

**Terrestrial Species of Concern Study for the  
Pensacola Hydroelectric Project  
(FERC Project No. 1494)  
Craig, Delaware, Mayes, and Ottawa Counties,  
Oklahoma  
Updated Study Report**

Job# HJN-21021

PREPARED FOR



GRAND RIVER DAM AUTHORITY

PREPARED BY



Environmental Services, Inc.

1507 S Interstate 35  
Austin, Texas 78741  
512.328.2430  
horizon-esi.com

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## SECTION 1 BACKGROUND

This report serves as an update to the 2021 Initial Study Report (ISR) re: beetles and bats.

The purpose of the American Burying Beetle (*Nicrophorus americanus*; ABB) portion of this report is to provide a comparison of distributions of beetles to inundation maps generated by the Comprehensive Hydraulic Model (CHM) to characterize the effects of anticipated operations of the Pensacola Hydroelectric Project (Project) operations.

The purpose of the bat portion of this report is to assess the degree to which anticipated Project operations under the new license would inundate the main entrance to Beaver Dam Cave and compare the frequency of inundation with that associated with baseline operations. Grand River Dam Authority (GRDA) has determined whether the secondary exit suffices to provide an alternative access by gray bats (*Myotis grisescens*) to the cave (during times of inundation under anticipated Project operations).

Access to cave DL-2 (Beaver Dam Cave) and cave DL-91 (Twin Cave) has the potential to be affected by anticipated Project operations. Data generated by the CHM as part of the H&H Study were used and analyzed with respect to the gray bat to determine potential effects of anticipated Project operations to the species.

## SECTION 2 AMERICAN BURYING BEETLE

Horizon conducted a 2021 and 2022 American burying beetle (*Nicrophorus americanus*; ABB) presence/absence survey in accordance with the USFWS American Burying Beetle Range-Wide Presence/Absence Survey Guidance, dated May 2018 (Guidance). Communication with Kevin Stubbs (USFWS) (Appendix C) ensured Horizon that our Project Area sufficiently covered beetle habitat types including those located in GRDA's Wildlife Management Areas (WMA). The Project Area is located within the range of the federally threatened ABB, but outside of any conservation priority area (CPA) (Appendix A).

ABBs are habitat generalists and may use a variety of habitats that provide friable, moist soils and contain leaf litter and a variety of native vegetation above 8 inches in height to both retain soil moisture and support prey species. The USFWS provides guidance for what is considered unsuitable ABB habitat in their American Burying Beetle Conservation Strategy for the Establishment, Management, and Operation of Mitigation Lands for Impacts that Occur in Oklahoma guidance document, dated 1 September 2019.

### **ABB Habitat Exclusions**

While the ABB uses a wide variety of habitats, the USFWS currently believes that areas exhibiting the following characteristics will not be of conservation value to ABBs and will not be credited as mitigation, except as possible buffer credits described below under the Crediting Method section. Areas exhibiting these characteristics should be excluded from mitigation lands because they are considered unfavorable for use by ABBs based on disturbance regime, vegetation structure, unsuitable soil conditions, and carrion availability:

1. Land that is tilled on a regular basis, planted in monoculture, and does not contain native vegetation.
2. Pasture or grassland that has been maintained through frequent mowing, grazing, or herbicide application at a height of 20 cm (8 inches) or less.
3. Land that has already been developed and no longer exhibits topsoil, leaf litter, or vegetation.
4. Urban areas with maintained lawns, paved surfaces, or roadways.
5. Stockpiled soil without vegetation.
6. Wetlands or permanent waterbodies with standing water or saturated soils. Areas adjacent to wetlands and/or riparian areas are not considered unfavorable for the ABB, as they may be important for ABBs seeking moist soils during dry conditions.

### **2.1 ABB Study Year One**

As reported in the ISR, six traps were deployed within suitable, representative terrain within the Project Area. Trap sites were selected based on suitable habitat and capture of the most significant in size terrestrial areas within the study area boundary in Delaware and Ottawa counties. Surveys were conducted between 18 July and 23 July 2021 with valid weather conditions through the duration of the survey effort. No ABBs were found during the 2021 presence/absence survey (**Figure 1**).

## 2.2 ABB Study Year Two

Six baited pitfall bucket traps were deployed within suitable, representative terrain on 9 June 2022 in Delaware and Ottawa counties. This presence/absence survey was conducted as an early season survey in accordance with the approved study plan. Trap placement was also selected based on discussion and advisement of USFWS staff, in email communication dated 25 March 2022. Mr. Stubbs requested that the traps be placed within the best suitable habitat including designated WMAs and the Coal Creek wetland mitigation site (**Figure 2**).

The survey continued with five nights of valid weather parameters. Guidance defines valid weather parameters as:

1. Nighttime temperature during the survey period above 60° F (15.5 C)
2. Wind speed no greater than 10 mph in excess of 20% of the time (1 hour 24 minutes) between 9:00 p.m. and 4:00 a.m.,
3. Precipitation less than 0.5 inches between 9:00 p.m. and 4:00 a.m.

Weather conditions were valid throughout the course of the survey effort. No ABBs were captured or observed during this survey. These negative survey findings indicate that the ABB is not active within the Project Area; thus, take (defined by the Endangered Species Act [ESA] as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species”) is not expected as a result of this project.

## SECTION 3 BATS

Based on the respective roosting habitats of the two bat species and known patterns of cave use adjacent to Grand Lake, the federally threatened northern long-eared bat (*Myotis septentrionalis*) is unlikely to be affected by alterations in cave access associated with Project operations. As a result, for this objective, GRDA will focus its efforts on federally endangered gray bats (*Myotis grisescens*) in the caves which they are known to use.

Cave DL-2 (Beaver Dam Cave) in Delaware County is adjacent to Drowning Creek, a tributary of Grand Lake, and is within the maximum inundation area on the lentic conversion maps (**Figures 3 and 4**). The cave passage is <65 meters (m) long with a single historical roost site for gray bats located 4 m above a persistent stream and about 5 m from the entrance to the cave. Complete inundation of the cave passage occurs at 752 feet in elevation. The roost was first documented as housing a colony of gray bats in 1981 when the colony was estimated to be 13,700 bats. Except during major flood events, based on recent exit and capture surveys at the entrance, the size and status (lactating females) of the colony remains relatively constant for the past 25 years.

Cave DL-91 (Twin Cave) is also located in Delaware County about 1 kilometer (km) from Grand Lake with an elevation (840 feet) precluding any threat of inundation. It is also outside of the maximum inundation area on the lentic conversion maps (**Figures 3 and 5**). The cave has a mapped passage of 803 m and has historical records of nine roost sites for gray bats. Prior to 1973, DL-91 historically housed the largest colony of gray bats in Oklahoma, estimated to be as many as 113,000 bats (Martin et al. 2000). Recent population estimates of the summer colony have been as high as 31,962 bats.

### 3.1 Procedures in 2021 Maternity Season

Infrared (IR)-illuminated entrance and night vision optics were used to conduct non-intrusive exit surveys and population estimates of gray bat colonies exiting caves DL-2 and DL-91 in the 2021 summer maternity and post-maternity season. Such surveys are used to document habitation, assist in estimating colony size at the respective caves, and monitor movements of the colony during potential high water and flood events on Grand Lake.

Exit surveys were conducted at cave DL-2 on 22 June and at cave DL-91 on 24 June and again on 16 July 2021 (Table 1). The post-maternity colony population estimate at cave DL-91 during late summer 2021 (Table 1) was within the range of 10,000 to 29,905 bats (average =18,245) over the past decade (Table 3).

**Table 1: Population estimates of gray bat colonies at caves DL-2 and DL-91 in Delaware County, OK in the 2021 maternity season**

Date	Survey Method	Population at Cave DL-2	Population at Cave DL-91
6/22/2021	Exit Survey	11,800	
6/24/2021	Exit Survey		510

Date	Survey Method	Population at Cave DL-2	Population at Cave DL-91
7/16/2021	Exit Survey		20,440

<sup>1</sup> Gray bat colony size estimates are based on exit surveys using infrared-illuminated entrances and night vision optics during summer 2021.

### 3.2 Procedures in 2022 Maternity Season

An IR-illuminated entrance and night vision optics were used to conduct non-intrusive exit surveys and population estimates of gray bat colonies exiting caves DL-2 and DL-91 in the 2022 summer maternity and post-maternity season. Such surveys are used to document habitation, assist in estimating colony size at the respective caves, and monitor movements of the colony during potential high water and flood events on Grand Lake.

Exit surveys were conducted at cave DL-2 on 27 June and at cave DL-91 on 10 May during a high-water event, and 22 June and 4 August (Table 1). The post-maternity colony population estimate at cave DL-91 during late summer 2022 (Table 2) was within the range of 10,000 to 29,905 bats (average =19,877) over the past decade (Table 3).

**Table 2: Population estimates of gray bat colonies<sup>1</sup> at caves DL-2 and DL-91 in Delaware County, OK in the 2022 maternity season**

Date	Survey Method	Population at Cave DL-2	Population at Cave DL-91
5/10/2022	Exit Survey		20,620
6/22/2022	Exit Survey		6,600
6/27/2022	Exit Survey	13,300	
8/4/2022	Exit Survey		23,877

<sup>1</sup> Gray bat colony size estimates are based on exit surveys using infrared-illuminated entrances and night vision optics during summer 2022.

**Table 3: Ten-year post-maternity population<sup>2</sup> estimates of the colony of gray bats using caves DL-2 and DI-91 in Delaware County, Oklahoma**

Date	Population at Cave DL-91
8/22/2013	29,905
9/11/2014	18,015
8/5/2015	20,585
7/21/2016	16,520
9/12/2017	19,340

Date	Population at Cave DL-91
8/30/2018	18,000
5/21/2019	15,200
8/25/2020	16,883
7/16/2021	20,440
8/4/2022	23,877

<sup>2</sup> The post-maternity colony is historically found at cave DL-91.

Cave abandonment may result from high water events, or late-season migration after young become volant as often occurs in other areas of the species' range. Under favorable conditions, the colony ultimately vacates the maternity cave at DL-2 entirely in mid-summer and migrates to cave DL-91 located <5 km away (Grigsby et al. 1993; Martin et al. 2000) where the colony tends to remain until migration to hibernacula in November. Although cave DL-91 has intermittently served as a favorable maternity location, it is possible that it provides suboptimal climate conditions for a maternity colony compared to cave DL-2 with respect to microclimate and proximity to an abundant food source for developing young. Annual mid-summer migration phenomena are intriguing because migration of any type elicits its own inherent effects on animal populations that are exacerbated in young and reproductive adults.

During a high-water event in early May 2022 the exit survey at DL-91 was greater than 20,000 bats indicating the colony successfully vacated DL-2 prior to passage inundation by the rising Grand Lake levels. In review of surveys since 2007 there have now been 10 such high-water events resulting in the colony's successful relocation to cave DL-91. This leads to a trend of the colony using each cave on average about the same number of years as the maternity colony roost, and the ecological importance of management and monitoring of both sites. Historically when flooding events have occurred early in the spring followed by receding lake levels (April and early May), it is not unusual for the colony to return to cave DL-2 for the maternity period. This phenomenon was verified again on 27 June 2022 when the population was observed in cave DL-2 for the maternity period (Table 2). Observations from the 2022 season once again supports historical evidence that during high water or flood events during the maternity season, the maternity colony of the endangered gray bat can successfully vacate cave DL-2 and migrate to cave DL-91.

Complete inundation of the cave passage of DL-2 occurs at about elevation 752 feet Pensacola Datum (PD). When Grand Lake is at about elevation 751 feet PD, only about one foot of flyway exists between the top of the water in the cave and the rock ceiling of the flyway, likely resulting in a significant to normal behavior including feeding, rearing of young, and sheltering, and possibly forcing evacuation of the colony to the alternative cave (Table 4). Forcing the colony to vacate during critical maternity periods (March through July) likely adversely affects pregnant or lactating females, and non-volant or newly volant young. If bats become trapped in cave DL-2, they could survive only a limited amount of time due to the high energy demands of raising young. Other potential adverse effects include the stress of being trapped, drowning, and, if adults are trapped outside the cave, stress and mortality of non-volant young.



In October 2008 a small, high passage within cave DL-2 was identified and minimally excavated and enlarged. Enlarging this passage was suspected to provide an alternative escape route for exiting bats, particularly during high water. Additional excavation and enlargement of this second-high passage was completed in October 2013. The length of the high passage was about 5m and was widened to about 0.40 meters wide by 0.50 meters tall. An inspection of the passage following a flood event in summer 2015, and again during this project period in 2022, revealed scattered guano in the enlarged passage indicating use by bats. The post-inundation monitoring visit to the cave on 27 June 2022 failed to give any indication that take had occurred as a result of inundation in early May 2022.

**Table 4: Records of highwater events<sup>3</sup> where the elevation of Grand Lake exceeded elevation 750.00 feet PD from 2005-2022**

Year	Date Beginning	Date Ending	Maximum Elevation (ft)	Total Duration	Impact on Colony
2007	3 July	16 July	754.54	14 days	Successfully Vacated
2008	11 April	20 April	753.04	10 days	Successfully Vacated
2008	13 June	26 June	752.48	14 days	Successfully Vacated
2011	27 April	28 April	750.80	2 days	Successfully Vacated
2011	25 May	26 May	751.71	2 days	Successfully Vacated
2015	27 May	22 June	754.89	27 days	Successfully Vacated
2017	30 April	25 May	754.77	26 days	Successfully Vacated
2019	14 May	15 July	755.02	63 days	Successfully Vacated
2022	7 May	10 May	753.30	3 days	Successfully Vacated

<sup>3</sup> At elevation 752 feet PD, the existing flyway inside cave DL-2 is inundated preventing colony exit and re-entry.

## SECTION 4 ANALYSIS

In support of the Terrestrial Species Study, GRDA performed additional simulations that were used to assess operational impact to specific terrestrial species. One product of the simulations specific to the ABB analysis was the development of maps showing areas of potential lentic or lotic conversion which could impact the habits of specific terrestrial species.

The seasonal period identified by the Terrestrial Species Study team was the entire calendar year, January 1 to December 31 because ABBs could be impacted during both their active and inactive or hibernation periods each year.

For both anticipated operations and baseline operations, the seasonal median operational level and inflows were simulated in the CHM. Results and maps were provided to the Terrestrial Species Study team.

In accordance with Section 2.6 of the Terrestrial Species Revised Study Plan, maximum inundation was also identified on all terrestrial maps created. The maximum inundation was virtually identical for anticipated and baseline operations because the maximum inundation boundary occurs when the USACE is in flood control operations, and it is not an effect of GRDA baseline or anticipated operations. Therefore, to analyze the impacts of the baseline versus the anticipated Project operations, the normal (median) inundations are used because they occur on such a regular basis that a habitat conversion can occur versus just a regular inundation.

See Appendix A, **Figures 6.1 – 6.23** for the Terrestrial Species Lentic Conversion Maps.

The second product of the CHM for the Terrestrial Species Study was specific to the gray bat analysis and provided the percentage of time the reservoir would be above the key reservoir elevations of 746 feet PD, 751 feet PD, and 752 feet PD for both the baseline and anticipated Project operations during the key season for gray bats of April 1 to July 31 each year.

The results are presented in Table 5.

**Table 5: Percentage of time Grand Lake Reservoir is above key elevations**

Percentage of Time Above Reservoir Elevation	Baseline Operations	Anticipated Operations	Percentage Increase
746 feet PD	16.5%	16.9%	0.4%
751 feet PD	2.9%	2.7%	(0.2%)
752 feet PD	1.9%	1.9%	0%

### 4.1 ABB

The comparison of the baseline and anticipated Project operations yielded 2.79% terrestrial habitat may become aquatic habitat as a result of the anticipated operations (**Figures 6.1 – 6.23**).

Much of this area is comprised of unsuitable ABB habitat such as rocky and/or sandy shoreline devoid of vegetation. Further, no ABBs have been located within the two years of project-specific

study efforts nor have any ABBs been found within Delaware or Ottawa Counties in historical records provided by the USFWS spanning 1979 – 2018 (**Figure 7**). As a result, despite the expectation that some suitable ABB habitat may be converted to aquatic habitat, there is no reasonable expectation that ABBs are or have been using the habitat and thus, the impact, if any, is negligible.

## 4.2 Bats

The CHM analysis shows under the anticipated operations of the Project, the Grand Lake Reservoir will exceed 746 feet PD, the reservoir elevation at which water flows into the entrance of cave DL-2 (Beaver Dam) 16.5% under baseline operations and 16.9% under anticipated operations. The anticipated operations will cause this situation to occur 0.4% more frequently.

Evacuation of DL-2 generally does not begin to occur until Grand Lake reaches an elevation of approximately 751 feet PD. According to the CHM analysis, under the anticipated operations of the Project, the Grand Lake Reservoir will exceed 751 feet PD, 2.9% under baseline operations and 2.7% under anticipated operations. The anticipated operations will cause this situation to occur 0.2% less frequently.

A Grand Lake Reservoir elevation of 752 feet PD results in a complete inundation of the cave passage in DL-2 forcing evacuation. According to the CHM analysis, under the anticipated operations of the Project, the Grand Lake Reservoir will exceed 752 feet PD, 1.9% under baseline operations and 1.9% under anticipated operations. The anticipated operations will cause this situation to occur the same percentage of time as the baseline operations.

The average post-maternity colony size illustrates relative consistency, ranging from 15,200 to 29,905 bats with an average colony size of 19,877 gray bats for the past 10 years. (Table 2). Efforts should be concentrated on maintaining strong ties with the landowner of the access to cave DL-2, so that similar security efforts can continue there for the long-term.

In sum, the gray bat colony sharing caves DL-2 and DL-91 each summer appears to maintain a stable population size.

The CHM analysis shows very little increase (0.4%) in the potential for water to enter the cave opening of DL-2 at an elevation of 746 feet PD and very little decrease in the potential for water to enter the cave to an elevation of 751 feet PD that possibly forces and evacuation of the colony to the alternative cave. Lastly, the CHM results indicate there is no change in the percentage of time the passage in cave DL-2 becomes entirely submerged at an elevation of 752 feet PD under the anticipated operations.

## SECTION 5 CONCLUSIONS

### 5.1 ABB

Much of the habitat within the Project area is shoreline, and as such, is largely unsuitable for the ABB (rocky and/or sandy shoreline devoid of vegetation). Further, no ABBs have been located within the two years of project-specific study efforts nor have any ABBs been found within Delaware or Ottawa Counties, nor within the vicinity of the project area within Craig and Mayes Counties in historical records provided by the USFWS spanning 1979 – 2018. As a result, despite the expectation that some suitable ABB habitat could be converted to aquatic habitat, there is no reasonable expectation that ABBs are or have been using the habitat and thus, the impact, if any, is negligible and no further coordination with the USFWS is recommended.

