



ACOUSTIC DETECTOR SURVEY FOR BATS
Friends of the Drew Forest at Drew University
Morris County, Madison, New Jersey

Submitted to: Davey Resource Group, Inc.
4 Walter E. Foran Blvd, Suite 209
Flemington, NJ 08822

Date: July 19, 2023

INTRODUCTION

ICF Jones & Stokes (ICF) was contracted by Davey Resource Group, Inc. (Davey) to conduct summer bat acoustic surveys for Friends of the Drew Forest within the Drew Forest Preserve on the campus of Drew University located in Morris County, New Jersey. The proposed project area lies within the predicted range of the federally endangered Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), and the proposed endangered tri-colored bat (*Perimyotis subflavus*). On May 10, 2023, ICF submitted a study plan to Alicia Protus of the U. S. Fish and Wildlife Service (USFWS) in the Galloway, New Jersey Field Office, detailing proposed level of effort for presence/probable absence surveys for the federally listed bat species. Approval and concurrence of the study plan was received from USFWS on May 11, 2023. Acoustic surveys and analysis were conducted by permitted biologists under ICF's USFWS Permit #ES810274. This report delineates the methods, results, and conclusions of the acoustic surveys completed by ICF from June 6-12, 2023. Conclusions were formulated using all data collected.

PROJECT BACKGROUND

Drew University proposes to utilize the Drew Forest Preserve for development. The Drew University Forest Reserve is a 52.4-acre oak/hickory forest that surrounds the western and southern borders of the Drew University campus (Figure 1). Almost half of the Drew Forest Preserve is surrounded by wildlife fencing and divided into two sections: the Zuck Arboretum and the Hepburn Woods. These areas are primarily used for recreation and ecological significant research including biodiversity gardens, wildlife ecology research plots, and invasive plant research/removal.

SURVEY METHODOLOGY

Habitat Assessment

A federally permitted biologist conducted a bat habitat assessment during a walk-through of the project area. To identify potential suitable bat habitat, biologists looked for open areas within the forest, potential roost trees, and foraging corridor habitat within Drew Forest. No rocky outcrops, caves, or mines are located within the limits of Drew Forest. Roost trees are generally tall deciduous snags with shaggy bark and a large diameter at breast height (dbh), and foraging habitat includes open areas in forests or linear trails through forests near water sources or



floodplains (USFWS 2023). Representative photographs and the USFWS habitat assessment datasheet can be found in Appendix A.

Acoustic Monitoring Survey Level of Effort

Survey level of effort was determined in compliance with the 2023 Range-wide Indiana bat and Northern Long-eared bat Survey Guidelines (USFWS 2023). Out of the 52.4 acres within the project area, only 0.3 are unforested but still provide suitable foraging habitat for local bats species. The areas of the project area that are not forested are comprised of the ponds located in the Zuck Arboretum, roads, and parking lots. Based on the current USFWS guidelines, a total of 15 acoustic detector nights were conducted to determine the presence/probable absence of Indiana, northern long-eared, and/or tri-colored bats. A total of six acoustic survey sites were spread across the project area and surveyed for three nights each (Table 1; Figure 2); equaling 15 detector nights.

Table 1. Acoustic survey site locations at Drew Forest Preserve located on the campus of Drew University in Morris County, NJ.

Acoustic Survey Site #	Coordinates
D1	40.764000°; -74.429950°
D2	40.760150°; -74.432617°
D3	40.759540°; -74.430730°
D4	40.757420°; -74.431500°
D5	40.757190°; -74.426500°
D2 ALT	40.758820°; -74.432500°

Acoustic Monitoring Data Collection and Analysis

One Wildlife Acoustics SM Mini Bat acoustic detector was placed at each acoustic survey site in a location that best sampled available bat foraging habitat while minimizing interference from vegetative clutter and debris. The Wildlife Acoustics Mini Bat is equipped with an omnidirectional microphone that was positioned at a 0° angle (parallel with the ground) during deployment. All detector unit microphones were tested prior to deploying the units. The acoustic detectors were attached to painters’ poles and extended at least 10 feet in the air and at least 33 feet from any surrounding vegetation. The detectors were deployed on June 6, 2023, and were programmed to run 30 minutes before sunset (20:30) until 30 minutes after sunrise (05:57). The calls were recorded in Full Spectrum and converted to Zero Crossing for manual analysis purposes. The acoustic detectors were checked each morning to inspect for potential tampering or theft and to ensure that each detector unit was operating properly during each night of survey.

