STREAM RESTORATION DESIGN COMPONENTS OF THE BOIS D'ARC LAKE WATERSHED-SCALE ECOLOGICAL RESTORATION AND MITIGATION PROJECT

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BOIS D'ARC LAKE
NORTH TEXAS MUNICIPAL WATER DISTRICT
The Bois d' Arc Lake Mitigation Project
A Watershed Scale Ecological Restoration Project
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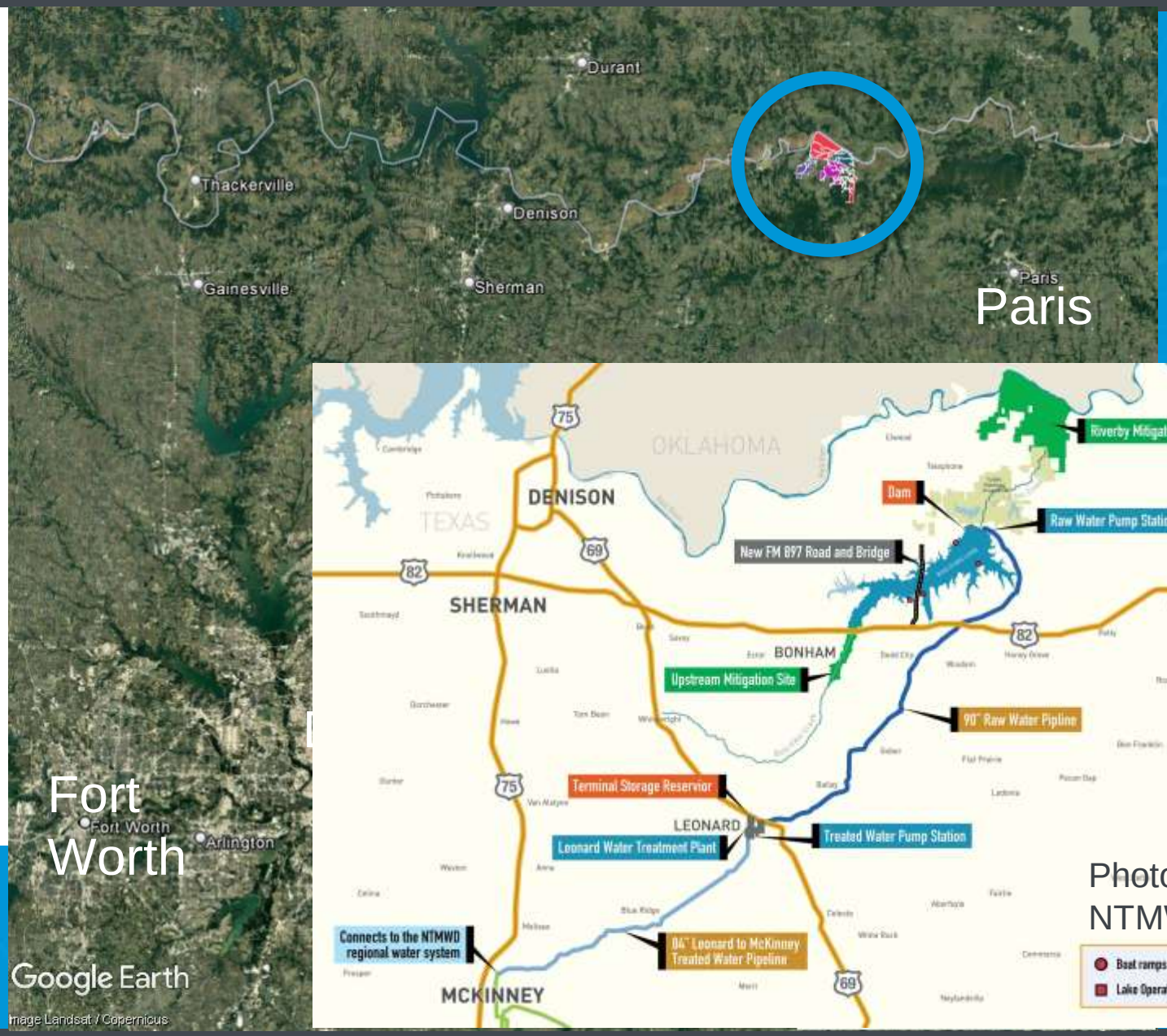
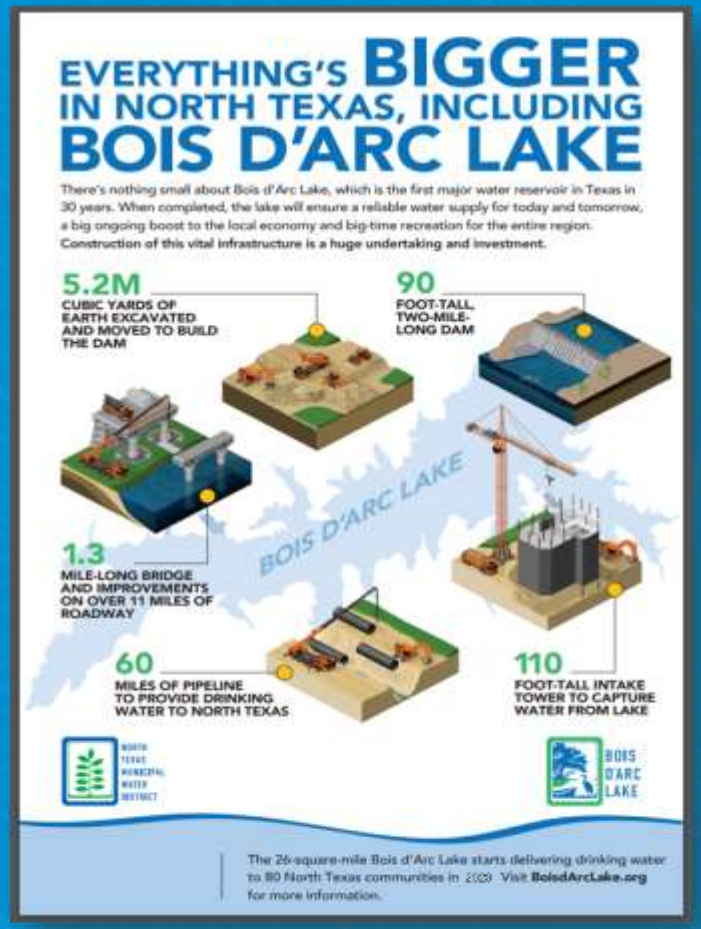


