2010 ARIZONA HEDGEHOG CACTUS SURVEY REPORT PINAL COUNTY, ARIZONA

Prepared for:

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EXECUTIVE SUMMARY

WestLand Resources, Inc. (WestLand) was retained by Resolution Copper Company to conduct surveys for Arizona hedgehog cactus (AHC; *Echinocereus triglochidactus var. arizonicus*) within the Resolution Pre-feasibility Activities area in conformance with the monitoring required by the Resolution Copper Mining Pre-feasibility Activities Plan of Operations Environmental Assessment (EA; Tonto National Forest May 2010) and the Forest Service's Biological Assessment and Evaluation (BA&E; WestLand 2009).

Pursuant to mitigation and monitoring measures identified in the EA and BA&E, resurvey of the Prefeasibility Activities area (Action Area) within AHC habitat or Potential AHC habitat is required every two years. The Action Area includes a 100-foot wide corridor centered along each of the roadways included in the Pre-feasibility Study Plan of Operations and a 500-foot radius around the drill pads. To ease field logistics we did not utilize the 500-foot radius; instead a 500-foot by 500-foot square centered on proposed and existing drill sites was surveyed. Surveys were expanded outside of the Action Area along the roadways. This expanded area included an additional 50 feet along each side of the access roads for a total width of 200 feet.

The monitoring survey area included private and State land and totaled approximately 738 acres, 548 acres along roadways and 190 acres within and around 33 drill sites. This estimate is conservative as there is some overlap of acreage along the roadways adjacent to drill sites. Approximately 3 acres of existing disturbance is associated with previously authorized drill sites [redacted]). Figure 1 depicts the total survey area. Within this area WestLand biologists conducted pedestrian surveys of those portions of the survey area that could be safely accessed. To accomplish this, each surveyor walked parallel belt transects. Where rugged terrain and geologic formations limited direct access, visual surveys were conducted by inspecting inaccessible areas with binoculars. Survey was conducted from April 22, 2010 through May 13, 2010.

A total of 346 Arizona hedgehog cacti were located during the 2010 survey effort. Similar to previous investigations, AHC were detected in the northeastern portion of the Pre-feasibility Studies Action Area and none were detected along [redacted] and its associated drill sites south of the Old Magma Mine Road or within those portions of the Action Area in and around Oak Flat.

1. INTRODUCTION AND BACKGROUND

WestLand Resources, Inc. (WestLand) was retained by Resolution Copper Mining, Inc. (RCM) to conduct surveys for Arizona hedgehog cactus (AHC; *Echinocereus triglochidactus var. arizonicus*) within portions of the Resolution Pre-feasibility Action Area in conformance with the monitoring requirements of the Resolution Copper Mining Pre-feasibility Activities Plan of Operations Environmental Assessment (EA; Tonto National Forest May 2010) the Forest Service's Biological Assessment and Evaluation (BA&E; WestLand 2009). Figure 1 depicts the area included in this survey effort.

Pursuant to mitigation and monitoring measures identified in the EA and BA&E, resurvey of the Prefeasibility Activities area (Action Area) within AHC habitat or Potential AHC habitat is required every two years. The Action Area includes a 100-foot wide corridor centered along each of the roadways included in the Pre-feasibility Study Plan of Operations and a 500-foot radius around the drill pads. For ease of field logistics we did not utilize the 500-foot radius; instead a 500-foot by 500-foot square centered on proposed and existing drill sites was surveyed. Surveys were expanded outside of the Action Area along the roadways. This expanded area included an additional 50 feet along each side of the access roads for a total width of 200 feet.

