfates to meet standards. The construction cost of a large (2,000 gpm) chemical precipitation plant, utilizing the existing tailings thickeners, would be approximately $4 million. The estimated operating cost for a large (2,000 gpm) precipitation plant was approximately $7.27per thousand gallons.

- Filtering/Membrane Technology: Reverse osmosis (RO) systems can effectively remove a great number of constituents from the process flow. The effluent must first be clarified, neutralized, softened, filtered and softened again prior to being fed into a two-stage nanofilter before discharge to the RO system for removal of constituents like fluorine and cobalt. The construction cost of a large (2,000 gpm) membrane filter plant would be approximately $5 million. The estimated operating cost for a large (2,000 gpm) membrane filter plant was approximately $4.42perthousand gallons.

- Bioremediation: Small scale bioremediation cells have been used to process effluent from mine water outfalls, especially from gob piles at coal cleaning plants. The major contaminants in the effluents are typically iron and sulfate. Bioremediation may not be appropriate for all of the metals found in the MPP effluent. The wet and dry weather cycles may also be detrimental to bioremediation. The construction cost of a large (2,000 gpm) bioremediation plant may be over $3 million. The estimated operating cost for a large (2,000 gpm) bioremediation plant was approximately $1 per thousand gallons. Bioremediation as a stand alone process required to meet New Mexico water quality standards is unlikely and therefore may require the necessity of being combined with other technologies.

- Electrocoagulation: Testing has shown that dissolved metals and organics can be removed from effluent through the application of an electrical charge. The process equipment in an electrocoagulation plant may be acceptable for extended idle periods. The construction cost of a large (2,000 gpm) electrocoagulation plant may be approximately $2 million. The estimated operating cost for a large (2,000 gpm) electrocoagulation plant is estimated at $1.35/ thousand gallons.

It was assumed that the plant feed rate would be approximately 350 gpm, the approximate production rate of the MPP wells. The plant production rate was also assumed to average 350 gpm.

The location nearest to the MPP wells at which a treatment plant could be constructed is at the concentrator site. See Figure MDW3. A short pipeline would deliver the plant product to its discharge location into the Mangas

Wash, below the #3 PLS pond. If the product of the plant was to be discharged into the Mimbres drainage instead of Mangas Wash, a discharge pipeline with pump would be required.

Because of the possible variability in the solutions to be processed, any plant constructed will have to contain the process technology to treat any and all of the targeted contaminants, at the concentrations that detected in past sampling. Any treatment plant would need to be constructed within a containment to prevent the escape of effluent. The size of this containment must therefore reflect the total volume of effluent in the plant at any time.

Sampling and process controls within the plant would be redundant to provide the quality control necessary to prevent an illegal discharge of effluent. A reservoir to contain treated water for quality assurance testing prior to discharge into the ground may also be required.

The design of the collection and conveyance system assumes the following basic elements beyond existing infrastructure.

- 15,000 foot long, 6 inch pipeline from MPP wells to lined feed pond;
- 350 gpm booster pump from the MPP wells to the feed pond;
- 500,000 gallon (350 gpm @24 hours) , minimal area, lined feed pond;
- 350 gpm contaminant removal plant;
- 500,000 gallon (350 gpm @24 hours) minimal area, lined product storage pond;
- 3,000 foot long, 6 inch product discharge pipeline to Mangas Wash, and
- security fence.

As derived from “Heavy Construction Cost Data 1999”, the capital cost per gallon of waste water treatment plant capacity for a 350 gpm plant is approximately $4.00 per gallon of plant capacity ($ 2005), or $2,017,000. The cost of the effluent pipeline from the MPP wells to the plant feed pond cost is $202,000. The cost of a booster pump is $50,000. The cost of the product discharge pipeline is $31,000. The cost of each of 500,000 gallon lined feed pond and treated storage pond is $68,000 each. A plant security fence may cost $90,000. The total construction cost of a treatment plant for these effluents would be approximately $2,526,000. Engineering for such a plant would be approximately 10% of construction costs, or $253,000. The preparation, submittal and approval of a new discharge permit may cost approximately $60,000. Design, permitting and construction costs may total

$2,839,000. Adding GRT @ 7% and contingencies of 20% yields an estimated total project capital cost of $3,606,000. Assuming operating costs of $5 per thousand gallons, yields annual operating costs of approximately $50,000.

Design time for a treatment facility may be 6 months, after the scope and size of project was determined. The preparation, submittal and approval of a new discharge permit may require 12 months.

A discharge permit for the new plant must be approved. Permitting would occur after design is complete. The preparation, submittal and approval of a new discharge permit may require 12 months.

Procurement and construction may require 12 months. Effluents to the 1X Tailings Dam must be eliminated early enough to allow the dam to dry prior to reclamation, which is planned to begin during the fourth quarter 2006.

Because of the schedule conflicts, costs and complexity this alternative was eliminated from consideration.

