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Optimising Production for Unconventional Fields with Limited Water Disposal

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Genesis

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Introduction

- Produced Water Disposal is a major issue for unconventional producers
- Recycle and reuse for frac' water can minimize this (either as saline or treated water), and reduces demand for freshwater
- Needs planning as part of overall field development strategy

Methodology & Objectives

- Definition of development scenarios
- Generation of PW profile
- Determination of parameters affecting PW disposal volumes
- Effect of recycle on PW disposal volumes
- Optimal PW storage capacity
- Effect on Cost of Supply
- Conclusions

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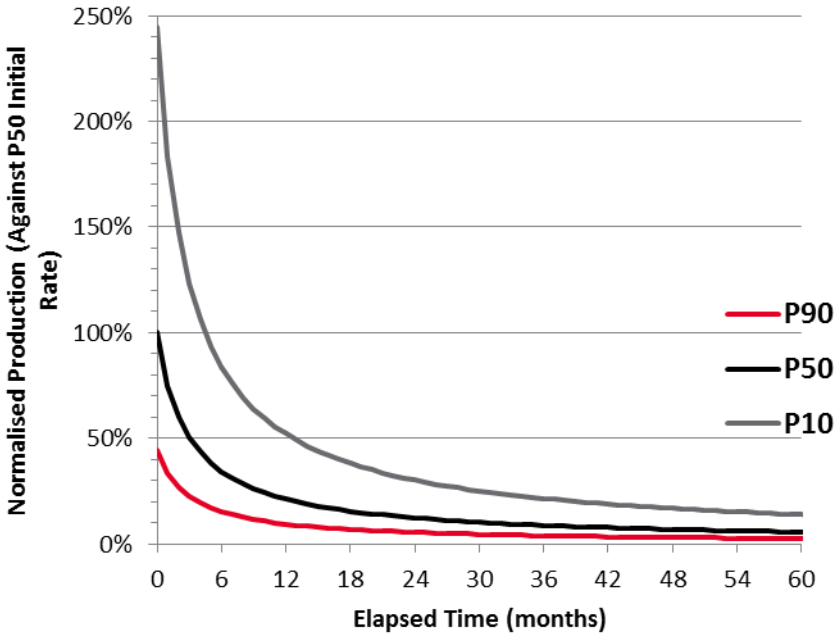
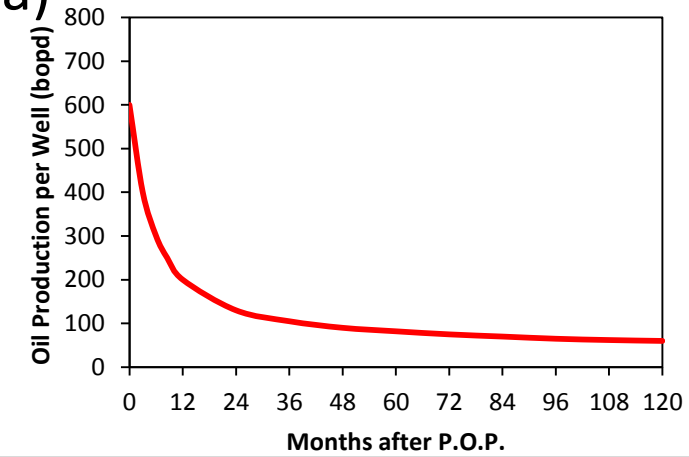
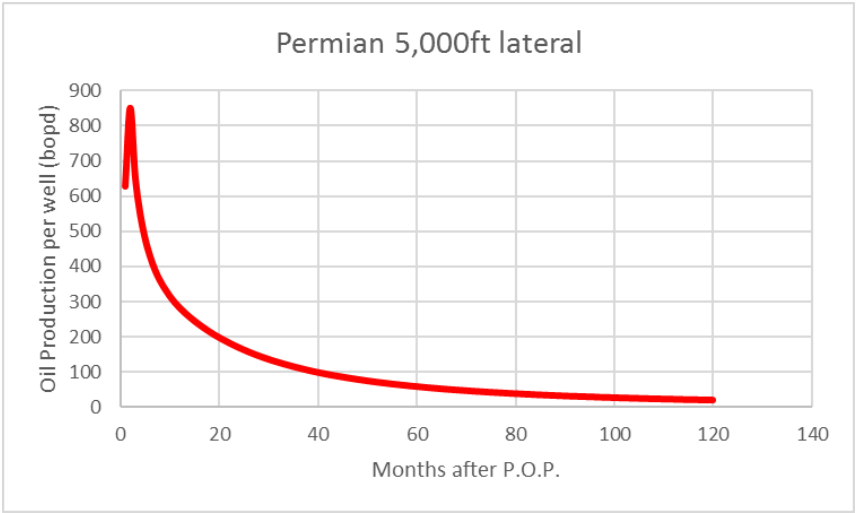
Basis

- Example type curves (from EIA data)
- Type curves are field specific







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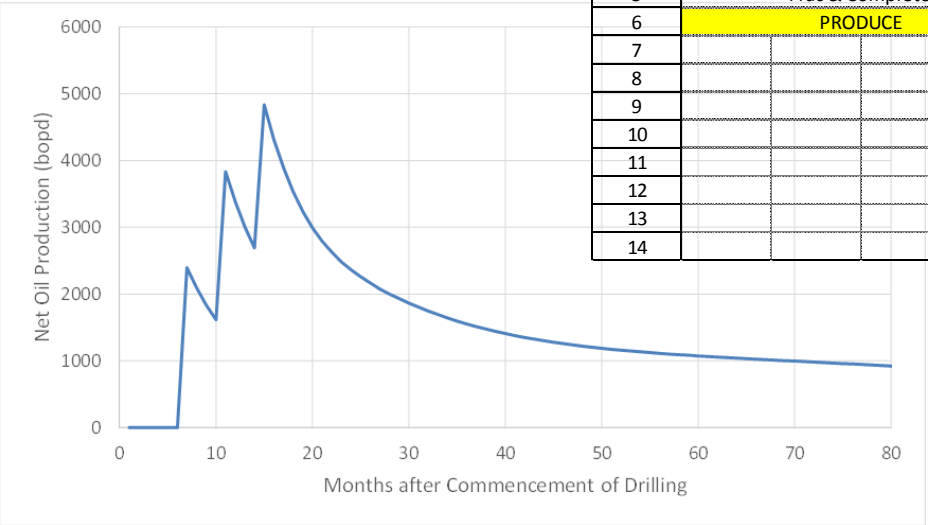
Example Development Scenario