Only areas considered AHC habitat or potential AHC habitat, as defined in the EA and BA&E, were surveyed. Potential AHC habitat includes those areas that 1) occur within the reported elevation range of this species; 2) occur in biotic communities similar to those known to be preferred by this species; and 3) contain bedrock geology that is known to support AHC. Those areas that contain these habitat elements and have documented occurrences of AHC are referred to as AHC Habitat. [redacted]

AHC is federally listed as endangered without critical habitat throughout its entire range in Arizona. This species is one of 1,700 native plants that were proposed for listing as endangered by the U.S. Fish and Wildlife Service (USFWS) on June 16, 1976 (USFWS 1976). On October 25, 1979, USFWS published the final rule listing the AHC as an endangered species (USFWS 1979). Taxonomy of the *Triglochidiatus* section of the *Echinocereus* has been in a state of flux for the past few decades (Baker 2006; Cedar Creek Associates 1994; Matthews 1994). NatureServe and a number of scientific publications on the species refer to this variety of AHC as *Echinocereus coccineus* var. *arizonicus* (Rose ex Orcutt) Ferguson. In this document we have followed the nomenclature utilized by the USFWS.

This species is known to occur within the highlands of Pinal and Gila Counties. AHC are 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 above 3,300 feet amsl (AGFD 2008c, TNF 1996). This species occurs from 3,300 to 5,700 feet (TNF 1996) on

open slopes and cracks and crevices between boulders in Interior Chaparral and Madrean Evergreen Woodland habitats (sensu Brown 1984).

The distribution of the AHC 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 the AHC prefers stable rock formations such as the Apache Leap tuff and Schultze granite (Cedar Creek Associates 1994). These rock types weather very slowly, form stable ridges and outcrops and provide opportunities for AHC to establish and grow. The remaining two rock types that are known to be associated with the AHC are either poorly distributed within the known range of the species (Pioneer quartzites) or weather more rapidly (Pinal schist). These rock types create a soil substrate that is colonized by dense stands of vegetation and do not appear to be colonized by AHC to the same extent as certain kinds of tuff or granite.

2. METHODS

WestLand biological field technicians familiar with this species conducted survey of the Action Area from April 22, 2010 through May 13, 2010. The survey was timed to coincide with the flowering season of the AHC when the brilliant red blooms enhance observers' ability to detect the plant.

The Action Area was surveyed by observers walking parallel transects. Visual detection was augmented by the use of binoculars. Virtually the entire Action Area was fully accessible to pedestrian surveys. Due to safety concerns, visual survey of inaccessible cliff walls and rock outcroppings were conducted by glassing with binoculars**.** Binocular surveys were conducted from a safe vantage point that offered the best view of the target area. The observer glassed the area in overlapping sweeps with the binoculars, choosing obvious landmarks to use as reference points.

During the ground search, transect widths were determined by the density of vegetation. Belts of no more than 80 feet in width (approximately 40 feet on each side) were surveyed by each observer. In dense stands of vegetation transects widths were reduced as appropriate in order to achieve full survey coverage. Within each transect, observers slowly walked in a zigzag pattern inspecting the ground surface to the front, sides, and rear. To facilitate control, the outside observer maintained position of the transect with the aid of a Trimble Geo XH GPS unit in which the Action Area has been programmed. Transects were organized to take advantage of topography, road cuts, vegetation openings, or other features of the landscape to insure efficient and complete coverage of all portions of the Action Area surveyed.

Upon locating AHC, a more intensive search was conducted within the immediate vicinity of the cactus. Data recorded on individual plants began with a sketched diagram of each plant with the individual stems alpha-numerically labeled. Tabular data recorded for each individual stem included it's height in centimeters along with the number of buds, flowers, and fruits. Representative photos of each plant were taken**.** Each plant was marked with a numbered metal tag which was either attached to a rebar stake pounded into the ground or affixed directly to an adjoining rock face with concrete cutter nails.

