Wetlands and Riparian Habitat Study for the Pensacola Hydroelectric Project (FERC Project No. 1494) Craig, Delaware, Mayes, and Ottawa Counties, Oklahoma

Prepared for:

Grand River Dam Authority

Prepared by:

Horizon Environmental Services, Inc.

TABLE OF CONTENTS

LIST OF TABLES

ATTACHMENTS

1.0 INTRODUCTION

Horizon conducted an updated Wetlands and Riparian Habitat Study (Study) for the Grand River Dam Authority (GRDA) on the Grand Lake O' the Cherokees (Grand Lake) located in Craig, Delaware, Mayes, and Ottawa counties, Oklahoma, to evaluate the effects of anticipated operations of the Pensacola Hydroelectric Project (Project) operations to wetlands and riparian habitat areas based on the inundation maps generated by the Comprehensive Hydraulic Model (CHM).

Inundation maps generated by the CHM were overlaid onto preliminary base maps that were developed using National Wetlands Inventory and other existing wetlands information and information related to the riparian habitat areas and Wildlife Management Areas (WMAs). The maps delineated the median areas inundated under baseline operations and the median areas to be inundated under anticipated operations during the growing season along with the current Project boundary. Horizon assessed the potential impacts to wetlands, riparian areas, and WMAs by identifying the extent, duration, and seasonality (timing) of inundation occurring in the Project boundary.

2.0 STUDY YEAR TWO ACTIVITIES

2.1 DATABASE CONTENTS

Project operations influence water levels of Grand Lake. These water level fluctuations have the potential to affect aquatic vegetation, wetlands, and riparian habitat, which can be important habitats for fish and wildlife. As such, Horizon was contracted to conduct a wetlands and riparian habitat study to quantify and refine the potential impacts associated with the anticipated change in Project operations under the new Federal Energy Regulatory Commission (FERC) license for the Project. Horizon used the National Wetlands Inventory (NWI) and CHM data to identify, display, and describe the composition of wetland and riparian communities (within the study area) in a geographic information systems (GIS) database. For this study, we utilized the CHM data to determine the median elevation for the baseline operation and the anticipated operation of the project during the growing season (March 30 to November 2) to develop wetland and riparian inundation areas.

GRDA currently operates the Project's conservation pool to target reservoir surface elevations to serve multiple purposes, including hydropower generation, water supply, public recreation, and wildlife enhancement. This operational scheme, referred to as the Project's rule curve, is required by Article 401 of the license. Over the years, the rule curve has been adjusted several times by the FERC. Even during the existing license term, the Article 401 rule curve requirements have been amended several times. As recently as 2015, GRDA was required by the FERC to target a low elevation of 741 feet Pensacola Datum (PD) during the latter part of the growing season beginning September 1 through mid-October of each year. The recent operations of the Project as modified by the FERC from time to time are generally considered in the established baseline operation. Under baseline Project operations, the median elevation as determined by the CHM has been 742.92 feet PD.

Under the Project's new license, GRDA does not anticipate Project operations in accordance with a rule curve. In 2019, Congress enacted the National Defense Authorization Act for Fiscal Year 2020 (NDAA 2020), which, among other things, granted GRDA autonomy in establishing reservoir levels within Grand Lake:

> "(A) IN GENERAL.—Except as may be required by the Secretary [of the Army] to carry out responsibilities under section 7 of the Flood Control Act of 1944 (33 U.S.C. 709),

> the Commission or any other Federal or State agency shall not include in any license for the project any condition or other requirement relating to—
>
> (i) surface elevations of the conservation pool; or
>
> (ii) the flood pool (except to the extent it references flood control requirements prescribed by the Secretary).
>
> (B) EXCEPTION.—Notwithstanding subparagraph (A), the project shall remain subject to the Commission's rules and regulations for project safety and protection of human health."
>
> Pub. L. No. 116-92, § 7612(b)(2), 133 Stat. 1198, 2312 (2019).

