Organic Oil Recovery—A New Twist on an Old Idea for Uncertain Economic Times

March 2016

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The Titan Process is Controllable and More Consistent than Former Microbial Processes

- Preferentially targets mature water floods
- Uses microbes that are resident in the reservoir
- Batch treats with specifically selected nutrients
- Manages microbial ecology of the reservoir
- Promotes oil interactive microbes
- Impacts at the oil-water interface

True EOR--not just accelerated production rate, true additional reserves and new value creation

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Organic Oil Recovery Has a Cost and Efficiency Advantage Over Other EOR Methods

C02 Recovery

Infrastructure Needed

Cost per bbl: $20 – $70

2-3 Years to Implement

ASP Recovery

Infrastructure Needed

Cost per bbl: $30 – $80

2-3 Years to Implement

Organic Oil Recovery

Temporary Trucks 1-2 Days/Qtr. per well treated

Cost per bbl: $6 – $10

150 Days to Implement

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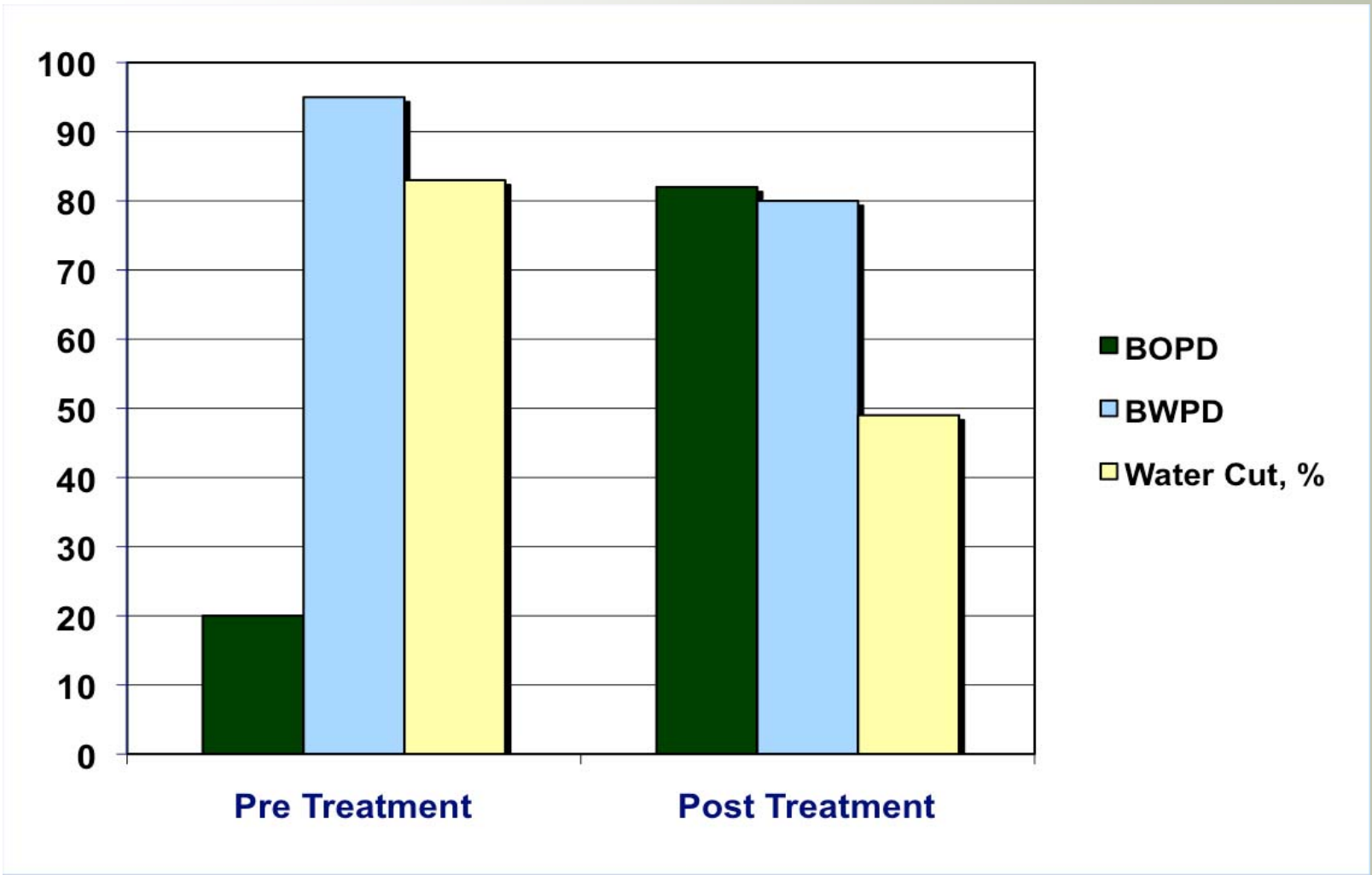
Fourfold Increase Seen in California Producing Well—Ideal Response