Data collected from each plant included the total number of stems, stem height, number of flowers, and width and height of the cluster. Initial survey efforts included collection of size and flower data from each stem. After initial field efforts were completed, the effort required to gather detailed information regarding each stem's size and reproductive effort was deemed unwarranted and a more limited sampling effort was completed. For plants with fewer than seven stems, the uppermost spine cluster of each rib on every individual stem was marked with yellow Testors Paint**.** Marking the stems in this fashion will allow for future measurement of tubercle production on the marked stems. For plants with seven or more stems, the uppermost spine clusters of five to seven stems were marked. The location of each stem with the uppermost spine cluster painted was recorded on the data sheets. Other data collected included any evidence of human disturbance, the plants relative susceptibility to fire damage, and any evidence of animal damage. Plants other than AHC growing in association within two meters of the cacti were identified and recorded. This data along with GPS coordinates in NAD 83 were recorded on the *Arizona Hedgehog Cactus Survey Data Sheet* for each cactus found on the Project Area. The locations were also entered into the handheld Trimble Geo XH GPS unit.[1] Where plants were located in close proximity to each other, a single Trimble location in the center of the AHC cluster was saved digitally on the GPS unit and each individual plant's location was recorded n the data sheet. Photographs were taken of each plant detected during survey with the plant number clearly visible in the photograph.

All data, including scanned images of the field datasheets and photographs have been entered into an Access Database for management and record keeping purposes. A digital copy of AHC data sheets and photographs are provided as an attachment to this report.

3. RESULTS

WestLand mapped, tagged, and recorded data for each of the 346 AHC found during this survey/ monitoring effort.[2] The field data sheets and photographs of each plant are provided in a digital format on a DVD provided as Appendix A of this report. All of the data collected and links to each photo-page and datasheet have been entered into an access database for long term record keeping.

The locations of each AHC detected during survey are provided in Attachments 1 to 4. Similar to previous surveys in the region, AHC were generally located in the northern and eastern portions of the Action Area. Table 1 summarizes the distribution of AHC by road/drill site survey area.

[1] Plant Locations were manually recorded for each plant on data sheets and on the Trimble GPS unit. The normal fluctuations in GPS signal has naturally resulted in minor variation in the value recorded digitally and the datasheet.
[2] Plant ID tags 299, 331, 340-349 were not assigned to any plants during the 2010 monitoring/survey effort.

Table 1. Plan of Operations Road and Drill Sites 2010 Survey Status

Activity Name	Location	Land Ownership	Arizona Hedgehog Cactus 2010 Survey Status	Acreage Surveyed
Exploration Boreholes				
QC-04	[redacted]	Forest Service	Survey Not Required	0
MB-03	[redacted]	Forest Service	Survey Not Required	0
OF-1	[redacted]	Forest Service	Surveyed	5.7
OF-2N	[redacted]	Forest Service	Surveyed	5.7
OF-3	[redacted]	Forest Service	Surveyed	5.7
4-W	[redacted]	Forest Service	Surveyed	5.7
4-E	[redacted]	Forest Service	Surveyed	5.7
A	[redacted]	Forest Service	Surveyed	5.7
B	[redacted]	Forest Service	Surveyed	5.7
C	[redacted]	Forest Service	Surveyed	5.7
D	[redacted]	Forest Service	Surveyed	5.7
F	[redacted]	Forest Service	Surveyed	5.7
M	[redacted]	Forest Service	Surveyed	5.7
#1	[redacted]	Forest Service	Surveyed	5.7
#2	[redacted]	Forest Service	Surveyed	5.7
#3	[redacted]	Forest Service	Surveyed	5.7
H-L	[redacted]	Forest Service	Surveyed	5.7
H-K	[redacted]	Forest Service	Surveyed	5.7
H-N	[redacted]	Forest Service	Surveyed	5.7

Activity Name	Location	Land Ownership	Arizona Hedgehog Cactus 2010 Survey Status	Acreage Surveyed
H-B		State Land Dept	Surveyed	5.7
H-C		Forest Service	Not Surveyed – Not Considered AHC Habitat or Potential AHC Habitat	0
H-E		Forest Service	Surveyed	5.7
H-F		Forest Service	Surveyed	5.7
H-G		Forest Service	Surveyed	5.7
H-H		State Land Dept	Surveyed	5.7
H-I		Forest Service	Surveyed	5.7
H-K		Forest Service	Surveyed	5.7
Cross Canyon Well		Private	Not Surveyed – Not Considered AHC Habitat or Potential AHC Habitat	0
DOE		Forest Service	Surveyed	5.7
Tunnel Characterization Boreholes				
PVT-3		Forest Service	Surveyed	5.7
PVT-4		Forest Service	Surveyed	5.7
PVT-5		Forest Service	Surveyed	5.7
PVT-6		Forest Service	Surveyed	5.7
PVT-7		Forest Service	Not Surveyed – Access Difficult, Site Development Not Anticipated Within Next Year	0
PVT-8		Forest Service	Surveyed	5.7
PVT-9		Forest Service	Surveyed	5.7