### 5.2 Bats

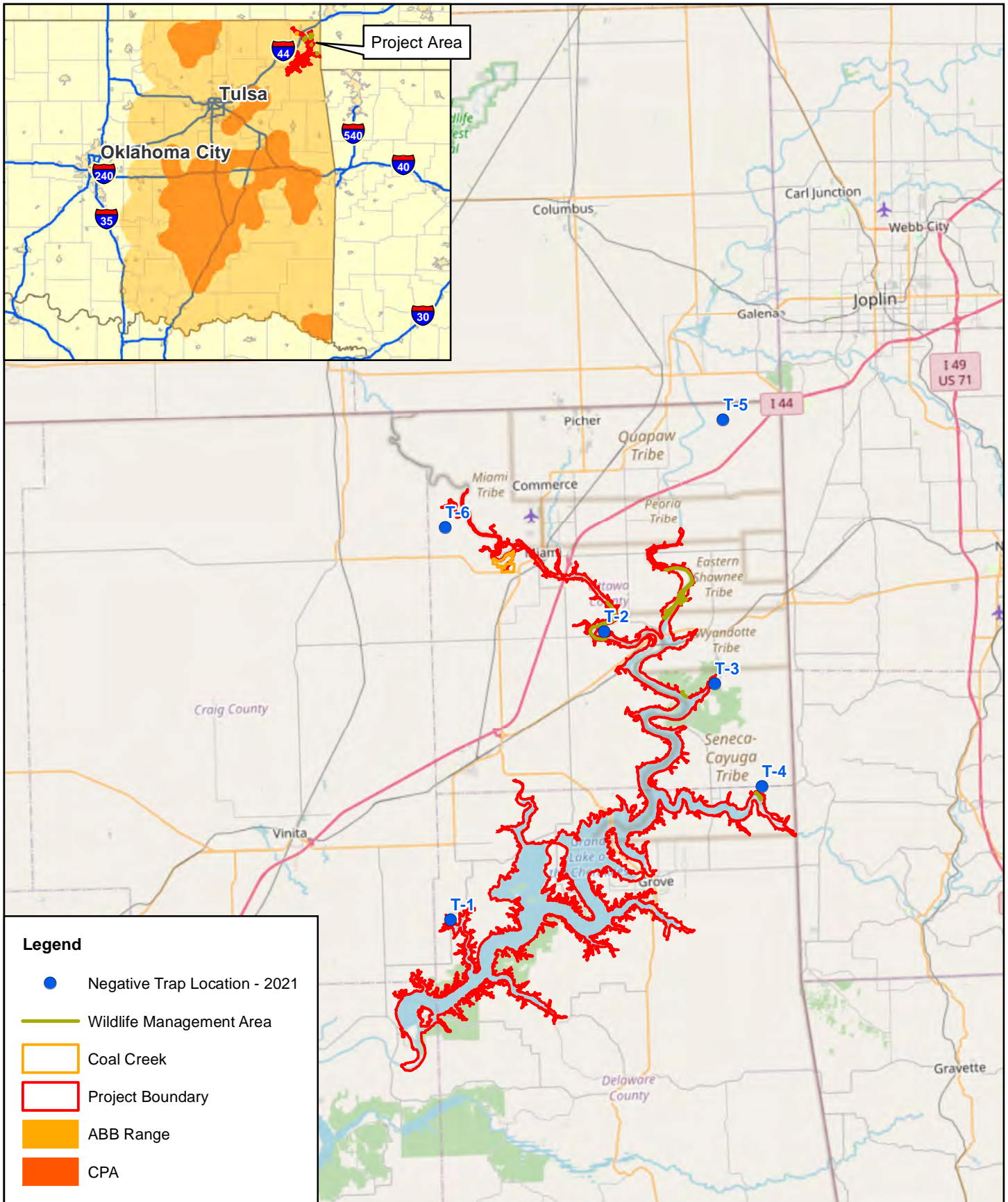
The findings of the gray bat study indicate the secondary exit suffices to provide an alternative access by gray bats in cave DL-2. Regardless of the efficacy of the alternative access, the entrance to cave DL-2 does not become completely inundated to elevations 751 feet PD and greater (complete inundation is 752 feet PD) any more frequently under the anticipated Project operations than it becomes inundated under the baseline Project operations. Therefore, the impact to gray bats is negligible.

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**APPENDIX A**  
Figures




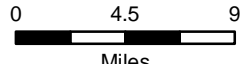
**Legend**

- Negative Trap Location - 2021
- Wildlife Management Area
- Coal Creek
- Project Boundary
- ABB Range
- CPA

Date:	09/03/2021
Drawn:	KRW
HJN NO:	21021
Source:	OSM, 2021

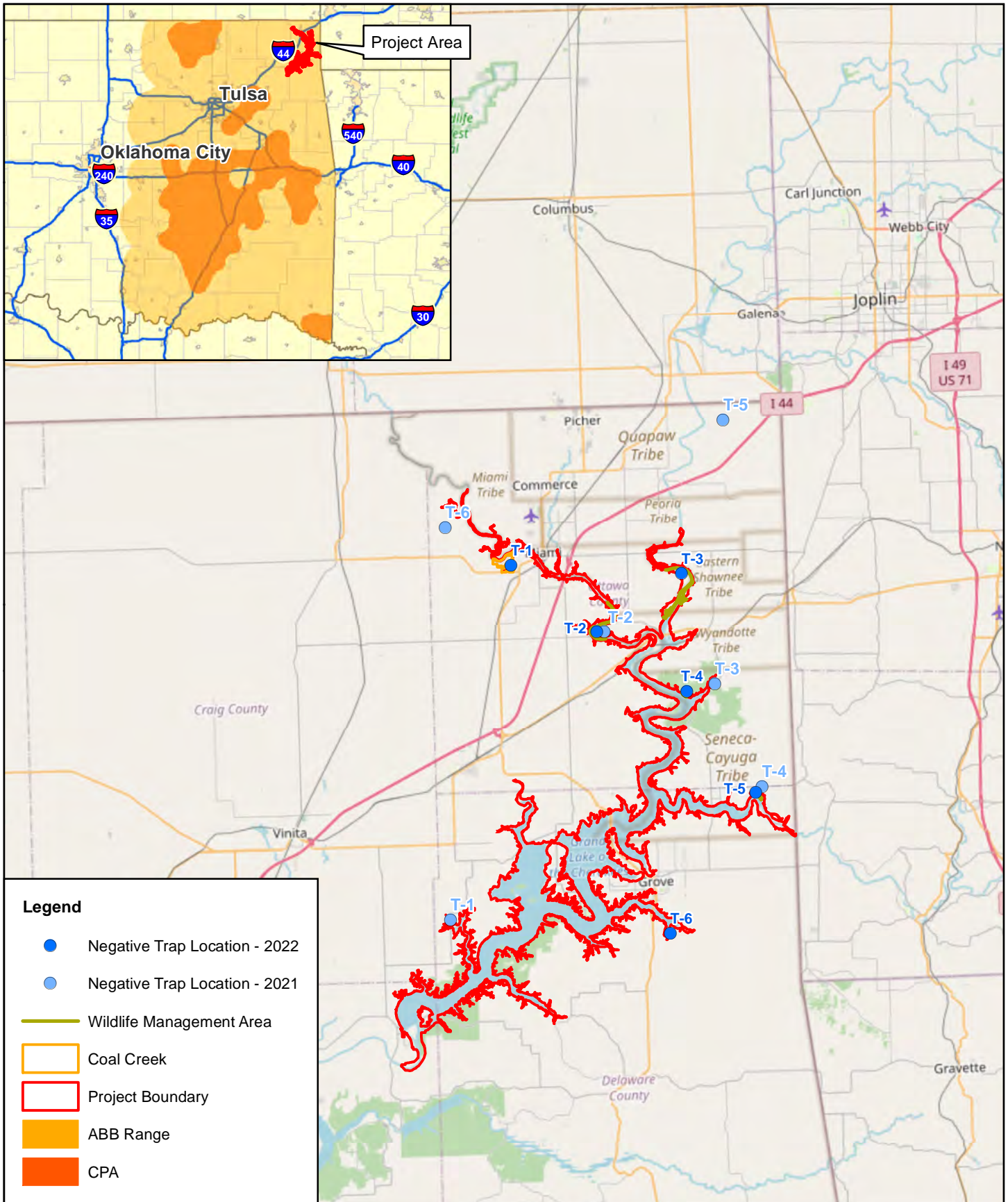
**Figure 1**  
 2021 ABB Survey Map  
 GRDA Pensacola Project  
 Craig, Delaware, Mayes &  
 Ottawa Counties, Oklahoma





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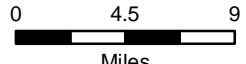
**Legend**

- Negative Trap Location - 2022
- Negative Trap Location - 2021
- Wildlife Management Area
- Coal Creek
- Project Boundary
- ABB Range
- CPA

Date:	08/29/2022
Drawn:	KRW
HJN NO:	21021
Source:	OSM, 2022

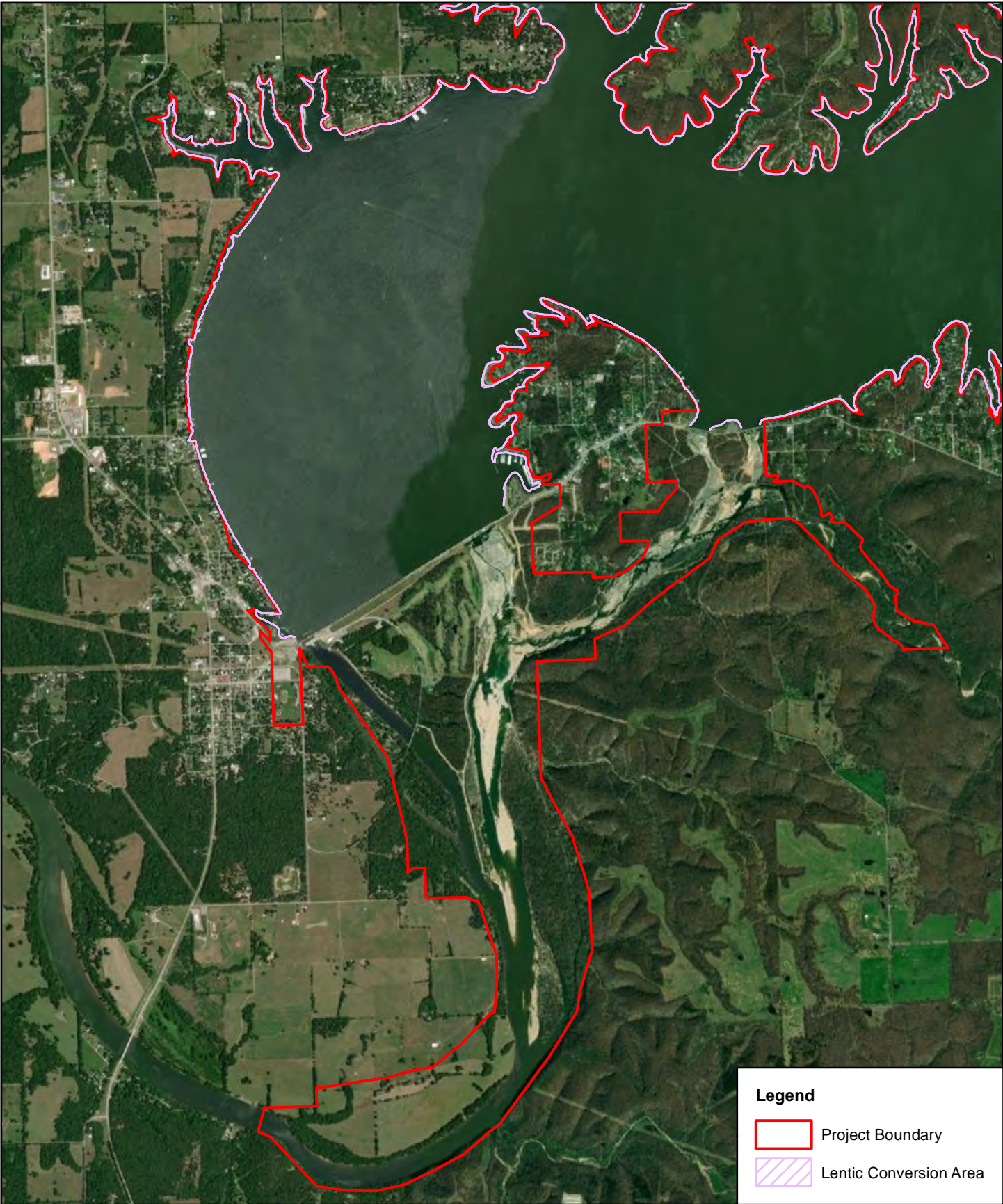
**Figure 2**  
 2022 ABB Survey Map  
 GRDA Pensacola Project  
 Craig, Delaware, Mayes &  
 Ottawa Counties, Oklahoma





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**Figures 3 - 5 are filed as privileged  
due to sensitive location information.**




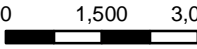
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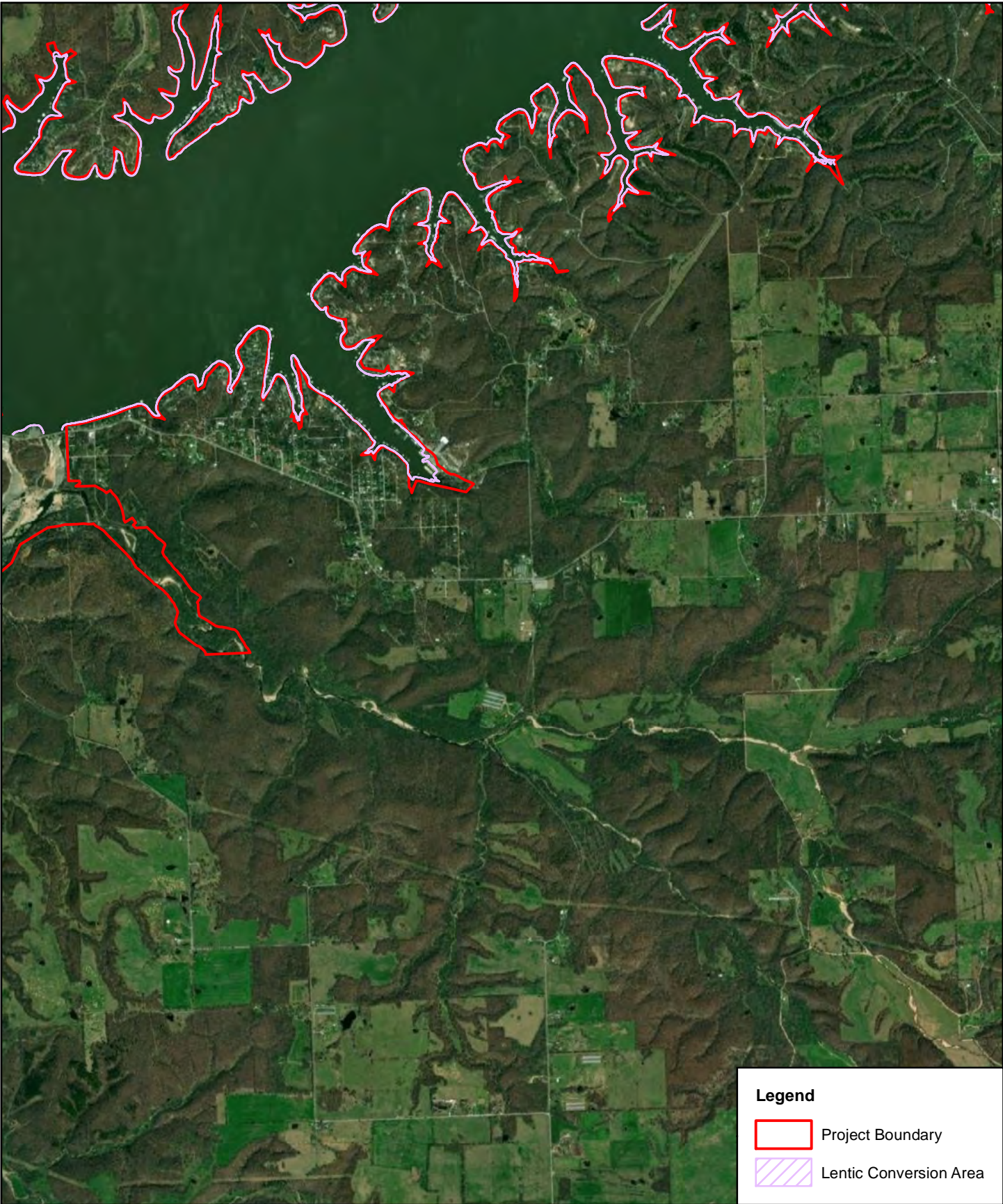
- Project Boundary
- Lentic Conversion Area

**Horizon**<sup>TM</sup>  
Environmental Services, Inc.



Date:	08/29/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.1**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma

  
 0    1,500    3,000  
  
 Feet



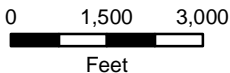
**Legend**

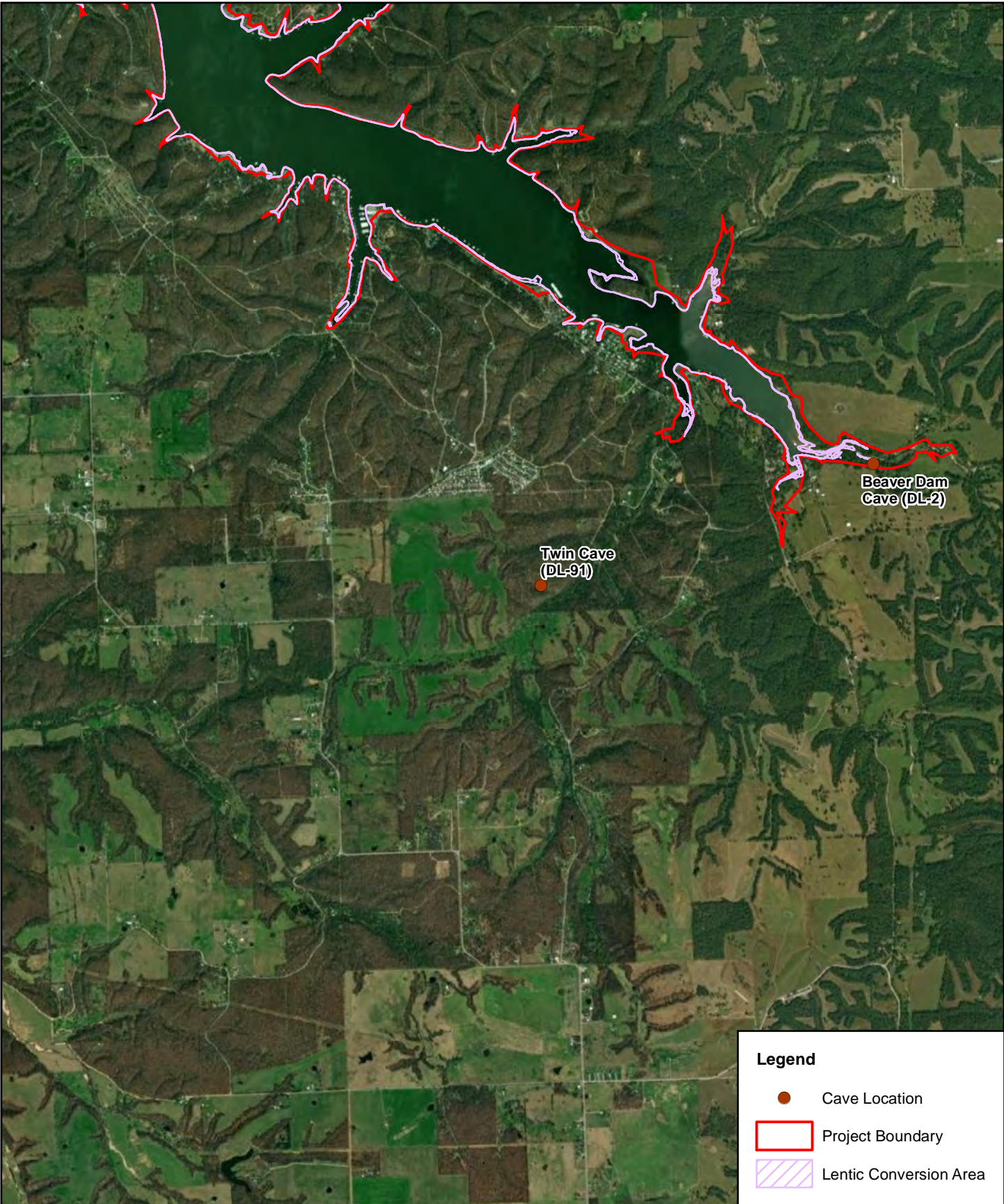
-  Project Boundary
-  Lentic Conversion Area

