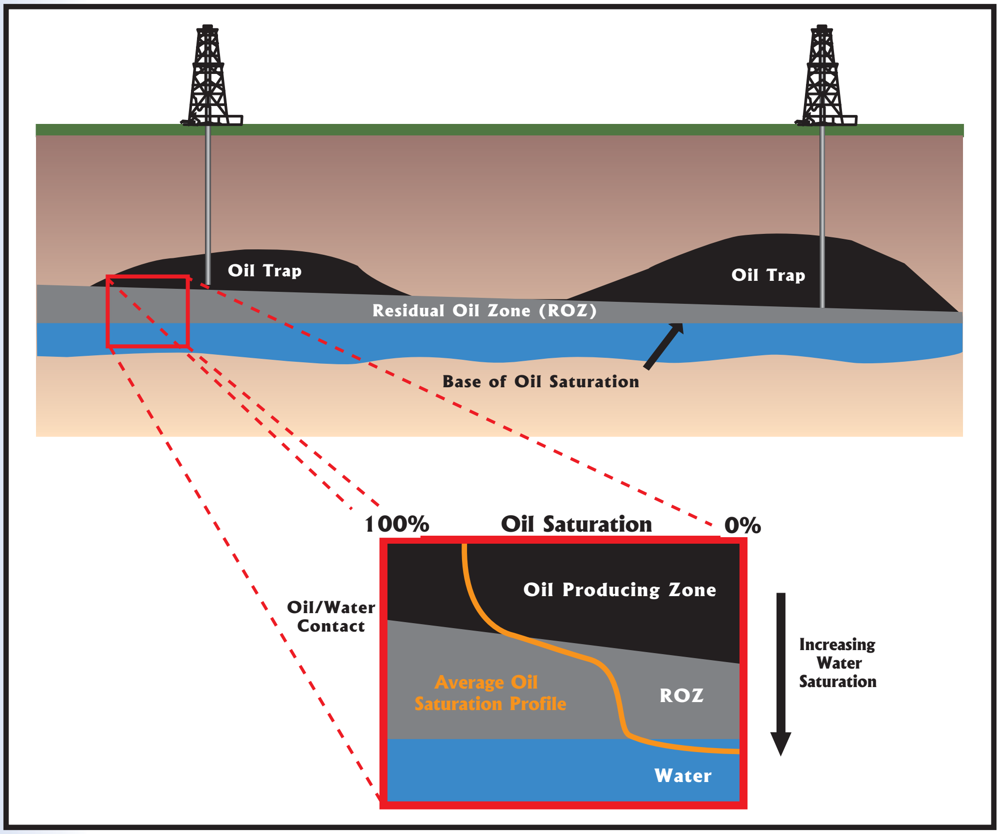
# Assessing Technical and Economic Recovery of Oil Resources in Residual Oil Zones




Prepared for
**U.S. Department of Energy**
***Office of Fossil Energy - Office of Oil and Natural Gas***

Prepared by
**Advanced Resources International**

**February 2006**

# ASSESSING TECHNICAL AND ECONOMIC RECOVERY OF OIL RESOURCES IN RESIDUAL OIL ZONES

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**U.S. Department of Energy**
**Office of Fossil Energy**
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Prepared by
**George J. Koperna**
**Vello A. Kuuskraa**
**Advanced Resources International**
**4501 Fairfax Drive, Suite 910**
**Arlington, VA 22203 USA**

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# EXECUTIVE SUMMARY

Our first study, "Stranded Oil in the Residual Oil Zone"[1], identified a large, previously overlooked source of domestic oil resources. This follow-on study "Assessing Technical and Economic Recovery of Oil Resources in Residual Oil Zones", examines how much of this large, new domestic oil resource could be recovered with $CO_2$ enhanced oil recovery technology.

1. ***Detailed reservoir simulation-based modeling shows that basin uplift and hydrodynamic forces can create a significant interval of lower oil saturation (ROZ) in the oil column of an oil reservoir****.* The first study set forth the argument that basin uplift and aquifer-imposed hydrodynamics can sweep away significant portions of a reservoir's original oil column, creating a tilted oil-water contact and a large residual oil zone. The net result of this "mother-nature's" waterflood is the upward movement of the transition zone (TZ) and the creation of a "wedge-shaped" residual oil zone (ROZ) potentially holding substantial volumes of previously undocumented and undeveloped domestic oil. This study confirms, using reservoir simulation, that basin tilt and hydrodynamics can create a substantial zone of residual oil below the traditionally established producing water-oil contact.

2. ***These residual oil and transition zone intervals, with lower oil saturation, primarily produce water and thus are uneconomic to develop with primary and secondary oil recovery technology.*** In the past, due to low oil and its high water saturations, operators avoided these transition and residual oil zones (TZ/ROZ). As such, field operators completed their wells and established their producing oil-water contact

[1] Melzer, S., (2006) "Stranded Oil in the Residual Zone." Advanced Resources International for U.S. Department of Energy (report under review).

(OWC) in the higher oil saturation and upper oil column portions of the reservoir.

3. ***The application of advanced $CO_2$ enhanced oil recovery technology can mobilize this low residual oil, making these previously avoided transition and residual oil zones productive.*** Today, with the advent of advanced $CO_2$-EOR technology there is growing interest in evaluating the lower oil saturation portion of a reservoir and attempting to produce a portion of this previously undocumented domestic oil resource.

4. ***The size of the TZ/ROZ resource is large, estimated at 15 billion barrels of oil in-place for tilted OWC San Andres formation oil fields in the Permian Basin; the national TZ/ROZ resource may approach 100 billion barrels.*** Our first study examined the geological settings of nine tilted OWC fields in the Permian Basin - - Adair, Cowden (N&S), Fuhrman-Mascho, Means, Reeves, Seminole, Seminole East, Wasson, and Yellowhouse. These nine oil reservoirs were judged to hold 8 billion barrels of oil resource in-place in their transition and residual oil zones (TZ/ROZ). When this data was extrapolated to all tilted OWC San Andres formation oil fields, identified to date in the Permian Basin, we estimate a TZ/ROZ resource in-place of 15 billion barrels. Further investigation of the Permian Basin and other domestic oil basins indicates that the TZ/ROZ may be as large as 100 billion barrels of oil in-place nationwide.

5. ***This study applied reservoir stimulation and economic analysis to address the feasibility of technically and economically recovering oil from the TZ/ROZ in five significant Permian Basin oil reservoirs.*** Considerable uncertainty still surrounds the ability to technically and economically recover this challenging, undefined in-place oil resource. To examine the feasibility of recovering the TZ/ROZ oil resource, this study applies detailed reservoir simulation and economic analysis to five significant Permian Basin, San Andres formation reservoirs that appear to

have favorable TZ/ROZ characteristics. Three of the study fields – Wasson's Denver and Bennett Ranch Units and Seminole's San Andres Unit – currently have CO2-EOR based ROZ pilot projects within their field boundaries. The Vacuum Field was selected for its highly tilted oil-water contact inferring a large potential ROZ. The Robertson Field was selected for its disproportionately large residual oil zone compared to its main pay zone (MPZ).

6. ***In-depth reservoir simulation shows that, when properly designed, the oil resource in the TZ/ROZ can be efficiently recovered without excess production of water.*** Based on detailed reservoir simulation results, as set forth in this report, the low to residual saturation oil in the TZ/ROZ is technically recoverable using $CO_2$-EOR. In examining the feasibility of producing the TZ/ROZ resource, the study identified two keys: 1) deepen and complete wells in the full transition zone and in the upper portion of the residual oil zone; and 2) where possible, conduct the TZ/ROZ $CO_2$ flood jointly with the main pay zone (MPZ) $CO_2$ flood.

   The generally thin transition zone contains oil that ranges from moderate, mobile oil saturations to low, immobile oil saturations and should always be included in the completion interval. The generally thicker residual oil zone has oil saturations that decline from immobile at the top of the ROZ (±35%) to near zero at the base of the oil column, **Figure EX-1**. The saturation profile and how it tails off (abruptly or gently) is important in determining the optimum TZ/ROZ completion interval and the associated ROZ oil resource target. (Further complicating the ROZ completion interval selection is the potential for water coning in the producing wells due to aquifer influx. As further discussed in the report, this may be mitigated by completing wells higher in the ROZ interval.)

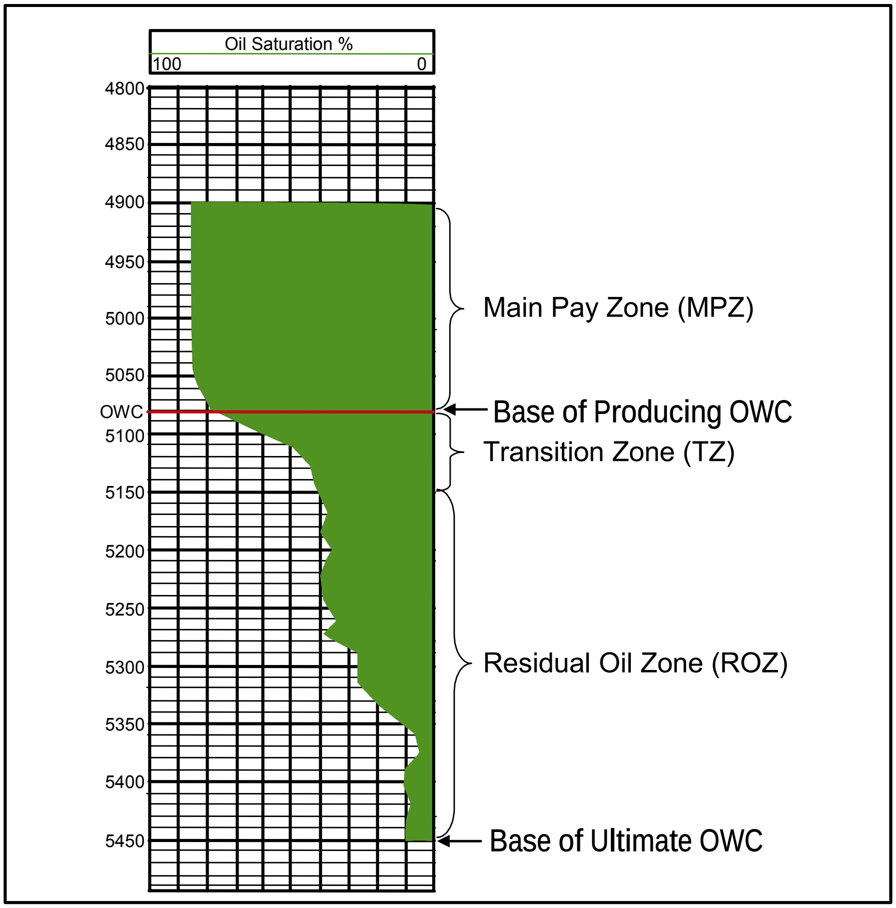


**Figure EX-1. Oil Saturation Profile in the TZ/ROZ: Adapted from Wasson Denver Unit Well.**

7. ***Simultaneous application of $CO_2$-EOR to the main pay zone and the TZ/ROZ provides superior results compared to flooding these two reservoir zones individually.*** Our in depth reservoir simulation shows that simultaneous main pay zone (MPZ) and transition zone/residual oil zone (TZ/ROZ) $CO_2$ floods are superior to individual MPZ and TZ/ROZ floods, using the Wasson Denver Unit reservoir and fluid properties as the oil field example. When these two reservoir units are $CO_2$ flooded simultaneously, the project recovers nearly 20% more oil than when these two reservoir units are $CO_2$ flooded separately. This is due to much more efficient use of $CO_2$, improved pressure balance in the oil column and more efficient capture of the displaced oil. The most significant of these is the reduction in the out of zone movement of the injected and displaced fluids ($CO_2$, oil and water).

8. ***The technically recoverable ROZ/TZ resource in the Permian Basin is estimated at 5 billion barrels, based on a recovery efficiency of 35% of the 15 billion barrels of ROZ/TZ oil in-place.*** The study established that, overall, 2.5 billion barrels of oil resource could be ultimately technically recovered from the five study fields using "state-of-the-art" $CO_2$-EOR technology. Of this, 1.4 billion barrels is from the transition and residual oil zone (TZ/ROZ) resource. The remaining 1.1 billion is recoverable from the remaining oil in-place in the main pay zone (MPZ) (**Table EX-1**), with 0.6 billion of this already produced or proven.

Table EX-1. Technically Recoverable Oil Resources from Applying CO2-EOR to the MPZ and TZ/ROZ

| Field/Unit | Simultaneous MPZ and TZ/ ROZ $CO_2$-EOR (MMbbl) | MPZ Only $CO_2$-EOR (MMbbl) | Additional Due to TZ/ROZ $CO_2$-EOR (MMbbl) |
|---|---|---|---|
| Seminole (San Andres Unit) | 569 | 268 | 301 |
| Wasson (Denver Unit) | 1,064 | 570 | 494 |
| Wasson (Bennett Ranch Unit) | 179 | 84 | 95 |
| Vacuum (San Andres) | 577 | 172 | 405 |
| Robertson (San Andres) | 83 | - | 83 |
| Total | 2,473 | 1,094* | 1,379 |

*Of the 1,094 million barrels recoverable from the MPZ, 650 million barrels has already been produced or proven from application of $CO_2$-EOR.

The 1.4 billion barrels of oil recoverable from the TZ/ROZ represents a recovery efficiency of 35% of the oil in-place in the TZ/ROZ of these five fields. (This translates to 18% of the original oil in-place, before hydrodynamic sweeping of the ROZ – See **Appendix A.**)

Applying the 35% recovery factor to the previously estimated 15 billion barrels of TZ/ROZ oil in-place estimated for the Permian Basin would add 5 billion barrels of technically recoverable oil to our domestic resource base. Application of "next generation" $CO_2$-EOR oil recovery technologies, as examined in our recently completed report, "Evaluating The Potential For "Game Changer" Improvements In Oil Recovery Efficiency From $CO_2$ Enhanced Oil Recovery"[2], would significantly increase recovery efficiency and the technically recoverable resource from the TZ/ROZ.

9. ***Our detailed cost and economic studies show that the TZ/ROZ oil resource in these five Permian Basin oil reservoirs can be economically produced with $CO_2$-EOR at oil prices of $35 per barrel.*** To examine the economics of producing the TZ/ROZ, Advanced Resources constructed an up-to-date economic and cash flow cost model and applied this model to the five study fields. The model includes costs for deepening wells and reworking them for $CO_2$-EOR, drilling new injection and production wells (as required), and operating the project. The economic model uses an oil price of $35 per barrel, a $CO_2$ purchase costs (per Mcf) of 4% of the oil price and a $CO_2$ recycling cost (per Mcf) of 1% of the oil price. A 25% (pre-tax) rate of return (ROR) economic threshold is used to account for the higher risk nature of pursuing the TZ/ROZ resource.

Detailed economic analysis of the Wasson Denver Unit San Andres oil reservoir shows that while the main pay zone $CO_2$ flood (conducted separately) exceeds the ROR economic threshold, the TZ/ROZ flood (conducted separately) does not. However, when these two reservoir units are $CO_2$ flooded jointly, the overall MPZ+TZ/ROZ flood has a ROR that exceeds the economic threshold. This is due to inherent inefficiencies of separately flooding the TZ/ROZ, leading to higher operating and $CO_2$ purchase costs and lower recoverable oil.

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2 "Evaluating The Potential For "Game Changer" Improvements In Oil Recovery Efficiency From $CO_2$ Enhanced Oil Recovery", Advanced Resources International for U.S. Department of Energy (February 2006).

When conducted simultaneously, each of MPZ and TZ/ROZ $CO_2$-EOR floods in the five study fields (Seminole (San Andres Unit), Wasson (Denver Unit and Bennett Ranch Units), Vacuum and Robertson) has a ROR that exceeded the economic threshold. Of note, the Robertson San Andres flood, essentially a TZ/ROZ flood due to its very limited main pay (2 feet), is economic while the Wasson Denver TZ/ROZ flood is not. This suggests that reservoirs containing minimal to no main pay zones but significant transitional and residual zones may be viable targets for $CO_2$-EOR in the TZ/ROZ. Producing these TZ/ROZ reservoir types may not suffer the same out of zone losses and inefficiencies as reservoirs with large main pay zones.

10. ***Applying $CO_2$-EOR to these five Permian Basin oil reservoirs would provide 1.4 billion of economically recoverable oil from the TZ/ROZ.*** The economic analysis shows that 1.4 billion barrels of "stranded" oil in the TZ/ROZ may become economically recoverable from the five Permian Basin oil reservoirs using "state-of-the-art" $CO_2$-EOR technology and a simultaneous flooding scheme. An additional 1.1 billion barrels is economically recoverable from the MPZ, using $CO_2$-EOR. Of this, 0.6 billion barrels has already been produced or proven.

    However, if separate $CO_2$ flooding schemes are employed for the main pay zone and transition/residual oil zones, the economically recoverable oil drops to 1.1 billion barrels (with 0.6 billion already produced or proven), all in the main pay zone. Under this individual zone, $CO_2$-EOR flooding strategy, the oil in the TZ/ROZ will remain uneconomic and "stranded".

# I. INTRODUCTION

Residual oil zones (ROZ), the portions of oil reservoirs below their traditional producing oil-water contacts, can hold large volumes of previously undocumented and undeveloped domestic oil resources. The first comprehensive report on this topic, "Stranded Oil in the Residual Oil Zone," examined the origin, nature and presence of ROZ resources.[3] It set forth a preliminary estimate of 15 billion barrels of ROZ resource in-place for the Permian Basin of West Texas and East New Mexico. This second report, "Assessing Technical and Economic Recovery of Oil Resources in Residual Oil Zones," examines how much of this resource in-place may become technically and economically recoverable.

**A. Overview of ROZ Recovery Potential**. Because of their low to moderate oil saturation settings, ROZ resources are not economic when using primary or secondary oil recovery. As such, the great majority of domestic oil wells are completed above the residual oil zone. Outside of the knowledge base being developed by a small group of forward-looking operators, little is known about the ability to successfully target and produce the ROZ resource. However, in the current economic climate, with depleting domestic oil reserves and operators' desires to extend reservoir life, ROZ resources offer new sources of domestic oil production. Because of this, there is growing interest in further understanding the recoverable oil potential in the relatively thick (100 to 300 feet) residual oil zones located beneath the traditional main pay zones of oil reservoirs.

Carbon dioxide ($CO_2$) enhanced oil recovery (EOR) has emerged as a viable technique for recovering residual oil left behind ("stranded") after waterflooding, mainly in light oil reservoirs below 3,000 feet in depth. Yet, the oil saturation in the residual oil zones (ROZ) (and transition zones (TZ)) of a reservoir is often similar to the oil

[3] Melzer, S., (2006) "Stranded Oil in the Residual Zone." U.S. Department of Energy Report (under review).

saturation left after waterflooding. As such, with progress in $CO_2$ flooding technology and availability of affordable supplies of $CO_2$, the oil in the ROZ (and the TZ) could become a source for future domestic oil supplies.

Further confirmation of this new oil resource potential is provided by the three residual and transition oil zone $CO_2$-EOR pilot tests currently underway. Two of these pilot tests are operated by OxyPermian in the Denver and Bennett Ranch Units of the giant Wasson oil field. The Denver Unit pilot was the first to target transition and residual oil zones. The third ROZ pilot test, operated by Amerada Hess, is in the Seminole San Andres Unit. This is a 500 acre pilot TZ/ROZ flood underway since 1996. The response from the Seminole San Andres Unit field pilot test has been promising, providing an estimated cumulative recovery of 3 million barrels of oil to date, at an oil rate of 1,400 bbls/day.[4]

The information on the operation and performance of these three ROZ field pilot projects has been most valuable in calibrating the reservoir simulation-based oil recovery assessments of the ROZ and TZ resource examined by this study.

**B. Outline for Report.** This report assesses the potential for technically and economically recovering oil from residual and transition oil zones. It summarizes the origin and occurrence of residual oil zones in the Permian Basin and highlights the on-going field research projects that are seeking to extract both residual and transition zone oil from below the traditional oil reservoir's producing oil-water contact (OWC). Then, it examines, using reservoir simulation and an industry-standard economic and cash flow model, the feasibility of producing this previously by-passed TZ/ROZ resources (in five major Permian Basin oil fields) using $CO_2$-EOR.

[4] "2004 Worldwide EOR Survey," Oil & Gas Journal, April 12, 2004, pp. 53-65.

# II. ORIGIN AND OCCURRENCE OF RESIDUAL OIL ZONES

The term ***residual oil zon*e (ROZ)**, as used in this study, does not include the more commonly known ***transition zone* (TZ)**. Although often used interchangeably, the two terms describe different portions of an oil reservoir. All oil reservoirs have a transition zone, an interval tens of feet below the traditionally-defined producing oil-water contact (OWC) where the oil saturation falls rapidly. The thickness of this interval is controlled by capillary forces and the nature of the rock's "wetting phase", with lower permeability oil-wet rocks providing thicker TZ's and water-wet rocks providing thinner ones.

While all oil reservoirs have a transition zone, not all have a residual oil zone, as specific hydrological or geological conditions need to have occurred to create a ROZ, as further discussed below. The great bulk of the ROZ will be at a residual oil saturation (similar to that after a conventional waterflood), tapering to near zero oil saturation at the base. A typical reservoir oil saturation profile is shown in **Figure 1***, Oil Saturation Profile in the TZ/ROZ: Adapted from a Wasson Denver Unit Well.*

The transition zone (TZ) is the upper portion of the reservoir interval just below the traditional OWC and produces both water and oil. The residual oil zone (ROZ) is generally the middle and lower portions of the reservoir interval below the traditional OWC and produces primarily water.

The reason that both terms - - residual oil zone (ROZ) and transition zone (TZ) - - are used in this report is to bring special attention to the abnormally thick ROZs that can exist for reasons beyond normal capillary effects. For example, if the original oil trap possessed a thick oil column in its geologic past and the lower portion of this oil column was tilted and/or invaded by water, this lower reservoir interval would have an oil saturation much like that of the residual oil saturation in the swept zone of a water flood. In certain geologic settings, oil reservoirs can have an anomalously thick ROZ and thus could contribute considerable additional $CO_2$-EOR reserves.

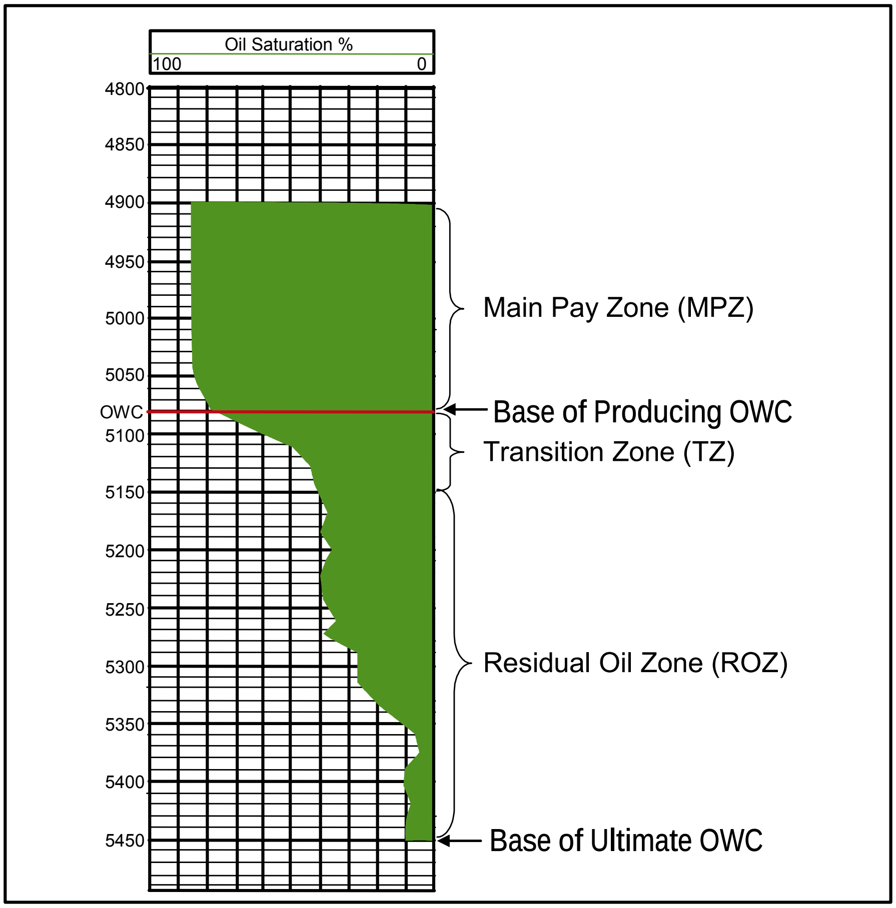



**Figure 1. Oil Saturation Profile in the TZ/ROZ: Adapted from a Wasson Denver Unit Well**

**A. Origin of Residual Oil Zones.** Three possible origins for ROZs were set forth in the initial report.[5] To illustrate the origins of ROZs, we begin with a conventional but hypothetical hydrocarbon accumulation, shown on **Figure 2**, *Original Oil Accumulation Under Static Aquifer Conditions (A Hypothetical Example)*. This original oil accumulation may subsequently be affected by natural forces such as regional basin uplift, seal breach, or a change in the hydrodynamics of the underlying regional aquifer, leading to the development of a ROZ.

[5] Melzer, S., (2006) "Stranded Oil in the Residual Zone." U.S. Department of Energy Report (under review).

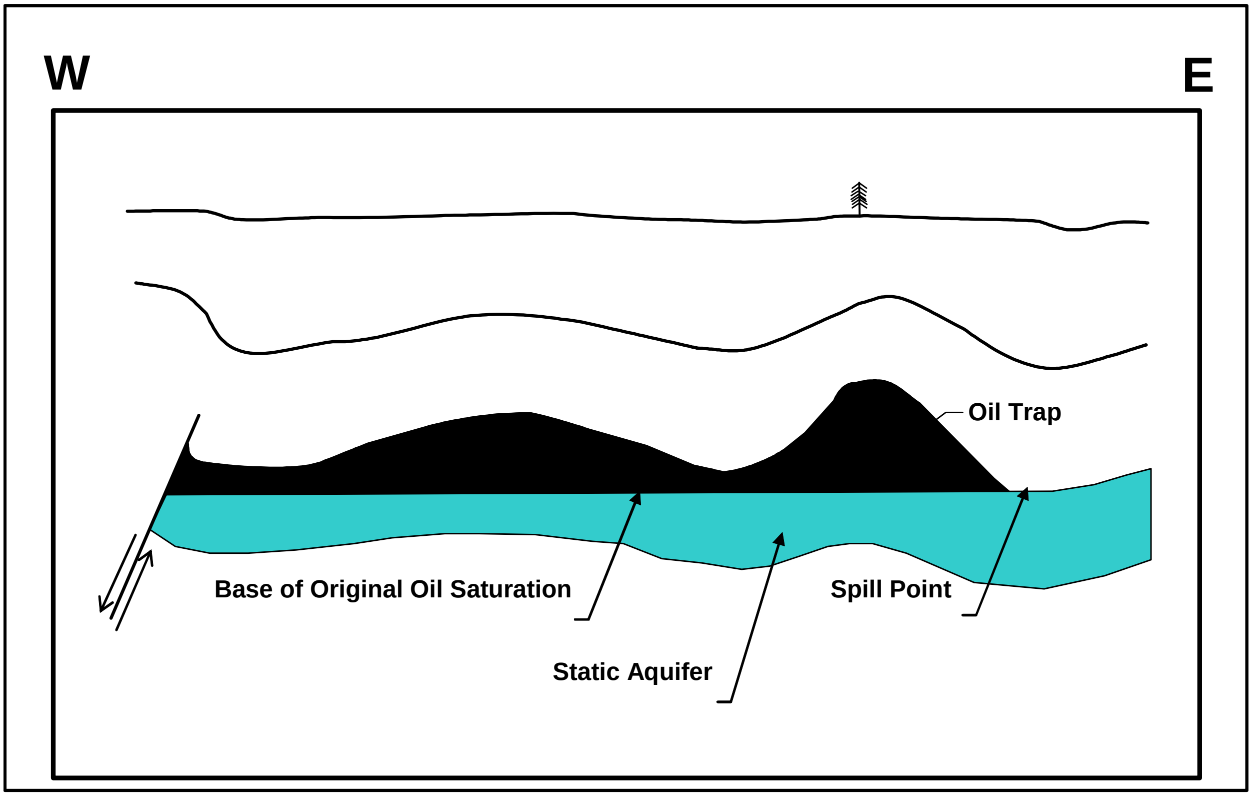



**Figure 2. Original Oil Accumulation Under Static Aquifer Conditions (A Hypothetical Example)**

1. Regional or Local Basin Tilt. Figure 3, *Original Oil Accumulation Subject to Regional Tilt, Forming a ROZ,* illustrates an original oil trap with a hydrocarbon spill point on the east. The trap is subsequently subjected to an upward basin tilt on the west of approximately 40 feet per mile. This hypothetical situation preserves the spill point of the original hydrocarbon accumulation on the east side and causes the oil column to thin on the west side, leaving behind a zone of “water swept” oil. The resulting main oil column is now tilted and the Type 1 ROZ is wedge shaped with the updip (west) side being thicker.

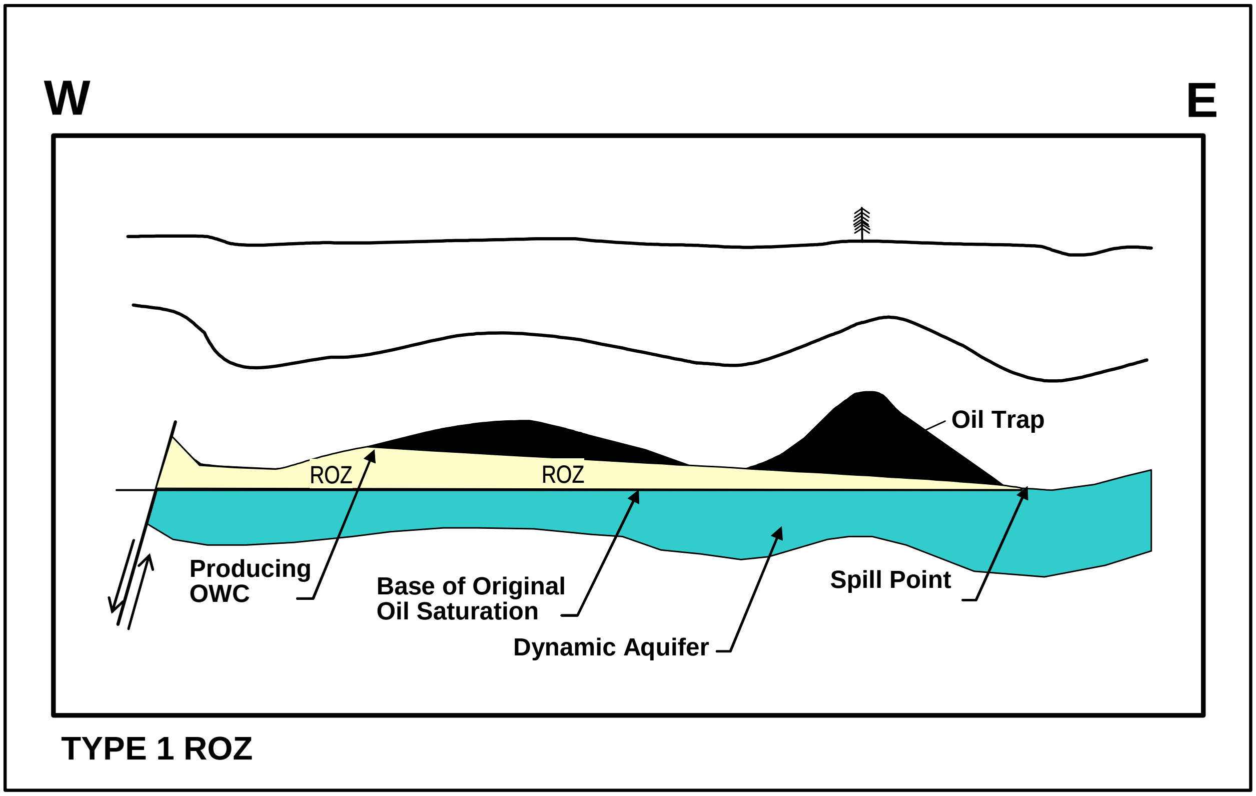



**Figure 3. Original Oil Accumulation Subject to Regional Tilt, Forming a ROZ**

2. Breached and Reformed Reservoir Seals. **Figure 4**, *Original Accumulation with a Breached/Repaired Seal, Forming a ROZ*, presents a second source of ROZs. Here, the breaching and repair of the original oil trap forms the ROZ. This can occur, for example, through buildup of fluid pressures during hydrocarbon formation, escape of a portion of the hydrocarbons, subsequent healing of the seal, and re-entrapment of hydrocarbons. The second oil trap now contains a thinner main oil column than was originally present and a ROZ. In this second case, the base of oil saturation, the TZ/ROZ, and the producing OWC would be horizontal. (Tar mats and other solid hydrocarbons within the oil column may provide evidence of breached and reformed reservoir seals.) While breached seals of original hydrocarbon accumulations are probably quite commonplace in the subsurface, no examples of this Type 2 ROZ reservoir have been found to date in the literature.