Activity Name	Location	Land Ownership	Arizona Hedgehog Cactus 2010 Survey Status	Acreage Surveyed
APV-6	[redacted]	Forest Service	Surveyed	5.7
APV-8	[redacted]	Forest Service	Surveyed	5.7
Existing Access Road Improvements				
[redacted]	[redacted]	Forest Service	[redacted] – Not Considered AHC Habitat or Potential AHC Habitat	0
[redacted]	[redacted]	Forest Service (From Magma Mine Road to State Land)	Surveyed	37.1
[redacted]	[redacted]	Forest Service	Surveyed	15.3
[redacted]	[redacted]	Forest Service (A portion of [redacted] traverses privately owned lands – include elsewhere)	Surveyed	16.6
[redacted]	[redacted]	Forest Service	Not Surveyed – Not Considered AHC Habitat or Potential AHC Habitat	0
[redacted]	[redacted]	Forest Service ([redacted] privately owned lands located within the TNF)	Not Surveyed – Not Considered AHC Habitat or Potential AHC Habitat	0
[redacted]	[redacted]	Forest Service	Surveyed	20.5
[redacted]	[redacted]	Forest Service	Surveyed	11.7
[redacted]	[redacted]	Forest Service (A portion o[redacted] extends onto adjacent State Lands)	Surveyed	101.8

ACTIVITY NAME	LOCATION	LAND OWNERSHIP	ARIZONA HEDGEHOG CACTUS 2010 SURVEY STATUS	ACREAGE SURVEYED
[redacted]		FOREST SERVICE (A PORTION OF [redacted] EXTENDS ONTO ADJACENT STATE LANDS)	SURVEYED	39.6
[redacted]		FOREST SERVICE	SURVEYED	11.3
[redacted]		FOREST SERVICE	NOT SURVEYED – ACCESS DIFFICULT, SITE DEVELOPMENT NOT ANTICIPATED WITHIN NEXT YEAR. [redacted] WAS MONITORED BY FS IN SEPTEMBER 2010 AND IS HEALTHY	0
[redacted]		FOREST SERVICE	NOT SURVEYED – NOT CONSIDERED AHC HABITAT OR POTENTIAL AHC HABITAT	0
[redacted]		FOREST SERVICE	NOT SURVEYED – NOT CONSIDERED AHC HABITAT OR POTENTIAL AHC HABITAT	0
EXISTING UNIDENTIFIED ROAD [redacted]		FOREST SERVICE	SURVEYED	17.6
EXISTING UNIDENTIFIED ROAD [redacted]		FOREST SERVICE	NOT SURVEYED – NOT CONSIDERED AHC HABITAT OR POTENTIAL AHC HABITAT	0
EXISTING UNIDENTIFIED ROAD [redacted]		FOREST SERVICE	SURVEYED	15.9
EXISTING UNIDENTIFIED ROAD [redacted]		FOREST SERVICE	SURVEYED	3.1
[redacted]		STATE LAND DEPT	SURVEYED	50.1
[redacted]		PRIVATE	SURVEYED	15.5

