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## Technical Memorandum

<b>To:</b>	Kathy Arnold	<b>From:</b>	David Krizek
<b>Company:</b>	Rosemont Copper Company	<b>Date:</b>	August 31, 2010
<b>Re:</b>	Rosemont Flow-Through Drain Design Summary	<b>Doc #:</b>	240/10-320877-5.3
<b>CC:</b>	Karen Schwab (Kimberlite)		

### 1.0 Introduction

This Technical Memorandum provides information related to the flow-through drain system that is proposed as part of the Rosemont Copper Project (Project) in Pima County, Arizona. This information is provided 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) as part of the aquifer protection permit (APP) application submitted to ADEQ in 2009 (Tetra Tech, 2009). Specifically, this Technical Memorandum answers items nos. 14a and 14b on Page 9 of 18 and no. 15 on page 10 of 18.

- *No. 14a: Please provide an estimated amount of surface and subsurface flows designed for discharge through the underdrain system;*
- *No. 14b: ADEQ recognizes that the underdrain system is designed to discharge the surface and subsurface flows below the tailings pile. However, please demonstrate that the underdrain system will remain functional to effectively discharge surface and subsurface flows without threatening the integrity of the tailings pile. The flow computations should include sediment load for the underdrain system to determine underdrain stability. Underdrain stability in this context implies that there is no net aggradation or degradation of the underdrain bed or clogging of the CPe pipes used in the underdrain system; and*
- *No. 15: CPe Pipe Deflection – Appendix G-4: Three parallel CPe pipes, each 36-inch diameter, 500 LF (DWG NO. 600-CI-940), are used in the flow-through drain beneath the tailings pile. Please summarize the results of CPe pipe deflection and conclusion as to its effectiveness and suitability in the flow-through drain.*

### 2.0 Flow-Through Drain Design and Sizing

As part of the *Site Water Management Update* report (Tetra Tech, 2010a), an update to the flow-through drain system designed by AMEC Earth & Environmental, Inc (AMEC, 2009) was presented. Section 6.0 of the *Site Water Management Update* report describes the updated



flow-through drain. Two (2) technical memoranda were prepared in support of the updated design as listed below:

- *Rosemont Flow-Through Drain Design* dated April 5, 2010 (Tetra Tech, 2010b); and
- *Rosemont Flow-Through Drain Sizing* dated April 5, 2010 (Tetra Tech, 2010c).

These technical memoranda are provided in Attachment A and Attachment B, respectively, and provide the design methodology as well as the design flows. In general, the flow-through drains were sized to accommodate the Local or General Probable Maximum Precipitation (PMP) event.

Table 1 below summarizes the maximum contributing watershed areas reporting to the various flow-through drain inlets and their corresponding stormwater runoff volumes based on the 100-year, 24-hour and PMP events.

**Table 1 Surface Flows Reporting to Underdrain Inlets**

Drain			Watershed Reporting		Incoming Volume of Surface Flow (ac-ft) (Per Precipitation type)		
Location	ID	Description	Basin ID	Area (acres)	100yr, 24hr	Local PMP	General PMP
South Drain	S1A	Contributes to South 1 and receives all the runoff from Basin S1A.	S1A	244.47	66.5	269.9	348.8
	S1C	Basin S1E contributes to S1C from the top of the South Dry Stack Tailings Facility.	S1C	55.73	14.6	60.7	78.7
			S1E	210.83	55.1	229.7	297.5
	S2B	South 2 Drain receives runoff from Basin S2B.	S2B	231.00	60.4	251.6	326.0
North Drain	N1	Only Basin N1 contributes to Drain N1.	N1A	193.95	29.9	175.4	235.6
	N2	Basin N1B will contribute to Drain N2 for the General and local PMP. Basin N2B will only contribute for events larger than 1000yr, 24 hr event.	N1B	548.42	84.7	496.0	666.3
			N2A	193.89	29.9	175.4	235.6
			N2B	219.95	34.0	198.9	267.2
	N3	Basin N3 runoff contributes to the Drain N3	N3	47.67	8.9	46.2	61.2
NM1	North Main Drain.	NM1	0.83	82.5	483.3	649.2	

### 3.0 Flow-Through Infiltration Assessment

An infiltration analysis was performed as part of the flow-through drain design based on average-annual conditions and for a 100-year, 24-hour storm event. An updated version of the infiltration analysis included in the *Site Water Management Update* report is provided in Attachment C (Technical Memorandum titled *Rosemont Infiltration Analysis - Revised* dated April 5, 2010 (Tetra Tech, 2010d)).

