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Technical Memorandum

To:	Kathy Arnold	**From:**	Ronson Chee
Company:	Rosemont Copper Company	**Date:**	September 15, 2010
Re:	Rosemont Expanded Barrel Only Alternative Stormwater Control Features	**Doc #:**	249/10-320878-5.3
CC:	David Krizek, P.E. (Tetra Tech); Joel Carrasco (Tetra Tech)		

1.0 Introduction

This Technical Memorandum summarizes the stormwater control features anticipated for the Expanded Barrel Only Alternative associated with the proposed Rosemont Copper Project (Project) in Pima County, Arizona. A preliminary grading scheme was prepared for this alternative as shown on Figure 1 and is referred to as the Expanded Barrel Only Landform (Landform). The Landform consists of a Waste Rock Storage Area, a Dry Stack Tailings Facility encapsulated with waste rock, and a closed Heap Leach Facility, also encapsulated with waste rock. The main feature of the Landform shape shown on Figure 1 is the New Barrel Canyon drainage. New Barrel Canyon drainage is designed to route large storm events off the reclaimed Landform surface into Lower Barrel Canyon wash.

2.0 Landform Grading Criteria

The strategic placement of drainage benches defined the grading scheme shown on Figure 1. Reclamation design of the Rosemont Ridge Landform, as presented in the *Reclamation Concept Update* report (Tetra Tech, 2010b), in conjunction with the report prepared by Golder Associates Inc. (Golder), 2010) titled *Rosemont Mine Landforming Evaluation of Mine Waste Slope Geometry,* was used to establish the grading criteria for the Landform, i.e., spacing of drainage benches.

Per the Golder report, the reclaimed surface of the Landform was assumed to consist of soil material having a D_{50} of 3 inches with planar concave slopes. Based on these assumptions, the following slope grading criteria was selected:

- The maximum slope length for a 6H:1V slope is approximately 700 feet;
- The maximum slope length for a 4H:1V slope is approximately 400 feet;
- The maximum slope length for a 3H:1V slope is approximately 300 feet; and
- The maximum slope length for a 2H:1V slope is approximately 200 feet.

Final reclaimed slopes of the Expanded Barrel Only Landform range from 6H:1V to 2H:1V. With the exception of the 2H:1V slope, adding a drainage bench every 100 feet of vertical elevation

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Memorandum

To:	Bev Everson
Cc:	Tom Furgason
From:	Kathy Arnold
Doc #:	041/10 – 15.3.2
Subject:	**Transmittal of Information for Alternatives**
Date:	September 30, 2010

Rosemont is pleased to transmit the following documents:

- *A Cultural Resource Survey of the 46kV Alternative and Additional Areas for the Rosemont Project 138kV Line,* EPG, September 2010
- *Technical Memorandum Rosemont Alternatives Infiltration Analysis,* Tetra Tech, September 15, 2010
- *Technical Memorandum on Expanded Barrel Only Alternative Stormwater Assessment,* Tetra Tech, September 10, 2010
- *Technical Memorandum Rosemont Expanded Barrel Only Alternative Stormwater Control Features,* Tetra Tech, September 15, 2010

Rosemont is providing three hardcopies and two disk copies for the Forest and two hardcopies and one disk copy for SWCA of the reports.

on the Landform surface satisfies the grading criteria established above. The area with the 2H:1V slopes is assumed armored with run-of-mine (ROM) rock.

3.0 Design Storm Criteria

Based on the design of the Rosemont Ridge Landform (Tetra Tech, 2010b), and the stormwater controls and criteria developed as part of the *Site Water Management Update* report (Tetra Tech, 2010c), the design criteria listed below were selected to size stormwater control structures associated with the Expanded Barrel Only Landform. Further description of these structures is provided in Section 4.0.

- At a minimum, drop structures would be designed to convey the peak flow from a National Resource Conservation Service (NRCS) 500-year, 24-hour event;
- Detention pools in the waste rock area would contain runoff from up to the NRCS 500-year, 24-hour event;
- At a minimum, drainage bench channels would be designed to convey the peak flow from an NRCS 500-year 24-hour event; and
- Perimeter containment areas (PCAs), in conjunction with detention pools, would be designed to accommodate the volume generated from a General Probable Maximum Precipitation (PMP) event.

Discussion of the NRCS method is provided in the Technical Memorandum titled *Rosemont Hydrology Method Justification* (Tetra Tech, 2010a).

