ECOLOGICAL OVERVIEW

JX RANCH PARCEL
GILA COUNTY, ARIZONA

Prepared for:

Resolution Copper Company

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

WestLand Resources, Inc. (WestLand) was retained by Resolution Copper Company to prepare an Ecological Overview for approximately 59.5 hectares (147 acres) of land along Turkey and Rock Creeks within the Tonto National Forest in Gila County, Arizona (referred to as the Property or JX Ranch in this report). The Property is located in the highlands of the Sierra Ancha, on the eastern side of the crest of the range. JX Ranch is in the Turkey and Rock Creek canyons, principally on the northern and western (south- and east-facing) slopes but extending to the canyon floor and including sections of the streams and floodplains. The nearest large metropolitan community is Phoenix, Arizona, located approximately 80 kilometers (50 miles) west of the Property.

This evaluation of the Property was conducted to:

- Identify the types and relative condition of the biological resources found,
- Evaluate the ecological characteristics,
- Identify remarkable resources attributes, and
- Briefly assess the resource conservation values and opportunities in reference to local and regional contexts.

The JX Ranch is a private in-holding of reportedly homesteaded land within the Tonto National Forest, surrounded by public land (with one other in-holding nearby but not adjacent), and historically used as a residence and for limited livestock grazing. The Property is currently vacant and used for unauthorized dispersed recreational activities by persons accessing the Property from adjacent public lands.

There are three landscape features that have remarkable biological value on JX Ranch:

- Upland vegetation mosaic,
- Montane riparian corridor (particularly on the deeper alluvial surfaces), and
- Turkey and Rock Creeks.

The upland vegetation mosaic on the Property has specific biological value due to the broad range and condition of vegetation present, and the resultant diversity of wildlife. This mosaic is a combination of the low and moderate density interior chaparral, evergreen, and woodland to forest biotic communities. The overlap of these biotic communities in the mosaic results in greater diversity of wildlife than is likely present in more uniform areas. Furthermore, a forest fire in 2003 has apparently created a deeper kind of variation across the landscape than would otherwise occur. Wildlife diversity and population are likely increased in burned as compared to unburned areas. Thus, the upland vegetation portions of the Property are likely particularly rich in wildlife species.

The Montane riparian corridor has specific biological value due to the presence of native trees and the potential presence of the threatened Mexican spotted owl. Both sycamores and narrow-leaf cottonwood

have specific value for breeding birds. Sycamores are particularly important in southern Arizona for providing habitat requirements that will maintain abundant and diverse songbird communities. Within the area of the JX Ranch, it is the stands of narrow-leaf cottonwood that provide exceptional habitat value for wildlife, especially migratory and nesting songbirds and browsing ungulates.

The Property and its immediate vicinity contain elements of suitable Mexican spotted owl habitat and there are two documented owl territories adjacent to the Property, classified as Mexican spotted owl Protected Activity Centers. The proposed transfer of the Property from private ownership to the Tonto National Forest will automatically incorporate the site into Mexican spotted owl critical habitat. The inclusion of the Property into critical habitat will enable land managers to implement conservation measures for the benefit of the Mexican spotted owl.

Turkey and Rock Creeks have specific biological value due to the presence or potential presence of native fish and frogs (including threatened or endangered species). Three native fish species have been documented on the Property: desert suckers, roundtail chubs, and speckled dace. Unfortunately, populations of native fishes are rapidly declining in Arizona, primarily due to a combination of the loss or modification of aquatic habitats and competition with and predation by introduced fishes. The important headwater aquatic habitats at intermediate elevations, such as those found on the Property, provide some of the last dependable refuges for southwestern endemic fishes. The headwaters are still subject to the drastic seasonal variations to which the native fishes are adapted. Two intermittent reaches of streams downstream from the Property provide a "double buffer" between the aquatic habitats on the Property and Tonto Creek, which supports high numbers of introduced predatory fishes.

The Property contains potential habitat for the Chiricahua leopard frog. The same conditions that buffer native fishes from harmful introduced species have the potential to aid in the conservation of Chiricahua leopard frogs as well. The Property is considered to be "un-surveyed potential habitat" by the USFS. Surveys may indicate that the Chiricahua leopard frog is present or if the site is deemed a suitable location for the reintroduction of this species.

These three areas of remarkable biological value provide three similar areas of conservation opportunity at the Property.

Opportunity #1: Turkey and Rock Creeks

The habitat characteristics of the headwater reaches of Turkey and Rock Creeks that favor native fishes over exotics have allowed at least three native fish species to persist on the Property. And, the streams may be occupied by or provide suitable habitat for the Chiricahua leopard frog. The preservation and possible enhancement of this area will provide valuable opportunities for native fish and frog research, conservation, and recovery. Federal ownership of the Property would prevent stream alteration for

private use as well as allow for management methods such as restrictions on cattle grazing. Furthermore, species-specific studies for the presence or absence of native fishes or frogs (including any threatened or endangered species) will enlarge the knowledge base for these valuable members of the biological community.

Opportunity #2: Montane Riparian Corridor

Increasing the number of stems and acreage of narrow-leaf cottonwood along the stream on the JX Ranch would restore the alluvial terraces to a natural vegetative condition and prevent their further erosion. The on-site visit and an inspection of the aerial photographs indicate that the two alluvial terraces on the Property have had a significant loss of riparian trees, probably since the time of the original settlement. This pattern is evident in alluvial terraces along streams throughout the area. Narrow-leaf cottonwood can be readily established with vegetative cuttings (International Poplar Commission, 1979); these vegetative cuttings can be small cuttings rooted in situ.

There is an urgency with respect to reestablishing narrow-leaf cottonwood along both Turkey and Rock Creeks. Elk are present in the area and have the potential to intensely browse the leading shoots of the young soboles that are produced by the fire-killed mature cottonwoods. If all or nearly all shoots are browsed by elk during this vulnerable phase (when the shoots are still less than about 5 m [16.5 ft] high), the browsing may result in the death of that particular clone within 2 or 3 years. Thus, there is a relatively narrow window of opportunity in which the cottonwood recruitment could occur from the existing fire-damaged population. Elk grazing of soboles could, if uncontrolled, kill the cottonwood clones, losing the opportunity to restore the alluvial terraces to natural conditions.

Opportunity #3: Upland Vegetation Mosaic

Unique conservation opportunities are limited for the upland vegetation mosaic, but we believe that streamlined public lands management that would result from public ownership of the land will allow for improved regional approaches to issues such as fire control as compared to the challenges presented by private in-holdings. Furthermore, continued maintenance of this area will assist in the quality of more unique features such as the riparian areas and streams, home to native fishes and, potentially, threatened and endangered species such as the Mexican spotted owl and Chiricahua leopard frog.

1. INTRODUCTION AND METHODS

1.1. PURPOSE AND ORGANIZATION OF REPORT

WestLand Resources, Inc. (WestLand) was retained by Resolution Copper Company (Resolution) to prepare an Ecological Overview for approximately 59.5 hectares (147 acres) of land along Turkey Creek in the Tonto National Forest, Gila County, Arizona. In this report, the site is referred to as the Property or JX Ranch.

The Property is located in the highlands of the Sierra Ancha, on the eastern side of the crest of the range (Figure 1). JX Ranch is in the Turkey and Rock Creek canyons, principally on the northern and western (south- and east-facing) slopes and extending to the canyon floors, including sections of the streams and floodplains (Figure 2). Access to the Property is via Forest Road (FR) 416 from the west.

This evaluation of the Property was conducted to:

- Identify the types and relative condition of the biological resources found,
- Evaluate the ecological characteristics,
- Identify remarkable resources attributes, and
- Briefly assess the resource conservation values and opportunities in reference to local and regional contexts.

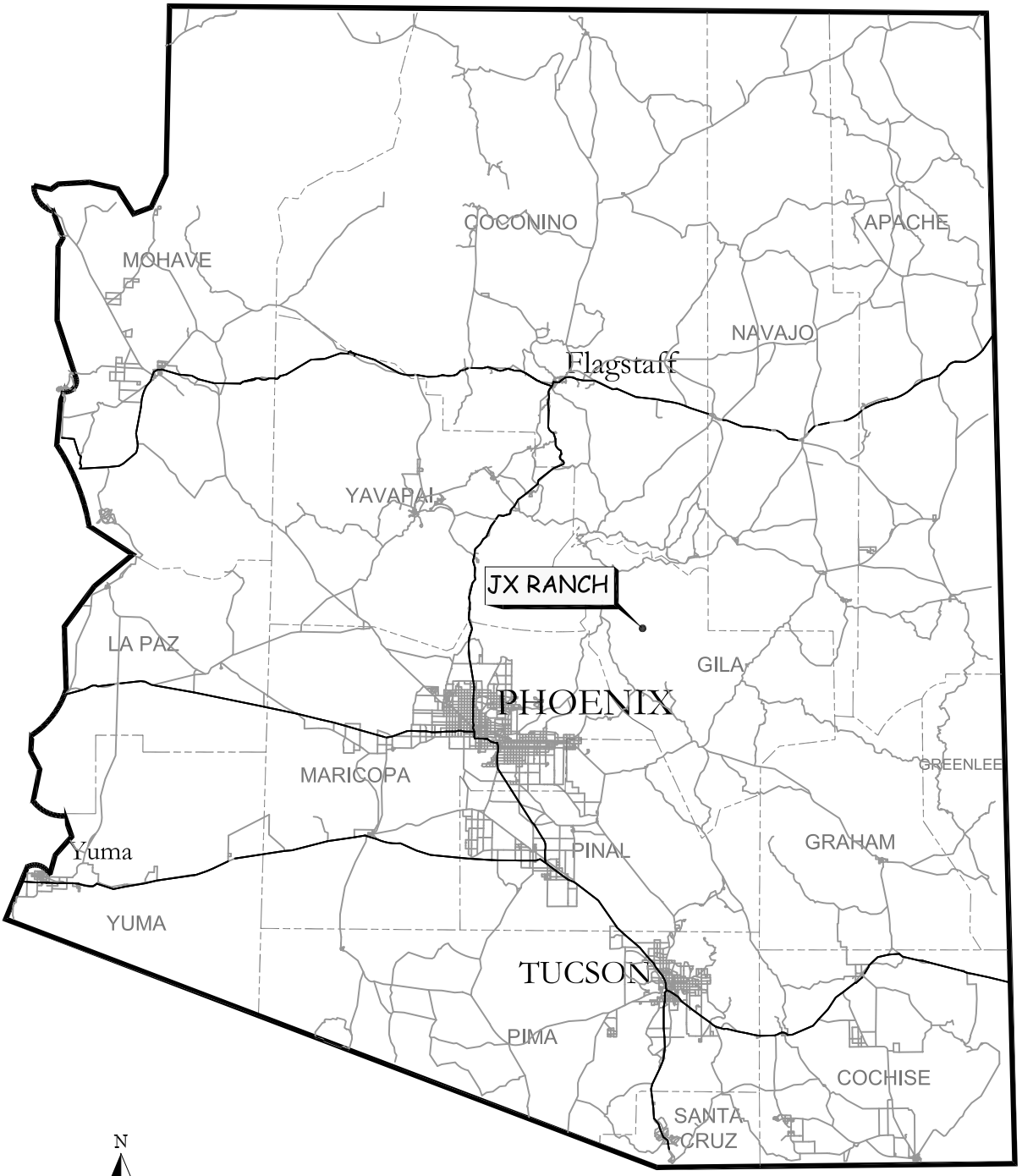
This report is presented in seven sections:

- Section 1 – Introduction and Methods (this section)
- Section 2 – Regional Setting
- Section 3 – Existing and Adjacent Land Uses
- Section 4 – Physical Resources
- Section 5 – Biological Resources
- Section 6 – Conservation Values and Opportunities
- Section 7 – References

1.2. METHODS AND APPROACH

WestLand completed this evaluation by conducting background research of available natural history information and aerial photography of the Property and surrounding region, and through field reconnaissance to identify, map, and photograph vegetation and habitat. WestLand also interviewed the past and current Property owners to determine the human development history of the JX Ranch.

ARIZONA



Resolution Copper Company

JX RANCH

VICINITY MAP
Figure 1

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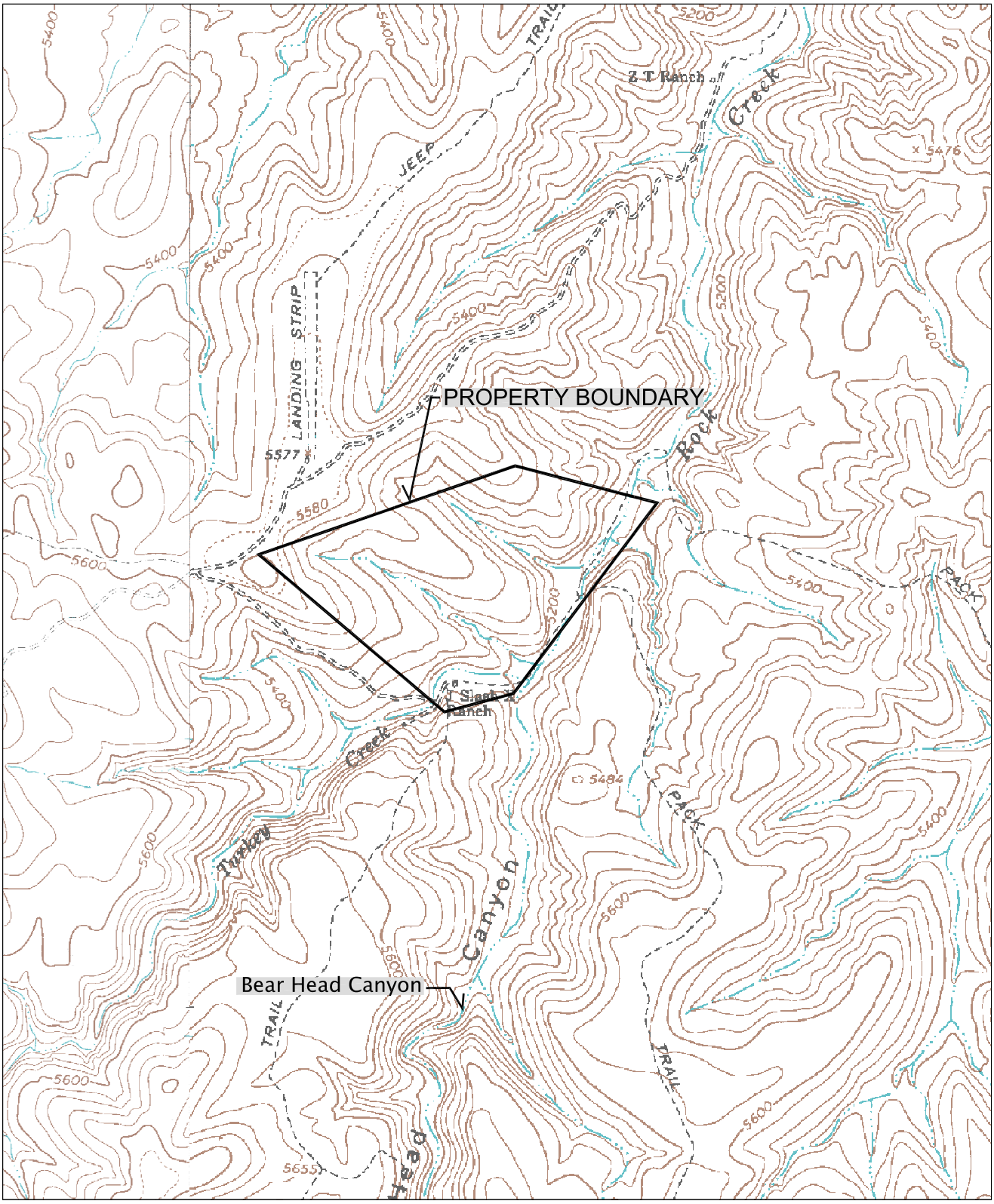

T.7N.,R.12E. Portion of Sections 3 & 4, Gila County, Arizona

Located on the Copper Mt. USGS Quadrangle

0' 800' 1600'

SCALE: 1" = 1600'

N

W E

S

Resolution Copper Company

JX RANCH

JX RANCH STUDY AREA

Figure 2

WestLand Resources Inc.
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WestLand obtained and reviewed available literature pertaining to biotic communities of the southwest, riparian ecosystems, and the Sierra Ancha. Primary sources of information that were reviewed include *Biotic Communities of the Southwestern United States and Northwestern Mexico* (Brown, 1994; a comprehensive reference of the desert southwest), wildlife abstracts from the U.S. Fish & Wildlife Service (USFWS), and various documents published and websites maintained by the US Forest Service (USFS) Tonto National Forest, Arizona Department of Water Resources (ADWR), Arizona Game & Fish Department (AGFD), and other agencies and conservation organizations. These references and aerial photographs were reviewed to identify potential and confirm observed vegetation communities on the Property.