Activity Name	Location	Land Ownership	Arizona Hedgehog Cactus 2010 Survey Status	Acreage Surveyed
[redacted]	[redacted]	Private	Not Surveyed – Not Considered AHC Habitat or Potential AHC Habitat	0
Extension of [redacted]	[redacted]	State Land Dept	Surveyed	51.2
Existing Roads that Do Not Require Improvement but May Require Periodic Maintenance				
Magma Mine Road to PVT In-holding	[redacted]	Forest Service	Surveyed	2.4
Magma Mine Road	[redacted]	Forest Service	Surveyed	49.4
Magma Mine Road to #1	[redacted]	Forest Service	Surveyed	counted within drill site #1
Magma Mine Road to PVT-3	[redacted]	Forest Service	Surveyed	3.3
From [redacted]	[redacted]	Forest Service	Surveyed	11.9
From [redacted]	[redacted]	Forest Service	Surveyed	11.1
[redacted]	[redacted]	Forest Service	Surveyed	19.0
[redacted]	[redacted]	Forest Service	Surveyed	3.4
[redacted]	[redacted]	Forest Service	Surveyed	24.8
New Access Roads				
2 new access roads [redacted]	SW ¼ Section 21	Forest Service	Surveyed	Counted Within the Drill Site
New access roa[redacted]	[redacted]	Forest Service	Surveyed	1.9

ACTIVITY NAME	LOCATION	LAND OWNERSHIP	ARIZONA HEDGEHOG CACTUS 2010 SURVEY STATUS	ACREAGE SURVEYED
NEW ACCESS ROAD FROM FR [redacted]	[redacted]	FOREST SERVICE	SURVEYED	4.8
4B	[redacted]	FOREST SERVICE AND STATE	SURVEYED	24.3

Table 2. Location of AHC by road and drill site within the portions of the Action Area surveyed

Road Segment	No. of AHC
[redacted]	0
	53
	79
	11
	10
	164
	0
	1*
	0
	0
	0
	0
	29
	0
	0
	0
	0
	0
	0
	0
	0
	0
	0
	0

Table 3 and Figure 2 summarize the size class distribution (indicated by number of stems) of all AHC detected during the 2010 monitoring survey effort. To better understand the size class distribution of the plants detected within the survey area during the 2010 survey effort, a chart depicting the number of plants in 14 five-stem size classes is provided as Figure 2.

Table 3. Size Class Summary Statistics of 2010 AHC Survey

Number of Plants Detected	346[1]
Average Number of Stems Per Plant	10.5
Maximum Number of Stems Per Plant	99
Minimum Number of Stems Per Plant	1
Mode (Stems per Plant)	1
25th Percentile (Stems per Plant)	3.0
Median (Stems per Plant)	6.0
75th Percentile (Stems per Plant)	13.0
95th Percentile (Stems per Plant)	33.8

[1]This number does include the individual located along FR 2511, which has 12 stems.