2.2.5.2 Alternative 5B, Water Treatment of Mine Dewatering Water (MDW) from the Pit Lake

Treatment is the general heading for processing the effluent in such a way as to lower the concentrations of contaminants to insure the treated water is suitable for discharge or use in other applications. For this alternative, Tyrone assumed that the water would be treated to levels acceptable for direct discharge to a surface water course or to groundwater. Two methods of water treatment were evaluated: dilution and contaminant removal.

As a result of sampling of the Main Pit Lake performed on November 6, 2003, it was determined that composite results from the pit lake exceeded the maximum allowable concentrations for ten (10) contaminants, when compared to groundwater and surface water quality standards as published in the *New Mexico Water Quality Control Commission Regulations* Title 20.6.2.3103.A, B and C.

The assumed dewater/treatment rate for the Main Pit Lake was projected at 2,000 gallons per minute, as referenced in the *"Scoping Study, Treatment and Disposal Options for Water in Main Pit, Phelps Dodge Tyrone, Inc., December, 2000."*

Dilution

Dilution would be accomplished by mixing the impacted Main Pit lake water with Tyrone's fresh water sources to allow the effluent to comply with surface and groundwater standards, prior to its discharge.

For the purposes of this analysis, a suitable location for the plant was assumed to be near the area of the concentrator within the Tyrone property.

The requirement for treatment by dilution of the pit lake water by blending with process water from the Mimbres Wells system may range from 0.2:1 for total dissolved solids to 105:1 for manganese, as evidenced by the water quality monitoring data from water samples collected on November 6, 2003, and included in Table 1 of the *Discharge Elimination Work Plan for Mine Dewatering Water and Main Pit Interceptor Well Water to the 1X Tailing Dam, January 14, 2004*. The dilution requirement was established by comparing concentrations of contaminants from a pit lake sample (November 6, 2003) and a sample from the Mimbres well system (March 18, 2005) to the allowable water quality standards reported in the *New Mexico Water Quality Control Commission Regulations Title 20.6.2.3103.A, B and C.* Table 1 attached.

Testing performed as part of the Main Pit Water Management Project report on Evaluation of Treatment Alternatives, John Shomaker & Associates, Inc., July 14, 2002 showed that from 30% to 50% of the dissolved iron and from 20% to 30% of the dissolved manganese in the MPP well water could be removed through aeration and the subsequent precipitation of iron and manganese minerals. If 40% of the iron and 25% of the manganese in the pit lake water could be eliminated through aeration, the dilution requirement for pit lake discharge would be reduced to 79:1. See Table 2, attached.

The dilution requirement for the contaminant of greatest concentration is 79:1 after pretreatment. An average of the dilution requirements for the ten (10) contaminants for which the pit lake water needs to be treated is approximately 14.6. Because of the impractical flow requirements of makeup or fresh water required to perform this level of dilution, this process was considered unrealistic and will be dropped from further consideration.

Removal of Contaminants

Contaminants can be removed from the effluent through filtering, chemical reaction and electrostatic precipitation. The "*Scoping Study: Treatment and Disposal Options for Water in Main Pit*" for Tyrone by M3 Engineering & Technology Corporation (December 2000) was used as a source for a portion of the data.

- Chemical Reaction: Metals can be precipitated from the effluent by increasing the pH through the use of lime or other alkaline chemicals. The resultant sludge may be difficult to dewater, greatly increasing disposal cost. It would also likely require an additional polishing or dilution step to remove sulfates to meet standards. The construction cost of a large (2,000 gpm) chemical precipitation plant, utilizing the existing tailings thickeners, would be approximately $4 million. The estimated operating cost for a large (2,000 gpm) precipitation plant was approximately $7.27 per thousand gallons.

- Filtering/Membrane Technology: Reverse osmosis (RO) systems can effectively remove a great number of constituents from the process flow. The effluent must first be clarified, neutralized, softened, filtered and softened again prior to being fed into a two-stage nanofilter before discharge to the RO system for removal of constituents like fluorine and cobalt. The construction cost of a large (2,000 gpm) membrane filter plant would be approximately $5 million. The estimated operating cost for a large (2,000 gpm) membrane filter plant was approximately $4.42perthousand gallons.

- Bioremediation: Small scale bioremediation cells have been used to process effluent from mine water outfalls, especially from gob piles at coal cleaning plants. The major contaminants in the effluents are typically iron and sulfate. Bioremediation may not be appropriate for all of the metals found in the MPP effluent. The wet and dry weather cycles may also be detrimental to bioremediation. The construction cost of a large (2,000 gpm) bioremediation plant may be over $3 million. The estimated operating cost for a large (2,000 gpm) bioremediation plant was approximately $1 per thousand gallons. Bioremediation as a stand alone process required to meet New Mexico water quality standards is unlikely and therefore may require the necessity of being combined with other technologies.

- Electrocoagulation: Testing has shown that dissolved metals and organics can be removed from effluent through the application of an electrical charge. The process equipment in an electrocoagulation plant may be acceptable for extended idle periods. The construction cost of a large (2,000 gpm) electrocoagulation plant may be approximately $2 million. The estimated operating cost for a large (2,000 gpm) electrocoagulation plant is estimated at $1.35 per thousand gallons.