- 125 well pads, 4 oil wells per wellpad
- New shale oil
- Average type curve

Month	Well Pad 1				Well Pad 2				Well Pad 3			
	Well 1	Well 2	Well 3	Well 4	Well 1	Well 2	Well 3	Well 4	Well 1	Well 2	Well 3	Well 4
1	Drill											
2		Drill										
3			Drill									
4				Drill								
5	Frac & Complete				Drill							
6	PRODUCE					Drill						
7							Drill					
8								Drill				
9					Frac & Complete				Drill			
10					PRODUCE					Drill		
11											Drill	
12												Drill
13									Frac & Complete			
14									PRODUCE			



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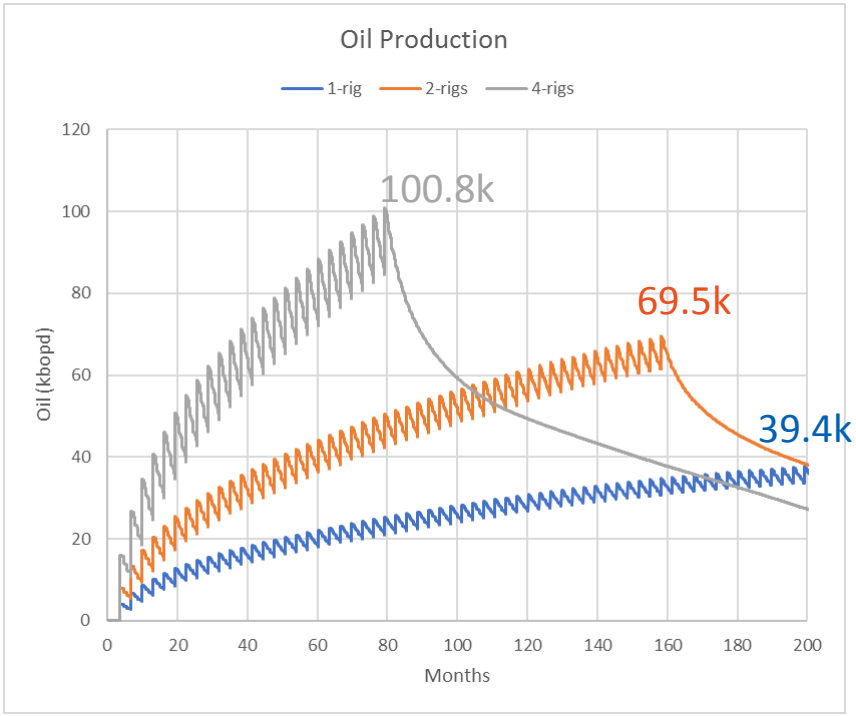
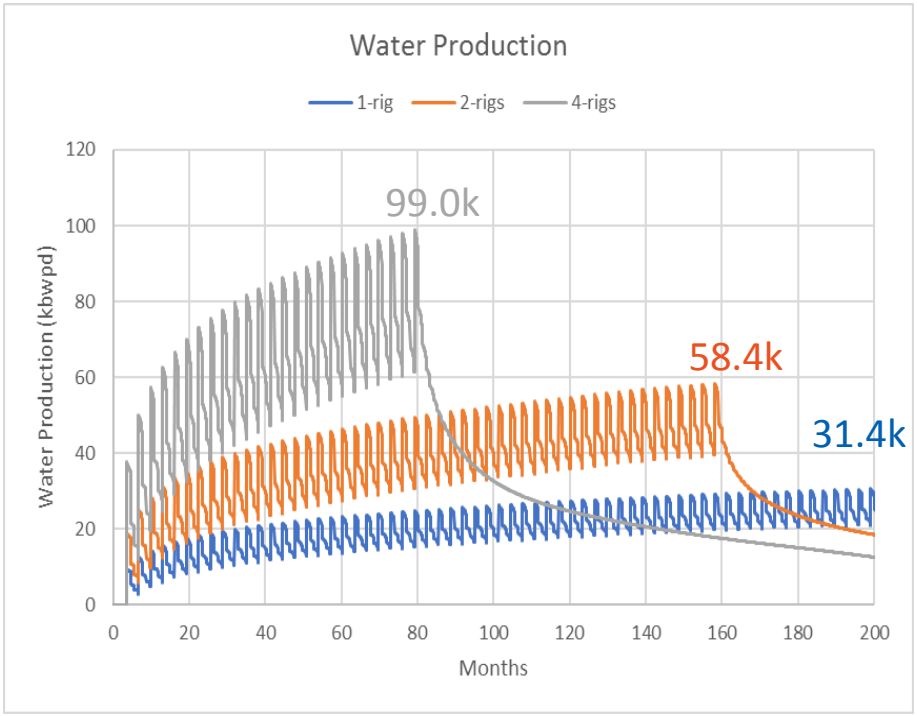
Rig Count Sensitivities

Production Profile Build-up:

- 1, 2 and 4 rigs





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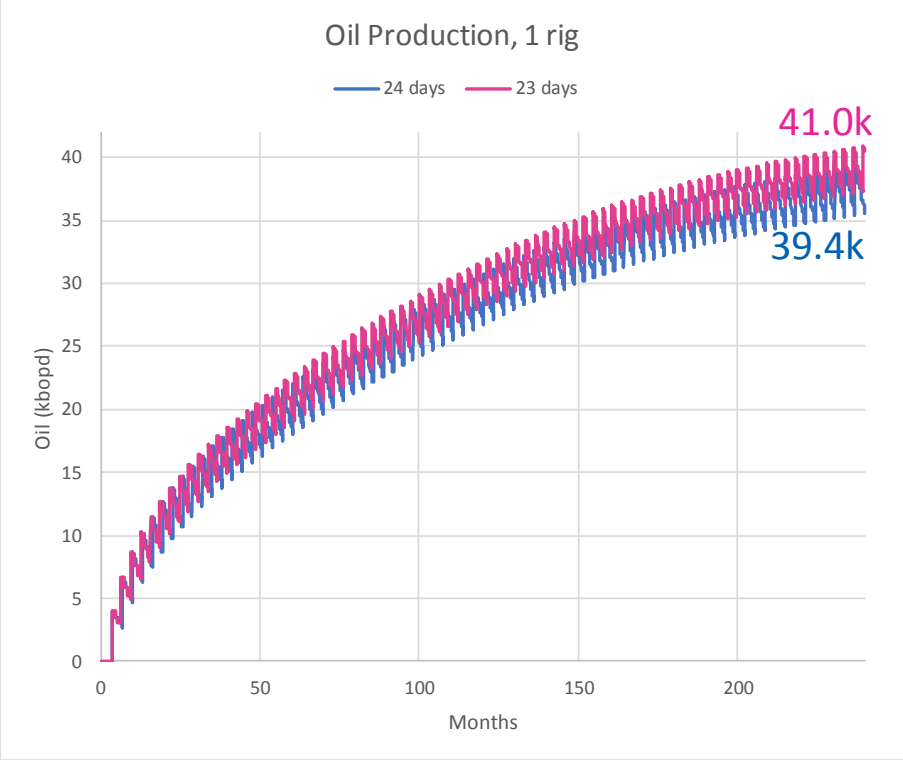
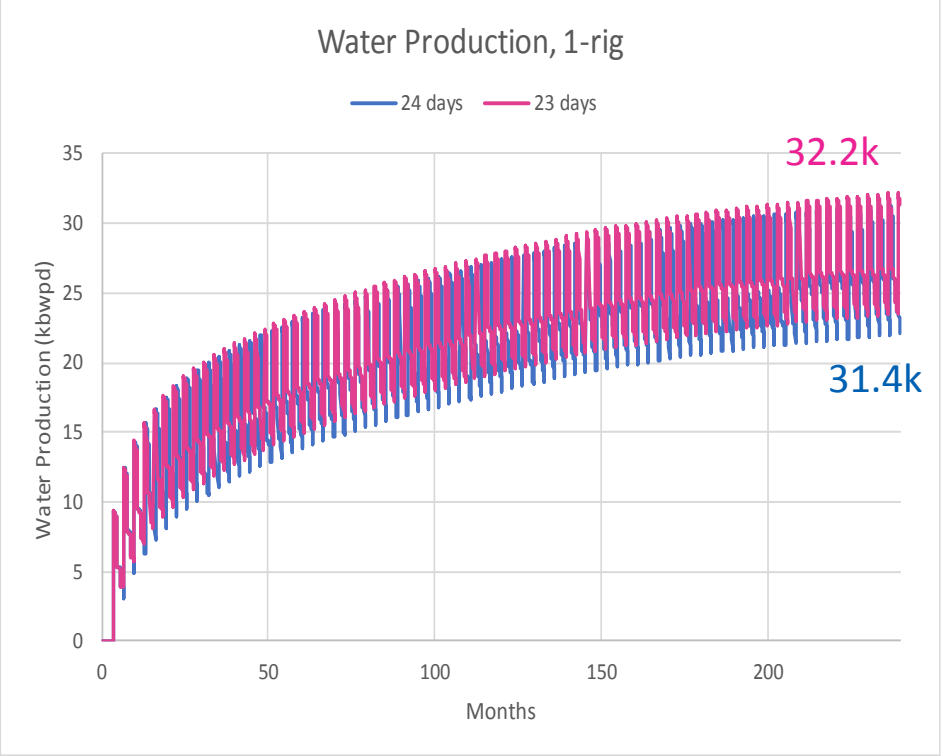
Drilling Time Sensitivities

Production Profile Build-up:

- 24 and 23 drilling days per well





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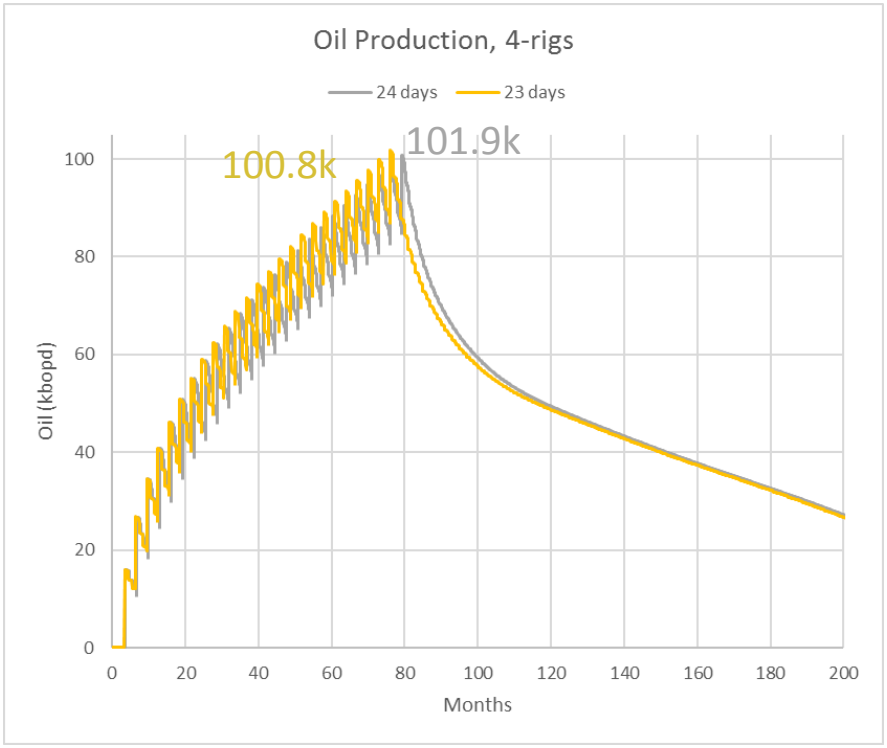

