US Army Corps of Engineers®
Tulsa District

*FINAL*

# LUTHER ROAD
## OKLAHOMA COUNTY, OKLAHOMA

# SECTION 14 STREAMBANK STABILIZATION PROJECT

## PLANNING AND DESIGN ANALYSIS REPORT

**TULSA DISTRICT**
**U.S. ARMY CORPS OF ENGINEERS**

**AUGUST 2013**

October 2013

Addendum
To the

FINAL
**LUTHER ROAD**
**OKLAHOMA COUNTY, OKLAHOMA**
**SECTION 14 STREAMBANK STABILIZATION PROJECT**

Planning and Design Analysis Report

U.S. Army Corps of Engineers
Southwestern Division
Tulsa District

This addendum provides information to clarify and update the above referenced Planning and Design Analysis Report dated August 2013. These clarifications and updates include (1) alternative numbering system, (2) the project cost estimate and (3) project schedule. These clarifications and updates will be discussed in the following paragraphs.

**Alternative Numbering System.** During the time that the Environmental Assessment (EA) was being prepared, this Planning and Design Analysis (PDA) Report was also being revised per a Project Guidance Memorandum received from Southwestern Division (SWD) dated 19 June 2013. To make the EA and PDA Report be consistent, the alternatives numbering system previously used in the prior submissions of the PDA Report was changed as indicated below.

| Previous PDA Reports | This PDA Report |
|---|---|
| No Action without Project Conditions | Alternative 1 |
| Alternative 1 | Alternative 2 |
| Alternative 2 | Alternative 3 |
| Alternative 3 | Alternative 4 |
| Alternative 4 | Alternative 5 |
| Alternative 5 | Alternative 6 |
| Alternative 6 | Alternative 7 |
| | |

The old numbering system was not updated in the Engineering Appendix or the Real Estate Appendix. The recommended plan and the National Economic Development (NED) Plan is still Alternative 1 from the previously submitted PDA reports, but according to the new numbering system is Alternative 2.

**Project Cost Estimate.** Since this project is very dynamic, at the same time that the EA and PDA Report were being written and revised, early work on the plans and specifications were underway also. During this time the project manager, design engineer and cost engineer made a site visit to assess the site conditions at the project. Since the PDA Report was first submitted for review and approval in August 2012, it was determined by the site visit participants that the site conditions had changed substantially and warranted a new project cost estimate for the construction of this project. The distance along the left streambank to have riprap placed on it for the alternatives was determined to be 3,000 to 3,500 feet not the 1.5 miles mentioned in the Engineering Appendix. This distance was corrected in the PDA Report (main report) dated August 2013, but not updated in the Engineering Appendix. The corrected streambank distance will be used in the design of this project. The foot print of the project had changed and caused an increase in the real estate needs from 5.2 acres to 7.62 acres. The landowners that currently own this acreage didn't change. The design engineer and the cost engineer reassessed the quantities of riprap and dirt work preparation needed for the project and came up with a revised higher project cost estimate. A revised cost estimate was created for the construction costs of this project using the TRACES MII, version 4.2, estimating software. Both the real estate and construction cost increases are shown in the table below. The table also shows the comparison of the revised project cost estimate to the current project cost estimate in the PDA Report dated August 2013.

| **NED Plan Feature** | **Aug 2013 PDA Cost Estimate** | **Oct 2013 Revised Cost Estimate** |
|---|---|---|
| Construction | $1,005,000 | $1,631,000 |
| Planning, Engineering & Design | $100,000 | $130,000 |
| Construction Management | $83,000 | $140,000 |
| LERRD (contingency included) | $52,400 | $59,000 |
| Contingency | $314,000 | $192,000 |
| **Total Estimated Project Cost** | **$1,554,400** | **$2,152,000** |
| | | |
| **NED Plan Cost Sharing** | | |
| Federal Share (65%) | $1,010,360 | $1,398,800 |
| Non-Federal Share (35%) | $544,040 | $753,200 |
| | | |

The benefit to cost ratio for the revised cost is 4.0 and still economically feasible. The annual cost for Alternative 2 is $153,417 and includes $2,000 annually for OMRR&R. Net benefits for Alternative 2 are $460,252.

Economic analysis for the revised cost estimate of Alternative 2 was conducted using a 20 year period of analysis and updated to October 2013 (FY 2014) price levels at an interest rate of 3.5%.

Revised cost estimates were not determined for Alternatives 3 and 4. Using professional judgment, it was determined if Alternatives 3 and 4 were more expensive in the cost estimates submitted with the PDA Report dated August 2013 that revised costs for these

two alternatives would still be more expensive than Alternative 2. Alternatives 3 and 4 would still have a lower benefit to cost ratio than Alternative 2 and Alternatives 3 and 4 would have less net benefits than Alternative 2. Alternative 2 would still be the recommended and NED Plan.

In accordance with SMART planning principles, the adjustments to the revised cost estimate will be made during the Design and Implementation phase where costs and quantities are normally verified in the project process.

The revised real estate costs and acreages needed reflected in the Real Estate Plan Appendix were not updated in the PDA Report dated August 2013 or the Engineering Appendix.

**Project Schedule.** The current project schedule located in Appendix E of this PDA Report dated August 2013 was initially submitted in the PDA Report in August 2012 and was updated and re-submitted after SWD review in the PDA Report in March 2013. The project schedule will be updated during the Design and Implementation phase of this project upon the approval of this PDA Report dated August 2013.

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# EXECUTIVE SUMMARY

This proposed Section 14 Streambank Stabilization Project is conducted in accordance with Section 14 of the Flood Control Act of 1946, as amended. Section 14 provides the authority for the USACE to plan and construct emergency streambank and shoreline protection projects to protect endangered highways, highway bridge approaches, and public facilities, such as water and sewer lines, churches, public and private non-profit schools and hospitals, and other non-profit public facilities. A Section 14 project may include new streambank or shoreline protection works, or may repair, restore, or modify existing works. Oklahoma County is the Local Sponsor in this effort.

The study area, the left bank of the North Canadian River adjacent to the west side of Luther Road, is located about 0.5 miles north of the intersection of Highway 62 and Luther Road, northwest of the town of Harrah, in eastern Oklahoma County. Luther Road and the bridge spanning the North Canadian River are the public facilities that are in jeopardy of failure should the meander of the river continue to erode its streambank and migrate eastward at its present rate and in its present direction.

This planning and design analysis study (feasibility phase of a Section 14 project) evaluates the streambank erosion problems and identifies potential solutions to protect the public safety and facilities.

The river flow undercuts the tow of the bank slope and causes sloughing of the streambank. As a result, the slope of the streambanks is nearly vertical. This meander has migrated approximately 900 feet eastward in the past ten years and is now within 100 feet of the Luther Road pavement. The left bank of the river has eroded for a distance of approximately 3,000 to 3,500 linear feet. Similar action has occurred along approximately 250 to 300 feet of the right bank and exposed the foundation of the bridge piers.

This stabilization is needed to protect public safety and facilities. In addition to Luther Road and bridge, there are utilities paralleling the west side of Luther Road and power transmission lines located along the left bank of the river at the west end of the proposed project area.

Aerial photography shows that a majority of this erosion occurred within a 4 month period during 2007 (April through August) and was due to toe cutting and subsequent vertical sloughing. At the current rate of erosion (approximately 100 feet per year), Luther Road could be undercut and structurally compromised within the next year or two. However, a single large flood event or series of smaller events could accelerate the erosion process. In the event of road and bridge failure, the construction of a new

bridge spanning both the North Canadian River and the Arkansas-Oklahoma Railroad would be required.

Luther Road is classified by the Oklahoma Department of Transportation as a major rural collector roadway. Major rural collector routes generally serve travel of primarily intracounty rather than statewide importance and constitute those routes on which predominant travel distances are shorter than on arterial routes. These routes provide service to any county seat not on an arterial route and to other traffic generators such as schools, shipping points, county parks, and important agricultural areas.

Luther Road is a north-south rural collector route that connects US Highway 62 (US 62), approximately 0.5-miles to the south and US Route 66 Interstate 44, approximately 11.5- and 10-miles, respectively, to the north. US Route 66 is a major collector highway that collects traffic from rural routes and channels it into the arterial system. US 62, also named NE 23rd St., is classified as a principal east-west arterial to central Oklahoma City through Harrah with an annual average daily traffic count of 8,200 vehicles. Arterials serve the major traffic movement within urbanized areas and connect residential areas to major intercity communities and businesses.

In order to meet the goals of this streambank stabilization project, measures were considered to address the problems and opportunities available to prevent structural failure of the road and bridge. Six structural measures considered for use in reducing and/or preventing erosion of the streambanks were riprap, drop structures, bendway weirs, hydraulic jacks, live plantings, and streambank re-shaping. These structural measures were screened and eventually developed into six potential alternatives. Four of these potential measures (drop structures, bendway weirs and hydraulic jacks, and live plantings as a stand-alone measure) were screened from further consideration since they were considered to be inappropriate to stabilize the streambanks due to the size and relative narrowness of the river and/or the application of these measures given the existing flow regime.

Screening criteria dictates the best alternative would be the combination of measures that protects the streambank with minimal impact to the environment; prevents and/or reduces damages, thereby producing benefits; and is cost effective with regard to the benefits provided. The remaining structural measures identified as the most appropriate were riprap, live plantings, and streambank reshaping.
These measures (riprap, live plantings, and bank reshaping) were combined into six alternatives developed as feasible solutions to stabilize the streambank, impede the erosion, and prevent the movement of the river meander eastward. These six alternatives are presented in this feasibility study and evaluated, along with the No-

Action alternative (the Future Without Project Alternative) in an Environmental Assessment (EA) that is incorporated in this feasibility study report by reference. As detailed in this report and in the EA, these seven alternatives are identified as:

- **Alternative 1**: No-Action (the Future Without Project Condition)
- **Alternative 2**: Riprap the streambanks to the 1-year frequency discharge elevation at a 2 horizontal to one vertical ratio (2h:1v) slope
- **Alternative 3**: Riprap the streambanks to the 2-year frequency discharge elevation at a 2h:1v slope
- **Alternative 4**: Riprap the streambanks to the 10-year frequency discharge elevation at a 2h:1v slope
- **Alternative 5**: Riprap the streambanks to the 1-year frequency discharge elevation at a 3 horizontal to one vertical ratio (3h:1v) slope
- **Alternative 6**: Riprap the streambanks to the 2-year frequency discharge elevation at a 3h:1v slope
- **Alternative 7**: Riprap the streambanks to the 10-year frequency discharge elevation at a 3h:1v slope

Although all six action alternatives are evaluated in the accompanying EA, these six action alternatives were further screened in the planning process to determine which should be identified as the most cost effective for the benefits provided. Three alternatives, 2, 3, and 4 were identified as the most effective solutions to solve the problems and protect the public facilities.

The Tentatively Selected Plan and recommended alternative is Alternative 2. This alternative consists of a temporary staging area, access road, drainage ditch, removing the rubble along the left bank and disposing it at a commercial landfill at an off-site location. The streambanks would be reshaped to a 2h:1v slope for a distance of approximately 3,000 to 3,500 linear feet. A layer of 6-inches of bedding/filter fabric and riprap, 24 inches thick, would be placed starting at the toe of the slope of the river bed and continue upslope, stopping at the 1-year frequency discharge elevation.

Appropriate vegetation will be used to stabilize approximately 6 acres above the riprap to the top of slope. Replanting could involve using woody species similar to those species found in the surrounding area, with a variety of mixed cool season and warm season grasses adapted to sandy soils in the upslope areas above the riprap elevation. Since the unimproved access road would be permanent so as to accommodate maintenance, no vegetation is expected to be planted above the top of bank.

Alternative 2 is also the National Economic Development (NED) plan. It is the most efficient solution combining cost effectiveness and providing incidental environmental benefits as well. This alternative also achieves the goal of the proposed project. The

recommended alternative has a total investment cost of $1,527,727, annual net benefits of $499,256 and a benefit-cost ratio of 5.36. The operation, maintenance, repair, rehabilitation and replacement costs will be approximately $2,000 annually for this alternative. The recommended alternative requires lands, easements, rights-of-way, relocations, and/or disposal areas (LERRD) of 5.2 acres. The estimated cost share for this alternative would be $993,023 Federal and $534,704 Non-Federal.

**LUTHER ROAD**
**OKLAHOMA COUNTY, OKLAHOMA**
**SECTION 14 STREAMBANK STABILIZATION PROJECT**

**PLANNING AND DESIGN ANALYSIS REPORT**

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# LUTHER ROAD
# OKLAHOMA COUNTY, OKLAHOMA
# SECTION 14 STREAMBANK STABILIZATION PROJECT

# PLANNING AND DESIGN ANALYSIS REPORT

**Panorama of the Proposed Project Site**

## 1.0 INTRODUCTION

The North Canadian River flows eastward from northwest Oklahoma, eastward and northeastward through Oklahoma City, north of Midwest City, then southeastward, meandering across its floodplain through more rural areas toward Harrah, in eastern Oklahoma County. The Luther Road Bridge spans both the North Canadian River and the Arkansas/Oklahoma Railroad, west-northwest of Harrah, Oklahoma. The city limits of Harrah begin on the south side of the railroad easement.

A meander of the North Canadian River has migrated eastward toward Luther Road and its bridge approach by eroding its left streambank. The meander of the river has migrated approximately 900 feet eastward in the past ten years and is now located approximately 100 feet west of the roadway pavement. If the river continues eroding at its present rate and in its present direction, total failure of Luther Road and the bridge within the next year would be possible. Failure of the road and bridge would close the roadway and bridge approach and interrupt the utility service to the surrounding area.

This planning and design analysis study (feasibility phase of Section 14 project) addresses the streambank erosion problems on the left bank (north and east side) of the North Canadian River adjacent to the west side of Luther Road in Oklahoma County, Oklahoma. This streambank erosion has been occurring for several years and now has become a major threat for undermining Luther Road and severing the bridge approach on the north side of the North Canadian River Bridge.

## 1.1 Purpose and Need

The purpose of this proposed project is to address streambank erosion and bank slope instability by stabilizing a total of approximately 3,000 to 3,500 linear feet of streambank, most of which would be located along the left bank. A smaller area, approximately 250 to 300 feet on the right bank, on the north side of the bridge piers, also needs stabilizing. Stabilizing the left streambank would be expected to stop the eastward migration of the meander as it erodes the toe of the bank and causes bank sloughing. Stabilizing the right bank would protect the southern bridge pier.

The stabilization project is needed to protect public safety and facilities. In addition to Luther Road and bridge, there are electric utilities paralleling the west side of the road and electric transmission lines located along the left bank of the North Canadian River at the northern edge of the proposed streambank stabilization area.

This planning and design analysis report documents the site visits; assesses the instability problems; inventories current site conditions; forecasts future conditions without a project; compares conceptual alternatives with respect to feasibility; and recommends the preferred alternative to accomplish the streambank protection repairs.

The overall purposes for this phase of the project are to determine if Federal participation in a streambank project is warranted; compare concept design alternatives, including a no-action alternative, with project costs and benefits; identify the most efficient and environmentally acceptable alternative in terms of protection reliability, project costs, and net benefits; and submit and obtain approval for the report and the recommended plan.

Luther Road is classified by the Oklahoma Department of Transportation as a major rural collector roadway. Major Rural Collector routes generally serve travel of primarily intra-county rather than statewide importance and constitute those routes on which predominant travel distances are shorter than on arterial routes. These routes provide service to any county seat not on an arterial route and to other traffic generators such as schools, shipping points, county parks, and important agricultural areas.

Luther Road is the north-south rural collector route that connects US Highway 62 (US 62), approximately 0.5-miles to the south and US Route 66 Interstate 44, approximately 11.5- and 10-miles, respectively, to the north. US Route 66 is a major collector highway that collects traffic from rural routes and channels it into the arterial system. US 62, also named NE 23rd St., is classified as a principal east-west arterial to central Oklahoma City through Harrah with an annual average daily traffic count of 8,200 vehicles. Arterials serve the major traffic movement within urbanized areas and connecting residential areas to major intercity communities and businesses.

Since Luther Road is a major public highway that connects several local towns and cities (Luther, Jones, Harrah, Choctaw and Oklahoma City), it is an important road for local, business, emergency, and school use. The protection of the Luther Road Bridge is critical to typical quality of life issues and needed to protect public safety. For many residents in this rural part of the county, the Luther Road Bridge is the only direct access to necessities such as food and emergency services, i.e., ambulance, fire, and police, all of which are located within the city boundaries of Harrah and south of the North Canadian River. Also, elementary and high schools are located in Harrah; however, the majority of the Harrah school district is situated north of the river.

The Luther Road Bridge is only one of two bridges that cross the North Canadian River, the other bridge is located approximately two straight-line miles east of the proposed site and at the easternmost end of the business district of Harrah. However, should the road and bridge fail, the travel routes to access the other bridge would be considerably more than two additional miles and involve traveling on many rural, unimproved roads.

## 1.2 Study Area

As shown in Figure 1, the general location of the study area is along a segment of the North Canadian River adjacent to the west side of Luther Road in rural eastern Oklahoma County. The study area is approximately 18 miles east-northeast of Oklahoma City and approximately 2 miles northwest of the City of Harrah. Figure 2 shows the specific location of the proposed project area and the eroded areas in the study area that require stabilization. The project site is located approximately one-half mile north of the intersection of US Highway 62, which is also identified as NE 23rd Street. The Luther Road Bridge spans both the North Canadian River and the Arkansas-Oklahoma Railroad tracks.

**Figure 1-1: Vicinity Map**

**Figure 1-2: Project Location Map**

## 1.3 Study Authority

This Section 14 Streambank Stabilization Project is conducted in accordance with Section 14 of the Flood Control Act of 1946 (Public Law 79-526), as amended, provides the authority for the Corps to plan and construct emergency streambank and shoreline protection projects to protect endangered highways, highway bridge approaches, public facilities such as water and sewer lines, churches, public and private non-profit schools and hospitals, and other non-profit public facilities. This authority reads, in part:

> *"The Secretary of the Army is authorized to allot from any appropriation heretofore or hereinafter made for flood control---for the construction, repair, restoration, and modification of emergency streambank and shoreline protection works to prevent damage to highways, bridge approaches, public works, churches, hospitals, schools, and other non-profit public services, when in the opinion of the Chief of Engineers such work is advisable: Provided that not more than $1,500,000 shall be allotted for this purpose at any single locality from the appropriations for any one fiscal year."*

A project is accepted for construction only after an investigation shows that it is feasible from an engineering perspective, is environmentally acceptable, and is justified economically. The Federal cost share for any one Section 14 project may not exceed $1.5 million.

## 1.4 Study Area Description

The study area is primarily the left bank of the North Canadian River. The area surrounding the study area is rural farmland and is situated within the 100-year floodplain of the river. Historically, the lands adjacent to the left bank of the river have been in agricultural production.

The business district for Harrah is approximately two miles southeast of the study area on Highway 62 (NE 23rd Street); however, the city limits extend to the railroad immediately south of the study area. The western portions of the City of Harrah are also relatively rural with few housing subdivisions.

## 1.5 Bridge Background Information

There are two bridges (North Canadian River bridge and a railroad overpass bridge) located immediately south of the study area. These bridges would become unusable if the current streambank erosion problem is not stopped. These two bridges will be discussed more in the following paragraphs.

The bridge over the North Canadian River is four spans and approximately 370 feet in length. Construction of the bridge was completed in 1981. The bridge plans are located in the Engineering Appendix (Appendix A to this report). Just south of this bridge is a bridge over a railroad which is 3 spans and approximately 150 feet in length and which was also built in 1981.

As a major rural county collector road, Luther Road is the only north-south collector that connects US Highway 62 (US 62), approximately 0.5-miles to the south to US Route 66 and Interstate 44, approximately 11.5- and 10-miles, respectively, to the north. The average daily traffic count for Luther Road is approximately 3000 vehicles per day. US Route 66 is a major collector highway that collects traffic from rural routes and channels it into the arterial system. US 62, also named NE 23rd St., is classified as a principal east-west arterial to central Oklahoma City through Harrah with an annual average daily traffic count of 8,200 vehicles.

Recent inspections performed by Oklahoma Department of Transportation rated the Luther Road Bridge spanning the North Canadian River and railroad in good condition. The bridge decking received a rating of satisfactory, the superstructure receiving a rating of good and the substructure receiving a rating of good.

The railroad overpass bridge was also inspected by the Oklahoma Department of Transportation and also given a good rating. The bridge deck received a satisfactory rating while the superstructure and substructure both were rated as good. The bridge inspection reports for these bridges are located in Appendix B (Bridge Inspection Reports).

## 1.6 Analysis of Project Photographs

### 1.6.1 Aerial Photographs

Aerial photographs from the Oklahoma County Assessor's office for March 2003, March 2004, February 2005, January 2006, April 2007 and March 2010 (Appendix C – Aerial Maps and Site Visit Photographs) were compared to determine how much the North Canadian River channel had moved during the past 7 years and show the severity of the erosion problem.

The aerial maps from March 2003 until April 2007 (Aerial Maps 1 through 5) show that on average the river has moved (eroded) to the east (toward Luther Road) approximately 26 feet per year. In 2005, it did move (erode) 54 feet. But in 2007 between April and August, the river moved approximately 470 feet to the east. And now as can be seen by the 2010 aerial map (Aerial Map 6), the river is approximately 147 feet from Luther Road. The approximate overall erosion rate for the 7 year period (2003 – 2010) is 100 feet per year. During the site visits of July 2010 and April 2011, it appears that the river is approximately 100 to 125 feet from Luther Road.

### 1.6.2 Site Visit Photographs

Site visit photographs from the April 2007 and April 2011 site visits are included in Appendix C – Aerial Maps and Site Visit Photographs. As evident from the photographs, continued bank erosion is occurring just upstream of the bridge. These photographs continue to reinforce just how much this left streambank has eroded between 2007 and 2011. Observations and discussions from the site visits are located in section 5.1 (Site Visits) of this report.

## 1.7 Prior Studies.

There are no prior studies for this study area.

# 2.0 PLAN FORMULATION

## 2.1 Problems and Opportunities

In an effort to impede streambank erosion and protect Luther Road and the bridge, the Oklahoma County road maintenance department has deposited rubble of varying sizes on the left bank for several hundred feet (Appendix C, Photograph #3). There are public utility lines paralleling the Westside of Luther Road and a power transmission line tower at the westernmost end of the eroded streambank that are also in danger of being undermined.

This concrete rubble has not provided an acceptable engineering solution for this streambank erosion. The combination of the voids between concrete pieces and the existing sandy soils provide nick points that allow high flows and landside sheet erosion to form gullies perpendicular to the streambank. Over time, especially in high flow events, the rubble can be undermined, the eroded gullies increase in size, and streambank sloughing continues. As such, the meander of the river continues its eastward migration. A large flood event or a series of smaller events could erode the sandy soils behind the rubble and allow the advancement of the meander. Given its current rate of eastward movement, there is a high probability that Luther Road could be structurally damaged by the North Canadian River within one to one-and-one-half years.

The problems and opportunities addressed in this Section 14 study include:

- The North Canadian River has eroded more than 900 feet in the last 10 years, with the most dramatic migration occurring between 2003 and 2008.

- The existing, rubble-covered North Canadian streambanks are very steep, nearly a one-to-one slope ratio approximately 20 feet high, and underlain by sandy soils typical to this area.

- If the meander of the North Canadian River continues eroding at its present rate and in its current direction, total failure of Luther Road and the bridge approach within the next 1 to 1.5 years could be expected. Failure of the road and bridge would close the roadway and bridge and interrupt utility service to the area and beyond.

- There is an opportunity to protect Luther Road from being structurally compromised and maintain the north-south movement of traffic through this rural area.

## 2.2 Objectives and Constraints

All federal planning studies share the federal objectives of contributing to the national economic development consistent with protecting the Nation's environment. Plans for restoring habitat in the study area must be technically sound, economically reasonable, and locally acceptable. The Section 14 authority limits Federal expenditures to $1.5 million, which includes the study costs, preparation of plans and specifications, and construction. The selected plan must be complete and fully effective, requiring no additional obligation by the Federal Government to make the project operational. If the Federal portion of project cost exceeds the Federal limitation, the local sponsor must pay the difference. Any recommended project must be justified under established Federal planning criteria. The recommended project must be acceptable and supported by a local sponsor. The study planning objectives and constraints listed below are specific to this study.

### 2.2.1 Objectives

The objectives of this feasibility study is to verify that there is a Federal interest to protect the Luther Road and bridge approach, as well as the utilities paralleling the road; identify the National Economic Development (NED) plan in terms of the maximum net annual economic benefits for protection of Luther Road and the bridge approach that meets Section 14 criteria and provides reliable protection for a 20-year time horizon; and develop a plan to protect these public facilities while minimizing adverse environmental effects of stabilization techniques.

### 2.2.2 Constraints

Unlike planning objectives that represent desired positive changes, planning constraints represent restrictions that should not be violated. Just as there are national planning objectives, there are also national planning constraints which apply to all studies. The plans developed must be technically sound, environmentally and economically feasible, and locally acceptable.

The selected plan must comply with all applicable state and Federal laws, regulations, Executive Orders, and USACE Environmental Operating Principles. The selected plan must be complete and fully effective, requiring no additional obligation by the Federal Government to make the project operational. Any recommended plan must be justified under established Federal planning criteria. The recommended plan must be acceptable and supported by a local sponsor. The study constraints apply to the study area as a whole.

The specific planning constraints identified for this study include: avoiding any measure or alternative that would adversely impact the infrastructure to be

protected; avoiding any measure or alternative that would adversely affect adjacent lands; avoiding measures or alternatives that adversely affect river stability or induce impacts to other areas.

## 2.3 Existing Site Conditions

A meander of the North Canadian River has migrated laterally eastward and is now approximately 100 to 125 feet from the west side of Luther Road. The left bank of the river, shown on Figures 2-1, 2-2, and 2-3, has sustained continued erosion on about 3,000 to 3,500 linear feet and has moved eastward approximately 900 feet in the last 10 years, with most of the eastward movement of the meander occurring between 2003 and 2008. This is an approximate rate of erosion and advancement of 100 feet per year.

**Figure 2-1: North Canadian River Meander 2003**

**Figure 2-2: North Canadian River Meander 2008**

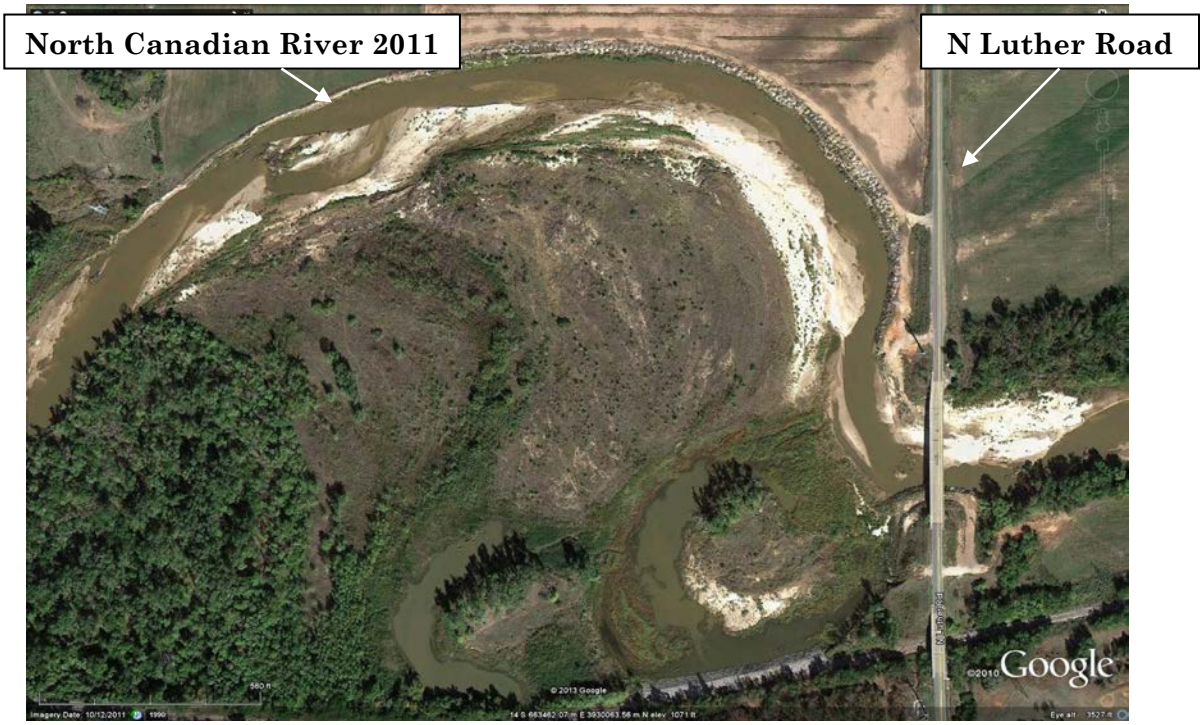


**Figure 2-3: North Canadian River Meander 2011**

As previously explained, Oklahoma County road maintenance has placed rubble (see site photographs in Appendix C) on the left bank of the river and along a relatively short section of the right streambank in front of the southernmost bridge piers in an effort to stabilize the streambank, prevent further erosion, and protect the bridge approach. On the upstream end of the erosion, newer gullies have formed that are undermining the rubble located at the westernmost end of the project site. The river streambank is very steep, with a nearly vertical slope, and approximately 20 feet high. Sandy soils are located throughout this area.

The bridges (North Canadian River and the railroad overpass) on Luther Road near the project site are both in good operating condition. Oklahoma County continues to maintain these bridges. The Arkansas-Oklahoma Railroad stabilized the streambank adjacent to right bank with riprap several years ago. That area has since been cut off by the natural river processes and those areas are now oxbows. The oxbows are separated from the main channel by aggrading sediments forming a new streambank approximately five feet in height.

## 2.4 Existing Environmental Conditions

The environmental resources are discussed in detail in the EA prepared for this proposed project. General environmental conditions are discussed in this section of the feasibility report.

The areas surrounding the proposed project site are rural. Agriculture is the primary land use, and those areas adjacent to the left bank of the river have historically been used for agricultural production. The North Canadian River has historically meandered across its floodplain and has removed both woody vegetation and cropland. The project area and the adjacent farm fields all are situated within the 100-year floodplain, with the nearest structure approximately 1,500 feet north of the site. The floodplain extends approximately 3,500 feet landward of the streambank.

The North Canadian River originates in the high plateau of New Mexico and flows eastward through the plains of central Oklahoma. Surface flows are moderated by three USACE dams at Optima, Ft. Supply, and Canton. Additionally, there are numerous municipal and NRCS structures that have some influence on flows. Flow records from a US Geologic Survey (USGS) gage located at the Luther Road bridge were analyzed by the Tulsa District to develop the frequency discharges for the 1-, 2-, and 10-year events. These are the frequency discharges that are considered the channel forming events.

The North Canadian River is recognized as a "Waters of the United States" (WOUS). As such, any fill placed below the ordinary high water mark is regulated by USACE and would need to be authorized through issuance of a regulatory permit pursuant to Section 404 of the Clean Water Act prior to construction of the project.

With regard to Water Quality, the designated beneficial uses for the North Canadian River in this area include Aesthetics, Agriculture (livestock and irrigation), Fish and Wildlife Propagation/Warm Water Aquatic Community, Fish Consumption, Primary Body Contact Recreation, and Emergency Water Supply. Based on the Oklahoma Department of Environmental Quality's 2010 Oklahoma Integrated Report, satisfying Section 303(d) of the amended Clean Water Act, this segment of the North Canadian River is classified as 'Impaired' and not supporting the listed beneficial uses.

Preliminary site visits verified that the majority of the study area is vegetated with large populations of the invasive species Johnsongrass and assorted other herbaceous plant species, with limited scrub shrub or woody species present. Soil and streambank erosion associated with the migration of the North Canadian River has removed most of the woody vegetation.

There are no wetlands at the site; however, the oxbows adjacent to the right bank of the river and west of the proposed site work demonstrate the requisite criteria that could classify them as wetlands. No impact to wetlands is anticipated with the streambank stabilization efforts.

Three (3) federally-protected, threatened and endangered species are known to occur in Oklahoma County: the interior least tern, whooping crane, and piping plover. No critical habitat is currently mapped for this segment of the river. A field survey to determine the presence of listed species has been completed and coordination with the US Fish and Wildlife Service under Section 7 of the Endangered Species Act and the Fish and Wildlife Coordination Act was accomplished during the preparation of the EA. No impact to Threatened and Endangered species is anticipated.

Cultural resources investigations are required by Section 106 of the National Historic Preservation Act of 1966 (as amended) and require identification of all historic properties that may be affected by an undertaking. Historic properties include both archaeological sites and historic standing structures that are eligible for listing on the National Register of Historic Places. Coordination with the Oklahoma State Historic Preservation Officer, State Archaeologist, and appropriate Native American tribes generally coincides with the preparation of the EA and prior to any earth-moving activity associated with construction. Given that the site has

been modified by erosive events and previous attempts to stabilize the streambanks, the potential of finding intact cultural horizons is very low. As such, no impact to historic properties is anticipated.

Existing databases were referenced to determine what, if any, known use of hazardous materials and/or wastes in this area. No sites were identified within one-half mile of the study area. One EPA-regulated facility, an oil recycling facility, is located approximately one mile southwest of the study area, on Highway 62. Since the surrounding areas are rural and have never been developed, hazardous materials should not be encountered as part of this effort.

## 2.5 Future Without Project Conditions

Absent any Federal project, the Future Without Project Condition could have the greatest negative impact to the human and natural environment. The anticipated migration of the river meander is shown on Figure 6. If no action is taken to prevent the North Canadian River from eroding Luther Road, then the roadway and bridge failure would cause closures that could last indefinitely. Utilities serving the rural area and transmitting electric power to and from the metropolitan Oklahoma City urban centers could also be interrupted since there are both distribution and transmission lines along the left bank of the river.

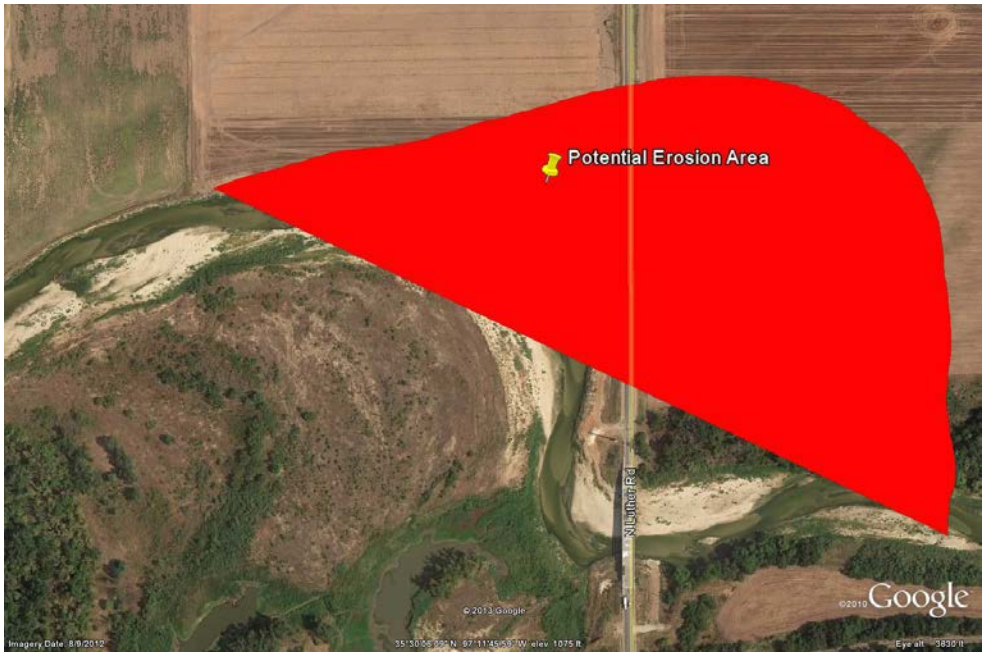


**Figure 2-4: Future Potential Erosion Area**

Bridge failure could also adversely and disproportionately affect children, since the majority of the Harrah school district lies on the north side of the river and the schools are located south of the river. The Luther Road bridge is only one of two that connects the schools in Harrah to the majority of its school district.
A new bridge could be approximately 1600 feet long, based on anticipated future movement and cost millions of dollars. No change to existing environmental conditions would be expected.

### 2.6 Public Involvement

Informal involvement with the public happened during a site visit in 2010. USACE personnel met with the Oklahoma County Commissioner for this district, other federal and state officials, and interested landowners. Residents living in this rural area have been interested solving the erosion issues and there is local consensus to fix the problem.

Formal coordination with other Federal, State, and local agencies, and the general public is generally conducted during the EA process. Although the CEQ Regulations do not require a specific scoping meeting for the preparation of an EA, in accordance with the National Environmental Policy Act, the Tulsa District recognizes the value of agency and public input in the process. As such, the Tulsa District mailed scoping letters concerning the urgent nature of this proposed project and invited comments from other federal and state agencies, Native American tribes, and other interested parties in June 2013. The EA prepared for this proposed project was posted on the Tulsa District website and electronic copies made available on request.

## 3.0 ANALYSIS OF THE STREAMBANK EROSION PROBLEM

### 3.1 Flow Conditions

The North Canadian River basin is approximately 840 miles in length and drains approximately 17,712 square miles. The terrain consists of gently rolling hills, with grassland on the upper slopes interspersed with a mosaic of forested areas. Land use in the floodplain is mostly rangeland grazing and farming. Flows are modified by three Corps dams at Optima, Ft. Supply, and Canton. In addition, there are numerous municipal and NRCS structures that also influence flows through this segment of river.

Urban centers are principally associated with the Oklahoma City metropolitan area east and upstream of the study area. The urbanization of western Oklahoma County contributes to the flashy runoff characteristics experienced in this segment

of river. The highest flows seem to occur between March and June and the lowest flows in September, December, and January.

Preliminary site visits confirmed that erosion appears to be the result cutting along the toe of the streambank slope and subsequent bank sloughing. The result is a nearly vertical streambank slope with exposed sandy soil and/or concrete rubble, or both. In general, frequency discharges associated with 1-year, 2-year, and 10-year events produce flows that form stream channels.

The existing conditions for the North Canadian River were modeled to establish a base line and to develop a corrected effective model. The effective flows from the Flood Insurance Study were used and the resulting 100-year water surface profiles were tied into the effective elevations at the upper and lower ends of this study.

## 3.2 Materials

While the rubble previously placed along the left bank for emergency protection has somewhat slowed the erosion of the streambank, there continues to be pockets of erosion that are expanding. This situation can happen during flow events that erode the sandy soils from between and behind the rubble pieces.

## 3.3 Geotechnical

The soils along the banks of North Canadian River are alluvial deposits. The majority of the soil in the study area is classified as sandy or sandy loam. As construction rubble was added to the site, the soils have been compacted as a result of heavy equipment entering and exiting the site. Information on specific soils and site conditions regarding soils can be found in the EA prepared for this project.

## 3.4 Rate of Erosion

For the purposes of this study, the rate of erosion has been estimated at approximately 100-feet per year. Comparisons of aerial photography as documented in Figures 3, 4, and 5, from 2003 to 2011, respectively, show the migration of the meander. In the past ten years, this meander has migrated eastward approximately 900 feet. It is important to note that the majority of this erosion occurred between 2003 and 2008.

# 4.0 PROJECT SITE HYDROLOGY AND HYDRAULICS

## 4.1 Discharges

The North Canadian River has an estimated drainage area of over 13,222 square miles at the project location. The project area is a part of the Federal Emergency Management Agency (FEMA) Flood Insurance Study for Oklahoma County, Oklahoma and consists of the 100-year floodplain for the North Canadian River. There is a US Geological Survey (USGS) stream gage on the left bank of the North Canadian River just downstream of the Luther Road Bridge.

Discharge calculations for the North Canadian River in the study area are included in Appendix A within the hydrology and hydraulics report. Based on the results from the Corps of Engineers, Hydrologic Engineering Center's Statistical Software Package (HEC-SSP), frequency discharges for the project area were developed for the 1-, 2- and 10-year events. The flows that shape a natural channel are generally in this 1-year to 10-year event range. Protection of the channel toe for these types of events should provide stabilization for the channel. The 100-year event was taken from the effective FEMA model for the study reach. Table 1 shows the results of the hydrologic calculations for discharges in cubic feet per second (cfs) at the project site.

**Table 1: Hydrologic Discharge Data**

| Exceedance Probability | Return Frequency | Discharge (Regression Equations) |
|---|---|---|
| 99% | 1-Year | 1,500 cfs |
| 50% | 2-Year | 6,200 cfs |
| 10% | 10-Year | 15,500 cfs |
| 1% | 100-Year | 53,500 cfs |

## 4.2 Hydraulic Modeling

The discharges developed using the HEC-SSP program for the study area were used in the computer model, Hydrologic Engineering Center's River Analysis System (HEC-RAS) to develop water elevations for the study area. Then as measures were developed into alternatives, the HEC-RAS program was used to see how the different alternatives would affect the water elevations in the study area. Detailed information including tables of water surface elevations for the different alternatives considered are located in the hydrology and hydraulics report of Appendix A (Engineering Appendix).

## 5.0 DATA COLLECTION

Data collection consisted of site visits; discussions with Corps of Engineers (USACE) personnel; receipt, evaluation, and usage of materials provided by Oklahoma County. Construction cost unit price data for excavation, disposal, fill placement, riprap, and riprap installation was taken from similar Section 14 projects and potential quarries.

### 5.1 Site Visits

The first site visit was conducted on August 3, 2007. The personnel at the site visit were:

- Jeff Waldie COE Engineering & Construction Division
- Doug Williams Oklahoma County Superintendent

It appeared that the main area of concern for this project is the erosion of the left streambank of the North Canadian River and its advance to the east with the possibility of damaging Luther Road. At the time of this site visit by Jeff Waldie, the river had advanced to the east approximately 460 feet and was approximately 340 feet from Luther Road. This was a dramatic change from the aerial map from April 2007 (Appendix C) which showed the river approximately 807 feet from Luther Road. In only 4 months the meander of the river had moved eastward about 460 feet.

The second site visit was conducted on August 8, 2007. The personnel at the site visit consisted of the following individuals:

- Richard Bilinski COE Programs & Project Management
- Rick Thomas COE Planning & Environmental Division
- Keith Rice COE Engineering & Construction

Since this site visit was only about one week later than the first site visit, conditions of the streambank erosion had not changed significantly.

The third site visit was conducted on July 15, 2010. The personnel at this site visit were:

- Richard Bilinski COE Programs & Project Management
- Rick Thomas COE Planning & Environmental Division
- Honorable Brian Maughan Oklahoma County Commissioner

During this site visit, the Corps personnel observed that the North Canadian River had continued to experience erosion of its left bank and the meander had migrated to within approximately 140 to 150 feet from Luther Road pavement edge. Without

some kind of streambank protection measure, it is just a matter of time before the river damages Luther Road. The Oklahoma County road maintenance has dumped many dump truck loads of construction debris on the left streambank in an attempt to stabilize the streambank. The streambank is high (approximately 20 feet) and steeply sloped. The eroded streambank is about 1800 linear feet in distance. The Corps personnel met with Oklahoma County Commissioner Maughan to discuss the Luther Road Section 14 project during this site visit. A large crowd of interested land owners, state and Federal agency official were also in attendance at this site visit. The consensus of those attending this site visit was favorable for a Section 14 project.

The fourth site visit was conducted on April 20, 2011. The personnel at the site visit consisted of the following:

| | | |
|---|---|---|
| • Jay Johnson | COE | Civil Design Section |
| • Joe Large | COE | Civil Design Section |
| • Rick Thomas | COE | Planning & Environmental Division |

The site visit was made so that the civil design engineer could see the project site and obtain field site information to be used in developing alternatives for the streambank protection.

Additional miscellaneous site visits were conducted by Corps' Hydrology and Hydraulics personnel to observe field conditions, make bridge measurements, and obtain approximate stream cross sections based on hand level readings. During these visits, the morphology of the river was closely observed. Based on the bare, nearly vertical channel bank, it was concluded that the erosion was due to toe cutting undermining the bank, causing the bank to slough.

## 5.2 Additional Sources of Information

The following is a list of the information referenced and used in the preparation of this feasibility report:

- Bridge Plans (North Canadian River) dated 31 October 1980
- Oklahoma County Aerial Maps dated 2003 to 2010
- Bridge Inspection Reports for the North Canadian River Bridge and the railroad overpass bridge, dated 13 November 2009.

# 6.0 ALTERNATIVE FORMULATION

## 6.1 Identification of Management Measures

Measures were considered that would address the problems identified and meet the overall goal of protecting the public facility (Luther Road). Five measures, four structural measures and one non-structural measure were identified. These measures included:

- **Drop Structures:** Drop structures are used as grade controls. They are also known as weirs or sills and are used to lower river elevations while controlling the energy and velocity of the water as it passes over the top of the structure. Drop structures are mostly used on watercourses with step gradients to alleviate head cutting and slow the velocity of flow through the channel.
- **Bendway Weirs:** Bendway weirs are rock sills that control velocities and direct current in watercourses and are an important tool in erosion control, stream restoration, and habitat improvements. Bendway weirs consist of a series of upstream-angled, low elevation stone sills, keyed into the outer streambank, and are high enough and long enough to direct water current perpendicular to the angle of the weir and away from the degrading bank. They are spaced close enough to interrupt the outward flow of the water and redirect it more towards the center of the watercourse. Bendway weirs can reduce outer bank erosion and redirect both the primary concentrated flow and the secondary stream currents
- **Hydraulic Jacks:** Hydraulic jacks are pre-cast concrete or steel structures that resemble 3-dimensional crosses that are essentially two concrete T-shaped pieces joined perpendicularly at the middle with six outward projections. Hydraulic jacks resemble the children's toy commonly known as "jacks". Jacks can be used as bank stabilization, flow and grade control, and scour protection for in-stream bridge structures by increasing the relative roughness of a channel bank. Jacks are placed perpendicular to the flow of a watercourse. Often, wires are attached to the beams to increase trapped sediment and increase debris catch.
- **Riprap:** Riprap is stone material of varying sizes used to armor stream banks, bridge abutments, pilings, or other structures to prevent erosion. Limestone and/or granite are the common sources of riprap, but it can also be composed rubble from building and paving demolition. Armoring with riprap can be used for water containment in a variety of situations and functions to absorb the energy from the flow of water flowing in a watercourse. Riprap is versatile in its application and can accommodate a wide range of bank slope configurations both vertically and horizontally.

- **Live Plantings:** Vegetation can be used as a nonstructural measure to stabilize streambanks, especially vegetation with rhizomatous or fibrous root systems. Live plantings are most successful when streambank grading is gently sloped and terraced.

## 6.1 Screening of Measures

Of these five measures presented above, four were determined to be inappropriate for the river size, flow, and\or feasibility. As such, these measures were screened from further use as stand-alone alternatives or in combination with other measures for the reasons detailed below.

- **Drop Structures.** Initially, the use of a drop structure was considered for use at the upstream end of the migrating meander since these weirs can alleviate head cutting. However, on site investigations confirmed that there is no evidence of headcut migration. In addition with the volume of sediment being transported by the stream, flow would be slowed such that sediment would be expected to be deposited along the downstream face of the structure and fill the downstream channel, possibly to the height of the structure. Should the elevation of the riverbed be raised through deposition of sediment to the height of the drop structure, then the surface elevation of the stream would be expected to rise proportionally. The result could cause more erosion to occur. For these reasons, a drop structure was eliminated from further consideration.
- **Bendway Weirs.** This option was considered as a method of redirecting stream flow away from the eroding streambank and reducing the flow velocity during high flow events. However, the North Canadian River in this area is considered a small stream with typically low flow velocities. Additionally, the highly erodible soils of the area, when combined with the geomorphic dynamics, are such that rerouting channel flow, even slightly, could have damaging effects downstream of the constructed bendway weirs. As such, constructing bendway weirs was eliminated from further consideration. The bendway weir theory was originally developed to address erosion issues associated with large, navigable waterways, such as the Mississippi River, that rarely experience low flow velocities. The normal flow velocities in the North Canadian River were deemed too low for this measure.
- **Hydraulic Jacks.** Hydraulic jacks were commonly used in the 1940s and 1950s, but as more versatile streambank erosion control methods have been developed, the use of hydraulic jacks has diminished. Currently, the use of jacks is not recommended for effective erosion control in small stream systems.
- **Live Plantings.** This measure was not carried forward as stand-alone alternative; however, the use of live plantings is combined with the action alternatives as a component of that alternative. Generally, live plantings alone as bank stabilization result in a high probably of failure, especially during the establishment phase. Bank shaping is a critical component of

using live plantings and requires greater area to terrace the banks so as to best use the fibrous root systems to hold the bank soils. Vegetation generally requires at least two years to become established, during which there would be higher chance of bank failure if vegetation is the only material used. The stream velocities, especially during high flow events, were deemed too great for this non-structural measure to be used as a stand-alone alternative.

