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Abstract

Oxford Resource Partners propose to extract coal from a 517 acre parcel of land south of Central City, KY. This action will require the removal of woody vegetation. Four net sites were surveyed along with 4 acoustic monitoring sites in order to document the endangered Indiana bat (*Myotis sodalis*). Thirty-three bats of 3 species were captured: 1 big brown bat (*Eptesicus fuscus*), 19 red bats (*Lasiurus borealis*), and 13 tricolor bats (*Perimyotis subflavus*). No Indiana bats were captured and it is unlikely that the proposed action in this area will affect this species.

Acknowledgements

I would like to thank Oxford Resource Partners for the opportunity to conduct this survey for bats, especially Sean Jones who was instrumental for this process. I would also like to thank the other Copperhead Consulting employees Mark Gumbert, Theresa Wetzel and Erin Watts for their hard work and dedication to the project.

Introduction

Oxford Resource Partners proposes to extract coal using underground mining practices on a 517-acre parcel of land which will require the removal of woody vegetation. The clearing of trees during the summer months raises questions and concerns for the welfare of the federally endangered Indiana bat (*Myotis sodalis*) and its summer habitat. Humphrey et al. (1977) reported the discovery of an Indiana bat colony by a utility company during the clearing process after cutting the limb that housed the bats. To prevent such an untimely discovery of an Indiana bat colony, Copperhead Environmental Consulting, Inc. (dba: Copperhead Consulting) was contracted to conduct a survey for Indiana bats near a proposed mining project as a requirement for the permitting process.

The proposed project site is located south of Central City and west of Greenville in Muhlenberg County within the Western Kentucky Coalfield physiographic region of Kentucky. The property is entirely within the Greenville USGS quadrangle and the center point is approximately N37.19803°, W87.23340°. Although the permitted proposed mining area will cover approximately 517 acres, only 392 acres are forested. Portions of the unit have been pre-law mined and these areas have been allowed to regenerate. The forest in the area is typical second growth deciduous hardwood forest native to western Kentucky.

Materials and Methods

Mist Net Locations

A total of four sites were selected and netted from 13 – 16 June during the 2011 bat survey conducted on the Geibel Property (Figure 1). The level of effort was based on the forested acreage of the project area (392 ac). Site reconnaissance was conducted 13 -14 June and the four sites netted were chosen based on the presence of suitable Indiana bat habitat. Mist netting was implemented in accordance with the Indiana Bat Survey Guidance for Kentucky (USFWS and KDFWR 2011).

Location of each survey site was recorded using a handheld Global Positioning System (GPS) unit (Table 1). Mist nets were set prior to sunset and deployed at dusk. Nets were left open for at least five hours from sunset each night, checked every 10 minutes, and disturbance near the nets was kept to a minimum. Weather data, including temperature, relative wind speed, and cloud cover was recorded for each site on an hourly basis to ensure compliance with mist netting guidelines (e.g., temperature during survey > 50°F). Although there was rain in the area during those four days and nights, precipitation did not interfere with netting efforts from 2000 – 0130 hr (CST) and temperatures were well above 50°F.

Low visibility, high-quality, nylon nets, 6 to 12 meters (18 - 42 ft) in length (depending upon the width of the corridor) were used for each net set. A two tier set, 7 meters (20 ft) high, constituted a net set. Netting at each site consisted of a minimum of two mist net sets, no closer than 30 meters (100 ft) apart. Each of the two sites was netted for two nights (totaling 16 net nights of effort) over the term of the project. Bat identification was verified by Mark Gumbert or Piper Roby, and data recorded for bats captured included capture time, species, sex, age (adult or juvenile), reproductive condition (pregnant, lactating, post-lactating, scrotal, non-reproductive), weight (g), and forearm length (mm). In addition, the height and the specific net set of capture were recorded for each bat. Completed data sheets may be found in Appendix A and photographs of mist-net locations are located in Appendix B.

Table 1. Location of mist net sites surveyed for bats on the Geibel permit #889-0130 Oxford Resources Partners, Muhlenberg County, KY, 2011.

Site #	Site description	Dates netted	Latitude	Longitude	# net nights
1	Large pond on Northwest side of property	13-14 June 2011	37.19937	-87.23582	4
2	Access road on southwest section of property	13-14 June 2011	37.19312	-87.24089	4
3	Access at south end, east of site 2	15-16 June 2011	37.19240	-87.23751	4
4	Sharon Depoy road	15-16 June 2011	37.19037	-87.24654	4

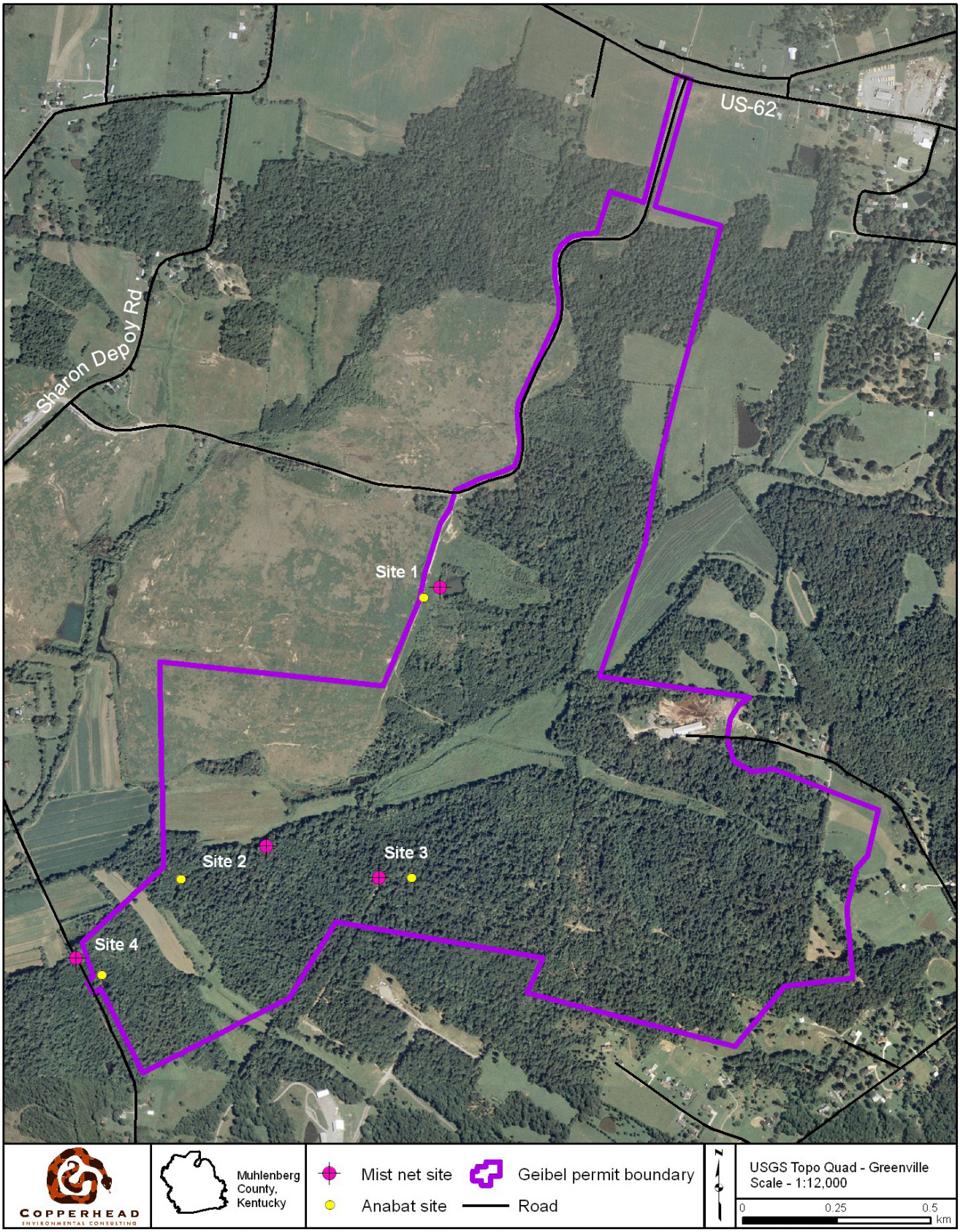

Figure 1. Mist net and Anabat sites surveyed for bats on 392 forested acres of the Geibel property (permit #889-0130) for Oxford Resource Partners, Muhlenberg County, KY, June 2011.

Acoustical Sampling

Acoustical sampling was conducted at four sites selected during the project in conjunction with mist net sampling in accordance with the Indiana Bat Survey Guidance for Kentucky (USFWS and KDFWR 2011). Use of acoustic sampling was used in order to provide greater accuracy in documenting Indiana bat use of a sampled area. Analysis of echolocation calls can pinpoint vocalizations to genera or even species, thereby allowing biologists to use multiple methods of documenting bat species and possibly to focus mist netting on locations likely used by target species. Acoustical surveys can also detect bats that evade capture as some species are particularly difficult to catch (due to their habit of flying above the tree canopy or their ability to avoid mist nets). Echolocation calls of bats were recorded using Anabat II™ bat detectors (Titley Scientific, QLD, Australia) attached to CF storage ZCAIMs during netting efforts.

One acoustical detector was employed for each site for each night netted during the summer 2011 mist net survey conducted on Oxford Coal's Geibel property. Each detector was placed at least 100 meters from net sites in areas that maximize detection (Table 2). Acoustic sampling began at sunset and continued for a minimum of 5 hours. Like mist-netting, acoustical sampling efforts were conducted within weather parameters outlined in the Guidance. Photographs of Anabat survey locations can be found in Appendix C.

Bat vocalizations were downloaded to a computer, viewed and analyzed in Analook™ (Titley Scientific, QLD, Australia) computer software, and were subsequently filtered through the NOISE filter provided by USFWS and KDFWR. In addition, the ID1 program was run to create a PARAMS file for further analysis. The final step ran the files through a statistical program (MATLAB) using the GUI software to determine the probability of detecting Indiana bat calls.

In the event that the GUI program determined that there was a 99% probability of Indiana bat call detection, additional netting may be required. All data collected via acoustical sampling equipment (e.g., project directories, DAT files, noise-filtered bat calls, and GUI program outputs) are stored electronically in the event further review is required.

Table 2. Acoustic sites surveyed using Anabat II detectors on Geibel permit #889-0130 for Oxford Resources Partners, Muhlenberg County, KY, 2011. Filters used included Noise and ID1. GUI analysis determined probability of Indiana bat call detection.

Site #	Site description	Dates surveyed	Latitude	Longitude
1	Dirt road through an open field	13-14 June 2011	37.19913	-87.23633
2	Log landing	13-14 June 2011	37.19229	-87.24344
3	Log landing	15-16 June 2011	37.19241	-87.23655
4	Pond	15-16 June 2011	37.18998	-87.24576

White-Nose Syndrome Protocol

In an effort to minimize the impact of white-nose syndrome (WNS) to captured bats, all netting and field activities followed guidelines established by USFWS. All netting equipment was sanitized with Lysol IC © solution prior to arrival. Individual captured bats were kept in unused paper "lunch" bags while awaiting processing and for weighing. Disposable latex gloves were worn over sanitized handling gloves and changed following the handling of each bat. All non-disposable equipment, e.g., Pesola scales, rulers, etc., coming into contact with bats was sanitized with Formula 409 spray immediately following the handling of each bat.

Results

Bat Capture

Thirty-three bats of three species were captured during the 16 net nights: 1 big brown bat (*Eptesicus fuscus*), 19 red bats (*Lasiurus borealis*), and 13 tricolor bats (*Perimyotis subflavus*). All bats were adult, 58% were females (n = 19), 30% were male, and the remaining 12% were escaped bats. Most of the female tricolor bats were pregnant and most of the red bats were lactating (Table 3). No endangered species were encountered during this survey. Net sites 2 and 4 were the most productive with 12 and 15 bat captures, respectively. Sites 1 and 3 caught considerably fewer bats (Table 4). Details on all bats captured can be found in Appendix D and photos of representative bat species captured can be found in Appendix E.

Acoustic Analysis

A total of four sites were surveyed for two nights each over four calendar nights. Calls that were recorded and subsequently analyzed did not indicate the presence of any endangered species (Indiana bats or gray bats [*Myotis grisescens*]) at the appropriate level of probability (Table 5).

Table 3. Bat capture summary during a survey on the Geibel permit #889-0130 Oxford Resources Partners, Muhlenberg County, KY, 2011.

Species	Adult Female					Adult Male	UNK	Total
	P	L	PL	NR	UNK			
Big brown bat (*Eptesicus fuscus*)	-	-	-	1	-	-	-	**1**
Red bat (Lasiurus borealis)	1	8	-	-	1	6	3	**19**
Tricolor bat (Perimyotis subflavus)	7			1		4	1	**13**
Total	**8**	**8**	**0**	**2**	**1**	**10**	**4**	**33**

Table 4. Bat species documented at each site during a survey on the Geibel permit #889-0130 Oxford Resources Partners, Muhlenberg County, KY, 2011.

Species	Site 1		Site 2		Site 3		Site 4		Total
	Night 1	Night 2	Night 1	Night 2	Night 1	Night 2	Night 1	Night 2	
Big brown bat (*Eptesicus fuscus*)	-	-	1	-	-	-	-	-	**1**
Red bat (Lasiurus borealis)	1	1	3	2	1	1	5	**5**	**19**
Tricolor bat (Perimyotis subflavus)	1	-	6	-	1	-	4	**1**	**13**
Total per night	**2**	**1**	**10**	**2**	**2**	**1**	**9**	**6**	**33**
Total per site	**3**		**12**		**3**		**15**		

Table 5. Results of acoustic data collected in conjunction with mist netting on the Geibel permit #889-0130 for Oxford Resources Partners, Muhlenberg County, KY, 2011.

Site #	Time of operation (central standard time)		#of bat call files		Probability of MYSO calls*	
	Night 1	Night 2	Night 1	Night 2	Night 1	Night 2
1	2009 - 0118 hr	2012 - 0131 hr	34	31	0	0
2	2010 - 1300 hr	2007 - 0134 hr	13	25	0	0
3	2001 - 0121 hr	2012 - 0125 hr	112	163	1	2
4	2057 - 0145 hr	2001 - 0117 hr	52	53	0	0

* MYSO: *Myotis sodalis* (Indiana bat). 0: p = 0.00, 1: p = 0.10, 2: p = 0.05, 3: p = 0.01

Discussion

Although there was no rain during the time period when nets and acoustic detectors were deployed, the area did receive periodic rain showers almost daily. Some nets were set over or along access points to streams or ponds while others were stretched across flight corridors (i.e., dirt roads). Although water sources are important for bats, the amount of rain the area received may have made the streams and ponds less attractive to bats during this time. Light created by the full moon phase may cause bats to fly below the canopy due to prey availability (Lang et al. 2006, Hecker and Brigham 1999). However, many of the nights were clouded over and bats may have been flying above the forested corridors, thereby avoiding being caught in mist-nets.

The clustering of net sites at the southern end of the property was due to habitat availability and nettable areas. Much of the northern portion of the property was open field or very dense young forest. The southern portion provided better bat habitat with wide dirt roads through more mature forest and portions of accessible stream corridor. Nets covered selected corridors well in most situations. However at Site 1, an opening in the trees accessing the large pond was covered but bats could access the pond by flying over the trees/net. There was little bat activity visually observed by researchers and very few calls recorded during acoustic data collection. At Site 2, there were 4 pregnant tricolor bats (*Perimyotis subflavus*) caught very early in the night, indicating that the site may have been near a maternity colony. The high number of bat calls on the Anabat detector at site 3 may have been due to a small number of bats foraging near the detector and making multiple passes across the opening.

The few species of bats, low number of bats captured in nets and low number of bat calls at most sites indicates that the area is not ideal for supporting a diverse assemblage of bat species or large numbers of individual bats. The absence of individuals caught in nets and the <99% probability of identifying Indiana bats by acoustic detection leads us to conclude that tree removal on this property will not likely adversely affect this species.

Literature Cited

Hecker, K.R. and R.M. Brigham. (1999). Does moonlight change vertical stratification of activity by forest-dwelling insectivorous bats? Journal of Mammaogy 80:1196–1201

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Lang, A.B., E.K.V. Kalko, H. Römer, C. Bockholdt, and D.K.N. Dechmann. 2006. Activity levels of bats and katydids in relation to the lunar cycle. Oecologia 146: 659–666.

USFWS and KDFWR (United States Fish & Wildlife Service AND Kentucky Department for Fish & Wildlife Resources). 2011. Indiana bat survey guidance for Kentucky. USFWS, Frankfort, KY. 34 pp.

Appendix A
Mist net datasheets

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Times in CST

Mist Netting Data Form (2011)

Page 1 of 1

Site No. 1 Project: No./ Name 194.03 / Oxford Coal Geibel Permit Date 13 Jun 11

Site Location Large Pond on Northwest side of property Photos taken? Yes or No

County Muhlenberg State Ky Quad Greenville Time Up: 2000 Time Down: 0110 Anabat number: 5

Lat-Long/UTM: N/E 37.19937 W/N 87.23582 Zone — Datum: NAD83 Observers: PLR, TW

#	Time	Species	Age	Sex / Repr.	Mass (g)	Fa / Pp (mm)	Net / Height (m)	WDI	G/H/B/T	Band # Type KYFWS	Freq. #
1	2140	PESU	A	M / NR	5.0	33 / -	A / 2.5	0	—	A15856	
2	2141	LABO	A	F / —	—	— / —	B / 3.0	Escaped from net			
3				/		/	/				
4				/		/	/				
5				/		/	/				
6				/		/	/				
7				/		/	/				
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9				/		/	/				
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27				/		/	/				
28				/		/	/				
29				/		/	/				

Moon Phase 97% wax or wane	Rise	Set
Moon	1813	0321
Sun	0528	2009

Time	Temp (F)	Sky	Wind	No. of Bats	Hum. %
2030	66.0	1	0	0	80%
2100	64.4	2	0	0	85%
2200	66.0	3	0	2	87%
2300	65.8	3	1	0	87%
0000	64.4	2	0	0	85%
0100	61.5	2	0	0	91%
Av.					

Sky Code	
0	Clear
1	Few clouds
2	Partly cloudy
3	Cloudy or overcast
4	Fog or smoke
5	Drizzle or light rain
6	Thunder Storm

Beaufort Wind Scale	
0	Calm (< 1 mph)
1	Light air (1-3 mph)
2	Light breeze (4-6 mph)
3	Gentle breeze (7-10 mph)
4	Moderate breeze (11-16 mph)

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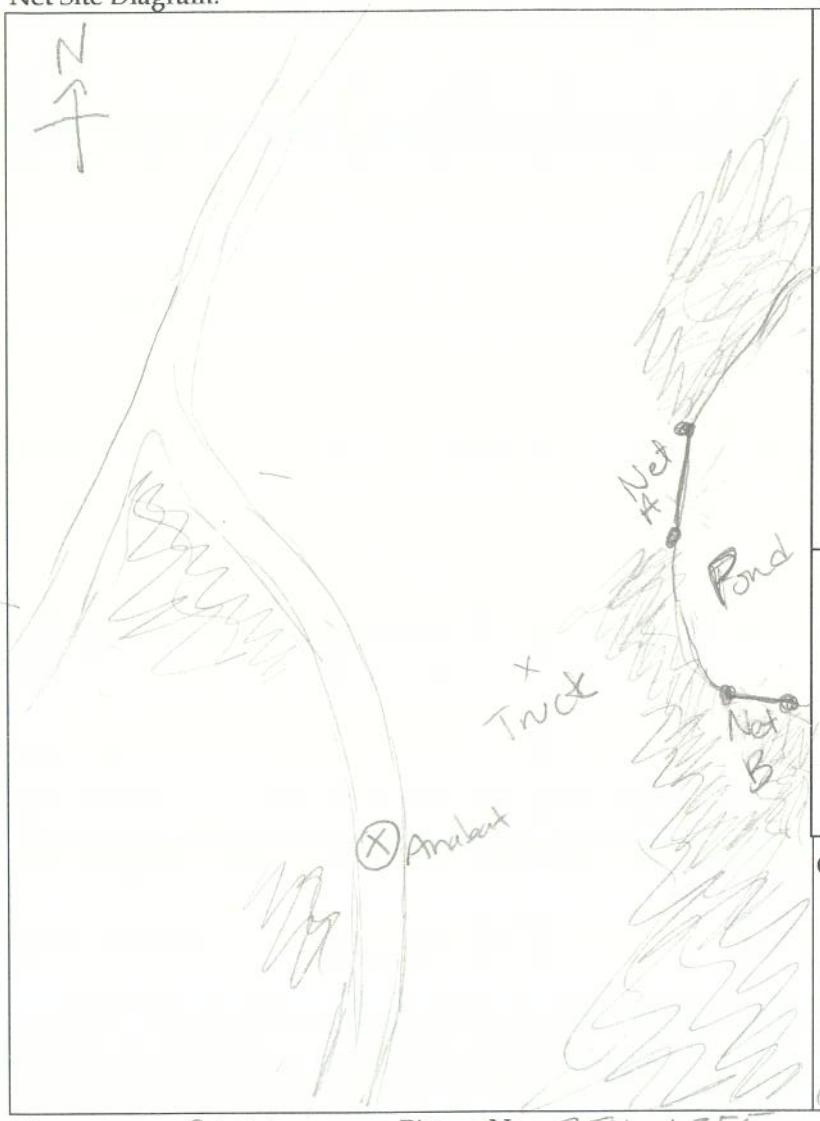
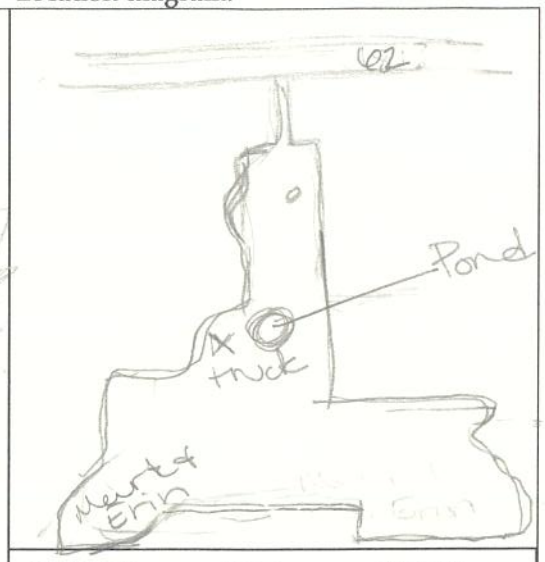
Net Site Diagram:



Location diagram:



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Other species:

Cricket frogs bullfrog
Red-wing black bird
Whip-poor-will
Eastern Towhee
Chuck-wills-widows

Dominant Vegetation

1. A. sycamore
2. sweetgum
3. cedar
4. Tulip poplar
5. _____

Net Set by Habitat(s)

Habitat	A	B	C
River			
Stream			
Pond	X	X	
Road rut			
Corridor			
Cave / Mine			
Total			

Net height X net length (m)

A	=	6	x	12
B	=	6	x	9
C	=		x	
D	=		x	

Camera: Piper Picture No: 354 + 355 Anabat Start/Stop: 2009 / 0118

Comments: An

Anabat location:
37.19913 / -87.23633
Picture: 356
34 bat call files

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Mist Netting Data Form (2011)

Page _____ of _____

Site No. 1 Project: No./ Name 194.03 / Oxford Coal Griebel Permit Date 14Jun11

Site Location Large Pond on Northwest side of property Photos taken? Yes or No

County Muhlenberg State KY Quad Greenville Time Up: 2008 Time Down: _____ Anabat number: 5

Lat-Long/UTM: N/E 37.19937 W/N 87.23582 Zone — Datum: NAD83 Observers: PLR, TANW

#	Time	Species	Age	Sex / Repr.	Mass (g)	Fa / Pp (mm)	Net / Height (m)	WDI	G/H/B/T	Band # Type _____	Freq. #
✓ 1	2259	LABO	F	Escaped		- / -	A / 6	—	—	—	—
2				/		/	/				
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29				/		/	/				

Moon Phase 99 % wax or wane		
	Rise	Set
Moon	1918	0412
Sun	0528	2009

Time	Temp (F)	Sky	Wind	No. of Bats	Hum %
2030	65.3	1	0	0	87
2100	64.4	1	0	0	91
2200	65.4	1	0	0	99
2300	64.2	3	0	1	99
0000	63.5	2	0	0	99
0100	64.2	1	0	0	91
Av.					

