

**RESOLUTION PRE-FEASIBILITY ACTIVITIES
2007-2008
ARIZONA HEDGEHOG CACTUS SURVEY
Pinal County, Arizona**

Prepared for:



102 Magma Heights
Superior, Arizona 85273

Prepared by:



4001 East Paradise Falls Drive
Tucson, Arizona 85712

MAY 9, 2008
Job No. 807.17

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EXECUTIVE SUMMARY

Resolution Copper Mining, LLC (RCM) proposes to continue previously approved exploration operations and conduct various new activities associated with the planning stages for copper mining within Tonto National Forest. As part of planning for proposed pre-feasibility studies, RCM retained WestLand Resources, Inc. (WestLand) to conduct an Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*; ETA) survey along areas proposed for pre-feasibility activities.

All proposed pre-feasibility activity areas were surveyed for ETA in July and September, 2007, and in January, February, and March 2008. A qualified WestLand field crew of two to three surveyors conducted ETA surveys within the proposed pre-feasibility activity areas plus a 50- to 100-foot wide survey buffer. Survey methods employed by WestLand were based on cactus survey protocols that were designed in consultation with the United States Fish and Wildlife Service and the USDA Forest Service (USFS).

Once survey efforts were completed, ETA were mapped on 2007 aerial imagery at a 1"=100' scale with 10-foot contour intervals, and their locations were field-verified by WestLand biologists and RCM geologists to ensure a precise and accurate representation of their location for planning purposes. These detailed plan views of proposed activities that identify ETA locations with respect to the proposed pre-feasibility activities were submitted to RCM and USFS on February 14, 2008.

Sixty-three ETA were located within the designated survey areas on USFS lands. An additional 26 ETA were recorded just outside the survey area or along planned access routes on privately owned lands. Generally, ETA were found in northern portions of the proposed pre-feasibility activity areas within areas that support vegetation that is consistent with Interior Chaparral, as described by Brown (1994). [REDACTED]

[REDACTED] Typical of this species, most of the observed ETA within the survey area were found on open slopes within cracks and crevices between boulders.

1. INTRODUCTION AND BACKGROUND

1.1 STATEMENT OF PURPOSE

Resolution Copper Mining, LLC (RCM) proposes to continue previously approved exploration operations and conduct various new activities associated with the planning stages for copper mining within Tonto National Forest. The proposed activities would occur on USDA Forest Service (USFS) lands within Township 1 South, Range 12 East, portions of Section 36; Township 1 South, Range 13 East, Sections 11, 13, 14, 21 through 24, and 26 through 35; Township 1 South, Range 14 East; portions of Sections 5, 7, and 8; Township 2 South, Range 12 East, portions of Sections 1, 2, 3, 11, 12, 13, and 25; Township 2 South, Range 13 East, portions of Sections 6, 7, 18, 19, 20, and 30, Gila and Salt River Baseline and Meridian (Figure 1).

As part of planning for proposed pre-feasibility activities, RCM retained WestLand Resources, Inc. (WestLand) to conduct an Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*; ETA) survey along areas proposed for pre-feasibility studies. This survey was conducted in accordance with established survey protocols and procedures as described in Section 2 of this report.

1.2 SITE DESCRIPTION

The survey area is located in the Pinal Mountains within the Central Highlands Province, a transitional zone between the Colorado Plateau and the Basin and Range provinces (Chronic, 1983). This zone is composed of a series of smooth-floored basins separated by rugged mountain ranges.

The survey area lies within the western portion of the Pinal Mountains, an upland area typified by thick chaparral and oak woodlands. This area is known as the Globe-Superior or Pinal Highlands. The western edge of the Pinal Mountains is marked by Apache Leap, a steep escarpment that drops down to the town of Superior and the lower Queen Creek Valley. Elevations within the survey area vary significantly, ranging from approximately 3,100 to 4,640 feet above mean sea level. The topography of the survey area likewise ranges from steep mountain slopes with rock escarpments and deep canyons to the generally flat margins of basins.

The majority of the survey area is characterized by rocky ridges and small valleys located between Devils Canyon and Rawhide Canyon. These large canyons drain into Mineral Creek, a tributary of the Gila River, whose confluence lies approximately 12 miles south of the survey area, near the town of Kelvin. Other portions of the survey area are located in Oak Flat, a rocky basin east of Apache Leap, and in upper Queen Creek. The easternmost part of the survey area is located on the margins of Mason's Valley (also known as Top of the World), a large, flat alluvial basin surrounded by rugged mountain peaks.