## 6.2 Alternative Formulation

The remaining structural and non-structural measures, riprap and live plantings, were combined to form alternatives. Since riprap is a versatile bank stabilizing material, measures relating to potential slope design configurations (steepness of slope) of riprap were then identified and are described in Table 2 below. Slope design entails either a two horizontal to one vertical (2h:1v) slope ratio or a three horizontal to one vertical (3h:1v) slope ratio.

**Table 2: Riprap Slope Design Options**

| OPTION | 2h:1v BANK SLOPE | OPTION | 3h:1v BANK SLOPE |
|---|---|---|---|
| **1** | RIPRAP SLOPE TO 1-YR FREQUENCY DISCHARGE | **4** | RIPRAP SLOPE TO 1-YR FREQUENCY DISCHARGE |
| **2** | RIPRAP SLOPE TO 2-YR FREQUENCY DISCHARGE | **5** | RIPRAP SLOPE TO 2-YR FREQUENCY DISCHARGE |
| **3** | RIPRAP SLOPE TO 10-YR FREQUENCY DISCHARGE | **6** | RIPRAP SLOPE TO 10-YR FREQUENCY DISCHARGE |

These six design options for the riprap measure, when combined with the non-structural measure of live plantings, formed the alternatives that are discussed in this report and the alternatives presented for detailed evaluation in the EA. To clarify and make this feasibility report congruent with the EA, these alternatives are presented as Alternatives 2 through 7, since the No-Action alternative is presented in the EA as Alternative 1.

As such, the final array of alternatives is as follows:

- **Alternative 1**: No-Action (the Future Without Project Condition)
- **Alternative 2**: Riprap the streambanks to the 1-year frequency discharge elevation at a 2 horizontal to one vertical ratio (2h:1v) slope
- **Alternative 3**: Riprap the streambanks to the 2-year frequency discharge elevation at a 2h:1v slope
- **Alternative 4**: Riprap the streambanks to the 10-year frequency discharge elevation at a 2h:1v slope
- **Alternative 5**: Riprap the streambanks to the 1-year frequency discharge elevation at a 3 horizontal to one vertical ratio (3h:1v) slope

- **Alternative 6**: Riprap the streambanks to the 2-year frequency discharge elevation at a 3h:1v slope
- **Alternative 7**: Riprap the streambanks to the 10-year frequency discharge elevation at a 3h:1v slope

## 6.3 Alternatives

There is one no-action alternative and six action alternatives. All of the action alternatives are similar in that they include minimal clearing and grading, establishing a temporary staging area, grading a permanent unimproved access road and associated drainage ditch, the removal of concrete rubble and disposing of it offsite at a commercial landfill, bank reshaping, emplacement of 6-inches of bedding/filter fabric and riprap 24-inches thick along approximately 3,000 to 3,500 linear feet of the left streambank and approximately 250 to 300 feet on the right bank, and stabilization of soils above the riprap with live plantings and/or seeding, or both.

The action alternatives differ in the slope steepness, the upslope elevation of the riprap placement, and the planting area on the bank above the riprap. Slope steepness would either be at a ratio of 2-horizontal to 1-vertical (2h:1v) or to a 3-horizontal to 1-vertical (3h:1v) slope. The upslope elevation of riprap would correspond to the 1-year, 2-year, and 10-year frequency discharge levels of protection.

### 6.3.1 Alternative 1: No-Action

The No-Action Alternative (or the Future Without Project Condition) is the alternative that assumes no action is taken. This alternative does not meet the goal of stabilizing the streambank and protecting the public facility (Luther Road). No streambank stabilization would occur and the eastward migration of the meander would be expected to continue.

Absent a federal project, Luther Road and the bridge approach could fail and be closed for an indefinite period of time. This situation could cause Oklahoma County to replace the failed roadway with a longer bridge spanning the river and railroad. As shown in Figure 7, a new bridge would be constructed and connected to the existing bridge, thereby adding approximately 1600 feet to the existing bridge structure. The existing utility lines attached to the poles paralleling Luther Road would also need to be replaced and/or relocated.

An approximate cost to build the road approach to the bridge and construct the new bridge is estimated at $7,360,000. This bridge construction estimate was calculated using the replacement cost for the existing Luther Road Bridge over the North

Canadian River. This approximation cost was obtained from Oklahoma County and was approximately $4,600 per foot. A contingency of 20% will be added to the construction cost to allow for incidental costs which were not included in the construction cost. It is assumed that any new bridge would be constructed along the existing road alignment and within the existing road right-of-way. Therefore no additional real estate easements/right of ways would be needed.

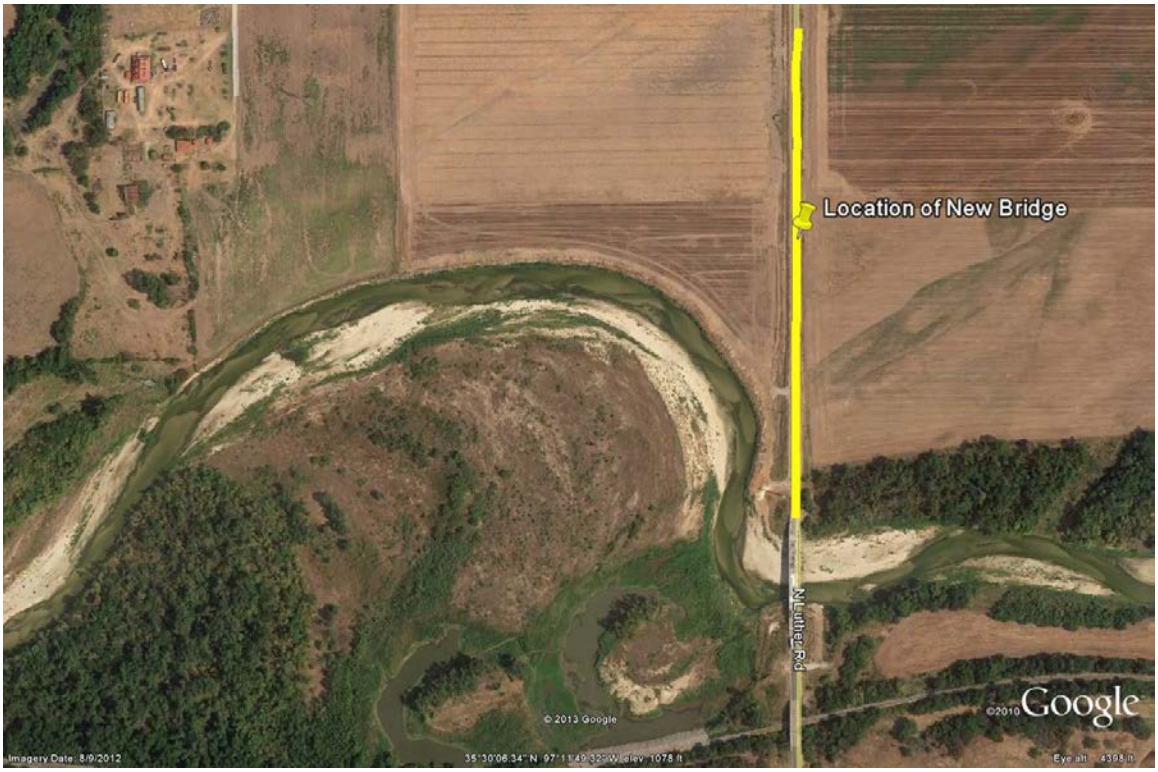


**Figure 6-1: Potential Location Site for New Bridge**

### 6.3.2 Alternative 2: Riprap streambanks to the 1-year frequency discharge elevation at a 2h:1v slope

This alternative consists of the common elements of the temporary staging area, access road, drainage ditch, removing the rubble along the left bank and disposing it at a commercial landfill at an off-site location. The streambanks would be reshaped to a 2h:1v slope for a distance of approximately 3,000 to 3,500 linear feet. A layer of 6-inches of bedding/filter fabric and riprap, 24 inches thick, would be placed starting at the toe of the slope of the river bed and continue upslope, stopping at the 1-year frequency discharge elevation. Appropriate vegetation would be used to stabilize approximately 6 acres above the riprap to the top of slope.

Project Drawing #3 in Appendix EA-1 of the Engineering Appendix (Appendix A) is the conceptual schematic for this alternative. The same schematic can also be found in the EA, in Figure 2-1.

Alternative 2 is estimated to cost $1,344,028 which includes design, construction, engineering during construction, real estate and contingency. The operation, maintenance, repair, rehabilitation and replacement (OMRR&R) cost for this alternative was estimated to be $2,000 annually.

### 6.3.3 Alternative 3: Riprap streambanks to the 2-year frequency discharge elevation at a 2h:1v slope

This alternative consists of the common elements of the temporary staging area, access road, drainage ditch, removing the rubble along the left bank and disposing it at a commercial landfill at an off-site location. The streambanks would be reshaped to a 2h:1v slope for a distance of approximately 3,000 to 3,500 linear feet. A layer of 6-inches of bedding/filter fabric and riprap, 24 inches thick, would be placed starting at the toe of the slope of the river bed and continue upslope, stopping at the 2-year frequency discharge elevation. Appropriate vegetation would be used to stabilize approximately 3.6 acres above the riprap to the top of slope.

Project Drawing #4 in Appendix EA-1 of the Engineering Appendix (Appendix A) is the conceptual schematic for this alternative. The same schematic can also be found in the EA, in Figure 2-2.

Alternative 2 is estimated to cost $1,920,431 which includes design, construction, engineering during construction, real estate and contingency. The OMRR&R cost for this alternative was estimated to be $1,500 annually.

### 6.3.4 Alternative 4: Riprap streambanks to the 10-year frequency discharge elevation at a 2h:1v slope

This alternative consists of the common elements of the temporary staging area, access road, drainage ditch, removing the rubble along the left bank and disposing it at a commercial landfill at an off-site location. The streambanks would be reshaped to a 2h:1v slope for a distance of approximately 3,000 to 3,500 linear feet. A layer of 6-inches of bedding/filter fabric and riprap, 24 inches thick, would be placed starting at the toe of the slope of the river bed and continue upslope, stopping at the 10-year frequency discharge elevation. Appropriate vegetation will be used to stabilize approximately 2.4 acres above the riprap to the top of slope.

Alternative 4 is estimated to cost $2,735,546 which includes design, construction, engineering during construction, real estate and contingency. The OMRR&R cost for this alternative was estimated to be $1,000 annually.

Project Drawing #5 in Appendix EA-1 of the Engineering Appendix (Appendix A) is the conceptual schematic for this alternative. The same schematic can also be found in the EA, in Figure 2-3.

### 6.3.5 Alternative 5: Riprap streambanks to the 1-year frequency discharge elevation at a 3h:1v slope

This alternative consists of the common elements of the temporary staging area, access road, drainage ditch, removing the rubble along the left bank and disposing it at a commercial landfill at an off-site location. The streambanks would be reshaped to a 3h:1v slope for a distance of approximately 3,000 to 3,500 linear feet. A layer of 6-inches of bedding/filter fabric and riprap, 24 inches thick, would be placed starting at the toe of the slope of the river bed and continue upslope, stopping at the 1-year frequency discharge elevation. Appropriate vegetation will be used to stabilize approximately 4.7 acres above the riprap to the top of slope.

Alternative 5 is estimated to cost $1,738,217 which includes design, construction, engineering during construction, real estate and contingency. The OMRR&R cost for this alternative was estimated to be $2,000 annually.

Project Drawing #6 in Appendix EA-1 of the Engineering Appendix (Appendix A) is the conceptual schematic for this alternative. The same schematic can also be found in the EA, in Figure 2-4.

### 6.3.6 Alternative 6: Riprap streambanks to the 2-year frequency discharge elevation at a 3h:1v slope

This alternative consists of the common elements of the temporary staging area, access road, drainage ditch, removing the rubble along the left bank and disposing it at a commercial landfill at an off-site location. The streambanks would be reshaped to a 3h:1v slope for a distance of approximately 3,000 to 3,500 linear feet. A layer of 6-inches of bedding/filter fabric and riprap, 24 inches thick, would be placed starting at the toe of the slope of the river bed and continue upslope, stopping at the 2-year frequency discharge elevation. Appropriate live plantings will be used to stabilize approximately 3 acres above the riprap to the top of slope.

Alternative 6 is estimated to cost $2,374,044 which includes design, construction, engineering during construction, real estate and contingency. The OMRR&R cost for this alternative was estimated to be $1,500 annually.

Project Drawing #7 in Appendix EA-1 of the Engineering Appendix (Appendix A) is the conceptual schematic for this alternative. The same schematic can also be found in the EA, in Figure 2-5.

#### 6.3.7 Alternative 7: Riprap streambanks to the 10-year frequency discharge elevation at a 3h:1v slope

This alternative consists of the common elements of the temporary staging area, access road, drainage ditch, removing approximately 1,800 tons of rubble along the left bank and disposing it at a commercial landfill at an off-site location. The streambanks would be reshaped to a 3h:1v slope for a distance of approximately 3,000 to 3,500 linear feet. A layer of 6-inches of bedding/filter fabric and riprap, 24 inches thick, would be placed starting at the toe of the slope of the river bed and continue upslope, stopping at the 10-year frequency discharge elevation. Approximately 25,950 tons of riprap would be needed; however, this quantity may change with final design Appropriate vegetation will be used to stabilize approximately 2 acres above the riprap to the top of slope.

Alternative 7 is estimated to cost $3,361,056 which includes design, construction, engineering during construction, real estate and contingency. The OMRR&R cost for this alternative was estimated to be $1,000 annually.

Project Drawing #8 in Appendix EA-1 of the Engineering Appendix (Appendix A) is the conceptual schematic for this alternative. The same schematic can also be found in the EA, in Figure 2-6.

## 6.4 Screening of Alternatives

### 6.4.1 Evaluation of Alternatives

The alternative selected would be the alternative that best protects the streambank with minimal impact to the environment; one that prevents and\or reduces damages, thereby producing benefits, and is cost effective with regard to the benefits provided. The alternatives were compared against each other to screen those that best achieve this goal. All seven alternatives are evaluated in the EA prepared for this proposed project.

As previously stated, the No-Action Alternative does not achieve the goal of protecting the public facility (Luther Road). Economically, this alternative could have the greatest impact to the human environment should the eroding meander cause road and bridge failure. It also has a significant cost associated with in since a new bridge would need to be constructed.

Alternatives 2, 3, and 4 are similar in that they all propose grading the streambank at a 2h:1v slope. They differ in the required quantity and up-slope elevation of riprap and reseeding areas. Action Alternatives 2, 3, and 4 would require the acquisition of approximately 5.2 acres for the temporary staging area, access road, drainage ditch, and construction.

Alternatives 5, 6, and 7 are similar in that they all propose to establish a temporary staging area, access road, and drainage ditch; remove the existing concrete rubble; grade the streambank at a 3h:1v slope; place a layer of 6-inches of bedding material or filter fabric; and placing riprap, 24 inches thick. They differ in the required quantity and up-slope elevation of riprap and planting areas. Action Alternatives 5, 6, and 7 would require the acquisition of approximately 6.5 acres for the temporary staging area, access road, drainage ditch, and construction.

Many of the impacts associated with erosion control measures are independent of the material used. Generally, impacts arise from the habitat characteristics of the structure and the influence of the structure on riparian vegetation. It is important to note that the impacts associated with the use of riprap are generally minimized by reducing the height of protection, increasing the slope of the embankment, and by sizing the riprap in order to create adequate habitat within the aquatic environment (Fischenich, USACE, 2003).

Riprap is a highly effective and versatile way to correct streambank erosion, is a long standing method used for controlling streambank erosion, and has been used with success in other areas of the North Canadian River in similar situations. Slope stability utilizing riprap is generally the same, whether the slope is a 2h:1v slope or a 3h:1v slope.

Since all of the alternatives considered involved slope toe protection, and bank toe cutting and sloughing were considered to be the cause of the eroding streambanks, cost became the critical criterion to use in screening the alternatives. As such, Alternatives 5, 6 and 7 were screened from further consideration for this project. These alternatives are included in the detailed evaluation in the EA.

It was also noted by the hydraulic engineer that the 1-year flood event elevation (Alternative 2) should adequately prevent future streambank toe erosion for the project. However, since Alternatives 2, 3, and 4 would all meet the goal of stabilizing the streambank and protecting the public facility, these alternatives are carried forward for detailed analysis in this report to determine which of them would be identified as the recommended alternative and become the Tentatively Selected Plan. Any of these alternatives could become the recommended plan and may be

selected by the sponsor as a locally preferred plan. However, Oklahoma County would become responsible for those costs not covered by the Federal government.

### 6.4.2 Comparison of Alternatives 2, 3, and 4

Each alternative shall be compared to each of four criteria described in the Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G). These four criteria are completeness, efficiency, effectiveness and acceptability. Completeness is measured by how well each alternative supports the planning study goals and objectives, and is within the planning constraints. Effectiveness is measured by how well the alternative alleviates the problems noted for this study and how well the alternative takes advantage of the opportunities afforded by this study. Efficiency is measured by the extent to which the alternative is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities consistent with protecting the Nation's environment. Acceptability is measured as the workability and viability of the alternative with respect to acceptance by the local sponsor and state regulating agencies, and the alternative's compatibility with existing laws, regulations and public policies.

Alternatives 1 (No Action), 2, 3, and 4 were compared against each other based on their costs and benefits to the project area. All of the remaining action alternatives would require riprap for the linear distance of approximately 3,000 to 3,500 feet along the left bank and approximately 250 to 300 feet along the right bank in front of the bridge piers. The real estate requirements for alternatives 2, 3 and 4 are also the same and would require approximately 5.2 acres.

- The "No Action" alternative could require the construction of a new bridge in the event that Luther Road is structurally compromised and fails. A new bridge would be expected to add approximately 1600 feet to the existing bridge (reference Figures 6 and 7). The approximate cost of the new bridge could be $8,272,000.
- Alternative 2 would prevent any future streambank toe cutting and stabilize the streambank. Live plantings and/or seeding, or both would be used to stabilize approximately 6 acres along the area upslope of the riprap. These actions would protect Luther Road from failure. This alternative has the lowest cost of the three action alternatives.
- Alternative 3 would also prevent future streambank toe cutting and stabilize the streambank. This alternative would require more riprap to be placed to a higher elevation, thereby increasing the costs associated with acquiring riprap. Less plant material would be needed, since the upslope area above

the riprap would be approximately 3.6 acres. This alternative does not offer more slope toe protection than Alternative 2.

- Alternative 4 would also prevent future streambank toe cutting and stabilize the streambank. This alternative would require the most riprap to be placed to a higher elevation, thereby increasing the costs beyond Alternative 3 associated with acquiring riprap. Less plant material would be needed, since the upslope area above the riprap would be approximately 2.4 acres. This alternative does not offer more slope toe protection than Alternative 1.

All of the action alternatives meet the goal of this study to stabilize the streambank and protect the public facility (Luther Road). Alternatives 2, 3, and 4 each would meet the effectiveness criteria for this study. Alternative 2 is the most cost-effective; therefore, best supports the efficiency criteria for this study.

Alternatives 2, 3, and 4 are feasible solutions and would also be acceptable to the local sponsor. As determined in the EA for this proposed project, Alternatives 2, 3, and 4 would be expected to have to adverse impacts on the environment. These alternatives would be considered as compatible with existing laws, regulations and public policies. As such, each of the alternatives 2, 3, and 4 would support the acceptability criteria.

Finally, the "No Action Alternative and Alternatives 1, 2 and 3 were compared by a detailed economic analysis performed to determine which alternative has the most net benefits and highest benefit to cost ratio. The alternative with the most net benefits will be the National Economic Development (NED) plan for this project and will be the recommended alternative.

## 6.5 Detailed Economic Analysis and Identification of the National Economic Development Plan

Economic analyses of the proposed alternatives were evaluated using a 20 year period of analysis and the FY12 Federal interest rate of 4.00%. The price level for the analysis is June 2012. Three different alternatives were analyzed. The plan that maximizes net benefits is the NED plan. Table 3 shows the detailed costs, annualized cost, net benefits and benefit to cost ratios for each alternative. The detailed costs estimates for each alternative can be found in Appendix EA-2 of the Engineering Appendix (Appendix A).

### 6.5.1 Without project condition/No Action Alternative

Economic costs of the without project condition alternative are based on the assumed construction of a new bridge on Luther Road from the existing bridge

crossing the North Canadian River northward for approximately 1600 feet. This new bridge could be the solution for the consequences of no action to stabilize the streambanks at the North Canadian River crossing. Current new construction cost for this bridge is $7,360,000. An additional 20% contingency ($1,472,000) was added to the construction cost to cover any miscellaneous costs not included at this feasibility level cost estimate. The new bridge would be constructed on the same alignment of the existing Luther Road and within the existing road right-of-way, so no new real estate easements would be needed. This new bridge construction estimate was interpolated from the replacement cost of the existing North Canadian River Bridge ($1,700,000 or approximately $4,600/foot) over the North Canadian River. This bridge replacement cost was obtained from Oklahoma County and was in 2011 dollars. Additional costs for planning and design and operation, maintenance, repair, rehabilitation and replacement (OMRR&R) are also included in Table 2 for the future without project condition. The replacement costs avoided are the primary factor considered in this evaluation.

It appears that the left streambank is currently about 125 feet from the road, and at this rate of erosion of approximately 100 feet per year will encroach upon the road in the next 1 to 1.5 years. Oklahoma County would likely not wait till then to implement a response. This analysis assumes that replacement would take place in year two. Present value costs for the new bridge construction are $8,272,004. The total annual cost of replacement would be $613,669 which includes $5,000 for OMRR&R.

#### 6.5.2 Alternative 2: Riprap streambanks to the 1-year frequency discharge elevation at a 2h:1v slope

This alternative has a total estimated investment cost of $1,344,028 and annual costs of $100,896 which includes annual OMRR&R of $2,000. The benefit-cost ratio (BCR) is 6.08.

#### 6.5.3 Alternative 3: Riprap streambanks to the 2-year frequency discharge elevation at a 2h:1v slope

This alternative has a total estimated investment cost of $1,920,431 and annual costs of $142,809 which includes annual OMRR&R of $1,500. The benefit-cost ratio is 4.30.

#### 6.5.4 Alternative 4: Riprap streambanks to the 10-year frequency discharge elevation at a 2h:1v slope

This alternative has a total estimated investment cost of $2,735,546 and annual costs of $202,286 which includes annual OMRR&R of $1,000. The benefit-cost ratio is 3.03

## 6.6 Selection of Recommended Alternative

Alternative 2 is the NED plan and recommended alternative for the project. It is the most efficient solution for cost effectiveness. While all of the alternatives are economically justified, each having a BCR higher than 1, Alternative 2 was identified as the NED Plan because it maximized net benefits. Alternative 2 has a total investment cost of $1,344,028, annual net benefits of $512,773 and a benefit to cost ratio of 6.08. Alternative 2 achieves the main goal of the project which is to stabilize the streambank and protect the public facility (Luther Road) from failure. This alternative is also evaluated in detail in the EA and is presented in the EA as the Tentatively Selected Plan.

**Table 3: Economic Analysis for Proposed Alternatives**

| | No Action Without Project Condition | Alt. 2 2 h:1v slope ratio; riprap to 1 year elevation | Alt. 3 2 h:1v slope ratio; riprap to 2 year elevation | Alt. 4 2 h:1v slope ratio; riprap to 10 year elevation |
|---|---|---|---|---|
| **Construction Cost** | $7,360,000 | $988,897 | $1,472,904 | $2,157,357 |
| **Construction Contingency** | $1,472,000 | $188,781 | $281,177 | $411,839 |
| **Planning & Design Costs** | $100,000 | $100,000 | $100,000 | $100,000 |
| **Planning & Design Contingency** | $15,000 | $15,000 | $15,000 | $15,000 |
| **Real Estate Costs** | 1/ | $49,040 | $49,040 | $49,040 |
| **Real Estate Contingency** | 1/ | $2,310 | $2,310 | $2,310 |
| **Rate of Interest during Installation Period** | n/a | n/a | n/a | n/a |
| **Total investment** | $8,947,000 | $1,344,028 | $1,920,431 | $2,735,546 |
| **Present value** | $8,272,004 | $1,344,028 | $1,920,431 | $2,735,546 |
| **Interest and amortization** | $ 608,669 | $98,896 | $141,309 | $201,286 |
| **Annual OMRR&R** | $ 5,000 | $2,000 | $1,500 | $1,000 |
| **Total Annual Costs** | $ 613,669 | $100,896 | $142,809 | $202,286 |
| **Total Annual Benefits** | n/a | $613,669 | $613,669 | $613,669 |
| **BC Ratio** | n/a | **6.08** | **4.30** | **3.03** |
| **NET BENEFITS** | n/a | **$512,773** | **$470,860** | **$411,382** |

**Price Level: June 2012; Interest Rate:4.00%; Installation Period: n/a; Period of Analysis: 20 years**
**1/ There won't be any additional real estate easements needed because the new bridge will be constructed on the existing Luther Road alignment.**

### 6.7 Operation, Maintenance, Repair, Rehabilitation & Replacement

Expected Operations, Maintenance, Repair, Rehabilitation & Replacement (OMRR&R) activities would be minimal for Alternative 2. Operation and maintenance would require removal of debris and obstructions that may accumulate on the streambanks after flood events. Repair, rehabilitation and replacement activities would include replacement of damaged or missing riprap. Maintenance activities would not be expected to be more than approximately $2,000 annually.

### 6.8 Recommended Alternative

Alternative 2 is the recommended plan for this project. It is the most cost effective plan for this project and does not cause any long term, adverse environmental effects to the project area. Alternative 2 presents the greatest net benefits of $512,773 annually. The total project cost for this alternative is $1,344,028 and it has a benefit to cost ratio of 6.08.

## 7.0 CONSIDERATIONS OF THE NATIONAL ECONOMIC DEVELOPMENT PLAN

### 7.1 Environmental and Cultural Considerations

An Environmental Assessment (EA), as required under the National Environmental Policy Act (NEPA) of 1969, as amended (42 USC 4321, *et seq*.) has been conducted for this proposed project. Resources that are evaluated in this EA include soils, water quality, wetlands, terrestrial resources, fish and wildlife resources, threatened and endangered species, invasive species, floodplains, land use, socioeconomics, and cultural resources.

The analysis presented in the EA indicates that there would not be any significant, adverse, or long-term impacts from any of the seven alternatives evaluated. No Federally-protected species or critical habitat is known to occur in the project area. No wetlands occur within the projects area.

The North Canadian River is a jurisdictional water of the U.S. and a 404(b)(1) analysis will be required subsequent to the EA. Since the Corps does not permit itself, Oklahoma County, as the non-federal sponsor, will need to complete an application for a Department of the Army (DA) permit. A 30-day public and interagency coordination, separate from the EA process, is part of the DA Permit process and is required by regulation (33 CFR 325). Other permits required for this project include a Section 401 Water Quality Certification for the State of Oklahoma, which must be issued before the DA Permit can be issued, and a storm water discharge permit, in accordance with the national Pollution Discharge Elimination

System (NPDES), also from the state, is required for construction activities exceeding one acre.

Some short term, temporary impacts to water quality, terrestrial habitat, fish and wildlife, noise, and transportation would likely occur during construction. These impacts would be minimized through the use of best management practices during construction and planting and/or reseeding disturbed areas with appropriate plant material at the completion of the project.

During the EA preparation process, coordination with the Oklahoma SHPO and State Archaeologist has occurred. The proposed project area has been heavily modified, both by natural erosive events and previous attempt to stabilize the streambanks, thereby eliminating the potential for in situ cultural horizons. Aerial photographs illustrate that between 2008 and 2011 the project area was reshaped by cut and fill activities (the bank was sloped) and concrete debris was emplaced in order to protect the bank. Therefore, the project area has already sustained impacts of the same type as those proposed for the federal project. Additional proposed cut and fill activities will be insignificant in nature, and emplacement of additional riprap to protect the bank will result in extremely minor, if any, impacts of a ground-disturbing nature.

Aerial photographs show that between 2006 and 2008 the active channel eroded several hundred feet laterally to the east, illustrating the dynamic character of the river in high flow events. In fact, during this time period a standing structure, most likely a barn/utility shed was lost or removed because of the erosion. Channel movement including lateral migration within the active floodplain is therefore demonstrably significant, which is indicative of a very low potential for in situ archaeological deposits. This low potential is further corroborated by consulting the USDA Soil Survey for the area, indicating that the soils in the project area consist of Canadian and Crevasse Series, which essentially are soils with thin A horizons and B horizons consisting of unstructured sandy loams. The presence of these soils is more evidence that thin A horizons have built over short spans of time on top of fluvial sand deposits. Cultural horizons are likely to either be not present because of lateral stream migration or deeply buried. As such, no impact to historic properties is anticipated.

## 7.2 Real Estate Considerations

The property in the project area that would be required by the NED Plan is not owned by the local sponsor and requires a real estate easement. Approximately 5.2 acres would be required by the NED Plan. The required lands, easements, rights-of-way, relocations, and/or disposal areas (LERRD) has an estimated price of $51,350. This property will be secured by the local sponsor as part of their share of the project

costs. The local sponsor currently owns 1.34 acres of land that is the Luther Road right-of-way. Although this acreage is part of the LERRDs, it is not creditable as part of the local Sponsor's cost share. A detailed Real Estate Plan is provided in Appendix D.

# 8.0 PLAN REQUIREMENTS

## 8.1 Cost Sharing

Table 4 presents a detailed cost estimate and cost sharing for the NED Plan. This cost estimate includes costs and contingencies for construction management which were not previously included in earlier estimates. Final cost estimates are shown at the June 2012 and Fully-Funded price levels. The Fully-Funded cost estimate reflects expected inflation to the midpoint of project construction, currently estimated to be July 2013. The sponsor has agreed to provide their share in cash funds, exceeding the non-Federal Sponsor's mandatory 5% cash requirement.

**Table 4: National Economic Development Plan Cost Sharing**

| NED PLAN FEATURE | JUNE 2012 | FULLY FUNDED |
|---|---|---|
| Construction | $ 988,897 | $ 1,005,000 |
| Planning, Engineering, & Design | $ 98,000 | $ 100,000 |
| Construction Management | $ 80,000 | $ 83,000 |
| LERRD (contingency included) | $ 51,350 | $52,400 |
| Contingency | $ 309,480 | $ 314,000 |
| **Total Estimated Project Cost** | $ 1,527,727 | $ 1,554,400 |
| | | |
| **NED Plan Cost Sharing** | | |
| Federal Share (65%) | $ 993,023 | $ 1,010,360 |
| Non-Federal Share (35%) | $ 534,704 | $544,040 |

## 8.2 Construction Schedule

Pending the outcome of the Project Design Phase, implementation of the NED Plan will most likely occur during the spring months of 2014. Grass seeding would occur immediately after the upper portion of the slope is built. Surface soils would need to be moist with the seasonal rains prior to planting of the shrubs and trees. If shrubs and trees cannot be planted before the high spring/summer stream flows, planting will be delayed until the next suitable planting season. A milestone list and detailed project schedule from feasibility through the completion of construction is provided in Appendix E.

### 8.3 Future Operations, Maintenance, Repair, Rehabilitation & Replacement

Operations, Maintenance, Repair, Rehabilitation, & Replacement (OMRR&R) of the newly riprapped streambanks will become the responsibility of the local sponsor after construction is complete and the project has been turned over to them for OMRR&R. An OMRR&R manual will be developed during the design phase as part of design documentation for the project, and will be submitted to the project local sponsor upon completion of construction.

## 9.0 CONCLUSION AND RECOMMENDATION

### 9.1 Conclusion

Protection of the public facilities of Luther Road and the bridge approach by stabilizing the streambanks of the North Canadian River is technically and economically feasible.

This Planning and Design Analysis Report has included an examination of the practicable alternatives for meeting the study objective to stabilize the streambanks of the North Canadian River thereby providing protection for the Luther Road bridge approach and the existing utilities. The NED Plan would best meet this objective, while providing a significant benefit-to-cost ratio, and would meet the needs of the sponsor. Additionally, the NED Plan builds upon lessons learned from previous similar repairs and provide a lasting repair to the erosion problem in this affected area of the streambank, thereby removing the risk of roadway damage and failure while resulting in minimal OMRR&R costs for the sponsor.

### 9.2 Recommendation

Upon considering the economic, environmental, social, and engineering aspects presented in this Planning and Design Analysis Report, it has been determined that a project to protect Luther Road is in the public interest. Accordingly, the Corps of Engineers, Tulsa District, recommends that the NED Plan, as identified herein, be adopted and carried forward for implementation pursuant to Section 14 of the Flood Control Act of 1946, as amended (Public Law 79-526), subject to the availability of federal funds.

The estimated cost of the NED Plan is $993,023 Federal and $534,704 Non-Federal, for a total estimated cost of $1,527,727 at June 2012 price levels. Average annual net benefits are $499,256, indicating a very strong contribution to the nation's economic output by the project. The average annual benefits of the NED Plan exceed the average annual cost by a ratio of 5.36 to 1.

Federal implementation of the NED Plan would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, as stipulated in the model Section 14 Project Partnership Agreement.

**The recommendations contained herein reflect the information available at the time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program, nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendation may be modified prior to implementation. However, the project partner, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.**

for

Stephen Nolen
Chief, Planning and
Environmental Division

# APPENDIX A

# ENGINEERING

US Army Corps
of Engineers

# Engineering Technical Supplement

## Luther Road
## Section 14 Streambank Stabilization Project

**U.S. Army Corps of Engineers – Tulsa District**
1645 S. 101st E Ave
Tulsa, OK 74128

**JULY 2012**

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# 1.0 ALTERNATIVE PLANS DESIGN AND COST

## 1.1 Scope

During this phase of the project, Engineering and Construction Division was tasked to develop for further consideration, a range of technically feasible alternatives capable of protecting Luther Road and the Luther Road Bridge from the encroaching erosion of the banks of the North Canadian River. This Engineering Technical Supplement contains feasibility level designs as well as cost estimates for the implementation of each design alternative.

## 1.2 Infeasible Alternatives

Erosion control measures considered and deemed technically infeasible for this project include Drop Structures, Bendway Weirs, and Hydraulic Jacks. These methods, which are discussed in detail in the Hydrology and Hydraulics Report (See Appendix EA-6) and more briefly below, have been ruled out for further consideration.

### 1.2.1 Drop Structures

Initially, a controlled drop structure was considered at the upper end of the project area. It was thought that a drop structure could alleviate head cutting and slow channel velocities, but upon further investigation, appreciable head cutting and migration issues were not found in the area. Additionally, heavy sediment load in the river would likely deposit below the drop structure and potentially fill in the channel back to existing conditions.

### 1.2.2 Bendway Weirs

Bendway weirs are typically utilized to control flow in larger rivers where the flow volume and velocity are relatively large. Since the section of the North Canadian River at Luther Road has relatively small flow volume and velocity, use of Bendway Weirs was deemed impractical. Additionally, due to the highly erodible soils of the area the geomorphologic dynamics of the area are such that rerouting the channel flow, even slightly, could potentially have damaging effects downstream of the installed weirs.

### 1.2.3 Hydraulic Jacks

These structures are steel or concrete beams in the shape of an “X”. They are placed perpendicular to flow. Wires are sometimes tied to the beams to increase debris catch. The jacks work by trapping debris and sediment in the beams and wires, thus slowing velocities in the area. Examples of hydraulic jacks can be found on the Dodge City, Kansas levee on the Arkansas River. They were commonly used erosion control structures in the 1940’s and 50’s, but since then, their popularity and use has diminished. Currently, the employment of hydraulic jacks is not recommended for erosion control measures.

## 1.3 Feasible Alternatives

Riprap is an effective, highly versatile and long-standing method of controlling streambank erosion. Due to the high level of meandering currently occurring in the project area, it is considered the most prudent choice for protection.

### 1.3.1 Riprap – Alternative Design Options

Preliminary designs for six different rip rap configurations, including 1-year, 2-year and 10-year (full channel flow) frequency discharge events have been provided for consideration. See Appendix EA-1 – Project Drawings, for the alternative design drawings.

The 2:1 side slopes included in options 1, 2 and 3 provide the maximum recommended slope for rip rap. The maximum slope provides the minimum allowable slope stability and requires slightly less land area for construction than options 4, 5 and 6.

The more gradual 3:1 side slopes in options 4, 5 and 6 provide additional slope stability and require more land area for construction than options 1, 2 and 3.

All options include removal and disposal off-site of the existing rubble and reshaping the north bank of the river to the west of the bridge and the south bank at the bridge to either a 2:1 or 3:1 slope (horizontal to vertical), providing a rip rap bedding layer as well as the addition of a maintenance road and drainage ditch. The six configurations are listed in Table 1.1 below:

**Table 1.1 Alternative Design Options**

| 2:1 Bank Slope | 3:1 Bank Slope |
|---|---|
| 1. Riprap slope to 1-yr freq. discharge elev. | 4. Riprap slope to 1-yr freq. discharge elev. |
| 2. Riprap slope to 2-yr freq. discharge elev. | 5. Riprap slope to 2-yr freq. discharge elev. |
| 3. Riprap slope to10-yr freq. discharge elev. | 6. Riprap slope to10-yr freq. discharge elev. |

### 1.4 Lands

The lands that will be affected by the different options are four different privately owned properties (see Real Estate Map Appendix EA-5 and Construction Limit Drawings in Appendix EA-1). These areas of land, or portions thereof, would have to be acquired by the local sponsor. Final design of the selected alternative is required to accurately define the limits of construction and, by extension, amount of land to be purchased.

The estimated amount of land required for purchase to complete Option 1, 2 or 3, is approximately 5.2 *total* acres from multiple owners. Option 4, 5, or 6 would require the purchase of approximately 6.5 *total* acres from multiple owners. Total cost of all real estate transactions is estimated at $48,015 (see Appendix EA-7). The real estate cost is separate and additional to the engineering cost estimate provided in Appendix EA-2.

### 1.5 Site Work

The existing north bank of the North Canadian River has been reinforced with rubble. In each of the alternative design options, the following is assumed:

1. Existing rubble is to be removed and disposed of off-site
2. The existing bank is to be reshaped to either a 2:1 or 3:1 slope

3. An access road for maintenance and a drainage ditch are part of the feasibility level design.

The existing project limits are within an undeveloped area with primarily ground vegetation. Minimal clearing will be required for this project.

### 1.6 Surveying and Mapping

Field measurements were taken to base the design estimate for this stage of the project. A detailed survey of the area was not completed. Boundary-line surveys as well as the survey of project areas and features (for earthwork quantity calculation) would be required to exercise any of the options discussed in this report. Costs associated with required surveys have been estimated and included in the cost estimate.

### 1.7 Care and Control of Water

Some care and control of water during construction is expected and included in the cost estimate. The risk associated with working in a riparian environment subject to flooding is a contributing factor in estimated contingency.

### 1.8 Design and Engineering

Feasibility-level design for each alternative is provided in this report. The future design effort required to implement any of the options discussed will likely include survey-based, civil, site development as well as the development of final plans and construction specifications. Refined cost estimates should be developed for the selected construction alternative.

### 1.9 Cost Estimate

A cost estimate was prepared using TRACES MII Version 4.1 estimating software. Unit prices were developed from equipment, labor, and materials in the Region V database and fuel costs were adjusted to current levels. Various unknowns associated with each line item in the estimate were evaluated and appropriate contingencies assigned. The MII estimate is included in Appendix EA-2.

## 2.0 HYDROLOGY AND HYDRAULICS

### 2.1 General

Hydrologic and hydraulic conditions were evaluated for this project using Certified Hydrologic Engineering Center (HEC) software. Design alternatives were developed and modeled to provide floodplain and design details. The Hydrology and Hydraulics Report is included in Appendix EA-7.

## 3.0 Soils and Stone Protection

### 3.1 Soils

The types of soils present in the project are shown on a Natural Resources Conservation Service soils map of the area that is included in Appendix EA-4 of this report. The soils along the bank to be protected are generally described as sandy loam. These types of

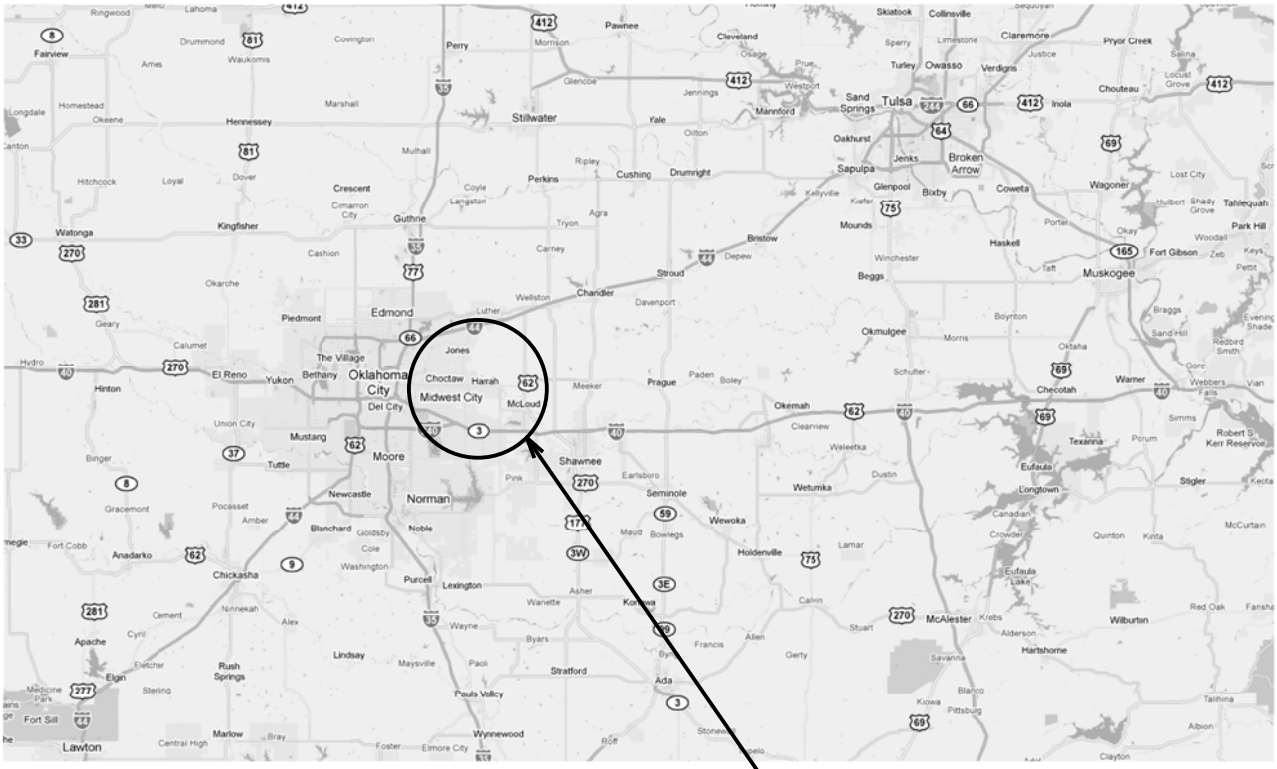
soils will tend to pipe through the protection stone if an engineered filter is not present. An engineered filter consists of the stone bedding layer and filter layers between the bedding and native soil. In the next phase of design, representative soil samples along the bank will need to be obtained for gradation testing to support design of an engineered filter.

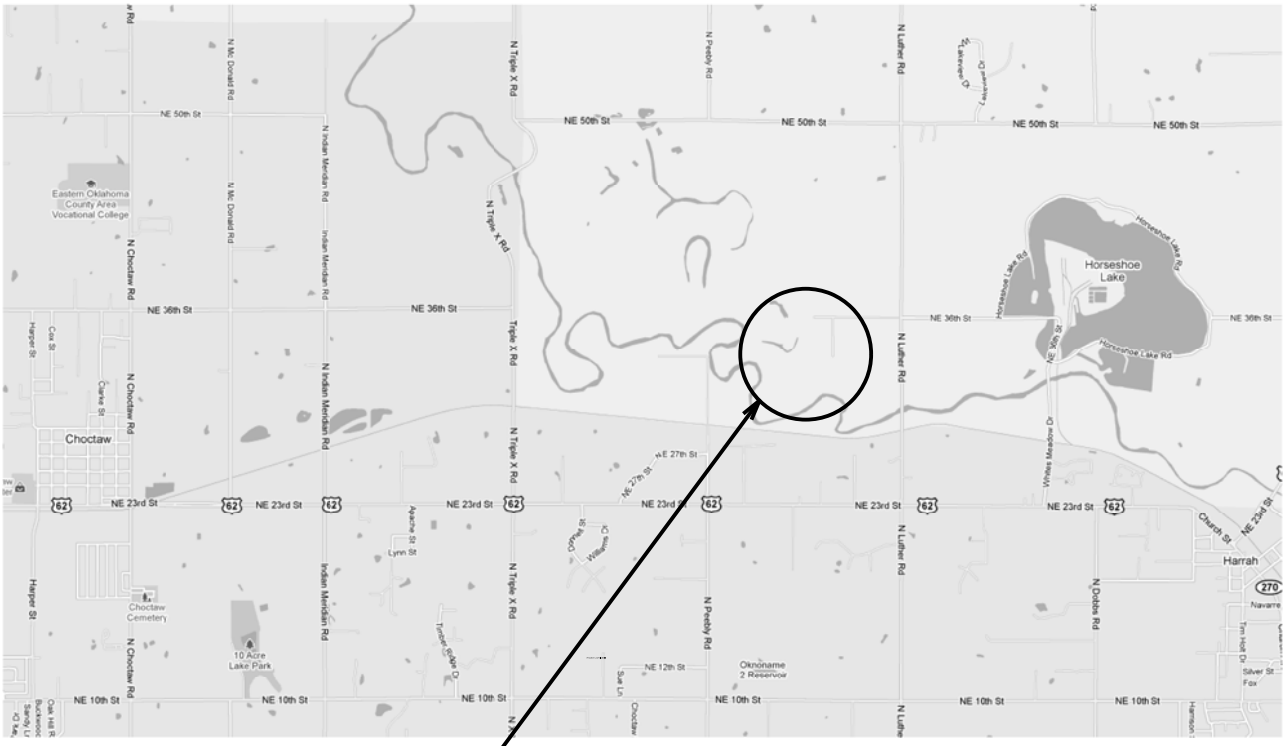
### 3.2 Stone Protection

The length of the proposed bank protection project is approximately 1.5 miles. The quantities of riprap and bedding stone will be large. In the project specifications, time for locating a quarry to supply the large quantities of riprap and bedding and for testing those materials, if necessary, shall be included. At a minimum, 60 days shall be allowed for locating a quarry and for testing.

