APPENDIX D
REDMAN REPORT

Lake Bella Vista Dam Project

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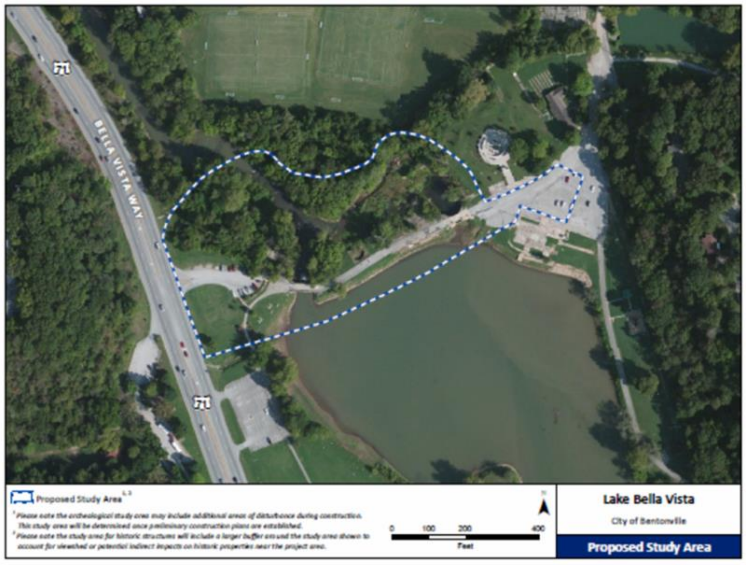
SUMMARY

Site investigations of the area of intent for Lake Bella Vista were conducted on April 3, April 18 and June 7, 2013. The area of intent was investigated for standing snags, dead trees with exfoliating bark, trees with cavities, karst openings, springs, seeps, and relic mussel shells. Shorelines in the area were also examined for use by Piping Plover.

During the study period no endangered species from the list of occurrences provided to CP&Y by the Arkansas Department of Heritage were found using the area of intent as outlined in Figure 1. There were no karst openings large enough to sample for the troglobitic or troglophitic species. The only springs found on the site were at the interface between the soil and the confining layer of bedrock where seepage was occurring. These seeps also seemed to have water only immediately after a rain event.

The stream that enters the site from the northeast originates as a spring emergence from a western facing hillside. The water flows approximately 623 ft to a series of ponds once used as a trout hatchery, and then flows an additional approximately 1,121 ft entering into the area of intent. Once within the area of intent it flows an additional approximately 374 ft before entering into Clear Creek. Sampling of the stream resulted in 2 species of darters, stippled darter (*Etheostoma punctulatum)* and orangethroat darter (*Etheostoma spectabile*). Also, specimens representing the genus of *Ambloplites* sp. (rock basses), *Noturus* sp. (madtoms), and *Pimephales* sp. (minnows) were collected. Previous work by Slay et al., in the spring reach above the trout farm found no Arkansas darters present. Sampling efforts within the area of intent again showed no Arkansas darters. The high percentage of overhead canopy and lack of overhanging vegetation is the most likely cause as this habitat is unsuitable for the species.

Figure 1: Area of Intent for the Lake Bella Vista Dam Project



Piping Plover
(*Charadrius melodus*)

Federal Status	LT
Global Rank	G3
State Rank	N/A

The piping plover (*Charadrius melodus*) is a small sand-colored, sparrow-sized shorebird that nests and feeds along coastal sand and gravel beaches in North America. The adult has yellow-orange legs, a black band across the forehead from eye to eye, and a black ring around the neck. This chest band is usually thicker in males during the breeding season, and it's the only reliable way to tell the sexes apart. It is difficult to see when standing still as it blends well with open, sandy beach habitats. It typically runs in short starts and stops.

The piping plover lives the majority of its life on open, sandy beaches or rocky shores, often in high, dry sections away from water. They can be found on the Atlantic Coast of the U.S. and Canada on the ocean or bay beaches and on the Great Lakes shores. It builds its nests higher on the shore near beach grass and other objects. It is very rare to see a piping plover anywhere outside of sand or rocky beaches/shores while not migrating.