It was assumed that the plant feed rate would be approximately 2,000 gpm. The plant output rate was also assumed to average 2,000 gpm.

The location nearest to the pit lake at which a treatment plant could be constructed is at the concentrator site. See Figure MDW3. A pipeline would deliver the treated water to its discharge location into the Mangas

Wash, below the #3 PLS pond. If treated water was to be discharged into the Mimbres drainage instead of Mangas Wash, a discharge pipeline with pump would be required.

Because of the possible variability in the solutions to be processed, any plant constructed will have to contain the process technology to treat any and all of the targeted contaminants, at the concentrations that detected in past sampling. Any treatment plant would need to be constructed within a containment to prevent the escape of effluent. The size of this containment must therefore reflect the total volume of effluent in the plant at any time.

Sampling and process controls within the plant would be redundant to provide the quality control necessary to prevent an illegal discharge of effluent. A reservoir to contain treated water for quality assurance testing prior to discharge into the ground may also be required.

The design of the collection and conveyance system assumes the following basic elements beyond existing infrastructure.

- 15,000 foot long, 14 inch pipeline from the pit lake to lined plant feed pond. There is adequate pumping capacity in place to lift the water to the plant feed pond;
- 1,500,000 gallon (12 hr @ 2,000 gpm) , minimal area, lined feed pond;
- 2,000 gpm contaminant removal plant;
- 3,000,000 gallon (24 hr @ 2,000 gpm), minimal area, lined product storage pond;
- 3,000 foot long, 14 inch discharge pipeline to Mangas Wash, and
- security fence.

As derived from "Heavy Construction Cost Data 1999", the capital cost per gallon of waste water treatment plant capacity for a 2,000 gpm plant is approximately $4.55 per gallon of plant capacity ($ 2005), or $13,662,000. The cost of the effluent pipeline from the pit lake to the feed pond cost is $573,000. The cost of the treated water discharge pipeline is $114,000. The cost of the 1,500,000 gallon feed pond is $174,000. The cost of the 3,000,000 gallon plant product pond is $379,000. A plant security fence is estimated at $100,000. The total construction cost of a treatment plant for these effluents is approximately $15,002,000. Engineering for such a plant would be approximately 10% of construction costs, or $1,500,000. The preparation, submittal and approval of a new discharge permit may cost approximately $60,000. Design, permitting and construction costs may total

$16,562,000. Adding GRT @ 7% and contingencies of 20% yields an estimated total project capital cost of $21,034,000. Assuming operating costs of $5 per thousand gallons, yields annual operating costs of approximately $50,000. These costs are excessive for a project of this duration.

There is an adequate power supply near the possible plant location to operate such a plant.

A discharge permit for the new plant must be approved. Permitting would occur after design is complete.

Design time for a treatment facility may be 6 months, after the scope and size of project was determined.

The preparation, submittal and approval of a new discharge permit may require 12 months. Procurement and construction may require 12 months. Effluents to the 1X Tailings Dam must be eliminated early enough to allow the dam to dry prior to reclamation, which is planned to begin at the fourth quarter of 2006.

Because of the schedule conflicts, costs and complexity this alternative was eliminated from consideration.

3.0 CONCLUSION

Tyrone has evaluated five alternatives for the elimination of the mine dewatering water from the Main Pit lake and the Mine Production Pump wells to the 1X Tailing Impoundment. This analysis was based on five criteria, which considered 1) impact on closure schedule, 2) permitting requirements, 3) operational compatibility, 4) environmental considerations, and 5) costs. Permitting issues, operational compatibility and the ability to meet the required reclamation schedules are the primary determining factors. Unreasonable costs as compared to alternatives of similar results were also a factor in some cases.

As discussed in the analysis above, Tyrone rejected alternatives 4 and 5 due to adverse impacts on the closure schedule, operational incompatibility and cost.

Alternative 1 involves blending MPP water with Mimbres well field water to produce a discharge that is acceptable for use as process or makeup water. This is beneficial use of the MPP water that will offset a portion of the presently used well field water for process or makeup water at a moderate project cost.

Alternative 2 involves constructing a surge pond nearby the raffinate booster that will allow mine dewatering water to be added into the raffinate system at flow rates below the minimal threshold for the mine dewatering system. This is beneficial use of the mine dewatering water will offset a portion of the raffinate makeup water obtained from the well fields, at a moderate project cost.

Alternative 3 involves changing the irrigation system on the leach stockpiles from drip emitters to sprays nozels to increase the evaporative water loss. Evaporation from the leach stockpiles is the largest water loss mechanism at the Tyrone operations. Increasing the leach system evaporation will significantly increase usage of mine dewatering water. However, this is not a beneficial use. The cost required to make a change in irrigation system from drip emitters to sprays is moderate. There will be an increase in pumping costs because of the increased water consumption. Water balance can be obtained by managing application rates.

A combination of alternatives 1, 2 and 3 should be implemented. They are alternatives that complement the reclamation water management plan and schedule; they allow use of existing mine facilities and are the most compatible alternative with operations.

