

Williams Fork, Piceance Basin: Flowback Water Reuse – Quality and Quantity

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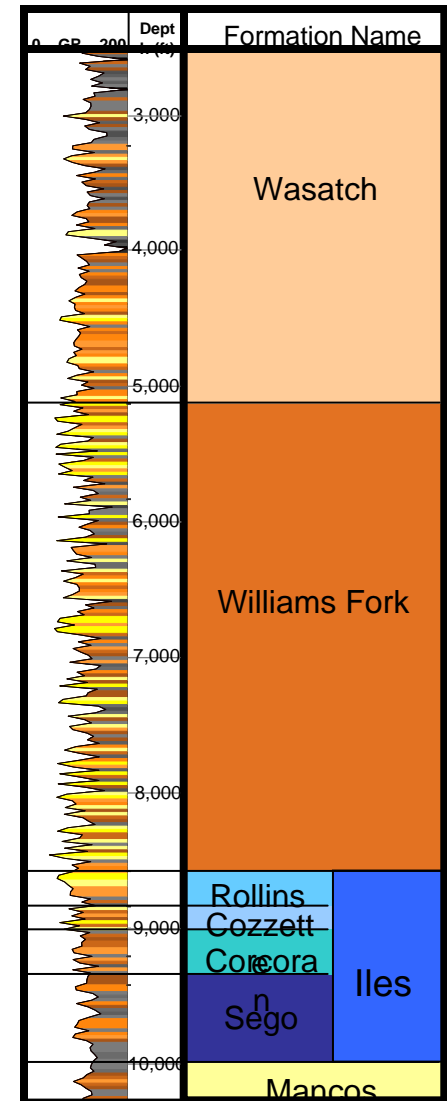
Williams Fork, Piceance Basin Water Strategy Presentation Outline

Piceance Overview

- Geology and Fracturing Necessities
- Current Water Quality and Infrastructure
- Source Inflow Volumes of Water
- Outflows of Water

Piceance Basin – Williams Fork

- Geology
 - Overpressure Reservoir
 - 3000' Vertical Section
 - Shale, Sandstone, Coal Deposition
 - Avg Porosity 6%
 - Avg Permeability 7 μ D
 - Avg Water Saturation 65%
 - Frac Gradient 0.5-0.75 psi/ft
- Frac Characteristics
 - Highly Naturally Fractured
 - High-Perm Formation Created When Hydraulically Fractured