Based on authority granted to GRDA under NDAA 2020 and informed by the first season of relicensing studies, GRDA has determined that the following anticipated operational parameters will apply during the new license term:

1. GRDA will no longer utilize a rule curve with seasonal target elevations.
2. GRDA will maintain the conservation pool between elevations 742 and 745 feet PD for purposes of normal hydropower operations. While hydropower operations may occur when water surface elevations are outside this range (e.g., maintenance drawdowns and high-flow events), GRDA expects to generally maintain water surface elevations between 742 and 745 feet PD during normal Project operations.
3. Instead of managing the Project to target a specified seasonal elevation, GRDA's new operations may fluctuate reservoir levels within the elevational range of 742 and 745 feet PD, for purposes of responding to grid demands, market conditions, and the public interest, such as environmental and recreational considerations.
4. GRDA will continue to adhere to the Corps' direction on flood control operations in accordance with the Water Control Manual, with no changes to existing operations.

These anticipated Project operations under the new FERC license will result in a water level fluctuation between 742 to 745 feet PD, with a CHM predicted median elevation of 743.46 ft PD during the growing season.

To meet the objectives of this study, median wetland and riparian inundation levels during baseline operations and anticipated operations were compared to the wetland and habitat types from the NWI database. The NWI database was clipped below the baseline median elevation to remove erroneous areas of open water. The analysis of the wetland acres that may be affected was then assessed between the baseline median and anticipated median inundation levels during the growing season.

To determine the net change (increase) in wetland, riparian habitats, and WMAs between the baseline and anticipated median operational levels, Horizon assessed 160.78 acres of

wetland habitat types as defined by the NWI map layer and as reported in Table 1. As provided in Table 2, the study area contains 2.70 acres of riparian habitat types. As reported in Table 3, the study area contains 28.54 acres of WMAs. These data are also displayed graphically in a map set that is included in Attachment A. It should be noted that the wetland and riparian areas that are listed in the tables below and illustrated in Attachment A are difficult to display due to the large geographical scope of the study and the narrow area between the baseline and anticipated operation water line. The majority of the water line difference, in a horizontal direction, between the baseline and anticipated operation ranges between a few to several feet wide along the lake shoreline.

Table 1. Wetland Composition within Study Area

Wetland Habitat Type	Acres Within Study Area
Freshwater Emergent Wetlands	
Palustrine, Emergent, Persistent, Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded, Diked/Impounded (PEM1/SS1Ch)	0.23
Palustrine, Emergent, Persistent, Temporary Flooded (PEM1A)	0.02
Palustrine, Emergent, Persistent, Seasonally Flooded (PEM1C)	3.61
Palustrine, Emergent, Persistent, Seasonally Flooded, Diked/Impounded (PEM1Ch)	2.02
Total Freshwater Emergent Wetlands Acres	**5.88**
Freshwater Forested Wetland	
Palustrine, Forested, Broad-Leaved Deciduous, Emergent, Persistent, Seasonally Flooded, Diked/Impounded (PFO1/EM1Ch)	0.80
Palustrine, Forested, Broad-Leaved Deciduous, Scrub-Shrub, Broad-Leaved Deciduous, Temporary Flooded (PFO1/SS1A)	0.55
Palustrine, Forested, Broad-Leaved Deciduous, Scrub-Shrub, Broad-Leaved Deciduous, Temporary Flooded, Diked/Impounded (PFO1/SS1Ah)	3.33
Palustrine, Forested, Broad-Leaved Deciduous, Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded (PFO1/SS1C)	0.36
Palustrine, Forested, Broad-Leaved Deciduous, Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded, Diked/Impounded (PFO1/SS1Ch)	22.12
Palustrine, Forested, Broad-Leaved Deciduous, Unconsolidated Bottom, Semi-permanently Flooded, Diked/Impounded (PFO1/UBFh)	3.28
Palustrine, Forested, Broad-Leaved Deciduous, Temporary Flooded (PFO1A)	11.32
Palustrine, Forested, Broad-Leaved Deciduous, Temporary Flooded, Diked/Impounded (PFO1Ah)	7.84
Palustrine, Forested, Broad-Leaved Deciduous, Seasonally Flooded (PFO1C)	9.52

