

A photographic assessment of greenness and land surface character at the proposed Rosemont Copper mine site

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Rosemont consultants have run air quality models that require careful assessment and inputs of key parameters related to mixing layer growth and depth (i.e., Albedo, Surface Roughness, and Bowen Ratio). The table below shows the values chosen by Rosemont consultants for these key parameters. However, the table values and the statements below the table indicate that Rosemont consultants used the **most simple, default options** from the AERSURFACE User’s Guide (EPA-454/B-08-001, January 2008 (http://www.epa.gov/scram001/7thconf/aermod/aersurface_userguide.pdf) and did not determine more accurate, site-specific conditions – **this is a serious flaw, given the very complex surface character of the Rosemont project area.**

For example, the well-known summer monsoon occurs over southeastern Arizona from July through September, making the default use of “standard U.S. seasons inappropriate to the site. The summer monsoon should be characterized by the lowest Bowen Ratio, while Spring (April, May, and June at the site) should have the highest Bowen ratio, approaching a value of 10. The table indicates that something went seriously awry when Rosemont consultants applied the AERSURFACE self-help, applications. Surface roughness was set essentially as constant, even though considerable changes occur to the surface character during the year. The terrain rises abruptly to the west, with the ridgeline of the northern Santa Rita Mountains, a Sky Island, only a km away to the west. Thus, the effective roughness is likely different for an upwind sector from the on-site weather station (northwest to southwest - the sector from which prevailing winds blow). While AERSURFACE allows the user to include such sector aspects of the nearby terrain and roughness, Rosemont consultants chose a simple, inappropriate default setting.

Table 5.1 Surface Characteristics used in the AERMOD Modeling				
Surface Characteristic *	Spring	Summer	Autumn	Winter
Albedo	0.25	0.25	0.25	0.25
Bowen Ratio	2.88	3.76	5.70	5.70
Surface Roughness	0.153	0.153	0.153	0.152
* Generated by AERSURFACE, dated 08009 Center UTM Easting (meters): 522896.0; Center UTM Northing (meters): 3521802.0; UTM Zone: 12, Datum: NAD83 Study radius (km) for surface roughness: 1.0 Airport? N, Continuous snow cover? N Surface moisture? Average, Arid region? Y, Month/Season assignments? Default Late autumn after frost and harvest, or winter with no snow: 12 1 2 Winter with continuous snow on the ground: 0 Transitional spring (partial green coverage, short annuals): 3 4 5 Midsummer with lush vegetation: 6 7 8; Autumn with un-harvested cropland: 9 10 11				

Table 1 – Surface characteristic specified by Rosemont consultants for their air quality modeling efforts.

Albedo was set to be **constant** through the year at 0.25 – Table A-1 of the AERSURFACE Guide indicates that this is the suggested value for desert shrublands through the year, since there is little change through the seasons for this land surface character. However, Albedos suggested for non-arid shrublands and evergreen forest are about half the default values used by Rosemont consultants.

