

Thinking Outside the Box: Eliminating Junction Structures on Large Gravity Pipelines



Kelly Davis, P.E.
Manager, Engineering Services
Planning, Design and Construction Administration
Trinity River Authority of Texas



Greg Vaughn, P.E.
Senior Associate, Team Leader
Lockwood, Andrews & Newnam, Inc.

February 7th, 2023



Trinity River Authority of Texas

- Created by State of Texas in 1955
- 3 Core Functions
 - Treatment Services
 - Local Sponsor
 - River Basin Management



Northern Region



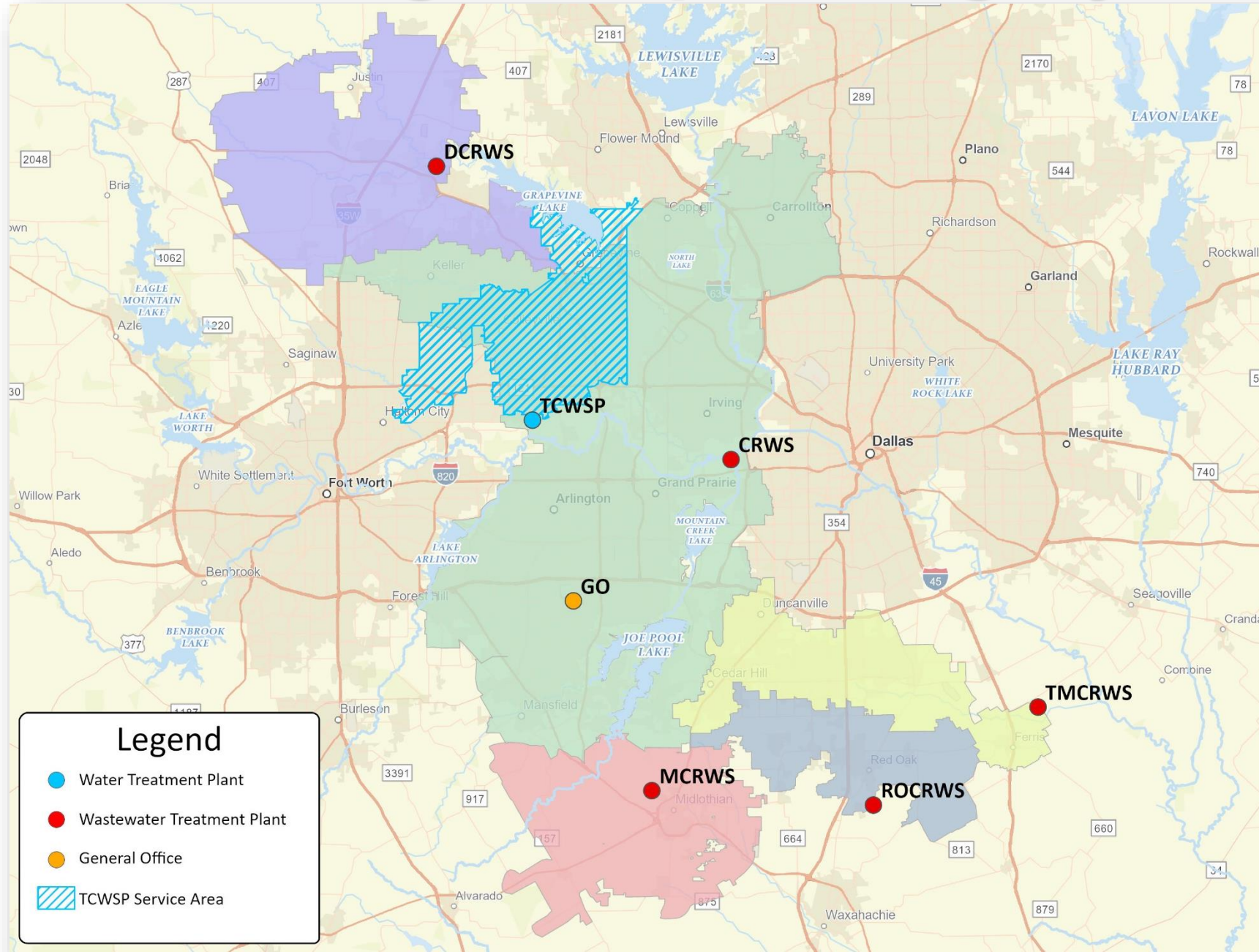
Southern Region



Trinity River Basin



Northern Region Operating Systems



Reinforced Concrete Pipe

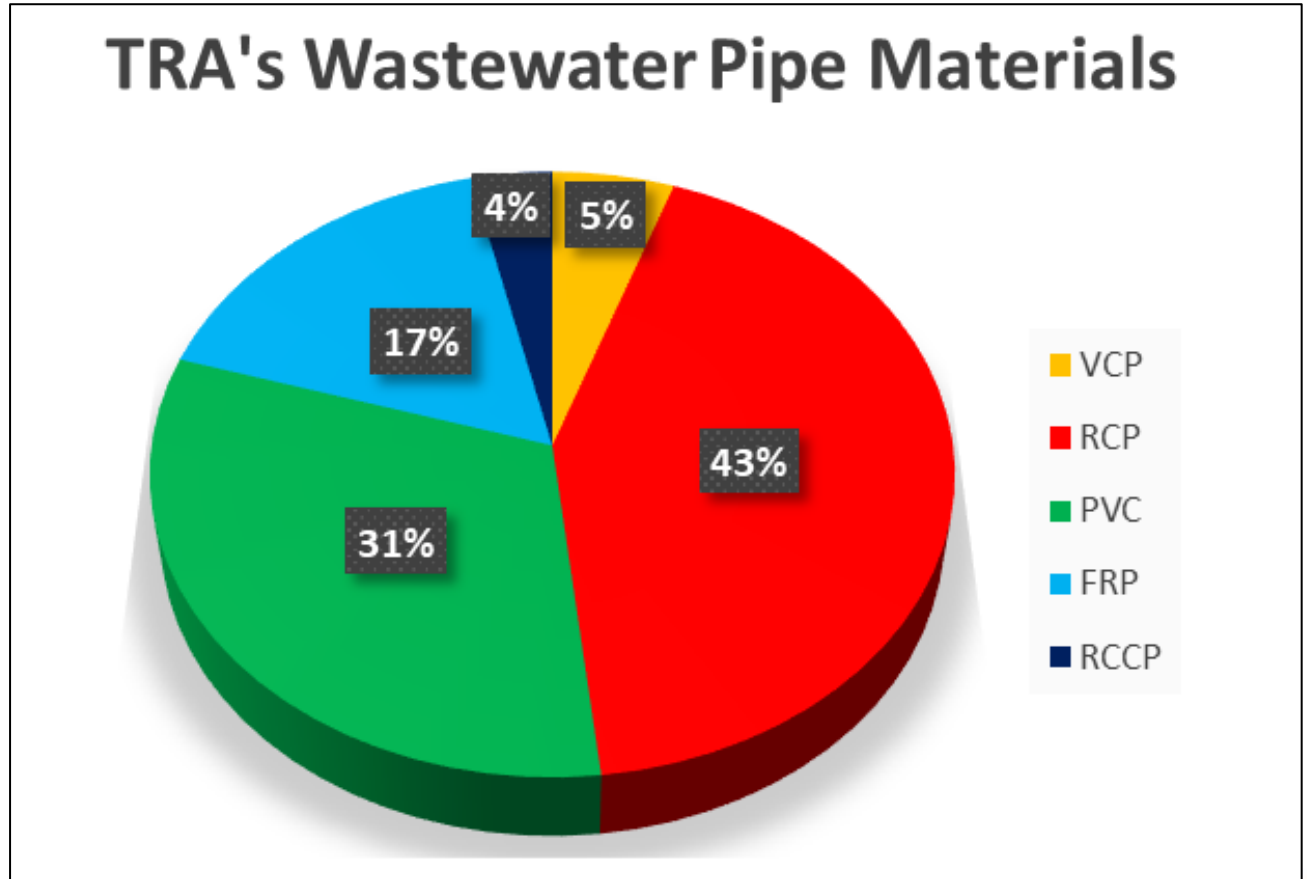
5 Wastewater Treatment Systems

- Approximately 350 miles of wastewater pipeline
- Approximately 165 miles of unlined reinforced concrete pipe



Ongoing RCP Condition Assessment

- 2022 – TRA initiated 258,000 feet of multi-sensor inspection (MSI)
 - 90,000 completed
 - Remainder to be completed in 2023
- 2024 – 260,000 feet of RCP to be inspected



PROBLEM?

UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL





UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL







UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



SOLUTION

UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL





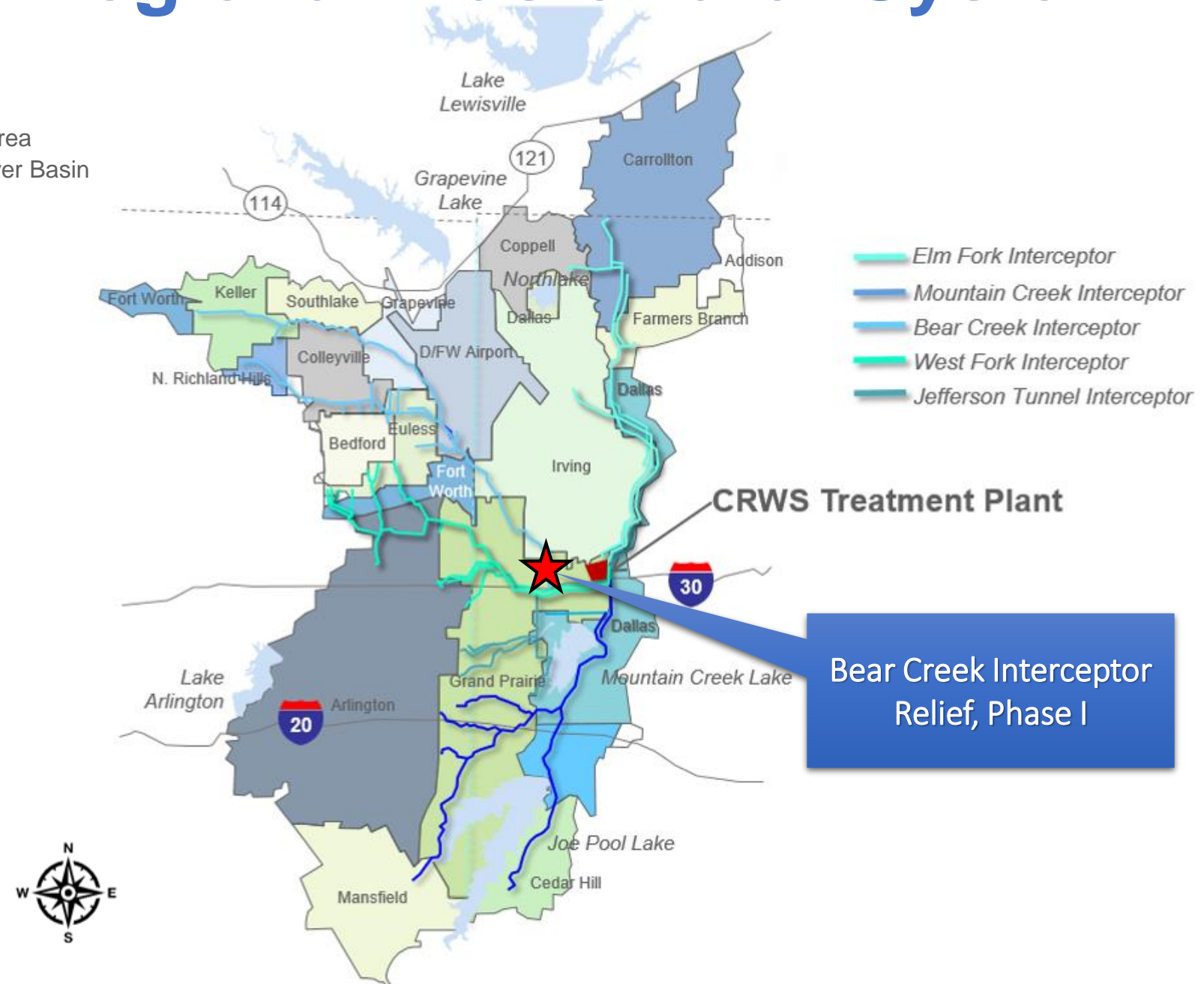


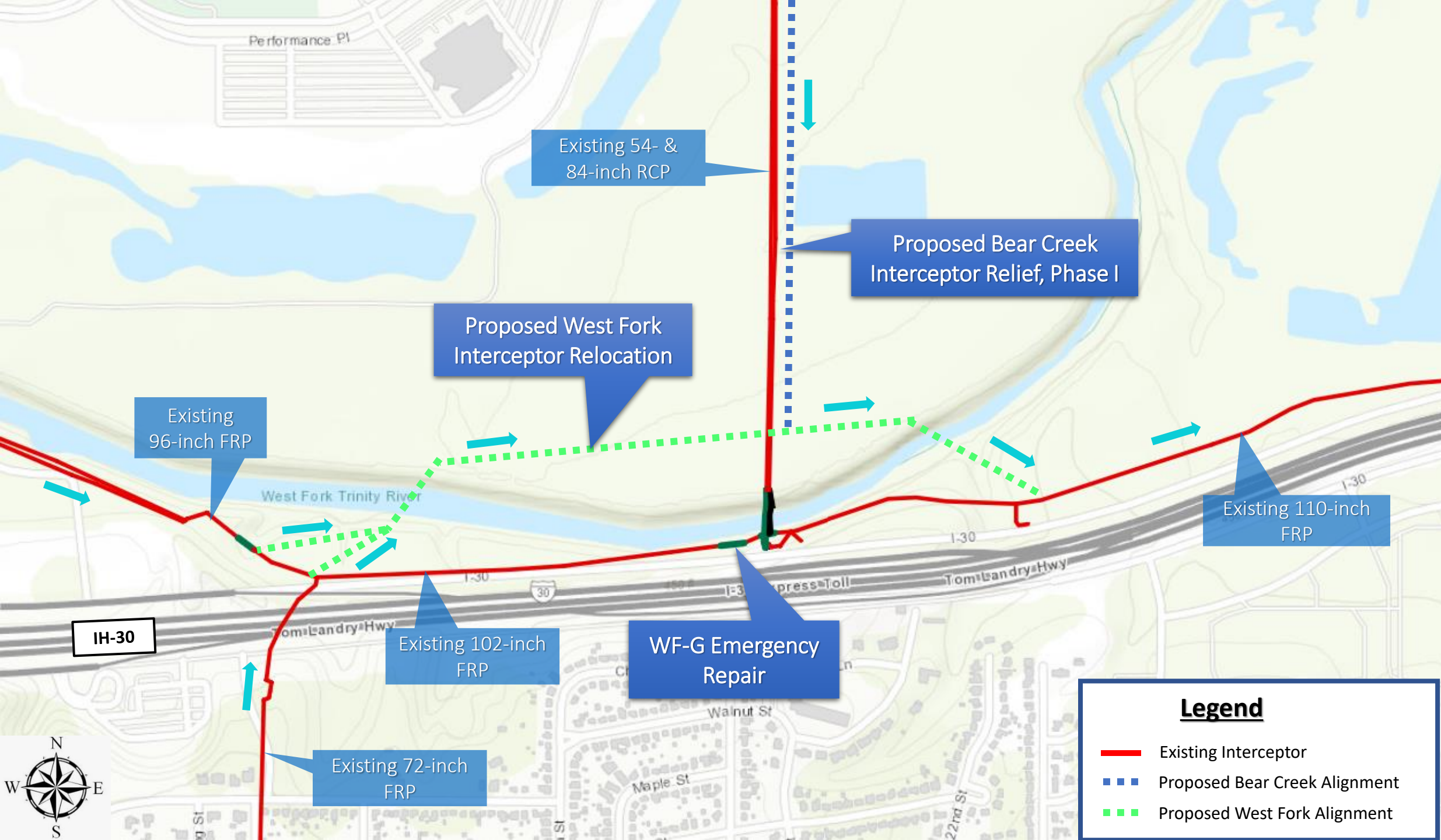


UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



Central Regional Wastewater System