Wetland Habitat Type	Acres Within Study Area
Palustrine, Forested, Broad-Leaved Deciduous, Seasonally Flooded, Diked/Impounded (PFO1Ch)	51.31
Palustrine, Forested, Broad-Leaved Deciduous, Semi-permanently Flooded, Diked/Impounded (PFO1Fh)	7.98
Palustrine, Forested, Dead, Broad-Leaved Deciduous, Semi-permanently Flooded, Diked/Impounded (PFO5/1Fh)	0.83
Total Freshwater Forested Wetland Acres	**119.24**
Freshwater Scrub-Shrub Wetlands	
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Emergent, Persistent, Temporary Flooded, Ditched (PSS1/EM1Ad)	0.37
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Emergent, Persistent, Seasonally Flooded (PSS1/EM1C)	0.73
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Emergent, Persistent, Seasonally Flooded, Diked/Impounded (PSS1/EM1Ch)	6.13
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Unconsolidated Bottom, Semi-permanently Flooded, Diked/Impounded (PSS1/UBFh)	0.13
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Temporary Flooded (PSS1A)	0.59
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Temporary Flooded, Diked/Impounded (PSS1Ah)	0.11
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded (PSS1C)	1.22
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded, Diked/Impounded (PSS1Ch)	15.13
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Semi-permanently Flooded (PSS1F)	0.07
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Semi-permanently Flooded, Diked/Impounded (PSS1Fh)	9.21
Total Freshwater Scrub-Shrub Wetlands Acres	**33.69**
Freshwater Open Water	
Palustrine, Unconsolidated Bottom, Permanently Flooded, Diked/Impounded (PUBHh)	1.84
Palustrine, Unconsolidated Bottom, Permanently Flooded, Excavated (PUBHx)	0.13
Total Freshwater Open Water Acres	**1.97**
Total Wetland Acres Within Study Area	**160.78**

Table 2. Riparian Composition within Study Area

Riparian Habitat Type	Acres Within Study Area
Riparian, Lotic, Forested, Deciduous (Rp1FO6)	2.49
Riparian, Lentic, Forested, Deciduous (Rp2FO6)	0.21
Total Riparian Habitat Acres	**2.70**

Table 3. Wildlife Management Areas within Study Area

WMA Name	Acres Within Study Area
Connors Bridge	0.22
Mallard Point	13.4
West Spring River	14.92
Total WMA Acres	**28.54**

2.2 DISCUSSION AND CONCLUSION

According to NWI and GRDA data, 160.78 acres of wetlands, 2.70 acres of riparian habitat, and 28.54 acres of WMAs were identified in the study area and will be periodically inundated more often under the anticipated operations than under the baseline operations (i.e, the median elevation is expected to be slightly higher under the anticipated operations than it is under current, baseline operations).

In some areas of the reservoir far upstream, the stream channel had migrated to one side or the other from the location mapped in the original NWI data. The majority of these areas occur in portions of the reservoir where the median elevation differences are indistinguishable between the baseline and anticipated operations. Therefore, no major deviations from the preliminary wetland cover types required ground-truthing.

Overall, GRDA's anticipated operations under the new license will result in water level fluctuations ranging from 742 to 745 feet PD (or 3 feet), whereas baseline operations have resulted in frequent water level fluctuations ranging from 741 to 745 feet PD (or 4 feet). As a result, fewer overall impacts to wetlands, riparian areas, and WMAs are expected under the anticipated operations than under baseline operations. Additional wetlands will experience permanent inundation between 741 and 742 feet PD under the anticipated operations.

