Waste Rock Handling Plan

As Required By: Mitigation Measure OA-GW-02
Aquifer Protection Permit
No. P-106100

June 2018

Prepared by:

Rosemont Copper Company

HUDBAY

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Monitoring and Reporting Schedule

Task Schedule	*Purpose/Description/Timing*	*Active Mining Phase/ Operations Phase*				*Closure Phase[1]*	
		AN	*D*	*W/M*	*Q*	*D*	*Q*
Review and update database/block model	Short-term mine planning/material placement planning			X			
Inspection of blast zone prior to blasting	To identify major rock types, faults, etc., take samples		X				
Waste rock material testing (NAG materials)	ABA testing on at least two (2) random samples per week or one (1) sample every 250,000 tons	X					
Waste rock material testing (NAG materials)	SPLP testing on one (1) sample per blast zone or one (1) sample every 250,000 tons	X					
Waste rock material testing (PAG materials)	ABA testing on composite sample (each blast containing PAG zone)		X				
Waste rock material testing (AG materials)	ABA testing on composite sample (each blast containing AG zone)		X				
Re-handled waste rock	Track placement of re-handled materials					X	
Reporting	To Forest Service				X		X

AN = As Needed (based on tonnage); D = Daily (when needed); M = Monthly; Q = Quarterly; W = Weekly; [1] = Re-handling of materials.

Revision Log

Revision Number	*Revision Lead*	*Purpose of Revision*	*Revision Date*
1	Rosemont	Updated plan date from original June 2017 MPO submittal, added revision number.	March 2018
2	Rosemont	Minor format standardization text edits.	June 2018

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1.0 PLAN OBJECTIVE AND DESCRIPTION

This *Waste Rock Handling Plan* (Plan) was developed as a mitigation and monitoring measure (Mitigation Measure) requirement of the U.S. Forest Service's (USFS, Forest Service) Coronado National Forest (Coronado) Final Environmental Impact Statement (FEIS; USFS, 2013) for the Rosemont Copper Project (Project). The Mitigation Measure requirement is specified as "OA-GW-02: Reduction of the potential for acid generation and metal leaching from tailings and waste rock as required under the aquifer protection permit" on page B-84 in Appendix B of the FEIS.

This Mitigation Measure is based on Rosemont's aquifer protection permit (APP) No. P-106100 issued by the Arizona Department of Environmental Quality (ADEQ) for the Project. Rosemont's initial APP was issued on April 3, 2012 (ADEQ, 2012). This Plan follows the Technical Memorandum titled *Rosemont Waste Rock Segregation Plan – Revision 1*, dated January 25, 2011 (Tetra Tech, 2011), which is part of the approved APP.

Monitoring for Mitigation Measure OA-GW-02 will begin once waste rock materials are being excavated from, and placed outside of, the open pit area (Active Mining Phase). Testing of waste rock under this Mitigation Measure will be discontinued when waste rock is no longer being excavated from the open pit. As needed, waste rock materials that are rehandled after the Active Mining Phase will be sourced from existing 'stockpiled' areas having known geochemical parameters.

1.1 PLAN OBJECTIVE

The objective of Mitigation Measure OA-GW-02 is to:

- Avoid or reduce impacts to groundwater and surface water quality by reducing the potential of acid production and by characterizing the reactivity of the material with regard to drainage from waste rock areas.

Other Forest Service mitigation measures and/or other permits/ requirements/certifications associated with geochemical related issues include:

- FS-GW-01: Monitoring of waste rock for seepage. This mitigation measure includes the monitoring of waste rock placed in the Waste Rock Storage Area and in the perimeter buttress of the Dry Stack Tailings Facility for evidence of seepage via infiltration of meteoric water/stormwater. If occurring, a sample of this water would be collected and analyzed (see pages B-16 and B-17 in Appendix B of the FEIS);

- FS-GW-03: Additional operational waste rock and tailings characterization. This mitigation measure includes the testing of waste rock and tailings to provide data on the long-term behavior of the waste rock and tailings with respect to acid generation and metals leaching (see pages B-19 through B-21 in Appendix B of the FEIS);

- FS-GW-04: Periodic update and rerunning of pit lake geochemistry model throughout life of mine. This mitigation measure includes a periodic (every 5 years) assessment of the predicted water quality in the post-closure pit lake based on mine plan updates, and on-going data collection, including updates to the groundwater model (see pages B-21 and B-22 in Appendix B of the FEIS);

- OA-GW-06: Groundwater quality and groundwater level monitoring required under the aquifer protection permit. This mitigation measure is tied to Rosemont's APP No. P-106100 with regard to monitoring point-of-compliance (POC) wells located around the down-gradient perimeter of the Project facilities. Both water quality samples and water level readings are taken at these POC well locations (see pages B-87 and B-88 in Appendix B of the FEIS); and

- OA-SW-01: Detention and testing of stormwater. This mitigation measure is tied to Rosemont's Multi-Sector General Stormwater Permit No. AZMSG-74939 with regard to

monitoring stormwater quality at the Sediment Control Structures located down-gradient of the Project facilities (see pages B-88 and B-89 in Appendix B of the FEIS).

1.2 PLAN DESCRIPTION

The remainder of this Plan includes the following sections:

- Section 2.0: Waste Rock Classification;
- Section 3.0: Operational Mapping and Assay Sampling (for metal content);
- Section 4.0: Operational Sampling and Testing of Waste Rock;
- Section 5.0: Material Placement Strategies;
- Section 6.0: Material Placement Tracking;
- Section 7.0: Monitoring and Reporting;
- Section 8.0: Closure and Bond Release;
- Section 9.0: Adaptive Management;
- Section 10.0: Data Management; and
- Section 11.0: References.

2.0 WASTE ROCK CLASSIFICATION

Rosemont maintains a geologic database and block model showing the various material types located within the planned limits of the open pit. Both the database and block model are regularly updated to improve mining and operations, as a result, the geochemical information will also be kept up-to-date. Material types are characterized as either ore or non-ore (overburden/waste rock) depending on the grade (target metal content) of the material. This database and model will be updated during the life of the mine as new exploration holes are drilled and logged and as the pit is excavated and mapped. Materials, whether classified as ore or non-ore, are also characterized by rock type. The mine plan includes the excavation of over 1.2 billion tons of non-ore materials.