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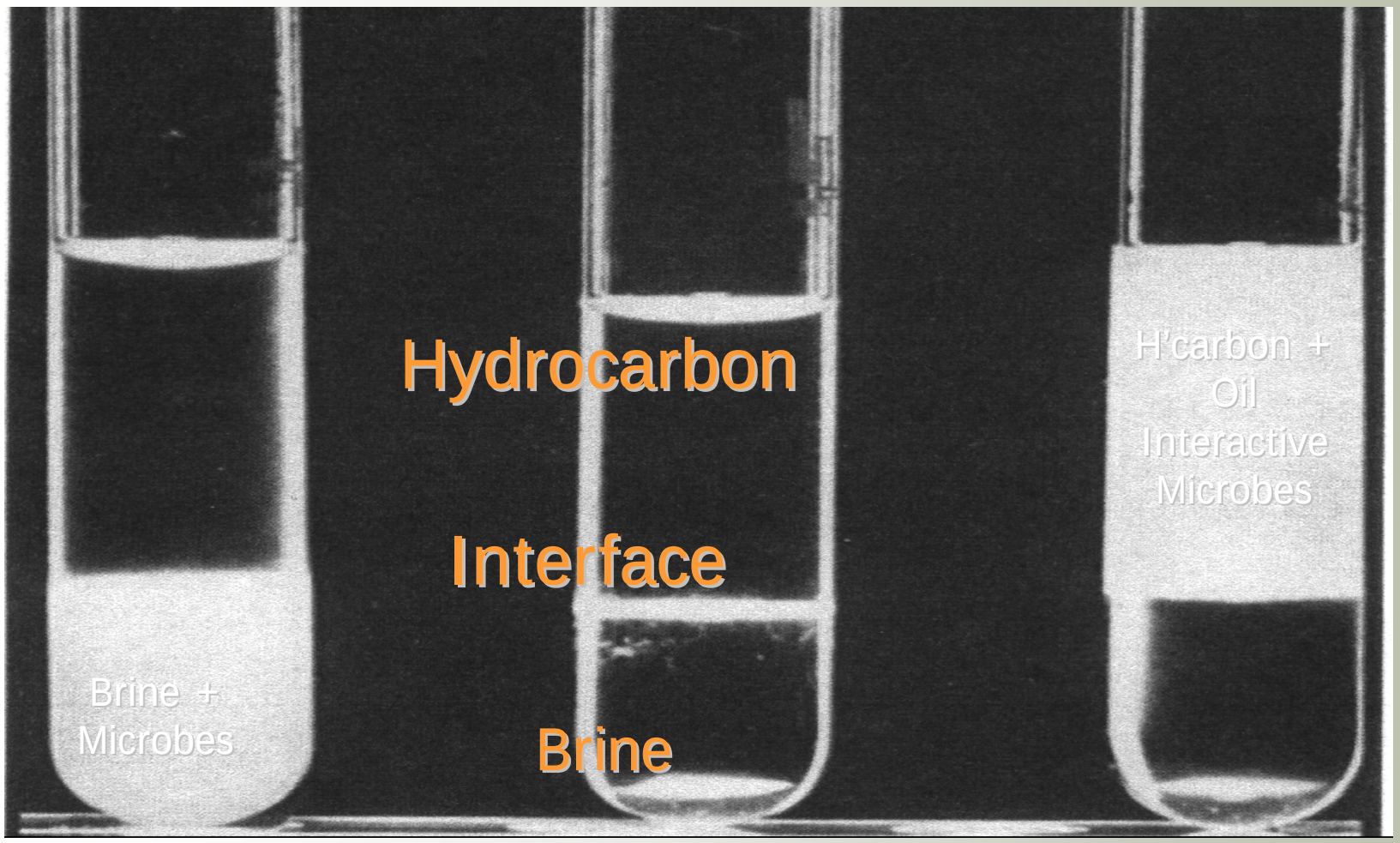
Microbes can be Manipulated with Nutrients to Yield Positive “Work” in the Reservoir



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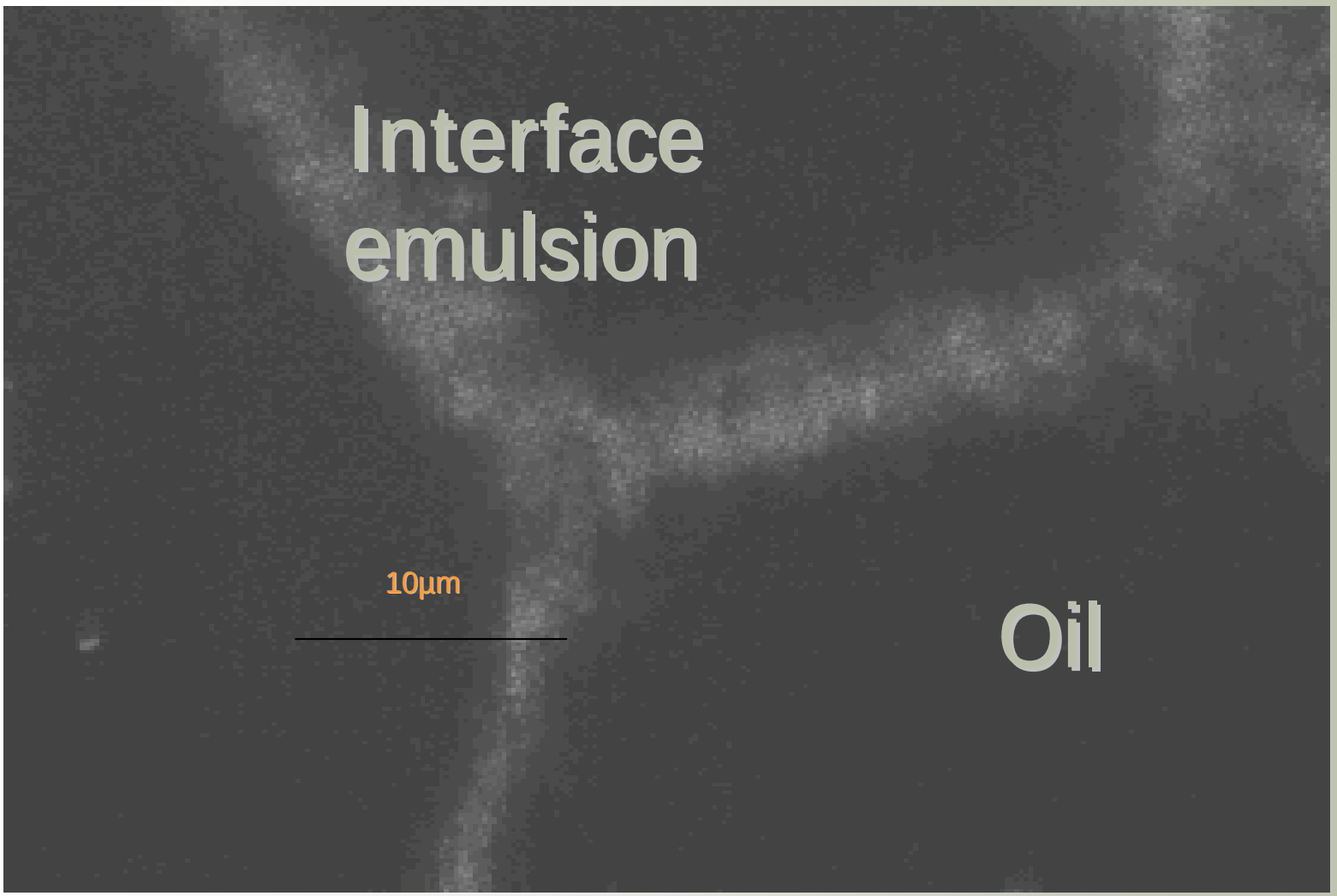
Micro-emulsion Creates Low Interfacial Tension Between Oil and Water



