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May 17, 2011

Ms. Kathy Arnold
ROSEMONT COPPER COMPANY
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Tucson, AZ 85740-5130

SUBJECT: SECOND RESPONSE TO APRIL 5, 2011 SELECTED COMMENTS PROVIDED BY U.S. FOREST SERVICE REGARDING GROUNDWATER FLOW MODELING CONDUCTED FOR THE ROSEMONT PROJECT

Dear Ms. Arnold:

Enclosed are our expanded responses to three comments provided in the April 5, 2011 letter from the Coronado National Forest concerning their review of documents submitted in support of groundwater impacts for the Rosemont Environmental Impact Statement (EIS). The expanded comments are prepared at the request of the Coronado National Forest.

WEST-SIDE COMMENTS AND EXPANDED RESPONSES:

FS/BLM Comment (WS-1): *Describe in detail why extending the model time frame after pumping cessation is not possible or warranted. Presently the model drawdown contours are temporally described only at the end of pumping. The 1 foot and 10 foot cone of depression contours could extend laterally further out for years, depending on aquifer parameters.*

> **M&A WS-1 Response:** It is correct that residual drawdown will propagate outward after shutdown of the Rosemont wellfield; however, the groundwater levels will begin recovering immediately after shutdown in the vicinity of the Rosemont wellfield, which is the primary focus of the impact study for Rosemont pumping. For illustration purposes, the 10-foot projected drawdown contour from end of pumping through 140 years after pumping ends is shown for 10-year increments on **Figure WS-1**. Results indicate the 10-foot drawdown contour continues to propagate outward, reaching maximum extents in different directions during the 140-year post-pumping period.
>
> Drawdown due to Rosemont pumping is determined by subtracting projected groundwater levels for the Rosemont pumping simulation from projected groundwater levels for a simulation without Rosemont pumping. Due to

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declining regional groundwater levels in the Tucson Basin, extension of the model simulation into the future resulted in cessation of some regional layer 2 pumping due to dewatered model cells; in some cases these cells dewatered sooner in the Rosemont pumping simulation. To remedy this problem, starting in 2038 all pumping from layer 2 was moved to layer 3 for purposes of comparing with and without Rosemont pumping simulations to determine drawdown from Rosemont pumping only.

The 10-foot contour provides an obvious metric for the determination of drawdown impacts based on the Arizona Administrative Code's Well Spacing Rule R12-15-1302, which **specifies drawdown at a well adjacent to a new pumping well cannot exceed 10 feet within 5 years after the start of pumping. However, the Rosemont wells will be permitted as mineral extraction wells and are exempt from this well spacing requirement, and the 10-foot drawdown contours shown on Figure WS-1 are for as much as 160 years after start of pumping rather than 5 years.**

FS Comment (WS-2): *Describe in detail the feasibility of a groundwater model using seasonality. Describe what data is available and data requirements to using seasonality in the existing groundwater model such as a telescoped model focusing on the area of the cone of depression using at a minimum the 2 pumping seasons (on/off) or the 4 seasons (summer, winter etc). Such a telescoped model could include all of the appropriate seasonal variation without having to apply it to the more general, larger model, which would be used to supply boundary conditions.*

M&A WS-2 Response: It is possible to construct a model which simulates seasonal variability of groundwater stresses in the study area; however, the historic variations in the model would be poorly calibrated due to a substantial lack of seasonal observed data, and the projected seasonal variations would not be accurate. **It is important to emphasize that a model which simulates seasonal stresses in the aquifer would project the same drawdown due to Rosemont pumping as does the current annual stress period model used for the EIS analysis (M&A, 2009)**. Superposition of the recent observed seasonal groundwater level variations in the Sahuarita Heights area (data from continuously monitored deep wells E-1 and RC-2 and shallow domestic wells) onto the projected drawdown from the annual stress period model provides the most accurate estimate of future seasonal drawdown variations in the Sahuarita Heights area.

Published data for pumping in the study area are available only as annual volumes; therefore, estimating seasonality for some of the pumping in the study area would be speculative. Artificial recharge from the Pima Mine Road recharge project and wastewater recharge in the area is not necessarily seasonally variable. Recharge from the Santa Cruz River and from agricultural irrigation is best

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estimated as annual averages; applying seasonality to the arrival of these recharged waters to the water table would be speculative and subject to substantial error. Estimating the seasonality of these stresses in the model requires good observations of seasonal groundwater level variation in the study area; however, seasonal water level data is not available, with the exception of the recent data for the two wells (E-1 and RC-2) in Sahuarita Heights. Therefore, adjustment of seasonal stresses in the model would be largely uncalibrated and subject to substantial error. As stated previously, the errors introduced in estimating seasonality of these simulated stresses would not improve the ability to predict seasonality of groundwater level changes in the Sahuarita Heights area as compared to the current method presented in the report, which is based on actual observed data.

