Enid's Kaw Lake Water Supply Pipeline

Where Affordability Meets Constructability

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2022 SOUTHWEST SECTION AWWA / CONFERENCE & EXPOSITION / OCTOBER 4, 2022

Agenda:

- Purpose
- Program Overview
- Pipe Design
- Embedment Evaluation
- Integration of Design Concept
- Constructability
- Takeaways

Presentation Purpose:

Highlight the challenges associated with implementing the innovative design concepts that were used on the City of Enid's Kaw Lake Water Supply Project, through the evaluation and implementation of native material for use as pipe embedment.

US Army Corps of Engineers
Tulsa District

OWRB Water Resources Board

DEQ Oklahoma Department of Environmental Quality

CITY OF Enid OKLAHOMA

$248.5M CONSTRUCTION

GARVER
Program Manager/Designer

Garney Construction ADVANCING WATER
Construction Manager @ Risk

FREESE AND NICHOLS
Pipeline Manager/Designer

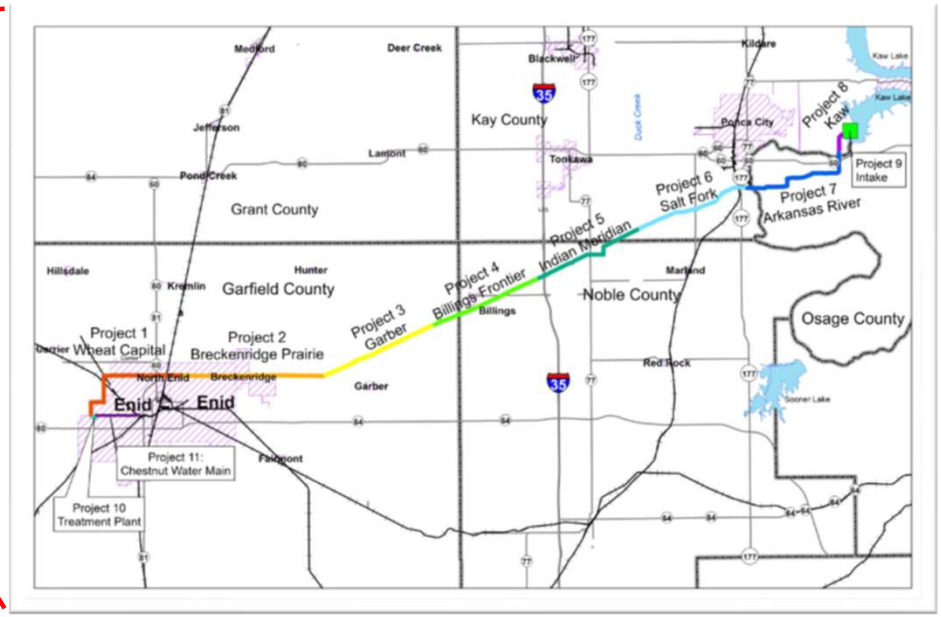
Program Infrastructure

An in-lake micro-tunnel and pump station withdraws water from Kaw Lake

Intake

68-miles of raw water is conveyed through a 30/36-inch pipeline

Pipeline Segments



A new 1 MG storage tank near Garber and pump station to boost flow to Enid

Intermediate Pump Station

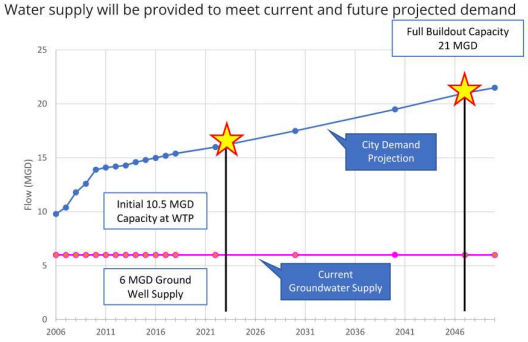
A new 10.5 MGD plant on the west side of Enid treats and blends with existing ground well system