Acoustic data were analyzed using a USFWS approved software program Kaleidoscope Pro (Version 5.4.7). This automated software program is designed to identify bat calls to the species level throughout the Eastern U.S. and is one of the USFWS approved software packages for use in identifying potential Indiana bat sonograms (USFWS 2023). For this study, calls were analyzed using “New Jersey” as this species set is capable of scanning files for the ten bat species with the potential to occur in the project area, including the Indiana bat, northern long-eared bat, and tri-colored bat.



The output file produced for this study was used to identify the presence and relative activity of echolocating bats. In addition to species identification at the file level, Kaleidoscope Pro produces a nightly Maximum Likelihood (MLE) P-value for the null hypothesis that a species is not present at a site on a given night. A low P-value indicates that a species is likely present at a site. ICF conducted manual qualitative analysis on all files when Kaleidoscope Pro identified a call sequence as belonging to the genus *Myotis*, regardless of the MLE value. Suspected *Myotis* call sequences were evaluated based on characteristics such as shape, slope, and the minimum frequency of pulses, as well as general call pattern. Kaleidoscope Pro was also used to manually analyze calls from species of interest. Data analysis was conducted by ICF biologists Kory Armstrong and Drew Powell.

RESULTS

Potential Bat Habitat

Approximately 52.1 acres of potential summer habitat for the Indiana, northern long-eared, and tricolored bat occur within the proposed project area (Figures 1 & 2). Forested habitat consisted of lowland and upland hardwoods of mostly early to mid-successional composition (i.e., <15" DBH) with mature trees (i.e., >15" DBH) scattered throughout. Sugar maple (*Acer saccharum*), red maple (*Acer rubrum*), red oak (*Quercus rubra*), white oak (*Quercus alba*), and mockernut hickory (*Carya tomentosa*), and American beech (*Fagus grandifolia*) were among the dominant tree species. Tulip poplar (*Liriodendron tulipifera*), sugar maple (*Acer saccharum*), and black locust (*Robinia pseudoacacia*) could be found throughout the understory in many areas. Black locust and dead ash (*Fraxinus* sp.) snags were also present in the understory and provide an important cavity roost resource for individual and/or small colonies (< 5 bats) of bats. The more mature areas contained an oak-maple-hickory mix. Few dead ash snags were observed that had the potential to house a mid-size colony of bats. Two ponds are located in the Zuck Arboretum within the project area and provide an open foraging for bats, with some sections of the ponds being slightly cluttered due to overhanging tree branches and shrubs. Although some of the forest understory was moderately cluttered, ICF biologists classified the potential suitability of habitat in the area as moderate in quality due to the existing foraging corridor and amount of roost potential. Habitat photographs can be found in Appendix A.

Acoustic Monitoring Results

Five (5) Wildlife Acoustics SM Mini Bat acoustic detector sites were monitored for three calendar nights each from June 6-9, 2023 (Figure 2). On the night of June 8, 2023, the temperature dropped below 50° Fahrenheit around midnight, thus requiring an additional night of surveys to achieve 100% survey effort as defined in the USFWS guidelines. Periods of thick smoke from the Canadian wildfires was observed in the air during in the first two days of surveys. It is undetermined if the smoke had any effect on bat activity during the nights of June 6 and June 7, 2023. During three total calendar survey nights (June 6, 2023, through June 9, 2023, excluding the night of June 8, 2023) of acoustical sampling, Kaleidoscope reported 3,340 noise-filtered files and 11 unidentified calls (Table 2). Photographs of all acoustic survey sites can be found in Appendix A. Although the night of June 8, 2023, is considered an invalid night due to weather, these data were reviewed and calls files belonging to *Myotis* were manually reviewed.