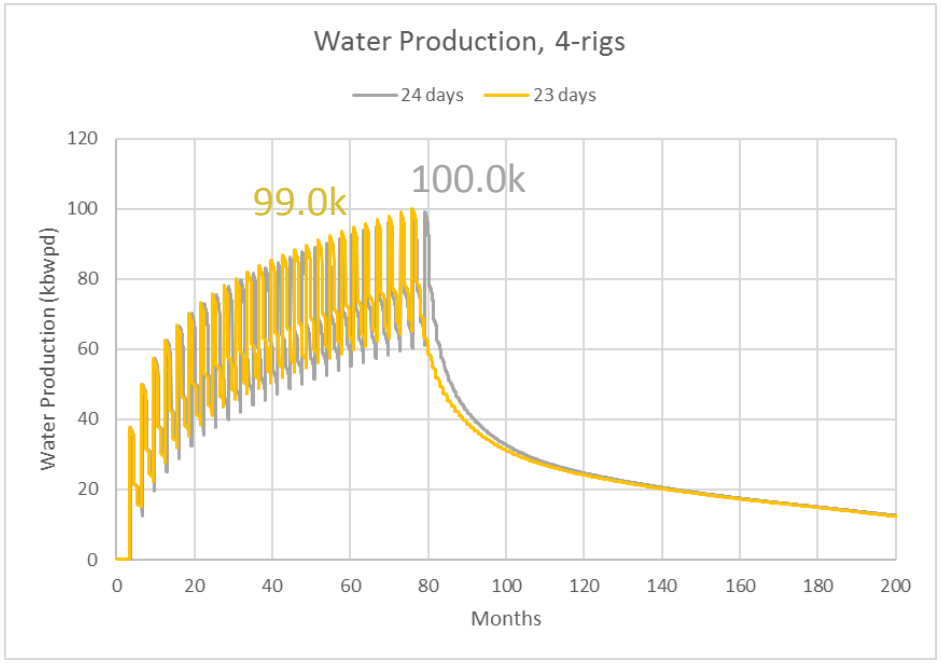

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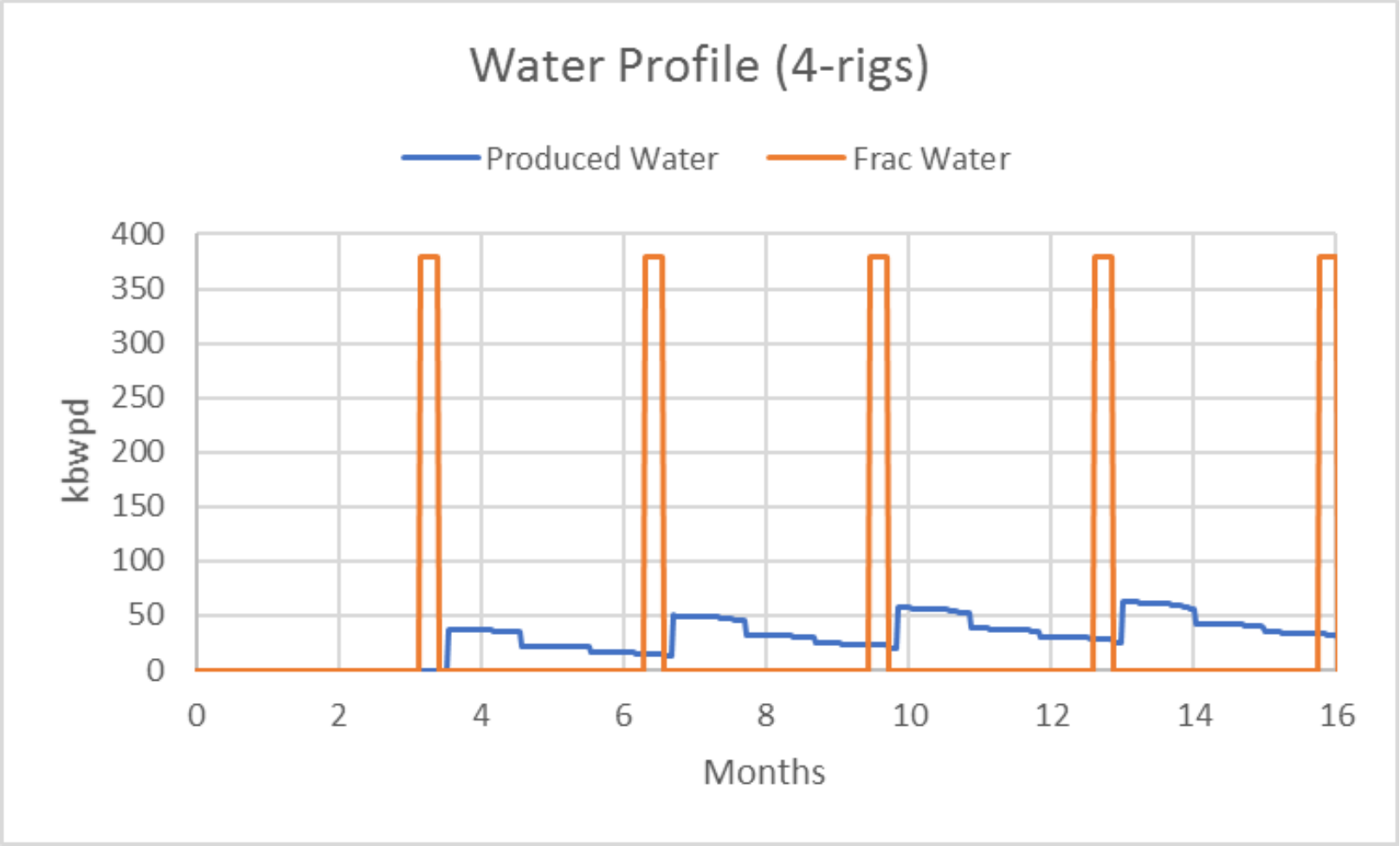
Water Profile