For each of the non-ore rock types listed in the database, previously collected acid-base accounting (ABA) data was used to classify the material into the following categories:

- Non-acid generating (NAG);
- Potentially acid generating (PAG); and
- Acid generating (AG)

There are two methods for evaluating ABA results: Net Neutralization Potential (NNP) and Neutralization Potential Ratio (NPR). The database currently has assigned representative NNP and NPR values to all non-ore rock types.

NNP is defined as NP-AP, where NP is Acid Neutralization Potential and AP is Acid Generating Potential. Both NP and AP are expressed in units of tons of calcium carbonate (CaCO3) per kiloton of rock (tons CaCO3/kton rock). Per the ADEQ BADCT Manual (ADEQ, 2004), the following guidance is provided concerning evaluation of NNP:

- If the NNP is less than -20 tons CaCO3/kton (NNP ≤ -20), then the sample is acid generating;
- If the NNP is between -20 and +20 (-20 < NNP < +20), then the sample is potentially acid generating; and
- If the NNP is greater than +20 (NNP > +20), then the sample is considered non-acid generating.

The ratio of NP to AP can also be used to assess the risk of developing acid rock drainage (ARD), where again NP refers to Acid Neutralization Potential and AP refers to Acid Generating Potential. This ratio is the Neutralization Potential Ratio (NPR) (NPR = NP/AP). Per the BADCT Manual (ADEQ, 2004), the following guidance is provided concerning evaluation of NPR:

- If the ratio is less than or equal to one (1) (NP/AP ≤ 1), the sample is likely to be acid generating;
- If the ratio is greater than one (1) but less than three (3), then the sample is potentially acid generating; and
- If the ratio is equal or greater than three (3) (NP/AP ≥ 3), then the sample is considered non-acid generating.

For planning purposes, tonnages of PAG, AG, and NAG waste rock materials to be mined can either be assigned an NNP or NPR value (or both) in the database. Based on the assigned NNP/NPR value, a blast zone, or portions of a blast zone, can be evaluated in terms of placement requirements associated with the Landform, which is the consolidated and reclaimed Dry Stack Tailings Facility and Waste Rock Storage Area. Waste rock materials will be assigned as follows:

- Material classified as NAG will preferentially be placed on the outer slopes of the Landform;

- Material classified as PAG will preferentially be placed on the interior of the Landform; and
- Material classified as AG will be placed in select areas within the Waste Rock Storage Area and possibly mixed (co-mingled) with NAG materials.

Additionally, material types can be tagged in the database and preferentially treated as AG or PAG materials regardless of their ABA designation, i.e., classified as NAG but treated as AG or PAG. These “override” designations can be made based on select material types or per visual observations made during inspection of the drill zone/drill cuttings. An entire blast pattern, or partial blast pattern can be tagged in this manner.

A short summary explaining the reason to override or otherwise supplement the ABA data would be provided in the database. The database would be reviewed monthly (or weekly if needed depending on where active mining is taking place and the waste rock composition in that area) by Rosemont’s geologist or mine planner to identify areas of concern ahead of drilling and blasting operations. This will facilitate timely adjustments to the short-term mine planning efforts.

3.0 OPERATIONAL MAPPING AND ASSAY SAMPLING

A typical production blast in the open pit may consist of about 150 holes. Blastholes are anticipated to be drilled on approximate 32-foot centers with a 10-5/8 inch rotary percussion drill bit. Holes will generally be drilled to accommodate 50-foot benches, i.e., holes will be drilled about 55-58 feet (5 to 8 feet below surface of next bench in order to maintain grade control). Each hole is provided a unique identification number (hole number) and its position is surveyed via global positioning system (GPS). On average, each blast pattern will yield about 250,000 tons of blasted material.

Geologic mapping of the drill site (blast zone) will be performed by a geologist during this process to identify major rock units, faults, etc., prior to blasting and compared to the data base/mine model. As the blastholes are drilled, drill cuttings will accumulate at the top of each hole as shown on Photo No. 1. For each blasthole drilled in ore, an assay sample will be taken either from an automatic sampler on the drill rig or from two (2) to three (3) locations (trenches) from within the drill cuttings pile. Assay samples may also be taken in waste rock to confirm the delineation of the ore zone based on exploration drilling and the mine model. Assay samples are then analyzed for metal content. A rock type is also assigned to the sample.

In a typical scenario, materials are assayed/tested the day prior to being excavated via the planned truck and shovel operations. The assay information is uploaded into the database/block model. Computerized 3-dimensional model information is provided onboard the shovels during excavation to guide operators. Not only can the information in the block model be viewed to distinguish between ore and non-ore materials, but ore of different grades can possibly be blended or stockpiled as needed.

Photo No. 1: Close-up of Drill Cuttings around Blasthole

In summary, the following actions take place (if possible, at the drill site) related to ore control:

- Mapping of geologic rock units and structures;
- Sampling of drill cuttings from each blasthole; and
- If possible, identifying the major rock type represented by each blasthole. (Identifying the major rock type may be difficult based on just cuttings.)

As noted, assay samples may be taken in waste rock areas in order to help define the ore zone. In areas known to be in waste rock, assay samples will not be taken. However, mapping of geologic rock units and structures within the waste rock zone will still be performed. The geologic database and mine model will also be reviewed to identify waste rock zones, including classification of the waste rock such as non-acid generating, PAG, or acid generating.

4.0 OPERATIONAL SAMPLING AND TESTING OF WASTE ROCK

As described in Section 3.0, geologic mapping of the drill site (blast zone) will be performed by a geologist during this process to identify major rock units, variation in lithologies, faults, etc., prior to blasting. Depending on the results of the database review and field inspection, sampling and testing will be adjusted based on the presence of NAG, PAG, or AG materials.

Per Tetra Tech (2011; Appendix A) and this Plan, the following testing is required on waste rock samples:

- ABA testing; and
- Synthetic Precipitation Leaching Procedure (SPLP) testing.

Table 2 provides a summary of the test methods, objectives, and sampling frequencies that will be conducted under this Plan. Testing will either be done on drill cutting samples taken from an individual borehole or on a composite sample taken from several boreholes. Sample composites for environmental testing could be made from materials covering the entire blast pattern or from portions of the blast pattern depending on visual observations, queries of the database/block model, or specific physical attributes anticipated for the blasted materials.