**Horizon**<sup>TM</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.2**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma






**Legend**

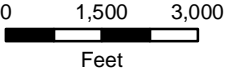
- Cave Location
- Project Boundary
- Lentic Conversion Area

**Horizon**<sup>™</sup>  
Environmental Services, Inc.

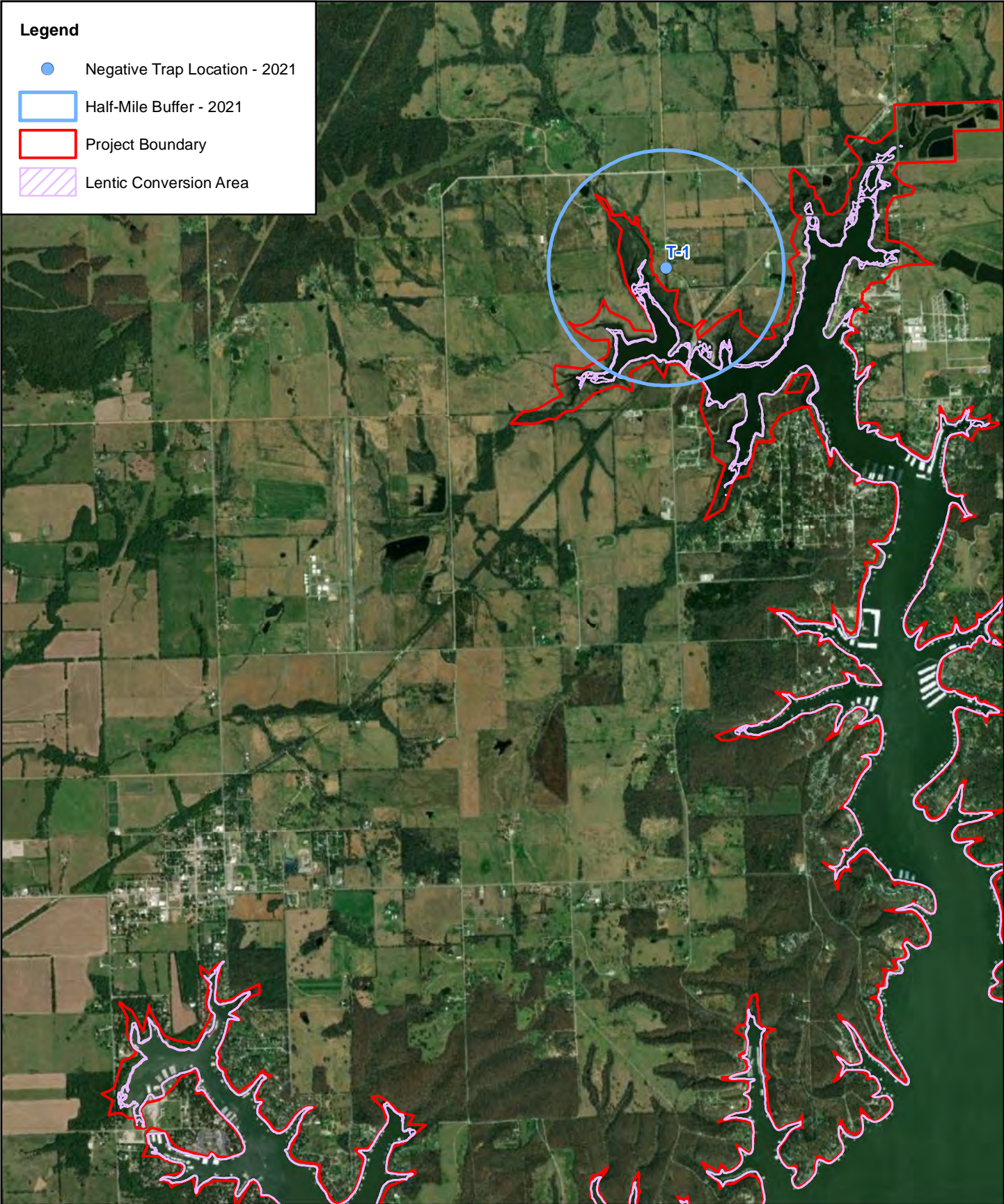
Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.3**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma





0    1,500    3,000  
Feet





**Legend**

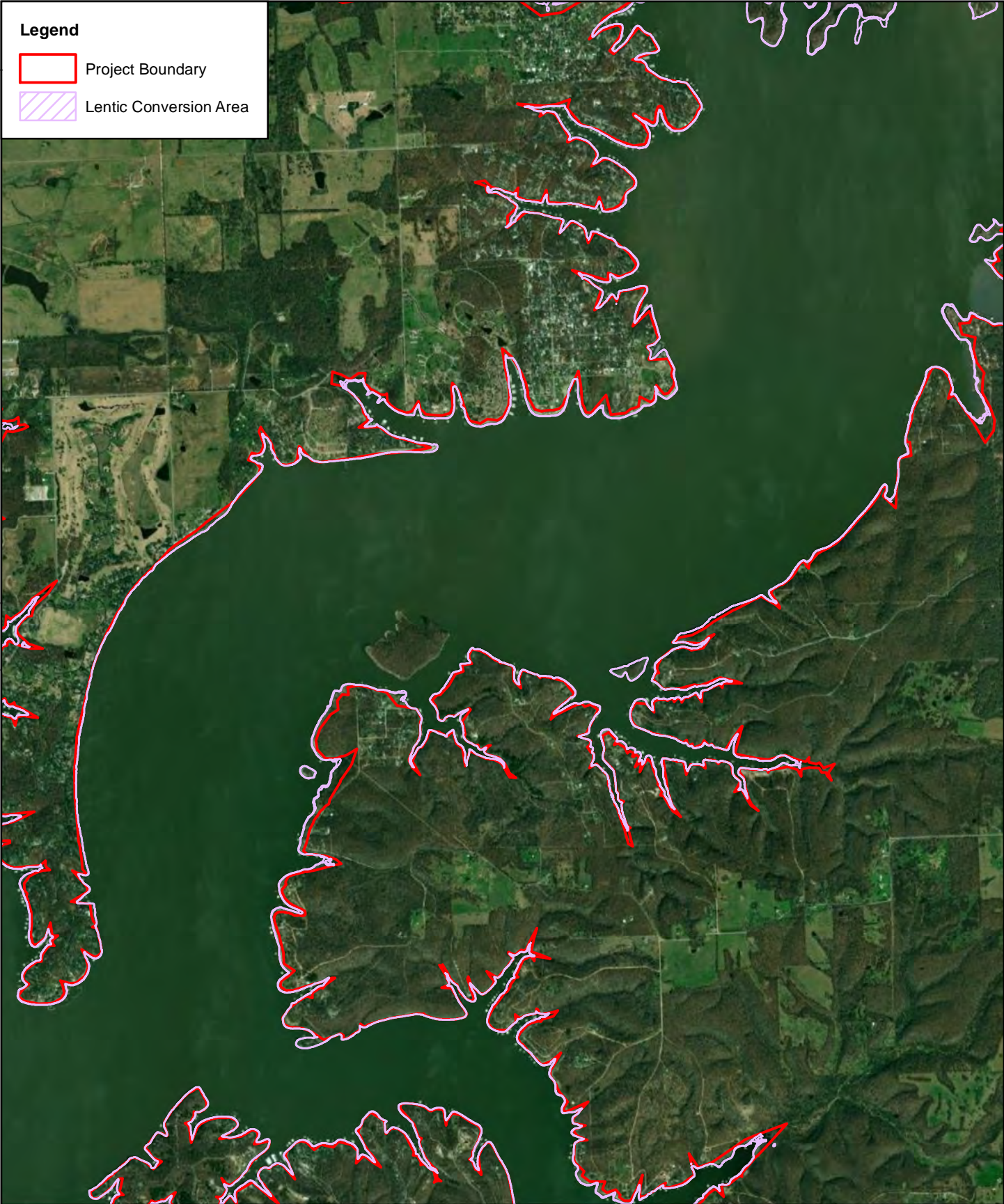
- Negative Trap Location - 2021
- Half-Mile Buffer - 2021
- Project Boundary
- Lentic Conversion Area

**Horizon**<sup>™</sup>  
Environmental Services, Inc.



Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.4**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma

  
 0    1,500    3,000  
  
 Feet



**Legend**

-  Project Boundary
-  Lentic Conversion Area

**Horizon**<sup>TM</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020


**Figure 6.5**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma




0 1,500 3,000  
Feet



**Legend**


 Project Boundary

 Lentic Conversion Area

**Horizon**<sup>TM</sup>  
Environmental Services, Inc.

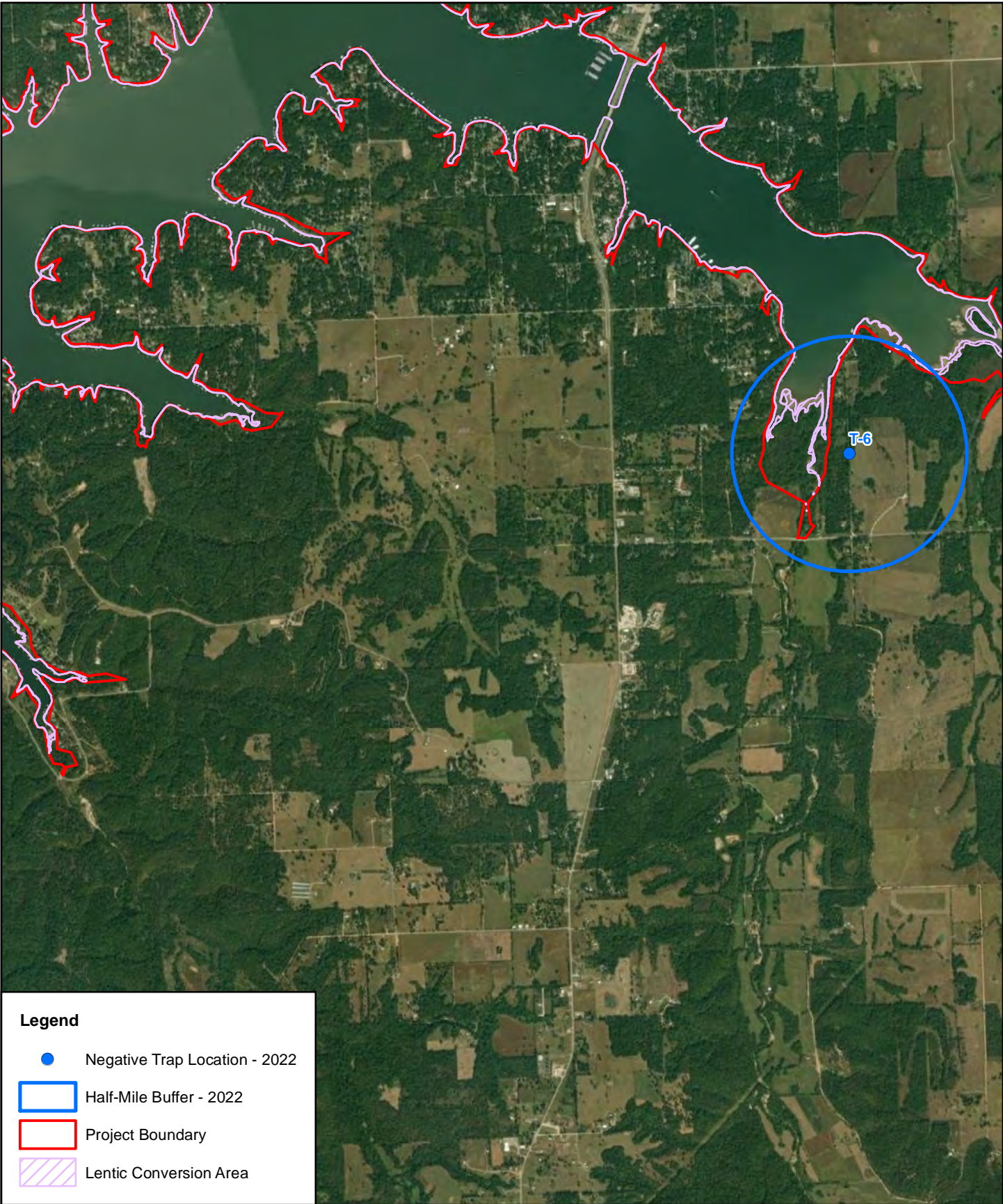
Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.6**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma



0 1,500 3,000  
Feet





**Legend**

- Negative Trap Location - 2022
- Half-Mile Buffer - 2022
- Project Boundary
- Lentic Conversion Area

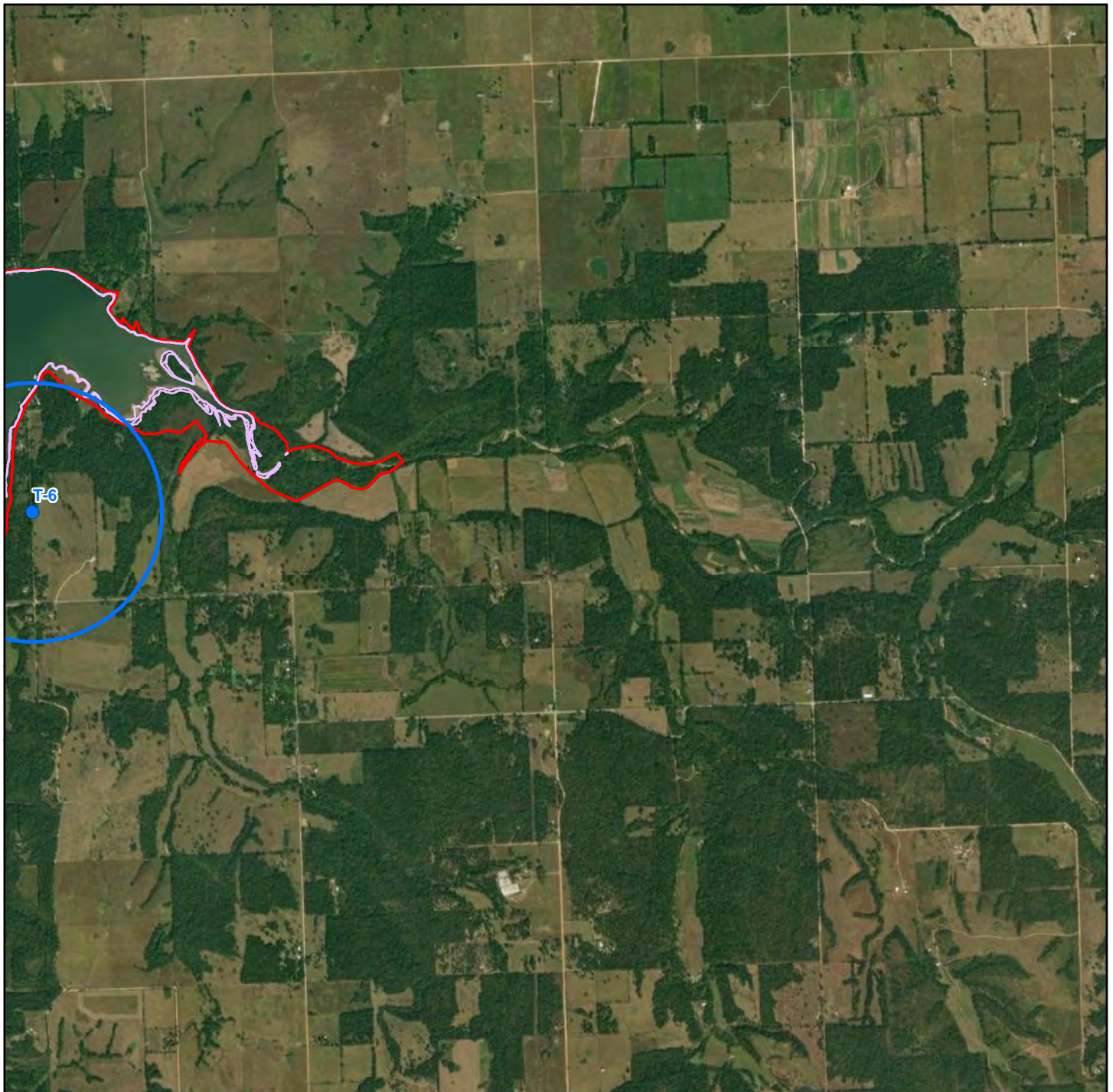
**Horizon**<sup>™</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.7**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma



0 1,500 3,000  
Feet




**Legend**

- Negative Trap Location - 2022
- Half-Mile Buffer - 2022
- Project Boundary
- Lentic Conversion Area

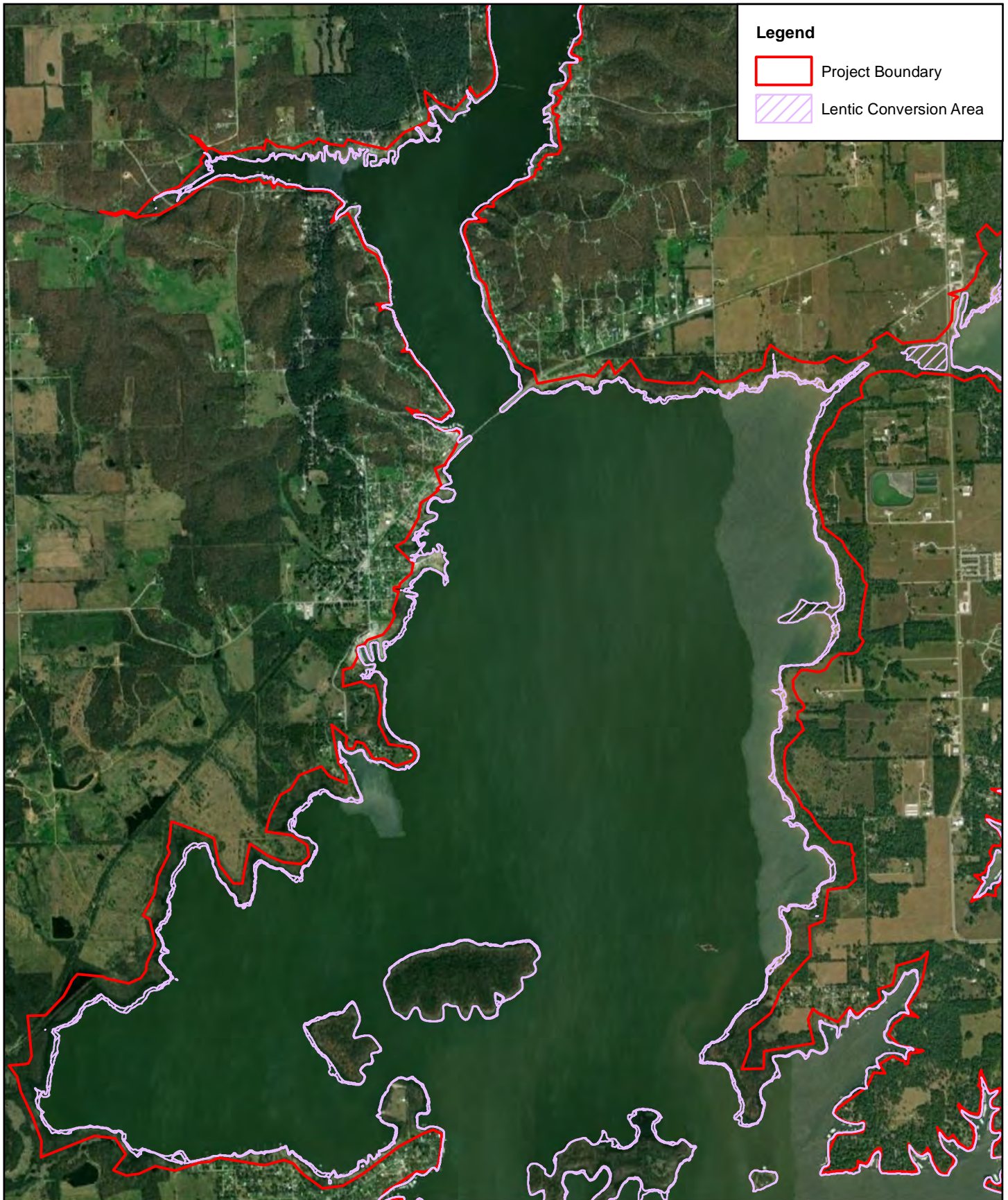
**Horizon**  
 Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020