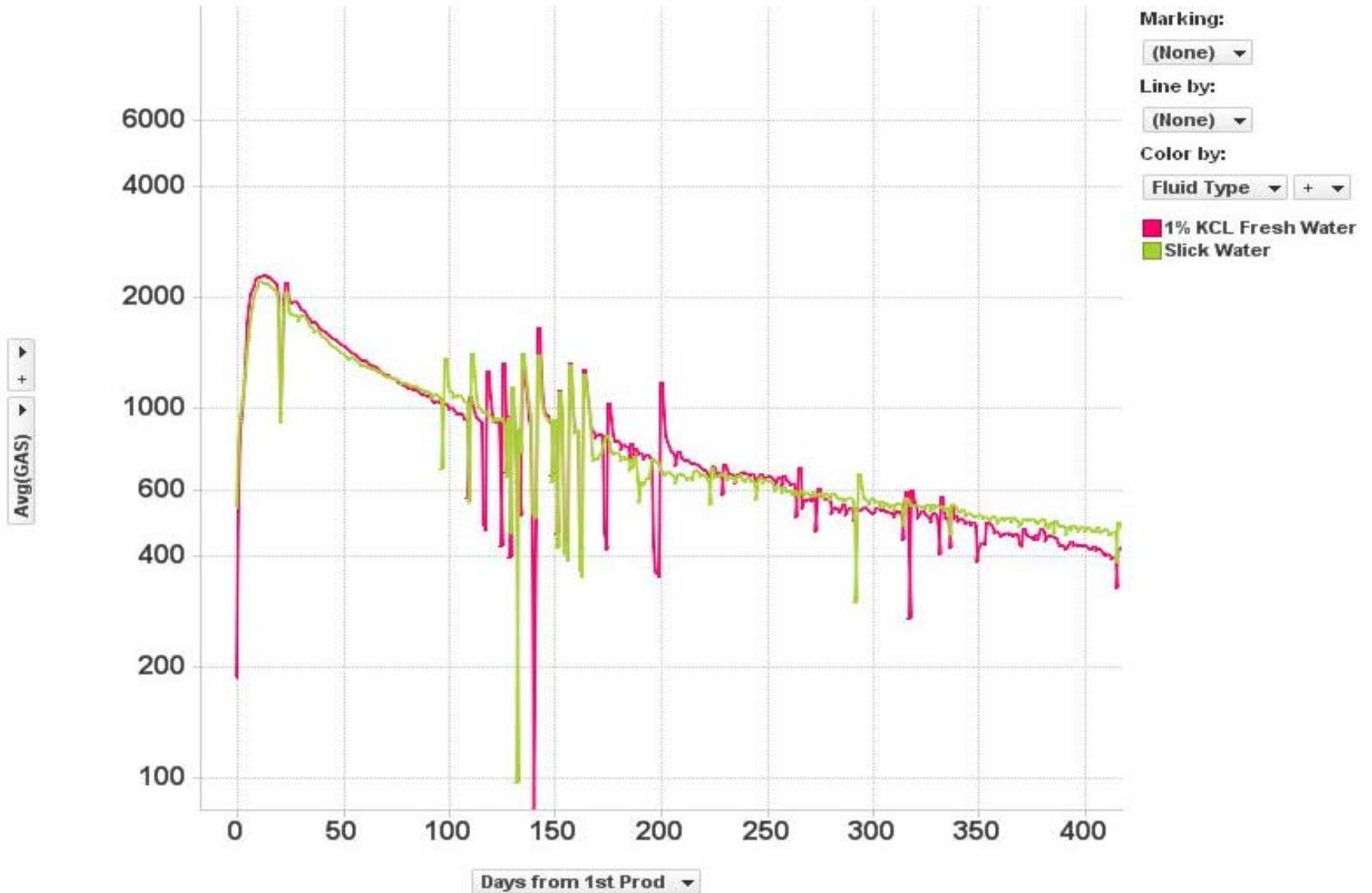
Why Produced Water

- Formation Needs
 - Proppant
 - High Perm Fractured Environment
 - Low/No Proppant
 - Gels
 - Cause Damage to Formation
 - Not Needed For Proppant Transport
 - Not Needed For Fracture Height Growth
 - Water
 - Clay Swelling Not an Issue
 - Very Little Fines Migration
 - Compatibility

