



# **GRP Review Committee Meeting**

**July 24, 2023**

# Item 1

## Call to Order

# Item 2

## Public Comments

# Item 3

## Approval of Minutes

# Item 4

## GRP Division Updates

# FY2023 Surface Water Allocations\*

Participant Name	FY23 Allocation	FY23 Actual	% used	% remaining	FY23 Remaining	Est. GPD
City of Conroe	1,413,420,000	902,885,000	64%	36%	510,535,000	5,549,293
City of Oak Ridge North	43,993,000	38,425,000	87%	13%	5,568,000	60,522
MUD 99	123,382,000	56,790,000	46%	54%	66,592,000	723,826
MSEC	290,971,000	33,396,000	11%	89%	257,575,000	2,799,728
Rayford Road MUD	133,400,000	66,560,000	50%	50%	66,840,000	726,522
San Jacinto River Authority	2,830,803,000	2,080,209,000	73%	27%	750,594,000	8,158,630
Southern Montgomery County MUD	139,621,000	118,452,000	85%	15%	21,169,000	230,098
<b>Total</b>	<b>4,975,590,000</b>	<b>3,296,717,000</b>	<b>66%</b>	<b>34%</b>	<b>1,678,873,000</b>	<b>18,248,620</b>

\*Numbers current as of 6/30/2023. FY23 Remaining applies to 7/1/2023 – 8/31/2023.

# Texas Water Conservation Association

## Summer Conference at the Woodlands

~ SJRA team members who attended ~



**Robert Smith, UE Asset Management Specialist, presented on our Digital Water Project.**



## *June 15<sup>th</sup> Tour: CobbFendley Interns and Mentors*

# Process Water Recovery Basins Lining Improvements

**Construction Amount:** \$2,348,897.50

**Notice to Proceed:** May 22, 2023

**Substantial Completion:** November 20, 2023

**Final Completion:** December 18, 2023

## **Progress to Date:**

- Mobilization & Submittals
- Demolition of Northern Basin
- Piping Inspection and Wrapping
- Rebar Placement and Formwork





## **Item 5**

**Discuss and Act on City of Willis Request to Waive Pumpage Fee on Water Used for Well Rehabilitation**

**Item 6**  
**Presentation on Suspected Panther Branch  
Fault Study**

# San Jacinto River Authority Groundwater Reduction Plan Program

## Analysis of Panther Branch Fault Protection on 42" GRP Water Transmission line (Segment W2A)

7/24/23



# Agenda

1. The Woodlands Subsidence Faults
2. W1 / W2 GRP Water Transmission Line Projects
3. Preliminary Fault Study
4. Discussion of Steel Pipe Performance
5. Findings and Conclusions

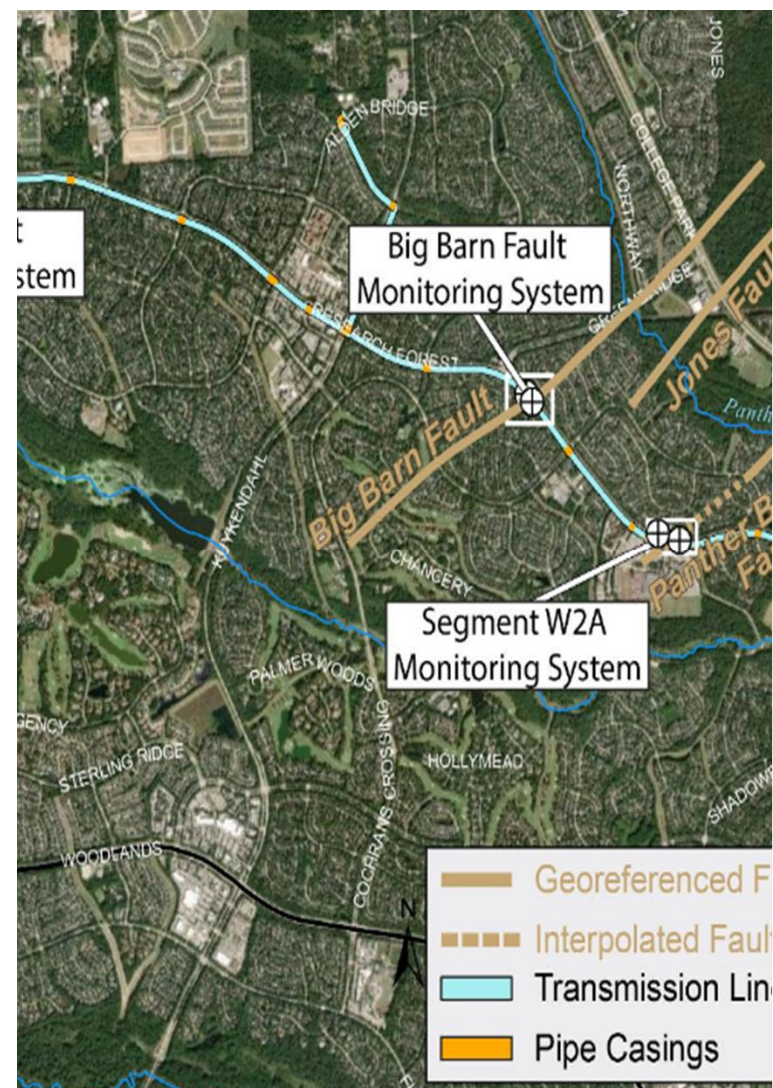
## Scope:

*Evaluate the risk to the W2A 42-inch Water Line due to ground movement at Cat's Cradle Dr.*