Sky Code	
0	Clear
1	Few clouds
2	Partly cloudy
3	Cloudy or overcast
4	Fog or smoke
5	Drizzle or light rain
6	Thunder Storm

Beaufort Wind Scale	
0	Calm (< 1 mph)
1	Light air (1-3 mph)
2	Light breeze (4-6 mph)
3	Gentle breeze (7-10 mph)
4	Moderate breeze (11-16 mph)

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Net Site Diagram:

See 6/13/11

Location diagram:

See 6/13/11

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Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____

Other species:
Whip-poor-will
bullfrog
Chuck-will's-widow
coyotes

Dominant Vegetation
1. A. Sycamore
2. Sweetgum
3. cedar
4. Tulip poplar
5.

Net Set by Habitat(s)			
Habitat	A	B	C
River			
Stream			
Pond	X	X	
Road rut			
Corridor			
Cave / Mine			
Total			

Net height X net length (m)

A	=	6	x	12
B	=	6	x	9
C	=		x	
D	=		x	

Camera: _____ Picture No: 354 & 355 Anabat Start/Stop: 2012 / 0131

Comments:
Changed Anabat 9-V @ 2120

Anabat Location:
37.19913 / -87.23633
Picture: 356
31 bat call files

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Mist Netting Data Form (2011)

Site No. 2 Project: No./ Name 194.03 / Oxford coal, Geibel Date 13 June 2011

Site Location Access road on Stripmine (Geibel) Photos taken? Yes or No

County Muhlenberg State KY Quad Greenville Time Up: 2009 Time Down: 0112 Anabat number: 2

Lat-Long/UTM: N/E 37.19312 W/N 87.24089 Zone — Datum: NAD83 Observers: MWG, EW

	#	Time	Species	Age	Sex / Repr.	Mass (g)	Fa / Pp (mm)	Net / Height (m)	WDI	G/H/B/T	Band # Type KYFW	Freq. #
(CST)	1	2030	LABO	A	♀ / L	12.5	40 / —	A / 1	0	Y/N/N/N	B09251	—
	2	2035	PESU	A	♂ / —	5.0	— / —	B / 3	ESCAPE			—
	3	2035	PESU	A	♀ / P	8.5	35 / —	B / 4	8	N/N/N/N	B09252	—
	4	2035	PESU	A	♀ / P	6.2	36 / —	B / 4	0	N/N/N/N	B09253	—
	5	2035	PESU	A	♀ / P	8.5	35 / —	B / 3	0	N/N/N/N	B09254	—
	6	2035	PESU	A	♀ / P	8.0	35 / —	B / 3	0	N/N/N/N	B09255	—
	7	2130	LABO	A	♀ / L	15.5	43 / —	B / 1.5	0	N/N/N/N	B09256	—
	8	2220	EPFU	A	♀ / NR	23	50 / —	B / 2	0	Y/N/N/N	B09257	—
	9	2250	LABO	A	♂ / NR	10	39 / —	B / 4	0	Y/N/N/N	B09258	—
	10	2345	PESU	A	♂ / NR	6.5	35 / —	A / 1.5	0	N/N/N/N	B09259	—
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	27				/		/	/				
	28				/		/	/				
	29				/		/	/				

Moon Phase 95 % wax or wane

	Rise	Set
Moon	1813	0321
Sun	0528	2009

Time	Temp (F)	Sky	Wind	No. of Bats
2000	84.5	3	0	0
2100	68.5	3	0	6
2200	66.5	2	0	0
2300	66.5	3	0	2
0000	65.5	3	0	1
0100	63.0	2	0	
Av.				

Sky Code	
0	Clear
1	Few clouds
2	Partly cloudy
3	Cloudy or overcast
4	Fog or smoke
5	Drizzle or light rain
6	Thunder Storm

Beaufort Wind Scale	
0	Calm (< 1 mph)
1	Light air (1-3 mph)
2	Light breeze (4-6 mph)
3	Gentle breeze (7-10 mph)
4	Moderate breeze (11-16 mph)

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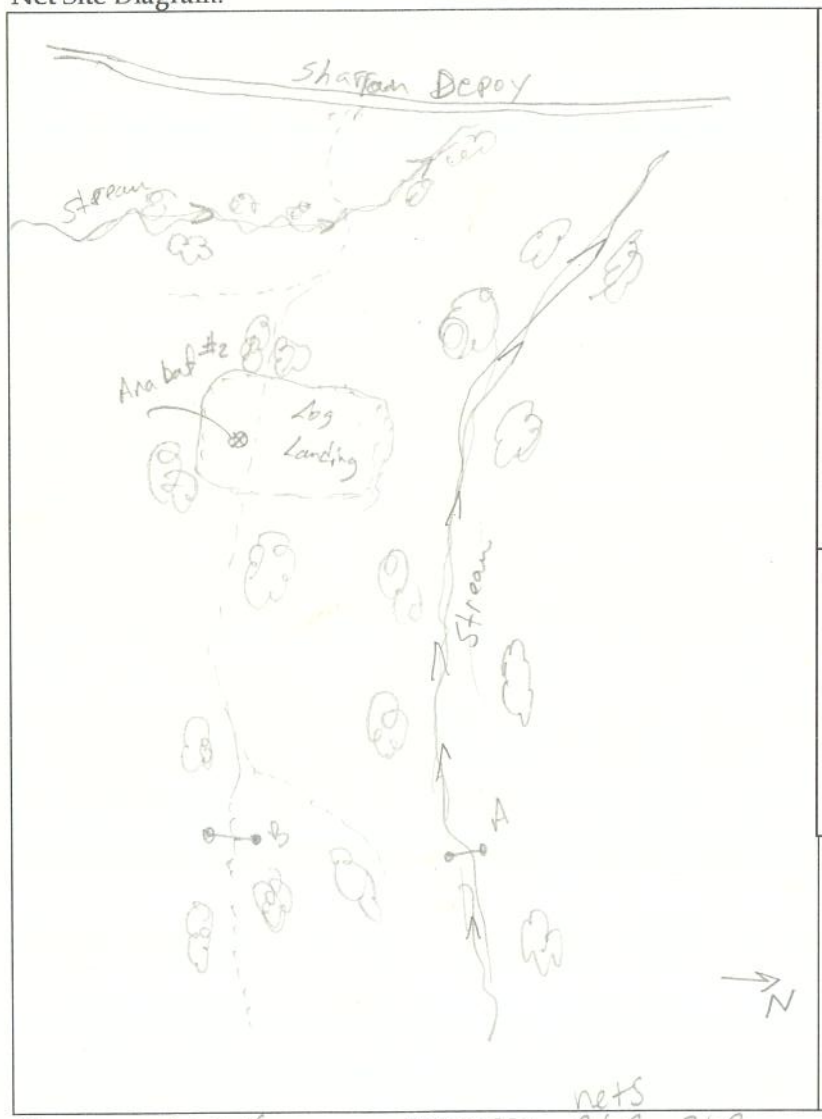
Net Site Diagram:



Location diagram:

Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
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Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____

Other species: Barred owl
Whipoorwill
Southern Leopard Frog
Green frog
Copes Gray Tree Frog
Midland water snake
Rough Green Snake

Dominant Vegetation

1. Sweetgum
2. Sycamore
3. tulip tree
4. White oak
5. _____

Net Set by Habitat(s)

Habitat	A	B	C
River			
Stream	X		
Pond			
Road rut			
Corridor		X	
Cave / Mine			
Total	1	1	

Net height X net length (m)

A	=	6	x	6
B	=	6	x	9
C	=		x	
D	=		x	

Camera: Piper Picture No: 362-363 nets anabat-361 Anabat Start/Stop: 2010 / all night

Comments:
B9252 - Skin peeling off tibia and forearm.
Anabat was left out all night inside weatherproof case

N 37.19229
W 87.24344
13 anabat calls

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Mist Netting Data Form (2011)

Site No. 2 Project: No./ Name 194.03 / Oxford coal, Geibel Date 14 June 2011

Site Location Access road on Stripmine (Geibel permit) Photos taken? Yes or No

County Muhlenberg State KY Quad Greenville Time Up: 2009 Time Down: 0109 Anabat number: 2

Lat-Long/UTM: N/E 37.19312 W/N 87.24089 Zone — Datum: NAD83 Observers: MWG, EW

#	Time	Species	Age	Sex / Repr.	Mass (g)	Fa / Pp (mm)	Net / Height (m)	WDI	G/H/B/T	Band # Type ____	Freq. #
✓ 1	2215	LABO	ESCAPED	—	—	— / —	B / 5	—			—
✓ 2	2250	LABO	A	♂ / NP	12	40 / —	B / 1	0	N/N/N/N	609260	—
3				/		/	/				
4				/		/	/				
5				/		/	/				
6				/		/	/				
7				/		/	/				
8				/		/	/				
9				/		/	/				
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21				/		/	/				
22				/		/	/				
23				/		/	/				
24				/		/	/				
25				/		/	/				
26				/		/	/				
27				/		/	/				
28				/		/	/				
29				/		/	/				

Moon Phase 100 % wax or wane		
	Rise	Set
Moon	1918	0412
Sun	0528	2009

Time	Temp (F)	Sky	Wind	No. of Bats
2000	68	0	0	0
2100	65.5	0	0	0
2200	64	0	0	1
2300	63	0	0	0
0000	61	0	0	0
0100	63.5	0	0	0
Av.				

Sky Code	
0	Clear
1	Few clouds
2	Partly cloudy
3	Cloudy or overcast
4	Fog or smoke
5	Drizzle or light rain
6	Thunder Storm

Beaufort Wind Scale	
0	Calm (< 1 mph)
1	Light air (1-3 mph)
2	Light breeze (4-6 mph)
3	Gentle breeze (7-10 mph)
4	Moderate breeze (11-16 mph)

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Net Site Diagram:

see 13 June sheet

Location diagram:

see 13 June 11

Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____

Other species: whipoorwill
coyotes

Dominant Vegetation

1. Sweetgum
2. sycamore
3. tulip tree
4. white oak
5. _____

Net Set by Habitat(s)

Habitat	A	B	C
River			
Stream	X		
Pond			
Road rut			
Corridor		X	
Cave / Mine			
Total	1	1	

Net height X net length (m)

A	=	9	x	6
B	=	9	x	9
C	=		x	
D	=		x	

Camera: Piper Picture No: See 13 June 2011 sheet Anabat Start/Stop: 2007 / 0234

Comments:
N 37.19229
W 87.24344
25 anabat call files

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Times in CST

Mist Netting Data Form (2011)

Site No. 3 Project: No./ Name 194.03 / Oxford Mining - Geibel Date 15 June 2011

Site Location Access road @ south end, east of site 2 Photos taken? Yes or No

County Muhlenberg State KY Quad Greenville Time Up: 2010 Time Down: 0110 Anabat number: 5

Lat-Long/UTM: N/E 37.19240 W/N 87.23751 Zone — Datum: NAD 83 Observers: PR, EW

#	Time	Species	Age	Sex / Repr.	Mass (g)	Fa / Pp (mm)	Net / Height (m)	WDI	G/H/B/T	Band # Type KYFW	Freq. #
1	2330	LABO	A	♂ / NR	12.5	39 / —	A / 3	1	N/N/N/N	A15857	—
2	0030	PESU	A	♀ / NR	6.0	32 / —	A / 2	0	—	A15858	
3				/		/	/				
4				/		/	/				
5				/		/	/				
6				/		/	/				
7				/		/	/				
8				/		/	/				
9				/		/	/				
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25				/		/	/				
26				/		/	/				
27				/		/	/				
28				/		/	/				
29				/		/	/				

Moon Phase 100 % wax or wane		
	Rise	Set
Moon	2017	0509
Sun	0528	2010

Time	Temp (F)	Sky	Wind	No. of Bats	Hum.
2030	76.2	2	0	0	82%
2100	76.2	3	0	0	85%
2200	72.8	2	0	0	91%
2300	70.5	0	0	0	93%
0000	69.2	0	0	1	93%
0100	68.1	0	0	1	93%
Av.					

Sky Code	
0	Clear
1	Few clouds
2	Partly cloudy
3	Cloudy or overcast
4	Fog or smoke
5	Drizzle or light rain
6	Thunder Storm

Beaufort Wind Scale	
0	Calm (< 1 mph)
1	Light air (1-3 mph)
2	Light breeze (4-6 mph)
3	Gentle breeze (7-10 mph)
4	Moderate breeze (11-16 mph)

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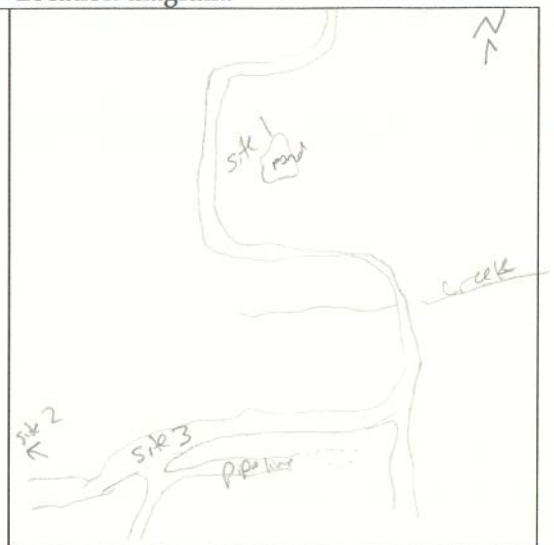
Net Site Diagram:

Location diagram:



Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____

Other species:

Cope's gray tree frog
Barred owl
Whip-poor-will

Dominant Vegetation

1. White oak
2. Sweet gum
3. Cedar
4. _____
5. _____

Net Set by Habitat(s)

Habitat	A	B	C
River			
Stream			
Pond			
Road rut			
Corridor	X	X	
Cave / Mine			
Total	1	1	

Net height X net length (m)

A	=	6	x	6
B	=	6	x	6
C	=	_____	x	_____
D	=	_____	x	_____

Camera: PR Picture No: 364 - 365 Anabat - 367 Anabat Start/Stop: 2001 / 0121

Comments:

Start time on Anabat 2101 }
end time on Anabat 0221 } EST
(no finger rub visual)
112 raw files

N 37.19241
W 87.23655
112 bat call files
MYSO = 1

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Mist Netting Data Form (2011)

Site No. 3 Project: No./ Name 194.03 / Oxford Mining - Geibel Date 16 June 2011

Site Location Access road on strip mine (Geibel) Photos taken? Yes or No

County Muhlenberg State KY Quad Greenville Time Up: 2010 Time Down: 0110 Anabat number: 5

Lat-Long/UTM: N/E 37.19240 W/N 87.23751 Zone — Datum: NAD 83 Observers: PR, EW

#	Time	Species	Age	Sex / Repr.	Mass (g)	Fa / Pp (mm)	Net / Height (m)	WDI	G/H/B/T	Band # Type RYFW	Freq. #
1	2230	LABO	A	♂ / NR	11.0	40 / —	B / 5	0	N/N/N/N	A15859	—
2				/		/	/				
3				/		/	/				
4				/		/	/				
5				/		/	/				
6				/		/	/				
7				/		/	/				
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27				/		/	/				
28				/		/	/				
29				/		/	/				

Moon Phase 100 % ~~wax or wane~~	Rise	Set
Moon	2107	0611
Sun	0528	2010

Time	Temp (F)	Sky	Wind	No. of Bats	% humid
2100	73.4	3	0		75
2200	73.2	3	0	0	77
2300	72.8	3	0	1	77
0000	76.2	2	1	0	70
0100	73.4	2	0	0	75
Av.					

Sky Code	
0	Clear
1	Few clouds
2	Partly cloudy
3	Cloudy or overcast
4	Fog or smoke
5	Drizzle or light rain
6	Thunder Storm

Beaufort Wind Scale	
0	Calm (< 1 mph)
1	Light air (1-3 mph)
2	Light breeze (4-6 mph)
3	Gentle breeze (7-10 mph)
4	Moderate breeze (11-16 mph)

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Net Site Diagram:

See 15 June sheet

Location diagram:

Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____
Trans freq:_____ Type: _____ Weight:_____

Other species:
whipoorwill
Coyotes

Dominant Vegetation

1._____
2._____
3._____
4._____
5._____

Net Set by Habitat(s)

Habitat	A	B	C
River			
Stream			
Pond			
Road rut			
Corridor	X	X	
Cave / Mine			
Total	1	1	

Net height X net length (m)

A	=	6	x	6
B	=	6	x	6
C	=		x	
D	=		x	

Camera: PR Picture No: See 15 June sheet Anabat Start/Stop: 2012 / 0125

Comments: Anabat start time 2112 }
Anabat end time 0225 } EST
163 files

163 bat calls
MYSE = 2
more net = 0

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Mist Netting Data Form (2011)

Site No. 4 Project: No./ Name 194.03 / Oxford Coal Geibel Permit Date 15 Jun 11

Site Location Sharon Depoy Rd. Photos taken? Yes or No

County Muhlenberg State KY Quad Greenville Time Up: 2010 Time Down: 0110 Anabat number: 2

Lat-Long/UTM: N/E 3719037 W/N -87.24654 Zone — Datum: NAD83 Observers: JAMW, MWG

#	Time	Species	Age	Sex / Repr.	Mass (g)	Fa / Pp (mm)	Net / Height (m)	WDI	G/H/B/T	Band # Type KYFN	Freq. #
1	2051	LABO	ESCAPED			/ —	A / 1	—	—	—	—
2	2109	PSUB	A	F / PR	9.0	35 / —	A / 3	0	—	B09261	—
* 3	2120	LABO	A	F / L	12.75	42 / —	A / 1.5	1	Y / —	B09262	—
4	2145	LABO	A	M / NR	12.5	39 / —	A / 1	0	—	B092163	—
5	2145	LABO	A	F / L	12.75	42 / —	A / 3	1	Y —	B092162	recapture
6	2224	PSUB	—	ESCAPED		/	A / —	—	—	—	—
7	2242	PSUB	A	F / PR	8.75	34 / —	A / 3	0	—	B09264	—
8	2300	PSUB	A	M / NR	6.8	35 / —	A / 3.5	0	Y —	B09265	—
9	2300	LABO	A	F / PR	17.5	44 / —	A / 3.5	0	Y —	B09266	—
10				/		/	/				
11				/		/	/				
12				/		/	/				
13				/		/	/				
14				/		/	/				
15				/		/	/				
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28				/		/	/				
29				/		/	/				

Moon Phase 100 % wax or wane	Rise	Set
Moon	2017	0509
Sun	0528	2010

Time	Temp (F)	Sky	Wind	No. of Bats
2100	74.0	3	1	4
2200	71.0	2	0	2
2300	69.0	2	0	2
0000	68.0	1	0	0
0100	66.5	1	0	
Av.				

