Western Midstream®

Water and Natural Resources Committee Meeting:

A Comprehensive Approach to Beneficial Reuse

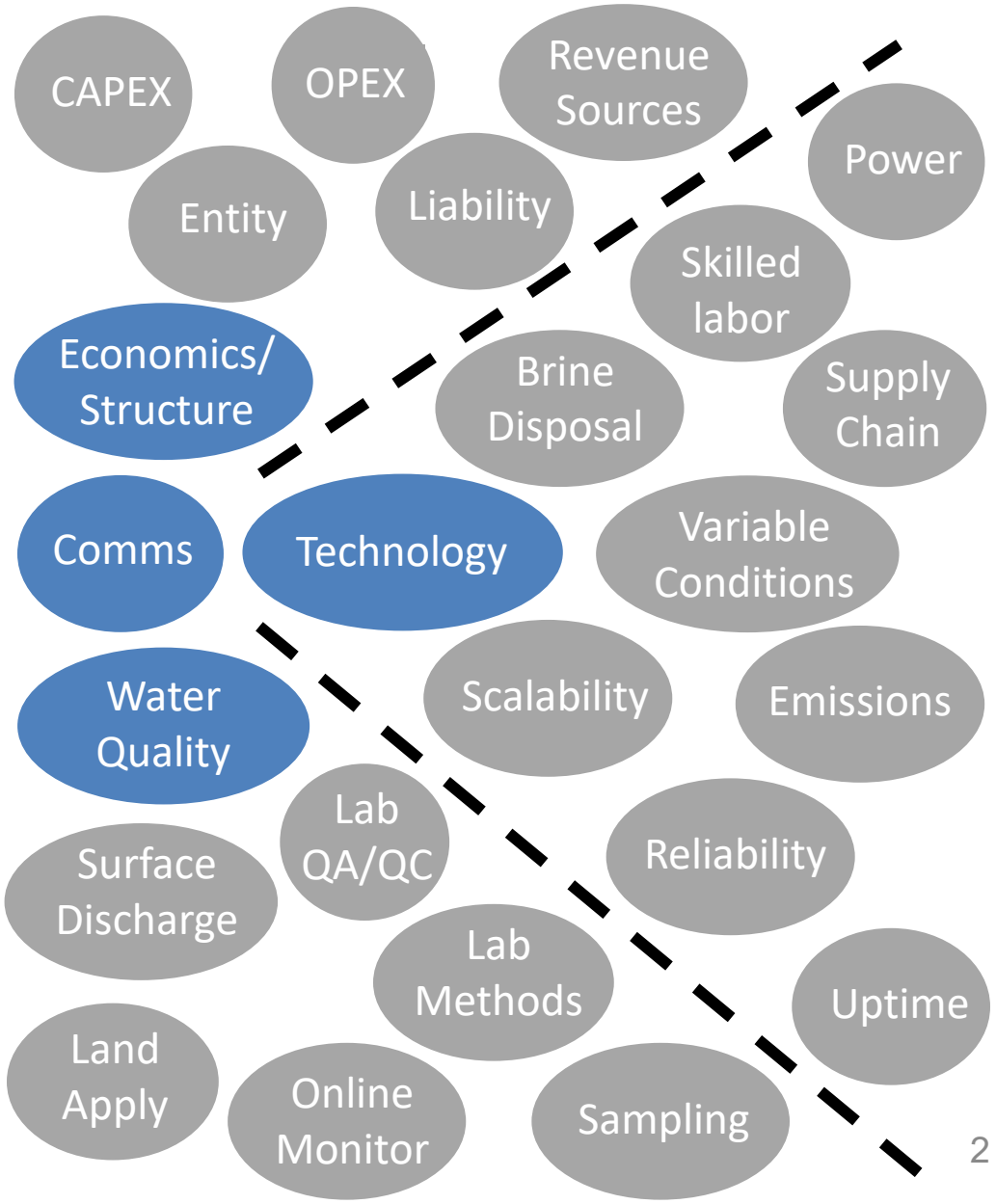
October 29th-30th 2025

What is the depth and breadth of beneficial reuse testing?

- **Joint Industry Project (JIP)**
  - Western Midstream (recently acquired Aris Water Solutions) has assembled a team of world class water treatment experts
  - Partnered with Chevron, Conoco, Coterra, and Exxon
  - Engaged with communities, regulators, and academia

- **JIP1 Evaluation – Key Accomplishments**
  - Piloted over 24 months to determine best available tech
  - Demonstrated water quality during all seasons & all conditions, while treating water directly off the pipeline (>50,000 data pts)
  - Collected extensive operating data and lessons learned
  - Established viable baseline economics

- **JIP2 Demonstration to Commercial Scale**
  - Refine/optimize quality, uptime, reliability, & treatment costs
  - Continue to evaluate brine disposal and online monitoring
  - Advance options for clean water including two-year irrigation study, surface discharge, and industrial use
  - Executing initial FEED study to capture full investment



How do we create clean water from produced water?