Photo by: NTMWD

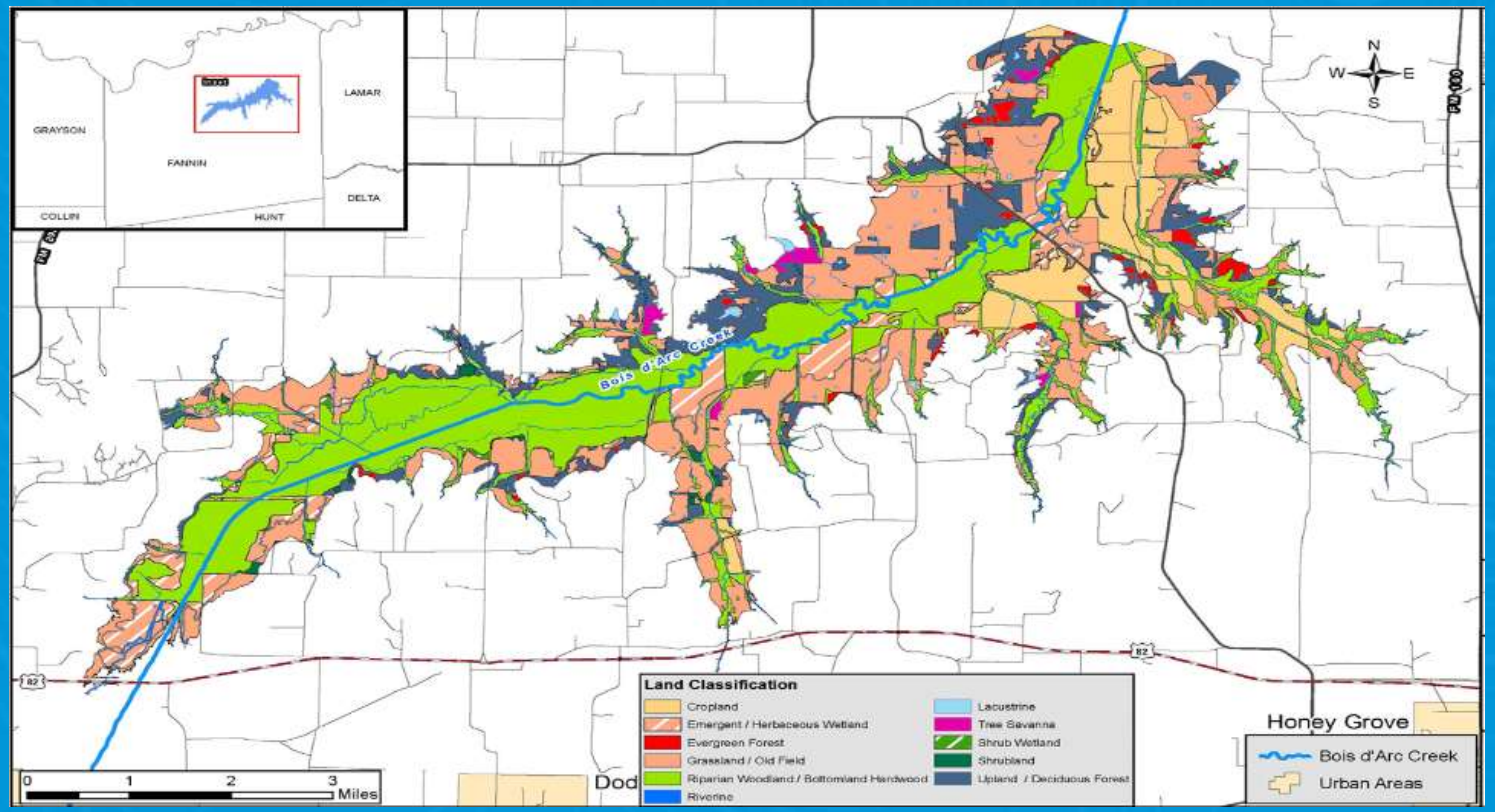


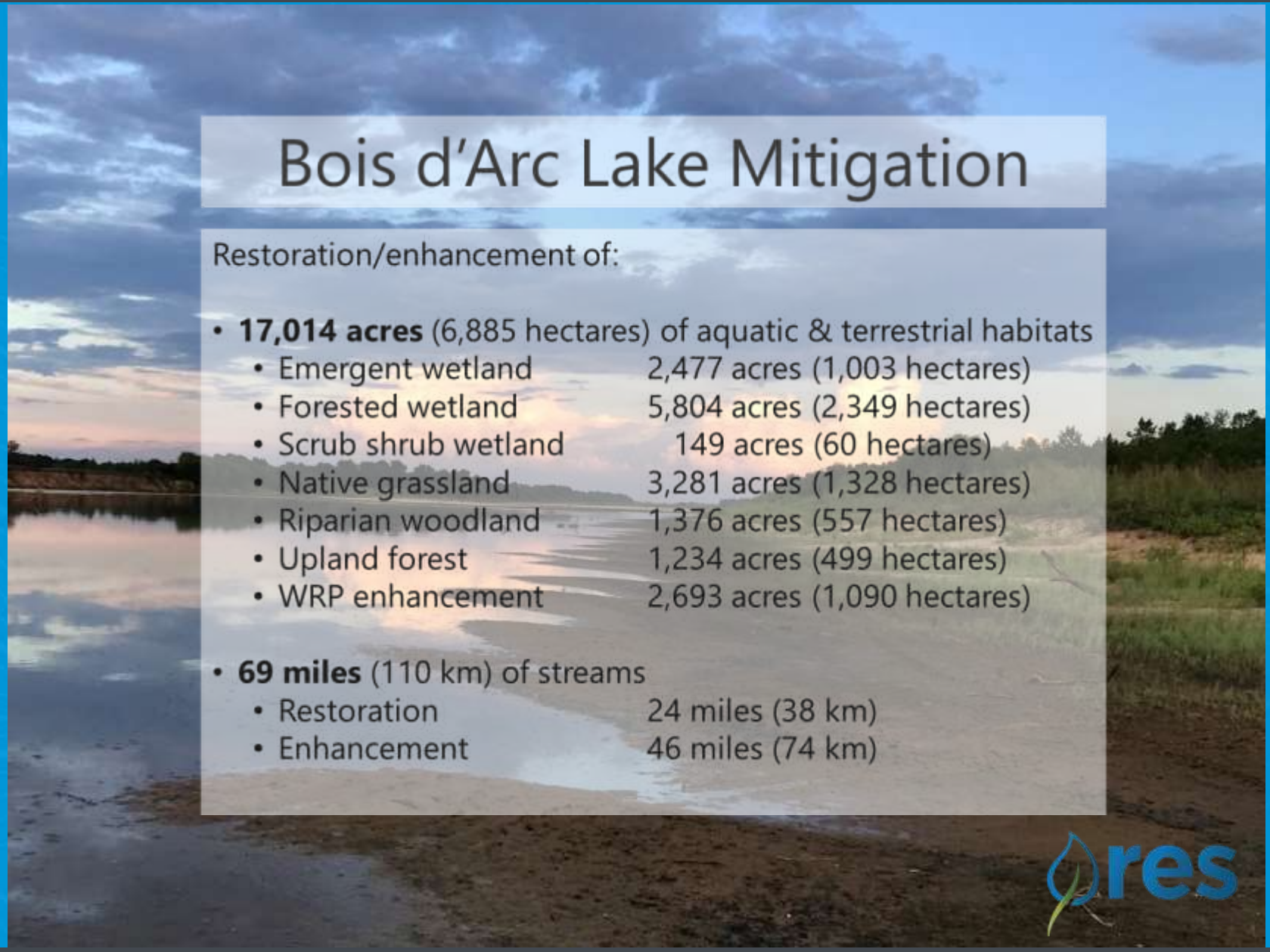
Bois d'Arc Lake

- Owner & operator: NTMWD
- Surface Area: 16,641 acres
- Cost Estimate: $1.6B
- First Reservoir in 30 years
- 10+ years of planning & permitting
- Permitting:
  - TCEQ TX Water Rights – received June 2015
  - USACE Section 404 – received Feb. 2018
- Construction began May 2018
- Water delivery expected in 2023