Historically, baseline operations enforced by the rule curve frequently resulted in an operational range between 741 and 745 feet PD (4 feet). In comparison, the median baseline and anticipated reservoir elevations during the growing season (March 30 to November 2) yield elevations of 742.92 feet PD and 743.46 feet PD, respectively. This increase of 0.54 feet is not likely to yield significant changes to wetlands in the affected areas. Furthermore, the comparisons between the baseline and anticipated operations also include the historical and now-abandoned fall drawdown of the reservoir to 741 feet PD to expose mudflats.

Using historical data to represent normal events, including 1-year flood events, the output of the CHM produced a comparison of the median water surface elevation (WSEL) under baseline operations versus the median WSEL under anticipated operations for the growing season (March 30 to November 2). The mapped output when overlaid on other sources of data, including the NWI data, showed very small differences along shorelines that could result in a net increase or conversion to other types of wetlands, because the anticipated operations have a higher median elevation during the growing season than do the baseline operations.

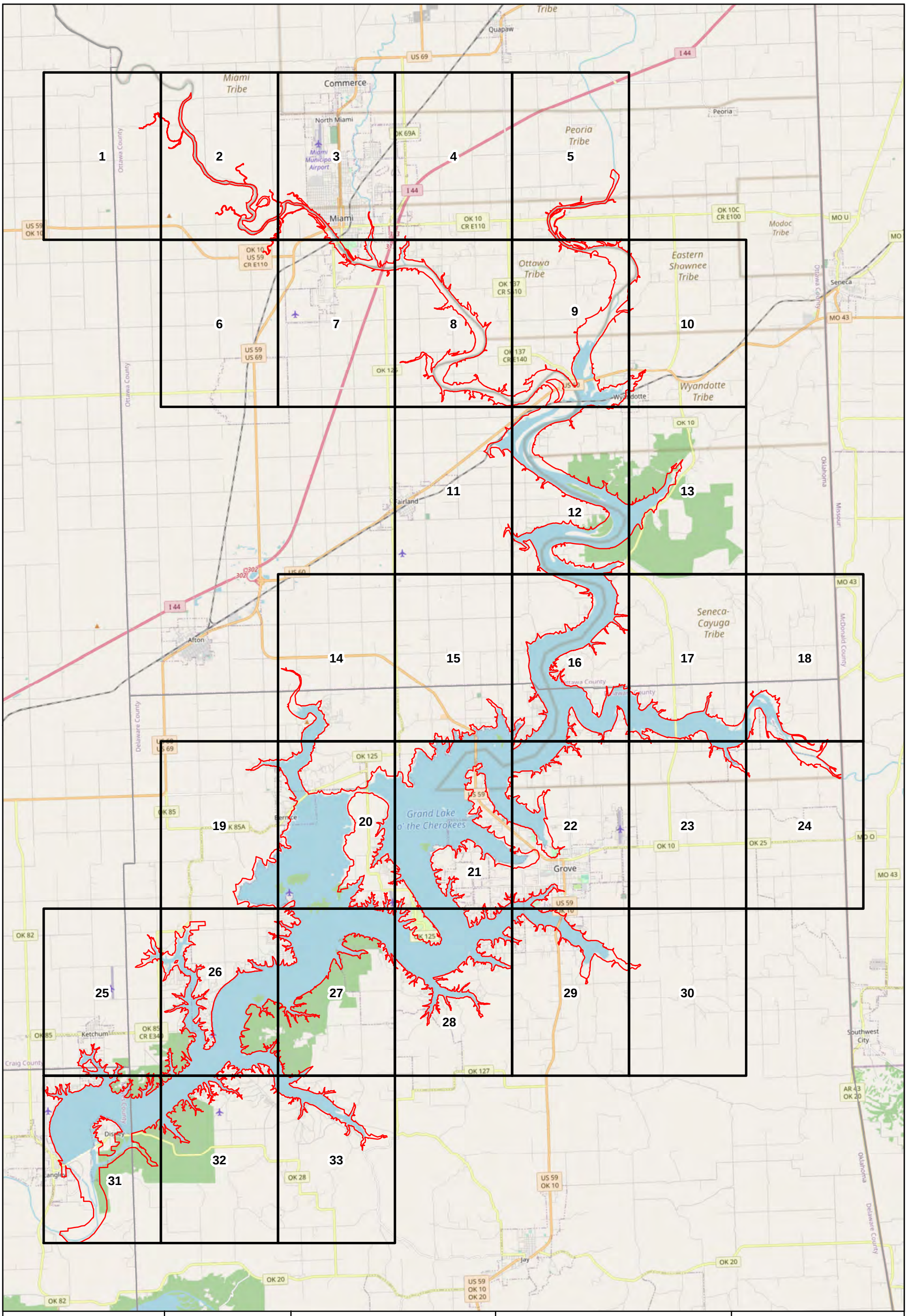
3.0 REFERENCES CITED