Per Tetra Tech (2011), both ABA testing and SPLP testing are to be performed on slightly different schedules and for different material categories. Additionally, other testing requirements are specified under Mitigation Measure FS-GW-03 as outlined in the *Additional Operational Waste Rock and Tailings Characterization Plan* (MPO Volume II-a).

4.1 NON-ACID GENERATING WASTE ROCK ZONE

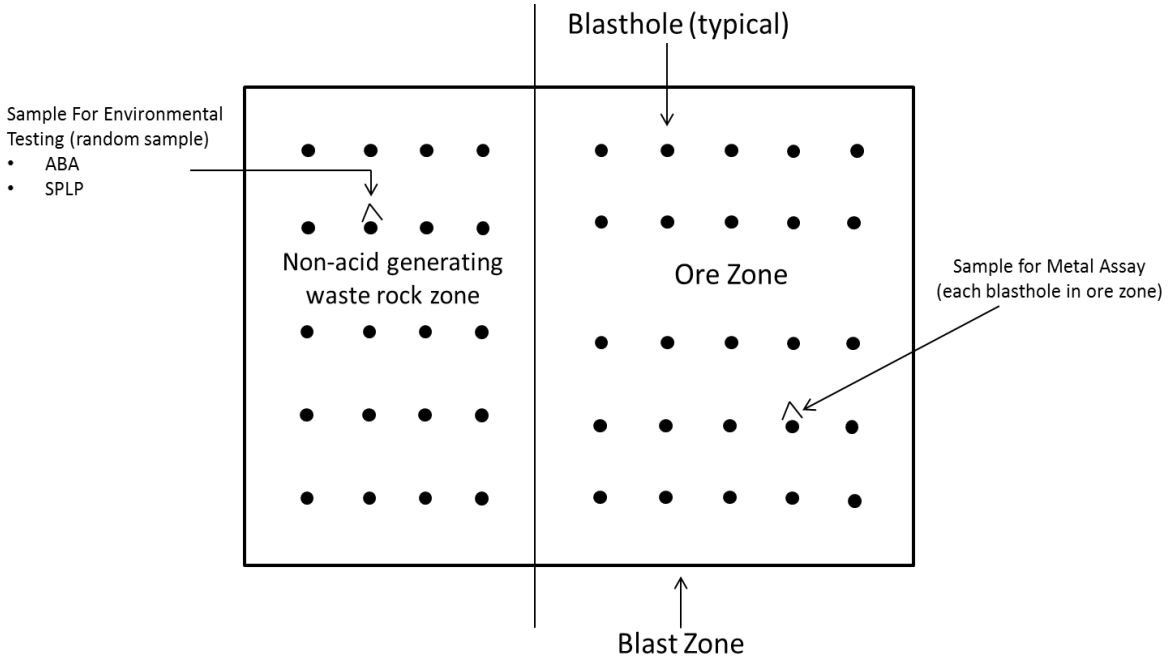
A conceptual approach to sampling non-acid waste rock in a split pattern is shown below in Illustration 1, which represents a hypothetical blast zone separated into an ore zone and a zone containing NAG waste rock. As described in Section 3.0, identification of the ore zone would be via assay sampling and testing. Identification of the NAG waste rock zone could be by one or a combination of the following:

- Inspection of the lithologies present in the blast zone; and
- Review of the database.

A single blasthole of NAG waste rock will be selected for sampling to represent the blast zone. The major rock type/lithology associated with that waste rock sample will be noted. It is anticipated that, over time, the samples will be distributed throughout the various rock types/lithologies encountered during excavation of the open pit.

If SPLP analysis is required, a minimum of five (5) pounds of material will be taken for each random sample. The random sample will be taken from one borehole location and will be composited from two (2) to three (3) locations (trenches) from within the drill cuttings pile. These locations will take into consideration the major visible rock compositions. As noted, the major rock type expressed in the pile will also be recorded during this time and assigned to the sample. Sample selection and preparation will also be coordinated with the *Additional Operational Tailings and Waste Rock Characterization Plan* (MPO Volume II-a). In some cases, a 10-pound (4.5 kilogram) sample will be collected.

Illustration 1: Example Non-Acid Generating Waste Rock Zone



Per Tetra Tech (2011), ABA testing is required on a random sample of the NAG waste rock based on the following schedule or quantity, whichever is more frequent:

- Minimum of twice per week; or
- 250,000 tons of waste rock mined.

SPLP testing will be performed on each NAG sample taken from blast zones that will be placed on the outer slopes of the Landform, i.e. non-acid generating based on ABA data. Table 2 provides a list of analytes for the SPLP tests.

As noted in Section 3.0, a typical blast pattern is about 250,000 tons.

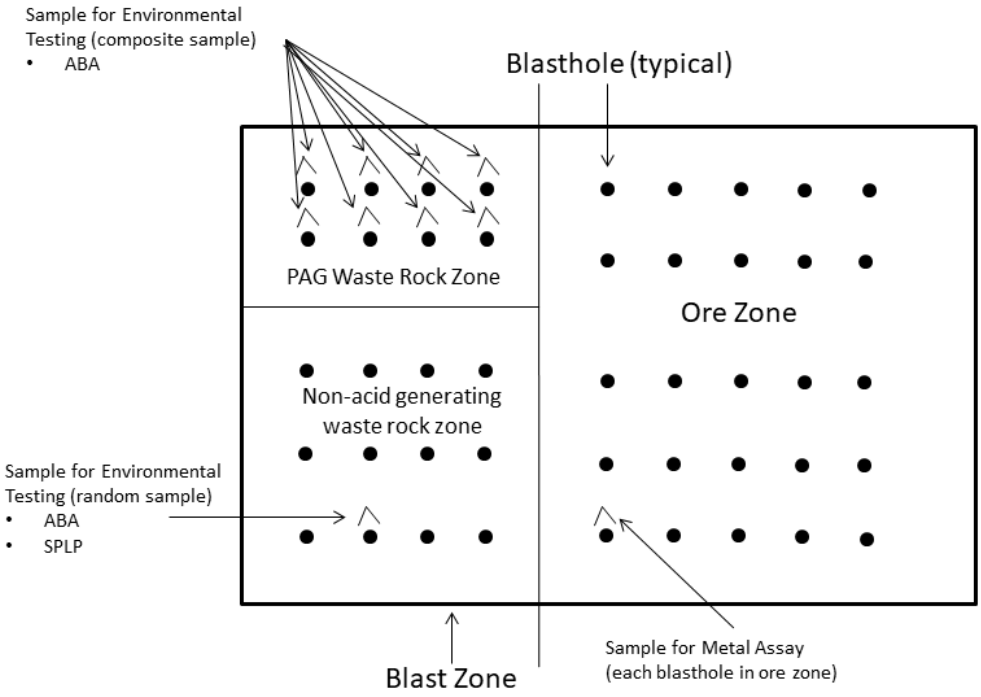
4.2 PAG WASTE ROCK ZONE

If waste rock material is identified and determined to be one of, or include one of, the units that have been identified as PAG, ABA testing of a composite waste rock sample will be conducted.