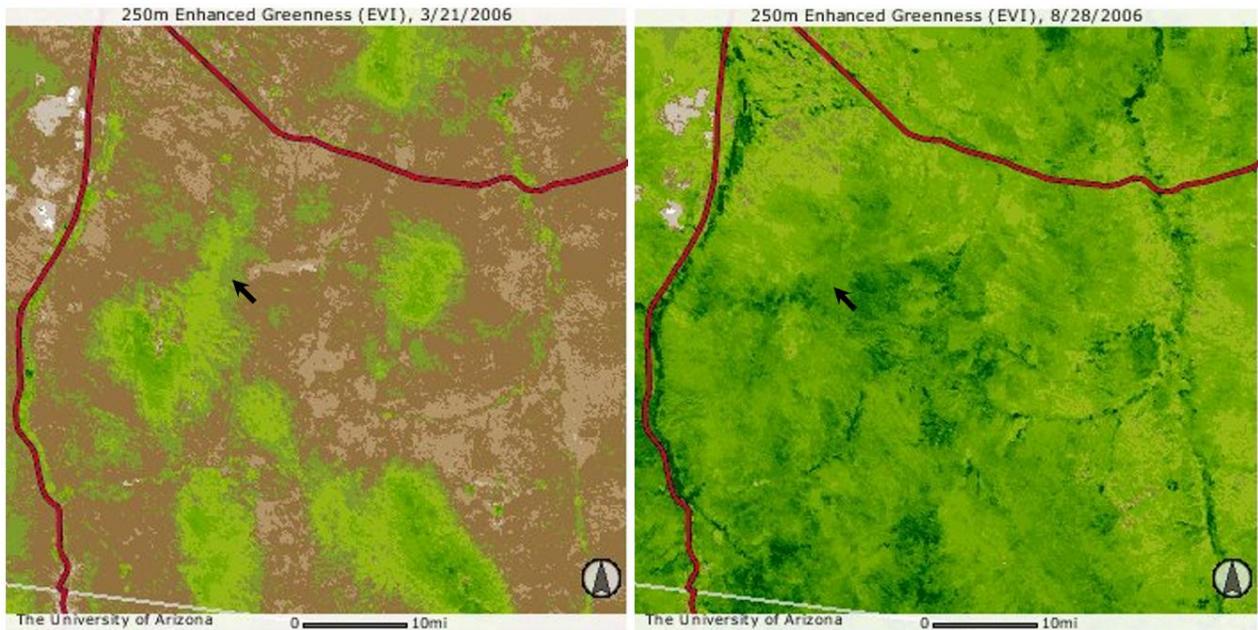


Figure 1– Typical greenness for pre-monsoon period (left) and monsoon period (right) – black arrows point to approximate center of the Rosemont project area.

Figure 1 above shows typical greenness (EVI) determined from satellite data for the pre-monsoon period (left) and during the monsoon (right). Note – Interstate 10 (to the north) and 19 (to the west) are shown in red and the Rosemont site is about 5 miles west of the center of the images. Obviously, the monsoon triggers a very significant greening that leads to substantial changes in Bowen Ratio and Albedo. The site is much more complex than is desert shrubland. The photo in Fig. 2 below shows an example of simple desert shrubland.



Figure 2 – Photo of typical desert shrubland.



Figure 3 –Image showing complex mix of shrubland and evergreen forest across Rosemont site – black “X” is at approximate center of the Rosemont project area.

Figure 3 above is an image from the NLCD92 surface character database. Even this simple categorization (used within AERSURFACE) indicates a complex mix of shrubland and evergreen forest across the site (at center of image, which shows Highway 83). The Albedo and Bowen Ratio used within AERMOD is supposed to represent an average for a 10 x 10 km area centered on the onsite observation station. Based on years of personal observations along Highway 83, which runs along the east side of the Rosemont site, I know that the site is a complex blend of land surface features and characteristics that range from desert shrubland at the lowest elevations on the northeast periphery, to forest, and to grasslands, as the elevation and annual rainfall increases to the south.

Figure 4 shows two photos of the site taken from the scenic overlook along Highway 83. Figure 4a is in September 2013 near the end of the summer monsoon, and Figure 4b is from November 2011 after the onset of fall dryness with the grasses gone dormant.



Figure 4a – View from Highway 83 in September 2013 near the end of the summer monsoon.



Figure 4b – View from Highway 83 in November 2011 after onset of fall dryness.

Figures 5 to 8 below illustrate the wide variety of types of landscape character across the Rosemont project site.



Figure 5 – Photo taken on the site (September 2013 from east of the proposed open pit) showing arroyos covered by mesquite trees and juniper, with interspersed grasses.



Figure 6 – Photo taken in September 2013 showing live oak forests on the southern portion of project area.



Figure 7 – Photo showing mixed live oaks and grasses; taken in September 2013 from near the southwestern corner of the project area looking north toward the ridgeline of the Santa Rita Mountains (i.e., toward the proposed open pit).



Figure 8 – Photo taken in September 2013 of grasses and live oaks looking northwest toward the southeastern corner of the project area.