AQUA PURE
CLEAR SOLUTIONS

SHALE GAS WATER MANAGEMENT

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SHALE GAS

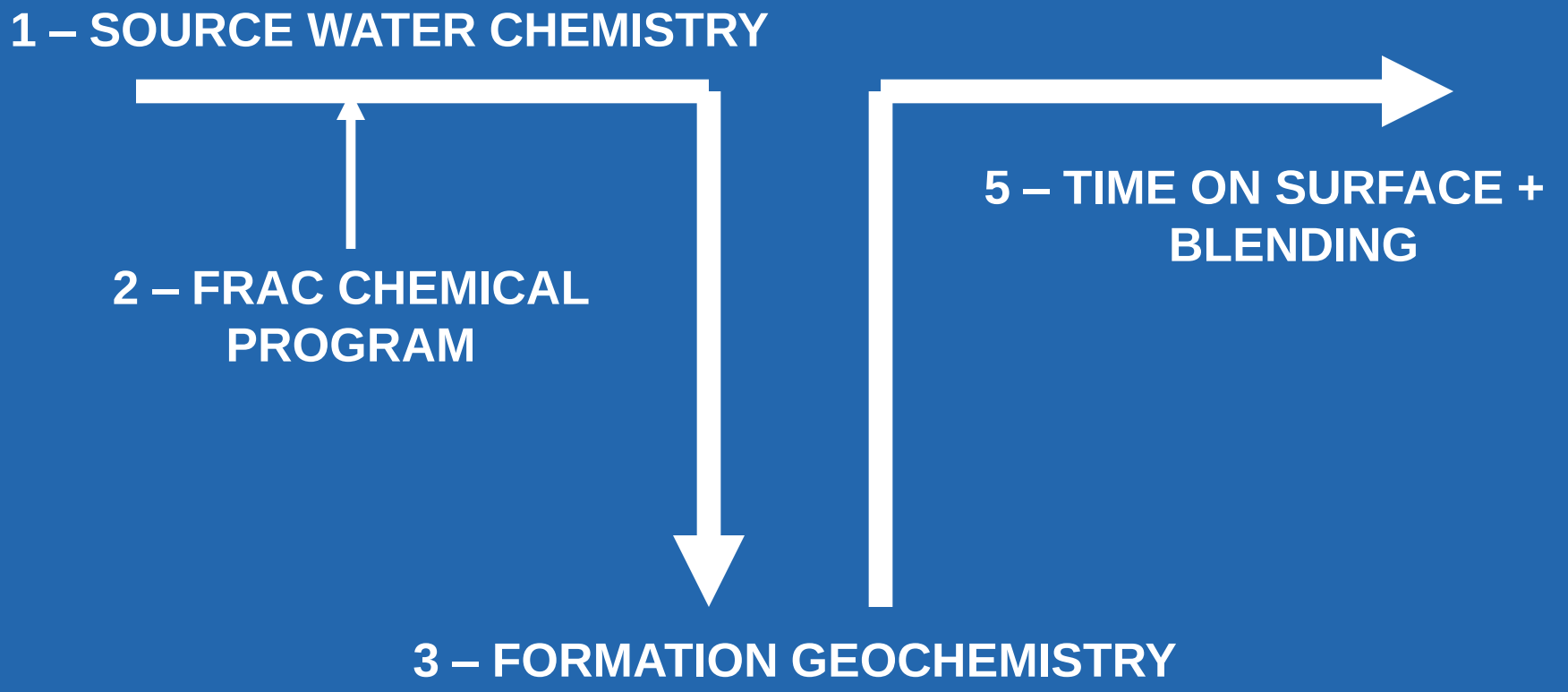
WHY WATER MANAGEMENT?

- US Shale Gas Reserve: 353 Trillion Cubic Feet
- Shale Gas made up 19% of total US NG Consumption in 2009 and expected to rise to 45% by 2035.
- Shale Gas Requires Horizontal Wells and Hydraulic Fracturing
- Hydraulic Fracturing of Horizontal Wells requires 275 times the water of Fracturing Conventional Vertical Wells.

