# UPPER MISSISSIPPI RIVER RESTORATION
# FEASIBILITY REPORT
# WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

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## HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOL 25, UPPER MISSISSIPPI RIVER MILES 252-248**
**CALHOUN COUNTY, IL**

Appendix N: Structural Engineering

US Army Corps of Engineers
St. Louis District

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Upper Mississippi River Restoration
Leading·Innovating·Partnering

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# 1 INTRODUCTION

The structural aspect of this project consists of aluminum corrugated metal pipe (CMP) water control structures (WCS) with a riser and stoplog system similar to Ducks Unlimited drawings. See attached reference documents that were used for the conceptual design and estimate of the project according to the alternative selected.

These structures consist of an aluminum CMP with a diameter of 20in and a CMP riser with a stoplog system. The aluminum CMP was assumed to be 150ft long and have class 3 riprap located around the end sections. The riprap placement volume is assumed to be 6ft wide, 14ft long and 1.5ft deep resulting on a weight of approximately 16.4 ton per WCS. The riprap is going to be placed over geotextile, therefore 168ft$^2$ of geotextile is estimated.

The aluminum CMP riser was assumed to have a reinforced concrete base of 4ft x 8ft x 1ft. The stoplog guide system will be located inside the riser per drawings details.

Another structural feature includes a reinforced concrete slab on ground to place a pump and concrete piles to support the pump pipe similar to **Figure 6**. Four piles were assumed and estimated to have 2ft of diameter and be 20ft long. The piles were estimated to be in two locations and have one pile on each side of the pipe.

Three alternatives were considered and are discussed in the following section.

# 2 ALTERNATIVES

## 2.1 MAXIMUM ALTERNATIVE

The maximum alternative consisted of 3 aluminum CMP WCS (see **Figure 4** for location). Each WCS was assumed to have all the details described in the Introduction and presented in the attached drawings.

This alternative also includes the reinforced concrete slab on ground to place the pump and the concrete piles to support the pump pipe as described in the Introduction.

## 2.2 INTERMEDIATE ALTERNATIVE

The intermediate alternative consisted of 3 aluminum CMP WCS (see **Figure 5** for location). Each WCS was assumed to have all the details described in the Introduction and presented in the attached drawings.

## 2.3 MINIMUM ALTERNATIVE

The minimum alternative does not have any structural feature.

# 3 ADDITIONAL NOTES

The aluminum culvert needs to be constructed per AASHTO requirements. Since it is classified as a flexural culvert, the compaction around it will provide the strength capacity of the culvert. Meaning that the compaction is critical for the culvert performances. Corrosion consideration needs to be performed to extend life

expectancy of culverts.

## 4 DESIGN CRITERIA

Possible EMs and Design Codes needed are:

- EM 1110-2-2104: Strength Design for Reinforced Concrete Hydraulic Structures
- EM 1110-2-2100: Stability Analysis of Concrete Structures
- EM 1110-2-2902: Conduits, Pipes, and Culverts Associated with Dams and Levee Systems
- EM 1110-2-2906: Design of Pile Foundations
- ACI 318: Building Code Requirements for Structural Concrete
- ASCE 7-16: Minimum Design Loads and Associated Criteria for Buildings and Other Structures
- AASHTO LRFD: AASHTO LRFD Bridge Design Specifications