Areas of PAG material within a blast zone will either be identified through a query of the database and/or through inspection of the blast zone. As indicated above, field tests can also be used to identify PAG materials.

Once the PAG zone is identified, a composite sample of random blasthole cuttings will be taken within the zone. The major rock type encountered in the zone will be assigned to the sample. Illustration 2 provides an example of sampling within a PAG zone.

Illustration 2: Example PAG Waste Rock Zone



ABA testing will be performed on the composite sample. SPLP testing is not required since PAG materials will not be placed on the outer slopes of the Landform. Per Tetra Tech (2011), the minimum required ABA testing is as follows:

- Minimum of twice per week; or
- 250,000 tons of waste rock mined.

However, the present plan provides for ABA testing of all identified PAG material in all blasts.

A minimum of five (5) pounds of material will be taken for each random composite sample. Equal amounts of material will be taken from each borehole within the identified PAG zone to make up the composite sample. From each borehole, the sample will be taken from two (2) to three (3) locations (trenches) from within the drill cuttings pile. These locations will take into consideration the major visible rock compositions. The major rock type expressed in each of the piles will be recorded along with the major rock type assigned to the composite sample.

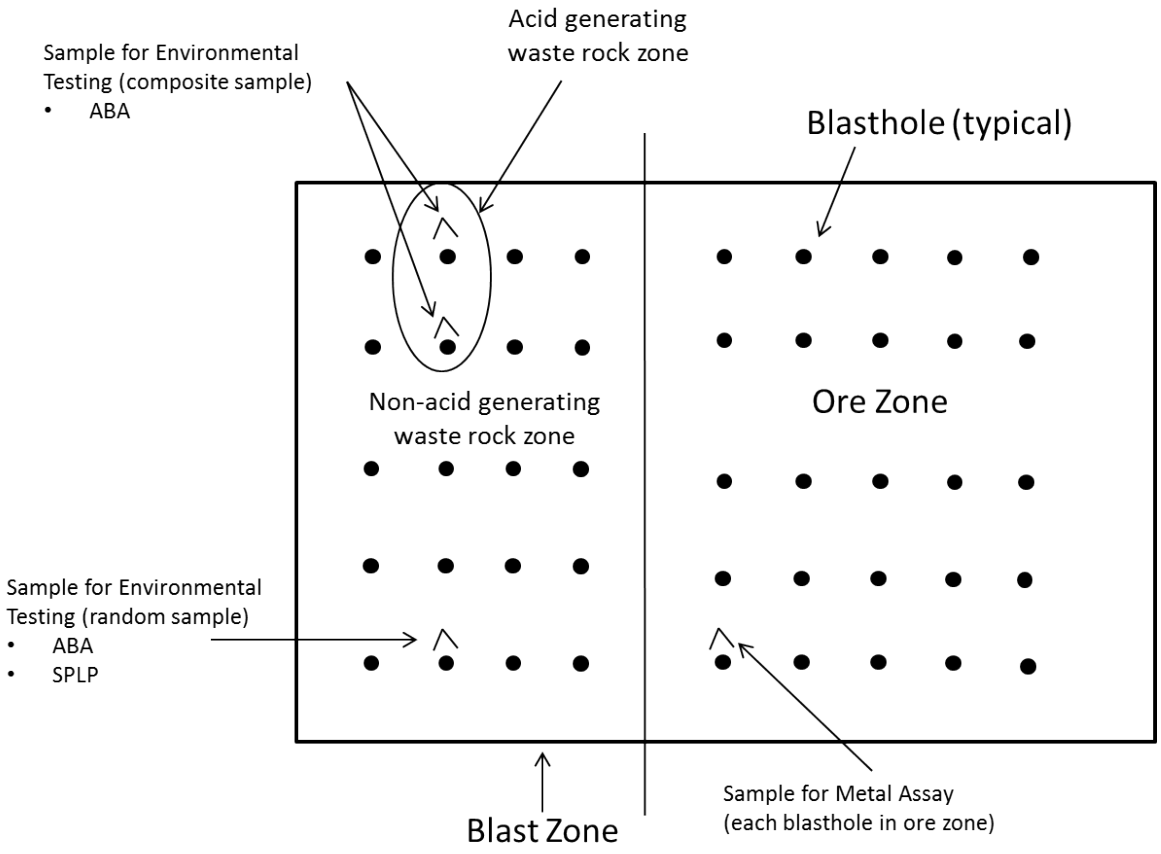
Should the composite ABA analysis indicate that the zone, as a whole, is NAG, further review and/or testing may be needed (e.g. SPLP) if material will be treated as such, i.e. placement on outer slope of Landform.

4.3 ACID GENERATING WASTE ROCK ZONE

Rock types occurring in a blast that are known to be AG, or suspected to be AG, will be isolated as an AG zone, per Illustration 3. A composite sample of the zone will be collected, prepared and tested

for ABA similar to the sample preparation described in Section 4.2. However, the materials in the zone will be treated as AG with respect to Landform placement, regardless of the ABA test results.

Illustration 3: Example Acid Generating Waste Rock Zone



5.0 MATERIAL PLACEMENT STRATEGIES

The placement location of waste rock from an entire blast zone or portion of a blast zone can be designated based on the information gathered in the field or query of the database/block model. As indicated in Section 4.0, the following general placement requirements would be applicable:

- Material classified as NAG will preferentially be placed on the outer slopes of the Landform;
- Material classified as PAG will preferentially be placed on the interior of the Landform; and
- Material classified as AG will be placed in select areas within the Waste Rock Storage Area and possibly mixed (co-mingled) with NAG materials.