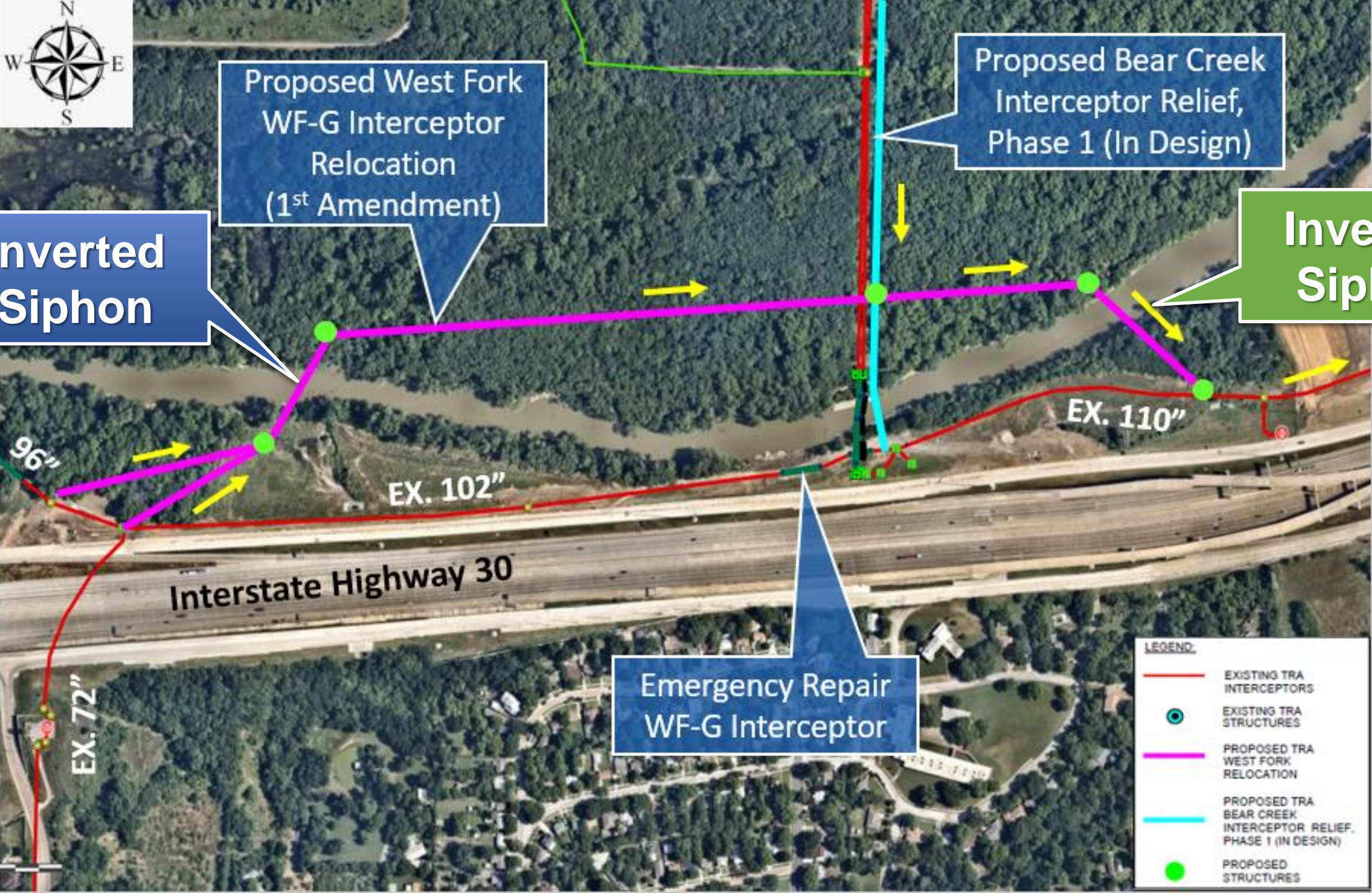
Proposed West Fork
WF-G Interceptor
Relocation
(1st Amendment)

Proposed Bear Creek
Interceptor Relief,
Phase 1 (In Design)

Inverted
Siphon

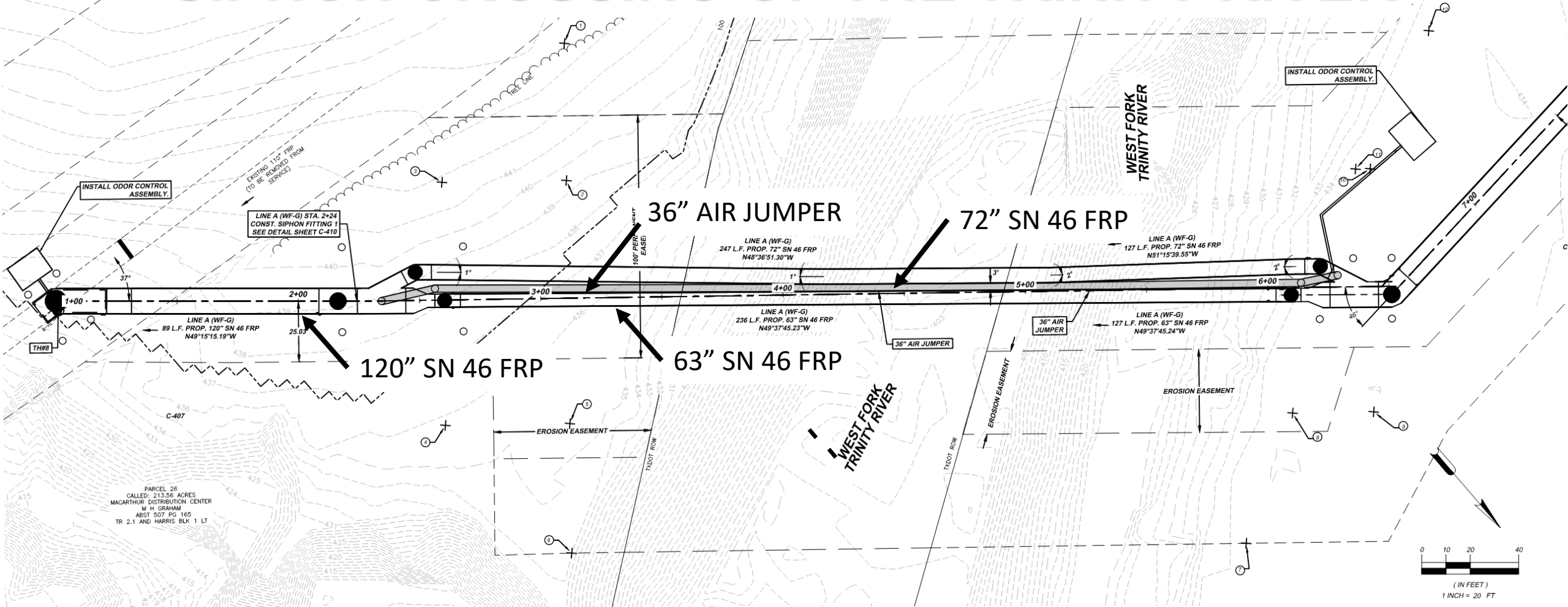
Inverted
Siphon

Emergency Repair
WF-G Interceptor



LEGEND	
	EXISTING TRA INTERCEPTORS
	EXISTING TRA STRUCTURES
	PROPOSED TRA WEST FORK RELOCATION
	PROPOSED TRA BEAR CREEK INTERCEPTOR RELIEF, PHASE 1 (IN DESIGN)
	PROPOSED STRUCTURES