Sky Code	
0	Clear
1	Few clouds
2	Partly cloudy
3	Cloudy or overcast
4	Fog or smoke
5	Drizzle or light rain
6	Thunder Storm

Beaufort Wind Scale	
0	Calm (< 1 mph)
1	Light air (1-3 mph)
2	Light breeze (4-6 mph)
3	Gentle breeze (7-10 mph)
4	Moderate breeze (11-16 mph)

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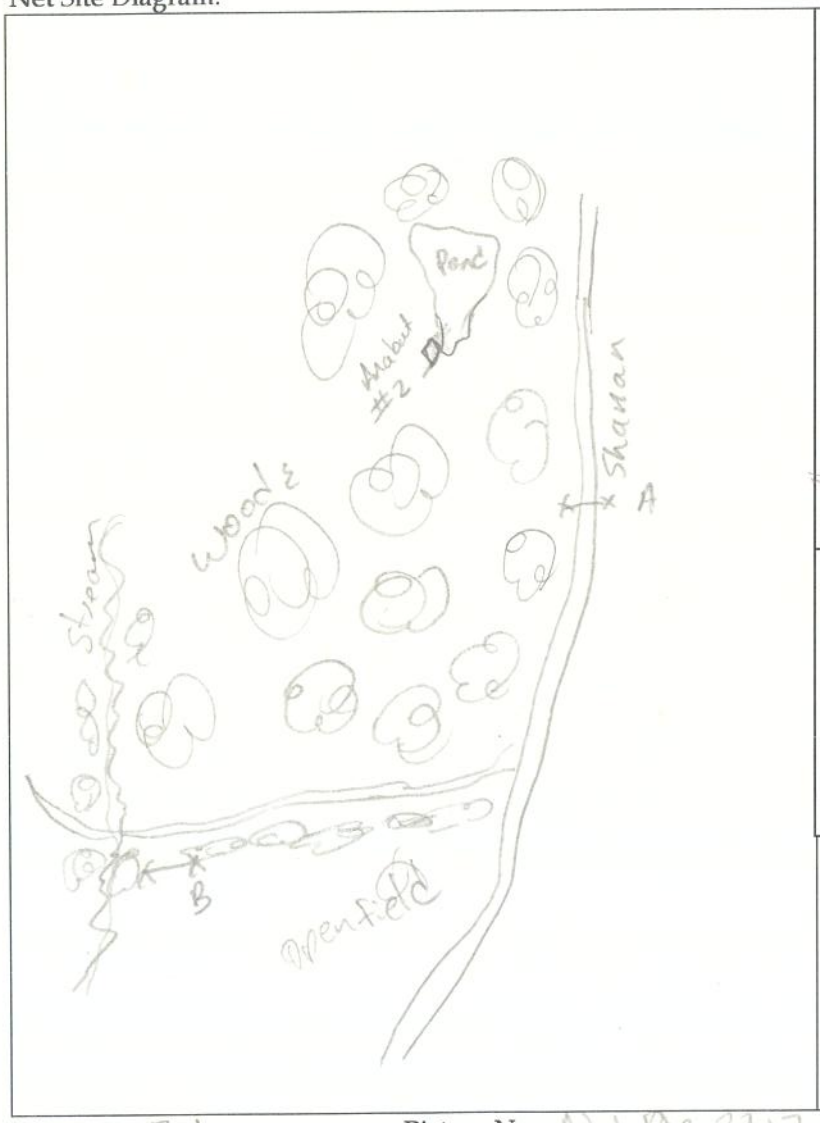
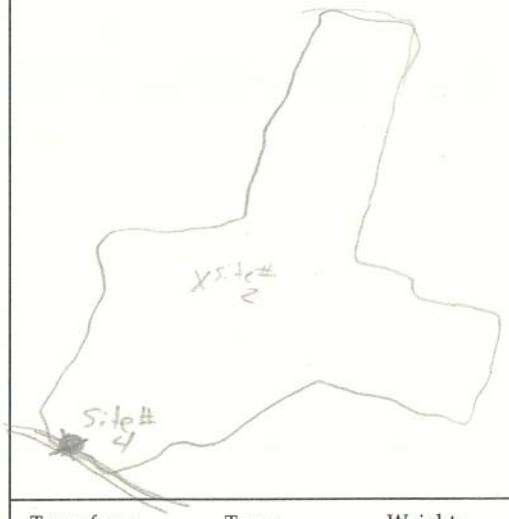
* Broken wing tip

Net Site Diagram:



Location diagram:



Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____
Trans freq:_____	Type: _____	Weight:_____

Other species:

A. chry-v

Dominant Vegetation

1. Red Oak
2. Sweetgum
3. A. Sycamore
4. Red Maple
5. Sassafras

Net Set by Habitat(s)

Habitat	A	B	C
River			
Stream			
Pond			
Road rut			
Corridor	X	X	
Cave / Mine			
Total			

Net height X net length (m)

A	=	6	x	9
B	=	6	x	6
C	=		x	
D	=		x	

Camera: TW Picture No: Net B: 2317 & 2319 Net A: 2304-2305 Anabat Start/Stop: 2057 / 0145

Comments:

Start time on Anabat 2057
End time on Anabat 0145
52 total files

Anabat Location:
N 37.18998 Pic: 2307
W-87.24576
0 myso calls 52 bat calls

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Mist Netting Data Form (2011)

Page 1 of 1

Site No. 4 Project: No./ Name 194.03 / Oxford Coal Gerbel Permit Date 16 Jun 11

Site Location Sharon Depoy Rd. Photos taken? Yes or No

County Muhlenberg State KY Quad Greenville Time Up: 2010 Time Down: 0110 Anabat number: 2

Lat-Long/UTM: N/E 37.19037 W/N -87.24654 Zone — Datum: NAD83 Observers: TANW, MWG

#	Time	Species	Age	Sex / Repr.	Mass (g)	Fa / Pp (mm)	Net / Height (m)	WDI	G/H/B/T	Band # Type KEWS	Freq. #
1	2145	LABO	A	F / L	13.0	45 / —	A / 2.5	1	Y —	B09267	—
2	2207	LABO	A	M / NR	13.0	42 / —	A / 3	0	—	B09268	—
3	2207	LABO	A	F / L	16.2	42 / —	A / 2	0	—	B09266	recap
4	2310	PSUB	A	F / P	8.5	36 / —	A / 3	0	—	B09269	—
5	2310	LABO	A	F / L	15.1	43 / —	A / 4	0	—	B09270	—
6	0029	LABO	A	F / L	13.2	41 / —	A / 1.5	0		B09271	—
7				/		/	/				
8				/		/	/				
9				/		/	/				
10				/		/	/				
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26				/		/	/				
27				/		/	/				
28				/		/	/				
29				/		/	/				

Moon Phase 99 % wax or wane

	Rise	Set
Moon	2107	0611
Sun	0528	2010

Time	Temp (F)	Sky	Wind	No. of Bats
2100	68.5	2	0	1
2200	70.0	2	1	2
2300	72.0	3	1	2
0000	74.8	2	1	1
0100	70.5	2	1	0
Av.				

Sky Code	
0	Clear
1	Few clouds
2	Partly cloudy
3	Cloudy or overcast
4	Fog or smoke
5	Drizzle or light rain
6	Thunder Storm

Beaufort Wind Scale	
0	Calm (< 1 mph)
1	Light air (1-3 mph)
2	Light breeze (4-6 mph)
3	Gentle breeze (7-10 mph)
4	Moderate breeze (11-16 mph)

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P.O. Box 73, 11641 Richmond Rd., Paint Lick, Kentucky 40461 (859) 925-9012

Net Site Diagram:

See 6/15/11

Location diagram:

See 6/15/11

Trans freq:_____ Type: _____ Weight:____
Trans freq:_____ Type: _____ Weight:____
Trans freq:_____ Type: _____ Weight:____
Trans freq:_____ Type: _____ Weight:____
Trans freq:_____ Type: _____ Weight:____
Trans freq:_____ Type: _____ Weight:____
Trans freq:_____ Type: _____ Weight:____
Trans freq:_____ Type: _____ Weight:____
Trans freq:_____ Type: _____ Weight:____
Trans freq:_____ Type: _____ Weight:____

Other species:
Whip-poor-will
flying squirrel
barred owl
Cope's gray tree frog
Fowler's toad

Dominant Vegetation

1._____
2._____
3._____
4._____
5._____

Net Set by Habitat(s)

Habitat	A	B	C
River			
Stream			
Pond			
Road rut			
Corridor	X	X	
Cave / Mine			
Total			

Net height X net length (m)

A	=	6	x	9
B	=	6	x	6
C	=		x	
D	=		x	

Camera: TW Picture No: Net A: 2304-2305 Net B: 2317 & 2319 Anabat Start/Stop: _____/_____

Comments:

Anabat start time 2101
Anabat end time 0217
56 files

Anabat Location:
N 37.18998
W -87.24576
Pic: 2307

MYSO = 0 53 bat calls

COPPERHEAD ENVIRONMENTAL CONSULTING, INC.

Copperhead Environmental Consulting Inc.
P.O. Box 73, 11641 Richmond Rd., Paint Lick, Kentucky 40461 (859) 925-9012

Appendix B
Photos of mist net sites

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SITE 1

SITE 2

SITE 3

SITE 4

Appendix C
Photos of Anabat sites

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SITE 1

SITE 2

SITE 3

Appendix D
Table of bat captures

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Appendix D. All bats captured during netting efforts at four sites on the Geibel permit #889-0130 for Oxford Resources Partners, Muhlenberg County, KY, 2011.

Species												
Site#	**Date**	**Time**	**Age**	**Sex**	**Reproductive condition***	**Mass (g)**	**Forearm (mm)**	**Net**	**Height (m)**	**Wing Damage Index**	**KYFWS Band #**	**Notes**
Big brown bat (*Eptesicus fuscus*)												
2	13-Jun-11	2220	A	F	NR	23.0	50	B	2	0	B09257	
Red bat (*Lasiurus borealis*)												
1	13-Jun-11	2141	A	F	-	-	-	B	3	-	-	Escaped
1	14-Jun-11	2259	-	-	-	-	-	A	6	-	-	Escaped
2	13-Jun-11	2030	A	F	L	12.5	40	A	1	0	B09251	
2	13-Jun-11	2130	A	F	L	15.5	43	B	1.5	0	B09256	
2	13-Jun-11	2250	A	M	NR	10.0	39	B	4	0	B09258	
2	14-Jun-11	2215	-	-	-	-	-	B	5	-	-	Escaped
2	14-Jun-11	2250	A	M	NR	12.0	40	B	1	0	B09260	
3	15-Jun-11	2330	A	M	NR	12.5	39	A	3	1	A15857	
3	16-Jun-11	2230	A	M	NR	11.0	40	B	5	0	A15859	
4	15-Jun-11	2051	-	-	-	-	-	A	1	-	-	Escaped
4	15-Jun-11	2120	A	F	L	12.8	42	A	1.5	1	B09262	Broken wing tip
4	15-Jun-11	2145	A	M	NR	12.5	39	A	1	0	B09263	
4	15-Jun-11	2145	A	F	L	12.5	42	A	3	1	B09262	Recapture
4	15-Jun-11	2300	A	F	P	17.5	44	A	3.5	0	B09266	
4	16-Jun-11	2145	A	F	L	13.0	45	A	2.5	1	B09267	
4	16-Jun-11	2207	A	M	NR	13.0	42	A	3	0	B09268	
4	16-Jun-11	2207	A	F	L	16.2	44	A	2	0	B09266	Recapture
4	16-Jun-11	2310	A	F	L	15.1	43	A	4	0	B09270	
4	16-Jun-11	0029	A	F	L	13.2	41	A	1.5	0	B09271	
Tricolor bat (*Perimyotis subflavus*)												
1	13-Jun-11	2140	A	M	NR	5.0	33	A	2.5	0	A15856	
2	13-Jun-11	2035	A	M	-	5.0	-	B	3	-	-	Escaped

Species												
Site#	Date	Time	Age	Sex	Reproductive condition*	Mass (g)	Forearm (mm)	Net	Height (m)	Wing Damage Index	KYFWS Band #	Notes
Tricolor bat (*Perimyotis subflavus*) continued												
2	13-Jun-11	2035	A	F	P	8.5	35	B	4	1	B09252	
2	13-Jun-11	2035	A	F	P	6.2	36	B	4	0	B09253	
2	13-Jun-11	2035	A	F	P	8.5	35	B	3	0	B09254	
2	13-Jun-11	2035	A	F	P	8.0	35	B	3	0	B09255	
2	13-Jun-11	2345	A	M	NR	6.5	35	A	1.5	0	B09259	
3	15-Jun-11	0030	A	F	NR	6.0	32	A	2	0	A15858	
4	15-Jun-11	2109	A	F	P	9.0	35	A	3	0	B09261	
4	15-Jun-11	2224	A	-	-	-	-	A	-	-	-	Escaped
4	15-Jun-11	2242	A	F	P	8.8	34	A	3	0	B09264	
4	15-Jun-11	2300	A	M	NR	6.8	35	A	3.5	0	B09265	
4	16-Jun-11	2310	A	F	P	8.5	36	A	3	0	B09269	

* NR = non-reproductive, L = lactating, P = pregnant

Appendix E
Representative photos of bats

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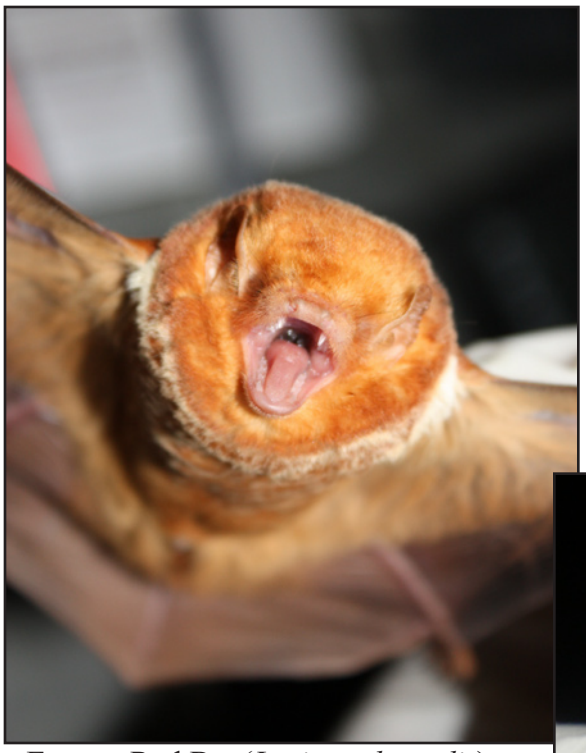

Eastern Red Bat (*Lasiurus borealis*)

Tricolor Bat (*Perimyotis subflavus*)

Big Brown Bat (*Eptesicus fuscus*)

Appendix F
USFWS Concurrence Letter

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Kentucky Ecological Services Field Office
330 West Broadway, Suite 265
Frankfort, Kentucky 40601
(502) 695-0468

Indiana Bat Summer Survey and Winter Habitat Assessment Report
For Surface Mining Projects

Date: 6/21/2011

Project Information

KYFO No: 2007-B-1227

Project Name: 889-0130

Location: Muhlenberg Co., KY

Acreage: 517 acres (total), 392 acres (forested)

Mist Net Sites: 4

Surveyor: Copperhead Consulting

On Behalf of: Oxford Resource Partners

Exp. Date: 6/16/2016

The U.S. Fish and Wildlife Service's Kentucky Field Office (KYFO) has reviewed an Indiana Bat Summer Mist Net Survey and Winter Habitat Assessment report for the above-referenced project. No Indiana bats were captured and no potential Indiana bat winter habitat was identified onsite. We find the survey acceptable and believe that any potential effects to summer and/or winter habitat of the Indiana bat would not be attributable to the Kentucky Department of Natural Resources (DNR) or the U.S. Army Corps of Engineers (COE) permitting process. Pursuant to the Range-wide Indiana Bat Protection and Enhancement Plan Guidelines (2009), the results of this survey are valid for a period of five years. These comments have been discussed and approved by Mr. Virgil Lee Andrews, Jr., Field Supervisor and therefore should be considered the comments of the KYFO. If you have any questions regarding this letter, please contact me at (502) 695-0468, Ext. 103.

Sincerely,

CLAllison

Carrie L. Allison
Fish and Wildlife Biologist

STEVEN L. BESHEAR
GOVERNOR

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL

MARCHETA SPARROW
SECRETARY

THE STATE HISTORIC PRESERVATION OFFICE
300 WASHINGTON STREET
FRANKFORT, KENTUCKY 40601
PHONE (502) 564-7005
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www.heritage.ky.gov

LINDY CASEBIER
ACTING EXECUTIVE DIRECTOR AND
STATE HISTORIC PRESERVATION OFFICER

July 19, 2011

Davie Ransdell, Supervisor
Critical Resources Review Section
DSMRE/Division of Permits
#2 Hudson Hollow Complex
U.S. 127 South
Frankfort, Kentucky 40601

2011 JUL 27 PM 4:07

Re: ***Phase I Cultural Resource of Oxford Mining Company-Kentucky LLC, Mine Permit No. 889-0130 Near Depoy, Muhlenberg County, Kentucky*** **by Titus, et al. of American Resources Group, LTD Carbondale, Illinois**

Oxford Mining Company, LLC
Application 889-0130 NW
Muhlenberg County

Ms. Ransdell,

This office has received the above mentioned report for review. The report documented ten previously unrecorded archaeological sites (15Mu295-15Mu302, 15Mu304, and 15Mu306) as well as the investigation of one previously recorded site (15Mu174). The authors recommended that site 15Mu174, sites 15Mu297-15Mu301, and site 15Mu304 are not eligible for listing in the National Register of Historic Places, and they recommend no further archaeological investigation of those sites. Additionally, the authors recommended Phase II evaluation of sites 15Mu295, 15Mu296, 15Mu302, and 15Mu306. I concur with the authors' findings.

If you have any questions, please do not hesitate to contact Phillip Johnson of my staff at (502) 564-7005 ext 122.

Sincerely,

Lindy Casebier, Acting Executive Director
Kentucky Heritage Council and
State Historic Preservation Officer

LC:prj

cc. Dr. George Crothers (UK-OSA)
Steve Titus (ARG)

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR NATURAL RESOURCES

Steven L. Beshear
Governor

Division of Mine Permits
2 Hudson Hollow
Frankfort, Kentucky 40601
Phone (502) 564-2320
Fax (502) 564-6764
www.minepermits.ky.gov

Leonard K. Peters
Secretary

Carl E. Campbell
Commissioner

July 28, 2011

DALE DAVIS
ERMC2
229 MADISON SQUARE DRIVE
MADISONVILLE, KENTUCKY 42431

RE: Oxford Mining Company-Kentucky, LLC
Application # 889-0130, NW

Dear Mr. Davis:

This office recently received the report, "Phase I Cultural Resources Investigation of Oxford Mining Company-Kentucky, LLC, Mine Permit No. 889-0130 near Depoy, Muhlenburg County, Kentucky," prepared by Cally Lence, Chip Perkins, Monica Shah Lomas, Steve Titus, John Schwegman, and Bob Sadler of American Resources Group, Ltd. This report presents the results of a preliminary reconnaissance survey of the above referenced permit application.

During the course of the archaeological investigation, eleven archaeological sites were recorded or revisited. Of these, sites 15Mu174, 15Mu297, 15Mu298, 15Mu299, 15Mu300, 15Mu301, and 15Mu304 were determined to be not eligible for listing in the National Register of Historic Places and no further work is required for these sites. The remaining four sites, 15Mu295, 15Mu296, 15Mu302, and 15Mu303 were evaluated as being potentially eligible for listing in the National Register. The authors have **recommended that Phase II testing to determine National Register eligibility be conducted for 15Mu295, 15Mu296, 15Mu302, and 15Mu303. In lieu of testing the sites may be protected for mining related impacts by marked 200-foot radius buffer zones.** Division of Mine Permits personnel and the State Historic Preservation Officer have reviewed the author's methodology and conclusions, and concur with this recommendation. A copy of the SHPO comments is attached for your information.

If Phase II testing is chosen all required archaeological investigations and written reports must be reviewed and accepted by both the Division and SHPO before this application can be considered to be technically complete for cultural resources. If the sites

are to be buffered the buffer zones must be marked on the MRP and labeled as "No disturbance zones". If you have any questions concerning this matter, please contact Rose Moore, staff archaeologist, Critical Resources Review Section at (502) 564-2320.

Sincerely,

Davie R. Ransdell

Davie Ransdell, Supervisor
Critical Resources Review Section
Division of Mine Permits

c: Rose Moore (e)
Permit File Emily Lawson (e)
Steve Titus, American Resources Group, 127 N. Washington St., Carbondale, Illinois 62901
Mark Dennen, SHPO (e)

STEVEN L. BESHEAR
GOVERNOR

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL

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LINDY CASEBIER
ACTING EXECUTIVE DIRECTOR AND
STATE HISTORIC PRESERVATION OFFICER

October 28, 2011

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DIVISION OF PERMITS

Davie Ransdell, Supervisor
Critical Resources Review Section
DSMRE/Division of Permits
#2 Hudson Hollow Complex
U.S. 127 South
Frankfort, Kentucky 40601

Re: ***Phase II Testing at Site 15Mu296 in Oxford Mining Company-Kentucky, LLC, Mine Permit No. 889-0130, Muhlenberg County, Kentucky*** **by Schwegman et al. of American Resources Group, Ltd.**

Oxford Mining Company-Kentucky, LLC
Application # 889-0130, NW
Muhlenberg County

Ms. Ransdell,

This office has received the above-listed report for review. This report documents the results of archaeological investigations conducted at site 15Mu296 in Muhlenberg County. These investigations consisted of the excavation of six 1-x-2-m test units, two 5-m long trenches, shallow stripping, and documentation of several features, along with specialized analyses of recovered materials, including lithic tools and debris, botanical remains, and radiocarbon dating. We have several comments regarding this report that should be taken into consideration with any resulting data recovery efforts and reporting for this site.

- *General Comment*: The authors should be sure to reference the most recent version (2006) of the *Specifications for Conducting Fieldwork and Preparing Cultural Resource Assessment Reports* and the most recent version (2008) of the State Plan, *The Archaeology of Kentucky: An Update*. Also, please note that the updated State Plan was edited by David Pollack, but had many contributing authors. Please reference the appropriate author(s) for the section of the plan cited in future reports.
- *Prehistoric Artifact Analysis, Material Type Analysis (pp.* 25-29): The authors correctly recognize the importance of identifying raw materials used in the production of the stone tools and debris found on these archaeological sites. However, some of the resources presently identified as coming from sources at greater distance from the site bear similarities to those that are known to occur in closer proximity. For example, the materials identified as Wyandotte may in fact be other Ste. Genevieve Limestone cherts that are known to outcrop in other locations of western Kentucky. This does not preclude the possibility of non-local or exotic lithic raw materials being present in these assemblages, but does warrant consideration. It may be worthwhile to consult area geological quadrangles, the comparative chert collection at the University of Kentucky Museum of Anthropology, and other previous studies in the area. If based on these additional efforts it seems apparent that some of the raw material identifications from the Phase II investigations were perhaps inaccurate, it may be

necessary to revisit the analyses of the lithics and the resulting behavioral implications and make adjustments accordingly in the Phase III analysis and report.

- *Figures Displaying Artifacts*: For the Phase III report, please provide a metric scale in addition to or in place of the English scale.
- *15Mu296 Site Stratigraphy*: Given the descriptions of the deeper deposits at 15Mu296 and the recovery of artifacts from the deepest levels of some of the Test Units, it does not seem clear that "sterile" or non-culture bearing deposits were reached during the Phase II investigations. The extent to which the potential for more deeply buried, intact cultural deposits may or may not be present should be more adequately addressed through the Phase III field investigations and resulting report. A professional geoarchaeologist or geomorphologist should be consulted to assist in this assessment. If deeper deposits are potentially present, it may be necessary to make adjustments to the data recovery efforts, as such deposits would likely be significant in and of themselves and warrant additional investigation.

Despite these comments, we feel we have sufficient information to assess the significance of Site 15Mu296. Based on the results of these investigations, the authors recommend that the site has outstanding research potential, and have recommended that Site 15Mu296 is eligible for listing on the National Register of Historic Places under Criterion D. The authors recommend that impacts to Site 15Mu296 should be avoided, and if impacts to the site cannot be avoided they recommend Phase III data recovery at Site 15Mu296. I concur with the authors' recommendations, and in the event that impacts to Site 15Mu296 cannot be avoided I look forward to further consultation regarding Phase III data recovery for the site.