A WestLand biologist conducted field reconnaissance of the Property on February 13, 2004 to observe current site conditions, biological resources, and abiotic factors affecting biotic distribution and relative habitat value within the Property. The reconnaissance consisted of a pedestrian survey that focused on areas of interest identified during the background research phase of the evaluation. Inaccessible areas were scanned using binoculars to observe distant vegetation communities. Field observations were recorded and photographs taken during the reconnaissance to document the various physical and biological resources present on the Property. In particular, vegetation patterns were noted and observed species were recorded. The general vegetation patterns were delineated on an aerial photograph and transcribed onto a vegetation map of the Property. Direct and indirect (tracks, scat, burrows, etc.) observation of wildlife was noted.

In order to identify special status species that might occur on the Property, we obtained the current list of federally listed species for Gila County from the Arizona Ecological Services Field Office of the USFWS. The life history of each of these species was then studied to determine habitat requirements such as vegetation communities, elevation ranges, presence of surface water, and other landscape features. This information was used in a screening analysis to identify species potentially occurring on or near the Property for further evaluation, as well as to eliminate from consideration those that were unlikely to occur. Additional literature research was conducted and summarized for those species that have known ranges and habitat requirements close to or which have a high likelihood of occurring on the Property. We principally used the AGFD Arizona Heritage Data Management System (HDMS) for this research.

Using the list of special status species and data collected during field reconnaissance, we conducted a screening analysis to identify those special status species that had the potential to occur on or near the Property. Information such as the Property's elevation range, habitat type, water resources, climate, and other related data was compiled and compared to the background research information to predict the potential for occurrence of listed species in the Property area. This screening analysis resulted in a list of target species that have a reasonable potential to occur on the Property.

2. REGIONAL SETTING

The Property is located just east of the crest of the Sierra Ancha, a rugged mountain range in central Arizona with peaks rising to over 1,800 meters (m; 6,000 feet [ft]) in elevation (Figure 1), some 1,000 m (3,300 ft) above a valley just 20 km (12.5 miles) west of the Property.

Photograph 1. Overview of JX Ranch (fore- and mid-ground).

Two streams running through the JX Ranch drain the uplands immediately southwest and south of the Property. Turkey Creek enters the Property at the southwestern corner and flows toward the northeast; Bear Head Canyon enters the Property at the southeast corner and flows north (Figure 2; Photograph 1). The confluence of Turkey Creek and Bear Head Canyon is near the southeastern corner of the Property; from that point, the stream is known as Rock Creek. Rock Creek flows north to join Spring Creek, which trends to the northwest and joins Tonto Creek about 19 kilometers (km; 12 miles) north of the Property. Tonto Creek flows southwest and then south, discharging to Roosevelt Lake about 29 km (18 miles) south-southwest of the Property. Prior to impoundment of the Salt River by Roosevelt Lake in 1911, Tonto Creek entered the Salt River directly.

The entire area is considered part of the Salt River watershed, which also discharges to Roosevelt Lake. Although now impounded in many places and flowing ephemerally to intermittently, the Salt River flows westward toward Phoenix eventually joining the Gila and then Colorado Rivers, and ultimately discharging to the Sea of Cortez (Gulf of California).

The closest large metropolitan community is Phoenix, Arizona, located approximately 80 km (50 miles) to the south. Maricopa County, in which the Phoenix metropolitan area lies, has some 3.2 million residents. No significantly populous communities are within 32 km (20 miles) of the Property; the nearest town is the unincorporated Punkin Center, which lies that distance west of the Property, adjacent to Tonto Creek.

3. PROPERTY AND ADJACENT LAND USES

The JX Ranch was reportedly homesteaded by the Kline family in the early 1890s. The Property is currently owned by Mr. George Randall, who acquired the JX Ranch from the Ewing family (descendants of the Kline family) in 2001. The Property was used as a residence and for limited cattle grazing, with regular use into the latter half of the 20th century. The Property is currently vacant and used for unauthorized dispersed recreational activities by persons accessing the site from adjacent public lands.

Photograph 2. Homestead Site at JX Ranch.

As previously mentioned, the Property is accessed by FR 416, which follows a ridgeline above the western portion of the Property. A primitive road ("jeep trail") crosses the Property, leading from FR 416 down the slope to the southwestern corner of the Property at Turkey Creek and thereafter roughly following the course of Turkey and Rock Creeks.

The majority of the Property is undeveloped. The developed portion constitutes less than 5 percent of the total acreage. Remnants of the homestead improvements are evident on the Property in a meadow adjacent to Turkey Creek near the southwestern corner of the Property (Photograph 2). A small stone wall structure, measuring approximately 3.3 m by 3.3 m (10 by 10 ft) and up to 1 m (3 ft) high, is present near the western extent of this meadow. This structure has a dirt floor and no roof; it may have been a root cellar or similar storage facility. Nearby is a low L-shaped dirt mound with a pile of rocks at one end and flat stones embedded in the ground around portions of the perimeter. This feature may have been a cabin, since burned, with the stones the only remaining evidence of a chimney and simple foundation. A shallow excavation, approximately 2.8 m (5 ft) in diameter and 0.5 m (1.5 ft) deep, with stone perimeter, is adjacent to the potential cabin feature. Now largely filled in, and containing two 55-gallon drums filled with trash, this feature may have been a hand-dug well (according to the previous owner). East of these constructed features, near the center of the meadow, is a row of fruit trees, probably apples. Portions of the Property are crossed by wire fences that, in some locations, appear to define the Property boundaries.

Land uses evident on adjoining properties include the aforementioned dispersed recreational activities (hunting and off-road vehicle use). Designated pack and jeep trails are located on nearby public lands. Roads accessing the site and surrounding properties are dirt, and appear to be frequently used by off-road vehicle enthusiasts.

4. PHYSICAL RESOURCES

This section describes the regional and local features of the ground surface (form, type, and age), climate (temperature and precipitation ranges), and water (surface and subsurface occurrence).

4.1. LANDFORM AND TOPOGRAPHY

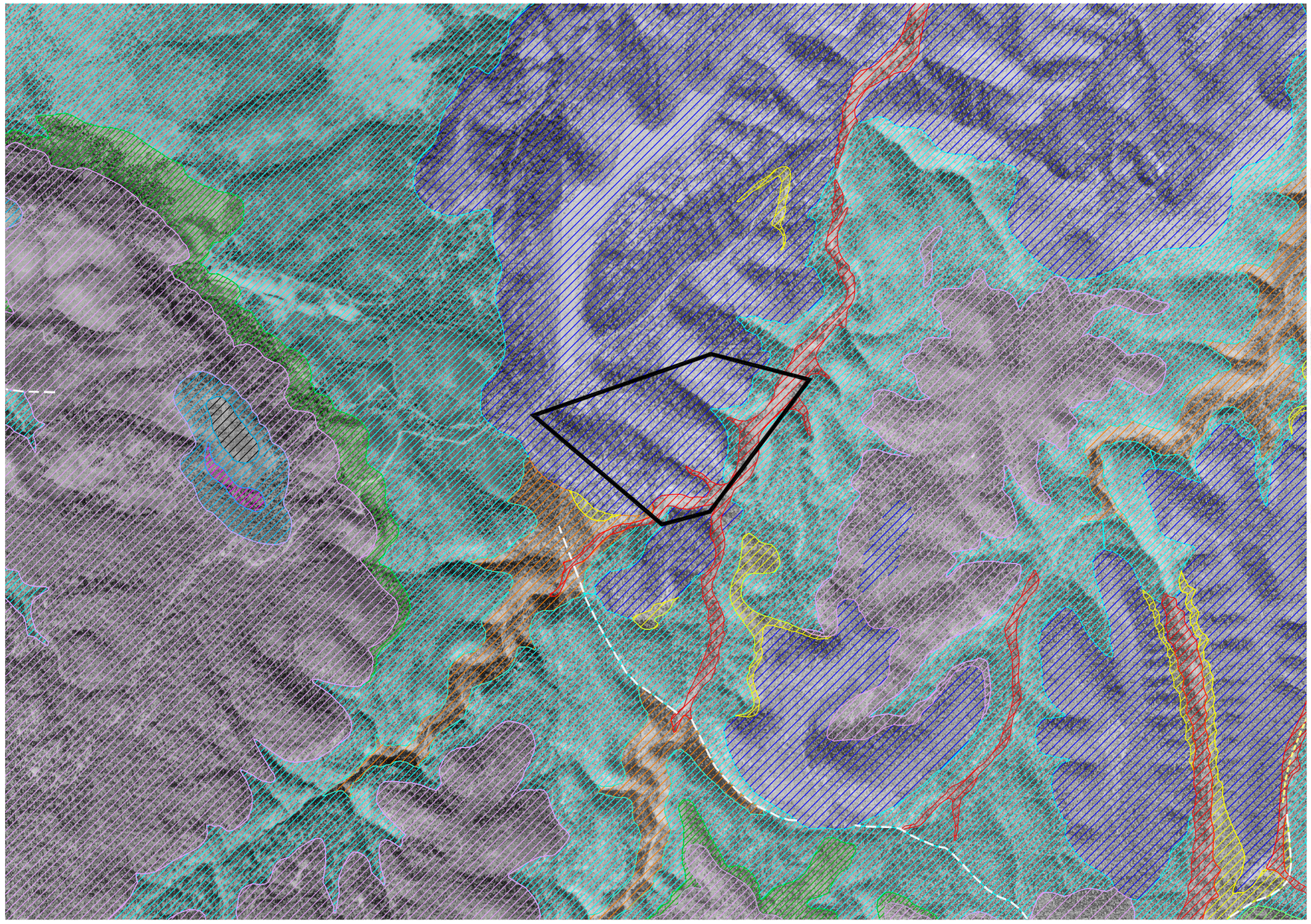
The JX Ranch is situated on the east side of the crest of the Sierra Ancha (Figure 1), in a rugged landscape of narrow canyons and mesas. The most notable landform features of the JX Ranch are the streams (Turkey and Rock Creeks) and the canyon slopes and cliffs cut by these streams. As previously described, Turkey Creek passes through the southern portion of the Property and, at the southeastern corner of the Property, joins Bear Head Canyon (Figure 2). At their confluence, Rock Creek begins, extending to the northeastern corner of the Property. There is an additional structural feature near the Property, a fault that crosses both Bear Head Canyon and Turkey Creek (Figure 3).

The Turkey Creek watershed measures approximately 6.5 km² (2.5 square miles). Turkey Creek originates on the north slopes of Picture Mountain at 1,960 m (6,430 ft) above mean sea level (amsl) some 5 km (3 miles) southwest of the Property and descends to just below 1,585 m (5,200 ft) amsl at its confluence with Bear Head Canyon. From the on-site confluence of Turkey Creek and Bear Head Canyon, the channel bed of Rock Creek is relatively level, dropping less than 12 m (40 ft) during the next 0.8 km (0.5 miles) stretch within the Property.

The elevation of the JX Ranch ranges from about 1,701 m (5,580 ft) amsl at the top of the west slope near the western extreme of the Property to just under 1,585 m (5,200 ft) amsl at the bottom of Rock Creek near the northeastern corner of the Property.

4.2. GEOLOGY AND GEOMORPHOLOGY

The geology of the Turkey Creek area, including the JX Ranch, has been recently mapped in detail (1:24,000 scale) by Skotnicki (1999a, b). Skotnicki concurrently mapped the Picture Mountain and Copper Mountain 7.5-minute quadrangles. Prior to Skotnicki, Berquist et al. (1981) had mapped the Apache Group of rocks and underlying granite to the south and east as part of a larger study of the Sierra Ancha Wilderness area, Spencer et al. (1999) had mapped the northwestern part of the Greenback Creek quadrangle to the southwest, and Wessels (1991) had mapped the northwest corner of the Picture Mountain quadrangle as part of a larger geologic study of the Jakes Corner area. The following paragraphs summarize unconsolidated and consolidated materials on the Property and in the vicinity, and the subsequent sections present specific descriptions of the geologic units present, based on Skotnicki (1999a, b).



Geology of J Slash X Ranch, north side of Sierra Ancha, Gila County, Arizona

Quaternary Deposits

Qy Holocene alluvium (< 10 ka)

Tertiary Rocks

Tco Older conglomerate (early to middle Tertiary)

Tb Tertiary basalt

Proterozoic Diabase

Yd Diabase (Middle Proterozoic)

Apache Group

Yma Argillite (Middle Proterozoic)

Ymx Chert breccia of the Mescal Limestone (Middle Proterozoic)

Ymc Mescal basal conglomerate (Middle Proterozoic)

Ymu Algal member of the Mescal Limestone (Middle Proterozoic)

Yml Lower member of the Mescal Limestone (Middle Proterozoic)

Ym Mescal Limestone, undivided (Middle Proterozoic)

Ydu Upper member of the Dripping Spring Quartzite (Middle Proterozoic) [In general, this unit forms a slope on top of the cliff-forming lower member. Locally the top of this unit is weathered and pitted; where accumulations are large enough, they were mapped as Ymc.]

Ydl Lower member of the Dripping Spring Quartzite (middle Proterozoic

Property Boundary

Fault

T.7N.,R.12E. PORTION OF SECTION 3 & 4, GILA COUNTY, ARIZONA
LOCATED ON THE COPPER MT. USGS QUADRANGLE

Photo Source: USGS Digital Ortho Quarter Quadrangles.
Copper Mtn. NW & Picture MTN. NE, 1992.

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N
W E
S

0' 900' 1800'
SCALE: 1" = 1800'

Source of mapped bedrock and legend text:
Skotnicki, S. J. 1999. Geologic map of the Copper Mountain Quadrangle, Gila County, Arizona. Arizona Geological Survey Open-File Report 99-24.

Skotnicki, S. J. 1999. Geologic map of the Picture Mountain Quadrangle, Gila County, Arizona. Arizona Geoogical Survey Open-File Report 99-23.