Table 2. Kaleidoscope automated acoustic analysis results table, showing number of files recorded for each species.

Site	Coordinates	Date	<i>Eptesicus fuscus</i>	<i>Lasionycteris noctivagans</i>	<i>Lasiurus borealis</i>	<i>Lasiurus cinereus</i>	<i>Nycticeius humeralis</i>	<i>Myotis lebeii</i>	<i>Myotis lucifugus</i>	<i>Myotis septentrionalis</i>	<i>Myotis sodalis</i>	<i>Perimyotis subflavus</i>	Unknown**	Total
D1	40.764000° -74.429950°	6/6/23	130	66	31	31	7	-	-	-	-	2	1	267
		6/7/23	66	32	17	17	3	-	10	-	1	1	1	147
		6/8/23*	90	51	12	33	3	-	1	-	-	1	-	191
		6/9/23	193	76	31	57	4	-	2	-	-	1	1	364
D2	40.760150° -74.432617°	6/6/23	163	1	81	6	6	-	44	1	-	-	-	302
		6/7/23	21	1	28	10	1	-	-	-	1	-	-	62
		6/8/23*	50	-	46	2	2	-	32	-	-	1	-	133
		6/9/23	133	7	45	5	5	-	10	2	1	-	1	208
D3	40.759540° -74.430730°	6/6/23	153	9	7	1	1	-	39	2	4	-	2	216
		6/7/23	31	2	12	-	-	-	44	-	-	9	-	98
		6/8/23*	91	2	8	3	-	-	40	1	13	1	2	159
		6/9/23	75	7	4	9	1	-	55	-	6	-	1	157
D4	40.757420° -74.431500°	6/6/23	1309	13	156	1	50	-	1	-	-	-	1	1530
		6/7/23	389	2	75	1	15	-	2	-	-	1	-	485
		6/8/23*	913	8	129	2	35	-	1	-	-	2	1	1090
		6/9/23	928	7	64	1	10	-	5	-	-	1	1	1016
D5	40.757190° -74.426500°	6/6/23	267	34	23	18	8	-	9	2	3	-	-	364
		6/7/23	94	6	11	7	-	1	6	-	1	-	1	126
		6/8/23*	152	17	5	9	5	-	6	-	-	-	-	194
		6/9/23	164	21	27	9	19	-	8	1	1	-	1	250
TOTAL			5412	362	812	222	175	1	315	9	31	20	14	7359

*Temperature dropped below 50°F requiring an additional night of survey

**Not included in the overall totals

Eastern bats in the genus *Myotis* produce calls similar to one another with minimum frequencies of approximately 40 to 45 kHz, and often pose problems for acoustic analysis software. In addition, there are a number of non-*Myotis* species that can produce calls with quantitative and qualitative parameters that are also similar to *Myotis* species, including the eastern red bat and evening bat. Several *Myotis* species, including the northern long-eared bat, little brown bat (*Myotis lucifugus*), and Indiana bat have calls with similar characteristics which often make these calls nearly indistinguishable by acoustic analysis software. However, these species can frequently be discerned through manual analysis via interpretation of variables such as slope, duration, intensity, call shape, and context of call sequence time relative to other calls.



A total of 376 calls were identified as being produced by *Myotis* species. By Kaleidoscope Pro, 14 unknown species call sequences, 5,412 big brown bat (*Eptesicus fuscus*), 362 silver-haired bat (*Lasionycteris noctivagans*), 222 Hoary bat (*Lasiurus cinereus*), 812 eastern red bat (*Lasiurus borealis*), and 175 evening bat (*Nycticeius humeralis*) call sequences. Through manual analysis of the *Myotis* species calls identified by Kaleidoscope Pro, these calls were all produced by eastern red bats. All automated output results from Kaleidoscope can be found in an electronic folder included with this document (Appendix B).