6.0 MATERIAL PLACEMENT TRACKING

All of the major mining machinery will be equipped with GPS units that will track their locations/movements. In addition to being used for efficiency studies, this technology will be used to track the origin and placement of the materials excavated from the pit. In summary, the following will be recorded, and/or can be calculated, for each haul truck load:

- General coordinates of where material was excavated within the pit;
- General coordinates of where material was placed;
- Load tonnage; and
- Load characteristics (rock types, ABA, etc.).

Re-handling of waste rock within the Landform can also be tracked in this manner.

7.0 MONITORING AND REPORTING

Monitoring and reporting requirements for Mitigation Measure OA-GW-02 are listed below.

7.1 MONITORING

7.1.1 Monitoring Data

Monitoring for Mitigation Measure OA-GW-02 will consist of recording information on each production blast associated with waste rock removal. The following data will be included in the record:

- Blast number;
- Time and day of the blast;
- Location of blast, including average surface elevation in blast area;
- Record of zones/material types tagged in database/block model for special handling;
- Summary of field inspection of blast zone, including description of faults and areas tagged for special handling based on visual observations;
- Summary of anticipated rock types (and tonnages or percentages) from database/block model along with individual ABA numbers and composite ABA number (as appropriate), including summary of rock types (along with estimated tonnages/percentages) recorded in field; and
- Summary of correlation between the database/block model and results of the field testing/observations.

Re-handling of waste rock materials within the Waste Rock Storage Area will also be recorded in terms of origin and destination.

7.1.2 Monitoring Frequency

Table 1 lists the monitoring frequency of each test method that will be conducted under this Plan.

In addition to the testwork, Rosemont will audit the material placement tracking (Section 6.0) to ensure material is placed according to the waste rock segregation plan.

7.1.3 Analytical Parameters

Waste rock samples collected under this Plan will be submitted for the analyses listed in Table 1. The SPLP samples will be analyzed for the parameters listed in Table 2. The analytical laboratory will be licensed by the Arizona Department of Health Services, Laboratory Licensure Division, for each parameter they are analyzing.

7.2 REPORTING

Reporting on Mitigation Measure OA-GW-02 to the Forest Service will be performed quarterly. Each report will include the following information:

- Total tonnage of overburden/waste rock moved during the reporting period, including breakout of rock types;
- Tonnage identified as NAG;
- Tonnage identified a PAG;

- Tonnage identified as AG;
- Tabulated ABA test results;
- Tabulated SPLP test results;
- Laboratory analytical reports;
- Information regarding material placement for purposes of ensuring compliance with the requirements; and
- Relevant figures, maps, and/or graphs.

Field notes, material placement coordinates, and other relevant information will be maintained on-site and available upon request.

8.0 CLOSURE AND BOND RELEASE

This section addresses closure activities associated with this Plan as well as the approach for funding of those activities and bond release of those funds. If bonding is set for one year or less (i.e., simply completing testwork or finalizing reporting) no bond release is proposed. For longer periods, the bonding terms and application for bond release, as well as the mechanism for that release, are included.

8.1 INTERIM CLOSURE

There are no interim closure activities associated with this measure.

8.2 FINAL CLOSURE

There are no final closure activities associated with this measure. Any rehandling of materials used for cover, etc., would be sourced from existing “stockpiled” areas with known geochemical parameters. Although testing is not anticipated for this Mitigation Measure, on-going, on-site environmental monitoring/supervision costs are included in the *Reclamation and Closure Plan* (MPO Volume III-a) during the Final Reclamation and Closure Phase (Closure Phase).

8.3 BOND RELEASE

There is no bonding associated with this measure.

9.0 ADAPTIVE MANAGEMENT

Rosemont will incorporate the adaptive management process into the implementation of Mitigation Measure OA-GW-02 (as acceptable to ADEQ). This process will ensure that the initial intent of the waste rock segregation program is being met and that pertinent data is being collected and reported. The three key general components of adaptive management are:

- Testing assumptions – collecting and using monitoring data to determine if current assumptions are valid;
- Adaptation – making changes to assumptions and monitoring program to respond to new or different information obtained through the monitoring data and project experience; and
- Learning – documenting the planning and implementation processes and its successes and failures for internal learning.

Elements that may be modified as part of the adaptive management process for this Plan include, but are not limited to, the following:

- Reporting of material tonnage and placement;
- Analytical parameters;
- Test type; and
- Testing frequency.

Rosemont is currently working on a surrogate method to determine PAG, AG, and NAG materials. This method uses the analytical data generated as part of analysis planned for operations. The operational data will be more readily available. The neutralization potential of the Rosemont mine rock is highly correlated with calcium and magnesium, while the acid potential generally correlates with total sulfur. Further analysis will be completed, as well as discussions with the agencies, before Rosemont proposes this surrogate method.

10.0 DATA MANAGEMENT

Rosemont currently maintains data in various formats including logbooks, electronic logbooks, spreadsheets, hardcopy and database formats. It is Rosemont's intent that, ultimately, a robust database will be used to house all data collected for the various monitoring programs. Numeric data ultimately will be stored in a database and spatial data will be maintained in an ESRI database.

Depending upon the type of data to be reported, Rosemont will develop custom reports displaying required information in table or figure format. Electronic submittals will be provided in pdf format to provide a permanent record of the submittal and "raw" data will be maintained on-site for review by the Forest Service. If the Forest Service requests numeric data, it may include information such as cumulative results documenting the monitoring history and include baseline data for the resource.

Electronic submittals will be made on the reporting period specified. Reports will be submitted in hardcopy form with a duplicate electronic pdf file. Delivery of the electronic files will depend upon the size of the file and will either be made via email, via a CD/DVD or thumb drive, or via a website set up and maintained for delivery of files to the Forest Service. Details regarding access will need to be worked out so transmittals can take place seamlessly.

11.0 REFERENCES

ADEQ, 2004. *Arizona Mining BADCT Guidance Manual, Aquifer Protection Program*. Publication TB-04-01.

2012. *Aquifer Protection Permit No. P-106100 for Rosemont Copper Project*. Originally issued to Rosemont April 3, 2012.

2015. Aquifer Protection Permit No. P-106100 for Rosemont Copper Project. Most recent amended permit, issued to Rosemont Copper Company August 26, 2015.

Tetra Tech, 2011. *Rosemont Waste Rock Segregation Plan – Revision 1*. Memorandum to Katherine Arnold (Rosemont). Dated January 25, 2011

USFS, 2013. *Final Environmental Impact Statement for Rosemont Copper Project, Appendix B Mitigation and Monitoring Plan*. December 2013.