*Recommend options to minimize the risk to the water line*

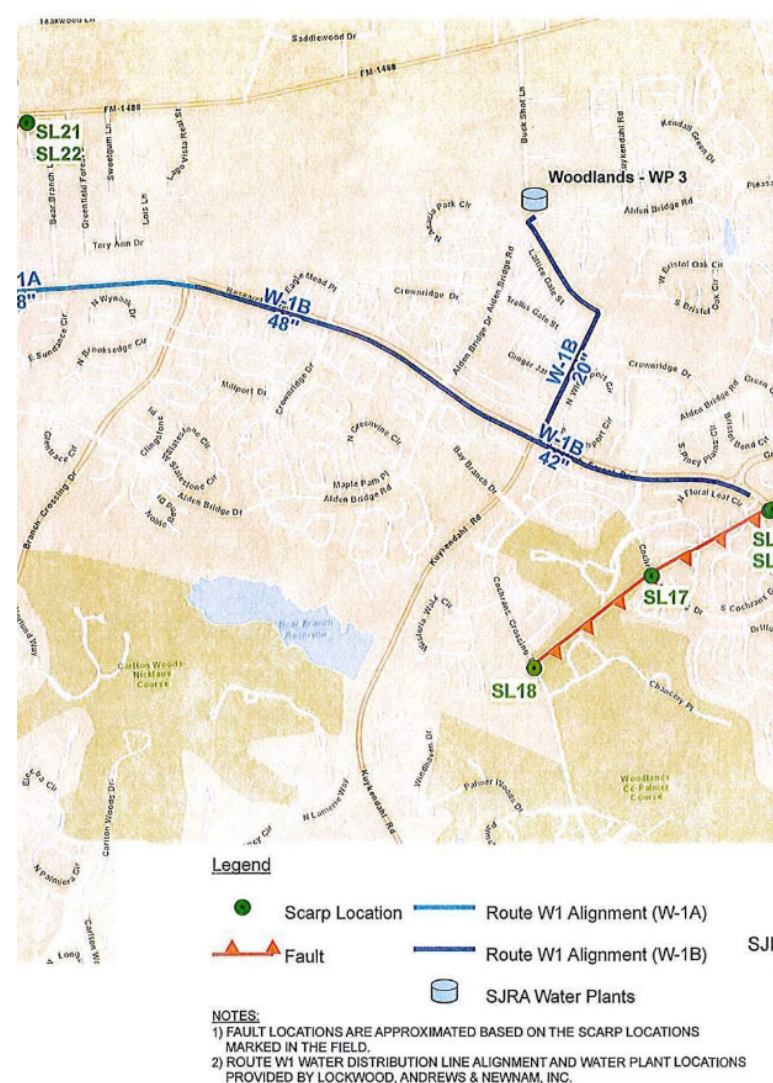
# The Woodlands Subsidence Faults

- Known and suspected faults:
  - Egypt
  - Big Barn
  - Jones
  - Panther Branch
- Vertical Movement
- Varying rates of movement
- Typical dip angle between 70 – 85 degrees from horizontal



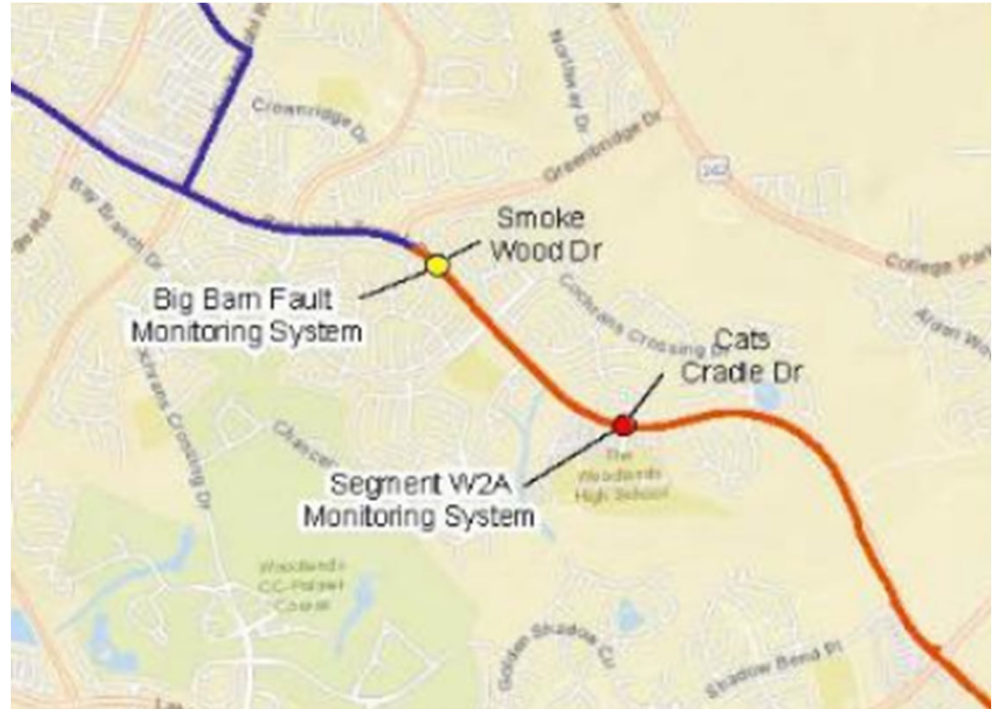
# W1A / W1B

- 48-inch WL along Research Forest
- Engineer = LAN
- Constructed ~ 2015
- 16-inch WL along FM2978
- Crosses the Egypt Fault x2
  - Incorporated protection measures to account for expected ground movement



# W2A

- 48-inch and 30-inch WL along Research Forest
- Engineer = Binkley & Barfield, Incorporated.
- Constructed ~ 2015
- Crosses:
  - Big Barn Fault
    - Incorporates protection measures
  - Jones Fault ?
    - Small movement predicted
  - Panther Branch Fault ??
    - Determined not to cross the WL alignment



## Per the Phase I Fault Study for Segment W2:

“The Panther Branch Fault approaches Research Forest from the northeast, but apparently dies out before reaching it.”