Additional Survey Nights

Additional nights of acoustic surveys were requested by Friends of the Drew Forest to obtain more data of local bats species usage of the Drew Forest Preserve. The acoustic detectors were left out for three additional nights at their original locations, with the exception of detector site D2 which was moved to a location 656 feet from its original location. (Table 3). As a result, 15 additional detector nights were collected and analyzed for a total of 30 valid detector nights and 5 invalid (weather related) detector nights. Photographs of the alternate acoustic detector location are included with the representative photographs at the end of this report.

Table 3. Kaleidoscope automated acoustic analysis results table during the additional nights of survey, showing number of files recorded for each species.

Site	Coordinates	Date	<i>Eptesicus fuscus</i>	<i>Lasionycteris noctivagans</i>	<i>Lasiurus borealis</i>	<i>Lasiurus cinereus</i>	<i>Nycticeius humeralis</i>	<i>Myotis lebelli</i>	<i>Myotis lucifugus</i>	<i>Myotis septentrionalis</i>	<i>Myotis sodalis</i>	<i>Perimyotis subflavus</i>	Unknown*	Total
D1	40.764000° -74.429950°	6/10/23	360	98	19	28	1	-	1	-	-	1	-	508
		6/11/23	483	108	26	72	6	-	1	-	-	-	1	696
		6/12/23	86	49	1	33	1	-	-	-	-	-	3	170
D2 ALT	40.758820° -74.432500°	6/10/23	1272	14	88	5	9	-	3	-	-	-	8	1391
		6/11/23	658	9	82	3	1	-	2	2	1	-	2	758
		6/12/23	1854	10	73	-	4	-	17	-	-	-	-	1958
D3	40.759540° -74.430730°	6/10/23	149	1	3	3	1	-	49	6	12	1	1	225
		6/11/23	56	1	3	8	-	-	22	1	5	-	1	96
		6/12/23	646	12	1	12	1	-	48	4	8	1	1	733
D4	40.757420° -74.431500°	6/10/23	1305	27	17	14	11	-	3	-	-	-	1	1377
		6/11/23	742	47	32	18	17	-	1	-	-	-	5	857
		6/12/23	1292	17	23	1	24	-	-	-	-	-	2	1357
D5	40.757190° -74.426500°	6/10/23	378	30	37	13	62	-	22	3	5	-	5	550
		6/11/23	318	62	17	22	15	-	5	-	-	-	1	439
		6/12/23	578	8	9	1	5	-	10	-	7	1	1	619



Site	Coordinates	Date	<i>Eptesicus fuscus</i>	<i>Lasionycteris noctivagans</i>	<i>Lasiurus borealis</i>	<i>Lasiurus cinereus</i>	<i>Nycticeius humeralis</i>	<i>Myotis lebeii</i>	<i>Myotis lucifugus</i>	<i>Myotis septentrionalis</i>	<i>Myotis sodalis</i>	<i>Perimyotis subflavus</i>	Unknown*	Total
TOTAL			10177	493	431	233	158	-	184	16	38	4	32	11734

*Not included in the overall totals

CONCLUSION

Approximately 52.1 acres of forested habitat occur within the 52.4 acre project area. The potential summer habitat in the area was characterized as being moderate quality for supporting *Myotis* species of bats. The majority of the habitat was early to mid-successional forest with a moderate to high amount of clutter in the understory and a limited number of potential roost trees. Moderate quality habitat for all listed species is present within the project area.