**Figure 6.8**  
 Terrestrial Species Lentic Conversion Map  
 GRDA Pensacola Project  
 Craig, Delaware, Mayes &  
 Ottawa Counties, Oklahoma



0 1,500 3,000  
 Feet



**Legend**

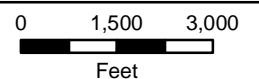
-  Project Boundary
-  Lentic Conversion Area

**Horizon**<sup>TM</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020



**Figure 6.9**

Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma






**Legend**


-  Project Boundary
-  Lentic Conversion Area

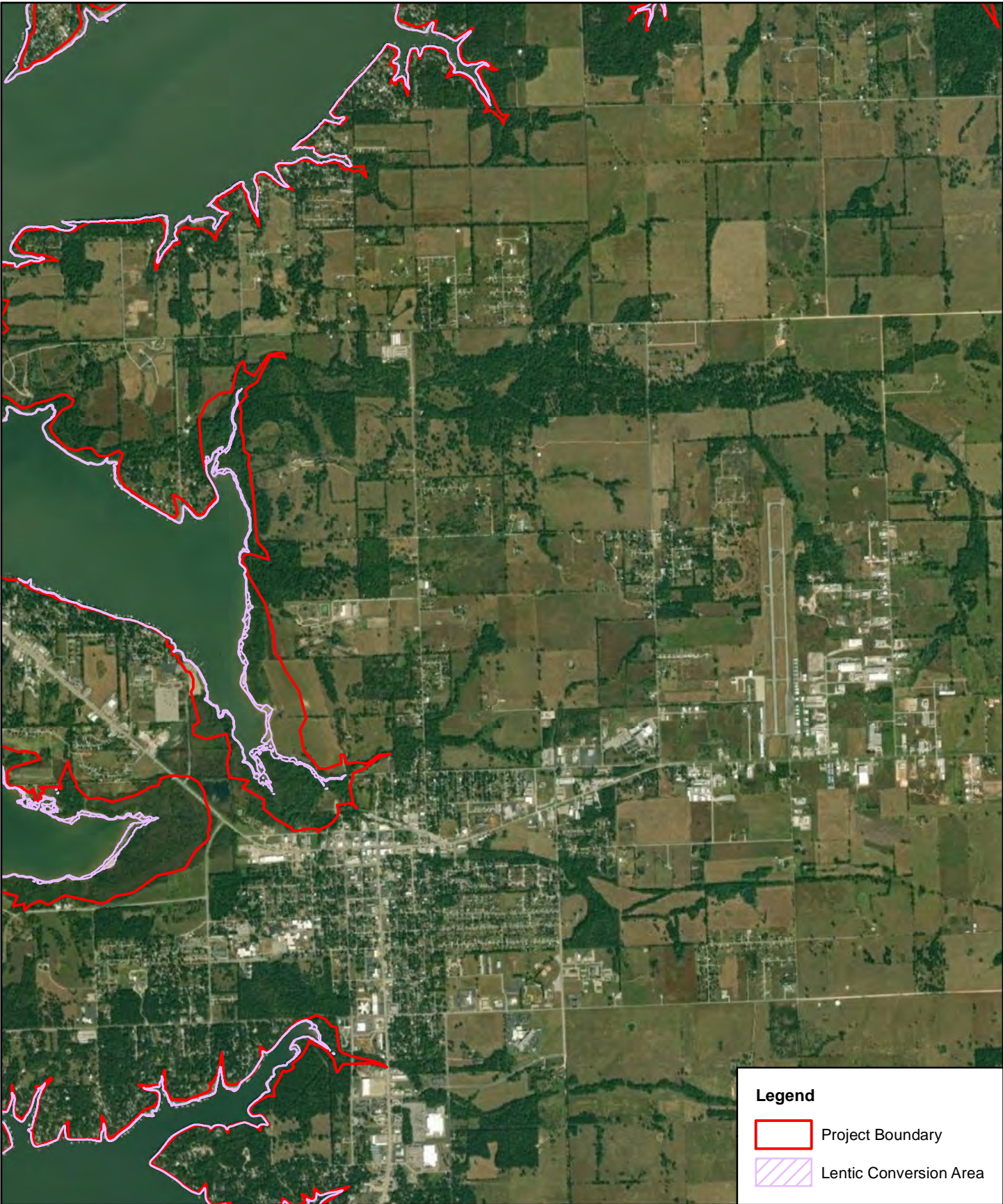
**Horizon**<sup>™</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.10**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma



0    1,500    3,000  
  
 Feet




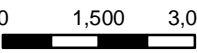
**Legend**

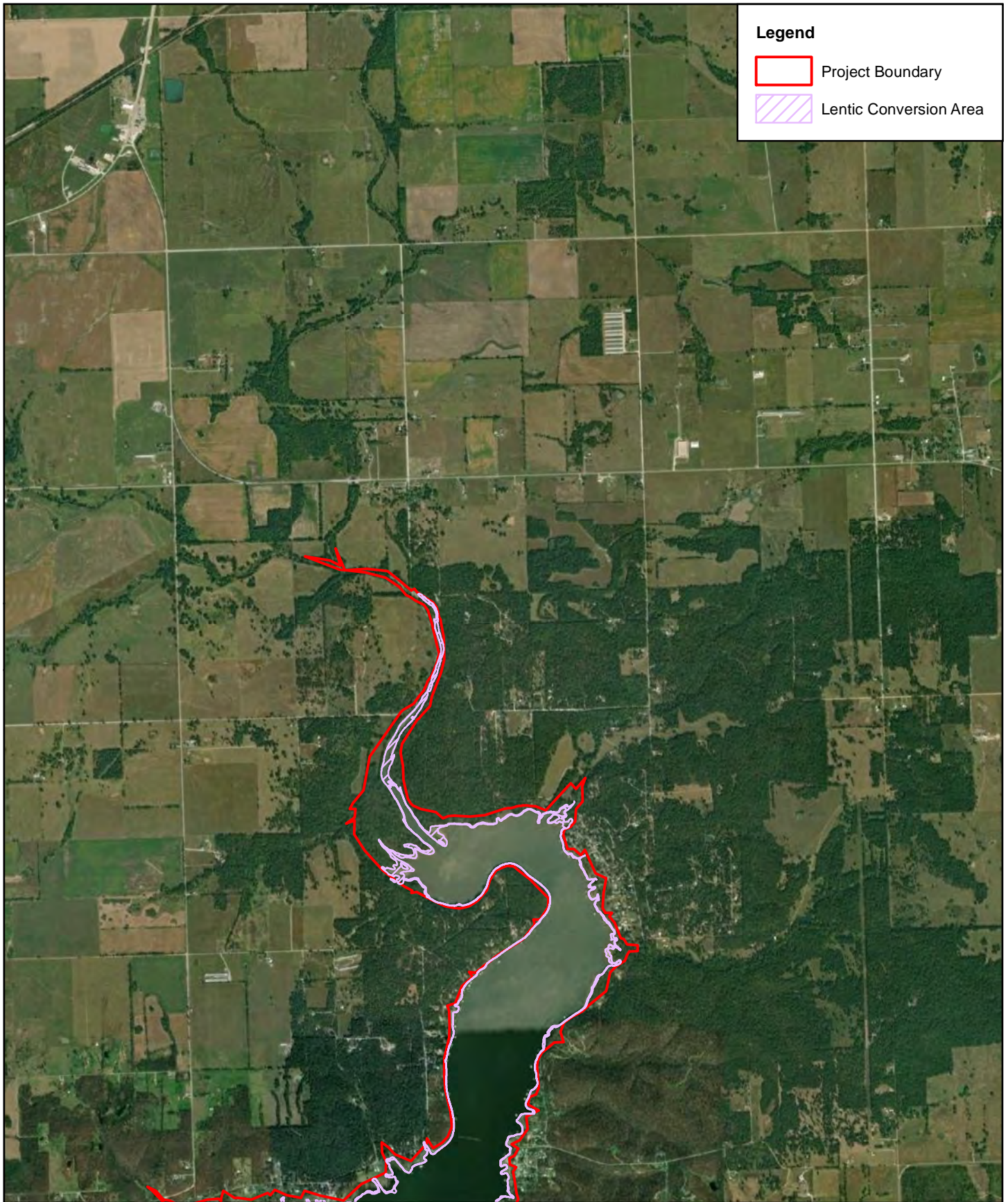
- Project Boundary
- Lentic Conversion Area

**Horizon**<sup>TM</sup>  
Environmental Services, Inc.



Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.11**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma

  
 0    1,500    3,000  
  
 Feet



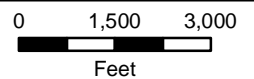
**Legend**

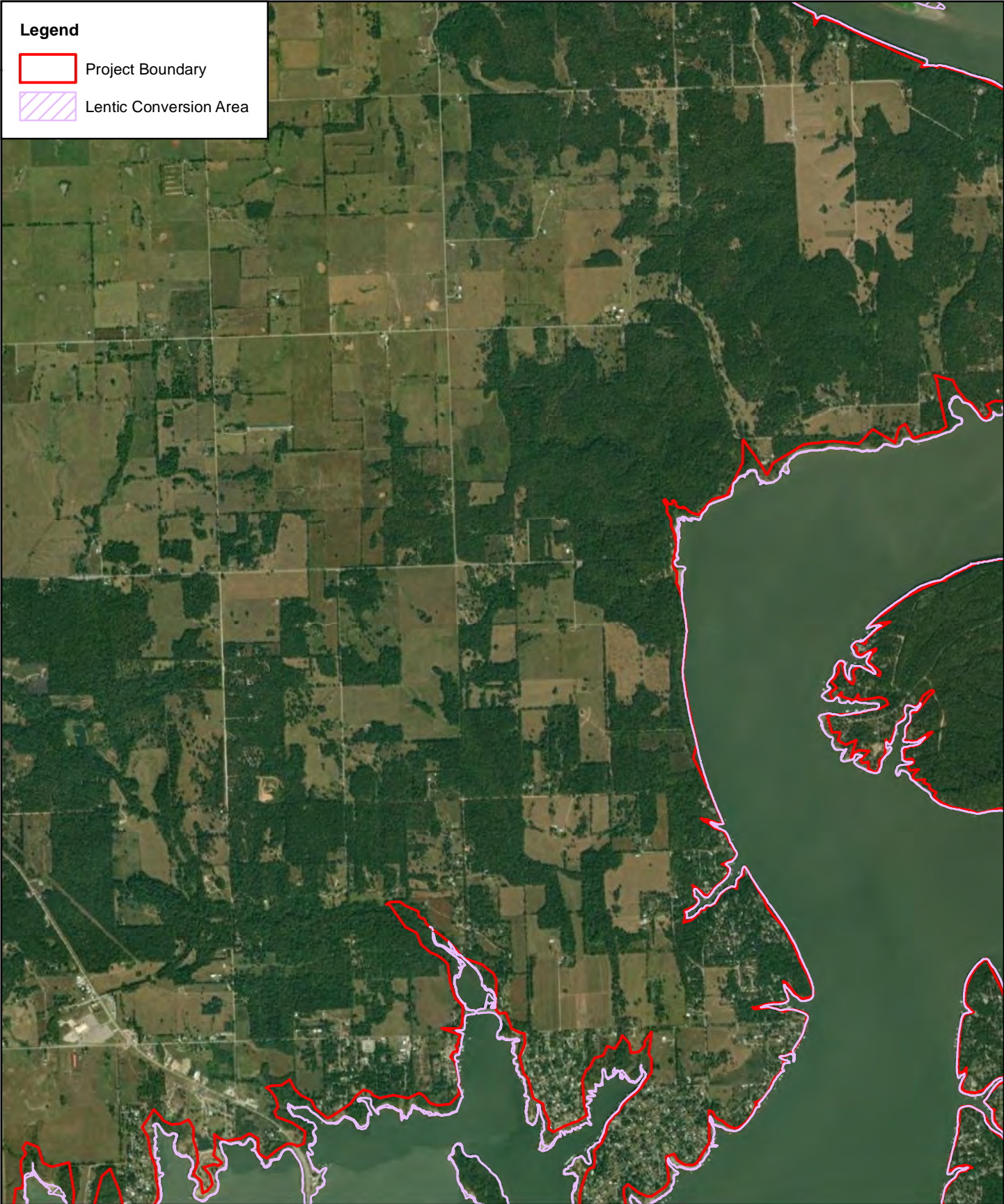
-  Project Boundary
-  Lentic Conversion Area

**Horizon**<sup>TM</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.12**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma






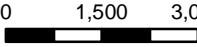
**Legend**

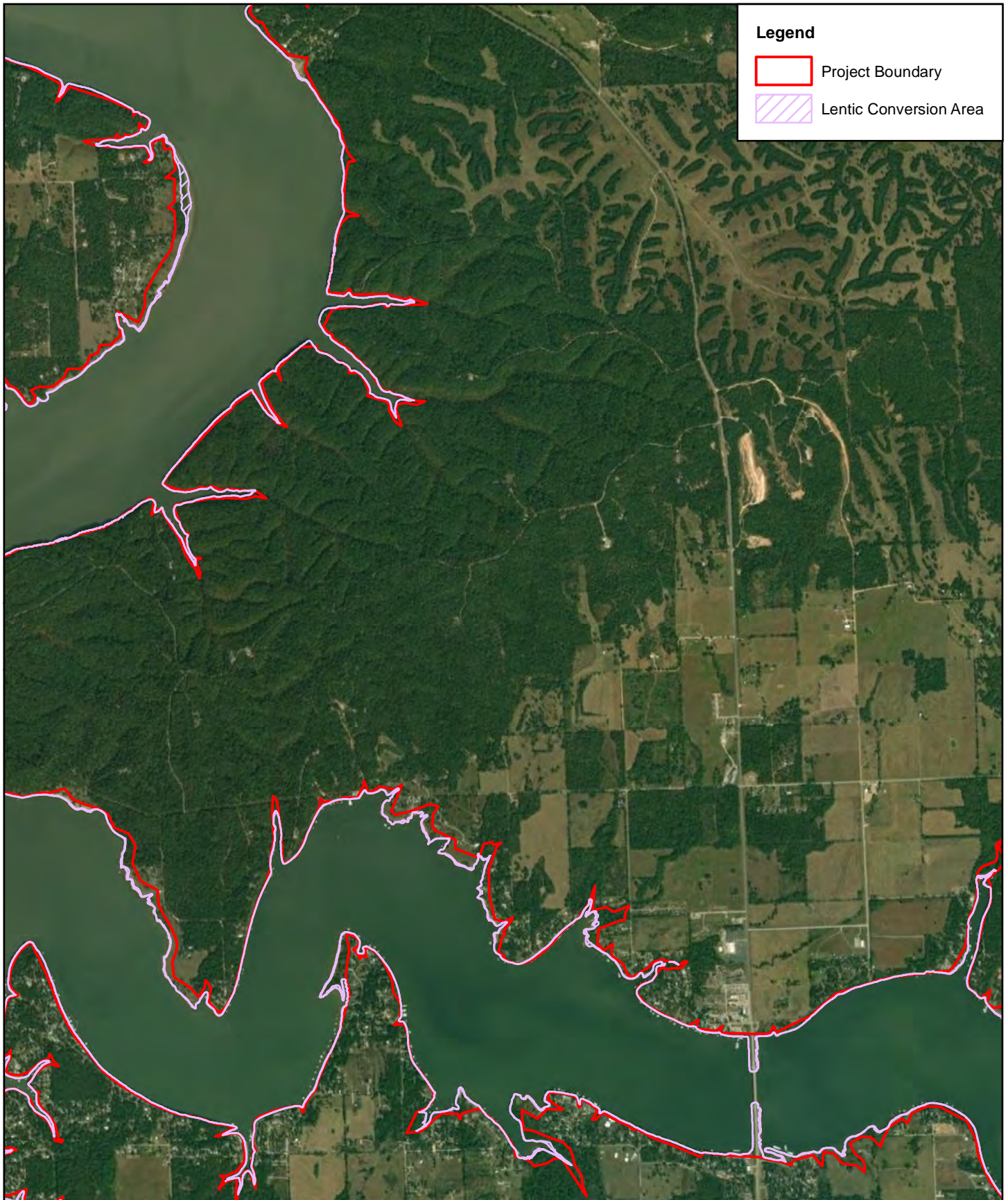
- Project Boundary
- Lentic Conversion Area

**Horizon**<sup>™</sup>  
Environmental Services, Inc.



Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.13**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma

  
  
 Feet



**Legend**

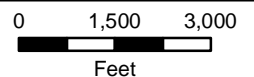
-  Project Boundary
-  Lentic Conversion Area