SIPHON CROSSING OF THE TRINITY RIVER

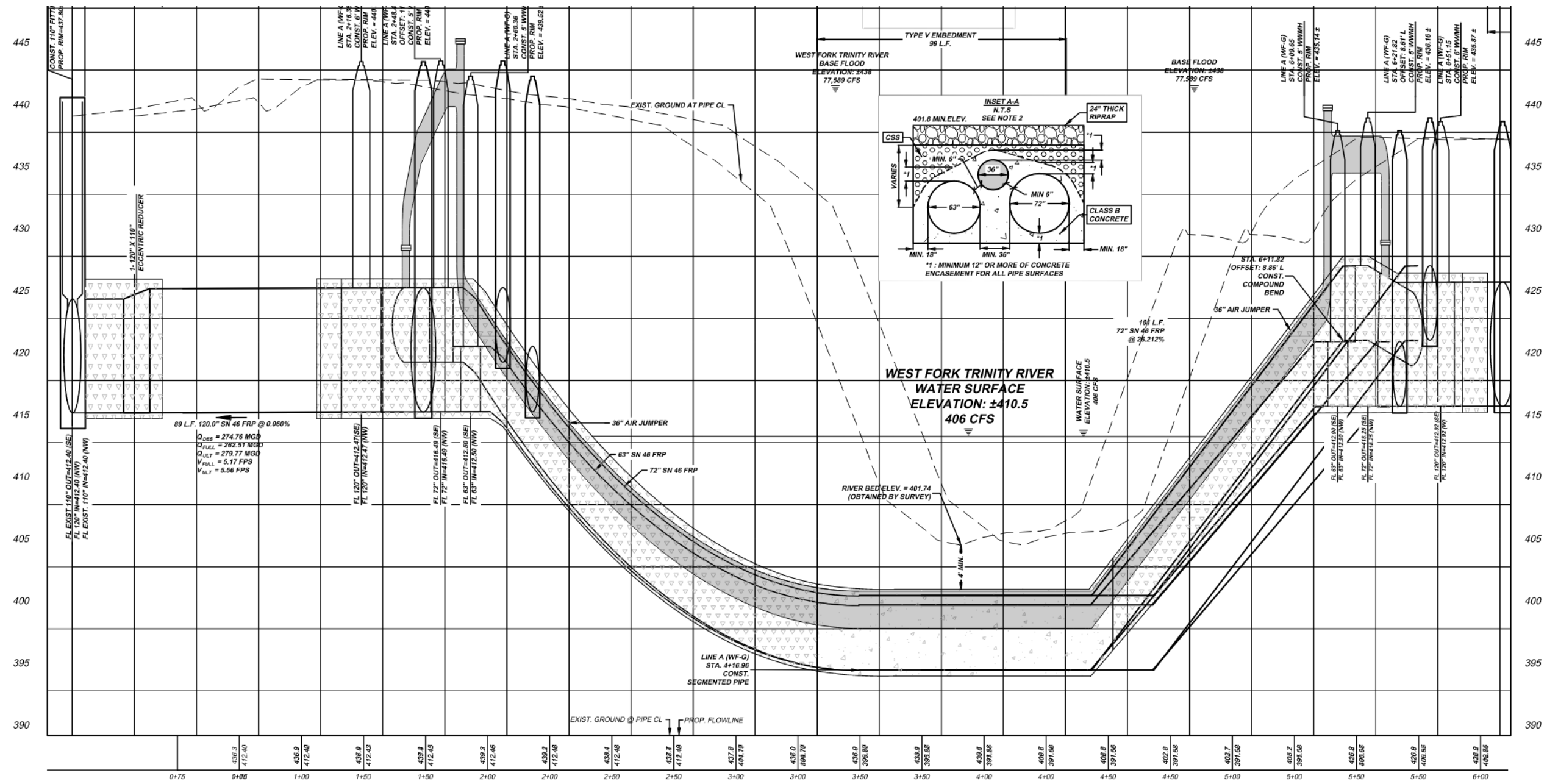


UNDERGROUND CONSTRUCTION TECHNOLOGY

THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



SIPHON PROFILE



Interceptor Information		
Project Name	WF-G Interceptor Relocation	
Project Number	130-10845-002	
Siphon Name	East Crossing	
Client	Trinity River Authority	
System Information	Average Daily Minimum Flow (MGD)	52.50
	Average Daily Flow (MGD)	78.70
	Average Daily Maximum Flow (MGD)	91.80
	Peak Wet Weather Flow (MGD)	274.76
	Interceptor Manning's Coefficient ¹	0.013
	Siphon Manning's Coefficient ²	0.015
Inflow Interceptor	Diameter (in)	120
	Invert (ft)	412.92
	Overt (ft)	422.92
	Slope (ft/ft) ⁶	0.0006
Outflow Interceptor	Diameter (in)	120
	Invert (ft)	412.47
	Overt (ft)	422.47
	Slope (ft/ft) ⁶	0.0006
First Siphon	Diameter (in)	63
	Inlet Invert (ft)	412.900
	Inlet Overt (ft) ⁴	418.150
	Outlet Invert (ft) ³	412.500
	Outlet Overt (ft)	417.75
	Length (ft) ⁵	353.530
Second Siphon	Diameter (in)	72
	Inlet Invert (ft)	418.250
	Inlet Overt (ft) ⁴	424.250
	Outlet Invert (ft) ³	416.490
	Outlet Overt (ft)	s
	Length (ft) ⁵	413.010
Third Siphon	Diameter (in)	0
	Inlet Invert (ft)	0.000
	Inlet Overt (ft) ⁴	0.000
	Outlet Invert (ft) ³	0.000
	Outlet Overt (ft)	0.000
	Length (ft) ⁵	0.000

		Siphon Capacity			
		Avg. Daily Min.	Avg. Daily	Avg. Daily Max.	PWW
System Flow		52.50	78.70	91.80	274.76
Inlet Structure Flow Depth (in)		-13.28	49.36	56.70	155.17
Water Surface Elev. (ft) ⁷		417.03	417.01	417.63	425.83
WSE Fine Guess (ft) ⁸		0.00	0.00	0.00	422.90
Surcharge Depth (ft) ⁹		0.00	0.00	0.00	0.00
First Siphon	Flow Rate (MGD)	N/A	78.70	91.80	116.72
	Velocity (FPS) ¹⁰	N/A	5.62	6.56	8.34
	HGL	N/A	0.0022	0.0030	0.0049
Second Siphon	Flow Rate (MGD)	N/A	N/A	N/A	158.04
	Velocity (FPS) ¹⁰	N/A	N/A	N/A	8.65
	HGL	N/A	0.0022	0.0030	0.0049
Third Siphon	Flow Rate (MGD)	N/A	N/A	N/A	N/A
	Velocity (FPS) ¹⁰	N/A	N/A	N/A	N/A
	HGL	N/A	0.0022	0.0030	0.0049
Siphon Capacity ¹¹		N/A	78.70	91.80	274.76

This calculator was developed by Greg Vaughn, P.E. and John Van Hoosier out of the LAN Fort Worth Office. Please note that the calculations occur on hidden tabs and any edits to these tabs should be made by Greg Vaughn or John Van Hoosier. Reach out with any questions, concerns, or issues regarding this calculator.

While this calculator does into remove all the iteration needed in the design of a siphon system, it does speed up the trial-and-error process considerably. The siphon capacity calculations are handled by the calculator while determining the best siphon barrel diameters and their final arrangement is left to the user. Furthermore, this calculator has a shallow learning curve relative to more training-intensive modeling programs. This calculator provides a quick design for a small part of a larger system. This is not intended as a replacement for larger modeling programs capable of providing a more wholistic analysis of a larger, system view.

Greg Vaughn, P.E.
(817) 338-7507
gavaughn@lan-inc.com

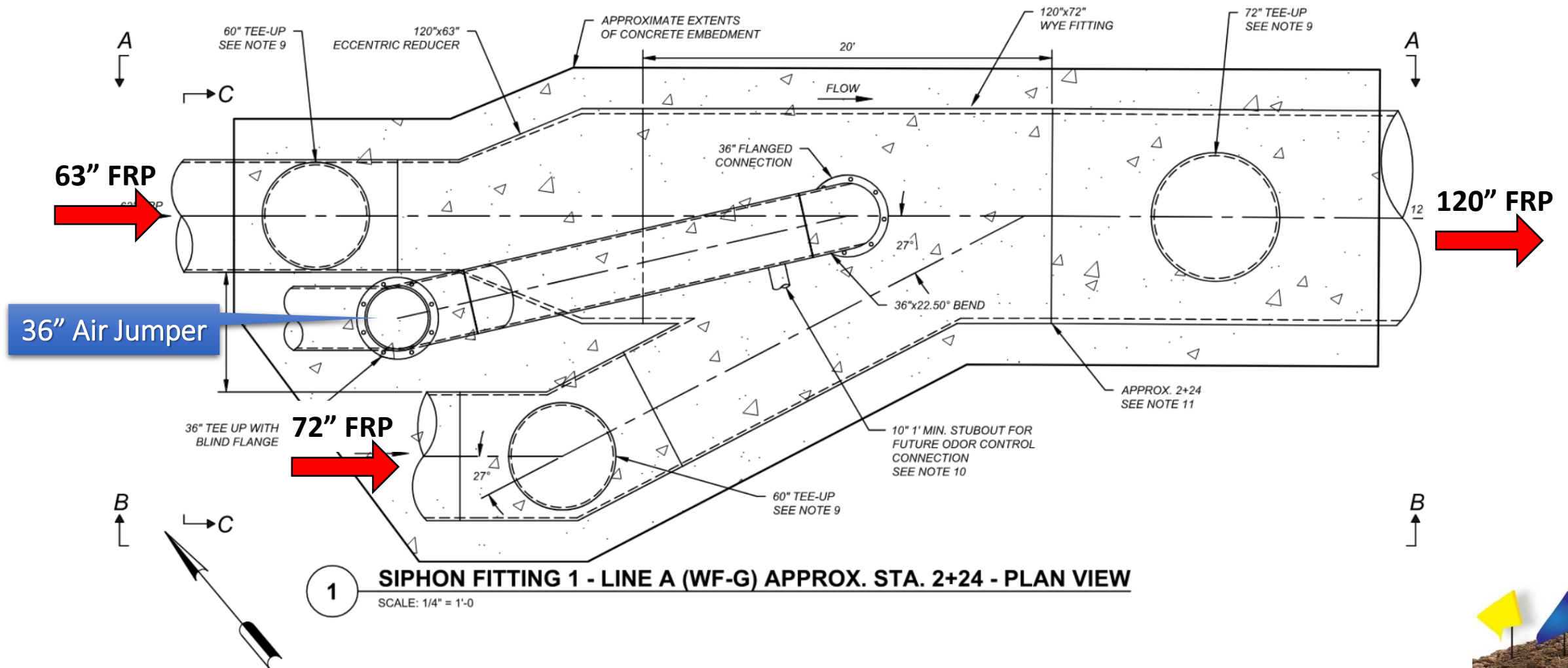
John Van Hoosier
(817) 338-7532
jvanhoosier@lan-inc.com