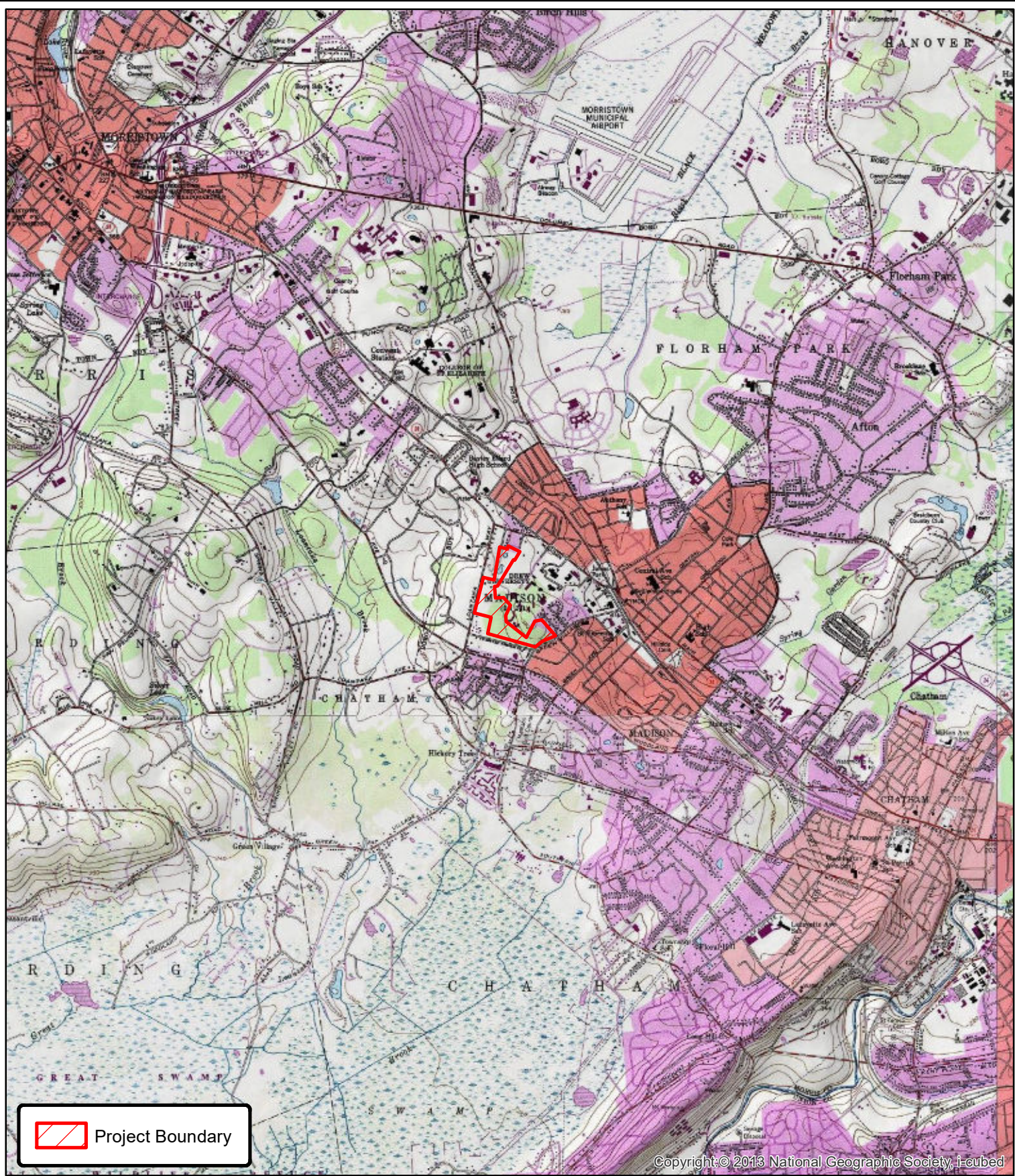
ICF conducted automated and qualitative analysis of 35 detector nights (1 detector for one calendar night = 1 detector night) including 5 invalid nights due to weather related issues. Based on the automated acoustic identifications from the Kaleidoscope Pro software and existing available habitat, the project area is capable of supporting bat species known to Morris County including common species such as big browns, hoary, eastern red and evening bats. Qualitative analysis performed by ICF biologists of the 376 suspected *Myotis* species calls determined these calls as being from eastern red bats. Though this study did not confirm the presence of northern long-eared, Indiana, or tricolored bats, a previous study provided to ICF for review identified tricolored bats in the project area.