# APPENDIX EA-1

# Project Drawings

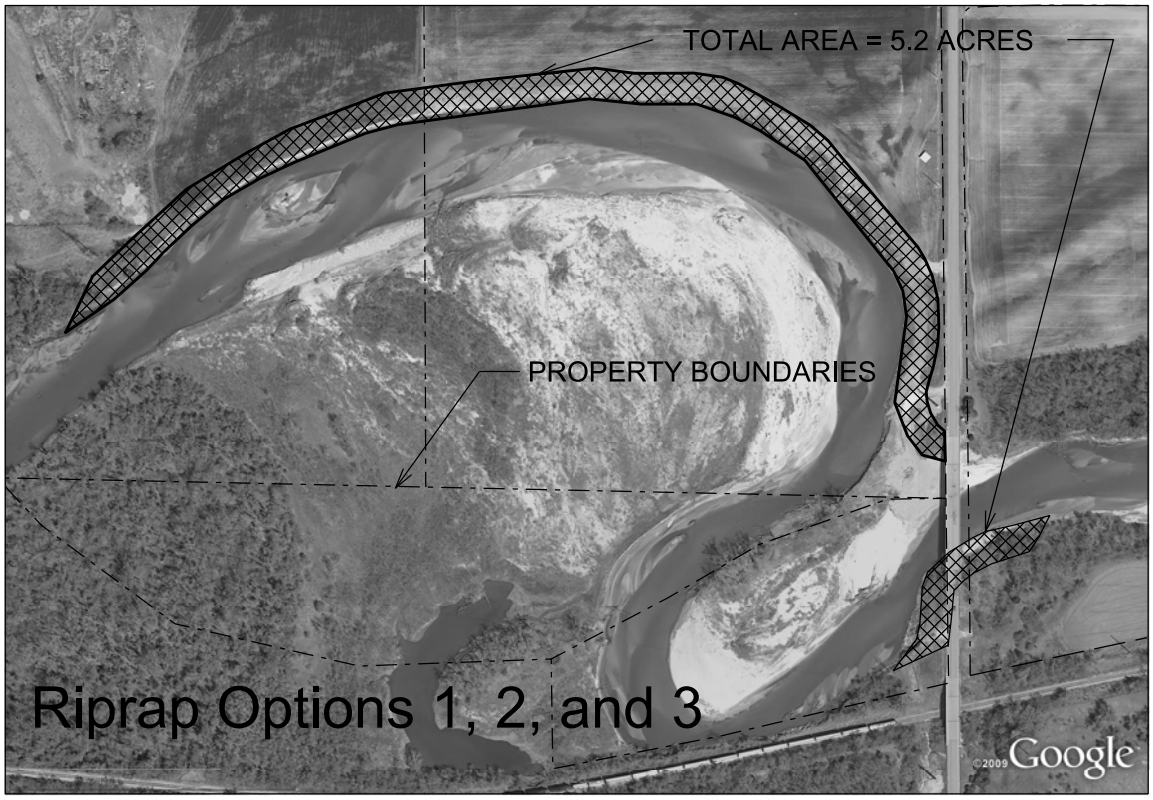


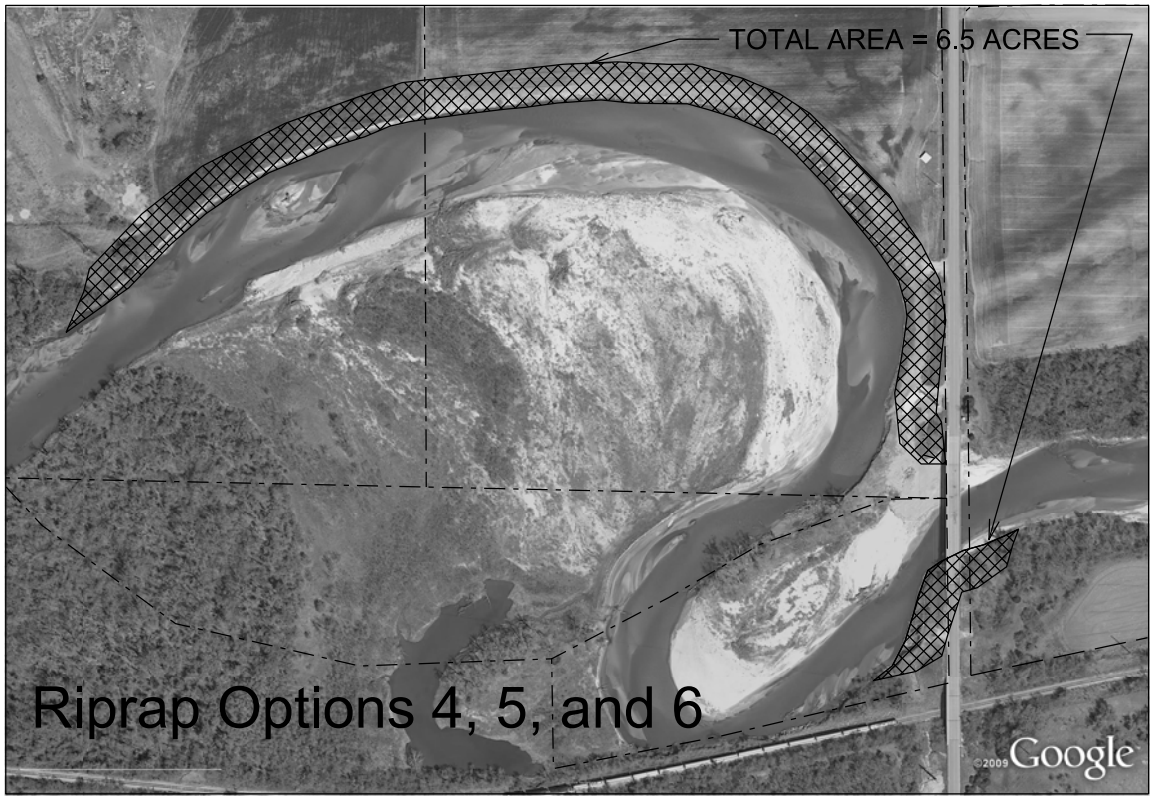




PROJECT DRAWING #1

U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

| | | |
|---|---|---|
| TULSA CADD | Luther Road - Section 14 Streambank Stabilization Project<br>Project Vicinity/Location | |
| | DESIGNER: JMJ | DATE:6/2011 |
| | REVIEWED BY: | |



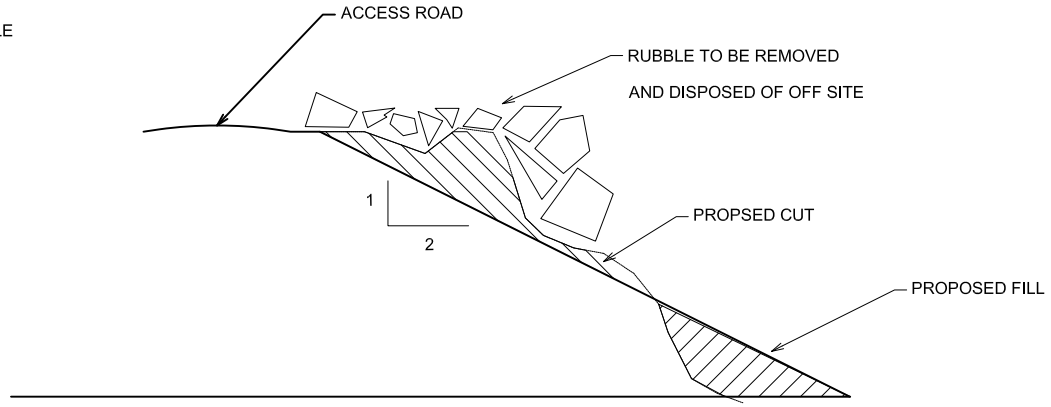

PROJECT DRAWING #2

U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

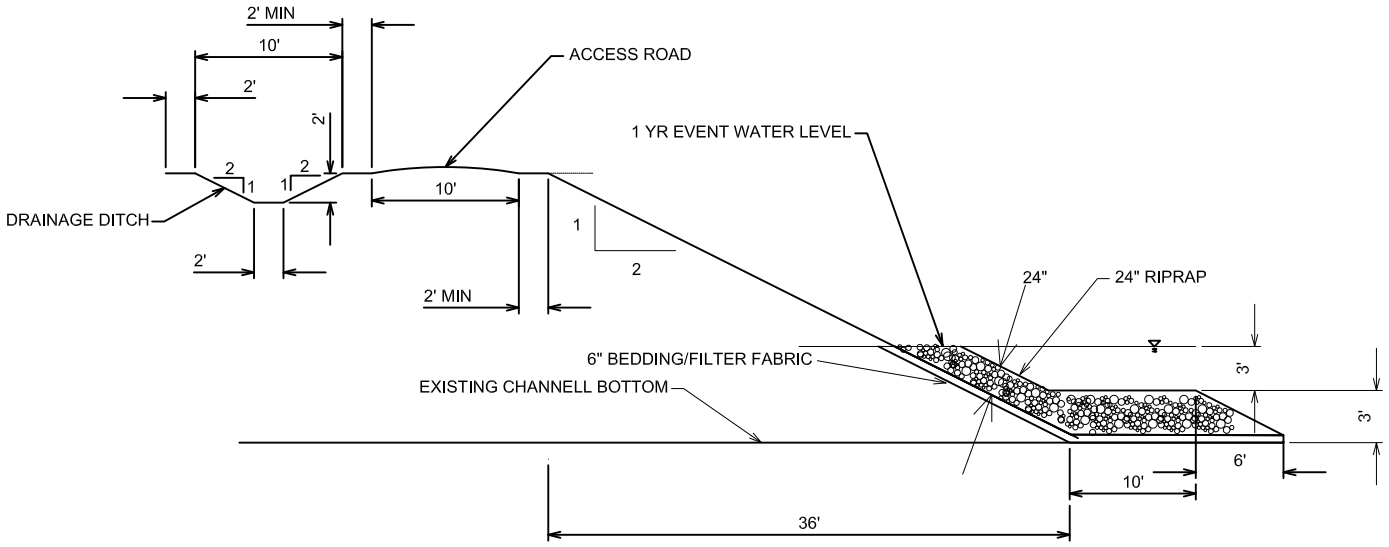
**Luther Road - Section 14 Streambank Stabilization Project**
**Limits of Construction**

| | |
|---|---|
| DESIGNER: JMJ | DATE:6/2011 |
| REVIEWED BY: | |

NOT TO SCALE




TYPICAL EXISTING SECTION




TYPICAL EMBANKMENT SECTION PROPOSED

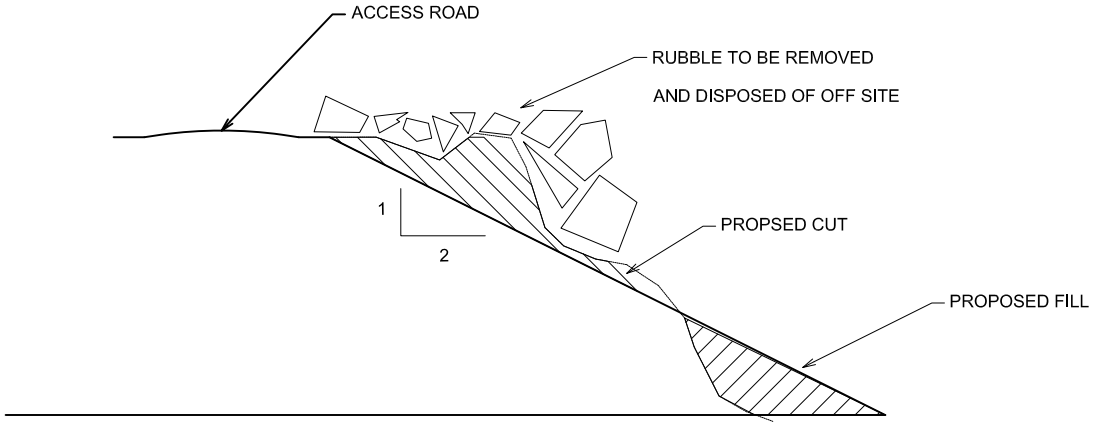
# Project Drawing #3

U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

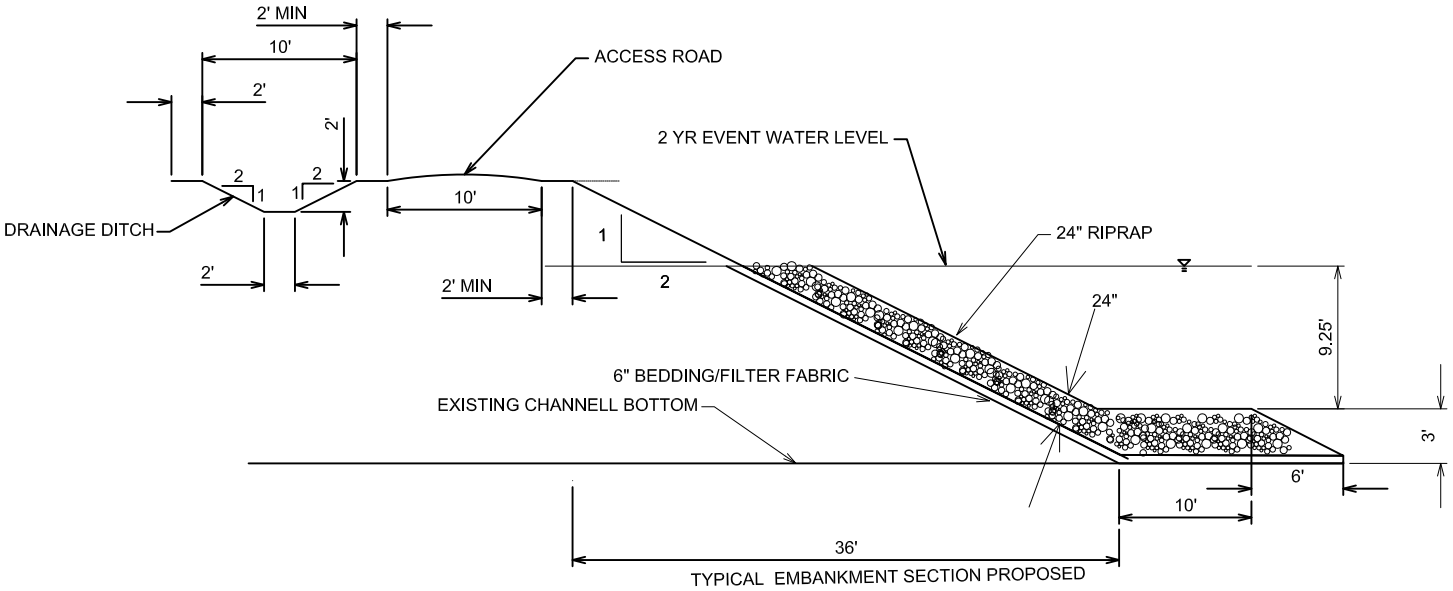
Luther Road - Section 14 Streambank Stabilization Project
ALTERNATIVE 1 - RIPRAP AT 2:1 SLOPE , 1 YR EVENT

| | |
|---|---|
| DESIGNER: LARGE | DATE: 6/2011 |
| REVIEWED BY: J. JOHNSON | |

NOT TO SCALE




TYPICAL EXISTING SECTION




TYPICAL EMBANKMENT SECTION PROPOSED

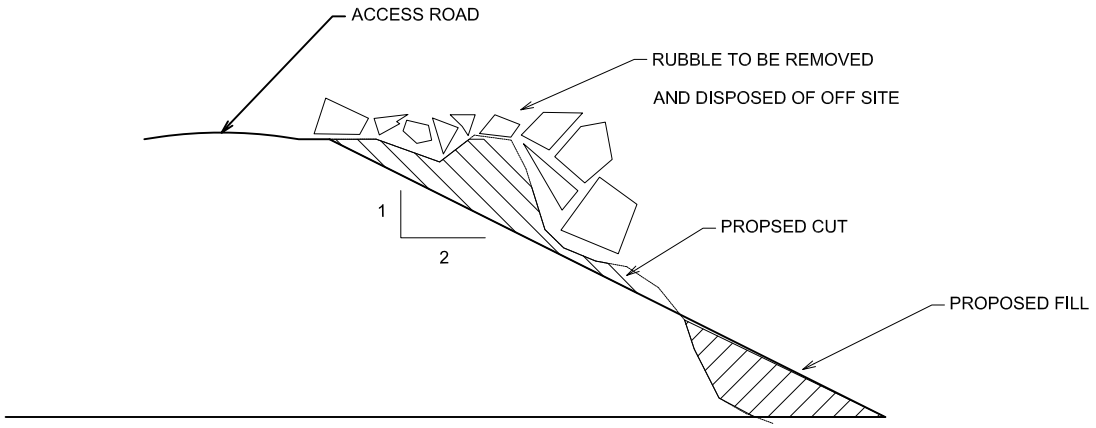
# Project Drawing #4

U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

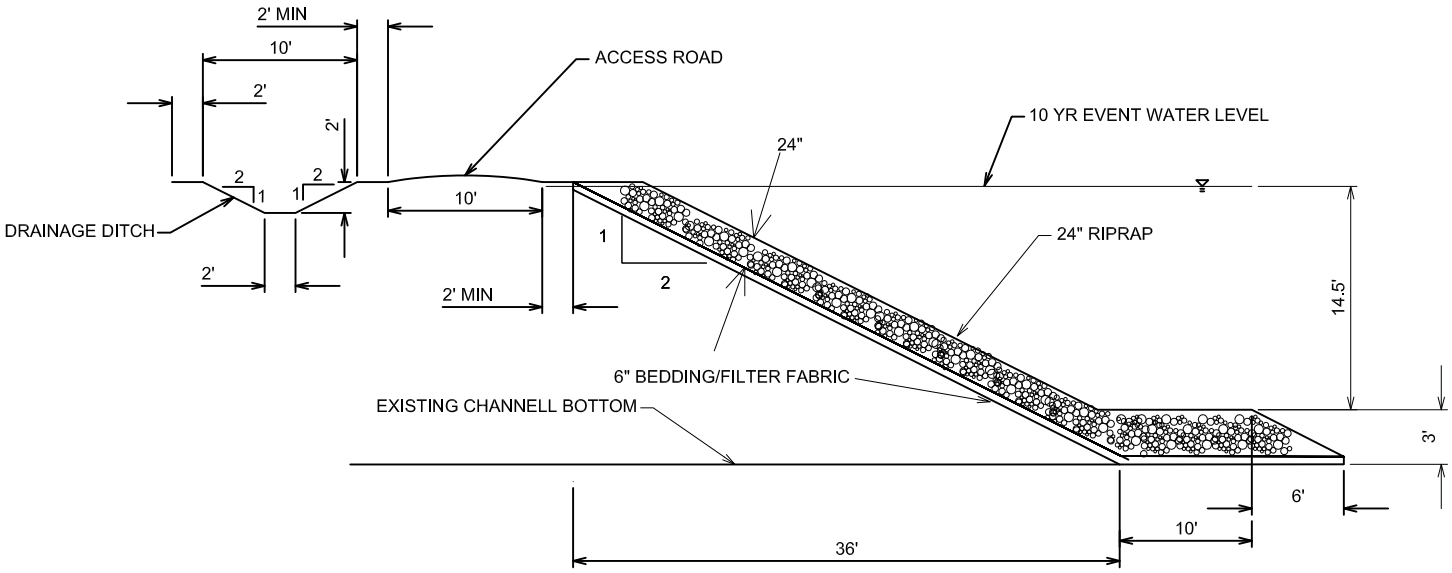
Luther Road - Section 14 Streambank Stabilization Project
ALTERNATIVE 2 - RIPRAP AT 2:1 SLOPE, 2 YR EVENT

| | |
|---|---|
| DESIGNER: LARGE | DATE: 6/2011 |
| REVIEWED BY: J. JOHNSON | |

NOT TO SCALE




TYPICAL EXISTING SECTION




TYPICAL EMBANKMENT SECTION PROPOSED

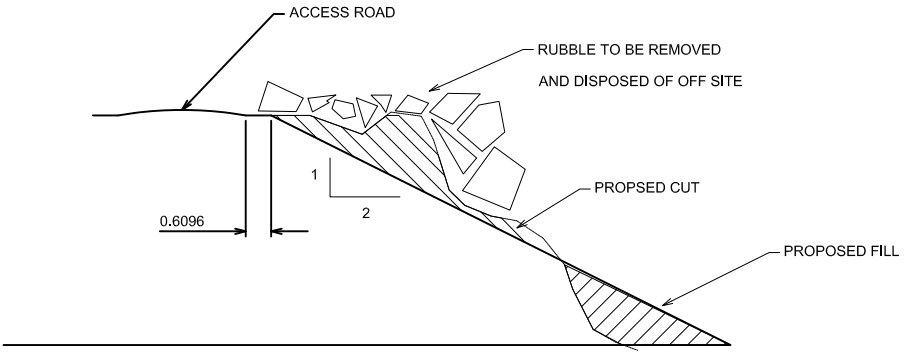
# Project Drawing #5

U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

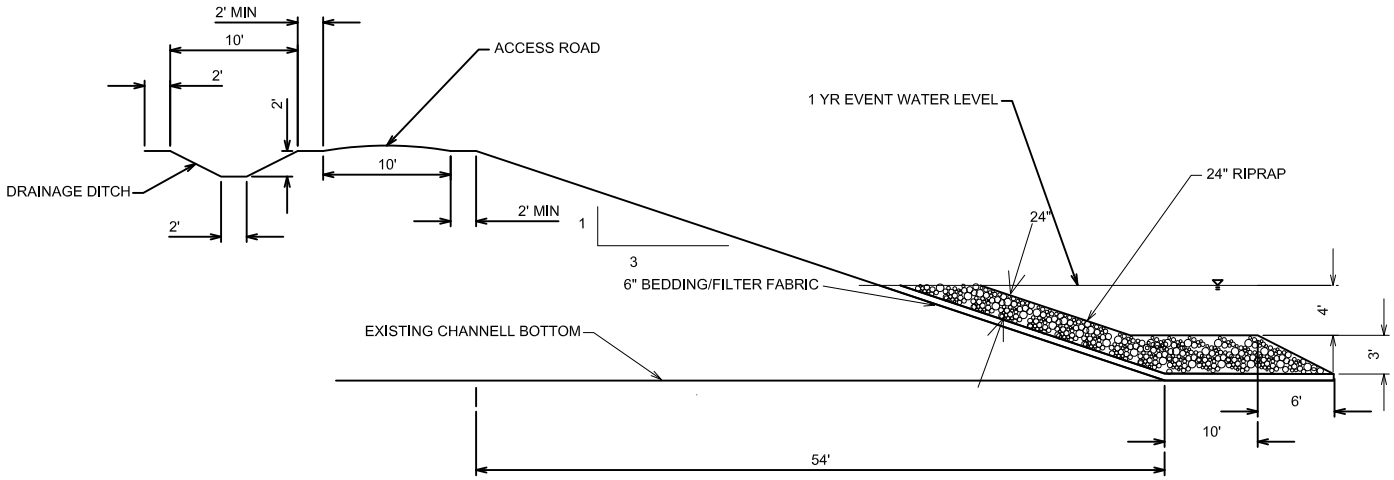
Luther Road - Section 14 Streambank Stabilization Project
ALTERNATIVE 3 - RIPRAP AT 2:1 SLOPE, 10 YR EVENT

| | |
|---|---|
| DESIGNER: LARGE | DATE: 6/2011 |
| REVIEWED BY: J. JOHNSON | |

NOT TO SCALE




TYPICAL EXISTING SECTION




TYPICAL EMBANKMENT SECTION PROPOSED

# Project Drawing #6

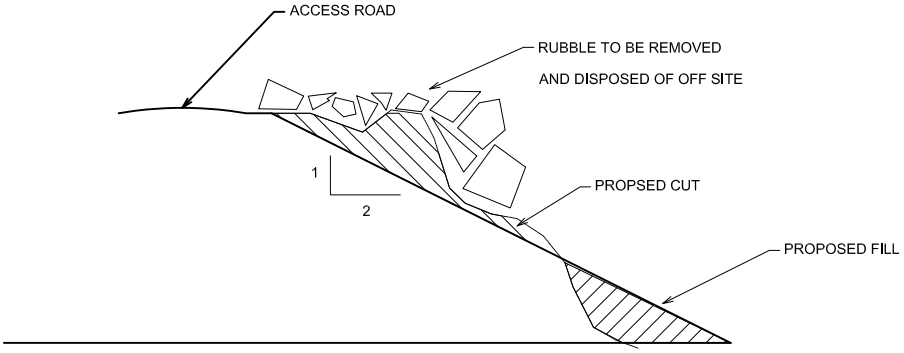
U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

Luther Road - Section 14 Streambank Stabilization Project
ALTERNATIVE 4 - RIPRAP AT 3:1 SLOPE, 1 YR EVENT

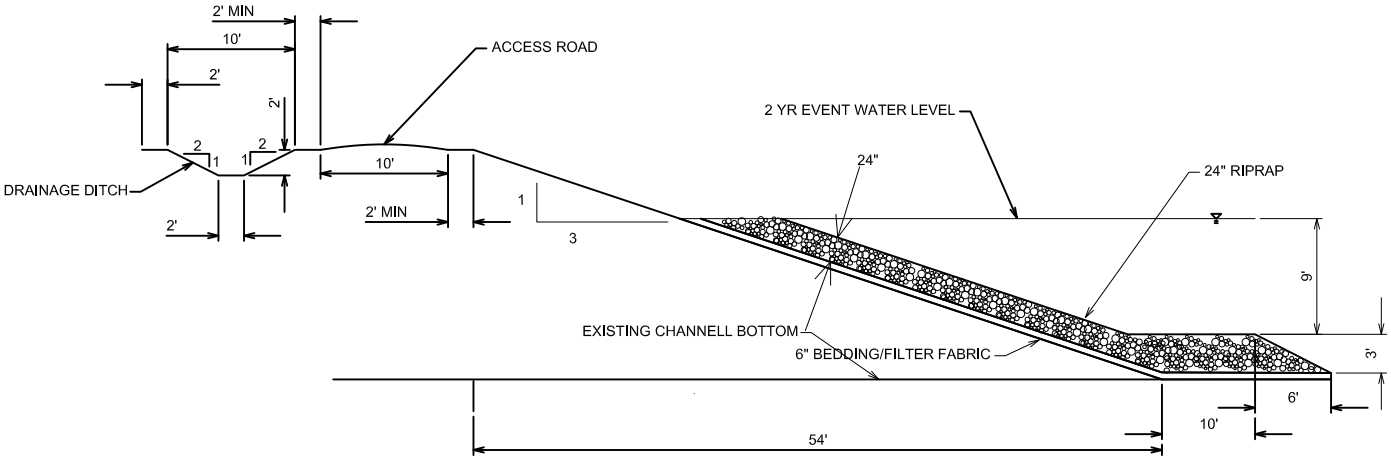
DESIGNER: LARGE | DATE: 6/2011

REVIEWED BY: J. JOHNSON

NOT TO SCALE




TYPICAL EXISTING SECTION




TYPICAL EMBANKMENT SECTION PROPOSED

# Project Drawing #7

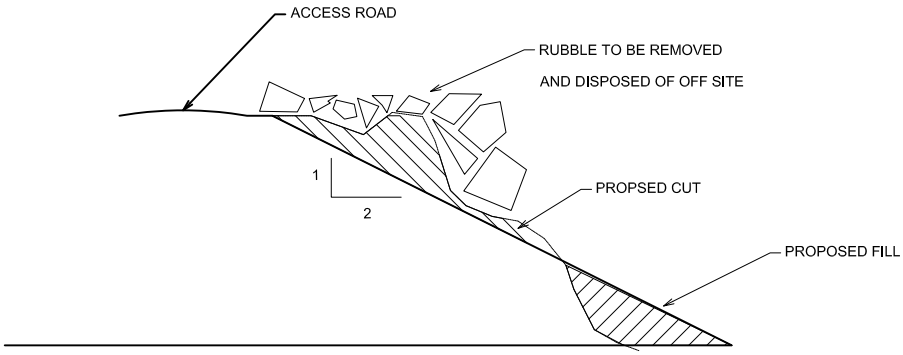
U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

Luther Road - Section 14 Streambank Stabilization Project
ALTERNATIVE 5 - RIPRAP AT 3:1 SLOPE, 2 YR EVENT

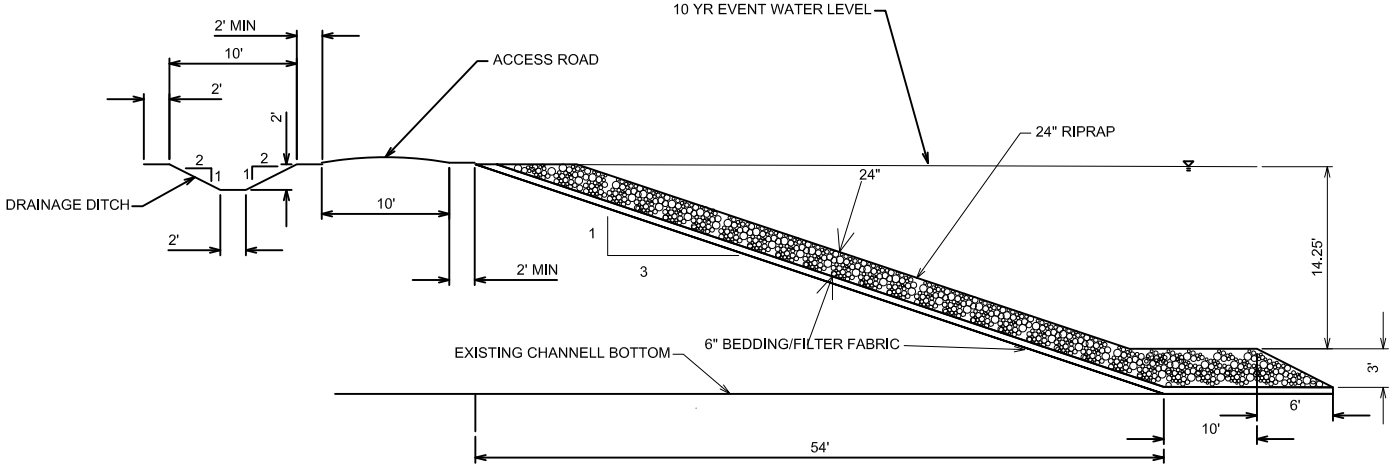
DESIGNER: LARGE | DATE: 6/2011

REVIEWED BY: J. JOHNSON

NOT TO SCALE




TYPICAL EXISTING SECTION




TYPICAL EMBANKMENT SECTION PROPOSED

# Project Drawing #8

U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT

Luther Road - Section 14 Streambank Stabilization Project
ALTERNATIVE 6 - RIPRAP AT 3:1 SLOPE, 10 YR EVENT

| | |
|---|---|
| DESIGNER: LARGE | DATE: 6/2011 |
| REVIEWED BY: J. JOHNSON | |

# APPENDIX EA-2

# Cost Estimate Report

Luther Road - Section 14 Bank Stabilization Project
Harrah, Oklahoma
Section 14 Streambank Stabilization Project for North Candian River

| | |
|---|---|
| Estimated by | Michael McGill |
| Designed by | |
| Prepared by | USACE Tulsa District |
| Preparation Date | 5/22/2012 |
| Effective Date of Pricing | 5/22/2012 |
| Estimated Construction Time | 300 Days |

This report is not copyrighted, but the information contained herein is For Official Use Only.

| Date | Author | Note |
|---|---|---|
| 5/24/2012 | Tom Skelton | 6/8/2011 - This project compares a number of alternative plans for bank stabilization along the North Canadian River near Luther road at Harrah, OK. The work includes removing existing bank protection consisting of masonary and concrete rubble, shaping the bank to either a 2h on 1v or a 3h on 1v slope and placing bedding and riprap along the slope. The various alternatives include the two different slopes, and bringing the rock protection to three different elevations along the bank. The closest rock quarry is about 60 miles away at the Anchor Stone Quapaw quarry near Drumright. It was assumed that this rock would meet COE specs, however this is not known at this time. The next closest quarries are Pawnee, 91 miles away, or Dolese's quarry at Davis, which is 97 miles away. The Dolese rock is known to meet specs. If the Anchor Stone riprap does not meet specs, the riprap cost would increase about $12 per ton due to the increased haul distance. The contracting method to be used is not known at this time. If it is issued as an 8A contract, it is likely the costs will increase 25 to 30 percent. |
| 5/24/2012 | Michael McGill | This is an updated IGE based on the original IGE performed by Tom Skelton during June of 2011. Updates were made based on the ATR comments submitted by the Walla Walla District. The majority of the updates include: Using the Civil Works Work Breakdown Template, adding in an 80% Productivity rate & a 10% Overtime rate. The HOOH for the Prime has been increased from 5% to 12%. A risk based analysis was performed to produce the proper Contingency of 19%. All of the slope excavation is assumed to be used as fill which would not require hauling. All of the bar ditch excavation has been assumed to be dumped and spread nearby which would not require hauling. Slightly different production rates, equipment and crews have been applied for each of the alternatives. It has been assumed that the 6" bedding material & placement as well as the 24" riprap material & placement will be subcontracted while all other items will be performed by the Prime Contractor. A mob/demob fee of approximately 5% of the contract cost has been added into each alternative. The control of water bid item has been increased to more closely match the anticipated costs of dewatering. |

| Description | UOM | Quantity | CostToPrime | PrimeCMU | ContractCost | Contingency | ProjectCost |
|---|---|---|---|---|---|---|---|
| **Project Owner Summary** | | | 7,362,850 | 3,112,609 | 10,475,458 | 1,999,765 | 12,475,224 |
| **Bank Stabilization** | LS | 1 | 7,362,850 | 3,112,609 | 10,475,458 | 1,999,765 | 12,475,224 |
| **Alternative 1 (RECOMMENDED) - Riprap @ 2:1 Slope,1 Year Event Level** | EA | 1 | 695,063 | 293,834 | 988,897 | 188,781 | 1,177,678 |
| **Bank Stabilization** | LS | 1 | 695,063 | 293,834 | 988,897 | 188,781 | 1,177,678 |
| **Bank Stabilization** | LS | 1 | 695,063 | 293,834 | 988,897 | 188,781 | 1,177,678 |
| **Mob, Demob & Preparatory Work** | LS | 1 | 32,400 | 13,697 | 46,097 | 8,800 | 54,897 |
| **Earthwork** | EA | 1 | 134,449 | 56,838 | 191,287 | 36,517 | 227,803 |
| **Riprap Slope Treatment** | LS | 1 | 528,214 | 223,300 | 751,514 | 143,464 | 894,978 |
| **Alternative 2 - Riprap @ 2:1 Slope, 2 Year Event Level** | EA | 1 | 1,035,255 | 437,649 | 1,472,904 | 281,177 | 1,754,082 |
| **Bank Stabilization** | LS | 1 | 1,035,255 | 437,649 | 1,472,904 | 281,177 | 1,754,082 |
| **Bank Stabilization** | LS | 1 | 1,035,255 | 437,649 | 1,472,904 | 281,177 | 1,754,082 |
| **Mob, Demob & Preparatory Work** | LS | 1 | 48,600 | 20,545 | 69,145 | 13,200 | 82,345 |
| **Earthwork** | EA | 1 | 134,449 | 56,838 | 191,287 | 36,517 | 227,803 |
| **Riprap Slope Treatment** | LS | 1 | 852,206 | 360,266 | 1,212,472 | 231,461 | 1,443,933 |
| **Alternative 3 - Riprap @ 2:1 Slope, 10 Year Event Level** | EA | 1 | 1,516,334 | 641,023 | 2,157,357 | 411,839 | 2,569,196 |
| **Bank Stabilization** | LS | 1 | 1,516,334 | 641,023 | 2,157,357 | 411,839 | 2,569,196 |
| **Bank Stabilization** | LS | 1 | 1,516,334 | 641,023 | 2,157,357 | 411,839 | 2,569,196 |
| **Mob, Demob & Preparatory Work** | LS | 1 | 69,120 | 29,220 | 98,340 | 18,773 | 117,113 |
| **Earthwork** | EA | 1 | 134,449 | 56,838 | 191,287 | 36,517 | 227,803 |
| **Riprap Slope Treatment** | LS | 1 | 1,312,765 | 554,965 | 1,867,730 | 356,550 | 2,224,280 |
| **Alternative 4 - Riprap @ 3:1 Slope, 1 Year Event Level** | EA | 1 | 927,712 | 392,186 | 1,319,898 | 251,969 | 1,571,866 |
| **Bank Stabilization** | LS | 1 | 927,712 | 392,186 | 1,319,898 | 251,969 | 1,571,866 |
| **Bank Stabilization** | LS | 1 | 927,712 | 392,186 | 1,319,898 | 251,969 | 1,571,866 |
| **Mob, Demob & Preparatory Work** | LS | 1 | 43,200 | 18,263 | 61,463 | 11,733 | 73,196 |
| **Earthwork** | EA | 1 | 210,349 | 88,924 | 299,273 | 57,131 | 356,404 |
| **Riprap Slope Treatment** | LS | 1 | 674,163 | 284,999 | 959,163 | 183,104 | 1,142,267 |
| **Alternative 5 - Riprap @ 3:1 Slope, 2 Year Event Level** | EA | 1 | 1,302,976 | 550,827 | 1,853,803 | 353,891 | 2,207,694 |
| **Bank Stabilization** | LS | 1 | 1,302,976 | 550,827 | 1,853,803 | 353,891 | 2,207,694 |
| **Bank Stabilization** | LS | 1 | 1,302,976 | 550,827 | 1,853,803 | 353,891 | 2,207,694 |
| **Mob, Demob & Preparatory Work** | LS | 1 | 59,400 | 25,111 | 84,511 | 16,133 | 100,644 |

| Description | UOM | Quantity | CostToPrime | PrimeCMU | ContractCost | Contingency | ProjectCost |
|---|---|---|---|---|---|---|---|
| **Earthwork** | **EA** | **1** | **210,349** | **88,924** | **299,273** | **57,131** | **356,404** |
| **Riprap Slope Treatment** | **LS** | **1** | **1,033,228** | **436,792** | **1,470,019** | **280,627** | **1,750,646** |
| **Alternative 6 - Riprap @ 3:1 Slope, 10 Year Event Level** | **EA** | **1** | **1,885,509** | **797,090** | **2,682,598** | **512,108** | **3,194,707** |
| **Bank Stabilization** | **LS** | **1** | **1,885,509** | **797,090** | **2,682,598** | **512,108** | **3,194,707** |
| **Bank Stabilization** | **LS** | **1** | **1,885,509** | **797,090** | **2,682,598** | **512,108** | **3,194,707** |
| **Mob, Demob & Preparatory Work** | **LS** | **1** | **83,700** | **35,384** | **119,084** | **22,733** | **141,817** |
| **Earthwork** | **EA** | **1** | **210,349** | **88,924** | **299,273** | **57,131** | **356,404** |
| **Riprap Slope Treatment** | **LS** | **1** | **1,591,460** | **672,782** | **2,264,242** | **432,244** | **2,696,486** |

Table of Contents

| Description | Page |
|---|---|
| **Project Notes** | **i** |
| **Project Owner Summary** | **1** |
| Bank Stabilization | 1 |
| Alternative 1 (RECOMMENDED) - Riprap @ 2:1 Slope,1 Year Event Level | 1 |
| Bank Stabilization | 1 |
| Bank Stabilization | 1 |
| Mob, Demob & Preparatory Work | 1 |
| Earthwork | 1 |
| Riprap Slope Treatment | 1 |
| Alternative 2 - Riprap @ 2:1 Slope, 2 Year Event Level | 1 |
| Bank Stabilization | 1 |
| Bank Stabilization | 1 |
| Mob, Demob & Preparatory Work | 1 |
| Earthwork | 1 |
| Riprap Slope Treatment | 1 |
| Alternative 3 - Riprap @ 2:1 Slope, 10 Year Event Level | 1 |
| Bank Stabilization | 1 |
| Bank Stabilization | 1 |
| Mob, Demob & Preparatory Work | 1 |
| Earthwork | 1 |
| Riprap Slope Treatment | 1 |
| Alternative 4 - Riprap @ 3:1 Slope, 1 Year Event Level | 1 |
| Bank Stabilization | 1 |
| Bank Stabilization | 1 |
| Mob, Demob & Preparatory Work | 1 |
| Earthwork | 1 |
| Riprap Slope Treatment | 1 |
| Alternative 5 - Riprap @ 3:1 Slope, 2 Year Event Level | 1 |
| Bank Stabilization | 1 |
| Bank Stabilization | 1 |
| Mob, Demob & Preparatory Work | 1 |
| Earthwork | 1 |
| Earthwork | 2 |
| Riprap Slope Treatment | 2 |
| Alternative 6 - Riprap @ 3:1 Slope, 10 Year Event Level | 2 |
| Bank Stabilization | 2 |
| Bank Stabilization | 2 |
| Mob, Demob & Preparatory Work | 2 |
| Earthwork | 2 |
| Riprap Slope Treatment | 2 |

# Contractor Markups Report

**[] Luther Road - Section 14 Bank Stabilization Project**

**C:\Users\m5ec5mjm\Desktop\Final Luther Road bank Stabilization IGE.mlp**

## Prime Contractor

| Markup | | Own Work | | Sub Work |
|---|---|---|---|---|
| JOOH [Running %] | | 15.00% | | 15.00% |
| HOOH [Running %] | | 12.00% | | 12.00% |
| Profit [Profit] | | 9.60% | | 9.60% |
| | **Desc** | **Value** | **Weight** | **Percentage** |
| | Risk | 0.09 | 20 | 1.80% |
| | Difficulty | 0.09 | 15 | 1.35% |
| | Size | 0.1 | 15 | 1.50% |
| | Period | 0.12 | 15 | 1.80% |
| | Invest (Contractor's) | 0.09 | 5 | 0.45% |
| | Assist (Assistance by) | 0.09 | 5 | 0.45% |
| | SubContracting | 0.09 | 25 | 2.25% |
| | | **Total** | 100 | 9.60% |
| Bond [Bond] | Class B 24 mo. | 0.79% | | 0.79% |

## Sub Contractor

| Markup | Own Work | Sub Work |
|---|---|---|
| Sub OH [Running %] | 15.00% | 15.00% |
| Sub Profit [Running %] | 10.00% | 10.00% |

# APPENDIX EA-3

# Bridge Plans

SUB: 11-4-80

| FED. ROAD DIST. NO. | PROJECT NO. | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|
| 6 | | 1 | |

# STATE OF OKLAHOMA
# DEPARTMENT OF TRANSPORTATION

## PLAN OF PROPOSED
# COUNTY HIGHWAY

**FEDERAL AID SECONDARY PROJECT NO. RS-5553(104)C**

**GRADING, DRAINAGE, SURFACING AND BRIDGE PLANS**

# OKLAHOMA COUNTY

**STATE JOB NO. 01372(04)**

### INDEX OF SHEETS


| SHEET NO. | TITLE |
|---|---|
| 1 | TITLE SHEET |
| 2 | TYPICAL SECTION & SUMMARY OF PAY QUANTITIES (ROADWAY) |
| 3 | SUMMARY OF QUANTITIES & GENERAL NOTES (BRIDGES) |
| 4 & 5 | PLAN & PROFILE SHEETS |
| 6 | STD. TCD-1-2 |
| 7 | STD. TCD-2-0 |
| 8 | STD. TCD-3-0 |
| 9 | STD. TCD-10-1 |
| 10 | STD. FM-3-2 |
| 11 | STD. RS-2-17 |
| 12 | STD. MD-2-25 |
| 13 | STD. GCN-2-21 |
| 14 | STD. PCES-1-3 |
| 15 | STD. GRH-1-5 |
| 16 | STD. GRAU-1-5 |
| 17 | STD. GRAU-2-0 |
| 18 | STD. SAAB-2-2 |
| 19 | GENERAL PLAN & ELEVATION & SUMMARY OF PAY QUANTITIES-STR. "A" |
| 20 | BRIDGE STAKING DIAGRAM-STR. "A" |
| 21 | ABUTMENT DETAILS-STR. "A" |
| 22 | PIER DETAILS-STR. "A" |
| 23 | GENERAL PLAN & ELEVATION & SUMMARY OF PAY QUANTITIES-STR. "B" |
| 24 | BRIDGE STAKING DIAGRAM-STR. "B" |
| 25 | ABUTMENT DETAILS-STR. "B" |
| 26 | PIER DETAILS-STR. "B" |
| 27-29 | SUPERSTRUCTURE DETAILS-STR. "B" |
| 30 | STD. P-1-14 |
| 31 | STD. DEB-5-3 |
| 32 | STD. PSAJ-17 |
| 33 | STD. PCB-32-1-8 |
| 34 | STD. PCB-32-2-5 |
| 35 | STD. PCB-32-3-5 |
| 36 | STD. PCB-32-4-5 |
| 37 | STD. PCB-32-5-3 |
| 38 | STD. PCB-32-6-3 |
| 39 | STD. AB-32-5 |
| 40 | STD. AB-32-6 |
| 41 | STD. AS-SW-4 |
| 42 | STD. DC-1-19 |
| 43 | STD. SSIF-1 |
| 44 | STD. SSG-1 |
| 45 | STD. SPI |
| 46 | STD. FHT-2 |
| 47-51 | CROSS SECTIONS |

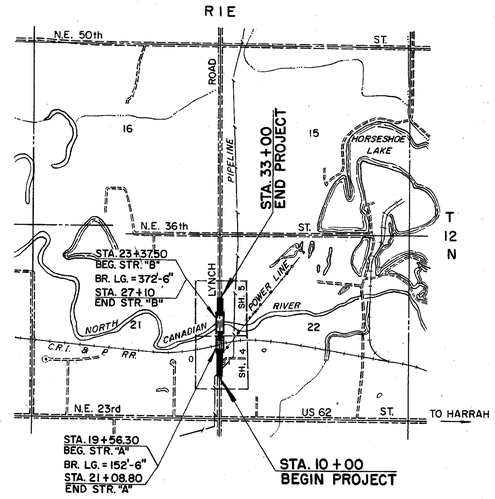

### DESIGN DATA

| | |
|---|---|
| ADT - 1980 | 625 |
| ADT - 2000 | 1,050 |
| V - | 40 MPH |

### SCALES

1"

| | | |
|---|---|---|
| PLAN | 1"= | 50' |
| PROFILE HOR. | 1"= | 50' |
| VER. | 1"= | 5' |
| LAYOUT MAP | 1"= | 2,000' |




| | | |
|---|---|---|
| ROADWAY LENGTH | 1,775.00 FT. | 0.336 MI. |
| BRIDGE LENGTH | 525.00 FT. | 0.099 MI. |
| PROJECT LENGTH | | 0.435 MI. |

EQUATIONS: NONE
EXCEPTIONS: NONE

Submitted By: RGDC INC.

Donald G. Douglas
Registered Professional Engineer No. 5625

REGISTERED PROFESSIONAL ENGINEER DONALD G. DOUGLAS 5625 OKLAHOMA

Approved By:
BOARD OF COUNTY COMMISSIONERS
OKLAHOMA COUNTY, OKLAHOMA

Chairman -

Member -

Member -

County Engineer -

County Clerk -

### CONVENTIONAL SIGNS

- PROPOSED ROAD
- RAILROADS
- RANGE & TOWNSHIP
- SECTION LINES
- QUARTER SECTION LINES
- FENCES
- GROUND LINE
- EXISTING ROADS
- BASE LINE
- GRADE LINES
- TELEPHONE & TELEGRAPH
- POWER LINES
- OIL WELLS
- BUILDINGS
- DRAINAGE STRUCTURES - IN PLACE
- DRAINAGE STRUCTURES - NEW
- RGHT-OF-WAY LINES - EXISTING
- RIWY — RIGHT-OF-WAY LINES - NEW
- RIGHT-OF-WAY MARKERS - IN PLACE
- RIGHT-OF-WAY MARKERS - REMOVE & RESET
- RIGHT-OF-WAY MARKERS - NEW
- CONTROLLED ACCESS
- RIGHT-OF-WAY FENCE

1976 OKLAHOMA STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION GOVERN, APPROVED BY THE DEPARTMENT OF TRANSPORTATION, FEDERAL HIGHWAY ADMINISTRATION, MAY 4, 1976.

P.E. NO.

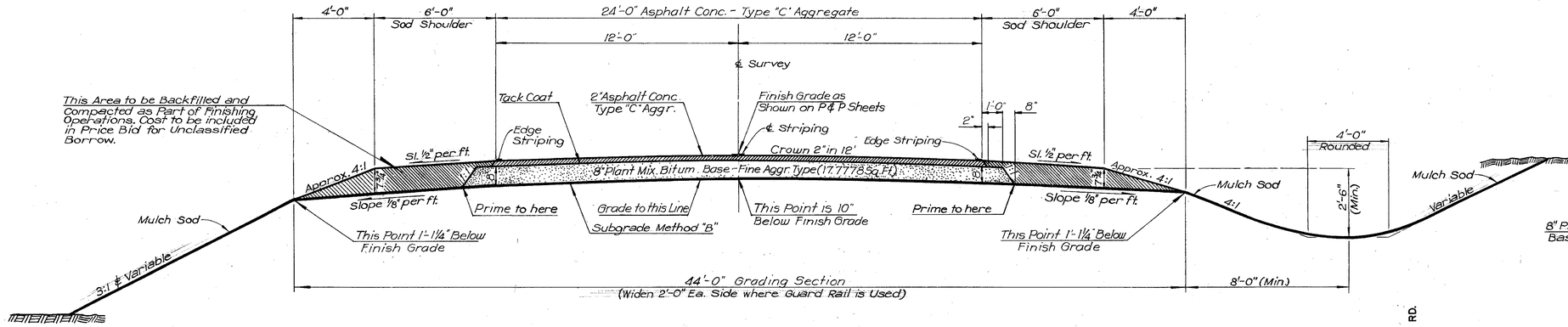
| OKLAHOMA DEPARTMENT OF TRANSPORTATION | DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION |
|---|---|
| DATE APPROVED 31 Oct. '80 | DATE APPROVED |
| BY Mark C Murphy | BY |
| ASST. DIRECTOR - PLANNING & RESEARCH | DIVISION ADMINISTRATOR |

SWO. F.A.S. Project No. RS-5553(104)C Sheet No. 1

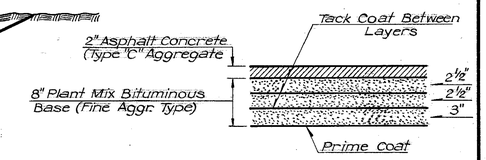
1976

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

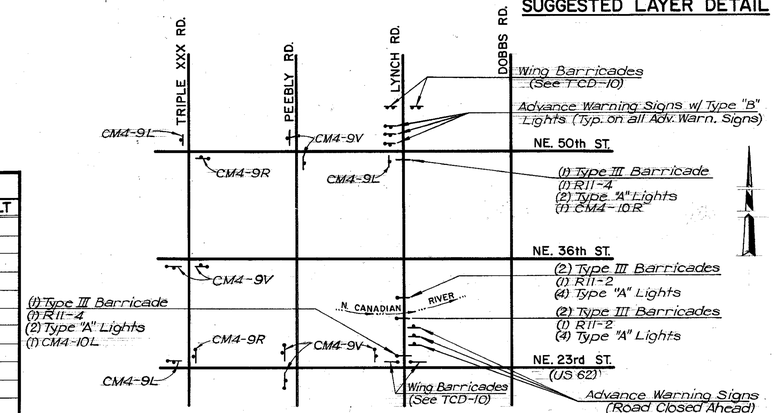
| REVISIONS | |
|---|---|
| DESCRIPTION | DATE |
| | |




## TYPICAL SECTION




## SUGGESTED LAYER DETAIL




## TYPICAL CONSTR. SIGN PLACEMENT

### GENERAL CONSTRUCTION NOTES

See Std. General Construction Notes, Sheet No. 13. Only the following notes apply: E-2, E-8, E-15 & E-24

### GENERAL NOTES

1. Thickness Dimensions are approximate. The tolerances of the governing specifications will control.
2. For details, see Std. FM-3-2.
3. Existing fences to be removed and reconstructed in a manner and at location approved by the Engineer. All cost for fence removal and reconstruction shall be included in the price bid for other items of work.