Resolution Copper Company

JX RANCH

Surficial Geology Map
Figure 3

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Most of the Property is bedrock covered with a thin veneer of soil on uplands, with a limited amount of alluvium in the channel bottom and talus or colluvium on the slopes. The JX Ranch homestead site is on the largest span of alluvium on the Property, on the inside of a bend of Turkey Creek near the southern boundary. Another large span of alluvium is present on the west side of the Rock Creek channel near the northeastern corner of the Property.

According to Skotnicki (1999a, b), there are essentially two major groups of bedrock within the area: Tertiary conglomerates (and to a lesser degree, some intruded Tertiary basalts) and Middle Proterozoic Apache Group rocks. The Apache Group includes the Dripping Springs Quartzite and the overlying Mescal Limestone.

The uppermost bedrock of the JX Ranch and a radius of about 1.5 miles of the surrounding area, based on Skotnicki (1999a, b), is depicted in Figure 3. Most of the Property is covered with Tertiary conglomerate, present as highly weathered, rounded ridges. The cliffs along the west side of Rock Creek on the Property are exposures of the upper member of Dripping Springs Quartzite. The quartzite forms a regional plateau that dips very gently to the north-northeast; in some places, this plateau is horizontal.

4.2.1. Surficial Deposits

Quaternary (Qy) Holocene alluvium (< 10 ka) – The alluvium consists of unconsolidated sand to small boulders, reaching sizes up to 25 centimeters (cm; 10 inches [in]) in diameter upstream but clasts are smaller and fewer downstream. Larger clasts are quartzite and granite; smaller clasts are subangular granitic grus. These deposits are characterized by stratified, poorly to moderately sorted sands (in many areas a dark diabase sand), gravels, and cobbles frequently mantled by sandy loam sediment. The alluvium locally exhibits bar and swale topography, the bars being typically more vegetated. Soil development is relatively weak with only slight texturally or structurally modified B horizons and slight calcification (Stage I). Some of the older soils may contain weakly developed argillic horizons. Because surface soils are not indurated with clay or calcium carbonate, these surfaces have relatively high permeability and porosity.

Photograph 3. Alluvial surface at homestead site.

During our visit on February 13, 2004, we found that the alluvial surface where the homestead is located was still largely intact (Photograph 3). The height of the alluvial surface is about 1 to 1.5 m (3 to 5 ft) above the channel bottom. There is one incipient shallow channel that cuts though the alluvium on the west side of the homestead site (foreground, Photograph 2, Page 7). Below the

confluence of Turkey Creek with Bear Head Canyon, there are large areas where the original alluvium has been removed or has been back-cut. These alluvial deposits were originally up to 2 m (6.5 ft) in depth with respect to the channel bottom. It was not possible for us during our visit to determine to what extent the loss of alluvium within Rock Creek was part of a long-term (Holocene [10,000 yr]) regional phase of channel entrenchment, or part of a short-term (< 150 yr) entrenchment that may have been at least initiated by loss of vegetation on the alluvium due to historic phases of over-grazing and/or fire. There are mature trees (at least 50 to 75 years of age) established on portions of the younger, lower channel cuts, which suggests a minimum time for the cuts. Given the current conditions, it is evident that loss of alluvium along Rock Creek within the Property is still ongoing. However, the rate of annual loss of alluvial deposits along Rock Creek may be less than first impressions convey if the bank cuts are developing only by a few centimeters with each high water event. The channel bottom upstream from the Property (Photograph 4), at the confluence of Turkey Creek with Bear Head Canyon (Photograph 5), and downstream on Rock Creek within the Property (Photograph 6), appears to be relatively stable, due in large measure to the bedrock bottom of the channel along much of this reach.

Photograph 4. Turkey Creek upstream.

Photograph 5. Confluence of Turkey Creek (right) and Bear Head Canyon Left).

Photograph 6. Rock Creek downstream.

4.2.2. Bedrock

4.2.2.1. Tertiary Rocks

Tertiary conglomerate (Tco) (early to middle Tertiary) -- This unit contains medium-bedded, moderately consolidated conglomerate interbedded with moderately sorted sandstone, pebble, and cobble layers. Clasts are angular to subrounded and range in size from sand to boulders > 1 m ((3.3 ft) across. The deposits contain clasts derived from all Apache Group rocks, Troy Quartzite, and diabase. Calcite cement is locally abundant and gives the rock a light grey to tan color. Outcrops are almost everywhere mantled by lag gravel. Locally, thin basalt flows (Tb) are interbedded with these sediments.

We did not locate exposures of Tertiary conglomerate during our visit. These probably could be found in steep channel cuts. The majority of the Tertiary conglomerate was covered by a veneer of soil with vegetation (Photograph 7).

Photograph 7. Vegetation on Tertiary conglomerate.

4.2.2.2. Proterozoic Rocks

All of the Proterozoic rocks in the vicinity of the Property date from the middle Proterozoic. They are divided into two basic groups by Skotnicki (1999a, b): Proterozoic diabase and the Apache Group, which includes a range of chert, limestone, quartzite, and conglomerate units. Only the Apache Group Dripping Springs Quartzite is present on-site and discussed below.

Upper member of the Dripping Springs Quartzite (Ydu) – This unit is composed of thinly bedded light tan-yellow argillite and fine-grained quartzite (Photograph 8). Bedding is thin and wavy (Photograph 9). In general, this unit forms a slope on top of the cliff-forming lower member not seen on the Property. Locally the top of this unit is weathered and pitted; where accumulations are large enough, they were mapped as Ymc.

Photograph 8. Dripping Springs Quartzite.

Photograph 9. Quartzite bedding.

east side of Rock Creek. The boulders seen in the talus slope are blue-green due to the amount of cover by the lichen, *Xanthoparmelia* sp.

In Photograph 10, cliffs about 10 m (30 ft) tall and talus slopes are evident along the Ydu exposure on the

Photograph 10. Cliff and talus on east side of Rock Creek.

4.3. CLIMATE

There are no weather stations in the immediate vicinity of the Property. To our knowledge, the nearest long-term weather station to JX Ranch is the Sierra Ancha Experimental Forest station is about 8.8 km (14 miles) south-southeast of JX Ranch, at 33º 48' N, 110º 58' W. At about 1,554 m (5,100 ft) amsl, the Sierra Ancha weather station is only about 30 m (100 ft) lower than lowest portion of the JX Ranch. The Sierra Ancha weather station is on the southwest face of the Sierra Ancha, whereas the JX Ranch is on the northeast slope. Despite the slope aspect difference, weather data from the Sierra Ancha station may be considered roughly comparable to on-site conditions.

Climatological data for the Sierra Anch station are reported by Sellers and Hill (1974), based on records from 1941 to 1970. Mean daily maximum temperatures for Sierra Ancha station range from a high 33.5º Centigrade (C; 92.3º Fahrenheit [F]) in July to a low of 12.2º C (54.0º F) in January. Mean daily minimum temperatures at this station range from a high 17.5º C (63.5º F) in July to a low of –0.5º C (31.1º F) in January. Mean annual precipitation is 62.9 cm (24.75 in). As is true for much of central and southern Arizona, precipitation is almost evenly divided between the monsoon season (July through

October) and winter (December through March). Thunderstorms develop almost every afternoon during the monsoon season as the air is forced to ascend the strongly heated mountain slopes in the area. Thunderstorms are intense but brief. Sellers and Hill note that Sierra Ancha, with its mean annual rainfall of 62.9 cm (24.75 in), has one of the wettest climates to be found in Arizona. The maximum annual rainfall recorded for the station was 101.6 cm (40 in) in 1915; the lowest was 33.0 cm (13 in) in 1956.

4.4. WATER RESOURCES

4.4.1. Surface Water Resources

There are no stream gauges along Turkey or Rock Creeks. There is a gauge on Parker Creek at the Sierra Ancha weather station south-southeast of the Property. The watershed reporting to the Parker Creek gauge (U.S. Geological Survey [USGS] gauge No. 09498503) measures approximately 2.6 km^2 (1 square mile) (USGS, 2004), roughly comparable in elevation to but somewhat smaller in size than the Turkey Creek watershed above the JX Ranch (at 6.5 km^2; 2.5 square miles). Based on the similarity of watershed and climate as noted above, stream gauging data from the Parker Creek site provides some insight into stream flow variability in Turkey Creek. The Parker Creek gauge period of record (1986 to 2002 [partial]) shows high variability in annual mean stream flow (0.014 to 0.62 cubic feet per second [cfs]), annual peak stream flow (most years below 10 cfs, with three years [1991, 1992, and 1995] near 70, 30, and 90 cfs, respectively). Furthermore, monthly mean stream flows indicate a seasonal variability ranging from a high of 3.48 cfs in the winter months (combined January, February, and March) to a low of 0.092 cfs in the summer months (combined June, July, and August). The order-of-magnitude variability in annual mean and peak flows, and the two orders-of-magnitude in seasonal variations, exhibited in the Parker Creek watershed are likely reflected in the Turkey Creek watershed.

An additional stream gauge is present at Cherry Creek about 16 km (10 miles) to the east. Cherry Creek has been analyzed for flow characteristics (Baldys and Bayles, 1990). One of their findings, applicable to a consideration of Turkey Creek, is that winter precipitation is more important than summer precipitation in contributing to stream discharge. The gentler winter rain apparently allows more infiltration (to alluvium) and subsequent release than the high intensity monsoon season rains that are subject to greater run-off. This study corroborates the seasonal variability in stream flow exhibited in Parker Creek and likely present in Turkey Creek.

During our visit on February 13, 2004, we found Turkey Creek flowing from near the fault upstream of the JX Ranch southwestern corner and intermittently through the Property. Flow was strong on the Property near the homestead site. Availability of water was doubtless one of the considerations applied to the choice of this homestead site in the late 1800s. Flow was very good on the northeastern portion of the Property where the channel of Rock Creek was directly on Dripping Springs quartzite. We did not find clear indications of perennial flow, such as thick accumulations of algae and organic matter in the stream bed, black water marks in the pools, or organisms (such as fish) that can be regarded as clear indications of perennial conditions.

However, the map of perennial streams in Arizona compiled by Brown et al. (1978) indicates an approximately 1.6-km (1-mile) stretch of perennial flow in a channel that, based on its relative position with respect to local landmarks and its orientation, appears to be Turkey Creek. (The state-wide scale of this map does not permit positive identification of small stream segments.) Furthermore, as discussed in Section 5.4 below, native fish have been collected in pools at the confluence of Turkey Creek and Bear Head Canyon, as well as downstream in Rock Creek. And finally, both AGFD and USFS personnel have anecdotally referred to the stream as perennial in this reach. Thus, the three streams associated with the Property may be perennial, or at least flow during the majority of the year, and the pools in particular may be perennial. It should be noted that drought conditions have persisted in southern Arizona for several years, thus potentially reducing the perennial flow to an occasional intermittent level.

On a broader regional scale, Smith and Stockton (1981) used tree-ring data from the upper or adjacent parts of the Salt River watershed (for trees growing on shallow soil slopes away from valley alluvium) to identify periods of above- and below-average precipitation and then correlated the tree-ring data to the actual discharge data on the Salt River calibrated from 1914 to 1979. The correlation was sufficient to reconstruct a discharge record for the Salt River, based on older tree-ring records, that extends back to 1580 (Figure 4). What is interesting, aside from significant maximum and minimum discharge events over the last nearly 400 years, is the 22.2-year return period of extended low flow periods. This finding suggests that regionally, including the Turkey Creek watershed in which the JX Ranch is located, low or deficient stream flow is expected to occur every 22 years. Mitchell et al. (1979) also found a pervasive 22-year periodicity to extended, large-area drought occurrence in western United States and related it to the 22-year Hale Solar Cycle. Current precipitation data suggest that Arizona is in the early stages of a drought cycle.

4.4.2. Ground Water Resources

No records of any on-site groundwater wells were found in USGS or ADWR databases. As described in Section 3, there is one open, hand-dug well to the northeast of the homestead site on the Property (Photograph 11). It has a dry-stacked, loose rock casement and the original depth of the well could not be ascertained during the site visit. The well has filled in and today appears to be only 0.5 m (1.5 ft) deep. The well was likely completed in unconsolidated materials (rather than bedrock) and accesses shallow groundwater in a saturated alluvial aquifer adjacent to Turkey Creek.

Photograph 11. Hand-dug well at homestead site.

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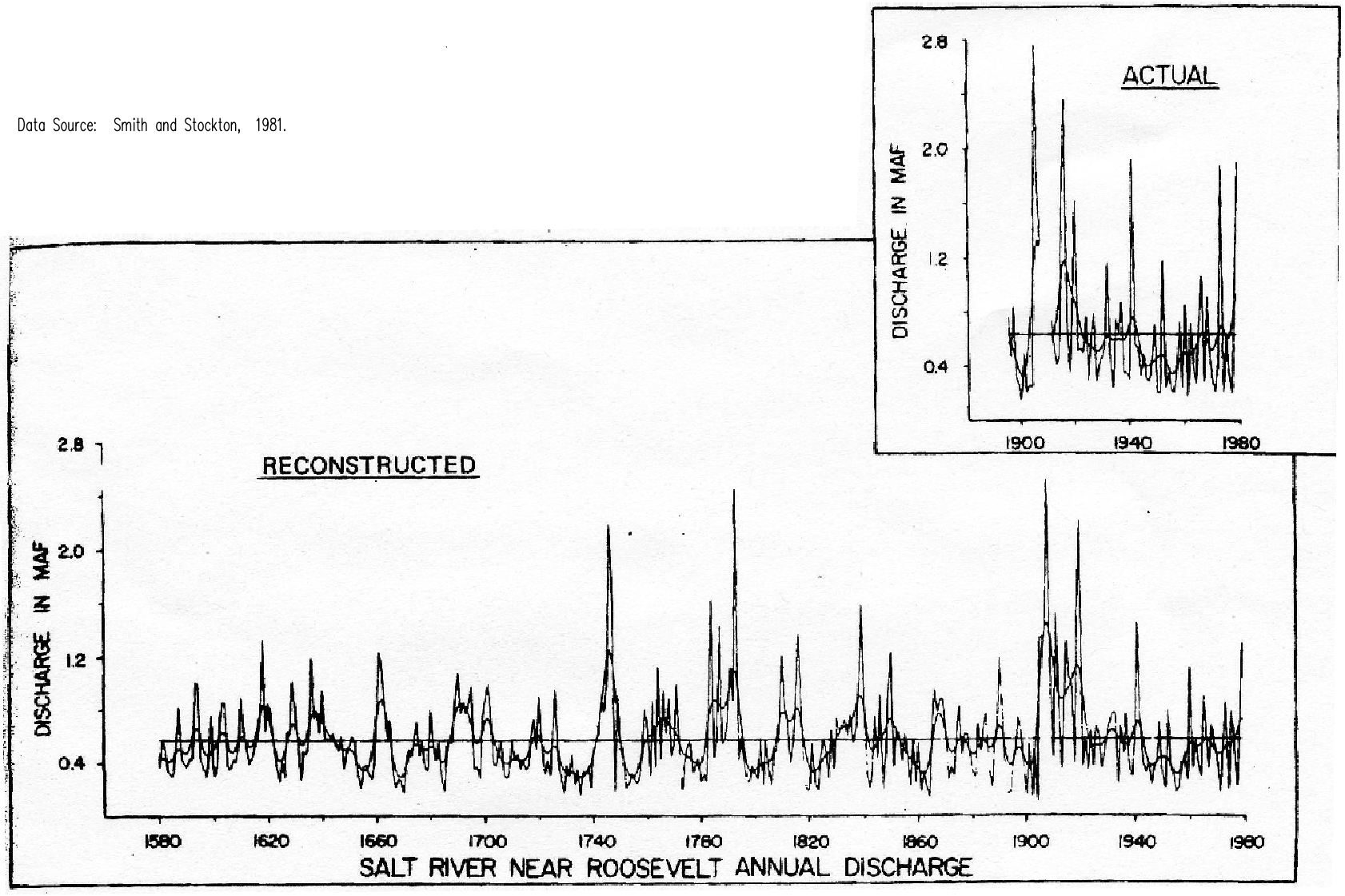
Reconstructed Stream Flow for the Salt and Verde Rivers From Tree-Ring Data

Data Source: Smith and Stockton, 1981.