EAST-SIDE COMMENT AND EXPANDED RESPONSE:

FS Comment (ES-1): *Describe in detail why constant and/or general head boundaries were employed on the model periphery, why the results of the model are not affected or minimized by them, and why basin boundaries were not utilized rather than the rectangular configuration in the current models. Please provide examples and references of any other projects which have handled boundaries in a similar manner. If it is necessary to show flux out of the model boundary on the west, and it is deemed that the best way to represent this is with a general head or constant head boundary, then the use of these boundary types should be limited to the region of outflow, rather than generally applied to the model periphery.*

M&A ES-1 Response: Constant head boundaries (CHBs) were specified to maintain constant groundwater levels at locations where future groundwater level drawdown from Rosemont pit development is not projected to reach the model boundary. Use of CHBs in this manner is consistent with accepted modeling practices where boundaries are located far from the projected stresses (Anderson and Woessner, 1992). Confirmation that CHBs were correctly located outside of pit-dewatering impacts is demonstrated by: (1) projected drawdown plots presented in the EIS model report (M&A, 2010); and (2) boundary flow data in Figure ES-3 and Table ES-3 (M&A, 2011) which show negligible changes in flow across CHBs for 1,000 years post-mining compared to steady-state conditions, indicating projected drawdown from pit development was not a factor at the CHBs. Projected change in flow across the CHBs at 1,000 years post-mining almost exclusively occurs in the northwest corner of the model within the Tucson basin, representing the negligible reduction in outflow from Cienega Creek basin into Tucson Basin due to pit dewatering.

General head boundaries (GHBs) were specified at locations where future groundwater level drawdown from Rosemont pit development is projected to reach the model boundary, resulting in either a decrease in model outflow or an increase in model inflow across the GHBs. Confirmation that GHBs were

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correctly located where pit-dewatering impacts reach the model boundary is demonstrated by: (1) projected drawdown plots presented in the EIS model report (M&A, 2010); and (2) Figure ES-3 and Table ES-3 (M&A, 2011), which show small changes in flow across GHBs for 1,000 years post-mining compared to steady-state conditions and show small changes compared to the negligible changes across CHBs.

Basin boundaries are typically used as model boundaries for basin fill models where the basin boundary is comprised of bedrock material and considered to be no-flow relative to the permeable basin fill aquifer. This is not the case for the Rosemont model where the primary focus is flow in the fractured bedrock, including formations along and beyond the topographic basin boundaries; therefore, a no-flow condition along the basin boundaries is unrealistic. The granodiorite core of the Santa Rita Mountains, which is the closest topographic divide to the open pit, is assumed to be very low- to no-permeability, and was simulated as very low-permeability in the model.

We disagree with the comment that the use of GHBs and CHBs should be limited to the "region of outflow". In particular the CHBs, which are distant from the pit, provide a reasonable approximation of groundwater level conditions for the regional flow system, and do not influence the projected groundwater level change due to pit development. This conclusion was reached at the model review meeting held February 22, 2010 between U.S. Forest Service, SWCA Environmental Consultants, SRK Consulting, Montgomery & Associates (M&A), and Tetra Tech. The approach of using GHB cells west of the pit area and CHB cells outside the area of hydraulic influence of the pit sink was agreed upon during this meeting.

The responses provided above are intended to resolve remaining concerns about potential hydrogeologic impacts related to the Rosemont Draft EIS. If you have any questions or need additional information or clarification, please let us know.