**Horizon**<sup>TM</sup>  
Environmental Services, Inc.

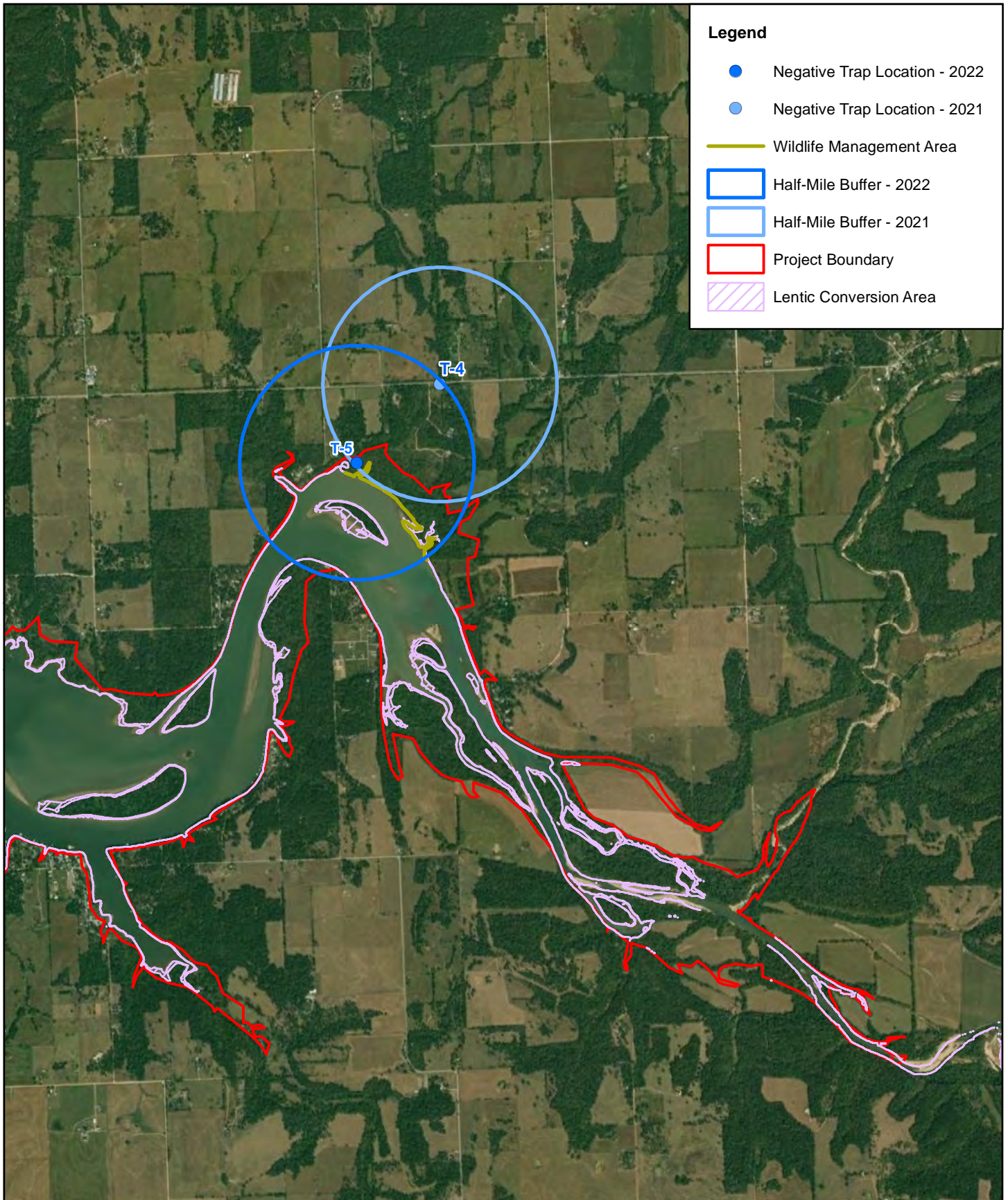
Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.14**

Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma







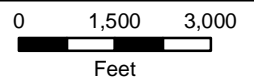
**Legend**

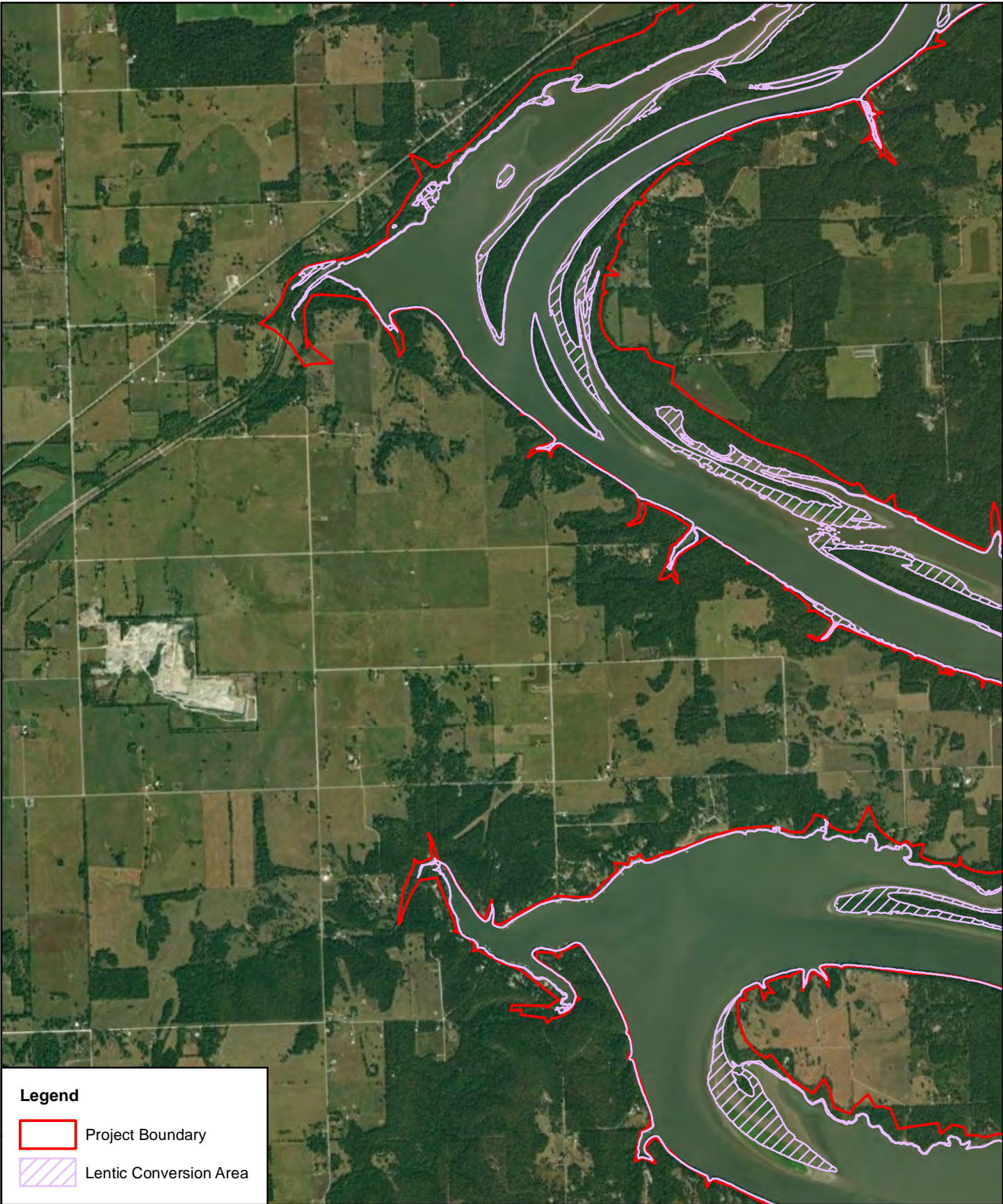
- Negative Trap Location - 2022
- Negative Trap Location - 2021
- Wildlife Management Area
- Half-Mile Buffer - 2022
- Half-Mile Buffer - 2021
- Project Boundary
- ▨ Lentic Conversion Area

**Horizon**<sup>TM</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.15**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma






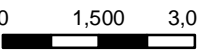
**Legend**

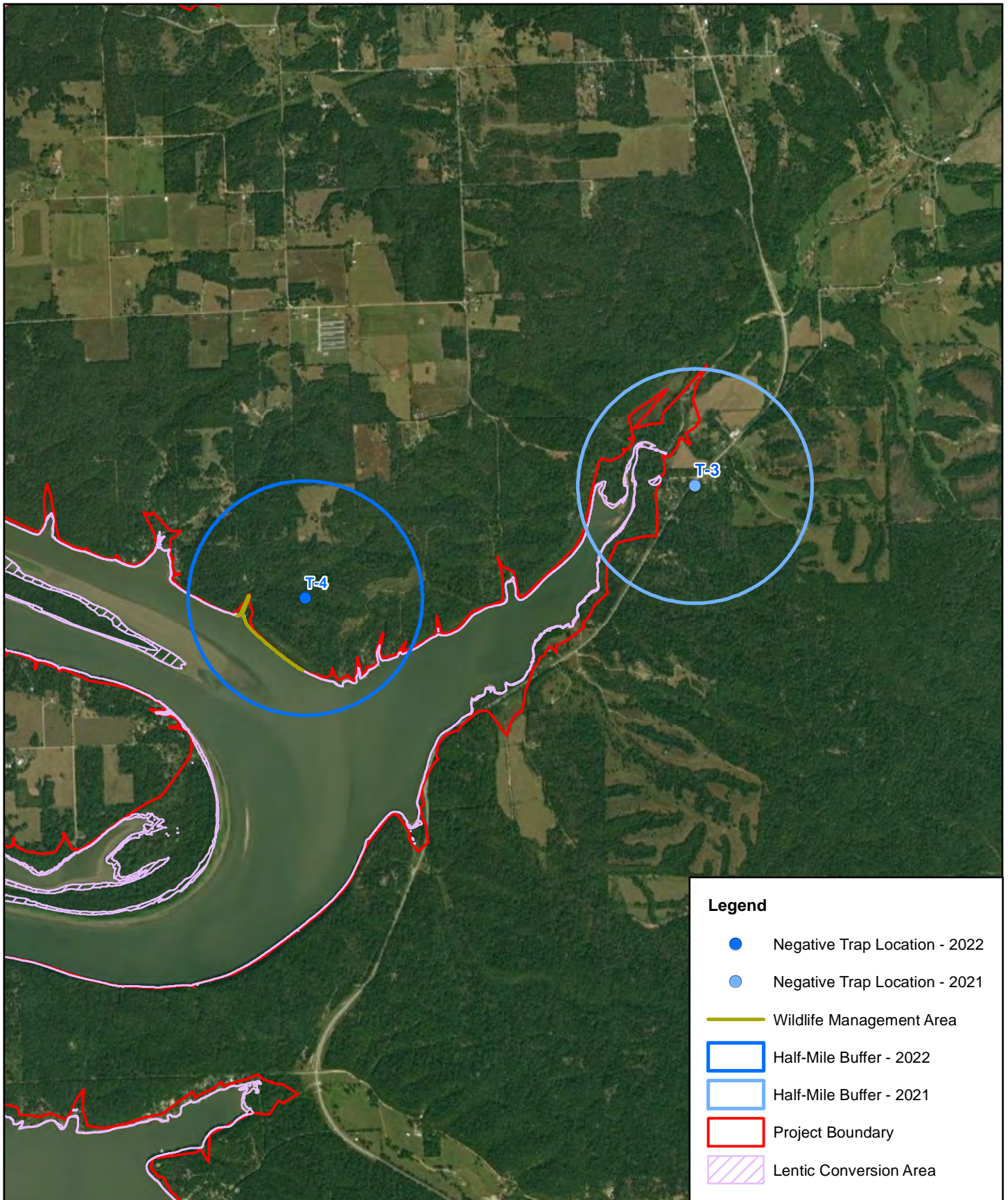
- Project Boundary
- Lentic Conversion Area

**Horizon**<sup>TM</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.16**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma

  
 0    1,500    3,000  
  
 Feet



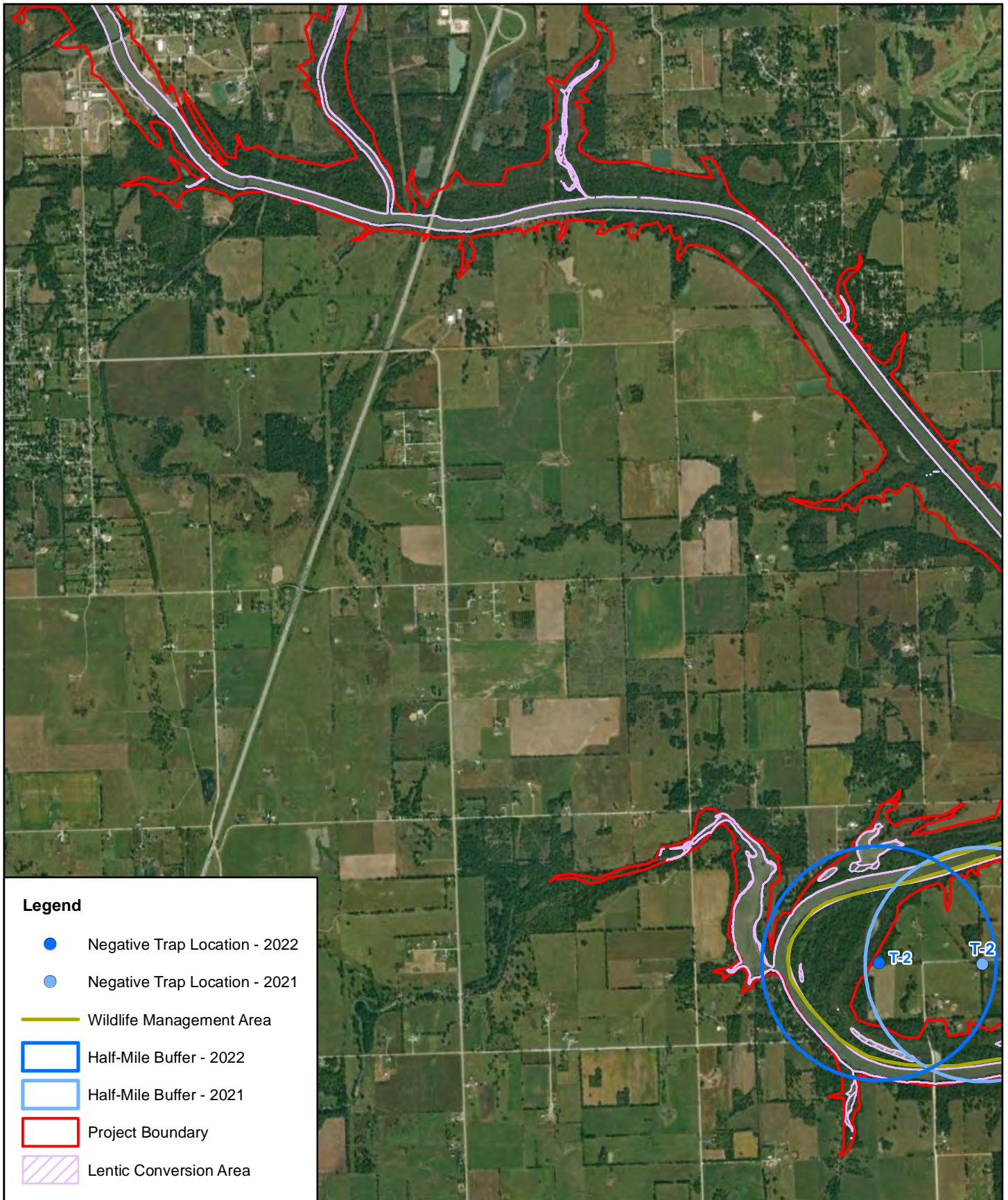
**Horizon**<sup>™</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.17**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma



0 1,500 3,000  
Feet




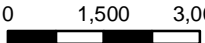
**Legend**

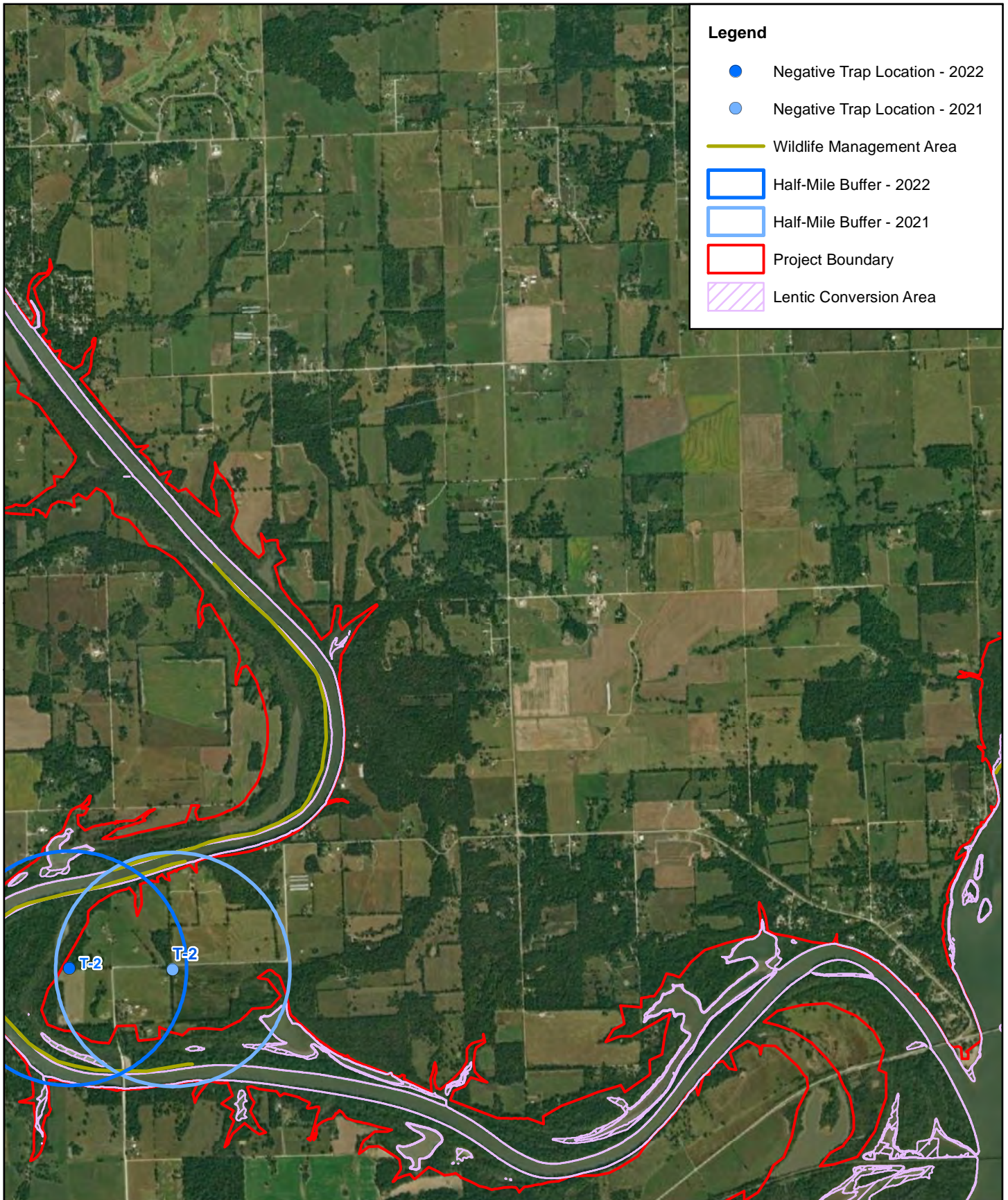
- Negative Trap Location - 2022
- Negative Trap Location - 2021
- Wildlife Management Area
- Half-Mile Buffer - 2022
- Half-Mile Buffer - 2021
- Project Boundary
- Lentic Conversion Area

**Horizon**  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.18**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma

  
 0    1,500    3,000  
  
 Feet





**Legend**

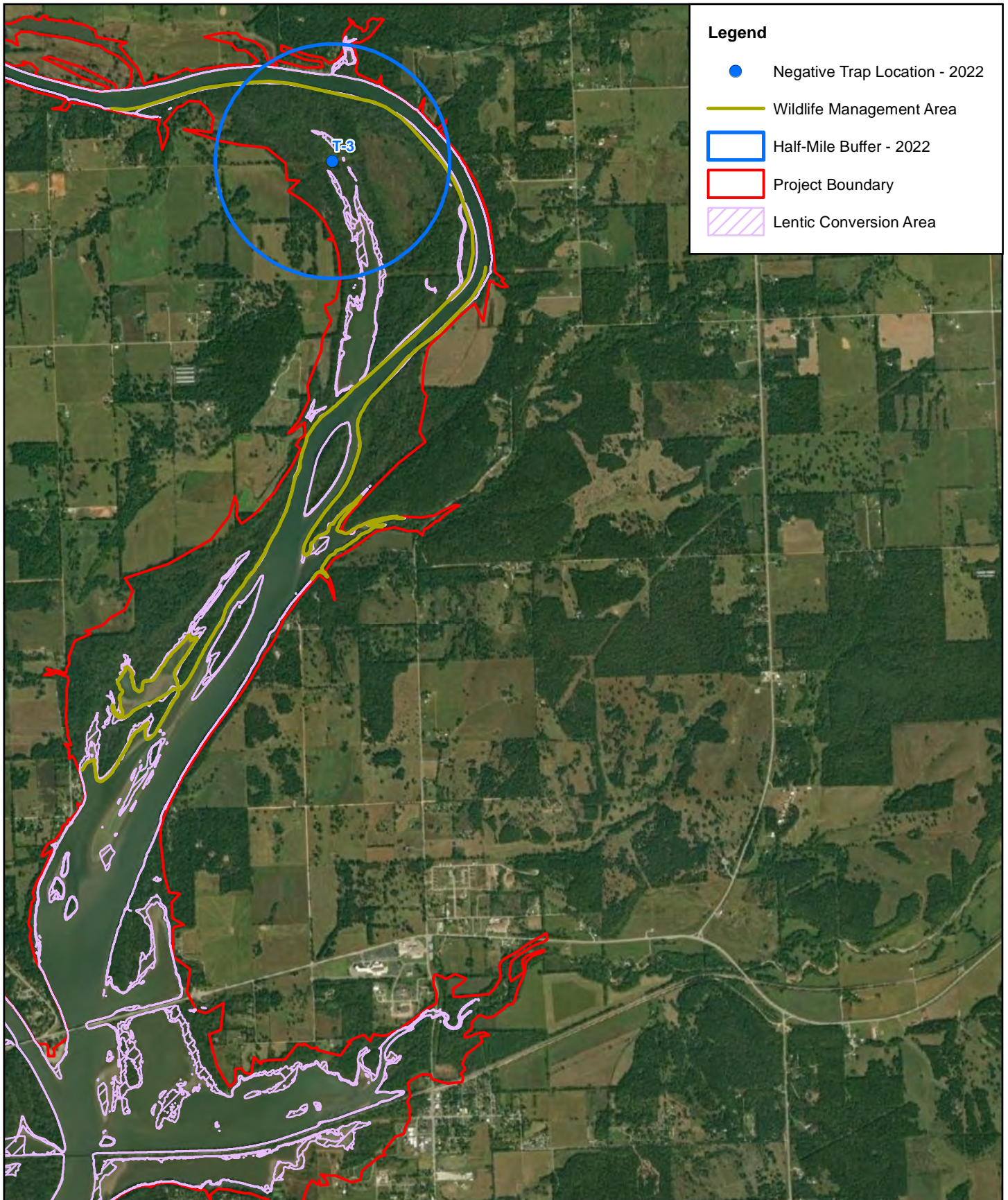
- Negative Trap Location - 2022
- Negative Trap Location - 2021
- Wildlife Management Area
- Half-Mile Buffer - 2022
- Half-Mile Buffer - 2021
- Project Boundary
- Lentic Conversion Area

**Horizon**<sup>™</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.19**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma

  
 0    1,500    3,000  
  
 Feet



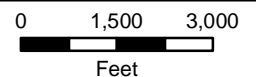
**Legend**

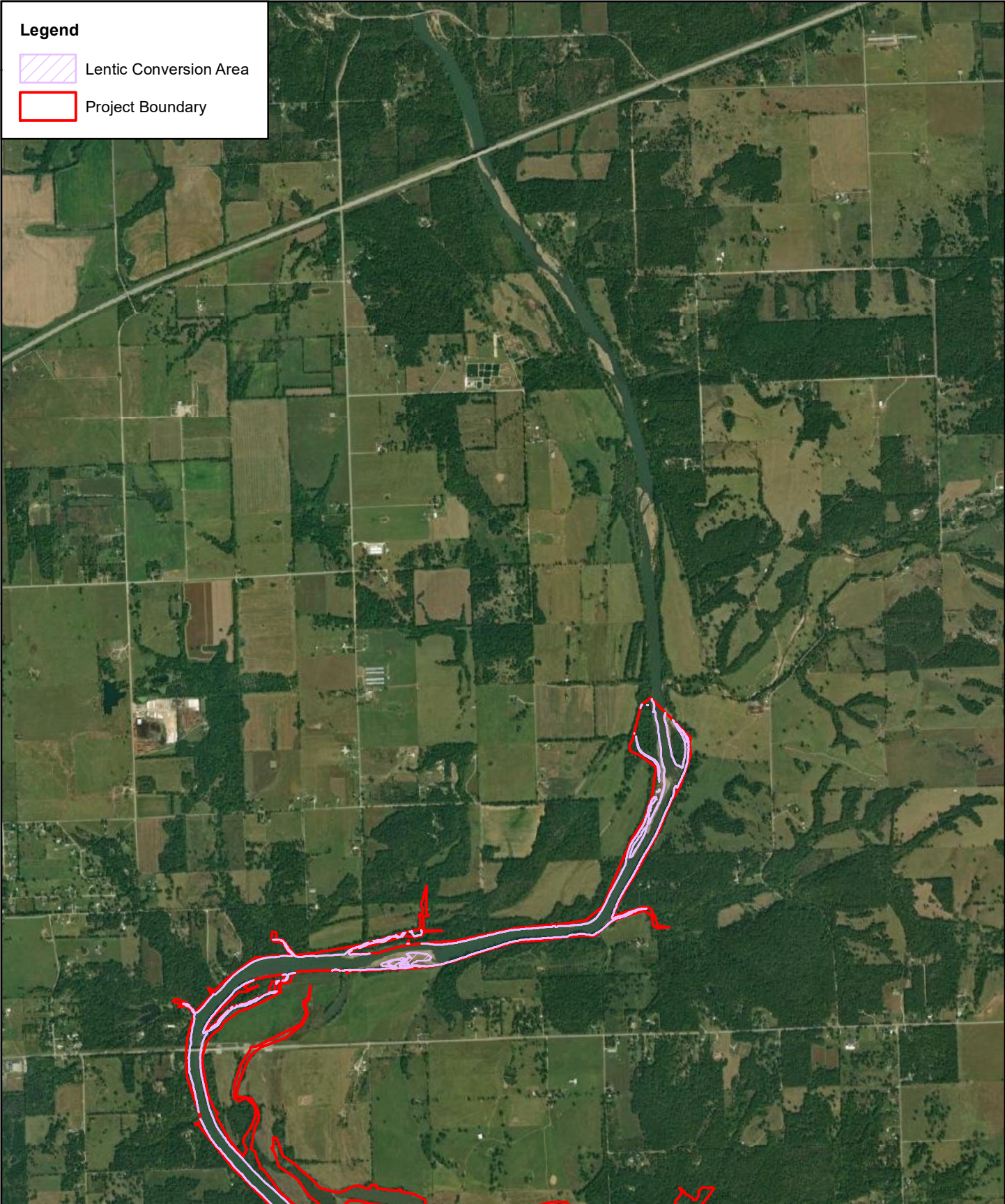
- Negative Trap Location - 2022
- Wildlife Management Area
- Half-Mile Buffer - 2022
- Project Boundary
- Lentic Conversion Area

**Horizon**<sup>™</sup>  
Environmental Services, Inc.



Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.20**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma





**Legend**

-  Lentic Conversion Area
-  Project Boundary

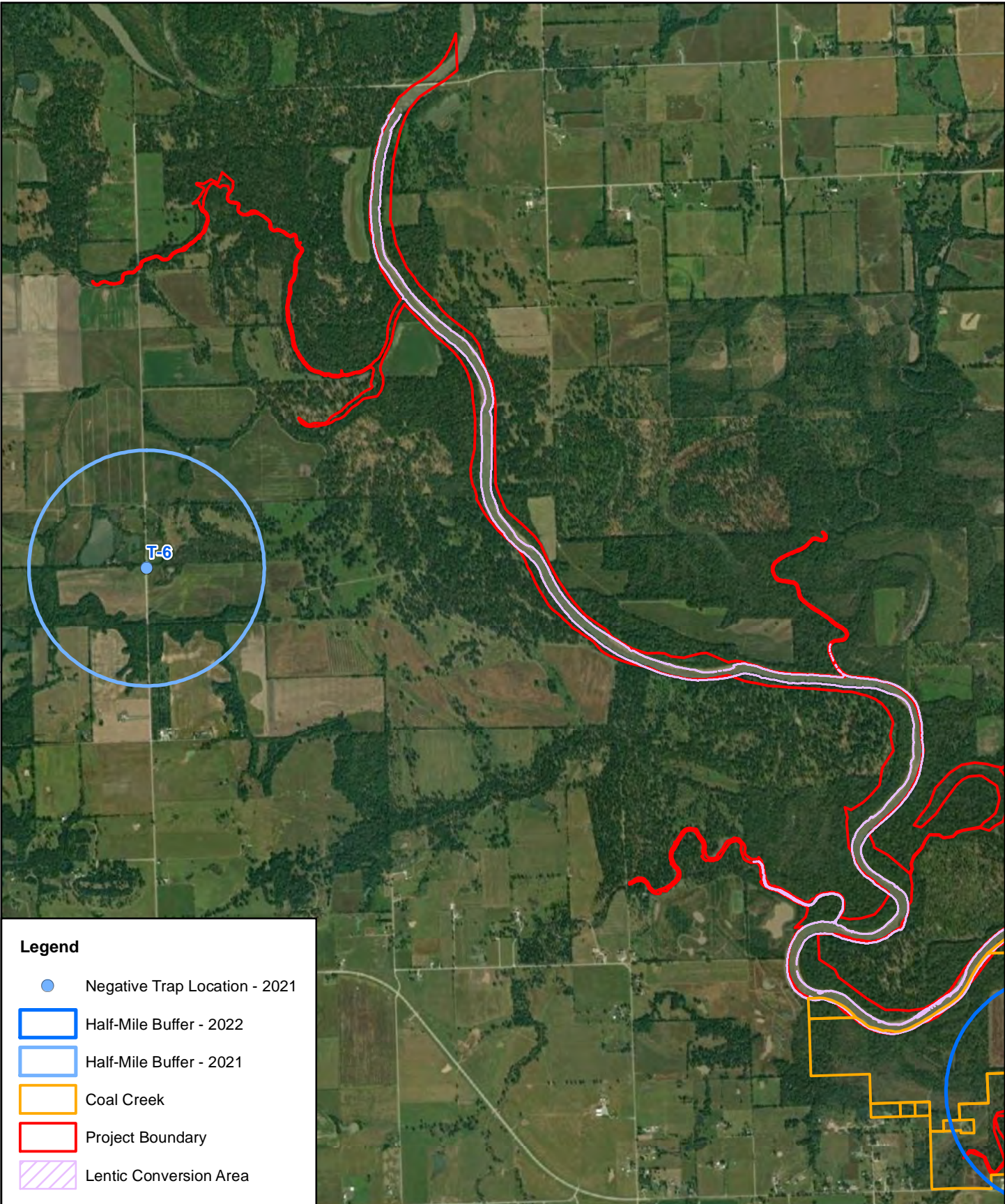
**Horizon**<sup>™</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.21**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma



0 1,500 3,000  
Feet



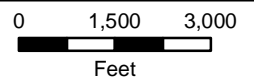
**Legend**

- Negative Trap Location - 2021
- Half-Mile Buffer - 2022
- Half-Mile Buffer - 2021
- Coal Creek
- Project Boundary
- Lentic Conversion Area

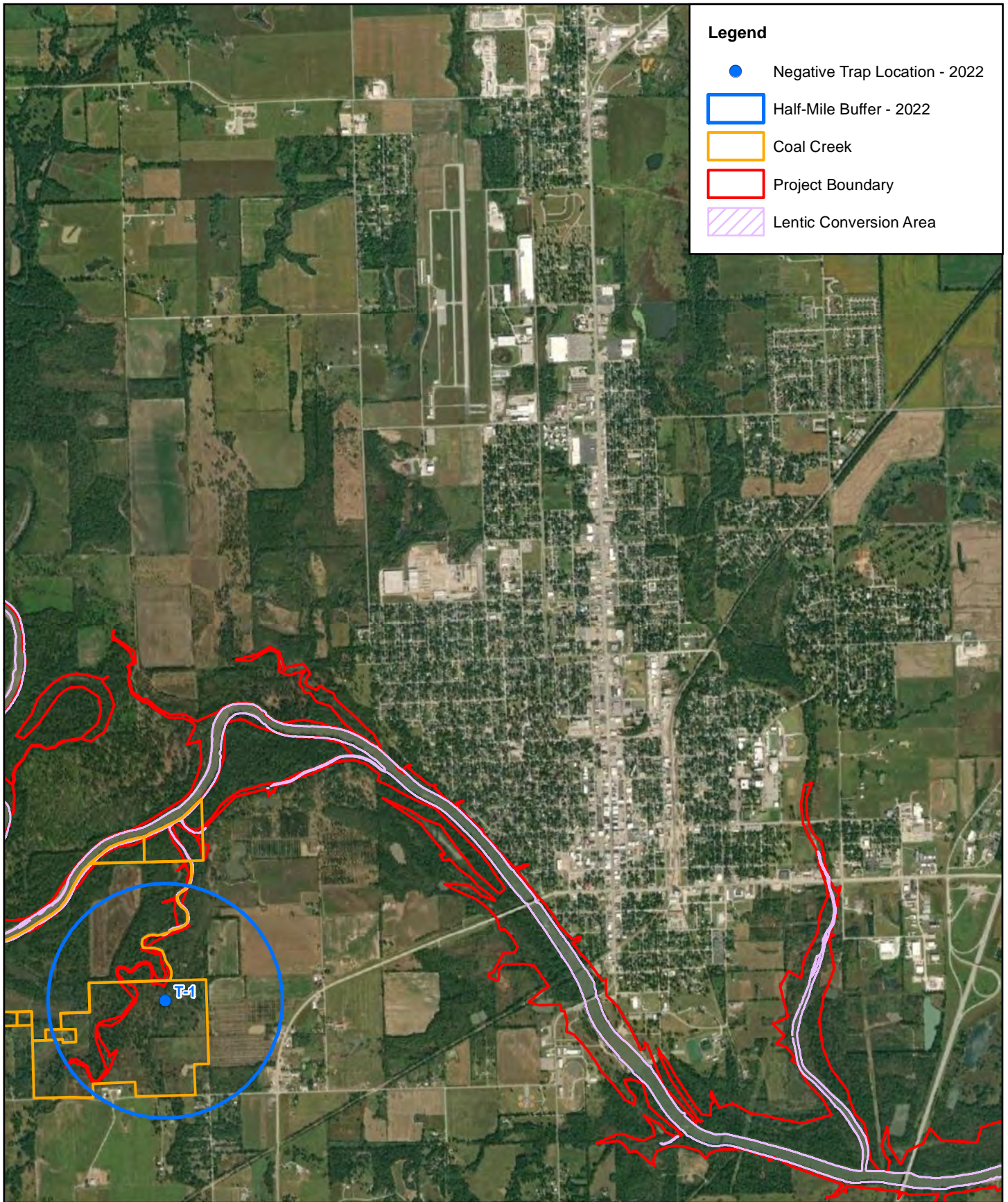
**Horizon**  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.22**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma








**Legend**

- Negative Trap Location - 2022
- Half-Mile Buffer - 2022
- Coal Creek
- Project Boundary
- Lentic Conversion Area

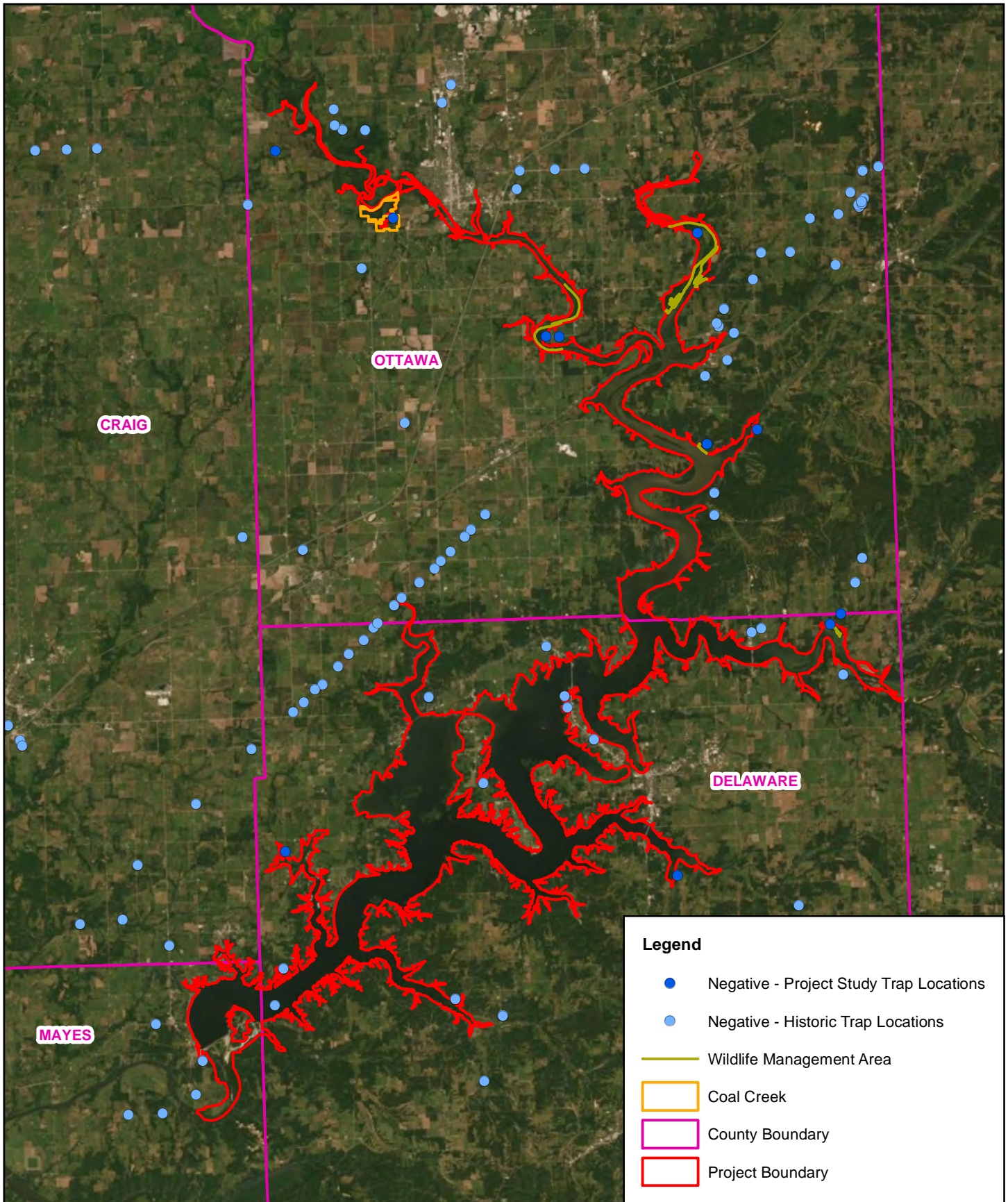
**Horizon**<sup>™</sup>  
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6.23**  
Terrestrial Species Lentic Conversion Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma



0 1,500 3,000  
Feet



**Legend**

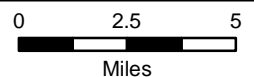
- Negative - Project Study Trap Locations
- Negative - Historic Trap Locations
- Wildlife Management Area
- Coal Creek
- County Boundary
- Project Boundary

**Horizon**<sup>™</sup>  
Environmental Services, Inc.

Date:	08/30/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020; USFWS, 2018

**Figure 7**

1979 - 2018 Historical ABB Data Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma



**APPENDIX B**

American Burying Beetle Pensacola Hydroelectric Project Survey Report 2022



Environmental Services, Inc.