Reconstructed and Actual Discharge of the Salt River Near Roosevelt (calibration period is from 1914-1979).

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Note: Not to Scale

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JX RANCH

RECONSTRUCTED STREAM FLOW

Figure 4

5. BIOLOGICAL RESOURCES

5.1. VEGETATION AND HABITAT DESCRIPTION

The on-site vegetation is described in terms of several of Brown's (1994) biotic communities of the southwestern United States and northwestern Mexico. Within 16 km (10 miles) of JX Ranch, Brown and Lowe (1994) mapped at least five biotic communities:

- Petran Montane Conifer Forest,
- Madrean Evergreen Woodland,
- Great Basin Woodland,
- Semidesert Grassland, and
- Interior Chaparral.

One additional unmapped biotic community, the Montane Riparian Wetlands, occurs in the well-defined corridors of Turkey Creek, Rock Creek, and Bear Head Canyon. Within the area of the Property there appears to be only four biotic communities. Although fairly good stands of grasses occur on the slopes of the Property, the presence of large woody plants in the overstory above the grasses suggests a woodland rather than grassland. Drawing freely from Brown (1994), the four biotic communities and characteristic species on the Property are:

- Petran Montane Conifer Forest. Ponderosa pine (*Pinus pondeosa*) is the dominant species in this community, with Gambel oak (*Quercus gambelii*) and New Mexican locust (*Robinia neomexicana*) also present.
- Madrean Evergreen Woodland. This community includes Emory oak (*Quercus emoryi*), Arizona white oak (*Quercus arizonica*), one-seed juniper (*Juniperus monosperma*), and netleaf oak (*Q. reticulata*).
- Interior Chaparral. The most characteristic woody species of this community is pointleaf manzanita (*Arctostaphylos pungens*); however, skunkbush sumac (*Rhus aromatica*), buckbrush (*Ceanothus fendleri*), and other species are also expected to occur.
- Montane Riparian Wetland. This is a "canyon bottom forest" which can occur along perennial and near-perennial streams at moderate elevations. Narrowleaf cottonwood (*Populus angustifolia*) is an unambiguous element of this biotic community. Willows (*Salix* spp.), New Mexican locust (*Robinia neomexicana*), and tree species like Ponderosa pine and oaks found on the higher slopes are also constituents of this community.

For the broad regional scale that Brown (1994) was addressing, climate plays an over-arching role in determining the distribution and composition of the biotic communities. Within the scale of the Property, the climate is essentially constant. Instead, surficial geology, presence or absence of surface water, depth to groundwater, and topography (slope and aspect) play more significant roles in determining plant species occurrences. Based on these factors and the biotic communities listed above, we recognized and mapped five groupings of vegetation on the Property (Figure 5):

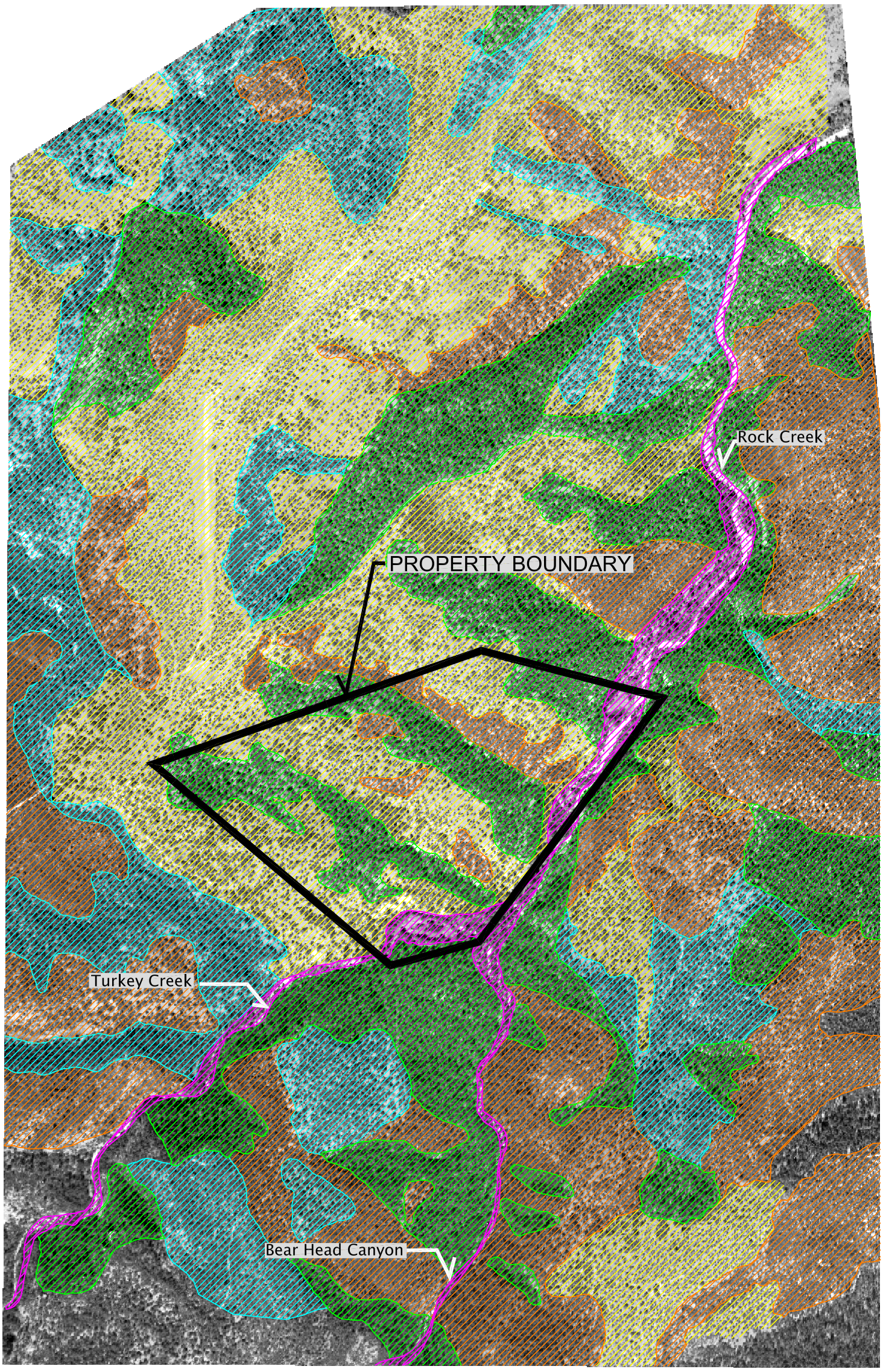
- Low density interior chaparral: manzanita and scrub oak (*Quercus turbinella*). Bare ground constitutes more than 30 percent of this class.
- Interior chaparral: dense stands of primarily manzanita and some scrub oak.
- Madrean evergreen woodlands: oak (*Quercu*s spp.) and one-seed juniper.
- Madrean woodlands to Petran montane forest: Ponderosa pines and larger oaks such as *Q. arizonica, Q. emoryi,* and *Q. reticulata*.
- Montane riparian wetland: sycamore (*Platanus wrightii*), narrow-leaf cottonwood, New Mexican locust, and willows.

It is clear that our groupings are almost identical to those of Brown (1994). However, by suggesting this more informal grouping, we are more comfortable with small patch sizes and the mosaic of vegetation on site that are hard to reconcile with the scale of "biotic communities".

The mapped groupings were delineated using USGS black and white aerial photographs (Figures 6a and 6b, from 1965 and 1992, respectively). It should be emphasized that the vegetation was mapped using the aerial photographs; ground-truthing of the delineated vegetation was not made and the vegetation types depicted in Figure 5 should be regarded as only provisional. The following sections discuss on-site vegetation and habitats in respect to these groupings.

5.1.1 Low density interior chaparral

On the south-facing slopes and ridgelines of the Tertiary conglomerate, Mescal Limestone, and Dripping Spring Quartzite are areas of very low vegetation density. The vegetation in these areas is essentially widely spaced individual shrubs of chaparral species. These areas have little soil accumulation. Within the local area surrounding the JX Ranch, Mescal Limestone tends to support sparse chaparral, but features of the Tertiary conglomerate (consolidated, calcite cemented) coupled with southern exposure also are conditions that permit only a very sparse chaparral. Brown (1994) discusses the recurring pattern of chaparral as "everywhere a drier adapted formation than evergreen sclerophylll woodland."



Five Vegetation Types in Proximity to the JX Ranch

- Low density woody shrubs, especially manzanita (*Arctostaphylos pungens*) and scrub oak (*Quercus turbinella*). Bare ground constitutes > 30% (approximately).
- Chaparral-type vegetation, dense stands of primarily manzanita and some scrub oak.
- Open woodlands of oak (*Quercus* spp.) and one-seed juniper (*Juniperus monosperma*).
- Denser woodlands to forest. North-facing slopes typically have stands of ponderosa pines (*Pinus ponderosa*) and larger oaks such as *Q. arizonica, Q. emoryi,* and *Q. reticulata.*
- Riparian trees, including sycamore (*Platanus wrightii*), narrow-leaf cottonwood (*Populus angustifolia*), New Mexican locust (*Robinia neomexicana*), and willows (*Salix* spp.).

Disclaimer: The vegetation is delineated using a USGS EROS black and white photograph (GS-VAOC, 2-21, taken September 30, 1962. Ground-truthing of the delineated vegetation was not made and vegetation types should be regarded as only provisional.

T.7N.,R.12E. PORTION OF SECTION 3 & 4,
GILA COUNTY, ARIZONA
LOCATED ON THE COPPER MT.,
USGS QUADRANGLE

Property Boundary

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N
W E
S

0' 500' 1000'
SCALE: 1" = 1000'

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JX RANCH

Vegetation Map
Figure 5

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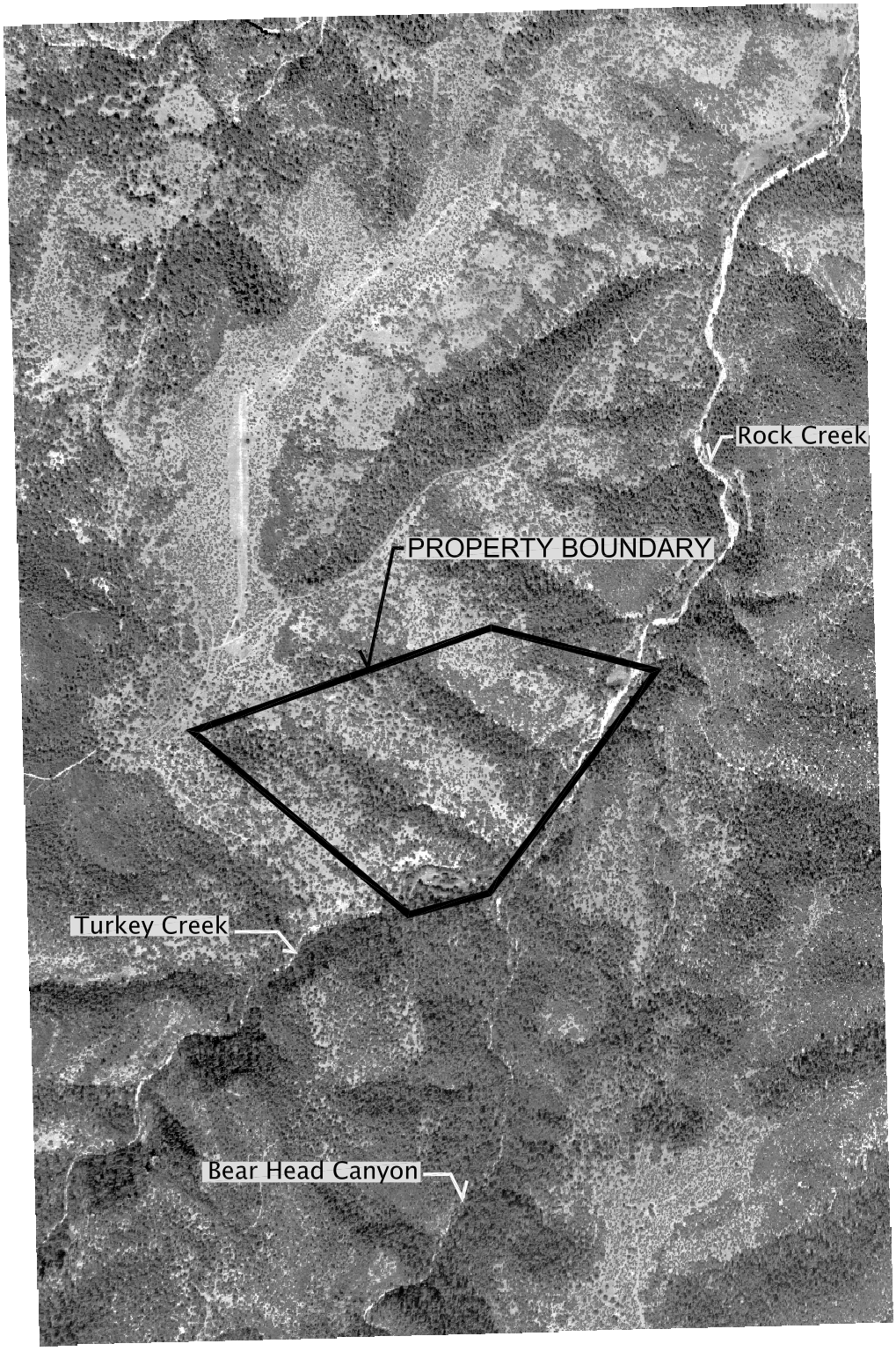

T.7N.,R.12E. Portion of Sections
3 & 4, Gila County, Arizona
Located on the Copper Mt.
USGS Quadrangle

0' 800' 1600'
SCALE: 1" = 1600'

N
W E
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Photo Provided By: EROS Data Center, 1962.