Cowardin, L., V. Carter, and E. LaRoe. Classification of Wetlands and Deepwater Habitats of the United States. US Fish and Wildlife Service publication. Published 1979.

(Esri) Environmental Systems Research Institute. World Imagery, <https://www.arcgis.com/home/item.html?id=10df2279f9684e4a9f6a7f08febac2a9>. Imagery date 29 March 2021.

ATTACHMENT A

Wetland and Riparian Inundation Changes Map Set



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

Horizon Environmental Services, Inc.

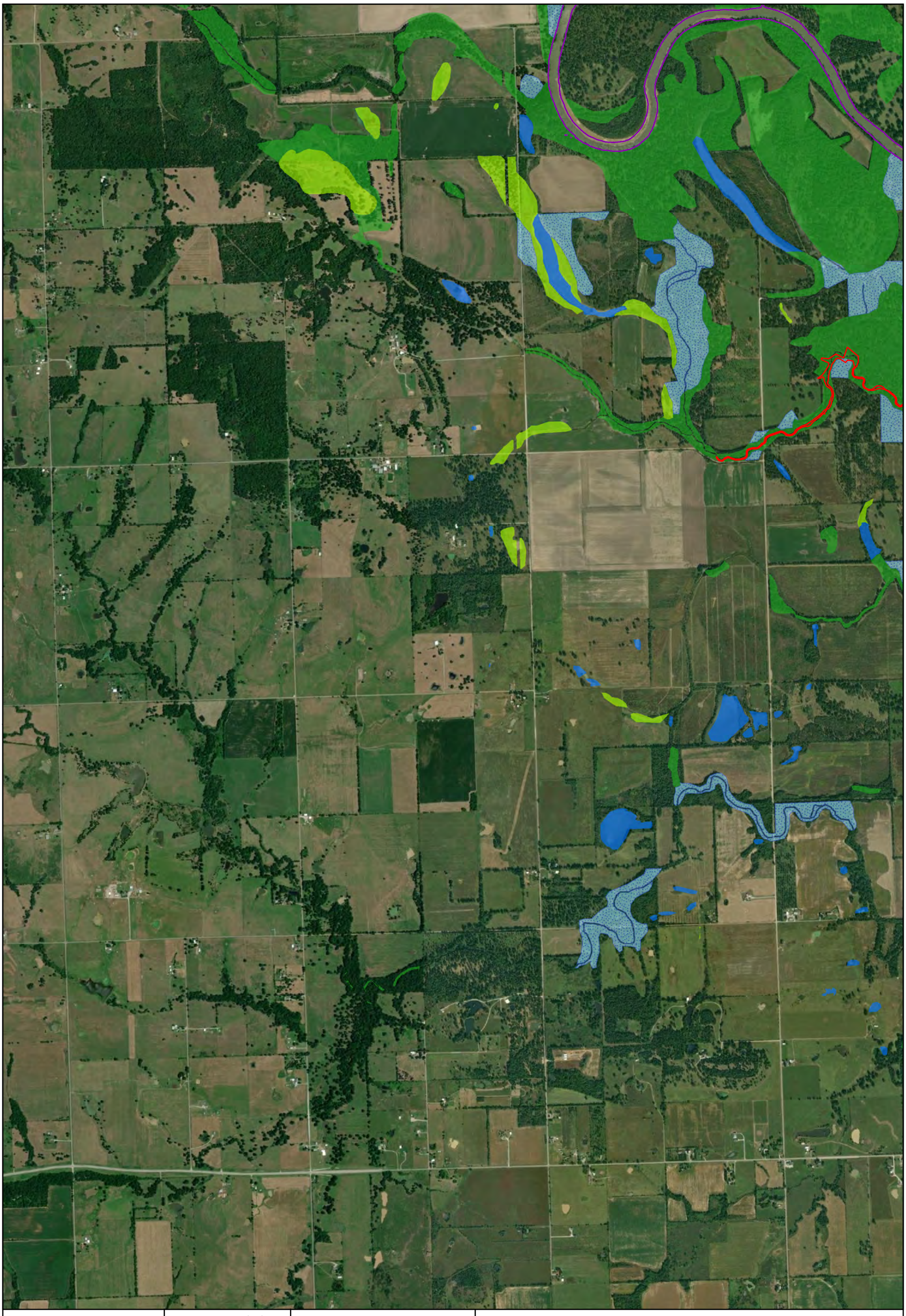
Wetland & Riparian Inundation Changes
Overall Map
GRDA Pensacola Project
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma