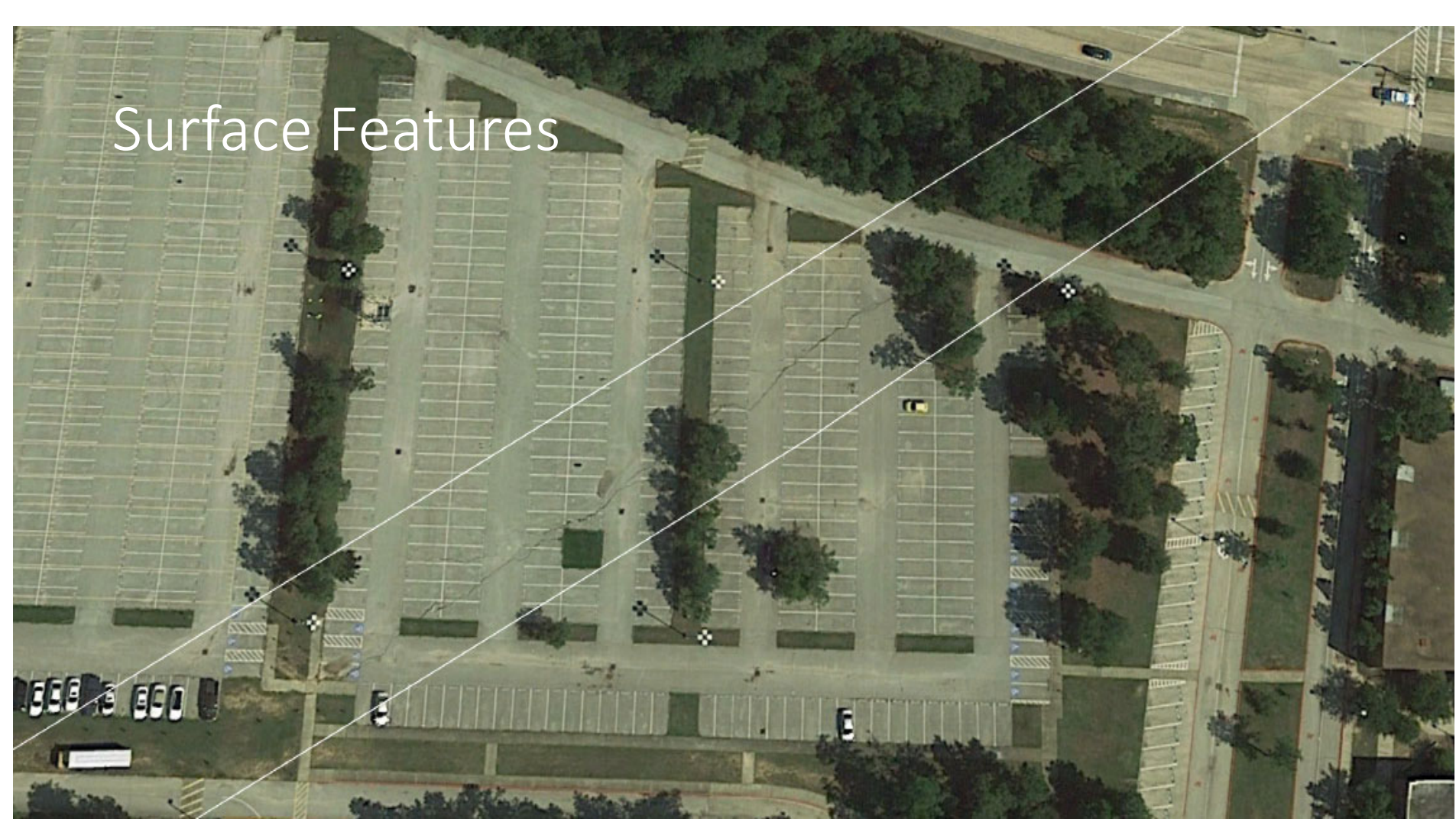
# 2022 - Phase I Fault Study

Limited to evaluating risk to 42" WL at Research Forest and Cat's Cradle

- Review past studies
- Identify surface features indicative of fault movement
- Identify potential fault location at water line
- Review monitoring data (provided by others)
- Evaluate potential concerns related to water line