The far western portion of the survey area, located west of Apache Leap in the lower foothills of the Pinal Mountains, is significantly lower in elevation than the rest of the survey area and supports vegetation that is consistent with the Sonoran Desertscrub biotic community, as described by Brown (1994). Sonoran Desertscrub is typified by open spaces interspersed with leguminous trees, small shrubs, and cacti. This area drains into Queen Creek, a tributary of the Gila River.

The survey area and vicinity are dominated by plant species associated with the Interior Chaparral biotic community, as described by Brown (1994). According to the statewide map prepared by Brown and Lowe (1994), Mason's Valley also includes the Madrean Evergreen Woodland biotic community. Relatively isolated patches of xeroriparian and mesoriparian vegetation are located throughout the survey area in association with ephemeral drainages. Typical of the Interior Chaparral biotic community, vegetation in the survey area is dominated by scrub live oak (*Quercus turbinella*) and pointleaf manzanita (*Arctostaphylos pungens*). A relatively low density of herbaceous cover is another characteristic of this biotic community. This is due to the higher shrub cover, thin to absent soil, and low annual precipitation.

Vegetation in the survey area has been impacted by recreational uses, camping, off-highway vehicle use, and cattle grazing. This is most evident throughout much of the survey area along existing roadways, on the level areas adjacent to roadways, and around cattle tanks.

1.3 DESCRIPTION, STATUS, RANGE AND HABITAT

1.3.1 Description

ETA was first discovered and described in the mid-1800s in the mountains and canyons between Globe and Superior, Arizona (USFS Draft Taxonomy, 1996).

ETA has dark green cylindroid stems that occur singly or in clusters of a few stems. Large, robust stems range from 23 to 41 centimeters (9.2 to 16.4 inches) high and 7.5 to 10.0 centimeters (3.0 to 4.0 inches) in diameter. Each stem has 7 to 12 robust tuberculate ribs. ETA has one to three gray or pinkish central spines; the largest central spine is deflexed (points down). Its 5 to 11 radial spines are slightly curved (AGFD, 2003). The accompanying photograph shows the cactus' stem and spine characteristics. A unique characteristic of the *Echinocereus* genus is that the flowers burst through the sides of the stems, leaving scar tissue on the stem above the spine.



Representative photograph of Arizona hedgehog cactus (*Echinocereus triglochidiatus arizonicus*).

ETA flowers are bright red (no bluish or lavender hues), which is the distinguishing feature from other hedgehog cacti found below 1,800 meters (6,000 feet). Flowers are produced on the upper third of stem ribs and are broad, about 5.0 centimeters (2.0 inches) in diameter and 7.4 centimeters (2.96 inches) long. Relative to other *Echinocereus*, ETA spines are shorter and more robust (AGFD, 2003). One other *Echinocereus* species was encountered during our survey effort, *Echinocereus fasciculatus* (EF); however, the identity of the two species was not confused. In addition to the difference in spine length and width between these two *Echinocereus* species, two other considerable differences exist in the appearance of these the two plants: 1) EF has a dense coverage of spines compared to that of ETA, and 2) the EF flower color is pink to magenta but bright red in the ETA.

1.3.2 Status

ETA is listed as an endangered species under the federal Endangered Species Act without Critical Habitat by the US Fish and Wildlife Service (USFWS) (40 FR 61556; Oct. 15, 1979), as Highly Safeguarded by the State of Arizona (Arizona Native Plant Law, 1993), and as a USFS Sensitive species (USFS Draft Taxonomy, 1996). ETA was listed as an endangered species because the limited geographic range of this plant increases its vulnerability to threats from mining, off-road vehicle use, illegal collecting, and road and utility construction.

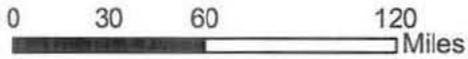
Controversy over the taxonomy of this species prevents the USFWS from developing a recovery plan or finalizing the draft taxonomy for the species. There are several populations of similar cacti growing in the mountains of the southwestern United States and in northern Mexico that are closely related to ETA. Up until the mid-1980s it was thought that there were eight different varieties of the species *Echinocereus triglochidiatus*, one of which is *arizonicus* or ETA. The other varieties have the same flower shape, color, and development (called a "claret-cup" flower because it is shaped like a claret wine goblet) but have different spine, stem, and rib characteristics. It is assumed that all of the varieties were able to interbreed with one another because there are many populations that appear to be intermediate between two neighboring varieties.