The habitat at Lake Bella Vista does not have the sandy beaches or rocky shore lines needed for the piping plover. The area around the lake is mostly covered by grass that is mowed regularly and not allowed to get much higher than 10 cm. No piping plover were seen during the survey period.

Neosho Mucket
(*Lampsilis rafinesqueana*)

M. C. Barnhart

Federal Status	PT;PCH
Global Rank	N/A
State Rank	N/A

The Neosho mucket is endemic to the Neosho and Verdigris basins of the Arkansas River system in Kansas, Missouri, Oklahoma and Arkansas. Distribution of relic shell material indicates that the species was once widespread throughout these basins. It was historically reported from the Illinois River in Oklahoma and Arkansas; the Neosho River in Oklahoma and Kansas; Neosho River tributaries, including the Elk River in Missouri, Cottonwood River in Kansas, and the Spring River in Oklahoma, Kansas, and Missouri, and Spring River tributaries, North Fork Spring River and Indian Creek in Missouri, and Shoal and Center Creeks in Kansas and Missouri; the Verdigris River in Oklahoma and Kansas, and its tributaries, Caney River in Oklahoma and Kansas, and Fall River in Kansas (USFWS, 2003). Recent status surveys conducted throughout this area indicate that the species has been extirpated from much of its range. In the Neosho River basin the species now survives in the Neosho River (KS), Elk River (MO), Spring River (MO, KS, possibly OK), North Fork Spring River (MO), Illinois River (OK, AR), and Shoal, Indian and Center creeks (MO). In the Verdigris basin the species survives in the Verdigris River (KS) and Fall River (KS) (USFWS, 2003).

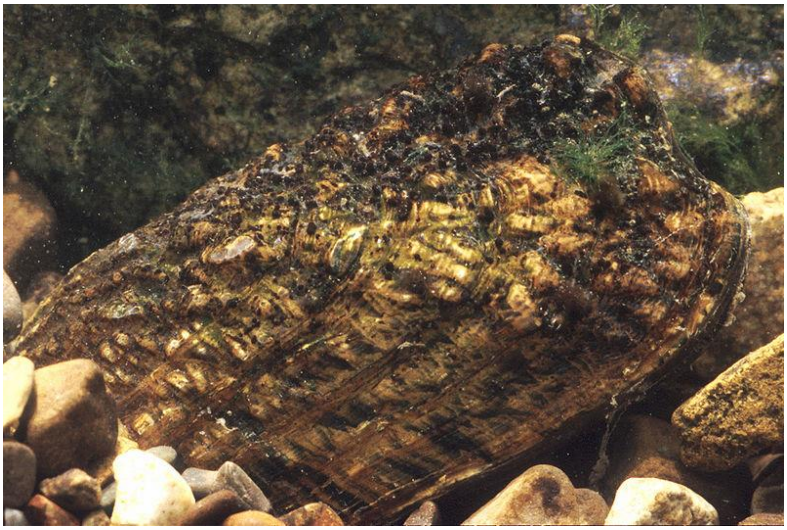
Neosho mucket glochidia have been successfully transformed on smallmouth (*Micropteris dolomieu*) and largemouth bass (*Micropteris salmoides*), indicating these species as possible glochidia hosts (Barnhart and Roberts, 1997; Barnhart and Baird, 2000; Barnhart et al., 1995). Gravid female Neosho muckets have been collected in June, July, and August, and females displaying mantle lures have been observed in July, August, and September. Mantle lures mimic small fish (USFWS, 2003).

The species is found in a variety of habitats in large streams and small rivers. Most often, it occurs in shallow riffles and runs with a predominantly gravel substrate. A survey on the Illinois River found this species concentrated in silty backwater areas (Mather, 1990).