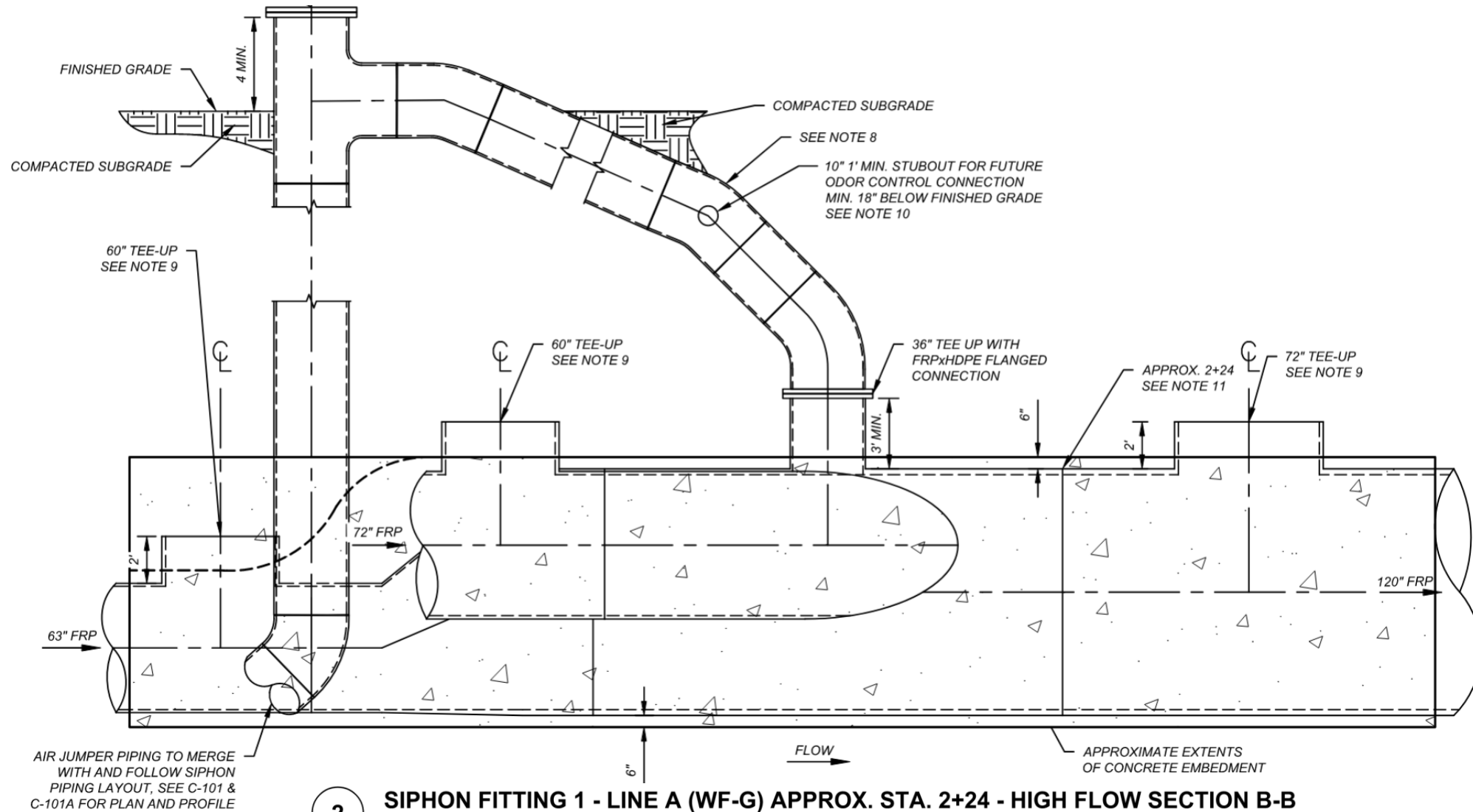
**Lockwood, Andrews
& Newnam, Inc.**
A LEO A DALY COMPANY