Conclusion: if we want to recycle PW, adequate storage is needed

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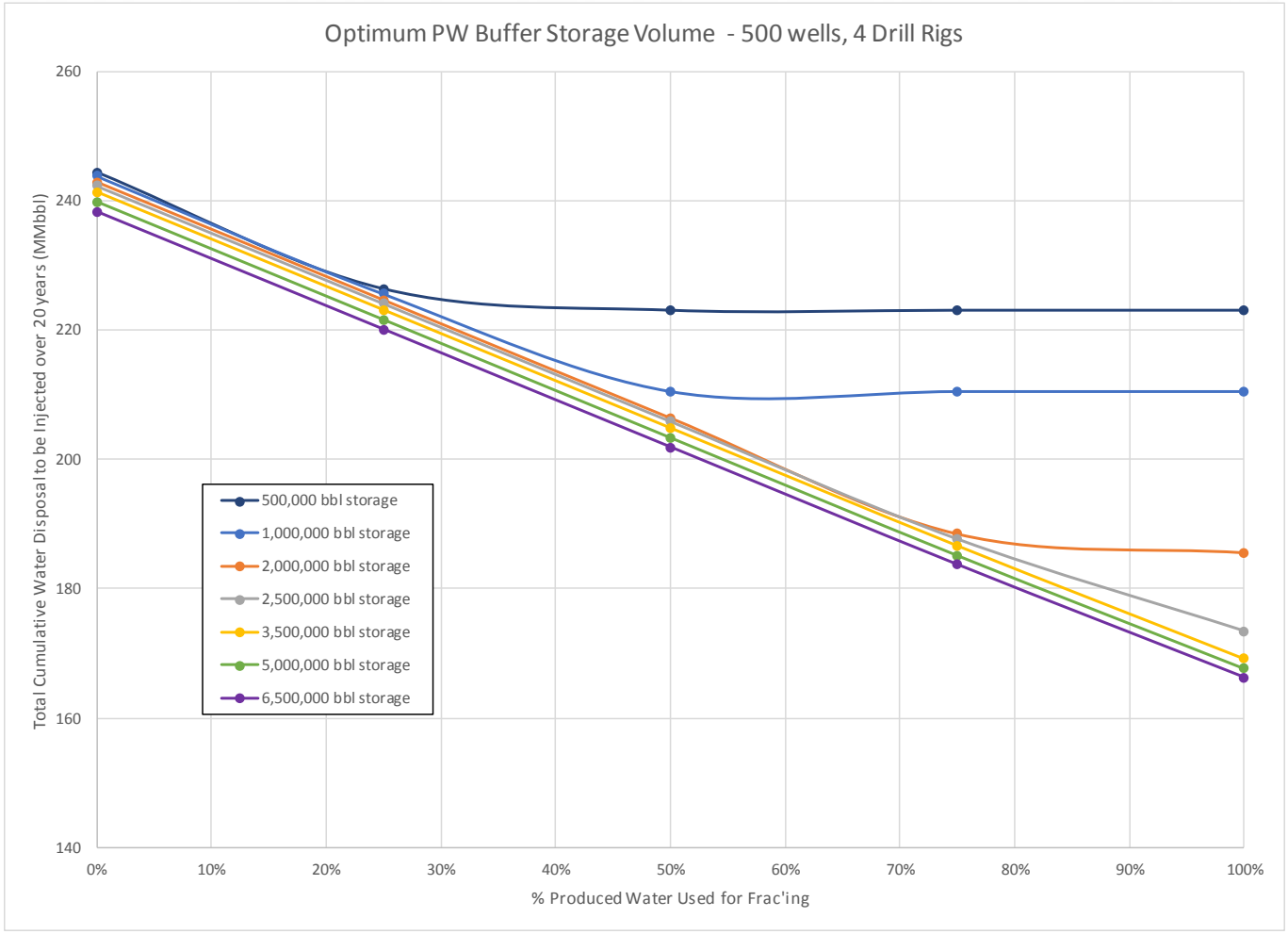
Effect of Recycle on Overall Water Disposal Volumes



Recycling for frac'ing in this formation has potential to reduce water disposal from 240 to 170 MMbbl