Main Treatment Steps

Pre-treatment
3-5 Barriers of Protection

Desalination
1-3 Barriers of Protection

Post-treatment
3-5 Barriers of Protection

Contaminant Removal

Pre-treatment
Solids, organics, iron, dissolved gases, manganese

Desalination
Salts, boron, NORM, ammonia

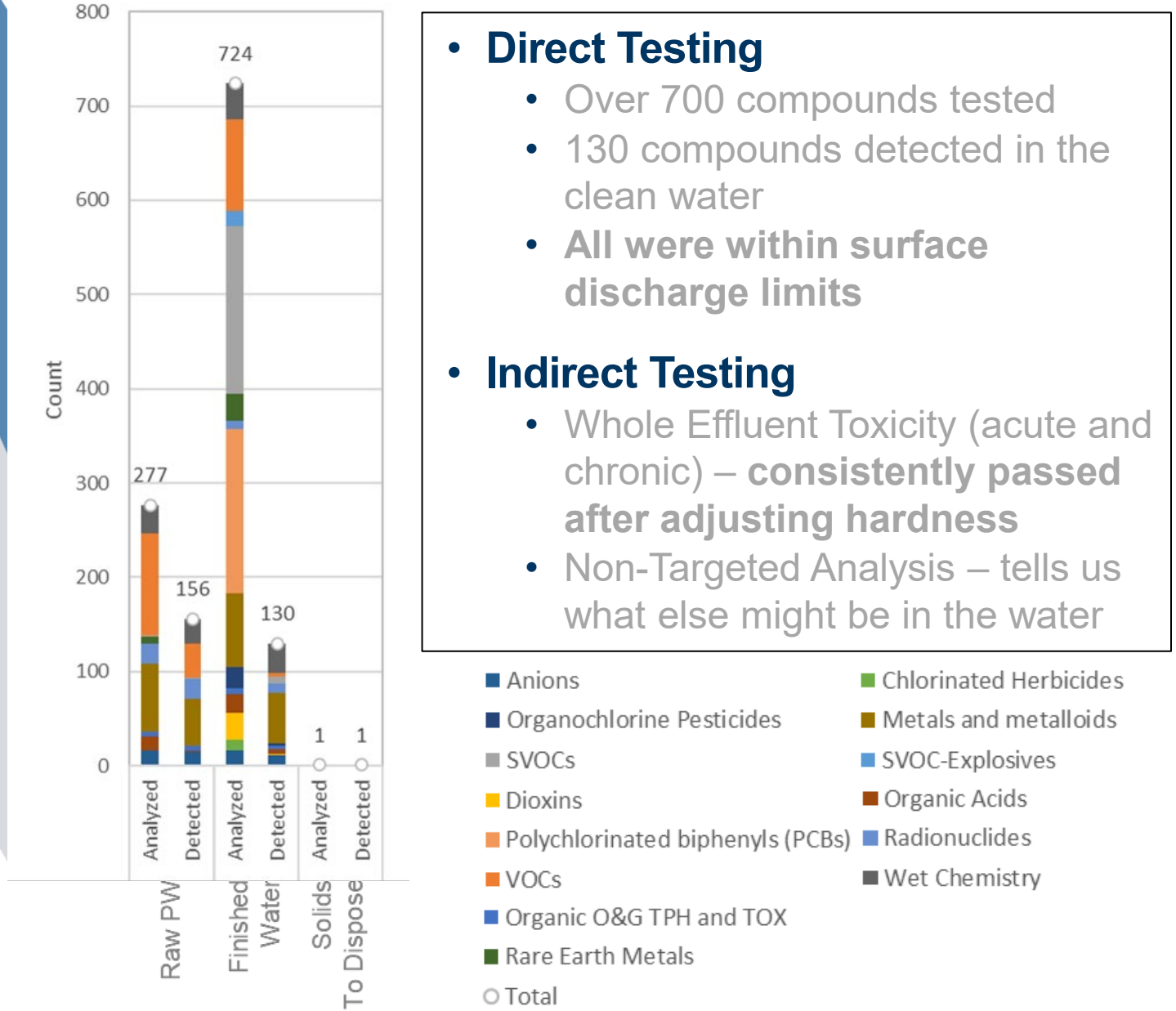
Post-treatment
Organics, ammonia, finishing pH & hardness

How do we construct a reliable treatment system?

