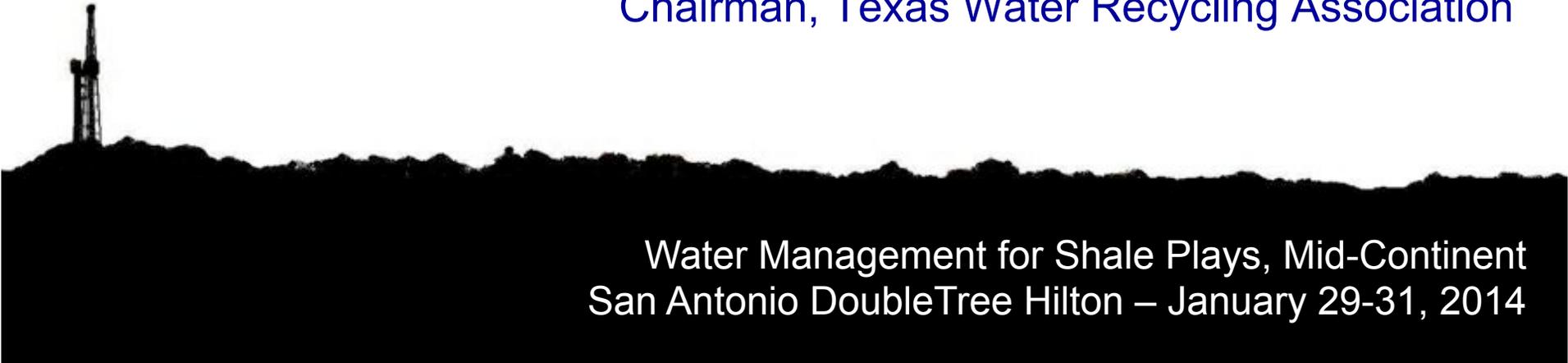




Successful Oilfield Water Management

Brent Halldorson, Fountain Quail Water Management
Chairman, Texas Water Recycling Association

A black silhouette of an oil rig on a hill, positioned on the left side of the slide.

Water Management for Shale Plays, Mid-Continent
San Antonio DoubleTree Hilton – January 29-31, 2014

Water Management – *the Past...*

- Water was viewed as an afterthought.
- Volumes increased over time – were simply a cost of production.



UNCONVENTIONALS ARE DIFFERENT

- Water is needed BEFORE the resource can be developed.
- Water treatment was viewed as a science project – interesting but not integral.

Water Management – *the Present...*

- America is waking up to the fact that it is becoming energy independent.
- Water is vital to the development.
- Experience is becoming more important. Black Boxes are going away.

RECYCLING IS BECOMING NORMAL

- Water is being recognized as essential.
- Supplies & disposal can be limited.
- The Texas drought has raised the profile of water availability in areas like West Texas.