# Surface Features



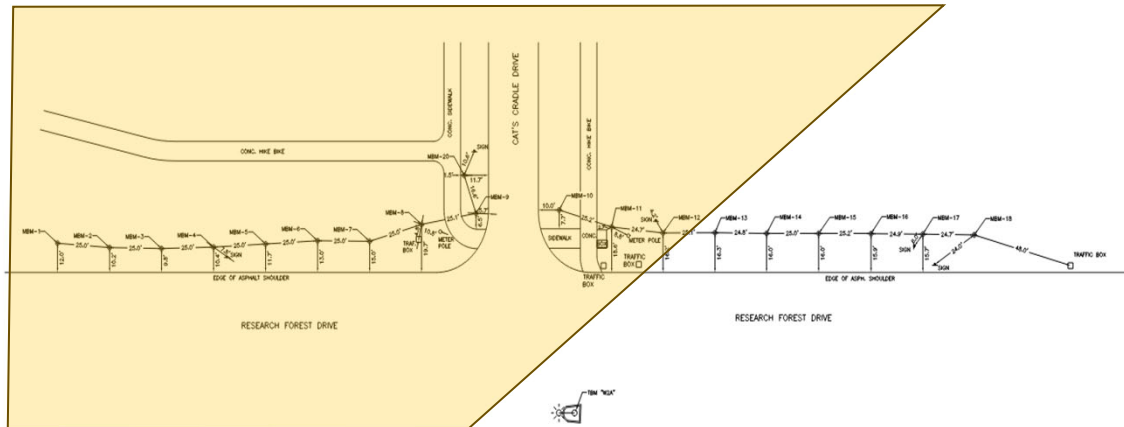
# Surface Features





# Surface Monitoring Summary

- Measured negative surface movement (settlement), west of interpolated fault line
- Maximum settlement = **1.08"** at one point, BM4
  - Average rate of **0.13"/yr**
- Average movement of points on the west side = **0.10"/yr**



8-year Total Movement (Inches)	Avg. Yearly Movement (Inches)
-0.84	-0.105
-0.84	-0.105
-0.96	-0.12
-1.08	-0.135
-0.84	-0.105
-0.72	-0.09
-0.72	-0.09
-0.84	-0.105
-0.84	-0.105
-0.84	-0.105
-0.48	-0.06
-0.48	-0.06
-0.84	-0.105
0	0
-0.12	-0.015
0	0
0	0
0	0
-0.12	-0.015

# Seasonal Variation of Survey

*\*Numbers below are in feet.*

6-Month difference in Ground Surface Elevation															
1 Fall 2015	2 Spring 2016	3 Fall 2016	4 Spring 2017	5 Fall 2017	6 Spring 2018	7 Fall 2018	8 Spring 2019	9 Fall 2019	10 Spring 2020	11 Fall 2020	12 Spring 2021	13 Fall 2021	14 Spring 2022	15 Fall 2022	16 Spring 2023
(0.01)	0.00	0.00	0.00	(0.01)	0.01	0.00	0.00	(0.01)	0.00	(0.01)	0.00	(0.01)	0.00	(0.03)	0.00
(0.01)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(0.01)	0.01	(0.01)	0.00	(0.01)	0.00	(0.04)	0.00
(0.01)	0.00	0.00	0.00	(0.01)	0.01	(0.01)	0.01	(0.02)	0.01	(0.01)	(0.01)	(0.01)	0.01	(0.04)	0.00
(0.01)	(0.01)	0.00	0.00	0.00	0.00	(0.01)	0.01	(0.02)	0.00	(0.01)	0.00	(0.02)	0.02	(0.04)	0.00
(0.01)	0.00	0.00	0.00	0.00	0.00	(0.01)	0.01	(0.01)	(0.01)	(0.01)	0.01	(0.01)	0.00	(0.04)	0.01
(0.01)	0.00	0.00	0.01	(0.01)	0.00	(0.01)	0.01	(0.01)	0.00	(0.01)	0.00	0.00	0.00	(0.04)	0.01
(0.01)	0.00	0.01	0.00	(0.01)	0.00	0.00	0.00	(0.01)	0.00	(0.01)	0.00	0.00	0.00	(0.03)	0.00
(0.02)	0.01	0.00	0.00	0.00	0.00	(0.02)	0.02	(0.02)	0.00	(0.01)	0.01	(0.01)	0.00	(0.04)	0.01
0.00	(0.01)	0.00	0.00	0.00	0.00	0.00	0.00	(0.01)	0.00	(0.01)	0.00	0.00	0.00	(0.03)	(0.01)
(0.01)	0.00	0.00	0.00	0.00	0.00	(0.01)	0.00	0.00	(0.01)	0.00	0.00	0.03	(0.04)	(0.04)	0.01
(0.02)	0.01	0.00	0.00	(0.01)	0.00	(0.02)	0.02	(0.02)	0.01	(0.02)	0.01	(0.01)	0.01	(0.03)	0.03
(0.01)	0.01	(0.01)	0.01	(0.01)	0.00	(0.01)	0.01	(0.02)	0.01	(0.02)	0.00	0.00	0.01	(0.03)	0.02
(0.01)	0.00	0.00	0.00	(0.01)	0.00	0.00	0.00	(0.01)	0.01	(0.01)	0.00	(0.01)	0.00	(0.03)	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(0.01)	0.01	0.00	0.00	(0.01)	0.01
0.00	0.00	0.00	0.00	0.00	0.00	(0.01)	0.01	(0.01)	0.00	0.00	0.00	0.00	0.01	(0.02)	0.01
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
(0.01)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(0.01)	0.01
(0.01)	0.01	(0.01)	0.01	0.00	0.00	(0.01)	0.01	(0.01)	0.00	0.00	0.01	0.00	0.00	(0.01)	0.01
(0.01)	0.01	(0.01)	0.01	0.00	0.00	(0.01)	0.01	(0.01)	0.01	(0.01)	0.01	(0.01)	0.01	(0.01)	0.00

# Interpretation of Survey

## Benchmark vs Monitoring Points

- Benchmark = light pole foundation ~30-foot-deep drilled shaft
- Monitoring Points = 4-foot rebar
  - Subject to influence of shrink/swell, surface consolidation
  - Indicates soil movement around 2-foot deep, whereas water line is 14 feet deep