ICF appreciates the opportunity to provide this report for summer acoustic bat detector surveys for Friends of the Drew Forest at the Drew University Forest Preserve in Madison, NJ. Should you have any questions or concerns, please contact Drew Powell at Drew.Powell@icf.com.

Sincerely,

Drew Powell
 Project Ecologist/Project Manger
 ICF

Attached: Figure 1: Project Location Map
 Figure 2: Acoustic Detector Location Map
 Appendix A: Representative Photographs & Habitat Assessment Datasheet
 Appendix B: Acoustic Survey Analysis Results (Electronic)



N

**Bat Acoustic Survey
Drew University Forest
Morris County, NJ**

0 1,300 2,600 3,900 5,200 6,500 Feet

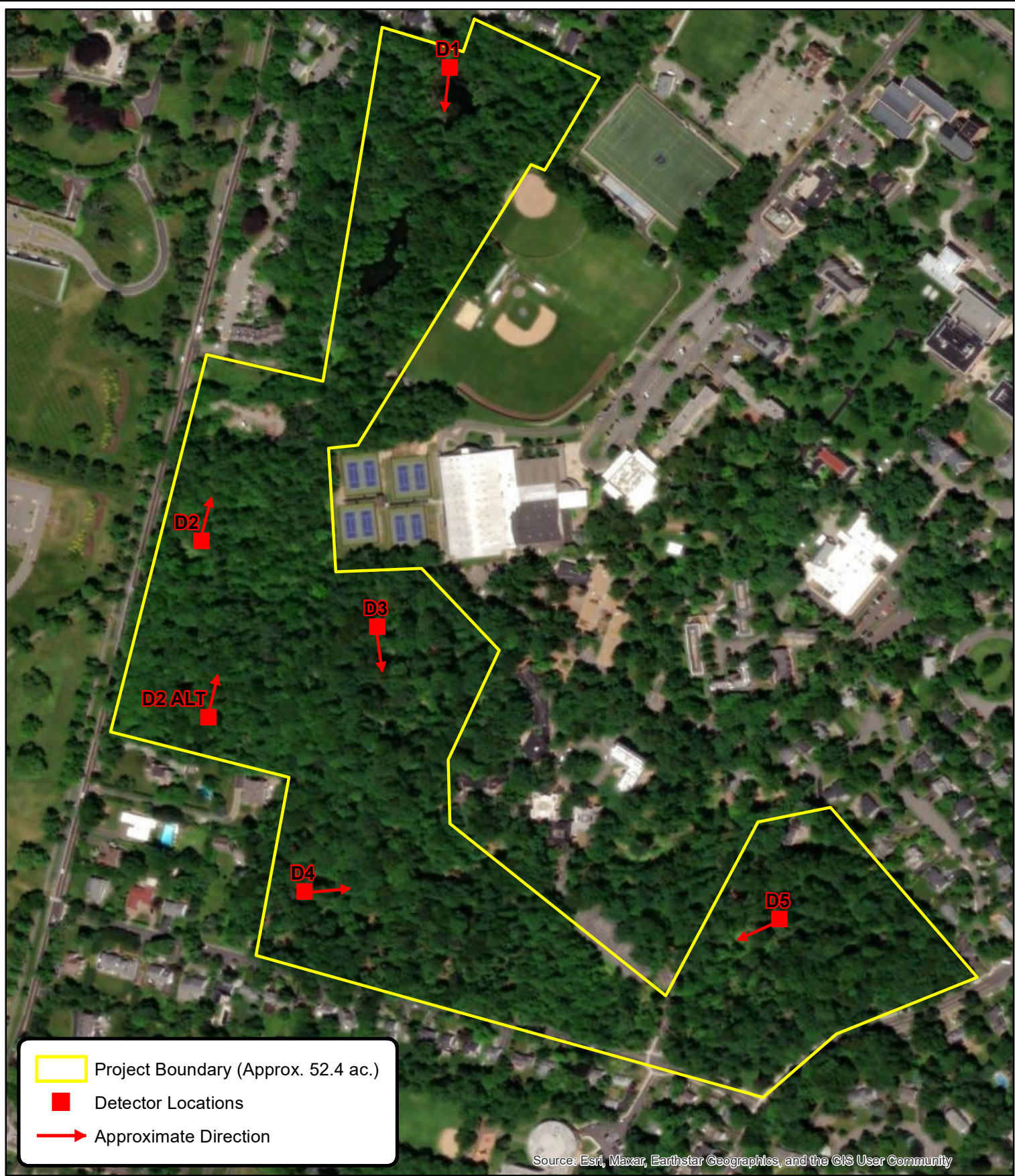
1 inch equals 0.8 miles

FIGURE 1

Project Location Map

Drawn by: SAS | Revised Date: 7-10-23

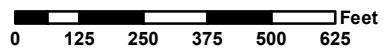
Prepared For: Davey Resource Group



Project Boundary (Approx. 52.4 ac.)
■ Detector Locations
→ Approximate Direction



**Bat Acoustic Survey
Drew University Forest
Morris County, NJ**



1 inch equals 0.1 miles

FIGURE 2

Acoustic Detector Location Map



Drawn by: SAS | Revised Date: 7-10-23