Additionally, it is anticipated that the New Barrel Canyon drainage would be sized to convey a minimum of the 500-year, 24-hour event.

4.0 Stormwater Management Features

In addition to the New Barrel Canyon drainage feature, the principles and concepts employed in developing the preliminary grading scheme and associated stormwater control features for the Expanded Barrel Only Landform are similar to features developed for the Rosemont Ridge Landform (Tetra Tech, 2010c). The major stormwater control features planned for the reclaimed surface of the Expanded Barrel Only Landform include:

- Detention pools/basins;
- Retention pools/basins (PCAs);
- Drop structures and energy dissipation pools; and
- Drainage benches with channels.

Drainage divides and drop structures were strategically placed based on the carrying capacity of the drainage bench channels. Stilling pools would be placed at the confluence of drainage bench flows and drop structures to dissipate flow energy. Once dissipated, storm flows would

leave the drainage benches via drop structures. Drop structures would either route stormwater off the Landform to McCleary Canyon, to PCA's located along the southern perimeter of the Landform, to New Barrel Canyon, or to the western side of the Landform. Storm flows routed to the western side of the Landform would generally report to flow-through drains. Flow-through drains are large rock drains designed to convey stormwater from the up-gradient side of the Landform to the down-gradient side (Tetra Tech, 2010c). Figure 2 shows the anticipated stormwater control features.

4.1 New Barrel Canyon Drainage

The driving factor in shaping the Expanded Barrel Only Landform was to shed as much storm runoff as possible off the structure and into Lower Barrel Canyon wash. This was accomplished by creating the New Barrel Canyon drainage feature.

The New Barrel Canyon drainage is anticipated to have a composite bed slope ranging from 4% to 5%. The profile of New Barrel Canyon would be stepped, with sloping channel segments and stilling/energy-dissipation pools located along its alignment. Drainage benches would feed into New Barrel Canyon at 100 foot elevation increments along the artificial canyon. The steepness of the New Barrel Canyon would require armoring with ROM rock along the entire length of the drainage. Channel dimensioning and the degree of erosion protection would be based on the flow characteristics reaching the different channel sections.

The two-dimensional land surface area of the Expanded Barrel Only Landform is about 2,800 acres (4.38 sq. mi). Of this total area, approximately 1,300 acres (~46% of the total area) could contribute runoff to New Barrel Canyon. The remaining areas would report to detention pools in the Waste Rock Storage Area or PCAs, or would drain completely off the Landform. As indicated, stormwater draining to the western side of the Landform would report to flow-through drains.

4.2 Waste Rock Storage Facility

The inner bench slopes on the eastern face of the Waste Rock Storage Area vary from 6H:1V to 3H:1V. The inner bench slopes along the southern and western sides of the Waste Rock Storage Area are generally 3H:1V. A small section along the western side also has 2H:1V inner bench slopes.

Stormwater control on the reclaimed surfaces of the Waste Rock Storage Area would consist of detention basins, drainage benches, stilling pools, and drop structures. Drainage benches were placed at 100 foot elevation increments in order to satisfy the grading criteria established in Section 2.0.

The southern side of the Waste Rock Storage Area would retain runoff in detention basins up to the NRCS 500-year, 24-hour event. Runoff volumes exceeding the 500-year, 24-hour event would be routed down the waste rock slopes at select locations (armored) and into PCAs. The spillover areas would be armored with ROM rock. The combined storage volume of the detention basins and the PCAs would manage runoff volumes up to the General PMP event.

Drainage benches on the southeastern side of the Waste Rock Storage Area would route runoff to drop structures and into a PCA. Overflow from the PCA would flow along the toe of the Waste Rock Storage Area and report to New Barrel Canyon via an Overflow Drainage Bench (see Figure 2). The Overflow Drainage Bench would be sized to convey a minimum of the 500-year, 24-hour event

A ridge runs along the eastern side of the Waste Rock Storage Area adjacent to Highway 83. The ridge serves as a drainage divide for the benches. Stormwater runoff on the eastern side of the ridge would report to a PCA and could eventually flow to the north along the toe of the Landform and into Lower Barrel Canyon wash.

Stormwater generated on the western side of the Waste Rock Storage Area would either report to a PCA or to a flow-through drain. The perimeter containment areas would also be used to mange runoff from the Pit Diversion Channel.