**Figure 1 Aluminum CMP Water Control Structure Riser, TYP**

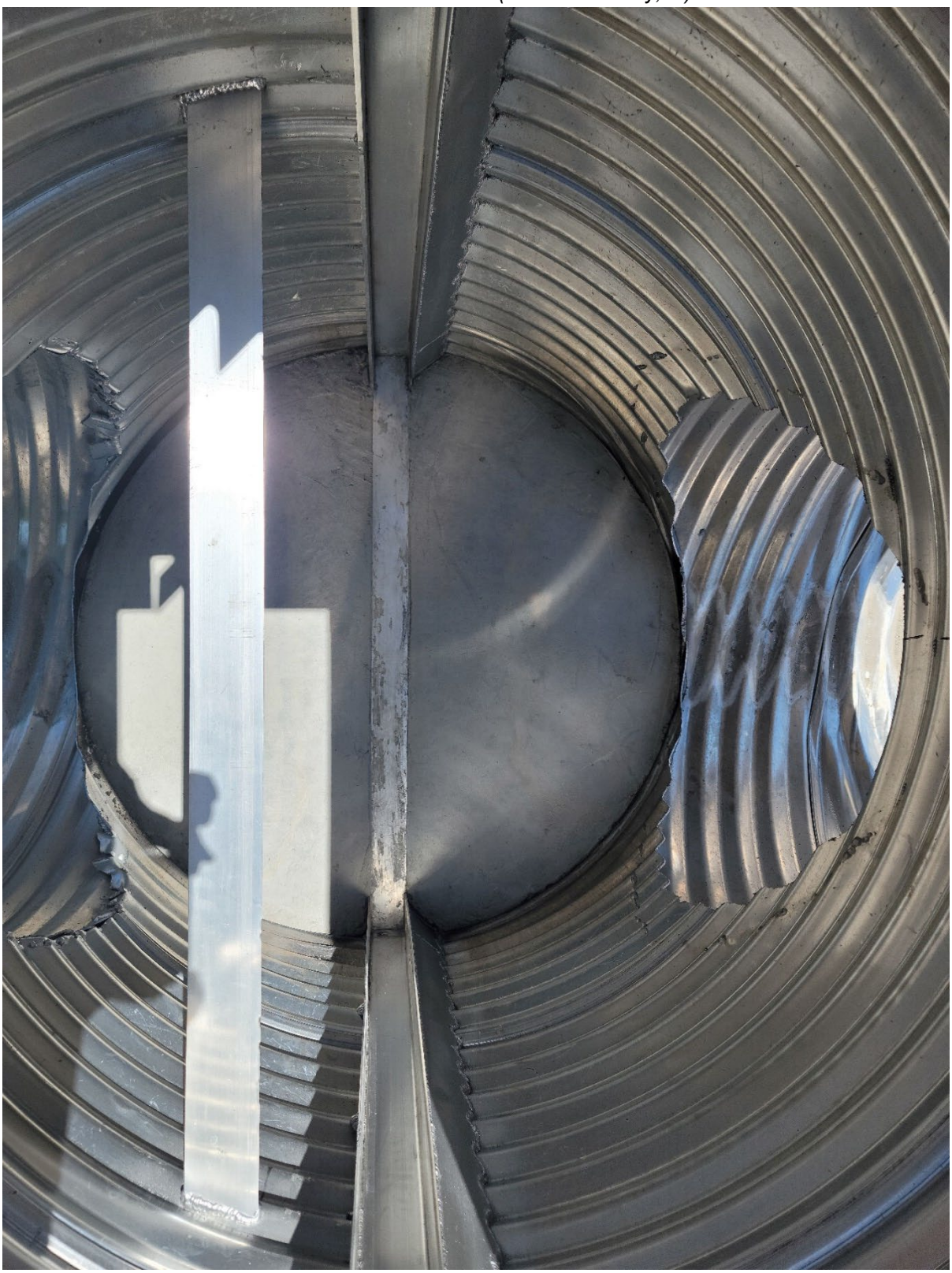

**Figure 2 Aluminum CMP Water Control Structure Riser Interior With Stoplog Guide