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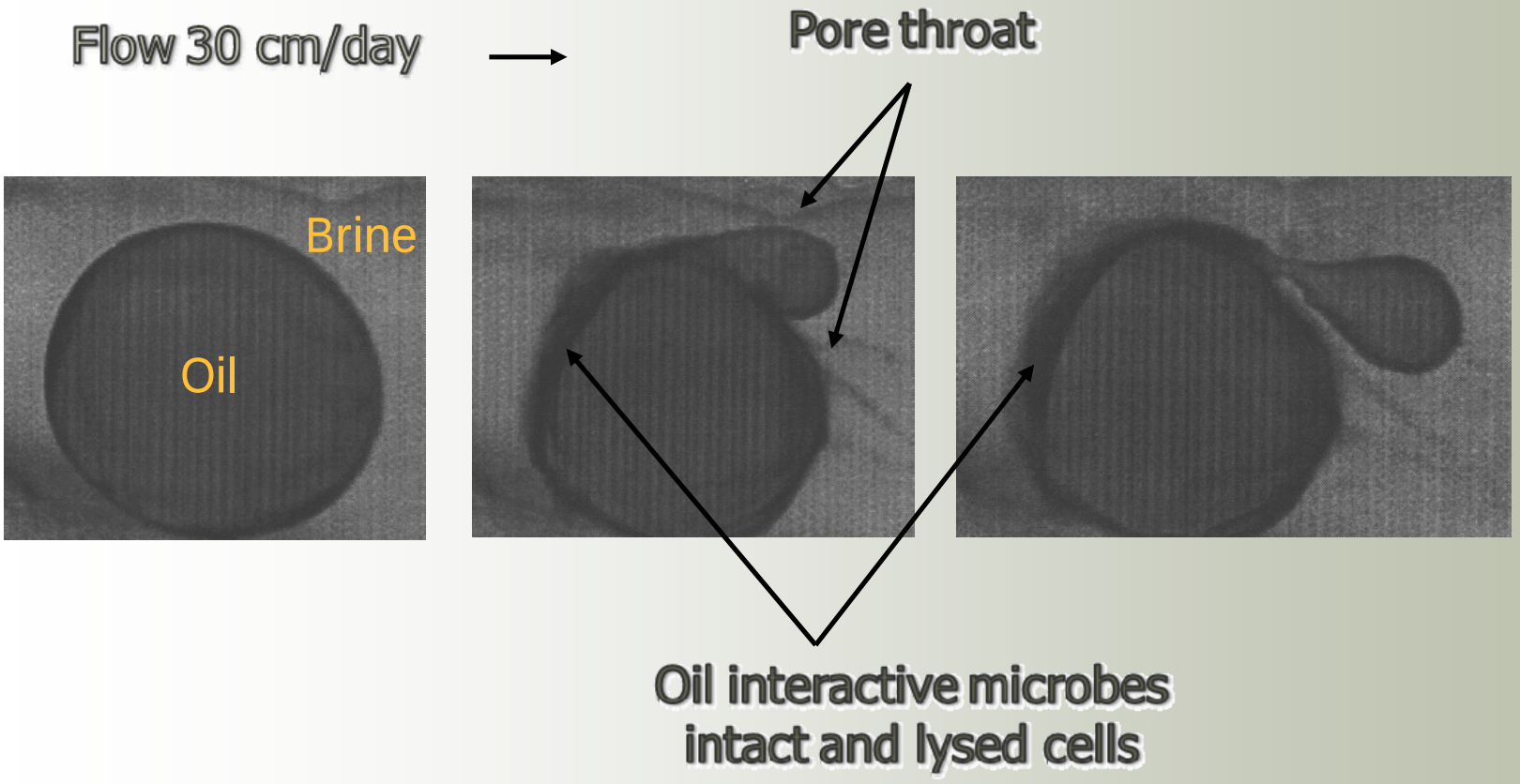
Oil Micro-Droplet Formation is a Key Release Mechanism



24 hours between photomicrographs

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Project 5-Step Application Process

- Field screening for suitable reservoir characteristics
- Laboratory analysis of produced water and injection water samples for suitable microbes and nutrient reactions
- In-Situ Microbial Response Analysis (ISMRA) test on a producing well
- Targeted water flood/pilot implementation
- Full field application

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Producing Well Treatments Result In Incremental Oil

- Producing well treatments are focused near-wellbore
- Generally treat down the tubing-casing annulus
- Nutrients are pumped into the well and then over-displaced into the producing reservoir
- Nutrients must be allowed to “incubate” with the in-situ microbes—generally 3 to 14 days
- Multiple samples are taken after the well is returned to production for laboratory analysis

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Injection Well Treatments are Targeted for Longer-Term Improved Recovery

- Treatments are based on the changed biology in adjacent producing wells
- Incubation time is coordinated with the operator/operator
  - Titan Prefers to shut-in the treated water injection wells
  - As a minimum, we usually curtail injection for about a week (if possible) during water injection well treatments
  - Depends on produced water handling capacity in the field
- Response time will depend on reservoir volume and “transit time” from injector to producers—we must move molecules from Point A to Point B

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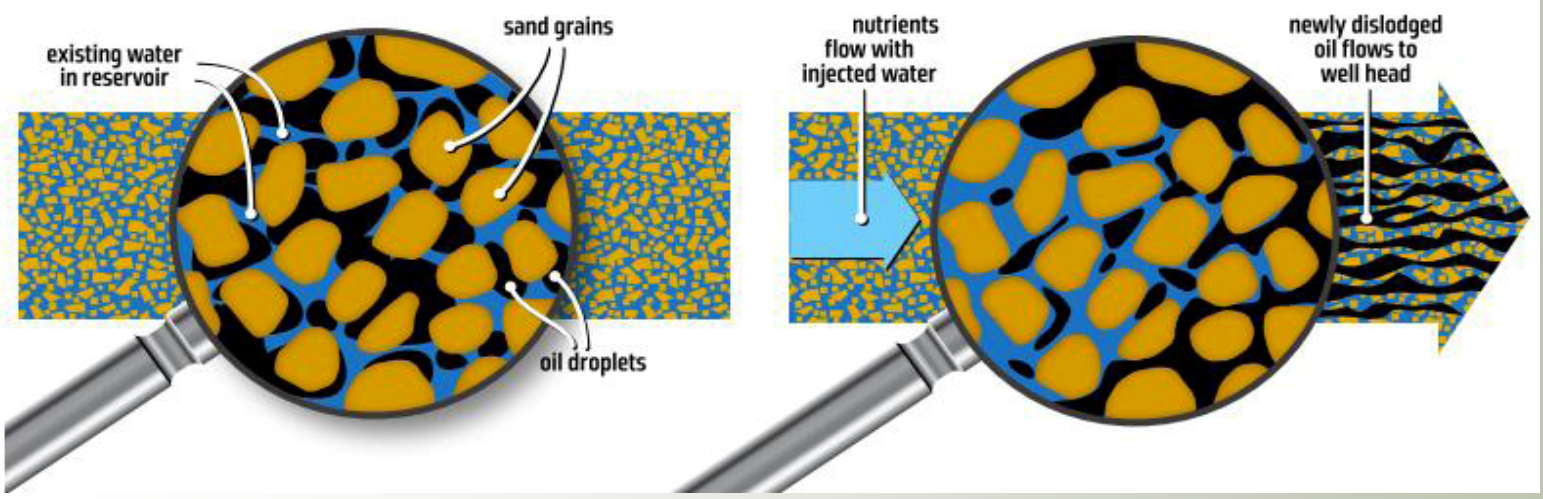
Most Optimal Use is in Existing Waterfloods