Resolution Copper Company

JX RANCH

1962 Aerial
Figure 6a

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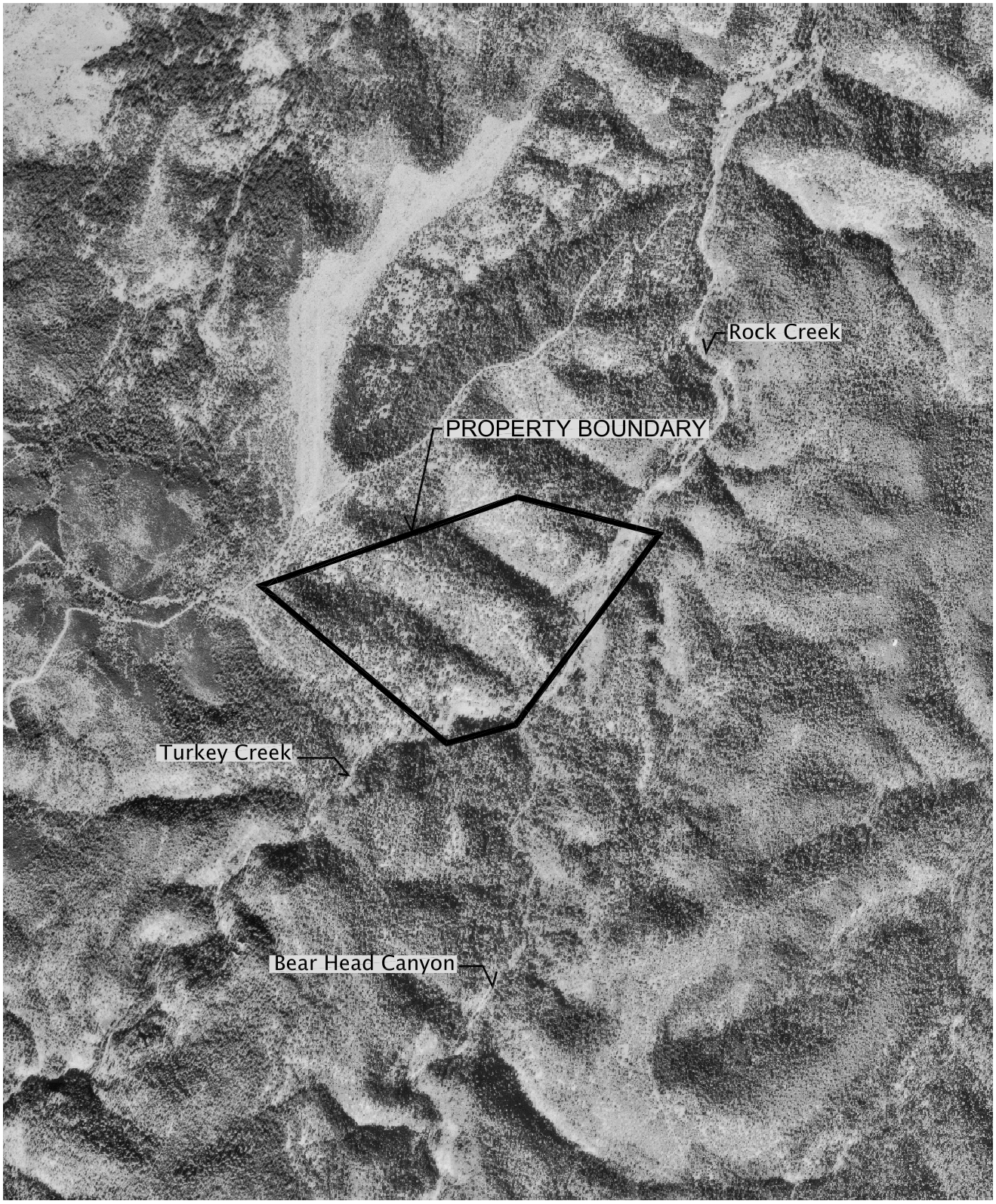

T.7N.,R.12E. Portion of Sections
3 & 4, Gila County, Arizona
Located on the Copper Mt.
USGS Quadrangle

0' 800' 1600'
SCALE: 1" = 1600'

N
W E
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Photo Source: USGS Digital Ortho Quarter Quadrangle
Copper Mt. NW & Picture Mt. NE, 1992.

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JX RANCH

1992 Aerial

Figure 6b

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5.1.2 Interior chaparral

This vegetation type is similar to the low density interior chaparral but on slopes and particular portions of the Tertiary conglomerate and Dripping Springs Quartzite that have conditions more favorable to the development of soil and retention of moisture. On the Property, pointleaf manzanita is the dominant shrub in this vegetation.

Photograph 12. Mandrean woodland to Petran Montane conifer forest.

5.1.3 Madrean evergreen

This vegetation type is transitional between interior chaparral and woodland. These are patches of vegetation visible on the aerial photographs that were not readily assignable to either chaparral or woodland-forest. Junipers, oaks, and manzanita are species that occur on these slopes on the Property.

5.1.4. Madrean woodland to Petran montane conifer forest

These patches of vegetation tend to occur on the north-facing slopes and in the bottoms of drainages. The most conspicuous species within these open woodlands or forests is Ponderosa pine. Photograph 12, taken not far upstream from the Property along Turkey Creek, includes not only large Ponderosa pine but also Gambel's oak, netleaf oak, and New Mexican locust.

Photograph 13. Sycamore.

5.1.5. Montane riparian wetland

Aside from the willows that are probably introduced (see Section 5.2, below), the channel bottoms have several riparian species including narrow-leaf cottonwood (Photographs 13 and 14). Sycamores (*Platanus wrightii*) are fairly common along the stream channels. The cottonwoods are distinctive in their architecture; the branches are ascending in the upper half of the trunk and form a narrowly spreading crown. In addition, these trees are soboliferous, forming basal shoots especially after the trunk has been killed by fire (see Section 5.3, below).

Photograph 14. Narrowleaf cottonwood.

Photograph 15. Apple trees at homestead site.

Photograph 16. Willow in Turkey Creek.

5.2. HUMAN ALTERED ASPECTS OF VEGETATION ON JX RANCH

There are two alluvial surfaces on the Property that have been cleared during the occupancy of JX Ranch. One cleared alluvial surface is along Turkey Creek and includes the homestead site (Photograph 2, Page 7, and visible in the aerial photographs, Figures 6a and 6b). In the middle of this surface are five large old apple trees in a row (Photograph 15) and several more to the north of this row. In addition, there are about fifteen very large willow trees (*Salix* sp. undetermined, possibly *S. alba*, an introduced European species) along the channel of Turkey Creek both upstream of the Property and along the channel on the Property. An example of one large willow tree upstream is depicted in Photograph 16. In the same area, several of the willows were severely burned during the 2003 fire (Photograph 17); the trunks are dead, although there is some post-fire basal sprouting that occurred presumably late last summer.

Photograph 17. Willow killed by fire.

Photograph 18. Cattle chute trap.

The other cleared alluvial surface, near the northeastern corner of the Property, is also clearly evident in the 1962 aerial photograph (Figure 6a). It includes the remnants of a chute trap/holding pen for cattle (Photograph 18). Salt blocks were likely used to attract the cattle. Although the salt blocks are no longer present, remnant salt is still much-used by native ungulates (Photograph 19). No fruit trees or other horticultural evidence occurs on this surface, although evidence of natural regeneration is apparent (as described below).

Photograph 19. Remnant salt lick.

5.3 VEGETATION AND FIRE

The 2003 summer fire in the Sierra Ancha burned, by our estimate, perhaps one-third of the vegetation on and near the JX Ranch. This fire did not result in a significant loss of forest or woodland vegetation in the immediate area of the Property. Photograph 1 (Page 5) (overlooking the confluence of Bear Head Canyon with Turkey Creek) is representative of the general patchy extent of the burns and the mosaic pattern of surviving vegetation.

Photograph 20. One-seed juniper killed by fire.

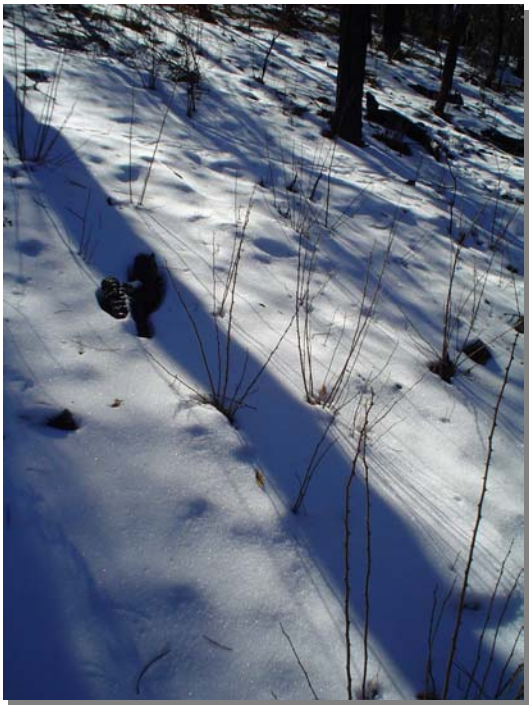
It appears that the drier chaparral and open woodlands probably experienced a greater percent loss of cover than the more mesic slopes and canyon bottoms. Some areas burned intensely, with the resulting loss of complete stands of one-seed juniper (Photograph 20), Ponderosa pine (Photograph 21), and manzanita (Photograph 22). The several riparian tree species (sycamore [Photograph 23], narrow-leaf cottonwood, willow) each appear to have been remarkably sensitive to the fire, with total loss of the trunks. Each of these riparian species appears to be capable of soboliferous regeneration. For example, near the

Photograph 21. Ponderosa pine killed by fire.

Photograph 23. Sycamore killed by fire.

Photograph 24. Narrow-leaf cottonwood shoots.

northeastern corner of the Property there are a number of shoot clusters of narrow-leaf cottonwood (Photograph 24) on the older alluvial surface. The large numbers of shoot clusters may have been initiated by the tree during the first sprouting following the fire or were produced in response to browsing (by elk) of the first few shoots. Similarly, on the north-facing slopes to the south of the JX Ranch we found evidence of vigorous resprouting of New Mexican locust (Photograph 25). Based on these observations, it appears that browse for ungulates is improved after fires because of the amount of available rapidly growing basal shoots produced by trees such as narrow-leaf cottonwood and New Mexican locust.



Photograph 25. New Mexican locust sprouts.

In addition to variation of loss to fire experienced by each vegetation type, the fire affected each patch of vegetation differently. The effects ranged from unburned, to partially burned, and completely incinerated. Some stands of Ponderosa pine, Madrean woodland, or chaparral did not burn at all; in other stands, the trees were completely killed. For at least the next 20 to 50 years (or forever, if Marshall's [1957] perspective is used), these vegetation patches will be on remarkably different successional trajectories. For example, some patches of fire-killed chaparral may have few seeds of manzanita left in the soil; these patches might be expected to revert to grasslands for a while before being reinvaded by manzanita. Other chaparral patches, with enough surviving manzanita stems, might quickly revert to chaparral. Bird, mammal, and invertebrate species are all likely to discriminate between these compositionally varied patches. Below, we briefly consider some of the effects of this vegetation- and burn-mosaic on bird species composition.

Kreisel and Stein (1999) documented the change in trunk and branch foraging species of birds during winter in burned and unburned mixed conifer forests in northeastern Washington. They found trunk and branch foraging species (woodpeckers, nuthatches, creepers) to be 2.5 times more abundant in winter in burned than in unburned forest; and trunk and branch foraging species significantly decreased from the first winter post-fire to the fourth winter post-fire. Most bird mortality occurs during the non-breeding season (Graber and Graber, 1983), so improved resources in winter may boost both numbers and condition of birds in the following breeding season. Cavity-nesting species are found to be more closely associated with early (< 9 yrs) post-fire forests than unburned forests (Hutto, 1995; Bock and Lynch, 1970; and others). For the first 5 years following fire, bark and wood-boring beetle populations are significantly elevated (Furniss, 1965; Amman and Ryan, 1991; Spring, 1965; Koplin, 1972). The general findings of these and other burn/unburned forest comparisons in western North America are likely to be directly applicable to understanding species occurrences and densities of insects, birds, and even some mammals in the vicinity of JX Ranch.

In northern Arizona, Rosenstock (1998) compared breeding bird communities in pure stands of Ponderosa pine to stands with both Ponderosa pine and Gambel oak. He found that "overall bird diversity was significantly greater in pine-oak stands, which also had more species of Neotropical migrants, ground nesters, primary cavity excavators, and secondary cavity users than did pine stands." He found only five bird species unique (restricted) to the pine forests. Once again, the fire is likely to have increased the amount of mixed oak-pine woodlands and forests in the general area. Based on the findings of Laudenslayer and Balda (1976) for an area north of Flagstaff, Arizona, the contact edges between patches of pine, juniper, manzanita, and oak in this area are not expected to have species of birds unique to the edge itself. Furthermore, "edge species", even if identified, are more likely to be early successional species that find forest and woodland edges sufficient for breeding, rather than being edge species per se (Imbeau, Drapeau, and Monkkonen, 2003).

5.4. WILDLIFE

As described above, the biotic communities (as identified by Brown, 1994) on and near the Property are Petran Montane Conifer Forest, Madrean Evergreen Woodland, low and moderate density Interior Chaparral, and Montane Riparian Wetlands. The mosaic of habitat types present suggests that a diversity of wildlife species, representative of these biotic communities, would be found on the Property.

Common reptile and amphibian species that can be expected to occur on or near the Property include black-tailed rattlesnake (*Crotalus molossus*), Arizona black rattlesnake (*Crotalus viridis cerberus*), Sonoran mountain kingsnake (*Lampropeltis pyromelana)*, black-necked garter snake (*Thamnophis cyrtopsis*), ornate tree lizard (*Urosaurus ornatus*), Clark's spiny lizard (*Sceloporus clarkii)*, red-spotted toad (*Bufo punctatus*), canyon tree frog (*Hyla arenicolor*), mountain tree frog (*Hyla eximia*), and Sonoran mud turtle (*Kinosternon sonoriense*) (Brown, 1994; Stebbins, 2003). Common bird species expected to occur on or near the Property include goshawk (*Accipiter gentillis*), great-horned owl (*Bufo virginianus*),

flamulated owl (*Otus flameolus*), northern pygmy owl (*Glaucidium gnoma*), western flycatcher (*Epidonax difficilis*), band-tailed pigeon (*Columba fasciata*), Merriam's turkey (*Meleagris gallopavo merriami*), common raven (*Corvus corax*), and Stellar's jay (*Cyanocitta stelleri*) (Brown, 1994; National Geographic, 1987). Common mammals expected to occur on or near the Property include white-footed mice (*Peromyscus* spp), pack rat (*Neotoma* spp.), cottontail rabbit (*Sylvilagus flouridanus*), elk (*Cervus elaphus*), coues white-tailed deer (*Odocoileus virginianus couesi*), mule deer (*O. hemionus*), javelina (*Tayassu tajacu*), bobcat (*Felis rufus*), mountain lion (*Felis concolor*), raccoon (*Procyon lotor*), black bear (*Ursus americanus*), and coyote (*Canis latrans*) (Hoffmeister, 1986).

Although portions of Turkey and Rock Creeks are intermittent, there are perennial reaches and pools that provide potential refugia for fish (and amphibians) during periods of low flow. As discussed above, the portion of Turkey Creek that flows through the Property may be perennial (Brown, et al, 1978). Three species of native fish have been recorded on the Property at the confluence of Turkey Creek and Bear Head Canyon (Photograph 6, Page 11). These species are desert sucker (*Catastomous clarki*), headwater chub (*Gila nigra*), and speckled dace (*Rhinichthys osculus*) (Schuetz, 2004a, b).