Impacts

16,641 acres of impacts to various habitats and streams




Bois d'Arc Lake Mitigation
Restoration/enhancement of:
• 17,014 acres (6,885 hectares) of aquatic & terrestrial habitats
• Emergent wetland 2,477 acres (1,003 hectares)
• Forested wetland 5,804 acres (2,349 hectares)
• Scrub shrub wetland 149 acres (60 hectares)
• Native grassland 3,281 acres (1,328 hectares)
• Riparian woodland 1,376 acres (557 hectares)
• Upland forest 1,234 acres (499 hectares)
• WRP enhancement 2,693 acres (1,090 hectares)
• 69 miles (110 km) of streams
• Restoration 24 miles (38 km)
• Enhancement 46 miles (74 km)
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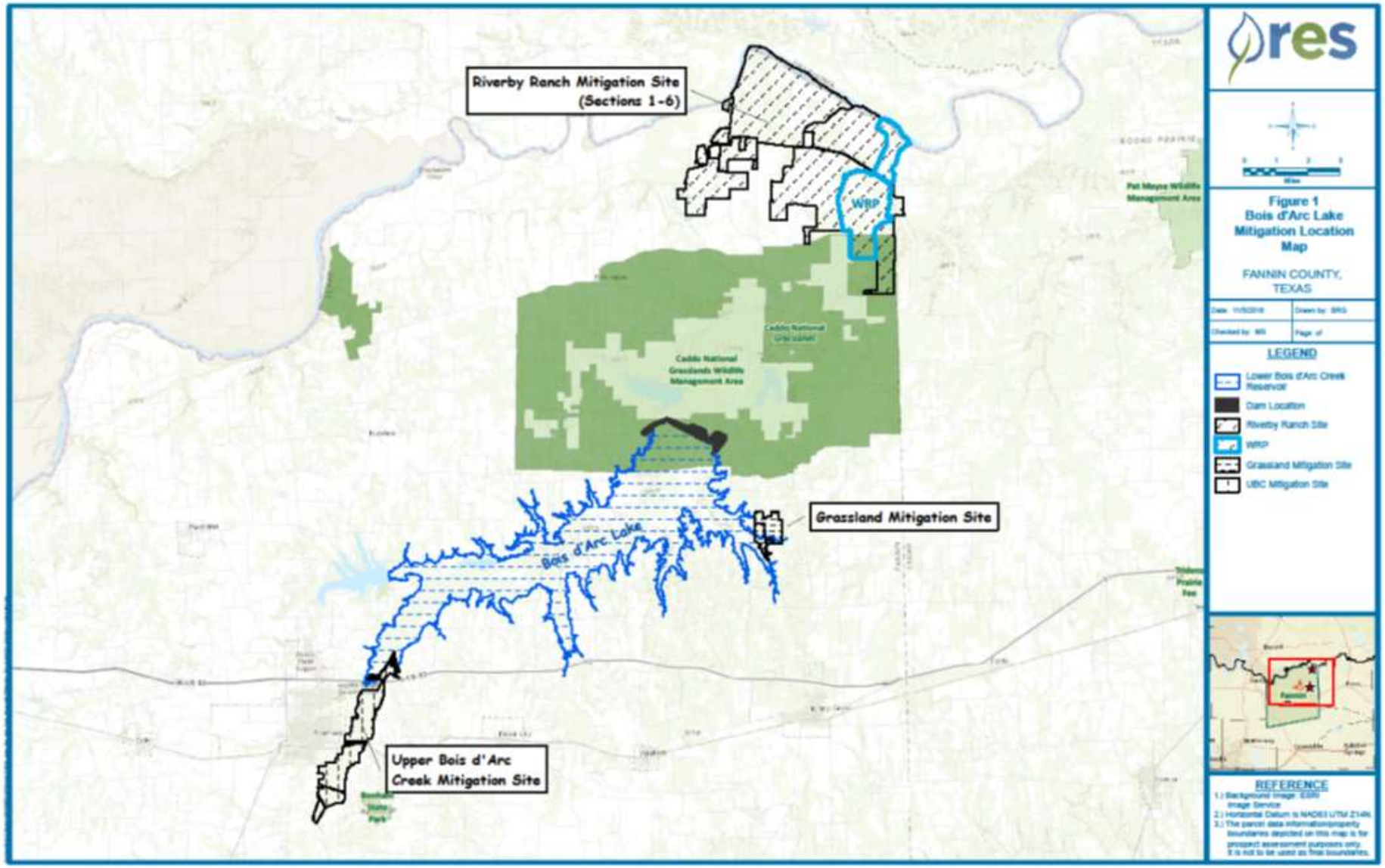
Riverby Ranch Mitigation Site
(Sections 1-6)
WRP
Caddo National Grasslands Wildlife Management Area
Grassland Mitigation Site
Bois d'Arc Lake
Upper Bois d'Arc Creek Mitigation Site
Pat Mayse Wildlife Management Area
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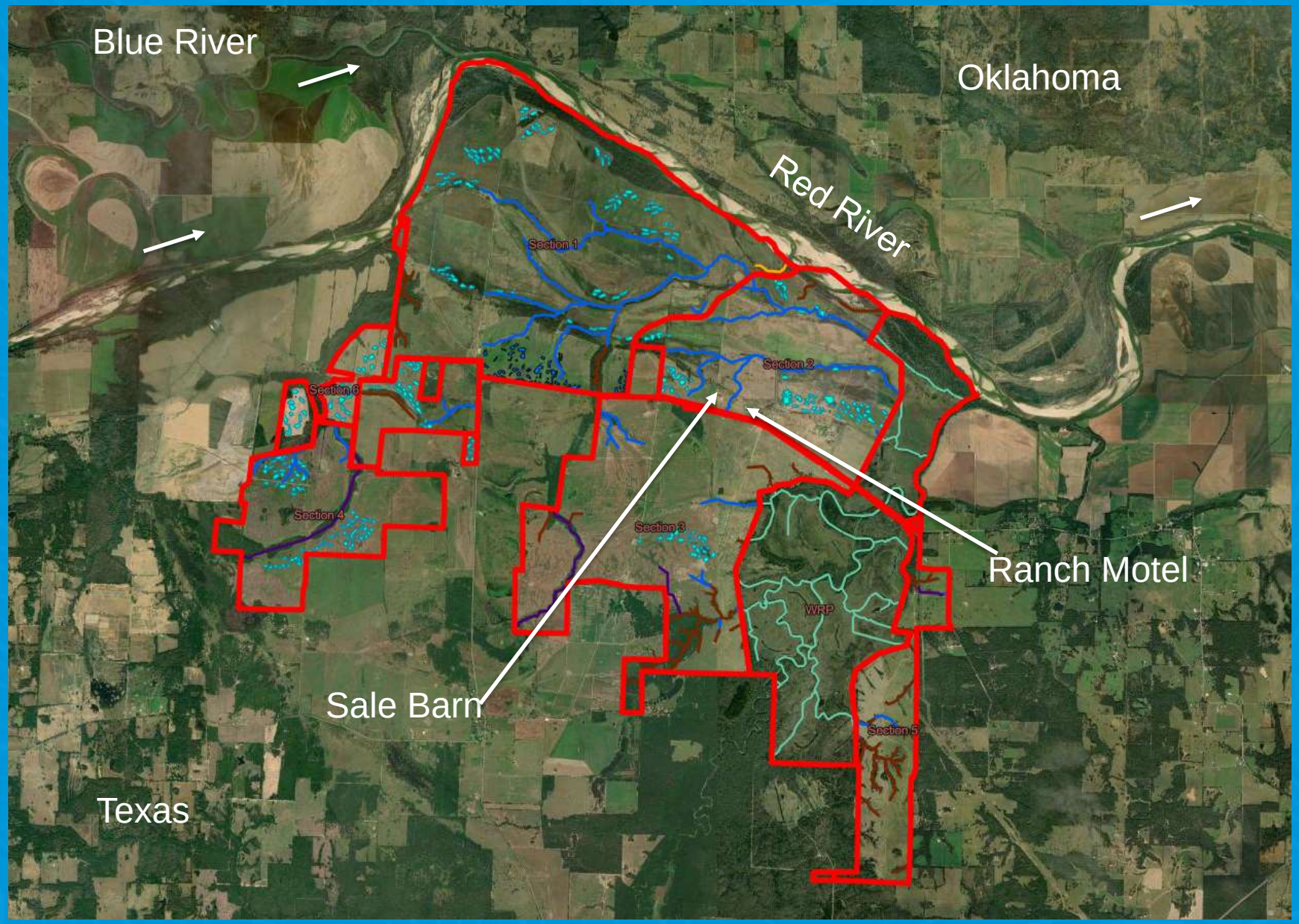
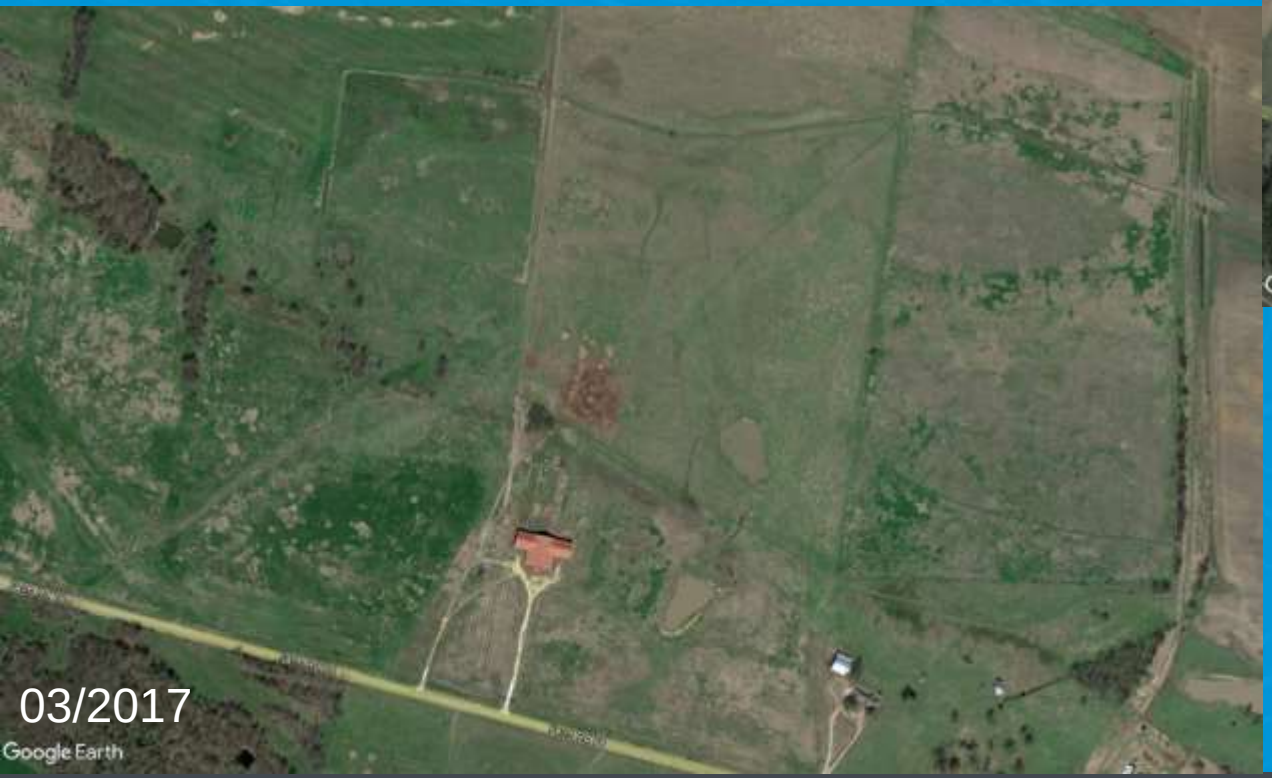
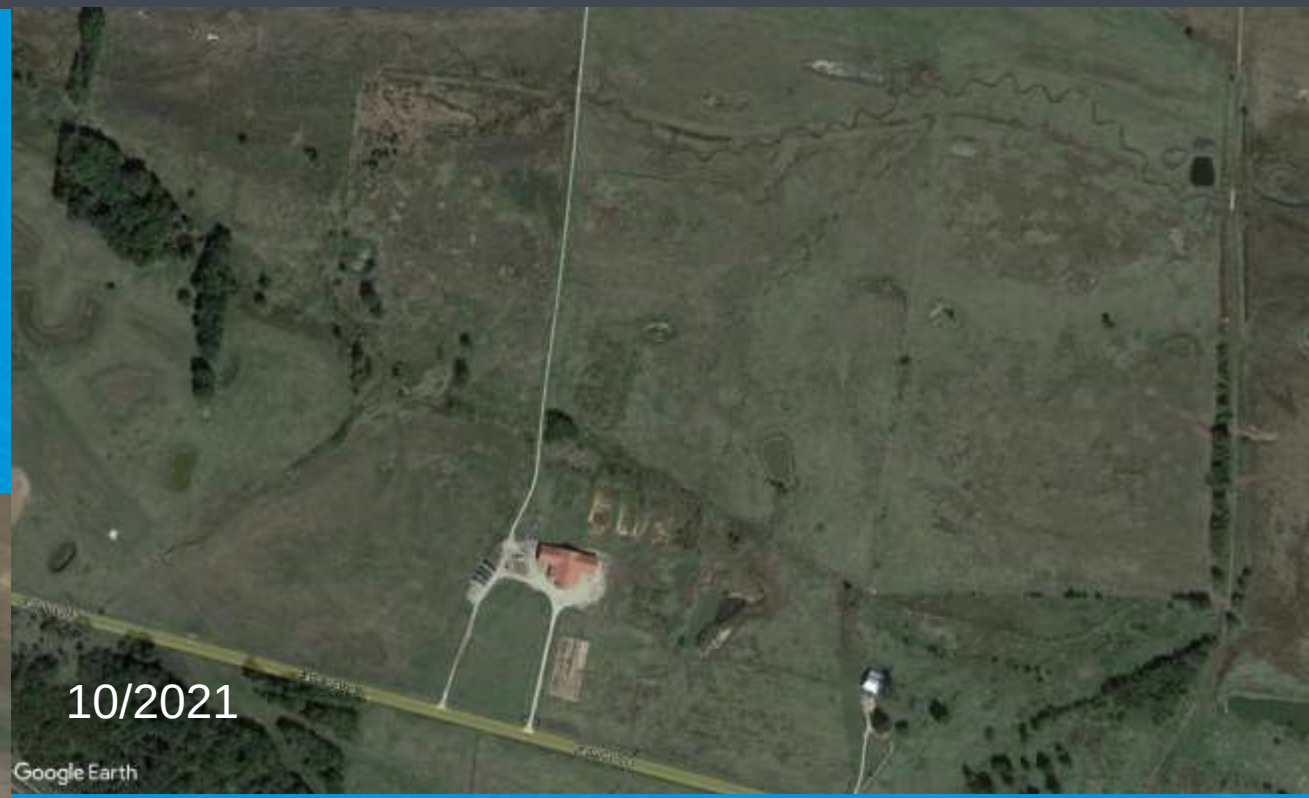
Figure 1
Bois d'Arc Lake
Mitigation Location
Map
FANNIN COUNTY,
TEXAS
LEGEND
Lower Bois d'Arc Creek Reservoir
Dam Location
Riverby Ranch Site
WRP
Grassland Mitigation Site
UBC Mitigation Site
REFERENCE