Once stormwater enters the flow-through drains, a portion of the volume will exit the down-gradient end of the drain and some will infiltrate into the ground as water passes through the system. Table 2 summarizes the anticipated infiltration and surface flow exiting the drains based on average-annual conditions and the 100-year, 24-hour event.

**Table 2 Summary of Infiltration with Flow-Through Drains**

Drain Inlet	Drainage Area (acres)	Average-Annual Runoff at the Inlets (ac-ft)	Regulatory 100yr, 24hr Flood Runoff at the Outlets (ac-ft)	Average-Annual Runoff at the Outlets (ac-ft)	Infiltration Within Drains for 100yr, 24hr Regulatory Flood (ac-ft)	Infiltration Within Drains for Average-Annual Runoff (ac-ft)
North-N1	733.45	137.05	0.00	0.00	1.83	137.05
North-N2	193.89	36.37	0.00	0.00	0.97	36.37
North-N3	47.67	9.06	3.16	0.10	3.64	8.96
South-S1	232.18	42.79	16.67	0.99	20.48	41.80
South-S1C	46.67	8.85	4.50	0.18	5.18	8.67
South-S2A	213.00	40.65	0.00	0.00	26.09	40.65

### 4.0 Sediment Control at Flow-Through Drain Inlets

As part of the redesign of the flow-through drain design, the CPe pipes illustrated in the *Rosemont Copper Company Tailings Storage Facility Final Design Report* (AMEC, 2009) were eliminated. These pipes were originally incorporated into the design in case of plugging at the drain inlet. As a design modification, the flow-through drains were extended beyond the toe of Rosemont Ridge Landform and the use of geotextile is anticipated to prevent sediments from filtering into the flow-through drains via the inlet areas. Extending the drain out from the facility toe allows for access to, and reconstruction of, the sediment filtering system as needed.

The use of geotextiles at the drain inlet areas for sediment control is anticipated during operations and for a limited post-closure period. As appropriate, the same geotextile protection would be employed at the Detention Basin embankments designed by AMEC (see report titled *Dry Stack Tailings Storage Facility Stormwater Management Design Report* (AMEC, 2010) in Appendix A of the *Site Water Management Update* report (Tetra Tech, 2010a)).

During final design of the site water management facilities associated with the Rosemont Copper Project, best management practices (BMPs) would be employed to reduce the flow



velocity of stormwater reporting to the drain inlets and to retain sediments upstream of the drain inlets as much as practicable.

Attachment D provides a Technical Memorandum titled *Rosemont Flow-Through Drain Sedimentation Analysis* dated August 31, 2010 (Tetra Tech, 2010e) describing the anticipated sediment loading to the drain inlets for various storm events. This analysis assumes that the watershed areas initially reporting to the drain inlets would have sparse vegetation. Over time, however, the soils in these watersheds are anticipated to stabilize with a corresponding decrease in sediment loading to the inlets. Section 5.0 below summarizes the findings of the sedimentation analysis provided in Attachment D.

## **5.0 Sedimentation Analysis**

Sediment loading to the drain inlets was estimated using the current version of the software package SEDCAD (Sediment, Erosion, Discharge by Computer Aided Design), which is a comprehensive sedimentology program that incorporates standard hydrology and hydraulic principles. This program is used to analyze the design and efficiency of alternative surface water, erosion, and sediment control systems.

The analysis performed assumed that ponding would occur at the upstream end of the drains. This allowed modeling of the system as a detention reservoir routing system with the ponding area acting as the reservoir, the basin hydrograph controlling inflow to the reservoir, and the drain acting as the outlet. SEDCAD was employed in this analysis to model the contributing watersheds and their ponds as sediment basins in order to conservatively predict and quantify the potential sedimentation at the inlets of the various drains. Details of this analysis are presented in Attachment D.