Wildlife species observed[1] by WestLand on the Property include elk, deer, Stellar's jay, Mexican Jay (*Aphelocoma ultramarina*), raven, turkey, white-breasted nuthatch (*Sitta carolinensis*), sapsucker (*Sphyrapicus* spp.) northern flicker (*Coloptes auratus*), Hutton's vireo (*Vireo huttoni*), dark-eyed junco (*Junco hyemalis*), and caddisfly (*Trichoptera* spp.). It should be noted that the field reconnaissance on the JX Ranch was conducted in February, when wildlife activity is relatively low and migratory birds are not present. Wintering birds were noted. A more extensive list of wildlife observations would be expected in spring and fall.

5.5. SPECIAL STATUS SPECIES

The following special status species list (Table 1) was provided by the USFWS and contains all federally listed threatened, endangered, proposed, and candidate species for Gila County, Arizona. The table includes the species' common and scientific name, federal listing status, and WestLand's evaluation of the likelihood of occurrence on or near the Property.

[1] Wildlife observations included direct visual observation and the observation of tracks and scat.

Table 1 Special-Status Species: Known or Suspected to Occur in Gila County, Arizona.

Species	Status	Potential Occurrence at Project Site and Basis for Potential Occurrence Determination
Arizona agave *(Agave arizonica)*	Endangered	**Possible:** the Property is within the elevational range occupied by this species, and there are known populations of this plant elsewhere in the Sierra Ancha. The nearest record of this species in the HDMS database is 26.5 km (16.5 miles) southeast of the Property. No specimens were observed during field reconnaissance.
Arizona bugbane *(Cimicifuga arizonica)*	Conservation Agreement[2]	None: the Property lacks canyon areas of deep shade and moist soils with a high humus content required for this species.
Arizona hedgehog cactus *(Echinocereus triglochidiatus arizonicus)*	Endangered	None: the Property is outside of the known area of distribution for this variety of hedgehog cactus
Apache (Arizona) trout *(Oncorhynchus apache)*	Threatened	None: the Property is located outside of the known area of distribution for this species.
Colorado white salmon (pikeminnow) (*Ptychocheilus lucius)*	Endangered	None: this species occupies rivers with high silt content, warm water, and turbulence under 1,220 m (4,000 ft) in elevation. The Property and Turkey Creek is cool, clear, and intermittent.
Gila chub (*Gila intermedia)*	Proposed Threatened	None: all known populations of this species have been extirpated from the Salt River drainage.
Gila topminnow (*Poeciliopsis occidentalis occidentalis*)	Endangered	None: the Property is above the elevational range occupied by this species. This species has been historically extirpated from the Tonto Basin. There is one reintroduced population at Kayler Springs approximately 18 km (11 miles) to the west of the Property.
Gila trout (*Oncorhynchus gilae)*	Endangered	None: Gila trout require perennial mountain streams above 1,650 m (5,400 ft) in elevation. Turkey Creek is an intermittent stream with perennial pools and the Property is below the elevational range of this species. In addition, the Property is located outside of the known are of distribution for this species. The only known occurrence of this species in Gila County is a reintroduced population at Dude Creek.
Loach minnow *(Tiaroga cobitis)*	Threatened	None: the Property is located outside of its known currently occupied range in Arizona.
Razorback sucker *(Xyrauchen texanus)*	Endangered	None: this species occupies large to intermediate sized perennial rivers. Turkey Creek is cool, clear, and intermittent. In addition, the upper elevational limit of this species is 1,525 m (5,000 ft). The Property is above the elevational range of this species.
Spikedace *(Meda fulgida)*	Threatened	None: this species range in Arizona is restricted to Aravaipa Creek in Pinal County, Eagle Creek in Greenlee County, and the Verde River in Yavapai County.
Chiricahua leopard frog (*Rana chiricahuensis*)	Threatened	**Possible:** Turkey Creek provides suitable habitat for this species and the Property is within the elevational range occupied by the Chiricahua leopard frog. There are known populations of lowland leopard frogs in the lower reaches of this drainage. The nearest record of this species in the HDMS database is 26 km (16 miles) northeast of the Property. The USFS considers Turkey Creek to be "un-surveyed potential habitat" and focused surveys for this species in the upper Turkey Creek watershed are pending.
Bald eagle (*Haliaeetus leucocephalus*)	Threatened	**Possible:** Bald eagles spend most of their time along major waterways. However, there is a known bald eagle breeding territory in an upland area high in the Sierra Anchas approximately 8 km (5 miles) south of the Property. There are also a number of documented bald eagle breeding territories along Tonto Creek, Roosevelt Lake, and the Salt River west, south, and east of the Property. There is some potential for the Property to be utilized by resident or wintering bald eagles.

[2] Conservation agreement signed in June 1999.

Table 1 Special-Status Species: Known or Suspected to Occur in Gila County, Arizona.

Species	Status	Potential Occurrence at Project Site and Basis for Potential Occurrence Determination
Cactus ferruginous pygmy-owl *(Glaucidium brasilianum cactorum)*	Endangered	None: cactus ferruginous pygmy owls do not occupy habitats above 1,220m (4,000 ft) in elevation. The Property is above the elevational of range of this species.
California Brown pelican *(Pelecanus occidentalis californicus)*	Endangered	None: occurrence of this species is Arizona is limited to larger lakes and rivers
Mexican spotted owl (*Strix occidentalis lucida*)	Threatened	**Possible:** the Property and its immediate vicinity contains suitable habitat of dense forest and steep canyons for this species. There are two documented spotted owl territories within 3 km (2 miles) of the Property.
Southwestern willow flycatcher (*Empidonax traillii extimus)*	Endangered	None: the Property lacks riparian habitat containing significant cottonwood/ willow and/or tamarisk vegetation communities along rivers and streams that are required by this species.
Yellow-billed cuckoo *(Coccyzus americanus)*	Candidate	None: the Property lacks large blocks riparian woodlands (Cottonwood, willow, and tamarisk galleries) required by this species.
Yuma clapper rail *(Rallus longirostris yumanensis)*	Endangered	None: this species occupies densely vegetated riparian and marshland habitats below 1,370 m (4,500 ft) in elevation. The Property lacks densely vegetated marshland and is located above the elevational range of this species.
Lesser long-nosed bat *(leptonycteris curasoae yerbabuenae)*	Endangered	None: the Property is located outside of the known area of distribution for this species.

Primary Source: AGFD HDMS

The screening analysis conducted by WestLand indicates that four federally listed threatened, endangered, proposed, or candidate species have the potential to occur on the Property. These species are the Arizona agave (*Agave arizonica)*, Chiricahua leopard frog (*Rana chiricahuensis),* bald eagle (*Haliaeetus leucocephalus*), and Mexican spotted owl (*Strix occidentalis lucida*). These species are discussed in the following sections.

5.5.1. Arizona Agave

Life History

Arizona agave has rosettes of bright green leaves with dark mahogany margins; mature leaves are 17 to 24 cm (7 to 10 in) long and 2 to 4 cm (0.8 to 1.5 in) wide. The yellow flowers are born on sub-umbellate inflorescence. This species occurs in the transition zone between oak-juniper woodland and mountain mahogany-oak scrub at 900 to 1,850 m (3,000 to 6,000 ft) in elevation. Arizona agave primarily inhabits steep rocky slopes but is also known to occur on drainage bottoms or gentle slopes or saddles. Its current documented range in Arizona includes the New River Mountains (Maricopa and Yavapai Counties) and the Sierra Ancha (Gila County). There are known occurrences of this plant 26.5 km (16.5 miles) southeast of the Property (Klein, 2004). Other areas of potential occurrence, such as the Mazatzal Mountains west of the Property, have not been surveyed for Arizona agave.

The Arizona agave was listed as endangered in 1984 (AGFD, 2003) because it was deemed vulnerable due to low numbers and limited distribution. Other perceived threats include habitat degradation due to overgrazing by livestock, feral burros, and wildlife.

There is a growing body of evidence that this plant may be a hybrid. In the final listing for the species, the USFS "expressed doubt" that Arizona agave is a good species indicating that it appears in some respects to be intermediate between two other species in the genus, apparently sets seeds infrequently, and may be of recent hybrid origin. In the *Arizona Rare Plant Field Guide* (AGFD,2002a), the plant is referred to as *Agave x. arizonica*, emphasizing its hybrid status. Recent research indicates that the plant is likely a hybrid between *A. chrysantha* and *A. toumeyara*. It is possible that, because of its hybrid status, the USFWS may petition to delist this species (Faulk, 2002).

Potential for Occurrence on the Property

It is possible that Arizona agave occurs on the Property. However, no specimens of any agave species were observed on the Property during field reconnaissance. As noted above, the nearest known location of this plant is 26.5 km (16.5 miles) southeast of the Property.

5.5.2. Chiricahua leopard frog

Life History

The Chiricahua leopard frog requires permanent or nearly permanent water sources, including streams, rivers, backwaters, ponds, and stock tanks that are free from introduced fish, crayfish, and bullfrogs. Historical distribution of the Chiricahua leopard frog includes elevation ranges from 1,000 to 2,710 m (3,281 to 8,890 ft) amsl in central and southeastern Arizona, including Gila County.

The Chiricahua leopard frog was designated as a threatened species throughout its range in 2002. Critical habitat has not been designated at this time and a recovery plan for this species has not yet been drafted. According to the listing summary, this species is absent from more than 75 percent of its known historical sites and former range. Habitat destruction, predation and displacement by non-native species, and disease are suspected contributing factors to the species' decline.

Potential for Occurrence on the Property

Turkey Creek provides suitable habitat for this species and the Property is within the elevational range occupied by the Chiricahua leopard frog. The nearest record of this species in the HDMS database is 26 km (16 miles) northeast of the Property. The USFS considers Turkey Creek to be "un-surveyed potential habitat" (Klein, 2004). Focused surveys for this species would be required in order to document the presence or absence of this threatened species on the Property.

There are known populations of lowland leopard frogs, a closely related species commonly occurring at lower elevations, in the lower reaches of this drainage. The presence of a closely related species suggests a potential of occurrence for the Chiricahua leopard frog in similar habitat on the Property.

5.5.3. Bald Eagle

Life History

This large bird of prey is 1 m (3 ft) long and has a wingspan of 1.8 to 2.1 m (6 to 7 ft) (AGFD, 2002b). Adults have a characteristic white head and tail with a brown body. Immature bald eagles are mostly dark and lack the white head and tail found in adult birds. Nesting populations are increasing throughout the United States. Arizona supports a small, widely dispersed resident population of approximately 40 pairs that breeds along the Salt, Verde, Gila, Bill Williams, Agua Fria, and San Francisco Rivers and associated reservoirs, as well as Tonto and Canyon Creeks. Arizona also hosts a number of wintering bald eagles, with at least 200 to 300 wintering birds documented each year. Bald eagles in Arizona prey upon fish, waterfowl, small mammals, and carrion (Southwestern Bald Eagle Management Committee, 2004; USFWS, 2004).

Terrestrial habitats are also utilized during certain periods of the year, especially by non-breeding and wintering birds. Cattle (as carrion) may become important as a food item both episodically (during prolonged droughts) and periodically during the calving season (such as early spring) when placentas, stillborn calves, and cows that die while calving become available to scavengers. Terrestrial habitats also supply elk[3] and deer carrion, rabbits, and other mammals of appropriate size, upland birds, and reptiles (Hunt et. al. 1992).

[14] Elk sign is common on the site and Westland biologists documented the skeletal remains of a female elk calf on the Property

The bald eagle was originally listed as endangered in most of the lower 48 states in 1978 (USFWS, 1978). Recovery plans were established for five geographic regions in the country in the 1980s, and the species' population had increased by 462 percent from 1978 until 1995, with a broad increase in range as well (USFWS, 1995). The bald eagle was downlisted from endangered to threatened status in all 48 lower states in 1995 (USFWS, 1995), and proposed for delisting in 1999 (USFWS, 1999). There has been no change to the federal listing status since 1999.

Potential for Occurrence on the Property

There is a potential for the Property to be utilized for foraging by resident or wintering bald eagles. Turkey Creek provides potential foraging habitat. Desert suckers are an important prey species for bald eagles in Arizona and are known to occur on the Property.

There is a documented bald eagle breeding site in the Sierra Ancha approximately 8 km (5 miles) south of the Property (Driscoll, 2004). This nest site is unusual in Arizona in that it is located in an upland area miles away from the nearest typical foraging habitats such as along Tonto Creek and Roosevelt Lake. Research conducted by the AGFD indicates that this pair of bald eagles is known to forage at Roosevelt Lake approximately 22.5 km (14 miles) to the south. It is quite likely that this pair of eagles also forages in the various headwater streams in the Property's vicinity, especially during sucker spawning runs. Wintering bald eagles are also known to range widely throughout central Arizona, including areas within the Property's vicinity.

5.5.4. Mexican Spotted Owl

Life History

The Mexican spotted owl is a brown bird about 40 to 50 cm (16 to 19 in) long with a wingspan of approximately 105 to 135 cm (42 to 54 in) (AGFD, 2001). The owl's lack of ear tufts gives its head a large round appearance. The head and back are covered with white spots, hence the common name. The Mexican spotted owl, described as a "perch and pounce" predator, primarily consumes small to medium-sized rodents such as pack rats, mice (*Peromyscus* spp.), and voles (*Microtus* spp.). It also preys upon bats, birds, reptiles, and arthropods. MSOs are quite tame and will tolerate close range observations if the observer is quiet (Ganney, 1998).