Legend

- County Boundary
- Project Boundary
- 1:24,000-scale Map Sheet

0 1.5 3
Miles

21021--GRDA_Pensacola_Project_Relicensing\Graphics\Wetland_Report_Maps\21021-002EA_01A_Overall



Horizon™ Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000

Feet

Figure 1

Wetland & Riparian Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- USFWS Riparian Habitat
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021–GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 2

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- USFWS Riparian Habitat
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021–GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 3

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- USFWS Riparian Habitat
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 4

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- USFWS Riparian Habitat
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 5

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- USFWS Riparian Habitat
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 6

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- USFWS Riparian Habitat
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 7

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- USFWS Riparian Habitat
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 8

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Wildlife Management Area
- USFWS Riparian Habitat
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021–GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 9

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Wildlife Management Area
- USFWS Riparian Habitat
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 10

Wetland & Riparian Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Wildlife Management Area
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021–GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

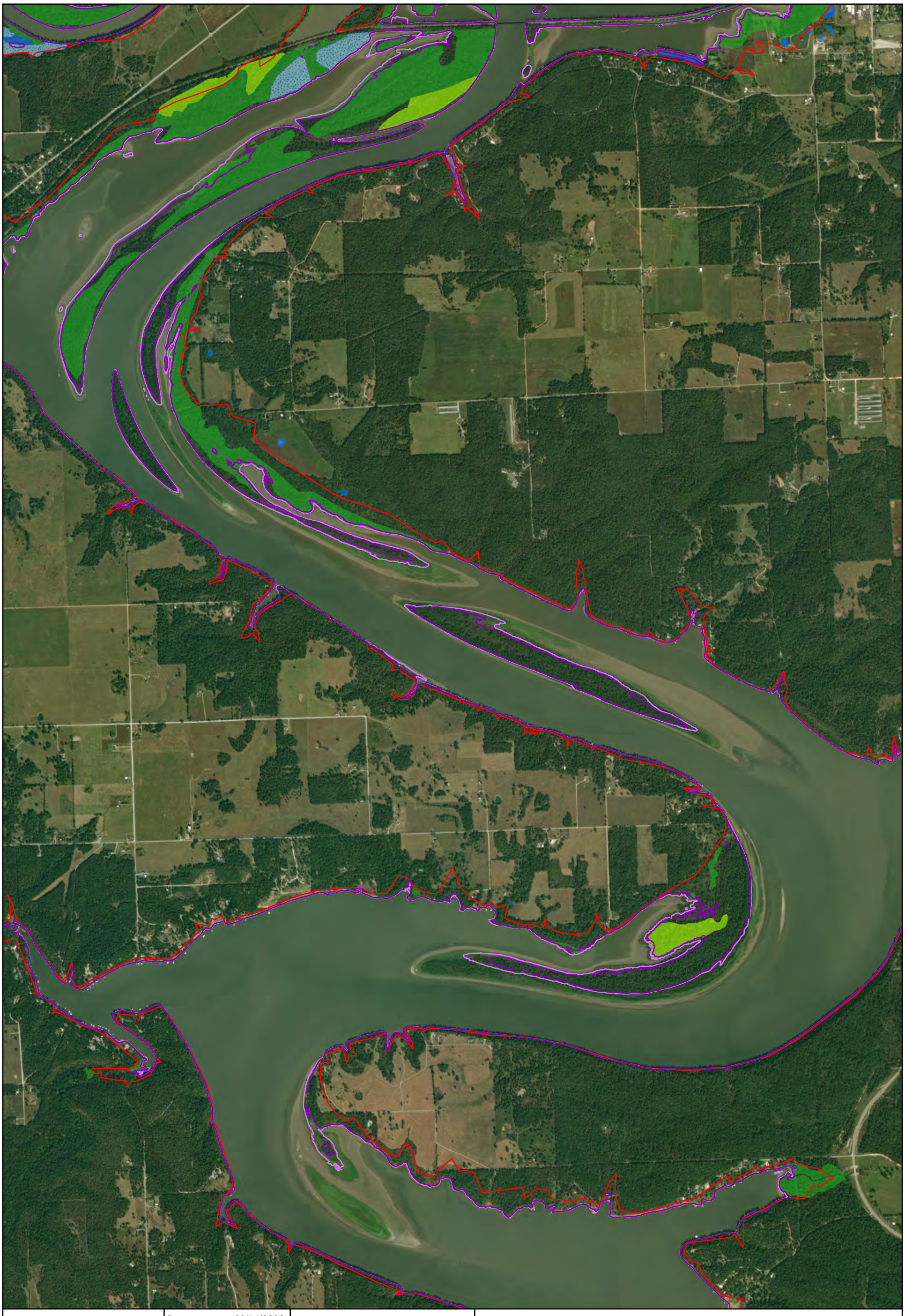
Figure 11

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- USFWS Riparian Habitat
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021–GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian



Horizon™ Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 12

Wetland & Riparian Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- USFWS Riparian Habitat
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™ Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 13

Wetland & Riparian Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™ Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 14

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 15

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021–GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 16

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 17

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 18

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021–GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 19

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 20

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 21

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 22

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™ Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 23

Wetland & Riparian Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021–GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 24

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 25

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021–GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™ Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 26

Wetland & Riparian Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 27

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 28

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021–GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™ Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 29

Wetland & Riparian Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 30

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Freshwater Forested/Shrub Wetland

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™ Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000