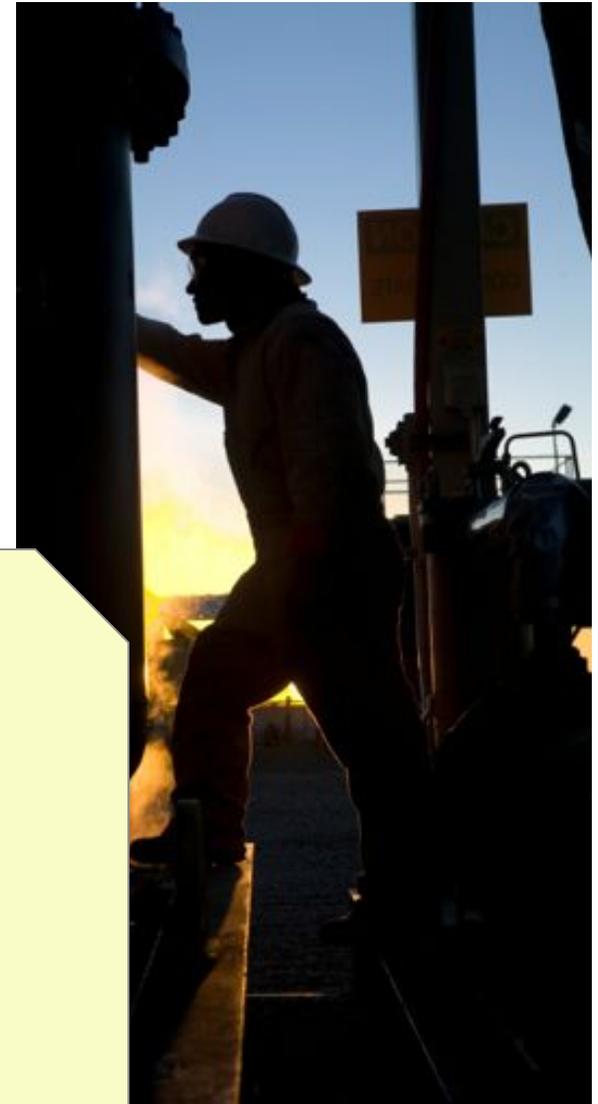


Water Management – *the Future...*

- Water must be used more effectively to ensure continued development.
- Industry wide codes and best practices will emerge for water recycling.
- PW is becoming viewed as an asset.

RECYCLING WILL BE A NORMAL PART OF SHALE PRODUCTION

- Recognized leaders in this space will emerge.
- Water-related businesses will be bundled (supply, transport, recycling, disposal).





Water is a precious resource.

The TWRA is committed to developing positive, sustainable solutions to Texas' water challenges.

The TWRA seeks to:

- ① Encourage water reuse and recycling.
- ② Protect water without adversely impacting industry.
- ③ Maintain and advance Texas as a global economic leader.

The TWRA supports all viable water recycling technologies and their vendors.

www.txwra.org

Recent Rule Changes

New RRC Recycling Rules:

- Permit-by-rule. Applies to most recycling operations.
- Multi-Lease, Multi-Operator.
- Special distinction for distilled water.

HB 2767:

- Transfers liability away from producers.
- Liability transfers to recycler and onto purchaser/user of water.

The state has removed many of the roadblocks to water recycling. According to the RRC *“the Commission sets up a regulatory framework in which recycling is a viable alternative to disposal, but allows the operators to make their own water and waste management decisions.”*

The Big Question

Saltwater or Freshwater?

Saltwater

- Lower cost (minimal treatment).
- Difficult logistics (storage + transport)

Freshwater

- Higher cost (thermal distillation).
- Lower risk – store and transport freshwater.