- Restored Stream
- Enhanced Stream
- Section Boundary
- Emergent Wetland
- Stream Enhancement in Wetlands Reserve Program (WRP)

- July 2018 – September 2018
  - 30% design
  - >55 miles of proposed stream restoration and enhancement
  - >800 pages stream design plan sets





- September 2018 – January 2021
  - 90% design and As-built
  - 69 miles of proposed stream restoration and enhancement
  - >350 pages stream restoration plan sets
  - >450 pages stream as-built plan sets

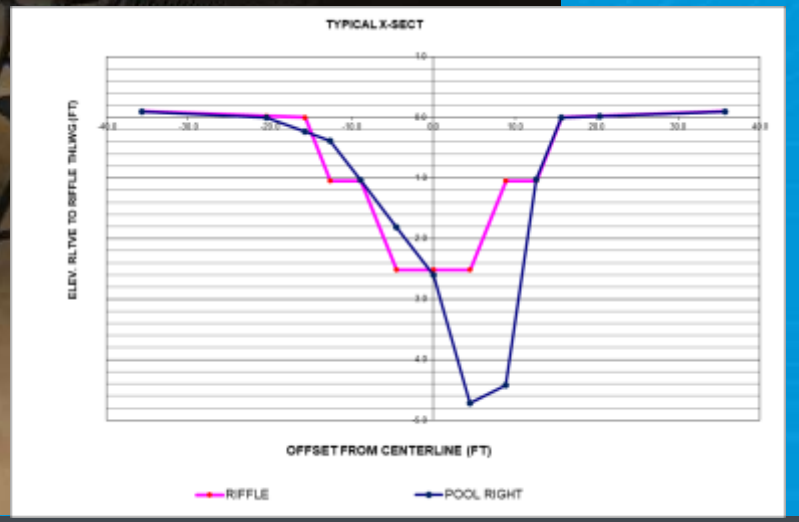

>15 feet

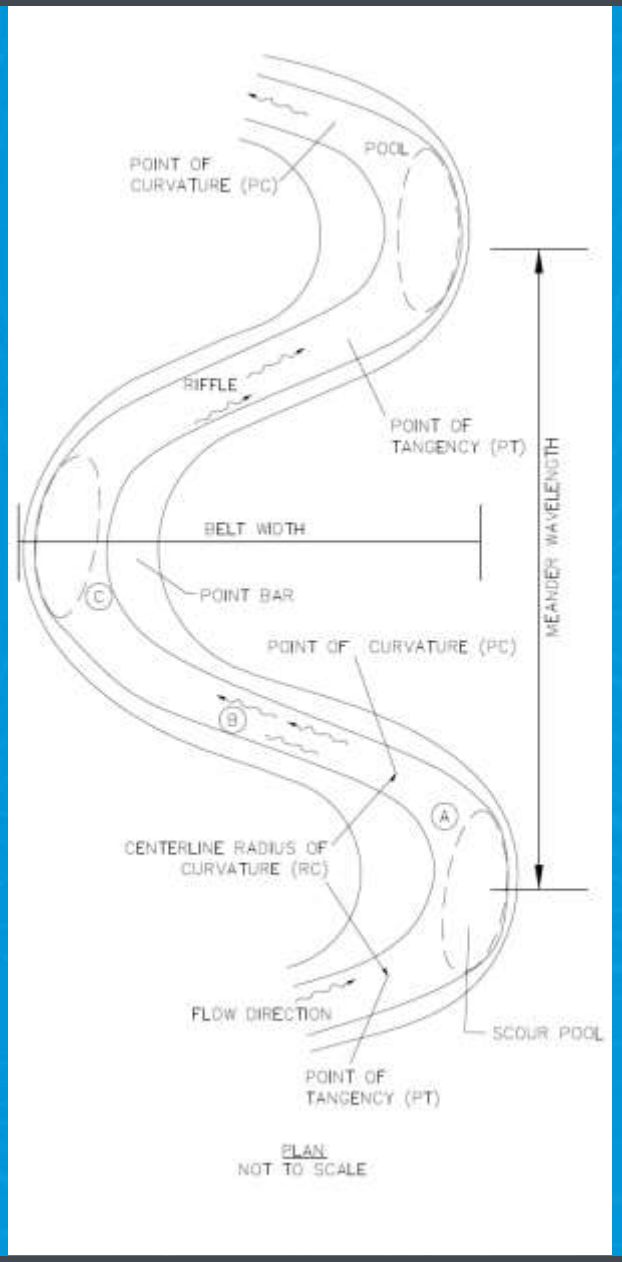
WILLOW BRANCH CREEK – DURING CONSTRUCTION (JUNE 2020)

WILLOW BRANCH CREEK – AFTER CONSTRUCTION (SEPTEMBER 2020)

- 3 Classes, >20 Students.
- 3-4 Senior Engineers.
- Real Project Reaches to Design.
- Breakline Program and Civil 3D
- 1~2 Week Training:

From learning AutoCAD and stream geomorphology on first day to design stream reaches on last day.

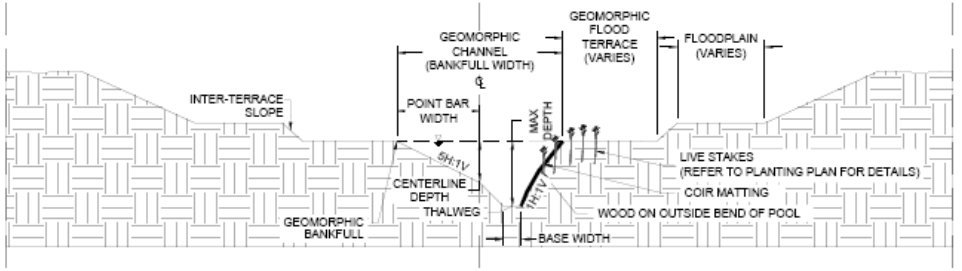




STREAM DESIGN USING AUTOCAD

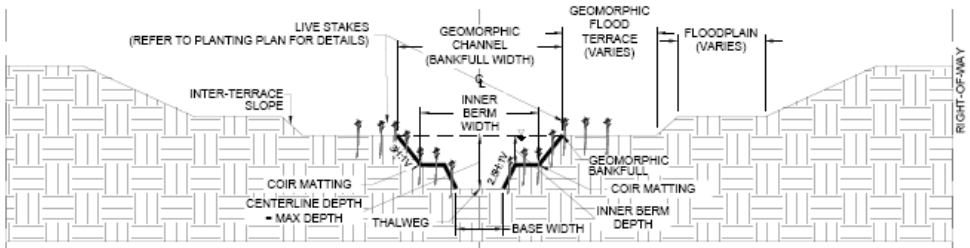
A TYPICAL SECTION - POOL RIGHT
NOT TO SCALE