Water Treatment Plant

Water is distributed through 2.75-mile Chestnut Water Main

Chestnut Water Main

Water supply will be provided to meet current and future projected demand



Water Supply Capacity

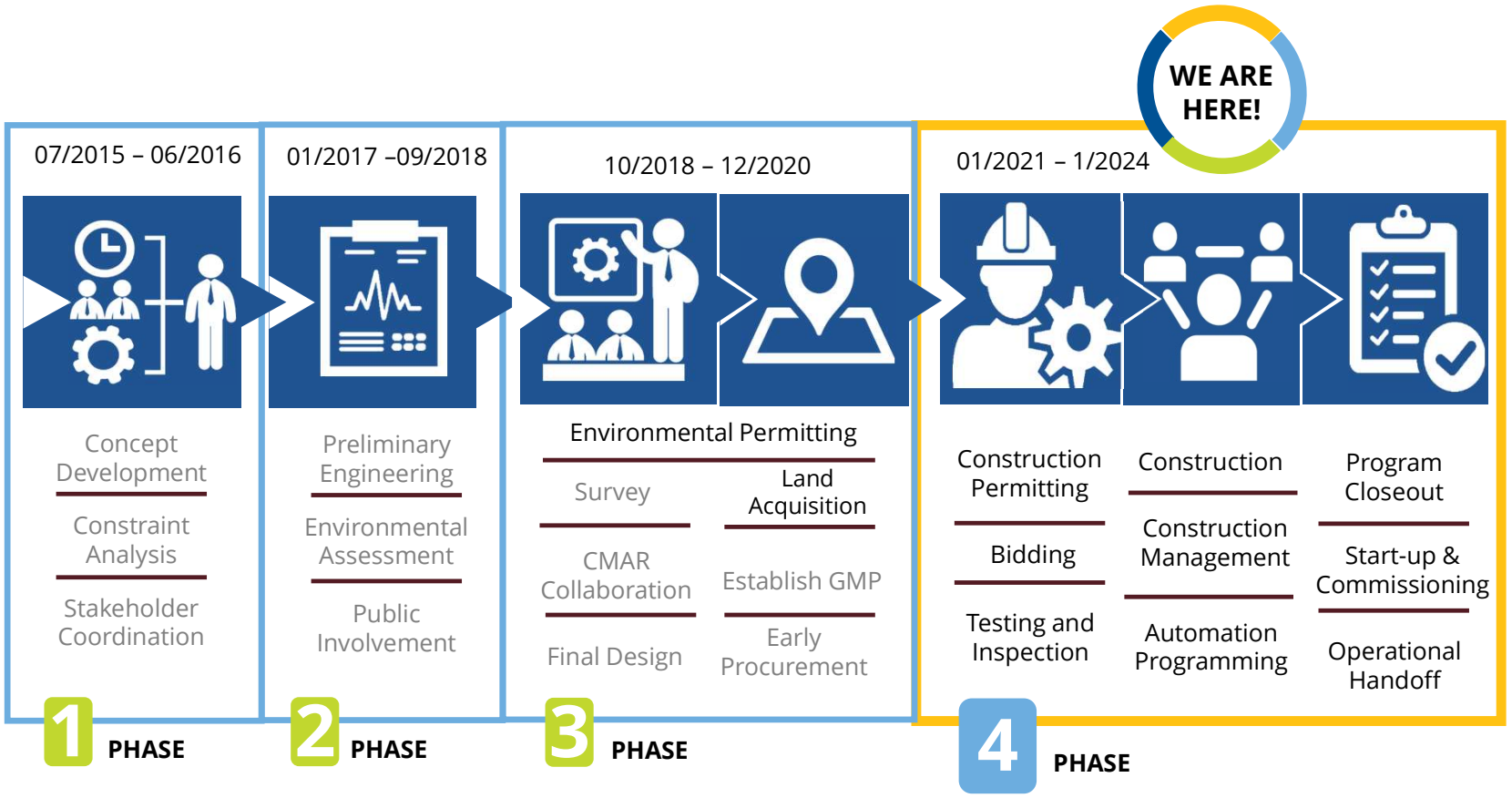
Today
- 6 Million Gallons per Day

2023
- Initial Build-out
  10.5 Million Gallons per Day

2047
- Full Build-out
  21 Million Gallons per Day

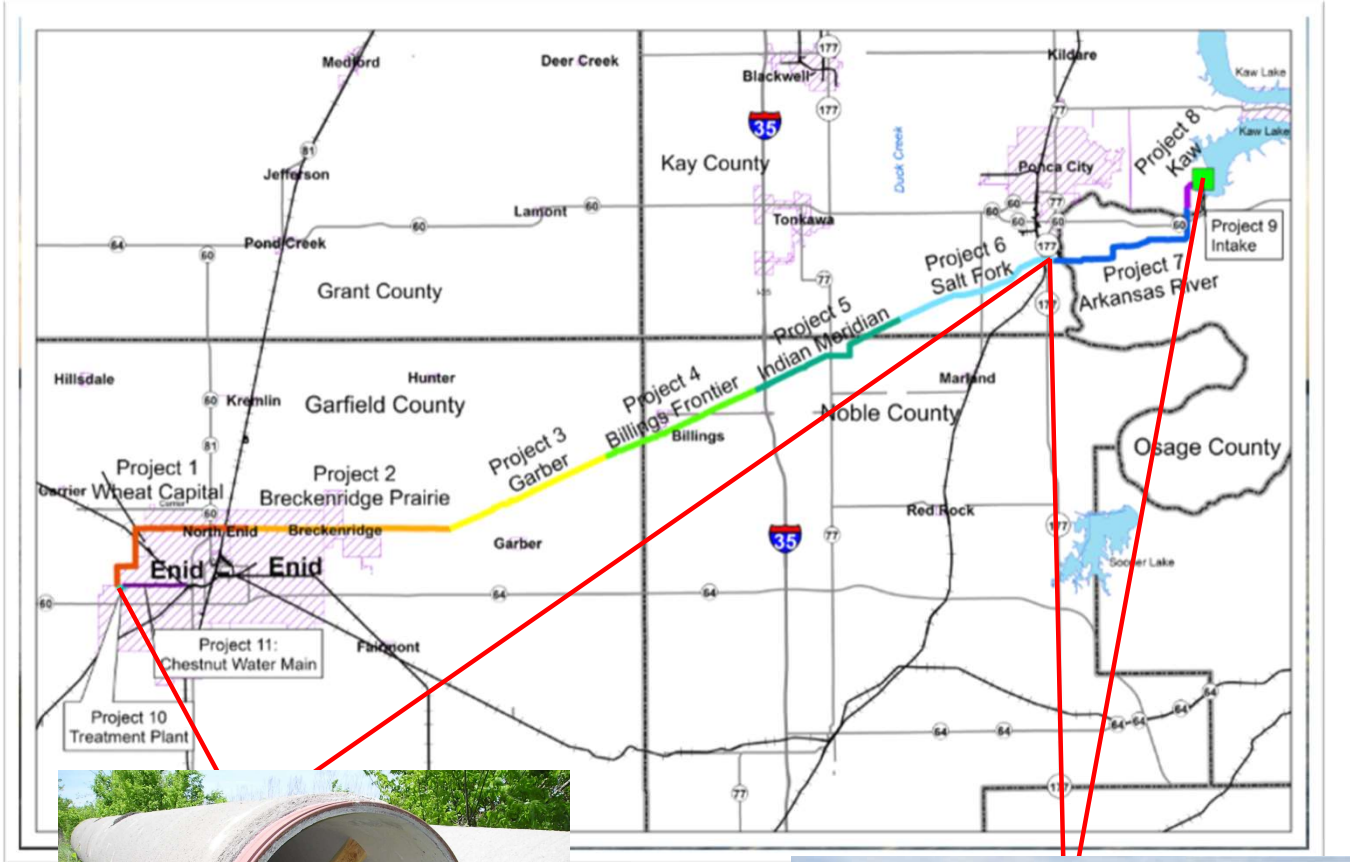
*MGD= Million Gallons per Day

Program Schedule Overview



Raw Water Pipeline:

- **12 miles:** 36” AWWA C200 Steel Pipe
- **56 miles:** 30” AWWA C303 Concrete Pipe



Design Parameters

Bar-Wrapped Concrete Pipe

- Wall Thickness = *Variable**
- Deflection Lag Factor = 1.1
- Deflection = 1%

Steel Pipe

- Wall Thickness = min. 0.183” or Pipe I.D./230
- Deflection Lag Factor = 1.1
- Deflection = 2%

Question: What embedment material do we use?