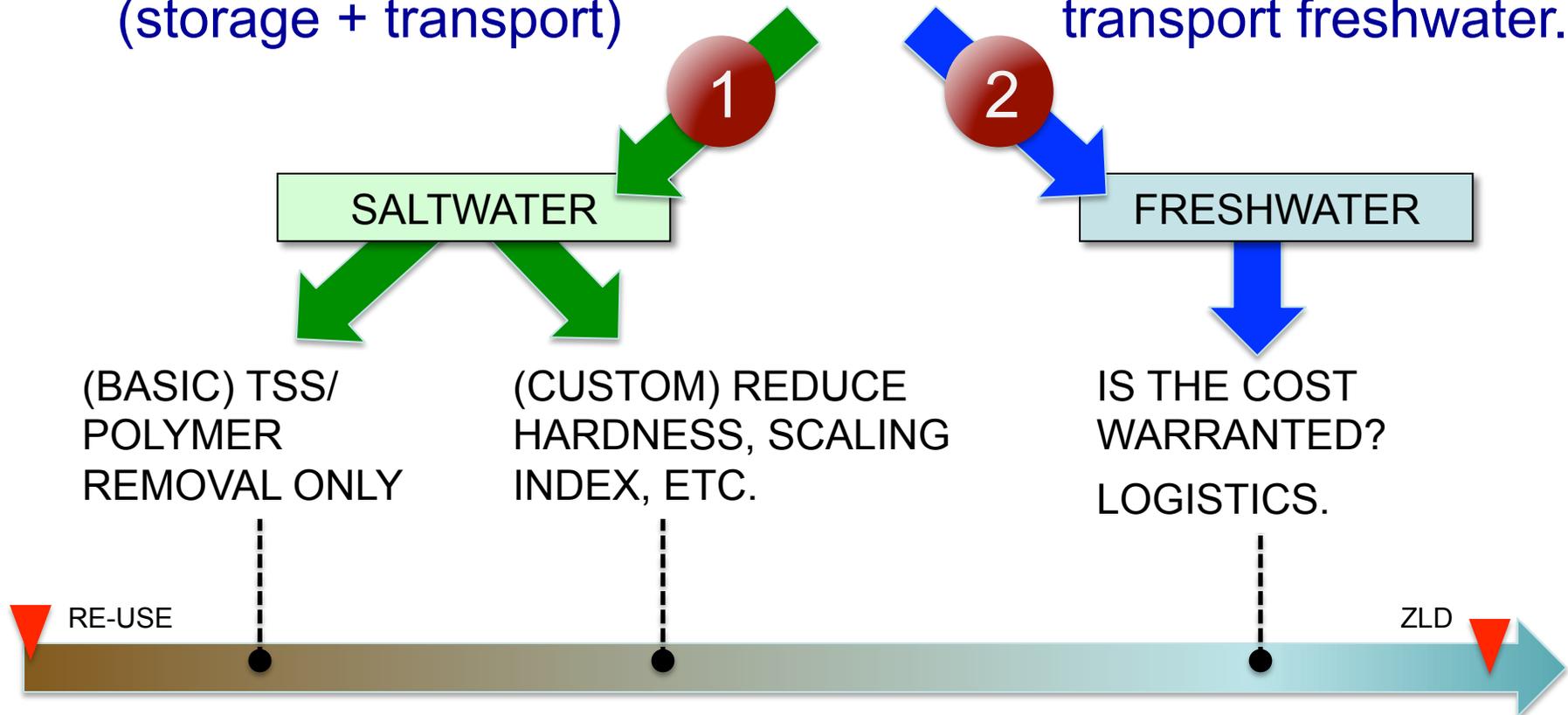
Charting a Logical Path

Saltwater

- Lower cost (minimal treatment).
- Difficult logistics (storage + transport)

Freshwater

- Higher cost (thermal distillation).
- Lower risk – store and transport freshwater.



ROVER System



Rugged, on-site brine re-use.
High capacity (10,000bbl/d), proven.