TYP**

**Figure 3 Aluminum CMP Water Control Structure Riser Exterior With Stoplog Guide TYP**

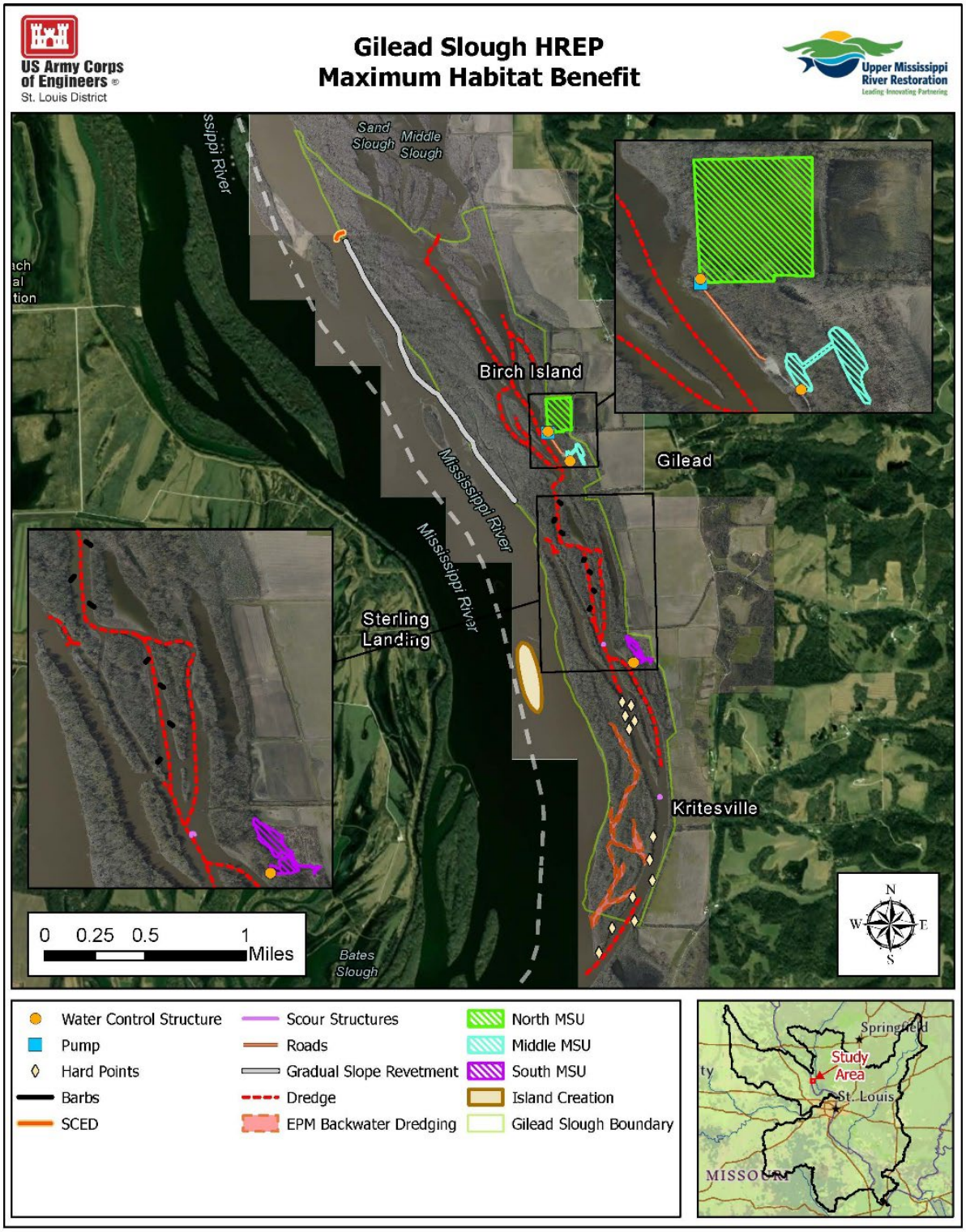


**Figure 4 WCS Locations For Maximum Alternative**