If you have any questions, please do not hesitate to contact Kary Stackelbeck of my staff at 502.564.7005 ext 147.

Sincerely,

Lindy Casebier, Acting Executive Director
Kentucky Heritage Council and
State Historic Preservation Officer

LC:prj/kls
cc. Dr. George Crothers (UK-OSA)
Steve Titus (ARG)

ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR NATURAL RESOURCES

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Governor

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Leonard K. Peters
Secretary

Carl E. Campbell
Commissioner

November 8, 2011

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DALE DAVIS
ERMC2
229 MADISON SQUARE DRIVE
MADISONVILLE, KENTUCKY 42431

RE: Oxford Mining Company-Kentucky, LLC
Application # 889-0130, NW

Dear Mr. Davis:

This office recently received the report, "Phase II Testing at Site 15Mu296 in Oxford Mining Company-Kentucky, LLC, Mine Permit No. 889-0130, Muhlenberg County, Kentucky," prepared by John Schwegman, Chip Perkins, and Kathryn Parker of American Resources Group, Ltd. This report presents the results of the Phase II testing to determine National Register eligibility of site 15Mu296 within the above referenced permit application. This office also recently received the "Proposal for Phase III Data recovery at Site 15Mu296 Located in Oxford Mining Company-Kentucky, LLC, Geibel Mine Permit No. 889-0130, Muhlenberg County, Kentucky," by Steve Titus of American Resources Group, Ltd.

During the course of the Phase II testing, it was determined that site 15Mu296 is eligible for listing in the National Register of Historic Places based on the number of artifacts, features, botanical remains and radiocarbon dates providing evidence for outstanding research potential. Therefore, the investigator has **recommended that site 15Mu296 be protected from mining related impacts or that Phase III data recovery be conducted**. Division of Mine Permits personnel and the State Historic Preservation Officer have reviewed the author's methodology and conclusions, and concur with this recommendation. The Phase III data recovery plan has been reviewed and accepted with a few additions by SHPO. The consultant is aware of these additions and has incorporated them into the fieldwork. A copy of the SHPO comments is attached for your information.

The applicant must submit four (4) copies of the Phase III data recovery report to the following address: Critical Resources Review Section, Division of Mine Permits, Department for Natural Resources, No. 2 Hudson Hollow, Frankfort, KY 40601. The report must be reviewed and accepted by the SHPO and the Division in order for the applicant to have successfully

completed the permitting requirement to consider and protect significant cultural resources for the subject permit application. If you have any questions, please contact the staff archaeologist, Rose Moore at (502) 564-2320.

Sincerely,

Davie Ransdell, Supervisor
Critical Resources Review Section
Division of Mine Permits

c: Rose Moore (e)
Permit File Emily Lawson (e)
Steve Titus, American Resources Group, Ltd.,
127 North Washington, Carbondale, IL 62901
Rick Parks, Oxford Mining Company-Kentucky, Geibel Mine,
3060 Cleaton Road, Central City, KY 42330
Lindy Casebier, SHPO (e)

STEVEN L. BESHEAR
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LINDY CASEBIER
ACTING EXECUTIVE DIRECTOR AND
STATE HISTORIC PRESERVATION OFFICER

October 28, 2011

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MINE PERMITS

Davie Ransdell, Supervisor
Critical Resources Review Section
DSMRE/Division of Permits
#2 Hudson Hollow Complex
U.S. 127 South
Frankfort, Kentucky 40601

Re: ***Proposal for Phase III Data Recovery at Site 15Mu296 Located in Oxford Mining Company-Kentucky, LLC, Giebel Mine Permit No. 889-0130, Muhlenberg County, Kentucky*** **by Steve Titus of American Resources Group, Ltd.**

Oxford Mining Company-Kentucky, LLC
Application # 889-0130, NW
Muhlenberg County

Ms. Ransdell,

Thank you for submitting the above-listed Phase III data recovery plan for review. Site 15Mu296 in Muhlenberg County has been documented to contain well-preserved deposits spanning the Middle and Late Archaic and has been determined eligible for listing on the National Register of Historic Places under Criterion D. It is our understanding that this site cannot be avoided by the proposed undertaking; as such data recovery efforts are warranted. We largely concur with methods proposed for data recovery at Site 15Mu296; however, we have the following recommendations:

- Systematically collect representative soil samples vertically and horizontally from across the site to compare against soil samples collected from features.
- Compare chert from Site 15Mu296 to collections at regional facilities that may include more locally available materials.
- Potentially incorporate a field survey to locate the reported local source of chert (Shaffer 2000:15) identified on page 39 of the Phase II report.
- Further investigate for deeply buried deposits, especially in low-lying areas of alluvial deposition and at the toe-slope near Deep Trench #3 where cultural material was recovered at 90cmbs.
- Consult with a professional geoarchaeologist or geomorphologist to assess the potential for more deeply-buried cultural deposits and to interpret site stratigraphy and depositional environment.
- *Report Preparation*: The author states that a management summary will be submitted to Patriot Coal, LP, and DMP "in support of mine clearance". We have not given authorization for "clearance" based only on a

management summary. Unless determined otherwise through consultation with DMP, our expectation will be that our concurrence with the mitigation measures will not be offered until our receipt, review, and acceptance of the final report, and any other agreed-upon mitigation measures.

If you have any questions, please contact Kary Stackelbeck of my staff at 502.564.7005, ext 147.

Sincerely,

Lindy Casebier, Acting Executive Director
Kentucky Heritage Council and
State Historic Preservation Officer

LC:prj/kls

Final Report

Phase II Testing at Site 15Mu296 in Oxford Mining Company-Kentucky, LLC, Mine Permit No. 889-0130, Muhlenberg County, Kentucky

KyOSA Project Registration No. FY11-6724

Lead Agency
Division of Mine Permits, Kentucky Department of Natural Resources
Oxford Mining Company-Kentucky, LLC, Mine Permit No. 889-0130

Prepared for
Oxford Mining Company-Kentucky, LLC
Central City, Kentucky

Prepared by
American Resources Group, Ltd.
Carbondale, Illinois

Principal Investigator
Steve Titus

Authors
John Schwegman
Chip Perkins
Kathryn Parker

Cultural Resources Management
Report No. 1733

September 2011

Final Report

Phase II Testing at Site 15Mu296 in Oxford Mining Company-Kentucky, LLC, Mine Permit No. 889-0130, Muhlenberg County, Kentucky

KyOSA Project Registration No. FY11-6724

Lead Agency
Division of Mine Permits, Kentucky Department of Natural Resources
Oxford Mining Company-Kentucky, LLC, Mine Permit No. 889-0130

Prepared for
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Central City, Kentucky
Phone: (270) 754-2815

Prepared by
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Carbondale, Illinois
Phone: (618) 529-2741

Principal Investigator
Steve Titus

Steve Titus, Principal Investigator
(618) 529-2741
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Authors
John Schwegman
Chip Perkins
Kathryn Parker

Cultural Resources Management
Report No. 1733

September 2011

Abstract

This report describes the results of the Phase II archaeological investigation conducted at site 15Mu296 for Oxford Mining Company-Kentucky, LLC. The site is situated within a proposed coal mining permit area, permit application # 889-0130, approximately 4.5 km (2.8 miles) west of Greenville in central Muhlenberg County, Kentucky. The primary objectives of this Phase II investigation were to determine the extent of previous disturbances to site 15Mu296 and evaluate the significance of the site using the National Register of Historic Places (NRHP) criteria. These objectives were obtained through a literature review, archaeological fieldwork, and artifact analysis. The Phase II investigations at site 15Mu296 resulted in the recovery of a large amount of data pertaining to the Middle and Late Archaic periods in the Western Coal Fields of Kentucky.

Site 15Mu296 is a Middle to Late Archaic field camp with an ephemeral Early Archaic component. Six 1-x-2-m test units and two 5-m long by 1-m deep-testing trenches were excavated along with shallow mechanical stripping as part of the Phase II testing. These excavations represent 2.4 percent of the total site area. Six features were identified, but only three were completely excavated. Of the excavated features, one was determined to be a hearth while another was identified as a deep earth oven. Botanicals from these features consisted primarily of thick-shelled hickory (*Carya* sp.) suggesting that the harvest and processing of this resource was the principal economic activity at site 15Mu296. Three of these features were not excavated during the Phase II investigations because it was determined that sufficient evidence had been recovered and evaluated to recommend a Phase III investigation of the site, and it was preferable to excavate these features at that later stage. Temporally diagnostic prehistoric artifacts from the Phase II investigation included Kirk Corner Notched, Matanzas Side Notched, Etley, Pickwick, Saratoga Parallel Stemmed, Kramer Stemmed, and McWhinney Heavy Stemmed. A radiocarbon date taken from one of the three excavated features returned a conventional date of 4950+/-60 BP (calibrated, 2-Sigma range of 3940 to 3850 B.C. and 3820 to 3640 B.C.). Phase II excavations also confirmed that the site has not been plowed and that the surficial A horizon contained intact culture-bearing deposits. For these reasons, site 15Mu296 has great potential to address research topics developed as part of the Kentucky State Preservation Plan; therefore, site 15Mu296 is evaluated as eligible for NRHP listing under Criterion D. It is recommended that the site be avoided by mining activities. If the site cannot be avoided, Phase III archaeological data recovery is recommended.

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Chapter 1 - Introduction

This report describes the results of Phase II test excavations at site 15Mu296 within Oxford Mining Company-Kentucky, LLC, Mine Permit Area (DNR Mine Permit No. 889-0130) in Muhlenberg County, Kentucky (Figures 1-1 and 1-2). The testing was conducted by American Resources Group, Ltd. (ARG), of Carbondale, Illinois, under the terms of a contract with Oxford Mining Company-Kentucky, LLC, Central City, Kentucky.

Project Description

Mine Permit Area No. 889-0130 is a 504.7-acre (204.2 ha) parcel of land located approximately 4.5 km (2.8 miles) west of Greenville in central Muhlenberg County, Kentucky (Figure 1-1). The Phase I archaeological survey that identified site 15Mu296 covered approximately 403 acres (163 ha) of the mine permit area (Lence et al. 2011). During the Phase II investigation, site 15Mu296 was identified on the southern-central portion of the survey area. Site 15Mu296 was originally identified through systematic shovel testing on a 5-m grid as a moderately large, dense prehistoric lithic scatter with no diagnostic artifacts. During the shovel testing, no plow zone was distinguished, and one shovel test recovered soils that appeared to represent a feature. For these reasons, the site was evaluated as having potential for intact cultural deposits, including pit features. This, combined with the facts that the site was characterized by high artifact density and diversity and a large amount of cracked rock was identified, led to the evaluation that the site appeared to meet the significance criteria of the NRHP. Consequently site 15Mu296 was evaluated as potentially eligible for NRHP listing (Lence et al. 2011). The proposed impact to site 15Mu296 consists of surface coal mining. For the purposes of this report, site 15Mu296 will also be referred to as the Project Area.

The primary objectives of the Phase II investigation were to determine the extent of previous disturbance to the site and to evaluate its significance using NRHP criteria (36CFR60.6, *Federal Register* 1976). These objectives were achieved through a literature review, archival research, artifact analysis, and archaeological fieldwork.

The cultural resources investigation reported herein is authorized by the Department of Natural Resources, Division of Mine Permits Permanent Program Regulations 405 KAR Sections 8:010, 8:020, 8:030, 8:040, 24:040 (revised June 28, 1989). All work conformed to professional standards and guidelines in accordance with the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation (*Federal Register* 1983) and the Kentucky State Historic Preservation Office (KSHPO) "Specifications for Conducting Fieldwork and Preparing Cultural Resource Assessment Reports," issued in 1991 and revised in 2001 (Sanders 2001).

The Phase II test excavations at site 15Mu296 included test unit excavation, mechanical stripping, deep-testing trenching, feature excavation, and site mapping. Six features were identified, but only three were excavated; the three features that were not excavated will be excavated during Phase III testing.

This work has resulted in the accumulation of a large amount of data regarding the Middle to Late

Figure 1-1. Topographic map of site 15Mu296 within the Oxford Mining Company-Kentucky, LLC, Permit No. 889-0130.

Archaic periods in the Western Coal Fields of Kentucky. Consequently, site 15Mu296 is evaluated as eligible for listing to the NRHP.

Personnel

The archaeological fieldwork for this Phase II project was conducted from July 25–30, 2011. Steve Titus served as the principal investigator and John Schwegman served as the supervising archaeologist. The four-person field crew consisted of Bob Sadler, Mike Brawley, James Burrow, and Loy Addington. James Burrow conducted the prehistoric artifact analysis, and Kevin Lomas prepared the report graphics. The report was written by John Schwegman and Chip Perkins. Kathryn Parker of Great Lakes Ecosystems, Indian River, Michigan, conducted the botanical analysis presented in Chapter 6. The report was edited and formatted by Chip Perkins.

Report Format

An overview of the regional and local environment is presented in Chapter 2. Chapter 3 provides a cultural overview of the region and includes a brief discussion of previous investigations conducted in the project area vicinity. The research design of the project, including the field and laboratory methods employed during the investigation, is presented in Chapter 4. Chapter 5 provides a summary of the artifact collections made at the tested site. Chapter 6 presents the botanical analysis, and Chapter 7 presents a detailed description of the results of testing at each site. Chapter 8 contains a summary and evaluation of site 15Mu296 according to NRHP criteria along with management recommendations. The artifact tables are presented in Appendix A, and the radiocarbon dating analysis materials are presented in Appendix B.

Curation

After acceptance of the final report, all maps, field notes, artifacts, photographs, and other documents will be placed in storage containers and submitted for permanent curation to the Department of Geoscience, Murray State University, Murray, Kentucky.

Chapter 2 - Environmental Overview

Site 15Mu296 is situated in the Western Kentucky Coal Field physiographic division (Figure 2-1) (Ulack 1998). Within Kentucky, this area is bounded by the Ohio River to the north and the Mississippian Plateaus to the west, south, and east. Topographically, the county varies from areas of rugged relief in the southern portion of the county to more level areas in the central and northern portions of the county, with elevations ranging from 108 to 232 m (355 to 760 feet) above mean sea level (amsl).

Drainages

Site 15Mu296 is drained by Spurlins Creek which is located approximately 75 m (246 feet) to the north of the site. Spurlins Creek drains west about 6 km (3.8 miles) into Pond River. Pond River flows in a northwesterly direction to its point of confluence with the Green River, approximately 23 miles (37 km) northwest of the site. The Green River eventually empties into the Ohio River (Figure 2-2).

Soils

Belknap silt loam soils occupy the area where site 15Mu296 is located. These soils are poorly drained, subject to occasional flooding, have very level slopes (0–2 percent) and are composed of coarse-silty alluvium (Soil Survey Staff 2011).

Geology

Geologically, site 15Mu296 is situated in the Western Kentucky Coal Field physiographic province, a region of Pennsylvanian shales, sandstones, and coal beds (Newell 2001). This province consists of hilly uplands which are dissected by streams. Stream valleys are wide, poorly drained, and often swampy. The hills and valleys of the Western Kentucky Coal Field region lie in a structural basin surrounded on the west, south, and east by the Mississippian Plateau. The boundary between the two regions is formed by a high rim of sandstone ridges. The alluvial Ohio River valley bounds the northern portion of the region (Newell 2001).

Vegetation

The area surrounding site 15Mu296 is within the Eastern Broadleaf (Continental) province (Bailey 1995). Generally the vegetation within this region can be classified as oak-hickory forest, blackbelt, and a mosaic of bluestem prairie and oak-hickory forest (Figure 2-3). The most common vegetation is associated with temperate lowland and submontane broad-leaved cold-deciduous forest and cold-deciduous alluvial forest (Bailey 1995). Oak-hickory forests characterize most of the wooded regions in this section. Species within drier forests include oaks such as post, southern red, scarlet, chestnut, and blackjack. Moist forests were predominately white, southern red, and black oak. Other species found in these forests include shortleaf pine and hickories such as pignut, mockernut, shagbark, and bitternut (Bailey 1995). Bottom land forests are associated with alluviated locations along major

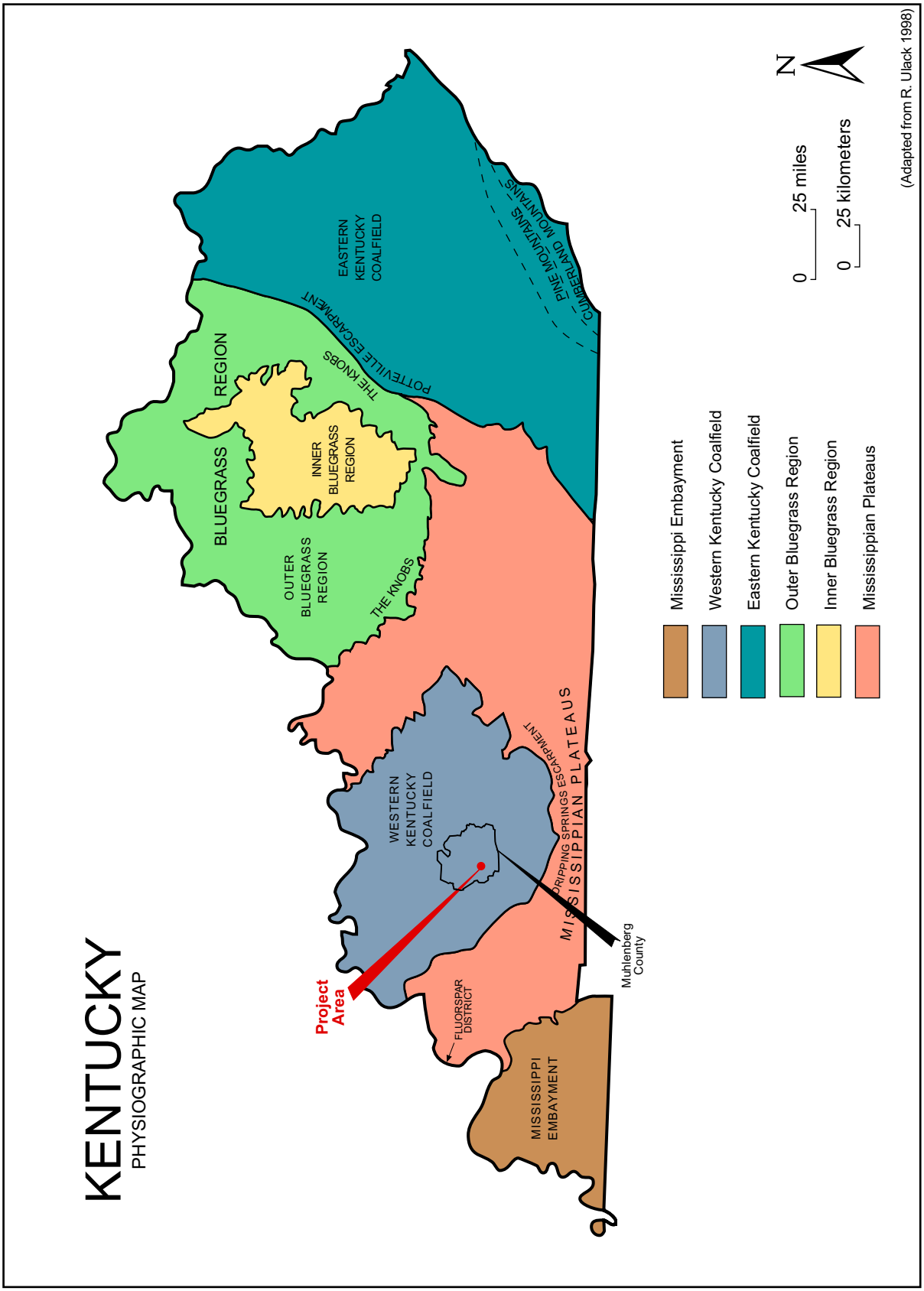

Figure 2-1. Location of the project area in relation to the physiographic regions of Kentucky.

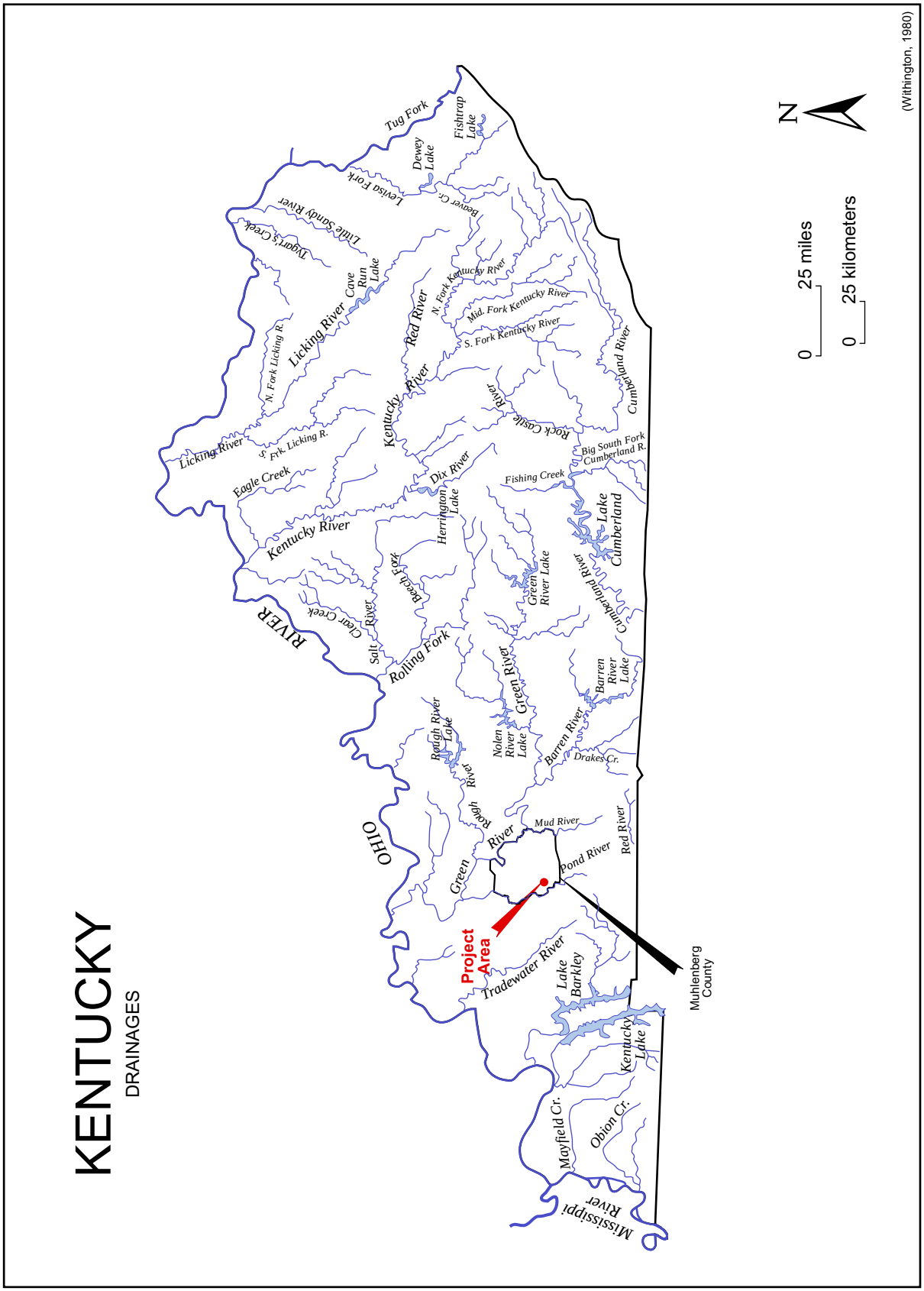

Figure 2-2. Location of the project area in relation to the major drainages of Kentucky.