WATER MANAGEMENT IS CRITICAL TO SHALE GAS

NATURE OF FLOWBACK

FACTORS → QUALITY AND QUANTITY

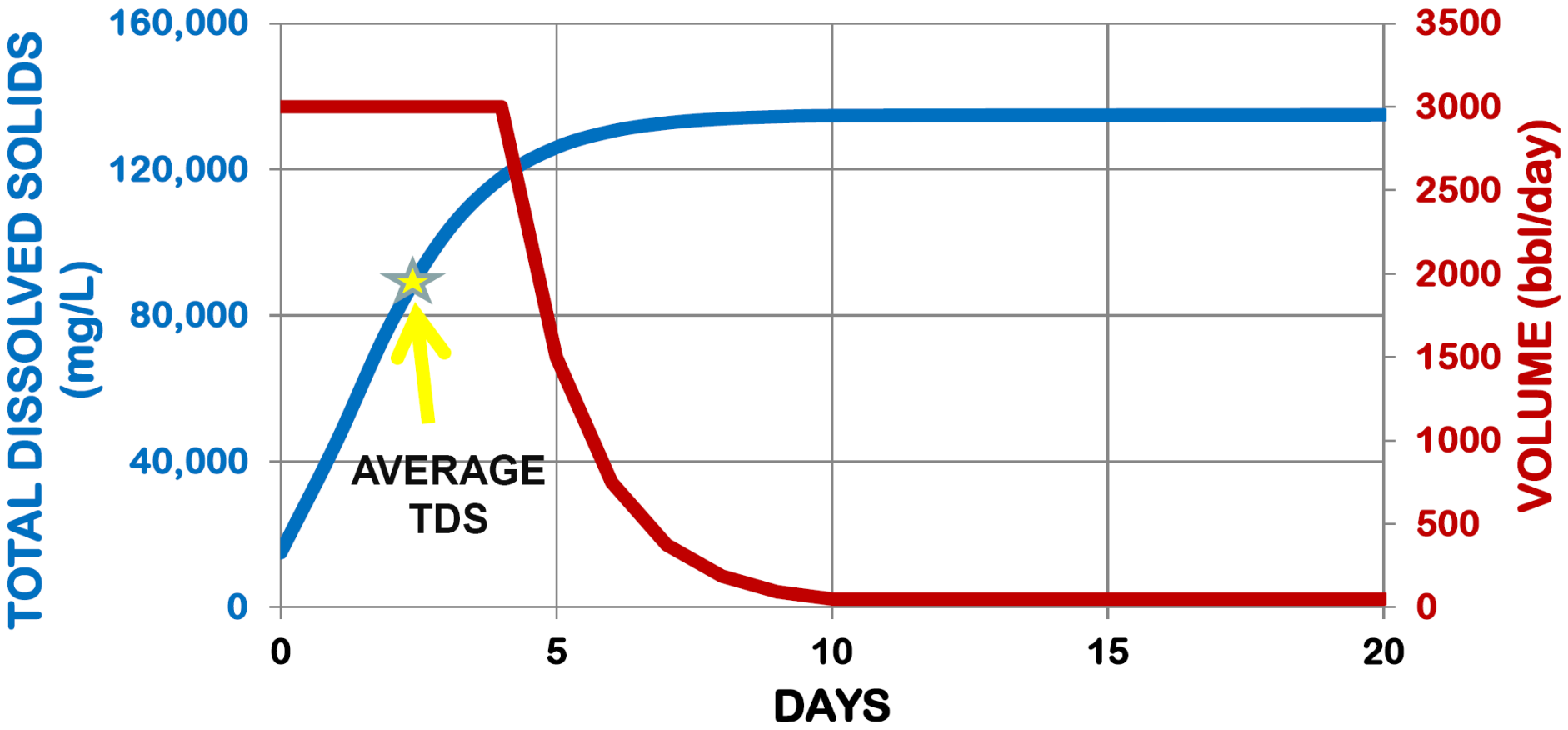


FLOWBACK ANALYSIS = 1 + 2 + 3 + 4 + 5

(VARIABLES ARE NEVER EXACTLY THE SAME)