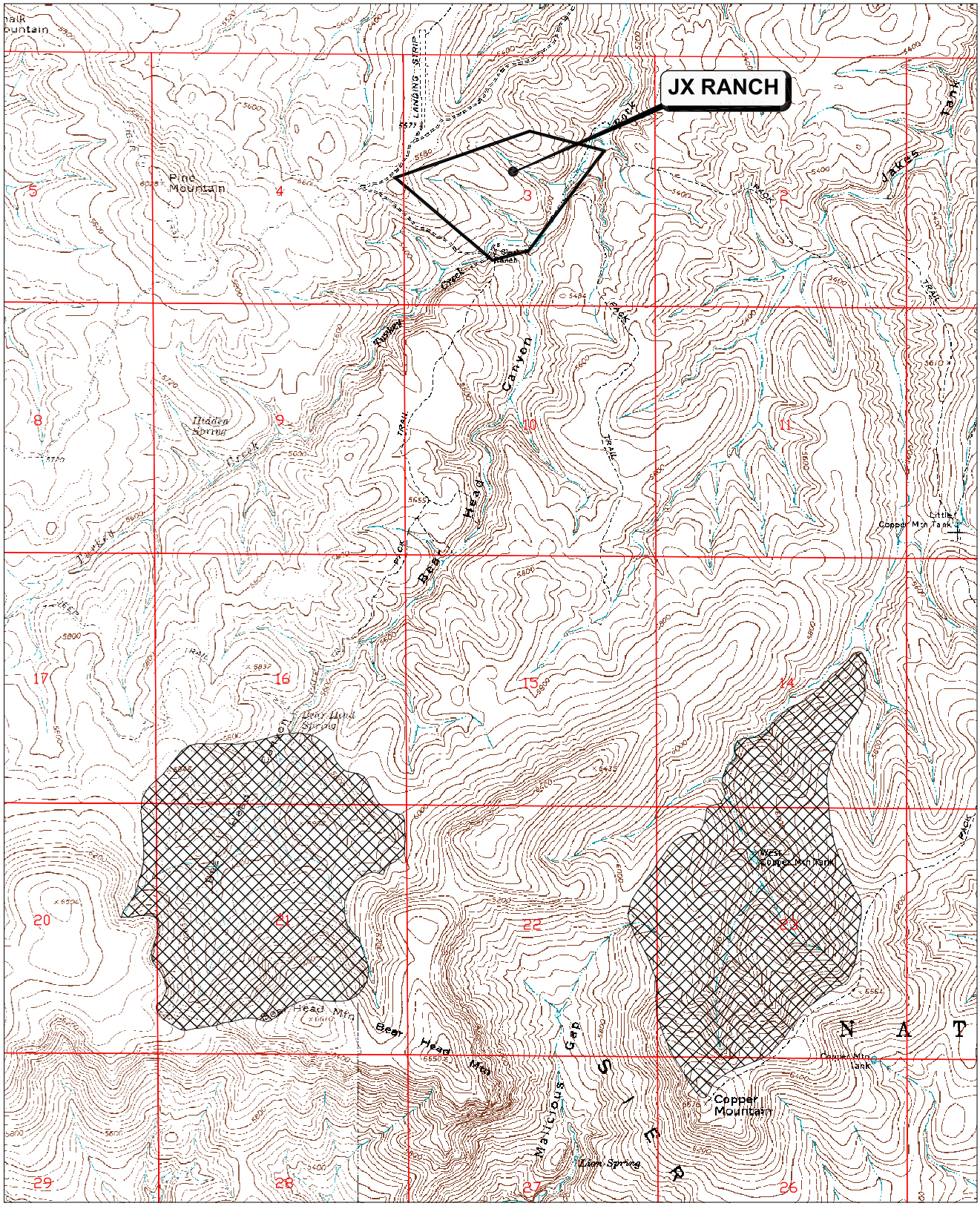
The Mexican spotted owl inhabits steep canyon and montane forest habitats in a range extending from southern Utah and Colorado through Arizona, New Mexico, west Texas, and Mexico (AGFD, 2001). In the northern portion of its range (Utah, Colorado, northern Arizona, and New Mexico), this owl primarily occurs in steep walled rocky canyons with mixed conifers. Below the Mogollon Rim of central Arizona and New Mexico, the Mexican spotted owl occupied a much more diverse array of habitat types. Here,

breeding owls occupy canyons containing mixed conifers, Madrean pine-oak and or Ponderosa pine forests, encinal oak woodlands, and riparian forests. Some Mexican spotted owls remain in their breeding territories year round, while other migrate, generally to lower elevations, in winter. This seasonal elevational migration has been noted within the Tonto Creek watershed, which includes the Property.

The Mexican spotted owl was designated as a threatened species throughout its range in 1993 (USFWS, 1993) and critical habitat was established in 2001 (USFWS, 2001). Threats to this species' viability include logging of old growth forests and competition from great horned owls in forests that have been thinned.

Potential for Occurrence on the Property

The Property and its immediate vicinity contain elements of suitable Mexican spotted owl habitat and the Tonto National Forest lands surrounding the site are within proposed critical habitat for the Mexican spotted owl. This species is known to occur in the Property's immediate vicinity, with two documented territories within 3.2 km (2 miles) of the Property, one of which is located within Bear Head Canyon immediately up canyon from the Property. The second territory is located in an adjacent drainage a similar distance from the Property. These areas have been classified as Mexican Spotted Owl Protected Activity Centers (PACs) (Figure 7). PACS are established by the USFWS at sites that have been known to harbor Mexican spotted owls in the recent past (1989 to present). Both of these PACs are centered on areas where the owl's breeding activity has been documented. Specific guidelines for PACs established by USFWS have been designed to promote Mexican spotted owl conservation. The primary objective of these guidelines is to protect the best available habitat for the Mexican spotted owl. Specific management methods considered within these guidelines address activities such as timber harvest, fire suppression, and road building. Given the fact that the Property contains suitable habitat and is proximate to known breeding territories, it is likely that the Property is utilized by the MSO for breeding, foraging, dispersal, migration, and/or winter range.



T.7N.,R.12E. PORTION OF SECTION 3 & 4
GILA COUNTY, ARIZONA
LOCATED ON THE
COPPER MT. & PICTURE MT.
USGS QUADRANGLE

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WestLand Resources Inc.
Engineering and Environmental Consultants
2343 E. Broadway Blvd. Suite 202
Tucson, Az 85719 (520) 206-9585

Resolution Copper Company

Resolution Project

MEXICAN SPOTTED OWL PROTECTED ACTIVITY CENTER
ADJACENT TO JX RANCH
Figure 7

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6. CONSERVATION VALUES AND OPPORTUNITIES

JX Ranch is a private in-holding parcel within the northern part of the Sierra Ancha in Tonto National Forest. Acquisition of the Property would contribute to seamless management of surrounding public lands and offer additional management options with regard to recreation, grazing, fire control, and land rehabilitation. The following paragraphs summarize the unique conservation values and opportunities presented by the Property.

6.1 VALUES

There are three landscape features that have remarkable biological value on JX Ranch:

- Upland vegetation mosaic,
- Montane riparian corridor (particularly on the deeper alluvial surfaces), and
- Turkey and Rock Creeks.

Upland Vegetation Mosaic

The upland vegetation mosaic on the Property has specific biological value due to the broad range and condition of vegetation present, and the resultant diversity of wildlife. This mosaic is a combination of the low and moderate density interior chaparral, evergreen, and woodland to forest biotic communities. The mosaic of upland vegetation (clearly evident in Figure 5) provides a much greater array of environments for animals than if the upland vegetation were composed of only one or a few species of woody plants. The upland vegetation mosaic of the Property, comprising some 95 percent of the land surface, is transitional between areas where low density interior chaparral is more dominant to the north and the chaparral and woodlands-to-forest communities are dominant to the south (as depicted in Figure 5). The overlap of these biotic communities in the mosaic results in greater diversity of wildlife than is likely present in more uniform areas.

Furthermore, the recent fire has apparently created a deeper kind of variation across the landscape than would otherwise occur. As explained in Section 5.3, wildlife diversity and population are likely increased in burned as compared to unburned areas. Thus, the upland vegetation portions of the Property are likely particularly rich in wildlife species.

Montane Riparian Corridor

The Montane riparian corridor has specific biological value due to the presence of native trees and the potential presence of the threatened Mexican spotted owl, as explained in the following paragraphs.

Native Trees

We found two species of native trees that were restricted to the riparian corridor along Turkey and Rock Creeks: sycamore and narrow-leaf cottonwood. Both included mature trees and almost no saplings along the channel reach on the Property. Both also appeared to be highly susceptible to the death of the entire trunk and crown in the fire, and both showed evidence of rapid soboliferous stem production following fire (with narrow-leaf cottonwood producing many more stems and at greater distances from the trunk of the tree than sycamore).

Both sycamores and narrow-leaf cottonwood have specific value for breeding birds. For example, Powell and Steidl (2002) emphasized the importance of sycamores in southern Arizona for providing habitat requirements that will maintain abundant and diverse songbird communities. Within the area of the JX Ranch, it is the stands of narrow-leaf cottonwood that provide exceptional habitat value for wildlife, especially migratory and nesting songbirds and browsing ungulates. Davidson and Knight (2001), in a study along the Yampa River in Colorado, showed that even relatively small patches of narrow-leaf cottonwood supported breeding populations of forest-interior birds. They compared nest parasitism and nest survival in relation to cottonwood patch size and found that there was no relationship between parasitism and patch size. They did find that both richness and abundance of forest-interior bird species increased with patch size.

The notable richness and abundance of breeding bird species in groves of narrow-leaf cottonwood is due, at least in part, to the number and abundance of insect species that feed on cottonwood. There are large numbers of beetle larvae that can be collected from staminate catkins when flowering. There are additional beetle larvae that burrow through upper branches and the trunk. There are a large number of insects that are specialized in sucking sap from the smaller twigs, and a large number of insect species that chew the leaves. At least 350 articles concern the genus *Populus* in the biological electronic referencing index 'Biosis' since about 1980. Of these articles, at least a quarter to a third deal with genotypic variation in susceptibility of cultivars of *Populus* species (clones) to pathogenic fungi or insect infestations. Collectively, these studies suggest both the amount of damage (or conversely the large number of organisms that *Populus* individuals can support), and the amount of interclonal variation in sexually reproducing populations.

Mexican Spotted Owl

The Property and its immediate vicinity contain elements of suitable Mexican spotted owl habitat and there are two documented owl territories adjacent to the Property, classified as Mexican spotted owl PACs. Specific guidelines for PACs established by USFWS have been designed to promote Mexican spotted owl conservation. Furthermore, Tonto National Forest lands surrounding the Property are within proposed critical habitat for the Mexican spotted owl. When critical habitat was proposed by the USFWS, private in-holdings were excluded from proposed designation. The proposed transfer of the Property from

private ownership to the Tonto National Forest will automatically incorporate the site into Mexican spotted owl critical habitat. The inclusion of the Property into critical habitat will enable land managers to implement conservation measures for the benefit of the Mexican spotted owl.

Turkey and Rock Creeks

Turkey and Rock Creeks have specific biological value due to the presence or potential presence of native fish and frogs (including threatened or endangered species), as explained in the following paragraphs.

Native Fish

Three native fish species have been documented on the Property. Native fishes in the Colorado River basin (in which the Property lies) are uniquely adapted to life in riverine habitats subject to abrupt changes in turbidity and flow (Minkley, 1973). Rivers and streams in this system are subject to drastic changes in water temperatures, volumes, velocity, and turbidity. In order to prosper here, native fish fauna have evolved to cope with periodic periods of low flows and high water temperatures associated with hot summers and drought as well as high flows and variable temperatures associated with winter runoff and summer monsoons. For example, native fish species (including desert suckers and roundtail chubs[4]) are not displaced by flood events (Bestgen, et al., 1987). The speckled dace, in addition to being somewhat resistant to flooding, is also exceptionally good at re-colonizing habitats from which it has been eliminated (Pearsons and Hiram, 1992).

The native fishes are able to withstand intermittent flows (Carter and Hubert, 1995). They accomplish this by being tolerant of low water conditions with high temperatures and low levels of dissolved oxygen. This allows them to take refuge in perennial pools that may exist in otherwise intermittent conditions. Another means by which native fishes area able to survive in variable habitats is by undertaking seasonal long-distance movements. For example, tagged desert suckers and roundtail chubs in Aravaipa Creek, Arizona, made seasonal movements from open areas with warm water to closed canyon areas with cooler water in the heat of the summer. These same fish moved out of the cool canyon reaches into the warmer open areas in winter (Siebert, 1980). The ability to make these long distance seasonal movements allows these fish to exploit habitats that may experience periods of drought and intermittent flows.

Unfortunately, populations of native fishes are rapidly declining in Arizona, primarily due to a combination of the loss or modification of aquatic habitats and competition with and predation by introduced fishes (Rinne and Minkley, 1991). Free-flowing rivers have been largely transformed into regulated systems dominated by impoundments and controlled flows that minimize the variability to which native fishes are adapted. Furthermore, numerous exotic fishes have been introduced into these

[4] The roundtail chub is closely related to the headwater chub. The headwater chub is thought to have originated through hybridization of roundtail and Gila chubs (*G. intermedia*).

modified systems to provide sport-fishing opportunities. These introduced predatory fishes have been directly linked to the decline of many native fish species in the southwest (Dudley and Matter, 2000; Minkley and Deacon, 2001). This decline in native fish populations is especially pronounced in the lower reaches of the river system where the effects of habitat modification are greatest (Minkley, 1981).

The important headwater aquatic habitats at intermediate elevations, such as those found on the Property in Turkey Creek, Bear Canyon, and Rock Creek, provide some of the last dependable refuges for southwestern endemic fishes. Rinne and Minkley (1991) discuss how native fishes can persist in intermediate elevations and headwater reaches where the negative effects of habitat alteration and exotic species are minimal. The headwaters are still subject to the drastic seasonal variations to which the native fishes are adapted.

Most introduced fishes, with the exception of trout, are quiet water species and are poorly adapted to life in dynamic systems. These introduced species are particularly intolerant of flooding. Populations of introduced predators such as green sunfish (*Lepomis cyanellus*) and large-mouthed bass (*Micropterus salmoides*) have been consistently eliminated from headwater areas by flooding. Another factor that limits populations of introduced fishes in dynamic southwestern streams is their intermittent nature and periodic drought. Most introduced fishes come from well-watered areas of the eastern United States and are ill adapted to intermittent conditions and drought.

There is an approximately 1.6-km (1-mile) stretch of apparently perennial water in Turkey and Rock Creeks that flows through the Property. Immediately downstream of the Property, Rock Creek becomes intermittent for several miles, where it again becomes perennial until its confluence with Spring Creek. The lower portion of Spring Creek is intermittent for approximately 16 km (10 miles) before it reaches Tonto Creek. These two intermittent reaches provide a "double buffer" between the aquatic habitats on the Property and Tonto Creek, which supports high numbers of introduced predatory fishes (Hunt, et al., 1992; M. Cross personal observation).

Chiricahua Leopard Frog

The Property contains potential habitat for the Chiricahua leopard frog. The Chiricahua leopard frog requires permanent or nearly permanent water sources, including streams, rivers, backwaters, ponds, and stock tanks that are free from introduced fish, crayfish, and bullfrogs. The same conditions that buffer native fishes from harmful introduced species have the potential to aid in the conservation of Chiricahua leopard frogs as well. Turkey and Rock Creeks provides suitable habitat for this species and the Property is considered to be "un-surveyed potential habitat" by the USFS. Surveys may indicate that the Chiricahua leopard frog is present or if the site is deemed a suitable location for the reintroduction of this species.

6.2. OPPORTUNITIES

Opportunity #1: Turkey and Rock Creeks

The habitat characteristics of the headwater reaches of Turkey and Rock Creeks that favor native fishes over exotics have allowed at least three native fish species to persist on the Property. And, the streams may be occupied by or provide suitable habitat for the Chiricahua leopard frog. The preservation and possible enhancement of this area will provide valuable opportunities for native fish and frog research, conservation, and recovery. Federal ownership of the Property would prevent stream alteration for private use as well as allow for management methods such as restrictions on cattle grazing. Furthermore, species-specific studies for the presence or absence of native fishes or frogs (including any threatened or endangered species) will enlarge the knowledge base for these valuable members of the biological community.

Opportunity #2: Montane Riparian Corridor

Increasing the number of stems and acreage of narrow-leaf cottonwood along the stream on the JX Ranch would restore the alluvial terraces to a natural vegetative condition and prevent their further erosion. The on-site visit and an inspection of the aerial photographs indicate that the two alluvial terraces on the Property (the homestead site and the chute-trap corral site) have had a significant loss of riparian trees, probably since the time of the original settlement. This pattern is evident in alluvial terraces along streams throughout the area. Narrow-leaf cottonwood can be readily established with vegetative cuttings (International Poplar Commission, 1979); these vegetative cuttings can be small cuttings rooted in situ, rooted for one year at another site and transplanted, or grown for two to three years before transplant. It is essential that the soil remains moist near the surface since narrow-leaf cottonwood has a relatively slow rate of root elongation (Kranjcec et al., 1998); a rapid decline in water table can kill young plants of this species.