There are three currently recognized varieties of the species *Echinocereus triglochidiatus*: *triglochidiatus*, *mojavensis*, and *arizonicus*. Some botanists have suggested that the populations of hedgehog cactus growing in the mountains of Cochise County, Arizona, and southeast New Mexico are the same as *arizonicus* or ETA. In the past these populations have been called *E. triglochidiatus* var. *neomexicanus*. The Cochise County cacti are thought to be the same as *arizonicus* because they are "robust" (large stems) and the diameter of their spines is large ("thick-spined"). If these populations are indeed the same variety as *arizonicus*, then the geographic distribution of the Arizona hedgehog cactus may be considered far more widespread than if the populations are distinct. Ramifications of this to the listing status of the ETA, if the Cochise County cacti are ETA, are unclear.

1.3.3 Range and Habitat

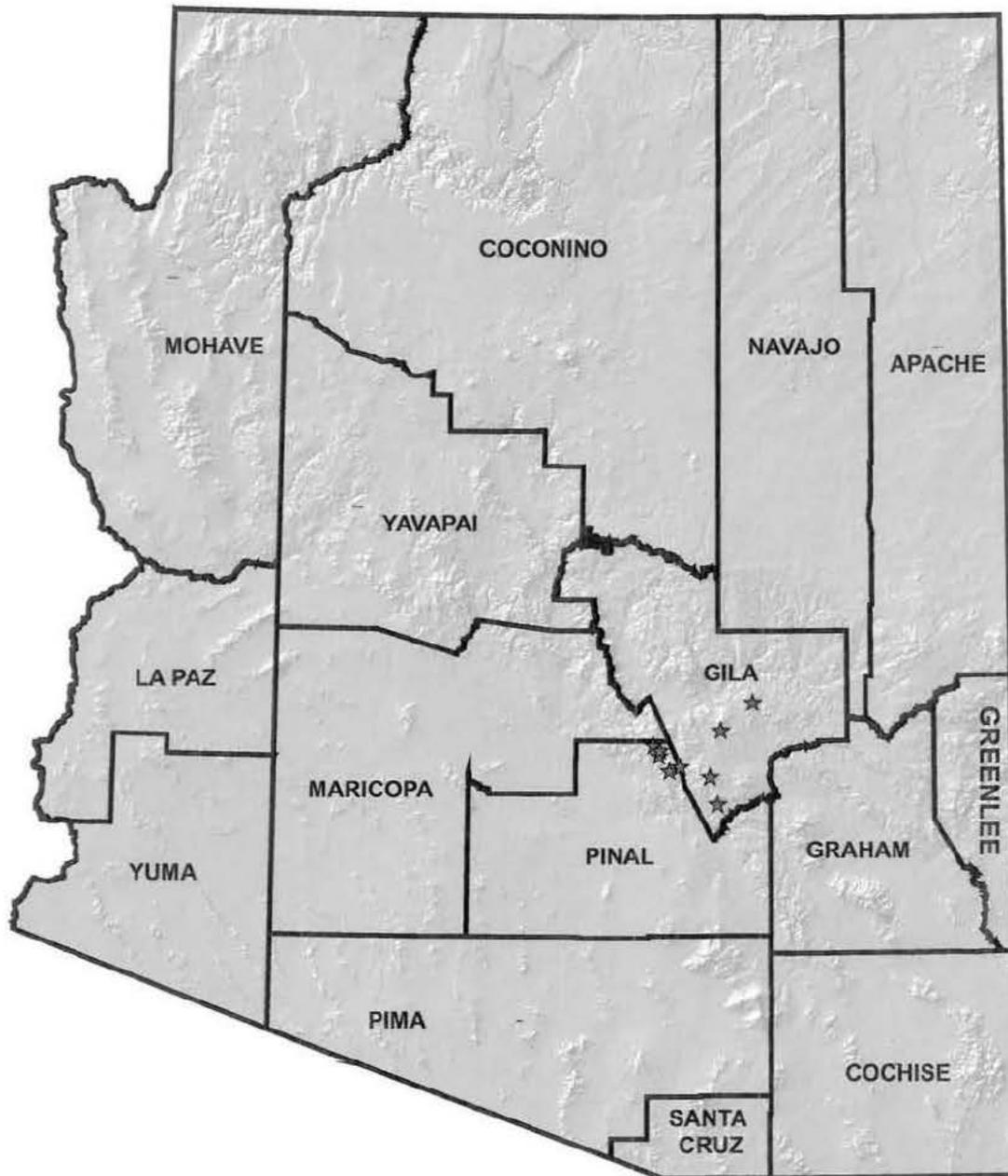
ETA, as currently defined, is found in Pinal County in the vicinity of Dripping Springs, the Superstition and Mescal mountains, the highlands between Globe and Superior, and in Devils Canyon and Queen Creek along the Gila/Pinal County line (AGFD, 2003) (Figure 2). Known habitat requirements include open slopes (or the understory of a more open canopy) and cracks and crevices between boulders. The substrate that is known to support this species has geologic parent materials consisting of volcanic tuff, dacite, and granite.