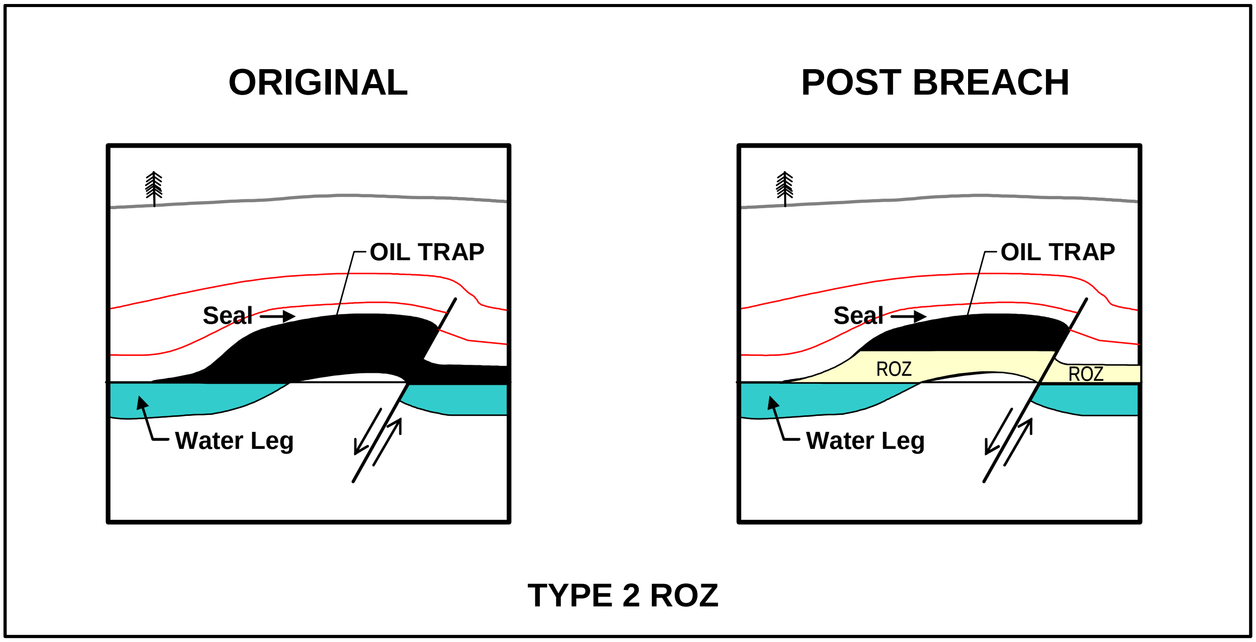



**Figure 4. Original Accumulation with a Breached/Repaired Seal, Forming a ROZ**

3. Altered Hydrodynamic Flow Fields. **Figure 5**, *Change in Hydrodynamic Conditions, Causing Sweep of the Lower Oil Column and the Oil/Water Contact Tilt, Forming a ROZ,* shows the same original trap seen in **Figure 2**. In this example, a change in the west-to-east hydrodynamic flowfield creates a tilted OWC and the ROZ. Here, the OWC tilt is due to the hydrodynamic forces on the oil column. Hubbert[6] provides analytical methods to determine oil-water contact tilts based upon the potentiometric gradient of the aquifer and the densities of the oil and water. With information on the current OWC tilt and knowledge of the oil and water densities, one can calculate the hydrodynamic flow field responsible for the oil-water contact tilt beneath the main oil column using the following formula:

[6] Hubbert, M.K. (1953), "Entrapment of Petroleum under Hydrodynamic Conditions," AAPG Bulletin, Vol 37, No. 8 (August 1953), pp. 1954-2028.

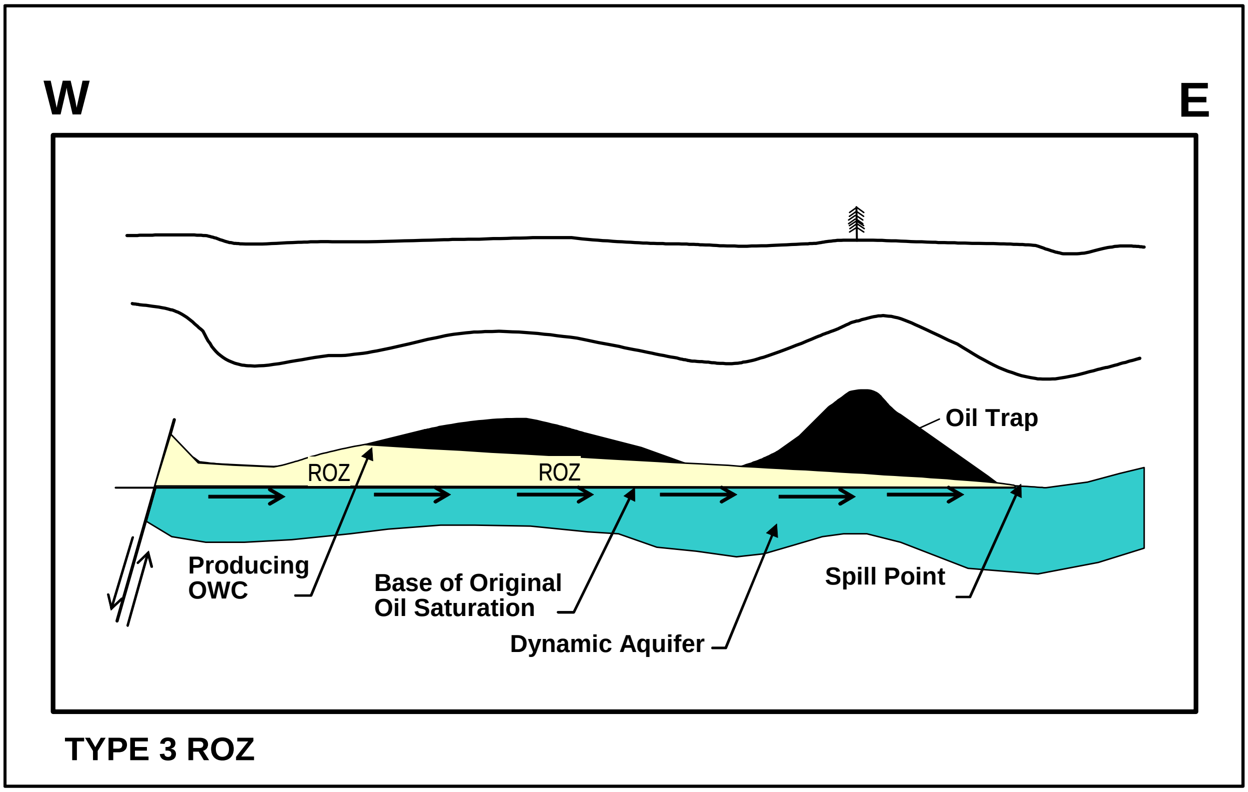



**Figure 5. Change in Hydrodynamic Conditions, Causing Sweep of the Lower Oil Column and the Oil/Water Contact Tilt, Forming a ROZ**

Oil-Water Contact Tilt = $dz/dx = - dp/dx * (\rho_w/(\rho_w - \rho_o))$

Where: $dp/dx$ = Pressure (Potentiometric) Gradient of the Aquifer

$\rho_w$ = Density of the Water in the Aquifer

$\rho_o$ = Density of the Oil

This Type 3 ROZ does not necessarily have to possess a retained main oil column as the entire original oil trap may become a ROZ. This situation may be prevalent where high hydrodynamic gradients are present, enabling low relief structural traps to be completely water flushed.

**B. Examining the Effects of Hydrodynamics and Reservoir Properties on Creating a Tilted OWC.** Some in the industry have questioned whether (and how) hydrodynamic flow is truly able to reshape the oil column in a reservoir, resulting in a substantial ROZ. One answer to this question is set forth in the theoretical equation above. This equation states that the tilt of the OWC and the subsequent development of the ROZ are influenced by aquifer flow rates and reservoir properties. To explore this issue in more depth, we first constructed a hypothetical 2-D cross section of a typical Permian Basin oil reservoir and its underlying aquifer. Next, we subjected this reservoir to varying horizontal aquifer flow rates and permeability values to examine the effect of these variables on the OWC tilt and the creation of a ROZ.

**Figure 6**, *Initial Oil Reservoir/Aquifer Conditions*, shows the initial geometry of the reservoir/aquifer cross section before a change in aquifer flow is induced. The Wasson Denver Unit San Andres reservoir was used for input data for the simulation. The key reservoir data include: porosity (12%), horizontal permeability (5 md), vertical permeability (0.5 md), oil gravity (33°API), and residual oil saturation (35%), among others. This 2-D system is 5,000 ft long horizontally and 600 ft tall vertically, with a 400 ft thick original oil column. Next, published Permian Basin San Andres formation capillary forces were imposed on the reservoir/aquifer, resulting in a 50 ft thick transition zone (TZ) and a 350 ft thick main pay zone. A 200 ft thick aquifer lies below the oil column. The water source is on the left side of the cross section and the spill point is on the right side, so flow is from left to right.

**Figure 7**, *Effects of Low Hydrodynamic Flow on OWC Tilt*, depicts the results of 2,000 years of water movement in this 2-D system. A steady-state aquifer flow system, with a low constant flows velocity of 0.1 feet per year was first introduced. Shown in Figure 7 are the resulting changes in the oil-water contact (OWC), transition zone (TZ), and residual oil zone (ROZ). Only modest OWC tilting and ROZ development occurs following the initiation of this low rate of water flow.

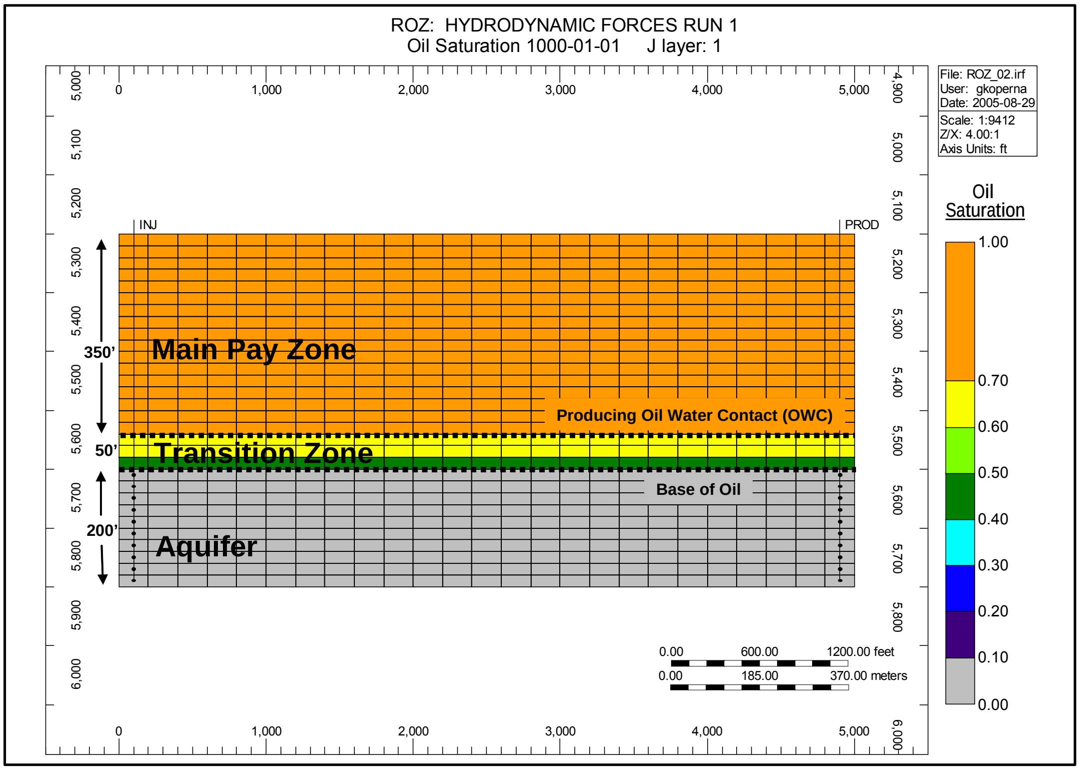



**Figure 6. Initial Oil Reservoir/Aquifer Conditions**

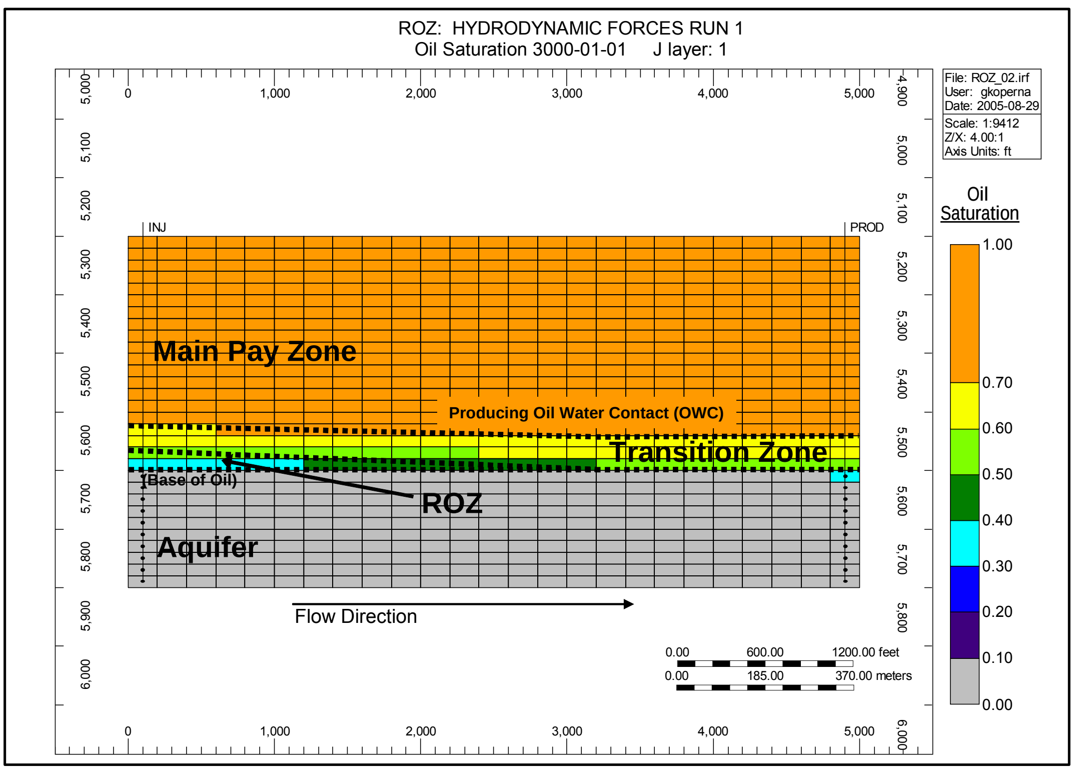



**Figure 7. Effects of Low Hydrodynamic Flow on OWC Tilt (0.01 STB/D, ~0.1 ft/yr)**

**Figure 8**, *Effects of High Hydrodynamic Flow on OWC Tilt,* on the other hand, shows much more pronounced changes in the OWC, TZ and ROZ of the reservoir following the initiation of a higher, more representative aquifer flow rate of 1 foot per year. The result is a larger ROZ and a diminished main pay zone.

Using aquifer flow of 1 foot per year and a higher horizontal permeability (50 md), **Figure 9**, *Effects of Aquifer Permeability on OWC Tilt,* leads to the creation of a more modest ROZ compared to the previous case (shown in Figure 8). This indicates that high horizontal permeability will decrease the hydrodynamic interaction between the aquifer and the oil column, suppressing the size of the ROZ.

Increasing the vertical to horizontal permeability ratio (kv/kh) to 1 (**Figure 10**, *Effects of High Kv/Kh on OWC Tilt*) does not appreciably change the final oil and water contact tilts, as compared to **Figure 8**. However, decreasing the vertical to horizontal permeability ratio to 0.01 creates an S-shaped OWC, with a very pronounced ROZ near the flow source and a subtle ROZ along the middle of the cross-section, **Figure 11**, *Effects of Low Kv/Kh on OWC Tilt*. A longer than 2,000 year hydrodynamic flow period would likely change the shape of this ROZ wedge, creating a much steeper TZ/ROZ interface.

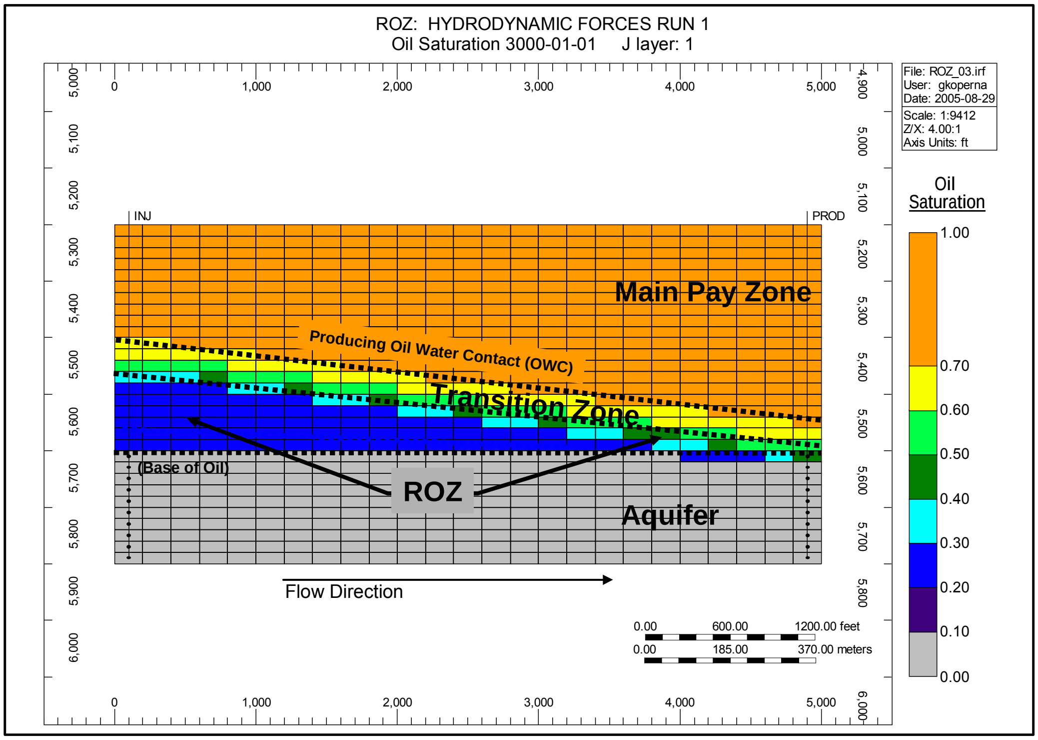



**Figure 8. Effects of High Hydrodynamic Flow on OWC Tilt (0.1 STB/D, ~1 ft/yr)**

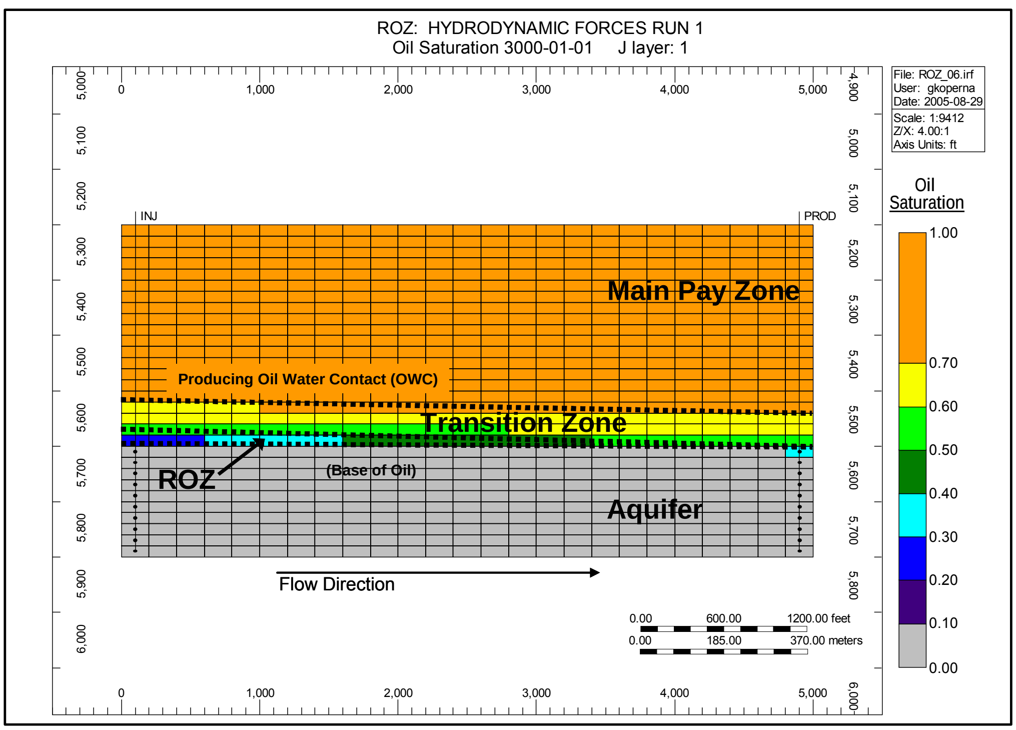



**Figure 9. Effects of Higher Aquifer Permeability on OWC Tilt (0.1 STB/D, ~1ft/yr) (Perm 50 md)**

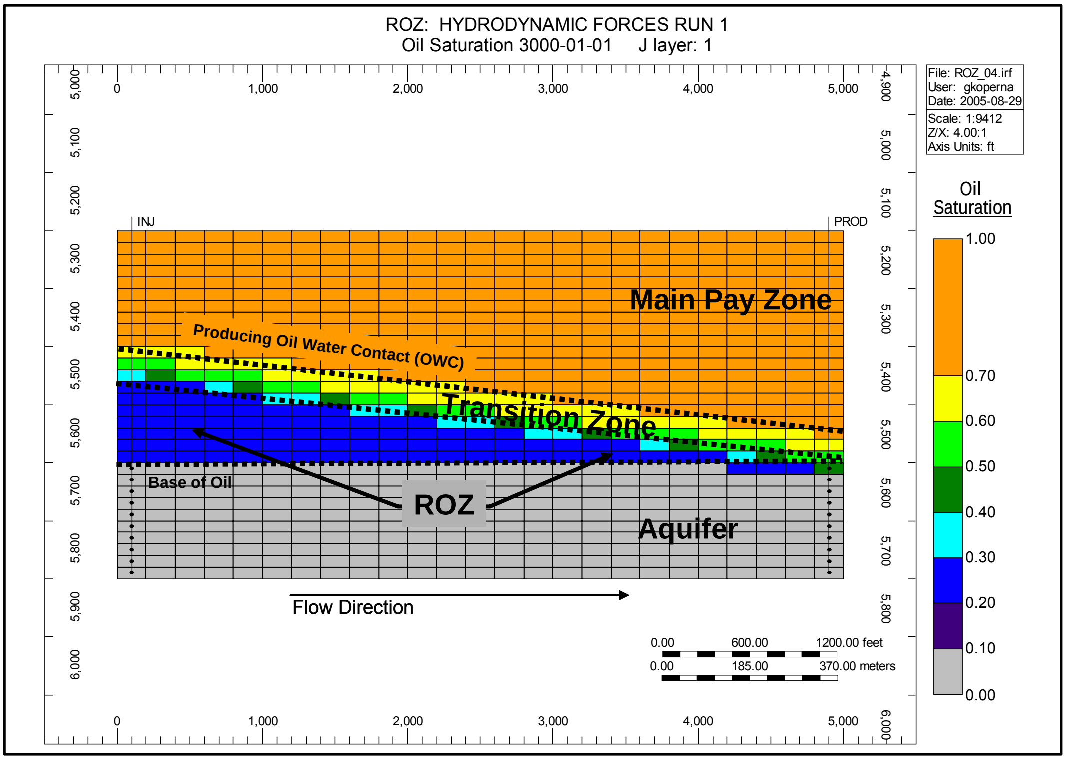



**Figure 10. Effects of High Kv/Kh on OWC TILT (0.1 STB/D, ~1ft/yr), Kv/Kh = 1**

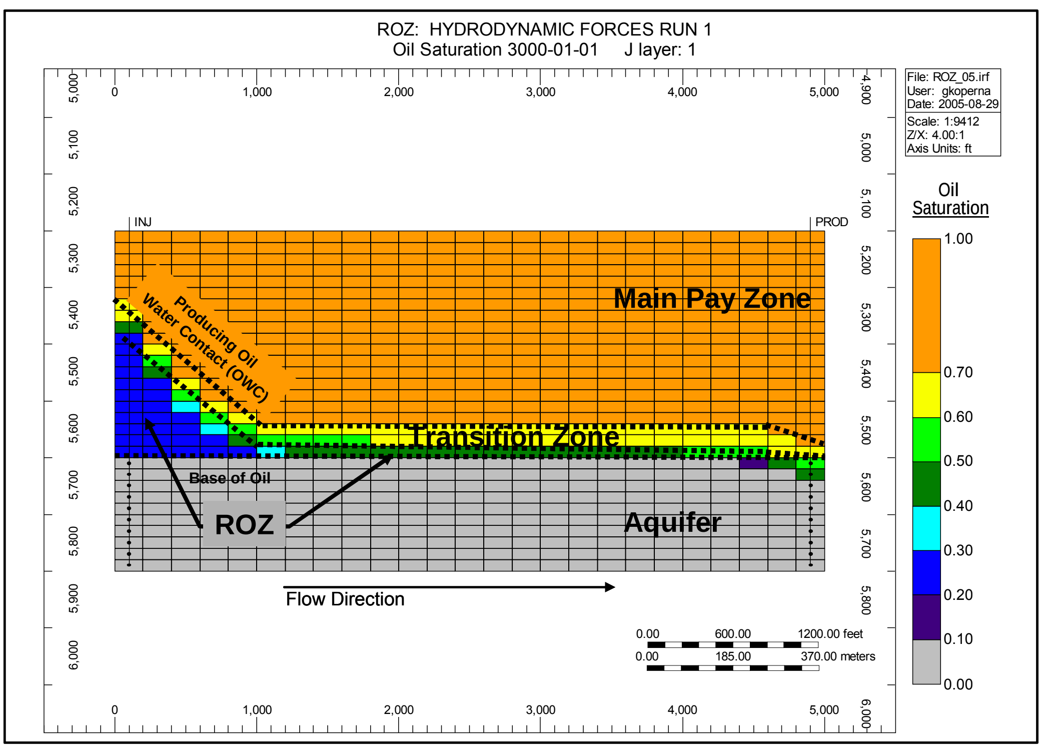



**Figure 11. Effects of Low Kv/Kh on OWC TILT (0.1 STB/D, ~1ft/yr), Kv/Kh = 0.01**

**C. Evidence for ROZs in the Permian Basin.** **Figure 12**, Oil Fields with *Tilted Oil-Water Contacts, Northern Shelf and Central Basin Platform, Permian Basin*, is taken from Brown (2001)[7]. The author made a thorough study of tilted OWCs in the carbonate shelf areas of the Permian Basin and concluded that many northern shelf San Andres fields have OWC tilts of hydrodynamic origin. This work, along with other information[8], makes a strong case that the Middle Tertiary uplift in central New Mexico elevated the San Andres outcrops, changing subsurface aquifer hydrodynamics. The uplift created large hydrodynamic gradients below the oil reservoirs in this portion of the Permian Basin, sweeping substantial oil out through the downdip reservoir spill points and creating OWC tilts and ROZs.

The contrasting ROZ oil saturation profiles of two Permian Basin fields demonstrate the variability that hydrodynamic forces may have on creating a ROZ.

- The residual oil zone (ROZ) profile at the Wasson Denver Unit is often referred to as a transition zone (TZ) because of the relatively uniform gradational nature of the water (and oil) saturation profile, **Figure 1**. However, the zone is 300 feet thick on the southwest side which clearly argues for an origin other than normal transition zone capillary forces.
- The ROZ profile at the Seminole San Andres Unit is substantially different from the oil saturation profile at Wasson. Here, a thick middle zone of nearly constant oil and water saturation is present, **Figure 13**, *Seminole Field Water Saturation Profile***.**
- But, both the Wasson and Seminole fields have tilted OWCs, implying past or current hydrodynamic forces at work. Horizontal water influx and flushing of oil would explain both the tilt and the thick ROZ profile in these two oil reservoirs.

[7] Brown, A., (2001), "Effects of Hydrodynamics on Cenozoic Oil Migration, Wasson Field Area, Northwestern Shelf of the Permian Basin," West Texas Geological Society Fall Symposium, Pub 01-110 (Viveiros, J.J. & Ingram, S.M. eds), Oct 2001, pp 133-142.
[8] Personal Communications (Mobil Oil Company) on the Salt Creek ROZ pilot, Kent County, TX.

Adapted from Brown, A., (2001), "Effects of Hydrodynamics on Cenozoic Oil Migration, Wasson Field Area, Northwestern Shelf of the Permian Basin," West Texas Geological Society Fall Symposium, Pub 01-110 (Viveiros, J.J. & Ingram, S.M. eds), Oct 2001, pp 133-142.

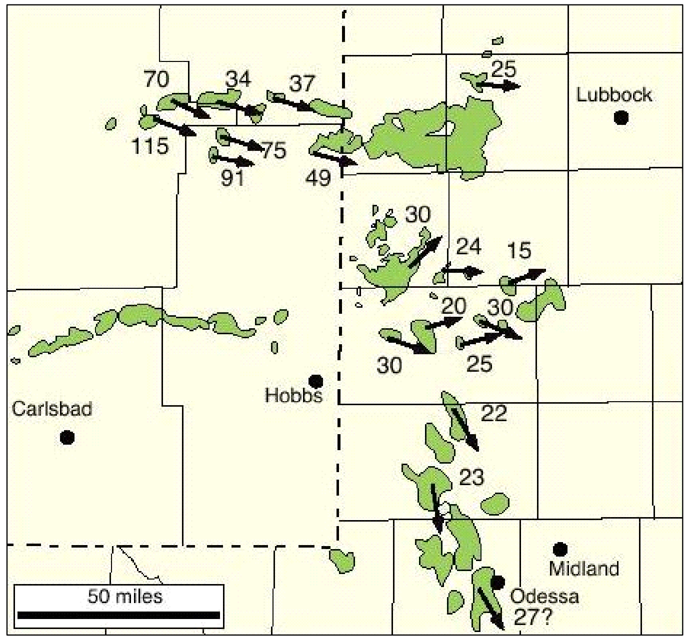



**Figure 12. Oil Fields with Tilted Oil-Water Contacts: Northern Shelf and Central Basin Platform, Permian Basin**

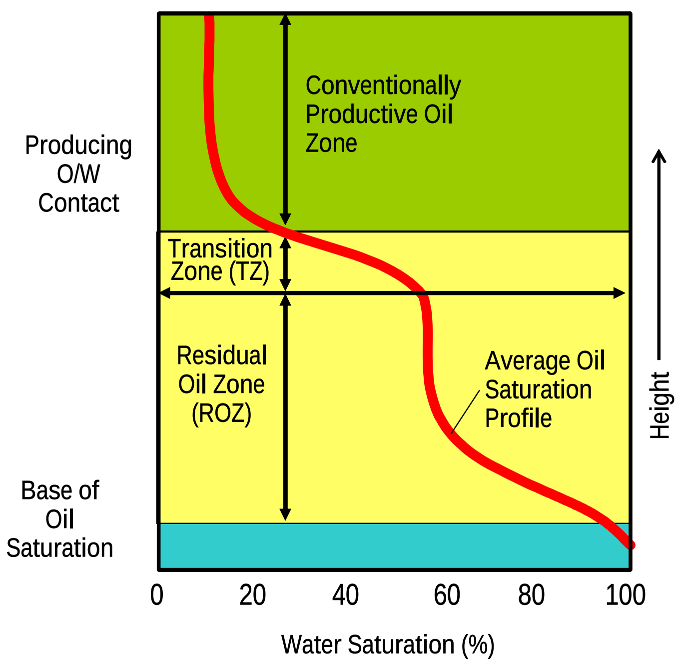



**Figure 13. Seminole Field Water Saturation Profile**

# III. EVALUATING OIL RECOVERY FROM RESIDUAL OIL ZONES

The Permian Basin appears to be well positioned to be the initial setting for delivering oil production from transition and residual oil zones. Since most of the TZ/ROZ oil resource is immobile, $CO_2$-EOR may be the only way to re-mobilize and produce these vast oil resources. The basin has a large $CO_2$ delivery infrastructure with many of the fields already under $CO_2$-EOR in their main pay zone (MPZ). Co-producing the MPZ and the TZ/ROZ could be a logical next step, as illustrated by the initial TZ/ROZ activity underway in this basin.

**A. Pilot Demonstrations of ROZ Floods.** Three ROZ $CO_2$-EOR pilot projects are currently underway in the Permian Basin. Two are being conducted within the giant Wasson Field (Denver and Bennett Ranch Units) while the third is in the Seminole-San Andres Unit. The following provides a brief discussion of these three ROZ pilot projects.