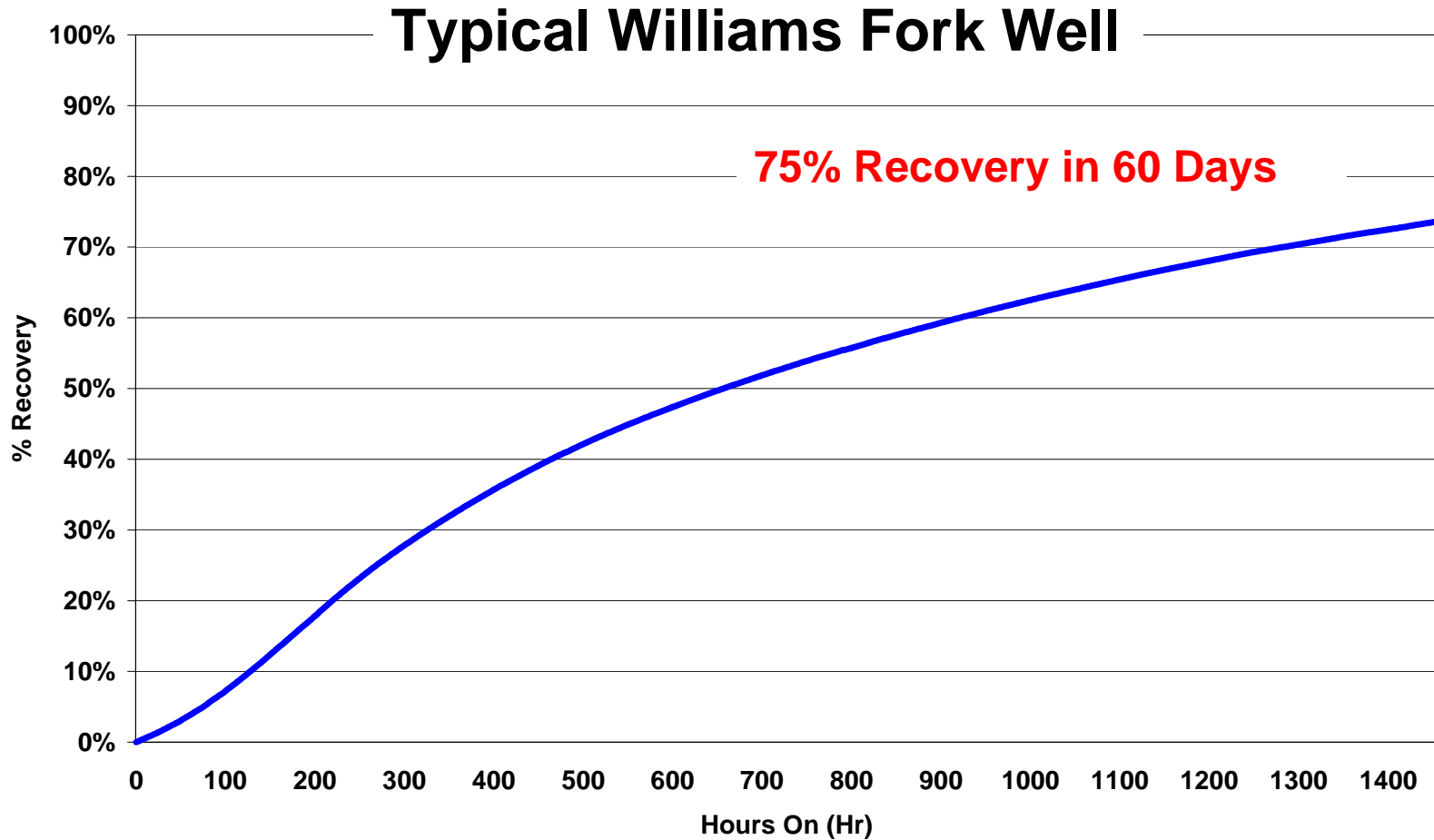
Example: Fracturing Fluid Composition

- “Slickwater” fracturing fluid
 - Water: 98.9% to 99.2% (average 100,000 bbl/well)
 - Sand (proppant): 0.7% to 1%
 - Other additives (combined): <0.09%
- Fluid and water flowed back is either recycled and used as frac fluid (reducing fresh water usage) or disposed of in permitted injection wells