DESIGN PARAMETERS	SIZE (FT)
BANKFULL WIDTH	17
POINT BAR WIDTH	9.9
MAX DEPTH	2.5
BASE WIDTH	1.3
CENTERLINE DEPTH	2.0



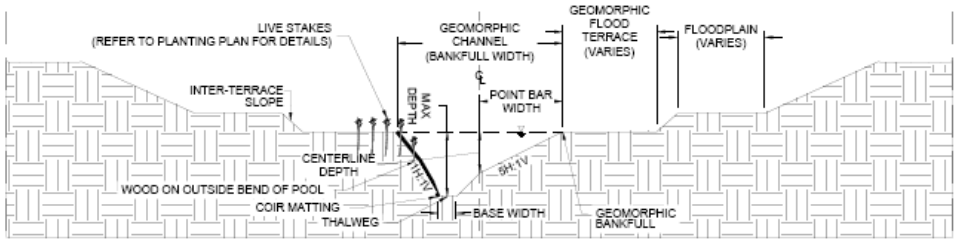
B TYPICAL SECTION - RIFFLE
NOT TO SCALE

DESIGN PARAMETERS	SIZE (FT)
BANKFULL WIDTH	14.1
MAX DEPTH	1.2
BASE WIDTH	4.6
INNER BERM DEPTH	0.3
INNER BERM WIDTH	5.8



C TYPICAL SECTION - POOL LEFT
NOT TO SCALE

DESIGN PARAMETERS	SIZE (FT)
BANKFULL WIDTH	17
POINT BAR WIDTH	9.9
MAX DEPTH	2.5
BASE WIDTH	1.3
CENTERLINE DEPTH	2.0



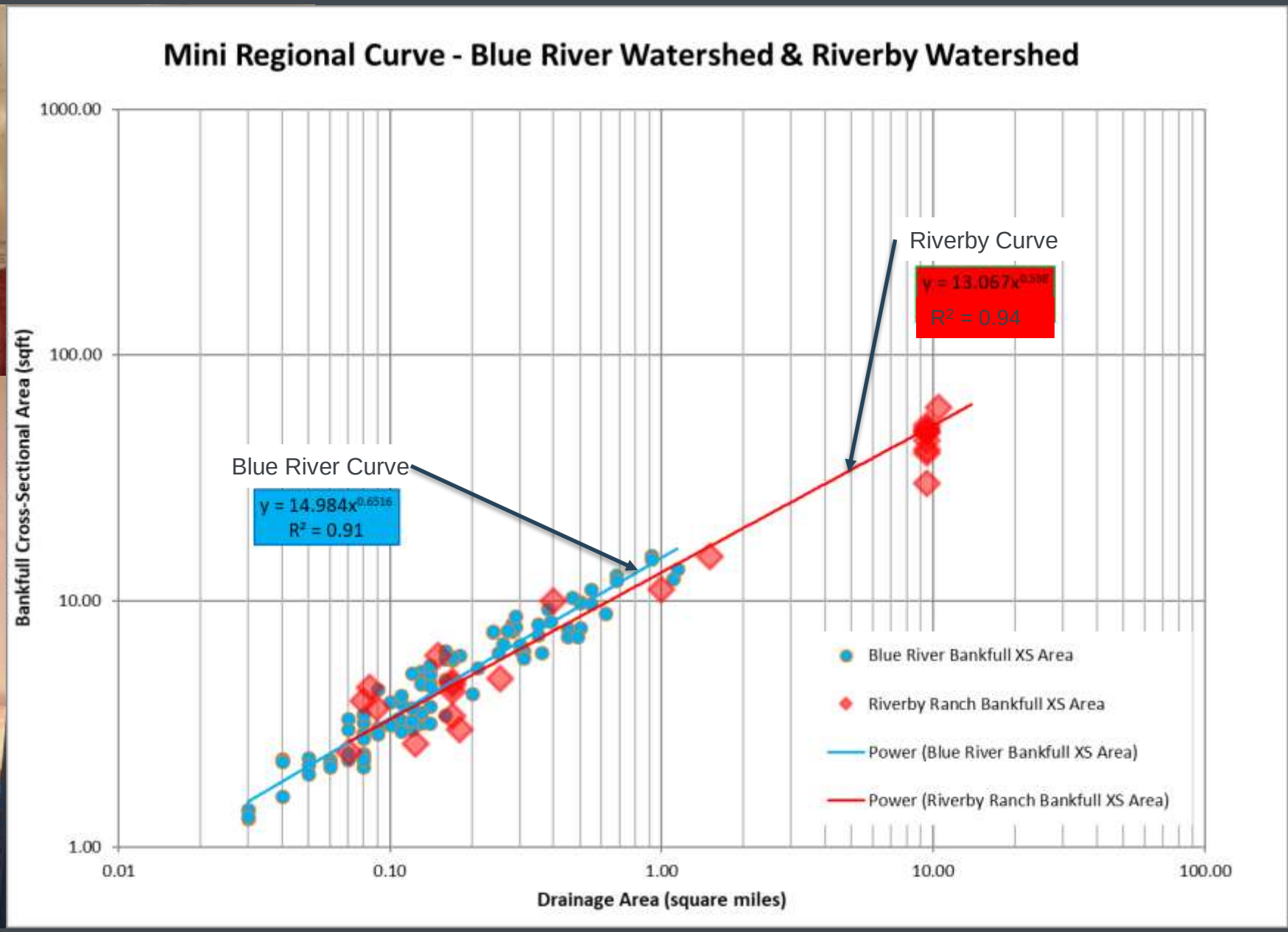

Mini Regional Curve - Blue River Watershed & Riverby Watershed
Bankfull Cross-Sectional Area (sqft)
1000.00
100.00
10.00
1.00
0.01
0.10
1.00
10.00
100.00
Drainage Area (square miles)
Riverby Curve
y = 13.067x^0.5987
R² = 0.94
Blue River Curve
y = 14.984x^0.6516
R² = 0.91
Blue River Bankfull XS Area
Riverby Ranch Bankfull XS Area
Power (Blue River Bankfull XS Area)
Power (Riverby Ranch Bankfull XS Area)