There is an urgency with respect to reestablishing narrow-leaf cottonwood along both Turkey and Rock Creeks. Elk are present in the area and have the potential to intensely browse the leading shoots of the young soboles that are produced by the fire-killed mature cottonwoods. If all or nearly all shoots are browsed by elk during this vulnerable phase (when the shoots are still less than about 5 m [16.5 ft] high), the browsing may result in the death of that particular clone within 2 or 3 years. This phenomena has been studied in Yellowstone National Park where elk are occurring in historically record numbers (due to historic lack of predation) and are having a significant effect on aspen (*Populus tremuloides*) (Romme et al., 1995; Ripple and Larsen, 2000; Singer et al., 1998; White et al., 1998) and narrow-leaf cottonwood (Keigley, 1997) regeneration. There is not a simple consensus view on the interactions. However, Ripple and Larsen (2000), based on tree-ring analyses, conclude that 10 percent of the overstory trees originated before 1871, 85 percent between 1871 and 1920, and 5 percent since 1920. Since aspen generally live less than 125 years, and these data indicate that the majority of the trees are between 75 and 125 years old, the population is aging with little recruitment. After Yellowstone's wolves were extirpated in 1920,

recruitment of aspen essentially ceased as elk grazing on shoots increased dramatically with rising elk population. Recent re-introduction of wolves in the park may reverse this trend.

Thus, there is a relatively narrow (2 to 3 years) window of opportunity in which the cottonwood recruitment could occur from the existing fire-damaged population. Elk grazing of soboles could, if uncontrolled, kill the cottonwood clones, losing the opportunity to restore the alluvial terraces to natural conditions.

Similar concerns attend a transplant program. Attention to at least two details is required in replanting narrow-leaf cottonwood on the alluvial terraces of Turkey Creek and Rock Creek: (1) collecting cuttings from a wide distribution of trees across several nearby streams in order to increase the genetic diversity of the starting population, and (2) protecting the young plantations from browsing deer and elk. Increasing the genetic diversity of the starting trees is important in order to avoid over-representing either one sex (because *Populus* is dioecious) or one genotype. For narrow-leaf cottonwood, Gom and Rood (1999a, b, c) and Rood et al. (1994) have considered natural regeneration of clones following floods, fires and natural distribution of clonal stands. Protecting the young plantations with electric game fencing (Hoare, 1992; Thouless and Sakwa, 1995) powered by solar panels should be considered. The hot wires could be placed at two heights determined to be most effective at keeping out both deer and elk, much in the manner described by Young et al. (2002), Hoare (1992), and Thoule and Sakwa (1995) for excluding African megafauna, including elephants.

Opportunity #3: Upland Vegetation Mosaic

Unique conservation opportunities are limited for the upland vegetation mosaic, but we believe that streamlined public lands management that would result from USFS ownership of the land will allow for improved regional approaches to issues such as fire control as compared to the challenges presented by private in-holdings. Furthermore, continued maintenance of this area will assist in the quality of more unique features such as the riparian areas and streams, home to native fishes and, potentially, threatened and endangered species such as the Mexican spotted owl and Chiricahua leopard frog.

7. REFERENCES

AGFD, 2001. *Strix occidentalis lucida.* Unpublished abstract compiled and edited by HDMS, AGFD: Phoenix.

_____. 2002a. Arizona rare plant field guide: a collaboration of agencies and organizations. HDMS, AGFD: Phoenix.

_____. 2002b. *Haliaeetus leucocephalus.* Unpublished abstract compiled and edited by HDMS, AGFD: Phoenix.

_____. 2003. *Agave arizonica.* Unpublished abstract compiled and edited by HDMS, AGFD: Phoenix.

_____. 2004a. *Tiaroga cobitis.* Unpublished animal abstract compiled and edited by HDMS, AGFD: Phoenix.

_____. 2004b. *Xyrauchen texanus.* Unpublished animal abstract complied and edited by HDMS, AGFD: Phoenix.

_____. 2004c. *Meda fulgida.* Unpublished animal abstract compiled and edited by HDMS, AGFD: Phoenix.

Amman, G.D. and K.C. Ryan. 1991. Insect infestations of fire-injured trees in the greater Yellowstone area. Intermountain Research Station, Research Note INT-398. USFS: Ogden, UT.

Baldys, S. and J.A. Bayles. 1990. Flow characteristics of streams that drain the Fort Apache and San Carlos Indian Reservations, east-central Arizona, 1930-1986. USGS Water-Resources Investigations Report 90-4053.

Bergquist, J.R., A.F. Shride, and C.T. Wrucke. 1981. Geologic map of the Sierra Ancha Wilderness and Salome Study Area, Gila County, Arizona. USGS Miscellaneous Field Studies Map MF-1162-A, scale 1:48,000.

Bestgen, R.B., D.A. Henrickson, D.M. Kubley, and D.L. Propst. 1987. Movements and Growth of Fishes in the Gila River Drainage, Arizona and New Mexico. The Southwestern Naturalist 32(3): 351-356.

Bock, C.E. and J.F. Lynch. 1970. Breeding bird populations of burned and unburned conifer forests in the Sierra Nevada. Condor 72: 182-189.

Brown, D.E. (editor). 1994. Biotic communities: southwestern United States and northwestern Mexico. University of Utah Press: Salt Lake City.

Brown, D.E. and C.H. Lowe. 1994. Biotic communities of the Southwest [map]. University of Utah Press: Salt Lake City.

Brown, D.E., N.B. Carmony, and R. M. Turner. 1978. Drainage map of Arizona showing perennial streams and some important wetlands. AGFD: Phoenix.

Carter, B. and W.A. Hubert. 1995. Factors influencing fish assemblages of a high elevation stream in Wyoming. Great Basin Naturalist. 55(2): pp 169-173.

Davidson, A.S. and R.L. Knight. 2001. Avian nest success and community composition in a western riparian forest. Journal of Wildlife Management 65: 334-344.

Driscoll, J. (AGFD). 2004. Personal communication with M. Cross (WestLand). February 2004.

Dudley, R.K. and W.J. Matter. 2000. Effects of small green sunfish (*Lepomis cyanellus*) on recruitment of Gila chub (*Gila intermedia*) in Sabino Creek, Arizona. The Soutwestern Naturalist 45(1): 24-29

Faulk, Mima (USFWS). 2002. Personal communication with R. Schmalzel (WestLand).

Furniss, M.M. 1965. Susceptibility of fire injured Douglas-fir to bark beetle attack in southern Idaho. Journal of Forestry 63: 8-11.

Ganey, J.L. 1998. Spotted Owl. *In* Raptors of Arizona. University of Arizona Press: Tucson, AZ.

Gom, L.A. and S.B. Rood. 1999a. The discrimination of cottonwood clones in a mature grove along the Oldman River in southern Alberta. Canadian Journal of Botany 77: 1084-1094.

_____. 1999b. Patterns of clonal occurrence in a mature cottonwood grove along the Oldman River, Alberta. Canadian Journal of Botany 77: 1095-1105.

_____. 1999c. Fire induces clonal sprouting of riparian cottonwoods. Canadian Journal of Botany 77: 1604-1616.

Graber, J. W. and R. R. Graber. 1983. Expectable decline of forest bird populations in severe and mild winters. Wilson Bulletin 95: 682-690.

Hoare, R.E. 1992. Present and future use of fencing in the management of larger African mammals. Environmental Conservation 19: 160-164.

Hoffmeister, D.F. 1986. *Mammals of Arizona*. University of Arizona Press: Tucson, AZ.

Hunt, W.G., D.E. Driscol, E.W. Bianchi, and R.E. Jackman. 1992. Ecology of Bald Eagles in Arizona. Volumes I-IV. Unpublished report to U.S. Bureau of Reclamation, Contract 6-CS-30-04470. BioSystems Analysis, Inc.: Santa Cruz, CA.

Hutto, R.L. 1995. Composition of bird communities following stand replacement fires in northern Rocky Mountain conifer forests. Conservation Biologist 9: 1041-1058.

Imbeau, L., P. Drapeau, and M. Monkkonen. 2003. Are forest birds categorized as "edge species" strictly associated with edges? Ecography 26: 514-520.

International Popular Commission. 1979. Poplars and Willows in Wood Production and Land Use. Food and Agriculture Organization of the United Nations: Rome.

Keigley, R.B. 1997. An increase in herbivory of cottonwood in Yellowstone National Park. Northwest Science 71: 127-136.

Klein, E.H. Duke (USFS). 2004. Personal communication with M. Cross (WestLand) on March 2, 2004.

Koplin, J.R. 1972. Measuring predator impact of woodpeckers on spruce beetles. Journal of Wildlife Management 36: 308-320.

Kranjcec, J., J.M. Mahoney, and S.B. Rood. 1998. The responses of three riparian cottonwood species to water table decline. Forest Ecology and Management 110: 77-87.

Kreisel, K.J. and S.J. Stein. 1999. Bird use of burned and unburned coniferous forests during winter. Wilson Bulletin 111: 243-250.

Laudenslayer, W.F. and R.P. Balda. 1976. Breeding bird use of a pinyon-juniper-ponderosa pine ecotone. The Auk 93: 571-586.

Marshall, J.T. 1957. Birds of pine-oak woodland in southern Arizona and adjacent Mexico. Pacific Coast Avifauna No. 32.

Minkley, W.L. 1973. Fishes of Arizona. Arizona State University: Tempe, AZ.

_____. 1981. Ecological Study of Aravaipa Creek, Central Arizona, Relative to Past, Present, and Future Uses. BLM: Safford, AZ.

Minkley, W.L. and J.E. Deacon. 2001. Battle Against Extinction, Native Fish Management in the American West. University of Arizona Press: Tucson, AZ.

Mitchell, J.M., C.W. Stockton, and D.M. Meko. 1979. Evidence of a 22-year rhythm of drought in the western United States related to the Hale Solar Cycle since the 17th century. *IN*: B.M. McCormac and T.A. Seliga (eds.) Solar-Terrestrial Influences on Weather and Climate. D. Reidel Publishing Company, Dordrecht, The Netherlands. Pp. 125-143.

Pearsons,T.M. and W.L. Hiram, 1992. Influence of habitat complexity on resistance to flooding and resilience of stream fish assemblages. Transactions of the American Fisheries Society. 121(4): 427-436

Powell, B.F. and R.J. Steidl. 2002. Habitat selection by riparian songbirds breeding in southern Arizona. Journal of Wildlife Management 66: 1096-1103.

Ripple, W.J. and E.J. Larsen. 2000. Historic aspen recruitment, elk, and wolves in northern Yellowstone National Park, USA. Biological Conservation 95: 361-370.

Rinne, J.L. and W.L. Minkley. 1991. Native Fishes of Arid Lands: a Dwindling Resource of the Desert Southwest. U.S. Department of Agriculture, Forest Service, General Technical Report RM-206. Rocky Mountain Forest and Range Experimental Station: Fort Collins, CO.

Romme, W.H., M.G. Turner, L.L. Wallace, and J.S. Walker. 1995. Aspen, elk, and fire in northern Yellowstone National Park. Ecology 76: 2097-2106.

Rood, S.B., C. Hillman, T. Sanche, and J.M. Mahoney. 1994. Clonal reproduction of riparian cottonwoods in southern Alberta. Canadian Journal of Botany 72: 1766-1774.

Rosenstock, S.S. 1998. Influence of Gambel oak on breeding birds in ponderosa pine forest of northern Arizona. The Condor 100: 485-492.

Schuetz, Sue (AGFD). 2004a. Personal communication with M. Cross (WestLand), March 10, 2004.

_____. 2004b. Personal communication with M. Cross (WestLand), March 17, 2004.

Sellers, W.D. and R.H. Hill. 1974. Arizona climate, 1931-1972. University of Arizona Press: Tucson, AZ.

Siebert, D.J. 1980. Movements of Fishes in Aravaipa Creek, Arizona. Unpublished M.S. Thesis. Arizona State University: Tempe, AZ.

Singer, F.J., D.M. Swift, M.B. Coughenour, and J.D. Varley. 1998. Thunder on the Yellowstone revisited: an assessment of management of native ungulates by natural regulation, 1968-1993. Wildlife Society Bulletin 26: 375-390.

Skotnicki, S.J. 1999a. Geologic map of the Picture Mountain Quadrangle, Gila County, Arizona. AGS Open-File Report 99-23.

_____. 1999b. Geologic map of the Copper Mountain Quadrangle, Gila County, Arizona. AGS Open-File Report 99-24.

Smith, L.P. and C.W. Stockton. 1981. Reconstructed stream flow for the Salt and Verde Rivers from tree-ring data. American Water Resources Association, Water Resources Bulletin 17: 939-947.

Southwestern Bald Eagle Management Committee. 2004. Bald eagles in Arizona. http://arizonaes.fws.gov/bald.htm. Accessed on March 8, 2004.

Spencer, J.E., S.M. Richard, C.A. Ferguson, and W.G. Gilbert. 1999. Geologic map of the northwestern part of the Greenback Creek 7.5' quadrangle, Gila County, Arizona. AGS Open-File Report 99-10, scale 1:24,000.

Spring, L.W. 1965. Climbing and pecking adaptations in some North American woodpeckers. Condor 67: 457-488.

Stebbins, R. C. 2003. A Field Guide to Western Reptiles and Amphibians, 3rd Ed. Houghton Mifflin Company: New York.

The National Geographic Society. 1987. Field Guide to Birds in North America. National Geographic Society: Washington D.C.

Thouless, C.R. and J. Sakwa. 1995. Shocking elephants: fences and crop raiders in Laikipia District, Kenya. Biological Conservation 72: 99-107.

USFWS. 1978. Endangered and Threatened Wildlife and Plants, Determination of Certain Bald Eagle Populations as Endangered or Threatened. 43 FR 6230.

_____. 1993. Final rule to list the Mexican spotted owl as a threatened species. 58 FR 14248.

_____. 1995a. Endangered and threatened species; bald eagle reclassification; final rule. 60 FR 35999.

_____. 1995b. Recovery Plan for the Mexican Spotted Owl; Vol. I.

_____. 1999. Endangered and threatened wildlife and plants; proposed rule to remove the bald eagle in the lower 48 states from the list of endangered and threatened wildlife; proposed rule. 64 FR 36453.

_____. 2001. Endangered and threatened wildlife and plants; final designation of critical habitat for the Mexican spotted owl. 66 FR 8530.

_____. 2002. Listing the Gila Chub as endangered with critical habitat. 67 FR 51948.

USGS. 2004. Calendar year streamflow statistics for Arizona; USGS 09498503 South Fork Parker Creek near Roosevelt, AZ. http://nwis.waterdata.usgs.gov/az/nwis/annual/?site_no=09498503&agency_cd=USGS. Accessed on March 10, 2004.

Wessels, R.L. 1991. Geologic map of the Jakes Corner area, northern Sierra Ancha, Gila County, Arizona. Arizona Geological Survey Contributed Map CM-91-I, scale 1:10,000.

White, C.A., C.E. Olmsted, and C. E. Kay. 1998. Aspen, elk, and fire in the Rocky Mountain national parks of North America. Wildlife Society Bulletin 26: 449-462.

Young, T.P., M.L. Stanton, and C.E. Christian. 2002. Effects of natural and simulated herbivory on spine lengths of *Acacia drepanolobium* in Kenya. Oikos 101: 171-179.