DOWNSTREAM SIPHON – PLAN VIEW



DOWNSTREAM SIPHON – HIGH FLOW SECTION VIEW



2

SIPHON FITTING 1 - LINE A (WF-G) APPROX. STA. 2+24 - HIGH FLOW SECTION B-B

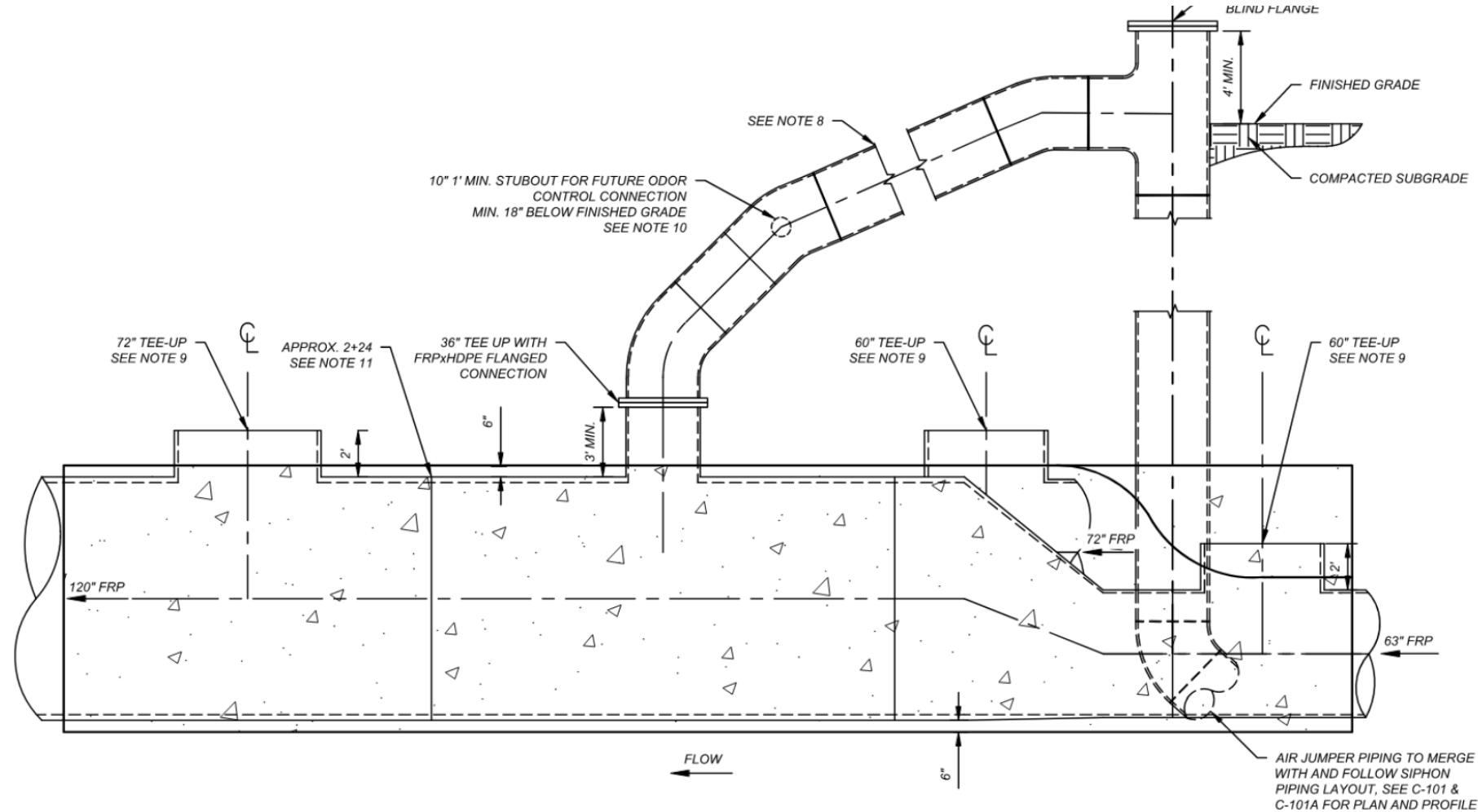
SCALE: 1/4" = 1'-0

UNDERGROUND CONSTRUCTION TECHNOLOGY

THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



DOWNSTREAM SIPHON – LOW FLOW SECTION VIEW



3

SIPHON FITTING 1 - LINE A (WF-G) APPROX. STA. 2+24 - LOW FLOW SECTION A-A

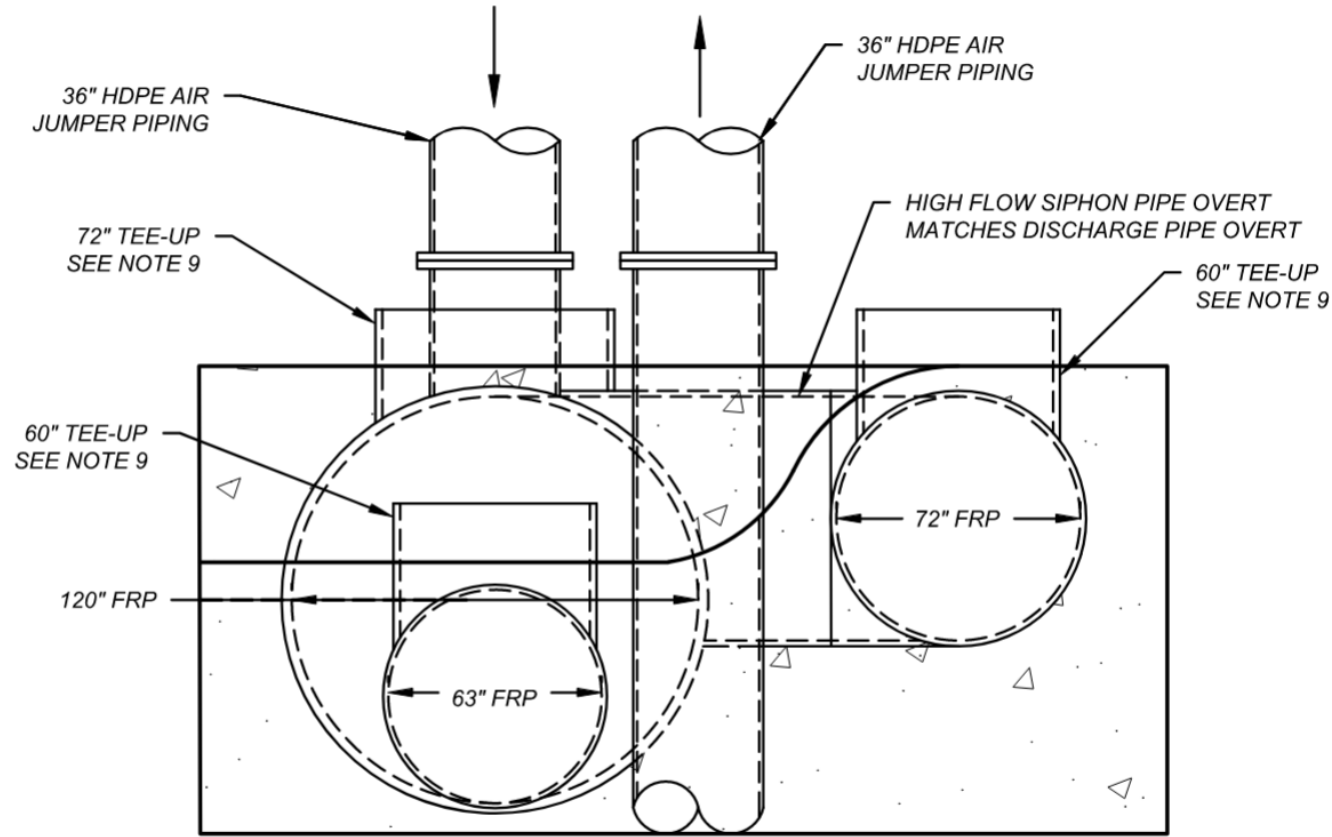
SCALE: 1/4" = 1'-0

UNDERGROUND CONSTRUCTION TECHNOLOGY

THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



DOWNSTREAM SIPHON – SECTION VIEW



4

SIPHON FITTING 1 - LINE A (WF-G) APPROX. STA. 2+24 - SECTION C-C