The area of intent at Lake Bella Vista was surveyed and no suitable habitat was found within the area. Creek bed substrate was bedrock in the west channel. The east channel started as a scour pool below the dam and was about 3 – 4 meters deep. Largemouth bass and smallmouth bass were seen in the pools. Point bars and riffles were checked for relic mussel shells. The Asian clam (*Corbicula fluminea*) was found in all channels and tributaries. An attempt was made to sample riffle glides in the area of intent but no suitable glides were found, most “riffles” were concrete encased utilities crossing the

stream downstream of the study area. No, *Lampsilis rafinesqueana* were found within the area of intent.

Rabbitsfoot
(*Quadrula cylindrica cylindrica*)



Federal Status	PT;PCH
Global Rank	G3G4T3
State Rank	S2

In the lower Mississippi River sub-basin, a viable population exists in the St. Francis River. In the White River system, at least three viable populations remain, primarily in the lower portions of the White, Black, and Strawberry Rivers in Arkansas. In the Arkansas River system, the rabbitsfoot shows limited viability in the Neosho and Illinois Rivers. In the Red River system, all 7 streams (of 11 historically) that the species is known from are considered small and could easily become extirpated but parts of the Little River population are considered viable (Butler, 2005).

Through laboratory testing, Barnhart and Baird (2000) determined glochidial hosts for this species to be blacktail shiner (*Cyprinella venusta*). Watters et al. (2009) confirmed host transformation on rainbow darter, *Etheostoma caeruleum* (8%) and striped shiner- *Luxilus chrysocephalus* (3%). Yeager and Neves (1986) subjectively aged (by counting external growth rings) the rough rabbitsfoot to 22 years, and Henley et al. (no date, p. 16) objectively aged (by thin-sectioning shells) a specimen at 63 years. Anthony et al. (2001) surmised that growth ring counts, however, may not be annual and that counts may actually be underestimating longevity by a factor of 3 to 10. This might mean that the some mussels (possibly including the rabbitsfoot) may live for centuries. Age at sexual maturity for the rabbitsfoot is 4 to 6 years for populations in the upper Arkansas, White, and Red River Systems (Fobian, 2007).

Areas that might possibly have mussels living in them or have relic shells (i.e., point bars, riffle glides, etc.) were examined and no shells were found within the study area. The lack of suitable habitat and urban influenced water quality are probably the most limiting factors.

Benton County Cave Crayfish
(*Cambarus aculabrum*)

Federal Status	LE
Global Rank	G1
State Rank	S?

So little is known about Arkansas's two cave-dwelling crayfish that neither has a common name. *Cambarus aculabrum* exists in only two caves in northwest Arkansas, including Logan Cave NWR. Like so many cave animals, these crayfish are albinos, with no pigments coloring their white bodies. They live in cave streams and are extremely rare. No more than six *C. aculabrum* have been seen at one time.

Groundwater contamination is the major threat to these crayfish. Scientists fear herbicides used to clear the right-of-way for an electrical transmission line near the Stone County cave could accidentally enter the cave stream, decimating the crayfish population. Three nearby industrial plants store petroleum products that could spill or leak into the cave. Subdivision growth around Mountain View could threaten water quality in the cave due to construction runoff, sheet wash and waste water from septic tanks. Until threats of contamination are eliminated, the continued existence of these species is suspect at best.

This species is highly imperiled. This species has an extent of occurrence of less than 10 sq. km as each of the four cave pools has a maximum area of 200 m. The caves are severely fragmented and they are not connected to each other. There is a continuing decline in the extent and quality of habitat due to continued human disturbances and impacts through trampling and groundwater pollution. This species is extremely sensitive to groundwater quality and there is evidence that it is predated on by banded sculpin (*Cottus carolinae*). It has a very low population of only 40 individuals and longevity of 75 years, indicating that there is a late age of reproductive maturity. A recovery plan was initiated by the USFWS in 1996, which has been putting in place measures to protect this species. However, even with this recovery plan in place, the population still remains low and sensitive to disturbance and quality of habitat.

The area of intent at Lake Bella Vista does not have any karst openings. Seeps were located during the survey but had no open conduits and occurred along the edge of the stream where the bedrock interface made downward movement of water resurface along the impermeable layer. Water was observed flowing only immediately after rainfall events.