The Process is used with waterflooding to release oil "trapped" after Primary and Secondary Recovery processes



Pre-Treatment Oil Saturation **Following waterflood processes, an average of 65% of the original-oil-in-place remains trapped in the pore space of the oil reservoir (in the microscopic spaces between sand grains).**

Post-Treatment Oil Saturation **Following the OOR Process, the interaction of oil, water, microbes and proprietary nutrient formulae cause trapped oil to be released to improve both oil production rate and ultimate recovery from the oil reservoir.**

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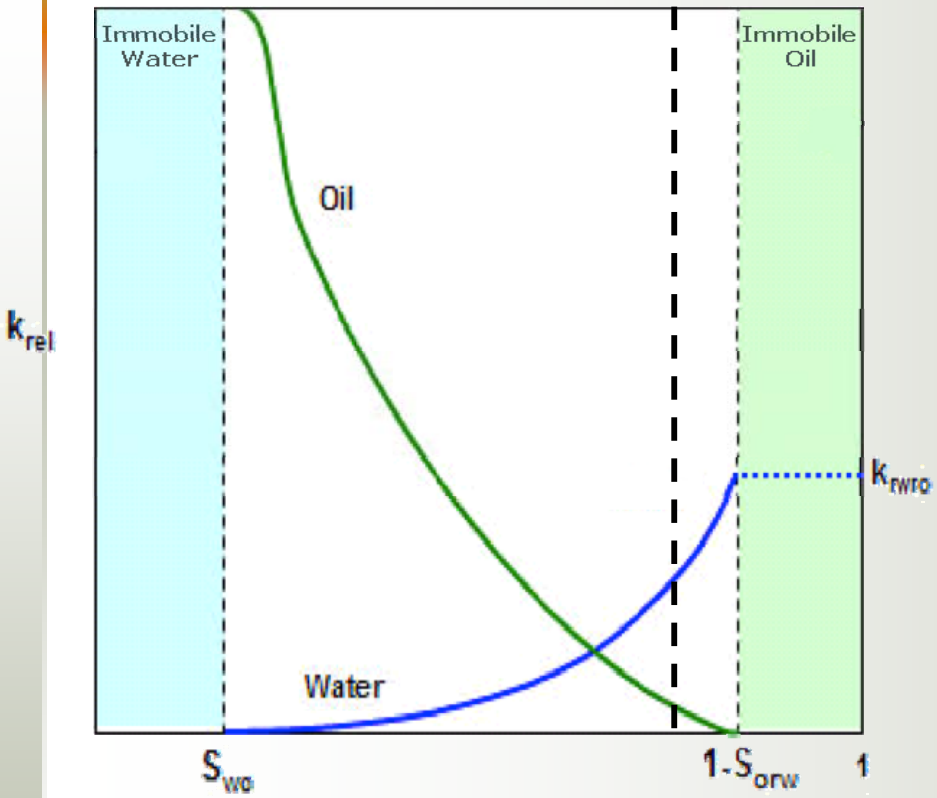
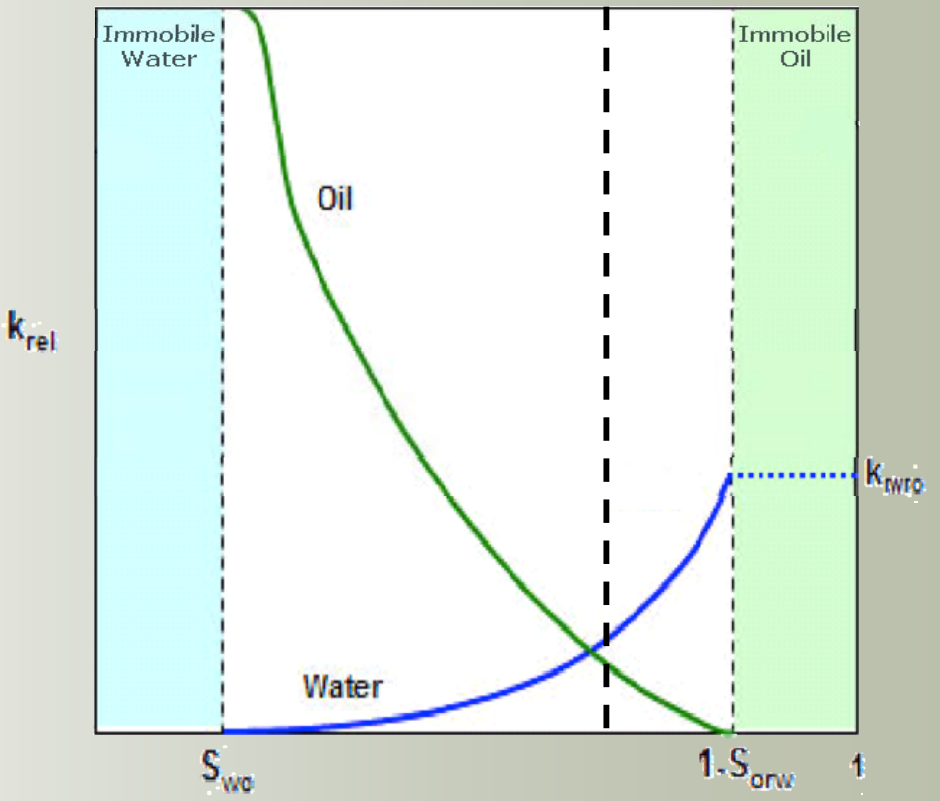
Released Oil Increases Oil Saturation and Improves Relative Permeability