Fresh vs Produced Water Study



Flowback Water Recovery

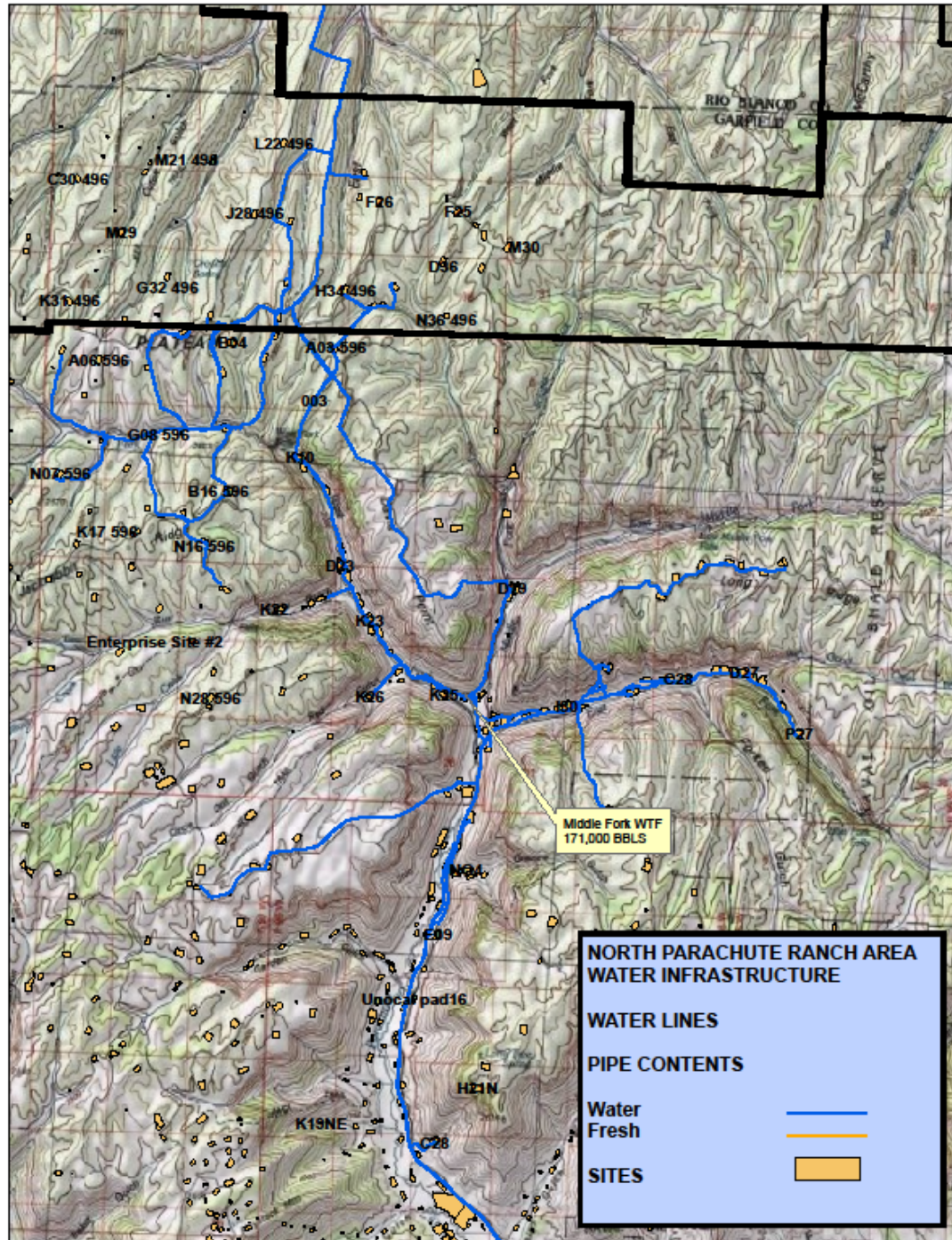


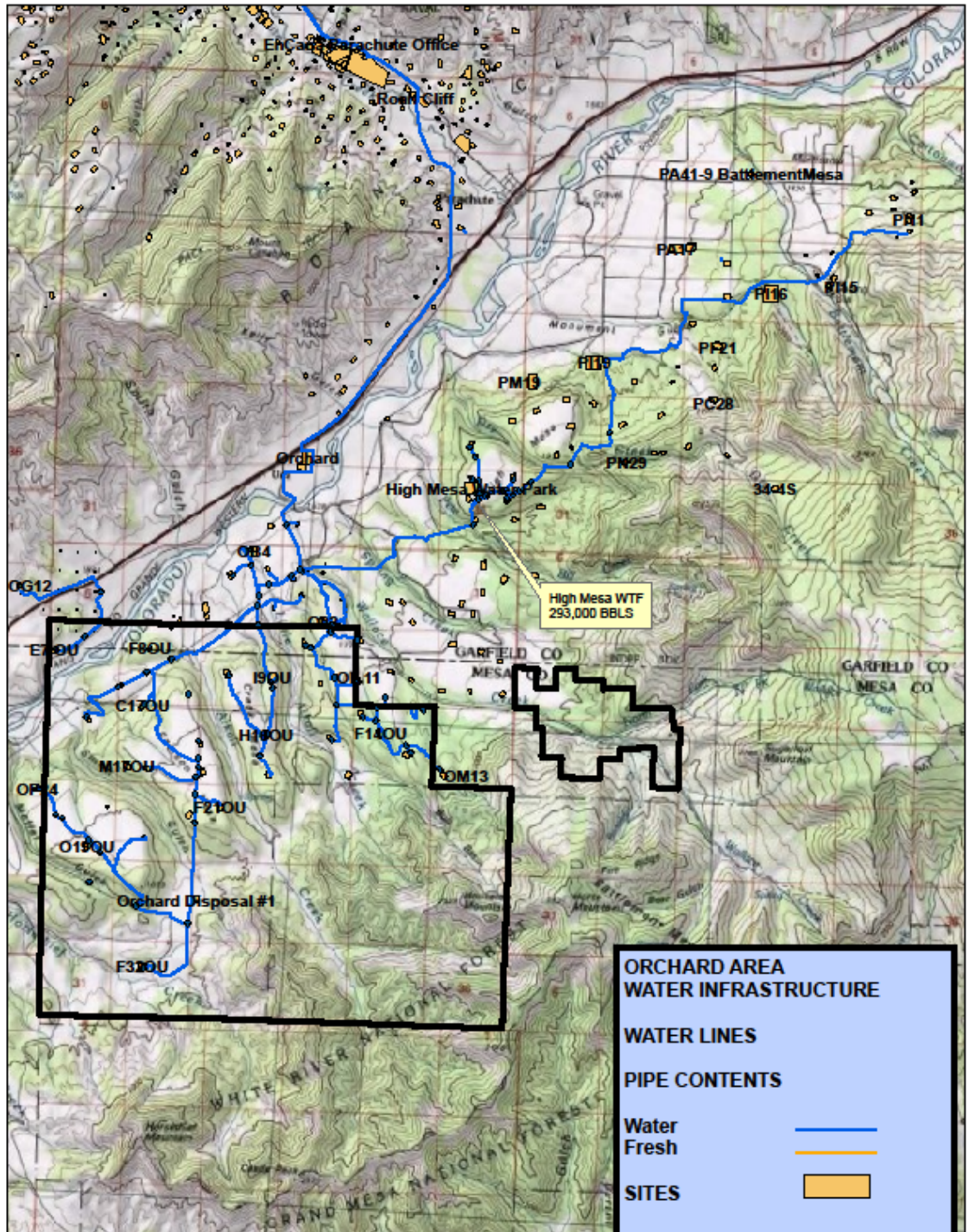
- 100% Recovery over Life of Well

Piceance Basin Water Strategy

Water Recycling Composition

- North and South Piceance operations are interconnected
- Produced and flowback water taken to central water facility by pipeline (where available) or water truck
- Water is treated for reuse
 - Solids, iron and hydrocarbon levels decreased
 - Stored in tanks or large facility ponds
 - Water is chemically treated for scaling and to break emulsions
- Water reused in completions operations
 - Transport by pipeline or truck, within geologic basin
 - Disposal minimized where possible
- On average 90% - 95%, of the water used in Piceance operations is recycled; the balance is fresh water used in drilling