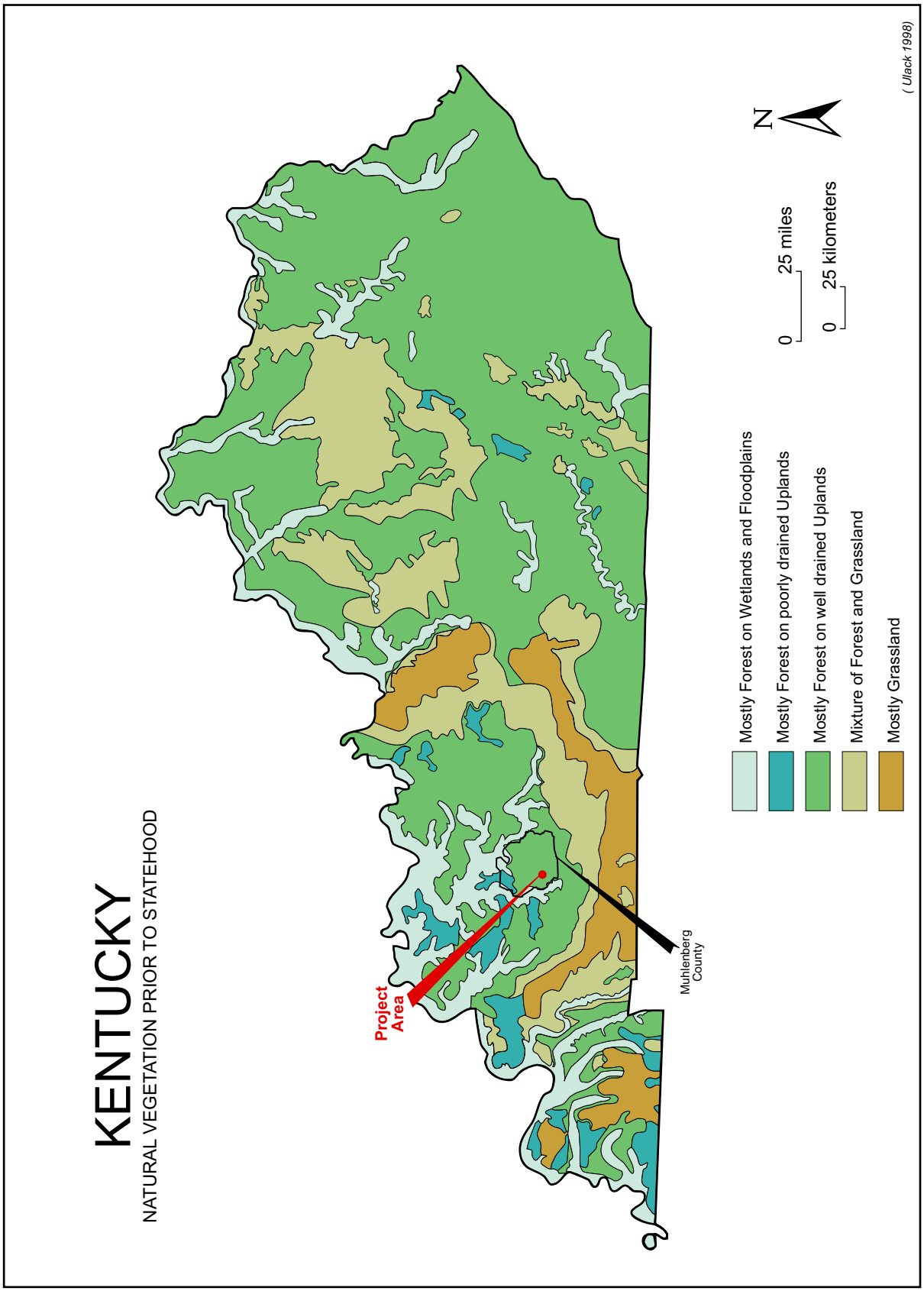

Figure 2-3. Location of the project area in relation to the natural vegetation of Kentucky prior to statehood.

rivers such as the Tennessee River. Within these forests young stands are dominated by eastern cottonwood and black willow, with more mature stands being characterized by a mixture of species, such as hackberry, sugarberry, American elm, boxelder, overcup oak, water hickory, and green ash (Bailey 1995).

Fauna

Economically important mammals for the early inhabitants in this region included white-tailed deer, black bear, bobcat, gray fox, raccoon, gray squirrel, and fox squirrel. Other mammals present include eastern chipmunk, white-footed mouse, pine vole, short-tailed shrew, and cotton mouse. Potentially important game birds would have included turkey, ruffed grouse, bobwhite, and mourning dove (Bailey 1995).

Stream environments would have yielded a number of different species of fish and mussels including various suckers, gar, creek chub, black bass, sunfish, bluegill, and catfish. Useful semiaquatic species would have included beaver, mink, muskrat, otter, snapping turtle, painted turtle, and red-eared turtle (Bailey 1995).

Climate

Within the area where site 15Mu296 is located, the average annual precipitation is 30 to 55 inches (76 to 138 cm). The average annual temperature ranges from 46o to 68o F (7o to 20o C), and the growing season lasts 168 to 212 days (Soil Survey Staff 2011).

Chapter 3 - Cultural Overview

Contemporary approaches to cultural resource management emphasize the importance of placing archaeological and historic properties in contexts which describe selected aspects, patterns, or processes of historic development in a particular area. A historic context is a theoretical construct that is defined as "... an organizational format that groups information about related historic properties based on a theme, geographic limits, and chronological period" (*Federal Register* 1983:44718). The chronological periods outlined in the cultural overviews that follow are intended to provide historic contexts for the cultural resources of the region.

Prehistoric Overview

Archaeologists have divided the prehistoric past in eastern North America into four broad chronological periods: Paleoindian, Archaic, Woodland, and Mississippian. These temporal divisions are marked by stylistic differences in artifacts and correspond to major technological innovations or important shifts in adaptational patterns. Developed through decades of archaeological research, this prehistoric cultural sequence forms a framework that is useful for organizing and interpreting new archaeological data.

The long prehistoric period in eastern North America reflects a general trend toward increasing cultural complexity, beginning with small, egalitarian bands that later developed into more sedentary and complex societies. The subsistence activities of the earliest New World societies focused on hunting and gathering wild plant and animal foods. However, by late prehistoric times, agricultural economies based on three major New World crops—corn, beans, and squash—were characteristic of many societies in the eastern United States. Increases in the size and density of the human population and a trend toward increasing sedentism were also evident and reached their highest levels during late prehistoric times (Ford 1974, 1977). There was considerable regional variation in the timing and extent to which these trends were expressed, therefore, contemporary archaeological complexes located in adjacent regions may reflect different stages of development.

A major cultural sequence developed for Kentucky by Lewis (1996:17–19) and Pollack (2008) includes the following cultural periods: Paleoindian (circa 10,000 to 8000 B.C.), Early Archaic (8000 to 6000 B.C.), Middle Archaic (6000 to 3000 B.C.), Late Archaic (3000 to 1000 B.C.), Early Woodland (1000 to 200 B.C.), Middle Woodland (200 B.C. to A.D. 400/500), Late Woodland (A.D. 400 to 900/1000), Mississippian (A.D. 900 to 1700), and Historic (post A.D. 1700). The following sections provide a general description of each period and examples of associated occupations in western Kentucky.

Paleoindian Period (circa 10,000 to 8000 B.C.)

The Paleoindians were descended from the people of northeast Asia who migrated into the presumably previously uninhabited continents of North and South America during the late Pleistocene. They were highly mobile, nomadic hunters who understood the cold subarctic and boreal environment and the movements of herds of large mammals including mammoth, mastodon,

giant bison, camel, and horse. It is presumed they also gathered plants and hunted smaller animals for food. Evidence for small game use comes from the ancient salt licks at Kimmswick, Missouri, where a variety of animal bones were preserved including giant mastodons and small squirrels (Adams 1953; Graham 1980; Graham et al. 1983; Koch 1839).

Due to the large amount of time that has elapsed since the Paleoindian period, most of their presumed material culture (made of perishable materials like wood or hide) has not survived for archaeologists to recover. The exceptions are stone tools and the lithic debris left from their manufacture. The most diagnostic Paleoindian stone tools found in Kentucky are points, which have names derived from their original place of discovery and/or shape. These points are often referred to as projectile points, although they were also used as cutting tools. The diagnostic Kentucky Paleoindian points include lanceolate forms with fluted channels on both sides of the base that facilitated their hafting to wooden/bone foreshafts. The edges of the base were usually ground smooth so that the haft binding would not be cut. Kentucky Fluted points include Clovis and Cumberland types. Fluted points were used as spear points or dart projectiles as well as for cutting and sawing. Lanceolate points are of similar forms but without fluted bases. These points occurred later in the cultural sequence and included Beaver Lake, Quad, Agate Basin, and Dalton types. Other lithic tools found with Paleoindian components include gravers, drills or perforators, and scrapers with side or end edge bevels.

The limited artifact types are in part due to the presumed rarity of these early sites combined with the difficulty of finding occupations of such age. Most Paleoindian sites in Kentucky are small and consist of shallow or culturally mixed deposits. Many have likely been obscured for thousands of years by alluvial and colluvial deposition or destroyed by natural erosion or human land alteration. Paleoindian points are undoubtedly under reported in the archaeological literature and remain to be recognized in private and institutional collections that have not been examined by professional archaeologists. Systematic searches of targeted landforms (including testing of buried landscapes) could determine whether Paleoindian artifacts other than hunting debris are still extant in western Kentucky. Most known sites are in areas of low relief and concentrated along major watercourses and interfluvial divides.

The end of the Pleistocene and the beginning of the Holocene geological epoch (9000 B.C.) is marked by the extinction of many Pleistocene animals including not only all of the megafauna, such as the mammoth and mastodon, but also the horse and other species. These animals were not able to adapt to the warming of the regional climate and the corresponding change in the plants they depended upon. While human predation may have contributed to these extinctions, given the relatively low numbers of people and widespread disappearance of many Pleistocene animals, current opinion is that environmental change was the primary reason for the extinctions.

While there are no reliably dated Paleoindian components in Kentucky, six occupations with early diagnostic material have been documented in western Kentucky. These sites include Henderson, Roach, Morris, Parrish, Adams, and Savage Cave (Tankersley 1996). With the exception of Savage Cave, these sites are all open air camp sites.

The Savage Cave site is located at the entrance to a limestone cave located in Logan County. This site produced Paleoindian projectile points (Gainey and Clovis types) and remains of extinct megafauna, but no unquestionable link between the two (Tankersley 1996).

The Adams site is situated along the northern Fork of the Little River in Christian County, Kentucky. This occupation contained fluted point preforms, unifacial tools, large blade cores, and a very large amount of debitage concentrated around a sinkhole pond. The type and amount of lithic debitage suggest that this site functioned as both a habitation and a lithic workshop (Tankersley 1996).

A multicomponent site, the Parrish site is located on a terrace in Hopkins County, Kentucky (Tankersley 1996). Although the primary occupation dates to the Late Archaic period, fluted points and 280

unifacial tools including endscrapers, gravers, and multipurpose blade tools were found. The Paleoindian occupation was disturbed by the later prehistoric component, and no stratified Paleoindian deposits were identified

The Henderson site is located along the Cumberland River in Lyon County, Kentucky. A Middle Paleoindian site, it contained portions of three Cumberland points along with 33 end scrapers, and 63 informal flake tools. Based on the artifact assemblage, it is likely that activities at the site included meat and hide processing (Tankersley 1996).

Located approximately 25 km (16 miles) southwest of the Henderson site in Trigg County, the Roach site is a multicomponent site with a late Paleoindian occupation. This occupation produced 13 Dalton-like points along with an assemblage of 115 scrapers and 52 informal gravers and knives (Tankersley 1996).

The Morris site is located on a terrace above Sugar Creek in Hopkins County, Kentucky. This site was situated along a major bison path and contained a late Paleoindian occupation with 27 points, 253 scrapers, and 54 flake tools (Tankersley 1996). The projectile points include two Cumberland types with the remainder identified as Dalton types.

Early Archaic Period (7000 to 5000 B.C.)

The Early Archaic period was a time of significant change in the subsistence strategies in the Midwest as climatic changes continued to develop new ecological niches that produced new and varied food sources. Plant gathering and harvesting aquatic resources augmented traditional hunting and foraging strategies as floodplain lakes, sloughs, and marshes developed. Projectile point styles changed from unnotched lanceolate forms to corner- and side-notched forms. These forms include Thebes, Kirk Corner Notched, Kirk Stemmed, Kirk Serrated, Hardin, St. Charles, McCorkle, and Lake Erie/ Kanawha points (Justice 1987; Sieber et al. 1989). Characteristic of some projectile forms is beveling of opposite blade edges, a product of resharpening. This may suggest that these tools were serving several different functions. Scrapers, burins, and chipped-stone blades suggest an expansion of the tool kit and perhaps changes in tool function from earlier periods.

Early Archaic projectile points are numerous in the Midwest occurring on all locations of the landscape. Isolated points are found in large numbers in the uplands along secondary drainages, springs, and sinkholes (Sieber et al. 1989). The extensive use of rockshelters and caves also occurs about this time (Goodyear 1982; Kelly and Todd 1988). Excavations at buried, stratified Early Archaic sites in North Carolina (Coe and Flannery 1964), the Little Tennessee River valley of eastern Tennessee (Chapman 1975; Chapman 1976, 1977, 1978), the lower Ohio River valley of Kentucky (Collins 1979), and the Swan's Landing site in Indiana (Smith 1986) suggest a subsistence strategy organized around short-term, seasonally occupied camps.

In the lower Tennessee and Cumberland river valleys, well documented Early Archaic components have been described at the Morrisroe site, the Whalon site, and the Lawrence site (Jefferies 1996; Mocas 1985; Nance 1988).

The stratified mulitcomponent Morrisroe site (15Lv156) is situated on the north bank of the Tennessee River in Livingston County, Kentucky. Archaic and Woodland components were present at the site. A light Early Archaic midden deposit contained Kirk type points and appeared to be associated with a short-term occupation. The Middle Archaic component represented a base camp possibly occupied on a permanent basis, but by the Late Archaic, use of the site was again temporary and sporadic (Nance 1986, 1988). A recent visit to the site area (Carstens and Carstens 2003) concluded that all the deposits have been completely destroyed by erosion from the Tennessee River.

The Whalon site (15Ly48) is situated on the east bank of the Cumberland River in Lyon County, Kentucky (Nance 1988). Similar to the Morrisroe site, this NRHP listed site exhibited multiple components with a possible Kirk occupation,

dating to about 6200 B.C., located about 3 m (10 feet) bs. An intensive Middle Archaic occupation and a much smaller Late Archaic occupation were identified above this zone (Nance 1988).

The Lawrence site is situated in the uplands of Trigg County east of the Cumberland River. This site contained a major Early Archaic occupation represented by numerous pit features and a large midden formed by sequential short-term occupations. Radiocarbon samples placed this component at approximately 5400 B.C. The site also provided one of the best examples of Early Archaic funerary treatment in Kentucky (Mocas 1985). Two adult male skeletons were found buried in flexed positions and interred with grave goods including domestic dog and beaver tooth necklaces. One of the burials contained a cache of stone tools, and their size, form, and position suggested they were meant for use in the afterlife.

Middle Archaic Period (5000 to 3000 B.C.)

The Middle Archaic period coincides generally with the Hypsithermal, a period of higher average temperatures and reduced precipitation that occurred during the Middle Holocene (Wendland 1978). During this period, the expansion of grasslands opened new ecological niches, and human settlement and subsistence strategies adapted to these drier conditions. The Middle Archaic tool kit closely resembles that of the earlier period with the inclusion of groundstone tools. Projectile points typical of this period in western Kentucky include Eva, Cypress Creek, and Big Sandy points. The presence of mortars, pestles, and manos on Middle Archaic sites may suggest an increased reliance on nuts and grains. Aquatic resources also increased in importance as indicated by bone fishing hooks, net sinkers, and extensive shell middens.

Evidence from across the Midwest suggests that during the Middle Archaic populations became concentrated along the major river valleys with the large expanses of upland prairie and forest being largely abandoned (Chapman 1975; Conrad 1981; Munson 1988; Sieber et al. 1989; Stafford et al. 1988). Munson (1988) and Stafford et al. (1988) have recognized a similar shift in settlement strategies in southwestern and southern Indiana with campsites being relocated in the principal stream valleys, with upland areas apparently being restricted to short hunting and gathering forays. This shift in settlement appears to be an adaptive response to environmental change. In the uplands, conditions became warm and dry, while in the major river valleys, slack water lakes, ponds, and sloughs provided rich and diverse ecosystems (Brown and Vierra 1983). At this time, the exploitation of fresh water mussels became important. Large numbers of discarded mussel shells in camp middens produced large shell mounds, a tradition that would continue into the Late Archaic. The Shell Mound Archaic, as these cultures are often referred, suggest cultural affiliations with traditions in the Southeast along the Tennessee and Cumberland rivers where shell mound villages appear during the Middle Archaic period (Lewis and Kneberg 1959).

Both the Morrisroe and Whalon sites (see above) contained substantial Middle Archaic occupations (Nance 1988, 1986; Jefferies 1996; Carstens and Carstens 2003). Based on investigations at these sites, Nance (1988:135) suggested that Archaic occupations of the lower Tennessee and Cumberland rivers were significantly less intensive during the Early and Late Archaic versus the heavily occupied Middle Archaic occupations. He attributes this to the pattern of increased use of the river valleys during the warm, dry, Hypsithermal climatic episode (circa 6000 to 3000 B.C.) that has been noted in many places in the Midwest (Nance 1988).

Major Middle Archaic occupations were also identified at the Eva site on the Tennessee floodplain in the lower Tennessee-Cumberland area. Two components dating to this period were present, one associated with the Eva phase and the second with the later Three Mile phase.

Late Archaic Period (3000 to 1000 B.C.)

The beginning of the Late Archaic period coincides generally with the end of the Hypsithermal. The

regional climate moderated, rainfall increased, and conditions in the Midwest and western Kentucky are thought to have become similar to present conditions.

The Late Archaic period demonstrates intensive adaptations to ecological niches not exploited earlier (Chapman 1975). In response to climate change, biotic resource distribution became more equitably distributed, allowing Late Archaic groups to expand their settlements to upland areas away from major river valleys (Lewis 1996). An analysis of lithic assemblages from Late Archaic sites in the Crooked Creek drainage of western Kentucky suggests that longer term occupation sites may have served as camps for hunting parties that exploited both upland and floodplain resources (Nance 1977). However, these sites do not appear to have been as intensively occupied as Middle Archaic sites.

Several phenomena that characterize the subsequent prehistoric culture periods can be traced to the Late Archaic. During this period, the emergence of a plant-forager economy, incipient gardening, increased sedentism, and population growth set in motion trends that would eventually lead to complex and dynamic political and social systems in the Midwest. While gardening is thought to have added to the subsistence strategy, the question over the appearance of domesticated forms of cucurbits and native starchy seed plants remains unanswered. Kay et al. (1980) reported squash at the Phillips Spring site in southwestern Missouri in a Late Archaic context. Winters (1969) also reported a fragment of squash from the Riverton site in Crawford County, Illinois. Data from the Koster site in west-central Illinois also suggests that some form of plant tending had developed by the end of the Archaic (Asch et al. 1972).

During the Late Archaic, tool kits became more diversified and the groundstone and worked bone industries became fully developed (Sieber et al. 1989). In western Kentucky, lithic assemblages are characterized by a variety of straight stemmed projectile points including Pickwick-Ledbetter, Adena, and Saratoga. Many Middle Archaic projectile point forms persisted into the Late Archaic. At this time, extensive trade networks were developed as marine shell, copper from the Great Lakes, steatite from the Appalachians, and other exotic materials arrived in the Ohio River valley (Sieber et al. 1989:35).

Cultural material from this period indicates that cultural change was taking place throughout the Late Archaic, becoming more pronounced during the later stages of the period. For unknown reasons, the use of locally available, high grade cherts declined as lower quality cherts, including glacial gravels, were exploited. The quality of the chipped-stone industry also declined (Seeman 1975).

Across the Midwest and Southeast, people moved out of the main river valleys on a seasonal basis and began to exploit upland resources. Suggestions are that small, intensively occupied, seasonal camps were established along small upland streams and springs (Munson 1988). So intense was the exploitation of aquatic resources during the Late Archaic, that Dragoo (1976) has referred to it as the Riverine Archaic tradition. Large quantities of mussel shells, discarded over time in camp middens, produced large shell mounds on which the villages and camps were located. Late Archaic shell mound sites are common along the valleys of the Tennessee, Cumberland, Green, and lower Ohio and Wabash rivers.

In western Kentucky, the most well known Late Archaic components have been documented at the Morrisroe site (see previous section) and at site 15 McN20 (Jefferies 1996). Site 15McN20 is located on an Ohio River alluvial ridge in McCracken County. This site contained substantial Late Archaic deposits (about 90 cm deep) that contained large amounts of fire-cracked rock, debitage, and carbonized plant remains. Diagnostics from these deposits included Saratoga-like and Trimble Side Notched type projectile points (Butler et al. 1981).

Early Woodland Period (1000 to 200 B.C.)