## Survey equipment accuracy

- $\pm 0.06''$

# Conclusions from Phase I Work



Visual evidence of  
pavement damage  
near focus area

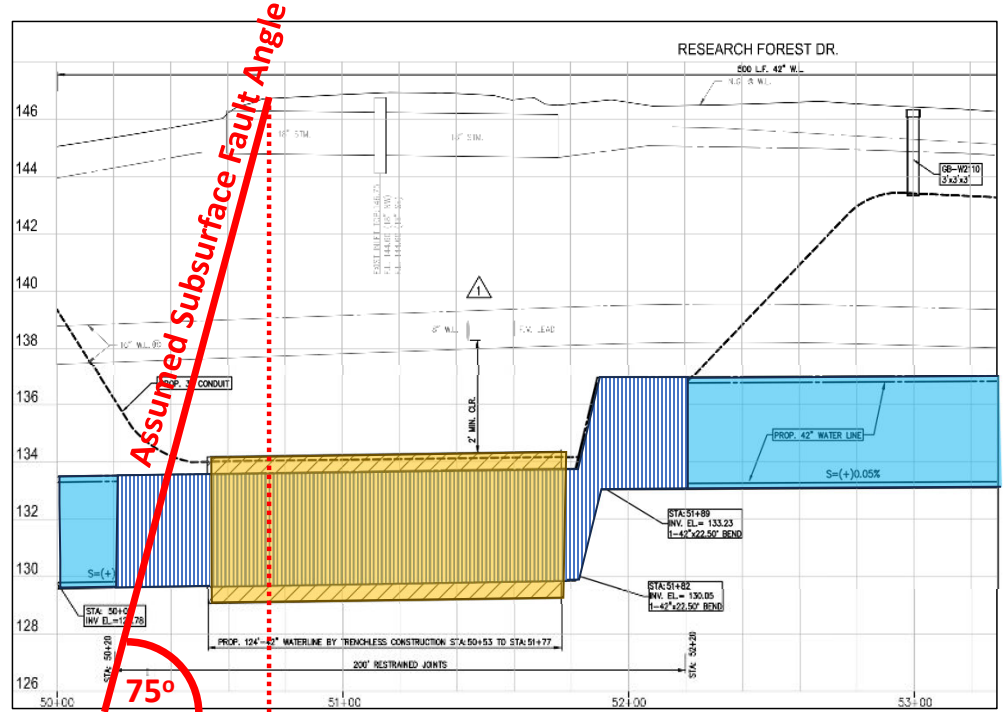
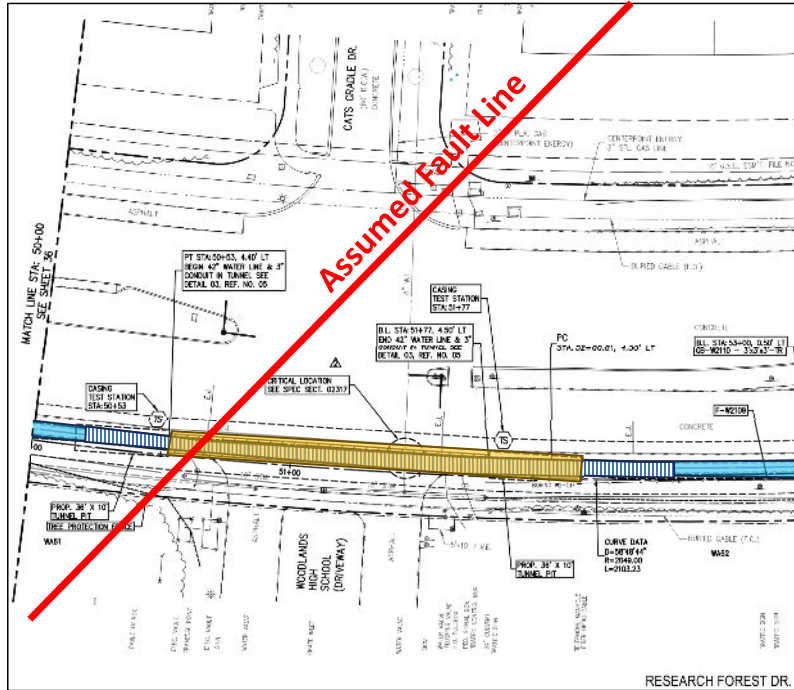