1. Seminole Field, San Andres Unit. Amerada Hess initiated a ROZ pilot in the San Andres Unit of the Seminole Field (SSAU) in April of 1996, **Figure 14**, *Area of the SSAU ROZ Phase I Pilot*. Four injection wells and fourteen producing wells were deepened to include the ROZ and the MPZ. Estimates of $CO_2$ injection into the ROZ and the MPZ were made by using $CO_2$ injection profile logs. The high $CO_2$-to-oil ratio of the pilot (according to the operator) is only partially indicative of the pilot ROZ performance, due to conformance issues with $CO_2$ injected into the ROZ. However, oil response from $CO_2$ injection into the ROZ has been clearly established. Oil production from the ROZ has increased to 1,400 barrels[9] per day and the watercut from the combined MPZ/ROZ $CO_2$ flood has declined significantly after opening the ROZ interval. **Figure 15**, *Composite Production Curve and Watercuts for the SSAU ROZ Phase I Project*, illustrates the aggregate response for the joint MPZ and ROZ pilot.

[9] "2004 Worldwide EOR Survey," Oil & Gas Journal, April 12, 2004, pp. 53-65.

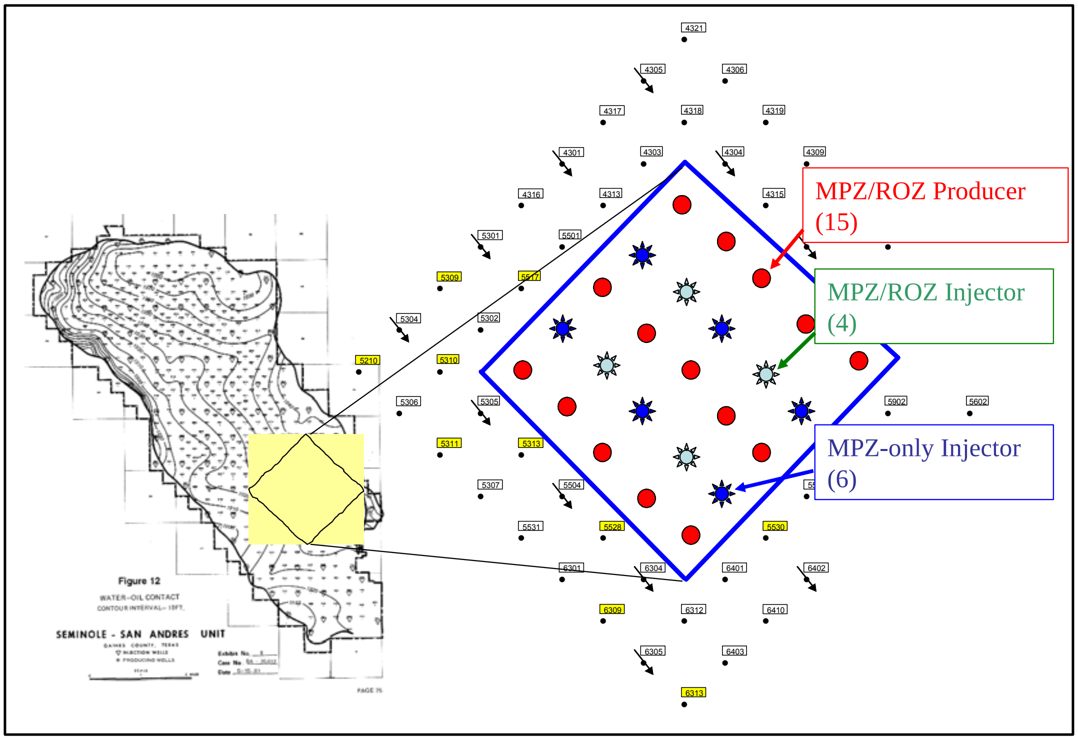



**Figure 14. Area of the SSAU ROZ Phase I Pilot**

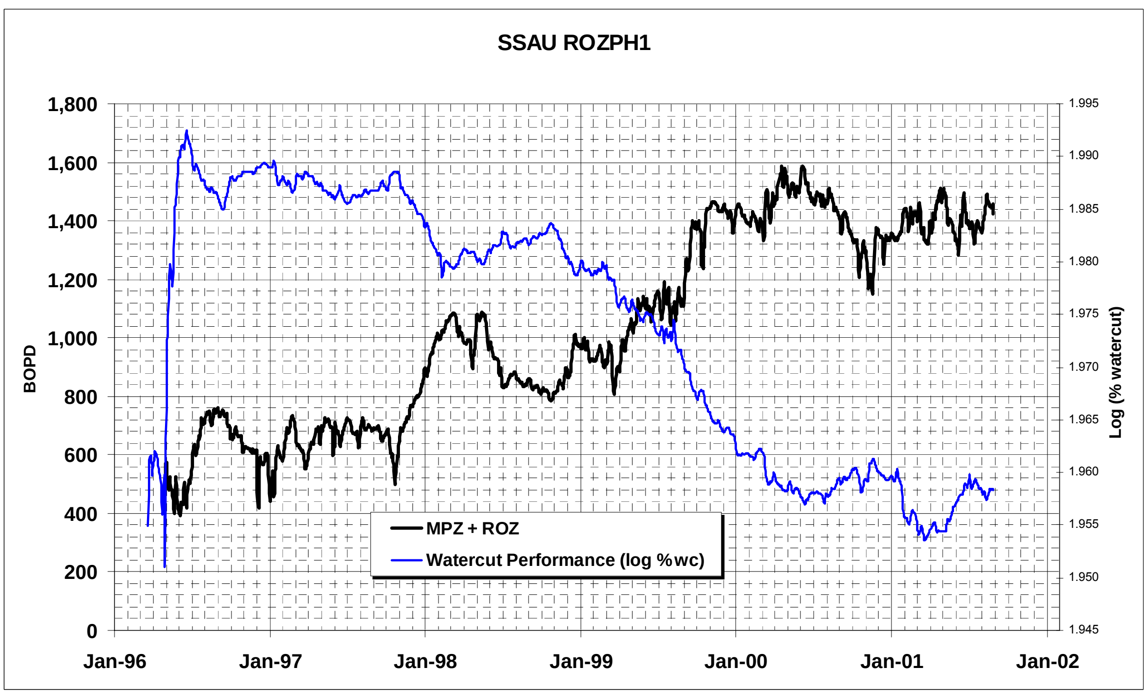



**Figure 15. Composite Production Curve and Watercuts for the SSAU ROZ Phase I Project**

Estimates of MPZ and ROZ oil production were determined on a well-by-well basis. MPZ oil production dominated initial $CO_2$-EOR performance until the ROZ oil response caused a significantly improved oil and watercut in 1998, **Figure 16**, *SSAU ROZ Phase I Performance: ROZ and MPZ Response*. The pilot has clearly demonstrated the ability to mobilize oil from the ROZ. In response to the success of the pilot flood, Amerada Hess has recently begun expanding the capacity of its $CO_2$ processing plant and is planning to expand the ROZ pilot.

2. Oxy Permian's Denver Unit. Shell initiated the first ROZ field pilot in 1991, with a six pattern $CO_2$ flood within an area of the Denver Unit called the transition zone sweetspot (TZSS). This is the portion of the Unit where the combination of rock properties and in-place residual oil provides a favorable oil target. The success of the TZSS pilot led to a 21-pattern expansion, with the entire project adopting the name, Transition Zone Sweetspot $CO_2$ Demonstration Project, **Figure 17**. As in the initial pilot areas, the upper 150 feet of the transition/residual oil zone was chosen for $CO_2$ injection, as shown in **Figure 18**, *Example Log from the Transition Zone Pilot at the Denver Unit*. With the sale of the Denver Unit, OxyPermian became the new operator of the TZSS Demonstration Project. A series of additional TZ field pilots and demonstrations followed the initial TZSS $CO_2$ FLOOD, **Figure 17**.

The incremental oil responses from three of the Denver Unit ROZ pilot and demonstration projects are further examined: the original TZSS, implemented in 1995 **(Figure 19)**; the Phase 1 Area, implemented in July 1997 **(Figure 20)**; and the Phase 2 Area, which was implemented in 2002 **(Figure 21)**. Much like the experience at SSAU, Oxy Permian has observed a somewhat higher utilization of $CO_2$ per barrel of produced oil in the transition zone pilots.

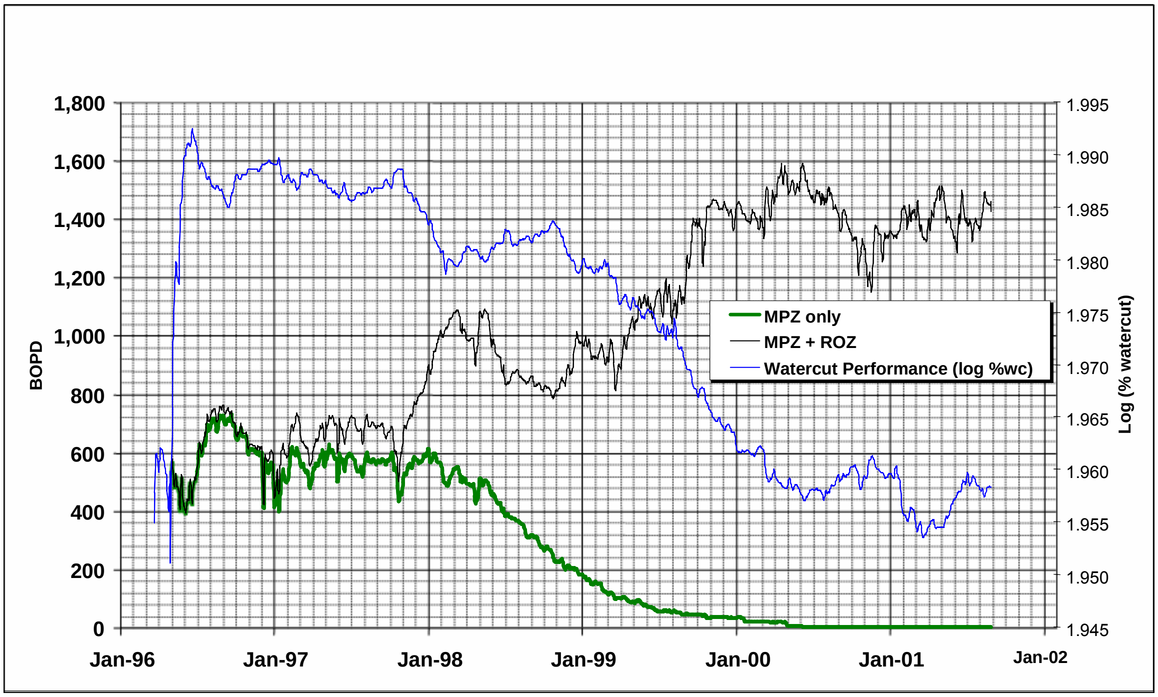



**Figure 16. SSAU ROZ Phase I Performance Separating ROZ and MPZ Response**

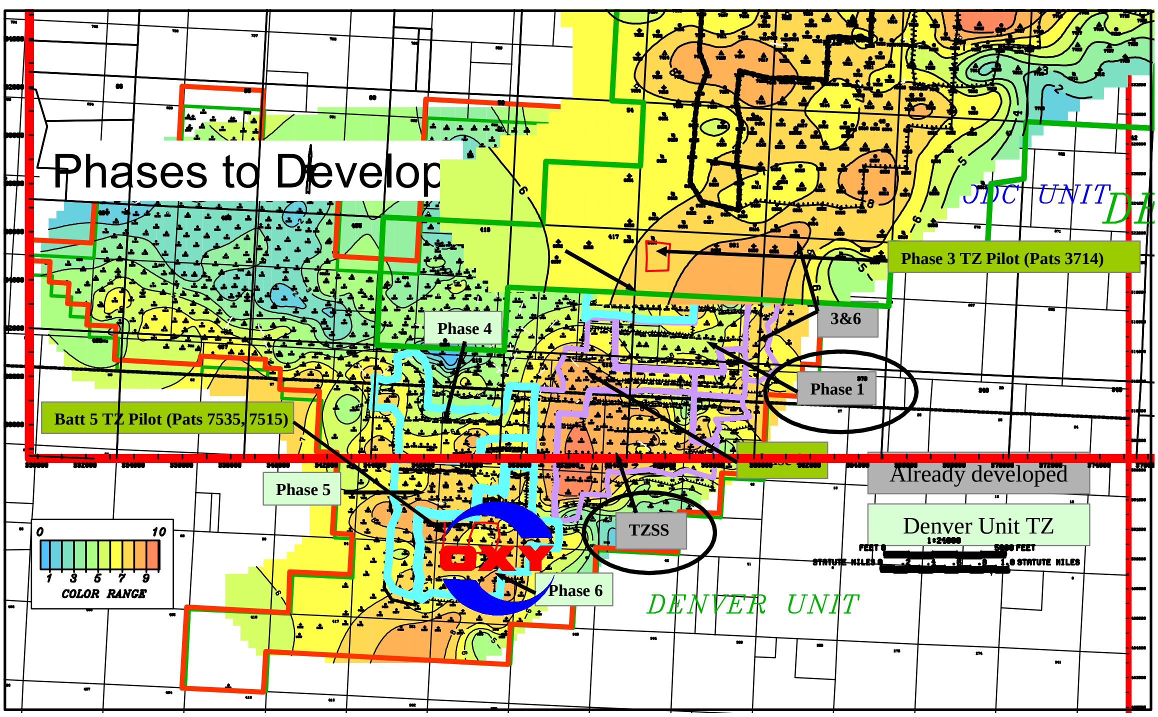
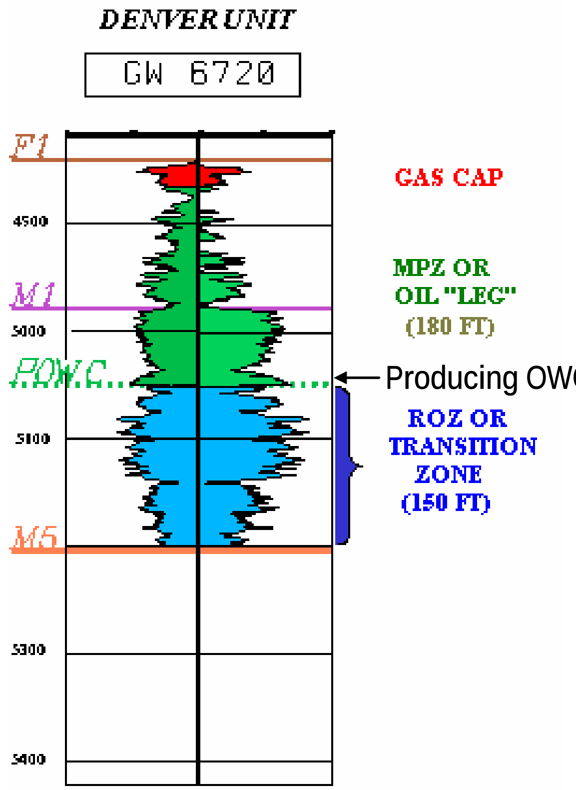



**Figure 17. Denver Unit Transition Zone Map Showing Phased Areas**




Adapted from Oxy Permian Ltd., (2005), Personal Communication and Presentation Slides, February 2005).

**Figure 18. Example Log from the Transition Zone Pilot at the Denver Unit**

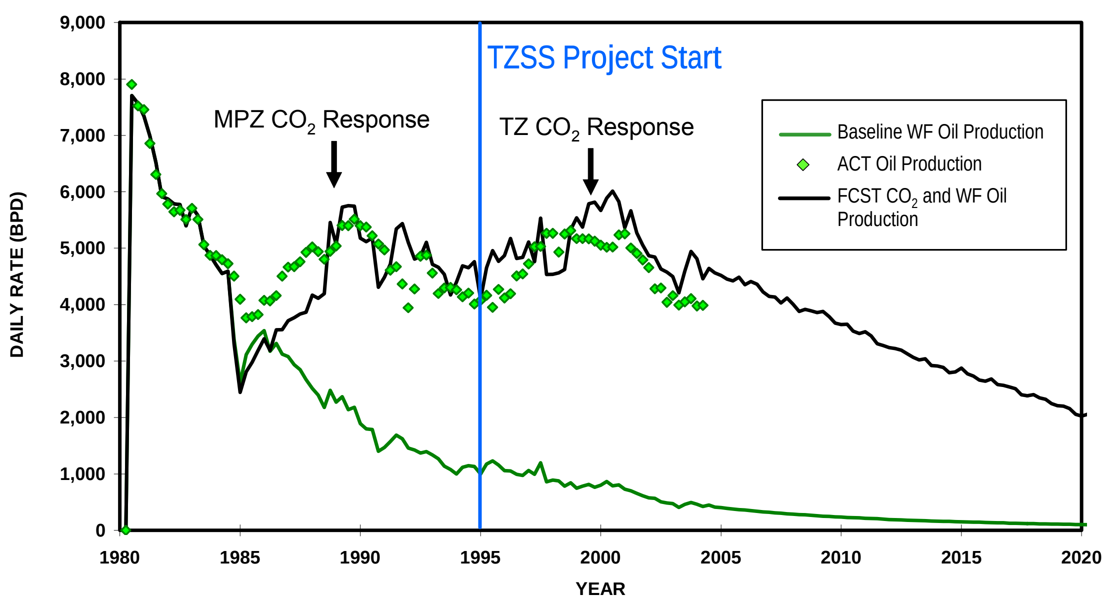



**Figure 19. Denver Transition Zone (TZSS) Oil Response (27 patterns)**

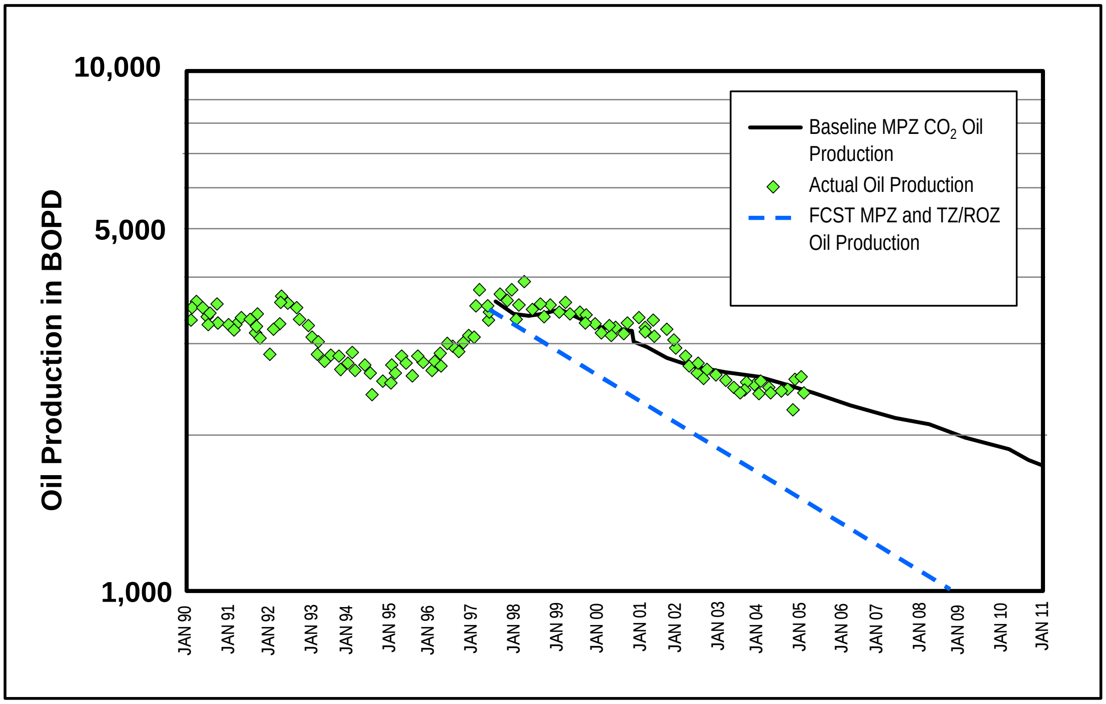



**Figure 20. Denver Transition Zone (Phase I Area) Oil Response (Phase I look back)**

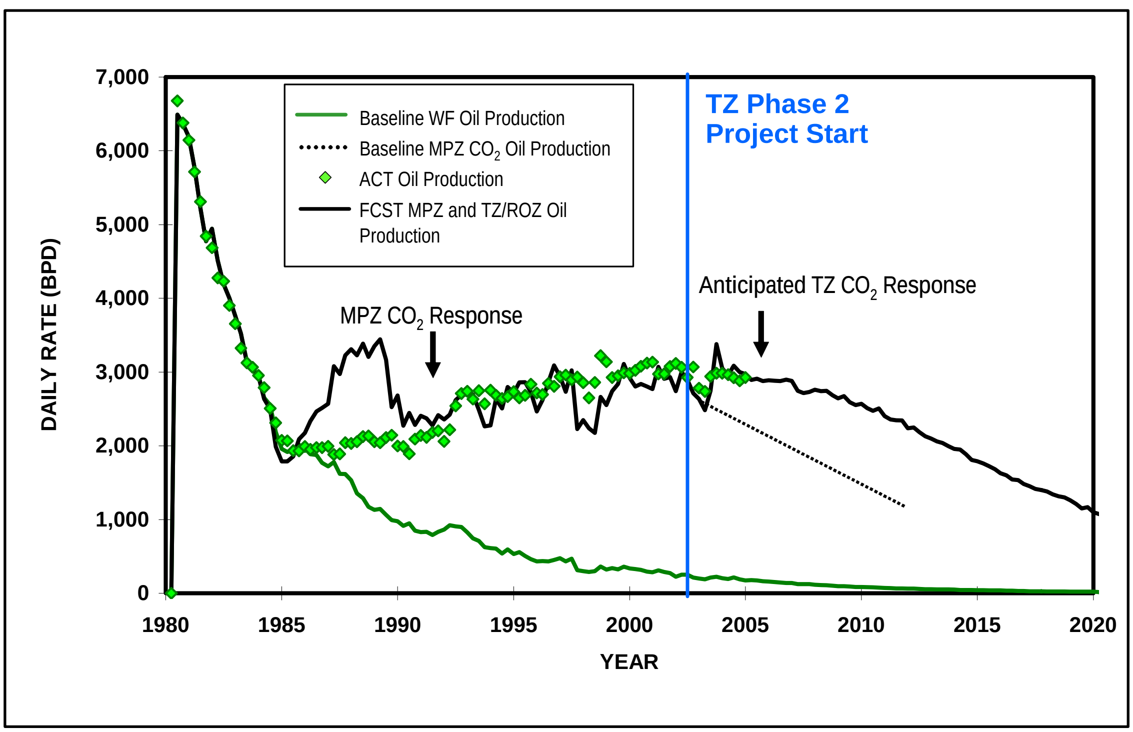



**Figure 21. Denver Transition Zone (Phase 2 Area) Oil Response**

The initial forecasts of oil response for these three projects were hampered by a lack of analog floods by which to make experience based predictions, necessitating an almost complete reliance on computer simulations. The match of expected oil response to actual oil production, as observed in **Figures 19** through **21**, has been exemplary and is a tribute to the foresightedness of the reservoir teams.

3. Oxy Permian's Bennet Ranch Unit. Shell's confidence in the economic viability of flooding the transition zone was further demonstrated in 1995 with plans for implementation of the Bennett Ranch Unit $CO_2$ flood[10]. The original plan called for deepening the injection and production wells to include 75 feet of the TZ/ROZ, making it the first $CO_2$ flood that would include both the MPZ and the TZ/ROZ in the original $CO_2$ flood. However, due to low oil prices, the wells were not deepened and only the MPZ was flooded in the initial implementation. In late 2003, Oxy Permian deepened wells into the TZ/ROZ, and this resource was added to the overall $CO_2$ flood. Today, about half of the $CO_2$ flooded patterns are being co-developed in the MPZ and TZ/ROZ. **Figure 22**, *Bennett Ranch Unit $CO_2$ Flood Response (Shell Forecast of 6-95)*, presents a look at the initial forecast of oil production for the 8 and 32 pattern $CO_2$ floods. **Figure 23**, *Bennett Ranch Unit (Wasson Field) Oil Response*, presents the oil production results at the Bennett Ranch Unit Project. The figure clearly shows increased oil production after the TZ/ROZ reservoir interval was added in 2003. Additional ROZ development at the Bennett Ranch Unit is being planned.

[10] Shell Western E&P, Inc. Field Briefing Materials upon the Implementation of the Bennett Ranch $CO_2$ Flood, June 1995.

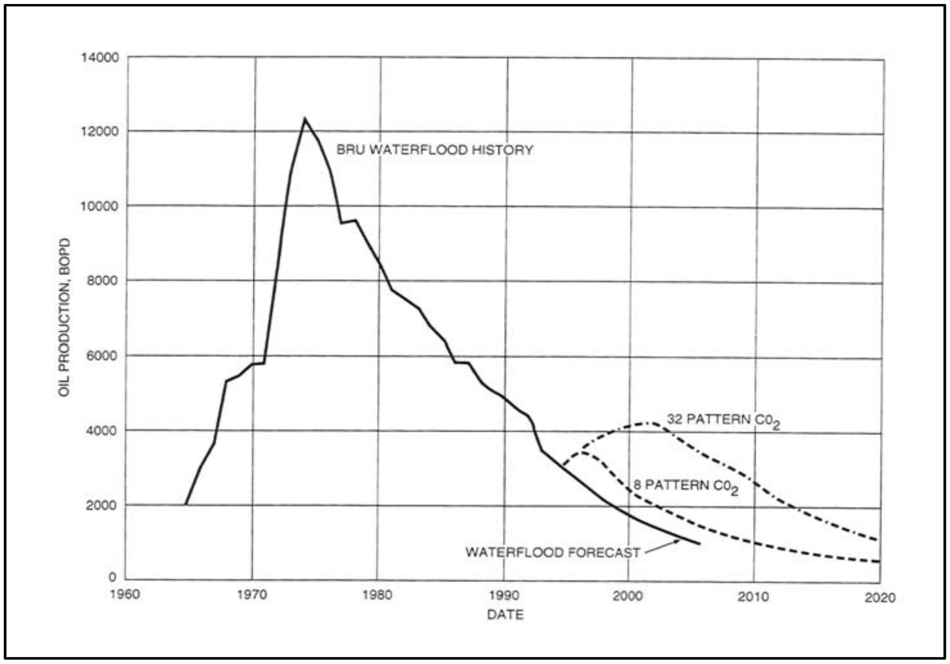



**Figure 22. Bennett Ranch Unit CO2 Flood Response (Shell Forecast of 6-95)**

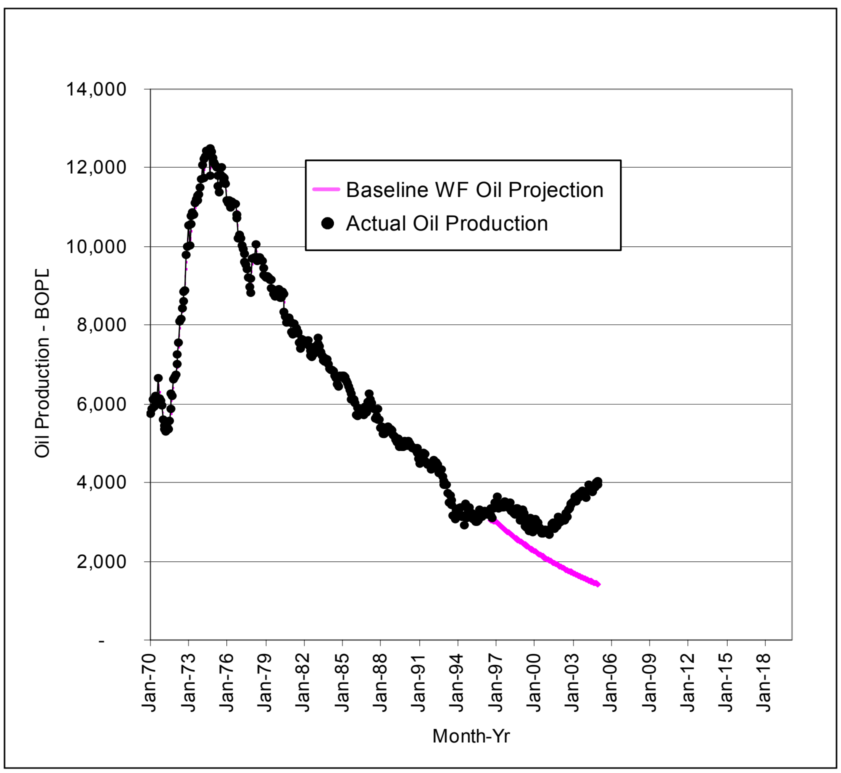
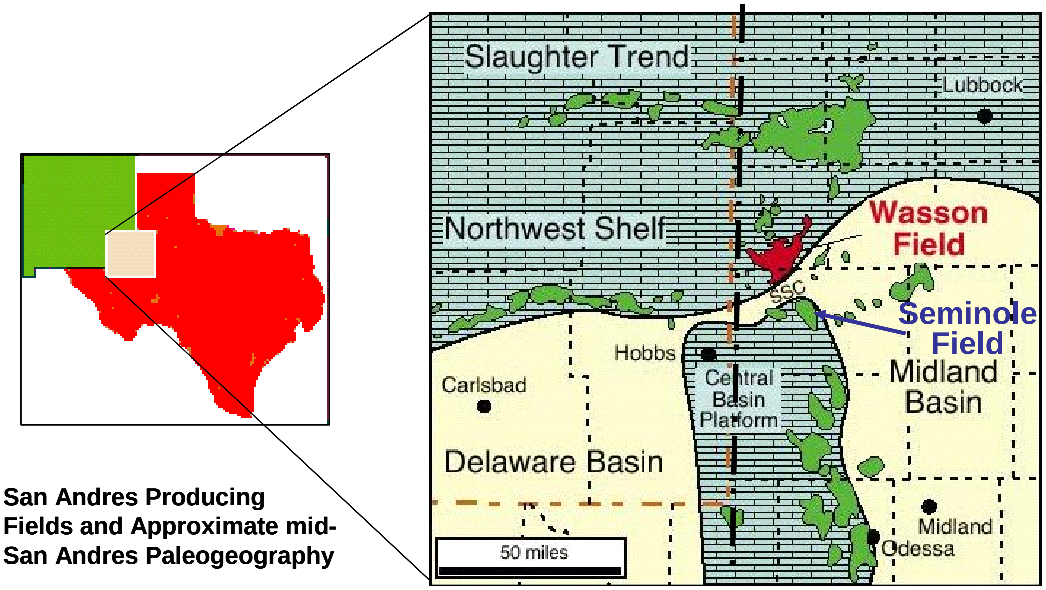



**Figure 23. Bennett Ranch Unit (Wasson Field) Oil Response**

**B. Sample ROZ Oil Fields.** Five major Permian Basin fields were assessed by this study, using reservoir simulation, to estimate the technical and economic feasibility of recovering oil from the TZ/ROZ. The five fields are all San Andres reservoirs and include the three units already undergoing ROZ field pilots – Wasson Denver Unit; Wasson Bennett Ranch Unit; and Seminole San Andres Unit – as well as two additional reservoirs of special interest – the Vacuum Grayburg/San Andres reservoir in East New Mexico and the Robertson San Andres reservoir in West Texas.

The Vacuum Field was selected to illustrate a setting with a very pronounced OWC tilt (50 ft/mile), implying a large ROZ target in addition to a favorable MPZ. The Robertson Field was selected to illustrate a setting with a very small MPZ (2 feet of net pay) and a large ROZ (65 feet of net pay) where the TZ/ROZ recovery project could greatly expand the field's ultimate oil recovery. Background information for each of the five study fields follows.

1. Seminole Field, San Andres Unit. The Seminole San Andres Unit is located on the northeast edge of the Central Basin Platform in Gaines County, Texas, about 60 miles NNW of the city of Midland, **Figure 24**, *Geographical and Geological Setting of the Wasson and Seminole Fields*. The Seminole oil field was discovered in 1936 and unitized in 1969. The San Andres Unit of the field covers 15,700 acres and has an estimated MPZ OOIP of 1,353 MMbbls and a ROZ OIP of 365 MMbbls (refer to next section for ROZ oil in-place calculation methodology). The MPZ for the Unit is at a depth of 5,100 feet and averages 135 feet in net thickness. The ROZ for the Unit is at a depth of 5,262 feet and has an estimated net thickness of 100 feet, **Figure 25,** *Seminole Field Input Parameters*.




**San Andres Producing Fields and Approximate mid-San Andres Paleogeography**

Adapted from Exxon Means Presentation at the 2004 CO2 Conference.