NATURE OF FLOWBACK

FLOWBACK TDS vs VOLUME PROFILE



NATURE OF FLOWBACK

COMPOSITION

- Dissolved Salts
- Dissolved Minerals
- Frac Chemicals
- Polymers (0 – 500 mg/L)
- Bacteria: (BOD 0 - 100 mg/L)
- TSS (200 – 1000 mg/L)
- NORM (0 – 15 pCi/L gross A)
- VOC (0 – 10 mg/L)
- SVOC (0 – 100 mg/L)
- Hydrocarbons (0 – 50 mg/L)
- Ammonia (0 – 150 mg/L)
- Carbonate Scales
- Sulphate Scales
- Silica Scales

CHANGES FROM PLAY TO PLAY WELL TO WELL DAY TO DAY

		Fayetteville	Marcellus	Barnett
Na	(mg/L)	5362.6	24445.0	12453.0
Mg	(mg/L)	77.3	263.1	253.0
Ca	(mg/L)	256.3	2921.0	2242.0
Sr	(mg/L)	21.0	347.0	357.0
Ba	(mg/L)	0.8	679.0	42.0
Mn	(mg/L)	0.5	3.9	44.0
Fe	(mg/L)	27.6	25.5	33.0
SO4	(mg/L)	149.4	9.1	60.0
HCO3	(mg/L)	1281.4	261.4	289.0
Cl	(mg/L)	8042.3	43578.4	23797.5
TDS	(mg/L)	15,219	72,533	39,570
S.G.		1.010	1.050	1.030

WATER MANAGEMENT DECISION FACTORS

THE BALANCING ACT

- PUBLIC SAFETY
- COMMUNITY RELATIONSHIPS
- REGULATORY CLIMATE
- ENVIRONMENTAL RISK / LIABILITY
- SHARED ACCESS TO WATER AND DISPOSAL
- WATER MANAGEMENT COSTS
- FRAC FLUID QUALITY
- LONG TERM WELL PERFORMANCE

WATER MANAGEMENT DECISION FACTORS

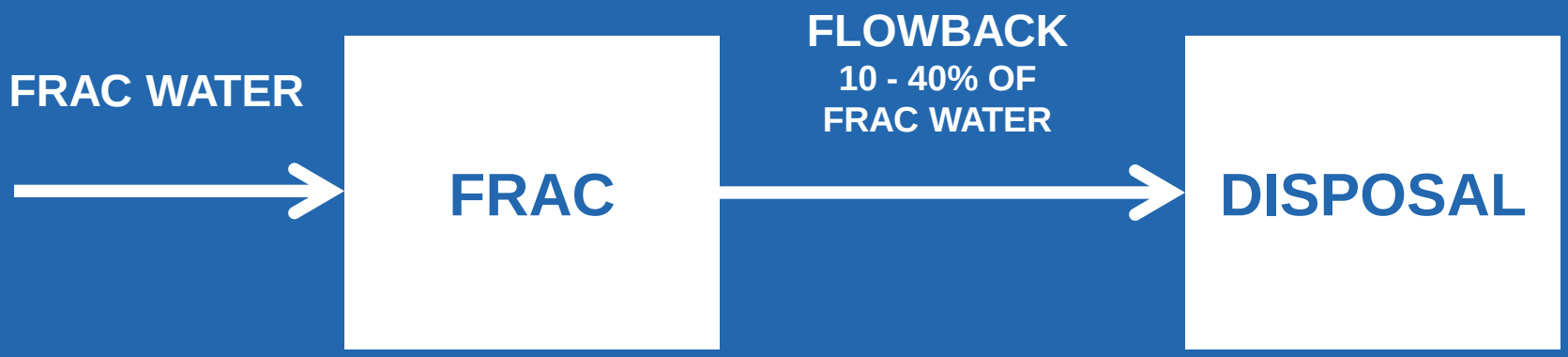
KEY CRITERIA

- FLOWBACK CHEMISTRY
- SOURCE WATER
- DISPOSAL
- STORAGE
- TRANSPORTATION
- TREATMENT TECHNOLOGY
- FRAC WATER SPEC

? AVAILABILITY / OPTIONS / COST / RISKS ?