The Summary of Alternatives is shown on Table 3.

References

Scoping Study: Treatment and Disposal Options for Water in Main Pit. M3 Engineering & Technology Corporation, December 2000.

Evaluation of the Suitability of Main Pit Interceptor Well Water for Industrial Supply, Tyrone, New Mexico, John Shomaker & Associates, Inc., June, 2005

New Mexico Water Quality Control Commission Regulations Title 20.6.2.3103.A, B and C.

Discharge Elimination Work Plan for Mine Dewatering Water and Main Pit Interceptor Well Water to the 1X Tailing Dam, Phelps Dodge Tyrone Inc., January 14, 2004

Building Construction Cost Data 2004", RS Means.

Heavy Construction Cost Data 1999", RS Means.

Main Pit Water Management Project report on Evaluation of Treatment Alternatives, John Shomaker & Associates, Inc., July 14, 2002

Mine Dewatering Water

Table 1

Water Quality Data & Dilution Requirement - No Pretreatment

Source	Sample Date	Al, Diss (mg/l)	As, Diss (mg/l)	Cd, Diss (mg/l)	Cl, Tot (mg/l)	Co, Diss (mg/l)	Cr, Diss (mg/l)	Cu, Diss (mg/l)	F. Tot (mg/l)	Fe, Diss (mg/l)
		Contaminant								
New Mexico Water Quality Standard		5	0.1	0.01	250	0.05	0.05	1	1.5	1
Mimbres Wellfield	3/18/2005	0.034	0	0	7.9	0	0	0.059	0.71	0.88
Main Pit Lake										
MP-8	11/6/2003	10.8	0.019	0.0718	6.33	0.132	<.006	8.53	10.7	2.28
Dilution Requirement - Mimbres Water/Pit Lake Water		1.2		6.2		1.6		8.0	11.6	10.7
Main Pit Interceptor Wells										
MPP-1	11/20/2002	1.82	0.01	0.002	4	0.0986	0.006	0.004	8.6	29.4
MPP-4	11/22/2002	0.024	0.01	0.002	5.3	0.0144	0.006	0.003	4.1	4.69
MPP-5	11/23/2002	0.02	0.01	0.002	5.1	0.0263	0.006	0.0056	3.7	9.99
MPP-6	11/21/2002	3.33	0.01	0.0021	4.7	0.083	0.006	0.0033	13	27.3
Weighted Average (Shomaker 6/2005)		1.55	0.01	0.002	4.7	0.0631	0.006	0.004	8	20.16
Dilution Requirement - Mimbres Water/MPP Water						0.3			8.2	159.7

Source	Sample Date		Mn, Diss (mg/l)	Ni, Diss (mg/l)	Pb, Diss (mg/l)	Zn, Diss (mg/l)	pH, field	ph, Lab	SO4, Tot (mg/l)	TDS (mg/l)
			Contaminant							
New Mexico Water Quality Standard			0.2	0.2	0.05	10	6 to 9	6 to 9	600	1000
Mimbres Wellfield	3/18/2005		0.012	0	0.026	0.065		8.04	29	220
Main Pit Lake										
MP-8	11/6/2003		20	0.038	<.005	17.1	5.72	4.6	771	1170
Dilution Requirement - Mimbres Water/Pit Lake Water			105.3			0.7			0.3	0.2
Main Pit Interceptor Wells										
MPP-1	11/20/2002		5.93	0.016	0.0065	4		5.92	560	910
MPP-4	11/22/2002		2.07	0.01	0.005	0.744		6.55	300	600
MPP-5	11/23/2002		3.67	0.01	0.005	1.22		6.49	390	700
MPP-6	11/21/2002		6.96	0.017	0.038	5.48		6.01	610	980
Weighted Average (Shomaker 6/2005)			5.08	0.014	0.0154	3.26		6.18	493	831
Dilution Requirement - Mimbres Water/MPP Water			26.0							