Results of the sediment loading calculations show that the pond storage capacities at the drain inlets would provide sufficient sediment storage at the drain inlets to reduce the need for periodic cleaning and maintenance during the operational period. Minimal to insignificant sedimentation would occur within the porous rock medium of the flow-through drains during this time since a filter geotextile will be placed at the drain inlet and covered with about a ten (10) foot thick layer of rock. Sediment removal from the drain inlet ponding areas would be performed as needed. Due to the design modification to the drain inlets, i.e., extension of drain beyond the toe of the landform, replacement of the geotextile fabric could also be performed, as needed.

Following operations and for a limited post-closure period, the drain inlet configuration may be modified by removing the filter geotextile and replacing the outer rock layer with a graded rock filter, as needed. A graded rock filter design would allow the flow-through drains to be self-cleaning by allowing sediments to settle out and deposit at this interface as surface water transitions from turbulent flow at the inlet to laminar flow through the graded rock filter and into the drain.

The watershed surfaces reporting to the drain inlets are expected to stabilize over time with a corresponding reduction in sediment loading. Sediment loading would be also mitigated with the addition of Best Management Practices (BMPs) throughout the Project area and especially up-gradient of the drain inlets.



Due to the combination of employing the filter fabric during operations, followed by a post-closure graded rock filter configuration at the inlet areas, along with the large ponding areas anticipated at the drain inlets (sediment traps) and up-gradient BMPs, sediment loading to the flow-through drains is anticipated to be limited. Design of the graded inlets would be performed either during the final design stage of the Project or at closure, when the need for the graded filter would be assessed.

## REFERENCES

- Tetra Tech (2009). *Aquifer Protection Permit Application*. Prepared for Rosemont Copper Company. Report Dated April 2009.
- Tetra Tech (2010a). *Site Water Management Update*. Prepared for Rosemont Copper Company. Report Dated April 2010.
- AMEC Earth & Environmental, Inc. (AMEC) (2009). *Rosemont Copper Company Dry Stack Tailings Storage Facility Final Design Report*. Prepared for Rosemont Copper Company. Report Dated April 15, 2009.
- Tetra Tech, Carrasco, J. and Salguero, M. (2010b). *Rosemont Flow-Through Drain Design*. Technical Memorandum to Kathy Arnold (Rosemont Copper Company). Technical Memorandum Dated April 5, 2010.
- Tetra Tech, Salguero, M. and Chee, R. (2010c). *Rosemont Flow-Through Drain Sizing*. Technical Memorandum to Kathy Arnold (Rosemont Copper Company). Technical Memorandum Dated April 5, 2010.
- Tetra Tech, Salguero, M. and Carrasco, J. (2010d). *Rosemont Infiltration Analysis - Revised*. Technical Memorandum to Kathy Arnold (Rosemont Copper Company). Technical Memorandum Dated April 5, 2010.
- AMEC (2010). *Rosemont Copper Company Dry Stack Tailings Storage Facility Stormwater Management Preliminary Design Report*. Prepared for Rosemont Copper Company. Report dated April 2, 2010.
- Tetra Tech, Hemmen, G. (2010e). *Rosemont Flow-Through Drain Sedimentation Analysis*. Technical Memorandum to Kathy Arnold (Rosemont Copper Company). Technical Memorandum Dated August 31, 2010.

**ATTACHMENT A**  
**TECHNICAL MEMORANDUM**  
**ROSEMONT FLOW-THROUGH DRAIN DESIGN**

# Rosemont Copper Project

## Locator Sheet

Record # 012424

Document Date 2010 04 05

Document Title: Rosemont Flow-Through Drain Design

Author/Recipient Joel Carrasco, Monica Salguero Tetra Tech

Description Summary of Tetra Tech's design analysis related to the use of flow-through drains at the proposed Rosemont project.

Other Notes Attachment A of 013396.