Ozark Cavefish
(*Amblyopsis rosae*)

Federal Status	LT
Global Rank	G2
State Rank	S1

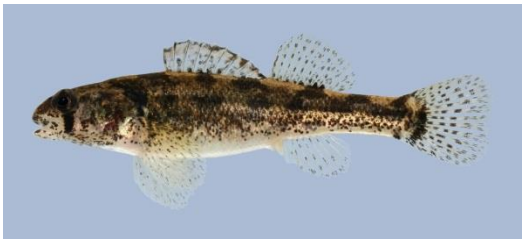
The historic range of the Ozark cavefish included 24 Ozark Mountain caves in Arkansas, Missouri and Oklahoma. That range has shrunk to 21 caves, including seven in northwest Arkansas.

The cavefish has no eyes, because in the underground streams it inhabits, there is no light by which to see. Special sensory organs cover the head, body and fins, permitting it to feel its way around in its eternally dark home. Were it not for the pinkish blood vessels, you could see through the translucent body of an Ozark cavefish. The fins resemble threads of glass. The flattened head lacks eyes, as if the fish were awaiting completion by its creator. A very low reproductive rate is one reason for their rarity. Cavefish may be 16 years old before first spawning. Only 20 percent spawn each year. Twenty to 25 eggs are incubated in the female's gill chamber until hatching.

Illegal collection by pet dealers is a great threat to these unusual fish. Removing even small numbers can seriously affect a population for years and may even destroy it. Groundwater pollution from sewage, livestock wastes and toxic compounds is another threat, one compounded by growing human populations and industrial development in the Ozarks. Ironically, the Ozark cavefish's life cycle is linked to that of another imperiled species, the gray bat. A cave's food supply depends on an outside energy source. The largest Ozark cavefish populations occur in caves used by the gray bat, where the bat's guano forms the cave's primary energy source. A reduction in bat numbers could cause a decline in the cavefish population.

The area of intent contained no karst features with open conduits, a critical habitat of the Ozark Cavefish.

Arkansas Darter
(*Etheostoma cragini*)



Federal Status	Cand
Global Rank	G3G4
State Rank	S1

Preferred habitat is spring-fed headwaters and creeks with cool, clear, shallow water, slow current, and herbaceous aquatic vegetation such as growths of watercress or other aquatic plants; often in pools with sand, fine gravel, or organic detritus substrate; the species is sometimes found in turbid water away from springs (Lee et al. 1980, Cross and Collins 1995, Hargrave and Johnson 2003, Miller and Robison 2004, Page and Burr 2011). Eggs are laid in gravel bottom streams.

The spring fed stream that enters the area of intent from the northeast was sampled on May 7th, 2013 for Arkansas darters. Previous work by Slay et al on the spring above the trout farm also found no Arkansas Darters. Fish collected during the sampling included 2 species of darters. However, no Arkansas darters were collected. Arkansas darters prefer open springs with overhanging vegetation. The area of intent contains mostly shaded areas, providing little to no suitable habitat.

Indiana Bat
(*Myotis sodalis*)

Federal Status	LE
Global Rank	G2
State Rank	S2

These small brown bats are known for their remarkable hibernation clusters. Each bat hangs by its feet from the cave ceiling, and as many as 480 have been counted in a single square foot.

Indiana bats range throughout much of the eastern U. S. They number less than 400,000. More than 85 percent hibernate at only seven locations --two caves and a mine in Missouri, two caves in Indiana and two caves in Kentucky.

A marked decline has been reported in Arkansas populations. Indianas no longer visit 10 caves where they previously hibernated. A Newton County cave that once contained 7,000 hibernating Indiana bats now shelters less than 200.

Currently, only eight Arkansas caves house more than 30 Indianas during their winter hibernation period (October to April). The present Arkansas population (less than 3,000) is half the 1981 size.