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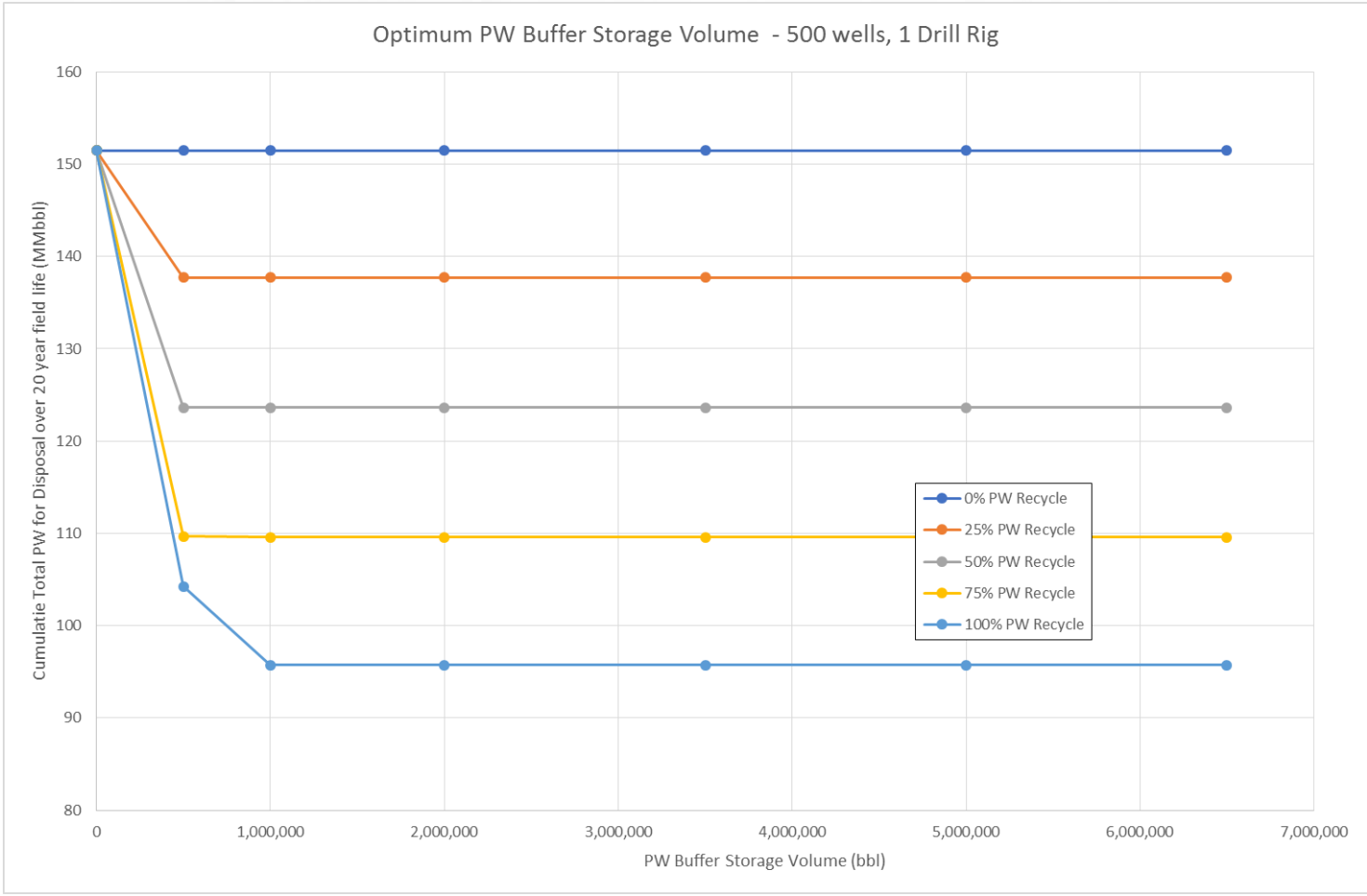
Optimum PW Storage – 1 Drill Rig



Recycling for frac'ing in this formation has potential to reduce water disposal from 150 to 95 MMbbl

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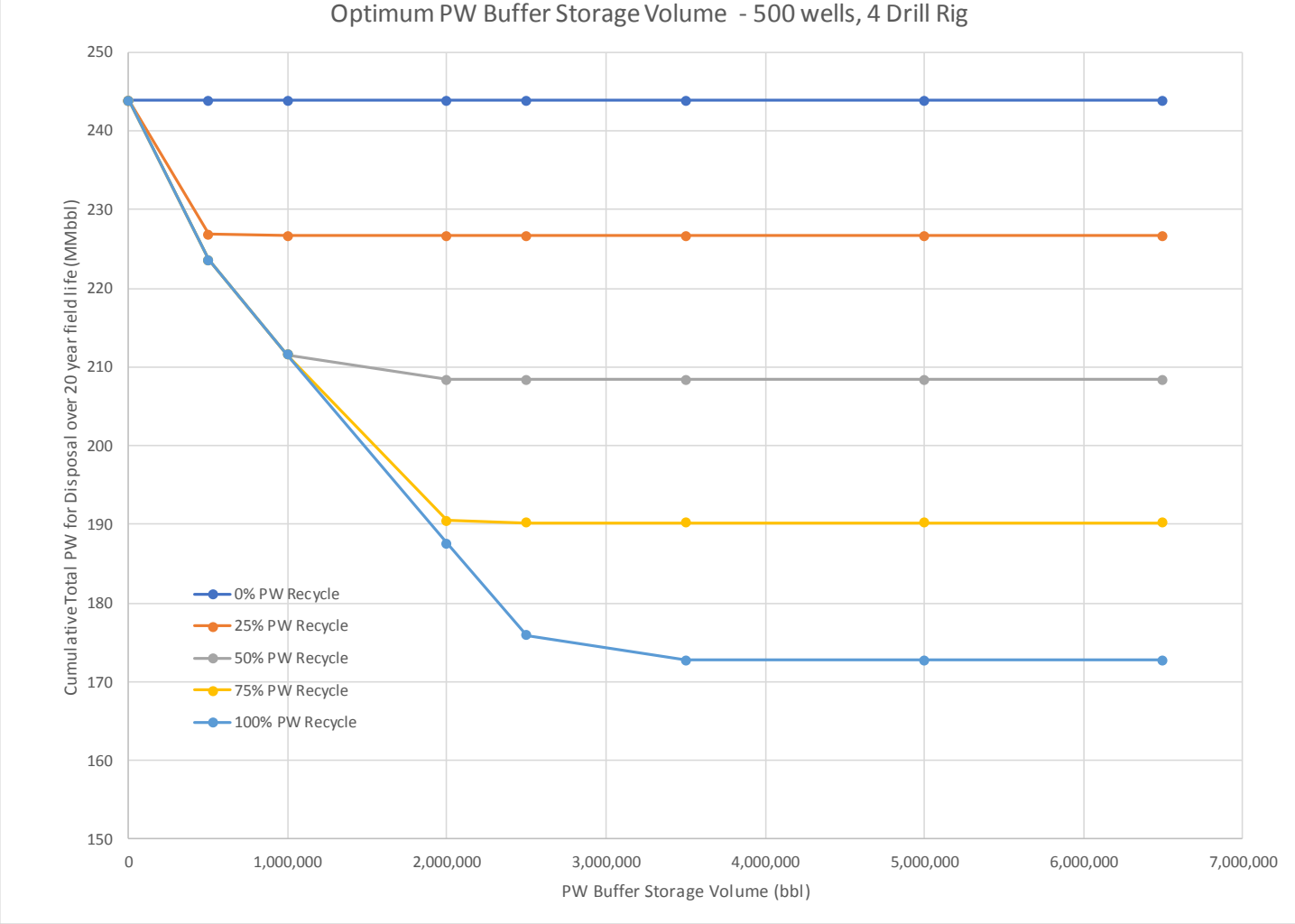
Optimum PW Storage – 4 Rigs