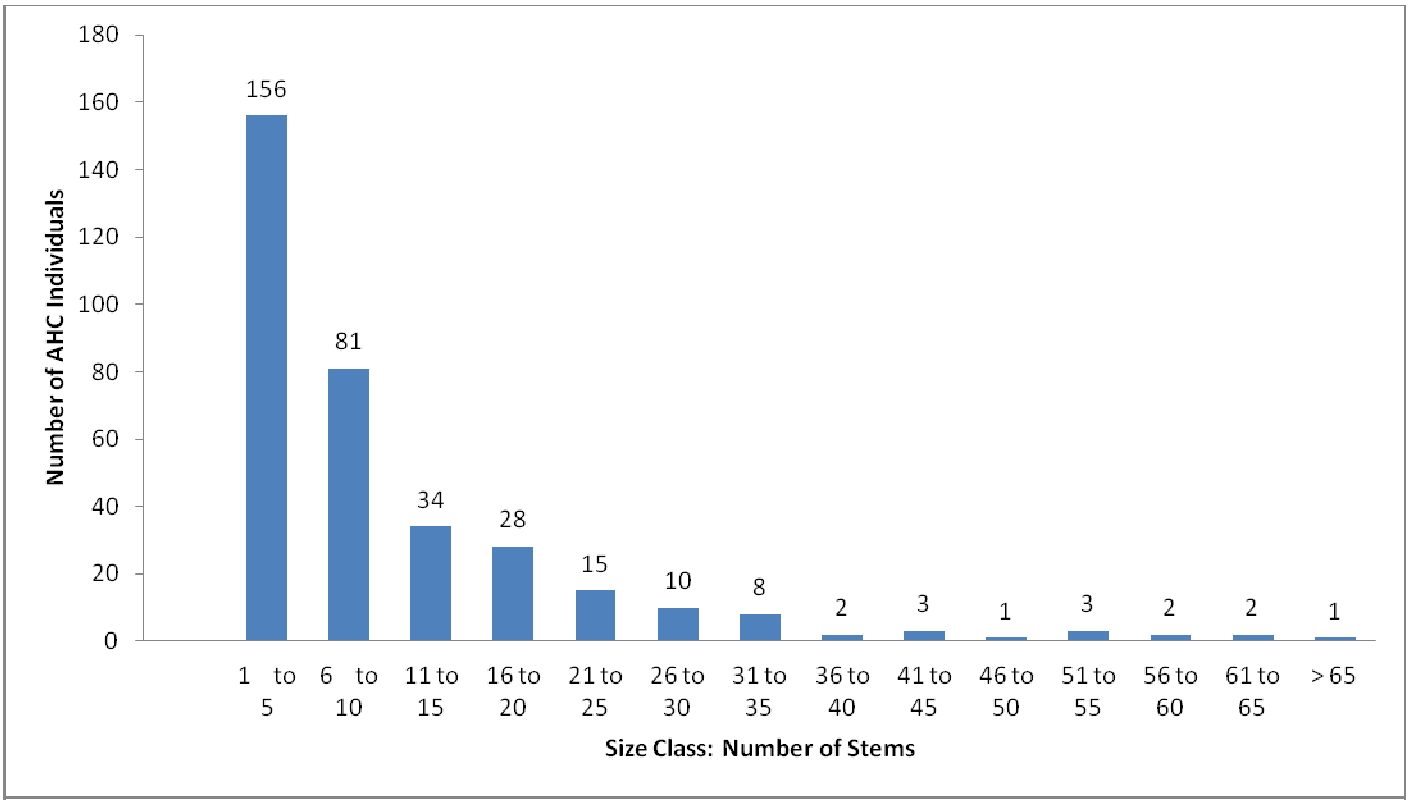

Figure 2. Size class distribution of Arizona Hedgehog Cacti detected during 2010 monitoring survey for RCM Pre-feasibility Activities Plan of Operations.

Table 4 is a summary of the survey effort for Arizona hedgehog cactus within the Resolution Pre-feasibility Activities area from April 22, 2010 through May 13, 2010. The survey was conducted by four people, and the final column of Table 4 shows the number of person-hours spent surveying. Dates shown in bold font in Table 4 indicate days when cacti were being processed. The only days of the survey when cacti were not being processed were April 26 and 27, and May 4. It is estimated that about 75 percent of the 695 hours of survey was spent processing cacti.

Table 4. Plan of Operations Road and Drill Sites 2010 Survey Status

Date	Location	Survey Time (hours)
4/22/10	[redacted]	40.5
4/23/10	FR 2466, H-G	40.5
4/24/10	[redacted]	41
4/26/10	[redacted]	40
4/27/10	[redacted]	40
4/28/10	[redacted]	40
4/29/10	[redacted]	40
4/30/10	[redacted]	40
5/3/10	[redacted]	39.5
5/4/10	[redacted]	42.5
5/5/10	[redacted]	40
5/6/10	V- [redacted]	39
5/7/10	[redacted]	40
5/10/10	[redacted]	42
5/11/10	[redacted]	42
5/12/10	[redacted]	44
5/13/10	[redacted]	44

4. REFERENCES

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WestLand Resources, Inc. (WestLand) 2009 *Biological Assessment and Evaluation* for the Resolution Pre-feasibility Activities Plan of Operations.

ATTACHMENT 1

OVERVIEW MAP

This report was originally 1,073 pages, but the information on pages 24 through 1,073 has been redacted. For ease of usability, pages 24 through 1,073 have been removed from this 508 accessible report.