The total U. S. population dropped more than 34 percent since 1983. The decline is attributed to commercialization of roosting caves, killing by vandals, disturbances caused by increased numbers of spelunkers and bat banding programs, use of bats as laboratory experimental animals and possible insecticide poisoning. Some winter hibernacula are unstable as a result of blocking or impeding air flow into the caves and thereby changing the cave's climate.

One Arkansas hibernation cave was fenced by the National Park Service to protect Indiana and gray bats. Four additional hibernation caves in the Ozark National Forest and one on Buffalo National River lands are closed to the public and posted with signs to protect bat colonies. Protecting these caves may result in an increase in bat populations at these caves, but experts say it is unlikely Indiana bats will recolonize

abandoned caves. It is believed that only male Indiana bats occur in Arkansas during summer and females migrate northward to maternity roosts north of the Ozarks.

Myotis sodalis hibernates in caves; maternity sites generally are behind loose bark of dead or dying trees or in tree cavities (Menzel et al. 2001). Foraging habitats include riparian areas, upland forests, ponds, and fields (Menzel et al. 2001), but forested landscapes are the most important habitat in agricultural landscapes (Menzel et al. 2005).

In hibernation, limestone caves with pools are preferred. Hall (1962) noted that preferred caves are of medium size with large, shallow passageways. Roosts usually are in the coldest part of the cave. Preferred sites have a mean midwinter air temperature of 4-8 C (tolerates much broader range) (Hall 1962, Henshaw and Folk 1966), well below that of caves that are not chosen (Clawson et al. 1980). Roost sites within caves may shift such that bats remain in the coldest area (Clawson et al. 1980); individuals may move from a location deeper in the cave to a site nearer the entrance as the cold season progresses; they may move away from areas that go below freezing. Hibernation in the coldest parts of the cave ensures a sufficiently low metabolic rate so that the fat reserves last through the six-month hibernation period (Henshaw and Folk 1966, Humphrey 1978). Relative humidity in occupied caves ranges from 66 to 95% and averages 87% throughout the year (Barbour and Davis 1969, Clawson et al. 1980). Because of these requirements, *Myotis sodalis* is highly selective of hibernacula.

During the fall, when these bats swarm and mate at their hibernacula, males roost in trees nearby during the day and fly to the cave during the night. In Kentucky, Kiser and Elliott (1996) found males roosting primarily in dead trees on upper slopes and ridgetops within 2.4 km of their hibernaculum. During September in West Virginia, males roosted within 5.6 km in trees near ridgetops, and often switched roost trees from day to day (C. Stihler, West Virginia Division of Natural Resources, pers. observ., October 1996, cited in USFWS 1999). Fall roost trees tend to be in sunnier areas rather than being shaded (J. MacGregor, pers. observ., October 1996, cited in USFWS 1999).

In summer, habitat consists of wooded or semi-wooded areas, often but not always along streams. Solitary females or small maternity colonies bear their offspring in hollow trees or under loose bark of living or dead trees (Humphrey et al. 1977, Garner and Gardner 1992). Humphrey et al. (1977) determined that dead trees are preferred roost sites and that trees standing in sunny openings are attractive because the air spaces and crevices under the bark are warmer. In Illinois, Garner and Gardner (1992) found that typical roosts were beneath the exfoliating bark of dead trees; other roost sites were beneath the bark of living trees and in cavities of dead trees. Kurta et al. (1993) found a large maternity colony in a dead, hollow, barkless, unshaded sycamore tree in a pasture in Illinois. In Michigan, a reproductively active colony occupied eight different roost trees (all green ash), all of which were exposed to direct sunlight throughout the day; bats roosted beneath loose bark of dead trees (Kurta et al. 1993). In western Virginia, a male used a mature, live, shagbark hickory tree as a diurnal roost; the bat foraged primarily among tree canopies of an 80-year-old oak-hickory forest (Hobson and Holland 1995). In Missouri, primary maternity roosts were in standing dead trees exposed to direct sunlight; there were 1-3 primary roosts per colony; alternate roosts were in living and dead trees that typically were within the shaded forest interior (Callahan et al. 1997). Though maternity sites have been reported as occurring mainly in riparian and floodplain forests (Humphrey et al. 1977, Garner and Gardner 1992), recent studies indicate that upland habitats are used by maternity colonies much more extensively than previously reported. Garner and Gardner (1992) reported that 38 of 51 roost trees in Illinois occurred in uplands and 13 trees were in floodplains. Of the 47 trees in forested habitat, 27 were in areas having a closed (80-100%) canopy, and 15 were in areas having an intermediate (30-80%) canopy. A single roost