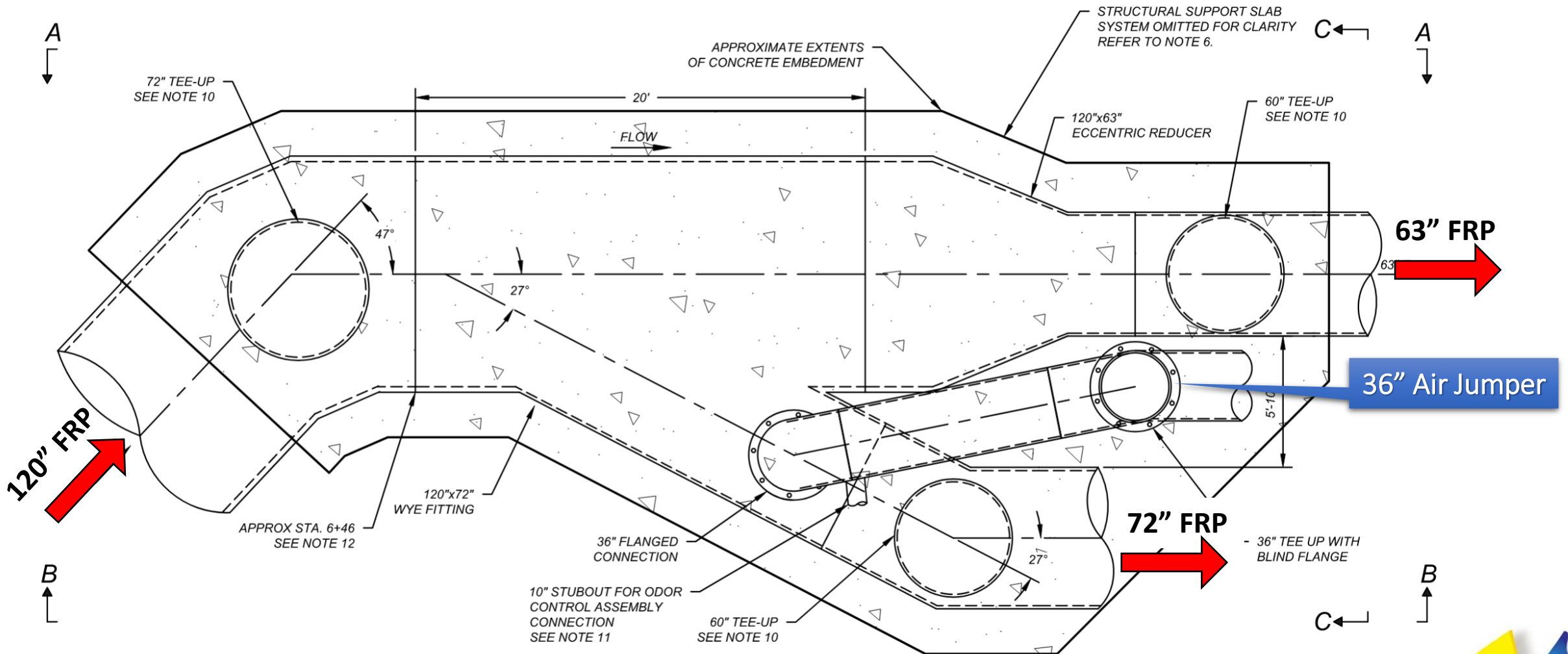
SCALE: 1/4" = 1'-0

UNDERGROUND CONSTRUCTION TECHNOLOGY

THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



UPSTREAM SIPHON – PLAN VIEW



1

SIPHON FITTING 2 - LINE A (WF-G) APPROX. STA. 6+46 - PLAN VIEW

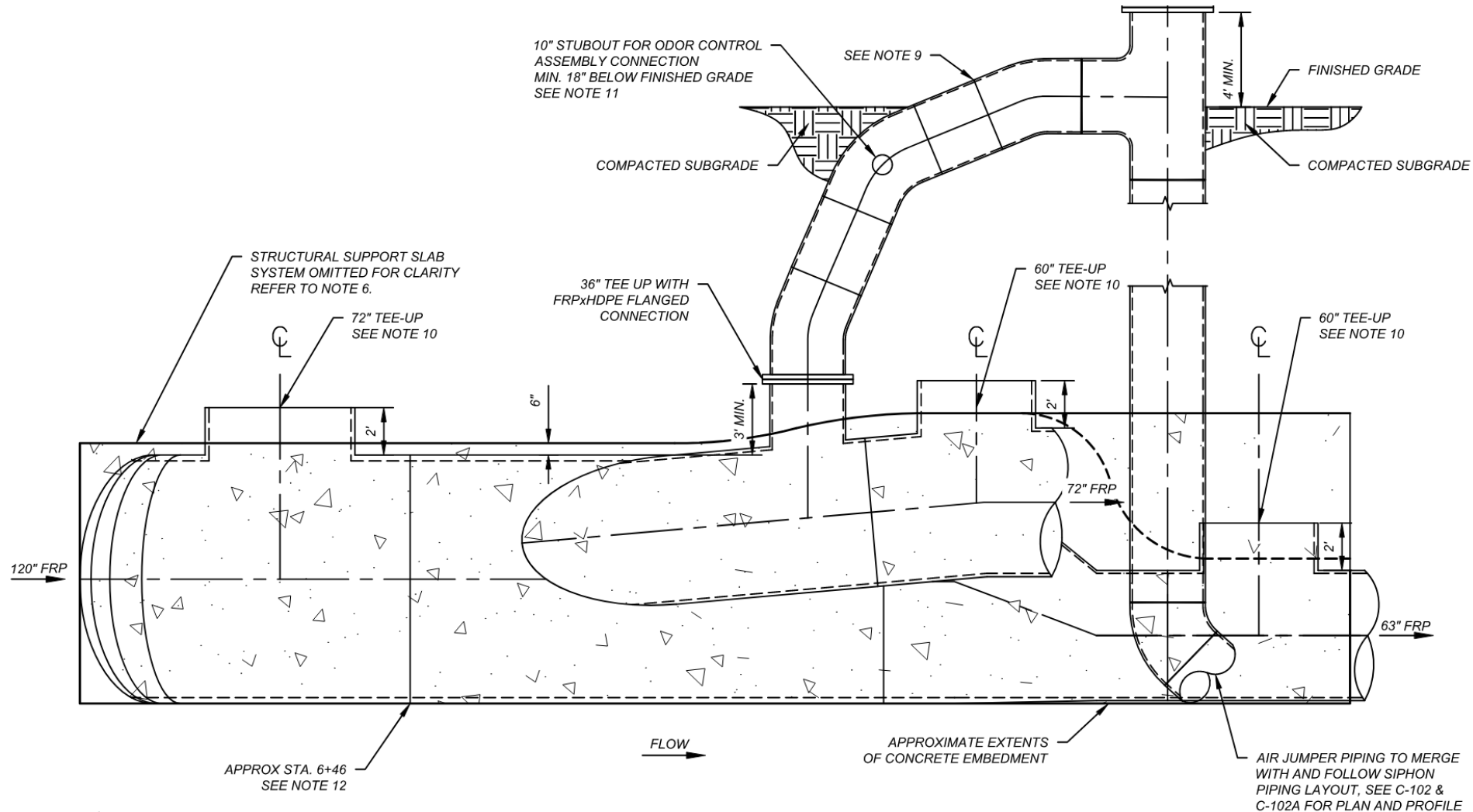
SCALE: 1/4" = 1'-0

UNDERGROUND CONSTRUCTION TECHNOLOGY

THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



UPSTREAM SIPHON – HIGH FLOW SECTION VIEW

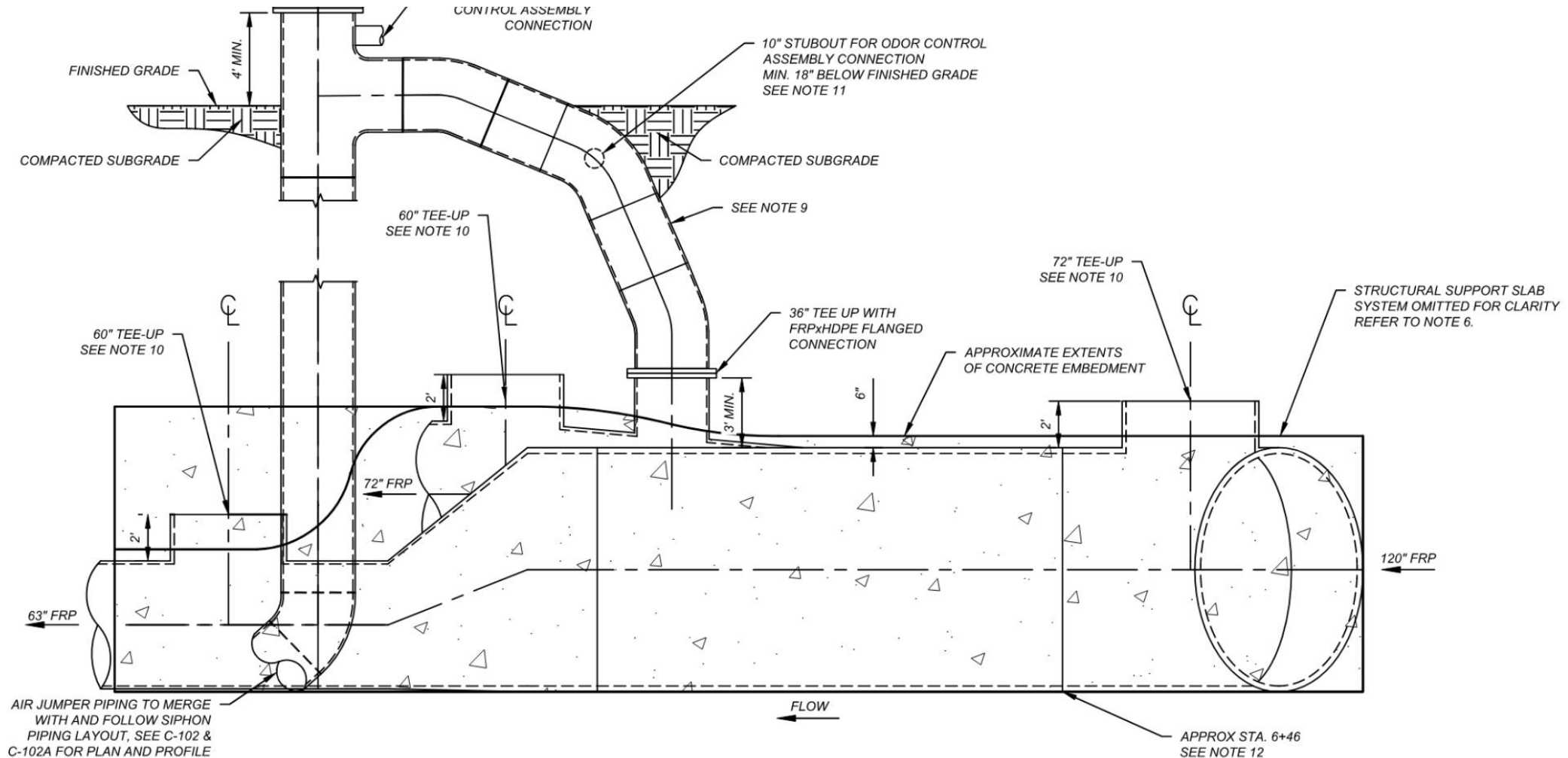


2

SIPHON FITTING 2 - LINE A (WF-G) APPROX. STA. 6+46 - HIGH FLOW SECTION B-B

SCALE: 1/4" = 1'-0

UPSTREAM SIPHON – LOW FLOW SECTION VIEW



3

SIPHON FITTING 2 - LINE A (WF-G) APPROX. STA. 6+46 - LOW FLOW SECTION A-A