Photo by RES

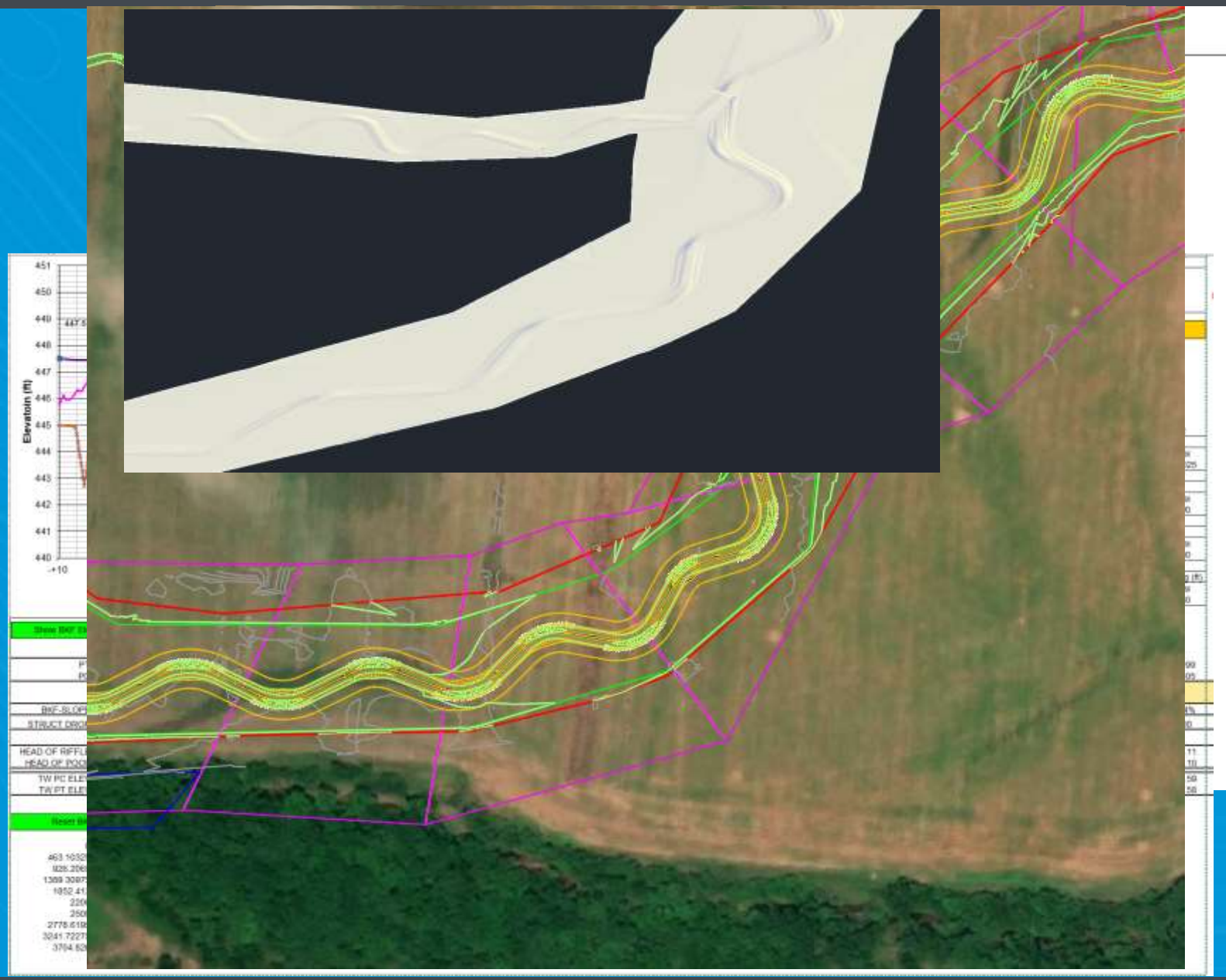
ENGINEERING AT THE PROJECT SITE – 24/7

Photo by RES

EXISTING PROJECT SITE STUDY

GEOMORPHOLOGICAL SURVEY AND MEASUREMENT

- Design alignment
- "Breakline" Program
- AutoCAD Civil 3D
- Cut/fill volume
  - Total earthwork volume
  - Every 400 ft segment earthwork volume
- Evaluate design and adjust for optimization
- Each iteration is ~20 minutes
- Field verify design with GPS



Bank Stabilization Structures

Structure Type	Reach Slope	BKF Width					
		6-10 ft	10-15 ft	15-20 ft	20-30 ft	30-35 ft	35-50 ft
Hay Bale Toe (L.F.)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Coir Single Lifts (L.F.)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Wood Toe (L.F.)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Sod Transplants Single Lifts (Each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Log Vane (Each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Log J-Hook (Each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						

Hay Bale Toe

Sod Transplants

Log J-Hook

Wood Toe

Grade Control Structures

Structure Type	Reach Slope	BKF Width					
		6-10 ft	10-15 ft	15-20 ft	20-30 ft	30-35 ft	35-50 ft
Hay Bale Riffles (Each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Log Sill (Each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Gravel Augmented Riffle (Each)	<0.15%						
	0.15% - 0.3%						
	0.30% - 1.0%						
	1.00% - 2.0%						
	2.00% - 4.0%						
Log/Boulder Constructed Riffle (Each)	<0.15%						
	0.15% - 0.30%						
	0.3% - 1.00%						
	1.0% - 2.00%						
	2.0% - 4.00%						
Log Constructed Riffle (Each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Rock J-Hook (each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Boulder Cross Vane (each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						

Hay Bale Riffle

Boulder Constructed Riffle

Gravel Augmented Riffle

Log/Boulder Constructed Riffle

Grade Control Structures

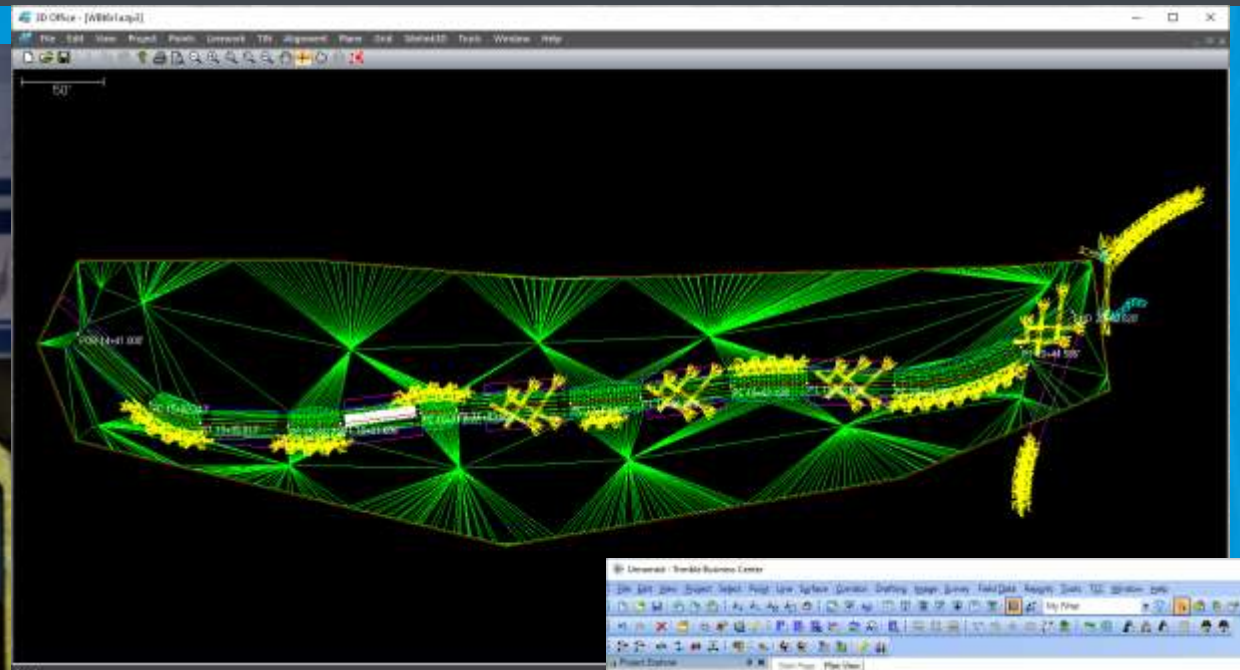
Structure Type	Reach Slope	BKF Width					
		6-10 ft	10-15 ft	15-20 ft	20-30 ft	30-35 ft	35-50 ft
Hay Bale Riffles (Each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Log Sill (Each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Gravel Augmented Riffle (Each)	<0.15%						
	0.15% - 0.3%						
	0.30% - 1.0%						
	1.00% - 2.0%						
	2.00% - 4.0%						
Log/Boulder Constructed Riffle (Each)	<0.15%						
	0.15% - 0.30%						
	0.3% - 1.00%						
	1.0% - 2.00%						
	2.0% - 4.00%						
Log Constructed Riffle (Each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Rock J-Hook (each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						
Boulder Cross Vane (each)	<0.15%						
	0.15% - 0.3%						
	0.3% - 1.0%						
	1.0% - 2.0%						
	2.0% - 4.0%						