30 August 2022

Jacklyn Jaggars  
Director of Hydropower Projects  
Grand River Dam Authority  
420 OK-28  
Langley, OK 74350  
918-981-8473 Office  
Jacklyn.Jaggars@grda.com

**RE: American Burying Beetle Presence/Absence Survey for the Pensacola Hydroelectric Project (Project; FERC [Federal Energy Regulatory Commission] No. 1494); Craig, Delaware, Mayes and Ottawa Counties, Oklahoma**

Dear Ms. Jaggars:

Horizon Environmental Services, Inc. (Horizon) appreciates the opportunity to provide environmental support services to the Grand River Dam Authority (GRDA) for the Pensacola Hydroelectric Project (Project; FERC [Federal Energy Regulatory Commission] No. 1494), spanning Craig, Delaware, Mayes & Ottawa Counties, Oklahoma (Project Area).

As part of the relicensing of the Pensacola Hydroelectric Project the GRDA filed a preapplication document with FERC on February 1, 2017 (GRDA 2017). The GRDA filed its Proposed Study Plan (PSP) for the relicensing on April 27, 2018 (GRDA 2018a). Also, on April 27, 2018, FERC released its Scoping Document 2 for the relicensing of the Project (FERC 2018).

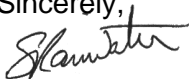
In support of the relicensing effort, Horizon was contracted to conduct two years of presence/absence surveys for the American burying beetle (*Nicrophorus americanus*; ABB) to determine whether the ABB, a federally threatened species, may be present within the proposed Project Area. The Project Area is located within the ABB's current range, but outside of any conservation priority area (CPA) as defined by the US Fish and Wildlife Service (USFWS) (see attached Vicinity Map). The 2021 ABB survey was concluded in July 2021 with negative findings for all six survey locations. The 2022 ABB survey was completed in June 2022 with negative findings for all six survey locations.

On 9 June 2022, Horizon ABB Specialist Stephanie Rainwater (permit number TE-00284A) placed six (6) traps to cover a representative sample of all suitable habitat types within the Project Area (see attached Trap Maps), as well as covering the largest surface areas of potential terrestrial impact from potential water level fluctuations determined by the output from the Comprehensive Hydraulic Model (CHM) developed from as part of the Hydrologic and Hydraulic Modeling Study (H&H Study) associated with this project. The traps were designed, baited and checked following the guidelines of the *American Burying Beetle Range-wide Presence/Absence Survey Guidance* (USFWS, 2018). Trap locations were oriented in Delaware and Ottawa Counties

only, but confirmed with Kevin Stubbs, USFWS National Species Lead via email as sufficiently representative of the overall four county Project Area.

The six traps were checked daily for a total of five nights with valid weather parameters and yielded no positive ABB findings. The survey effort concluded on 14 June 2022 (see attached Data Collection Forms). The results of this survey will remain valid until the conclusion of the 2022 ABB active season. These negative survey findings indicate that the ABB is not active within the Project Area; thus, take (defined by the Endangered Species Act [ESA] as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species”) is not expected as a result of this project.

If you have any questions or concerns, please do not hesitate to contact me.

Sincerely,  


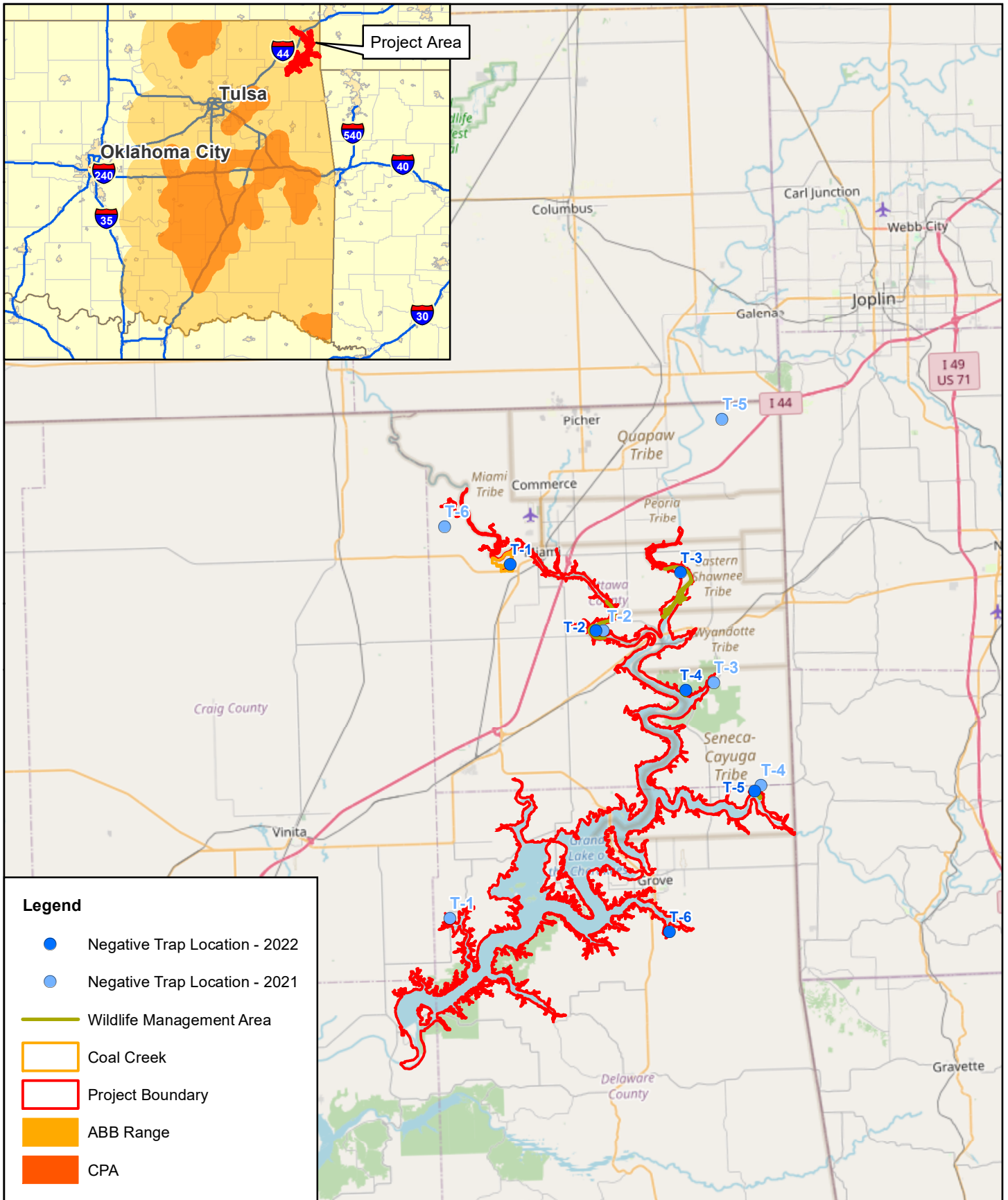
Stephanie Rainwater  
Project Manager/Biologist (USFWS Permit Number TE-00284A)  
Horizon Environmental Services, Inc.  
321 S. Boston Ave., Suite 300  
Tulsa, OK 74103  
918-219-9951  
srainwater@horizon-esi.com

**Attachments:**

1. Maps
2. Data Collection Forms

**References:**

- (Esri) Environmental Systems Research Institute. World Imagery, <<https://www.arcgis.com/home/item.html?id=10df2279f9684e4a9f6a7f08febac2a9>>. Imagery date 5 August 2020. Accessed 29 August 2022.
- (OSM) OpenStreetMap contributors. OpenStreetMap, <<http://www.openstreetmap.org>>. Available under the Open Database License ([www.opendatacommons.org/licenses/odbl](http://www.opendatacommons.org/licenses/odbl)). Accessed 10 August 2022.
- (USFWS) US Fish and Wildlife Service. *American Burying Beetle (Nicrophorus americanus) Range-wide Presence/Absence Survey Guidance*, <[https://www.fws.gov/southwest/es/oklahoma/Documents/ABB/Surveying%20final/ABB%20Rangewide%20Survey%20Guidance\\_Final8May2018.pdf](https://www.fws.gov/southwest/es/oklahoma/Documents/ABB/Surveying%20final/ABB%20Rangewide%20Survey%20Guidance_Final8May2018.pdf)>. Published May 2018.
- (USFWS) US Fish and Wildlife Service, Oklahoma Ecological Services Field Office. *American Burying Beetle: Additional Information*. ABB Range Map and Conservation Priority Area GIS Shapefiles, available at <[https://www.fws.gov/southwest/es/oklahoma/ABB\\_Add\\_Info.htm](https://www.fws.gov/southwest/es/oklahoma/ABB_Add_Info.htm)>. Range Map updated 2022; CPA Map updated 2022.


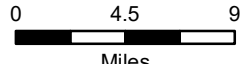


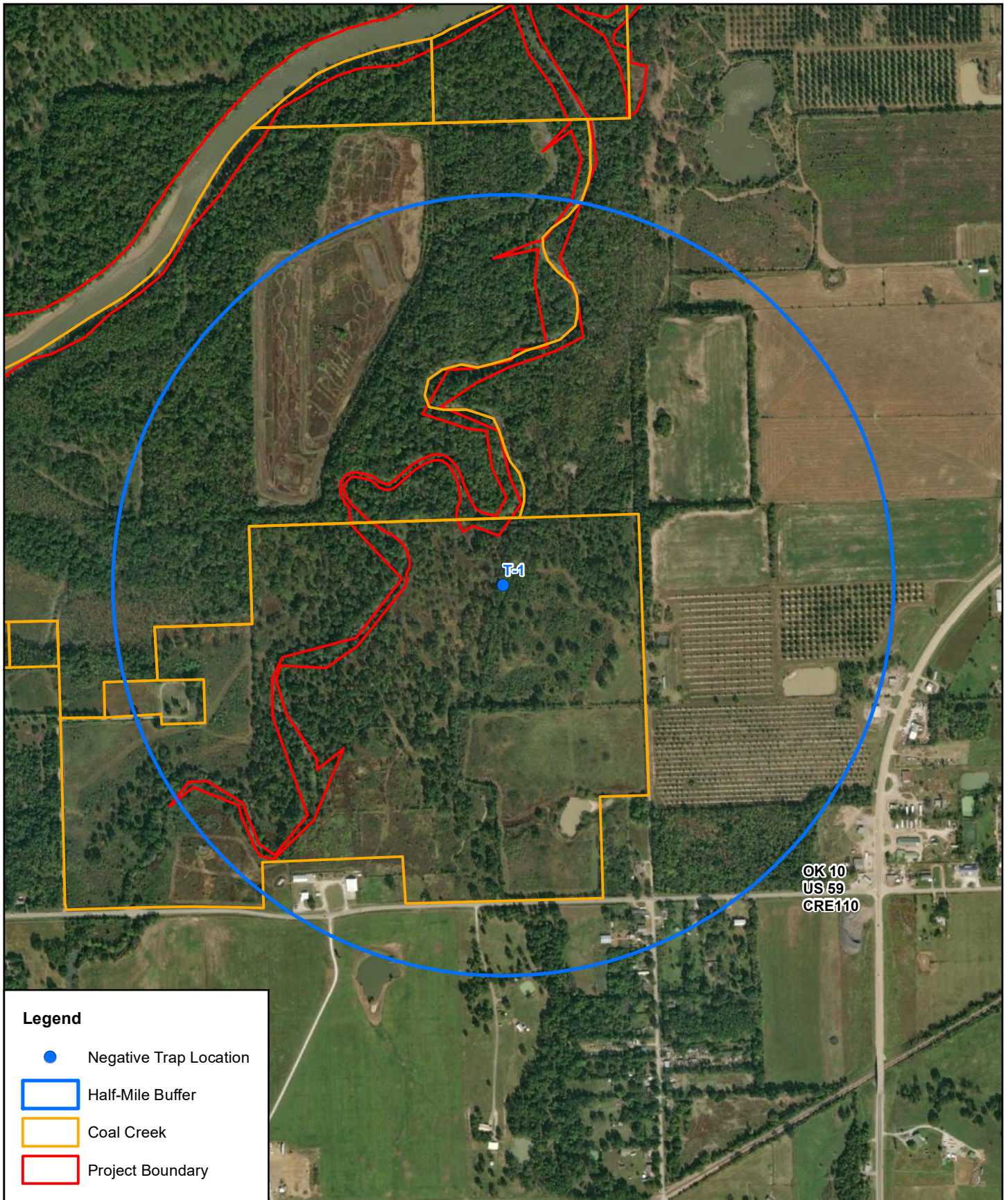
**Legend**

- Negative Trap Location - 2022
- Negative Trap Location - 2021
- Wildlife Management Area
- Coal Creek
- Project Boundary
- ABB Range
- CPA

Date:	08/29/2022
Drawn:	KRW
HJN NO:	21021
Source:	OSM, 2022

**Figure 2**  
 Vicinity Map  
 GRDA Pensacola Project  
 Craig, Delaware, Mayes &  
 Ottawa Counties, Oklahoma

  
  
 0 4.5 9  
 Miles



OK 10  
US 59  
CRE110


**Legend**

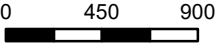
- Negative Trap Location
- Half-Mile Buffer
- Coal Creek
- Project Boundary

**Horizon**<sup>™</sup>  
Environmental Services, Inc.

Date:	08/29/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

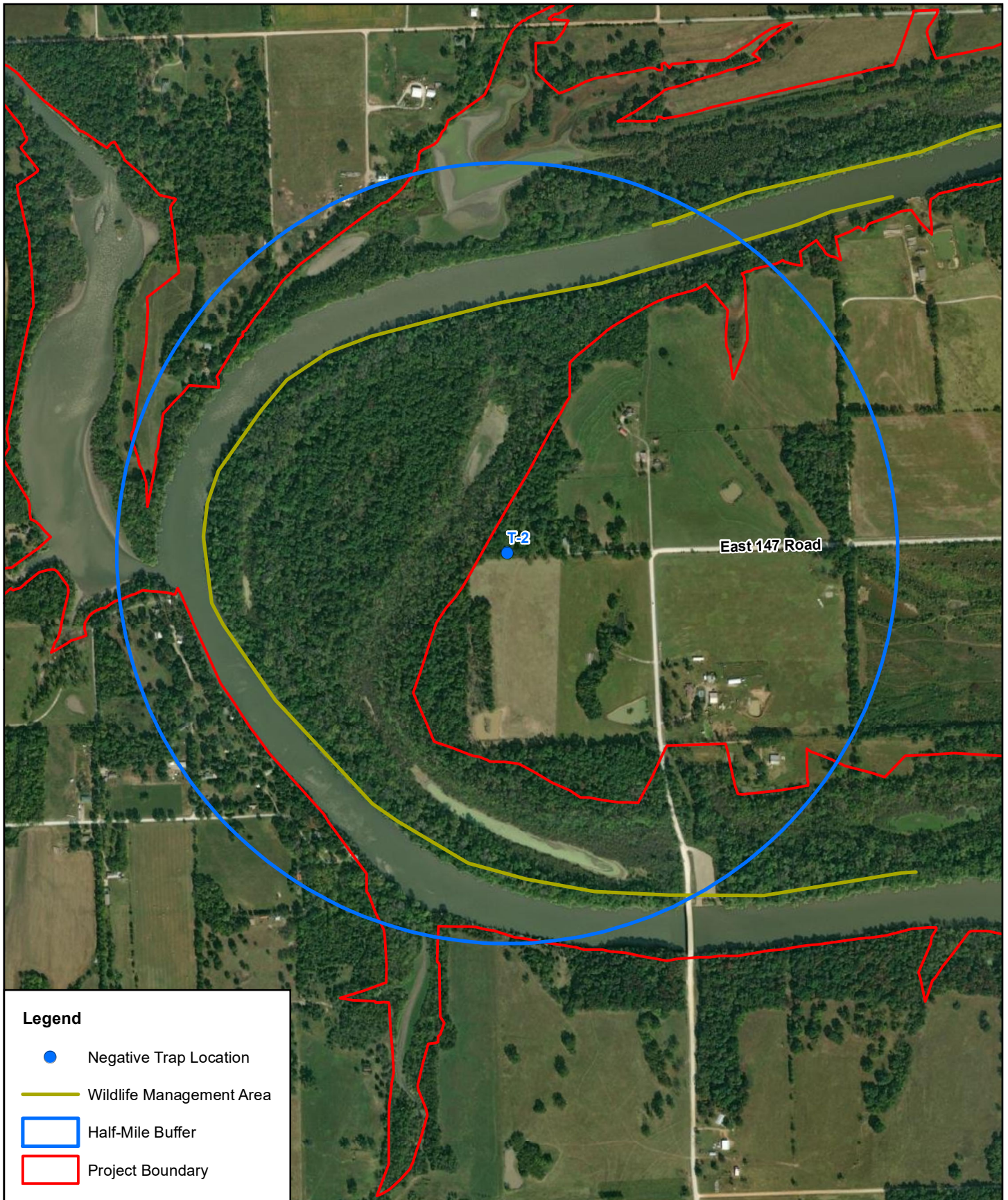
**Figure 2**  
Trap Location Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma





0      450      900  
Feet






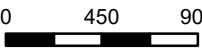
**Legend**

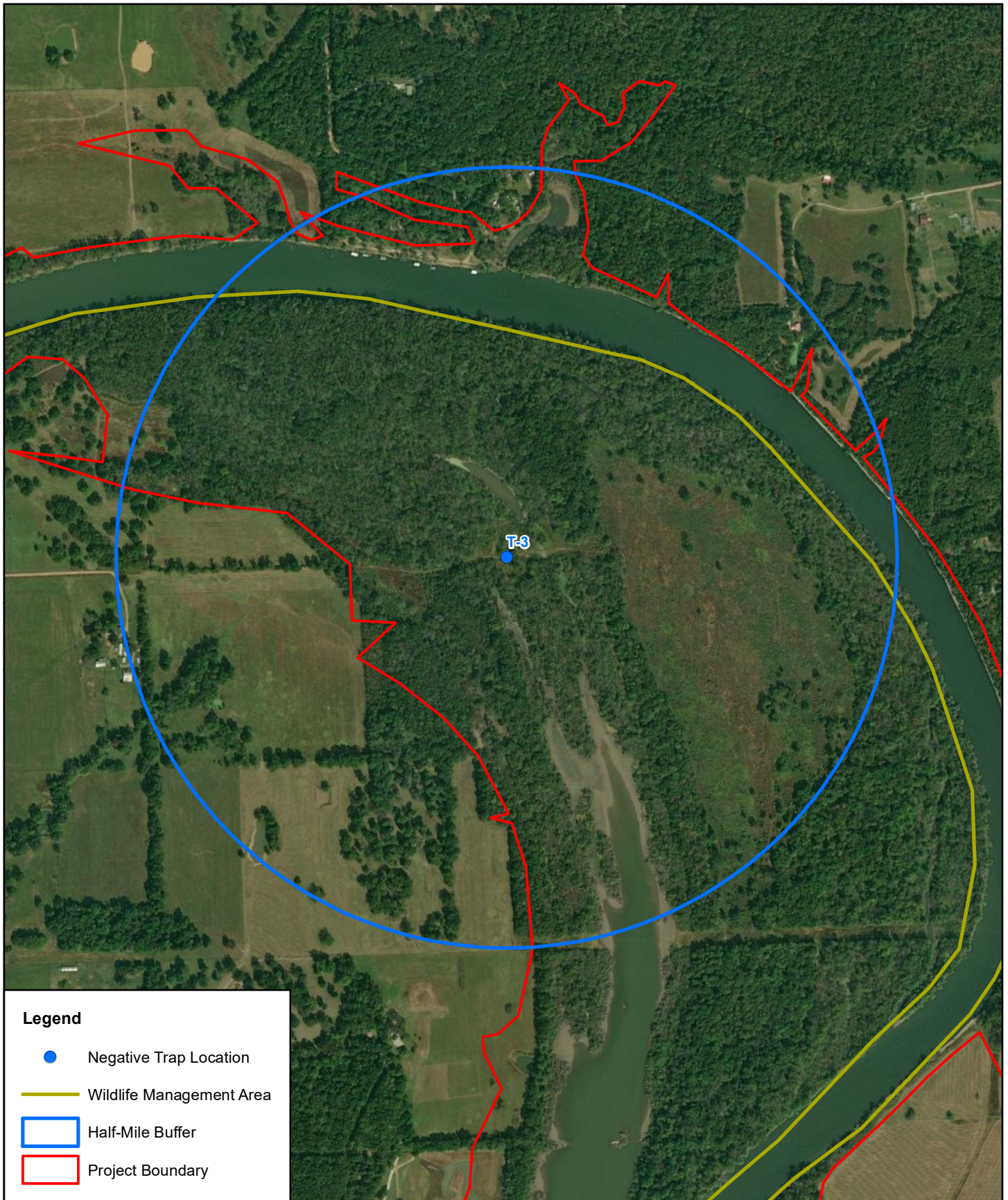
- Negative Trap Location
- Wildlife Management Area
- Half-Mile Buffer
- Project Boundary

**Horizon**<sup>™</sup>  
Environmental Services, Inc.

Date:	08/29/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 3**  
Trap Location Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma

  
 0      450      900  
  
 Feet




**Legend**


- Negative Trap Location
- Wildlife Management Area
- Half-Mile Buffer
- Project Boundary

**Horizon**<sup>™</sup>  
Environmental Services, Inc.

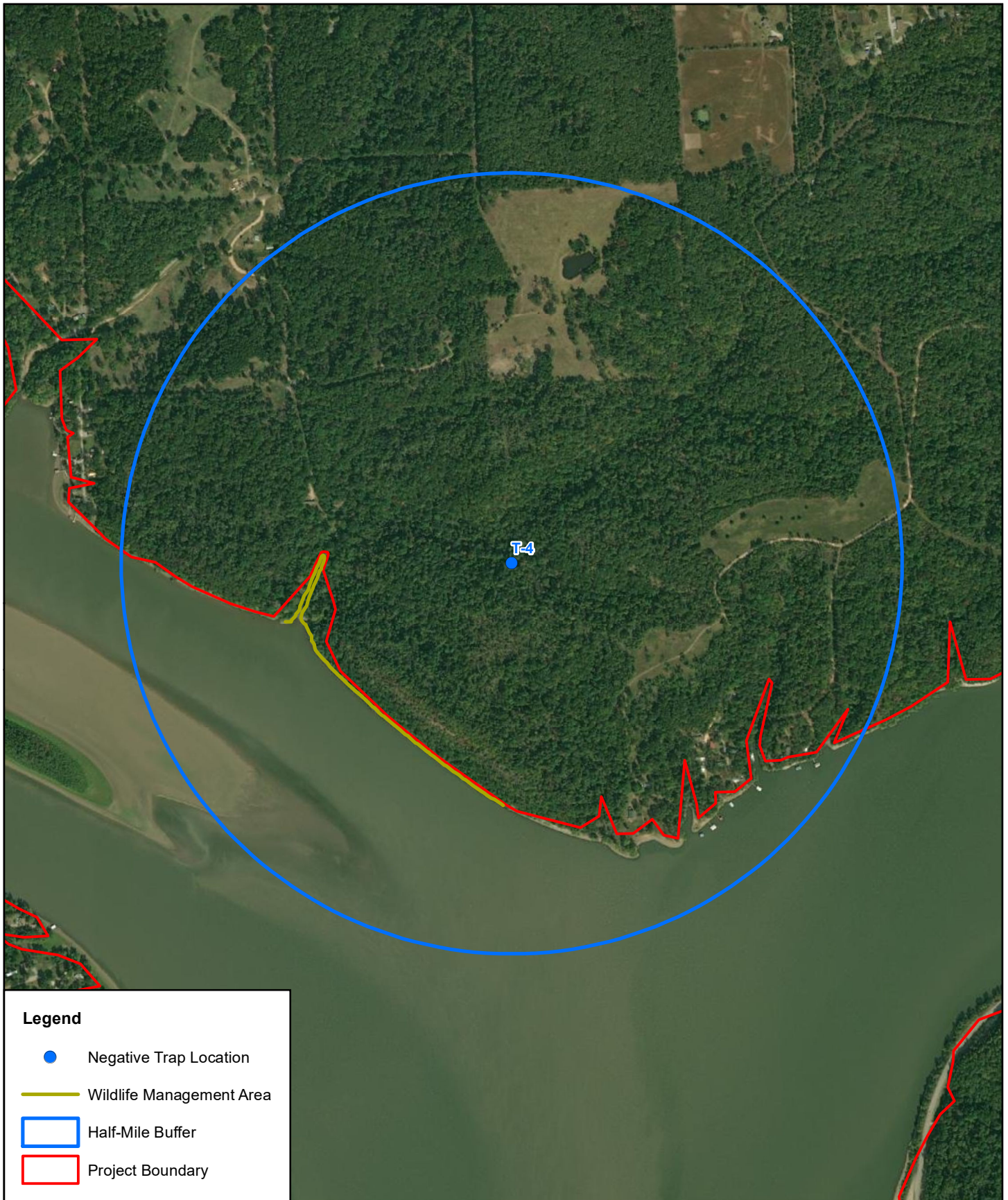
Date:	08/29/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 4**  
Trap Location Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma





0      450      900  
Feet




**Legend**


- Negative Trap Location
- Wildlife Management Area
- Half-Mile Buffer
- Project Boundary

**Horizon**  
Environmental Services, Inc.

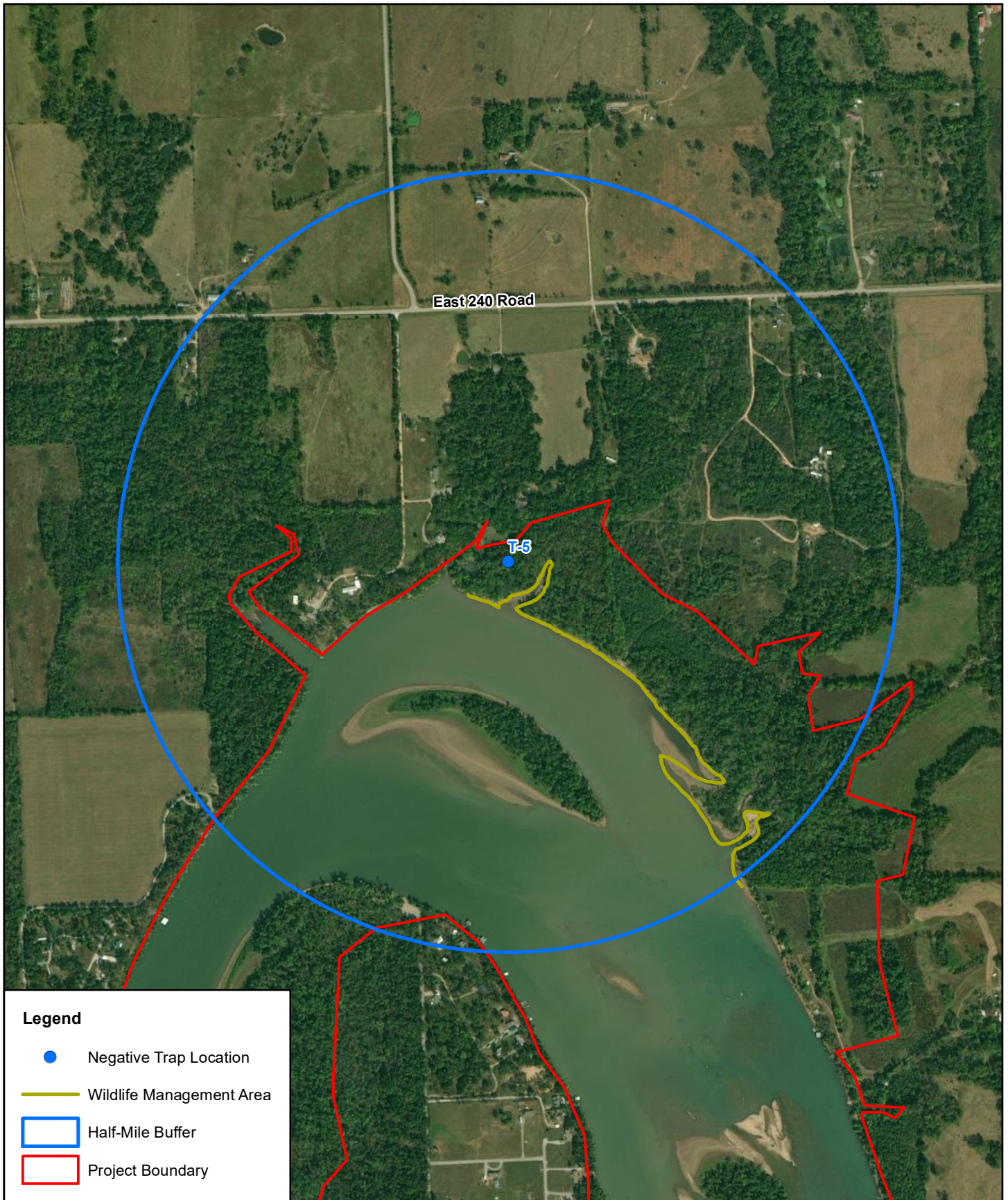
Date:	08/29/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 5**  
Trap Location Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma





0      450      900  
Feet



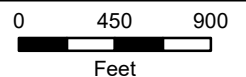
**Legend**

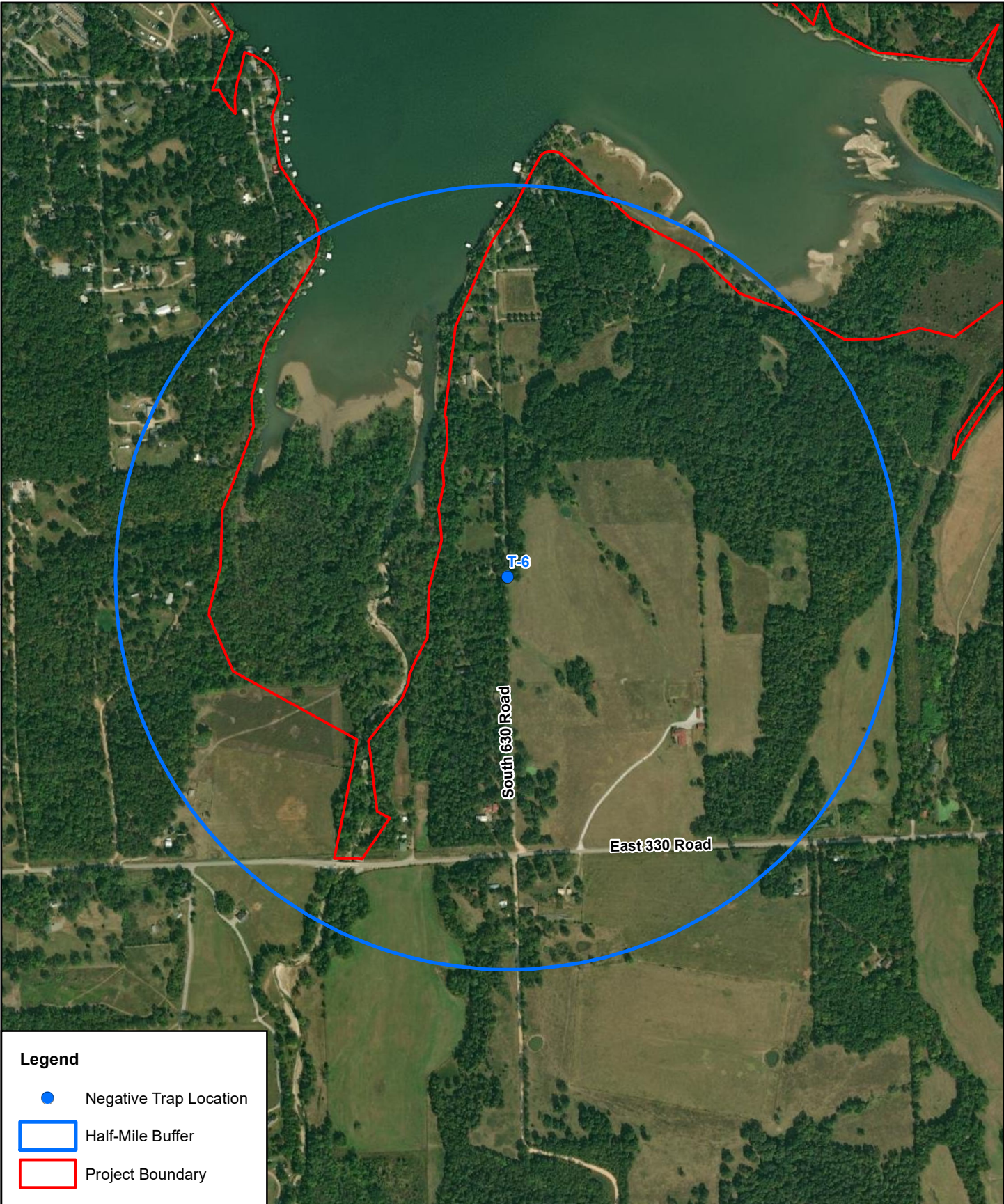
- Negative Trap Location
- Wildlife Management Area
- Half-Mile Buffer
- Project Boundary

**Horizon**<sup>™</sup>  
Environmental Services, Inc.

Date:	08/29/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 6**  
Trap Location Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes &  
Ottawa Counties, Oklahoma






**Legend**


- Negative Trap Location
- Half-Mile Buffer
- Project Boundary

**Horizon**<sup>™</sup>  
Environmental Services, Inc.

Date:	08/29/2022
Drawn:	KRW
HJN NO:	21021
Source:	Esri, 2020

**Figure 7**  
Trap Location Map  
GRDA Pensacola Project  
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma





0      450      900  
Feet



















**APPENDIX C**

USFWS Correspondence Re: Trap Placement

## Stephanie Rainwater

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**From:** Stubbs, Kevin <kevin\_stubbs@fws.gov>  
**Sent:** Wednesday, March 23, 2022 1:55 PM  
**To:** Stephanie Rainwater  
**Subject:** Re: [EXTERNAL] GRDA Pensacola Relicensing Project - ABB Trap Placement

### [EXTERNAL EMAIL]

That will work. Just put the traps in the best habitat that is available (more open grassland or mix with timber).

Kevin  
918-695-6769

---

**From:** Stephanie Rainwater <srainwater@horizon-esi.com>  
**Sent:** Monday, March 21, 2022 5:39 PM  
**To:** Stubbs, Kevin <kevin\_stubbs@fws.gov>  
**Subject:** RE: [EXTERNAL] GRDA Pensacola Relicensing Project - ABB Trap Placement

Kevin,

Good evening! I have attached a pdf map as well as a kmz showing the Coal Creek mitigation area and the wildlife management areas. I have overlaid five proposed trap sites which cover the four wildlife management areas and the mitigation site. We placed the 6<sup>th</sup> trap in a far southeastern area that has a somewhat significant terrestrial area between the project boundary and the shoreline. Please let me know if you concur these traps sites provide sufficient coverage in the proper areas for this project.

Thanks!

**Stephanie Rainwater**  
Project Manager

**Horizon Environmental Services, Inc.**  
www.horizon-esi.com | An LJA Company

**LJA Environmental Services, LLC**  
www.ljaenv.com

321 S. Boston, Suite 300, Tulsa, OK 74103  
O: 918.553.3232 | C: 918.219.9951

---

**From:** Stubbs, Kevin <kevin\_stubbs@fws.gov>  
**Sent:** Monday, March 14, 2022 3:07 PM  
**To:** Stephanie Rainwater <srainwater@horizon-esi.com>  
**Subject:** Re: [EXTERNAL] GRDA Pensacola Relicensing Project - ABB Trap Placement

### [EXTERNAL EMAIL]

The new project boundary will include all wildlife management and wetland mitigation areas Like the Coal Creek site. So I would put traps at those sites and any other sites with the best available habitat.

Kevin

918-695-6769

---

**From:** Stephanie Rainwater <[srainwater@horizon-esi.com](mailto:srainwater@horizon-esi.com)>  
**Sent:** Monday, March 14, 2022 1:25 PM  
**To:** Stubbs, Kevin <[kevin\\_stubbs@fws.gov](mailto:kevin_stubbs@fws.gov)>  
**Subject:** [EXTERNAL] GRDA Pensacola Relicensing Project - ABB Trap Placement

**This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.**

Kevin,

Good afternoon! I'm currently trying to plan the 2022 ABB survey effort for the GRDA Pensacola Relicensing Project and would like to get your input. As a refresher, when I placed the six 2021 survey traps, I positioned them in areas that provided the most terrestrial coverage within the presumed project area which was defined at that time by the upstream extents model (see attached kmz titled "ABB\_Trap\_Project.kmz"). The boundary has since been reduced based on the results of the H&H study (see attached kmz titled "Project\_Boundary\_NEW\_10012021.kmz"). As there are very few areas of significant terrestrial acreage between the shoreline and the project boundary for me to use the same site selection methodology, I was wondering if you would recommend the six locations that you would consider provide sufficient representation with respect to the project. You can just send me the lat/longs or drop pins in a kmz, whichever works best for you.

Thanks so much!

**Stephanie Rainwater**  
Project Manager

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**LJA Environmental Services, LLC**  
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321 S. Boston, Suite 300, Tulsa, OK 74103  
O: 918.553.3232 | C: 918.219.9951

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**[EXTERNAL EMAIL]** Exercise caution. Do not open attachments or click links from unknown senders or unexpected email