Imported Gravel

- Good E' Value (1,500 psi)
- Easily Compacted
- Available ($$$)

Imported Sand

- OK E' Value (1,000 psi)
- Easily Compacted
- Readily Available ($$)

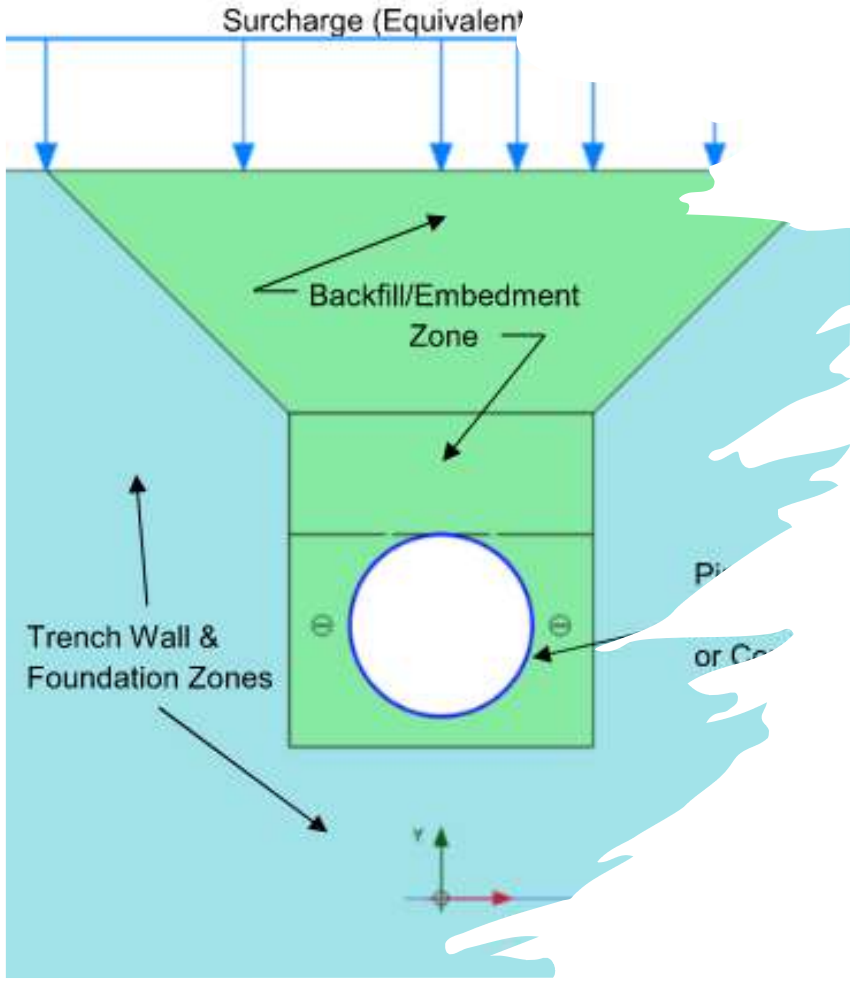
Question:
What about Trench Excavated Material?