Feet

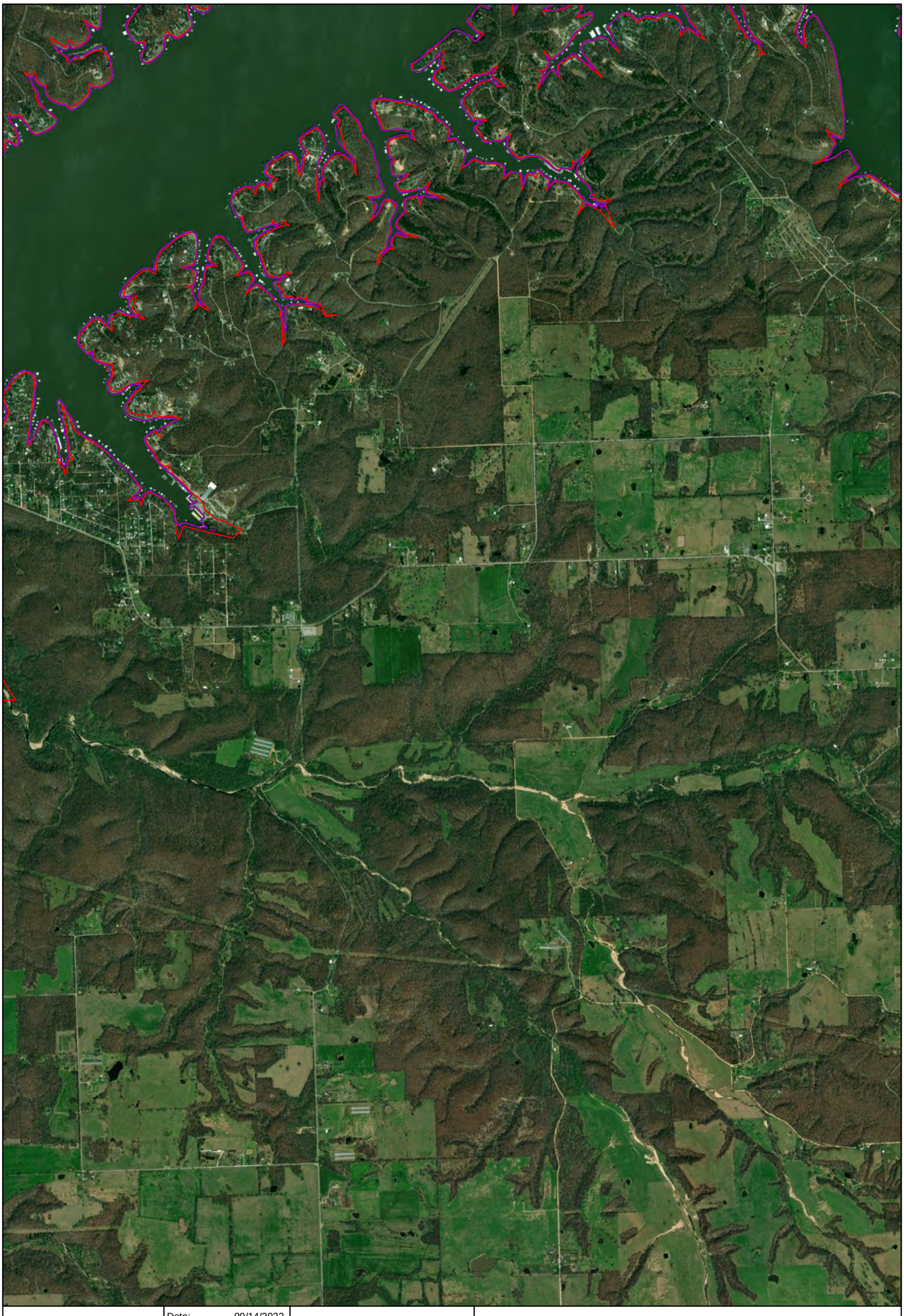
Figure 31

Wetland & Riparian Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland
- Freshwater Pond

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian



Horizon™ Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 32

Wetland & Riparian Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes & Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland

21021--GRDA_Pensacola_Project_Relicensing\Graphics\WD_2022\21021-001WD_02A_Wetland_and_Riparian

Horizon™
Environmental Services, Inc.

Date:	09/14/2022
Drawn:	KRW
Source:	Esri, 2021

0 1,000 2,000
Feet

Figure 33

Wetland & Riparian
Inundation Changes
GRDA Pensacola Project
Craig, Delaware, Mayes &
Ottawa Counties, Oklahoma

Legend

- Project Boundary
- Wetland & Riparian Anticipated Inundation Boundary
- Wetland & Riparian Baseline Inundation Boundary
- Freshwater Forested/Shrub Wetland
- Freshwater Pond