**Figure 24. Geographical and Geological Setting of the Wasson and Seminole Fields**

Currently, 358 production wells and 184 injection wells are active in the Unit. Cumulative MPZ oil production for the Seminole San Andres Unit is 621 MMbbls. Tertiary $CO_2$ flooding began in 1983 and accounts for 141 MMbbls of the cumulative MPZ oil production. As discussed above, a $CO_2$-EOR ROZ pilot is underway in this reservoir. The production history of the Seminole Field is shown in **Figure 26**, *Production History of the Seminole San Andres Unit (SSAU)*.

| | |
|---|---|
| **Basin Name** | Permian West Texas 8A |
| **Field Name** | SEMINOLE |
| **Reservoir** | SAN ANDRES |

**Reservoir Parameters:**

| | MPZ | ROZ |
|---|---|---|
| Area (A) | 15,700 | 15,700 |
| Net Pay (ft) | 135 | 100 |
| Depth (ft) | 5,100 | 5,262 |
| Oil-Water Contact Dip | N/A | 20 |
| Porosity | 13.0% | 13.0% |
| Reservoir Temp (deg F) | 157 | 157 |
| Initial Pressure (psi) | 2020 | 2020 |
| Pressure (psi) | 1360 | 1360 |
| $B_{oi}$ | 1.387 | 1.387 |
| $B_o$ @ $S_o$, swept | 1.050 | 1.387 |
| $S_{oi}$ | 0.880 | 0.320 |
| Swept Zone $S_o$ | 0.320 | 0.320 |
| $S_{wi}$ | 0.120 | 0.680 |
| API Gravity | 35 | 35 |
| Viscosity (cp) | 2.20 | 2.20 |
| Dykstra-Parsons | 0.75 | 0.75 |

**Oil Production**

| | MPZ | ROZ |
|---|---|---|
| Producing Wells (active) | 358 | 15 |
| Producing Wells (shut-in) | 250 | - |
| Cum Oil (MMbbl) | 620.5 | 3.0 |
| 2002 Production (MMbbl) | 8.6 | 0.5 |
| CO2-EOR Cum (MMbbl) | 141.0 | 3.0 |
| 2002 CO2-EOR (MMbbl) | 8.3 | 0.5 |
| 02 CO2-EOR Reserves (MMbbl) | 126.0 | 7.8 |

**Water Production**

| | MPZ | ROZ |
|---|---|---|
| 2002 Water Production (Mbbl) | 0 | 0 |
| Daily Water (Mbbl/d) | 0 | 0.0 |

**Injection**

| | MPZ | ROZ |
|---|---|---|
| Injection Wells (active) | 184 | 0 |
| Injection Wells (shut-in) | 0 | 0 |
| 2002 Water Injection (MMbbl) | 0 | 0.0 |
| Daily Injection - Field (Mbbl/d) | 0 | 0.0 |
| Cum Injection (MMbbl) | 0 | 0.0 |
| Daily Inj per Well (Bbl/d) | 0 | 0.0 |

**Volumes**

| | MPZ | ROZ |
|---|---|---|
| OOIP (MMbl) | 1,353.0 | 365.3 |
| Cum P/S Oil (MMbl) | 479.5 | - |
| 2002 P/S Reserves (MMbl) | 5.5 | - |
| Ult P/S Recovery (MMbl) | 485.0 | - |
| Remaining (MMbl) | 868.0 | 365.3 |
| Recovery Efficiency (%) | 36% | 0% |

**OOIP Volume Check**

| | MPZ | ROZ |
|---|---|---|
| Reservoir Volume (AF) | 2,119,500 | 1,570,000 |
| Bbl/AF | 639.9 | 232.7 |
| OOIP Check (MMbl) | 1,356.2 | 365.3 |

**SROIP Volume Check**

| | MPZ | ROZ |
|---|---|---|
| Reservoir Volume (AF) | 2,119,500 | 1,570,000 |
| Swept Zone Bbl/AF | 307.4 | 232.7 |
| SROIP Check (MMbl) | 651.5 | 365.3 |

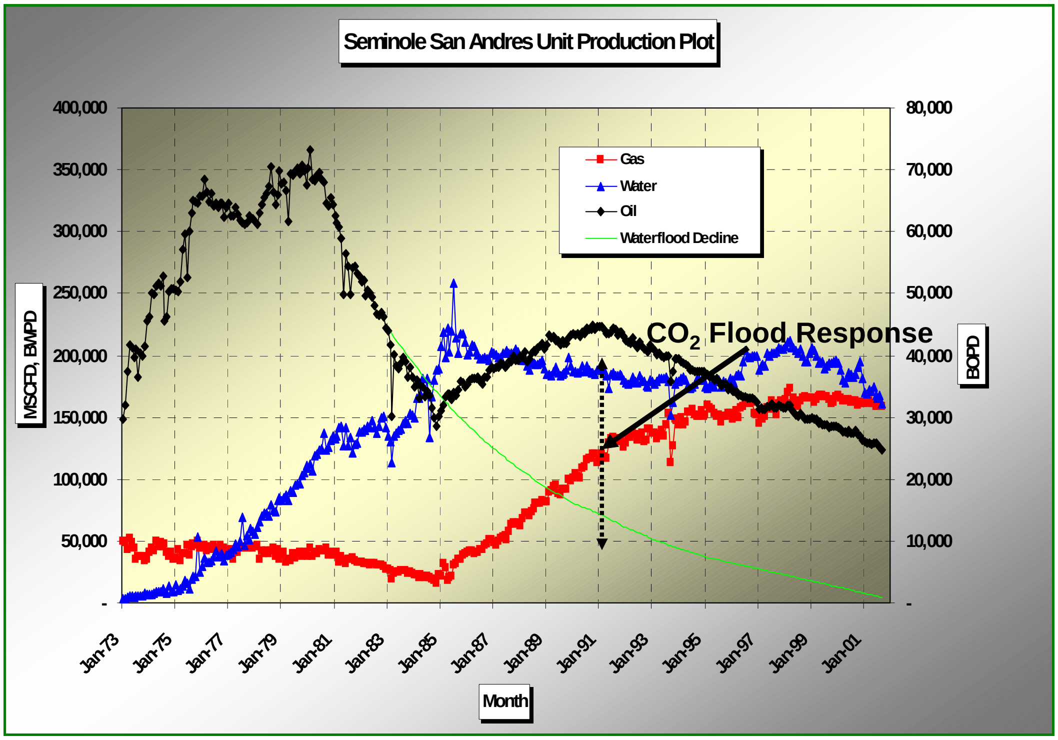
**ROIP Volume Check**

| | MPZ | ROZ |
|---|---|---|
| ROIP Check (MMbl) | 868.0 | 365.3 |

**Figure 25. Seminole Field Input Parameters Summary**

2. Wasson Field, Denver Unit. The Wasson Field is located on the southern limit of the Northwest Shelf of the Permian Basin in Yoakum County, Texas, about 80 miles NNW of the city of Midland, **Figure 24**. As seen in **Figure 27**, *Wasson Field Area with San Andres Formation Producing Units,* the Denver Unit is one of seven units of the huge Wasson Field. The greater Wasson Field covers over 68,000 acres and holds an estimated 4.5 billion barrels of OOIP in the MPZ. The Denver Unit lies within the southern portion of the Wasson Field and is the largest of the seven units, with a reservoir area of 27,848 acres, a MPZ OOIP of 2,372 MMbbls, and a ROZ OIP of 1,039 MMbbls. The MPZ is at a depth of 5,200 feet and has an average net thickness of 141 feet. The ROZ is at a depth of 5,380 feet and has an average net thickness of 150 feet, **Figure 28,** *Wasson-Denver Unit Input Parameters Summary*. The Denver Unit has 1,293 active production wells and 1,198 injection wells. Cumulative MPZ oil production for the Denver Unit is 1,211 MMbbls with 169 MMbbls of this due to tertiary $CO_2$ flooding. A series of $CO_2$-EOR ROZ pilot and demonstration projects have been underway in this reservoir unit since 1991, contributing to the above cited oil production from $CO_2$ flooding.

3. Wasson Field, Bennett Ranch Unit*.* As shown in **Figure 27**, the Wasson Bennett Ranch Unit is located in the northeastern portion of the greater Wasson Field. It has a reservoir area of 7,027 acres, a MPZ OOIP of 288 MMbbls and a ROZ OIP of 240 MMbbls. The MPZ is at a depth of 5,100 feet and has an average net thickness of 90 feet. The ROZ is at a depth of 5,305 feet and has an estimated net thickness of 150 feet, **Figure 29,** *Wasson-Bennett Ranch Unit Input Parameters.* The Bennett Ranch Unit has 81 active producing wells and 75 actual injection wells. Cumulative MPZ oil production for the Bennett Ranch Unit is 75 MMbbls with 3 MMbbls of this due to tertiary $CO_2$ flooding. A portion of the oil being recovered by $CO_2$ flooding is due to the recently started $CO_2$-EOR ROZ pilot.




Adapted from Shell Western E&P, Inc. Field Briefing Materials upon the Implementation of the Bennett Ranch CO2 Flood, 6/95.

**Figure 26. Production History of the Seminole San Andres Unit (SSAU)**

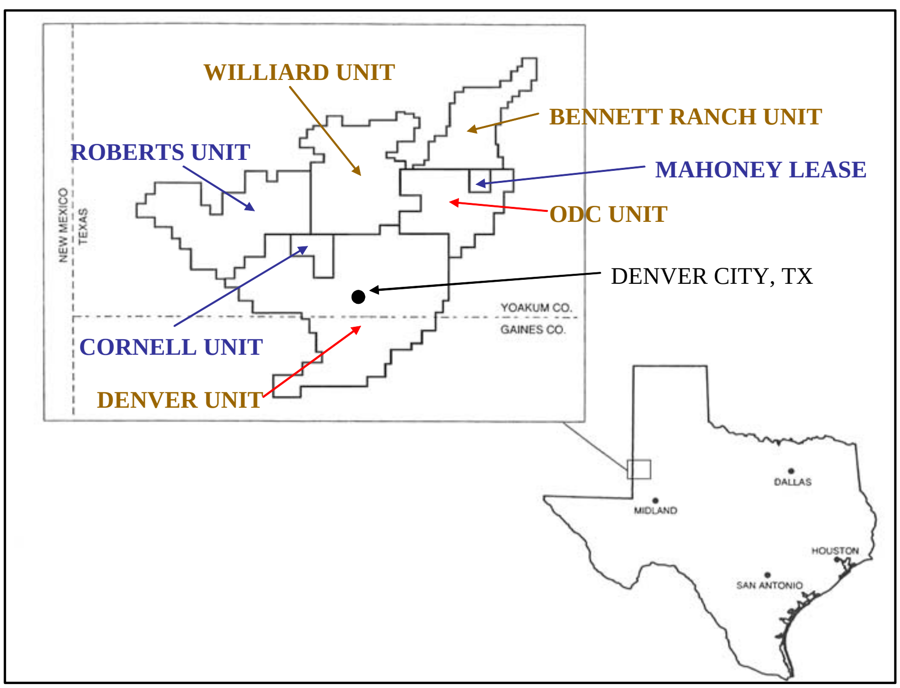



**Figure 27. Wasson Field Area with San Andres Formation Producing Units**

| | |
|---|---|
| **Basin Name** | Permian West Texas 8A |
| **Field Name** | WASSON (DENVER) |
| **Reservoir** | SAN ANDRES |

**Reservoir Parameters:**

| | MPZ | ROZ |
|---|---|---|
| Area (A) | 27,848 | 27,848 |
| Net Pay (ft) | 141 | 150 |
| Depth (ft) | 5,200 | 5,380 |
| Oil-Water Contact Dip | N/A | 30 |
| Porosity | 12.0% | 12.0% |
| Reservoir Temp (deg F) | 105 | 105 |
| Initial Pressure (psi) | 1850 | 1850 |
| Pressure (psi) | 1100 | 1100 |
| $B_{oi}$ | 1.310 | 1.310 |
| $B_o$ @ $S_o$, swept | 1.050 | 1.310 |
| $S_{oi}$ | 0.850 | 0.350 |
| Swept Zone $S_o$ | 0.350 | 0.350 |
| $S_{wi}$ | 0.150 | 0.650 |
| API Gravity | 33 | 33 |
| Viscosity (cp) | 1.18 | 1.18 |
| Dykstra-Parsons | 0.75 | 0.75 |

**Oil Production**

| | MPZ | ROZ |
|---|---|---|
| Producing Wells (active) | 1,293 | - |
| Producing Wells (shut-in) | 1,210 | - |
| Cum Oil (MMbbl) | 1,210.7 | - |
| 2002 Production (MMbbl) | 13.1 | - |
| CO2-EOR Cum (MMbbl) | 169.2 | - |
| 2002 CO2-EOR (MMbbl) | 9.3 | - |
| 02 CO2-EOR Reserves (MMbbl) | 141.8 | - |

**Water Production**

| | MPZ | ROZ |
|---|---|---|
| 2002 Water Production (Mbbl) | 0 | 0 |
| Daily Water (Mbbl/d) | 0 | 0.0 |

**Injection**

| | MPZ | ROZ |
|---|---|---|
| Injection Wells (active) | 1198 | 0 |
| Injection Wells (shut-in) | 0 | 0 |
| 2002 Water Injection (MMbbl) | 0 | 0.0 |
| Daily Injection - Field (Mbbl/d) | 0 | 0.0 |
| Cum Injection (MMbbl) | 0 | 0.0 |
| Daily Inj per Well (Bbl/d) | 0 | 0.0 |

**Volumes**

| | MPZ | ROZ |
|---|---|---|
| OOIP (MMbl) | 2,371.9 | 1,039.0 |
| Cum P/S Oil (MMbl) | 1,041.5 | - |
| 2002 P/S Reserves (MMbl) | 57.3 | - |
| Ult P/S Recovery (MMbl) | 1,098.8 | - |
| Remaining (MMbbl) | 1,273.1 | 1,039.0 |
| Recovery Efficiency (%) | 46% | 0% |

**OOIP Volume Check**

| | MPZ | ROZ |
|---|---|---|
| Reservoir Volume (AF) | 3,926,568 | 4,177,200 |
| Bbl/AF | 604.1 | 248.7 |
| OOIP Check (MMbl) | 2,371.9 | 1,039.0 |

**SROIP Volume Check**

| | MPZ | ROZ |
|---|---|---|
| Reservoir Volume (AF) | 3,926,568 | 4,177,200 |
| Swept Zone Bbl/AF | 310.3 | 248.7 |
| SROIP Check (MMbbl) | 1,218.5 | 1,039.0 |

**ROIP Volume Check**

| | MPZ | ROZ |
|---|---|---|
| ROIP Check (MMbl) | 1,273.1 | 1,039.0 |

**Figure 28. Wasson-Denver Unit Input Parameters**

**Basin Name**: Permian West Texas 8A

**Field Name**: WASSON (BENNETT RANCH)

**Reservoir**: SAN ANDRES

### Reservoir Parameters:

| | MPZ | ROZ |
|---|---|---|
| Area (A) | 7,027 | 7,027 |
| Net Pay (ft) | 90 | 150 |
| Depth (ft) | 5,100 | 5,305 |
| Oil-Water Contact Dip | N/A | 30 |
| Porosity | 11.0% | 11.0% |
| Reservoir Temp (deg F) | 105 | 105 |
| Initial Pressure (psi) | 1805 | 1805 |
| Pressure (psi) | 1000 | 1000 |
| $B_{oi}$ | 1.312 | 1.312 |
| $B_o$ @ $S_o$, swept | 1.050 | 1.312 |
| $S_{oi}$ | 0.700 | 0.350 |
| Swept Zone $S_o$ | 0.350 | 0.350 |
| $S_{wi}$ | 0.300 | 0.650 |
| API Gravity | 33 | 33 |
| Viscosity (cp) | 0.97 | 0.97 |
| Dykstra-Parsons | 0.75 | 0.75 |

### Oil Production

| | MPZ | ROZ |
|---|---|---|
| Producing Wells (active) | 81 | - |
| Producing Wells (shut-in) | 75 | - |
| Cum Oil (MMbbl) | 75.4 | - |
| 2002 Production (MMbbl) | 0.9 | - |
| CO2-EOR Cum (MMbbl) | 3.2 | - |
| 2002 CO2-EOR (MMbbl) | 0.7 | - |
| 02 CO2-EOR Reserves (MMbbl) | 10.0 | - |

### Water Production

| | MPZ | ROZ |
|---|---|---|
| 2002 Water Production (Mbbl) | 0 | 0 |
| Daily Water (Mbbl/d) | 0 | 0.0 |

### Injection

| | MPZ | ROZ |
|---|---|---|
| Injection Wells (active) | 75 | 0 |
| Injection Wells (shut-in) | 0 | 0 |
| 2002 Water Injection (MMbbl) | 0 | 0.0 |
| Daily Injection - Field (Mbbl/d) | 0 | 0.0 |
| Cum Injection (MMbbl) | 0 | 0.0 |
| Daily Inj per Well (Bbl/d) | 0 | 0.0 |

### Volumes

| | MPZ | ROZ |
|---|---|---|
| OOIP (MMbl) | 288.0 | 240.0 |
| Cum P/S Oil (MMbl) | 72.2 | - |
| 2002 P/S Reserves (MMbl) | 3.1 | - |
| Ult P/S Recovery (MMbl) | 75.2 | - |
| Remaining (MMbl) | 212.7 | 240.0 |
| Recovery Efficiency (%) | 26% | 0% |

### OOIP Volume Check

| | MPZ | ROZ |
|---|---|---|
| Reservoir Volume (AF) | 632,430 | 1,054,050 |
| Bbl/AF | 455.3 | 227.7 |
| OOIP Check (MMbl) | 288.0 | 240.0 |

### SROIP Volume Check

| | MPZ | ROZ |
|---|---|---|
| Reservoir Volume (AF) | 632,430 | 1,054,050 |
| Swept Zone Bbl/AF | 284.5 | 227.7 |
| SROIP Check (MMbbl) | 179.9 | 240.0 |

### ROIP Volume Check

| | MPZ | ROZ |
|---|---|---|
| ROIP Check (MMbl) | 212.7 | 240.0 |

**Figure 29. Wasson-Bennett Ranch Unit Input Parameters**

4. Vacuum Field, Grayburg/San Andres Unit. The Vacuum Field is located on the Artesia-Lovington uplift in Lea County, New Mexico, approximately 15 miles northwest of the city of Hobbs. The field was discovered in 1929, with primary development beginning in 1939 and waterflooding beginning in 1958. The Grayburg/San Andres Unit is located on the eastern side of the Vacuum Field and has a reservoir area of 19,200 acres, a MPZ OOIP of 999 MMbbls and a ROZ OIP of 781 MMbbls. The MPZ is at a depth of 4,500 feet and has an average net thickness of 95 feet. The ROZ is at a depth of 4,847 feet and has an estimated net thickness of 194 feet, **Figure 30,** *Vacuum–Grayburg/San Andres Unit Input Parameters*. The Grayburg/San Andres Unit has 466 active production wells and 172 active injection wells. Cumulative MPZ oil production for the Grayburg/San Andres Unit is 356 MMbbls with 25 MMbbls of this due to tertiary $CO_2$ flooding.

***5.*** Robertson Field, San Andres Reservoir. The Robertson Field has a reservoir area of 6,000 acres, a MPZ OOIP of 7 MMbbls and a ROZ OIP of 94 MMbbls. The MPZ is at a depth of 4,700 feet and has an average net thickness of 2 feet. The ROZ is at a depth of 4,754 feet and has an estimated net thickness of 65 feet, **Figure 31,** *Robertson Field Input Parameters*. The Robertson Field has 3 active production wells and no active injection wells. Cumulative MPZ oil production for the Robertson Field is 2 MMbbls. $CO_2$ flooding has not been performed in the Robertson San Andres Reservoir.

| | |
|---|---|
| **Basin Name** | Permian East New Mexico |
| **Field Name** | VACUUM |
| **Reservoir** | GRAYBURG-SAN ANDRES |

**Reservoir Parameters:**

| | MPZ | ROZ |
|---|---|---|
| Area (A) | 19,200 | 19,200 |
| Net Pay (ft) | 95 | 194 |
| Depth (ft) | 4,500 | 4,847 |
| Oil-Water Contact Dip | N/A | 50 |
| Porosity | 11.3% | 11.3% |
| Reservoir Temp (deg F) | 101 | 101 |
| Initial Pressure (psi) | 1625 | 1625 |
| Pressure (psi) | 1000 | 1000 |
| $B_{oi}$ | 1.310 | 1.310 |
| $B_o$ @ $S_o$, swept | 1.050 | 1.310 |
| $S_{oi}$ | 0.820 | 0.314 |
| Swept Zone $S_o$ | 0.314 | 0.314 |
| $S_{wi}$ | 0.180 | 0.686 |
| API Gravity | 36 | 36 |
| Viscosity (cp) | 1.47 | 1.47 |
| Dykstra-Parsons | 0.88 | 0.88 |

**Oil Production**

| | MPZ | ROZ |
|---|---|---|
| Producing Wells (active) | 466 | - |
| Producing Wells (shut-in) | 329 | - |
| Cum Oil (MMbbl) | 355.9 | - |
| 2002 Production (MMbbl) | 4.6 | - |
| CO2-EOR Cum (MMbbl) | 24.8 | - |
| 2002 CO2-EOR (MMbbl) | 2.9 | - |
| 02 CO2-EOR Reserves (MMbbl) | 33.8 | - |

**Water Production**

| | MPZ | ROZ |
|---|---|---|
| 2002 Water Production (Mbbl) | 0 | 0 |
| Daily Water (Mbbl/d) | 0 | 0.0 |

**Injection**

| | MPZ | ROZ |
|---|---|---|
| Injection Wells (active) | 329 | 0 |
| Injection Wells (shut-in) | 0 | 0 |
| 2002 Water Injection (MMbbl) | 0 | 0.0 |
| Daily Injection - Field (Mbbl/d) | 0 | 0.0 |
| Cum Injection (MMbbl) | 0 | 0.0 |
| Daily Inj per Well (Bbl/d) | 0 | 0.0 |

**Volumes**

| | MPZ | ROZ |
|---|---|---|
| OOIP (MMbl) | 998.6 | 781.3 |
| Cum P/S Oil (MMbl) | 331.1 | - |
| 2002 P/S Reserves (MMbl) | 19.4 | - |
| Ult P/S Recovery (MMbl) | 350.5 | - |
| Remaining (MMbl) | 648.2 | 781.3 |
| Recovery Efficiency (%) | 35% | 0% |

**OOIP Volume Check**

| | MPZ | ROZ |
|---|---|---|
| Reservoir Volume (AF) | 1,824,000 | 3,718,064 |
| Bbl/AF | 548.7 | 210.1 |
| OOIP Check (MMbl) | 1,000.9 | 781.3 |

**SROIP Volume Check**

| | MPZ | ROZ |
|---|---|---|
| Reservoir Volume (AF) | 1,824,000 | 3,718,064 |
| Swept Zone Bbl/AF | 262.2 | 210.1 |
| SROIP Check (MMbl) | 478.2 | 781.3 |

**ROIP Volume Check**

| | MPZ | ROZ |
|---|---|---|
| ROIP Check (MMbl) | 648.2 | 781.3 |

**Figure 30. Vacuum – Grayburg/San Andres Unit Input Parameters**

| | |
|---|---|
| **Basin Name** | Permian West Texas 8A |
| **Field Name** | ROBERTSON |
| **Reservoir** | SAN ANDRES |

| **Reservoir Parameters:** | MPZ | ROZ |
|---|---|---|
| Area (A) | 6,000 | 6,000 |
| Net Pay (ft) | 2 | 65 |
| Depth (ft) | 4,700 | 4,754 |
| Oil-Water Contact Dip | N/A | 30 |
| Porosity | 11.0% | 11.0% |
| Reservoir Temp (deg F) | 108 | 108 |
| Initial Pressure (psi) | -1 | -1 |
| Pressure (psi) | -1 | -1 |
| $B_{oi}$ | 1.240 | 1.240 |
| $B_o$ @ $S_o$, swept | 1.050 | 1.240 |
| $S_{oi}$ | 0.700 | 0.350 |
| Swept Zone $S_o$ | 0.350 | 0.350 |
| $S_{wi}$ | 0.300 | 0.650 |
| API Gravity | 32 | 32 |
| Viscosity (cp) | 1.54 | 1.54 |
| Dykstra-Parsons | 0.75 | 0.75 |

| **Oil Production** | MPZ | ROZ |
|---|---|---|
| Producing Wells (active) | 3 | - |
| Producing Wells (shut-in) | 1 | - |
| Cum Oil (MMbbl) | 2.3 | - |
| 2002 Production (MMbbl) | 0.0 | - |
| CO2-EOR Cum (MMbbl) | - | - |
| 2002 CO2-EOR (MMbbl) | - | - |
| 02 CO2-EOR Reserves (MMbbl) | - | - |

| **Water Production** | MPZ | ROZ |
|---|---|---|
| 2002 Water Production (Mbbl) | 0 | 0 |
| Daily Water (Mbbl/d) | 0 | 0.0 |

| **Injection** | MPZ | ROZ |
|---|---|---|
| Injection Wells (active) | 0 | 0 |
| Injection Wells (shut-in) | 0 | 0 |
| 2002 Water Injection (MMbbl) | 0 | 0.0 |
| Daily Injection - Field (Mbbl/d) | 0 | 0.0 |
| Cum Injection (MMbbl) | 0 | 0.0 |
| Daily Inj per Well (Bbl/d) | | 0.0 |

| **Volumes** | MPZ | ROZ |
|---|---|---|
| OOIP (MMbl) | 7.0 | 93.9 |
| Cum P/S Oil (MMbl) | 2.3 | - |
| 2002 P/S Reserves (MMbl) | 0.1 | - |
| Ult P/S Recovery (MMbl) | 2.4 | - |
| Remaining (MMbl) | 4.5 | 93.9 |
| Recovery Efficiency (%) | 35% | 0% |

| **OOIP Volume Check** | MPZ | ROZ |
|---|---|---|
| Reservoir Volume (AF) | 14,491 | 389,711 |
| Bbl/AF | 481.7 | 240.9 |
| OOIP Check (MMbl) | 7.0 | 93.9 |

| **SROIP Volume Check** | MPZ | ROZ |
|---|---|---|
| Reservoir Volume (AF) | 14,491 | 389,711 |
| Swept Zone Bbl/AF | 284.5 | 240.9 |
| SROIP Check (MMbbl) | 4.1 | 93.9 |

| **ROIP Volume Check** | MPZ | ROZ |
|---|---|---|
| ROIP Check (MMbl) | 4.5 | 93.9 |

**Figure 31. Robertson Field Input Parameters**

# IV. CALIBRATING THE OIL RECOVERY MODELS AND ESTIMATING TECHNICALLY RECOVERABLE ROZ RESOURCES

When performing studies on large numbers of oil fields, such as exist in the Permian Basin, it is often useful to employ simpler numerical models, such as streamtube models, to save on computational time and costs. One of these simpler streamtube models is *CO2-PROPHET.* This model has been used with good results in recent basin-wide EOR scoping studies by Advanced Resources for determining the potential of $CO_2$ enhanced oil recovery for adding significant new domestic oil supplies from numerous oil basins.[11]

This chapter discusses the comparison and calibration of the *CO2-PROPHET* model with a full-scale, industry standard compositional reservoir simulator, and presents the technically recoverable resources from applying $CO_2$-EOR to the remaining oil in-place in the transition and residual oil zones. As shown in the following materials, *CO2-PROPHET* provides an excellent match of oil recovery, for both the MPZ and the TZ/ROZ. As such, there is confidence in using the *CO2-PROPHET* model to estimate oil recovery from the sample of five oil fields assessed by this study and, most importantly, applying this model in future, larger scale reservoir assessment studies.

**A. *Background on CO2-PROPHET.*** The *CO2-PROPHET* model was developed by the Texaco Exploration and Production Technology Department (EPTD) as part of the DOE Class I cost-share program.[12]

In its simplest form, this model generates streamlines for fluid flow between injection and production wells, and then uses finite difference methods to determine oil displacement and recovery calculations along the established streamlines. Data input

[11] U.S. Department of Energy/Fossil Energy: "Basin-Oriented Strategies for CO2 Enhanced Oil Recovery: California, Onshore Gulf Coast, Offshore Louisiana, Oklahoma, Alaska and Illinois", April 2005.
[12] "Post Waterflood $CO_2$ Flood in a Light Oil, Fluvial Dominated Deltaic Reservoir" (DOE Contract No. DE-FC22-93BC14960).

requirements are less demanding and computational times are much shorter than when using full-scale reservoir simulation.

Input requirements for *CO2-PROPHET* can generally be obtained or calculated using engineering formulations. Key input parameters impacting oil recovery include:

1. Residual oil saturation,
2. Dykstra-Parsons coefficient,
3. Oil and water viscosity,
4. Reservoir pressure and temperature, and
5. Minimum miscibility pressure.

**B. Comparison and Calibration of *CO2-PROPHET* with a Full-Scale Reservoir Simulator.** The *CO2-PROPHET* model was compared and calibrated by Advanced Resources with an industry-standard compositional reservoir simulator. The primary reason for the comparison was to determine whether *CO2-PROPHET* could effectively model oil recovery from the TZ/ROZ. A second reason was to better understand how the absence of a gravity override function in *CO2-PROPHET* might influence the calculation of oil recovery in these low oil saturation zones.

The Wasson Denver Unit (San Andres) reservoir data set was used as the input file for modeling a simultaneous MPZ and TZ/ROZ $CO_2$ flood in the full-scale simulator. An analogous data set was placed into *CO2-PROPHET* to replicate the MPZ and TZ/ROZ simultaneous flood. First, for simplicity, all oil saturations in the input database for the *CO2-PROPHET* model were set at residual oil. Under this simplified condition, *CO2-PROPHET* had lower oil recoveries than the full-scale simulator.

A closer review of the two input data sets enabled us to understand the reasons for the divergence. No mobile oil saturations were initially included in the input file for *CO2-PROPHET*; however, the input data file for the full-scale reservoir simulator had higher (and mobile) oil saturation in the TZ interval. Using simple weight-averaging, a small mobile oil saturation (~3%) was added to each reservoir interval in the *CO2-*

*PROPHET* input file to account for the mobile oil in the TZ. An excellent match for cumulative oil recovery was obtained between *CO2-PROPHET* and the full-scale simulator, after making this adjustment. This two step comparison and match is shown on **Figure 33**.

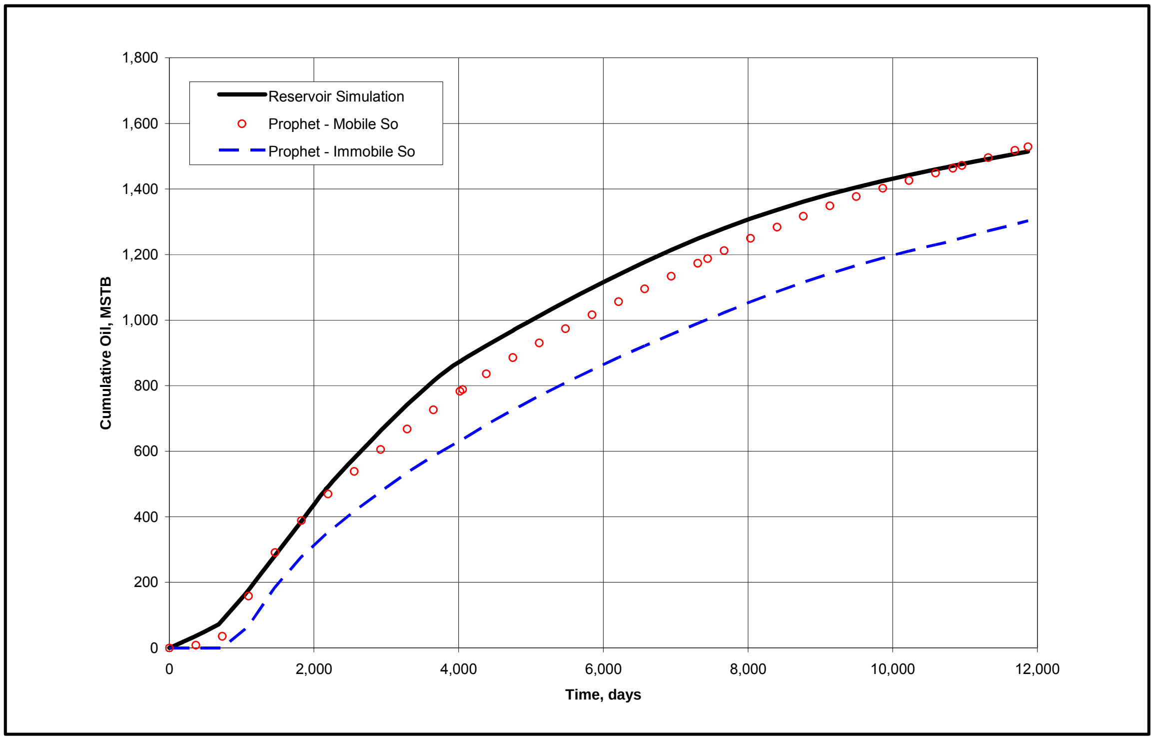



**Figure 33. Analysis of Simultaneous MPZ and TZ/ROZ Oil Recovery Simulation Results, Wasson Denver Unit**

Similar *CO2-PROPHET* and full-scale simulator comparisons were completed for the remaining four sample oil fields (**Figures 34 through 37**), again showing an excellent match between the two models when the oil saturation modification (discussed above) was included in the *CO2-PROPHET* input data set.