4.3 Dry Stack Tailings Facility

The inner bench slopes associated with the reclaimed surfaces of the Dry Stack Tailings Facility are mostly of 3H:1V slopes with drainage benches placed at 100 foot elevation increments. Stormwater controls consist of drainage benches and drop structures. Pooling of stormwater on the top surfaces of the Dry Stack Tailings Facility was limited.

Drainage benches on the northern face of the North Dry Stack Tailings Facility would route flows to a drop structure located at the northwest corner of the facility. This drop structure would direct flow into McCleary Canyon.

Drainage benches on the western face of the North Dry Stack Tailings Facility would eventually report to a flow-though drain (see Figure 2) via a ROM rock lined channel located parallel to a former haul road. Stormwater runoff generated on the top surface of the North Dry Stack Tailings Facility would also report to this haul road drainage channel.

Drainage benches on the eastern side of the North Dry Stack Tailings Facility would route flows to a drop structure and into New Barrel Canyon.

Drainage Benches on the western face of the South Dry Stack Tailings Facility would route flow off the Landform. This flow would travel north along the toe of the Landform and into a flow-through drain.

Drainage benches on the eastern side of the South Dry Stack Tailings Facility would route flow to a drop structure located at the southeastern corner of this facility and into New Barrel Canyon.

The South Dry Stack Tailings Facility would partially encapsulate the Heap leach Pad. Therefore, stormwater would generally be shed off the reclaimed surface of the South Dry Stack Tailings Facility without detention.

4.4 Flow-Through Drains

Flow-though drains would serve as a hydraulic connection between the up-gradient side of the Expanded Barrel Only Landform and the down-gradient side. Sizing of the flow-through drains associated with the Expanded Barrel Only Landform would be similar to the southern flow-through drains presented in the *Site Water Management Update* report (Tetra Tech, 2010c).

5.0 Conclusion

Except for the New Barrel Canyon drainage feature, stormwater control structures associated with the Expanded Barrel Only Alternative would closely resemble the structures presented in the *Sitewater Management Update* report (Tetra Tech, 2010c). New Barrel Canyon would be

designed to shed as much stormwater runoff from the reclaimed surface of the Expanded Barrel Only Landform as possible into Lower Barrel Canyon wash. This main drainage feature would likely be sized to convey the peak flow generated by ½ the Local PMP Event. Other stormwater control features would include detention basins, drainage bench channels, drop structures, stilling pools, and retention basins (PCAs).

REFERENCES

Golder Associates Inc. (Golder) (2010), *Rosemont Mine Landforming Evaluation of Mine Waste Slope Geometry*. Prepared for SWCA Environmental Consultants. Report Dated February 17, 2010.

Tetra Tech Chee, R., and Hemmen, G. (2010a). *Rosemont Hydrology Method Justification.* Technical Memorandum to Kathy Arnold (Rosemont Copper Company). Technical Memorandum Dated January 27, 2010.

Tetra Tech (2010b). *Reclamation Concept Update*. Prepared for Rosemont Copper Company. Report Dated March 2010.

Tetra Tech (2010c). *Site Water Management Update*. Prepared for Rosemont Copper Company. Report Dated April 2010.

FIGURES

N

SCALE
1000' 0 1000' 2000'

LEGEND

- EXISTING CONTOURS
- TOWNSHIP/RANGE LINE
- SECTION LINE
- PROPOSED CONTOURS

WEST ACCESS ROAD
PERMANENT DIVERSION CHANNEL NO. 1 (BY AMEC)
PLANT SITE
PRIMARY ACCESS ROAD
LOWER BARREL CANYON
MCCLEARY CANYON
OPEN PIT (ULTIMATE LIMITS)
OPEN PIT
NORTH DRY STACK TAILINGS FACILITY
HAUL ROAD DRAINAGE CHANNEL
SOUTH DRY STACK TAILINGS FACILITY
NEW BARREL CANYON
4% SLOPE
PERIMETER CONTAINMENT AREA (TYP.)
OVERFLOW DRAINAGE BENCH
SR 83
PIT DIVERSION CHANNEL
WASTE ROCK STORAGE AREA
WASTE ROCK STORAGE AREA
PIT DIVERSION CHANNEL OUTLET
LANDFORM
PERIMETER CONTAINMENT AREA (TYP.)
PERIMETER CONTAINMENT AREA (TYP.)
PERIMETER CONTAINMENT AREA (TYP.)
PERIMETER CONTAINMENT AREA (TYP.)