### TRAFFIC CONTROL PLAN

Road shall be closed during construction of this project. Traffic shall be detoured around the project by using existing roads. Detour shall begin at NE. 50th Street and Lynch Road; thence 2 miles West and 2 miles South to NE. 23rd Street; thence East 2 miles to NE. 23rd Street and Lynch Road and end of Detour. Alternate Detour shall begin at NE. 50th Street and Lynch Road; thence 2 miles East and 1¾ miles South to U.S. 62; thence West 2 miles on U.S. 62 to NE. 23rd Street and Lynch Road and end of Detour. All signing shall conform to the Manual on Uniform Traffic Control Devices and in a manner approved by the Engineer.

### PAY QUANTITIES - ROADWAY

| ITEM NO. | DESCRIPTION | | UNIT | QUANTITY | AS-BUILT |
|---|---|---|---|---|---|
| 202.06(C) | Unclassified Excavation | (9) | C.Y. | 2,522. | |
| 202.06(E) | Unclassified Borrow | (1) | C.Y. | 71,448. | |
| 229.06 | Ditch Liner Protection | | L.F. | 470. | |
| 230.06(B) | Mulch Sodding | (2) | S.Y. | 16,598. | |
| 310.06(B) | Subgrade Method B | | S.Y. | 7,700. | |
| 314.06(A) | Aggregates | (3) | TON | 1,741. | |
| 314.06(B) | Asphalt | (4) | TON | 102. | |
| 403.06(A) | Traf. Bound Surf. Cse., Type A | | TON | 65.5 | |
| 407.06 | Tack Coat | (5) | GAL. | 737. | |
| 408.06 | Prime Coat | (6) | GAL. | 1,389. | |
| 411.06(A-3) | Type C Aggregate | (7) | TON | 459. | |
| 411.06(B) | Asphalt | (8) | TON | 29. | |
| 414.06(A) | 8" Portland Cement Conc. Pav't. | | S.Y. | 40.9 | |
| 509.06(D) | Class "C" Conc. | | C.Y. | 12.56 | |
| 611.06(G) | Inlet Frame & Grate (SSF-1 frame, SSG-1 grate) | | EA. | 4. | |
| 613.06(B) | 24" R.C. Pipe, Class III | | L.F. | 264. | |
| 613.06(L) | 30" Round Pipe for Side Drain | | L.F. | 48. | |
| 613.06(L) | 29"x18" Arch Pipe for Side Drain | | L.F. | 148. | |
| 613.06(M) | 24" Round Prefab. Culv. End Section | | EA. | 4. | |
| 613.06(M) | 30" Round Prefab. Culv. End Section | | EA. | 4. | |
| 613.06(M) | 29"x18" Arch Prefab. Culv. End Section | | EA. | 10. | |
| 623.06(B) | Beam Type Guard Rail (Sgl.) | | L.F. | 237.5 | |
| 623.06(D) | Guard Rail Anchor Unit (Type "A") | (F-50) | EA. | 8. | |
| 623.06(D) | Guard Rail Anchor Unit (Type "D") | | EA. | 8. | |
| 640.06 | Field Office | | EA. | 1. | |
| 641.06 | Mobilization | | L. SUM | 1. | |
| 850.06(A) 850.06(C) | Sheet Metal Signs (Alum. or Galv. Steel) | (F-57) | S.F. | 16.64 | |
| 851.06(B) | 2" @ 3.65 Galv. Steel Pipe Posts | | L.F. | 64. | |
| 854.06 | Traffic Stripe (Paint) (White) | | L.F. | 4,600. | |
| 854.06 | Traffic Stripe (Paint) (Yellow) | | L.F. | 4,600. | |
| Special | Signs 0 to 6.25 S.F. | (F-57) | S.D. | 2,600. | |
| Special | Signs 6.26 to 15.99 S.F. | (F-57) | S.D. | 1,200. | |
| Special | Signs 16.0 and Over | (F-57) | S.D. | 2,000. | |
| Special | Barricades (Type I) | (F-57) | S.D. | 1,600. | |
| Special | Barricades (Type II) | (F-57) | S.D. | 200. | |
| Special | Barricades (Type III) | (F-57) | S.D. | 1,600. | |
| Special | Type A Light | (F-57) | S.D. | 5,000. | |
| Special | Type B Light | (F-57) | S.D. | 2,000. | |
| Special | Type C Light | (F-57) | S.D. | 1,600. | |
| Special | Drums | (F-57) | S.D. | 1,000. | |
| Special | Vertical Panels | (F-57) | S.D. | 600. | |
| Special | Wing Barricades | (F-57) | S.D. | 900. | |

(1) Includes 21,000 C.Y. for Ramps, Dikes & Miscellaneous Earthwork where no quantity is shown on P & P Sheets.
(2) Price Bid to include 1,660 Lbs. of Fertilizer (13-13-13). Est. at 100 Lbs. per 1,000 Sq. Yds. Price Bid to include 189 M. Gallons of Watering. Est. at 55 M. Gal. per Acre.
(3) Est. at 94.5% of Bit. Base } Bit. Base-Fine Aggr. Type Est. at 95 Lbs. per Sq. Yd. per 1" Thick
(4) Est. at 5.5% of Bit. Base
(5) Est. at 0.05 Gal. per Sq. Yd. prior to dilution.
(6) Est. at 0.25 Gal. per Sq. Yd.
(7) Est. at 94% of Asphalt Concrete } Asphalt Concrete Est. at 108 Lbs. per Sq. Yd. per 1" Thick
(8) Est. at 6% of Asphalt Concrete
(9) Removal of Existing Surface and Base to be included in the Price Bid of Unclassified Excavation.
(F-50) Includes cost of 8 Type 3 Delineators.
(F-51) Area of P.C. Conc. Paved Shldr. will be measured to the back of the variable Ht. Curb and the face of the Bridge Abutment Wing. Cost of the Var. Ht. Curb, Reinf. Steel and the Class "C" Conc. "Impact Slab" when used with Asphalt Pav't. shall be included in the Price Bid for 8" P.C. Conc. Paved Shldr. The Area of the "Slope Drain Inlet" will not be deducted from the area of the Paved Shoulder. (See Std. SAAB).
(F-52) Price Bid for "Inlet Frame and Grate" to include the cost of additional Conc., Frame & Grate, Reinf. Steel and all other incidentals necessary to construct the "Slope Drain Inlet" as shown on Std. SAAB.
(F-57) See Special Provisions.

### SUMMARY OF DRAINAGE STRUCTURES

| STR. NO. | P & P SHEET NO. | STATION | DESCRIPTION | STANDARD | DESIGN SHEET NO. | PIPE ARCH FOR SIDE DRAIN L.F 29"x18" | ROUND PIPE FOR SIDE DRAIN L.F 24" | ROUND PIPE FOR SIDE DRAIN L.F 30" | PREFAB. CULV. END SECTION ARCH EA. 29"x18" | PREFAB. CULV. END SECTION ROUND EA. 24" | PREFAB. CULV. END SECTION ROUND EA. 30" |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 4 | 10+15 | Constr. 29"x18" CGMPA Side Drain, Rt. | PCES-1-3 | 14 | 20 | | | 2 | | |
| 2 | 4 | 11+32 | Constr. 29"x18" CGMPA Side Drain, Lt. | PCES-1-3 | 14 | 20 | | | 2 | | |
| 3 | 4 | 13+42 | Constr. 29"x18" CGMPA Side Drain, Rt. | PCES-1-3 | 14 | 20 | | | 2 | | |
| 4 | 4 | 13+45 | Constr. 29"x18" CGMPA Side Drain, Lt. | PCES-1-3 | 14 | 20 | | | 2 | | |
| 5 | 4 | $20+18^{55}$ | Constr. 30" CGMP Side Drain, Lt. (10) | PCES-1-3 | 14 | | | 24 | | | 2 |
| 6 | 4 | $20+47^{64}$ | Constr. 30" CGMP Side Drain, Rt. (10) | PCES-1-3 | 14 | | | 24 | | | 2 |
| "A" | 4 | $20+32^{55}$ | Bridge | | | | | | | | |
| 7 | 5 | 22+10 | Constr. 24" RCP Side Drain, Lt. | PCES-1-3 | 14 | | 130 | | | 2 | |
| 8 | 5 | 22+23 | Constr. 24" RCP Side Drain, Rt. | PCES-1-3 | 14 | | 134 | | | 2 | |
| "B" | 5 | $25+23^{75}$ | Bridge | | | | | | | | |
| 9 | 5 | 28+14 | Constr. 29"x18" CGMPA Side Drain, Lt. | PCES-1-3 | 14 | 68 | | | 2 | | |
| | | | TOTAL | | | 148 | 264 | 48 | 10 | 4 | 4 |

(10) Str. No. 5 and 6 shall be constructed without interrupting Railroad Traffic and in a manner approved by the Engineer and Railroad Company.

### GUARD RAIL SCHEDULE

| LOCATION | UNIT | QUANTITY |
|---|---|---|
| Sta. 17+93.30 to Sta. 19+05.80, Rt. | L.F. | 112.5 |
| Sta. 17+93.30 to Sta. 19+05.80, Lt. | L.F. | 112.5 |
| Sta. 27+62.50 to Sta. 27+75, Rt. | L.F. | 12.5 |
| | | |
| | | |
| Total | | 237.5 |

### SUMMARY OF SIGNS

| STATION | TYPE OF SIGN | NO. OF SIGN | LEFT OR RIGHT | PROJ. OR SIDE ROAD | AREA OF SIGN | SIGN POSTS 2" |
|---|---|---|---|---|---|---|
| $19+43^{30}$ | Bridge End Marker | X-3 | Both | Proj. | 4.16 | 16. |
| $21+30^{90}$ | Bridge End Marker | X-3 | Both | Proj. | 4.16 | 16. |
| $23+22^{50}$ | Bridge End Marker | X-3 | Both | Proj. | 4.16 | 16. |
| 27+34 | Bridge End Marker | X-3 | Both | Proj. | 4.16 | 16. |
| | | | | | | |
| | TOTAL | | | | 16.64 | 64. |

| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

# TYPICAL SECTION & SUMMARY OF PAY QUANTITIES - ROADWAY

F.A.S. Project No. RS-5553(104)C Sheet No. 2

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

| REVISIONS | |
|---|---|
| DESCRIPTION | DATE |
| | |

# GENERAL NOTES

All construction and materials shall be in accordance with 1976 Oklahoma Standard Specification for Highway Construction and Special Provisions. (See Proposal for Special Provision).

All abutment piling shall be driven thru the compacted fill.

Steel Piling shall be driven to point bearing on solid foundation material at the approximate elevations shown on the plans. If practical refusal is not obtained at this elevation, driving shall continue until (100) tons bearing is obtained for 10" piling, (120) tons bearing is obtained for 12" piling.

The lengths of steel piling shown on the plans are for estimating purposes only.

ANCHOR BOLTS:

Anchor bolts shall be deformed reinforcing bars and shall be of sufficient size to produce a normal thread for size called for on the plans. Min. size of reinforcing bar shall be as follows: 3/4" Bolt - #7 Bar, 7/8" Bolt - #8 Bar, 1" Bolt - #9 Bar, 1 1/4" Bolt - #11 Bar.

If the contractor elects to place the anchor bolts after the concrete is poured, the setting of the anchor bolts shall be in accordance with the following procedure.

Holes of sufficient depth shall be pre-set at all anchor bolt locations. The material used to form holes shall not be oiled or greased and must be removed before the placing of the anchor bolts. Diameter of holes shall be 1 1/2" larger than the anchor bolts. Anchor bolts shall be set in melted sulphur or an approved embedding grout before bearing assemblies are set in place. The use of non-shrink grout will not be permitted.

Concrete surfaces under all beam supports (bearing assembly) shall be ground with a carborundum brick before placement of bearing assembly to secure full bearing of assembly on concrete.

The bridge deck waterproofing shall be placed as specified in the Special Provisions. The type selected shall be used on all bridges in this project.

USE OF MECHANICAL FINISHER:

Bridge decks for this project are to be finished with a mechanical type finishing machine. Overhanging slab forms will be required to be of sufficient strength to support the weight of the finishing machine. Prior to finishing operations, a proposal stipulating the type of finishing machine and the finishing procedure will be submitted to the Engineer. This proposal shall set forth any area in which a mechanical finisher cannot be used and the methods for finishing these areas.

No deck concrete shall be placed until this proposal is approved by the Bridge Engineer.

For Details of Piling see Std. P-1.
All concrete shall be poured in the dry.
All exposed edges shall have 3/4" chamfer unless otherwise shown or noted. All chamfer strips shall be sized lumber.
All reinforcing steel shall have 2" clearance unless otherwise shown or noted.
All reinforcing steel shall be deformed bars, cold bent with no welds.
Field welding of crossing reinforcing bars shall not be permitted.
Tack welding of reinforcing bars shall be prohibited in all cases.

Anchor plates for P.C. Beam bearing assembly shall be match-marked, shipped loose, and field welding to the encased sole plate in order that any necessary minor horizontal adjustment of the bearing pad location can be made. Metal used in field weld will not be measured for payment.

Allowance shall be made for temperature at time of setting of expansion anchor plates. Anchor plates shall be set with anchor bolts in center of slot for 60 degrees F. For each 100' of expansion to the bearing assembly, the anchor bolt shall be set 1/8" from centerline slot in the direction of the expansion for each 15 degrees the temperature is above 60 degrees F. or shall be set 1/8" from centerline slot in the direction of the contraction for each 15 degrees the temperature is below 60 degrees F.

Weight of bearing assembly (including plates, studs, anchor bolts, and shop welding) and diaphragm bolt assembly for prestressed girder bridges is included in the structural steel quantities. All cost of material, labor, equipment, and incidentals necessary to install diaphragm bolt and bearing assembly will be paid for at the unit price bid for structural steel. All cost of Elastomeric Bearing Pads will be included in the price bid for other items of work.

Guardrail connections (Std. Steel Bracket) shall be placed in the abutment wings at locations shown on the plans. Structural steel in guardrail connections (approx. 40 lbs. ea.) is included in the structural steel quantity. All cost of material, labor, and equipment necessary to install these connections will be paid for at the unit price bid for structural steel. For detail of Guardrail connection, see STD. GRH-1 and STD. GRAU-2.

Item "REMOVAL OF EXISTING BRIDGE STRUCTURE" consists of removal and disposal of the existing bridge in accordance with Section 619.04 (b)2 of the Specifications and in a manner approved by the Engineer. The existing bridge consists of the following:

a.) Span No.1, 2 & 3: 60'-90'-80' Steel Truss Spans with metal bridge deck and asphalt overlay and 15' Roadway.
b.) Span No.3 & 4: 2-30' Steel Beam Spans with metal bridge deck and asphalt overlay and 15' Roadway.
c.) Existing Abutments consist of Timber piles and Timber bulkheads.
d.) Pier No.1, 2 & 3 are concrete.
e.) Pier No.4 is a Timber pile bent.

The existing structure and material shall become the property of the Contractor.

PRESTRESSED CONCRETE BEAMS:

Chamfer all exposed edges of P.C. Beams 3/4" unless otherwise noted.

FORMS & PALLETS - All beams shall be cast in concrete floored pallets and metal forms.

FINISH - Top of beam to be rough floated. At approximately the time of initial set, entire top of beam shall be scrubbed transversely with coarse wire brush to remove all laitance and to produce a roughened surface for bonding slab.

CONCRETE - Concrete for Type IV Beams shall have a minimum strength of 6,000 psi at 28 days and concrete for Type II and III Beams shall have a minimum strength of 5,000 psi at 28 days. Where 6,000 psi concrete is specified for prestressed concrete beams, the contractor may increase the maximum cement requirements as specified in Section 503.02 of Oklahoma Standard Specifications for Highway Construction to 8 sacks per cubic yard.

CEMENT - Type I or III Portland Cement may be used for the Prestressed Concrete Beams.

CYLINDER STRENGTH - At transfer of the tensioning load, the cylinder strength of the concrete shall be at least 4,000 psi for 5,000 psi concrete and at least 4,800 psi for 6,000 psi concrete.

BRIDGE SEAT - Concrete surfaces under all beam supports (bearing assembly) shall be ground with a carborundum brick before placement of bearing assembly to secure full bearing of assembly on concrete.

HANDLING - In the handling of the beams, they must be maintained in an upright position at all times and must be picked up from the lifting eye provided at the beam ends. Disregard of this requirement may lead to collapse of the member.

STEEL - All strands shall be the size shown on the plans. Initial load per strand shall be 70 percent of the breaking strength of strand.

SPECIFICATIONS FOR STEEL STRANDS - Type 270 K, 7 wire, uncoated stress-relieved steel strand, shall conform to the requirements of ASTM Designation: A-416.

Initial load per strand shall be 28,910 lbs.

Stressed computed from elongation shall be based on the actual "E" given by test of the strands used.

SHOP DRAWING - PRESTRESSED CONCRETE BEAMS:

The contractor shall have his Prestressed Concrete Beam Fabricator furnish the Bridge Engineer, for his approval, two sets of checked shop drawings. One copy shall be returned to the fabricator approved or with any desired corrections indicated. The fabricator shall then furnish the Bridge Engineer with as many, generally five, corrected copies of the shop drawings as may be required for approval and distribution. The approval of the shop drawings in no way relieves the contractor or his fabricator of the responsibility for mistakes on the shop drawings.

Prestressed Beams shall be blocked or braced as they are set in place to assure lateral stability.

"Preformed Elastometric Compression Joint Sealer shall conform to the requirements as specified in Section 701.08(d) of the Oklahoma Standard Specifications." The dimensions and shapes shall be as shown on the plans or approved by the Bridge and Material Engineer, and shall be furnished full length with no splice permitted.

BASIS OF PAYMENT:

The joint seal shall be measured by the Linear Foot and payment will be made for joint seal in the completed structure at the price bid per linear foot for:

| | | |
|---|---|---|
| Special | 2 1/2" Joint Seal | Lin. Ft. |
| Special | 3 1/2" Joint Seal | Lin. Ft. |

The price bid shall be full compensation for furnishing all materials, including lubricant-adhesive, equipment, labor and incidentals required to install the joint seal complete in place.

Beams shall not be erected on pier caps until concrete in pier caps has been in place 10 days and meets the strength requirements of Subsection 701.01e.

## SUMMARY OF BRIDGE PAY QUANTITIES

DESCRIPTION: STRUCTURE "A" CENTER LINE STATION 20 + 32.55
45'-60'-45' PRESTRESSED CONCRETE BEAM SPANS
32'-0" CLEAR ROADWAY WITH 1'-4" BARRIER PARAPETS

BRID: X102

| ITEM NO. | ITEM | UNIT | TOTAL | AS-BUILT |
|---|---|---|---|---|
| 202.06 (E) | Unclassified Borrow | C.Y. | 70. | |
| 501.06 (B) | Substructure Excavation, Common | C.Y. | 80. | |
| 503.06 | Prestressed Concrete Beam (Type II) | L.F. | 353.4 | |
| 503.06 | Prestressed Concrete Beam (Type III) | L.F. | 236.7 | |
| 504.06 (A) | Class "AA" Concrete | C.Y. | 163.8 | |
| 506.06 (A) | Structural Steel | Lbs. | 4,660. | |
| 509.06 (B) | Class "A" Concrete | C.Y. | 135.8 | |
| 511.06 | Reinforcing Steel | Lbs. | 58,950 | |
| 514.06 (F) | Steel Piling Splices (HP 10 x 42) ① | Ea. | 14. | |
| 516.06 (A) Sp. | Drilled Shafts (48" Diameter) | L.F | 140. | |
| 516.06 (B) Sp. | Footing Bells | C.Y. | 11.4 | |
| 516.06 (D) Sp. | Obstructions | C.Y. | 10. | |
| 613.06 (D) | 12" Corr. Galv. Steel Pipe | L.F | 196. | |
| 613.06 (T) | Trench Excavation | C.Y. | 22. | |
| Special | 2½" Joint Seal | L.F. | 68. | |
| Special | Inlet and Basin | Ea. | 2. | |
| Special | 4" Concrete Slopewall | S.Y. | 428. | |
| | | | | |
| ALT. NO. 1 | | | | |
| 514.06 (E) | Steel Piling (HP 10 x 42) (Domestic) | L.F | 643. | |
| ALT. NO. 2 | | | | |
| 514.06 (E) | Steel Piling (HP 10 x 42) (Foreign) | L.F | 643. | |

① A Maximum of one pile splice will be allowed for each pile.

## SUMMARY OF BRIDGE PAY QUANTITIES

DESCRIPTION: STRUCTURE "B" CENTER LINE STATION 25 + 23.75
1-300' CONTINUOUS PRESTRESSED CONCRETE BEAM SPANS AND
1- 70' PRESTRESSED CONCRETE BEAM SPAN
32'-0" CLEAR ROADWAY WITH 1'-4" BARRIER PARAPETS

BRID: X002

| ITEM NO. | ITEM | UNIT | TOTAL | AS-BUILT |
|---|---|---|---|---|
| 202.06 (E) | Unclassified Borrow | C.Y. | 90. | |
| 501.06 (B) | Substructure Excavation, Common | C.Y. | 100. | |
| 503.06 | Prestressed Concrete Beam (Type III) | L.F. | 345.8 | |
| 503.06 | Prestressed Concrete Beam (Type IV) | L.F. | 1,486.3 | |
| 504.06 (A) | Class "AA" Concrete | C.Y. | 382.4 | |
| 506.06 (A) | Structural Steel | Lbs. | 10,810. | |
| * 509.06 (B) | Class "A" Concrete | C.Y. | 193.2 | |
| 511.06 | Reinforcing Steel | Lbs. | 141,860 | |
| 514.06 (F) | Steel Piling Splices (HP 10 x 42) ① | Ea. | 11. | |
| 514.06 (F) | Steel Piling Splices (HP 12 x 53) ① | Ea. | 7. | |
| 516.06 (A) Sp. | Drilled Shafts (60" Diameter) | L.F | 210. | |
| 516.06 (B) Sp. | Footing Bells | C.Y. | 31.8 | |
| 516.06 (C) Sp. | 60" Diameter, 16 Ga. Corr. Metal Pipe | L.F | 181.53 | |
| 516.06 (D) Sp. | Obstructions | C.Y. | 20. | |
| 601.06 (A-1) | Type I-A Plain Riprap | C.Y. | 1,520. | |
| 601.06 (A-2) | Type I-A Filter Blanket | C.Y. | 500. | |
| 613.06 (D) | 12" Corr. Galv. Steel Pipe | L.F. | 100. | |
| 613.06 (T) | Trench Excavation | C.Y. | 11. | |
| 619.06 (D) | Removal of Existing Bridge Structure | L.Sum | 1. | |
| Special | 2½" Joint Seal | L.F. | 34. | |
| Special | 3½" Joint Seal | L.F. | 34. | |
| Special | Inlet and Basin | Ea. | 2. | |
| | | | | |
| ALT. NO. 1 | | | | |
| 514.06 (E) | Steel Piling (HP 10 x 42) (Domestic) | L.F | 557. | |
| 514.06 (E) | Steel Piling (HP 12 x 53) (Domestic) | L.F | 399. | |
| ALT. NO. 2 | | | | |
| 514.06 (E) | Steel Piling (HP 10 x 42) (Foreign) | L.F | 557. | |
| 514.06 (E) | Steel Piling (HP 12 x 53) (Foreign) | L.F | 399. | |

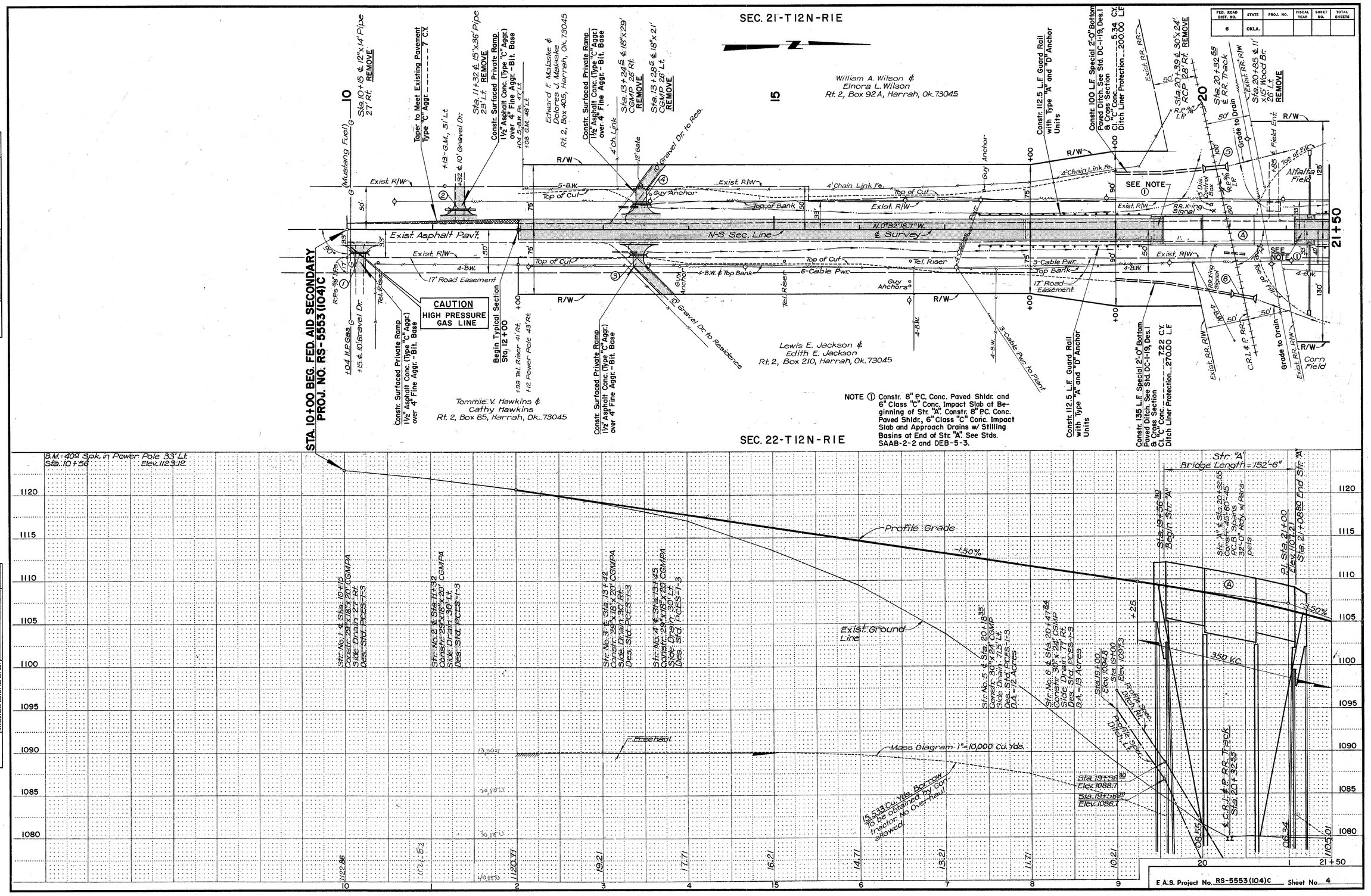
① A Maximum of one pile splice will be allowed for each pile.
* This quantity includes approximately 0.50 C.Y. of concrete for sign footings.

| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

SUMMARY OF PAY QUANTITIES
AND
GENERAL NOTES (BRIDGE)

F.A.S. Project No. RS-5553(104)C Sheet No. 3

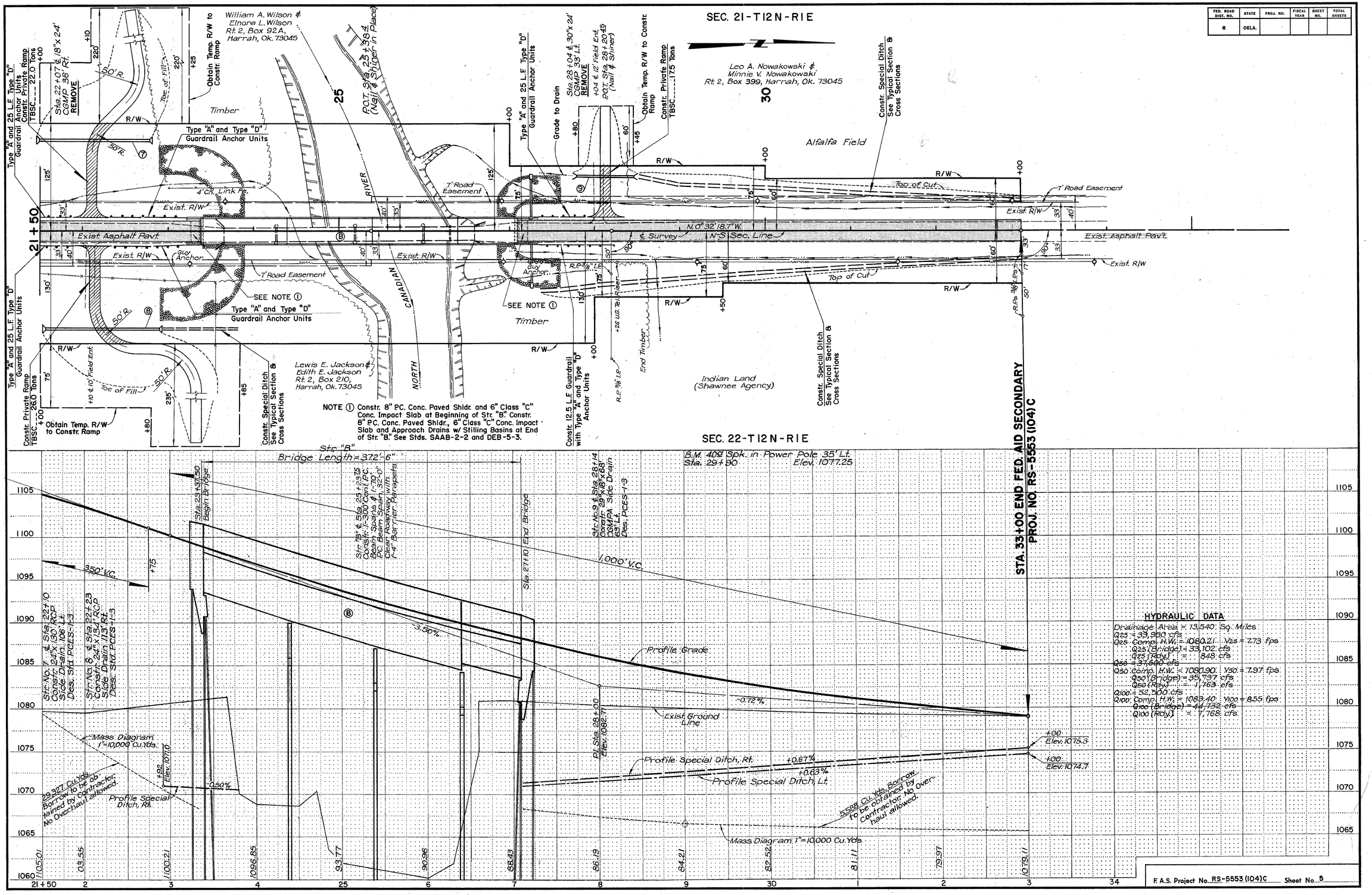
| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |




| PLAN | | BY | DATE |
|---|---|---|---|
| NOTE BOOK | SURVEYED | | |
| | PLOTTED | | |
| | ALIGNMENT CHECKED | | |
| NO. | RT. OF WAY CHECKED | | |

| PROFILE | | BY | DATE |
|---|---|---|---|
| NOTE BOOK | SURVEYED | | |
| | PLOTTED | | |
| | GRADES CHECKED | | |
| | B. M. & NOTED | | |
| NO. | STRUCTURE NOTATNS CH'KD. | | |

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |



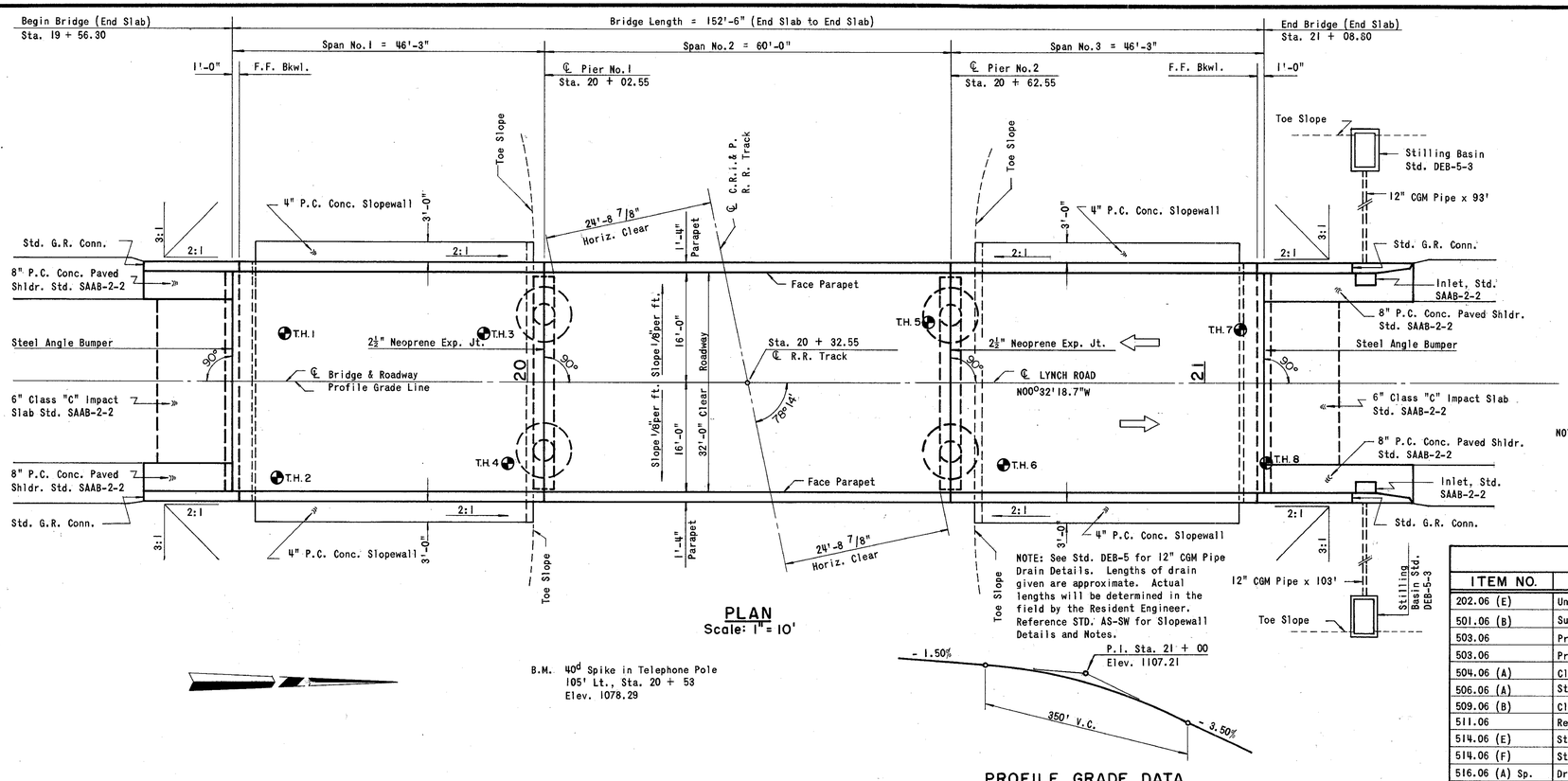

PLAN — SURVEYED, PLOTTED, ALIGNMENT CHECKED, RT. OF WAY CHECKED, NOTE BOOK, NO., BY, DATE

PROFILE — SURVEYED, PLOTTED, GRADES CHECKED, B. M. & NOTED, STRUCTURE NOTAT'NS CH'KED, NOTE BOOK, NO., BY, DATE

F.A.S. Project No. RS-5553 (104)C Sheet No. 5

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

| REVISIONS | |
|---|---|
| DESCRIPTION | DATE |
| | |

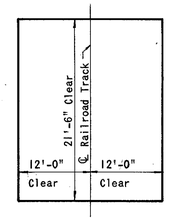



## PLAN
Scale: 1" = 10'

B.M. 40d Spike in Telephone Pole
105' Lt., Sta. 20 + 53
Elev. 1078.29




## PROFILE GRADE DATA




## RAILROAD CLEARANCE DIAGRAM

NOTE: Falsework clearance required by railway for operation during construction. Dimensions are at right angle to track.

## DESIGN DATA

DESIGN: AASHO SPECIFICATIONS, 1973 EDITION

LIVE LOAD: HS20-44 WITH 20 PSF FOR FUTURE WEARING SURFACE.

STRUCTURAL STEEL: 20,000 PSI

REINFORCING STEEL: 20,000 PSI

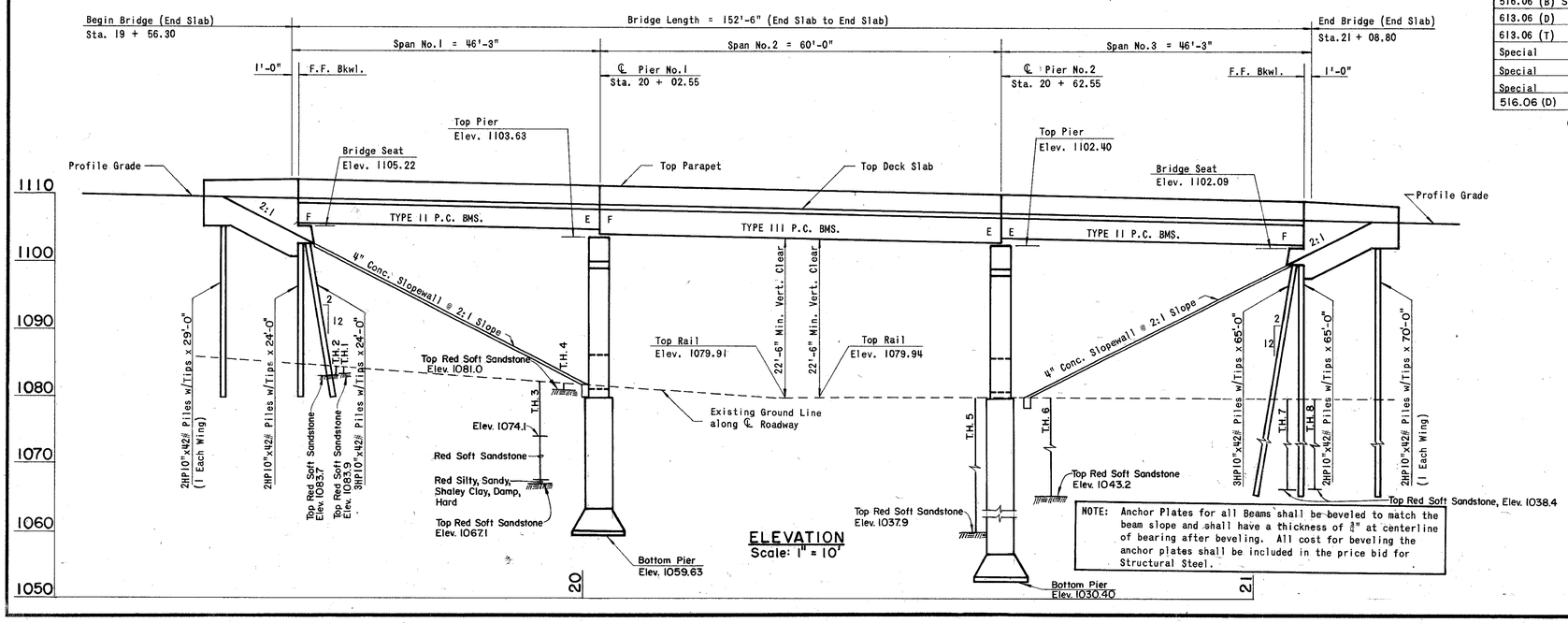
CONCRETE:
- CLASS "A" 1,000 PSI
- CLASS "AA" 1,200 PSI

MAXIMUM FOUNDATION LOADS:
- ABUTMENTS 35.9 TONS/PILE
- PIERS
  - DIRECT 4.8 TONS/S.F.

## SUMMARY OF QUANTITIES

| ITEM NO. | ITEM | UNIT | ABUTS. | PIERS | SUPSTR | TOTAL |
|---|---|---|---|---|---|---|
| 202.06 (E) | Unclassified Borrow | C.Y. | 70. | | | 70. |
| 501.06 (B) | Substructure Excavation, Common | C.Y. | 80. | | | 80. |
| 503.06 | Prestressed Concrete Beam (Type II) | L.F. | | | 353.4 | 353.4 |
| 503.06 | Prestressed Concrete Beam (Type III) | L.F. | | | 236.7 | 236.7 |
| 504.06 (A) | Class "AA" Concrete | C.Y. | | | 163.8 | 163.8 |
| 506.06 (A) | Structural Steel | Lbs. | 160. | | 4,500. | 4,660. |
| 509.06 (B) | Class "A" Concrete | C.Y. | 61.3 | 74.5 | | 135.8 |
| 511.06 | Reinforcing Steel | Lbs. | 7,230. | 12,970 | 38,750. | 58,950 |
| 514.06 (E) | Steel Piling (HP10"x42#) | L.F. | 643. | | | 643. |
| 514.06 (F) | Steel Piling Splices (HP10"x42#) ① | Ea. | 14. | | | 14. |
| 516.06 (A) Sp. | Drilled Shafts (48" Diameter) | L.F. | | 140. | | 140. |
| 516.06 (B) Sp. | Footing Bells | C.Y. | | 11.4 | | 11.4 |
| 613.06 (D) | 12" Corr. Galv. Steel Pipe | L.F. | | | | 196. |
| 613.06 (T) | Trench Excavation | C.Y. | | | | 22. |
| Special | 2½" Joint Seal | L.F. | | | 68. | 68. |
| Special | Inlet and Basin | Ea. | | | | 2. |
| Special | 4" Concrete Slopewall | S.Y. | | | | 428. |
| 516.06 (D) | Obstructions | C.Y. | | 10. | | 10.0 |

① A maximum of one pile splice will be allowed for each pile.




NOTE: Anchor Plates for all Beams shall be beveled to match the beam slope and shall have a thickness of ⅜" at centerline of bearing after beveling. All cost for beveling the anchor plates shall be included in the price bid for Structural Steel.

## ELEVATION
Scale: 1" = 10'

## INDEX OF SHEETS


| SHEET NO. | TITLE |
|---|---|
| 19 | GENERAL PLAN AND ELEVATION AND SUMMARY OF QUANTITIES |
| 20 | BRIDGE STAKING DIAGRAM |
| 21 | ABUTMENT DETAILS |
| 22 | PIER DETAILS |
| 30 | STD. P-1-14 |
| 31 | STD. DEB-5-3 |
| 15 | STD. GRH-1-5 |
| 16 | STD. GRAU-1-5 |
| 17 | STD. GRAU-2-0 |
| 32 | STD. PSAJ-17 |
| 18 | STD. SAAB-2-2 |
| 33 | STD. PCB-32-1-8 |
| 34 | STD. PCB-32-2-5 |
| 35 | STD. PCB-32-3-5 |
| 40 | STD. AB-32 |
| 41 | STD. AS-SW-4 |


LYNCH ROAD OVER C.R.I.&P. RAILROAD
45'-60'-45' PRESTRESSED CONCRETE BEAM SPANS
32'-0" CLEAR ROADWAY WITH 1'-4" BARRIER PARAPETS

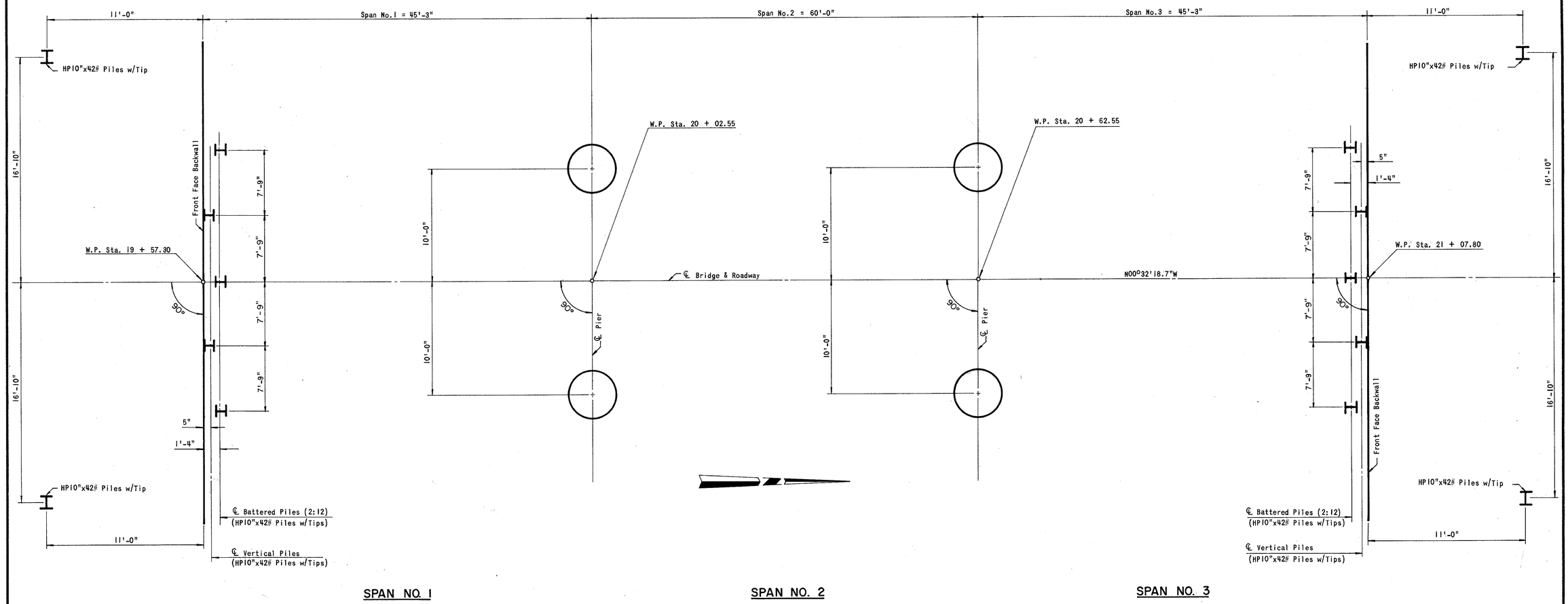
| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

# STRUCTURE "A" ℄ STA. 20+32.55
# GENERAL PLAN AND ELEVATION AND SUMMARY OF QUANTITIES

F.A.S. Project No. RS-5553(104)C Sheet No. 19

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

| REVISIONS | |
|---|---|
| DESCRIPTION | DATE |
| | |



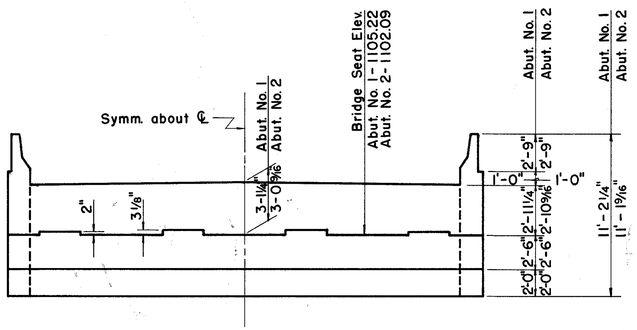

| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

STRUCTURE "A"
BRIDGE STAKING DIAGRAM

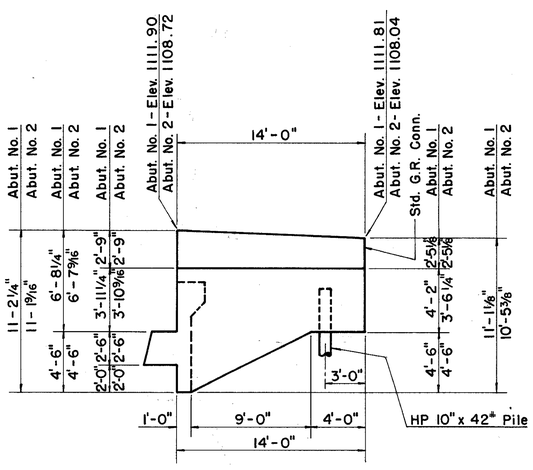
F.A.S. Project No. RS-5553(104)C Sheet No. 20

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

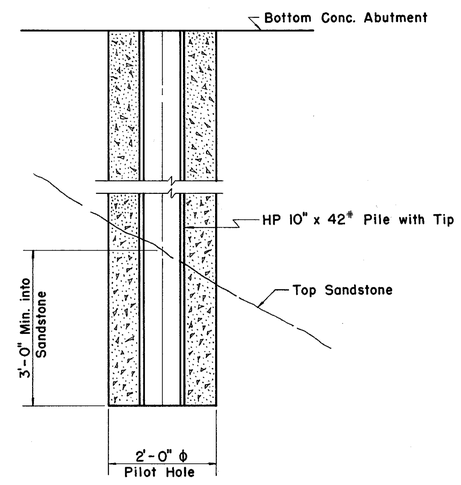
| REVISIONS | |
|---|---|
| DESCRIPTION | DATE |
| | |




ELEVATION




WING ELEVATION




PILE DETAIL
ABUTMENT NO. 1 ONLY

NOTE: Contractor shall drill a 24" ϕ Pilot Hole for each pile of Abutment No.1. Pilot Hole shall be drilled 3'-0" Minimum into Sandstone. Pilot Hole shall be backfilled with concrete after piles have been placed. All cost for drilling Pilot Holes and concrete backfill shall be included in the price bid for other items of work.