Mine Dewatering Water - Aerate & Precipitate		Table 2								
		Water Quality Data & Dilution Requirement - After Pretreatment								
		Contaminant								
Source	Sample Date	Al, Diss	As, Diss	Cd, Diss	Cl, Tot	Co, Diss	Cr, Diss	Cu, Diss	F. Tot	Fe, Diss
		(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
New Mexico Water Quality Standard		5	0.1	0.01	250	0.05	0.05	1	1.5	1
Mimbres Wellfield	3/18/2005	0.034	0	0	7.9	0	0	0.059	0.71	0.88
Main Pit Lake										
MP-8	11/6/2003	10.8	0.019	0.0718	6.33	0.132	<.006	8.53	10.7	2.28
Net Mn and Fe conc. after aeration & precipitation										
Dilution Requirement - Mimbres Water/Pit Lake Water		1.2		6.2		1.6		8	11.6	10.7
Main Pit Interceptor Wells										
MPP-1	11/20/2002	1.82	0.01	0.002	4	0.0986	0.006	0.004	8.6	29.4
MPP-4	11/22/2002	0.024	0.01	0.002	5.3	0.0144	0.006	0.003	4.1	4.69
MPP-5	11/23/2002	0.02	0.01	0.002	5.1	0.0263	0.006	0.0056	3.7	9.99
MPP-6	11/21/2002	3.33	0.01	0.0021	4.7	0.083	0.006	0.0033	13	27.3
Weighted Average (Shomaker 6/2005)		1.55	0.01	0.002	4.7	0.0631	0.006	0.004	8	20.16
Net Mn and Fe conc. after aeration & precipitation										12.1
Dilution Requirement - Mimbres Water/MPP Water						0.3			8.2	92.5
			Contaminant							
			Mn, Diss	Ni, Diss	Pb, Diss	Zn, Diss	pH, field	ph, Lab	SO4, Tot	TDS
			(mg/l)	(mg/l)	(mg/l)	(mg/l)			(mg/l)	(mg/l)
New Mexico Water Quality Standard			0.2	0.2	0.05	10	6 to 9	6 to 9	600	1000
Mimbres Wellfield	3/18/2005		0.012	0	0.026	0.065		8.04	29	220
Main Pit Lake										
MP-8	11/6/2003		20	0.038	<.005	17.1	5.72	4.6	771	1170
Net Mn and Fe conc. after aeration & precipitation										
Dilution Requirement - Mimbres Water/Pit Lake Water			78.7			0.7			0.3	0.2
Main Pit Interceptor Wells										
MPP-1	11/20/2002		5.93	0.016	0.0065	4		5.92	560	910
MPP-4	11/22/2002		2.07	0.01	0.005	0.744		6.55	300	600
MPP-5	11/23/2002		3.67	0.01	0.005	1.22		6.49	390	700
MPP-6	11/21/2002		6.96	0.017	0.038	5.48		6.01	610	980
Weighted Average (Shomaker 6/2005)			5.08	0.014	0.0154	3.26		6.18	493	831
Net Mn and Fe conc. after aeration & precipitation			3.81							
Dilution Requirement - Mimbres Water/MPP Water			26							

Engineers Inc. - Silver City Office

Phelps Dodge Tyrone - 1X Tailing Effluent Elimination

Job PDT0505P

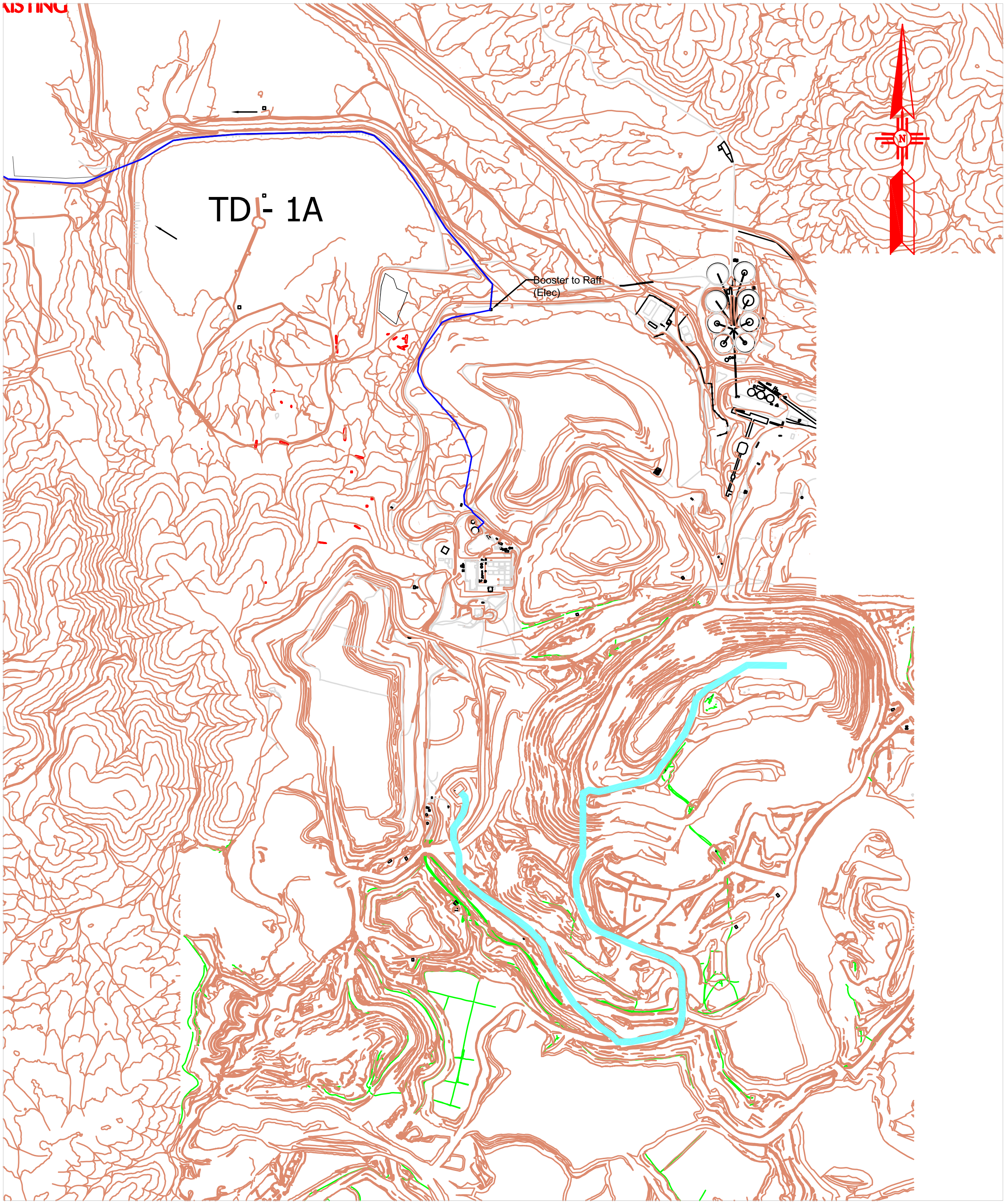
Table 1 **MINE DEWATERING WATER - DILUTION WORKSHEET**