Pre-Treatment



Water saturation after water-flood: Low oil permeability & high water permeability

Post-Treatment



Water saturation after treatment: Higher oil permeability & lower water permeability

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Field Experience of Over 300+ Treatments Has Expanded the Applicability of OOR

- Oil gravity from 41° API (100% production increase) to 16° API (533% production increase)
- Expanded temperature (205° F)and salinity (140,000 ppm TDS) applications
- Permeability as low as 7.5 md (a measure of the flow capacity of the reservoir)—must achieve contact of oil, water and nutrient materials injected
- Plugging and formation damage are not problems; no production upsets; no oil treating problems; no change in oil characteristics

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Reservoir Selection Diligence Increases Chance of Success Based on 300+ Treatment Results

- **Movable Oil Historically Demonstrated**
  - Documented waterflood response (a top indicator of success with OOR—assuming microbes are present in sufficient numbers)
  - Active water injection or water drive
  - 50 md permeability and above (treated as low as 7.5 md)
- **Microbes Must Be Present**
  - Reservoir temperature below 80° C (180° F).
  - Water salinity below 10%, 100,000 ppm Cl^-
  - pH in the neutral range
- **Some Areas of Caution**
  - **Not for ultra low rate stripper production (issue of economic benefit)**
  - **Assure mechanical integrity (know where your fluids are going)**
  - **Caution with very thick pay sections (nutrient distribution)**
  - **Watch mobility ratio**

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Value Is Created for Producing Companies

- Oil Fields Can Be Tested Easily and Inexpensively (generally between $6 to $10 per incremental barrel)
- Low Cost Field Trials (approximately $32,000 depending on field characteristics)
- No Capital Expense
- Routinely, a rig or pulling unit is not required
- Substantial Increase in Oil Production
- Reserves Increase
- Field Net Present Value Increases (ROE is excellent)
- Significant Increase in Cash Flow
- Well abandonment may be deferred (time value of money)

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What Does Success Look Like?

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Treatments Have Delivered an Average 92% Production Increase

	Number of Wells	Number of TMTS	Number of Increases	Success Rate	Oil Increase (per well basis)
PRODUCERS					
ISMRAs	47	49	36	73%	140%
Producers	18	19	17	89%	133%
INJECTORS					
Confirmed Results	81	238	234	98%	54%
ALL WELLS					
Confirmed Results	146	306	287	94%	92%

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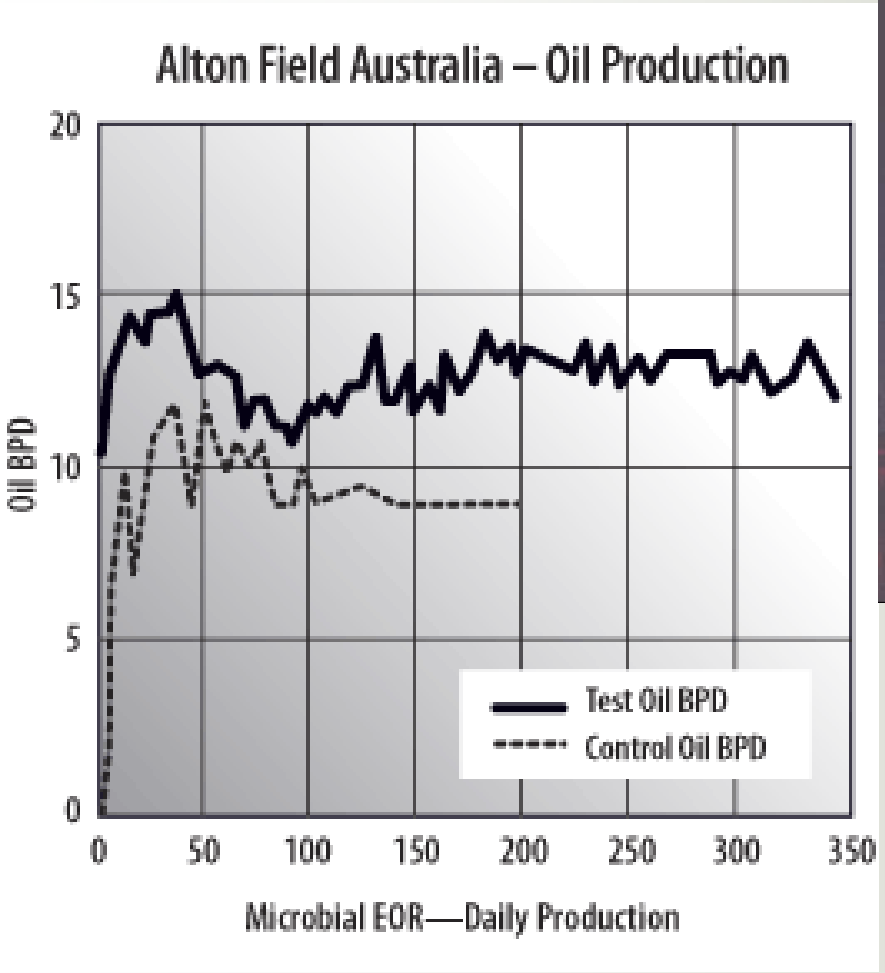
Alton Field
Queensland Australia