## BAR LIST (ONE ABUTMENT)

| ABUT. | MARK | NO. | SIZE | FORM | LENGTH | REMARKS |
|---|---|---|---|---|---|---|
| | B1 | 10 | #9 | Str. | 35'-0" | |
| | B2 | 15 | #4 | Str. | 2'-10" | |
| | BH1 | 16 | #4 | Str. | 35'-0" | |
| 1 | BV1 | 33 | #4 | Str. | 7'-2" Avg. | (7-1 to 7-3) |
| 2 | BV1 | 33 | #4 | Str. | 7'-1" Avg. | (7-0 to 7-2) |
| 1 | BV2 | 33 | #5 | Str. | 7'-2" Avg. | (7-1 to 7-3) |
| 2 | BV2 | 33 | #5 | Str. | 7'-1" Avg. | (7-0 to 7-2) |
| | P1 | 12 | #4 | Bnt. | 6'-8" | |
| | P2 | 16 | #4 | Bnt. | 5'-8" | |
| | PH1 | 12 | #4 | Str. | 13'-8" | |
| | PR1 | 30 | #5 | Bnt. | 3'-6" | |
| | PR3 | 30 | #5 | Bnt. | 4'-8" Avg. | (4-6 to 4-10) |
| | PR4 | 30 | #5 | Str. | 3'-0" | |
| | S | 36 | #4 | Bnt. | 10'-11" | |
| | SB | 33 | #4 | Bnt. | 5'-9" | |
| 1 | WH1 | 16 | #4 | Str. | 13'-8" | 4 Ea. Face @ 12"c/c |
| 2 | WH1 | 16 | #4 | Str. | 13'-8" | 4 Ea. Face @ 12"c/c |
| | WH2 | 12 | #6 | Str. | 8'-2" Avg. | (6-0 to 10-4) |
| | WH3 | 4 | #6 | Bnt. | 13'-10" | |
| | WH4 | 4 | #6 | Bnt. | 3'-10" | |
| | WH5 | 4 | #6 | Bnt. | 3'-9" | |
| | WT | 8 | #4 | Bnt. | 4'-0" | |
| 1 | WV1 | 8 | #4 | Str. | 8'-1" | |
| 2 | WV1 | 8 | #4 | Str. | 8'-0" | |
| 1 | WV2 | 32 | #4 | Str. | 6'-0" Avg. | (4-4 to 7-8) |
| 2 | WV2 | 32 | #4 | Str. | 5'-8" Avg. | (3-9 to 7-7) |
| 1 | WV3 | 20 | #4 | Str. | 3'-10" | |
| 2 | WV3 | 20 | #4 | Str. | 3'-2" | |

NOTE: Reference STD. AB-32 for Abutment Details, Notes, Bar Bends and Excavation Diagram not shown on this Sheet.

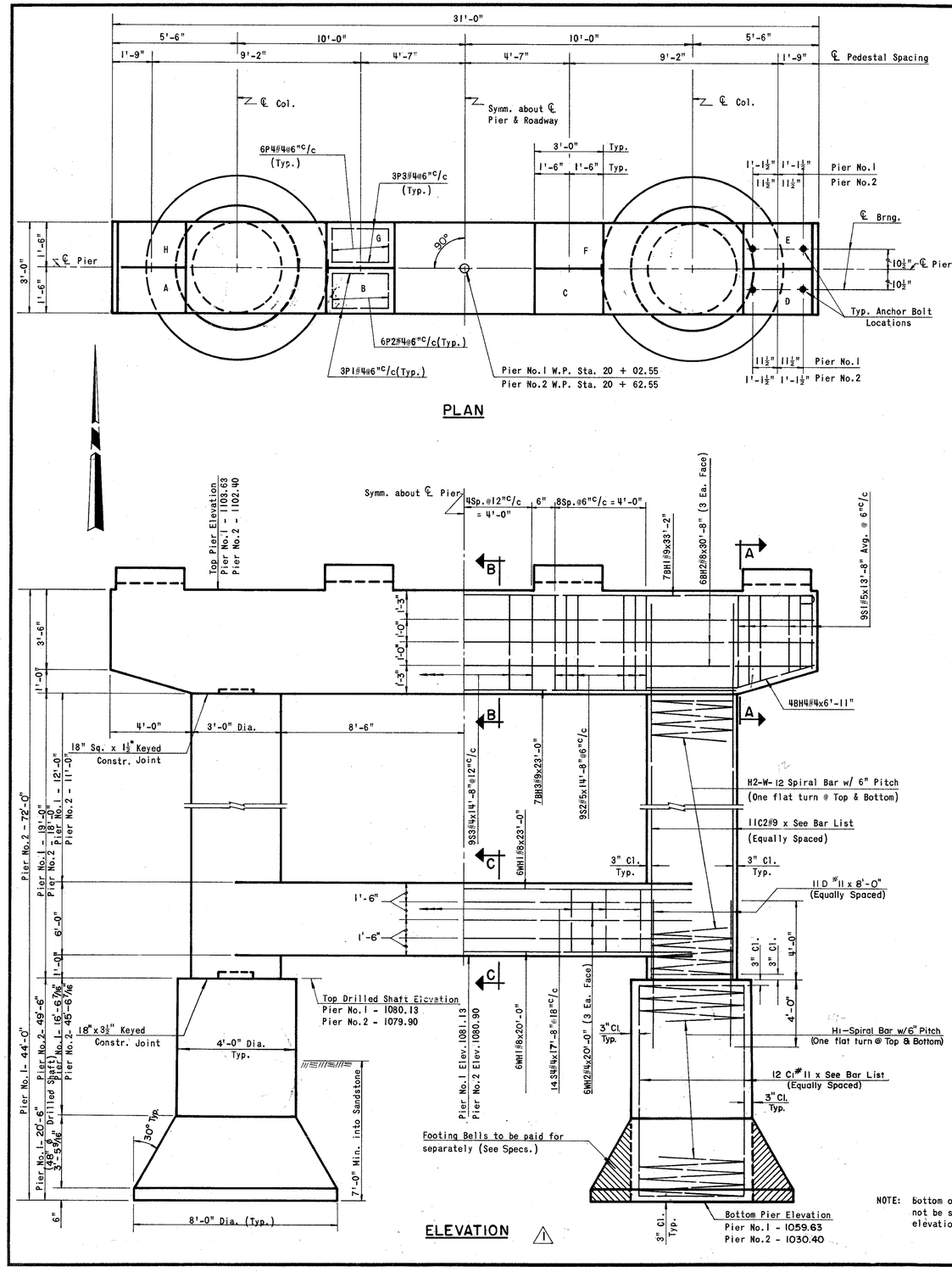
## QUANTITIES

| ITEM | UNIT | ABUT. NO. 1 | ABUT. NO. 2 |
|---|---|---|---|
| Unclassified Borrow | C.Y. | 35. | 35. |
| Substructure Excavation, Common | C.Y. | 40. | 40. |
| Structural Steel | Lbs. | 80. | 80. |
| Class "A" Concrete | C.Y. | 31.0 | 30.3 |
| Reinforcing Steel | Lbs. | 3,630. | 3,600. |
| Steel Piling (HP10"x42#) with Tips | L.F. | 178. | 465. |
| Steel Piling Splices (HP10"x42#) | Ea. | 7. | 7. |

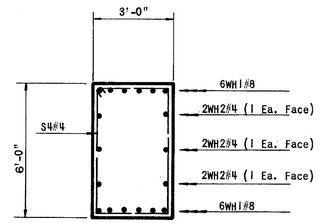
| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

STRUCTURE "A"
ABUTMENT DETAILS

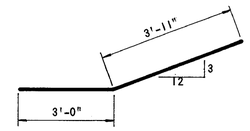
F.A.S. Project No. RS-5553(104)C Sheet No. 21



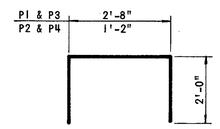

NOTE: Bottom of Piers shall not be set above elevations shown.



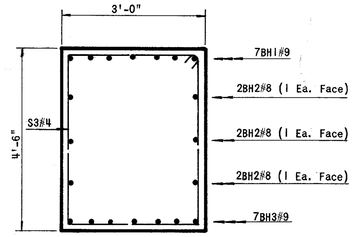

SECTION C-C



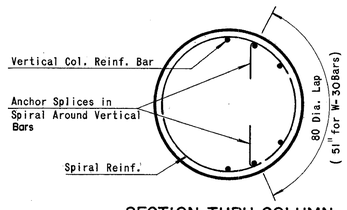

BH4 #4 x 6'-11"




P1 #4 x 6'-8"
P2 #4 x 5'-2"
P3 #4 x 6'-8"
P4 #4 x 5'-2"

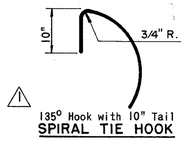



SECTION B-B



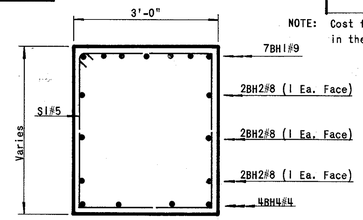

SECTION THRU COLUMN

(Showing Spiral Splice)

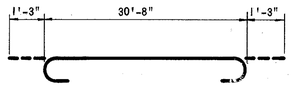



SPIRAL TIE HOOK

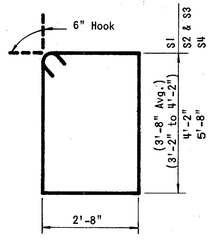
NOTE: Anchor spiral at top and bottom with one flat turn and hook.




SECTION A-A




BH1 #9 x 33'-2"




S1 #5 x 13'-8" Avg.
S2 #5 x 14'-8"
S3 #4 x 14'-8"
S4 #4 x 17'-8"

PIER NOTES

All exposed edges shall have 1½" chamfer unless otherwise shown or noted.
All pedestals shall have ¾" chamfer.
All chamfer strips shall be sized lumber.
All concrete shall be poured in the dry.
For Anchor Bolt detail and note, see Sheet No. 35.
All bar bends are out to out.
Bell footings shall not be set above elevation shown.
All reinforcing steel shall have 2" clearance unless otherwise shown or noted.
Any variation in the bell footing elevation greater than 1'-0" shall be approved by the Engineer prior to pouring the drilled shaft.
Bearing area of concrete under all bearing pads shall be ground with a carborundum brick before placing pads to secure full bearing on concrete.
For Staking Diagram, see Sheet No. 20.
For Additional General Notes, see Sheet No. 3.

## PEDESTAL HEIGHTS

| PEDESTAL | PIER 1 | PIER 2 |
|---|---|---|
| A | 11 11/16" | 2" |
| B | 1'-0 13/16" | 3 1/8" |
| C | 1'-0 13/16" | 3 1/8" |
| D | 11 11/16" | 2" |
| E | 2" | 10¾" |
| F | 3 1/8" | 11⅞" |
| G | 3 1/8" | 11⅞" |
| H | 2" | 10¾" |
| | | |
| | | |

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

REVISIONS

| DESCRIPTION | DATE |
|---|---|
| 1 W-BAR SIZE | 11-7-80 |
| 2 W-BAR SIZE | 6-19-81 |

## 2 BAR LIST (ONE ABUTMENT)

| PIER NO. | MARK | NO. | SIZE | FORM | LENGTH |
|---|---|---|---|---|---|
| | BH1 | 7 | #9 | Bnt. | 33'- 2" |
| | BH2 | 6 | #8 | Str. | 30'- 8" |
| | BH3 | 7 | #9 | Str. | 23'- 0" |
| | BH4 | 8 | #4 | Bnt. | 6'-11" |
| 1 | C1 | 24 | #11 | Str. | 20'- 1" |
| 2 | C1 | 24 | #11 | Str. | 49'- 1" |
| 1 | C2 | 22 | #9 | Str. | 23'- 0" |
| 2 | C2 | 22 | #9 | Str. | 22'- 0" |
| 1 | H1 | 2 | W-12 | Bnt. | 462'-4" |
| 2 | H1 | 2 | W-20 | Bnt. | 1,100'-9" |
| 1 | H2 | 2 | W-12 | Bnt. | 308'-0" |
| 2 | H2 | 2 | W-12 | Bnt. | 292'-6" |
| | P1 | 12 | #4 | Bnt. | 6'- 8" |
| | P2 | 24 | #4 | Bnt. | 5'- 2" |
| | P3 | 12 | #4 | Bnt. | 6'- 8" |
| | P4 | 24 | #4 | Bnt. | 5'- 2" |
| | S1 | 18 | #5 | Bnt. | 13'- 8" Avg. |
| | S2 | 18 | #5 | Bnt. | 14'- 8" |
| | S3 | 9 | #4 | Bnt. | 14'- 8" |
| | S4 | 14 | #4 | Bnt. | 17'- 8" |
| | WH1 | 12 | #8 | Str. | 20'- 0" |
| | WH2 | 6 | #4 | Str. | 20'- 0" |
| | D | 22 | #11 | Str. | 8'- 0" |
| | | | | | |
| | | | | | |
| | | | | | |

NOTE: Cost for C1 and H1 Reinforcing Bars to be included in the price bid for 48" ø Drilled Shaft.

NOTE: Quantities shown for H1 and H2 bars do not include lap.

6550 4460

## QUANTITIES

| ITEM | UNIT | PIER 1 | PIER 2 |
|---|---|---|---|
| Class "A" Concrete | C.Y. | 37.5 | 37.0 |
| Reinforcing Steel | Lbs. | 6,530 | 6,440 |
| Footing Bells | C.Y. | 5.7 | 5.7 |
| 48" ø Drilled Shaft | L.F. | 41.0 | 99. |
| | | | |
| | | | |

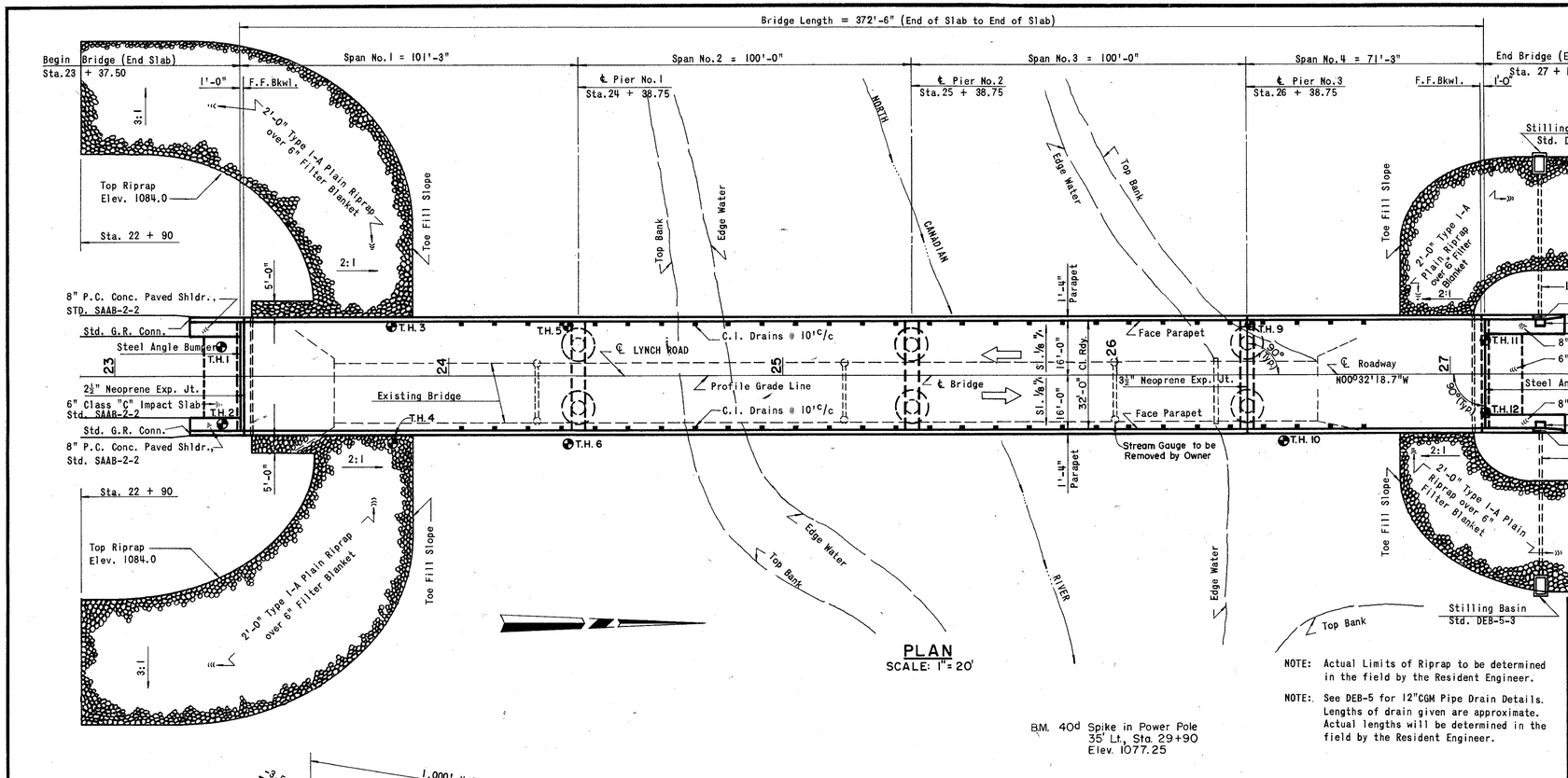
| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

# STRUCTURE "A" PIER DETAILS

F.A.S. Project No. RS-5553 (104) C Sheet No. 22

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

| REVISIONS | |
|---|---|
| DESCRIPTION | DATE |
| | |

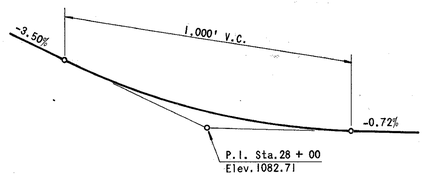



## PLAN
SCALE: 1" = 20'

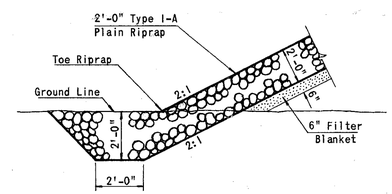
NOTE: Actual Limits of Riprap to be determined in the field by the Resident Engineer.

NOTE: See DEB-5 for 12"CGM Pipe Drain Details. Lengths of drain given are approximate. Actual lengths will be determined in the field by the Resident Engineer.

BM. 40d Spike in Power Pole 35' Lt. Sta. 29+90 Elev. 1077.25




## PROFILE GRADE DATA




## TOE OF RIPRAP DETAIL

## DESIGN DATA

DESIGN: AASHO SPECIFICATIONS, 1973 EDITION

LIVE LOAD: HS 20-44 with 20 psf for future wearing surface.

STRUCTURAL STEEL: 20,000 psi

REINFORCING STEEL: 20,000 psi

CONCRETE:
- CLASS "A" 1,000 psi
- CLASS "AA" 1,200 psi

MAXIMUM FOUNDATION LOADS:
- ABUTMENTS 49.1 TONS/PILE
- PIERS
  - DIRECT 5.1 TONS/S.F.

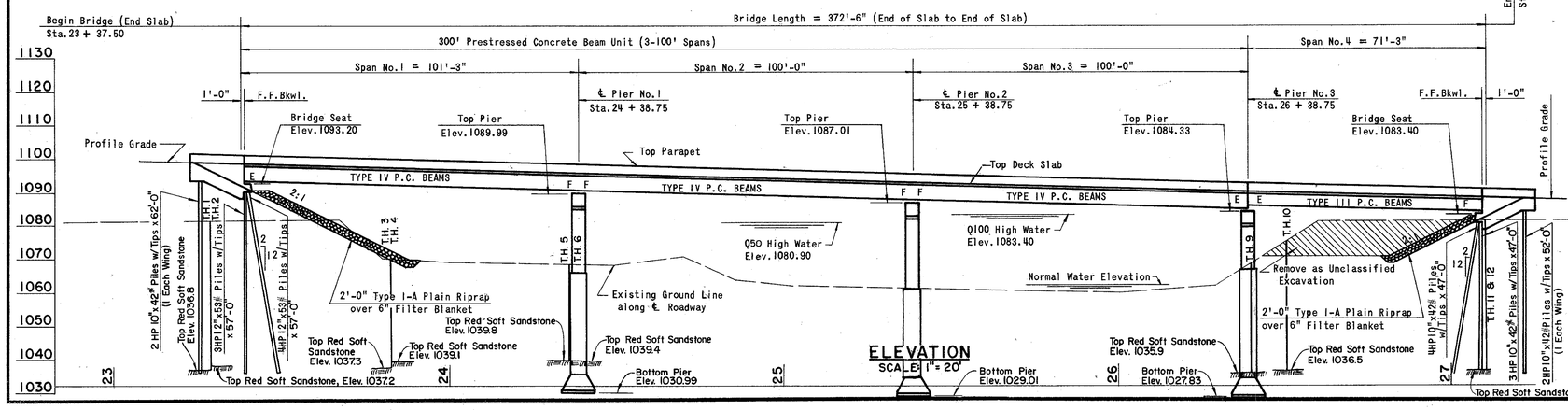
DRAINAGE AREA: 13,540 SQ.MI.

Q25 33,950 cfs
Q25 Comp. H.W. = 1080.21 V25 = 7.73 fps
Q25 (Bridge) = 33,102 cfs
Q25 (Rdy.) = 848 cfs
Q50 = 37,500 cfs
Q50 Comp. H.W. = 1080.90 V50 = 7.97 fps
Q50 (Bridge) = 35,737 cfs
Q50 (Rdy.) = 1,763 cfs
Q100 = 52,500 cfs
Q100 Comp. H.W. = 1083.40 V100 = 8.55 fps
Q100 (Bridge) = 44,732 cfs
Q100 (Rdy.) = 7,768 cfs

## SUMMARY OF QUANTITIES

| ITEM NO. | ITEM | UNIT | ABUTS. | PIERS | SUPSTR. | TOTAL |
|---|---|---|---|---|---|---|
| 202.06 (E) | Unclassified Borrow | C.Y. | 90. | | | 90. |
| 501.06 (B) | Substructure Excavation, Common | C.Y. | 100. | | | 100. |
| 503.06 | Prestressed Concrete Beam (Type III) | L.F. | | | 345.8 | 345.8 |
| 503.06 | Prestressed Concrete Beam (Type IV) | L.F. | | | 1,486.3 | 1,486.3 |
| 504.06 (A) | Class "AA" Concrete | C.Y. | | | 382.4 | 382.4 |
| 506.06 (A) | Structural Steel | Lbs. | 160. | | 10,650. | 10,810. |
| 509.06 (B) | Class "A" Concrete | C.Y. | 70.6 | 122.1 | | 192.7 |
| 511.06 | Reinforcing Steel | Lbs. | 8,000. | 28,260 | 105,600. | 141,860 |
| 514.06 (E) | Steel Piling (HP10x42) | L.F. | 557. | | | 557. |
| 514.06 (E) | Steel Piling (HP12x53) | L.F. | 399. | | | 399. |
| 514.06 (F) | Steel Piling Splices (HP10x42) ① | Ea. | 11. | | | 11. |
| 514.06 (F) | Steel Piling Splices (HP12x53) ① | Ea. | 7. | | | 7. |
| 516.06 (A) Sp. | Drilled Shafts (60" Diameter) | L.F. | | 210. | | 210. |
| 516.06 (B) Sp. | Footing Bells | C.Y. | | 31.8 | | 31.8 |
| 601.06 (A-1) | Type I-A Plain Riprap | C.Y. | | | | 1,520. |
| 601.06 (A-2) | Type I-A Filter Blanket | C.Y. | | | | 500. |
| 613.06 (D) | 12" Corr. Galv. Steel Pipe | L.F. | | | | 100. |
| 613.06 (T) | Trench Excavation | C.Y. | | | | 11. |
| 619.06 (D) | Removal of Existing Bridge Structure | L.Sum | | | | 1. |
| Special | 2½" Joint Seal | L.F. | | | 34. | 34. |
| Special | 3½" Joint Seal | L.F. | | | 34. | 34. |
| Special | Inlet and Basin | Ea. | | | | 2. |
| 516.06 (C) Sp. | 60" Dia., 16 Ga. Corr. Metal Pipe | L.F. | | 181.53 | | 181.53 |
| 516.06 (D) | Obstructions | C.Y. | | 20.0 | | 20.0 |

① A maximum of one pile splice will be allowed for each pile.




## ELEVATION
SCALE: 1" = 20'

## INDEX OF SHEETS


| SHEET NO. | TITLE |
|---|---|
| 23 | GENERAL PLAN & ELEVATION & SUMMARY OF QUANTITIES |
| 24 | BRIDGE STAKING DIAGRAM |
| 25 | ABUTMENT DETAILS |
| 26 | PIER DETAILS |
| 27-29 | SUPERSTRUCTURE DETAILS |
| 30 | STD. P-1-14 |
| 31 | STD. DEB-5-3 |
| 15 | STD. GRH-1-5 |
| 16 | STD. GRAU-1-5 |
| 17 | STD. GRAU-2-0 |
| 32 | STD. PSAJ-17 |
| 18 | STD. SAAB-2-2 |
| 36 | STD. PCB-32-4-5 |
| 37 | STD. PCB-32-5-3 |
| 38 | STD. PCB-32-6-3 |
| 39 | STD. AB-32-5 |


LYNCH ROAD OVER NORTH CANADIAN RIVER
1-300' Cont. P.C. Beam Spans and 1-70' P.C. Beam Span
32'-0" Clear Roadway with 1'-4" Barrier Parapets

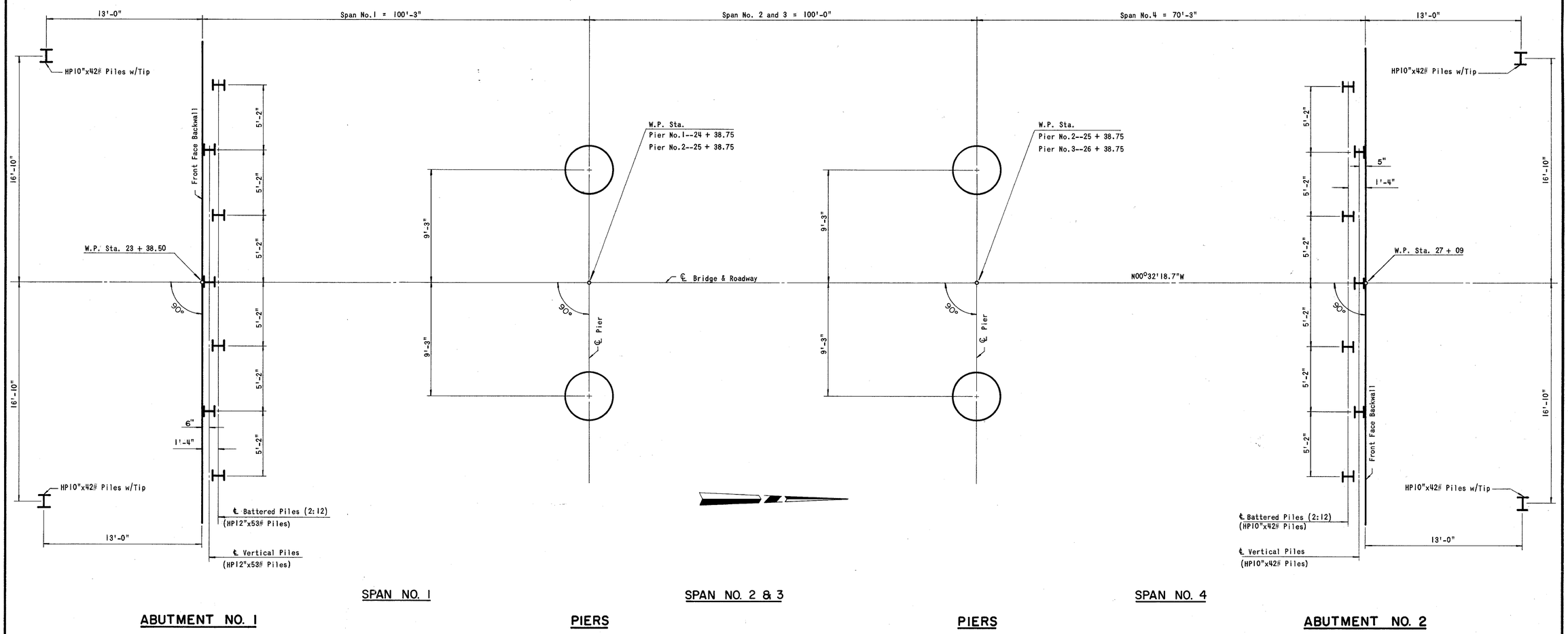
| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

# STRUCTURE "B" ℄ STA. 25+23.75
# GENERAL PLAN AND ELEVATION AND SUMMARY OF QUANTITIES

F.A.S. Project No. RS-5553 (104) C Sheet No. 23

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

| REVISIONS | |
|---|---|
| DESCRIPTION | DATE |
| | |



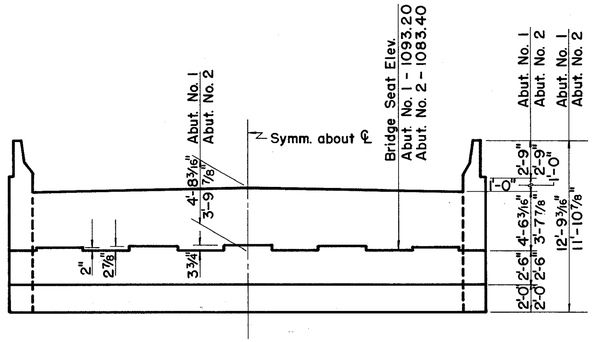

| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

STRUCTURE "B"
BRIDGE STAKING DIAGRAM

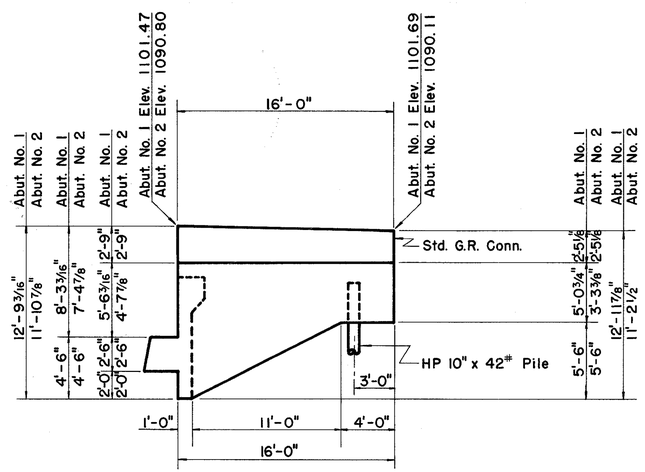
F.A.S. Project No. RS-5553 (104) C Sheet No. 24

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

| REVISIONS | |
|---|---|
| DESCRIPTION | DATE |
| | |




ELEVATION




WING ELEVATION

## BAR LIST (ONE ABUTMENT)

| ABUT. | MARK | NO. | SIZE | FORM | LENGTH | REMARKS |
|---|---|---|---|---|---|---|
| | B1 | 10 | #9 | Str. | 35'- 0" | |
| | B2 | 21 | #4 | Str. | 2'-10" | |
| | BH1 | 18 | #4 | Str. | 35'- 0" | |
| 2 | BV1 | 33 | #4 | Str. | 7'-11" Avg. | (7'-10" to 8'-0") (F.F Bkwl.) |
| 2 | BV2 | 33 | #5 | Str. | 7'-11" Avg. | (7'-10" to 8'-0") (B.F Bkwl.) |
| 1 | BV3 | 33 | #4 | Str. | 9'- 9" Avg. | (9'-8" to 9'-10") (F.F Bkwl.) |
| 1 | BV4 | 33 | #5 | Str. | 9'- 9" Avg. | (9'-8" to 9'-10") (B.F Bkwl.) |
| | P1 | 15 | #4 | Bnt. | 6'-10" | |
| | P2 | 20 | #4 | Bnt. | 5'- 4" | |
| | PH1 | 12 | #4 | Str. | 15'- 8" | |
| | PR1 | 34 | #5 | Bnt. | 3'- 6" | |
| | PR3 | 34 | #5 | Bnt. | 4'- 8" Avg. | (4'-6" to 4'-10") |
| | PR4 | 34 | #5 | Str. | 3'- 0" | |
| | S | 36 | #4 | Bnt. | 10'-11" | |
| | SB | 33 | #4 | Bnt. | 5'- 9" | |
| 1 | WH1 | 24 | #4 | Str. | 15'- 8" | 6 Ea. Face of Wing @ 11" C/c |
| 2 | WH1 | 16 | #4 | Str. | 15'- 8" | 4 Ea. Face of Wing @ 12" C/c |
| | WH2 | 12 | #6 | Str. | 8'- 1" Avg. | (5'-11" to 10'-3") |
| | WH3 | 4 | #6 | Bnt. | 16'- 1" | |
| | WH4 | 4 | #6 | Bnt. | 3'- 9" | |
| | WH5 | 4 | #6 | Bnt. | 3'- 9" | |
| 1 | WT | 10 | #4 | Bnt. | 4'- 0" | |
| 2 | WT | 8 | #4 | Bnt. | 4'- 0" | |
| 1 | WV1 | 8 | #4 | Str. | 9'- 8" | |
| 2 | WV1 | 8 | #4 | Str. | 8'-10" | |
| 1 | WV2 | 40 | #4 | Str. | 7'- 2" Avg. | (5'- 1" to 9'-3") |
| 2 | WV2 | 40 | #4 | Str. | 5'-11" Avg. | (3'-6" to 8'-4") |
| 1 | WV3 | 20 | #4 | Str. | 4'- 8" | |
| 2 | WV3 | 20 | #4 | Str. | 2'-11" | |

NOTE: Reference STD. AB-32-5 for Abutment Details, Notes, Bar Bends and Excavation Diagram not shown on this sheet.

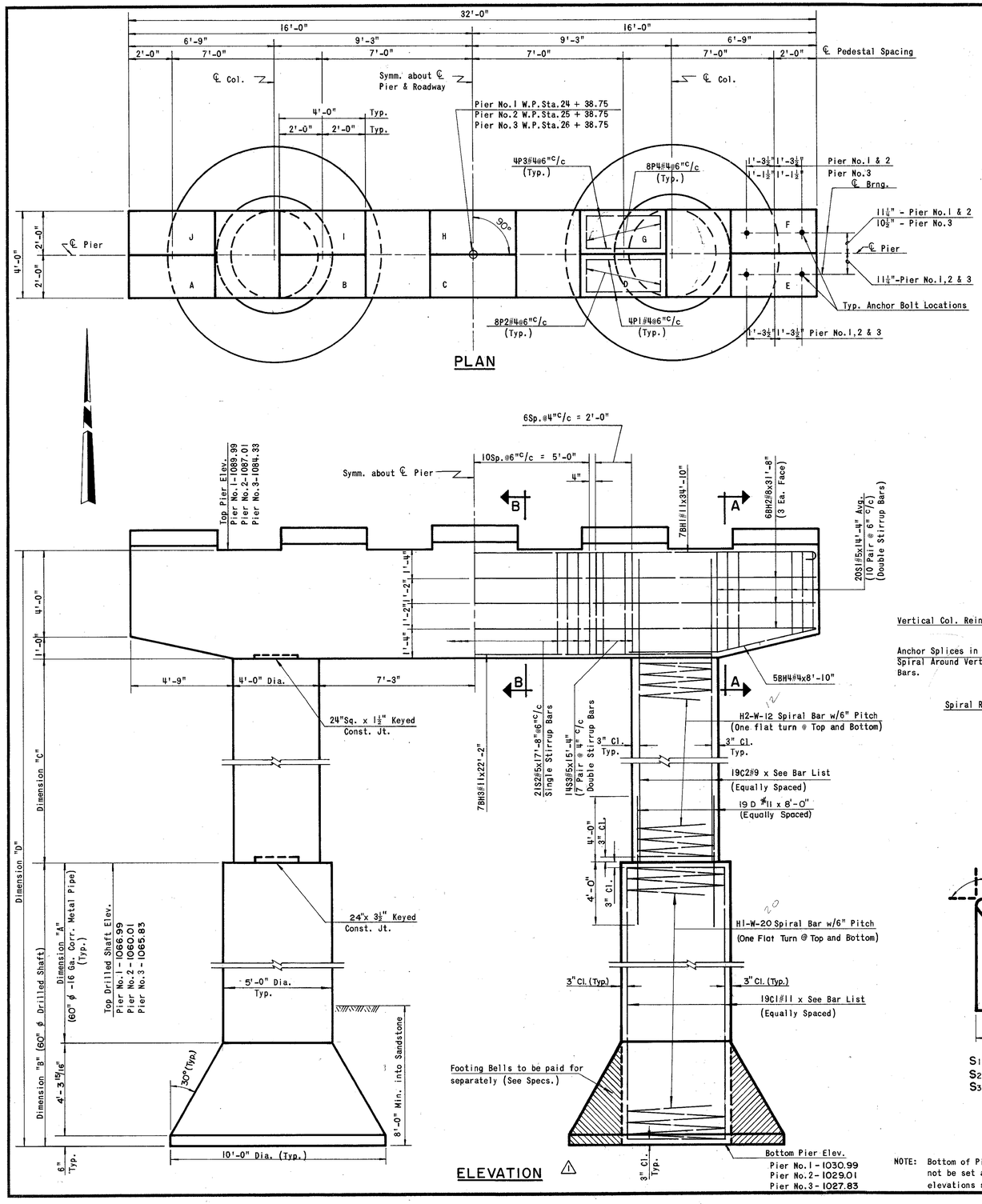
## QUANTITIES

| ITEM | UNIT | ABUT. NO. 1 | ABUT. NO. 2 |
|---|---|---|---|
| Unclassified Borrow | C.Y. | 45. | 45. |
| Substructure Excavation, Common | C.Y. | 50. | 50. |
| Structural Steel | Lbs. | 80. | 80. |
| Class "A" Concrete | C.Y. | 37.1 | 33.5 |
| Reinforcing Steel | Lbs. | 4,130. | 3,870. |
| Steel Piling (HP10"x42#) with Tips | L.F. | 124. | 433. |
| Steel Piling (HP12"x53#) with Tips | L.F. | 399. | |
| Steel Piling Splices (HP10"x42#) | Ea. | 2. | 9. |
| Steel Piling Splices (HP12"x53#) | Ea. | 7. | |

| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

# STRUCTURE "B"
# ABUTMENT DETAILS

F.A.S. Project No. RS-5553(104)C Sheet No. 25




NOTE: Bottom of Piers shall not be set above elevations shown.

**DOUBLE CASING METHOD OF CONSTRUCTION:**

The Contractor may be required to use this method if it is determined by the Engineer to be necessary and required. Construction shall conform to the following sequence:

(1) 66" Casing to be placed as pier is drilled to rock. Casing will be driven one foot into rock for sealing off water.
(2) Shaft to be drilled as shown on the plans.
(3) 60" diameter, 16 ga. corr. metal pipe to be set to the elevation of the top of the bell and supported from the top.
(4) Reinf. steel and concrete to be placed in corr. metal pipe.
(5) Sand backfill to be placed between casing and corr. metal pipe to top existing working grade after concrete is poured.
(6) After initial set, the 66" casing will be pulled. The 60" corr. metal pipe to remain in place.

All cost for labor and material necessary for the 66" casing will be included in the price bid for 60" Diameter Drilled Shaft.
All cost for labor and material necessary for the 60" diameter, 16 ga. corr. metal pipe and sand backfill shall be included in the price bid for 60" diameter, 16 ga. corr. metal pipe.

## PEDESTAL HEIGHTS

| PEDESTAL | PIER 1 | PIER 2 | PIER 3 |
|---|---|---|---|
| A | 2 11/16" | 2 11/16" | 2" |
| B | 3 9/16" | 3 9/16" | 2 7/8" |
| C | 4 7/16" | 4 7/16" | 3 3/4" |
| D | 3 9/16" | 3 9/16" | 2 7/8" |
| E | 2 11/16" | 2 11/16" | 2" |
| F | 2" | 2" | 11" |
| G | 2 7/8" | 2 7/8" | 11 7/8" |
| H | 3 3/4" | 3 3/4" | 11'-0 3/4" |
| I | 2 7/8" | 2 7/8" | 11 7/8" |
| J | 2" | 2" | 11" |

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

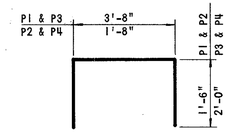
| REVISIONS | | |
|---|---|---|
| DESCRIPTION | | DATE |
| 1 | W-BAR SIZE | 11-7-80 |
| 2 | W-BAR SIZE | 6-19-81 |

## BAR LIST (One Pier)

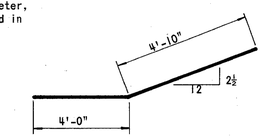
| PIER NO. | MARK | NO. | SIZE | FORM | LENGTH |
|---|---|---|---|---|---|
| | BH1 | 7 | #11 | Bnt. | 34'-10" |
| | BH2 | 6 | # 8 | Str. | 31'- 8" |
| | BH3 | 7 | #11 | Str. | 22'- 2" |
| | BH4 | 10 | # 4 | Bnt. | 8'-10" |
| 1 | C1 | 38 | #11 | Str. | 35'- 7" |
| 2 | C1 | 38 | #11 | Str. | 30'- 7" |
| 3 | C1 | 38 | #11 | Str. | 37'- 7" |
| 1 | C2 | 38 | # 9 | Str. | 22'- 6" |
| 2 | C2 | 38 | # 9 | Str. | 26'- 6" |
| 3 | C2 | 38 | # 9 | Str. | 18'- 0" |
| 1 | H1 | 2 | W-20 | Bnt. | 1,033'-8" |
| 2 | H1 | 2 | W-20 | Bnt. | 892'- 4" |
| 3 | H1 | 2 | W-20 | Bnt. | 1,090'-3" |
| 1 | H2 | 2 | W-12 | Bnt. | 408'- 6" |
| 2 | H2 | 2 | W-12 | Bnt. | 496'- 6" |
| 3 | H2 | 2 | W-12 | Bnt. | 309'- 6" |
| | P1 | 20 | # 4 | Bnt. | 6'-8" |
| | P2 | 40 | #4 | Bnt. | 4'-8" |
| | P3 | 20 | #4 | Bnt. | 7'-8" |
| | P4 | 40 | #4 | Bnt. | 5'-8" |
| | S1 | 40 | #5 | Bnt. | 14'-4" Avg. |
| | S2 | 21 | #5 | Bnt. | 17'-8" |
| | S3 | 28 | #5 | Bnt. | 15'-4" |
| | D | 38 | #11 | Str. | 8'-0" |

NOTE: Cost for C1 and H1 Reinforcing Bars to be included in the price bid for 60" Dia. Drilled Shaft.

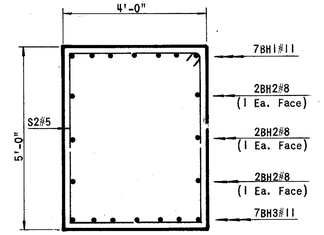
NOTE: Quantities shown for H1 and H2 bars do not include lap.



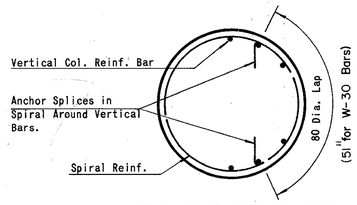

P1 #4 x 6'-8"
P2 #4 x 4'-8"
P3 #4 x 7'-8"
P4 #4 x 5'-8"



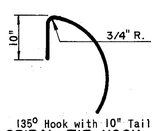

BH4 #4 x 8'-10"




SECTION B-B

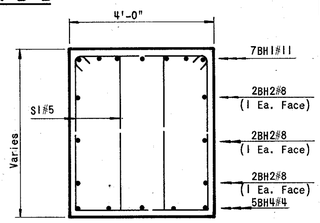



SECTION THRU COLUMN
(Showing Spiral Splice)

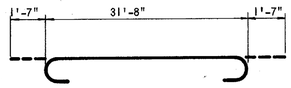



135° Hook with 10" Tail
SPIRAL TIE HOOK

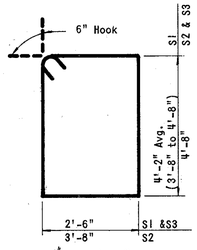
NOTE: Anchor spiral at top and bottom with one flat turn and hook.




SECTION A-A




BH1 #11 x 34'-10"




S1 #5 x 14'-4" Avg.
S2 #5 x 17'-8"
S3 #5 x 15'-4"

## DIMENSION SCHEDULE

| PIER NO. | DIM. "A" | DIM. "B" | DIM. "C" | DIM. "D" |
|---|---|---|---|---|
| 1 | 31'-2 1/16" | 36'-0" | 18'-0" | 59'-0" |
| 2 | 26'-2 1/16" | 31'-0" | 22'-0" | 58'-0" |
| 3 | 33'-2 1/16" | 38'-0" | 13'-6" | 56'-6" |

PIER NOTES

All exposed edges shall have 1½" chamfer unless otherwise shown or noted.
All pedestals shall have ⅞" chamfer.
All chamfer strips shall be sized lumber.
All concrete shall be poured in the dry.
For Anchor Bolt detail and note, see Sheet No. 29 & 38.
All bar bends are out to out.
Bell footings shall not be set above elevation shown.
All reinforcing steel shall have 2" clearance unless otherwise shown or noted.
Any variation in the bell footing elevation greater than 1'-0" shall be approved by the Engineer prior to pouring the drilled shaft.
Bearing area of concrete under all bearing pads shall be ground with a carborundum brick before placing pads to secure full bearing on concrete.
For Staking Diagram, see Sheet No. 24.
For Additional General Notes, see Sheet No. 3.