High Mesa WTF
293,000 BBLs

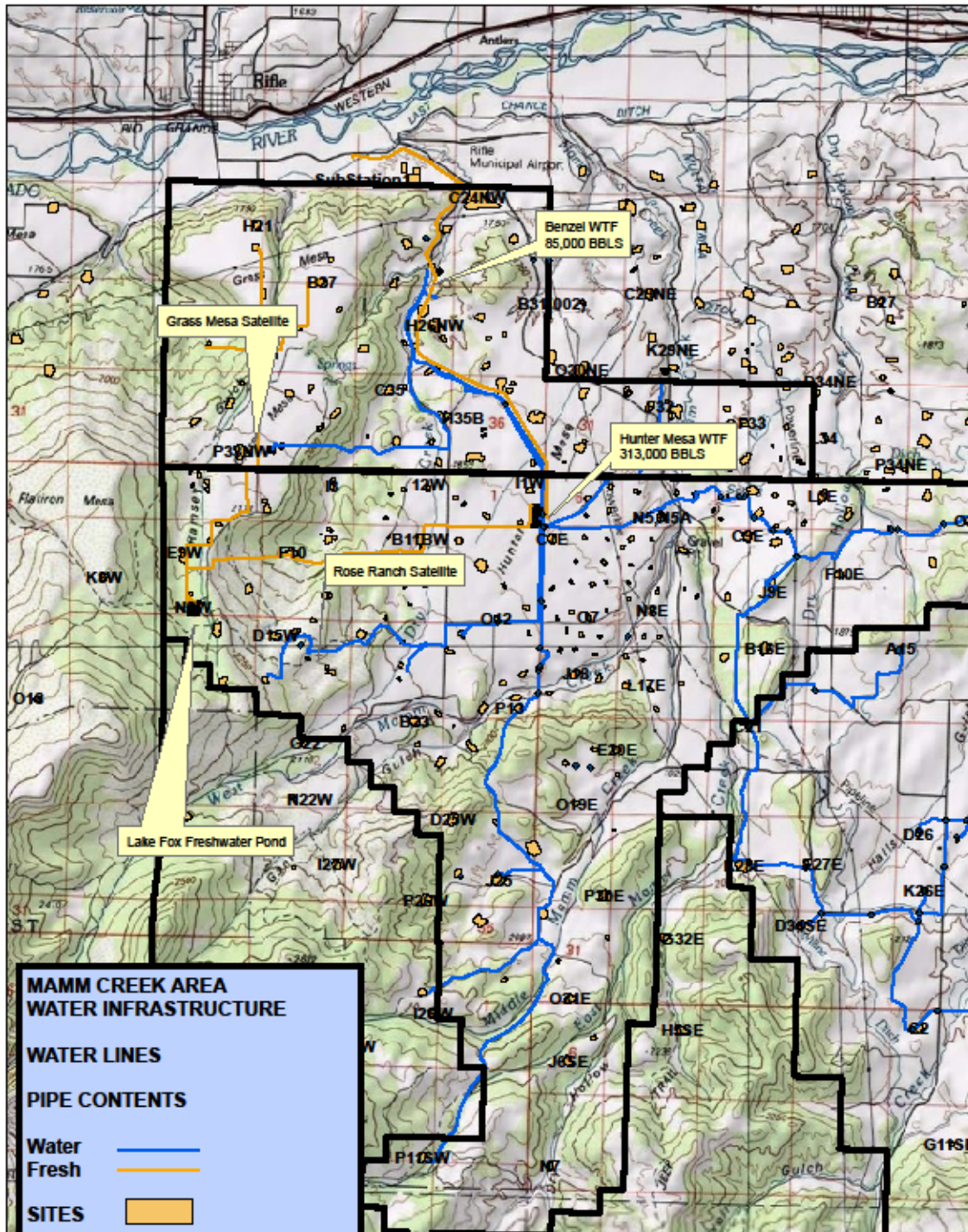
**ORCHARD AREA
WATER INFRASTRUCTURE**

WATER LINES

PIPE CONTENTS

Water Fresh — —

SITES



Grass Mesa Satellite

Benzel WTF
85,000 BBLs

Hunter Mesa WTF
313,000 BBLs

Rose Ranch Satellite

Lake Fox Freshwater Pond

Piceance Basin Water Strategy

Current Infrastructure (estimates)

Hunter Mesa Water Treatment Facility

- 40 miles of connected pipeline
- 2 high pressure pumps
- 310,000 bbl storage pond (13 million gallons ~ 40 acre-ft)

Benzel Water Treatment Facility

- 4 Miles of connected pipeline
- 85,000 bbl storage pond (3.6 million gallons ~ 11 acre-ft)