TABLES

Table 1 - Analytical Tests for Waste Rock

Type of Test	Specification	Objective of Test	Number of Samples
Acid Base Accounting (ABA)[1]	Paste pH[2]	Establish overall acid generating and acid neutralizing capability of waste rock. Also to be used for identifying those samples that require kinetic testing.	At least two (2) random samples per week or one (1) sample per approximate 250,000 tons of waste rock mined.
	Total sulfur – as S%		
	Sulfate – as S%		
	Sulfide – as S%		
	Acid neutralization potential (NP)		
	Acid generating potential (AP)		
	Neutralization potential ratio (NPR)		
SPLP Leaching Tests	EPA Method 1312	Provides indication of short-term leaching of soluble constituents.	One (1) sample per blast zone or one (1) sample per 250,000 tons of waste rock mined – whichever is less.

[1] = Modified Acid-Base Accounting test: Lawrence, R.W. and Wang, Y. (1997), *Determination of Neutralization Potential in the Prediction of Acid Rock Drainage.* Proc. 4th International Conference on Acid Rock Drainage, Vancouver, BC; p449-464; [2] = Sobek, A.A., Schuller, W.A., Freeman, J.R. and Smith, R.M. (1978), *Field and Laboratory Methods Applicable to Overburden and Minesoils*, Report EPA-600/2-78-054, U.S. National Technical Information Service Report PB-280 495.

Table 2 - Parameters to be Analyzed in Waste Rock SPLP Tests (EPA Method 1312)

Analytical Method	Parameter	Units	Acceptable Detection Limits (at or below the listed value)	Permit Limits / Thresholds	Applicable Water Quality Standard [1]
SM 4500 H+B	pH (final) – lab	S.U.	NA	NA	NNS
SM 2510 B	Conductivity	µS/cm	2.0	NA	NNS
SM 2540 C	Total dissolved solids	mg/L	20	NA	NNS
SM 2320 B	Total Alkalinity	mg/L	2.0	NA	NNS
EPA 300.0	Sulfate	mg/L	5.0	NA	NNS
Dissolved Metals					
EPA 200.8	Antimony	mg/L	0.001	NA	0.006
EPA 200.8	Arsenic	mg/L	0.0005	NA	0.05
EPA 200.7	Cadmium	mg/L	0.002	NA	0.005
EPA 200.7	Chromium	mg/L	0.03	NA	0.10
EPA 200.7	Copper	mg/L	0.02	NA	NNS
EPA 200.7	Iron	mg/L	0.30	NA	NNS
EPA 200.8	Lead	mg/L	0.0005	NA	0.05
EPA 200.7	Manganese	mg/L	0.01	NA	NNS
EPA 200.7	Nickel	mg/L	0.05	NA	0.10
EPA 200.8	Zinc	mg/L	0.0125	NA	NNS

Units: S.U. = standard units; µS/cm = micro Siemens per centimeter; mg/L = milligrams per liter; NA = not applicable;
NNS = No numeric standard; [1] = There are no applicable water quality standards for SPLP or waste rock sampling test data. Standards listed - for comparison purposes only - are the Arizona Aquifer Water Quality Standards (AWQSs), Arizona Administrative Code (A.A.C.) R18-11-406. Note: AWQSs are applicable to total recoverable metals only.

APPENDIX A

Waste Rock Segregation Plan

TETRA TECH

Tucson Office
3031 West Ina Road
Tucson, AZ 85741
Tel 520.297.7723 Fax 520.297.7724
www.tetratech.com

Technical Memorandum

To:	Kathy Arnold	**From:**	David Krizek
Company:	Rosemont Copper Company	**Date:**	January 25, 2011
Re:	Rosemont Waste Rock Segregation Plan – Revision 1	**Doc #:**	010/10-320877-5.3
CC:	Amy Hudson (Tetra Tech)		

1.0 Introduction

A Technical Memorandum titled *Rosemont Waste Rock Segregation Plan* (Tetra Tech, 2010) was prepared in response to the April 14, 2010 *Comprehensive Request for Additional Information* from the Arizona Department of Environmental Quality (ADEQ) to Rosemont Copper Company (Rosemont). This request is part of the aquifer protection permit (APP) application (Tetra Tech, 2009) submitted to ADEQ in February 2009 associated with the proposed Rosemont Copper Project (Project) in Pima County, Arizona. Specifically, Tetra Tech (2010) was developed to answer item no. 30a on page 13 of 18 of the April 14, 2010 request for information:

> *Application Vol. 1, February 2009, states "Waste rock will be managed by monitoring potentially acid generating (PAG) and non-acid generating (NAG) materials and placing materials in designated areas." It further states, "Because waste rock will be placed by segregating materials based on acid generating potential and testing results by source type and Waste Rock Storage Area will achieve greater engineering control potential compared to a typical unsegregated waste rock pile."*
>
> *Please provide the following:*
>
> *a) A detailed work plan for segregating potentially acid generating materials, including method of sampling, frequency of sampling, and what triggers or activates segregation and testing procedures;*
>
> *For characterizing waste rock to determine if the material is non-acid generating. Rosemont is referred to the guidelines specified under CHARACTERIZATION OF TAILING, SPENT ORE AND WASTE ROCK contained in the Arizona Mining BADCT Guidance Manual.*

An updated Technical Memorandum titled *Rosemont Waste Rock Segregation Plan – Revision 1* was prepared in response to additional comments received by Rosemont Copper Company in a letter from ADEQ titled *Incomplete Response to Technical Deficiencies* (dated December 3, 2010). Specifically this Technical Memorandum responds to Additional ADEQ's Comment #13 on page 25 of 34 of the December 3, 2010 letter:

> *Rosemont's proposed frequency of ABA testing on at least two random samples per week up to a maximum of 10 samples during one month and conduct quarterly Synthetic*

Precipitation Leaching Procedure, EPA Method 1312, on samples used as buttress or drain materials, is rather general and imprecise. ADEQ recommends that Rosemont should develop a more comprehensive plan to ensure segregation of potentially acid generating material using ABA testing and Synthetic Precipitation Leaching Procedure. Please submit a copy of the comprehensive plan for segregating potentially acid generating material.

2.0 General Project Information

The Project will include both sulfide and oxide ore mining and processing activities. Throughout active mining operations, grade control sampling and analysis will be performed as part of the overall mining process to control plant operations, to verify metals recovery, and to ensure proper segregation of materials.