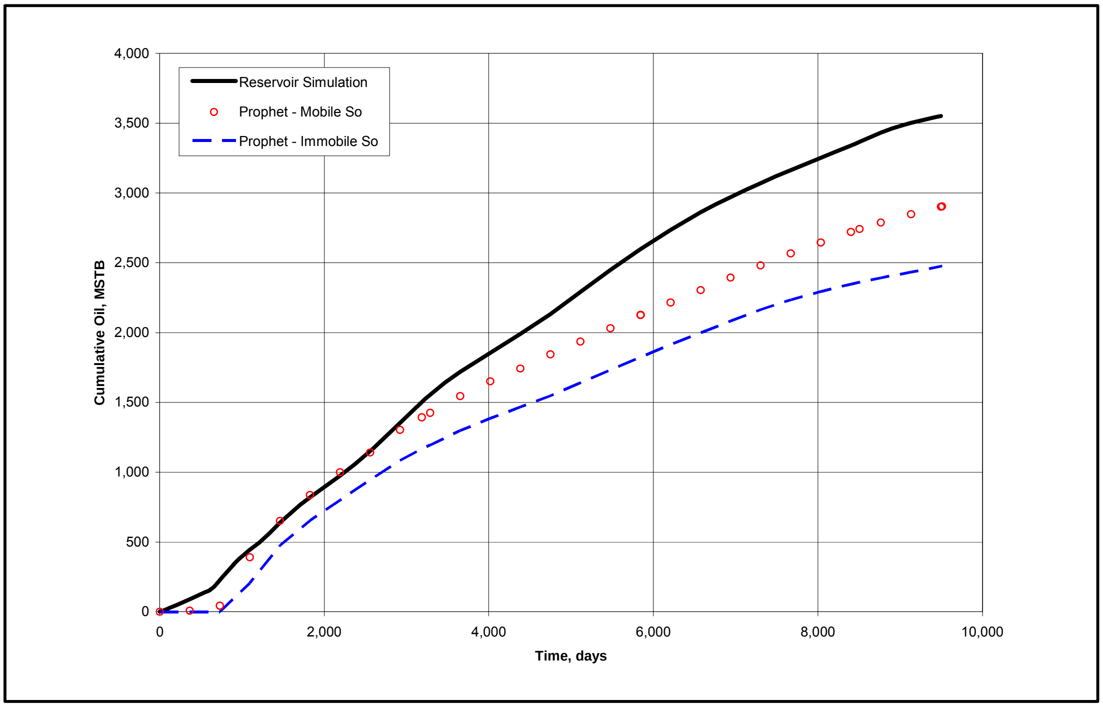



**Figure 34. Analysis of Simultaneous MPZ and TZ/ROZ Oil Recovery Simulation Results, Seminole San Andres Unit**

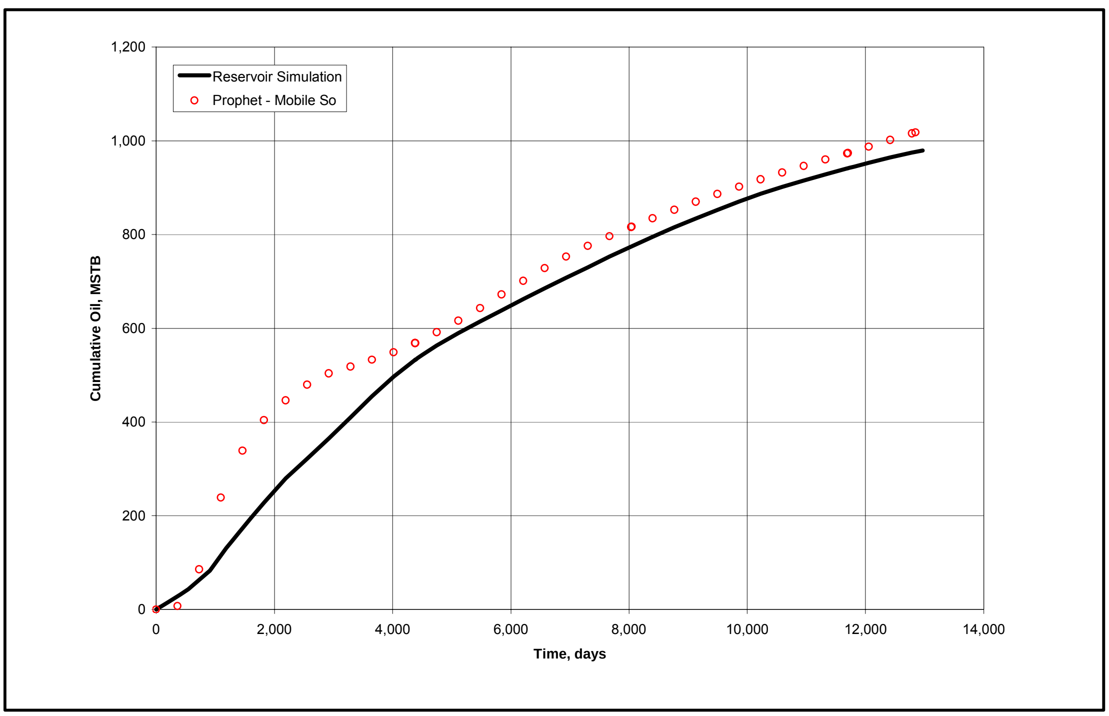



**Figure 35. Analysis of Simultaneous MPZ and TZ/ROZ Oil Recovery Simulation Results, Wasson Bennett Ranch Unit**

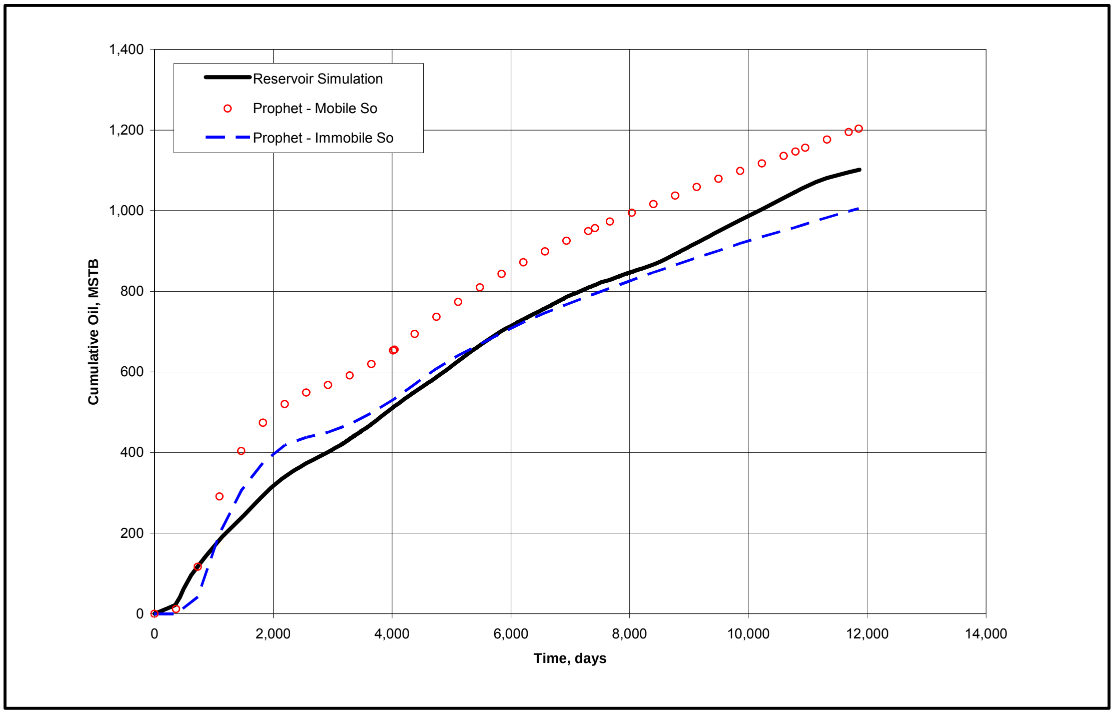



**Figure 36. Analysis of Simultaneous MPZ and TZ/ROZ Oil Recovery Simulation Results, Grayburg/Vacuum San Andres**

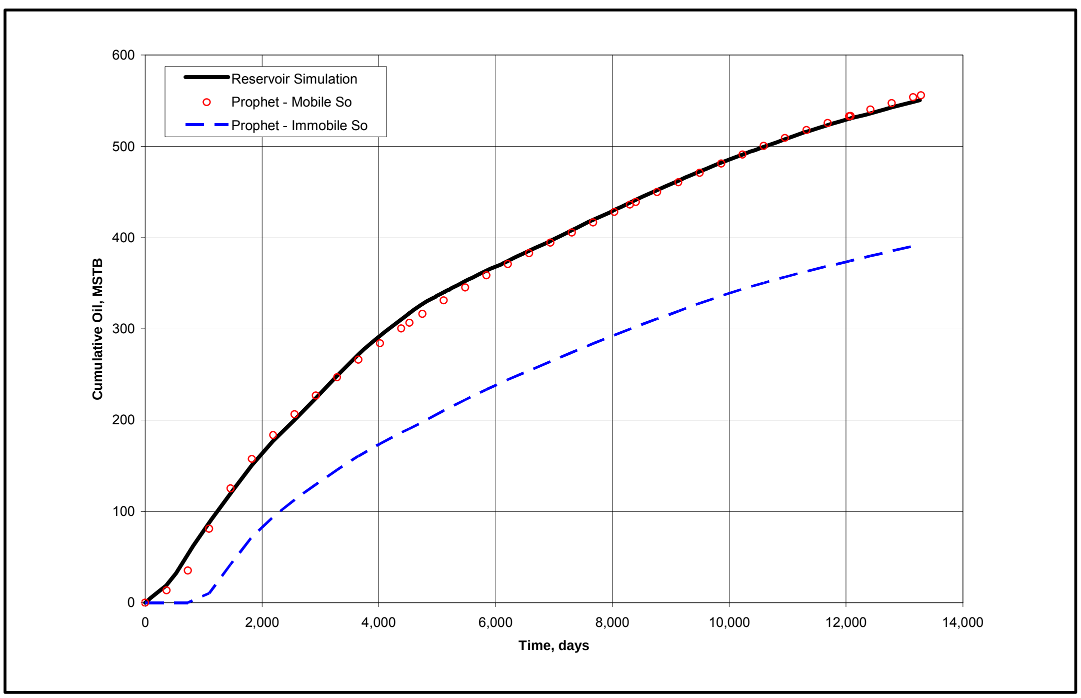



**Figure 37. Analysis of TZ/ROZ Oil RecoverySimulation Results, Robertson San Andres**

**Table 2** provides the model comparisons, with the ultimate oil recovery from these five sample oil fields scaled to field level. While oil recovery calculations for individual projects vary somewhat, the results are that overall the two models provide an excellent match of the aggregate oil production from the five fields.

**Table 2. Comparison of Compositional Model Simulation and *CO2-PROPHET* Model Simulation**

| Field/Unit | Compositional Model Simulation | *CO2-PROPHET* Model Simulation | % Difference Between Models |
|---|---|---|---|
| | Field Level Oil Recovery (MMB) | Field Level Oil Recovery (MMB) | |
| Seminole (San Andres Unit) | 696 | 569 | (18%) |
| Wasson (Denver Unit) | 1,054 | 1,064 | 1% |
| Wasson (Bennett Ranch Unit) | 172 | 179 | 4% |
| Vacuum (Grayburg/San Andres) | 529 | 577 | 9% |
| Robertson (San Andres) | 83 | 83 | - |
| **Total** | **2,534** | **2,473** | **(2%)** |

**C. Technically Recoverable Resources from the MPZ and ROZ.** Each model, the full-scale compositional simulator and *CO2-PROPHET*, provided estimates of 2.5 billion barrels of technically recoverable resources from applying $CO_2$-EOR to the remaining oil in-place in the combined MPZ and TZ/ROZ in the five study fields, **Table 3**. Of this, 1.4 billion barrels are from the TZ/ROZ and 1.1 billion barrels are from the MPZ in these five fields.

$CO_2$-EOR of the MPZ is underway in four of the five study fields, accounting for 0.65 billion barrels of past oil production and current reserves. After subtracting this oil production and reserves, the incremental oil resource from the MPZ would be 0.44 billion from the MPZ, **Table 4**.

**Table 3. Technical Oil Recovery Totals, Five Study Fields**

| Field/Unit | Total $CO_2$-EOR (MMB) | MPZ $CO_2$-EOR (MMB) | TZ/ROZ $CO_2$-EOR (MMB) |
|---|---|---|---|
| Seminole (San Andres Unit) | 569 | 268 | 301 |
| Wasson (Denver Unit) | 1,064 | 570 | 494 |
| Wasson (Bennett Ranch) | 179 | 84 | 95 |
| Vacuum (Grayburg/San Andres) | 577 | 172 | 405 |
| Robertson (San Andres) | 83 | - | 83 |
| Total | 2,473 | 1,094 | 1,379 |

$CO_2$-EOR of the TZ/ROZ is also underway in three of the five study fields, as discussed previously. However, the size of these pilot projects is small, and only limited data on the performances of these pilot projects is publicly available. Therefore, no reductions in the TZ/ROZ oil potential have been made in this study to account for the modest amount of past and ongoing TZ/ROZ development to date.

**Table 4. Estimates of On-Going MPZ $CO_2$-EOR, Five Study Fields**

| Field/Unit | Ultimate MPZ Only $CO_2$-EOR (MMB) | $CO_2$-EOR | | | Remaining MPZ Potential (MMB) |
|---|---|---|---|---|---|
| | | Cum. Prod. (MMB) | Reserves (MMB) | Total (MMB) | |
| Seminole (San Andres Unit) | 268 | (141)* | (126)* | (267)* | 1 |
| Wasson (Denver Unit) | 570 | (169) | (142) | (311) | 259 |
| Wasson (Bennett Ranch) | 84 | (3) | (10) | (13) | 71 |
| Vacuum (Grayburg/San Andres) | 172 | (25) | (34) | (59) | 113 |
| Robertson (San Andres) | - | - | - | - | - |
| Total | 1,094 | (338) | (312) | (650) | 444 |

*Excluding 8 MMB of estimated TZ/ROZ resource.

# V. OVERCOMING BARRIERS TO RECOVERING OIL FROM RESIDUAL OIL ZONES

The five sample fields – Seminole San Andres Unit, Wasson Denver Unit, Wasson Bennett Ranch Unit, Vacuum Grayburg/San Andres and Robertson San Andres – together hold an estimated oil in-place of approximately 3.8 billion barrels in their transitional and residual oil zones (See Appendix A). However, recovering this lower saturation oil will require overcoming numerous barriers and risks.

**A. Overview of Barriers.** Based on discussions with industry, there are two primary barriers to producing transition and residual oil zones with $CO_2$-EOR - - handing increased volumes of produced water and mitigating (or accelerating) the delayed oil response.

1. High Volumes of Produced Water**.** The transition and residual oil zones, because of their significant thickness and low oil saturation, can hold vast volumes of water. The estimated water in-place in the TZ/ROZ for the five study fields is nine billion barrels, with slightly more than half of this water volume being mobile. As such, production wells deepened to contact the transition and residual oil zones will initially produce significant volumes of water. (The produced water issue may become further complicated by the presence of a strong bottom water aquifer. Fortunately, many of the Permian Basin oil reservoirs have rather weak bottom water aquifers below the oil column.)

Should an operator determine the oil in-place target in the TZ/ROZ is worth the costs and risks of deepening wells and injecting $CO_2$, several steps can be taken to improve the produced oil cut and to minimize produced water, as discussed below.

- Selective ROZ Completion. First, since the transitional zone contains both mobile and residual oil and will most likely produce some oil initially, the inclusion of the full TZ in the TZ/ROZ $CO_2$-EOR project will help increase initial oil production, reducing the water cut.

Second, as shown in Figures 1 and 13, the ROZ oil saturation profile grades from a moderate residual oil saturation (35%) at the top of the ROZ to nearly 0% (100% water saturation) at the base of the ROZ. Depending on a field's oil saturation profile, the operator may wish to target only the upper, higher residual oil saturation portion of the ROZ, thus reducing the volume of produced water. For example, under an unfavorable oil saturation profile (with higher oil saturation at the top and low oil saturation at the bottom of the ROZ interval), one may wish to complete the well only in the upper portion of the residual oil zone. Under a more favorable oil saturation profile (with more uniform oil saturation across the ROZ interval), one may wish to target essentially the entire residual oil zone.

- Avoiding Water Coning in Production Wells. If water coning is an issue for the main pay zone $CO_2$ flood, it will, most likely, also be an issue for the ROZ $CO_2$-EOR flood. (Again, this may be less of an issue in settings with weak bottom water aquifers.) Mitigating water coning can be difficult, but steps can be taken through use of production well back-pressure controls, use of horizontal wells, and selective ROZ completion (as is used above) to enhance oil productivity and reduce water production.

  Permian Basin operators have a long history of dealing with high water cut oil production wells. Their experience in dealing with water handling issues will be most valuable when conducting a residual oil zone $CO_2$ flood.

2. Delayed Oil Response**.** Many $CO_2$-EOR field pilots and projects face the economic barrier of a delayed oil response, as the injected $CO_2$ must first mobilize the residual oil and then "drive" the oil to the surrounding production wells. Given the significant capital and $CO_2$ injection costs, a delayed oil response will greatly reduce the return

on investment. However, the delay in oil response may be reduced with closer well-spacing and higher $CO_2$ injection rates.

To improve oil recovery and project performance, one could flood the main pay zone, transition zone and residual oil zone simultaneously. Although pattern balancing would become more complex with the additional zones, a joint MPZ/TZ/ROZ flood would have numerous benefits - - an improved oil cut, improved oil recovery efficiency, and reduced upward $CO_2$ (and oil) migration from the TZ/ROZ into a previously $CO_2$ flooded MPZ. As such, simultaneous $CO_2$ flooding of the MPZ and TZ/ROZ will be one of the best strategies for reducing the delay in oil production. A joint flood will improve oil recovery efficiency not only from the TZ/ROZ, but also from the MPZ, due to the balance of pressures in each zone, and will reduce out-of-zone losses of $CO_2$.

Other options for reducing the delay in oil response include infill drilling (particularly by using horizontal wells) to intercept the oil bank and increasing the initial rate (and slug size) of $CO_2$ injection to stimulate earlier oil production.

**B. Evaluating Strategies for Overcoming Barriers.** The above discussion identified two primary “best practices”: 1) selectively completing the upper portion of the ROZ; and 2) simultaneously $CO_2$ flooding the MPZ and TZ/ROZ. These two strategies for more efficiently recovering oil resources from residual oil zones were explored through reservoir modeling.

***1. Performing Selective Zone Completions in the ROZ.*** To reduce water production and improve $CO_2$ utilization, the model assumes that the MPZ and TZ will be completed with the ROZ and that the primary variable will be the manner in which the ROZ is completed. Two primary ROZ completion options were explored: (1) completion of only the upper 60% of the ROZ; and (2) completion of the full ROZ interval. The two ROZ completion practices were further examined under variable oil saturation profiles and alternative vertical permeability situations.

- **Methodology**. Reservoir simulation was used to model the injection of one HCPV of $CO_2$ into the ROZ (only) zone. The Wasson Denver Unit's San Andres reservoir ROZ interval was used as the input data set. Two oil saturation profiles were used: (1) a uniform saturation through the ROZ (uniform); and, (2) a variable, high to low oil saturation through the ROZ (gradational). Finally, the vertical permeability was varied in the gradational oil saturation case.
- **Results. Table 5** shows the results for the two completion schemes (partial and full) and for each of the three sensitivity cases (uniform ROZ oil saturation, gradational ROZ oil saturation and gradational ROZ oil saturation with large vertical perm). These results are representative of a single forty acre, $CO_2$ EOR pattern.

The partial ROZ completion case outperforms the full ROZ completion case (in terms of $CO_2$-oil and water-oil ratios) and produces nearly as much oil. These results suggest that, in general, a partial ROZ completion should be considered. However, the full interaction of permeability and aquifer strength (not explored here) in combination with the oil saturation profile should be reviewed prior to making a final ROZ completion decision.

**Table 5. Results from Two ROZ Completion Schemes (Partial And Full)**

| Project | Cumulative Oil Production (MB) | Cumulative Gross $CO_2$ Injection (Bcf) | Gross $CO_2$/Oil Ratio (Mcf/B) | Cumulative Water Production (MB) | Producing Water-Oil Ratio (B/B) |
|---|---|---|---|---|---|
| 1. Uniform Oil Saturation | | | | | |
| Partial ROZ Completion | 273 | 6 | 22.0 | 2,439 | 8.9 |
| Full ROZ Completion | 280 | 10 | 35.7 | 3,965 | 14.1 |
| 2. Gradational Oil Saturation | | | | | |
| Partial ROZ Completion | 421 | 6 | 14.3 | 2,239 | 5.3 |
| Full ROZ Completion | 427 | 10 | 23.4 | 3,747 | 8.8 |
| 3. Gradational Oil Saturation/High Vertical Perm | | | | | |
| Partial ROZ Completion | 373 | 6 | 16.1 | 2,886 | 7.7 |
| Full ROZ Completion | 441 | 10 | 22.7 | 4,296 | 9.7 |

***2. Using Simultaneous MPZ and TZ/ROZ $CO_2$ Flooding.*** Significant efficiencies may also be gained by simultaneously $CO_2$ flooding the MPZ and the TZ/ROZ. Even where a MPZ $CO_2$ flood is already underway, the TZ/ROZ flood can be added. In fact, many of the Seminole San Andres Unit, the Wasson Denver Unit and the Wasson Bennett Ranch Unit patterns are now being developed using joint MPZ and TZ/ROZ $CO_2$ floods after initially $CO_2$ flooding the MPZ only.

- **Methodology**. Reservoir simulation was used to gain further understanding of simultaneously versus separately flooding the MPZ and TZ/ROZ zones. A 40 acre field pattern was modeled using an industry-standard compositional simulator. The input data drew on information from the Wasson Denver Unit's San Andres reservoir. The stacked pay included a 141 foot main pay zone, a 50 foot transition zone and a 150 foot residual oil zone. A weak Carter-Tracy aquifer was applied to the bottom of the reservoir to model water influx from the aquifer. Permeability was allowed to vary based on the Dykstra-Parsons coefficient, with an average permeability of 5 md.

Development of the reservoir started with a 2 HCPV of water flush into the main pay zone, simulating primary and secondary recovery, to reach residual oil saturation. Following the MPZ flush, 1 HCPV of $CO_2$ was injected using a coarsely tapered WAG scheme, which consisted of larger $CO_2$ slugs in the first 0.6 HCPV than in the remaining 0.4 HCPV of $CO_2$. Initially, this $CO_2$ flooding process was performed separately—first, in the main pay zone, and then followed by the transitional and residual oil zones. Next, both the main pay zone and the TZ/ROZ were $CO_2$ flooded simultaneously.

- **Results**. **Figure 32** shows the comparison of results for a forty acre pattern. The simultaneous MPZ+TZ/ROZ flood has a 25% higher oil recovery than the separate zone $CO_2$ flooding scheme. Further, oil production is accelerated, which should provide a superior economic return. Water production over the life of the each project is similar, **Table 6**.

A closer look at the reasons for the higher oil recovery efficiency from simultaneous flooding of the MPZ and TZ/ROZ shows a uniform distribution of pressure between the two zones, which limits out of zone flow and losses. In the separate case, each of the two flooding stages is plagued by out of zone flow (particularly upward flow by the injected $CO_2$), reducing the overall oil recovery and $CO_2$ utilization efficiency.

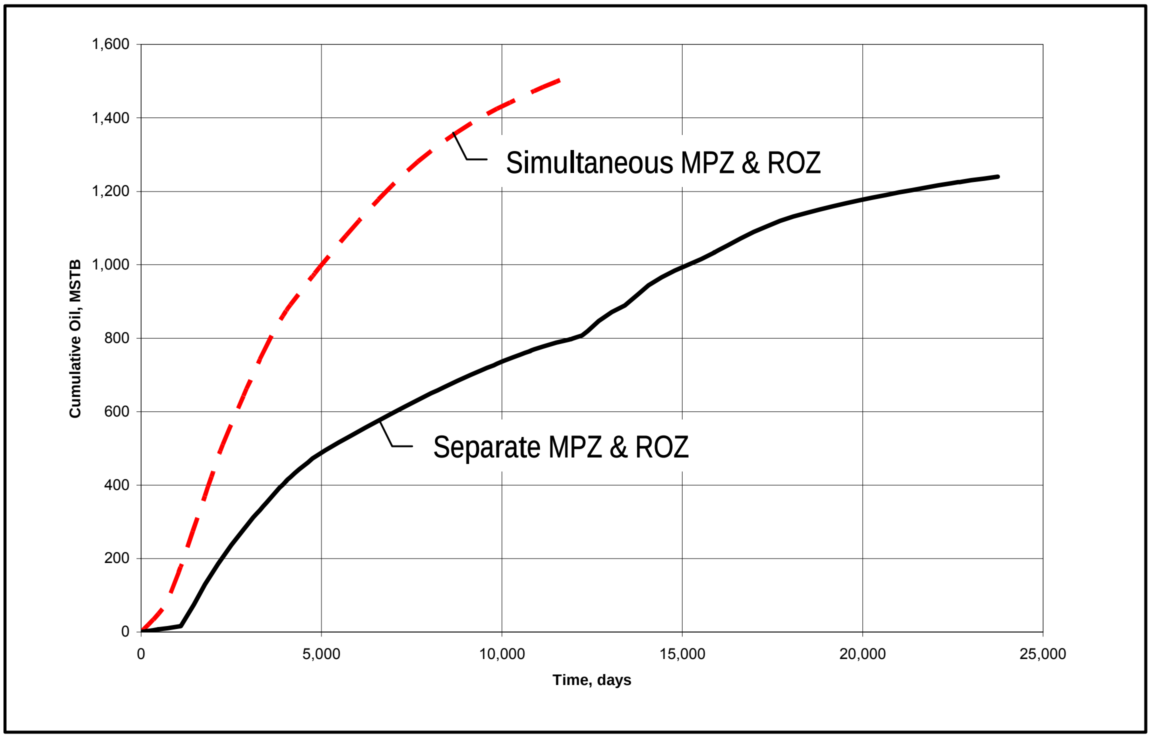



**Figure 32. Comparison of Simultaneous and Separate MPZ-ROZ CO2 Flooding, Sample Oil Reservoir**

**Table 6. Comparison of Separate vs. Simultaneous MPZ and TZ/ROZ $CO_2$-EOR Flooding: Sample Oil Reservoir**

| $CO_2$-EOR Strategy | Duration (Years) | Cumulative $CO_2$ Injection (Bcf) | Cumulative Oil (MMB) | Cumulative Water (MMB) |
|---|---|---|---|---|
| Separate MPZ and TZ/ROZ | 65.0 | 18.8 | 1.2 | 7.6 |
| Simultaneous MPZ and TZ/ROZ | 32.5 | 18.8 | 1.5 | 7.6 |

# VI. ECONOMICALLY RECOVERABLE OIL RESOURCES IN TRANSITION AND RESIDUAL OIL ZONES

In the previous chapters of this report, we presented the technically recoverable oil resource from the transition and residual oil zones. In this section, we will examine the question: *How much of the TZ/ROZ resource is economically recoverable from the five oil fields studied: Seminole, Wasson (Denver and Bennett Ranch Units), Vacuum and Robertson?*

**A. Basic Economic Model.** The basic economic model used in the analysis draws on the previously published economic models in the six state/region reports on "Basin Oriented Strategies for $CO_2$ Enhanced Recovery."[13] To reflect the specific cost and economic requirements of recovering oil from the TZ/ROZ of Permian Basin oil fields, four changes overall were made to the basic $CO_2$ –EOR economic model.

1. **Well Deepening.** A key requirement for targeting TZ/ROZ resources is deepening the existing production and injection wells. This involves:
    - Deepening of an existing well by 100 to 300 feet (depending on TZ/ROZ thickness)
    - Emplacement and perforation of well tubulars
    - Additional well workovers

2. **$CO_2$ Injection.** The costs of injecting $CO_2$ were estimated using the following pricing formula for Permian Basin oil fields:
    - Cost of Purchased $CO_2$ (per Mcf): 4 percent of oil price ($/Bbl)
    - Cost of Recycled $CO_2$ (per Mcf): 1 percent of oil price ($/Bbl)

[13] U.S. Department of Energy/Fossil Energy: Basin-Oriented Strategies for $CO_2$ Enhanced Oil Recovery: California, Onshore Gulf Coast, Offshore Louisiana, Oklahoma, Alaska, and Illinois, April 2005.

3. **<u>Oil Price.</u>** The oil price was assumed to be $35 per barrel (flat), with no basis differential. The oil gravity adjustment was based on a marker 40° API crude, using $0.25 per °API, above or below 40° API.

4. **<u>Economic Hurdle.</u>** The minimum economic threshold rate of return (ROR), before taxes, was set at 25%

**B. Individual Versus Simultaneous Flooding.** As set forth previously, based strictly on technically recoverable oil, a joint Main Pay Zone/Residual Oil Zone $CO_2$ flood was shown to be preferable to independently $CO_2$ flooding the MPZ and TZ/ROZ. To explore the economic implication of this choice, the Wasson Denver Unit simulations, discussed earlier, were used as input into the cost model.

In the individual zone $CO_2$ flood case, the MPZ is flooded first, which includes the drilling and re-working of wells, plus drilling new wells (as needed), to fully develop the field, and installation of a $CO_2$ recycle plant and trunkline. Following the completion of the MPZ flood, all wells are deepened and re-worked, and a new $CO_2$ recycle plant is installed for the TZ/ROZ flood. For the simultaneous MPZ/TZ/ROZ flood case, oil wells are drilled, deepened, and/or re-worked prior to flooding and only one larger $CO_2$ recycle plant is installated. **Table 7** shows the results of these two $CO_2$ –EOR flooding options.

The comparison of the individual $CO_2$ floods with the simultaneous $CO_2$ flood clearly shows the inefficiency of the individual zone $CO_2$ flooding scheme.

- First, the simultaneous MPZ and TZ/ROZ $CO_2$-EOR flood recovers an additional 151 million barrels of oil.
- Second, even though each of the $CO_2$-EOR flooding options injects 1 HCPV (13 Tcf of $CO_2$), the simultaneous $CO_2$-EOR flood requires less purchased (net) $CO_2$ due to fewer out-of-zone losses. This saves the simultaneous $CO_2$-EOR flood over $800 million.

- Finally, the largest single cost savings from conducting a simultaneous $CO_2$-EOR flood is $1,800 million of lower well O&M costs due to fewer required years for operating costs.

**Table 7. Economic Comparison of Individual Zone versus Simultaneous Zone $CO_2$-EOR: Wasson Denver Unit (San Andres Reservoir)**

| | MPZ Only Flood | TZ/ROZ Only Flood | Individual HPZ and TZ/ROZ Flows Total | Simultaneous MPZ and TZ/ROZ Flood |
|---|---|---|---|---|
| Oil Recovery (MMB) | 570 | 337 | 907 | 1,064 |
| % OOIP* | 24% | 11% | 17% | 20% |
| Net $CO_2$ Injection (Bcf) | 2,396 | 3,011 | 5,407 | 4,613 |
| Gross $CO_2$ Injection (Bcf) | 6,563 | 6,564 | 13,127 | 13,176 |
| Capital Investment ($10^6$$) | 474 | 651 | 1,125 | 1,067 |
| $CO_2$ Costs ($10^6$$) | 4,813 | 5,459 | 10,272 | 9,455 |
| O&M Costs ($10^6$$) | 2,719 | 2,730 | 5,449 | 3,632 |
| Total Costs ($10^6$$) | 8,006 | 8,803 | 16,846 | 14,154 |
| Economic Threshold (ROR>25%)** | Above Threshold | Below Threshold | n/a | Above Threshold |

*using MPZ/TZ/ROZ OOIP's (see Table B-2)
*Assumes long-term oil price of $35 per barrel, adjusted for gravity and location differentials; minimum threshold rate of return of 25% (real), before tax.

Operated independently, the main pay zone flood has a rate of return (ROR) above the minimum economic threshold. However, the TZ/ROZ-only flood does not reach this economic threshold. The simultaneous $CO_2$-EOR flood in the MPZ and TZ/ROZ does achieve an economic return, exceeding the minimum economic threshold. The detailed cash flows for this example are contained in Appendix C.

Applying the economic model to the simultaneous MPZ/TZ/ROZ flood in the remaining four fields (Wasson, Bennet Ranch Unit; Seminole; Robertson; and Vacuum) shows that simultaneous $CO_2$-EOR floods in the MPZ and TZ/ROZ will meet or exceed the economic threshold, **Table 8**. Detailed cash flows are provided in Appendix C.

**Table 8. Simultaneous MPZ and TZ/ROZ $CO_2$-EOR Flooding Results for Five Study Fields**

| | Wasson, Denver Unit | Wasson, Bennett Ranch Unit | Seminole San Andres Unit | Vacuum | Robertson |
|---|---|---|---|---|---|
| Oil Recovery (MMB) | 1,064 | 179 | 569 | 577 | 83 |
| % OOIP | 20% | 21% | 22% | 17% | 28% |
| Net $CO_2$ Injection (Bcf) | 4,613 | 628 | 1,847 | 1,970 | 263 |
| Gross $CO_2$ Injection (Bcf) | 13,176 | 2,469 | 5,620 | 7,761 | 792 |
| Capex ($10^6$\$) | 1,067 | 281 | 485 | 672 | 183 |
| $CO_2$ Costs ($10^6$\$) | 9,455 | 1,523 | 3,906 | 4,785 | 553 |
| O&M Costs ($10^6$\$) | 3,632 | 848 | 1,315 | 2,239 | 519 |
| Total Costs ($10^6$\$) | 14,154 | 2,652 | 5,706 | 7,696 | 1,255 |
| Economic Threshold (ROR>25%)** | above threshold | above threshold | above threshold | above threshold | above threshold |

*using MPZ/TZ/ROZ OOIP's (see Table B-2)
*Assumes long-term oil price of $35 per barrel, adjusted for gravity and location differentials; minimum threshold rate of return of 25% (real), before tax.