Prepared For: Davey Resource Group

Appendix A: Representative Photographs from Acoustic Detector Survey at Drew University & Habitat Assessment Datasheet

Representative Photographs from Acoustic Detector Survey at Drew University



Detector site D1 (6/6/2023)



Detector site D1 (6/6/2023)



Detector site D1 (6/6/2023)



Detector site D2 (6/6/2023)



Detector site D2 (6/6/2023)



Detector site D2 (6/6/2023)

Representative Photographs from Acoustic Detector Survey at Drew University



Detector site D3 (6/6/2023)



Detector site D3 (6/6/2023)



Detector site D3 (6/6/2023)



Detector site D4 (6/6/2023)



Detector site D4 (6/6/2023)



Detector site D4 (6/6/2023)

Representative Photographs from Acoustic Detector Survey at Drew University



Detector site D5 (6/6/2023)



Detector site D5 (6/6/2023)



Detector site D5 (6/6/2023)



Alternate D2 detector site D2 ALT (6/9/2023)



Alternate D2 detector site D2 ALT (6/9/2023)



Alternate D2 detector site D2 ALT (6/9/2023)

Representative Photographs from Acoustic Detector Survey at Drew University



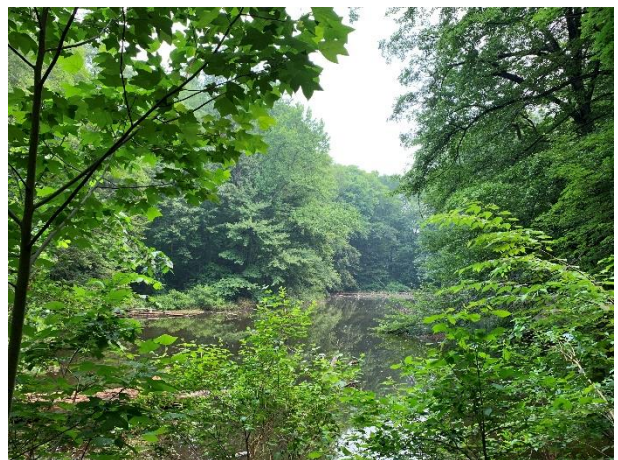
Opening in forest from fallen tree (6/6/2023)