Well history provides likely responses

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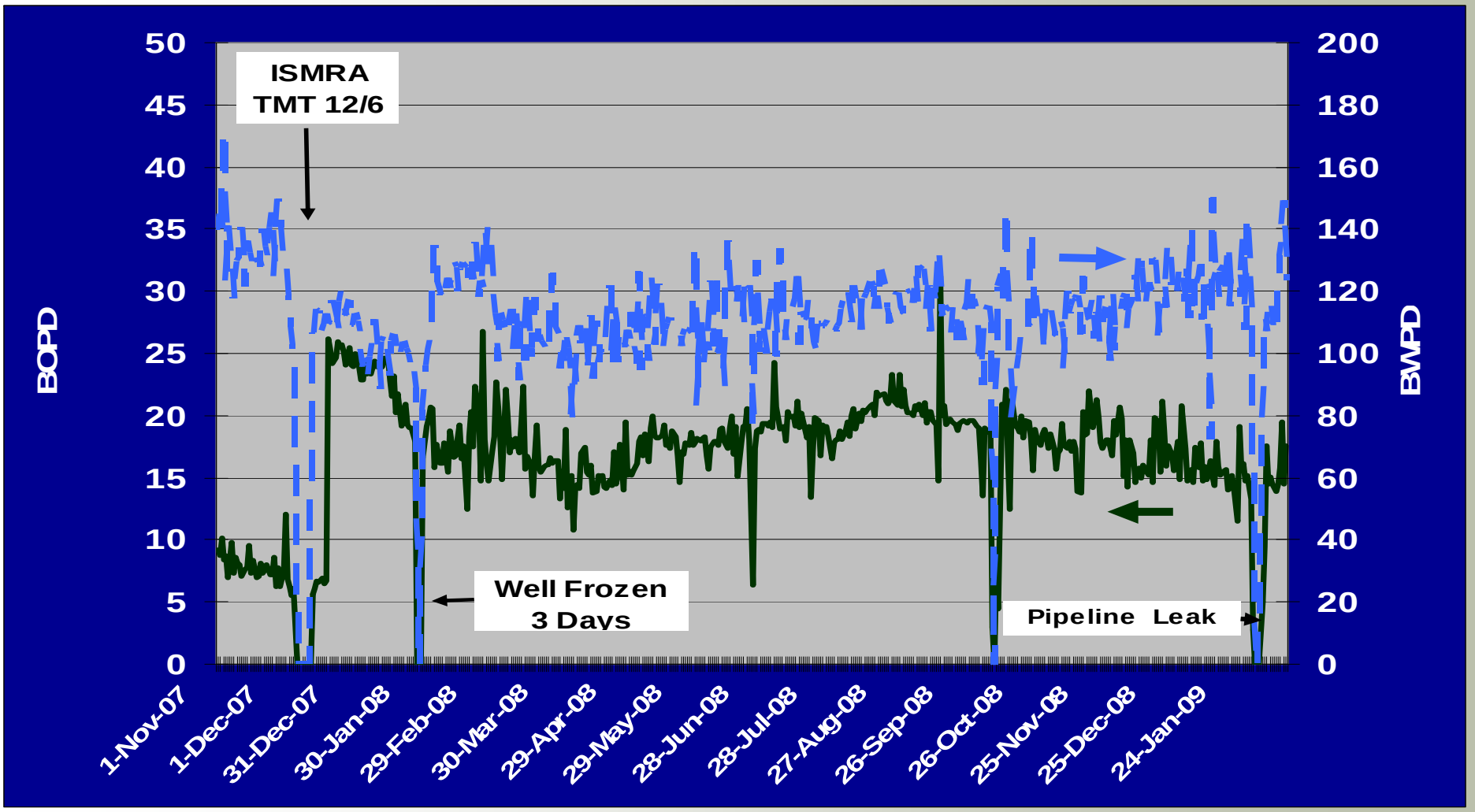
Saskatchewan Producing Well Response Continued For Over a Year



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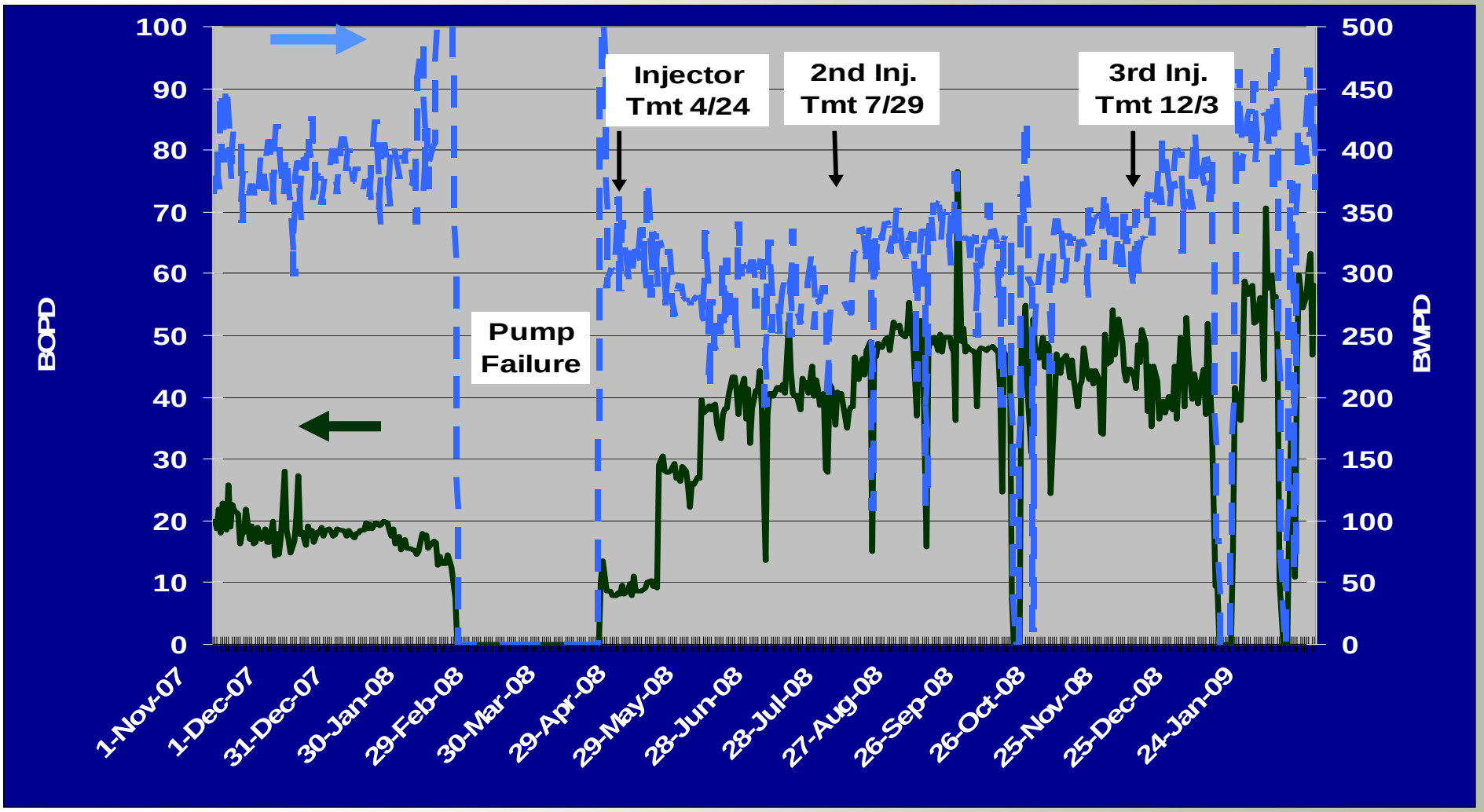
19.