Based on the results shown above, each of the projects exceeds the 25% minimum rate of return hurdle rate, suggesting co-development of MZ and TZ/ROZ with $CO_2$ flooding is the optimum method for recovering oil from residual oil zones.

The Robertson Field (with a thin MPZ) also surpassed the minimum rate of return hurdle even though it is essentially a transition and residual oil target. Its strong economic performance is due to minimal upward losses of $CO_2$ and a favorable pressure balance, resulting in superior $CO_2$ contact with the reservoir's crude.

**C. Economically Recoverable Resources.** This study suggests that nearly 2.5 billion barrels of residual ("stranded") oil can be recovered from these five San Andres Reservoirs through joint $CO_2$-EOR flooding of the main and residual oil zones, **Table 9**. This resource potential includes nearly 1.4 billion barrels of additional oil recovery from the TZ/ROZ and 1.1 billion barrels of oil from the MPZ (based on *$CO_2$-PROPHET* results). (Of the 1.1 billion barrels estimated as recoverable due to $CO_2$-EOR in the MPZ in these five study fields, 0.6 billion barrels has already been produced or proven.)

These 1.4 billion barrels of oil represents a significant oil target that may remain un-produced if not jointly flooded with the MPZ.

**Table 9. CO2-EOR Project Recovery Totals for the Five Study Fields**

| Field/Unit | Total $CO_2$-EOR (MMB) | MPZ $CO_2$-EOR (MMB) | TZ/ROZ $CO_2$-EOR (MMB) |
|---|---|---|---|
| Seminole (San Andres Unit) | 569 | 268 | 301 |
| Wasson (Denver Unit) | 1,064 | 570 | 494 |
| Wasson (Bennett Ranch) | 179 | 84 | 95 |
| Vacuum | 577 | 172 | 405 |
| Robertson | 83 | - | 83 |
| Total | 2,473 | 1,094 | 1,379 |

**D. Marginal Economic Analysis.** Because the MPZ-only $CO_2$-EOR project is economic on its own, the question arises: *Does adding the TZ/ROZ and conducting a simultaneous $CO_2$-EOR flood in both zones help or hurt overall economics?* This question can be answered using marginal economic analyses.

To assess the marginal economics of adding the transition and residual oil zones to an MPZ only flood (thus creating a simultaneous flood), a marginal cost analysis was performed for the Wasson Denver Unit, first for the MPZ-only, and then for the simultaneous (MPZ and TZ/ROZ) $CO_2$-EOR flood. **Table 10** shows the results, in terms of capital investment, $CO_2$ costs and well operating and maintenance costs (both in total and in dollars-per-barrel) for conducting these two flooding strategies.

The MPZ-only $CO_2$-EOR flood is estimated to cost $8,006 million, resulting in a cost per barrel of oil recovered of $14.05. The simultaneous flood costs $14,104 million and yields $13.30 per barrel of oil recovered. On a marginal basis, the additional costs of conducting the TZ/ROZ CO2-EOR flood are equal to the difference between the simultaneous flood and the MPZ-only flood. As such, the TZ/ROZ $CO_2$ flood costs $6,148 million and, with additional oil recovery of 494 million barrels, it has a lower cost of $12.44 per barrel of oil recovered.  This shows that adding the TZ/ROZ project to the MPZ flood leads to a lower cost per barrel of oil recovered.

**Table 10.  Marginal Economic Analysis – MPZ Only and Simultaneous MPZ and TZ/ROZ Floods**

| | Cost for MPZ Only Flood | | Marginal Cost for TZ/ROZ Flood | | Cost for Simultaneous MPZ & TZ/ROZ Flood | |
|---|---|---|---|---|---|---|
| | | Cost ($/bbl) | | Costs ($/bbl) | | Cost ($/bbl) |
| Oil Recovery (MMB) | 570 | | 494 | | 1,064 | |
| Capex ($10^6$$) | $474 | 0.83 | $593 | 1.20 | $1,067 | 1.00 |
| $CO_2$ Costs ($10^6$$) | 4,813 | 8.44 | 4,642 | 9.40 | 9,455 | 8.89 |
| O&M Costs ($10^6$$) | 2,719 | 4.77 | 913 | 1.85 | 3,632 | 3.41 |
| Total | $8,006 | 14.05 | $6,148 | 12.44 | $14,154 | 13.30 |

# APPENDIX A

# OIL IN-PLACE FOR THE TZ AND ROZ

# CALCULATING THE OIL IN-PLACE FOR THE TZ AND ROZ

Due to the lack of deep TZ/ROZ penetrating wells in several of the study fields and a lack of suitable well logs to yield net pay or oil saturation profiles for the TZ/ROZ, six key assumptions were made to calculate the oil in-place in the transition and residual zones. These were: 1) the reservoir area of the TZ/ROZ is the same as the main pay zone; 2) the properties of the crude oil are the same for each of the three oil zones; 3) the reservoir porosity is the same for each of the three zones; 4) the reservoir area is assumed to be a 2:1 (length to width) rectangle; 5) the resulting ROZ is triangular in profile and wedge-shaped in 3-dimensions, with the largest ROZ height dimension at the aquifer entry point and essentially zero ROZ height dimension at the exit point; and 6) the residual oil saturation in the ROZ is the same as in the water swept zone of the main pay zone.

These assumptions, plus a simple calculation, can be used to convert the reservoir area (in acres), to the length and width of the ROZ for each reservoir. The OWC tilt (derived from a mapping of the lifted OWC), in feet per mile, is then be used to determine the maximum height of the ROZ wedge. (The average thickness of the ROZ is half of the maximum height.) Given these reservoir volume parameters and the above assumptions, the oil in-place in the ROZ can be calculated. When log-based values were available for oil saturation or the ROZ thickness, such as for the Seminole (San Andres Unit) and Wasson (Denver Unit) fields, these log-derived values were used.

For the transitional zone, the net pay is assumed to be a constant 50 feet, based on available saturation profiles and capillary pressure data, and the average oil saturation is estimated to be 50%.

**Table A-1** shows the key input parameters and calculated oil in-place for the five reservoirs examined by this study.

**Table A-1. Key Inputs for Calculating ROZ Oil In-Place for the Five Study Fields**

| Field | Area (acres) | OWC Tilt (ft/mile) | Average Net Pay (ft) | $S_{or}$ (%) | Porosity (%) | ROZ OIP (MMbbl) |
|---|---|---|---|---|---|---|
| Seminole (San Andres Unit) | 15,700 | 20 | 100 | 32.0 | 13 | 365 |
| Wasson (Denver Unit) | 27,848 | 30 | 150 | 35.0 | 12 | 1,039 |
| Wasson (Bennett Ranch Unit) | 7,027 | 30 | 150 | 35.0 | 11 | 240 |
| Vacuum (Grayburg/San Andres Unit) | 19,200 | 50 | 194 | 31.4 | 11.3 | 781 |
| Robertson (San Andres) | 6,000 | 30 | 65 | 35.0 | 11 | 94 |

**Table A-2** presents the individual MPZ, TZ, and ROZ oil in-place estimates as well as the total TZ/ROZ oil in-place for each of the five study fields.

**Table A-2. Oil In-Place in the Main Pay, Transitional, and Residual Oil Zones for Five Study Fields**

| Field | ROIP MPZ (MMbbl) | TZ (MMbbl) | ROZ (MMbbl) | Total TZ/ROZ (MMbbl) |
|---|---|---|---|---|
| Seminole (San Andres Unit) | 868 | 285 | 365 | 650 |
| Wasson (Denver Unit) | 1,273 | 495 | 1,039 | 1,534 |
| Wasson (Bennett Ranch Unit) | 213 | 114 | 240 | 354 |
| Vacuum (Grayburg/San Andres Unit) | 648 | 321 | 781 | 1,102 |
| Robertson (San Andres) | 5 | 103 | 94 | 197 |
| Total | 3,007 | 1,318 | 2,519 | 3,837 |

The oil in-place from **Table A-2** was used as input data for calculating of oil recovery.

It is significant to note that the oil in-place in the TZ/ROZ (3.8 billion bbls) in the five study fields is larger than the estimated remaining oil in-place (ROIP) of the MPZ (3.0 billion bbls) in these five fields.

# APPENDIX B

# ADJUSTING THE ROZ OIL IN-PLACE VALUES FOR COMPARISONS OF OIL RECOVERY EFFICIENCY

## ADJUSTING THE ROZ OIL IN-PLACE VALUES

Application of $CO_2$-EOR to the MPZ plus TZ/ROZ in the five study oil fields shows a recovery of nearly 2.5 billion barrels (assuming simultaneous application of $CO_2$-EOR). As a percentage the MPZ OOIP and TZ/ROZ OIP this results in 28% oil recovery efficiency (**Table B-1**).

**Table B-1. CO2-EOR Project Recovery Totals**

| Project | MPZ OOIP and TZ/ROZ OIP (MMbbl) | Original MPZ, TZ, and ROZ OOIP (MMbbl) | Total EOR Oil (MMbbl) | Recovery Efficiency | |
|---|---|---|---|---|---|
| | | | | % OOIP/OIP | % Original OOIP |
| Seminole (San Andres Unit) | 2,003 | 2,643 | 569 | 28% | 22% |
| Wasson (Denver Unit) | 3,906 | 5,390 | 1,064 | 27% | 20% |
| Wasson (Bennett Ranch Unit) | 642 | 834 | 179 | 28% | 21% |
| Vacuum (Grayburg/San Andres Unit) | 2,101 | 3,360 | 577 | 27% | 17% |
| Robertson (San Andres) | 204 | 298 | 83 | 41% | 28% |
| Total | 8,856 | 12,525 | 2,473 | 28% | 20% |

While a 28% of OOIP recovery factor appears high, this value requires some adjustments to make it comparable with standard industry reporting practices of oil recovery efficiency. Due to hydrodynamic forces, or “mother nature’s” waterflood, a portion of the original oil in-place in the ROZ has been swept from the reservoir, leaving behind a smaller remaining OIP. To put the recovery in terms of the original oil in-place, the ROZ OOIP needs to be calculated prior to “mother nature’s” waterflood. This calculation is provided in **Table B-2** and summarized on **Table B-1**. (Note that due to capillary forces, the oil in-place in the transitional zone is deemed to be both the original and the remaining oil in-place and thus is not altered.)

**Table B-2. $CO_2$-EOR Project Recovery Totals Restated to True OOIP**

| Project | Residual ROZ OIP (MMbbl) | Original ROZ OIP (MMbbl) | TZ OOIP (MMbbl) | Total ROZ/TZ OOIP (MMbbl) | MPZ OOIP (MMbbl) | Total OOIP (MMbbl) |
|---|---|---|---|---|---|---|
| Seminole (San Andres Unit) | 365 | 1,005 | 285 | 1,290 | 1,353 | 2,643 |
| Wasson (Denver Unit) | 1,039 | 2,523 | 495 | 3,018 | 2,372 | 5,390 |
| Wasson (Bennett Ranch Unit) | 240 | 480 | 114 | 594 | 288 | 834 |
| Vacuum | 781 | 2,040 | 321 | 2,361 | 999 | 3,360 |
| Robertson | 94 | 188 | 103 | 291 | 7 | 298 |
| Total | 2,519 | 6,236 | 1,318 | 7,554 | 4,971 | 12,525 |

Adjusting the OIP in the ROZ to original conditions increases the OOIP and reduces the overall recovery efficiency to 20%, **Table B-1**.

# APPENDIX C

# ECONOMIC ANALYSES OF FIVE PERMIAN BASIN SAN ANDRES RESERVOIRS

1. Seminole (San Andres Unit)
2. Wasson (Denver Unit)
   - Simultaneous MPZ & TZ/ROZ
   - Individual MPZ
   - Individual TZ/ROZ
3. Wasson (Bennett Ranch Unit)
4. Vacuum
5. Robertson

| | |
|---|---|
| **Basin** | **Permian (West Texas 8A)** |
| **Field** | **SEMINOLE (SAN ANDRES UNIT)** |
| **Formation** | **SAN ANDRES** |
| **Technology Case** | **MPZ + TZ / ROZ (Simultaneous)** |
| Depth (ft) | 5,262 |
| Total OOIP (MMBls) | 2,643 |
| Cumulative Recovery (MMbls) * | 1,119 |
| EUR (MMbls) * | 1,124 |
| Total ROIP (MMbls) | 1,519 |
| API Gravity | 35 |
| Patterns | 196 |
| Existing Injectors Used | 184 |
| Converted Producers Used | 12 |
| New Injectors Drilled | 0 |
| Existing Producers Used | 225 |
| New Producers Drilled | 0 |

**Pattern Detail**

| | | | |
|---|---|---|---|
| Cum Oil (Mbbl) | 2,903 | | |
| Cum H2O (Mbw) | 12,226 | 4.21 | Bw/Bbl |
| Gross CO2 (MMcf) | 28,674 | 9.88 | Mcf/Bbl |
| Purchased CO2 (MMcf) | 9,756 | 3.36 | Mcf/Bbl |
| Recycled CO2 (MMcf) | 18,919 | 6.52 | Mcf/Bbl |

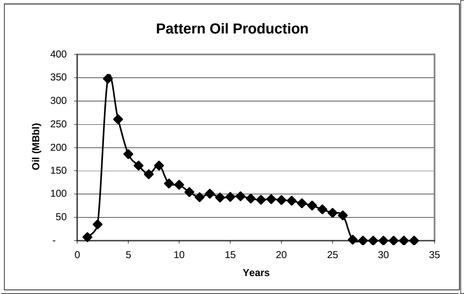
**Field Detail**

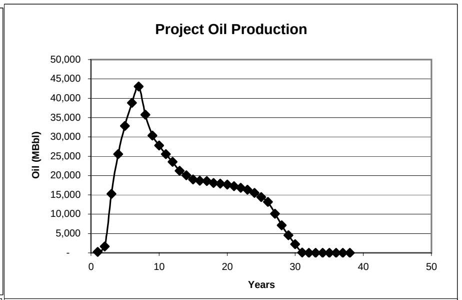
| | | |
|---|---|---|
| Cum Oil (MMbbl) | 568.99 | |
| % OOIP Recovered | 21.5% | |
| Cum H2O (MMbw) | 2,396 | |
| Gross CO2 (MMcf) | 5,620,182 | |
| Purchased CO2 (MMcf) | 1,846,971 | |
| Recycled CO2 (MMcf) | 3,773,212 | |
| Payback Period (per pattern) | 3 | years |
| Project Length | 31 | years |

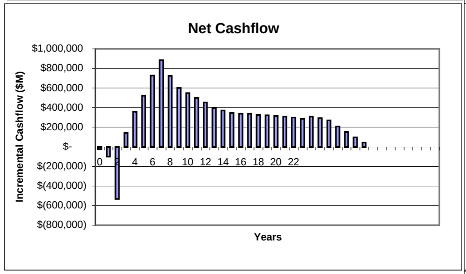
**Field Economics**

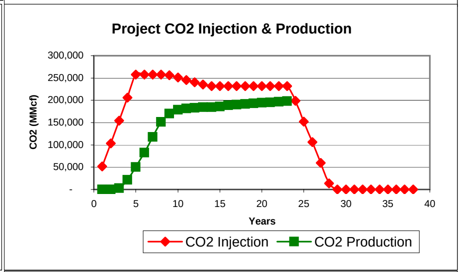
| | | $/BBl |
|---|---|---|
| Total Net Revenue ($M) | $ 15,542,707 | |
| Total Capital Investment ($M) | $ (485,395) | $ 0.85 |
| Total CO2 Cost ($M) | $ (3,906,383) | $ 6.87 |
| Total O&M Costs ($M) | $ (1,315,369) | $ 2.31 |
| | $ (5,707,148) | $ 10.03 |

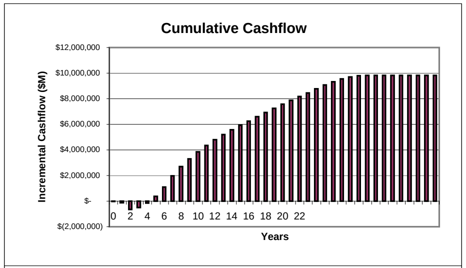
*Includes "Mother Nature's" waterflood oil displacement of 639 million barrels

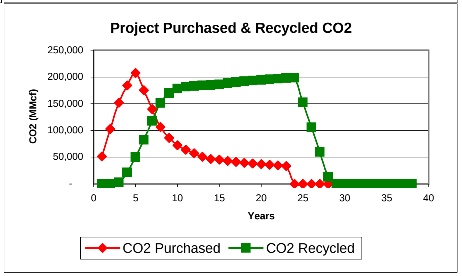


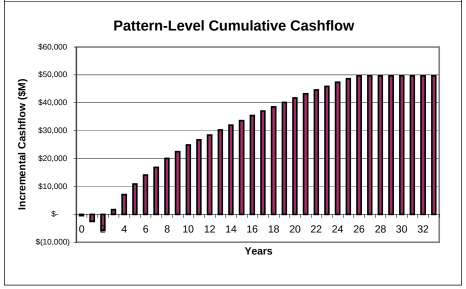




**Assumptions:**

| | |
|---|---|
| Oil Price | $ 35.00 |
| CO2 Purchase Cost | 4% of oil price |
| CO2 Recycle Cost | 1% of oil price |
| | |
| Recycling Plant Costs | 1 Year before Breakthru |
| Well O&M | Prod Wells Only |

**Field Cashflow Model**

| | |
|---|---|
| **State** | Permian (West Texas 8A) |
| **Field** | SEMINOLE (SAN ANDRES UNIT) |
| **Formation** | SAN ANDRES |
| **Depth** | 5262 |
| **Distance from Trunkline** | 10 miles |
| **# of Patterns** | 196.00 |
| **Miscibility:** | Miscible |

| Pattern | | Field | |
|---|---|---|---|
| Existing Injectors Used | 0.94 | Existing Injectors Used | 184 |
| Converted Producers Used | 0.06 | Converted Producers Used | 12 |
| New Injectors Needed | 0.00 | New Injectors Needed | 0 |
| New Producers Needed | 0.00 | New Producers Needed | 0 |
| Existing Producers Used | 1.15 | Existing Producers Used | 225 |

| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | | | 51,544 | 103,088 | 154,636 | 206,180 | 257,724 | 257,724 | 257,728 | 257,724 |
| $H_2O$ Injection (Mbw) | | | 12,885 | 25,774 | 38,659 | 51,544 | 64,433 | 64,433 | 64,429 | 64,429 |
| Oil Production (Mbbl) | | | 290 | 1,666 | 15,296 | 25,519 | 32,795 | 38,820 | 43,042 | 35,723 |
| $H_2O$ Production (MBw) | | | 36,977 | 72,838 | 94,750 | 112,524 | 128,874 | 107,306 | 86,338 | 78,082 |
| $CO_2$ Production (MMcf) | | | - | - | 2,815 | 21,787 | 50,184 | 82,657 | 117,776 | 151,151 |
| $CO_2$ Purchased (MMcf) | | | 51,544 | 103,088 | 151,822 | 184,393 | 207,540 | 175,067 | 139,952 | 106,573 |
| $CO_2$ Recycled (MMcf) | | | - | - | 2,815 | 21,787 | 50,184 | 82,657 | 117,776 | 151,151 |
| Oil Price ($/Bbl) | $ 35.00 | | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | 35 | | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 |
| Gross Revenues ($M) | | | $ 9,790 | $ 56,228 | $ 516,235 | $ 861,273 | $ 1,106,822 | $ 1,310,167 | $ 1,452,654 | $ 1,205,650 |
| Royalty ($M) | -12.5% | | $ (1,224) | $ (7,028) | $ (64,529) | $ (107,659) | $ (138,353) | $ (163,771) | $ (181,582) | $ (150,706) |
| Severance Taxes ($M) | -5.0% | | $ (428) | $ (2,460) | $ (22,585) | $ (37,681) | $ (48,423) | $ (57,320) | $ (63,554) | $ (52,747) |
| Ad Valorum ($M) | -2.5% | | $ (214) | $ (1,230) | $ (11,293) | $ (18,840) | $ (24,212) | $ (28,660) | $ (31,777) | $ (26,374) |
| Net Revenue($M) | | | $ 7,924 | $ 45,509 | $ 417,827 | $ 697,093 | $ 895,834 | $ 1,060,416 | $ 1,175,742 | $ 975,823 |
| **Capital Costs ($M)** | | | | | | | | | | |
| New Well - D&C | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | | $ (13,417) | $ (13,417) | $ (13,417) | $ (13,417) | $ (13,417) | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | | $ (3,517) | $ (3,517) | $ (3,517) | $ (3,517) | $ (3,517) | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | | $ (70) | $ (70) | $ (70) | $ (70) | $ (70) | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | | $ (2,460) | $ (2,460) | $ (2,460) | $ (2,460) | $ (2,460) | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | | $ - | $ - | $ (384,250) | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | | $ (3,819) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | | $ (23,284) | $ (19,465) | $ (403,715) | $ (19,465) | $ (19,465) | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | | | $ (72,162) | $ (144,323) | $ (213,535) | $ (265,776) | $ (308,121) | $ (274,024) | $ (237,154) | $ (202,105) |
| **O&M Costs ($M)** | | | | | | | | | | |
| Operating & Maintenance ($M) | | | $ (2,628) | $ (5,257) | $ (7,885) | $ (10,514) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) |
| Lifting Costs ($M) | | | $ (9,317) | $ (18,626) | $ (27,512) | $ (34,511) | $ (40,417) | $ (36,531) | $ (32,345) | $ (28,451) |
| G&A | 20% | | (2,389) | (4,777) | (7,079) | (9,005) | (10,712) | (9,935) | (9,097) | (8,319) |
| Total O&M Costs | | | $ (14,334) | $ (28,659) | $ (42,476) | $ (54,029) | $ (64,271) | $ (59,608) | $ (54,585) | $ (49,912) |
| Net Cash Flow ($M) | | $ (23,284) | $ (98,037) | $ (531,189) | $ 142,351 | $ 357,823 | $ 523,442 | $ 726,784 | $ 884,003 | $ 723,805 |
| Cum. Cash Flow | | $ (23,284) | $ (121,322) | $ (652,511) | $ (510,160) | $ (152,337) | $ 371,104 | $ 1,097,888 | $ 1,981,891 | $ 2,705,697 |
| Discount Factor | 25% | 1.00 | 0.80 | 0.64 | 0.51 | 0.41 | 0.33 | 0.26 | 0.21 | 0.17 |
| Disc. Net Cash Flow | | $ (23,284) | $ (78,430) | $ (339,961) | $ 72,884 | $ 146,564 | $ 171,521 | $ 190,522 | $ 185,389 | $ 121,434 |
| Disc. Cum Cash Flow | | $ (23,284) | $ (101,714) | $ (441,675) | $ (368,792) | $ (222,227) | $ (50,706) | $ 139,816 | $ 325,205 | $ 446,639 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 256,270 | 251,025 | 245,776 | 240,527 | 235,282 | 231,488 | 231,488 | 231,492 | 231,492 | 231,488 | 231,492 |
| $H_2O$ Injection (Mbw) | 65,158 | 67,781 | 70,403 | 73,030 | 75,656 | 77,549 | 77,549 | 77,549 | 77,549 | 77,549 | 77,549 |
| Oil Production (Mbbl) | 30,317 | 27,750 | 25,527 | 23,575 | 21,223 | 20,039 | 19,024 | 18,663 | 18,569 | 18,056 | 17,907 |
| $H_2O$ Production (MBw) | 74,829 | 73,567 | 74,441 | 75,864 | 77,930 | 79,062 | 79,615 | 78,706 | 77,839 | 77,698 | 77,220 |
| $CO_2$ Production (MMcf) | 169,869 | 178,415 | 181,712 | 183,244 | 184,295 | 184,691 | 185,737 | 188,438 | 190,473 | 191,888 | 193,225 |
| $CO_2$ Purchased (MMcf) | 86,401 | 72,610 | 64,065 | 57,283 | 50,987 | 46,797 | 45,750 | 43,053 | 41,019 | 39,600 | 38,267 |
| $CO_2$ Recycled (MMcf) | 169,869 | 178,415 | 181,712 | 183,244 | 184,295 | 184,691 | 185,737 | 188,438 | 190,473 | 191,888 | 193,225 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 |
| Gross Revenues ($M) | $ 1,023,208 | $ 936,552 | $ 861,538 | $ 795,652 | $ 716,272 | $ 676,318 | $ 642,052 | $ 629,880 | $ 626,705 | $ 609,374 | $ 604,346 |
| Royalty ($M) | $ (127,901) | $ (117,069) | $ (107,692) | $ (99,457) | $ (89,534) | $ (84,540) | $ (80,256) | $ (78,735) | $ (78,338) | $ (76,172) | $ (75,543) |
| Severance Taxes ($M) | $ (44,765) | $ (40,974) | $ (37,692) | $ (34,810) | $ (31,337) | $ (29,589) | $ (28,090) | $ (27,557) | $ (27,418) | $ (26,660) | $ (26,440) |
| Ad Valorum ($M) | $ (22,383) | $ (20,487) | $ (18,846) | $ (17,405) | $ (15,668) | $ (14,794) | $ (14,045) | $ (13,779) | $ (13,709) | $ (13,330) | $ (13,220) |
| Net Revenue($M) | $ 828,159 | $ 758,022 | $ 697,307 | $ 643,981 | $ 579,733 | $ 547,395 | $ 519,661 | $ 509,809 | $ 507,239 | $ 493,212 | $ 489,143 |
| **Capital Costs ($M)** | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (180,415) | $ (164,099) | $ (153,289) | $ (144,332) | $ (135,886) | $ (130,158) | $ (129,059) | $ (126,228) | $ (124,092) | $ (122,601) | $ (121,202) |
| **O&M Costs ($M)** | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) |
| Lifting Costs ($M) | $ (26,287) | $ (25,329) | $ (24,992) | $ (24,860) | $ (24,788) | $ (24,775) | $ (24,660) | $ (24,342) | $ (24,102) | $ (23,938) | $ (23,782) |
| G&A | (7,886) | (7,694) | (7,627) | (7,600) | (7,586) | (7,584) | (7,560) | (7,497) | (7,449) | (7,416) | (7,385) |
| Total O&M Costs | $ (47,315) | $ (46,166) | $ (45,761) | $ (45,602) | $ (45,516) | $ (45,501) | $ (45,362) | $ (44,981) | $ (44,693) | $ (44,497) | $ (44,309) |
| Net Cash Flow ($M) | $ 600,429 | $ 547,757 | $ 498,257 | $ 454,047 | $ 398,331 | $ 371,736 | $ 345,240 | $ 338,600 | $ 338,454 | $ 326,115 | $ 323,632 |
| Cum. Cash Flow | $ 3,306,126 | $ 3,853,883 | $ 4,352,139 | $ 4,806,186 | $ 5,204,517 | $ 5,576,253 | $ 5,921,493 | $ 6,260,093 | $ 6,598,547 | $ 6,924,662 | $ 7,248,293 |
| Discount Factor | 0.13 | 0.11 | 0.09 | 0.07 | 0.05 | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 | 0.01 |
| Disc. Net Cash Flow | $ 80,588 | $ 58,815 | $ 42,800 | $ 31,202 | $ 21,898 | $ 16,349 | $ 12,147 | $ 9,531 | $ 7,621 | $ 5,875 | $ 4,664 |
| Disc. Cum Cash Flow | $ 527,228 | $ 586,042 | $ 628,842 | $ 660,044 | $ 681,943 | $ 698,292 | $ 710,439 | $ 719,970 | $ 727,591 | $ 733,466 | $ 738,130 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 231,492 | 231,488 | 231,488 | 231,492 | 198,607 | 152,308 |
| $H_2O$ Injection (Mbw) | 77,549 | 77,549 | 77,549 | 77,545 | 93,990 | 117,137 |
| Oil Production (Mbbl) | 17,624 | 17,252 | 16,836 | 16,339 | 15,484 | 14,402 |
| $H_2O$ Production (MBw) | 76,891 | 76,789 | 76,699 | 76,558 | 77,220 | 87,365 |
| $CO_2$ Production (MMcf) | 194,538 | 195,553 | 196,666 | 198,042 | 200,359 | 183,899 |
| $CO_2$ Purchased (MMcf) | 36,954 | 35,935 | 34,821 | 33,449 | - | - |
| $CO_2$ Recycled (MMcf) | 194,538 | 195,553 | 196,666 | 198,042 | 198,607 | 152,308 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 |
| Gross Revenues ($M) | $ 594,821 | $ 582,252 | $ 568,229 | $ 551,426 | $ 522,585 | $ 486,070 |
| Royalty ($M) | $ (74,353) | $ (72,782) | $ (71,029) | $ (68,928) | $ (65,323) | $ (60,759) |
| Severance Taxes ($M) | $ (26,023) | $ (25,474) | $ (24,860) | $ (24,125) | $ (22,863) | $ (21,266) |
| Ad Valorum ($M) | $ (13,012) | $ (12,737) | $ (12,430) | $ (12,062) | $ (11,432) | $ (10,633) |
| Net Revenue($M) | $ 481,433 | $ 471,260 | $ 459,910 | $ 446,311 | $ 422,967 | $ 393,413 |
| **Capital Costs ($M)** | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | |
| Total $CO_2$ Cost ($M) | $ (119,824) | $ (118,752) | $ (117,583) | $ (116,144) | $ (69,512) | $ (53,308) |
| **O&M Costs ($M)** | | | | | | |
| Operating & Maintenance ($M) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) | $ (13,142) |
| Lifting Costs ($M) | $ (23,629) | $ (23,510) | $ (23,384) | $ (23,224) | $ (23,176) | $ (25,442) |
| G&A | (7,354) | (7,330) | (7,305) | (7,273) | (7,264) | (7,717) |
| Total O&M Costs | $ (44,125) | $ (43,983) | $ (43,831) | $ (43,640) | $ (43,582) | $ (46,301) |
| Net Cash Flow ($M) | $ 317,484 | $ 308,525 | $ 298,496 | $ 286,527 | $ 309,873 | $ 293,805 |
| Cum. Cash Flow | $ 7,565,778 | $ 7,874,303 | $ 8,172,799 | $ 8,459,326 | $ 8,769,199 | $ 9,063,004 |
| Discount Factor | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 |
| Disc. Net Cash Flow | $ 3,660 | $ 2,846 | $ 2,203 | $ 1,691 | $ 1,463 | $ 1,110 |
| Disc. Cum Cash Flow | $ 741,790 | $ 744,636 | $ 746,838 | $ 748,530 | $ 749,993 | $ 751,103 |

| | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 106,012 | 59,713 | 13,414 | - | - | - |
| $H_2O$ Injection (Mbw) | 140,289 | 126,381 | 110,873 | 78,921 | 40,262 | 1,603 |
| Oil Production (Mbbl) | 13,167 | 10,110 | 7,162 | 4,532 | 2,203 | 78 |
| $H_2O$ Production (MBw) | 103,649 | 89,666 | 74,225 | 58,388 | 32,932 | 1,376 |
| $CO_2$ Production (MMcf) | 154,801 | 115,303 | 75,272 | 33,532 | 10,690 | 302 |
| $CO_2$ Purchased (MMcf) | - | - | - | - | - | - |
| $CO_2$ Recycled (MMcf) | 106,012 | 59,713 | 13,414 | - | - | - |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 | $ 33.75 |
| Gross Revenues ($M) | $ 444,396 | $ 341,202 | $ 241,712 | $ 152,939 | $ 74,353 | $ 2,646 |
| Royalty ($M) | $ (55,549) | $ (42,650) | $ (30,214) | $ (19,117) | $ (9,294) | $ (331) |
| Severance Taxes ($M) | $ (19,442) | $ (14,928) | $ (10,575) | $ (6,691) | $ (3,253) | $ (116) |
| Ad Valorum ($M) | $ (9,721) | $ (7,464) | $ (5,287) | $ (3,346) | $ (1,626) | $ (58) |
| Net Revenue($M) | $ 359,683 | $ 276,160 | $ 195,636 | $ 123,785 | $ 60,179 | $ 2,142 |
| **Capital Costs ($M)** | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | |
| Total $CO_2$ Cost ($M) | $ (37,104) | $ (20,900) | $ (4,695) | $ - | $ - | $ - |
| **O&M Costs ($M)** | | | | | | |
| Operating & Maintenance ($M) | $ (13,142) | $ (13,142) | $ (10,514) | $ (7,885) | $ (5,257) | $ (2,628) |
| Lifting Costs ($M) | $ (29,204) | $ (24,944) | $ (20,347) | $ (15,730) | $ (8,784) | $ (364) |
| G&A | (8,469) | (7,617) | (6,172) | (4,723) | (2,808) | (598) |
| Total O&M Costs | $ (50,815) | $ (45,703) | $ (37,033) | $ (28,338) | $ (16,849) | $ (3,590) |
| Net Cash Flow ($M) | $ 271,763 | $ 209,557 | $ 153,908 | $ 95,446 | $ 43,330 | $ (1,449) |
| Cum. Cash Flow | $ 9,334,767 | $ 9,544,324 | $ 9,698,232 | $ 9,793,678 | $ 9,837,009 | $ 9,835,560 |
| Discount Factor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Disc. Net Cash Flow | $ 821 | $ 507 | $ 298 | $ 148 | $ 54 | $ (1) |
| Disc. Cum Cash Flow | $ 751,924 | $ 752,431 | $ 752,729 | $ 752,876 | $ 752,930 | $ 752,928 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 32 | 33 | 34 | 35 | 36 | 37 | 38 | Totals |
|---|---|---|---|---|---|---|---|---|
| CO2 Injection (MMcf) | - | - | - | - | - | - | - | 5,620,182 |
| H2O Injection (Mbw) | - | - | - | - | - | - | - | 2,223,561 |
| Oil Production (Mbbl) | - | - | - | - | - | - | - | 568,988 |
| H2O Production (MBw) | - | - | - | - | - | - | - | 2,396,218 |
| CO2 Production (MMcf) | - | - | - | - | - | - | - | 4,017,314 |
| CO2 Purchased (MMcf) | - | - | - | - | - | - | - | 1,846,971 |
| CO2 Recycled (MMcf) | - | - | - | - | - | - | - | 3,773,212 |
| Oil Price ($/Bbl) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | |
| Gravity Adjustment | $ (1.25) | $ (1.25) | $ (1.25) | $ (1.25) | $ (1.25) | $ (1.25) | $ - | |
| Gross Revenues ($M) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ 19,203,345 |
| Royalty ($M) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (2,400,418) |
| Severance Taxes ($M) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (840,146) |
| Ad Valorum ($M) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (420,073) |
| Net Revenue($M) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ 15,542,707 |
| **Capital Costs ($M)** | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (67,086) |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (17,585) |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (352) |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (12,302) |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| CO2 Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (384,250) |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (3,819) |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (485,395) |
| **CO2 Costs ($M)** | | | | | | | | |
| Total CO2 Cost ($M) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (3,906,383) |
| **O&M Costs ($M)** | | | | | | | | |
| Operating & Maintenance ($M) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (354,840) |
| Lifting Costs ($M) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (741,301) |
| G&A | - | - | - | - | - | - | - | $ (219,228) |
| Total O&M Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (1,315,369) |
| Net Cash Flow ($M) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ 9,835,560 |
| Cum. Cash Flow | $ 9,835,560 | $ 9,835,560 | $ 9,835,560 | $ 9,835,560 | $ 9,835,560 | $ 9,835,560 | ######## | |
| Discount Factor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| Disc. Net Cash Flow | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ 752,928 |
| Disc. Cum Cash Flow | $ 752,928 | $ 752,928 | $ 752,928 | $ 752,928 | $ 752,928 | $ 752,928 | $ 752,928 | |

| | |
|---|---|
| **Basin** | **Permian (West Texas 8A)** |
| **Field** | **WASSON (DENVER UNIT)** |
| **Formation** | **SAN ANDRES** |
| **Technology Case** | **MPZ + TZ / ROZ (Simultaneous)** |
| Depth (ft) | 5,380 |
| Total OOIP (MMBls) | 5,390 |
| Cumulative Recovery (MMbls) * | 2,526 |
| EUR (MMbls) * | 2,583 |
| Total ROIP (MMbls) | 2,807 |
| API Gravity | 33 |
| Patterns | 696 |
| Existing Injectors Used | 696 |
| Converted Producers Used | 0 |
| New Injectors Drilled | 0 |
| Existing Producers Used | 750 |
| New Producers Drilled | 0 |