Oxide ore will be placed on a lined heap leach pad and leached with dilute sulfuric acid. Sulfide ore will be processed in the milling and flotation circuit, with concentrate being shipped off-site for further processing. Tailings will be stored in the Dry Stack Tailings Facility. Waste rock, depending upon its type and characterization, will be placed in the Waste Rock Storage Area, used as buttress material for the Dry Stack Tailings, screening berms for the Waste Rock Storage Area, or used for various fill requirements.

Table 1 identifies the rock types, anticipated material tonnages, and the percentage of that rock type compared to the total anticipated waste rock volume. These tonnages are based on the current P673 pit configuration. Table 1 also lists some of the geochemical characterization tests previously performed on the various waste rock types. Analyses performed included Acid Base Accounting (ABA), net acid generation pH test (NAG pH), whole rock analysis, Synthetic Precipitation Leaching Procedure (SPLP), and Meteoric Water Mobility Procedure (MWMP).

Based on Table 1, approximately 1.2 billion tons of waste rock will be mined from the proposed Rosemont open pit. Mining rates vary but could be up to about 375,000 tons per day, with an average rate of about 210,000 tons per day.

Table 1 Summary of Rosemont Waste Rock Types and Tonnages

Rock Type	Tons of Material	Percent of Material (by weight)	No. of ABA/NAG pH Tests	No. of SPLP Tests	No. of MWMP Tests
Arkose	546,336,000	44.38%	55	8	8
Tertiary Gravel	141,227,000	11.47%	5	0	0
Abrigo	113,815,000	9.24%	6	5	0
Horquilla	87,141,000	7.08%	26	8	2
Glance	80,841,000	6.57%	4	0	0
Andesite	49,118,000	3.99%	38	4	6
Concha	34,107,000	2.77%	6	1	1
Martin	32,304,000	2.62%	7	4	0
Earp	29,577,000	2.40%	14	6	0
Epitaph	27,150,000	2.21%	16	6	0
Escabrosa	22,859,000	1.86%	10	4	0
Bolsa	23,447,000	1.90%	13	6	0
Colina	16,145,000	1.31%	11	4	0
Quartz Monzonite Porphyry	13,047,000	1.06%	9	2	1
Scherrer	8,524,000	0.69%	0	0	0
Pre-Cambrian Granodiorite	4,203,000	0.34%	0	0	0
Undefined	941,000	0.08%	0	0	0
Overburden	391,000	0.03%	6	2	2
Total Amounts	**1,231,173,000**	**100%**	**226**	**60**	**20**

3.0 Summary of Material Classification

As referenced in Section 1, the non-acid generating nature of the material will be based on the section in the Arizona Best Available Demonstrated Control Technology (BADCT) Guidance Manual (ADEQ, 2004) titled Characterization of Tailing, Spent Ore, and Waste Rock (Part A of Appendix B).

ABA analyses previously conducted for the waste rock samples evaluated the potential of the waste rock to generate acid based on Part A: Characterization of Tailing, Spent Ore and Waste Rock of Appendix B of the Arizona Mining BADCT Guidance Manual (ADEQ, 2004). The ABA analyses included a determination of the sulfur content, acid neutralization potential (ANP), and the acid generating potential (AGP) of the waste rock. The sulfur and sulfide content indicates the likelihood of whether the rock type may be acid generating. There are two (2) methods for evaluating ABA analysis results: the net neutralization potential and the neutralization potential ratio.

3.1 Net Neutralization Potential (NNP)

The ANP and the AGP are expressed in units of tons of calcium carbonate ($CaCO_3$) per kiloton of rock (tons $CaCO_3$/kton rock). The difference between the ANP and AGP is defined as the net neutralization potential (NNP) (NNP = ANP-AGP).

In general, a sample would be acid-generating if it has a significant amount of sulfur or sulfide minerals or if its net neutralization potential (NNP) was less than zero (0); however, the risk of acid rock drainage (ARD) has been found to be highest for samples with NNP values less than -20 tons $CaCO_3$/kton rock and is low when the NNP is greater than +20 tons $CaCO_3$/kton rock (Price, 1997).

Appendix B of the BADCT Manual (ADEQ, 2004) provides the following guidance:

- If the NNP is less than –20 tons $CaCO_3$/kton (NNP ≤ –20), then the sample is acid generating;
- If the NNP is between –20 and +20 (–20 < NNP < +20), then the sample is potentially acid generating; and
- If the NNP is greater than +20 (NNP > +20), then the sample is considered non-acid generating.

If NNP is less than -20 tons of $CaCO_3$/kton, it can be considered acid generating. Between -20 and +20, the potential exists for the waste rock to be acid generating. The more positive the NNP, the lower is the risk for the waste rock to be acid generating. When the NNP is above +20, the material can generally be considered non-acid generating. Prediction of the acid generating potential when the NNP is between +20 and -20 tons of $CaCO_3$/kton of sample is more difficult due to uncertainty in analysis and conversion factors.

3.2 Neutralization Potential Ratio

The ratio of ANP to AGP, the neutralization potential ratio (NPR) (NPR = ANP/AGP), can also be used to assess risk of developing acidic rock drainage (ARD). An NPR greater than 3 is thought to have a low ARD risk while samples with an NPR less than one (1) have a high ARD risk (Price, 1997).

The BADCT manual (ADEQ, 2004) provides the following guidance for evaluating the NPR:

- If the ratio is less than or equal to one (1) (ANP/AGP ≤ 1), the sample is likely to be acid generating;
- If the ratio is greater than one (1) but less than three (3), then the sample is potentially acid generating; and
- If the ratio is equal to or greater than three (3) to one (1) (ANP/AGP ≥ 3), then the sample is considered non-acid generating.

Ratios of ANP/AGP can also be used to assess the acid generation potential. An ANP/AGP ratio of 1:1 is equivalent to an NNP of zero (0). If the ratio of a sample's neutralization potential and acid production potential is greater than 3:1, then there is a low risk for acid drainage to develop. For samples with a NPR between 1:1 and 3:1, the uncertainty increases. As a result, additional testing is usually necessary using kinetic test methods as described under the Tire #2 protocols (ADEQ, 2004). Samples with a ratio of 1:1 or less are more likely to generate acid (Smith and Barton-Bridges, 1991).