tree was found in the following types of habitat: a heavily grazed ridge top pasture with a few scattered dead trees, a partially wooded swine feedlot, a palustrine wetland with emergent vegetation, a forested island in the Mississippi river, and a clear cut around a segment of an intermittent stream where dead trees were retained for wildlife. Roosts were not found in forests with open canopies (10-30%) or in old fields with less than or equal to 10% canopy cover. In eastern Tennessee and western North Carolina, several maternity colonies were in sun-exposed conifer snags (roost sites were above the surrounding canopy); some of these snags fell and were not used in subsequent years (Britzke et al. 2003). Rarely maternity colonies have been found in crevices in utility poles or in bat boxes (e.g., Ritzi et al. 2005

Known roost tree species include elm, oak, beech, hickory, maple, ash, sassafras, birch, sycamore, locust, aspen, cottonwood, pine, and hemlock (Cope et al. 1974, Humphrey et al. 1977, Garner and Gardner 1992, Britzke et al. 2003, Britzke et al. 2006), especially trees with exfoliating bark.

In Illinois, Indiana bats used the same, evidently traditional, roost sites in successive summers. Recapture of the same individuals within traditional roost sites during subsequent summers suggests site fidelity (Garner and Gardner 1992, Gardner et al. 1996).

Relatively few individuals roost in caves at the mouths of which late summer swarming occurs (Cope and Humphrey 1977, Barbour and Davis 1969).

The area of intent surrounding Lake Bella Vista does not have any caves of any size. The area does not have a karst opening suitable for Indiana Bats hibernation. The only use of Lake Bella Vista may possible be for foraging, but the chances are small considering where the closest cave with observed Indiana bats is located. Dead snags and other standing dead trees or trees with cavities were examined in the area of intent and no trees with exfoliating bark were found or cavities were being used by bats. However, it would be prudent to leave standing dead trees and snags for wildlife benefits.

Gray Bat
(*Myotis grisescens*)

Federal Status	LE
Global Rank	G3
State Rank	S2

The gray bat's range is concentrated in the cave regions of Arkansas, Missouri, Kentucky, Tennessee and Alabama, with occasional colonies and individuals in adjacent states. The population is estimated at more than 1.5 million; however, about 95 percent hibernate in only eight caves—two in Tennessee, three in Missouri, and one each in Kentucky, Alabama and Arkansas. This makes the population extremely vulnerable.

Gray bat numbers decreased significantly during recent decades—61 percent in Arkansas, 89 percent in Kentucky, 81 percent in Missouri and 76 percent in Tennessee and Alabama. The population is now on the upswing, though, as a result of improved breeding success due to better protection measures such as cave gates, fences and informational signs near caves. However, with the recent introduction of *Geomyces destructans* a fungus which causes white nose syndrome on several bat species population numbers are expected to decline. One Arkansas hibernation cave houses about 250,000 gray bats, over 15 percent of the total population. About 150,000 gray bats occupy Arkansas caves in summer.

People who disturb hibernation and maternity colonies present one of the greatest threats. Maternity colonies won't tolerate any disturbance, especially when flightless newborn young are present. Thousands of baby bats may be dropped to their deaths or abandoned by panicked parents. If aroused during hibernation, bats increase use of stored fat reserves, and if the disturbance is intense or frequent enough, starvation may result before insects are available in spring.