The Woodland period is characterized by a trend toward increased sedentism, intensified horticultural activity, expanding regional exchange networks,

and the elaboration of ceremonial activities and mortuary practices (Griffin 1967). The origin of these trends can be traced to the Late Archaic, but the elaboration of cultural elements became the hallmark for the time. These developmental trends form the basis for distinguishing the Early, Middle, and Late Woodland substages. Regional variations in the timing and extent to which these traditions were expressed, however, make this tripartite subdivision difficult to employ in certain areas.

During the latter part of the Early Woodland period, a ceremonial mortuary complex developed that was centered on the central Ohio River valley. The Adena culture involved the construction of burial mounds, many of which were accretional and attained great size, such as the Grave Creek mound in Ohio which measures 21 m (69 feet) high by 90 m (295 feet) in diameter (Seeman 1986:574). Evidence of charnel houses and log burial crypts has also been found. Seeman (1986:576) suggested that ceremonialism associated with death and burial reached high levels with complexly constructed ceremonial mortuary camps built for internment of the dead. In contrast, village life appears much simpler and organized around small local bands.

Early Woodland settlement patterns in Kentucky resemble those of the Late Archaic settlement system. Base camps are generally located on the floodplains of major streams and possess thick middens with numerous cultural features (Railey 1996). Hunting and gathering, augmented by some gardening, appear to represent the basic means of subsistence during the Early Woodland period. Evidence exists that gardening increased in importance; native starchy seeds such as maygress (*Phalaris caroliniana*), knotweed (*Polygonium erectum*), goosefoot (*Chenopodium bushianum*), marshelder (*Iva annua*), sunflower (*Helianthus* sp.), squash, and gourds *(Cucurbita* sp.) added to the traditional hunting/gathering economy (Cowan 1985).

In western Kentucky and elsewhere across the Midwest and Southeast, the Early Woodland period is differentiated from the preceding Late Archaic period by the introduction of pottery. Thick-walled coarse-tempered ware first appears in the upper Ohio River valley around 1000 B.C., whereas in the lower Ohio valley, pottery does not appear until around 500 B.C. (Seeman 1986:564).

Middle Woodland Period (200 B.C. to A.D. 500)

The developmental trends characteristic of the Woodland tradition are most strongly expressed in many regions of the Midwest during the Middle Woodland Hopewellian stage. The Hopewellian stage is exemplified by the Hopewell of southern Ohio and the Havana of the lower Illinois River valley (Muller 1986). Hopewell is most prominently marked by the appearance of large village and ceremonial sites containing geometric earthworks and conical burial mounds, an emerging pattern of social status differentiation, and a remarkable expansion of interregional exchange (Brose and Greber 1979; Muller 1986; Seeman 1979).

The Hopewell exchange network, or Hopewell Interaction Sphere, is still poorly understood. Struever (1964:89) described it as "the prehistoric logistics network within which quantities of raw materials circulated, together with an array of stylistic and probably ideological concepts that underwent local modification." Whatever Hopewell was, it involved an active economy oriented around distant exchange and deep socioreligious attitudes.

The Middle Woodland period of Kentucky has been divided into two sub-periods: early Middle Woodland from about 200 B.C. to A.D. 250 and late Middle Woodland from A.D. 250 to A.D. 500 (Railey 1990). Ceramics diagnostic of the early Middle Woodland are similar to the Early Woodland period and include conoidal, flat-based jars that are barrel- or flower pot-shaped. Surface treatments common at western Kentucky sites include fabric and cord wrapped dowel impressing as well as cord marking. A small number of sherds possess Havana-Hopewell-like decoration in the form of nodes or zoned incising/punctation or incising/dentate stamping (Railey 1990). Late Middle Woodland vessels are generally subconoidal or subglobular jars. Jars rarely possess flat bases, and surface treatments are usually cord marked or

plain (Railey 1990). Minority ceramic types at late Middle Woodland sites include check stamping, simple stamping, and complicated stamping as well as brushing and rocker stamping (Railey 1990).

Early to late Middle Woodland projectile points include expanding stem types such as Snyders and Affinis Snyders, Lowe Flared base, Steuben Stemmed, and Chesser Notched. Copena/Greenville triangular forms are also present during the Middle Woodland period.

Middle Woodland site types in western Kentucky are poorly known. It is unclear whether or not the large base camps present during the early Middle Woodland continue into the late Middle Woodland (Railey 1990). The few burial mounds known for western Kentucky appear to date to the Middle Woodland period. Middle Woodland subsistence patterns are poorly known but are thought to be similar to the preceding Early Woodland patterns with an emphasis on hunting and gathering supplemented by gardening.

Late Woodland Period (A.D. 400 to 900/1000)

The end of the Middle Woodland period was marked by a reduction in interregional trade, a decrease in the complexity of ceremonial/mortuary practices, and a reduction in the elaborateness that marked the period. A traditional view has been that the Late Woodland was a time of de-evolution in the cultural development across the Midwest and Southeast. However, important and dynamic cultural and organizational changes were taking place that set the stage for the development of the Mississippian in these areas. Some of these include changes in ceramic technology, the development of an agricultural economy, and the introduction of the bow and arrow.

The Late Woodland period in Kentucky has been divided into the early Late Woodland and terminal Late Woodland by Railey (1990). The early Late Woodland is dated from A.D. 500 to 800, while the terminal Late Woodland has been dated from A.D. 800 to 1000. Early Late Woodland cultural inventories are similar to those of the late Middle Woodland (Railey 1990). Ceramic vessels are usually subconoidal to subglobular cordmarked jars with unmodified lips. Occasional lip notching may occur but decoration is very rare.

In western Kentucky, there is a trend toward an increased "Mississippianization" of society between A.D. 600 to 900 (Muller 1986; Railey 1990). The Lewis phase appears to date from A.D. 600 to 900 in the Black Bottom of southern Illinois and the lower Ohio River valley (Muller 1986). Lewis phase sites are dispersed across the floodplains in a manner that foreshadows later Mississippian occupation (Muller 1978; Railey 1996). These settlements were of a permanent nature, containing rectangular structures and numerous pit features. Subsistence practices consisted of hunting and gathering as well as gardening, although maize cultivation is not evident (Muller 1986). Lewis phase ceramic vessels were generally grit-grog tempered and cordmarked with thin walls. Vessel shape consists of deep conoidal jars with more globular forms occurring later in the sequence (Muller 1986). Expanding stem projectile points such as Lowe Flared Base occur during the early Late Woodland and gradually give way to Jack's Reef Corner Notched, Jack's Reef Pentagonal points, and small triangular points later in the sequence (Railey 1996).

To the west in the Mississippi River valley, the Cane Hill phase parallels the Lewis phase in most aspects, but some Cane Hill phase sites are very large and possess thick midden deposits and evidence of a more pronounced occupation (Railey 1996). The Rice site in Fulton County, Kentucky, possesses three mounds, possibly a plaza arrangement, and a large midden that is reminiscent of later Mississippian settlements. Mississippian–like aspects of Cane Hill phase material culture include an increase in popularity of plain and red-filmed vessels and new vessels forms such as stumpware, plates, and hooded bottles (Railey 1996). Similarly, the material culture of the Douglas phase (A.D. 900 to 950) of the lower Ohio River valley, also becomes Mississippianized (Muller 1986).

Mississippian Period (A.D. 900 to 1700)

It was during the Mississippian that the prehistoric cultures in the Southeast and middle Mississippi River valley reached their peak of socio-political complexity. The period is marked by the development of complex chiefdom societies characterized by hereditary authority and social ranking. The Mississippian period is best known for its large, fortified civic/ceremonial centers constructed along major rivers valleys. The Kinkaid mound group in southern Illinois (Cole et al. 1951) and the Angel site in southern Indiana (Black 1967) are examples of major Mississippian ceremonial centers located along the lower Ohio River. Large, earthen, substructure mounds were constructed on which the houses/temples of the elite were built. Extensive exchange routes were established along which exotic, nonlocal materials were widely exchanged. An agricultural economy became firmly established with maize, beans, squash, and pumpkin being grown to augment traditional hunting and gathering. Typifying the Mississippian period is shell-tempered pottery, small triangular projectiles, a wide diversity of ceramic forms, and square to rectangular houses (many with subterranean floors).

Mississippian organization was based on a domestic economy with the household forming the basic economic unit of the Mississippian community. Settlements consisted of large, fortified towns containing substructure mounds, unfortified villages, hamlets, and individual households (Muller 1986; Smith 1978). Small special purpose structures that possibly served as farming stations may have been attached to households (Finney 1993).

Mississippian pottery is characterized by thin-walled, finely made, shell-tempered jars, bowls, bottles, plates, and pans along with more specialized forms such as seed jars, juice presses, and bean pots. Specialized ceramic forms and variation in the quality of ceramic manufacture suggest an expanded role of pottery in Mississippian life with some forms such as Ramey vessels possibly serving ideological/cosmological functions (Pauketat and Emerson 1991).

Work at the Chambers site, an upland Mississippian site in Marshall County, Kentucky, located a short distance south of 15Ml129, was conducted in 1984 (Pollock and Railey 1987). Excavations revealed the presence of wall trench structures, pits, post molds and midden deposits as well as a large ceramic assemblage. The authors interpret the Chambers site to represent an upland farming village community that was occupied from A.D. 1250 to A.D. 1350. The ceramic assemblage was most like those from other Mississippian sites in the lower Tennessee-Cumberland river area and contained a large number of handles and lugs. The Chambers site ceramic assemblage was determined to be similar to both the Angelly and Tinsley Hill ceramic assemblages (Pollack and Railey 1987).

Previous Archaeological Investigations

The following section provides a brief summary of selected Phase II investigations of prehistoric sites in the vicinity of site 15Mu296.

Site 15Mu36 was reported to be present about 3.4 km west of site 15Mu296 (Versluis 2009). The site was tested by Long (1960) and it consisted of a shallow midden on a hilltop that contained “flint and some groundstone”. It is unknown if the site was evaluated as eligible for NRHP listing.

Site 15Mu190, a Mississippian site, was tested by Versluis and Merritt (2002). Test unit excavation and mechanical stripping were conducted. Prehistoric ceramics and two features associated with the Mississippian period were found during the investigations; plant remains and bone were also recovered. Site 15Mu190 was evaluated as ineligible for listing to the NRHP due to erosion and fact that stripping revealed that the two features were the only evidence of prehistoric occupation that was intact at the site (Versluis and Merritt 2002:39).

Site 15Mu196, located 2.2 km (1.4 miles) west of site 15Mu296), was tested by Shaffer (2000). Surface survey, shovel testing, and test unit excavation was conducted along with the excavation of five prehistoric features. Testing produced Early Archaic, Late Archaic, and Mississippian components along with botanical remains. A midden associated with the Late Archaic was also identified. Site 15M196 was evaluated as eligible for listing to the NRHP based on intact features in stratigraphically definable context, the presence of datable materials, and the fact that further excavations would likely yield information important to the prehistory of the area. Avoidance of site 15Mu196 was recommended. It was also recommended that if site avoidance was not possible, Phase III excavations should be undertaken to mitigate adverse effects (Shaffer 2000:17).

Two prehistoric sites (15Mu265 and 15Mu266) that are located approximately 2 km to the east of site 15Mu296 were tested by ARG in the summer of 2009 (Ensor et al. 2009a). Site 15Mu265 was originally discovered by Great Rivers Archaeological Services, who recovered 162 prehistoric artifacts in screened shovel tests and on the surface of a dirt trail traversing the site (Versluis 2009:90–91). Diagnostic artifacts recovered from the Phase I investigation included an Early Archaic and Middle Woodland Copena projectile points/hafted knives. No ground-stone artifacts, fire-cracked rock, or pottery was recovered. Site 15Mu265 was evaluated as potentially eligible for NRHP listing due to the presence of culture-historic diagnostics and the potential to produce intact cultural deposits below the plow zone that could yield important information regarding the prehistory of the region (Versluis 2009:97). The site was tested in the summer of 2009. The site was subjected to test unit excavation and mechanical stripping. No diagnostic artifacts were recovered, and no features were identified. The site was evaluated as ineligible for NRHP listing due to severe disturbance and erosion from logging and vehicular traffic at the site, the lack of diagnostic artifacts and stratigraphic integrity, the diminished research value of the site, and the fact that cultural deposits were incapable of providing substantive data on important research questions (Ensor et al. 2009a:83).

Site 15Mu266, located 2.4 km (1.5 miles) to the southwest of site 15Mu296, was originally discovered by Great Rivers Archaeological Services, who recovered 71 prehistoric artifacts from surface survey as well as within screened shovel tests of the site. No diagnostic artifacts, ground-stone artifacts, fire-cracked rock, or pottery were recovered (Versluis 2009:96). Site 15Mu266 was subsequently evaluated as potentially eligible for NRHP listing because of the potential to produce intact cultural deposits below the plow zone that could yield important information regarding the prehistory of the region (Versluis 2009:97). The site was tested in the summer of 2009. The site was subjected to test unit excavation, mechanical stripping, and the excavation of two features. A radiocarbon date taken from one of the features indicated the presence of an Early Woodland Adena-related component, and a diagnostic projectile point/hafted knife indicated a Late Archaic component. The site was evaluated as ineligible for NRHP listing due to substantial disturbance from logging and erosion and a lack of vertical separation of components that suggested that the isolation of subsurface cultural deposits in good context would was improbable (Ensor et al. 2009a:98).

Two other prehistoric sites (15Mu263 and 15Mu276) that are located approximately 2.8 km to the southeast of site 15Mu296 were tested by ARG in the summer of 2009 (Mayo et al. 2009). Site 15Mu263 was originally discovered during a Phase I investigation by Great Rivers Archaeological Services, who found 71 prehistoric artifacts equitably distributed in screened shovel tests as well as on the ground surface (Versluis 2009:90–91). Diagnostic artifacts recovered included a Late Paleoindian Plainview projectile point/knife. No ground stone artifacts, fire-cracked rock, or pottery were recovered. Site 15Mu263 was subsequently evaluated as potentially eligible for NRHP listing because of the presence of culture-historic diagnostic artifacts and the potential to produce intact cultural deposits below the plow zone that could yield important information regarding the prehistory of the region (Versluis 2009:97). The site was tested in the summer of 2009. The site was subjected to surface survey, test unit excavation, and mechanical stripping. Two diagnostic hafted scrapers were

found during the Phase II investigations that are indicative of Early Archaic and Late Woodland components; however, these components could not be isolated. No features were identified. The site was evaluated as ineligible for NRHP listing due to lack of diagnostic components that could not be isolated, severe disturbance/erosion from logging operations and vehicular traffic at the site, and the fact that the cultural deposits were incapable of providing substantive data on important research questions (Mayo et al. 2009:54).

Site 15Mu276, located 2.6 km (1.6 miles) to the southwest of site 15Mu296, was originally discovered by Great Rivers Archaeological Services, who found 61 prehistoric artifacts from within 35 screened shovel tests. The one diagnostic artifact recovered was identified as a Late Archaic projectile point/hafted knife. No ground stone artifacts, fire-cracked rock, or pottery were recovered (Versluis 2009). The site was tested in the summer of 2009. The site was subjected to test unit excavation and mechanical stripping. Two diagnostic projectile points/hafted knives were recovered during the Phase II investigations that are indicative of Late Woodland and a probable Mississippian components. The site was evaluated as ineligible for NRHP listing due to lack of diagnostic components and stratigraphic integrity, severe disturbance/erosion from logging operations at the site, and the fact that the cultural deposits were incapable of providing substantive data on important research questions (Mayo et al. 2009:67).

Finally, one site with a prehistoric component (15Mu271) located about 3 km to the east of site 15Mu296 was also tested by ARG in the summer of 2009 (Ensor et al. 2009b). Site 15Mu271 was originally discovered by Great Rivers Archaeological Services, who recovered both prehistoric and historic artifacts at the site. Prehistoric artifacts (N=392) recovered during the Phase I investigation included fragments of Mississippian projectile points/hafted knives, shell-tempered Mississippian pottery, fire-cracked rock, animal bone, shell fragments, and fired clay/daub. The prehistoric component at site 15Mu271 was evaluated as potentially eligible for NRHP listing due to the presence of culture-historic diagnostics and the potential to produce intact cultural deposits below the plow zone that could yield important information regarding the prehistory of the region (Versluis 2009). The prehistoric component of the site was tested in the summer of 2009. The site was subjected to test unit excavation as well as the excavation of six features and nine post holes. The Phase II investigations recovered many diagnostic projectile points/hafted knives and ceramics that were diagnostic to the Early Archaic, Late Archaic, Early, Middle and Late Woodland, and Mississippian periods. Moreover, radiocarbon dates taken from features indicates a Late Mississippian occupation was present at the site 15Mu271 from A.D. 1270 to A.D. 1420. The site was evaluated as eligible for listing to the NRHP due to the dense artifact assemblage, the ubiquity of intact, well-preserved Mississippian features (including wall-trenches and pits), well preserved floral and faunal remains, and datable materials. It was recommended that site 15Mu271 be preserved and protected with a buffer zone of at least 200 feet during mining activities to insure site preservation. It was also recommended that if site avoidance was not possible, Phase III excavations should be undertaken prior to any ground disturbance from surface coal mining or other mine activities to mitigate adverse effects.

Chapter 4 - Research Design and Methodology

The primary objective of the Phase II investigations was to assess the significance of the prehistoric component at site 15Mu296, against the NRHP criteria of significance (36CFR60.6, Federal Register 1976). These criteria are:

> The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects of state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and:
>
> a. that are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> b. that are associated with the lives of persons significant in our past; or
>
> c. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic value, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> d. that have yielded, or may be likely to yield, information important in prehistory or history.
>
> Criteria considerations: ordinarily, cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, commemorative in nature, and properties that have achieved their significance within the past 50 years shall not be considered eligible for the National Register of Historic Places (*Federal Register* 1976:1595).

Criterion d is typically the most applicable evaluation criterion for archaeological properties. In general, only those sites containing intact subsurface deposits, either features or middens, are likely to yield "information important in prehistory or history," i.e., are likely to yield data that can be used to address questions of current research interest. The likelihood of a site containing intact subsurface deposits depends, in turn, on how intensively the site was occupied, its role within the subsistence/settlement system in which it functioned, and the degree to which it has been disturbed. Site condition and integrity are key factors in evaluating site significance.

Prehistoric Archaeological Research Orientation

The general theoretical approach employed by researchers at ARG may be classified within the cultural-ecological tradition in American archaeology. This tradition, which may be traced to studies of anthropological theorists such as Sahlins and Service (1960), Service (1962), and Steward (1955), has been developed as an archaeological approach in the writings of Binford (1972), Flannery (1968), Ford (1977), and Watson et al. (1971). Cultural ecologists view culture in systemic terms and regard it as the primary mechanism by which human beings adapt to their environment. Cultural systems are viewed as being open-ended, dynamic systems that change in response to internal and external conditions.

Archaeological research carried out in a cultural ecological framework involves reconstructing past cultural systems in their environmental settings, charting the trajectory of change over time, and identifying sociocultural and environmental processes that can explain the change observed during the study of particular cultural systems. Cultural changes can be inferred from the archaeological record with varying degrees of success through comparative analyses of artifactual remains as manifested by technology, settlement/subsistence systems, human biology, social organization, and ideology. However, the detail to which prehistoric cultural patterns can be reconstructed is often limited by the methods employed during Phase II test excavations.

Prehistoric Site Types

A site may be defined as a "spatial cluster of cultural features, items, or both" (Binford 1972:46). This definition applies to both prehistoric and historic archaeological sites. Archaeological context may be defined by including any of the following: soil staining, associated fire-cracked rock, ceramics, features, or a concentration of materials within a reasonably definable spatial boundary. For the present investigation, an archaeological site is any location where human activity "has resulted in the deposition of artifacts, or other evidence of purposive behavior at least 50 years of age" (Sanders 2001: 2).

Localities designated as sites may be differentiated into site types. Binford's prehistoric site type model (Binford 1980:8–10) was used for analysis and interpretation of the prehistoric components represented at the site tested during the present Phase II investigation. The prehistoric component at site 15Mu296 represents a field camp.

In Binford's model, artifact density, artifact type diversity and site size are differentiation factors for defining site types ranging from isolated artifacts to small short term sites reflecting limited or specific activity areas (e.g. lithic workshop, kill/butchering), to increasingly larger habitation sites such as field camps, base camps and villages.

Habitation sites contain archaeological deposits related to seasonal or permanent occupation and often have subsurface features. The presence and extent of organic staining indicative of food processing may reflect the duration and intensity of occupation. Buildings, structures, and task-specific activity areas may be tentatively identified from survey data, but extensive excavation is usually necessary to confirm these identifications. Site size is moderate to extensive. The density of cultural debris and diversity of artifact classes are moderate to high at habitation sites. However, larger site size and higher artifact density can also accumulate from repeated, short-term occupancy of a particular favorable locale. Repeated occupancy may be seasonal by the same group ongoing for generations or may occur sporadically at any interval, even millennia apart. Binford recognized two kinds of habitation sites: field camps and base camps or villages.

The field camp site type represents a temporary operational center that a task group maintains for itself while away from the residential base. Field camps may be further differentiated according to the nature of the resources that were procured by hunting or gathering (Binford 1980:10). The task

groups may obtain resources for social groups much larger than themselves. These sites may vary considerably with respect to location, size, and artifact content, depending upon the size of the task group, the number of times that the site was reoccupied, and the nature of the tasks performed. Artifact assemblages are often limited to task-specific tools and a few tools related to general maintenance. Subsurface features that are related to the procurement and processing of specific resources may be present. Field camps are sometimes designated with reference to the kinds of activities that are carried out at them: hunting camps, fishing stations, nut collecting and processing stations, etc. Field camps are temporary occupations, and contain artifacts and features reflecting a more limited and specific range of activities than more permanent settlements.

In contrast, the residential base camp and village sites are more permanently occupied by the larger social group and are the hub of subsistence activities, where most processing, manufacturing, and maintenance activities occur, and are the location from which foraging parties originate (Binford 1980:9). Residential base camps are usually manifested in the archaeological record of the Midwest as large sites with a high artifact density and a wide diversity of tools and other artifacts. Cultural features and midden deposits are usually present unless severe disturbance has occurred. However, due apparently to smaller group size during Paleoindian and Early Archaic Periods, residential camps are often less substantial than later sites. Subsistence remains at base camps and villages often indicate multiple seasons of occupation. Excavations at this site type usually expose substantial remains including evidence of buildings and storage facilities. Mortuary areas and facilities are often associated with these types of habitation sites.