Water Quality Monitoring Data

Source	Sample Date	Contaminant Al, Diss (mg/l)	As, Diss (mg/l)	Cd, Diss (mg/l)	Cl, Tot (mg/l)	Co, Diss (mg/l)	Cr, Diss (mg/l)	Cu, Diss (mg/l)	F. Tot (mg/l)	Fe, Diss (mg/l)	Mn, Diss (mg/l)	Ni, Diss (mg/l)	Pb, Diss (mg/l)	Zn, Diss (mg/l)	pH, field	ph, Lab	SO4, Tot (mg/l)	TDS (mg/l)
New Mexico Water Quality Standard		5	0.1	0.01	250	0.05	0.05	1	1.5	1	0.2	0.2	0.05	10	6 to 9	6 to 9	600	1000
Mimbres Wellfield	3/18/2005	0.034	0	0	7.9	0	0	0.059	0.71	0.88	0.012	0	0.026	0.065		8.04	29	220
Main Pit Lake																		
MP-8	11/6/2003	10.8	0.019	0.0718	6.33	0.132	<.006	8.53	10.7	2.28	20	0.038	<.005	17.1	5.72	4.6	771	1170
Net Mn and Fe conc. after aeration & precipitation																		
	Dilution Requirement	1.2		6.2		1.6		8.0	11.6	10.7	105.3			0.7			0.3	0.2
Main Pit Interceptor Wells																		
MPP-1	11/20/2002	1.82	0.01	0.002	4	0.0986	0.006	0.004	8.6	29.4	5.93	0.016	0.0065	4		5.92	560	910
MPP-4	11/22/2002	0.024	0.01	0.002	5.3	0.0144	0.006	0.003	4.1	4.69	2.07	0.01	0.005	0.744		6.55	300	600
MPP-5	11/23/2002	0.02	0.01	0.002	5.1	0.0263	0.006	0.0056	3.7	9.99	3.67	0.01	0.005	1.22		6.49	390	700
MPP-6	11/21/2002	3.33	0.01	0.0021	4.7	0.083	0.006	0.0033	13	27.3	6.96	0.017	0.038	5.48		6.01	610	980
Weighted Average (Shomaker 6/2005)		1.55	0.01	0.002	4.7	0.0631	0.006	0.004	8	20.16	5.08	0.014	0.0154	3.26		6.18	493	831
Net Mn and Fe conc. after aeration & precipitation																		
	Dilution Requirement					0.3			8.2	159.7	26.0							
Dilution Calculations																		
Main Pit Lake	Quantity Cont.	0.461267	5.263158	0.139276		0.378788		0.111085	0.079079	0.085714	0.009406			0.583211			0.769542	0.821053
	Quantity Dilute	0.538733	-4.26316	0.860724		0.621212		0.888915	0.920921	0.914286	0.990594			0.416789			0.230458	0.178947
	Dilution Ratio	1.167942	-0.81	6.18		1.64		8.002125	11.64557	10.66667	105.3191			0.714645			0.299475	0.217949
Check		5		0.01		0.05		1	1.5	1	0.2			10			600	1000
Main Pit Interceptor Wells																		
	Quantity Cont.					0.792393			0.108368	0.006224	0.037096							
	Quantity Dilute					0.207607			0.891632	0.993776	0.962904							
	Dilution Ratio					0.262			8.227848	159.6667	25.95745							
Check						0.05			1.5	1	0.2							

Table 3: Summary of Alternatives Analysis
Mine Dewatering Water and Main Pit Interceptor Wells Effluent Discharge