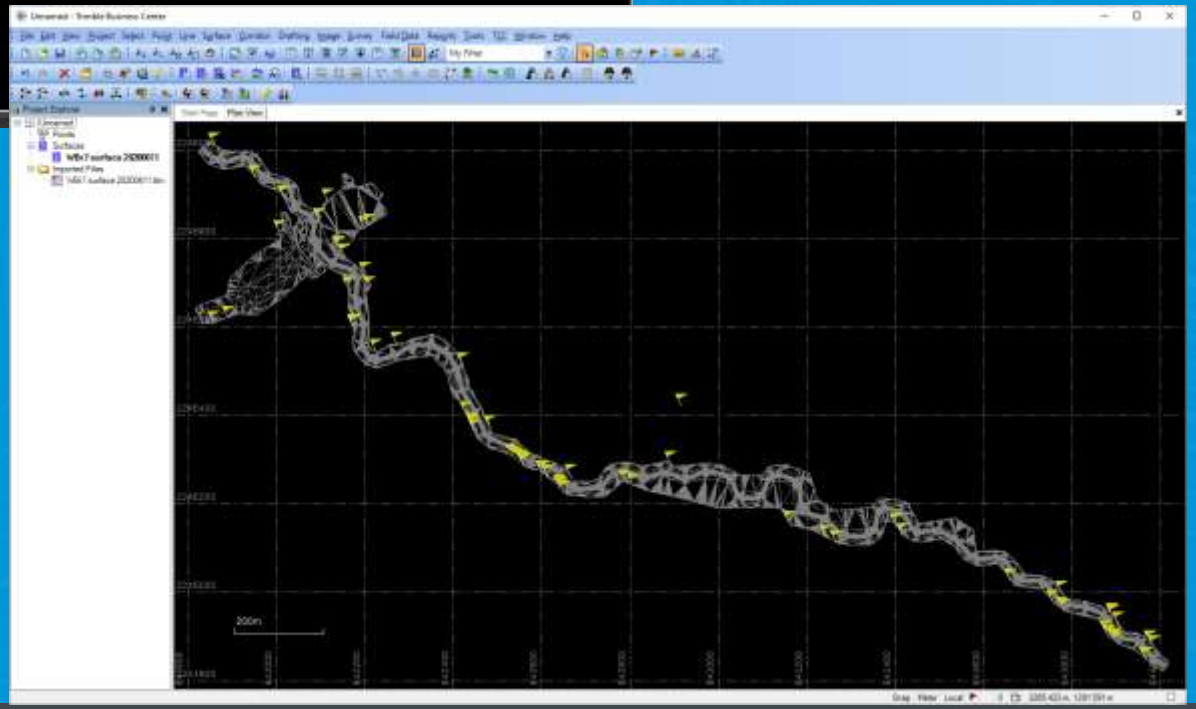
Log Constructed Riffle

Log Constructed Riffle

Log Sill

STREAM CONSTRUCTION WITH MACHINE FILES

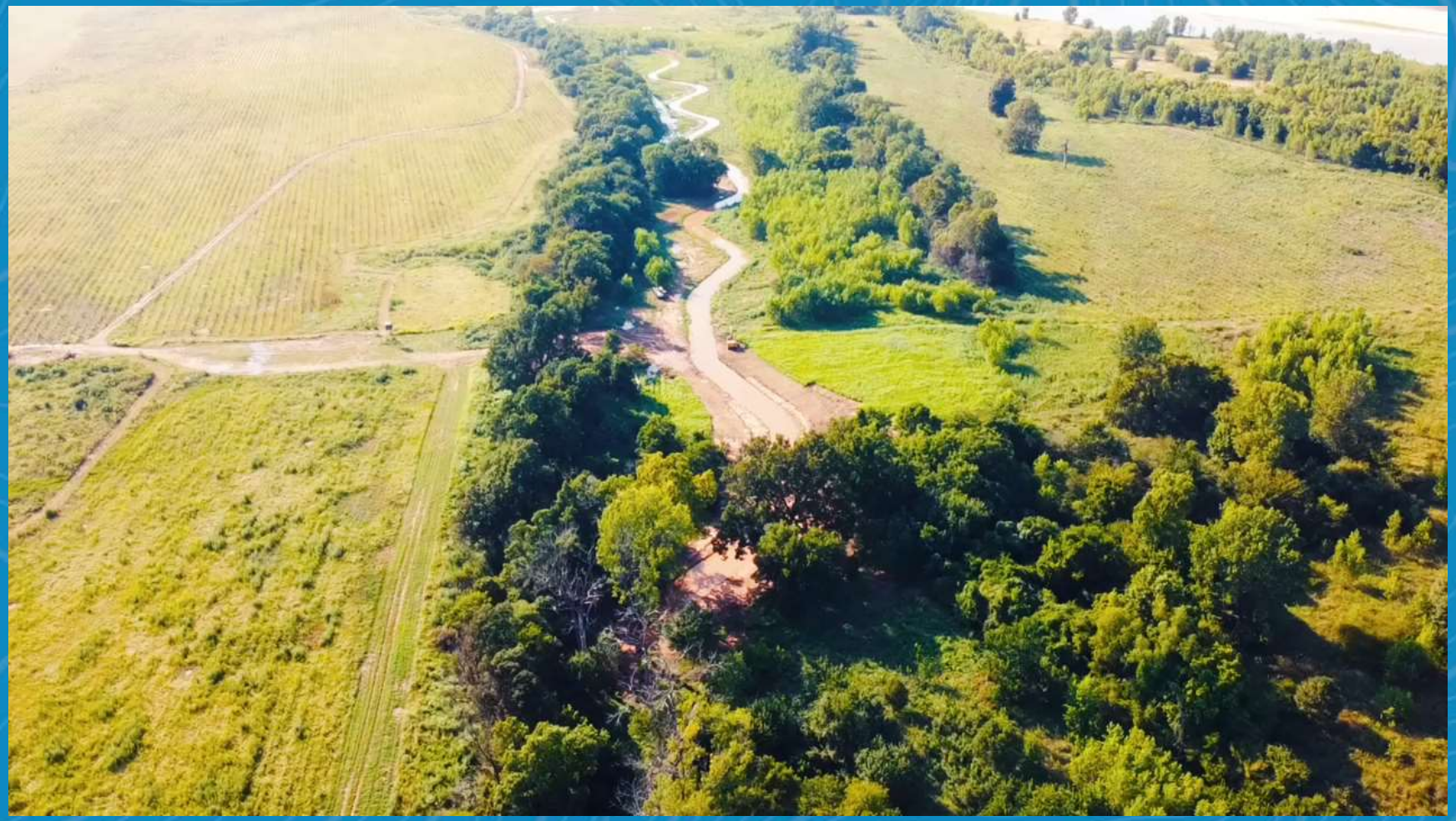




STREAM CONSTRUCTION

Photo by RES

THANK YOU!



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RAGSDALE CREEK – EXISTING CONDITION (FEBRUARY 2019)

RAGSDALE CREEK – DURING CONSTRUCTION (MARCH 2019)

RAGSDALE CREEK – AFTER CONSTRUCTION (SEPTEMBER 2020)