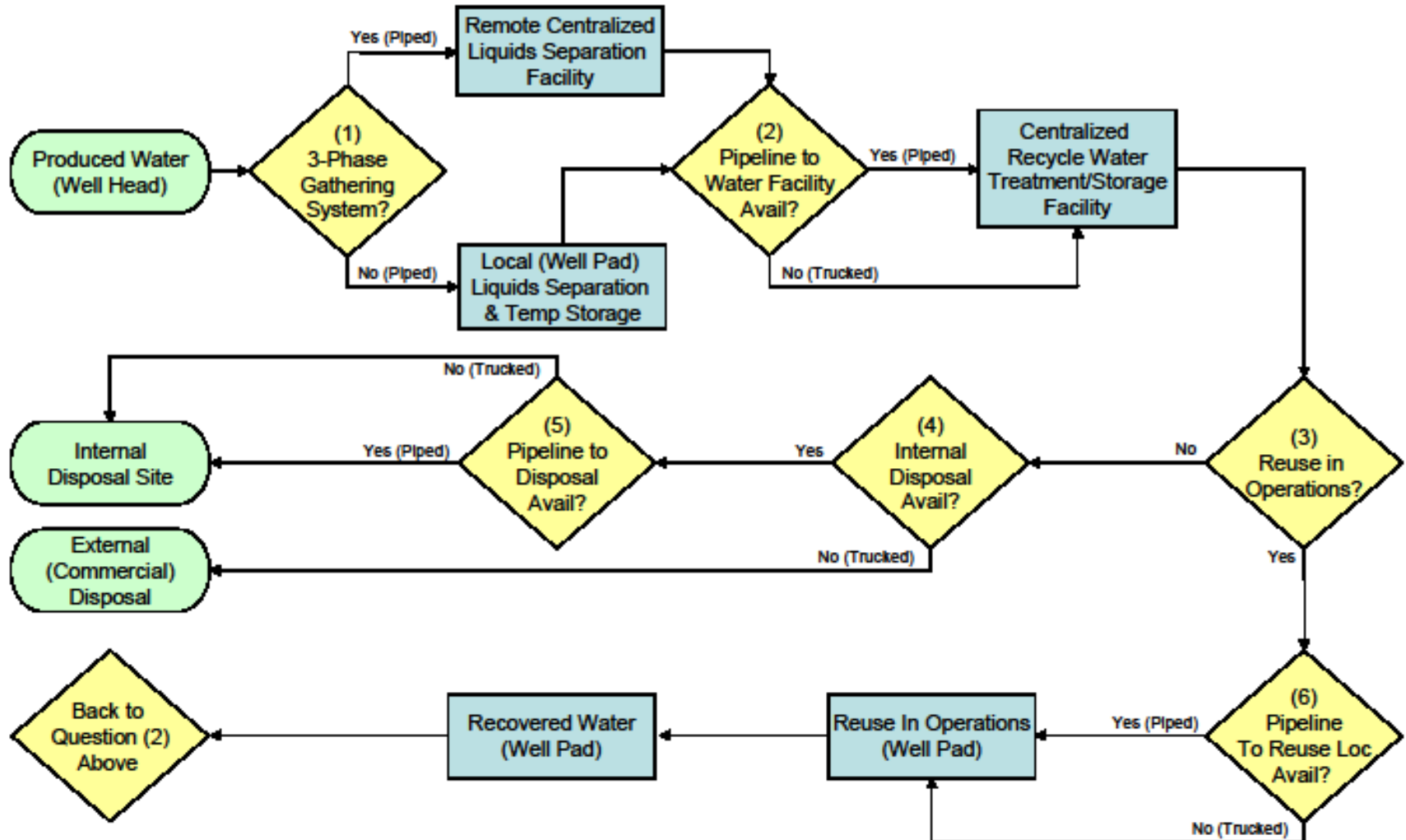
High Mesa Water Treatment Facility

- 40 miles of connected pipeline
- 1 high pressure pumps
- 208,000 bbl storage pond (8.7 million gallons ~ 27 acre-ft)

Middle Fork Water Facility

- 17 miles connected pipeline
- 4 high pressure pumps
- 217,000 bbl storage pond (9.1 million gallons ~ 28 acre-ft)

Piceance Produced Water Process Flowchart



Water Quality & Treatment

Typical Water Treatment Facility in the Industry



Piceance Water Basin Strategy

Secondary Water/Condensate/Solids Separation

- Dissolved Air Flotation - Solids and hydrocarbon removal step
- Oil/Water Separator – Hydrocarbon removal step



Piceance Basin Challenges & Opportunities

Dissolved Air Flotation Results



90% Solids Reduction
50% BOD Reduction



75% Iron
Reduction



80% Hydrocarbon
Reduction

Questions?