- Needs to be suitable material
- Can be less expensive than imported
  - Material cost
  - Hauling cost
  - Disposal cost
- Lesser E' Value (< 1,000 psi)
- Does require additional design

SAVES $5.0 MILLION

Native Material Design

- Geotechnical investigations of soils required
  - 117 borings spaced approx. 2,000 ft
- Finite Element analysis of pipe-soil interaction
- Requires skilled contractor
- Requires more quality control testing
- Specification modifications for bedding and compaction



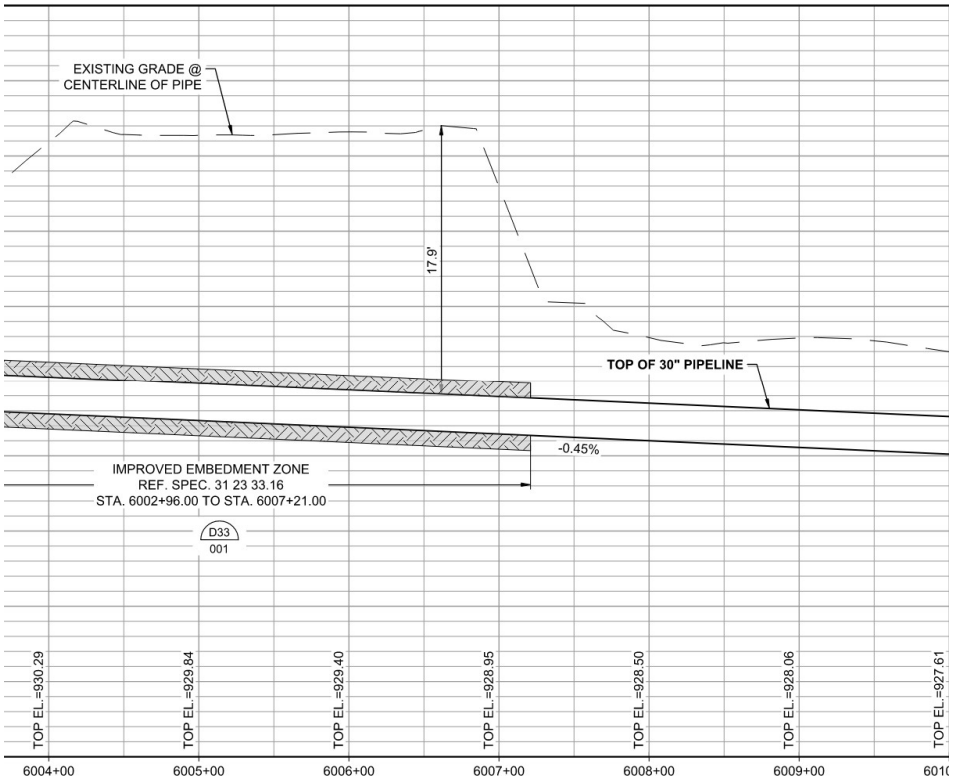
Basis for GMP

Specifications

Pipe Material	Pipe Diameter (inches)	Max. Allowable Pipe Depth of Cover (feet)			
		Granular	Sand	In-Situ*	CLSM
Steel	36	18	12	15/15/13	37
Steel	30	18	12	11/10/7	37
Bar Wrapped Concrete Cylinder	30	11	8	7/6/5	18

*The data shown for the In-Situ Material is based on the Pipeline Supplement Geotechnical Finite Element Analysis Report, May 2018, submitted by FNI. The in-situ soils were categorized by soil group type (Group 1/Group 2/Group 3).

Plans



Construction Submittal

Trench Width OD+3'		Bar Wrap Pipe (BWP) Class 125-9			
Bedding Material	E' Value (psi)	90% Compaction (k=0.090)		95% Compaction (k=0.085)	
		D_l = 1.1	D_l = 1.0	D_l = 1.1	D_l = 1.0
CLSM	3000	18.8	22.3	20.8	25
Granular	1500	11.6	13.3	12.6	14.4
Sand	1000	9.7	11	10.4	11.9
Group 1	959	9.5	10.8	10.3	11.7
Group 2	862	9.2	10.4	9.9	11.2
Group 3	730	8.7	9.9	9.4	10.6

Constructability

- Keep it Simple!
- Clear Direction
- Collaboration
- Conservative

Takeaways

Design

- Plan for additional geotech/design
- Iterative process
- Collaborate
- Be flexible

CM@R

- Local Market Supply
- Logistics/Public Impacts
- Design Criteria vs. Pipe Options
- Deliverable Timelines
- Clear drawings
- Qualified Installation Contractor

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