The Kentucky Historic Preservation Plan (Pollack 1990, 2008:28) outlines recognized site types and defines "open habitation sites without mounds" as a predominant type of prehistoric site, typically less than one hectare in size, usually associated with hunting and gathering functions, and often containing features. Base camps are larger than sites of the former type, typically over one hectare in size, and usually contain features or middens. Specialized activity areas are defined as a small site type with limited artifacts indicating specific activities (ibid:31). For example, a predominance of battered and pitted cobblestone tools could indicate a "nut collection camp", while utilized flakes or knives might indicate a butchering or skinning station. A specialized activity area may occur as a discrete site or, instead, as an area within a larger site. In terms of the site type model outlined in the Kentucky Historic Preservation Plan (Pollack 1990, 2008:28), the prehistoric components at site 15Mu296 are examples of "open habitation sites without mounds".

Site 15Mu296 Research Questions

Data obtained from testing excavations at site 15Mu296 during the investigation were used to address the following general research topics:

a. Determine whether subsurface deposits are present and define the horizontal and vertical extent of those deposits.

b. Assessment of site integrity and the extent and severity of prior impacts to the archaeological deposits.

c. Definition of site function and assignment to a site type.

Specific questions addressed where the data allow will include:

d. What is the cultural and temporal affiliation of the component(s) present at site 15Mu296?

e. Are multiple occupational components present, and if so, what is the horizontal and/or stratigraphic placement of the components?

f. Are subsurface features present? Are floral and faunal organic remains present in association with the lithic remains?

g. Are carbonized materials present which can be recovered to allow radiocarbon dating of the component(s)?

h. How do the components associated with the deposits relate to the settlement and subsistence systems of the relevant period(s) of occupation?

Methodology

The methods employed to achieve the objectives of this Phase I survey consisted of a records search and literature review and an archaeological field investigation and laboratory analysis.

Records Search and Literature Review

Prior to beginning the Phase I survey of the Mine Permit Area where site 15Mu296 is located, a records and literature review of the project area was conducted. Christina Pappas of the Office of the State Archaeologist (OSA) conducted a pre-field records search on February 21, 2011. The site inventory records of the OSA were examined in order to identify all previously recorded archaeological sites within the project area vicinity. A summary of Phase II testing projects of prehistoric sites in the vicinity of site 15Mu296 is discussed in Chapter 3.

Phase II Field Methods

The Phase II testing field excavations were conducted by a five-person field crew from July 25–30, 2011.

A variety of standard archaeological techniques were used to achieve the objectives of the Phase II investigation at site 15Mu296, including test unit excavation, limited mechanical stripping, deep-testing trenching, and feature excavation. Each of these techniques is outlined below.

Shovel Testing

The distribution of cultural material across the reported site location was documented through screened shovel testing conducted during the Phase I survey for this project (Lence et al. 2011). Shovel tests were excavated at 5-m intervals along transects spaced 5 m apart during the initial site survey. Excavated fill was passed through ¼-inch mesh screens, and artifacts were bagged by individual shovel test in order to obtain information on artifact frequency across the site. For the Phase II investigations, information on artifact density and distribution recovered during the Phase I shovel testing was used to determine where to place test units and mechanical excavations.

Magnetometer Survey

In the scope of work approved by the Kentucky State Historic Preservation Office, a magnetometer survey was proposed before excavation was to take place. However, when the Phase II testing was to be conducted, the vegetation covering the area where the site is located was so dense not enough of it could be removed to allow a magnetometer survey.

Test Unit Excavation

Six 1-m-x-2-m test units were excavated at the site in order to determine the nature, content, and vertical extent of site deposits. The placement of these units was governed by the results of shovel testing conducted during the Phase I survey for this project (Lence et al. 2011). Because there was no plow zone present at the site, all soils within each unit were hand excavated in arbitrary, 10-cm (3.9 in.) levels to culturally sterile subsoil. All excavated soil was screened through ¼-inch mesh. All cultural material was bagged and catalogued by test unit and excavation level. Excavation forms were completed for each level, and at least one wall profile of each test unit was drawn and photographed.

Mechanical Stripping

Mechanical stripping was implemented at the site following the completion of the test units. The placement of these trenches were determined by the data are obtained from the magnetometer survey and test unit excavations. This procedure involved the mechanical removal the underlying subsoil in order to expose subsurface features. Using a

backhoe with a toothless bucket, three shallow trenches were excavated. On a typical pass, 5 to 10 cm of earth was removed by the backhoe. An archaeologist monitored the stripping operation in order to flag potential features and collect prehistoric tools exposed after each pass. The mechanical excavations were performed to achieve two objectives: 1) to determine the presence, location, and extent of subsurface features that may be present within the site deposits; and, 2) to identify internal site structure and overall activity areas. When stripping was complete, the base of each stripping trench was shovel scraped to identify possible features. Upon completing of the three stripping trenches, six features were identified and investigated.

Feature Excavation

Of the six features defined, three were fully excavated (Features 1–3) while the remaining three (Features 4–6) were mapped and photographed in planview but not bisected. For these latter features, the maximum thickness of feature fill was determines by using an Oakfield soil core. Features 4–6 were not excavated because it was determined that sufficient evidence had been recovered and evaluated to recommend a Phase III investigation of the site, and it was preferable to excavate these features at that later stage. Therefore, once Features 4–6 were documented and their centerpoint shot in with the total station, each was covered with plastic and soil.

Deep-Testing Trenching

Following the completion of the mechanical stripping trenches, two 5-x-1-m deep-testing trenches were expanded upon mechanically stripped trenches 1 and 3. These deep-testing trenches were excavated 2 m deep at the site in order to determine whether buried, culture-bearing deposits were present. Using a backhoe with a toothless bucket, the trenches were first stripped to subsoil following the procedure described above. Deep-Testing Trench 1 was an expansion of Trench 1 and was positioned on its south wall, as well as along the western wall of Trench 2 near its northern end. Deep-Testing Trench 3 was expanded upon Trench 3 and positioned on its south wall. An archaeologist monitored the excavation of these deep-testing trenches in order to identify potential features. Both deep-testing trenches were extended to a depth of 2 m, and the walls of the trenches were troweled and carefully examined for cultural material and features.

Laboratory Analysis

Following the completion of the field work, all recovered materials were processed at the laboratory facilities of American Resources Group, Ltd., in Carbondale, Illinois, where they were washed, sorted, and catalogued. Artifacts were sorted into general categories, and were then sorted into analytical categories, counted, and weighed. The artifact categories used in the detailed analyses are presented in the chapter describing the site collections.

The flotation samples collected from features were processed using a gravity flow water-sieving unit. The samples were gently water-washed to flush loose sediment through three nested, woven, stainless steel mesh screens of decreasing sizes: 12.7 mm, 1 mm, and 0.5 mm. Each washed sample was placed in a container of water to collect the light fraction from the surface with a 0.5 mm standard test sieve; the heavy fraction was retrieved by pouring the remaining fluid over a 0.5 mm stainless steel mesh screen. The light and heavy fractions were air-dried, and obvious contaminants (e.g., roots) were removed. Each material type present in the sample (e.g., charcoal, seeds, artifacts) was counted, weighed, and recorded. A wood charcoal sample from Feature 3 was submitted to Beta Analytic, Inc., of Miami, Florida, for radiocarbon dating, and the botanical materials were submitted to Kathryn E. Parker of Great Lakes Ecosystems, Indian River, Michigan, for botanical analysis.

Prehistoric Artifact Analysis

A modified version of the functional artifact typology used by ARG for previous testing projects (Ensor and Titus 2004; Titus et al. 2002; Titus et al. 1999) has been used to organize the prehistoric artifact data presented in the artifact inventory tables prepared for site 15Mu939. This functional typological system is similar to that used by McMillan (1971) and Ahler and McMillan (1976) to analyze the artifacts from

Rogers shelter. Originally developed by Winters (1969), this typological system facilitates inference of site function by grouping artifacts classes into general behavioral categories.

All lithic materials recovered at the site were sorted into tool and debris categories and were then counted and weight. The tool and debitage categories used to analyze the lithic materials were adopted from a stone-tool typology developed by Koldehoff (1988) which was modified where necessary.

All flaked debris, or debitage, from the test units with sorted by flaked type in raw material and examined for evidence of use. The methodology employed during this procedure is discussed below. Use wear and morphology were used to sort lithic tools and debris into categories that were quantified by count and weight; all weights were rounded to the nearest .1 g. A 10x hand lens was used to examine the edges and surface of artifacts. Although this approach is not as precise as when high magnification is employed (e.g. Keeley 1980), the goals of the inventory were simple: (1) separate tools from debitage and (2) placed tools into general technological and functional categories. These categories are described below after presentation of the raw material descriptions.

Debitage (flaked debris) was separated into categories on the basis of specific attributes such as amount of dorsal cortex, platform angle, degree of platform faceting and lipping, flake shape and curvature, and overall size. The tool and debitage inventory was aided by prior experiments in stone tool production and use.

Chert Type Analysis

Chert type identification was based upon macroscopic inspection of artifacts in conjunction with a comparative collection of geologic samples collected from source areas. Chipped-stone materials were sorted into one category on the basis of color, texture, inclusion, and form. All were quantified by count and weight, with weights rounded to the nearest .1 g. A description of the chert type identified in the site collection is presented below in abbreviated form. A more detailed description can be found in Ray (1985). Likely source areas for the eight different chert types that were identified from the sites recorded in the project area are represented in Figure 4-1.

Allens Creek

Allens Creek chert is one of several highly fossiliferous cherts that occur in southern Indiana. The type site for this chert occurs in Monroe County, but it has also been found in Lawrence, Washington, and Floyd counties (Cantin 1994; Cantin and Tankersley 1988). The primary source for Allens Creek chert is in the Floyds Knob limestone of the Borden Groups, Mississippian System. For this reason, it has at times been referred to as “Knobs chert” (Janzen 1971). Allens Creek chert is light gray with speckles of gray, tan, and brown that are produced by the fossil crinoids. The size of the fossil inclusions varies from coarse to medium-coarse. The chert is of medium quality and produces a higher degree of choncoidal fracture than is typical with highly fossiliferous cherts (Cantin 1994:11). While similar to Harrodsburg/Ramp Creek cherts, a distinction can be made based on the difference in fossil content between the two cherts (Cantin 1994:11).

Burlington

Burlington chert is derived from the Burlington Limestone. This formation is rich in chert and is widely exposed along the Mississippi River and the Illinois River north of St. Louis, Missouri (Figure 4-4). Burlington is, on average, a moderate- to-high quality chert that is white to light gray in color, and occurs as residuum and as bedded layers in limestone. A Burlington chert source nearer the project area may be the chert cobbles contained within glacial till deposits in southwestern Indiana and southern Illinois; approximately one-half of the glacial chert cobbles collected from geologic context in southern Illinois exhibits macroscopic characteristics that nearly duplicate those of Burlington chert, except that the glacial cobbles tend to be of lesser quality (Koldehoff 1992). While Burlington may have entered the project area through exchange routes, it is also available in glacial outwash gravels, and therefore, may have been obtained regionally.

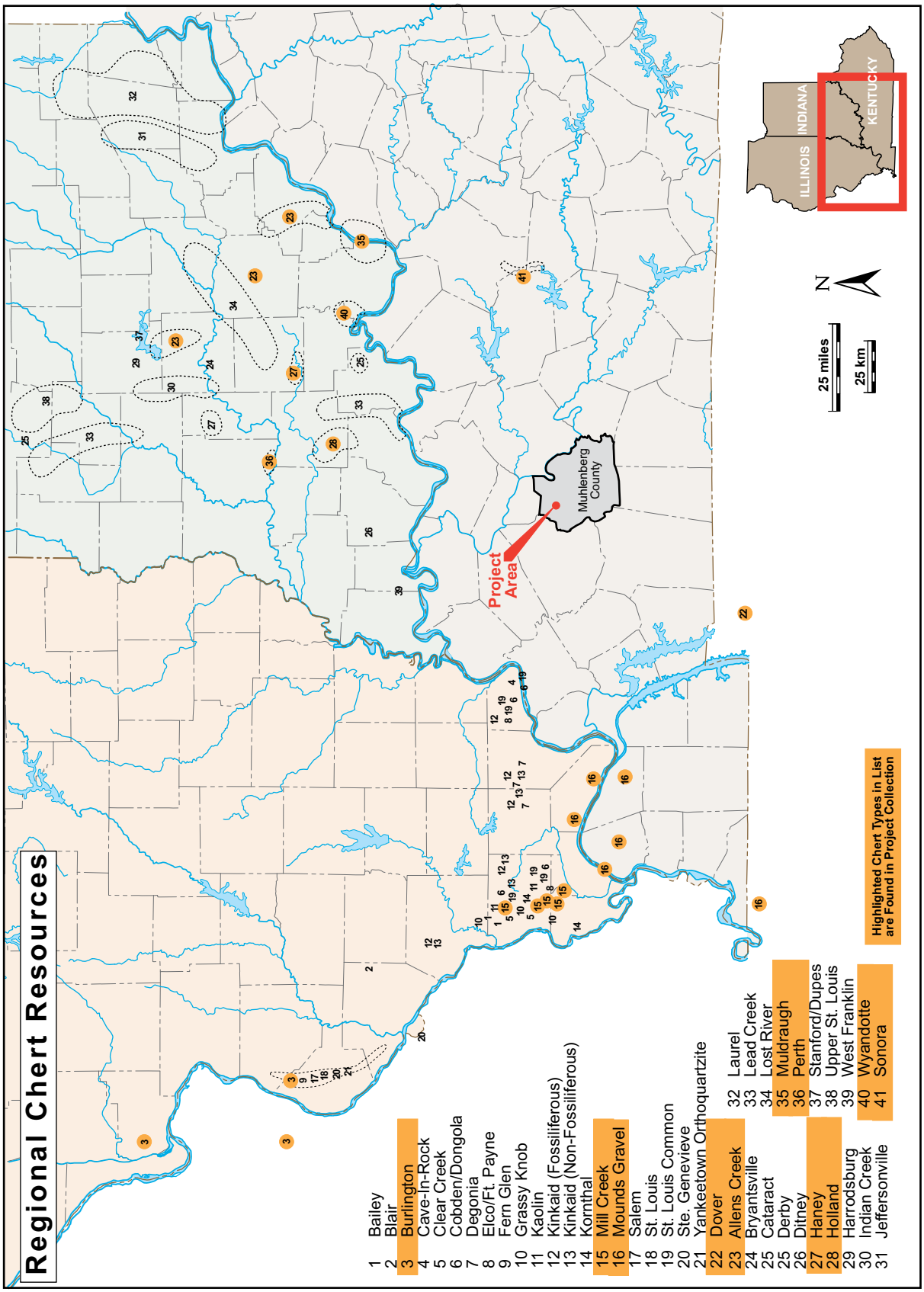

Figure 4-4. Map of chert source areas in southern Illinois, southern Indiana, and western Kentucky.

Dover

Dover chert derives from the Lower Mississippian Ft. Payne Formation, a chert-rich limestone formation that outcrops along the Tennessee and Cumberland rivers in northwestern Tennessee and adjacent portions of southwestern Kentucky. The main sources of Dover chert are located near the town of Dover in Stewart County, Tennessee, but it can be found in abundance along the Tennessee and Cumberland rivers a considerable distance downstream of this area. It is an opaque material with a dark brown color. Distinctive attributes include lenticular mottling with irregularly shaped inclusions. Overall, this chert exhibits a dull luster with few visible fossil inclusions.

Haney

This chert is available in Martin and southwestern Orange counties in Indiana. The chert is derived from the Haney Limestone of the Stephensport Group of the Mississippian System. Exposures of this chert may be found in Orange County as well as Dubois, Greene, and Martin with a possible primary source in Lawrence and Monroe counties (Cantin 1994:22). Haney chert is a light to brownish gray chert that is typically crinoidal. It occurs in tabular form and is of poor to medium quality (Munson and Munson 1984:156). It may contain brownish limonite inclusions that may prove to be useful in differentiating this chert from Allens Creek/Knobs and Harrodsburg chert.

Holland

Holland chert is grayish-blue in color with streaks of yellow or dark red. It has a waxy to vitreous texture and is similar to the Flint Ridge type of Ohio (DeRegnaucourt and Georgiady 1998). The chert is named after the town of Holland in Dubois County, Indiana. It derives from the Holland Limestone Formation which outcrops in Dubois County (and perhaps other nearby counties) and it is a bedded chert that occurs in lenses or tabular chunks (Figure 4-4). It was utilized prehistorically in southern Indiana and likely south of the Ohio River in northern Kentucky (DeRegnaucourt and Georgiady 1998).

Indeterminate

Artifacts in this category include unusual variants that could not be duplicated in the comparative collection.

Mill Creek

Occurring almost exclusively as long flat nodules, either in bedrock or as residuum, Mill Creek chert is generally believed to be derived from the Salem Limestone Formation. Its texture is grainy and color is generally shades of brown or gray, occasionally with shades of yellow or maroon present. Since the turn of the century, Mill Creek chert has been recognized as a major prehistoric lithic source for the central Mississippi Valley. Several source areas of Mill Creek chert have been identified, but the Mill Creek Quarries, located at the town of Mill Creek, Union County, Illinois, are the best known. The quarries represent mining of Mill Creek chert for the production of large chert hoe blades by Mississippian populations. Mill Creek chert nodules commonly occur as residuum either in streambeds or on ridges, some 6 m (20 feet) below the surface. Due to its accessibility and abundance, Mill Creek chert was utilized from Paleoindian through Mississippian times.

Mounds

Mounds Gravel, also called Lafayette Gravel, dates to the Pliocene Epoch. Its exact age is controversial; therefore, it is generally referred to as a Pliocene-Pleistocene gravel. Common throughout the Coastal Plain area of the lower Ohio Valley, deposits are common in most streambeds that drain the uplands that border the valleys of the Ohio River and its tributaries. Mounds Gravel represents chert that was eroded and redeposited primarily by streams. It possesses a thin weathered and often polished brown patina. While the chert is highly variable in color and texture, it is commonly grainy and brown or gray in color, with red present usually near the cortex. Cobbles are generally ovoid in shape and rarely exceed 10 cm (3.9 inches) in diameter and 15 cm (5.9 inches) in length. Because of its size, Mounds Gravel was utilized for small to medium sized chipped-stone tools. Regardless of its size, Mounds Gravel was rather intensively used throughout prehistory in the Ohio River valley of

extreme southern Illinois and western Kentucky, mainly because it was the nearest source of chert.

Muldraugh

This is a mottled light to dark gray chert that can vary with shades of tan or dark brown (DeRegnaucourt and Georgiady 1998:150). Heat treatment produces various shades of red and pink. This is a fossiliferous chert and heat treatment greatly enhances knappabilty. It outcrops within the Mississippian-age Muldraugh Formation in south-central Indiana and northern Kentucky. Muldraugh chert was commonly used along the Ohio River and tributary drainages in southern Indiana and northern Kentucky and in extreme southwestern Ohio (DeRegnaucourt and Georgiady 1998:150).

Perth

Perth chert was formally referred to as "Glendale" by Tomak (1984:18). It has been renamed to for its geological provenience in the Perth Limestone Member of the Staunton Formation, Raccoon Creek Group, Pennsylvanian System (Shaver et al. 1986:111–112; Cantin 1994:41). No outcrops of Perth chert have been identified, but abundant residual and secondary sources have been identified in southern Daviess County, Indiana. The color of this tabular chert ranges from light gray to medium gray to light blue-gray. Luster of the chert is usually dull, but can be waxy. Texture is medium to chalky, with irregular white or light gray mottles associated with the more chalky specimens. Perth chert contains stress fractures, vugs, and fossils that create a hackly fracture the reduces its knapping quality (Cantin 1994:41).

Sonora

Sonora chert is named for the town of Sonora, in Hardin County, Kentucky, which is located near the area where this chert outcrops. This chert derives from the Ste. Genevieve Member in the Slade Formation of the Upper Mississippian System. Sonora chert was commonly used in central Kentucky, its core area, through most of the prehistoric past. Sonora chert ranges in color from dark gray to medium blue, and it has a very waxy to vitreous luster. Occasionally, it is banded with red, pink, orange, or cream. Except for when iron sand grains or chalcedonic-quartz geode inclusions are present, Sonora chert is highly knappable (DeRegnaucourt and Georgiady 1998:162)

Wyandotte

Wyandotte chert was widely used throughout the prehistoric period in western Kentucky. This chert outcrops in Crawford and Harrison counties, Indiana, and has also been referred to as "Harrison County flint" or "Indiana Hornstone." Wyandotte is a non-fossiliferous chert that is medium to dark blue-gray in color and somewhat glossy. It is found in both nodular and tabular form (Munson and Munson 1984:158; Seeman 1975:47). This chert originates from the Fremontia Member of the Ste. Genevieve Limestone, which places it within the Blue River Group (Cantin and Tankersley 1988). Wyandotte is known for its superior quality, making it a preferred chert for knappers. Distribution of Wyandotte chert is widespread and was used in many highly developed prehistoric trade systems (Cantin 1994:48).

Lithic Technological and Functional Analysis

Observations on use wear and morphology were used to sort the prehistoric artifacts into ten different categories. The categories were quantified by count. A 10x hand lens was used to examine the edges and surfaces of chipped-stone artifacts. Admittedly, this approach is not as precise as when high magnification is employed (e.g., Keeley 1980), but the goals of this analysis were simple: (1) separate tools from debitage and (2) place tools into general technological and functional categories. Debitage was separated into categories on the basis of specific attributes such as amount of dorsal cortex, degree of platform faceting and lipping, flake shape and curvature, and overall size. The technological and functional analysis was aided by prior experiments in stone tool production and use. Materials from these experiments were on hand for comparative purposes.

Tool and debitage categories used to inventory the lithic materials were adopted from a stone-tool typology developed by Koldehoff (1988) and modified where necessary. The following general categories were identified during the inventory.

Projectile Points/Hafted Knives

These formal tools were predominantly designed to be hafted, and they functioned as projectile points and/or knives. Included in this category are hafted bifaces that were recycled into hafted scrapers. The point type descriptions used to classify points were obtained primarily from Justice (1987).

Unspecified Bifaces

Nondiagnostic fragments of bifacially flaked tools are placed in this category; for example, distal tips and midsections of projectile points or biface blanks.

Informal Flake Tools

Flakes placed within this category functioned primarily as cutting and lightweight scraping tools with little to no prior modification. They are expedient flake tools made from tertiary flakes and other flake types, as well as shatter.

Blades

Linear flakes that are at least twice as long as wide, that have parallel lateral edges, and that show evidence of sequential removal from a prepared core (see below). Typically, blades exhibit one to three flake scars that run parallel to each other down the length of the dorsal surface of the blades and that originate from the same striking platform as the blade itself or from the end opposite the blade platform. Blades often exhibit evidence of retouch and use.