Evidence of surface  
settlement near focus  
area



Recommend Phase II  
Geotech study to  
confirm subsurface  
fault

# W2A Pipeline at Cats Cradle Dr.



Assumed Fault Line

Assumed Subsurface Fault Angle

75°



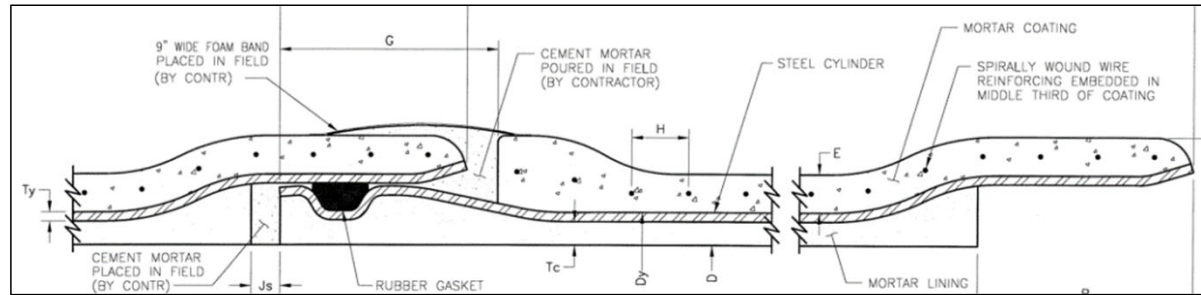
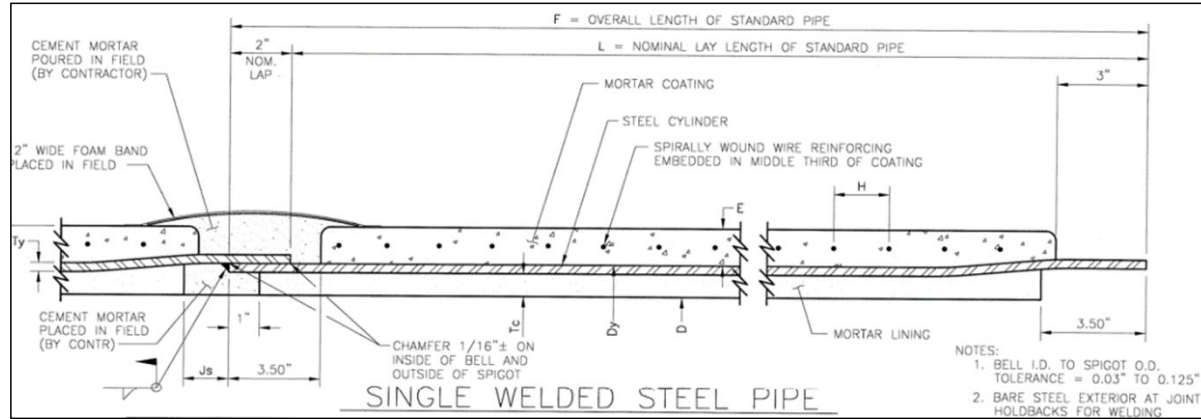
# W2A Pipeline

Spiral-welded steel segments connected by joints

- Welded (restrained)
- Gasketed (unrestrained)
- Tunnel with steel casing

## Corrosion Protection

- Internal cement mortar lining
- External mortar coating plus cathodic protection



# What is a Failure?

**Per AWWA:**

## Category 3

- Loss of service with time to plan
- “Leak”

## Category 2

- Significant structural weakness
- Identified by Inspection

## Category 1

- Catastrophic Rupture
- You know it when you see it...



# Failure Scenarios from slow ground movement Within limits of **Restrained Joint Pipe**

Ground movement causes the pipe to deform and creates stress

## Most Likely Scenario

- Deformation results in cracking and delamination of rigid internal and external cement mortar coatings
- Leads to long-term corrosion and, ultimately, pinhole-type leaks

## Less Likely Scenario

- Stress builds in pipe wall leading to failure of welded joint
- Could be catastrophic

# Theoretical Rates – Restrained Joint Pipe

## Assumptions:

- 0.13" per year vertical settlement
- Movement is occurs over a fault hazard band ~ 250 feet
- Calculate stress in steel and mortar

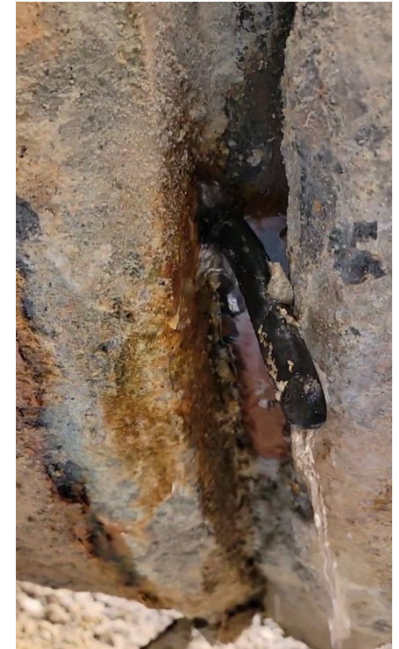
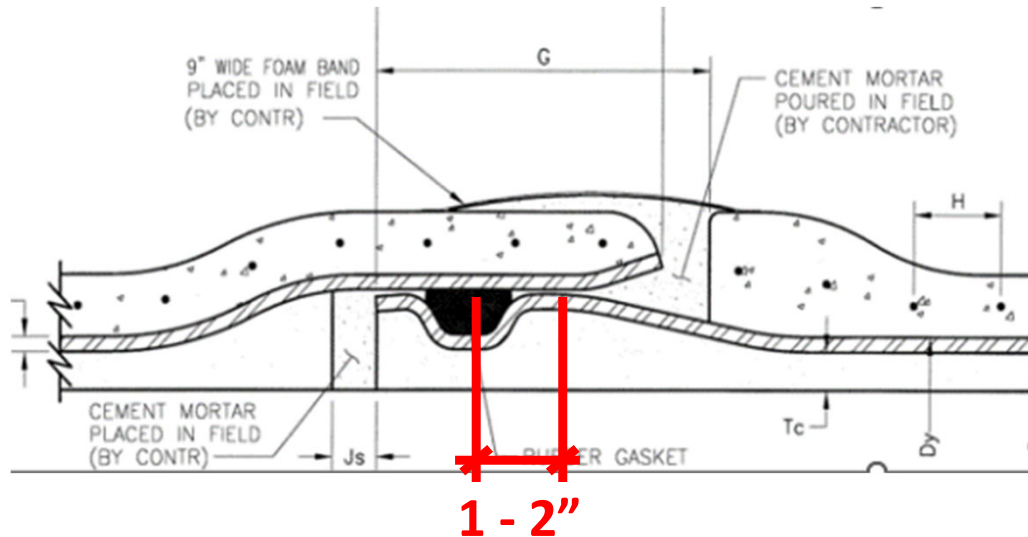
## Cement mortar could reach its tensile limit and crack ~ 25 years