## QUANTITIES

| ITEM | UNIT | PIER 1 | PIER 2 | PIER 3 |
|---|---|---|---|---|
| Class "A" Concrete | C.Y. | 40.5 | 44.2 | 37.4 |
| Reinforcing Steel | Lbs. | 9,450 | 10,030 | 8,780 |
| Footing Bells | C.Y. | 10.6 | 10.6 | 10.6 |
| 60" Ø Drilled Shaft | L.F. | 72.0 | 62.0 | 76.0 |
| 60" Ø - 16 Ga. Corr. Metal Pipe | L.F. | 62.51 | 52.51 | 66.51 |

| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

STRUCTURE "B"
PIER DETAILS

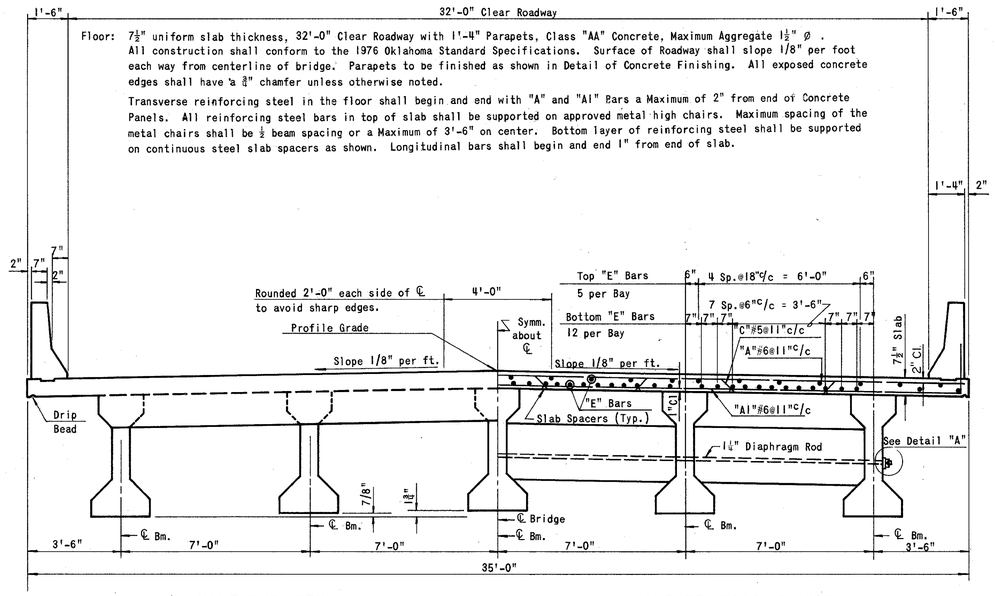
F.A.S. Project No. RS-5553 (104) C Sheet No. 26

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

| REVISIONS | |
|---|---|
| DESCRIPTION | DATE |
| | |

Floor: $7\frac{1}{2}$" uniform slab thickness, 32'-0" Clear Roadway with 1'-4" Parapets, Class "AA" Concrete, Maximum Aggregate $1\frac{1}{2}$" Ø . All construction shall conform to the 1976 Oklahoma Standard Specifications. Surface of Roadway shall slope 1/8" per foot each way from centerline of bridge. Parapets to be finished as shown in Detail of Concrete Finishing. All exposed concrete edges shall have a $\frac{3}{4}$" chamfer unless otherwise noted.

Transverse reinforcing steel in the floor shall begin and end with "A" and "A1" Bars a Maximum of 2" from end of Concrete Panels. All reinforcing steel bars in top of slab shall be supported on approved metal high chairs. Maximum spacing of the metal chairs shall be $\frac{1}{2}$ beam spacing or a Maximum of 3'-6" on center. Bottom layer of reinforcing steel shall be supported on continuous steel slab spacers as shown. Longitudinal bars shall begin and end 1" from end of slab.




HALF END VIEW

HALF REINFORCING VIEW

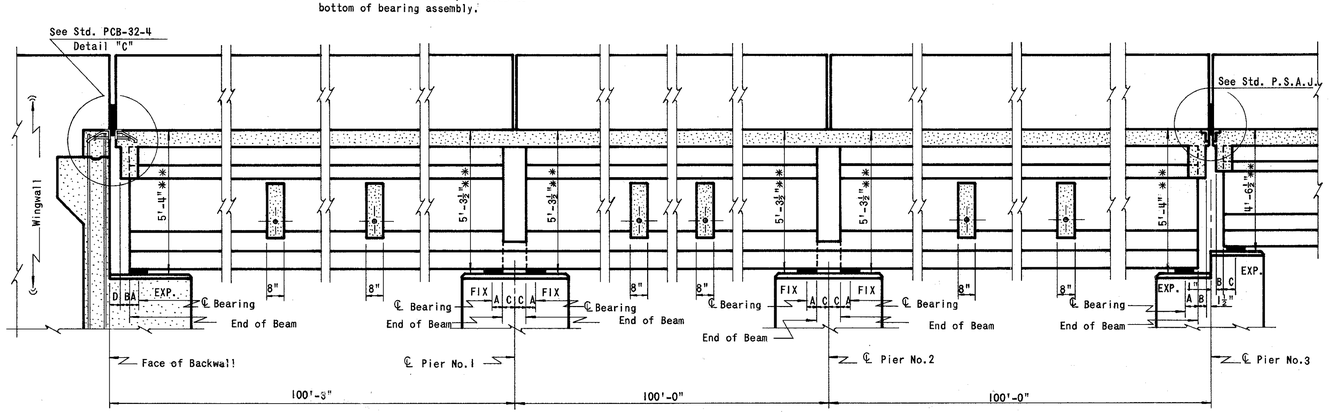
NOTE: See Sheet No. 28 for Partial Plan View for "E" Bars in Top of Slab.

Reference Std. PCB-32-4 and Std. PCB-32-6 for the following details.

1. "A", "A1", "C", "PH1", "PR1", "PR2", "AD", "UD", "U" and "F" reinforcing bar details and notes.
2. Detail "A" with diaphragm bolt notes.
3. Section thru Parapet.
4. Detail "B" and "C".
5. Steel Angle Bumper Detail and Note.
6. Cast Iron Drain Detail and Alternate Drain Note.
7. Control Crack Joint Detail and Optional Control Crack Joint Detail with Note.
8. Parapet Construction Joint Detail with Note.
9. Concrete Finishing Detail
10. Placement of Expansion Joint Sealer at Parapet Detail.

| QUANTITIES | | |
|---|---|---|
| ITEM | UNIT | TOTAL |
| CLASS "AA" CONCRETE | C.Y. | 382.4 |
| REINFORCING STEEL | LBS. | 105,600. |
| STRUCTURAL STEEL | LBS. | 10,650. |
| P.C. BEAMS (TYPE IV) | L.F. | 1,486.3 |
| $3\frac{1}{2}$" JOINT SEAL | L.F. | 34. |
| P.C. BEAMS (TYPE III) | L.F. | 345.8 |
| 2½" JOINT SEAL | L.F. | 34. |
| | | |
| | | |
| | | |

* * NOTE: Dimension taken from top of slab to bottom of bearing assembly.




SPAN NO. 1

SPAN NO. 2

SPAN NO. 3

LONGITUDINAL SECTION

NOTE: See Std. PCB-32-4 for Span No. 4 Longitudinal Section

NOTE: For Span No.4 Superstructure Details, See Stds. PCB-32-4, PCB-32-5 and PCB-32-6. Use 1" Beveled Beam Anchor Plates in lieu of $\frac{3}{4}$" Anchor Plates shown on Std. PCB-32-6.

NOTE: Anchor Plates for all beams in Span No. 1, 2, 3 and 4 shall be beveled to match the beam slope and shall have a thickness of 1" at centerline of bearing after beveling. All cost for beveling the anchor plates shall be included in the price bid for structural steel.

| TABLE OF DIMENSIONS | |
|---|---|
| MARK | DIMENSION |
| A | 5 3/4" |
| B | 4 " |
| C | 5 1/2" |
| D | 4 1/2" |

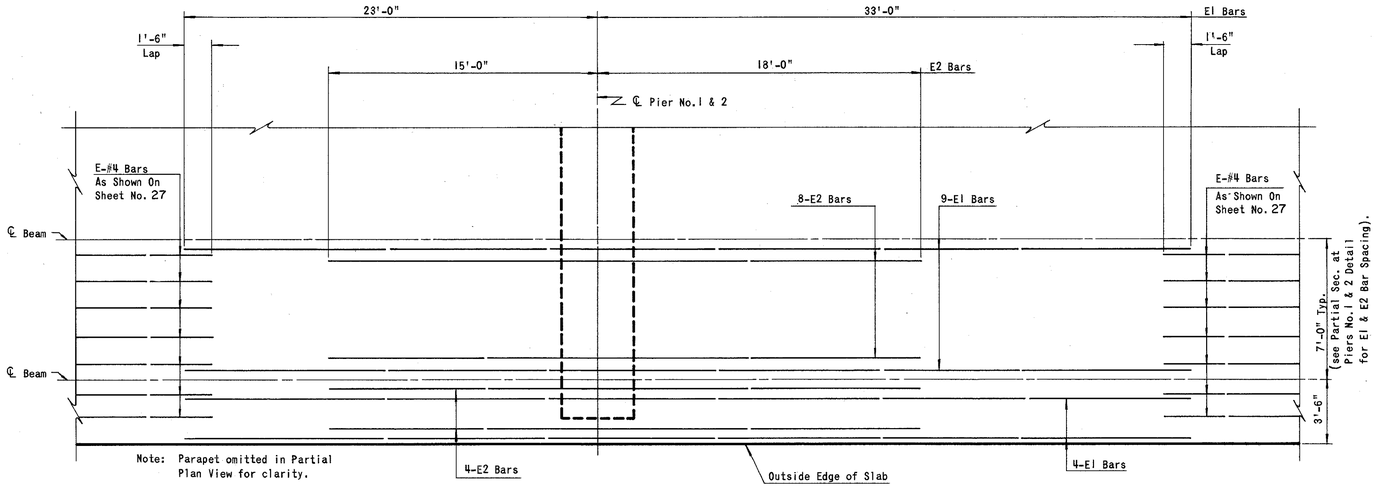
| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

STRUCTURE "B"
SUPERSTRUCTURE DETAILS

F.A.S. Project No. RS-5553 (104) C Sheet No. 27

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

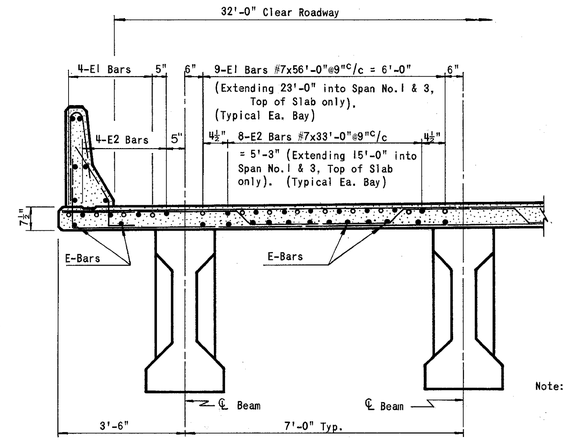
| REVISIONS | |
|---|---|
| DESCRIPTION | DATE |
| | |




SPAN NO. 1 & 3 — SPAN NO. 2

## PARTIAL PLAN VIEW AT PIER NO. 1 & 2
(SHOWING E1 & E2 BARS IN TOP OF SLAB)

Note: For Reinforcing and Details not shown, See Sheet No. 27




Note: E Bars in bottom of slab shall be as shown on Sheet No. 27

## PARTIAL SECTION AT PIER NO. 1 & 2

### CONCRETE POURING SEQUENCE FOR DECK SLAB

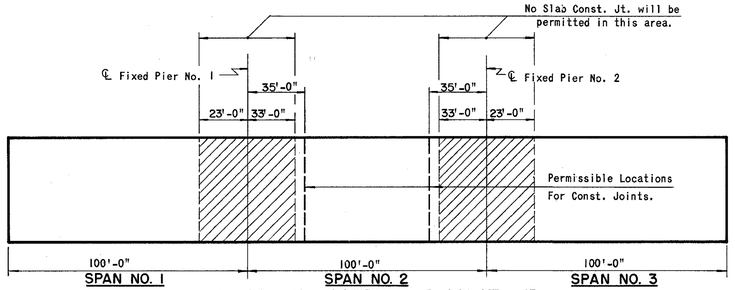
The contractor will select either of the locations shown on the plans for a construction joint in the continuous unit to be poured. The larger panel will be the initial pour. The slab will be poured as a continuous pour from the end of the unit to the construction joint at a minimum rate of pour of 25 Cu. Yds. per hour. The contractor must wait a minimum of 24 hours (Preferably until initial curing operations are complete) before resuming pouring operations. The remaining portion of the continous unit will then be poured in the same manner specified for the initial pour.

WARNING: Until the slab is in place on both sides of the construction joint, the slab is unsupported and no heavy construction machines or other equipment will be permitted on the finished slab within 5 feet of the construction joint.

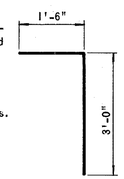
### OPTIONAL POURING SEQUENCE

If the contractor selects this option, each continous unit will be poured in a continuous pour at a minimum rate of 40 Cu.Yds. per hour.

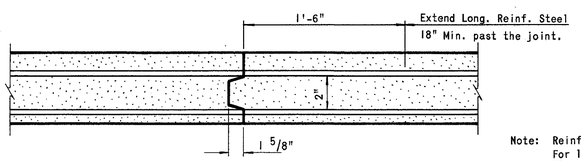
Should special circumstances arise that require pouring be interrupted, pouring will not be permitted to recommence until a period of at least 24 hours has elapsed. No construction joint will be permitted in the area adjacent to the piers as shown on the plans.




## PERMISSIBLE LOCATION OF CONST. JT.
(3-100' CONT. UNIT)




F6 Bars #4x4'-6"

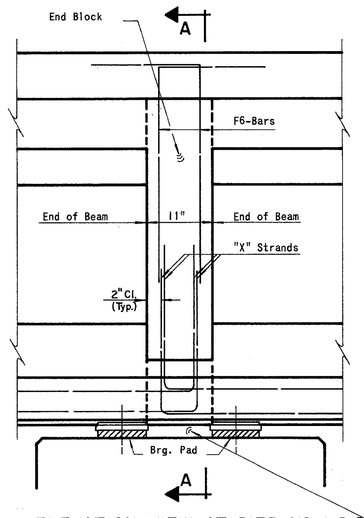



## DETAIL OF OPTIONAL SLAB CONST. JT.

Note: Reinforcing quantity shown includes (7) 18" laps For longitudinal steel (E-Bars). These laps are computed as Follows:
3-100' Unit 5 laps (Bottom E-Bars)
2 laps (Top E-Bars)

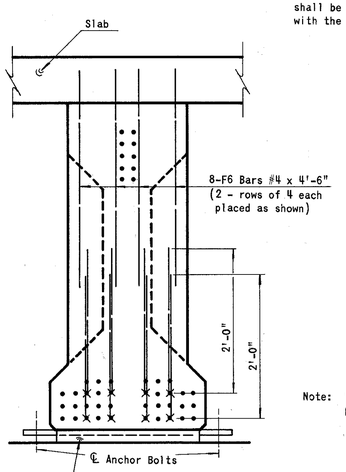
E-Bars shall not be spliced within 4'-0" of the Centerline of a Pier. Splicing will not be permitted on E1 & E2 Bars.

Note: End blocks at piers No. 1 & 2 shall be poured continuously with the slab.




## ELEVATION VIEW AT PIER NO. 1 & 2

18" thick Filler or Form with 1 layer of plastic sheeting for parting strip. To be substantially removed after concrete is poured.




## SECTION A-A

Note: "X" Strands extended and bent upward 2'-0" as shown.

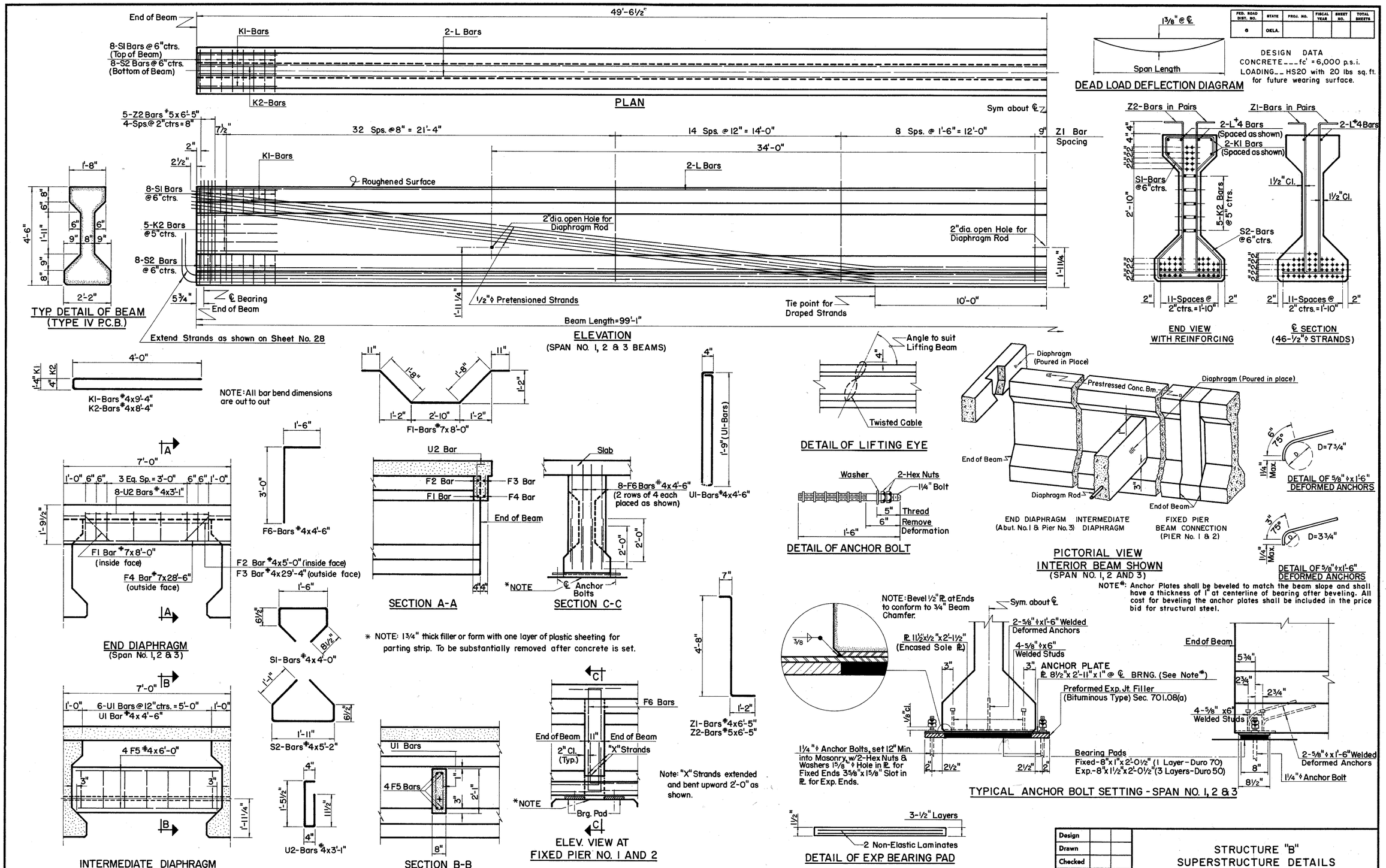
| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

# STRUCTURE "B"
# SUPERSTRUCTURE DETAILS
# SPAN NO. 1, 2 AND 3

F.A.S. Project No. RS-5553 (104) C Sheet No. 28

| FED. ROAD DIST. NO. | STATE | PROJ. NO. | FISCAL YEAR | SHEET NO. | TOTAL SHEETS |
|---|---|---|---|---|---|
| 6 | OKLA. | | | | |

DESIGN DATA
CONCRETE ___ fc' = 6,000 p.s.i.
LOADING __ HS20 with 20 lbs sq. ft. for future wearing surface.




| | | |
|---|---|---|
| Design | | |
| Drawn | | |
| Checked | | |
| Approved | | |
| Squad | | |

STRUCTURE "B"
SUPERSTRUCTURE DETAILS
SPAN NO. 1, 2 AND 3

F.A.S. Project No. RS-5553 (104) C Sheet No. 29

# APPENDIX EA-4

# Soil Map

Soil Map—Oklahoma County, Oklahoma
(Luther Road Soil Survey)

Map Scale: 1:7,420 if printed on A size (8.5" x 11") sheet.

N

Meters
0 100 200 400 600

Feet
0 400 800 1,600 2,400

## MAP LEGEND

**Area of Interest (AOI)**

Area of Interest (AOI)

**Soils**

Soil Map Units

**Special Point Features**

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

**Special Line Features**

Gully

Short Steep Slope

Other

**Political Features**

Cities

**Water Features**

Oceans

Streams and Canals

**Transportation**

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

## MAP INFORMATION

Map Scale: 1:7,420 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 14N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Oklahoma County, Oklahoma
Survey Area Data: Version 11, Sep 16, 2008

Date(s) aerial images were photographed: 6/1/2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

# Map Unit Legend

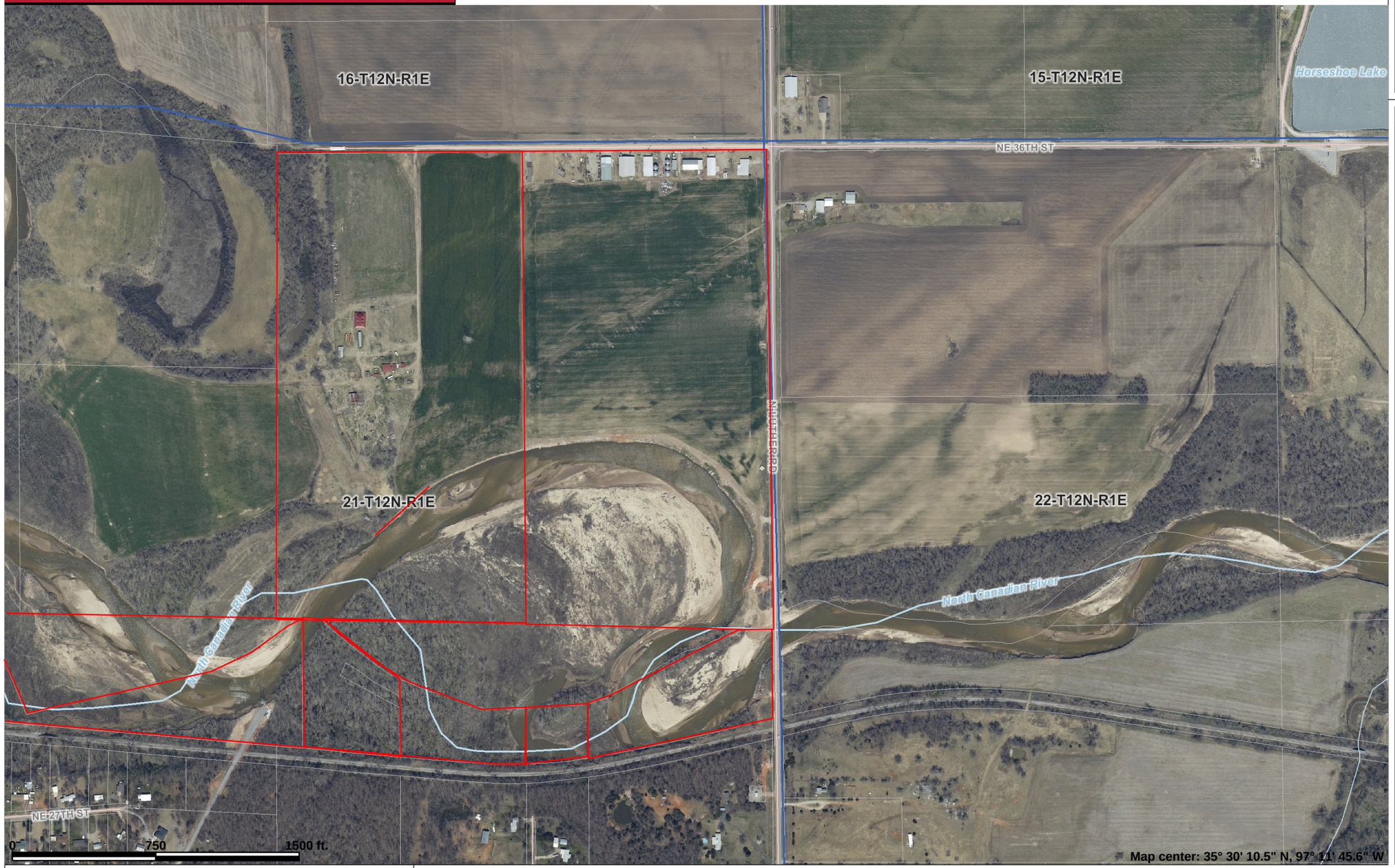
| Oklahoma County, Oklahoma (OK109) | | | |
|---|---|---|---|
| **Map Unit Symbol** | **Map Unit Name** | **Acres in AOI** | **Percent of AOI** |
| AmbE | Amber very fine sandy loam, 5 to 15 percent slopes, rarely flooded | 16.1 | 6.9% |
| GaGA | Gaddy-Gracemore complex, 0 to 1 percent slopes, frequently flooded | 49.5 | 21.3% |
| GcmA | Gracemont silty clay, 0 to 1 percent slopes, frequently flooded, overwash | 17.8 | 7.7% |
| GmtA | Gracemont fine sandy loam, 0 to 1 percent slopes, occasionally flooded | 14.2 | 6.1% |
| HarC | Harrah fine sandy loam, 3 to 5 percent slopes | 6.2 | 2.7% |
| KekA | Keokuk very fine sandy loam, 0 to 1 percent slopes, rarely flooded | 25.8 | 11.1% |
| KeoA | Keokuk very fine sandy loam, 0 to 1 percent slopes, occasionally flooded | 31.1 | 13.4% |
| LomA | Lomill silty clay loam, 0 to 1 percent slopes, occasionally flooded | 6.1 | 2.6% |
| SDND | Stephenville-Darsil-Newalla complex, 3 to 8 percent slopes | 0.8 | 0.3% |
| W | Water | 11.9 | 5.1% |
| YaGA | Yahola-Gaddy complex, 0 to 1 percent slopes, occasionally flooded | 13.5 | 5.8% |
| YahA | Yahola fine sandy loam, 0 to 1 percent slopes, occasionally flooded | 39.9 | 17.1% |
| **Totals for Area of Interest** | | **232.8** | **100.0%** |

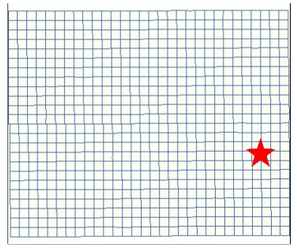
# APPENDIX EA-5

# Real Estate Map

Leonard Sullivan Oklahoma County Assessor
ONLINE MAPPING

# Internet Mapping Framework



## Legend

- Sections
- Streets
- Parcels
- North Canadian River
- Rivers & Creeks
- Lakes
- Aerials (flown Mar 19th-29th, 2010)
- County Background

N

Scale: 1:6,265

This map is a user generated static output from an Internet mapping site and is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. THIS MAP IS NOT TO BE USED FOR NAVIGATION.

Leonard Sullivan Oklahoma County Assessor
ONLINE MAPPING

# APPENDIX EA-6

# Hydrology and Hydraulics Report

# HYDROLOGIC AND HYDRAULIC ANALYSES
# NORTH CANADIAN RIVER AT LUTHER ROAD
# STREAMBANK PROTECTION PROJECT

## BASIN DESCRIPTION

The North Canadian River basin rises in the high plateau of northwestern New Mexico and flows eastward through the plains of central Oklahoma. The basin is 840 miles in length and drains 17,712 square miles. The terrain consists of gently rolling hills, with grassland on the upper slopes and some forests along the watercourses. Land use is mostly rangeland grazing, with some farming along the floodplain. Urbanization consists mostly of the Oklahoma City metropolitan area, which contributes to some flashy runoff characteristics in the Luther Road area. Flows are modified by three Corps of Engineers dams at Optima, Ft. Supply, and Canton. In addition, there are numerous municipal and NRCS structures that have some impact on flows. The soils in the floodplain are sandy and highly erodible, contributing to constant streambank caving and meandering.

## PRESENT STUDY

This study is a streambank protection analysis for the North Canadian River near Harrah, Oklahoma in Oklahoma County for Luther Road (Figure 1 - Vicinity Map). Luther Road is a significant roadway between the towns of Luther and Harrah, Oklahoma. A bend in the river is actively moving and advancing on the roadway. The meandering appears to be caused by toe cutting and subsequent bank sloughing. The project area is shown in Figure 2. A United States Geologic Survey (USGS) gage is located at the bridge and its flow records were analyzed for frequency using the computer program HEC-SSP version 2.0. Based on the results from HEC-SSP, frequency discharges for the project area were developed for the 1-, 2-, and 10 year events. These events are generally considered the channel forming events. By protecting the toe during

these events, the channel should be stabilized, and thus these frequencies were selected for further evaluations. The 100-year event was taken from the effective FEMA model for the reach. The discharges are given in Table 1. The discharges were used in the computer model HEC-RAS, version 4.1 and computed water surface elevations were developed. For verification purposes, the model's variables were adjusted so that the results matched the effective FEMA study at the starting and ending points. In addition, the model was calibrated to the USGS gage at the lower frequency flows. Data for the modeling was developed from bridge plans, field laser level measurements, and National Elevation Data (NED) from the USGS. The data is in NAD83 (1993) State Plane Coordinates, Oklahoma North Zone (3501). The vertical data is in NAVD88. Due to stream meandering, the NED data was very dated and was adjusted for the current stream location, based on the limited data available.

Figure 1 – Vicinity Map

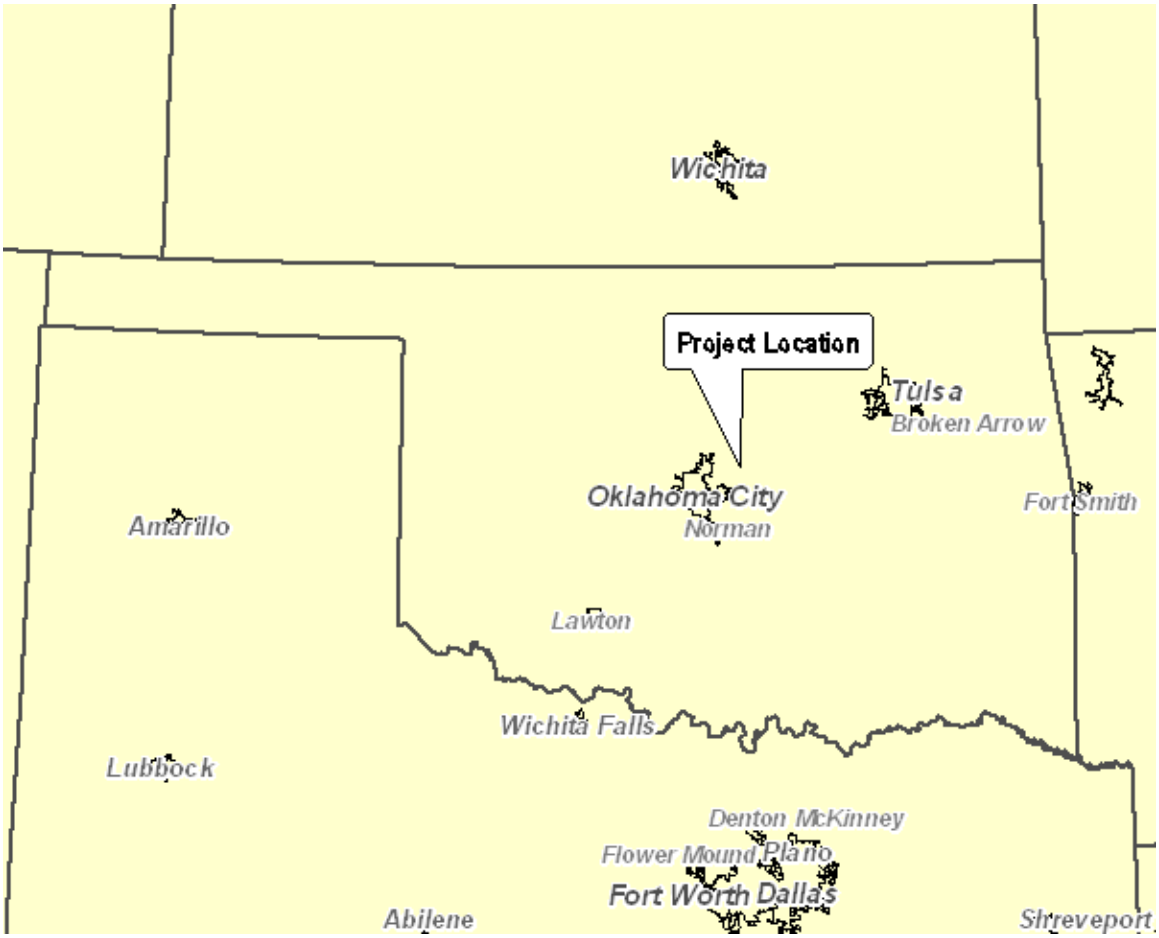


Figure 2 – Project Area

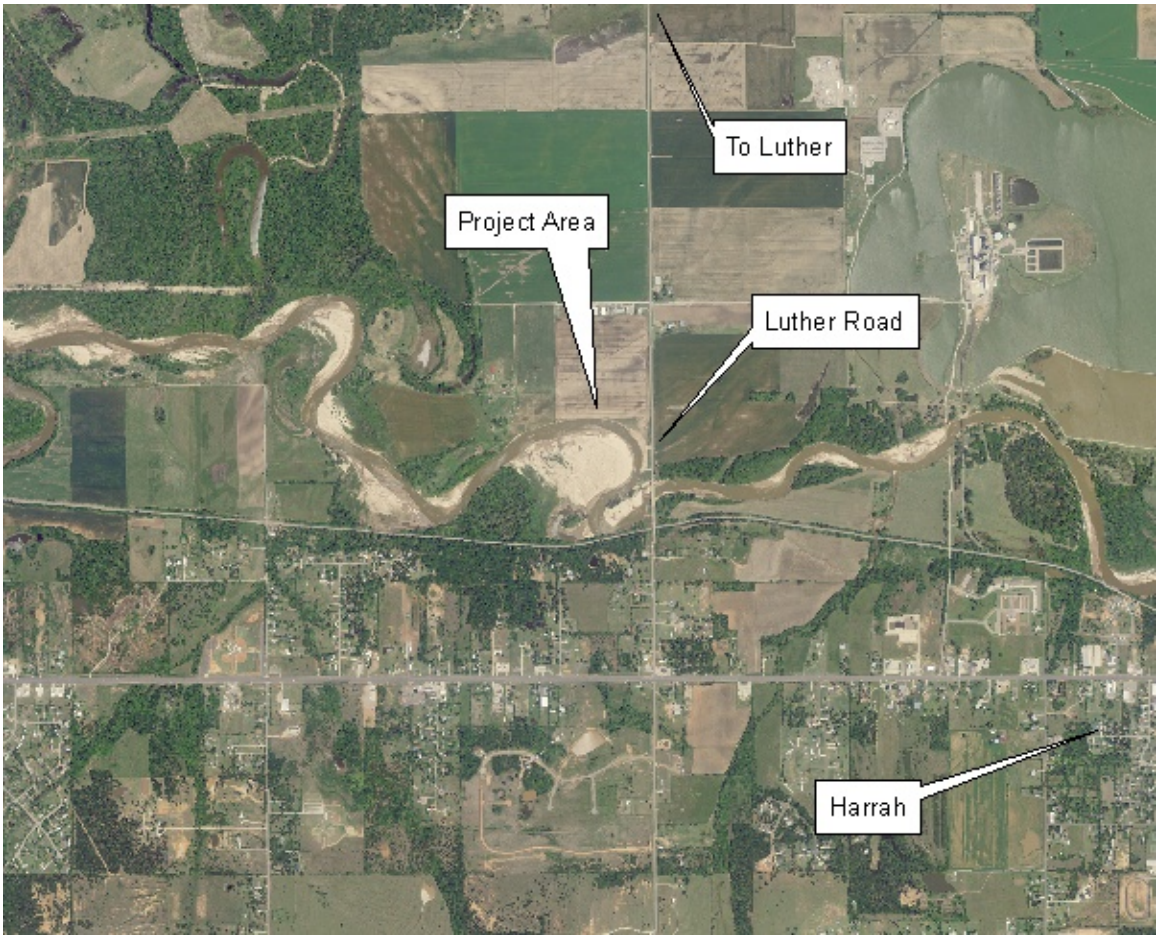


**Table 1**

**Summary of Discharges in Cubic Feet per Second (cfs)**

| **Location** | **1-year** | **2-year** | **10-year** | **100-year** | |
|---|---|---|---|---|---|
| **North Canadian River at Harrah** | 1,500 | 6,200 | 15,500 | 53,500 | |
| | | | | | |

## ALTERNATIVES

### Base Conditions

The existing conditions for the North Canadian River were modeled to establish a base line and to develop a corrected effective model. The effective Flood Insurance Study's flows were used and the resulting 100-year water surface profiles were tied into the effective elevations at the upper and lower ends of this study. The name of this project model is LutherRoadexchannnel. The results are shown in Table 2.

Table 2 – Existing Conditions Water Surface Profiles

| Reach | River Sta | Profile | Q Total | W.S. Elev |
|---|---|---|---|---|
| | | | (cfs) | (ft) |
| Luther Road | 9205.516 | 1-yr | 1500 | 1071.07 |
| Luther Road | 9205.516 | 2-yr | 6200 | 1073.53 |
| Luther Road | 9205.516 | 10-yr | 15500 | 1078.51 |
| Luther Road | 9205.516 | 100-yr | 53500 | 1085.12 |
| | | | | |
| Luther Road | 8102.303 | 1-yr | 1500 | 1067.79 |
| Luther Road | 8102.303 | 2-yr | 6200 | 1073.01 |
| Luther Road | 8102.303 | 10-yr | 15500 | 1078.32 |
| Luther Road | 8102.303 | 100-yr | 53500 | 1084.98 |
| | | | | |
| Luther Road | 7008.247 | 1-yr | 1500 | 1067.6 |
| Luther Road | 7008.247 | 2-yr | 6200 | 1072.9 |
| Luther Road | 7008.247 | 10-yr | 15500 | 1078.24 |
| Luther Road | 7008.247 | 100-yr | 53500 | 1084.9 |

| | | | | |
|---|---|---|---|---|
| Luther Road | 5933.286 | 1-yr | 1500 | 1067.17 |
| Luther Road | 5933.286 | 2-yr | 6200 | 1072.24 |
| Luther Road | 5933.286 | 10-yr | 15500 | 1077.09 |
| Luther Road | 5933.286 | 100-yr | 53500 | 1084.22 |
| | | | | |
| Luther Road | 4985.455 | 1-yr | 1500 | 1066.14 |
| Luther Road | 4985.455 | 2-yr | 6200 | 1071.19 |
| Luther Road | 4985.455 | 10-yr | 15500 | 1075.64 |
| Luther Road | 4985.455 | 100-yr | 53500 | 1083.51 |
| | | | | |
| Luther Road | 4410.133 | 1-yr | 1500 | 1065.02 |
| Luther Road | 4410.133 | 2-yr | 6200 | 1069.41 |
| Luther Road | 4410.133 | 10-yr | 15500 | 1075.35 |
| Luther Road | 4410.133 | 100-yr | 53500 | 1083.53 |
| | | | | |
| Luther Road | 3948.491 | 1-yr | 1500 | 1064.36 |
| Luther Road | 3948.491 | 2-yr | 6200 | 1068.82 |
| Luther Road | 3948.491 | 10-yr | 15500 | 1074.59 |
| Luther Road | 3948.491 | 100-yr | 53500 | 1083.23 |
| | | | | |
| Luther Road | 3821.16 | | Bridge | |
| | | | | |
| Luther Road | 3693.831 | 1-yr | 1500 | 1064.01 |
| Luther Road | 3693.831 | 2-yr | 6200 | 1068.4 |
| Luther Road | 3693.831 | 10-yr | 15500 | 1074.07 |
| Luther Road | 3693.831 | 100-yr | 53500 | 1082.95 |
| | | | | |
| Luther Road | 2872.639 | 1-yr | 1500 | 1063.86 |
| Luther Road | 2872.639 | 2-yr | 6200 | 1067.91 |
| Luther Road | 2872.639 | 10-yr | 15500 | 1073.51 |
| Luther Road | 2872.639 | 100-yr | 53500 | 1082.68 |
| | | | | |
| Luther Road | 2072.692 | 1-yr | 1500 | 1063.77 |
| Luther Road | 2072.692 | 2-yr | 6200 | 1067.54 |
| Luther Road | 2072.692 | 10-yr | 15500 | 1072.91 |
| Luther Road | 2072.692 | 100-yr | 53500 | 1082.42 |
| | | | | |
| Luther Road | 608.6311 | 1-yr | 1500 | 1063.68 |
| Luther Road | 608.6311 | 2-yr | 6200 | 1067.04 |
| Luther Road | 608.6311 | 10-yr | 15500 | 1072 |
| Luther Road | 608.6311 | 100-yr | 53500 | 1082.14 |

**Alternatives**

A variety of alternatives for streambank protection were considered. A controlled drop structure at the upper end of the project area would alleviate head cutting and slow channel velocities. However, there is no evidence of head cut migration and no detailed topographical data available for the stream to base the design. In addition, the heavy sediment load in the river would likely deposit below the drop structure and fill in the channel to existing conditions. For these reasons, a drop structure was not considered further.

A Bendway Weir option was also considered. A Bendway Weir is a stone sill that is angled upstream and is tied into the outer bank of a stream. The weirs vary in size depending upon the size and usage of the channel. The purpose of the Bendway Weir is to redirect the concentration of the flow. Since flow in an untreated stream is concentrated on the far outer bank, erosion will occur on that outer bank. The Bendway Weir method interrupts that flow, reducing velocities and relocating the concentrated flow in the stream. When the water flowing through the stream hits the weir, it is redirected at an angle perpendicular to the weir. This interrupts both the primary concentrated flow, as well as the stream's strong secondary currents. The relocation of the concentrated flow reduces outer bank erosion and provides for a better current alignment throughout the bend. Bendway weirs are most often used in large, navigable channels. The Bendway Weir Theory was originally developed to address erosion issues in the Mississippi River. Since the project stream is rather small and has low flow velocities, the use of Bendway Weirs would be unnecessary.

Another option for erosion control is the use of hydraulic jacks. Hydraulic jacks are structures used to prevent the erosion of soil in places such as stream banks and levees. These structures are basically steel or concrete beams in the shape of an "X", placed perpendicular to flow. Wires are sometimes tied to the beams to increase debris catch. The jacks work by trapping debris and sediment in the beams and wires, thus slowing velocities in the area. Examples of hydraulic jacks can be found on the Dodge City levee on the Arkansas River. They were commonly used erosion control structures in the 1940's and 50's, but since then, their popularity and use has diminished.

Currently, the employment of hydraulic jacks is not recommended for erosion control measures.

Finally, riprap for the stream was considered. Riprap is a highly versatile and long-standing method of controlling streambank erosion. Due to the high level of meandering currently occurring in the project area, it was considered the most prudent choice for streambank protection. Based on expected water velocities and geotechnical guidance, 24- inch diameter riprap was selected. Alternatives for the level of riprap were developed based on water surface profiles and channel side slopes. In cases where the 10-year water surface elevations exceeded bankfull, the riprap would only extend to the top of bank. In channel areas above riprap protection, the channel would be grass-lined. In all alternatives, the elevation of the riprap was set to provide protection from the observed cause of the meandering which was toe-cutting and subsequent vertical bank sloughing. Further refinement of the location of the riprap based on additional modeling and detailed topographical information may be warranted in final design. Also in the bridge area, the riprap would tie into the existing riprap and would not be dependent on the calculated elevations. Two side slopes were evaluated. A minimum of a 2 horizontal to 1 vertical side slope was analyzed. Levels of riprap were determined for the 1-, 2-yr, and 10-yr events. The name of the computer model for this analysis is LutherRoad2x1channel. These water surface elevations are shown in Table 3.

Table 3 – River with 2 x 1 Sideslope Riprap

| Reach | River Sta | Profile | Q Total | W.S. Elev | Channel Velocity |
|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft/sec) |
| Luther Road | 9205.516 | 1-yr | 1500 | 1071.07 | 1.96 |
| Luther Road | 9205.516 | 2-yr | 6200 | 1073.5 | 2.36 |
| Luther Road | 9205.516 | 10-yr | 15500 | 1078.37 | 2.24 |
| Luther Road | 9205.516 | 100-yr | 53500 | 1085.06 | 2.78 |
| | | | | | |
| Luther Road | 8102.303 | 1-yr | 1500 | 1067.79 | 5.65 |
| Luther Road | 8102.303 | 2-yr | 6200 | 1072.96 | 2.24 |
| Luther Road | 8102.303 | 10-yr | 15500 | 1078.17 | 2.08 |
| Luther Road | 8102.303 | 100-yr | 53500 | 1084.92 | 2.76 |
| | | | | | |
| Luther Road | 7008.247 | 1-yr | 1500 | 1067.59 | 0.94 |
| Luther Road | 7008.247 | 2-yr | 6200 | 1072.85 | 1.46 |

| | | | | | |
|---|---|---|---|---|---|
| Luther Road | 7008.247 | 10-yr | 15500 | 1078.08 | 1.94 |
| Luther Road | 7008.247 | 100-yr | 53500 | 1084.84 | 2.59 |
| | | | | | |
| Luther Road | 5933.286 | 1-yr | 1500 | 1067.17 | 3.59 |
| Luther Road | 5933.286 | 2-yr | 6200 | 1072.2 | 5.25 |
| Luther Road | 5933.286 | 10-yr | 15500 | 1076.94 | 7.48 |
| Luther Road | 5933.286 | 100-yr | 53500 | 1084.16 | 7.33 |
| | | | | | |
| Luther Road | 4985.455 | 1-yr | 1500 | 1066.09 | 2.62 |
| Luther Road | 4985.455 | 2-yr | 6200 | 1071.12 | 4.43 |
| Luther Road | 4985.455 | 10-yr | 15500 | 1075.41 | 6.78 |
| Luther Road | 4985.455 | 100-yr | 53500 | 1083.44 | 5.85 |
| | | | | | |
| Luther Road | 4410.133 | 1-yr | 1500 | 1064.79 | 5.47 |
| Luther Road | 4410.133 | 2-yr | 6200 | 1069.1 | 8.53 |
| Luther Road | 4410.133 | 10-yr | 15500 | 1074.95 | 5.85 |
| Luther Road | 4410.133 | 100-yr | 53500 | 1083.45 | 3.95 |
| | | | | | |
| Luther Road | 3948.491 | 1-yr | 1500 | 1064.3 | 2.28 |
| Luther Road | 3948.491 | 2-yr | 6200 | 1068.78 | 3.89 |
| Luther Road | 3948.491 | 10-yr | 15500 | 1074.51 | 4.78 |
| Luther Road | 3948.491 | 100-yr | 53500 | 1083.15 | 5.22 |
| | | | | | |
| Luther Road | 3821.16 | | Bridge | | |
| | | | | | |
| Luther Road | 3693.831 | 1-yr | 1500 | 1064.02 | 2.48 |
| Luther Road | 3693.831 | 2-yr | 6200 | 1068.39 | 4.13 |
| Luther Road | 3693.831 | 10-yr | 15500 | 1074.08 | 4.98 |
| Luther Road | 3693.831 | 100-yr | 53500 | 1082.92 | 5.37 |
| | | | | | |
| Luther Road | 2872.639 | 1-yr | 1500 | 1063.86 | 1.39 |
| Luther Road | 2872.639 | 2-yr | 6200 | 1067.91 | 3.60 |
| Luther Road | 2872.639 | 10-yr | 15500 | 1073.51 | 5.23 |
| Luther Road | 2872.639 | 100-yr | 53500 | 1082.68 | 5.03 |
| | | | | | |
| Luther Road | 2072.692 | 1-yr | 1500 | 1063.77 | 1.38 |
| Luther Road | 2072.692 | 2-yr | 6200 | 1067.54 | 3.67 |
| Luther Road | 2072.692 | 10-yr | 15500 | 1072.91 | 5.30 |
| Luther Road | 2072.692 | 100-yr | 53500 | 1082.42 | 4.80 |
| | | | | | |
| Luther Road | 608.6311 | 1-yr | 1500 | 1063.68 | 1.06 |
| Luther Road | 608.6311 | 2-yr | 6200 | 1067.04 | 3.06 |
| Luther Road | 608.6311 | 10-yr | 15500 | 1072 | 4.97 |
| Luther Road | 608.6311 | 100-yr | 53500 | 1082.14 | 4.20 |

A 3 horizontal to 1 vertical side slope was also analyzed for riprap protection. This is a more conventional side slope for riprap. Levels of riprap were determined for the 1-, 2-yr, and 10-yr events. In cases where the 10-year water surface elevations exceeded bankfull, the riprap would only extend to the top of bank. Also in the bridge area, the riprap would tie into the existing riprap and would not be dependent on the calculated elevations. The name of the computer model for this analysis was LutherRoad3x1channel. These water surface elevations are shown in Table 4.