This document is located in the following: [CIRCLE THE CATEGORY (from the list below) IN WHICH THIS ITEM IS FILED]

1. **Project Management**
  - a. Formal recommendations & Directions
  - b. Formal meeting minutes & memos
  - c. General Correspondence
  - d. Contracts, Agreements, & MOUs (Rosemont, Udall, SWCA)
  - e. Other
2. **Public Involvement**
  - a. Announcements & Public Meetings
  - b. Mailing Lists
  - c. Scoping Period Comments
  - d. Udall Foundation Working Group
  - e. Scoping Reports
  - f. Comments after Scoping Period
  - g. DEIS Public Comments
3. **Agency Consultation & Permits**
  - a. Army Corps of Engineers (404 permit)
  - b. US Fish & Wildlife Service (Sec. 7 T&E)
  - c. State Historic Preservation Office (Sec. 106)
  - d. Tribes (Sec. 106)
  - e. Advisory Council on Historic Preservation (Sec. 106)
  - f. Other
  - g. AZ Dept of Environmental Quality (APP)
4. **Communication**
  - a. Congressional
  - b. Cooperating Agencies
  - c. Organizations
  - d. Individuals
  - e. FOIA
  - f. Internal
  - g. Proponent
5. **Proposed Action**
  - a. Mine Plan (including compilation)
  - b. Supporting Documents
  - c. Detailed Designs
  - d. References
6. **Alternatives**
7. **Resources**
  - a. Air Quality & Climate Change
  - b. Biological
  - c. Dark Skies
  - d. Fuels & Fire Management
  - e. Hazardous Materials
  - f. Heritage
  - g. Land Use
  - h. Livestock Grazing
  - i. Noise & Vibration
  - j. Public Health & Safety
  - k. Recreation & Wilderness
  - l. Riparian
  - m. Socioeconomics & Environmental Justice
  - n. Soils & Geology
  - o. Transportation & Access
  - p. Visual
  - q. Water
8. **Reclamation**
  - a. Plans & Reports
  - b. Notes & Correspondence
  - c. References
  - d. Other
9. **DEIS**
  - a. DEIS
  - b. References
10. **FEIS**
11. **Geospatial Analysis (GIS Data)**
12. **FOIA Exempt Documents**
13. **ROD (including BLM & ACOE)**



**ATTACHMENT B**  
**TECHNICAL MEMORANDUM**  
**ROSEMONT FLOW-THROUGH DRAIN SIZING**

# Rosemont Copper Project

## Locator Sheet

Record # 012428

Document Date 2010 04 05

Document Title: Rosemont Flow-Through Drain Sizing

Author/Recipient Monica Salguero, Ronson Chee, TetraTech

Description Discusses the design & sizing of the flow-through drains associated w/base concept of Rosemont Ridge landform.

Other Notes Attachment B of 013396.

This document is located in the following: [CIRCLE THE CATEGORY (from the list below) IN WHICH THIS ITEM IS FILED]

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  - a. Formal recommendations & Directions
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  - a. DEIS
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12. **FOIA Exempt Documents**
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**ATTACHMENT C**  
**TECHNICAL MEMORANDUM**  
**ROSEMONT INFILTRATION ANALYSIS - REVISED**

**Rosemont Copper Project  
Locator Sheet**

Record # 013397

Document Date 2010 04 05

Document Title: Rosemont Infiltration Analysis- Revised

Author/Recipient Monica Salguero, Joel Carrasco, Tetra Tech

Description Revised tech memo pertaining to infiltration of stormwater runoff for baseline & post-mining conditions at Rosemont project.

Other Notes Attachment C of 013396.

This document is located in the following: [CIRCLE THE CATEGORY (from the list below) IN WHICH THIS ITEM IS FILED]