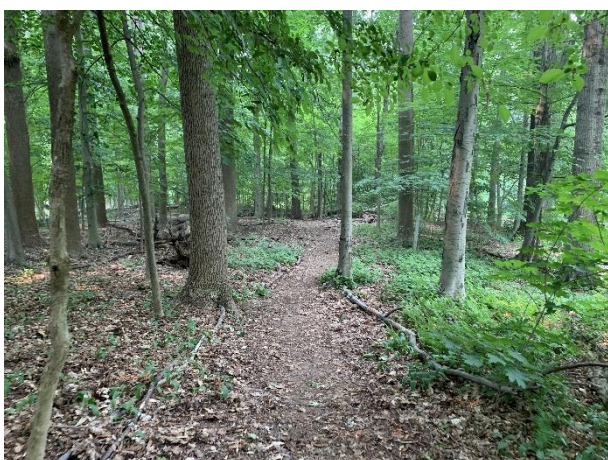
Forest interior in Hepburn Woods (6/6/2023)



Forest interior outside of Hepburn Woods (6/6/2023)



Pond located in the Zuck Arboretum (6/6/2023)



Trail around pond in the Zuck Arboretum (6/6/2023)



Pond located in the Zuck Arboretum (6/6/2023)



USFWS PHASE 1 HABITAT ASSESSMENTS

BAT HABITAT ASSESSMENT DATASHEET

Project Name: Acoustic Detector Survey for Bats at Drew University Date: 6/6/2023
Township/Range/Section: Madison, NJ
Lat Long/UTM/Zone: 40.759513° -74.432282° Surveyor: Drew Powell

Brief Project Description
Performing presence/absence acoustic detector surveys for bats in the Drew Forest Reserve on the campus of Drew University.

Table with columns: Project Area (Total Acres, Forest Acres, Open Acres) and Proposed Tree Removal (ac) (Completely cleared, Partially cleared, Preserve acres- no clearing).

Table with columns: Vegetation Cover Types (Pre-Project, Post-Project) listing forest types like Mature Oak/Hickory forest and Mid successional hardwood forest.

Landscape within 5 mile radius
Flight corridors to other forested areas? Yes
Describe Adjacent Properties (e.g. forested, grassland, commercial or residential development, water sources) Farmland, Woodland, semi-forested residential

Proximity to Public Land
What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?
2 miles from the Great Swamp National Wildlife Refuge Wilderness Area



USFWS PHASE 1 HABITAT ASSESSMENTS

Use additional sheets to assess discrete habitat types at multiple sites in a project area
 Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area
 A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): <u>HA-1</u>

Water Resources at Sample Site				Describe existing condition of water sources: <u>Two ponds (.5 & .83 acres) located in Zuck Arboretum</u>
Stream Type (# and length)	Ephemeral N/A	Intermittent N/A	Perennial N/A	
Pools/Ponds (# and size)	Open and accessible to bats?			
Wetlands (approx. ac.)	Permanent N/A	Seasonal N/A		

Forest Resources at Sample Site				1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81-100%
Closure/Density	Canopy (> 50%) 5	Midstory (20-50%) 2	Understory (<20%) 3	
Dominant Species of Mature Trees	<u>A. saccharum, Q. robra, C. tomentosa, L. tulipifera, A. rubrum</u>			
% Trees w/ Exfoliating Bark	1	0	0	
Size Composition of Live Trees (%)	Small (3-8 in) 2	Med (9-15 in) 5	Large (>15 in) 1	
No. of Suitable Snags	4			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes

IS THE HABITAT SUITABLE FOR NORTHERN LONG-EARED BATS? Yes

Additional Comments: Forest biodiversity is mostly uniform throughout forest Reserve with the exception of a few areas of high clutter in the mid and understory of the forest.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees, water sources

Appendix B: Acoustic Survey Analysis Results
(Electronic folder Attachment)