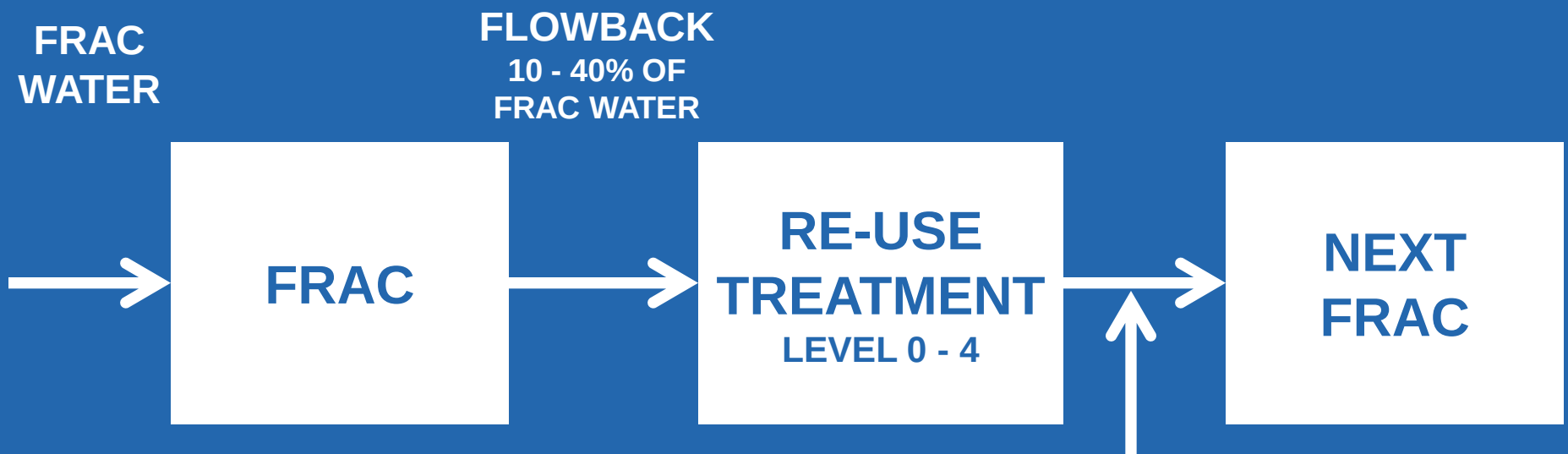
WATER MANAGEMENT STRATEGIES

DISPOSAL



WATER MANAGEMENT STRATEGIES

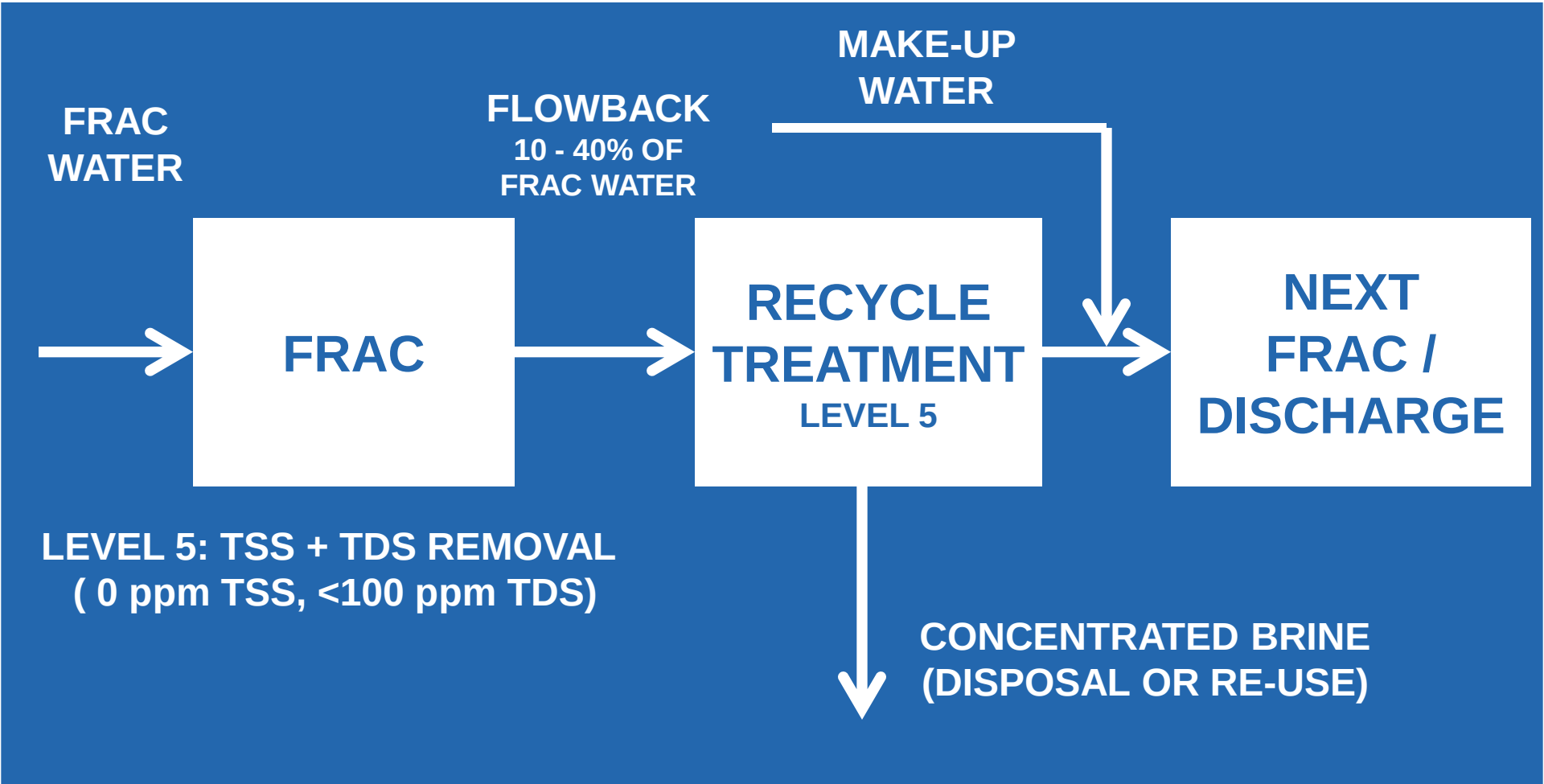
RE-USE



LEVEL 0: NO TREATMENT
LEVEL 1: TSS REMOVAL (< 50 ppm)
LEVEL 2: TSS REMOVAL (< 5 micron)
LEVEL 3: TSS REMOVAL (< 1 micron)
LEVEL 4: TSS + $2^{+/-}$ ION REMOVAL

WATER MANAGEMENT STRATEGIES

RECYCLE



CASE STUDY 1

BARNETT: RECYCLE → FRAC

LIMITED FRESH WATER + URBAN COMMUNITY

- 10,000 BPD LEVEL 5 INFIELD RECYCLING FACILITY (PRE-TREATMENT + NOMAD MVR EVAPORATOR)
- FLOWBACK RECYCLED AND BLENDED WITH MAKE-UP FOR NEXT FRAC.
- KEY DRIVERS:
  - REDUCE WATER USE (LIMITED AVAILABILITY)
  - REDUCE TRUCKING (COMMUNITY IMPACT)
  - REDUCE ENVIROMENTAL LIABILITY (LOW TDS TRANSPORT AND STORAGE)

CASE STUDY 2

MARCELLUS: RECYCLE → DISCHARGE

NO LOCAL DISPOSAL OPTION

- 7,500 BPD LEVEL 5 NEAR FIELD DISPOSAL FACILITY (PRE-TREATMENT + NOMAD MVR EVAPORATORS)
- FLOWBACK AND PRODUCED WATER TREATED FOR DISCHARGE TO MUNICIPLE WWTP (TDS <100 ppm)
- KEY DRIVERS:
  - REDUCE HIGH DIPOSAL COSTS (HIGH TRANSPORT COSTS TO OUT OF STATE DISPOSAL WELL)

CASE STUDY 3

EAGLEFORD: RE-USE → FRAC

- 10,000 BPD LEVEL 1 IN FIELD MOBILE TREATMENT UNIT (ROVER)
- FLOWBACK AND PRODUCED WATER TREATED AND BLENDED WITH MAKE-UP WATER FOR RE-USE
- KEY DRIVERS:
  - LIMITED TRANSPORATION
  - REDUCE DISPOSAL
  - REDUCE FRESH WATER CONSUMPTION