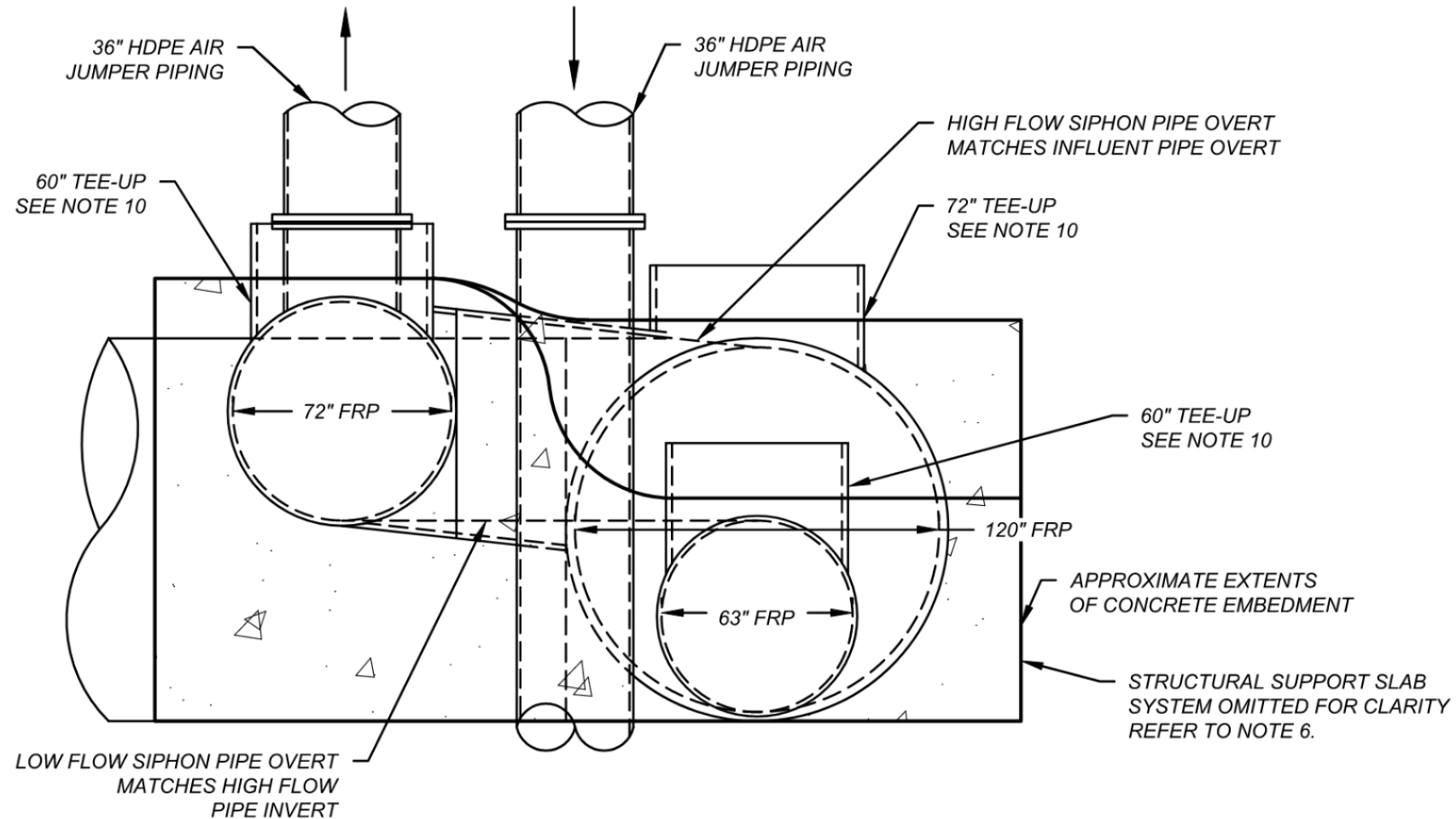
SCALE: 1/4" = 1'-0

UNDERGROUND CONSTRUCTION TECHNOLOGY

THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



UPSTREAM SIPHON –SECTION VIEW



4

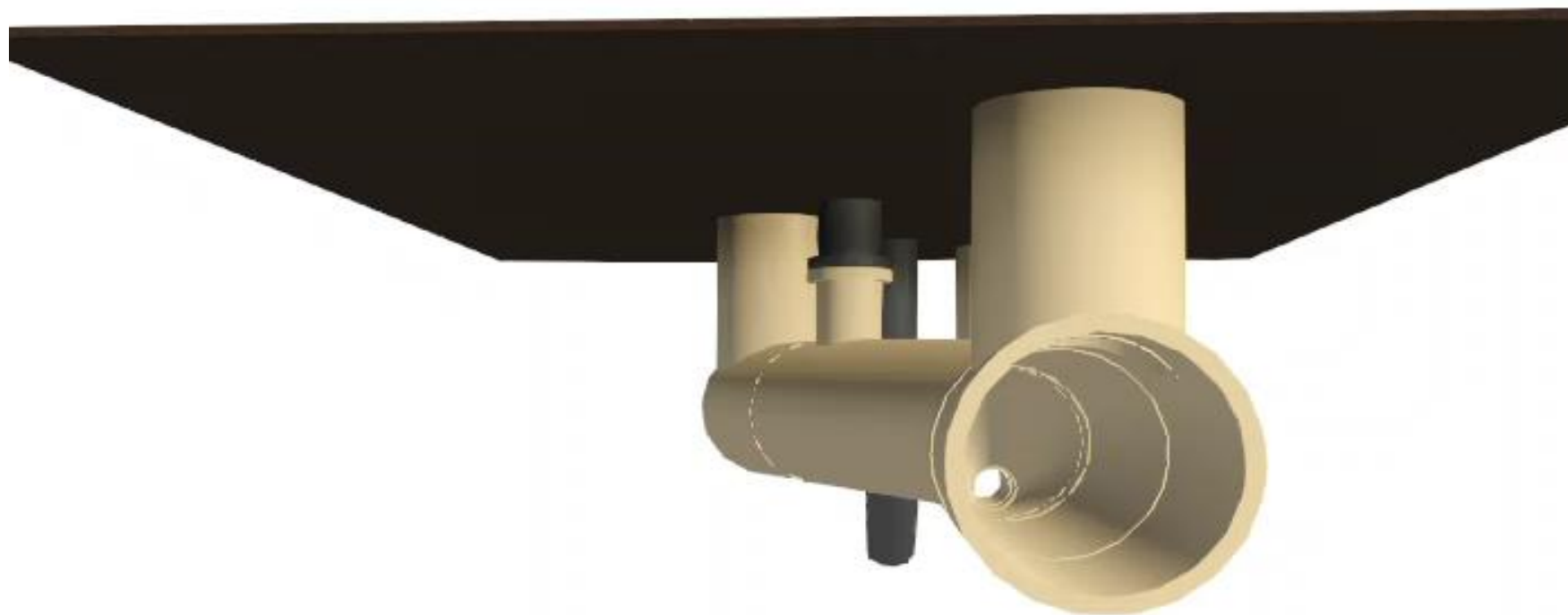
SIPHON FITTING 2 - LINE A (WF-G) APPROX. STA. 6+46 - SECTION C-C

SCALE: 1/4" = 1'-0

UNDERGROUND CONSTRUCTION TECHNOLOGY

THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL





UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL





UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL



THANK YOU!



Kelly Davis, P.E.
davisk@trinityra.org
Trinity River Authority of Texas



Greg Vaughn, P.E.
gavaughn@lan-inc.com
Lockwood, Andrews & Newnam, Inc.