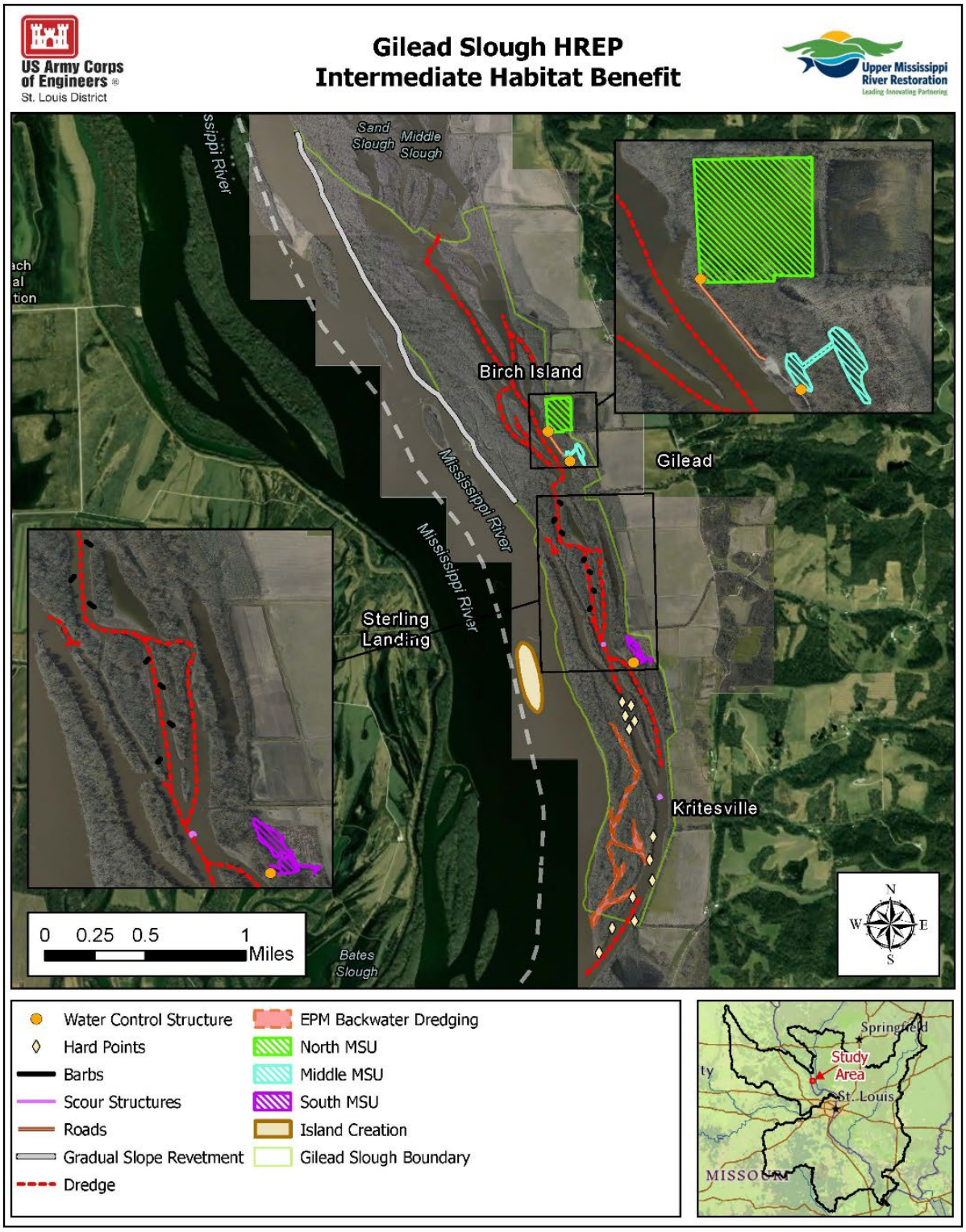


**Figure 5 WCS Locations For Intermediate Alternative**

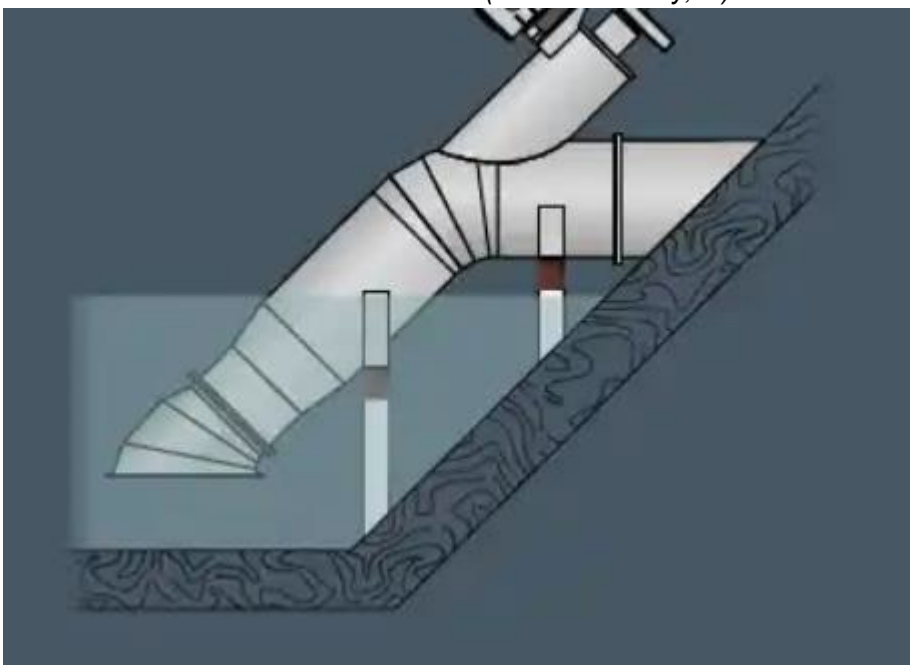

**Figure 6 Concrete Piles For Pump Pipe**