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|---|--|
| <p><b>1. Project Management</b></p> <ul style="list-style-type: none"><li>a. Formal recommendations &amp; Directions</li><li>b. Formal meeting minutes &amp; memos</li><li>c. General Correspondence</li><li>d. Contracts, Agreements, &amp; MOUs (Rosemont, Udall, SWCA)</li><li>e. Other</li></ul> <p><b>2. Public Involvement</b></p> <ul style="list-style-type: none"><li>a. Announcements &amp; Public Meetings</li><li>b. Mailing Lists</li><li>c. Scoping Period Comments</li><li>d. Udall Foundation Working Group</li><li>e. Scoping Reports</li><li>f. Comments after Scoping Period</li><li>g. DEIS Public Comments</li></ul> <p><b>3. Agency Consultation &amp; Permits</b></p> <ul style="list-style-type: none"><li>a. Army Corps of Engineers (404 permit)</li><li>b. US Fish &amp; Wildlife Service (Sec. 7 T&amp;E)</li><li>c. State Historic Preservation Office (Sec. 106)</li><li>d. Tribes (Sec. 106)</li><li>e. Advisory Council on Historic Preservation (Sec. 106)</li><li>f. Other</li><li>g. AZ Dept of Environmental Quality (APP)</li></ul> <p><b>4. Communication</b></p> <ul style="list-style-type: none"><li>a. Congressional</li><li>b. Cooperating Agencies</li><li>c. Organizations</li><li>d. Individuals</li><li>e. FOIA</li><li>f. Internal</li><li>g. Proponent</li></ul> <p><b>5. Proposed Action</b></p> <ul style="list-style-type: none"><li>a. Mine Plan (including compilation)</li><li>b. Supporting Documents</li><li>c. Detailed Designs</li><li>d. References</li></ul> <p><b>6. Alternatives</b></p> | <ul style="list-style-type: none"><li>a. Cumulative Effects Catalog</li><li>b. Connected Actions</li><li>c. Dismissed from Detailed Analysis</li><li>d. Analyzed in Detail<ul style="list-style-type: none"><li>i. Barrel McCleary</li><li>ii. Barrel Only</li><li>iii. Scholefield McCleary</li></ul></li></ul> <p><b>7. Resources</b></p> <ul style="list-style-type: none"><li>a. Air Quality &amp; Climate Change</li><li>b. Biological</li><li>c. Dark Skies</li><li>d. Fuels &amp; Fire Management</li><li>e. Hazardous Materials</li><li>f. Heritage</li><li>g. Land Use</li><li>h. Livestock Grazing</li><li>i. Noise &amp; Vibration</li><li>j. Public Health &amp; Safety</li><li>k. Recreation &amp; Wilderness</li><li>l. Riparian</li><li>m. Socioeconomics &amp; Environmental Justice</li><li>n. Soils &amp; Geology</li><li>o. Transportation &amp; Access</li><li>p. Visual</li><li><b>q. Water</b></li></ul> <p><b>8. Reclamation</b></p> <ul style="list-style-type: none"><li>a. Plans &amp; Reports</li><li>b. Notes &amp; Correspondence</li><li>c. References</li><li>d. Other</li></ul> <p><b>9. DEIS</b></p> <ul style="list-style-type: none"><li>a. DEIS</li><li>b. References</li></ul> <p><b>10. FEIS</b></p> <p><b>11. Geospatial Analysis (GIS Data)</b></p> <p><b>12. FOIA Exempt Documents</b></p> <p><b>13. ROD (including BLM &amp; ACOE)</b></p> |
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**ATTACHMENT D**  
**TECHNICAL MEMORANDUM**  
ROSEMONT FLOW-THROUGH DRAIN SEDIMENTATION  
ANALYSIS

# Rosemont Copper Project

## Locator Sheet

Record # 013398

Document Date 2010 08 31

Document Title: Rosemont Flow-Through Drain Sedimentation

### Analysis

Author/Recipient Gregory Hemmen, TetraTech

Description Estimates of sediment loading to the drain inlet areas & expands on the control of the sediments at the inlet areas.

Other Notes Attachment D of 013396.

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**3. Agency Consultation & Permits**

- a. Army Corps of Engineers (404 permit)
- b. US Fish & Wildlife Service (Sec. 7 T&E)
- c. State Historic Preservation Office (Sec. 106)
- d. Tribes (Sec. 106)
- e. Advisory Council on Historic Preservation (Sec. 106)
- f. Other
- g. AZ Dept of Environmental Quality (APP)

**4. Communication**

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  - iii. Scholefield McCleary

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- n. Soils & Geology
- o. Transportation & Access
- p. Visual

**q. Water**

**8. Reclamation**

- a. Plans & Reports
- b. Notes & Correspondence
- c. References
- d. Other

**9. DEIS**

- a. DEIS
- b. References

**10. FEIS**

**11. Geospatial Analysis (GIS Data)**

**12. FOIA Exempt Documents**

**13. ROD (including BLM & ACOE)**