Sincerely,

MONTGOMERY & ASSOCIATES

Hale W. Barter

Jonathan D. Whittier

Attachment

SENT VIA EMAIL AND U.S. MAIL

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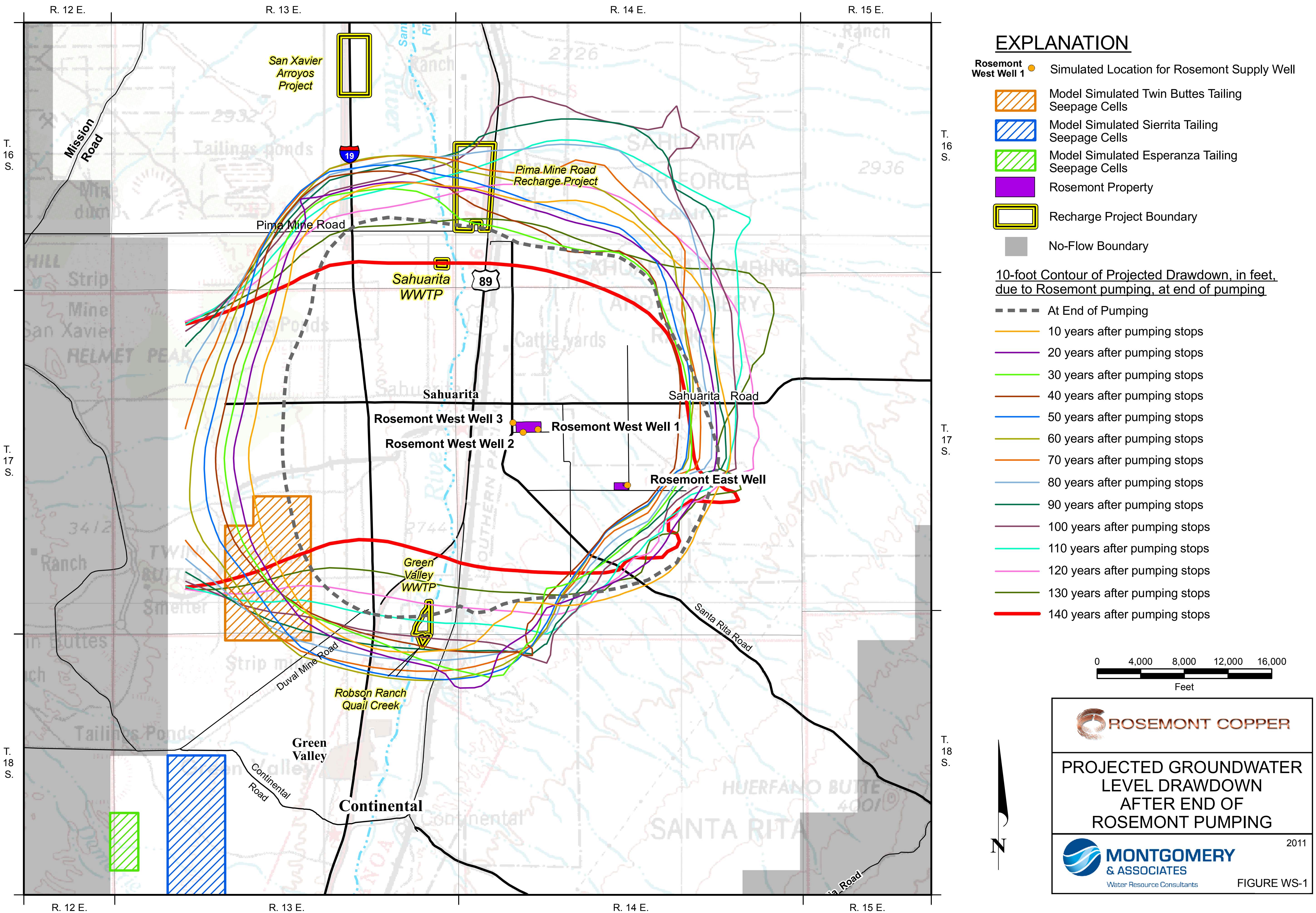
REFERENCES CITED

Anderson, M. P. and Woessner, W. W., 1992, Applied Groundwater Modeling Simulation of Flow and Advective Transport: Academic Press, 1992, p. 102.

Montgomery & Associates, 2009, **Groundwater Flow Modeling Conducted for Simulation of Rosemont Copper's Proposed Mine Supply Pumping, Sahuarita, Arizona:** prepared for Rosemont Copper, April 30, 2009.

_____, 2010, **Groundwater Flow Modeling Conducted for Simulation of Proposed Rosemont Pit Dewatering and Post-Closure, Rosemont Project, Pima County, Arizona:** prepared for Rosemont Copper, August 30, 2010.

_____, 2011, **Response to April 5, 2011 Comments Provided by U.S. Forest Service Regarding Groundwater Flow Modeling Conducted for the Rosemont Project:** letter to Kathy Arnold dated May 5, 2011.



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