- **Utilize proven technologies**
  - Over 90% of technologies in the treatment train are proven at large scale
- **Eliminate single-point failure**
  - Each contaminant is removed through **multiple barriers**
- **Conduct extended piloting**
  - Learn potential failure points to build in redundancy where needed
- **Design to recycle water if it is off-spec**

Barriers of Protection	Ammonia	Boron	BTEX	Chloride	Low MW Polar Organics	NORM	O&G/HEM	Total Dissolved Solids	Total Organic Carbon	Total Suspended Solids/Turbidity
Weir Tanks							✓		✓	✓
Flotation			✓			✓	✓		✓	✓
Coarse Filtration			✓				✓		✓	✓
Fine Filtration			✓				✓		✓	✓
Decarbonation			✓		✓					
Membrane Desalination	✓✓✓	✓✓✓		✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Advanced Oxidation			✓						✓	
Activated Carbon			✓		✓	✓	✓		✓	✓
Ammonia Polisher	✓		✓							✓
Ammonia Stripper	✓									
Total Barriers	**5**	**3**	**7**	**3**	**5**	**5**	**8**	**3**	**9**	**9**

How do we determine treated water quality?



- **Direct Testing**
  - Over 700 compounds tested
  - 130 compounds detected in the clean water
  - **All were within surface discharge limits**
- **Indirect Testing**
  - Whole Effluent Toxicity (acute and chronic) – **consistently passed after adjusting hardness**
  - Non-Targeted Analysis – tells us what else might be in the water

Major Compounds	Units	Membrane Avg.[1]	Surface Discharge
Ammonia	mg/L	0.14	<0.5 mg/L
Benzene	ug/L	<0.46	<5.0 ug/L
Boron[2]	mg/L	2.51	<5 mg/L (EPA)
Bromate	ug/L	<5.00	<10.0 ug/L
BTEX	ug/L	<2.56	-
Chlorides	mg/L	41.5	<100 mg/L
Dissolved Oxygen	mg/L	9.19	>5 mg/L
Low MW Polar Organics	mg/L	-	Compound specific
NORM	pCi/L	0.75	<5 pCi/L (Radium 226/228)
pH	SU	8.01	6.5-8.5
Salinity	mg/L	210	<250-500 mg/L

1. The Kaplan-Meier (KM) method was used for samples with BDL results
2. After adding the Boron IX/Boron RO, the average concentration in the finished water was <1.0 mg/L.

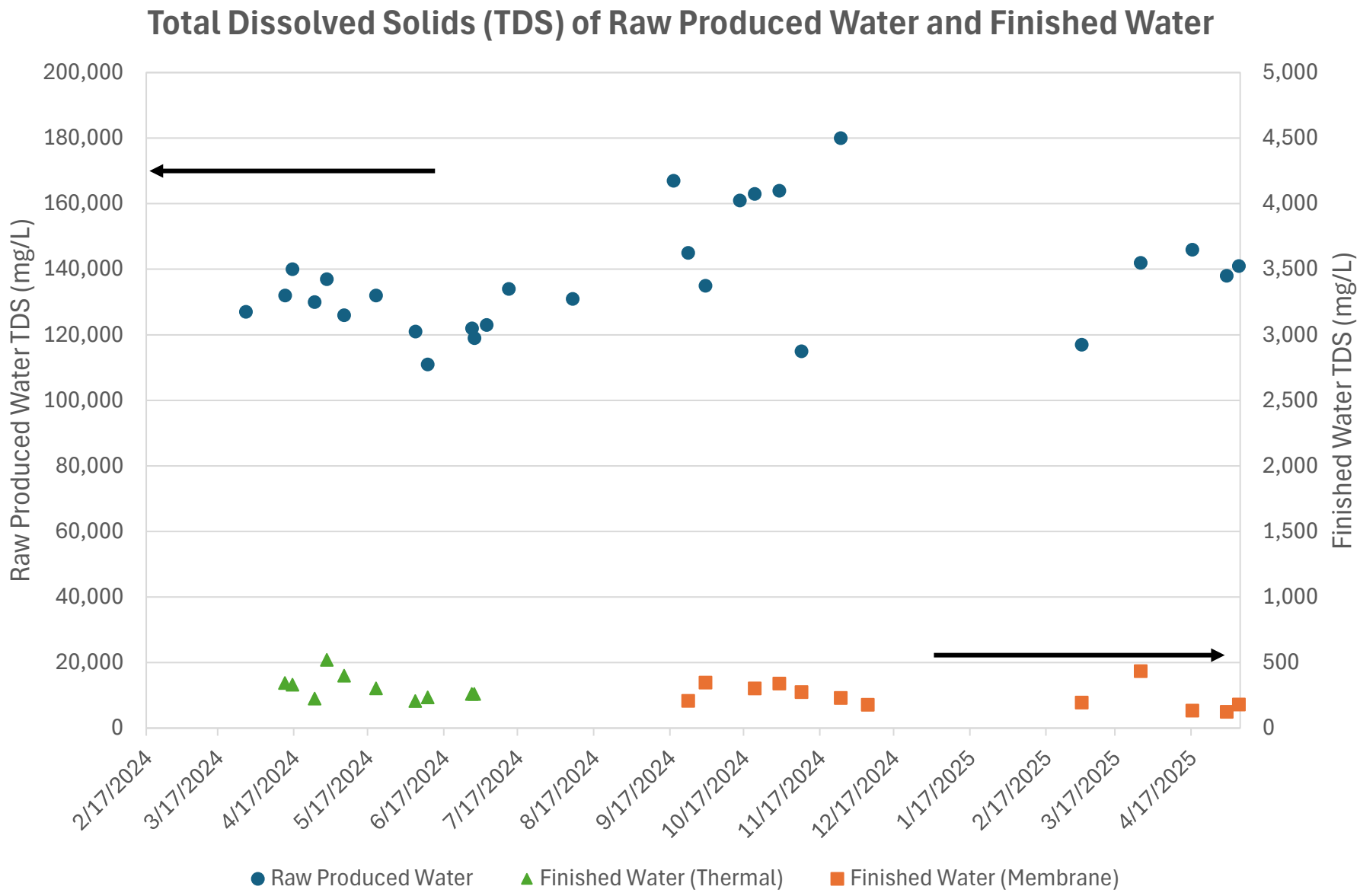
What are the “unknowns” and how are they removed?