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Optimum PW Storage

- Optimum PW buffer storage is enough for one frac' campaign

$$Storage\ Volume = N \times W \times F \times r$$

- where

N = No. of drilling rigs (rig count)

W = No. of wells per pad

F = Volume of water needed to frac' one well

r = Proportion of produced water able to be recycled

Effect on Cost of Supply

- For this example: over a 20 year field life, recycling P/W can reduce disposal by 70 MMbbl water (30% reduction from 244 MMbbl)
  - Total oil production for this field = 343 MMbbl
- If total water disposal or freshwater supply is limited, extra cost of $3.5/bbl water
  - Cost to truck offsite ~$3/bbl water
  - Cost of freshwater is ~$0.5/bbl
- Recycling cost is ~$2/bbl (electro-coagulation)

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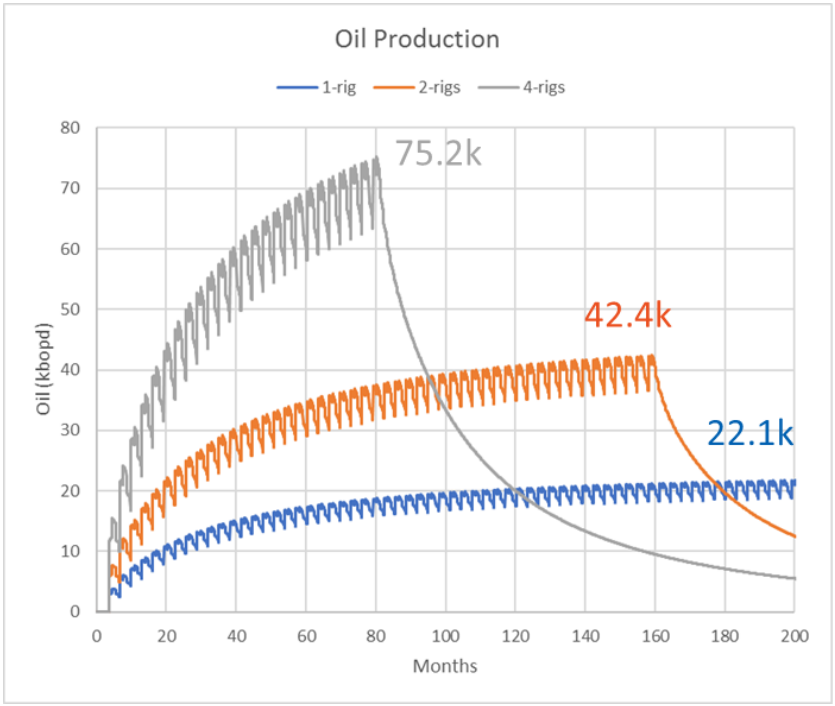
Effect on Cost of Supply (ctd)

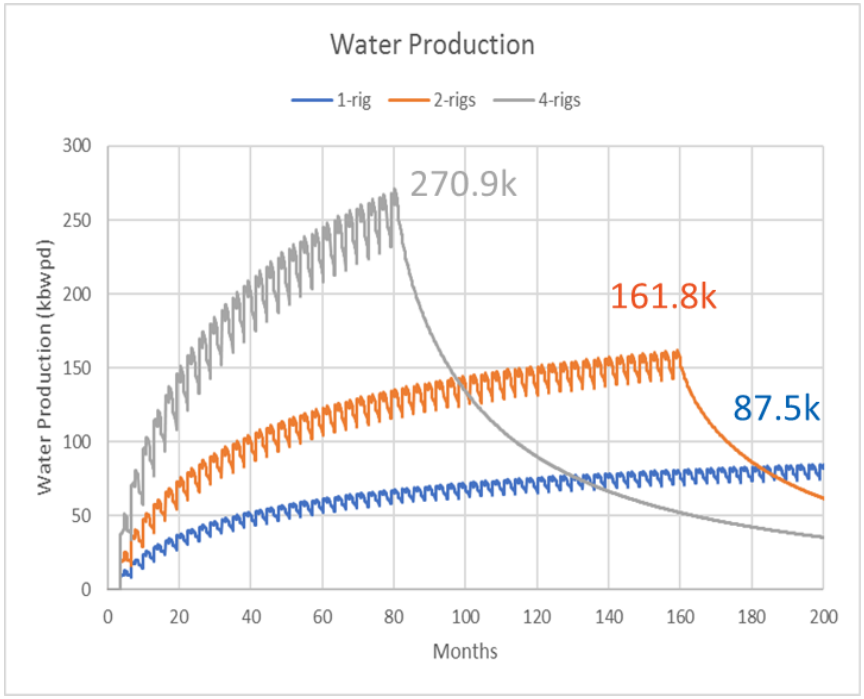
For this example:

- If no PW can be injected, cost to project is $780MM
  - Adds $2.3/bbl to cost of supply per barrel of oil over field life
- Recycling 30% for frac' water, saves $105MM
  - Reduces cost of supply per barrel by $0.31/bbl oil
- *Bigger issue is that water disposal capacity is a limited resource and needs to be managed*

Extreme Example: Permian Acreage producing large amounts of PW

- Based on actual Permian type curve, with PW/oil ratio is >> 3





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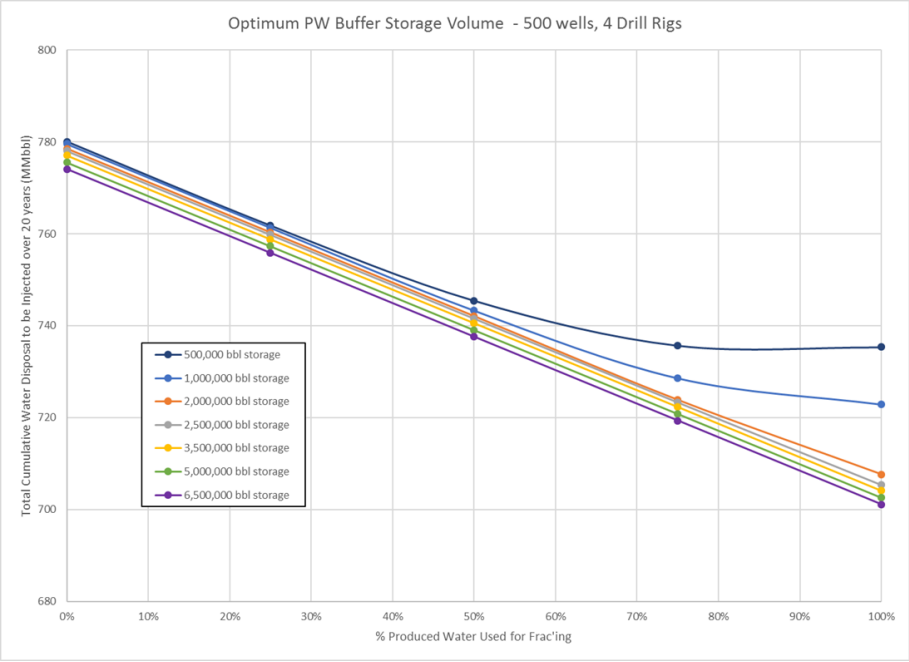
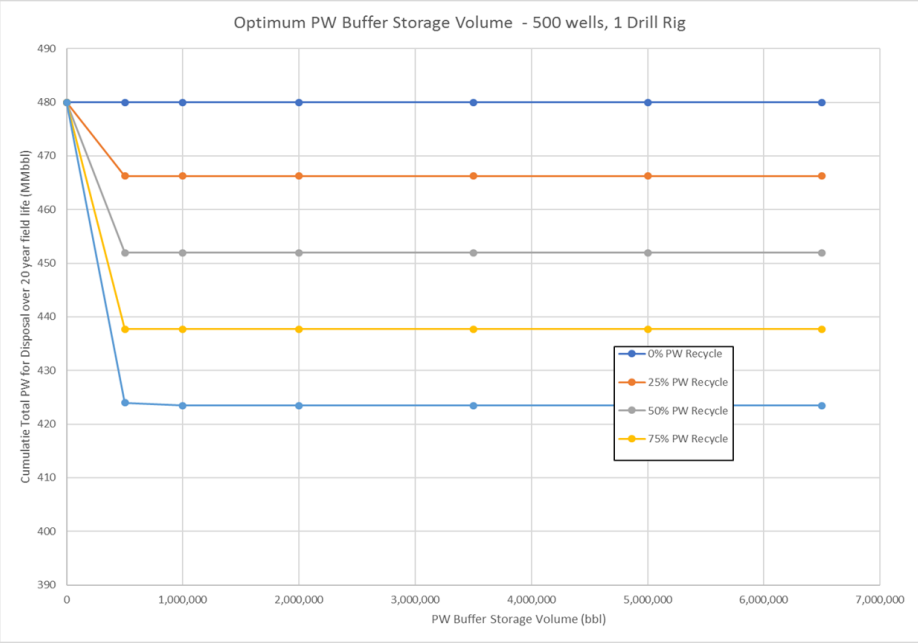
Effect on Cost of Supply - Permian

- For this severe example: over a 20 year field life, recycling PW can still reduce disposal by 70 MMbbl water (9% reduction from 780 MMbbl)
  - Total oil production for this field = 200 MMbbl





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Effect on Cost of Supply (ctd)

For this Permian example:

- If no PW can be injected, cost to project is $2,400MM
  - Adds $11.9/bbl to cost of supply per barrel of oil over field life
- Recycling 9% for frac' water, saves $109MM
  - Reduces cost of supply per barrel by $0.54/bbl oil

Conclusions

- Water disposal needs to be included in field development plan
- Recycling can reduce but is unlikely to eliminate PW disposal over field life
- Needs significant storage to balance timing of frac' water demand vs produced water
  - Storage volume needed is dependent on rig count
- Neglecting water disposal can add significant cost of supply per barrel of oil

Thank You

Contact us

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