**Pattern Detail**

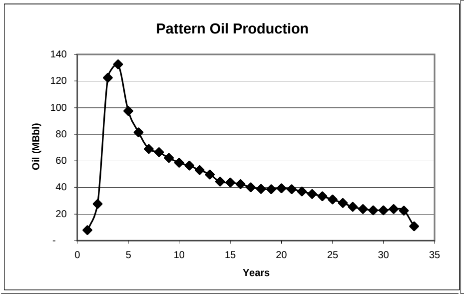
| | | | |
|---|---|---|---|
| Cum Oil (Mbbl) | 1,529 | | |
| Cum H2O (Mbw) | 7,403 | 4.84 | Bw/Bbl |
| Gross CO2 (MMcf) | 18,930 | 12.38 | Mcf/Bbl |
| Purchased CO2 (MMcf) | 6,752 | 4.42 | Mcf/Bbl |
| Recycled CO2 (MMcf) | 12,178 | 7.97 | Mcf/Bbl |

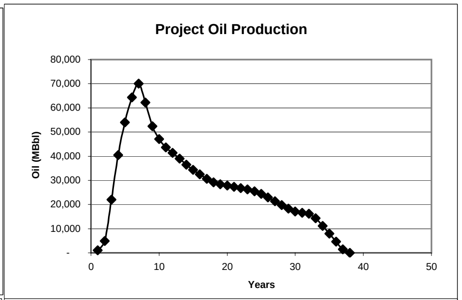
**Field Detail**

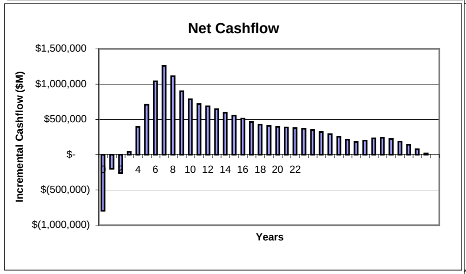
| | | |
|---|---|---|
| Cum Oil (MMbbl) | 1,064.11 | |
| % OOIP Recovered | 19.7% | |
| Cum H2O (MMbw) | 5,152 | |
| Gross CO2 (MMcf) | 13,175,558 | |
| Purchased CO2 (MMcf) | 4,612,615 | |
| Recycled CO2 (MMcf) | 8,562,944 | |
| Payback Period (per pattern) | 4 | years |
| Project Length | 37 | years |

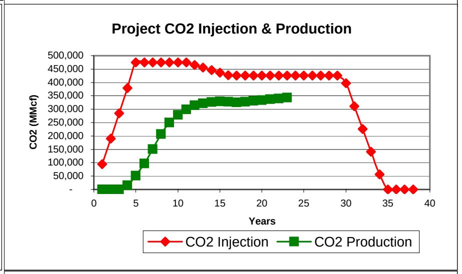
| **Field Economics** | | | $/BBl |
|---|---|---|---|
| Total Net Revenue ($M) | $ | 28,637,147 | |
| Total Capital Investment ($M) | $ | (1,067,389) | $ 1.00 |
| Total CO2 Cost ($M) | $ | (9,454,691) | $ 8.89 |
| Total O&M Costs ($M) | $ | (3,631,625) | $ 3.41 |
| | $ | (14,153,705) | $ 13.30 |

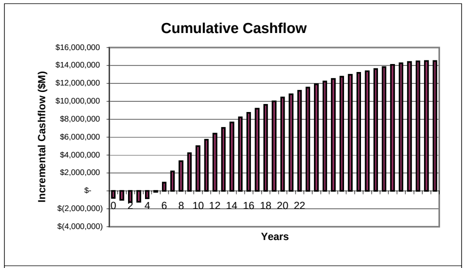
*Includes "Mother Nature's" waterflood oil displacement of 1,484 million barrels

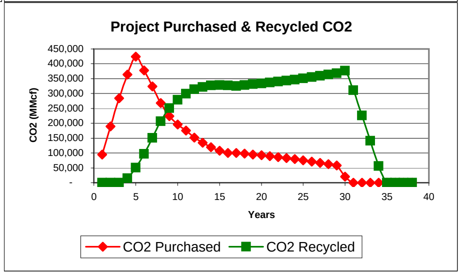


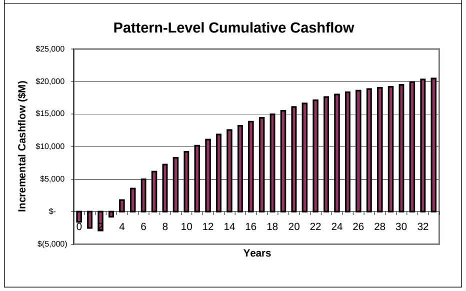




**Assumptions:**

| | |
|---|---|
| Oil Price | $ 35.00 |
| CO2 Purchase Cost | 4% of oil price |
| CO2 Recycle Cost | 1% of oil price |
| | |
| Recycling Plant Costs | 1 Year before Breakthru |
| Well O&M | Prod Wells Only |

**Field Cashflow Model**

| | |
|---|---|
| **State** | Permian (West Texas 8A) |
| **Field** | WASSON (DENVER UNIT) |
| **Formation** | SAN ANDRES |
| **Depth** | 5380 |
| **Distance from Trunkline** | 10 miles |
| **# of Patterns** | 696.00 |
| **Miscibility:** | Miscible |

| **Pattern** | | **Field** | |
|---|---|---|---|
| Existing Injectors Used | 1.00 | Existing Injectors Used | 696 |
| Converted Producers Used | 0.00 | Converted Producers Used | 0 |
| New Injectors Needed | 0.00 | New Injectors Needed | 0 |
| New Producers Needed | 0.00 | New Producers Needed | 0 |
| Existing Producers Used | 1.08 | Existing Producers Used | 750 |

| | | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 Injection (MMcf) | | | 94,907 | 189,813 | 284,720 | 379,626 | 474,547 | 474,547 | 474,547 | 474,547 |
| H2O Injection (Mbw) | | | 23,734 | 47,453 | 71,187 | 94,907 | 118,640 | 118,626 | 118,640 | 118,626 |
| Oil Production (Mbbl) | | | 1,100 | 4,956 | 22,008 | 40,465 | 54,037 | 64,283 | 70,032 | 62,250 |
| H2O Production (MBw) | | | 58,798 | 114,005 | 152,006 | 182,352 | 211,278 | 180,111 | 152,215 | 140,592 |
| CO2 Production (MMcf) | | | 84 | 84 | 167 | 15,423 | 50,878 | 97,148 | 150,211 | 206,768 |
| CO2 Purchased (MMcf) | | | 94,823 | 189,730 | 284,553 | 364,203 | 423,669 | 377,399 | 324,336 | 267,779 |
| CO2 Recycled (MMcf) | | | 84 | 84 | 167 | 15,423 | 50,878 | 97,148 | 150,211 | 206,768 |
| Oil Price ($/Bbl) | **$ 35.00** | | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | **33** | | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | | | $ 36,564 | $ 164,771 | $ 731,750 | $ 1,345,476 | $ 1,796,745 | $ 2,137,395 | $ 2,328,548 | $ 2,069,820 |
| Royalty ($M) | **-12.5%** | | $ (4,571) | $ (20,596) | $ (91,469) | $ (168,184) | $ (224,593) | $ (267,174) | $ (291,069) | $ (258,728) |
| Severance Taxes ($M) | **-5.0%** | | $ (1,600) | $ (7,209) | $ (32,014) | $ (58,865) | $ (78,608) | $ (93,511) | $ (101,874) | $ (90,555) |
| Ad Valorum ($M) | **-2.5%** | | $ (800) | $ (3,604) | $ (16,007) | $ (29,432) | $ (39,304) | $ (46,756) | $ (50,937) | $ (45,277) |
| Net Revenue($M) | | | $ 29,594 | $ 133,362 | $ 592,260 | $ 1,088,995 | $ 1,454,240 | $ 1,729,954 | $ 1,884,669 | $ 1,675,261 |
| **Capital Costs ($M)** | | | | | | | | | | |
| New Well - D&C | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | | $ (46,814) | $ (46,814) | $ (46,814) | $ (46,814) | $ (46,814) | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | | $ (12,043) | $ (12,043) | $ (12,043) | $ (12,043) | $ (12,043) | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | | $ (9,410) | $ (9,410) | $ (9,410) | $ (9,410) | $ (9,410) | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| CO2 Recycling Plant | | $ (721,910) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | | $ (4,146) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | | $ (794,323) | $ (68,267) | $ (68,267) | $ (68,267) | $ (68,267) | $ - | $ - | $ - | $ - |
| **CO2 Costs ($M)** | | | | | | | | | | |
| Total CO2 Cost ($M) | | | $ (132,781) | $ (265,651) | $ (398,432) | $ (515,282) | $ (610,944) | $ (562,360) | $ (506,644) | $ (447,259) |
| **O&M Costs ($M)** | | | | | | | | | | |
| Operating & Maintenance ($M) | | | $ (8,923) | $ (17,846) | $ (26,768) | $ (35,691) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) |
| Lifting Costs ($M) | | | $ (14,974) | $ (29,740) | $ (43,503) | $ (55,704) | $ (66,329) | $ (61,098) | $ (55,562) | $ (50,711) |
| G&A | **20%** | | (4,779) | (9,517) | (14,054) | (18,279) | (22,189) | (21,142) | (20,035) | (19,065) |
| Total O&M Costs | | | $ (28,677) | $ (57,103) | $ (84,326) | $ (109,674) | $ (133,131) | $ (126,855) | $ (120,211) | $ (114,389) |
| Net Cash Flow ($M) | | $ (794,323) | $ (200,130) | $ (257,658) | $ 41,235 | $ 395,771 | $ 710,165 | $ 1,040,739 | $ 1,257,814 | $ 1,113,612 |
| Cum. Cash Flow | | $ (794,323) | $ (994,453) | $ (1,252,111) | $ (1,210,876) | $ (815,105) | $ (104,939) | $ 935,800 | $ 2,193,614 | $ 3,307,226 |
| Discount Factor | **25%** | 1.00 | 0.80 | 0.64 | 0.51 | 0.41 | 0.33 | 0.26 | 0.21 | 0.17 |
| Disc. Net Cash Flow | | $ (794,323) | $ (160,104) | $ (164,901) | $ 21,113 | $ 162,108 | $ 232,707 | $ 272,824 | $ 263,783 | $ 186,833 |
| Disc. Cum Cash Flow | | $ (794,323) | $ (954,427) | $ (1,119,328) | $ (1,098,216) | $ (936,108) | $ (703,401) | $ (430,577) | $ (166,795) | $ 20,039 |

**Field Cashflow Model**

**State**

**Field**

**Formation**

**Depth**

**Distance from Trunkline**

**# of Patterns**

**Miscibility:**

| | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 Injection (MMcf) | 474,547 | 474,533 | 474,533 | 465,902 | 456,242 | 446,581 | 436,921 | 427,260 | 426,230 | 426,230 | 426,230 |
| H2O Injection (Mbw) | 118,640 | 118,626 | 118,640 | 122,955 | 127,786 | 132,616 | 137,446 | 142,276 | 142,777 | 142,791 | 142,791 |
| Oil Production (Mbbl) | 52,464 | 47,064 | 43,584 | 41,370 | 39,004 | 36,526 | 34,424 | 32,475 | 30,680 | 29,204 | 28,397 |
| H2O Production (MBw) | 136,472 | 132,574 | 129,345 | 127,396 | 128,718 | 131,126 | 134,217 | 138,295 | 141,539 | 142,443 | 142,221 |
| CO2 Production (MMcf) | 250,546 | 278,971 | 299,155 | 314,341 | 321,789 | 326,800 | 328,763 | 327,649 | 325,575 | 328,275 | 331,574 |
| CO2 Purchased (MMcf) | 224,001 | 195,562 | 175,378 | 151,561 | 134,453 | 119,782 | 108,158 | 99,612 | 100,656 | 97,955 | 94,656 |
| CO2 Recycled (MMcf) | 250,546 | 278,971 | 299,155 | 314,341 | 321,789 | 326,800 | 328,763 | 327,649 | 325,575 | 328,275 | 331,574 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | $ 1,744,444 | $ 1,564,862 | $ 1,449,152 | $ 1,375,560 | $ 1,296,878 | $ 1,214,492 | $ 1,144,603 | $ 1,079,806 | $ 1,020,099 | $ 971,038 | $ 944,194 |
| Royalty ($M) | $ (218,055) | $ (195,608) | $ (181,144) | $ (171,945) | $ (162,110) | $ (151,812) | $ (143,075) | $ (134,976) | $ (127,512) | $ (121,380) | $ (118,024) |
| Severance Taxes ($M) | $ (76,319) | $ (68,463) | $ (63,400) | $ (60,181) | $ (56,738) | $ (53,134) | $ (50,076) | $ (47,242) | $ (44,629) | $ (42,483) | $ (41,308) |
| Ad Valorum ($M) | $ (38,160) | $ (34,231) | $ (31,700) | $ (30,090) | $ (28,369) | $ (26,567) | $ (25,038) | $ (23,621) | $ (22,315) | $ (21,241) | $ (20,654) |
| Net Revenue($M) | $ 1,411,909 | $ 1,266,560 | $ 1,172,907 | $ 1,113,344 | $ 1,049,660 | $ 982,980 | $ 926,413 | $ 873,968 | $ 825,643 | $ 785,934 | $ 764,207 |
| **Capital Costs ($M)** | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| CO2 Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **CO2 Costs ($M)** | | | | | | | | | | | |
| Total CO2 Cost ($M) | $ (401,292) | $ (371,427) | $ (350,233) | $ (322,205) | $ (300,861) | $ (282,074) | $ (266,489) | $ (254,133) | $ (254,869) | $ (252,033) | $ (248,569) |
| **O&M Costs ($M)** | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) |
| Lifting Costs ($M) | $ (47,234) | $ (44,909) | $ (43,232) | $ (42,192) | $ (41,931) | $ (41,913) | $ (42,160) | $ (42,693) | $ (43,055) | $ (42,912) | $ (42,654) |
| G&A | (18,370) | (17,905) | (17,569) | (17,361) | (17,309) | (17,305) | (17,355) | (17,461) | (17,534) | (17,505) | (17,454) |
| Total O&M Costs | $ (110,217) | $ (107,428) | $ (105,415) | $ (104,166) | $ (103,853) | $ (103,832) | $ (104,129) | $ (104,768) | $ (105,202) | $ (105,031) | $ (104,722) |
| Net Cash Flow ($M) | $ 900,400 | $ 787,706 | $ 717,259 | $ 686,973 | $ 644,947 | $ 597,073 | $ 555,796 | $ 515,067 | $ 465,572 | $ 428,870 | $ 410,915 |
| Cum. Cash Flow | $ 4,207,626 | $ 4,995,332 | $ 5,712,591 | $ 6,399,564 | $ 7,044,510 | $ 7,641,583 | $ 8,197,379 | $ 8,712,446 | $ 9,178,018 | $ 9,606,888 | $ 10,017,803 |
| Discount Factor | 0.13 | 0.11 | 0.09 | 0.07 | 0.05 | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 | 0.01 |
| Disc. Net Cash Flow | $ 120,850 | $ 84,579 | $ 61,612 | $ 47,208 | $ 35,456 | $ 26,260 | $ 19,555 | $ 14,498 | $ 10,484 | $ 7,726 | $ 5,922 |
| Disc. Cum Cash Flow | $ 140,888 | $ 225,467 | $ 287,079 | $ 334,288 | $ 369,744 | $ 396,004 | $ 415,559 | $ 430,057 | $ 440,541 | $ 448,267 | $ 454,188 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 426,230 | 426,230 | 426,244 | 426,244 | 426,244 | 426,244 | 426,244 | 426,230 | 426,230 | 426,230 | 396,636 | 311,390 |
| $H_2O$ Injection (Mbw) | 142,791 | 142,791 | 142,791 | 142,791 | 142,777 | 142,791 | 142,777 | 142,791 | 142,791 | 142,791 | 157,588 | 200,211 |
| Oil Production (Mbbl) | 27,812 | 27,269 | 26,838 | 26,281 | 25,529 | 24,360 | 22,926 | 21,312 | 19,752 | 18,291 | 17,163 | 16,537 |
| $H_2O$ Production (MBw) | 142,193 | 141,706 | 141,093 | 140,508 | 140,105 | 140,091 | 140,300 | 140,634 | 140,968 | 141,218 | 143,014 | 155,514 |
| $CO_2$ Production (MMcf) | 333,662 | 336,767 | 339,829 | 343,156 | 346,789 | 350,756 | 355,099 | 359,665 | 364,105 | 368,407 | 376,425 | 371,525 |
| $CO_2$ Purchased (MMcf) | 92,568 | 89,464 | 86,415 | 83,088 | 79,455 | 75,488 | 71,145 | 66,565 | 62,125 | 57,824 | 20,212 | - |
| $CO_2$ Recycled (MMcf) | 333,662 | 336,767 | 339,829 | 343,156 | 346,789 | 350,756 | 355,099 | 359,665 | 364,105 | 368,407 | 376,425 | 311,390 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | $ 924,754 | $ 906,704 | $ 892,356 | $ 873,842 | $ 848,849 | $ 809,970 | $ 762,297 | $ 708,608 | $ 656,770 | $ 608,172 | $ 570,682 | $ 549,854 |
| Royalty ($M) | $ (115,594) | $ (113,338) | $ (111,544) | $ (109,230) | $ (106,106) | $ (101,246) | $ (95,287) | $ (88,576) | $ (82,096) | $ (76,021) | $ (71,335) | $ (68,732) |
| Severance Taxes ($M) | $ (40,458) | $ (39,668) | $ (39,041) | $ (38,231) | $ (37,137) | $ (35,436) | $ (33,351) | $ (31,002) | $ (28,734) | $ (26,608) | $ (24,967) | $ (24,056) |
| Ad Valorum ($M) | $ (20,229) | $ (19,834) | $ (19,520) | $ (19,115) | $ (18,569) | $ (17,718) | $ (16,675) | $ (15,501) | $ (14,367) | $ (13,304) | $ (12,484) | $ (12,028) |
| Net Revenue($M) | $ 748,473 | $ 733,863 | $ 722,250 | $ 707,266 | $ 687,037 | $ 655,569 | $ 616,985 | $ 573,530 | $ 531,573 | $ 492,239 | $ 461,896 | $ 445,038 |
| **Capital Costs ($M)** | | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (246,377) | $ (243,118) | $ (239,922) | $ (236,428) | $ (232,614) | $ (228,448) | $ (223,888) | $ (219,074) | $ (214,412) | $ (209,896) | $ (160,045) | $ (108,987) |
| **O&M Costs ($M)** | | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) |
| Lifting Costs ($M) | $ (42,501) | $ (42,244) | $ (41,983) | $ (41,697) | $ (41,409) | $ (41,113) | $ (40,806) | $ (40,486) | $ (40,180) | $ (39,877) | $ (40,044) | $ (43,013) |
| G&A | (17,423) | (17,372) | (17,319) | (17,262) | (17,204) | (17,145) | (17,084) | (17,020) | (16,959) | (16,898) | (16,932) | (17,525) |
| Total O&M Costs | $ (104,538) | $ (104,229) | $ (103,916) | $ (103,573) | $ (103,227) | $ (102,872) | $ (102,504) | $ (102,120) | $ (101,753) | $ (101,389) | $ (101,590) | $ (105,152) |
| Net Cash Flow ($M) | $ 397,558 | $ 386,516 | $ 378,413 | $ 367,264 | $ 351,196 | $ 324,250 | $ 290,592 | $ 252,335 | $ 215,409 | $ 180,954 | $ 200,261 | $ 230,899 |
| Cum. Cash Flow | $ 10,415,361 | $ 10,801,877 | $ 11,180,290 | $ 11,547,554 | $ 11,898,751 | $ 12,223,000 | $ 12,513,592 | $ 12,765,928 | $ 12,981,336 | $ 13,162,290 | $ 13,362,551 | $ 13,593,450 |
| Discount Factor | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Disc. Net Cash Flow | $ 4,584 | $ 3,565 | $ 2,792 | $ 2,168 | $ 1,658 | $ 1,225 | $ 878 | $ 610 | $ 417 | $ 280 | $ 248 | $ 229 |
| Disc. Cum Cash Flow | $ 458,772 | $ 462,337 | $ 465,129 | $ 467,297 | $ 468,956 | $ 470,181 | $ 471,059 | $ 471,669 | $ 472,086 | $ 472,366 | $ 472,613 | $ 472,842 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 32 | 33 | 34 | 35 | 36 | 37 | 38 | Totals |
|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 226,144 | 140,898 | 55,652 | - | - | - | - | 13,175,558 |
| $H_2O$ Injection (Mbw) | 242,834 | 250,003 | 221,453 | 178,092 | 106,920 | 35,733 | - | 4,979,880 |
| Oil Production (Mbbl) | 16,133 | 14,324 | 11,150 | 7,962 | 4,649 | 1,503 | - | 1,064,114 |
| $H_2O$ Production (MBw) | 183,257 | 185,220 | 156,962 | 127,090 | 86,388 | 30,318 | - | 5,152,279 |
| $CO_2$ Production (MMcf) | 326,340 | 260,749 | 185,470 | 105,555 | 37,584 | 8,964 | - | 9,125,047 |
| $CO_2$ Purchased (MMcf) | - | - | - | - | - | - | - | 4,612,615 |
| $CO_2$ Recycled (MMcf) | 226,144 | 140,898 | 55,652 | - | - | - | - | 8,562,944 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ - | |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ - | |
| Gross Revenues ($M) | $ 536,432 | $ 476,262 | $ 370,735 | $ 264,744 | $ 154,589 | $ 49,987 | $ - | $ 35,381,804 |
| Royalty ($M) | $ (67,054) | $ (59,533) | $ (46,342) | $ (33,093) | $ (19,324) | $ (6,248) | $ - | $ (4,422,725) |
| Severance Taxes ($M) | $ (23,469) | $ (20,836) | $ (16,220) | $ (11,583) | $ (6,763) | $ (2,187) | $ - | $ (1,547,954) |
| Ad Valorum ($M) | $ (11,734) | $ (10,418) | $ (8,110) | $ (5,791) | $ (3,382) | $ (1,093) | $ - | $ (773,977) |
| Net Revenue($M) | $ 434,174 | $ 385,475 | $ 300,064 | $ 214,278 | $ 125,120 | $ 40,458 | $ - | $ 28,637,147 |
| **Capital Costs ($M)** | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (234,069) |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (60,214) |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (47,050) |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (721,910) |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (4,146) |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (1,067,389) |
| **$CO_2$ Costs ($M)** | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (79,151) | $ (49,314) | $ (19,478) | $ - | $ - | $ - | $ - | $ (9,454,691) |
| **O&M Costs ($M)** | | | | | | | | |
| Operating & Maintenance ($M) | $ (44,614) | $ (44,614) | $ (35,691) | $ (26,768) | $ (17,846) | $ (8,923) | $ - | $ (1,472,256) |
| Lifting Costs ($M) | $ (49,848) | $ (49,886) | $ (42,028) | $ (33,763) | $ (22,759) | $ (7,955) | $ - | $ (1,554,098) |
| G&A | (18,892) | (18,900) | (15,544) | (12,106) | (8,121) | (3,376) | - | $ (605,271) |
| Total O&M Costs | $ (113,354) | $ (113,400) | $ (93,263) | $ (72,637) | $ (48,726) | $ (20,254) | $ - | $ (3,631,625) |
| Net Cash Flow ($M) | $ 241,670 | $ 222,761 | $ 187,322 | $ 141,640 | $ 76,394 | $ 20,204 | $ - | $ 14,483,443 |
| Cum. Cash Flow | $ 13,835,120 | $ 14,057,881 | $ 14,245,204 | $ 14,386,844 | $ 14,463,238 | $ 14,483,443 | ######## | |
| Discount Factor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| Disc. Net Cash Flow | $ 191 | $ 141 | $ 95 | $ 57 | $ 25 | $ 5 | $ - | $ 473,357 |
| Disc. Cum Cash Flow | $ 473,034 | $ 473,175 | $ 473,270 | $ 473,327 | $ 473,352 | $ 473,357 | $ 473,357 | |

| | |
|---|---|
| **Basin** | **Permian (West Texas 8A)** |
| **Field** | **WASSON (DENVER UNIT)** |
| **Formation** | **SAN ANDRES** |
| **Technology Case** | **MPZ (Individual)** |
| Depth (ft) | 5,380 |
| Total OOIP (MMBls) | 2,372 |
| Cumulative Recovery (MMbls) | 1,042 |
| EUR (MMbls) | 1,099 |
| Total ROIP (MMbls) | 1,273 |
| API Gravity | 33.0 |
| Patterns | 696 |
| Existing Injectors Used | 696 |
| Converted Producers Used | 0 |
| New Injectors Drilled | 0 |
| Existing Producers Used | 750 |
| New Producers Drilled | 0 |

**Pattern Detail**

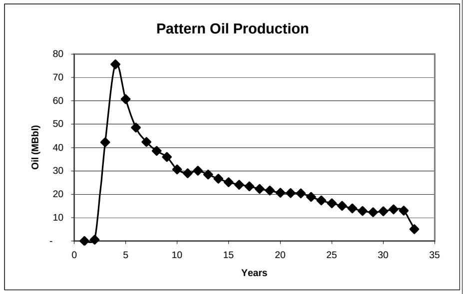
| | | | |
|---|---|---|---|
| Cum Oil (Mbbl) | 819 | | |
| Cum H2O (Mbw) | 3,890 | 4.75 | Bw/Bbl |
| Gross CO2 (MMcf) | 9,431 | 11.52 | Mcf/Bbl |
| Purchased CO2 (MMcf) | 3,511 | 4.29 | Mcf/Bbl |
| Recycled CO2 (MMcf) | 5,920 | 7.23 | Mcf/Bbl |

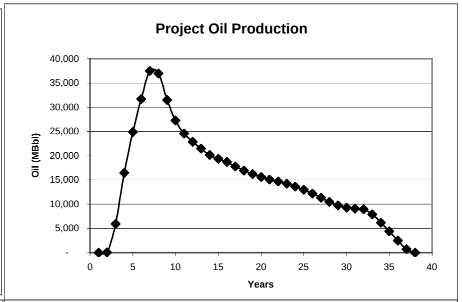
**Project Detail**

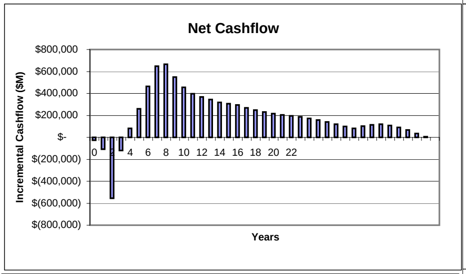
| | | |
|---|---|---|
| Cum Oil (MMbbl) | 569.68 | |
| % OOIP Recovered | 24.0% | |
| Cum H2O (MMbw) | 2,707 | |
| Gross CO2 (MMcf) | 6,563,698 | |
| Purchased CO2 (MMcf) | 2,395,994 | |
| Recycled CO2 (MMcf) | 4,167,704 | |
| Payback Period (per pattern) | 4 | years |
| Project Length | 36 | years |

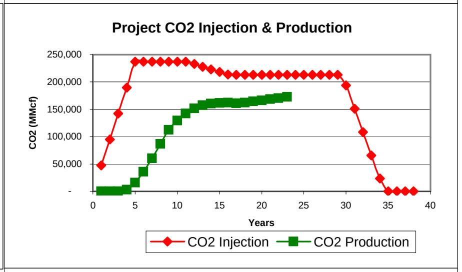
**Project Economics**

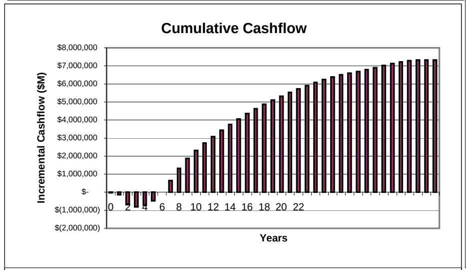
| | | | $/BBl |
|---|---|---|---|
| Total Net Revenue ($M) | $ 15,330,960 | | |
| Total Capital Investment ($M) | $ (474,194) | $ | 0.83 |
| Total CO2 Cost ($M) | $ (4,813,088) | $ | 8.45 |
| Total O&M Costs ($M) | $ (2,719,074) | $ | 4.77 |
| | $ (8,006,356) | $ | 14.05 |

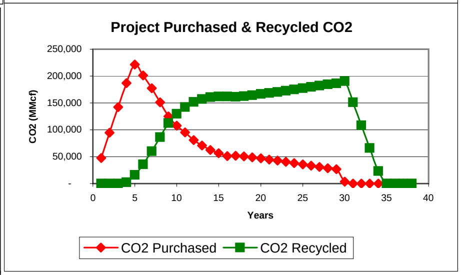


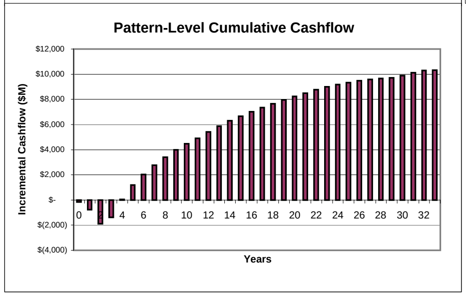




**Assumptions:**

| | |
|---|---|
| Oil Price | $ 35.00 |
| CO2 Purchase Cost | 4% of oil price |
| CO2 Recycle Cost | 1% of oil price |
| | |
| Recycling Plant Costs | 1 Year before Breakthru |
| Well O&M | Prod Wells Only |