NOMAD System

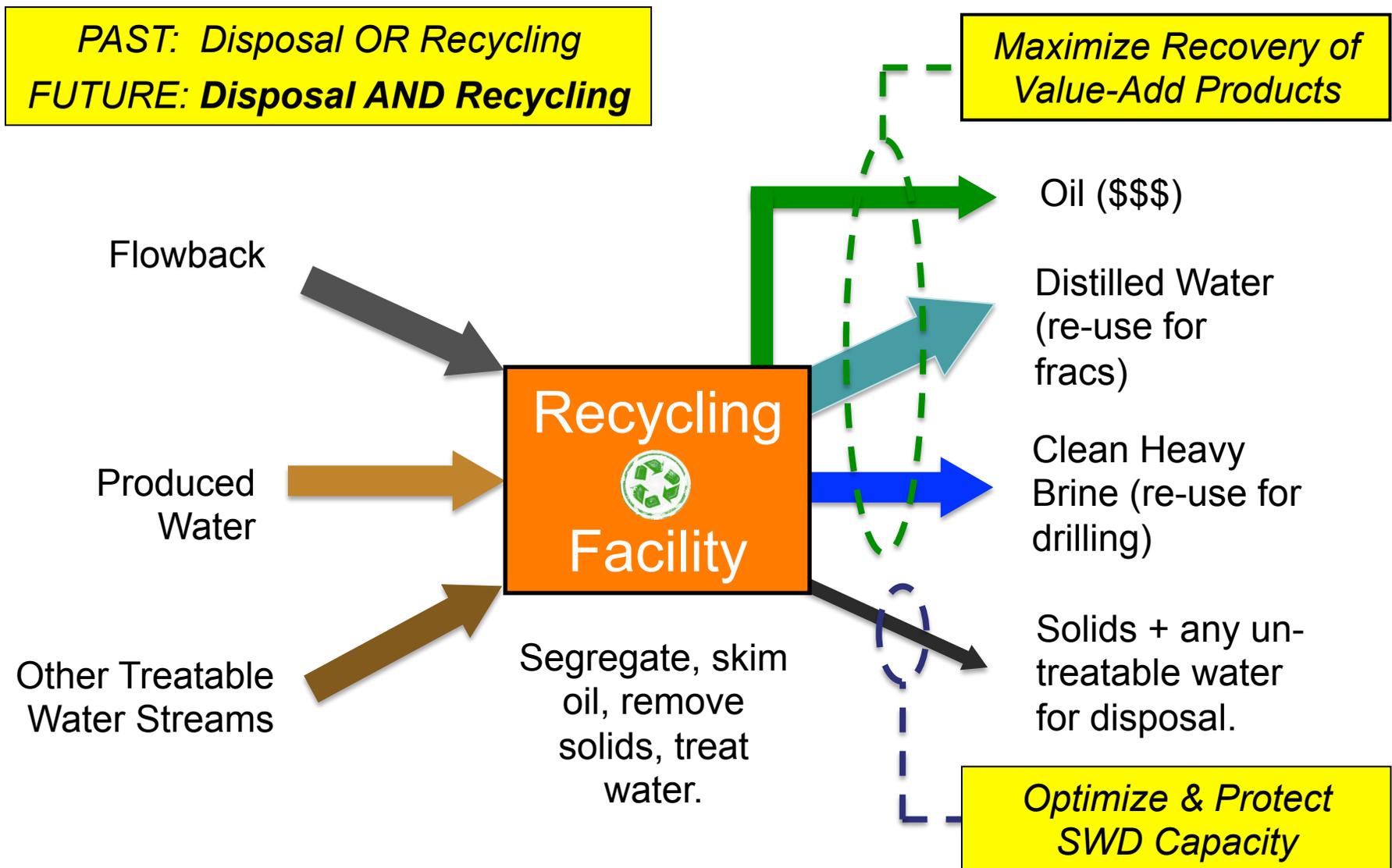


Move water recycling equipment near drilling activity to reduce transport costs.

Texas NOMAD Installations – Freshwater



Recycling Center – Hub for Water



ROVER Permian Project – Clean Saltwater

- Customer using PW as source water.
- High H₂S (~200ppm)
- FQWM and Select put together a package deal for customer (containment, transfer and recycling).

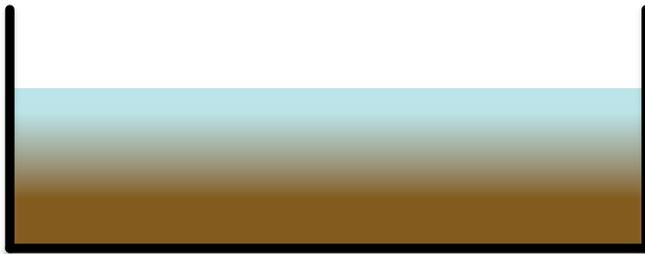


*Before / After ROVER
Treatment*

ROVER Solids Control

1

Direct re-use or “floc-n-drop” into containment.



- Solids build up & reduce effective volume of containment.
- Bacteria blooms.
- Lower cost initially.
- Expensive clean-up.

2

Remove solids prior to containment.



- Keep solids out of recycled water containment. 100% volume available for HF supply.
- Clean brine can be stored longer.
- Dry solids can be buried on location.

ROVER Permian Project – Clean Saltwater



- Keep solids out of recycled water containment
- Prevents bacteria blooms & messy cleanup
- PW is now a resource

New Trends

- ① Pit covers (prevent evaporation).
- ② Combine Recycling & Disposal (not Recycling *OR* Disposal).
- ③ More use of brackish water and saltwater – be careful about hydrogeology.
- ④ Incentivize, not mandate recycling (i.e.: TWRA).
www.txwra.org

Flexibility