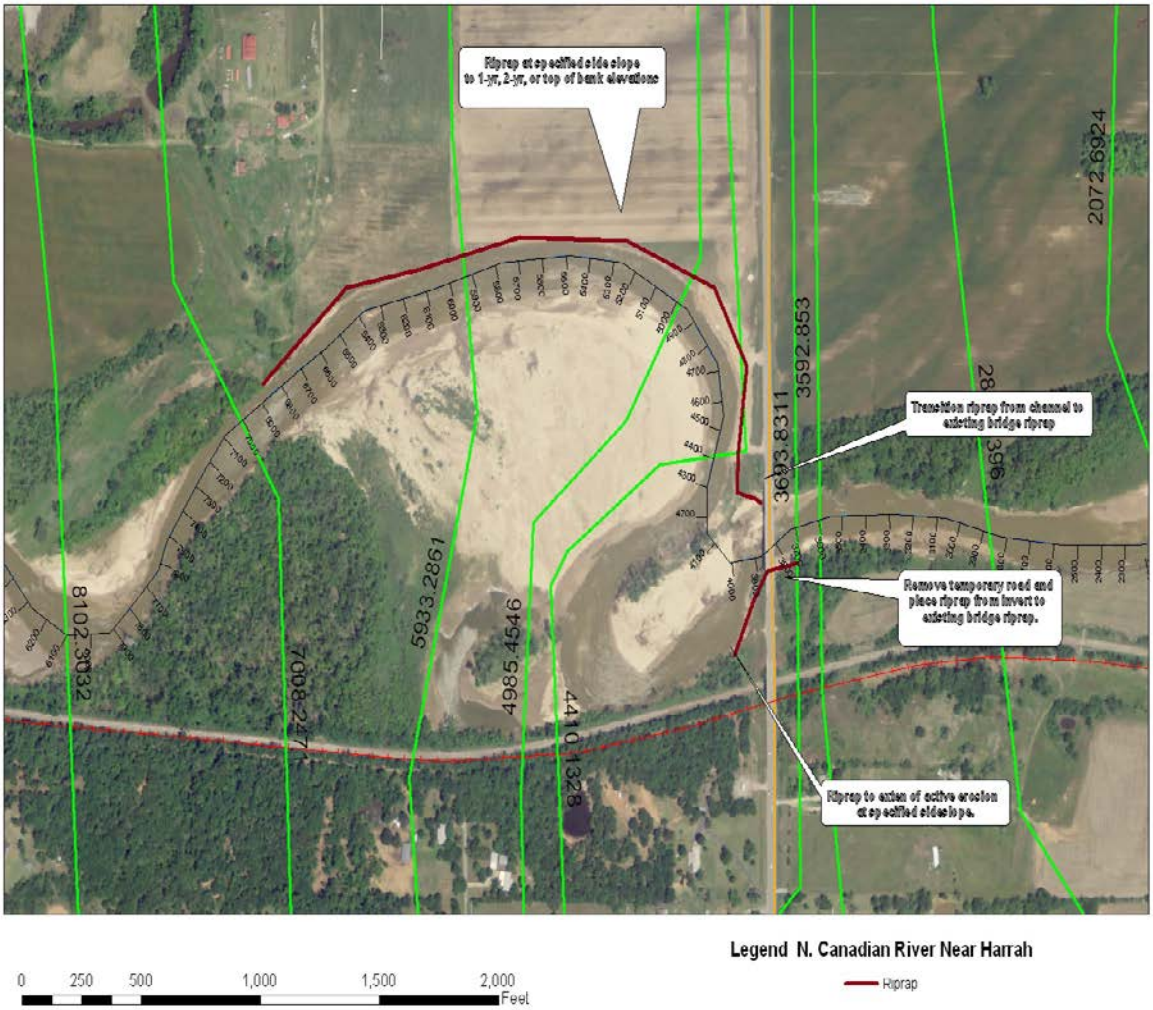
Table 4 – River with 3 x 1 Sideslope Riprap

| Reach | River Sta | Profile | Q Total | W.S. Elev | Channel Velocity |
|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft/sec) |
| Luther Road | 9205.516 | 1-yr | 1500.00 | 1071.07 | 1.96 |
| Luther Road | 9205.516 | 2-yr | 6200.00 | 1073.39 | 2.44 |
| Luther Road | 9205.516 | 10-yr | 15500.00 | 1078.18 | 2.29 |
| Luther Road | 9205.516 | 100-yr | 53500.00 | 1085.02 | 2.80 |
| | | | | | |
| Luther Road | 8102.303 | 1-yr | 1500.00 | 1067.79 | 5.65 |
| Luther Road | 8102.303 | 2-yr | 6200.00 | 1072.79 | 2.34 |
| Luther Road | 8102.303 | 10-yr | 15500.00 | 1077.97 | 2.13 |
| Luther Road | 8102.303 | 100-yr | 53500.00 | 1084.87 | 2.78 |
| | | | | | |
| Luther Road | 7008.247 | 1-yr | 1500.00 | 1067.52 | 0.95 |
| Luther Road | 7008.247 | 2-yr | 6200.00 | 1072.67 | 1.50 |
| Luther Road | 7008.247 | 10-yr | 15500.00 | 1077.87 | 2.01 |
| Luther Road | 7008.247 | 100-yr | 53500.00 | 1084.79 | 2.61 |
| | | | | | |
| Luther Road | 5933.286 | 1-yr | 1500.00 | 1067.09 | 3.51 |
| Luther Road | 5933.286 | 2-yr | 6200.00 | 1072.03 | 5.10 |
| Luther Road | 5933.286 | 10-yr | 15500.00 | 1076.81 | 7.14 |
| Luther Road | 5933.286 | 100-yr | 53500.00 | 1084.12 | 7.13 |
| | | | | | |
| Luther Road | 4985.455 | 1-yr | 1500.00 | 1066.02 | 2.59 |
| Luther Road | 4985.455 | 2-yr | 6200.00 | 1070.97 | 4.34 |
| Luther Road | 4985.455 | 10-yr | 15500.00 | 1075.39 | 6.46 |
| Luther Road | 4985.455 | 100-yr | 53500.00 | 1083.44 | 5.71 |
| | | | | | |
| Luther Road | 4410.133 | 1-yr | 1500.00 | 1064.79 | 5.19 |
| Luther Road | 4410.133 | 2-yr | 6200.00 | 1069.14 | 7.99 |

| | | | | | |
|---|---|---|---|---|---|
| Luther Road | 4410.133 | 10-yr | 15500.00 | 1074.94 | 5.64 |
| Luther Road | 4410.133 | 100-yr | 53500.00 | 1083.45 | 3.91 |
| | | | | | |
| Luther Road | 3948.491 | 1-yr | 1500.00 | 1064.30 | 2.28 |
| Luther Road | 3948.491 | 2-yr | 6200.00 | 1068.78 | 3.89 |
| Luther Road | 3948.491 | 10-yr | 15500.00 | 1074.51 | 4.78 |
| Luther Road | 3948.491 | 100-yr | 53500.00 | 1083.15 | 5.22 |
| | | | | | |
| Luther Road | 3821.16 | | Bridge | | |
| | | | | | |
| Luther Road | 3693.831 | 1-yr | 1500.00 | 1064.02 | 2.48 |
| Luther Road | 3693.831 | 2-yr | 6200.00 | 1068.39 | 4.13 |
| Luther Road | 3693.831 | 10-yr | 15500.00 | 1074.08 | 4.98 |
| Luther Road | 3693.831 | 100-yr | 53500.00 | 1082.92 | 5.37 |
| | | | | | |
| Luther Road | 2872.639 | 1-yr | 1500.00 | 1063.86 | 1.39 |
| Luther Road | 2872.639 | 2-yr | 6200.00 | 1067.91 | 3.60 |
| Luther Road | 2872.639 | 10-yr | 15500.00 | 1073.51 | 5.23 |
| Luther Road | 2872.639 | 100-yr | 53500.00 | 1082.68 | 5.03 |
| | | | | | |
| Luther Road | 2072.692 | 1-yr | 1500.00 | 1063.77 | 1.38 |
| Luther Road | 2072.692 | 2-yr | 6200.00 | 1067.54 | 3.67 |
| Luther Road | 2072.692 | 10-yr | 15500.00 | 1072.91 | 5.30 |
| Luther Road | 2072.692 | 100-yr | 53500.00 | 1082.42 | 4.80 |
| | | | | | |
| Luther Road | 608.6311 | 1-yr | 1500.00 | 1063.68 | 1.06 |
| Luther Road | 608.6311 | 2-yr | 6200.00 | 1067.04 | 3.06 |
| Luther Road | 608.6311 | 10-yr | 15500.00 | 1072.00 | 4.97 |
| Luther Road | 608.6311 | 100-yr | 53500.00 | 1082.14 | 4.20 |

The proposed riprap protection area is shown in Figure 3.

Figure 3 – Proposed Riprap Area



# APPENDIX EA-7

# Real Estate Cost Estimate

APPENDIX EA-7

Luther Road Streambank Stabilization

01 Lands and Damages

| REAL ESTATE INTEREST COSTS | | | | |
|---|---|---|---|---|
| Cost Acct No. | Item | Unit | Quantity | Non-Fed RE Interest Values |
| 01.M.3 | -- Fee, (Type of Fee estate) | Acre | 0 | |
| 01.M.3 | Bank Protection Easement | Acre | 4.9 | $ 11,400.00 |
| 01.M.3 | Drainage Ditch Easement | Acre | 0.8 | $ 2,000.00 |
| 01.M.3 | Access Road Easement | Acre | 0.8 | $ 2,000.00 |
| | Contingencies 15% +/- | | | $ 2,310.00 |
| SUBTOTAL RE VALUE | | | Total | $ 17,710 |

| REAL ESTATE ADMINISTRATION COSTS | | | | | | |
|---|---|---|---|---|---|---|
| Cost Acct No. | Item | Unit | Quantity | Non-Fed Admin Costs Per Unit | Total Non-Federal Admin Cost | Total Fed Admin |
| 01.D.2.D | Prepare Atty Opin.of Compen. | Tr | | - | | - |
| 01.D.2.F | Mapping, Survey | Tr | 4 | $ 3,250.00 | $ 13,000.00 | |
| 01.D.3.D | Compliance Review | Tr | | | | $ - |
| 01.D.3.F | Pre. Title/Ownership data | Tr | 4 | $ 1,000.00 | $ 4,000.00 | |
| 01.F.2.H | Compliance Review | Tr | | | | $ 1,200.00 |
| 01.F.2.F | Prepare appraisals for credit | Tr | 4 | $ 500.00 | $ 2,000.00 | |
| 01.D.4.D | Compliance Review | Tr | | | | $ 2,000.00 |
| 01.D.4.F | Negotiation & Closing | Tr | 4 | $ 2,000.00 | $ 8,000.00 | |
| | Coordination with Non-Fed | | | | | $ 3,000.00 |
| | Compliance Review for Credit | Tr | 4 | | | $ 440.00 |
| | | | | | | |
| | | | Totals | | $ 27,000.00 | $ 6,640.00 |

| | |
|---|---|
| SUBTOTAL Non-Fed Administration Cost | $ 27,000.00 |
| SUBTOTAL Fed Admininistration Cost | $ 6,640.00 |
| TOTAL REAL ESTATE INTEREST | $ 17,710.00 |
| TOTAL LANDS AND DAMAGES | $ 51,350.00 |

# APPENDIX B

# BRIDGE INSPECTION REPORTS

# OKLAHOMA DEPARTMENT OF TRANSPORTATION - Bridge Inspection Report

NBI No.: **19997** Structure No.: 55N3260E1040005 Local ID:179

Suff. Rating: 97.1 Not Deficient

Health Index : -1.0

## IDENTIFICATION

Description:
70',3-100' PREST CONC BM SPANS

State: Oklahoma 2. SHD District: Division 4
County Code: OKLAHOMA 4. Place Code: Unknown
Admin. Area: Cnty. District 2
5. Inventory Route (Route On Structure) : 1 - 4 - 1 - 5582C - 0
6. Feature Intersected: N. CANADIAN RIVER
7. Facility Carried: 5582C (LUTHER RD)
9. Location: .5N of NE 23 & LUTHER Rd 11. Mile Post: 8.498 mi
13. LRS Inv. Route./ Subroute.: -1 -1
16. Latitude: 35 30 00.00 17. Longitude: 097 11 36.00
98. Border Br. Code: Jnknown (P) % Resp. : Unkn 99. Border Br. #: Unknown

## STRUCTURE TYPE AND MATERIALS

43. Main Span Material and Design Type
Prestressed Concrete Stringer/Girder
44. Approach Span Material and Design Type
~~Unknown (NBI)~~ N/A ~~Unknown (P)~~ N/A
45. No. of Spans Main Unit: 4 46. No. of Approach Spans: 0
107. Deck Type: 1 Concrete-Cast-in-Place
108A. Wearing Surface: 1 Monolithic Concrete
108B. Membrane: 0 None
108C. Deck Protection: None

## AGE AND SERVICE

27. Year Built: 1981 106. Year Reconstructed: ~~Unknown~~ 0000
28A. Lanes on: 2 28B. Lanes Under: ~~-1~~ 0 19. Detour Length: 4.0 mi
29. ADT: 3000 30. Year of ADT: 2002 109. Truck ADT %: 15
42A. Type of Service on: 1 Highway
42B. Type of Service under: 5 Waterway

## GEOMETRIC DATA

10. Inv. Rte. Min. Vert. Clr.: 328.1 ft
32. Approach Roadway Width (W/ Shoulders): 25.0 ft
Deck Area: 13,024.3 sq. ft 33. Median: 0 No median
Skew: 0 35. Structure Flared: 0 No flare
47. Inv. Rte. Total Horiz. Clr.: 32.0 ft
48. Length Maximum Span: 100.1 ft 49. Structure Length: 372.0 ft
50A. Curb/Sdwlk Wdth L: 0.0 ft 50B. Curb/Sidewalk Width R: 0.0 ft
51. Width Curb to Curb: 32.0 ft 52. Width Out to Out: 35.0 ft
53. Minimum Vertical Clearance Over Bridge: 328.1 ft
54A/54B. Min. Vert. Underclearance : N Feature not hwy or RR 0.0 ft

| | N/E | | | S/W | | |
|---|---|---|---|---|---|---|
| Meas. | -1 0000 | -1 | -1 | -1 | -1 | -1 |
| Post. | -1 | -1 | -1 | -1 | -1 | -1 |

55A/55B. Minimum Lateral Undrclearance R: N Feature not hwy or RR 327.8 ft
56. Minimum Lateral Undrclearance L: ~~327.8~~ ft 0

## INSPECTION 11-30-09

| Type | Insp Req. | Insp Done | Freq: | Insp. Date: | Next Insp.: |
|---|---|---|---|---|---|
| NBI: | | Y | 24 | ~~12/19/2007~~ | 12/19/2009 |
| Element: | | Y | 24 | 12/19/2007 | 12/19/2009 |
| FC Freq.: | N | N | NA | NA | NA |
| UW Freq.: | N | N | NA | NA | NA |
| OS Freq.: | N | N | NA | NA | NA |

## CLASSIFICATION

12. Base Hwy Network : Not on Base Network 20. Toll Facility: 3 On free road
21. Custodian: 02 County Hwy Agency 22. Owner: 02 County Hwy Agency
26. Functional Class: 07 Rural Mjr Collecto 37. Historical Sig.: 5 Not eligible for NRHP
100. Defense Highway: 0 Not a STRAHNET h 101. Parallel Structure: No || bridge exists
102. Dir. of Traffic: 2 2-way traffic 103. Temp. Structure: ~~Unknown (NBI)~~ N/A
104. Highway System: 0 Not on NHS 105. Fed. Land Hwy 0 N/A (NBI)
110. National Truck Network: 0 Not part of nat 112. NBIS Length: Long Enough

## CONDITION

58. Deck: 6 Satisfactory 59. Super.: 7 Good 60. Sub.: ~~7~~ 5 Good
62. Culvert: N N/A (NBI) 61. Channel/Channel Protection: 6 Bank Slumping
Flowline Notes: 4'
EAST PARAPAT WALL TO FL = ~~37.3~~ 42'-10" WITH ~~24~~ 4' OF WATER

## LOAD RATING AND POSTING

31. Design Load: 5 MS 18 (HS 20/HS20+M 41. Posting status: A Open, no restriction
63. Op. Rating Method: Allowable Stress Alt. Op. Rating Meth.: Allowable Stress
64. Operating Rating (H / HS / 3-3 ): 50.0 89.9 -1.1
66. Inventory Rating ( H / HS / 3-3 ) : 19.9 36.0 -1.1
65. Inv. Rating Method: Allowable Stress Alt. Inv. Rating Meth.: Allowable Stress
70. Posting: 5 At/Above Legal Loads Date Rated : ~~5/2/1996~~ 1-14-02

## PROPOSED IMPROVEMENTS

94. Bridge Cost: $638,000 75. Type of Work: 31 Repl-Load Capacity
95. Roadway Cost: $351,000 76. Lgth. of Improvment: 410.1 ft
96. Total Cost: $1,001,000 114. Future ADT: 4800
97. Year of Cost Est.: 2004 115. Year of Future ADT: 2024

## NAVIGATION DATA

38. Navigation Control: Permit Not Required
39. Vertical Clearance: 0.0 ft 40. Horizontal Clearance: 0.0 ft
111. Pier Protection: 1 Not Required 116. Lift Bridge Vert. Clear.: 0.0 ft

## APPRAISAL

36A. Bridge Rail: 1 Meets Standards 36C. Approach Rail: 1 Meets Standards
36B. Transition: 1 Meets Standards 36D. Approach Rail Ends: 1 Meets Standards
67. Str. Evaluation: 7 Above Min Criteria 68. Deck Geometry: 4 Tolerable
69. Underclearance, Vertical and Horizontal: N Not applicable (NBI)
71. Waterway Adequacy: 8 Equal Desirable
72. Approach Alignment: 8 Equal Desirable Crit
113. Scour Critical: ~~7 Counterneasures~~ 8

200c. Temperature: ~~52~~ 58
200d. Weather: ~~PARTLY CLOUDY~~ CLR
201. Structural Steel ASTM Desig.: -1 -1
202. Waterproof Membrane : -1
Date Installed : 1/1/1901
203. Type Exp. Dev. : Armored Joint
-
204. Type of Handrail: Sloped Faced Parapet
205. Material and Quantity : -1.0
208. Type of Abutment : Skeleton
Type of Foundation : Steel Piling
209. Type of Pier / Found.: 2 Piers No
Drilled Shaft - No Footings
210. Foundation Elev. -1.0 -1.0
-1.0 -1.0 -1.0
211. Wear. Surf. Prot. System : -
Date Installed : 1/1/1901
Utilities Attached : -1
-1 -1 -1
-1 -1 -1

## STATE OF OKLAHOMA BRIDGE ITEMS

214a. Posted Weight Limit: NR
b. Posted Speed Limit : N
c. Narrow/One Lane Bridge sign : ~~N~~ N00
d. Vertical Clearance Sign: NO
Advanced Warning Sign : NO
Exisiting/Recommended Posting : N N
Min./ Max Vert. Clearance : N N
e. Navigation Lights : NO
Working/Not Working : NO
215. Overpass : D - ACCO Off System
221. Substructure Cond. (U/W) : -
222. Fill over RCB: -1
223. Appr. Slab/Rdwy Cond.: Good
224. Critical Feature Type: -1
225. Paint Type : -
Overcoat : -
226. Date Painted: -1
227. Paint Coloring: -1
233. Deck Forming: -
236. Deck Cleaning : -1

238. School Bus Rte: ~~Not on Desired or Current~~
240. Appr. Roadway Type: Asphalt/Bituminous
243. Girder Spacing : -1.0
244. Span Lengths :
100 70 -1
100 -1 -1
100 -1
245. Girder Depth : -1.000
246. Type of Overlay : _
246. Overlay Thickness : -1.0
246. Overlay Date : 1/1/1901
246. Overlay Depth Changed > 1"? _
247. Protective Systems : 1: ~~Working Cathodic P~~
2: _ 3: _
4: _ 5: _
248. No. of Field Splices w/ Corrosion : -1
249. Scour Crit. POA exists?: _
250. Culvert Headwall Dist.: -1.0
254. Thru Truss Type : _
256. Chan. Profile Up/Down Stream?: D.S.

# OKLAHOMA DEPARTMENT OF TRANSPORTATION - Bridge Inspection Report

NBI No.: **19997** Structure No.: 55N3260E1040005 Local ID:179

Suff. Rating: 97.1 Not Deficient

Health Index : -1.0

Inspection Date: ~~12/19/2007~~ Reported By: ~~GWILSON~~ MB

Invoice No.: OKCO1 11/30/09 Inspected With: ~~T0010738E60B0000003E~~

Agency : Cobb Eng. S. Hunt

**Structure / Inspection Notes**

< none >

| Elm. | Env. | Description | Un. | Qty. | Qty.St. 1 | % 1 | Qty.St. 2 | % 2 | Qty.St. 3 | % 3 | Qty.St. 4 | % 4 | Qty.St. 5 | % 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 1 | Concrete Deck - Protected w/ Coated Bars | (SF) | 13,057 | 0 | 0 % | 13,057 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 109 | 1 | P/S Conc Open Girder/Beam | (LF) | 1,660 | 1,660 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 119 | 1 | P/S Conc Open Girder/Beam Ends (5ft.) | (LF) | 200 | 200 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 205 | 1 | Reinforced Conc Column or Pile Extension | (EA) | 6 | 6 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 215 | 1 | Reinforced Conc Abutment | (LF) | 69 | 69 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 234 | 1 | Reinforced Conc Cap | (LF) | 105 | 103 | 98 % | 2 | 2 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 302 | 1 | Compression Joint Seal | (LF) | 105 | 0 | 0 % | 70 | 67 % | 35 | 33 % | 0 | 0 % | 0 | 0 % |
| 310 | 1 | Elastomeric Bearing | (EA) | 30 | 0 | 0 % | 26 ~~30~~ | 100 % | 4 ~~0~~ | 0 % | 0 | 0 % | 0 | 0 % |
| 331 | 1 | Reinforced Conc Bridge Railing | (LF) | 748 | 700 ~~748~~ | 100 % | 48 ~~0~~ | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 358 | 1 | Deck Cracking | (EA) | 1 | 1 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 359 | 1 | Soffit of Concrete Deck or Slab | (EA) | 1 | 1 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 361 | 1 | Scour | (EA) | 1 | 1 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |

Additional Elements 316 - BEARING ASSEM (26) (4)
365 - DEBRIS (1)

| Elem. | Element Notes (Include Size and Location of Deterioration |
|---|---|
| 26 | POP PUTS ALL OVER, NEAR CENTER OF DECK 3 OR 4 AREAS PATCHED, ~~DECK NEEDS CLEANED OF ROCKS~~ |
| 109 | < none > |
| 119 | < none > |
| 205 | < none > |
| 215 | < none > |
| 234 | #3 PIER CAP HAS SPALL AND EXPOSED REBAR AT WEST SIDE - MINOR |
| 302 | RUBBER FELL OUT |
| 310 | MINOR CRACKING ALL STUDS HVY FRECKLED RUST - OUTSIDE BEARINGS HVY RUST W/ MOD PITTING |
| 331 | < none > AREAS OF IMPACT SCRAPES - SMALL SPALLS W/ REBAR |
| 358 | HAIRLINE transverse cracks in deck. |
| 359 | < none > |
| 361 | SCOUR AROUND SOUTH PIER COLUMNS, UP TO 3 FEET OF SCOUR |

365 - U.S. DRIFT CAUGHT ON PIER AND SMALL BAR JUST U OF STA.

# OKLAHOMA BRIDGE ITEMS

## Channel Profile Measurements

Date: 11-30-09 Bridge Number: 179

Bridge Location:

Side of bridge measurements are taken on (Upstream, Downstream) Downstream

Feature on the bridge profile measurements are taken from (Curb, Railing) Top of Rail

| Substructure unit or other feature | Measurement from Substructure unit | Profile Measurement | Comments |
|---|---|---|---|
| Abutment | 0 | 10.3 Ft | |
| Pier + Edge of water | 100 | 37.7 Ft | |
| Flowline | 150 | 42.10 Ft | water Approx 4 Ft Deep |
| Pier | 200 | 39.6 Ft | |
| Edge of water | 215 | 33.11 Ft | |
| Pier | 300 | 27.4 Ft | |
| Abutment | 372 | 9 Ft | |
| | | | |
| | | | |
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| | | | |
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| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**CHANNEL PROFILE MEASUREMENTS**

This section provides a way to enter channel profile measurements into Pontis for piers, flowlines, debris, etc. Space is provided for up to 15 channel profile measurements per bridge. See Flowline Notes, above, to indicate whether the channel measurements are taken upstream or downstream and where the measurements are taken from. Currently this data is not displayed on any Pontis report.

Distance from beginning of bridge to baseline: Enter '0' if measurement begins at the abutment. For long bridges with no significant events to measure near the abutment, enter a horizontal distance (up to 999.9 ft.) from the abutment to the first point of measurement.

Distance from baseline to point of profile measurement: Enter the horizontal distance (up to 999.9 ft.) from the point of first measurement (e.g., abutment) to the object being measured.

Profile measurement: Enter the vertical distance (up to 99.9 ft.) from the point of reference (bridge deck, top of curb, etc.) down to the object being measured. Enter the value as a positive number.

Object Measured: Select the object to which the measurement is taken: Abutment, Pier, Slope Change, Edge of Water, Flowline, Edge of Debris, Top of Debris or Other.

# BRIDGE SCOUR OFFICE ASSESSMENT FORM

Cobb

**Division:** 04 **County:** Oklahoma **Local Id:** 179 **NBI#:** 199970000000000

**Structure No.:** 55N3260E1040005 **River Or Creek Name:** N. CANADIAN RIVER

**Type Of Foundation:** Unknown Spread footing Pile Bents Pile Footings Drilled Shafts Culvert

**Bridge Length:** 372.05000000000001 ft **Bridge Width:** 35 ft

**Flowline Measurement/ Location From Last 10 Inspections:**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Inspection Year | 2009 | 2007 | 2005 | 2003 | 2001 | 1999 | 1997 | 1995 | | |
| Flowline measurement | 42'-10" | 37'-3" | 36'-8" | 36'-0" | 35' | — | — | 35' | | |
| location of flowline | | | | | | | | | | |

**Degrading Flowline?** Yes or no

**Migrating Channel?** Yes or no

**Field Observation?** Yes or no

**Scour Computations** Made? Needed?
No Evaluation Based On Engineering Judgment

**Scour Potential?** [appendix C -23 Pontis manual] NO YES, OBSERVED

**Stable?** YES

**Compute SCRF to get recommended inspection frequency [Using instruction sheet]**
*******If recommended item 113 < = 3 then keep at 1 yr and keep rating**

**SPF=** 2 **LDA=** 1 **LBL=** 3 **ST=** 2 **SF=** 0.1 **SCRF=** 9
**SPF+LDA =** 3

**Recommended Inspection Freq.:** 2 yrs

**Recommended Item 113 coding:** 4 **POA needed?** No
****IF CODING IS DIFFERENT THAN WHAT IS IN INSPECTION, YOU MUST UPDATE PONTIS AND NOTIFY TEAM LEADER.

**Date Inspected:** 11-30-09 **Team Leader** Mike Baldwin

**Date Assessed:** 1-21-10 **Program Manager** Taylor Barnes

**Scour Elevation:[if computed]** **Foundation Bottom Elevation:**

**Remarks:**

**SIGNED**
**(must be signed sealed and dated by Program Manager approved in Contract**

**PE seal, date**

# OKLAHOMA COUNTY - OFF SYSTEM

STRUCTURE NO. 179

LOOKING NORTH

# OKLAHOMA COUNTY - OFF SYSTEM

STRUCTURE NO. 179

3RD DECK SPAN

# OKLAHOMA COUNTY - OFF SYSTEM

STRUCTURE NO. 179

2ND DECK SPAN

LOOKING WEST

# OKLAHOMA COUNTY - OFF SYSTEM

STRUCTURE NO. 179

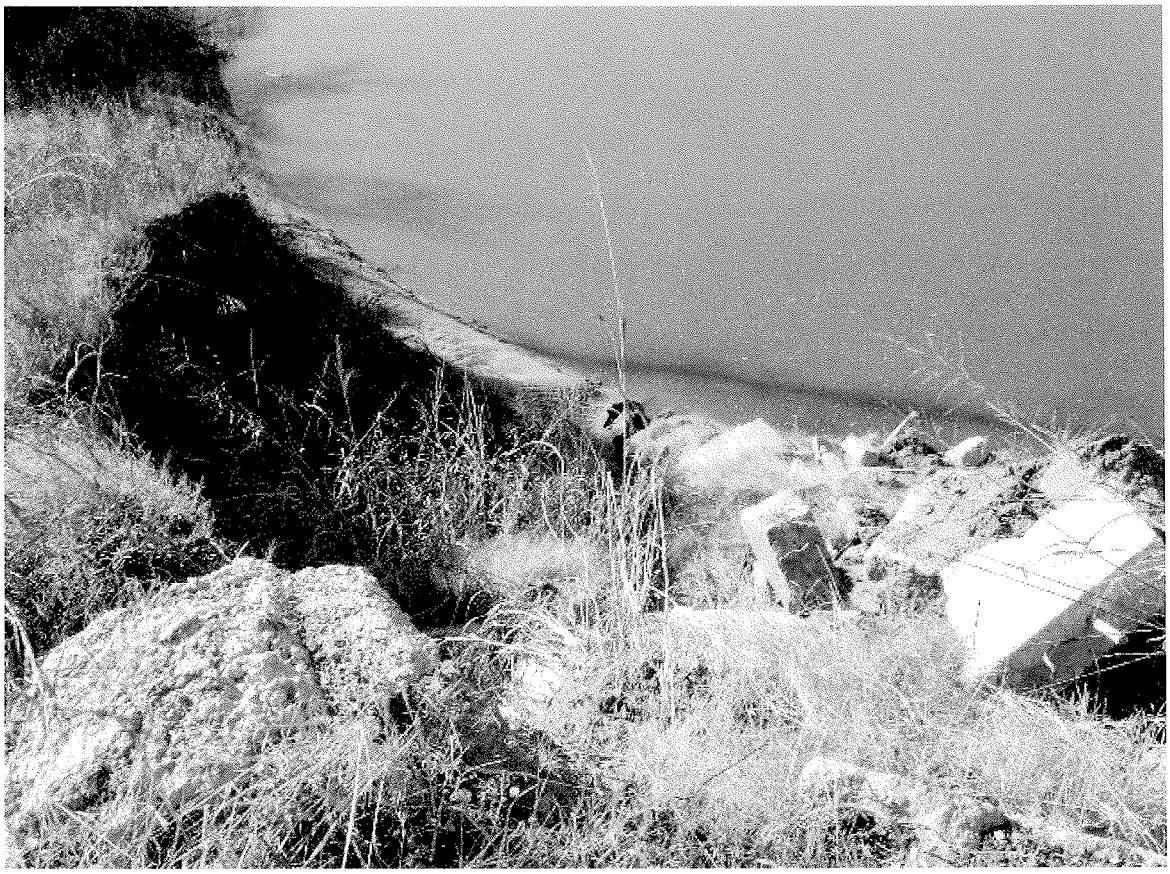
EAST CREEK

WEST CREEK

# OKLAHOMA COUNTY - OFF SYSTEM

STRUCTURE NO. 179

DRIFT



UPSTREAM BANK EROSION

# OKLAHOMA DEPARTMENT OF TRANSPORTATION - Bridge Inspection Report

NBI No.: **19972** Structure No.: 55N3260E1040006 Local ID:180

Suff. Rating: 97.1 Not Deficient

Health Index : 96.5

## IDENTIFICATION

Description:
45'-60'-45' PREST CONC BM SPANS
1. State: Oklahoma 2. SHD District: Division 4
3. County Code: OKLAHOMA 4. Place Code: Unknown
Admin. Area: Cnty. District 2
5. Inventory Route (Route On Structure) : 1 - 4 - 1 - N3260 - 0
6. Feature Intersected: R.R.
7. Facility Carried: N3260 (LUTHER RD) _
9. Location: .4N OF NE 23 11. Mile Post: 8.398 mi
13. LRS Inv. Route./ Subroute.: -1 -1
16. Latitude: 35 29 56.15 17. Longitude: 097 11 40.88
98. Border Br. Code: Jnknown (P) % Resp. : Unkn 99. Border Br. #: Unknown

## STRUCTURE TYPE AND MATERIALS

43. Main Span Material and Design Type
Prestressed Concrete Stringer/Girder
44. Approach Span Material and Design Type
Unknown (NBI) Unknown (P)
45. No. of Spans Main Unit: 3 46. No. of Approach Spans: 0
107. Deck Type: 1 Concrete-Cast-in-Place
108A. Wearing Surface: 1 Monolithic Concrete
108B. Membrane: 0 None
108C. Deck Protection: None

## AGE AND SERVICE

27. Year Built: 1981 106. Year Reconstructed: -4
28A. Lanes on: 2 28B. Lanes Under: 0 19. Detour Length: 4.0 mi
29. ADT: 3000 30. Year of ADT: 2007 109. Truck ADT %: 15
42A. Type of Service on: 1 Highway
42B. Type of Service under: 2 Railroad

## GEOMETRIC DATA

10. Inv. Rte. Min. Vert. Clr.: 328.1 ft
32. Approach Roadway Width (W/ Shoulders): 33.0 ft
Deck Area: 5,317.4 sq. ft 33. Median: 0 No median
34. Skew: 0 35. Structure Flared: 0 No flare
47. Inv. Rte. Total Horiz. Clr.: 32.0 ft
48. Length Maximum Span: 60.0 ft 49. Structure Length: 151.9 ft
50A. Curb/Sdwlk Wdth L: 0.0 ft 50B. Curb/Sidewalk Width R: 0.0 ft
51. Width Curb to Curb: 32.0 ft 52. Width Out to Out: 35.0 ft
53. Minimum Vertical Clearance Over Bridge: 328.1 ft
54A/54B. Min. Vert. Underclearance : R Railroad beneath struc 0.0 ft

| | N/E | | | S/W | | |
|---|---|---|---|---|---|---|
| Meas. | X0000 | -1 | -1 | X0000 | -1 | -1 |
| Post. | X0000 | -1 | -1 | X0000 | -1 | -1 |

55A/55B. Minimum Lateral Undrclearance R: R Railroad beneath struc 10.0 ft
56. Minimum Lateral Undrclearance L: 47.0 ft

## INSPECTION

| Type | Insp Req. | Insp Done | Freq: | Insp. Date: | Next Insp.: |
|---|---|---|---|---|---|
| NBI: | | Y | 24 | **11/30/2009** | 11/30/2011 |
| Element: | | Y | 24 | 11/30/2009 | 11/30/2011 |
| FC Freq.: | N | N | NA | NA | NA |
| UW Freq.: | N | N | NA | NA | NA |
| OS Freq.: | N | N | NA | NA | NA |

## CLASSIFICATION

12. Base Hwy Network : Not on Base Network 20. Toll Facility: 3 On free road
21. Custodian: 0 County Hwy Agency 22. Owner: 02 County Hwy Agency
26. Functional Class: 07 Rural Mjr Collecto 37. Historical Sig.: 5 Not eligible for NRHP
100. Defense Highway: 0 Not a STRAHNET h 101. Parallel Structure: No || bridge exists
102. Dir. of Traffic: 2 2-way traffic 103. Temp. Structure: Not Applicable (P)
104. Highway System: 0 Not on NHS 105. Fed. Land Hwy 1 IRR-Indian Res Rd
110. National Truck Network: 0 Not part of nat 112. NBIS Length: Long Enough

## CONDITION

58. Deck: 6 Satisfactory 59. Super.: 7 Good 60. Sub.: 7 Good
62. Culvert: N N/A (NBI) 61. Channel/Channel Protection: N N/A (NBI)
Flowline Notes:
28' FROM TOP OF DECK TO TOP OF RAILROAD RAIL

## LOAD RATING AND POSTING

31. Design Load: 5 MS 18 (HS 20/HS20+M 41. Posting status: A Open, no restriction
63. Op. Rating Method: Allowable Stress Alt. Op. Rating Meth.: Allowable Stress
64. Operating Rating (H / HS / 3-3 ): 40.0 73.0 -1.1
66. Inventory Rating ( H / HS / 3-3 ) : 19.9 36.0 -1.1
65. Inv. Rating Method: Allowable Stress Alt. Inv. Rating Meth.: Allowable Stress
70. Posting: 5 At/Above Legal Loads Date Rated : 1/2/1996

## PROPOSED IMPROVEMENTS

94. Bridge Cost: $236,000 75. Type of Work: 31 Repl-Load Capacity
95. Roadway Cost: $130,000 76. Lgth. of Improvment: 151.9 ft
96. Total Cost: $376,000 114. Future ADT: 4800
97. Year of Cost Est.: 2007 115. Year of Future ADT: 2027

## NAVIGATION DATA

38. Navigation Control: NA-no waterway
39. Vertical Clearance: 0.0 ft 40. Horizontal Clearance: 0.0 ft
111. Pier Protection: 1 Not Required 116. Lift Bridge Vert. Clear.: 0.0 ft

## APPRAISAL

36A. Bridge Rail: 1 Meets Standards 36C. Approach Rail: 1 Meets Standards
36B. Transition: 1 Meets Standards 36D. Approach Rail Ends: 0 Substandard
67. Str. Evaluation: 7 Above Min Criteria 68. Deck Geometry: 4 Tolerable
69. Underclearance, Vertical and Horizontal: N Not applicable (NBI)
71. Waterway Adequacy: N Not applicable
72. Approach Alignment: 8 Equal Desirable Crit
113. Scour Critical: N Not Over Waterway

200c. Temperature: 58
200d. Weather: CLEAR
201. Structural Steel ASTM Desig.: -1 -1
202. Waterproof Membrane : -1
Date Installed : 1/1/1901
203. Type Exp. Dev. : Sealed Expansion Joint
-
204. Type of Handrail: Sloped Faced Parapet
205. Material and Quantity : -1.0
208. Type of Abutment : Skeleton
Type of Foundation : Steel Piling
209. Type of Pier / Found.: 2 Piers Yes
Drilled Shaft - No Footings
210. Foundation Elev. -1.0 -1.0
-1.0 -1.0 -1.0
211. Wear. Surf. Prot. System : -
Date Installed : 1/1/1901
213. Utilities Attached : -1
-1 -1 -1
-1 -1 -1

## STATE OF OKLAHOMA BRIDGE ITEMS

214a. Posted Weight Limit: NR
b. Posted Speed Limit : N
c. Narrow/One Lane Bridge sign : N00
d. Vertical Clearance Sign: NO
Advanced Warning Sign : NO
Exisiting/Recommended Posting : N N
Min./ Max Vert. Clearance : N N
e. Navigation Lights : NO
Working/Not Working : NO
215. Overpass : D - ACCO Off System
221. Substructure Cond. (U/W) : -
222. Fill over RCB: -1
223. Appr. Slab/Rdwy Cond.: Good
224. Critical Feature Type: -1
225. Paint Type : -
Overcoat : 0
226. Date Painted: -1
227. Paint Coloring: -1
233. Deck Forming: -
236. Deck Cleaning : -1

238. School Bus Rte: Current and Desired Route
240. Appr. Roadway Type: Asphalt/Bituminous
243. Girder Spacing : -3.0
244. Span Lengths :
45 -1 -1
60 -1 -1
45 -1
245. Girder Depth : 36.000
246. Type of Overlay : _
246. Overlay Thickness : -1.0
246. Overlay Date : 1/1/1901
246. Overlay Depth Changed > 1"? _
247. Protective Systems : 1: Working Cathodic P
2: _ 3: _
4: _ 5: _
248. No. of Field Splices w/ Corrosion : -1
249. Scour Crit. POA exists?: No
250. Culvert Headwall Dist.: -1.0
254. Thru Truss Type : _
256. Chan. Profile Up/Down Stream?: _

# *OKLAHOMA DEPARTMENT OF TRANSPORTATION* - Bridge Inspection Report

NBI No.: **19972** Structure No.: 55N3260E1040006 Local ID:180

Suff. Rating: 97.1 Not Deficient

Health Index : 96.5

Inspection Date: 11/30/2009 Reported By: MBALDWIN

Invoice No.: OKCO09 Inspected With: SCOTT HUNT

Agency : Cobb Eng.