- Exterior protected with impressed current
- Interior unprotected = start of corrosion
  - Corrosion takes time, **assume another 25 years**

# Failure Scenarios from slow ground movement Within limits of Unrestrained Joint Pipe

Ground movement causes joint to slide open (disengage)

- May results in small, steadily increasing leak
- Occurs slowly with horizontal component of ground movement




# Theoretical Rates – Unrestrained Joint Pipe

## Assumptions:

- 0.13" per year vertical settlement
  - 75-degree dip angle
  - All movement is concentrated at a single joint
  - Pipe was properly installed
- } = 0.035"/yr horizontal movement

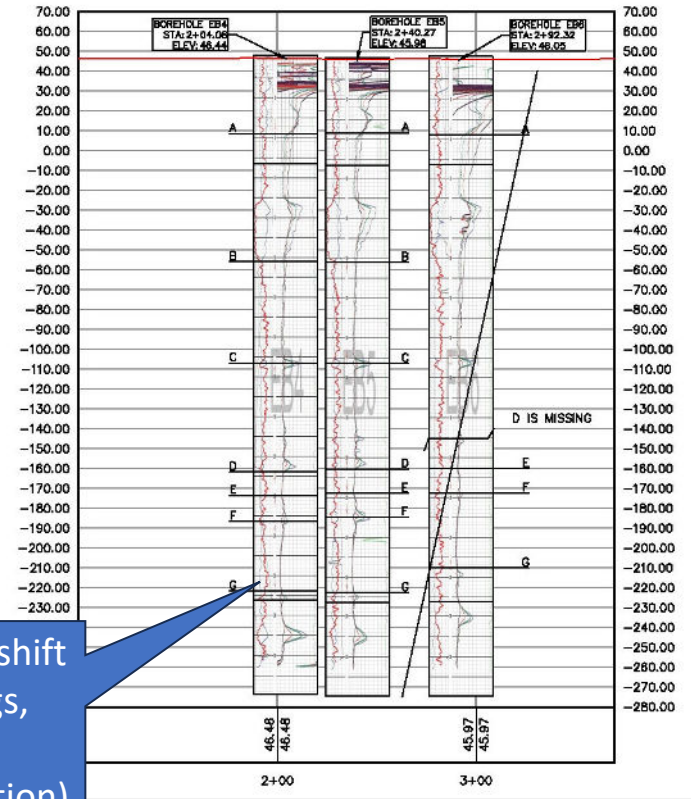
1" horizontal movement could be exceeded in 30 years or more

- Reality:
  - A properly installed joint can take up to 2" horizontal movement
  - Unlikely to concentrate all movement to one joint

Options to Further Evaluate and Minimize Risk		PROS	CONS
1	Perform a Phase II Fault Study to define location of concern		
2	Continue Current Operation Monitor and Repair as needed	Ongoing	
3	Perform periodic internal inspections Identify and correct damage	Direct assessment	Shut down
4	Restrain joints within the fault zone If it falls in unrestrained area	Eliminate joint separation concern	Shut down, Does not address mortar cracking
5	Replace the internal lining with a flexible lining	Eliminate risk of cracking internal lining	Shut down, Limited life of in-situ lining
6	Retrofit the pipe to incorporate dedicated expansion joints	Allow for movement	Shut down, Costly

# Phase II Geotechnical Study

- Invasive geotechnical investigation
  - Drilling and Logging soil geophysical characteristics
- Goal = Pinpoint actual fault scarp
  - At intersection with Water Line
  - Dip angle

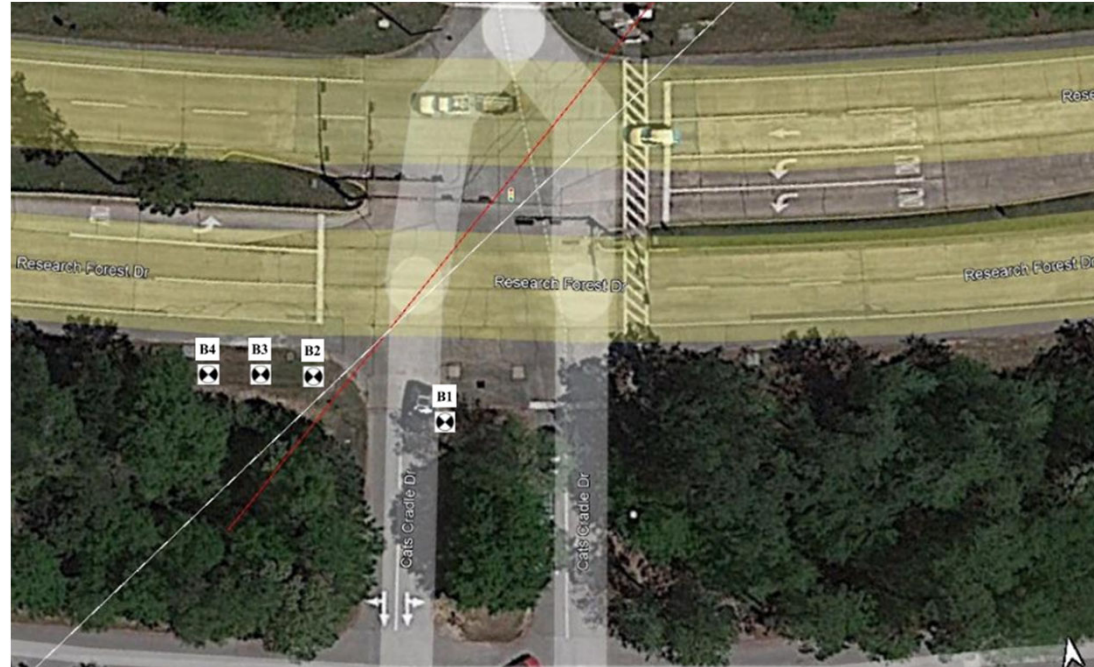


Example with clear shift between bore logs, indicating fault (from different location)