Other factors in the species' decline include vandalism, cave commercialization, pesticide poisoning, natural calamities such as flooding and cave-ins, loss of caves due to inundation by man-made impoundments and possibly a reduction of insect prey over streams that have been degraded by excessive pollution and siltation.

The range extends from southeastern Kansas and central Oklahoma east to western Virginia and western North Carolina, and from Missouri, Illinois, and Indiana south to southern Alabama and northwestern Florida (Decher and Choate 1995); occurs primarily in the cave region of Missouri, Arkansas, Kentucky, Tennessee, and Alabama. Summer and winter ranges are essentially the same.

Roost sites are nearly exclusively restricted to caves throughout the year (Hall and Wilson 1966, Barbour and Davis 1969, Tuttle 1976), though only a few percent of available caves are suitable (Tuttle 1979). Winter roosts are in deep vertical caves with domed halls. Large summer colonies utilize caves that trap warm air and provide restricted rooms or domed ceilings; maternity caves often have a stream flowing through them and are separate from the caves used in summer by males.

Occasionally non-cave roost sites are used. Hays and Bingman (1964) reported a colony in a storm sewer in Pittsburg, Kansas and, in 1988, a maternity colony was discovered using a storm sewer in Kansas (Decher and Choate 1988). Harvey and McDaniel (1988) located a maternity colony in a storm sewer in downtown Newark, Independence County, Arkansas. There are occasional reports of mines (Sealander 1979, Thom 1981, Brack et al. 1984, Harvey 1988) and buildings (Gunier and Elder 1971) being used as roost sites.

Winter caves are deep and vertical and provide a large volume of air below the lowest entrance that acts as a cold air trap (Tuttle 1976). Cold air flows in and is trapped during successive winters, providing mean annual temperatures 6 degrees C or more below the above-ground mean annual temperature (Tuttle 1978). Winter cave temperatures range from 6 to 11 degrees C (Tuttle 1979).

In the summer, maternity colonies prefer caves that act as warm air traps or that provide restricted rooms or domed ceilings that are capable of trapping the combined body heat from thousands of clustered individuals (Tuttle 1975, Tuttle and Stevenson 1977). Cave temperatures range from 14 to 24 C. Undisturbed summer colonies may contain up to 250,000 bats, and average 10,000 to 25,000 (Tuttle 1979). Summer caves are nearly always located within 1 km of a river or reservoir over which the bats forage (Tuttle 1979).

Tuttle (1979) showed that forested areas along the banks of streams and lakes provide important protection for adults and young. Young often feed and take shelter in forest areas near the entrance to cave roosts (Tuttle 1979). Do not feed in areas along rivers or reservoirs where the forest has been cleared (LaVal et al. 1977; Tuttle and Stevenson, in prep.).

Yearlings and adult males segregate into nomadic summer colonies that tend to roost in caves within a few kilometers of ones selected by adult females (Layne 1978).

Close inspection of the area of intent does not contain any cave openings of the size that Gray Bats would utilize for hibernation, transient, or maturity colonies. Grays bats may occasionally use Lake Bella Vista to forage over given the close proximity of a known gray bat maturity cave. However, there are other lakes in the area that would be similarly used by gray bats.

Ozark Big-Eared Bat
(*Corynorhinus townsendii ingens*)

Federal Status	LE
Global Rank	G4T1
State Rank	S1

This bat is aptly named, for its ears are of comic-book proportions. They're usually curled when the animal rests, like miniature ram's horns. Lump-nosed bat is another common name, a reference to a conspicuous protuberance between the nostril and eye.

About 1,700 Ozark big-eareds remain. Approximately 1,400 inhabit a few caves in eastern Oklahoma. The rest live in two Arkansas caves -- a hibernation cave and a nearby maternity cave in the Ozarks. A Missouri population is now considered extinct.

Ozark big-eared bats prefer to feed on moths. The bats will use nearby caves to feed as evidenced by the amount of moth wings found on the cave floor. Ozark big-eared bats are also known to use talus cracks to roost. A search of the area of intent revealed no karst openings or rock fissures of a size suitable for roosting or feeding by Ozark big-eared bats.