**Structure / Inspection Notes**

CONC SLOPES ARE STARTING TO SEPERATE FROM ABUTMENTS, MONITOR

< none >

| Elm. | Env. | Description | Un. | Qty. | Qty.St. 1 | % 1 | Qty.St. 2 | % 2 | Qty.St. 3 | % 3 | Qty.St. 4 | % 4 | Qty.St. 5 | % 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 4 | Concrete Deck - Protected w/ Coated Bars | (SF) | 5,328 | 0 | 0 % | 5,328 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 109 | 4 | P/S Conc Open Girder/Beam | (LF) | 480 | 480 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 119 | 4 | P/S Conc Open Girder/Beam Ends (5ft.) | (LF) | 120 | 120 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 205 | 4 | Reinforced Conc Column or Pile Extension | (EA) | 4 | 4 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 210 | 4 | Reinforced Conc Pier Wall | (LF) | 33 | 33 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 215 | 4 | Reinforced Conc Abutment | (LF) | 69 | 69 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 234 | 4 | Reinforced Conc Cap | (LF) | 69 | 69 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 302 | 4 | Compression Joint Seal | (LF) | 69 | 0 | 0 % | 69 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 310 | 4 | Elastomeric Bearing | (EA) | 24 | 24 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 316 | 4 | Steel Bearing Assenbly | (EA) | 24 | 24 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 331 | 4 | Reinforced Conc Bridge Railing | (LF) | 305 | 305 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 359 | 4 | Soffit of Concrete Deck or Slab | (EA) | 1 | 1 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |

Additional Elements

| Elem. | Element Notes (Include Size and Location of Deterioration |
|---|---|
| 26 | Deck is starting to get small pop-outs all over - SMALL SPALLS AROUND JOINT AREAS |
| 109 | < none > |
| 119 | < none > |
| 205 | < none > |
| 210 | < none > |
| 215 | < none > |
| 234 | < none > |
| 302 | FILLED WITH DIRT AND DEBRIS, NEEDS CLEANED OUT |
| 310 | < none > |
| 316 | |
| 331 | < none > |
| 359 | < none > |

# OKLAHOMA DEPARTMENT OF TRANSPORTATION - Bridge Inspection Report

NBI No.: **19972** Structure No.: 55N3260E1040006 Local ID:180

Suff. Rating: 97.1 Not Deficient

Health Index : -1.0

## IDENTIFICATION

Description:
45'-60'-45' PREST CONC BM SPANS

State: Oklahoma 2. SHD District: Division 4
County Code: OKLAHOMA 4. Place Code: Unknown
Admin. Area: Cnty. District 2
5. Inventory Route (Route On Structure) : 1 - 4 - 1 - N3260 - 0
6. Feature Intersected: R.R.
7. Facility Carried: N3260 (LUTHER RD)
9. Location: .4N OF NE 23 11. Mile Post: 8.398 mi
13. LRS Inv. Route./ Subroute.: -1 -1
16. Latitude: 35 29 54.00 17. Longitude: 097 11 36.00
98. Border Br. Code: Jnknown (P) % Resp. : Unkn 99. Border Br. #: Unknown

## STRUCTURE TYPE AND MATERIALS

43. Main Span Material and Design Type
Prestressed Concrete Stringer/Girder
44. Approach Span Material and Design Type
Unknown (NBI) Unknown (P)
45. No. of Spans Main Unit: 3 46. No. of Approach Spans: 0
107. Deck Type: 1 Concrete-Cast-in-Place
108A. Wearing Surface: 1 Monolithic Concrete
108B. Membrane: 0 None
108C. Deck Protection: None

## AGE AND SERVICE

27. Year Built: 1981 106. Year Reconstructed: ~~Unknown~~ 0000
28A. Lanes on: 2 28B. Lanes Under: ~~-1~~ 0 19. Detour Length: 4.0 mi
29. ADT: 3000 30. Year of ADT: 2002 109. Truck ADT %: 15
42A. Type of Service on: 1 Highway
42B. Type of Service under: 2 Railroad

## GEOMETRIC DATA

10. Inv. Rte. Min. Vert. Clr.: 328.1 ft
32. Approach Roadway Width (W/ Shoulders): 33.0 ft
Deck Area: 5,317.4 sq. ft 33. Median: 0 No median
Skew: 0 35. Structure Flared: 0 No flare
47. Inv. Rte. Total Horiz. Clr.: 32.0 ft
48. Length Maximum Span: 60.0 ft 49. Structure Length: 151.9 ft
50A. Curb/Sdwlk Wdth L: 0.0 ft 50B. Curb/Sidewalk Width R: 0.0 ft
51. Width Curb to Curb: 32.0 ft 52. Width Out to Out: 35.0 ft
53. Minimum Vertical Clearance Over Bridge: 328.1 ft
54A/54B. Min. Vert. Underclearance : R Railroad beneath struc 0.0 ft

| | N/E | | | S/W | | |
|---|---|---|---|---|---|---|
| Meas. | -1 | -1 | -1 | -1 | -1 | -1 |
| Post. | -1 | -1 | -1 | -1 | -1 | -1 |

55A/55B. Minimum Lateral Undrclearance R: R Railroad beneath struc 10.0 ft
56. Minimum Lateral Undrclearance L: 47.0 ft

## INSPECTION 11-30-09

| Type | Insp Req. | Insp Done | Freq: | Insp. Date: | Next Insp.: |
|---|---|---|---|---|---|
| NBI: | | Y | 24 | ~~12/19/2007~~ | 12/19/2009 |
| Element: | | Y | 24 | 12/19/2007 | 12/19/2009 |
| FC Freq.: | N | N | NA | NA | NA |
| UW Freq.: | N | N | NA | NA | NA |
| OS Freq.: | N | N | NA | NA | NA |

## CLASSIFICATION

12. Base Hwy Network : Not on Base Network 20. Toll Facility: 3 On free road
21. Custodian: 02 County Hwy Agency 22. Owner: 02 County Hwy Agency
26. Functional Class: 07 Rural Mjr Collector 37. Historical Sig.: 5 Not eligible for NRHP
100. Defense Highway: 0 Not a STRAHNET h 101. Parallel Structure: No || bridge exists
102. Dir. of Traffic: 2 2-way traffic 103. Temp. Structure: Unknown (NBI)
104. Highway System: 0 Not on NHS 105. Fed. Land Hwy 0 N/A (NBI)
110. National Truck Network: 0 Not part of nat 112. NBIS Length: Long Enough

## CONDITION

58. Deck: 6 Satisfactory 59. Super.: 7 Good 60. Sub.: 7 Good
62. Culvert: N N/A (NBI) 61. Channel/Channel Protection: N N/A (NBI)
Flowline Notes:
28' FROM TOP OF DECK TO TOP OF RAILROAD RAIL

## LOAD RATING AND POSTING

31. Design Load: 5 MS 18 (HS 20/HS20+M 41. Posting status: A Open, no restriction
63. Op. Rating Method: Allowable Stress Alt. Op. Rating Meth.: Allowable Stress
64. Operating Rating (H / HS / 3-3 ): 40.0 73.0 -1.1
66. Inventory Rating ( H / HS / 3-3 ) : 19.9 36.0 -1.1
65. Inv. Rating Method: Allowable Stress Alt. Inv. Rating Meth.: Allowable Stress
70. Posting: 5 At/Above Legal Loads Date Rated : ~~1/2/1996~~ 1/14/02

## PROPOSED IMPROVEMENTS

94. Bridge Cost: $236,000 75. Type of Work: 31 Repl-Load Capacity
95. Roadway Cost: $130,000 76. Lgth. of Improvment: 151.9 ft
96. Total Cost: $376,000 114. Future ADT: 4800
97. Year of Cost Est.: 2004 115. Year of Future ADT: 2024

## NAVIGATION DATA

38. Navigation Control: NA-no waterway
39. Vertical Clearance: 0.0 ft 40. Horizontal Clearance: 0.0 ft
111. Pier Protection: 1 Not Required 116. Lift Bridge Vert. Clear.: 0.0 ft

## APPRAISAL

36A. Bridge Rail: 1 Meets Standards 36C. Approach Rail: 1 Meets Standards
36B. Transition: 1 Meets Standards 36D. Approach Rail Ends: ~~0 Substandard~~ 1
67. Str. Evaluation: 7 Above Min Criteria 68. Deck Geometry: 4 Tolerable
69. Underclearance, Vertical and Horizontal: N Not applicable (NBI)
71. Waterway Adequacy: N Not applicable
72. Approach Alignment: 8 Equal Desirable Crit
113. Scour Critical: N Not Over Waterway NO SCOUR ITEMS ON THIS BRIDGE

200c. Temperature: ~~51~~ 58
200d. Weather: ~~PARTLY CLOUDY~~ CLR
201. Structural Steel ASTM Desig.: -1 -1
202. Waterproof Membrane : -1
Date Installed : 1/1/1901
203. Type Exp. Dev. : - SEJ
-
204. Type of Handrail: Sloped Faced Parapet
205. Material and Quantity : -1.0
208. Type of Abutment : Skeleton
Type of Foundation : Steel Piling
209. Type of Pier / Found.: 2 Piers Yes
Drilled Shaft - No Footings
210. Foundation Elev. -1.0 -1.0
-1.0 -1.0 -1.0
211. Wear. Surf. Prot. System : -
Date Installed : 1/1/1901
Utilities Attached : -1
-1 -1 -1
-1 -1 -1

## STATE OF OKLAHOMA BRIDGE ITEMS

214a. Posted Weight Limit: NR
b. Posted Speed Limit : N
c. Narrow/One Lane Bridge sign : ~~N~~ NOT
d. Vertical Clearance Sign: NO
Advanced Warning Sign : NO
Exisiting/Recommended Posting : N N
Min./ Max Vert. Clearance : N N
e. Navigation Lights : NO
Working/Not Working : NO
215. Overpass : A - ACOG (OKC Metro)
221. Substructure Cond. (U/W) : -
222. Fill over RCB: -1
223. Appr. Slab/Rdwy Cond.: Good
224. Critical Feature Type: -1
225. Paint Type : -
Overcoat : -
226. Date Painted: -1
227. Paint Coloring: -1
233. Deck Forming: -
236. Deck Cleaning : -1

238. School Bus Rte: Not on Desired or Current
240. Appr. Roadway Type: Asphalt/Bituminous
243. Girder Spacing : -3.0
244. Span Lengths :
45 -1 -1
60 -1 -1
45 -1
245. Girder Depth : 36.000
246. Type of Overlay : _
246. Overlay Thickness : -1.0
246. Overlay Date : 1/1/1901
246. Overlay Depth Changed > 1"? _
247. Protective Systems : 1: Working Cathodic P
2: _ 3: _
4: _ 5: _
248. No. of Field Splices w/ Corrosion : -1
249. Scour Crit. POA exists?: _
250. Culvert Headwall Dist.: -1.0
254. Thru Truss Type : _
256. Chan. Profile Up/Down Stream?: _

# OKLAHOMA DEPARTMENT OF TRANSPORTATION - Bridge Inspection Report

Suff. Rating: 97.1 Not Deficient

Health Index : -1.0

NBI No.: **19972** Structure No.: 55N3260E1040006 Local ID:180

Inspection Date: ~~12/19/2007~~ Reported By: ~~GWILSON~~ MB

Invoice No.: OKCO1 11/30/09 Inspected With: ~~T0010738E60B00000033~~

Agency : Cobb Eng. S. Hunt

**Structure / Inspection Notes**

< none >

| Elm. | Env. | Description | Un. | Qty. | Qty.St. 1 | % 1 | Qty.St. 2 | % 2 | Qty.St. 3 | % 3 | Qty.St. 4 | % 4 | Qty.St. 5 | % 5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 4 | Concrete Deck - Protected w/ Coated Bars | (SF) | 5,328 | 0 | 0 % | 5,328 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 109 | 4 | P/S Conc Open Girder/Beam | (LF) | 480 | 480 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 119 | 1 | P/S Conc Open Girder/Beam Ends (5ft.) | (LF) | 120 | 120 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 205 | 4 | Reinforced Conc Column or Pile Extension | (EA) | 4 | 4 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 210 | 4 | Reinforced Conc Pier Wall | (LF) | 33 | 33 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 215 | 4 | Reinforced Conc Abutment | (LF) | 69 | 69 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 234 | 4 | Reinforced Conc Cap | (LF) | 69 | 69 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 302 | 4 | Compression Joint Seal | (LF) | 69 | 0 | 0 % | 69 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 310 | 4 | Elastomeric Bearing | (EA) | 24 | 24 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 331 | 4 | Reinforced Conc Bridge Railing | (LF) | 305 | 305 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |
| 359 | 4 | Soffit of Concrete Deck or Slab | (EA) | 1 | 1 | 100 % | 0 | 0 % | 0 | 0 % | 0 | 0 % | 0 | 0 % |

Additional Elements 316 - BEARING ASSEM (24)

| Elem. | Element Notes (Include Size and Location of Deterioration |
|---|---|
| 26 | Deck is starting to get small pop-outs all over - small spalls around jt areas |
| 109 | < none > |
| 119 | < none > |
| 205 | < none > |
| 210 | < none > |
| | < none > |
| 234 | < none > |
| 302 | FILLED WITH DIRT AND DEBRIS, NEEDS CLEANED OUT - ~~MINOR SPALLS AT JOINTS~~ |
| 310 | < none > |
| 331 | < none > |
| 359 | < none > |

Conc. stones are starting to separate from abutments - monitor

# OKLAHOMA COUNTY - OFF SYSTEM

STRUCTURE NO. 180

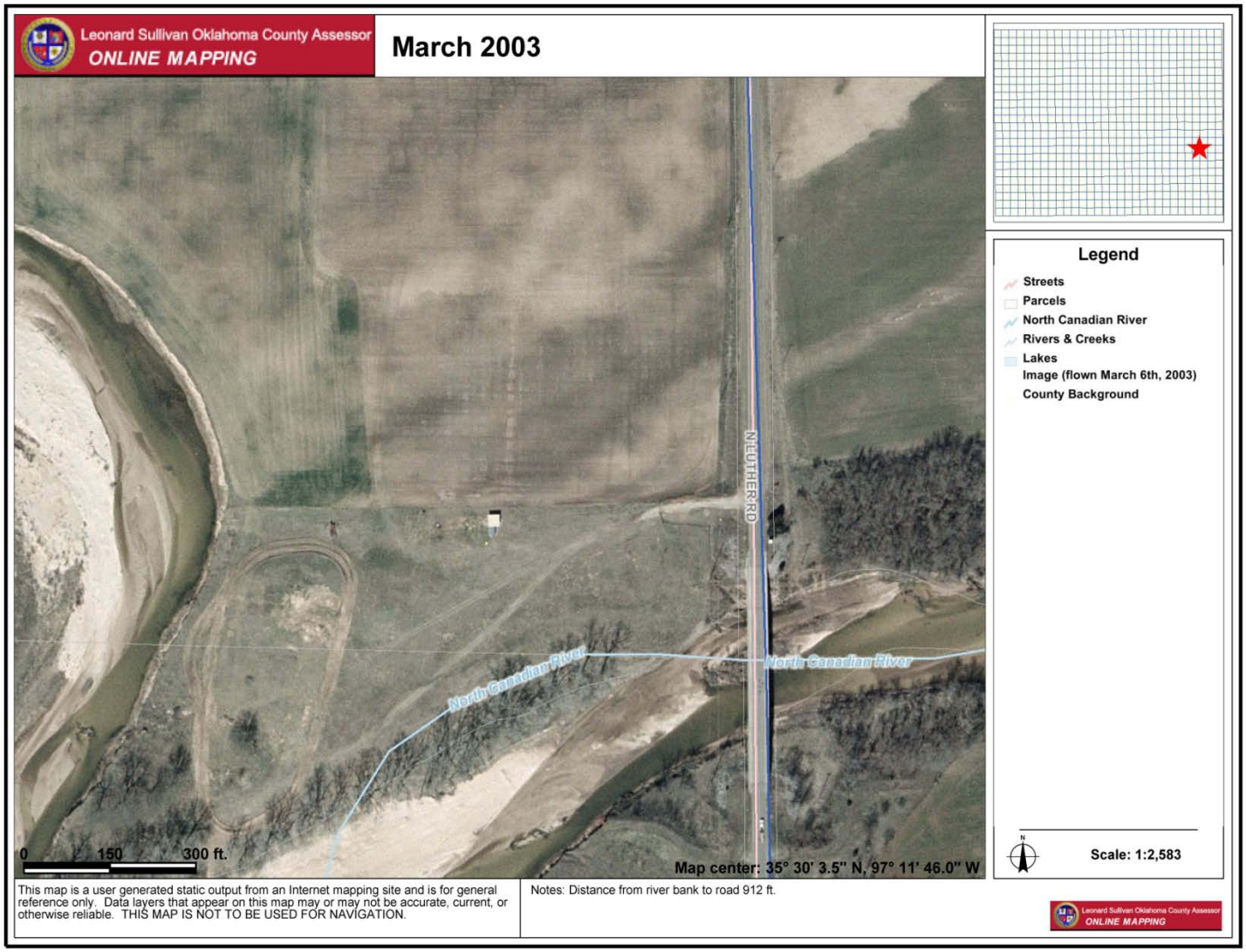
LOOKING SOUTH

LOOKING WEST

# APPENDIX C

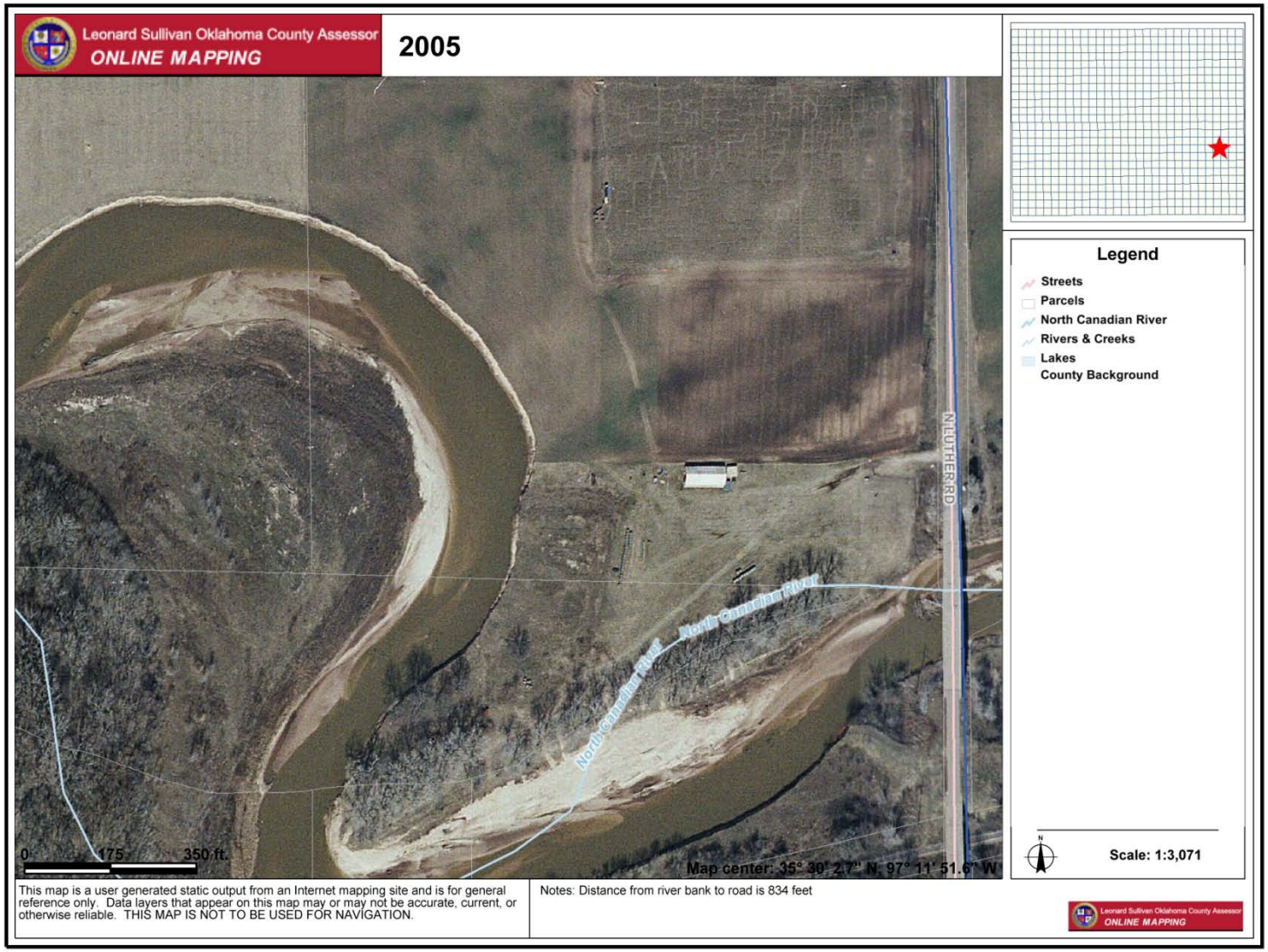
# AERIAL MAPS AND SITE VISIT PHOTOGRAPHS

# AERIAL MAPS

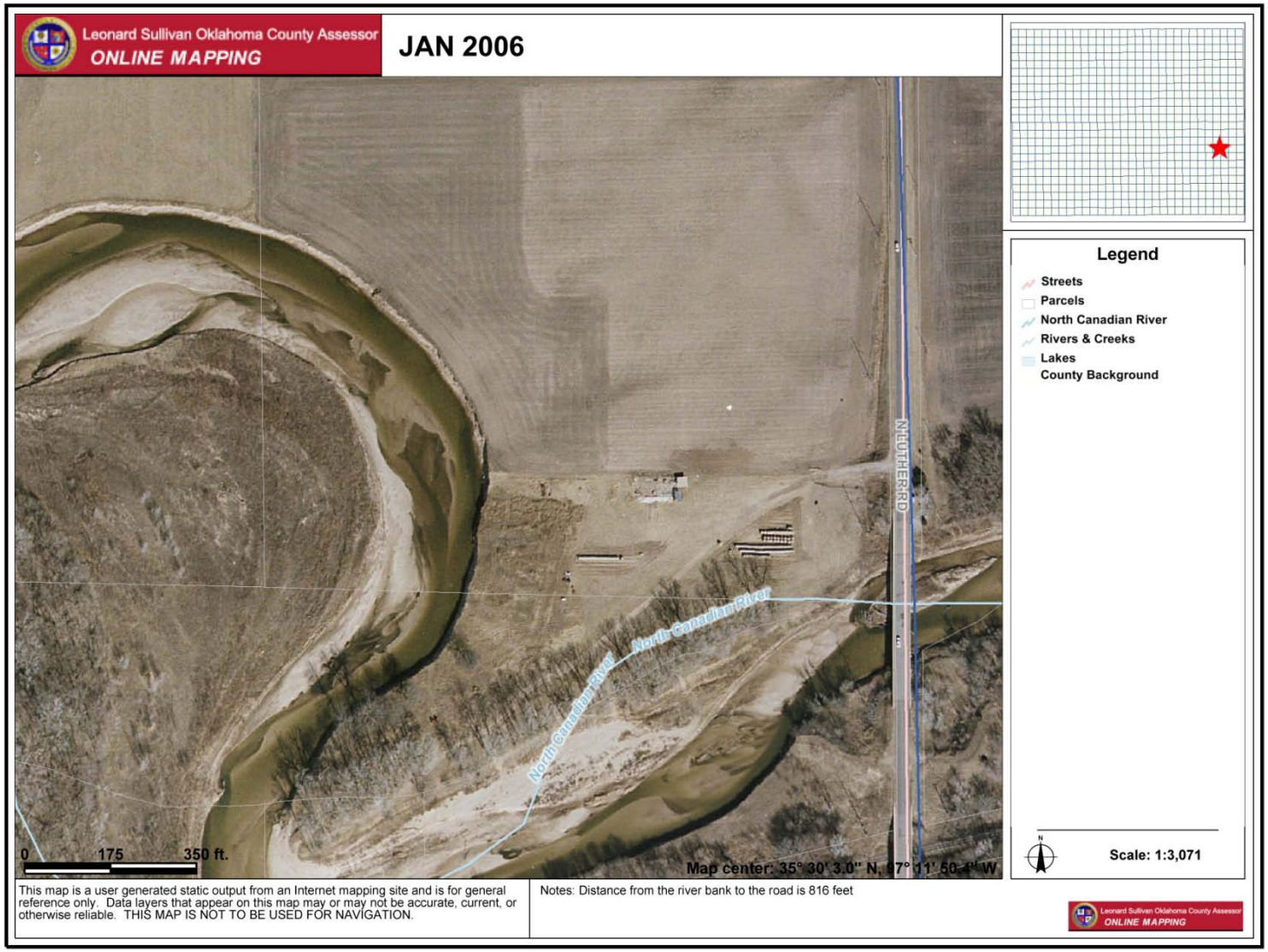



Aerial Map #1 – March 2003

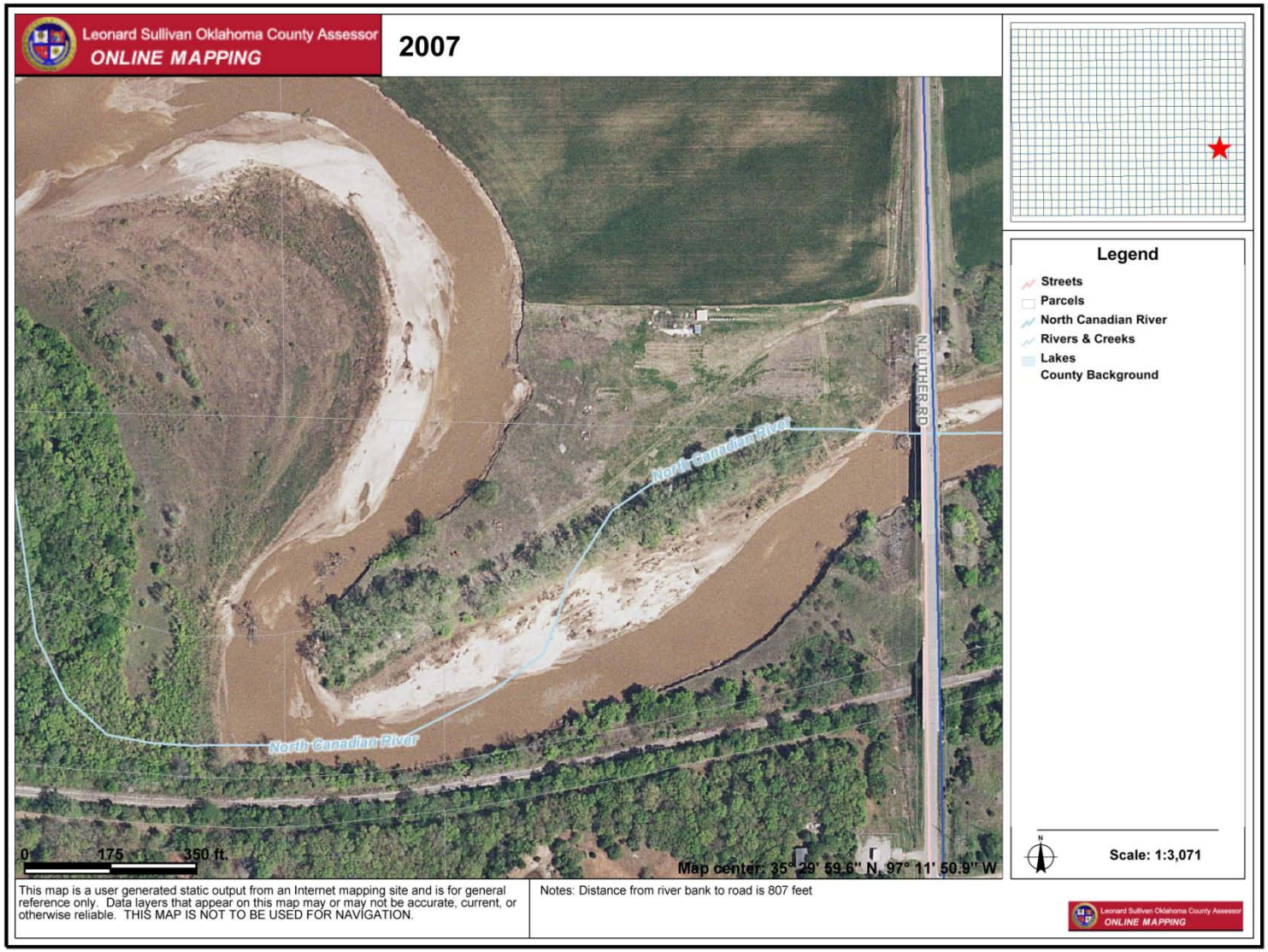
Aerial Map #2 – March 2004



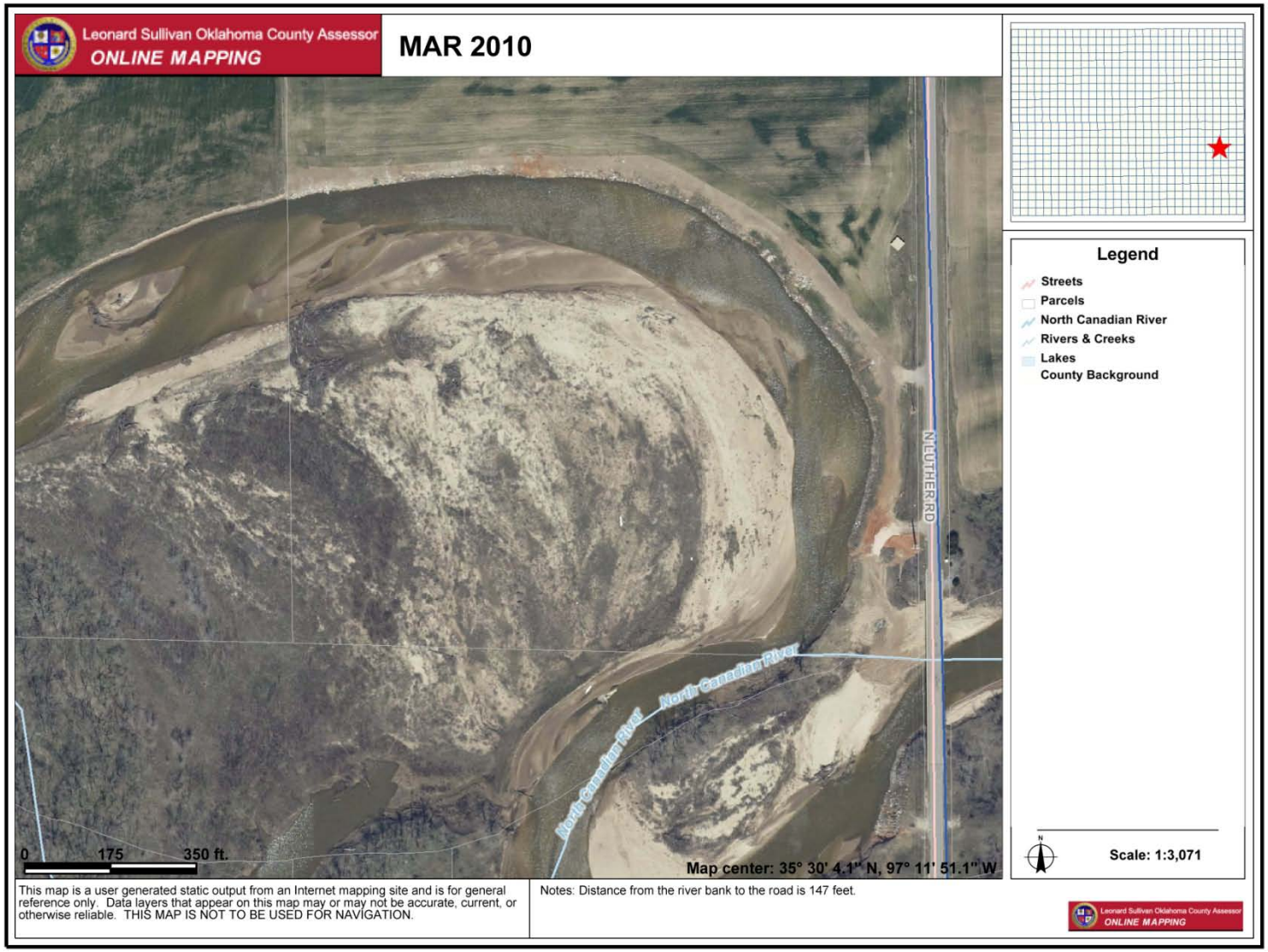

Aerial Map #3 – February 2005




Aerial Map #4 – January 2006




Aerial Map #5 - April 2007




Aerial Map #6 – March 2010

# SITE VISIT PHOTOGRAPHS

# AUGUST 2007 SITE VISIT

Photograph #1 – Looking west at the North Canadian River.

Photograph #2 – Looking north (upstream at the North Canadian River left bank erosion

# APRIL 2011 SITE VISIT

Photograph #3 – Looking (upstream) at the left bank of the North Canadian River.

Photograph # 4 – Looking to the northeast from the left bank of the North Canadian River. Truck coming toward the red truck is on Luther Road.

Photograph 5 – Looking west from Luther Road at the North Canadian River.

Photograph #6 – Looking southwest from Luther Road at the North Canadian River.

Photograph #7 – Looking east (downstream) from the left bank of the North Canadian River. Utility poles are on the west side of Luther Road.

# APPENDIX D

# REAL ESTATE

# Real Estate Plan

for

# Luther Road
# Oklahoma County, Oklahoma
# Section 14 Streambank Stabilization Project
# Planning and Design Analysis

US Army Corps of Engineers
Tulsa District
Real Estate Division
August 2013

# Real Estate Plan
# for
# Luther Road
# Oklahoma County, Oklahoma
# Section 14 Streambank Stabilization Project
# Planning and Design Analysis
# August 2013

1. Purpose. The purpose of this real estate plan is to address the real estate requirements for the Luther Road Bridge Streambank Stabilization Project in Harrah, Oklahoma. Harrah is located in Oklahoma County east of Oklahoma City. Erosion of the north bank of the North Canadian River is threatening the Luther Road Bridge on the north side of Harrah. The erosion is caused by the lateral movement of the river. Soil in this area is sandy loam and easily eroded during high flows and a single large flow event could destroy the north bridge approach and bridge abutment. The authority for this Project is Section 14 of the Flood Control Act of 1946 (PL 79-526), as amended. The Non-Federal Cost-Sharing Partner is Oklahoma County.

2. Lands, Easements, Rights-of-Way, and Disposal Areas (LERRD). Six (6) alternatives were presented during the Planning and Design Analysis report for the Luther Road Streambank Stabilization Project. Alternative 1 was the selected alternative. This option will encompass approximately 7.62 acres as illustrated on the attached Exhibit D. This alternative will require channel improvement, access road and drainage ditch easements. This will also require easements along the north bank of the North Canadian River west of Luther Road for the construction, operation, and maintenance of a rip rap bedding layer. The recommended estates to be acquired are listed in Exhibit A. These estates will be acquired by the Non-Federal Partner from two separate owners of land lying along the north bank of the North Canadian River west of Luther Road. The Non-Federal Partner will also need to acquire channel improvement, access road, and drainage ditch easements from two additional land owners who own property along the south bank of the North Canadian River on both sides of the southern Luther Road bridge approach. Disposal of excess cut material will be the responsibility of the construction contractor. The contractor is required to take excess cut material to an open and licensed commercial site. The Non-Federal Partner will not be required to provide real estate for a disposal area. This issue will be address through the construction contract.

3. LERRD Owned by the Non-Federal Partner. The Non-Federal Partner, Oklahoma County, owns a perpetual easement for the construction and maintenance of Luther Road. Approximately 1.34 acres of the Project area lies within this existing road right-of-way. The estate granted by this easement is insufficient for the purpose of this project. The 1.34 acres of the Project area lying within the existing right-of-way will be included in the channel improvement easements outlined in paragraph 2.

4. Non-Standard Estates. Non-standard estates are not anticipated for the project.

5. Existing Federal Project. Approximately 1.34 acres of Luther Road right-of-way will overlap the proposed Project area. Oklahoma County acquired and built Luther Road with Federal funds from the Federal Highway Administration in 1980; therefore, the value of the 1.34 acres will not be creditable to the Non-Federal Partner's share of the Project. Additionally, this acreage is part of the facility being protected by this Section 14 Project.

6. Federally Owned Land. No Federally owned land is included within the LERRD required for the Project.

7. Navigation Servitude. Navigation servitude is not available for use on this Project.

8. Map. See Exhibit D for a map of the Project area.

9. Induced Flooding. No induced flooding is anticipated as a result of the Project.

10. Baseline Cost Estimate for Real Estate. The Baseline Cost Estimate (Exhibit B) for the real estate acquisition is $58,654. The Baseline Cost Estimate is the cost of purchasing real estate interests, and Federal administrative costs which consist of the Government's Real Estate Division's coordination with the Non-Federal Partner and compliance reviews. The amount for LERRDS and the Non-Federal Partner's administrative costs as per LERRDS guidelines is $52,014; which might be eligible for crediting to the Non-Federal Sponsor.

11. Relocation Assistance under Public Law 91-646. No persons, farms or businesses will be displaced as a result of the Project.

12. Mineral Activity. There is no known mineral activity or timber harvesting activity in the Project area. At this time we don't see any mineral activity affecting the future use of the project lands.

13. Non-Federal Partner's Capability and Experience. The Non-Federal Partner has the legal capability to provide the LERRD required for the project. A representative for Oklahoma County has stated that real estate acquisition activities will be contracted to a real estate acquisition company (Exhibit C).

14. Zoning Ordinances. No application or enactment of zoning ordinances is anticipated to reduce the acquisition of LERRD required for the Project.

15. Acquisition Schedule. Acquisition of all LERRD required for the Project is scheduled to be completed within 9 months of the execution of the PPA.

16. Facility and Utility Relocations. No facility or utility relocations are anticipated; therefore, an Attorney's Opinion of Compensability is not required.

17. Known or Suspected Presence of Contaminants. There are no known or suspected contaminants present in, on, under, or adjacent to the LERRD required for the Project.

18. Opposition to the Project. There is no known opposition to the Project.

19. Acquisition Prior to PPA Execution. The Non-Federal Partner has been advised of the risks associated with acquisition prior to execution of the Project Partnership Agreement (PPA).

20. Other Real Estate Issues Relevant to the Project. None.

Prepared by:

Terrie Broomhall
Senior Realty Specialist

Aug. 21, 2013
Date

Reviewed by:

Rhonda Sallee
Chief, Realty and Acquisition Services Branch
Real Estate Contracting Officer

8-21-13
Date

**EXHIBIT A**

Estates

CHANNEL IMPROVEMENT EASEMENT

A perpetual and assignable easement and right-of-way in, on, over and across the land hereinafter described for the location, construction, operation, maintenance, alteration, repair, rehabilitation and replacement of a bank protection works, and for the placement of stone, riprap and other materials for the protection of the bank against erosion; together with the continuing right to trim, cut, fell, remove and dispose there from all trees, underbrush, obstructions, and other vegetation; and to remove and dispose of structures or obstructions within the limits of the right-of-way; and to place thereon dredged, excavated or other fill material, to shape and grade said land to desired slopes and contour, and to prevent erosion by structural and vegetative methods and to do any other work necessary and incident to the project; together with the right of ingress and egress for such work; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however to existing easements for public roads and highways, public utilities, railroads and pipelines.

ROAD EASEMENT

A perpetual and assignable easement and right-of-way in, on, over and across the land herein described for the location, operation, alteration, and maintenance of roads and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; reserving to the owners, their heirs and assigns, the right to cross over the right-of-way as access to their adjoining land; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

DRAINAGE DITCH EASEMENT

A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) Tracts Nos. _____, _____ for the location, construction, operation, maintenance, alteration replacement of (a) road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving, however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B, which will be included once an alternative is selected in the next phase of the project); subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

# EXHIBIT B

## Luther Road Streambank Stabilization

01 **Lands and Damages**

**REAL ESTATE INTEREST COSTS**

| Cost Acct No. | Item | Unit | Quantity | Non-Fed RE Interest Values |
|---|---|---|---|---|
| 01.M.3 | -- Fee, (Type of Fee estate) | Acre | 0 | |
| 01.M.3 | Bank Protection Easement | Acre | 6.02 | $ 17,750.00 |
| 01.M.3 | Drainage Ditch Easement | Acre | 0.8 | $ 2,000.00 |
| 01.M.3 | Access Road Easement | Acre | 0.8 | $ 2,000.00 |
| | Contingencies 15% +/- | | | 3,264.00 |
| **SUBTOTAL RE VALUE** | | | Total | **$ 25,014** |

**REAL ESTATE ADMINISTRATION COSTS**

| Cost Acct No. | **Item** | Unit | Quantity | Non-Fed Admin Costs Per Unit | Total Non-Federal Admin Cost | Total Fed Admin |
|---|---|---|---|---|---|---|
| 01.D.2.D | Prepare Atty Opin.of Compen. | Tr | | - | | - |
| 01.D.2.F | Mapping, Survey | Tr | 4 | $ 3,250.00 | $ 13,000.00 | |
| 01.D.3.D | Compliance Review | Tr | | | | $ - |
| 01.D.3.F | Pre. Title/Ownership data | Tr | 4 | $ 1,000.00 | $ 4,000.00 | |
| 01.F.2.H | Compliance Review | Tr | | | | $ 1,200.00 |
| 01.F.2.F | Prepare appraisals for credit | Tr | 4 | $ 500.00 | $ 2,000.00 | |
| 01.D.4.D | Compliance Review | Tr | | | | $ 2,000.00 |
| 01.D.4.F | Negotiation & Closing | Tr | 4 | $ 2,000.00 | $ 8,000.00 | |
| | Coordination with Non-Fed | | | | | $ 3,000.00 |
| | Compliance Review for Credit | Tr | 4 | | | $ 440.00 |
| | | | | | | |
| | | | **Totals** | | **$ 27,000.00** | **$ 6,640.00** |

| | |
|---|---|
| **SUBTOTAL Non-Fed Administration Cost** | **$ 27,000.00** |
| **SUBTOTAL Fed Admininistration Cost** | **$ 6,640.00** |
| **TOTAL REAL ESTATE INTEREST** | **$ 25,014.00** |
| **TOTAL LANDS AND DAMAGES** | **$ 58,654.00** |

**ASSESSMENT OF NON-FEDERAL SPONSOR'S**
**REAL ESTATE ACQUISITION CAPABILITY**

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project proposes? yes
b. Does the sponsor have the power of eminent domain for this project? no
c. Does the sponsor have "quick-take" authority for this project? no
d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? no
e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? no

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? no – **However, Corps personnel will brief the Partner on Federal acquisition requirements.**
b. If the answer to II. a. is "yes," has a reasonable plan been developed to provide such training? n/a
c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? no – **The sponsor will be contracting these responsibilities to a professional real estate acquisition service company.**
d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? yes
e. Can the sponsor obtain contractor support, if required in a timely fashion? yes
f. Will the sponsor likely request USACE assistance in acquiring real estate? no

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? yes
b. Has the sponsor approved the project/real estate schedule/milestones? yes

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? N/A
b. With regard to this project, the sponsor is anticipated to be: fully capable

V. Coordination:

a. Has this assessment been coordinated with the sponsor? yes
b. Does the sponsor concur with this assessment? yes

Stacey Trumbo
County Engineer
Oklahoma County

Terrie Broomhall
Senior Realty Specialist

Rhonda M. Sallee
Chief, Realty and Acquisition Service Branch
Real Estate Contracting Officer

8-21-13
date

**EXHIBIT D**

| SYMBOL | DESCRIPTION | DATE | APPR |
|---|---|---|---|

Tulsa District
Tulsa, Oklahoma

US Army Corps of Engineers

ARKANSAS RIVER WATERSHED — NORTH CANADIAN RIVER, OKLAHOMA

DESIGNED BY: R BEAUCHAMP, P.E.
DRAWN BY: R BEAUCHAMP, P.E.
REVIEWED BY: T BROOKHALL
SUBMITTED BY: MICHELLE LAY, P.E. CHIEF, CIVIL SECTION

LUTHER ROAD SECTION 14
STREAMBANK STABILIZATION PROJECT
FY:2014
REAL ESTATE PLAN

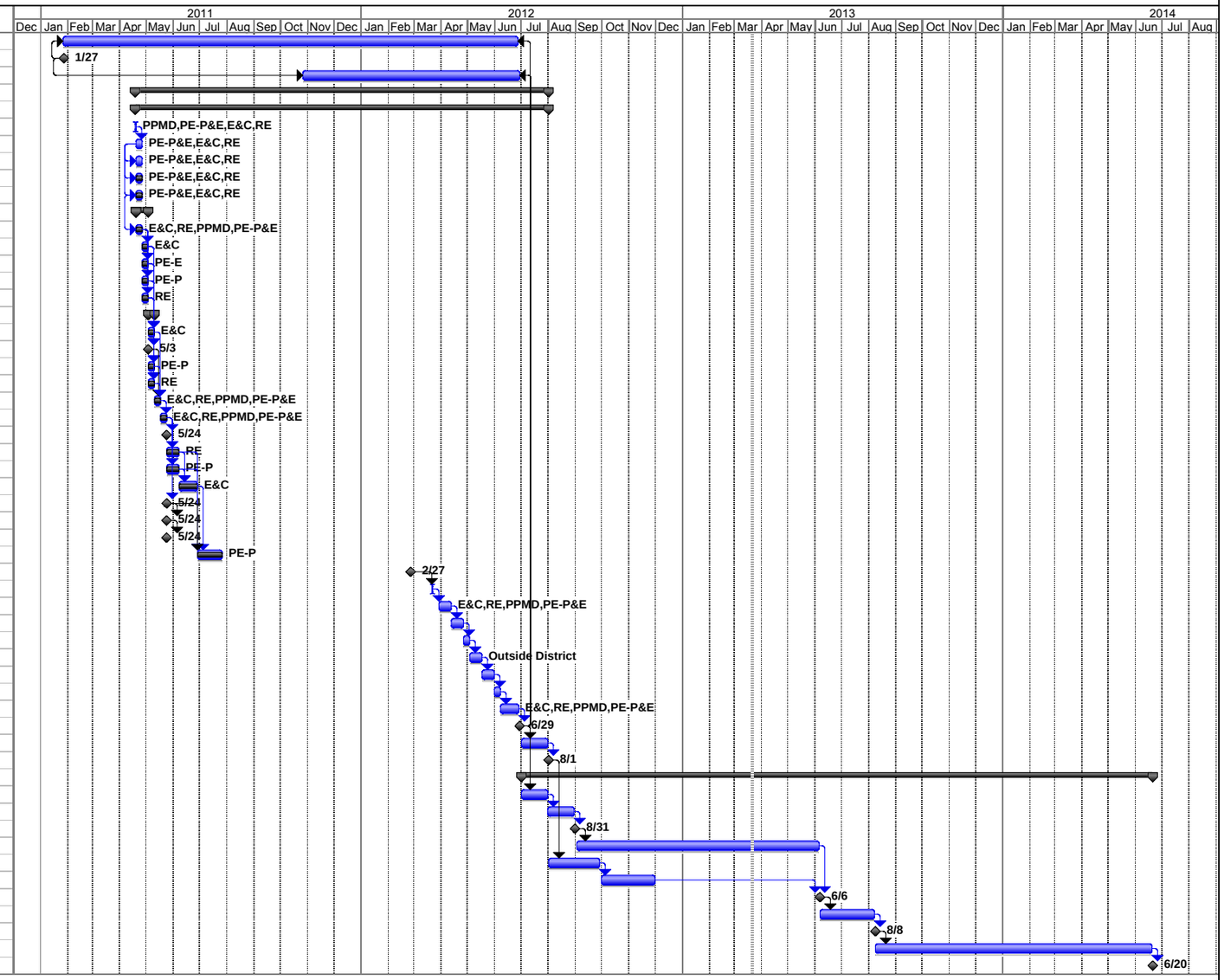
PLOT SCALE: 100:1
DESIGN FILE: REPTON 9AUG13.dgn
PLOT DATE: AUG 2013
DWG. CODE:
SHEET OF
CONTRACT DATE:
INVITATION NO. W912BV-..-B-....
CONTRACT NO. W912BV-..-C-....
SHEET REFERENCE NUMBER G100

# APPENDIX E

# CONSTRUCTION SCHEDULE AND MILESTONES

LUTHER ROAD SECTION 14 PROJECT
OKLAHOMA COUNTY, OKLAHOMA

| ID | Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|
| 1 | FEASIBILITY PHASE | 370 days | Thu 1/27/11 | Wed 6/27/12 | 2SS,41FF |
| 2 | Receive Funds | 1 day | Thu 1/27/11 | Thu 1/27/11 | |
| 3 | Project Management | 177 days | Thu 10/27/11 | Fri 6/29/12 | 2SS,41FF |
| 4 | **Planning and Design Analysis** | **337 days** | **Tue 4/19/11** | **Wed 8/1/12** | |
| 5 | **Plan Formulation** | **337 days** | **Tue 4/19/11** | **Wed 8/1/12** | |
| 6 | Site Visit | 1 day | Tue 4/19/11 | Tue 4/19/11 | |
| 7 | Study Area Description | 5 days | Wed 4/20/11 | Tue 4/26/11 | 6 |
| 8 | Problems and Opportunties Identification | 5 days | Wed 4/20/11 | Tue 4/26/11 | 7SS |
| 9 | Study Goals Objectives and Constraints | 5 days | Wed 4/20/11 | Tue 4/26/11 | 7SS |
| 10 | Future Without Project Conditions | 5 days | Wed 4/20/11 | Tue 4/26/11 | 7SS |
| 11 | **Formulate Measures and Alternatives** | **10 days** | **Wed 4/20/11** | **Tue 5/3/11** | |
| 12 | Initial Array of Measures and Alternatives | 5 days | Wed 4/20/11 | Tue 4/26/11 | 10SS |
| 13 | Prelim E&C (Design &Cost) | 5 days | Wed 4/27/11 | Tue 5/3/11 | 12 |
| 14 | Prelim PE-E (Envr Assess) | 5 days | Wed 4/27/11 | Tue 5/3/11 | 12 |
| 15 | Prelim PE-P (Econ and Social Analysis) | 5 days | Wed 4/27/11 | Tue 5/3/11 | 12 |
| 16 | Prelim Real Estate Assessment | 5 days | Wed 4/27/11 | Tue 5/3/11 | 12 |
| 17 | **Evaluate Measures and Alternatives** | **5 days** | **Tue 5/3/11** | **Tue 5/10/11** | |
| 18 | Addnl E&C (Design and Cost) | 5 days | Wed 5/4/11 | Tue 5/10/11 | 13,14,16,15 |
| 19 | Addnl PE-E (Envr Assess) (Des. Phase Act.) | 0 days | Tue 5/3/11 | Tue 5/3/11 | 13,14,16,15 |
| 20 | Addnl PE-P (Econ and Social Analysis) | 5 days | Wed 5/4/11 | Tue 5/10/11 | 13,14,15,16 |
| 21 | Addnl Real Estate Assessment | 5 days | Wed 5/4/11 | Tue 5/10/11 | 13,14,16,15 |
| 22 | Compare Alternatives | 5 days | Wed 5/11/11 | Tue 5/17/11 | 21,18,19,20 |
| 23 | Determine Recommended Alternative | 5 days | Wed 5/18/11 | Tue 5/24/11 | 22 |
| 24 | SWD Aternative Formulation Briefing (NA per Ed) | 0 days | Tue 5/24/11 | Tue 5/24/11 | 23 |
| 25 | Draft Real Estate Plan Appendix | 10 days | Wed 5/25/11 | Tue 6/7/11 | 23 |
| 26 | Draft Economic and Social Analysis Appendix | 10 days | Wed 5/25/11 | Tue 6/7/11 | 23 |
| 27 | Draft Engr Appendix | 15 days | Wed 6/8/11 | Tue 6/28/11 | 25,26 |
| 28 | Draft Envr Assessment (Des. Phase Act.) | 0 days | Tue 5/24/11 | Tue 5/24/11 | 23 |
| 29 | Draft Envr Assessment Public Review (Des. Phase Act. | 0 days | Tue 5/24/11 | Tue 5/24/11 | 28 |
| 30 | Finalize Envr Assessment and FONSI Signed (Des. Ph. | 0 days | Tue 5/24/11 | Tue 5/24/11 | 29 |
| 31 | Draft Planning and Design Analysis Report | 20 days | Wed 6/29/11 | Tue 7/26/11 | 25,26,27,28 |
| 32 | Receive FY12 Funds to Restart Study | 0 days | Mon 2/27/12 | Mon 2/27/12 | |
| 33 | PDT Meeting | 1 day | Thu 3/22/12 | Thu 3/22/12 | 32 |
| 34 | District Quality Assurance Review | 10 days | Fri 3/30/12 | Thu 4/12/12 | 33FS+5 days |
| 35 | Review DQR Comments & Incorporate as Appropriate | 10 days | Fri 4/13/12 | Thu 4/26/12 | 34 |
| 36 | Backcheck DQR Comments | 5 days | Fri 4/27/12 | Thu 5/3/12 | 35 |
| 37 | Agency Technical Review | 10 days | Fri 5/4/12 | Thu 5/17/12 | 36 |
| 38 | Review ATR Comments & Incorporate as Appropriate | 10 days | Fri 5/18/12 | Thu 5/31/12 | 37 |
| 39 | Backcheck ATR Comments | 5 days | Fri 6/1/12 | Thu 6/7/12 | 38 |
| 40 | Final Planning and Design Analysis Report | 15 days | Fri 6/8/12 | Thu 6/28/12 | 39 |
| 41 | Final Design and Analysis Report Submittal to SWD | 1 day | Fri 6/29/12 | Fri 6/29/12 | 40 |
| 42 | SWD Review Final Design and Analysis Report | 22 days | Mon 7/2/12 | Tue 7/31/12 | 41 |
| 43 | SWD Approval of Final Des. & Anal. Report | 1 day | Wed 8/1/12 | Wed 8/1/12 | 42 |
| 44 | **IMPLEMENTATION PHASE FOR ALTERNATIVE 1 (REC. PLAN** | **515 days** | **Mon 7/2/12** | **Fri 6/20/14** | |
| 45 | Develop Project Partnership Agreement (PPA) | 22 days | Mon 7/2/12 | Tue 7/31/12 | 41 |
| 46 | Negotiate PPA | 22 days | Wed 8/1/12 | Thu 8/30/12 | 45 |
| 47 | Execute PPA | 1 day | Fri 8/31/12 | Fri 8/31/12 | 46 |
| 48 | Real Estate Acquisition | 198 days | Mon 9/3/12 | Wed 6/5/13 | 47 |
| 49 | Finalize Design and Specifications & Revised Ind. Govt. Est. | 42 days | Thu 8/2/12 | Fri 9/28/12 | 43 |
| 50 | Construction Contract Preparation | 45 days | Mon 10/1/12 | Fri 11/30/12 | 49 |
| 51 | Construction Contract RTA | 1 day | Thu 6/6/13 | Thu 6/6/13 | 50,48 |
| 52 | Construction Contract Advertised/Receive Bids | 44 days | Fri 6/7/13 | Wed 8/7/13 | 51 |
| 53 | Construction Contract Awarded/NTP | 1 day | Thu 8/8/13 | Thu 8/8/13 | 52 |
| 54 | Construction Performance Period | 225 days | Fri 8/9/13 | Thu 6/19/14 | 53 |
| 55 | Construction Project Completion | 1 day | Fri 6/20/14 | Fri 6/20/14 | 54 |




Project: LutherRoadSec14Schedule02
Date: Thu 3/21/13
Status Date:Thu 2/9/12

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Task | | Milestone | | External Tasks | | Progress | Rolled Up Task |
| Split | | Summary | | External Milestone | | Milestone | Rolled Up Critical Task |
| Progress | | Project Summary | | Deadline | | Summary | |