3.3 Waste Rock Sampling

A total of 226 waste rock samples have been tested to date to evaluate the acid generating and acid neutralizing potential of the material. Based on previous characterization work, twelve (12) of the 226 waste rock samples analyzed for NPR were identified as being likely acid generating;

- Five (5) of 38 samples of Andesite had NPRs indicating that were likely acid generating;
- One (1) of 55 Arkose samples had an NPR indicating that the sample was likely acid generating; and
- The remaining potentially acid generating samples included five (5) Bolsa and one (1) Abrigo sample.

In summary, twelve (12) samples from Andesite, Arkose, Bolsa, Earp, and Qmp rock types had NPR ranges that indicated that the rock types were moderate or uncertain acid generation potential.

The NNPs for the 226 samples indicated that only one (1) sample of Andesite was likely acid generating, and approximately 51 samples of Abrigo, Andesite, Arkose, Bolsa, Earp, overburden, and Qmp, contained NNPs indicative of the type being moderately acid generating or uncertain. Most of these 51 samples were from Andesite, Arkose, and Qmp rock types.

Based on this information, very little of the waste rock at Rosemont has the potential to generate acidic conditions. Therefore, sampling and analysis of waste rock during operation will target specific rock types as well as incorporate an overall characterization plan. The plan would be designed to provide verification of the expected behavior of the materials that have been defined through the previous characterization program.

4.0 Waste Rock Segregation Plan

In general, the plan to segregate acid generating waste rock will be based on observations, sampling, and characterization of samples completed during mining operations. The operational sampling will be compared to prior to testing to verify the expected behavior of the material. Although specific material testing frequencies were not provided, the Global Acid Rock Drainage Guide (GARD) developed by the International Network for Acid Prevention (INAP, 2008) was reviewed and used to develop the plan outlined herein.

During the mining operations, drilling will be completed on 50-foot benches. Variations in lithology and mineralogy/geology, as well as degree and extent of fracturing, will be evaluated by a Rosemont Copper geologist or trained technician. Composites from the drill holes will be assayed as needed to characterize the material as waste rock, oxide ore, or sulfide ore. If waste rock material is identified and determined to be in one of, or include one of, the units (i.e., Andesite, Arkose, etc.) that have been identified as potentially acid generating, sampling and testing of the composite drill hole samples will be targeted to isolate the area within the blast zone that would require special handling. Although any material identified as waste rock will be subject to the operational testing program, the focus will be on those materials previously identified as uncertain or likely to generate acid.

Characterization of these samples will include Acid Base Accounting (ABA) or net acid generation pH test (NAG pH). The degree of sulfide and oxide mineralization would be determined as part of the aforementioned characterization. The data collected through the operational testing program will be added to the existing geochemical database. The full characterization database would be reviewed weekly to ensure the expected behavior of the material, and the characterization of the lithologies, are updated as necessary.

Decisions for segregation, particularly of any potentially acid generating waste rock, will be based on the results of the previous characterization program. Non-acid generating waste rock will be preferentially placed in the east and south haul roads, screening berms, dry stack tailings buttresses and exterior haul roads, drain fills, permanent diversion crossings, the crusher haul road, as leach pad cover, and any other exterior surface. Acid generating waste rock will be placed to the interior of the Waste Rock Storage Area and possibly mixed (comingled) with non-acid generating waste rock. Additionally, potentially acid generating waste rock will not be placed immediately below within 50 feet of areas designated for water management ponds that are part of the final landform. Potentially acid generating material placed with the interior of the Waste Rock Storage Area will also not be placed in areas subject to water conveyance, etc.

Specific waste rock segregation requirements will be detailed in operating plans that will be modified as appropriate. In general, however, these plans will include Rock Inspection and Classification, and Rock Type Monitoring as specified below.

4.1 Rock Inspection and Classification

As described above, drilling will be completed on 50-foot benches. Variations in lithology and mineralogy/geology, as well as degree and extent of fracturing, will be evaluated by the geologist or trained technician. Composites from the drill holes will be assayed as needed to characterize the material as waste rock, oxide ore, or sulfide ore. If waste rock material is identified and determined to be one of, or include one of, the units (i.e., Andesite, Arkose, etc.) that have been identified as potentially acid generating, sampling and testing of the composite drill hole samples will be targeted to isolate the area within the blast zone that would require special handling. The composite samples will be characterized using either ABA or NAG pH testing. Fizz testing with dilute hydrochloric acid (HCl) will also be conducted on the drill hole cuttings to help target samples collecting for ABA or NAG pH testing.

Both testing records and waste rock placement decisions shall be maintained, including the personnel involved in the decision, the testing or review involved, and if the rock was determined to be acid generating or not. Placement of the material should also be verified. The records shall be maintained on site and available for inspection.

4.2 Type Monitoring

In addition to the testing targeting specific lithologic units described in Section 4.1, ABA tests shall be completed at an on-site lab (when constructed) on at least two (2) random samples per week or one (1) sample per approximate 250,000 tons of waste rock material mined, whichever is more frequent. Sample selection will be distributed based on the rock types/lithologies encountered during the sampling period/increment.

These random samples will not be selected based on lithology and will be used to verify previous characterization work. ABA testing includes a measurement of the Acid Neutralization Potential (ANP) and the Acid Generating Potential (AGP) of the waste rock.

SPLP (Synthetic Precipitation Leaching Potential EPA Method 1312) shall be completed at the on-site lab when constructed on samples used as outer berm/buttress or drain materials to confirm that these materials are non-acid generating and have limited reactivity.

For waste rock materials used in the flow-through drains, one (1) SPLP sample shall be taken per blast zone or one (1) sample per 250,000 tons, whichever is less.

All geochemical testing records will be maintained on-site either in hardcopy or electronic form.

REFERENCES

Arizona Department of Environmental Quality (ADEQ) (2004). *Arizona Mining Best Available Demonstrated Control Technology (BADCT) Guidance Manual*. Aquifer Protection Program. Publication TB-04-01.

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Price, W.A. (1997). Draft: *Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia*. British Columbia Mine Reclamation Services (MRS). British Columbia Ministry of Employment and Investment, Energy and Minerals Division, Smithers, BC (April) 143 pgs.

Smith, A. and J.B. Barton Bridges, (1991). *Some Consideration in the Prediction and Control of Acid Mine Drainage Impact on Groundwater from Mining in North America*. Proceedings of the EPPIC Water Symposium. May 16-17, 1991, Johannesburg, South Africa.

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