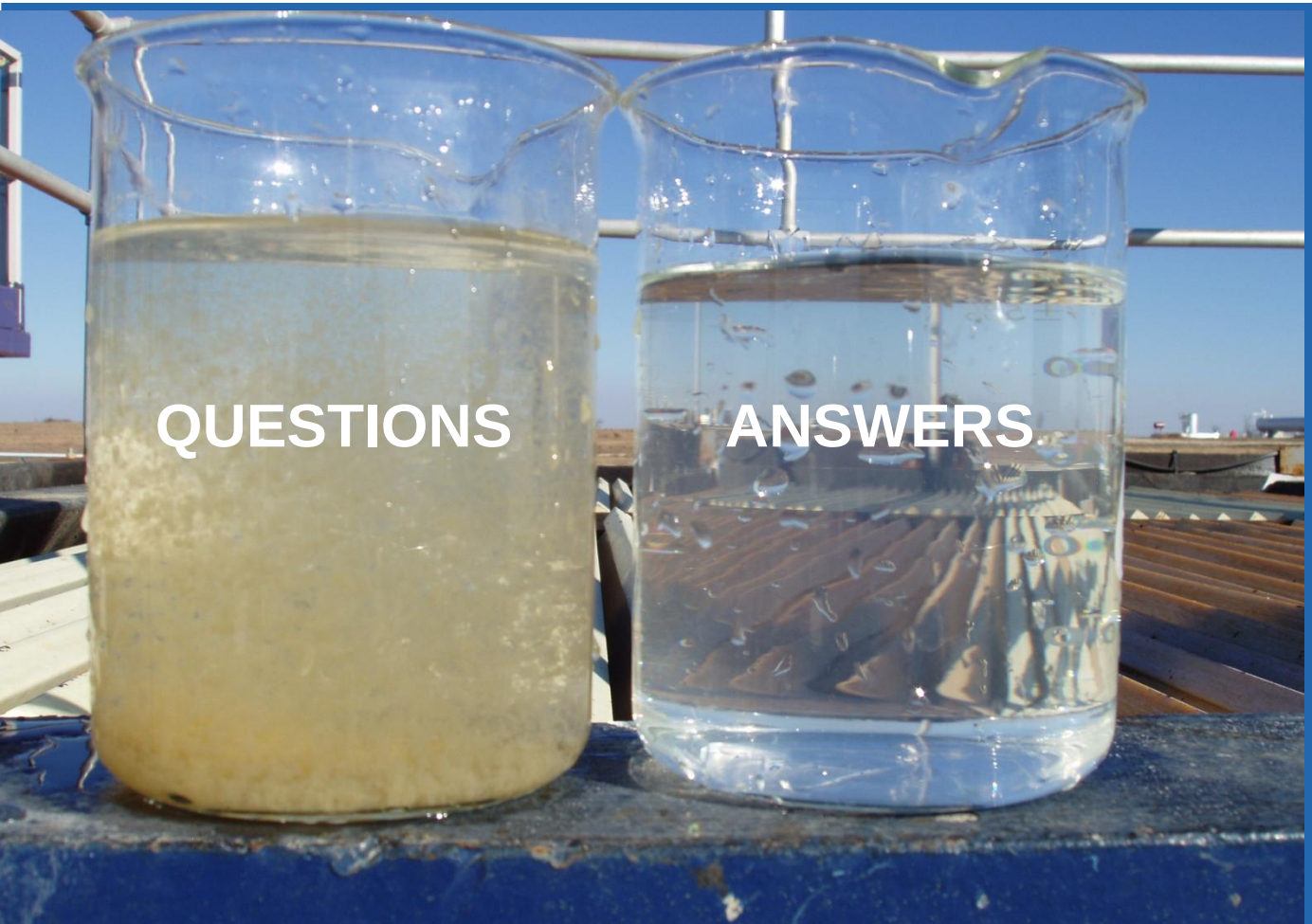
HIGH TRANSPORATION COSTS

AQUA PURE
CLEAR SOLUTIONS

THE AQUA-PURE ADVANTAGE:

- 16,000,000 bbls of Commercial Shale Gas Water Treatment Experience
- Over 12 different technology pilots (what works where)
- Commercial experience in 4 different shale plays
- Over 16 Commercial Facility Installations
- Operational equipment ready for deployment
- Third Party Technology Performance Validation (by GTI)
- Engineering services to adapt and customize solutions
- Full Service Water Management Solutions

FOLLOW-UP



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