Canadian Injector Treatment Clearly Impacts Offset Producer



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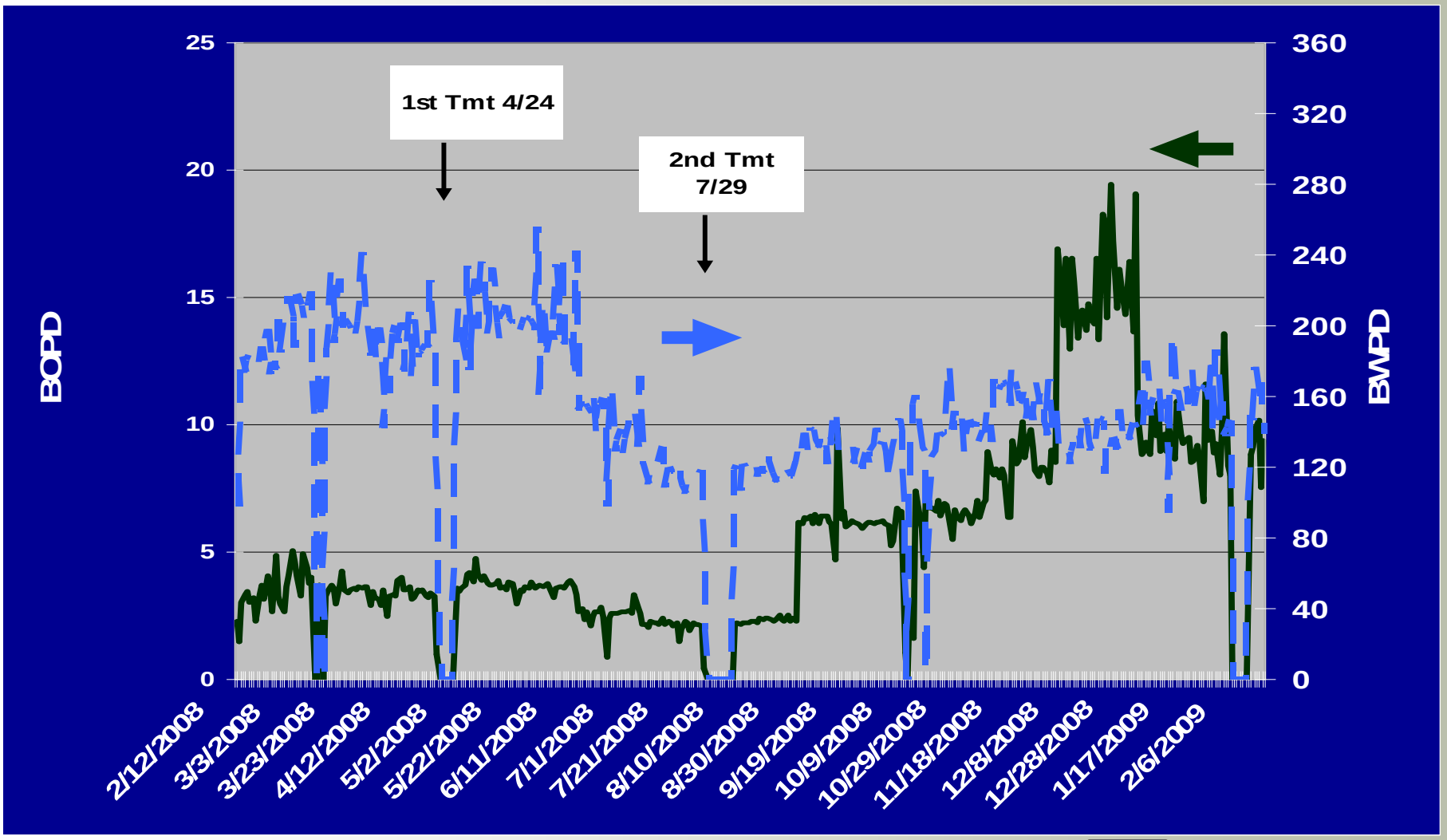
20.

Idle Well Returned to Production Responds to Treatment



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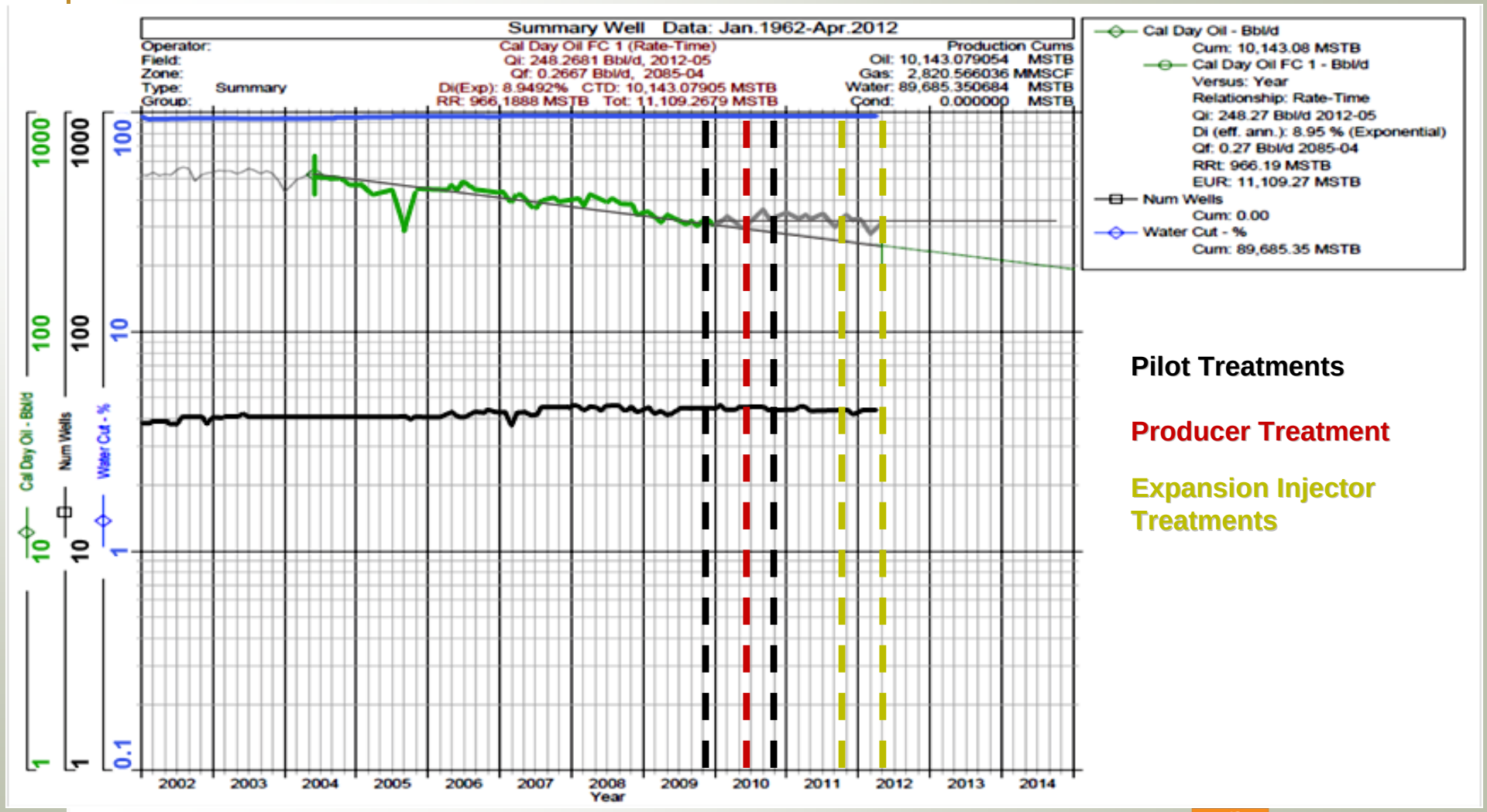
21.