- **Chemicals are added in the hydraulic fracturing process**
  - Type and amount vary by operator
  - We know the chemical classes that are added
  - An effective approach is to use non-targeted analysis to look for chemicals in those classes
- **Non-targeted analysis identified several downhole chemicals**
  - Raw water concentrations were all at the microgram per liter level
- **The multi-barrier approach is effective at removal**
  - All chemicals were removed to below detection limits and/or to safe levels

Downhole Chemical Classes	Barriers of Protection
Acids	3
Biocides	6
Clay Stabilizers	3
Corrosion Inhibitors	6
Crosslinkers	3
Emulsion Breakers	3
Friction Reducers	5
Gelling Agents	5
Iron Control	3
pH Adjusting Agents	3
Proppant	3
Scale Inhibitors	3
Surfactants	6

Identified Compounds	Units	Chemical Class	Avg. Raw Produced Water[1]	Membrane Finished Water[1]
Polyethylene Glycols	ug/L	Clay Stabilizers, Friction Reducers, Surfactants	50.1	<0.2
Polypropylene Glycols	ug/L		0.324	<0.2
Polyethylene Glycol Carboxylates	ug/L		1.78	<0.2
Linear Alkyl Ethoxylates	ug/L		1.00	<0.2
Benzylalkonium Chloride-C12	ug/L	Biocides, Surfactants	99.5	<0.1 / 0.3
Benzylalkonium Chloride-C14	ug/L		17.0	<0.1
Nonylphenol Ethoxylates	ug/L	Emulsion Breakers, Surfactants	1.92	<0.2
1-Docosanamine	ug/L	Corrosion Inhibitors, Surfactants	11.8	<0.1
Olefinic Amines	-		Detect	Non-Detect
Aliphatic Amines	-		Detect	Non-Detect

How do we know if the treated water quality is stable?



- **During >24 months of piloting testing:**
  - We tested water directly off the pipeline utilizing 24/7 operations
  - The feed salt level varied from 110,000 ppm to 180,000 ppm
  - Ambient temperature ranged from below freezing to over 100 F
  - Wind events created substantial dust storms
- **We were able to demonstrate consistent treated water quality**
  - Measured via online monitoring and monthly third-party testing

How can we collaborate to make beneficial reuse a win-win-win?

- **Potential Impacts of Successful Beneficial Reuse**
  - *Environment* – restore local ecosystems, surface flows, and aquifers
  - *Communities* – improve local water security and provide water for growth
  - *Industry* – reduce injection by ~50% along with seismicity/surface pressures and provide new water sources for new and existing users
  - *New Mexico* – improve state water security and provide water for new industry growth
  - *United States* – derisk geopolitical implications of the loss of energy independence

- **Potential Contributions of Key Stakeholders**
  - *Oil & Gas Industry* – Continue to fund and provide expertise for reliable and compliant treatment of produced water
  - *Legislature/Regulators* – Provide a clear and timely pathway for regulated uses of treated produced water within the state
  - *NMPWRC/WATR* – Continue to provide a framework and science to support regulated use of treated produced water
  - *NGOs* – Help identify potential best uses for the treated water and collaborate on development of associated regulations and processes
  - *Communities* – Help identify how treated produced water can best support local communities and provide feedback with any concerns