The distribution of ETA within its range appears to be closely associated with four major rock types: Tertiary Apache Leap tuff (dacite), Cretaceous or Tertiary Schultze granite, Precambrian Apache Group Pioneer quartzites, and Precambrian Pinal schist. Cedar Creek Associates' observations of more than 1,000 specimens located during field surveys for the nearby Carlota Project indicate that ETA prefers stable rock formations such as the Apache Leap tuff and Schultze granite (Cedar Creek Associates, 1994). These rock types weather very slowly, forming stable ridges and outcrops, which provide opportunities for ETA to establish and grow. The remaining two rock types that are known to be associated with ETA are either poorly distributed within the known range of ETA (Pioneer quartzites) or weather more rapidly (Pinal schist) creating a soil substrate that is colonized by dense stands of vegetation and do not appear to be used by ETA to the same extent as the tuff or granite.



★ Known Locations of Arizona Hedgehog Cactus

Data Source: ALRIS 2000 & AZGFD Heritage Data Management System
January 1, 2004



Resolution Pre-feasibility Activities
Arizona Hedgehog Cactus Survey Report

Arizona Hedgehog Cactus Distribution in Arizona

Figure 2

2. METHODS

All proposed pre-feasibility activity areas were surveyed for ETA in July and September, 2007, and in January, February, and March 2008. A qualified WestLand field crew of two to three surveyors conducted initial ETA surveys within the proposed pre-feasibility activity areas plus a 50- to 100-foot wide survey buffer. Survey methods employed by WestLand were based on cactus survey protocols that were designed in consultation with the USFWS and the USFS.

Two methods were used to survey for ETA. A pedestrian survey was conducted by observers walking parallel transects throughout the survey areas. Where rugged terrain and geologic formations limited direct access, visual surveys were conducted by glassing with 8x48 or 10x50 power binoculars. The total width of the survey area along proposed access roads was 100 feet or more centered on the roadway centerline. Survey areas at proposed drill sites were approximately 200-feet by 200-feet, providing a survey buffer of at least 50 feet on all sides. At proposed drill pad sites, observers conducted a complete walk around the area in parallel transects.

Pedestrian survey transect widths were determined by the density of vegetation. Belts of approximately 30 feet in width were surveyed by each observer. In dense stands of vegetation, transect widths were reduced to less than 20 feet depending on site-specific conditions. Within each survey belt, observers walked in a zigzag pattern inspecting the ground surface to the front, sides, and rear as they progressed across the transect. In this manner, the effort was maximized to gain view of the ground surface. The observers moved at a pace set by the slowest member to avoid unnecessary duplication of effort and missing portions of the survey belt. To facilitate control, the outside observer maintained position of the survey transect with the aid of a hand-held GPS unit or Trimble unit and/or using the alignment of the road.

Upon finding an ETA, a more intensive search was conducted within a 50-meter (300-foot) radius surrounding the cactus. Field personnel recorded the number of stems, ribs, and spines, and the length of the tallest and shortest stems in inches for those cacti that occurred within the survey area on USFS lands. In addition, observations on location, habitat and elevation, slope, and aspect were recorded. The observed cacti were numbered and identified by Universal Transverse Mercator (UTM) coordinates in North American Data 1927 (NAD 27). This information is recorded on an *Arizona Hedgehog Cactus Survey Data Sheet* (Appendix A).