ALTERNATIVE	IMPACT on CLOSURE SCHEDULE	ENVIRONMENTAL CONSIDERATIONS	PERMITTING REQUIREMENTS	OPERATIONAL ISSUES	PROCESS WATER USE	COST of IMPLEMENTATION
Main Pit Interceptor Well Water for Process Water	None	All Water Contained and Utilized Within System.	None	None	Reduced	Moderate
Mine Water Surge Pond	None	All Water Contained and Utilized Within System.	Modification of Discharge Permit for Storage Facility on Stockpile Required	Reduced Use of Mimbres Wells Water	Reduced	Low
Active Evaporation System	None	All Water Contained and Utilized Within System.	None	Increased Raffinate Pumping Cost.	None	Moderate
Pit Lake Level Management	Adverse	Pit Lake Elevation Must Remain Within Mandated Limits	None	Potential Pit Slope Stability Degradation.	None	Low
Water Treatment	Adverse	Requires Construction of Stand-Alone Plant. Direct Discharge of Product. Large Quantities of Water Required.	Discharge Permit for Construction and Operation of New Plant Required.	Variability in Requirement for Treatment of Effluent.	Increased	High



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(505) 538-5395 (OFFICE)
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REVISIONS: ---

DRAWING: MINE DEWATER TO MINE WATER SURGE POND ALTERNATIVE #2

DWG BY: WM

JOB #: PDT0505P

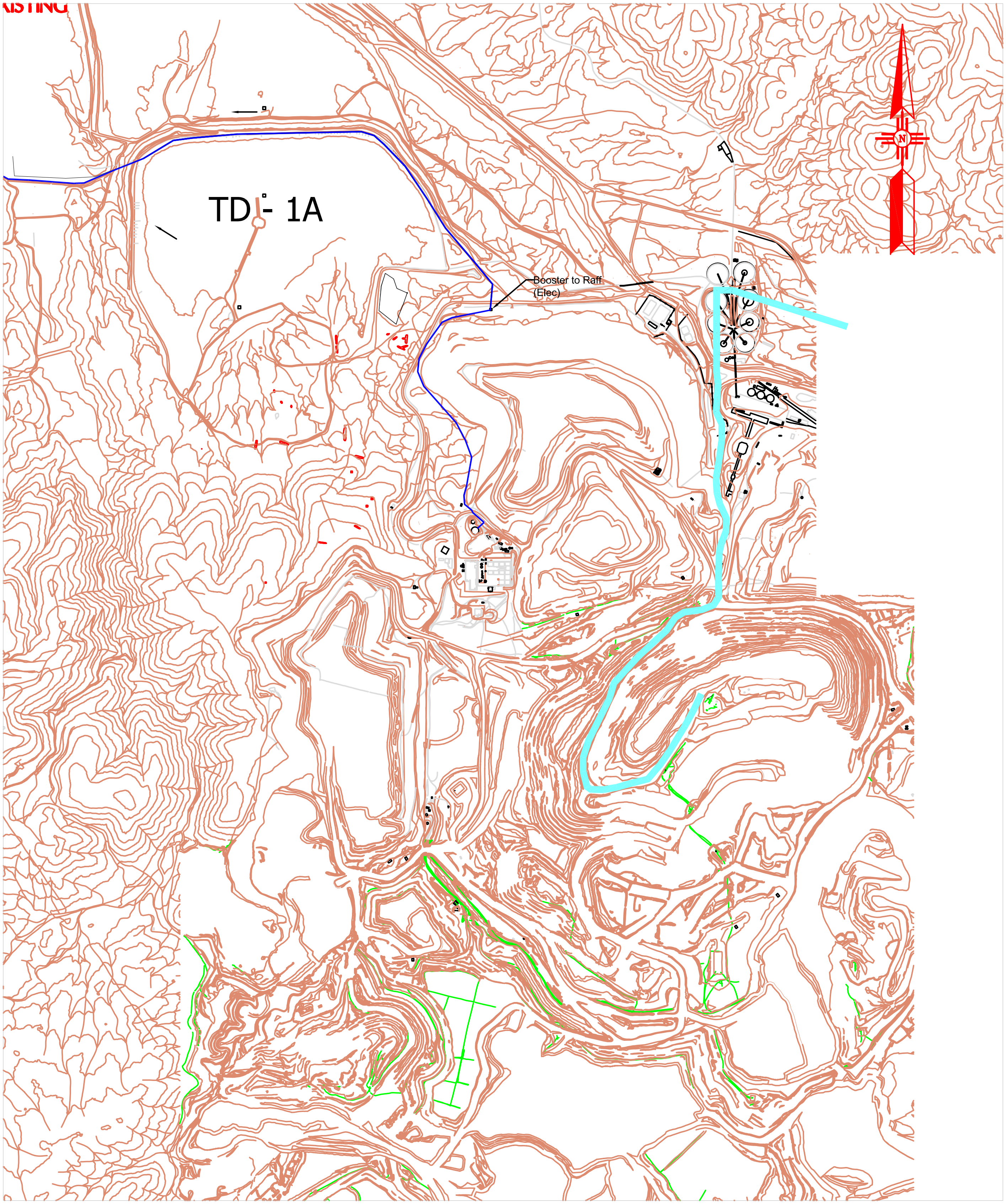
SCALE: NTS

SHEET: MDW-2

DATE: 9/02/05

PROJECT: 1X EFFLUENT ELIMINATION PHELPS DODGE, TYRONE

PATH: P:\PDT0505P/MINE DEWATERING\MDW-1,2,3.DWG



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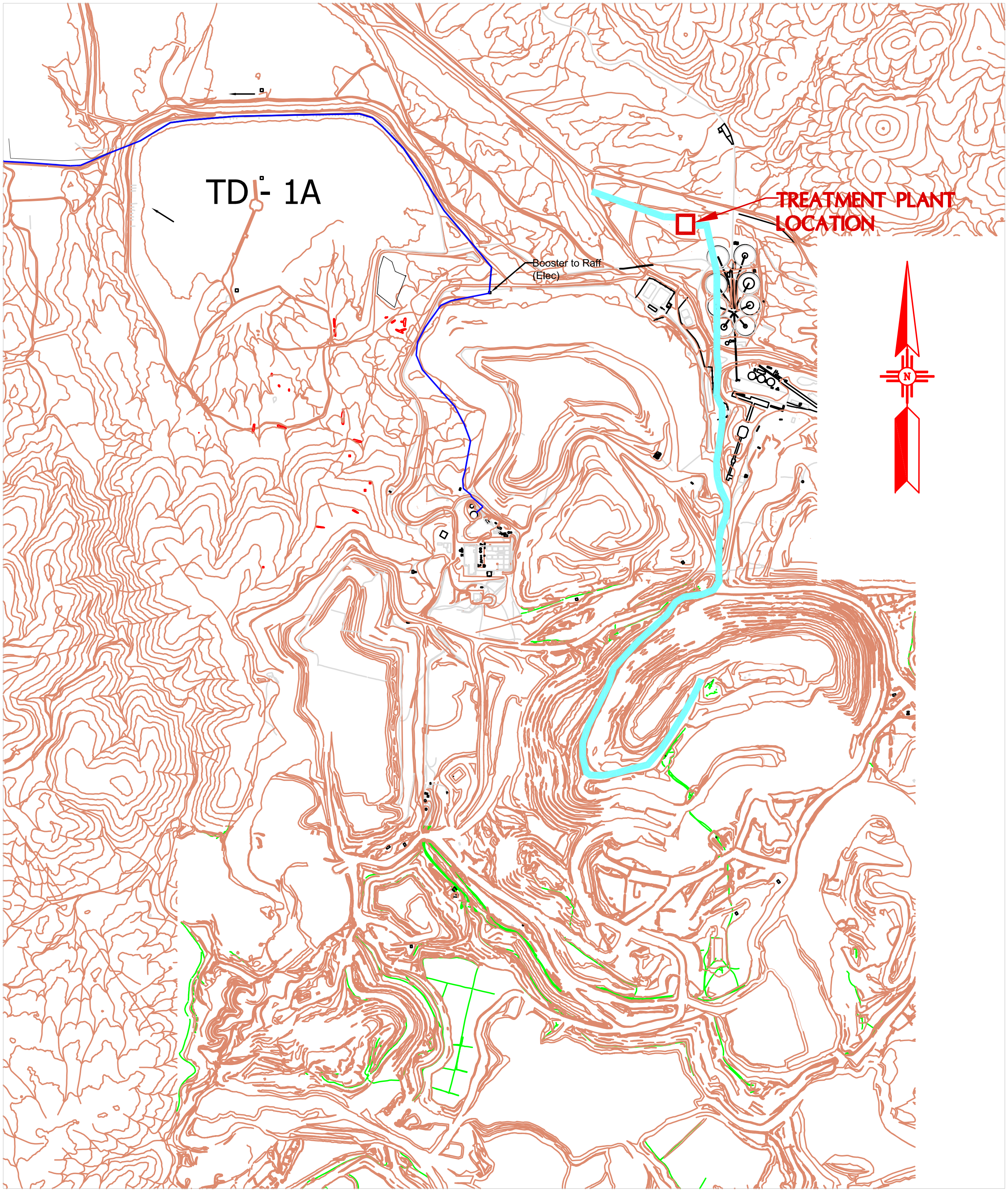
REVISIONS: ---	DRAWING: MAIN PIT PRODUCTION WELLS TREATMENT PLANT LOCATION ALTERNATIVE #1	DWG BY: WM JOB #: PDT0505P SCALE: NTS
DATE: 12/7/05	PROJECT: IX EFFLUENT ELIMINATION PHELPS DODGE, TYRONE	PATH: P:\PDT0505P/MINE DEWATERING\MDW-1,2,3.DWG

SHEET: MDW-1



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REVISIONS ---	DRAWING MINE DEWATER TO TREATMENT PLANT TREATMENT PLANT LOCATION ALTERNATIVE #5	DWG BY: WM JOB #: PDT0505P SCALE: NTS	SHEET MDW-3
DATE 12/7/05	PROJECT 1X EFFLUENT ELIMINATION PHELPS DODGE, TYRONE	PATH: P:\ PDT0505P/MINE DEWATERING \MDW-1,2,3.DWG	