Drill/Perforators/Gravers

As their name implies, these tools were likely used to penetrate and drill various materials such as hides, wood, antler, and bone. The majority of the specimens appear to be made on flakes and have been bifacially or unifacially flaked.

Spokeshave

These types of tools are characterized by one or more unifacially flaked concavity; they are used to scrape, smooth, or shape animal materials (e.g., bone and tendon) or wood.

Cores

A core is any piece of chert from which one or more flakes have been removed and has not been shaped into a tool or used extensively for a task other than that of a nucleus from which flakes have been struck. Cores range from chert cobbles, nodules, tabular pieces or chunks that have had one or more flakes removed in a random fashion (amorphous cores) to highly formalized prepared cores that produce standardized flakes (e.g., conical or blade cores). Tested cobbles/nodules are also considered cores; these artifacts are raw pieces of chert that have had one or two flakes removed to test the knapping quality.

Blanks

Unfinished hafted bifaces placed in this category are thick (relative to preforms), bilaterally asymmetrical, lack a lenticular cross section, have irregular, sinuous edges, and frequently have small amounts of cortex remaining on their edges and faces. Blanks are classified as initial stage bifaces. Initial stage bifaces have been edged or have been minimally modified from the parent material and show very little evidence of shaping or significant thinning.

Primary and Secondary Decortication Flakes

Amount of cortex is the distinguishing characteristic of these categories. Flakes and sizable flake fragments with greater than 50 percent dorsal cortex were placed within the primary decortication category, and those with 25 to 50 percent dorsal cortex were classified as secondary decortication flakes. Primary and secondary decortication flakes represent the first series of flakes detached from a nodule or cobble.

Tertiary Flakes

Flakes within this category possess no more than 25 percent dorsal cortex and do not exhibit attributes typical of biface thinning and retouching (resharpening) flakes. Tertiary flakes tend to be larger and more flattened in curvature than biface flakes, and they generally have irregularly shaped platforms with less than four facets. Tertiary flakes are byproducts of the early stages of biface reduction as well as byproducts of simple flake-tool production.

Biface Thinning and Retouching Flakes

Flakes in these categories exhibit attributes indicating their removal during the later stages of biface production (biface-1 flakes) or during biface maintenance (biface-2 flakes). Biface flakes possess platforms with an elliptical shape, multiple facets (four or more), lipping, and acute angles. The platforms are minute sections of what was the edge of the biface. Biface-1 flakes are substantially larger and more curved than biface-2 flakes.

Broken Flakes

Flake sections that could not be readily identified as one of the above flake types were considered broken flakes. Flakes may be broken during any stage of reduction or by post-depositional factors such as trampling.

Angular Fragments

Chert fragments within this category include angular chunks and small splinters. These fragments are produced during stone tool manufacture, particularly if poor quality (e.g., internally fractured) chert is used, bipolar reduction is employed, and/or lithic items are intensively reworked or recycled.

Thermal Shatter

Chert fragments and flake sections that exhibit heat-crazing, pot-lidding, or discoloration resulting from burning are placed in this category. Thermal shatter may result from either intentional heat-treating or burning.

Cracked Rock

Cracked rocks are fragments of sandstone or limestone bedrock or glacial cobbles of igneous/metamorphic rock that were fractured due to repeated exposure to thermal extremes. These rocks may have functioned as hearth stones or agents of heat retention and transfer in culinary activities. Cracked rock may also be fractured by direct impact breaking or from non-cultural activities such as freezing and thawing.

Culturally derived fire-cracked rocks tend to exhibit highly irregular fracture surfaces, reddening, crazing, and crystallization near their weathered rinds resulting from high temperature heating, rapid oxidation, and rapid cooling, while rocks cracked by natural freezing or thawing and more gradual temperature changes tend to exhibit more planar fracture surfaces and less internal color and structural changes. Rocks cracked by impact from cultural use as hammers may not always exhibit battering or evidence of impact. Rocks utilized for stone boiling and heat transfer/retention were probably selected for their resistance to cracking to avoid excessive grit in the foodstuffs. Unmodified cobbles may be heating stones which did not crack.

Baked Clay

Amorphous pieces of untempered, fire-baked clay are placed in this artifact category. Baked clay is interpreted to be the unintentional by-product of intense burning.

Modified Cobbles

These simple tools are igneous/metamorphic cobbles or pieces of sandstone that were used with little to no prior modification for tasks such as hammering (hammerstones), grinding (manos and pestles), cracking/crushing (pitted cobbles), sharpening (abraders), or a combination of functions

Minerals

Limonite, hematite (iron ore), and ochre are minerals that are frequently recovered from sites. These materials were converted into tools, ornaments, and pigments.

Curation

Archaeological materials collected during the Phase I survey will be temporarily curated at the facilities of ARG in Carbondale, Illinois, allowing for accessibility to materials during artifact analysis and preparation of the technical report. After acceptance of the final report, all materials will be placed in storage containers and submitted for permanent curation at the Murray State University Archaeology Laboratory in Murray, Kentucky.

Chapter 5 - Artifact Analysis

This chapter provides a detailed inventory of the artifacts recovered at site 15Mu296 during the present Phase II investigation. The prehistoric artifacts were identified according to material, manufacture, and function. The analytic methods used during the analysis of the prehistoric artifacts are presented in Chapter 4.

Introduction

A total of 4,040 prehistoric artifacts were recovered from the surface, the six test units, and the three mechanically excavated trenches at site 15Mu296 during the Phase II testing. The total weight of the artifacts collected equals 222,880.8 grams. This collection is described below. No ceramics were included in the collection.

Stone artifacts were analyzed and described according to raw material source and type, manufacturing technology, and, to a limited extent, use. The goal of the analysis is to identify raw material preferences, understand the lithic technologies employed by the inhabitants at the site, and to determine the range of activities that occurred at site 15Mu296.

All stone artifacts, including debitage and other materials are inventoried in Appendix A. The general analytic categories and raw materials recognized during the analysis are discussed in Tables 5-1 and 5-2, respectively. Specific information regarding technology and chronology and use are provided in this section as appropriate. Color photographs of selected, representative lithic artifacts are presented below. Tabular data for all stone artifacts and lithic debris are also presented, by minimal provenience, in Appendix A.

Results

Stone artifacts recovered at site 15Mu296 during the current investigation include hunting and general utility tools, fabricating and processing tools, stone tool production and maintenance debris, heating and cooking debris, domestic equipment, and other items (Table 5-1). Most of these items were recovered from the A horizon in excavating test units, with feature excavation also producing a substantial amount of material. Only a few artifacts were recovered during mechanical stripping and even less were recovered from the surface.

Hunting and General Utility Tools

A total of 575 flaked-stone tools are included in this functional category. Tools in this category include 25 projectile points/hafted knives, a hafted scraper, 29 unspecified bifaces, 517 informal flake tools, and three blade flakes.

All 25 of the projectile points/knives are fragments. Five fragments are bases or blade segments that exhibited fractures at the neck of the tool, four have blade fractures, and one has both a blade and neck fracture. The fragmentary nature of some of these point fragments made positive identification of defined types difficult. Projectile point types that were identified in the site 15Mu296 collection include Kirk Corner Notched, Matanzas Side Notched, Etley, Pickwick, Saratoga Parallel

Table 5-1. Artifact Inventory for Site 15Mu296.

15Mu296, Oxford Coal-Ph. I	Surface		Test Units		Trenches		Features		Total	
Count & Weight	#	Wt.	#	Wt.	#	Wt.	#	Wt.	#	Wt.
Hunting & General Utility Tools										
Proj. Pts./Hafted Knives			[20]	98.2	[4]	66.2	[1]	1.1	25	165.5
Hafted Scrapers			[1]	2.4					1	2.4
Unspecified Bifaces			[28]	79.9	[1]	34.0			29	113.9
Informal Flake Tools	3	19.8	482	443.3	8	24.0	24	25.7	517	512.8
Blades			[1]3	5.6					3	5.6
Fabricating & Processing Tools										
Drills			[6]	15.8					6	15.8
Spokeshaves			[1]	1.6					1	1.6
Stone Tool Production & Maintenance Debris										
Cores										
Amorphous			5	287.2	1	62.3			6	349.5
Blanks			[1]	25.2					1	25.2
Debitage										
Primary Decort. Flakes			44	86.4	4	24.2	7	4.2	55	114.8
Secondary Decort. Flakes			20	18.1			1	0.7	21	18.8
Tertiary Flakes			108	58.9			14	19.8	122	78.7
Biface-1 Flakes			49	21.4			5	2.6	54	24.0
Biface-2 Flakes			268	43.3			44	5.3	312	48.6
Broken Flakes			307	118.0	1	0.3	34	11.4	342	129.7
Angular Fragments			7	53.3			1	2.6	8	55.9
Thermal Shatter			207	246.4	1	4.3	22	26.4	230	277.1
Heating & Cooking Debris										
Cracked Rock										
Sandstone			1861	186670.0			291	22425.9	2152	209095.9
Igneous/Metamorphic			3	35.8					3	35.8
Baked Clay			11	41.2			4	2.0	15	43.2
Domestic Equipment										
Pestles			1	396.8					1	396.8
Hammerstones					1	441.7			1	441.7
Pitted Sandstone			1	666.8	1	368.2			2	1035.0
Multi-Pitted Sandstone			1	7711.1	1	1956.7			2	9667.8
Other Items										
Ochre			82	99.4			32	37.2	114	136.6
Limonite			15	86.9			1	0.3	16	87.2
Other - Small Geode			1	0.9					1	0.9
Overall Total by Count & Weight	3	19.8	3533	197313.9	23	2981.9	481	22565.2	4040	222880.8

Key: # = Count; Wt. = Weight in Grams; [ ] = Fragments

Stemmed, Kramer Stemmed, and McWhinney Heavy Stemmed. Jefferies (2009) places the last four point types into a Late Archaic stemmed cluster which he estimates were manufactured from 4300 B.C. to 800 B.C. The cultural period with which each of these artifacts is associated is presented in Table 5-2, along with information concerning provenience, the raw material from which each is made, and artifact dimensions; information regarding the dimensions of these points was very limited due to the fragmentary nature of all of them.

The single Kirk Corner Notched point from the 15Mu296 collection is a blade fragment which exhibits a portion of one notch (Figure 5-1a). It is made of Wyandotte chert. This artifact was recovered from Level 1 in Test Unit 6. Kirk Corner Notched points are associated with Early Archaic period components from across the Eastern United States and range in date from 7500 to 6900 B.C. (Justice 1987).

Four Matanzas Side Notched point fragments were recovered during the Phase II testing (Figures 5-1b–e). Three of these points were recovered during test unit excavation, and the remaining one was recovered during the excavation of Feature 3. Three of these points are snapped at the neck, while the remaining fragment is whole except for a blade fracture. Matanzas points are common across much of central and southern Indiana and Illinois (Justice 1987). The production of these artifacts is indicated at other locations in the Midwest, such as the Koster site, where they are recovered from Late Archaic period deposits dating from 3700 to 3000 B.C. (Justice 1987).

One Etley point and one possible Etley point fragment are included in the Phase II collection at site 15Mu296. The point that is definitely an Etley point was recovered from Level 3 of Test Unit 5. The diagnostic portion of this artifact is whole (Figure 5-1g). It is made of Wyandotte chert and exhibits cortex on the stem and a portion of the blade. The point stem is ground along most edges. A second fragment of a possible Etley point was recovered in Level 3 of Test Unit 6 (Figure 5-1h). This point exhibits a lateral break of the blade that extends from the notch. It is possible that this artifact is the fragment of a corner notched variant within the Etley cluster (Justice 1987). Etley points are primarily associated with Late Archaic components in western Illinois, southeastern Iowa, and eastern Missouri. In the lower Illinois River Valley, these points are associated with Titterington phase sites that date between 3000 and 1000 B.C. (Justice 1987).

One possible Pickwick point was recovered during excavation of Trench 2. This artifact, which is also made of Wyandotte chert, is very fragmentary and is missing portions of the base and the blade (Figure 5-1i). Pickwick points are included in the Ledbetter cluster (Justice 1987). These projectile points are common throughout the Tennessee River Valley

Table 5-2. Projectile Point/Hafted Kinfe Measurement Data.

Figure No.:	Cat. No.:	Provenience:	Description:	Type:	Raw Material:	Thermal Alteratio n:	Maximum Length (mm):	Haft Element Length (mm):	Maximum Width (mm):	Shoulder Width (mm):	Juncture Width (mm):	Basal Width (mm):	Maximum Thickness (mm):
Figure 5-1a	27	Test Unit 6, Level 1	Broken Point	Kirk Corner Notched	Wyandotte	Yes	-	-	-	-	-	-	5.8
Figure 5-1b	4	Test Unit 1, Level 2	Broken Point	Matanzas Side Notched	Wyandotte	No	-	12.4	23.1	22.1	18.3	20.7	9.4
Figure 5-1c	19	Test Unit 5, Level 1	Broken Point	Matanzas Side Notched	Allens Creek	Yes	-	-	-	-	-	-	5.3
Figure 5-1d	28	Test Unit 6, Level 2	Broken Point	Matanzas Side Notched	Indeterminate	No	-	-	-	-	11.1	15.1	5.9
Figure 5-1e	37	Feature 3	Broken Point	Matanzas Side Notched	Wyandotte	Yes	-	-	-	-	14.5	18.2	5.1
Figure 5-1f	10	Test Unit 1, Level 5	Broken Point	McWhinney Heavy Stemmed	Wyandotte	No	-	-	-	-	15.3	17.6	7.2
Figure 5-1g	23	Test Unit 5, Level 3	Broken Point	Etley	Wyandotte	No	-	11.2	28.2	24.4	14.9	15.6	9.6
Figure 5-1h	30	Test Unit 6, Level 3	Broken Point	Etley (Corner Notched var.)	Wyandotte	No	-	-	-	-	-	-	8.4
Figure 5-1i	36	Trench 2	Broken Point	Pickwick	Wyandotte	No	-	8.1	32.8	32.8	-	19.6	9.1
Figure 5-2a	36	Trench 2	Broken Point	Saratoga Parallel Stemmed	Wyandotte	No	-	8.0	30.6	30.6	-	15.1	8.9
Figure 5-2b	34	Trench 2	Broken Point	Kramer	Wyandotte	No	-	-	26.3	23.9	-	18.5	7.5

Figure 5-1. Selected prehistoric artifacts. (A) Kirk Corner Notched point, Test Unit 6, Level 1; (b) Matanzas Side Notched point, Test Unit 1, Level 2; (c) Matanzas Side Notched point, Test Unit 5, Level 1; (d) Matanzas Side Notched point, Test Unit 6, Level 2; (e) Matanzas Side Notched point, Feature 3; (f) McWhinney Heavy Stemmed point, Test Unit 1, Level 5; (g) Etley point, Test Unit 5, Level 3; (h) Etley point (Corner Notched variety), Test Unit 6, Level 3; (i) Pickwick point, Trench 2.

and range in distribution from southern Illinois and Indiana to northern Florida and southern Louisiana. Chronologically, Pickwick points are associated with Late Archaic period components which date from 2500 to 1000 B.C. (Justice 1987).

A single Saratoga Parallel Stemmed point was recovered from the A Horizon in Trench 2 while attempting to uncover the plan view of Feature 4. This point is almost whole except for its missing tip (Figure 5-2a). The basal edge of the point stem is un-worked, representing either the original striking platform or a snapped base. The lateral edges of the stem exhibit grinding. Saratoga cluster projectile points are found at sites in southern Illinois and Indiana and throughout most of Kentucky and Tennessee. These artifacts are associated with components dating from the Late Archaic period to the Early Woodland period where they are found in deposits thought to date after 2000 B.C. (Justice 1987).

A single point fragment recovered during the excavation of Trench 2 is identified as a Early Woodland Kramer point. This point is a midsection exhibiting a portion of the blade and stem; it is made of Wyandotte chert (Figure 5-2b). Justice (1987) places Kramer points in the Early Woodland stemmed cluster. These diagnostics are the predominant point style found at Late Archaic to Early Woodland sites in southern Illinois; these sites also produced Marion thick pottery (Justice 1987). The lack of any ceramics at site 15Mu296 suggest at this point may date to the Late Archaic period in this instance.

A single point fragment was identified as a McWhinney Heavy Stemmed point fragment. This point is only represented by a portion of the stem (Figure 5-1f). It is made of Wyandotte chert and was recovered from Level 5 in Test Unit 1. McWhinney points are common diagnostics of Late Archaic period components in the Ohio River Valley where they date from about 4000 to 1000 B.C. (Justice 1987).

While the above described projectile points would have been useful in the hunting of animals, the other types of hunting and general utility tools in the collection indicate that the processing of faunal resources was also an important activity that occurred at site 15Mu296. Specifically, the acute cutting edge present on the unspecified bifaces (N=28) (e.g., Figure 5-2d), informal flake tools (N=517), and blade flakes (N=3) would have been useful for cutting meat. The type of working edge present on the single hafted end scraper, that is almost 90 degrees, is typically found on tools that were utilized for hide processing. Three blade flakes were recovered from Test Units 4, 5 and 6 (Figures 5-2f–h). These artifacts showed no evidence of being made from a prepared blade core and were probably produced unintentionally. Therefore, these blade flakes are not considered to be diagnostic to a specific period (e.g. Middle Woodland).

Fabricating and Processing Tools

The production of perishable items at site 15Mu296 is suggested by the recovery of six drill fragments, a spokeshave (Figure 5-2e), and an unspecified biface that is an a possible adze fragment. The drills and spokeshave were recovered from test unit excavation, while the unspecified biface that may be an adze was discovered as part of the mechanical stripping of Trench 2. Given that no artifacts were recovered during testing of site 15Mu296 that showed evidence of being fabricated by tools like these, it is likely that perishable material, such as bone, hide, or wood, was being modified. The possible adze fragment is a chunky, 19.7 mm thick by 31.5 mm wide, unspecified biface of Wyandotte chert; it exhibits wear smoothing on the dorsal crest which suggests that it was hafted. However, because the distinctive asymmetrical working bit that would identify this artifact as an adze is missing from this fragment, its functional designation is questionable; this is the reason this artifact is designated as an unspecified biface fragment on Table 5-1.

Stone Tool Production and Maintenance Debris

The large amount of the chipped-stone debitage (N=1,144) suggests that chipped-stone-tool production and maintenance were an important activity at site 15Mu296. The presence of many debitage types also suggests that all stages of stone-

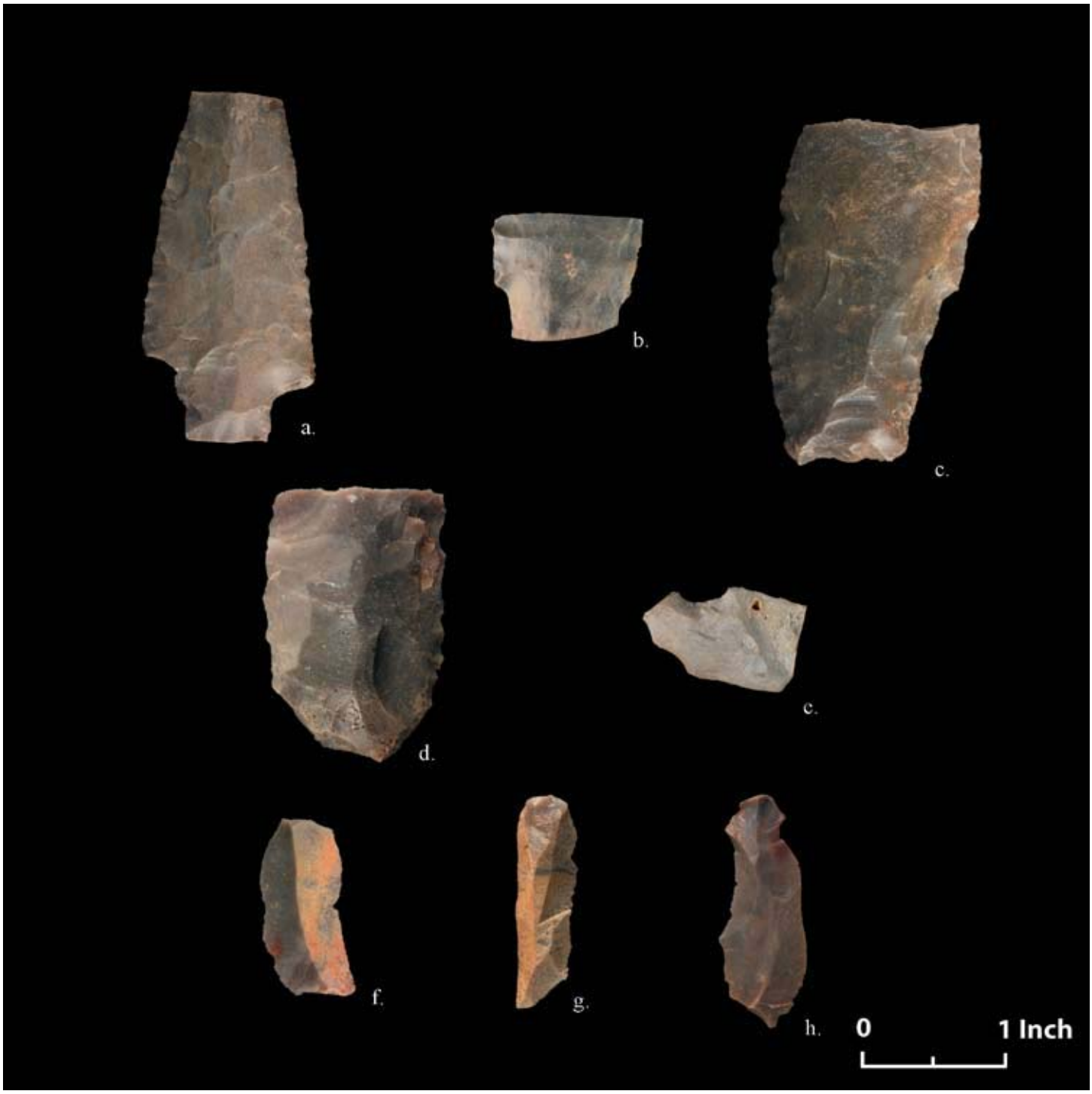

Figure 5-2. Selected prehistoric artifacts. (a) Saratoga Parallel Stemmed point, Trench 2; (b) Kramer point, Trench 2; (c) knife, Trench 2; (d) unspecified biface (possible adze), Trench 2; (e) spokeshave, Test Unit 1, Level 3; (f) blade, Test Unit 4, Level 3; (g) blade, Test Unit 5, Level 1; (h) blade, Test Unit 6, Level 1.