Once initial survey efforts were conducted, cacti were mapped on 2007 aerial imagery at a 1"=100' scale with 10-foot contour intervals, and their locations were field-verified by WestLand biologists and RCM geologists to ensure a precise and accurate representation of their location for planning purposes. Detailed plan views of proposed activities that identify ETA locations with respect to the proposed pre-feasibility activities were submitted to RCM and the USFS on February 14, 2008.

3. RESULTS AND DISCUSSION

WestLand mapped and recorded data for 63 ETA located inside the designated survey area on USFS lands. Twenty-six additional ETA were located and recorded just outside of the survey area and along a planned access route, [REDACTED], within privately owned lands.

Generally, ETA were found in northeastern portions of the proposed pre-feasibility activity areas within areas that support vegetation that is consistent with Interior Chaparral as described by Brown (1994). More specifically, [REDACTED]

[REDACTED] Detailed plan views of proposed activities that identify ETA locations with respect to the proposed pre-feasibility activities were submitted to RCM and the USFS on February 14, 2008. Typical of this species, most of the observed ETA were found on open slopes within cracks and crevices between boulders. Figure 3 provides a large-scale ETA location map using the USGS Quadrangle as a map base.

ETA located within the survey areas on Forest lands are identified by a number or letter (for example, 1 or A), and ETA located outside the survey areas on Forest lands or along [REDACTED] within privately owned lands are identified with an "O" (for example, O-1). Field data sheets are provided in Appendix A. UTM coordinates (NAD 27) of ETA located during the survey are provided in Table 1. The accuracy of the UTM coordinates is within 1.0 meter.

Table 1. Resolution Pre-feasibility Activities Observed Arizona Hedgehog Cactus Locations

Cactus ID	UTM Coordinates	
	Easting	Northing
1	[REDACTED]	[REDACTED]
2	[REDACTED]	[REDACTED]
3	[REDACTED]	[REDACTED]
4	[REDACTED]	[REDACTED]
5	[REDACTED]	[REDACTED]
6	[REDACTED]	[REDACTED]
7	[REDACTED]	[REDACTED]
8	[REDACTED]	[REDACTED]
9	[REDACTED]	[REDACTED]
9	[REDACTED]	[REDACTED]
10	[REDACTED]	[REDACTED]
11	[REDACTED]	[REDACTED]
12	[REDACTED]	[REDACTED]
13	[REDACTED]	[REDACTED]
14	[REDACTED]	[REDACTED]
A	[REDACTED]	[REDACTED]
B	[REDACTED]	[REDACTED]
15	[REDACTED]	[REDACTED]
16	[REDACTED]	[REDACTED]
17	[REDACTED]	[REDACTED]
18	[REDACTED]	[REDACTED]

**Table 1. Resolution Pre-feasibility Activities
Observed Arizona Hedgehog Cactus Locations**

Cactus ID	UTM Coordinates	
	Easting	Northing
19		
20		
21		
22		
23		
24		
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56		
O-1		
O-2		
O-3		

**Table 1. Resolution Pre-feasibility Activities
Observed Arizona Hedgehog Cactus Locations**

Cactus ID	UTM Coordinates	
	Easting	Northing
O-4		
O-5		
O-6		
O-7		
O-8		
O-9		
O-5		
O-10		
O-11		
O-12		
O-13		
O-14		
O-15		
O-16		
O-17		
O-18		
O-19		
O-20		
O-21		
O-22		
O-23		
O-24		
O-25		
O-26		

4. CONCLUSIONS

An ETA survey was conducted by WestLand biologists in July and September, 2007 and January, February, and March, 2008, to support RCM's planning effort for proposed pre-feasibility activities on Tonto National Forest. The designated survey area included the proposed pre-feasibility activity areas plus a 50- to 100-foot wide survey buffer. Field crew members observed 63 ETA within the designated survey areas on USFS lands. An additional 26 ETA were recorded just outside the survey area or along planned access routes on privately owned lands.

5. REFERENCES

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APPENDIX A
ARIZONA HEDGEHOG
SURVEY
DATA SHEETS