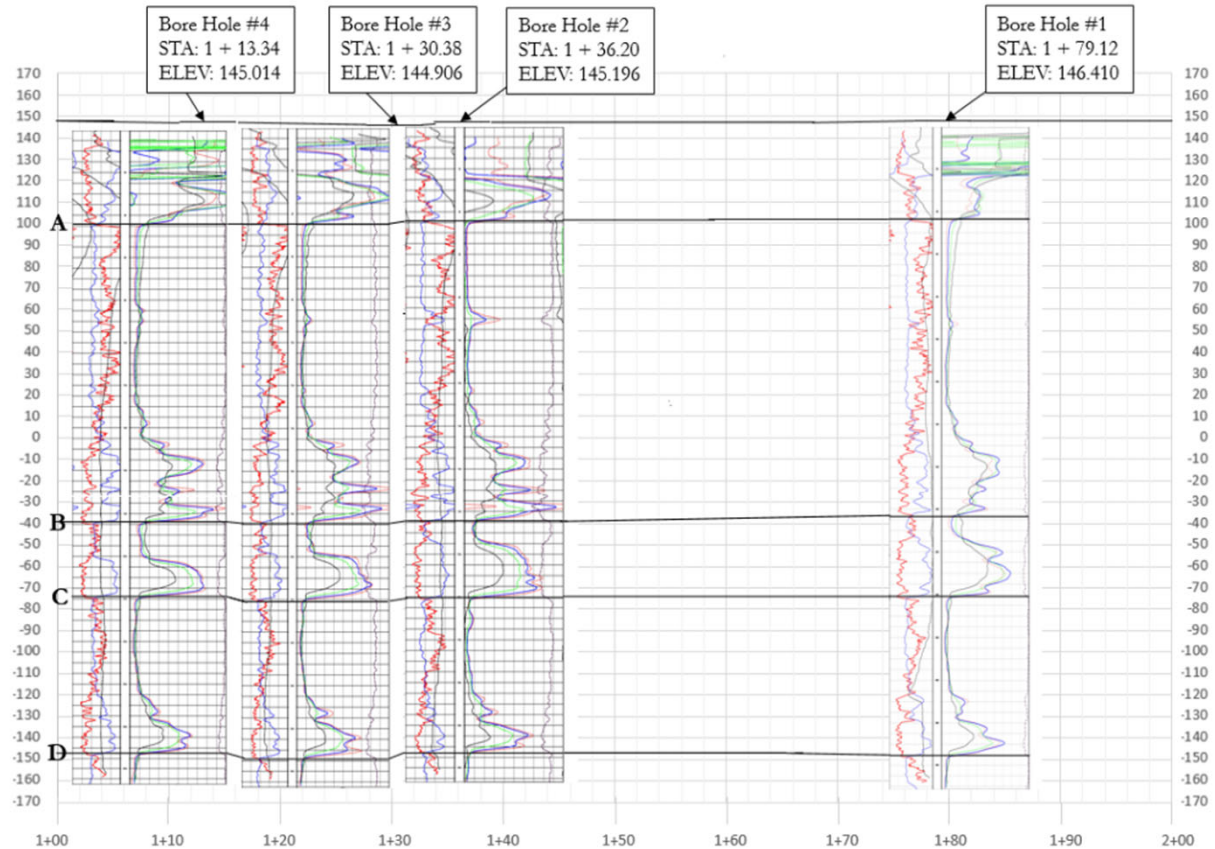
# Boring Locations at Cat's Cradle

- 4 x 300-ft deep borings
  - 1 on “stationary” side
  - 3 on “sinking” side
- Pre-locate existing utilities
- Traffic Control
- Work around School Schedule
- Soil disposal



# Bore Logs at Cat's Cradle

- No shift in soil between bore holes
- No indication of subsurface fault



# Conclusions



No evidence of subsurface faulting identified in vicinity of 42-inch WL



Small surface movements measured on north side of Research Forest



Low risk to 42-inch water line

Options to Further Evaluate and Minimize Risk		PROS	CONS
1	Perform a Phase II Fault Study to define location of concern	Complete	
2	Continue Current Operation Monitor and Repair as needed	Ongoing	
3	Perform periodic internal inspections Identify and correct damage	Direct assessment	Shut down
4	Restrain joints within the fault zone If it falls in unrestrained area	Eliminate joint separation concern	Shut down, Does not address mortar cracking
5	Replace the internal lining with a flexible lining	Eliminate risk of cracking internal lining	Shut down, Limited life of in-situ lining
6	Retrofit the pipe to incorporate dedicated expansion joints	Allow for movement	Shut down, Costly

# Questions

7/24/23



**Item 7**  
**Lone Star Groundwater Conservation  
District Report**

**Item 8**  
**GRP items for consideration by the**  
**SJRA Board of Directors on July 27, 2023**

# Item 9

## Attorney's Update



**Item 10**  
**Future GRP Review Committee Meeting**  
**Agenda Items**

## **Item 10a**

Discuss recommendation from Review Committee member to engage an operational efficiency consultant

**Item 11**  
**Future Meeting Schedule**

**Monday, August 21, 2023**

# Item 12

# Adjourn