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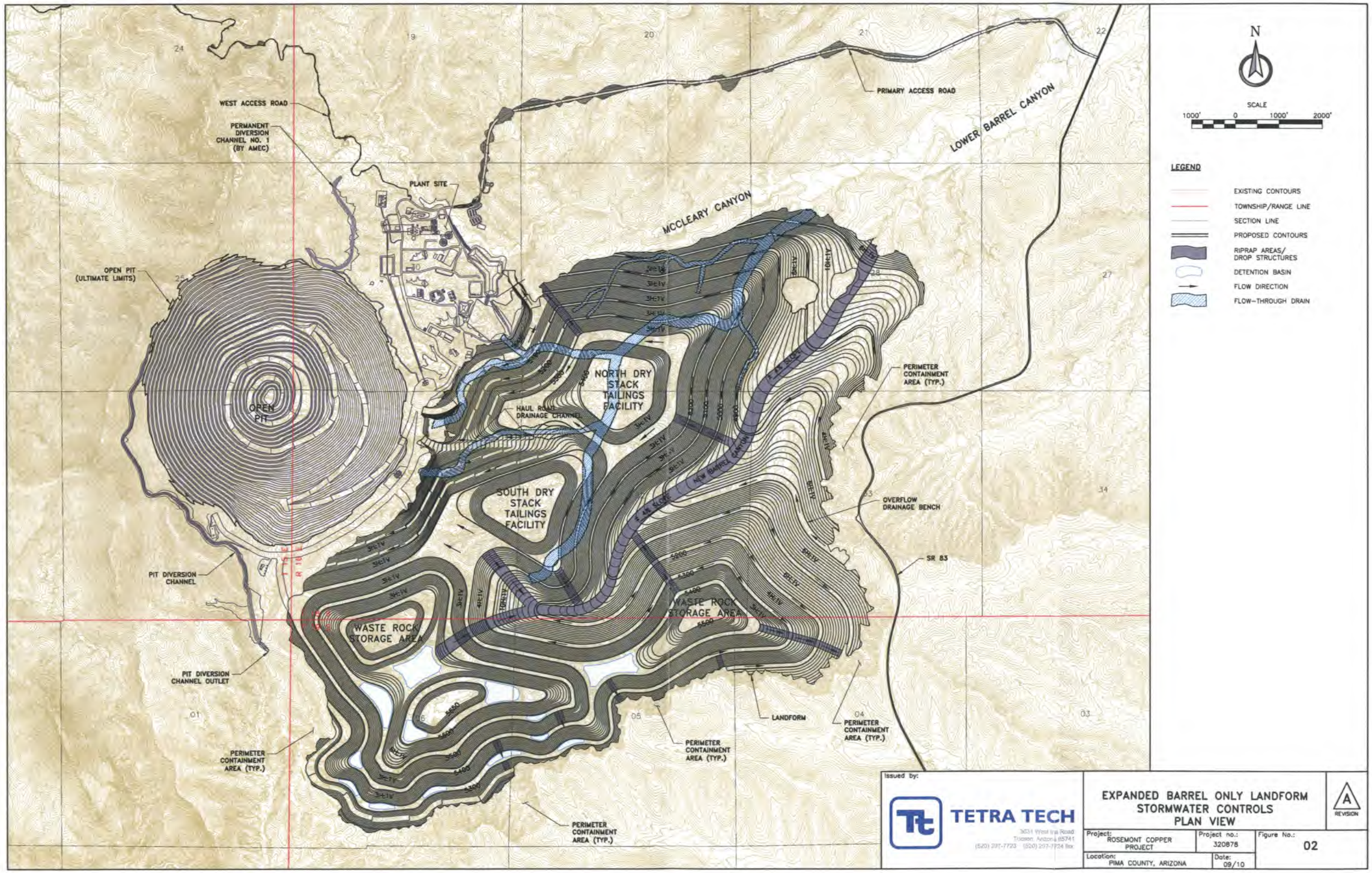
EXPANDED BARREL ONLY LANDFORM GRADING SCHEME PLAN VIEW

A REVISION

Project: ROSEMONT COPPER PROJECT	Project no.: 320878	Figure No.: 01
Location: PIMA COUNTY, ARIZONA	Date: 09/10	



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EXPANDED BARREL ONLY LANDFORM STORMWATER CONTROLS PLAN VIEW

A REVISION

Project: ROSEMONT COPPER PROJECT	Project no.: 320878	Figure No.: 02
Location: PIMA COUNTY, ARIZONA	Date: 09/10	