Unit Production Decline Flattened Resulting in 70,000 Barrels of Incremental Oil And Continuing



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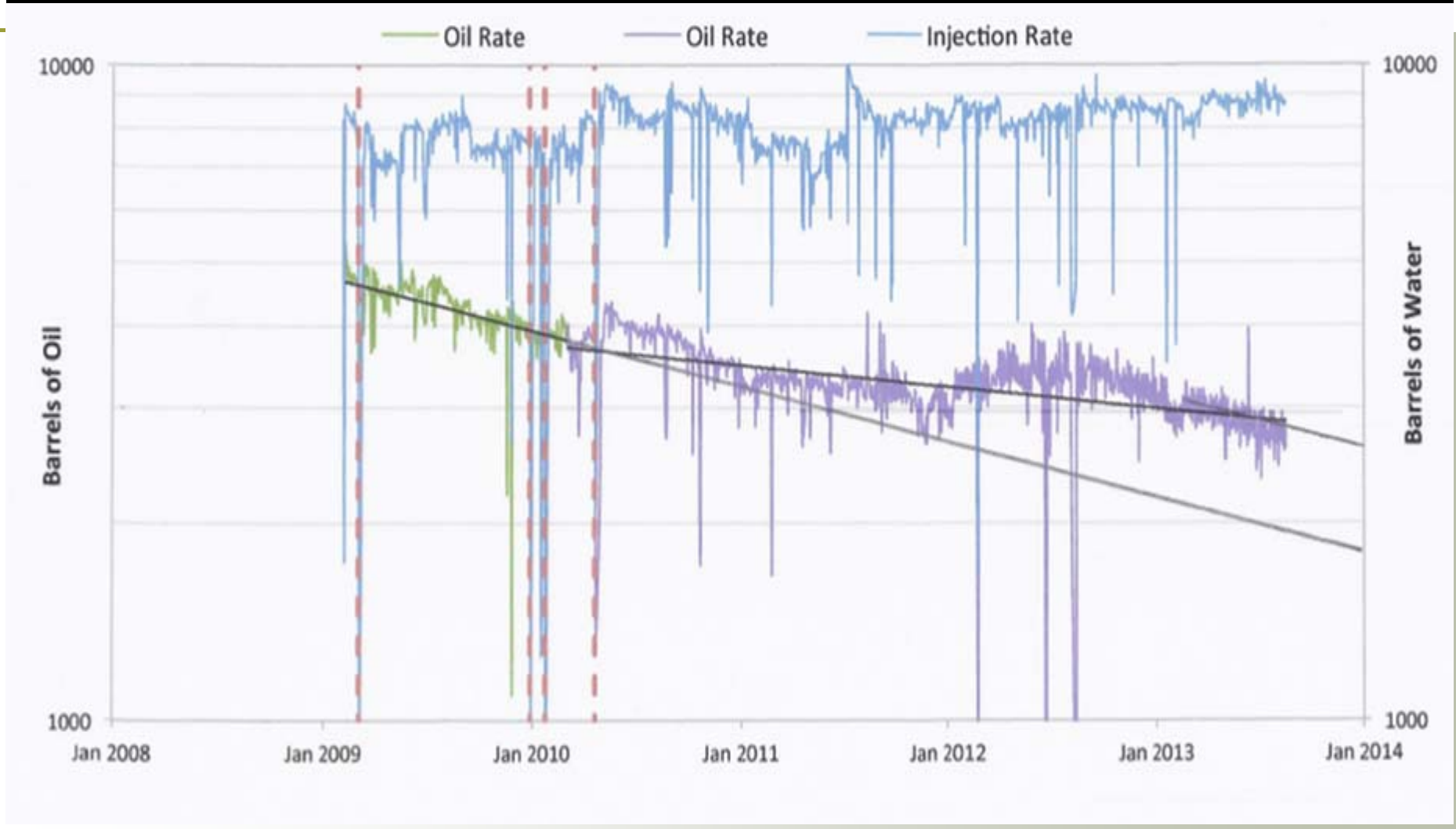
Offshore Platform Producer Treatment



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Field Screening is Critical for Both the Service Business and the Acquisition Business

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Optimal Physical Field Parameters—Create a Great Opportunity for Success
page 1

- Fields with well understood geology (mapping)
- Fields that have been numerically modeled would be ideal but not critical
- Water injection history will give indications of positive “mobility ratio” and displacement efficiency in the reservoir
- Reservoir rock data is very important
- Known status and condition of individual wells (well completion diagrams)
- Availability of reservoir studies or “tracer studies”—monitoring the movement of injected water

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Optimal Physical Field Parameters—Create a Great Opportunity for Success page 2

- Titan has treated sandstone reservoirs only to-date. Carbonate reservoirs of the right type are likely candidates. Sandstone reservoirs would be the “sweet spot” at this moment in time—perhaps not in the future
- Understanding the target field economic “drivers” will allow producers to make good acquisition decisions

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This is a Unique Moment-in-Time to Move Forward with a New Technology for Difficult Times

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