**Field Cashflow Model**

| | |
|---|---|
| **State** | Permian (West Texas 8A) |
| **Field** | WASSON (DENVER UNIT) |
| **Formation** | SAN ANDRES |
| **Depth** | 5380 |
| **Distance from Trunkline** | 10 miles |
| **# of Patterns** | 696.00 |
| **Miscibility:** | Miscible |

| **Pattern** | | **Field** | |
|---|---|---|---|
| Existing Injectors Used | 1.00 | Existing Injectors Used | 696 |
| Converted Producers Used | 0.00 | Converted Producers Used | 0 |
| New Injectors Needed | 0.00 | New Injectors Needed | 0 |
| New Producers Needed | 0.00 | New Producers Needed | 0 |
| Existing Producers Used | 1.08 | Existing Producers Used | 750 |

| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | | | 47,453 | 94,907 | 142,360 | 189,813 | 237,266 | 237,266 | 237,266 | 237,266 |
| $H_2O$ Injection (Mbw) | | | 11,860 | 23,734 | 35,593 | 47,453 | 59,313 | 59,327 | 59,313 | 59,313 |
| Oil Production (Mbbl) | | | - | 84 | 5,958 | 16,481 | 24,931 | 31,682 | 37,500 | 36,999 |
| $H_2O$ Production (MBw) | | | 30,248 | 60,427 | 84,522 | 102,771 | 119,058 | 104,247 | 88,824 | 79,163 |
| $CO_2$ Production (MMcf) | | | - | - | 42 | 2,645 | 15,924 | 35,983 | 60,051 | 86,360 |
| $CO_2$ Purchased (MMcf) | | | 47,453 | 94,907 | 142,318 | 187,168 | 221,342 | 201,283 | 177,216 | 150,907 |
| $CO_2$ Recycled (MMcf) | | | - | - | 42 | 2,645 | 15,924 | 35,983 | 60,051 | 86,360 |
| Oil Price ($/Bbl) | **$ 35.00** | | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | **33** | | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | | | $ - | $ 2,777 | $ 198,096 | $ 548,003 | $ 828,946 | $ 1,053,424 | $ 1,246,891 | $ 1,230,229 |
| Royalty ($M) | **-12.5%** | | $ - | $ (347) | $ (24,762) | $ (68,500) | $ (103,618) | $ (131,678) | $ (155,861) | $ (153,779) |
| Severance Taxes ($M) | **-5.0%** | | $ - | $ (121) | $ (8,667) | $ (23,975) | $ (36,266) | $ (46,087) | $ (54,551) | $ (53,823) |
| Ad Valorum ($M) | **-2.5%** | | $ - | $ (61) | $ (4,333) | $ (11,988) | $ (18,133) | $ (23,044) | $ (27,276) | $ (26,911) |
| Net Revenue($M) | | | $ - | $ 2,248 | $ 160,334 | $ 443,540 | $ 670,929 | $ 852,615 | $ 1,009,202 | $ 995,716 |
| **Capital Costs ($M)** | | | | | | | | | | |
| New Well - D&C | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | | $ (11,737) | $ (11,737) | $ (11,737) | $ (11,737) | $ (11,737) | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | | $ (9,312) | $ (9,312) | $ (9,312) | $ (9,312) | $ (9,312) | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | | $ - | $ - | $ (364,799) | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | | $ (4,146) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | | $ (25,196) | $ (21,050) | $ (385,849) | $ (21,050) | $ (21,050) | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | | | $ (66,435) | $ (132,869) | $ (199,260) | $ (262,961) | $ (315,452) | $ (294,391) | $ (269,120) | $ (241,495) |
| **O&M Costs ($M)** | | | | | | | | | | |
| Operating & Maintenance ($M) | | | $ (8,768) | $ (17,535) | $ (26,303) | $ (35,070) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) |
| Lifting Costs ($M) | | | $ (7,562) | $ (15,128) | $ (22,620) | $ (29,813) | $ (35,997) | $ (33,982) | $ (31,581) | $ (29,041) |
| G&A | **20%** | | (3,266) | (6,533) | (9,785) | (12,977) | (15,967) | (15,564) | (15,084) | (14,576) |
| Total O&M Costs | | | $ (19,596) | $ (39,195) | $ (58,707) | $ (77,860) | $ (95,802) | $ (93,384) | $ (90,503) | $ (87,454) |
| Net Cash Flow ($M) | | $ (25,196) | $ (107,080) | $ (555,666) | $ (118,683) | $ 81,668 | $ 259,674 | $ 464,840 | $ 649,580 | $ 666,767 |
| Cum. Cash Flow | | $ (25,196) | $ (132,276) | $ (687,942) | $ (806,625) | $ (724,957) | $ (465,283) | $ (442) | $ 649,138 | $ 1,315,905 |
| Discount Factor | **25%** | 1.00 | 0.80 | 0.64 | 0.51 | 0.41 | 0.33 | 0.26 | 0.21 | 0.17 |
| Disc. Net Cash Flow | | $ (25,196) | $ (85,664) | $ (355,626) | $ (60,766) | $ 33,451 | $ 85,090 | $ 121,855 | $ 136,227 | $ 111,865 |
| Disc. Cum Cash Flow | | $ (25,196) | $ (110,860) | $ (466,486) | $ (527,252) | $ (493,800) | $ (408,710) | $ (286,855) | $ (150,628) | $ (38,764) |

**Field Cashflow Model**

**State**

**Field**

**Formation**

**Depth**

**Distance from Trunkline**

**# of Patterns**

**Miscibility:**

| | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 237,280 | 237,280 | 237,280 | 232,756 | 227,926 | 223,082 | 218,252 | 213,421 | 213,129 | 213,129 | 213,129 | 213,129 |
| $H_2O$ Injection (Mbw) | 59,313 | 59,327 | 59,313 | 61,568 | 63,990 | 66,412 | 68,820 | 71,229 | 71,396 | 71,396 | 71,396 | 71,396 |
| Oil Production (Mbbl) | 31,487 | 27,311 | 24,597 | 22,884 | 21,465 | 20,170 | 19,404 | 18,722 | 17,790 | 16,941 | 16,231 | 15,604 |
| $H_2O$ Production (MBw) | 74,904 | 72,537 | 70,547 | 69,127 | 68,960 | 69,600 | 70,421 | 71,646 | 72,955 | 73,344 | 73,331 | 73,205 |
| $CO_2$ Production (MMcf) | 112,223 | 129,623 | 142,026 | 151,672 | 157,310 | 160,525 | 161,862 | 161,945 | 161,152 | 162,432 | 164,395 | 166,400 |
| $CO_2$ Purchased (MMcf) | 125,057 | 107,657 | 95,255 | 81,084 | 70,616 | 62,556 | 56,390 | 51,476 | 51,977 | 50,697 | 48,734 | 46,729 |
| $CO_2$ Recycled (MMcf) | 112,223 | 129,623 | 142,026 | 151,672 | 157,310 | 160,525 | 161,862 | 161,945 | 161,152 | 162,432 | 164,395 | 166,400 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | $ 1,046,944 | $ 908,092 | $ 817,838 | $ 760,909 | $ 713,699 | $ 670,655 | $ 645,199 | $ 622,520 | $ 591,510 | $ 563,276 | $ 539,671 | $ 518,844 |
| Royalty ($M) | $ (130,868) | $ (113,512) | $ (102,230) | $ (95,114) | $ (89,212) | $ (83,832) | $ (80,650) | $ (77,815) | $ (73,939) | $ (70,410) | $ (67,459) | $ (64,855) |
| Severance Taxes ($M) | $ (45,804) | $ (39,729) | $ (35,780) | $ (33,290) | $ (31,224) | $ (29,341) | $ (28,227) | $ (27,235) | $ (25,879) | $ (24,643) | $ (23,611) | $ (22,699) |
| Ad Valorum ($M) | $ (22,902) | $ (19,865) | $ (17,890) | $ (16,645) | $ (15,612) | $ (14,671) | $ (14,114) | $ (13,618) | $ (12,939) | $ (12,322) | $ (11,805) | $ (11,350) |
| Net Revenue($M) | $ 847,370 | $ 734,987 | $ 661,938 | $ 615,861 | $ 577,650 | $ 542,812 | $ 522,208 | $ 503,852 | $ 478,753 | $ 455,902 | $ 436,797 | $ 419,939 |
| **Capital Costs ($M)** | | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (214,358) | $ (196,088) | $ (183,065) | $ (166,603) | $ (153,921) | $ (143,763) | $ (135,598) | $ (128,747) | $ (129,171) | $ (127,827) | $ (125,766) | $ (123,661) |
| **O&M Costs ($M)** | | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) |
| Lifting Costs ($M) | $ (26,598) | $ (24,962) | $ (23,786) | $ (23,003) | $ (22,606) | $ (22,443) | $ (22,456) | $ (22,592) | $ (22,686) | $ (22,571) | $ (22,390) | $ (22,202) |
| G&A | (14,087) | (13,760) | (13,525) | (13,368) | (13,289) | (13,256) | (13,259) | (13,286) | (13,305) | (13,282) | (13,246) | (13,208) |
| Total O&M Costs | $ (84,523) | $ (82,560) | $ (81,148) | $ (80,209) | $ (79,733) | $ (79,537) | $ (79,553) | $ (79,716) | $ (79,829) | $ (79,691) | $ (79,474) | $ (79,248) |
| Net Cash Flow ($M) | $ 548,489 | $ 456,339 | $ 397,724 | $ 369,049 | $ 343,996 | $ 319,512 | $ 307,057 | $ 295,388 | $ 269,753 | $ 248,384 | $ 231,557 | $ 217,030 |
| Cum. Cash Flow | $ 1,864,394 | $ 2,320,733 | $ 2,718,457 | $ 3,087,506 | $ 3,431,502 | $ 3,751,014 | $ 4,058,072 | $ 4,353,460 | $ 4,623,213 | $ 4,871,597 | $ 5,103,154 | $ 5,320,184 |
| Discount Factor | 0.13 | 0.11 | 0.09 | 0.07 | 0.05 | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 | 0.01 | 0.01 |
| Disc. Net Cash Flow | $ 73,617 | $ 48,999 | $ 34,164 | $ 25,361 | $ 18,911 | $ 14,052 | $ 10,804 | $ 8,314 | $ 6,074 | $ 4,474 | $ 3,337 | $ 2,502 |
| Disc. Cum Cash Flow | $ 34,853 | $ 83,852 | $ 118,017 | $ 143,378 | $ 162,289 | $ 176,341 | $ 187,145 | $ 195,459 | $ 201,534 | $ 206,008 | $ 209,345 | $ 211,847 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 213,129 | 213,115 | 213,115 | 213,115 | 213,115 | 213,115 | 213,115 | 213,115 | 213,115 | 193,697 | 151,074 | 108,451 |
| $H_2O$ Injection (Mbw) | 71,396 | 71,396 | 71,396 | 71,396 | 71,396 | 71,396 | 71,396 | 71,396 | 71,396 | 81,098 | 102,423 | 123,735 |
| Oil Production (Mbbl) | 15,103 | 14,686 | 14,212 | 13,614 | 12,973 | 12,208 | 11,303 | 10,468 | 9,772 | 9,299 | 9,104 | 8,978 |
| $H_2O$ Production (MBw) | 72,969 | 72,607 | 72,245 | 71,966 | 71,660 | 71,535 | 71,577 | 71,632 | 71,660 | 72,746 | 79,720 | 93,779 |
| $CO_2$ Production (MMcf) | 168,362 | 170,436 | 172,622 | 174,974 | 177,452 | 179,888 | 182,199 | 184,315 | 186,110 | 190,217 | 185,122 | 161,514 |
| $CO_2$ Purchased (MMcf) | 44,767 | 42,679 | 40,493 | 38,141 | 35,663 | 33,227 | 30,916 | 28,800 | 27,005 | 3,480 | - | - |
| $CO_2$ Recycled (MMcf) | 168,362 | 170,436 | 172,622 | 174,974 | 177,452 | 179,888 | 182,199 | 184,315 | 186,110 | 190,217 | 151,074 | 108,451 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | $ 502,181 | $ 488,296 | $ 472,560 | $ 452,658 | $ 431,367 | $ 405,911 | $ 375,826 | $ 348,056 | $ 324,914 | $ 309,177 | $ 302,697 | $ 298,532 |
| Royalty ($M) | $ (62,773) | $ (61,037) | $ (59,070) | $ (56,582) | $ (53,921) | $ (50,739) | $ (46,978) | $ (43,507) | $ (40,614) | $ (38,647) | $ (37,837) | $ (37,316) |
| Severance Taxes ($M) | $ (21,970) | $ (21,363) | $ (20,674) | $ (19,804) | $ (18,872) | $ (17,759) | $ (16,442) | $ (15,227) | $ (14,215) | $ (13,526) | $ (13,243) | $ (13,061) |
| Ad Valorum ($M) | $ (10,985) | $ (10,681) | $ (10,337) | $ (9,902) | $ (9,436) | $ (8,879) | $ (8,221) | $ (7,614) | $ (7,107) | $ (6,763) | $ (6,622) | $ (6,530) |
| Net Revenue($M) | $ 406,453 | $ 395,215 | $ 382,478 | $ 366,370 | $ 349,138 | $ 328,534 | $ 304,184 | $ 281,708 | $ 262,977 | $ 250,240 | $ 244,996 | $ 241,624 |
| **Capital Costs ($M)** | | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (121,600) | $ (119,403) | $ (117,108) | $ (114,638) | $ (112,037) | $ (109,479) | $ (107,052) | $ (104,831) | $ (102,945) | $ (71,448) | $ (52,876) | $ (37,958) |
| **O&M Costs ($M)** | | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) | $ (43,838) |
| Lifting Costs ($M) | $ (22,018) | $ (21,823) | $ (21,614) | $ (21,395) | $ (21,158) | $ (20,936) | $ (20,720) | $ (20,525) | $ (20,358) | $ (20,511) | $ (22,206) | $ (25,689) |
| G&A | (13,171) | (13,132) | (13,090) | (13,047) | (12,999) | (12,955) | (12,912) | (12,873) | (12,839) | (12,870) | (13,209) | (13,905) |
| Total O&M Costs | $ (79,027) | $ (78,793) | $ (78,543) | $ (78,280) | $ (77,996) | $ (77,728) | $ (77,469) | $ (77,236) | $ (77,035) | $ (77,219) | $ (79,253) | $ (83,433) |
| Net Cash Flow ($M) | $ 205,826 | $ 197,019 | $ 186,827 | $ 173,452 | $ 159,105 | $ 141,327 | $ 119,662 | $ 99,641 | $ 82,997 | $ 101,574 | $ 112,867 | $ 120,234 |
| Cum. Cash Flow | $ 5,526,009 | $ 5,723,028 | $ 5,909,855 | $ 6,083,307 | $ 6,242,412 | $ 6,383,739 | $ 6,503,402 | $ 6,603,043 | $ 6,686,040 | $ 6,787,613 | $ 6,900,480 | $ 7,020,714 |
| Discount Factor | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Disc. Net Cash Flow | $ 1,898 | $ 1,454 | $ 1,103 | $ 819 | $ 601 | $ 427 | $ 289 | $ 193 | $ 128 | $ 126 | $ 112 | $ 95 |
| Disc. Cum Cash Flow | $ 213,746 | $ 215,199 | $ 216,302 | $ 217,121 | $ 217,723 | $ 218,150 | $ 218,439 | $ 218,632 | $ 218,760 | $ 218,886 | $ 218,998 | $ 219,093 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 33 | 34 | 35 | 36 | 37 | 38 | Totals |
|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 65,828 | 23,205 | - | - | - | - | 6,563,698 |
| $H_2O$ Injection (Mbw) | 123,791 | 109,509 | 85,524 | 49,931 | 14,338 | - | 2,484,372 |
| Oil Production (Mbbl) | 7,893 | 6,180 | 4,413 | 2,520 | 710 | - | 569,676 |
| $H_2O$ Production (MBw) | 91,594 | 77,228 | 61,833 | 40,549 | 12,166 | - | 2,707,301 |
| $CO_2$ Production (MMcf) | 127,646 | 89,854 | 49,249 | 17,400 | 3,703 | - | 4,453,634 |
| $CO_2$ Purchased (MMcf) | - | - | - | - | - | - | 2,395,994 |
| $CO_2$ Recycled (MMcf) | 65,828 | 23,205 | - | - | - | - | 4,167,704 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ - | |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ - | |
| Gross Revenues ($M) | $ 262,430 | $ 205,501 | $ 146,720 | $ 83,774 | $ 23,605 | $ - | $ 18,941,727 |
| Royalty ($M) | $ (32,804) | $ (25,688) | $ (18,340) | $ (10,472) | $ (2,951) | $ - | $ (2,367,716) |
| Severance Taxes ($M) | $ (11,481) | $ (8,991) | $ (6,419) | $ (3,665) | $ (1,033) | $ - | $ (828,701) |
| Ad Valorum ($M) | $ (5,741) | $ (4,495) | $ (3,210) | $ (1,833) | $ (516) | $ - | $ (414,350) |
| Net Revenue($M) | $ 212,405 | $ 166,327 | $ 118,752 | $ 67,805 | $ 19,105 | $ - | $ 15,330,960 |
| **Capital Costs ($M)** | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ (58,687) |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ (46,562) |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ (364,799) |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ (4,146) |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ (474,194) |
| **$CO_2$ Costs ($M)** | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (23,040) | $ (8,122) | $ - | $ - | $ - | $ - | $ (4,813,088) |
| **O&M Costs ($M)** | | | | | | | |
| Operating & Maintenance ($M) | $ (43,838) | $ (35,070) | $ (26,303) | $ (17,535) | $ (8,768) | $ - | $ (1,446,651) |
| Lifting Costs ($M) | $ (24,872) | $ (20,852) | $ (16,561) | $ (10,767) | $ (3,219) | $ - | $ (819,244) |
| G&A | (13,742) | (11,184) | (8,573) | (5,660) | (2,397) | - | $ (453,179) |
| Total O&M Costs | $ (82,451) | $ (67,107) | $ (51,437) | $ (33,963) | $ (14,384) | $ - | $ (2,719,074) |
| Net Cash Flow ($M) | $ 106,913 | $ 91,099 | $ 67,315 | $ 33,842 | $ 4,721 | $ - | $ 7,324,604 |
| Cum. Cash Flow | $ 7,127,628 | $ 7,218,726 | $ 7,286,041 | $ 7,319,883 | $ 7,324,604 | ######## | |
| Discount Factor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| Disc. Net Cash Flow | $ 68 | $ 46 | $ 27 | $ 11 | $ 1 | $ - | $ 219,246 |
| Disc. Cum Cash Flow | $ 219,161 | $ 219,207 | $ 219,234 | $ 219,245 | $ 219,246 | $219,246 | |

| Basin | Permian (West Texas 8A) | | |
|---|---|---|---|
| Field | WASSON (DENVER UNIT) | | |
| Formation | SAN ANDRES | | |
| Technology Case | TZ / ROZ (Individual) | | |
| Depth (ft) | 5,380 | | |
| Total OOIP (MMBls) | 3,018 | | |
| Cumulative Recovery (MMbls) * | 1,484 | | |
| EUR (MMbls) * | 1,484 | | |
| Total ROIP (MMbls) | 1,534 | | |
| API Gravity | 33.0 | | |
| Patterns | 696 | | |
| Existing Injectors Used | 696 | | |
| Converted Producers Used | 0 | | |
| New Injectors Drilled | 0 | | |
| Existing Producers Used | 750 | | |
| New Producers Drilled | 0 | | |

**Pattern Detail**

| | | | |
|---|---|---|---|
| Cum Oil (Mbbl) | 485 | | |
| Cum H2O (Mbw) | 4,127 | 8.51 | Bw/Bbl |
| Gross CO2 (MMcf) | 9,432 | 19.45 | Mcf/Bbl |
| Purchased CO2 (MMcf) | 4,435 | 9.15 | Mcf/Bbl |
| Recycled CO2 (MMcf) | 4,997 | 10.30 | Mcf/Bbl |

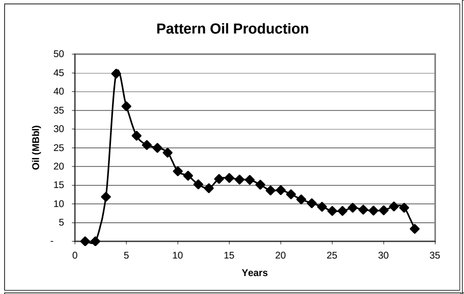
**Project Detail**

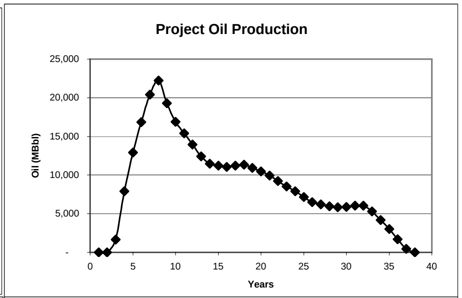
| | | |
|---|---|---|
| Cum Oil (MMbbl) | 337.49 | |
| % OOIP Recovered | 11.2% | |
| Cum H2O (MMbw) | 2,873 | |
| Gross CO2 (MMcf) | 6,564,324 | |
| Purchased CO2 (MMcf) | 3,011,078 | |
| Recycled CO2 (MMcf) | 3,553,246 | |
| Payback Period (per pattern) | 17 | years |
| Project Length | 35 | years |

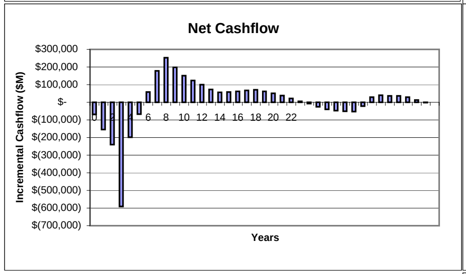
**Project Economics**

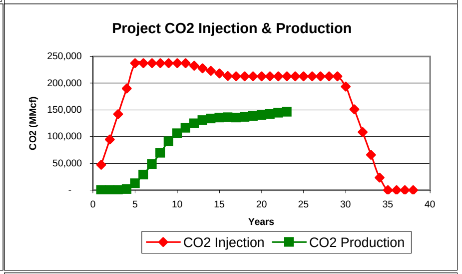
| | | $/BBl |
|---|---|---|
| Total Net Revenue ($M) | $ 9,082,447 | |
| Total Capital Investment ($M) | $ (651,072) | $ 1.93 |
| Total CO2 Cost ($M) | $ (5,459,145) | $ 16.18 |
| Total O&M Costs ($M) | $ (2,729,755) | $ 8.09 |
| | $ (8,839,972) | $ 26.19 |

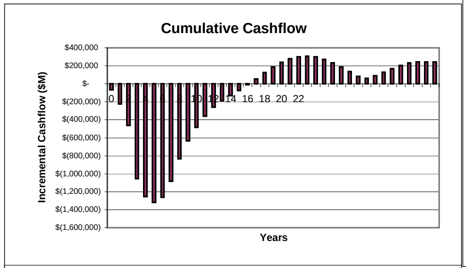
*Includes "Mother Nature's" waterflood oil displacement of 1,484 million barrels

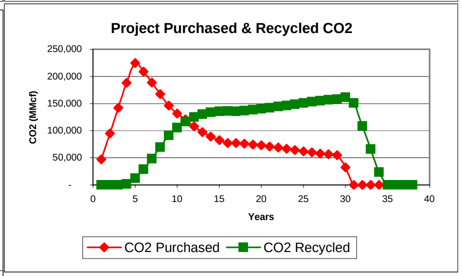


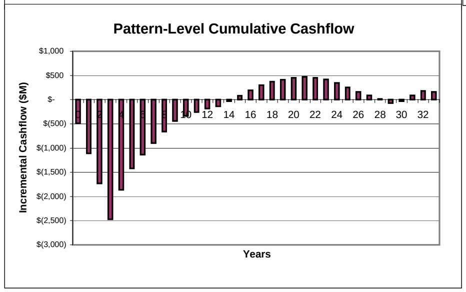




**Assumptions:**

| | |
|---|---|
| Oil Price | $ 35.00 |
| CO2 Purchase Cost | 4% of oil price |
| CO2 Recycle Cost | 1% of oil price |

| | |
|---|---|
| Recycling Plant Costs | 1 Year before Breakthru |
| Well O&M | Prod Wells Only |

**Field Cashflow Model**

| | |
|---|---|
| **State** | Permian (West Texas 8A) |
| **Field** | WASSON (DENVER UNIT) |
| **Formation** | SAN ANDRES |
| **Depth** | 5380 |
| **Distance from Trunkline** | 10 miles |
| **# of Patterns** | 696.00 |
| **Miscibility:** | Miscible |

| **Pattern** | | **Field** | |
|---|---|---|---|
| Existing Injectors Used | 1.00 | Existing Injectors Used | 696 |
| Converted Producers Used | 0.00 | Converted Producers Used | 0 |
| New Injectors Needed | 0.00 | New Injectors Needed | 0 |
| New Producers Needed | 0.00 | New Producers Needed | 0 |
| Existing Producers Used | 1.08 | Existing Producers Used | 750 |

| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 Injection (MMcf) | | | 47,453 | 94,907 | 142,360 | 189,813 | 237,266 | 237,266 | 237,266 | 237,266 | 237,280 |
| H2O Injection (Mbw) | | | 11,860 | 23,734 | 35,593 | 47,453 | 59,313 | 59,327 | 59,313 | 59,313 | 59,313 |
| Oil Production (Mbbl) | | | - | - | 1,656 | 7,893 | 12,918 | 16,843 | 20,421 | 22,244 | 19,307 |
| H2O Production (MBw) | | | 30,123 | 60,246 | 88,211 | 109,369 | 128,175 | 115,717 | 102,145 | 90,076 | 84,188 |
| CO2 Production (MMcf) | | | - | - | - | 1,881 | 12,424 | 28,633 | 48,334 | 69,750 | 91,154 |
| CO2 Purchased (MMcf) | | | 47,453 | 94,907 | 142,360 | 187,932 | 224,843 | 208,633 | 188,933 | 167,517 | 146,127 |
| CO2 Recycled (MMcf) | | | - | - | - | 1,881 | 12,424 | 28,633 | 48,334 | 69,750 | 91,154 |
| Oil Price ($/Bbl) | **$ 35.00** | | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | **33** | | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | | | $ - | $ - | $ 55,078 | $ 262,430 | $ 429,516 | $ 560,036 | $ 678,986 | $ 739,618 | $ 641,959 |
| Royalty ($M) | **-12.5%** | | $ - | $ - | $ (6,885) | $ (32,804) | $ (53,689) | $ (70,005) | $ (84,873) | $ (92,452) | $ (80,245) |
| Severance Taxes ($M) | **-5.0%** | | $ - | $ - | $ (2,410) | $ (11,481) | $ (18,791) | $ (24,502) | $ (29,706) | $ (32,358) | $ (28,086) |
| Ad Valorum ($M) | **-2.5%** | | $ - | $ - | $ (1,205) | $ (5,741) | $ (9,396) | $ (12,251) | $ (14,853) | $ (16,179) | $ (14,043) |
| Net Revenue($M) | | | $ - | $ - | $ 44,579 | $ 212,405 | $ 347,639 | $ 453,279 | $ 549,555 | $ 598,629 | $ 519,586 |
| **Capital Costs ($M)** | | | | | | | | | | | |
| New Well - D&C | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | | $ (46,814) | $ (46,814) | $ (46,814) | $ (46,814) | $ (46,814) | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | | $ (12,043) | $ (12,043) | $ (12,043) | $ (12,043) | $ (12,043) | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | | $ (9,410) | $ (9,410) | $ (9,410) | $ (9,410) | $ (9,410) | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| CO2 Recycling Plant | | $ - | $ - | $ - | $ (309,739) | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | | $ (68,267) | $ (68,267) | $ (68,267) | $ (378,006) | $ (68,267) | $ - | $ - | $ - | $ - | $ - |
| **CO2 Costs ($M)** | | | | | | | | | | | |
| Total CO2 Cost ($M) | | | $ (66,435) | $ (132,869) | $ (199,304) | $ (263,763) | $ (319,128) | $ (302,108) | $ (281,423) | $ (258,936) | $ (236,481) |
| **O&M Costs ($M)** | | | | | | | | | | | |
| Operating & Maintenance ($M) | | | $ (8,923) | $ (17,846) | $ (26,768) | $ (35,691) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) |
| Lifting Costs ($M) | | | $ (7,531) | $ (15,061) | $ (22,467) | $ (29,316) | $ (35,273) | $ (33,140) | $ (30,641) | $ (28,080) | $ (25,874) |
| G&A | **20%** | | (3,291) | (6,581) | (9,847) | (13,001) | (15,977) | (15,551) | (15,051) | (14,539) | (14,098) |
| Total O&M Costs | | | $ (19,744) | $ (39,488) | $ (59,082) | $ (78,008) | $ (95,865) | $ (93,305) | $ (90,306) | $ (87,233) | $ (84,585) |
| Net Cash Flow ($M) | | $ (68,267) | $ (154,445) | $ (240,624) | $ (591,813) | $ (197,633) | $ (67,354) | $ 57,867 | $ 177,826 | $ 252,460 | $ 198,519 |
| Cum. Cash Flow | | $ (68,267) | $ (222,712) | $ (463,336) | $ (1,055,149) | $ (1,252,782) | $ (1,320,135) | $ (1,262,268) | ######### | $ (831,982) | $ (633,463) |
| Discount Factor | **25%** | 1.00 | 0.80 | 0.64 | 0.51 | 0.41 | 0.33 | 0.26 | 0.21 | 0.17 | 0.13 |
| Disc. Net Cash Flow | | $ (68,267) | $ (123,556) | $ (153,999) | $ (303,008) | $ (80,950) | $ (22,070) | $ 15,169 | $ 37,293 | $ 42,356 | $ 26,645 |
| Disc. Cum Cash Flow | | $ (68,267) | $ (191,823) | $ (345,822) | $ (648,830) | $ (729,781) | $ (751,851) | $ (736,682) | $ (699,389) | $ (657,033) | $ (630,388) |

**Field Cashflow Model**

**State**

**Field**

**Formation**

**Depth**

**Distance from Trunkline**

**# of Patterns**

**Miscibility:**

| | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 237,280 | 237,280 | 232,770 | 227,940 | 223,096 | 218,266 | 213,435 | 213,115 | 213,115 | 213,115 | 213,115 | 213,115 |
| $H_2O$ Injection (Mbw) | 59,327 | 59,313 | 61,568 | 63,990 | 66,412 | 68,820 | 71,229 | 71,396 | 71,396 | 71,396 | 71,382 | 71,396 |
| Oil Production (Mbbl) | 16,885 | 15,396 | 13,934 | 12,431 | 11,456 | 11,206 | 11,066 | 11,233 | 11,359 | 10,927 | 10,482 | 9,939 |
| $H_2O$ Production (MBw) | 80,708 | 77,841 | 76,421 | 76,449 | 76,769 | 76,769 | 77,242 | 77,298 | 76,657 | 76,435 | 76,254 | 76,115 |
| $CO_2$ Production (MMcf) | 105,825 | 116,474 | 124,946 | 130,460 | 133,796 | 135,713 | 136,293 | 135,772 | 136,837 | 138,576 | 140,257 | 142,138 |
| $CO_2$ Purchased (MMcf) | 131,455 | 120,806 | 107,824 | 97,480 | 89,300 | 82,553 | 77,143 | 77,343 | 76,278 | 74,539 | 72,859 | 70,977 |
| $CO_2$ Recycled (MMcf) | 105,825 | 116,474 | 124,946 | 130,460 | 133,796 | 135,713 | 136,293 | 135,772 | 136,837 | 138,576 | 140,257 | 142,138 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | $ 561,425 | $ 511,901 | $ 463,303 | $ 413,316 | $ 380,917 | $ 372,586 | $ 367,958 | $ 373,512 | $ 377,677 | $ 363,329 | $ 348,519 | $ 330,468 |
| Royalty ($M) | $ (70,178) | $ (63,988) | $ (57,913) | $ (51,665) | $ (47,615) | $ (46,573) | $ (45,995) | $ (46,689) | $ (47,210) | $ (45,416) | $ (43,565) | $ (41,308) |
| Severance Taxes ($M) | $ (24,562) | $ (22,396) | $ (20,269) | $ (18,083) | $ (16,665) | $ (16,301) | $ (16,098) | $ (16,341) | $ (16,523) | $ (15,896) | $ (15,248) | $ (14,458) |
| Ad Valorum ($M) | $ (12,281) | $ (11,198) | $ (10,135) | $ (9,041) | $ (8,333) | $ (8,150) | $ (8,049) | $ (8,171) | $ (8,262) | $ (7,948) | $ (7,624) | $ (7,229) |
| Net Revenue($M) | $ 454,403 | $ 414,320 | $ 374,986 | $ 334,528 | $ 308,305 | $ 301,562 | $ 297,816 | $ 302,311 | $ 305,683 | $ 294,070 | $ 282,082 | $ 267,472 |
| **Capital Costs ($M)** | | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (221,076) | $ (209,895) | $ (194,685) | $ (182,133) | $ (171,848) | $ (163,073) | $ (155,702) | $ (155,800) | $ (154,682) | $ (152,856) | $ (151,092) | $ (149,117) |
| **O&M Costs ($M)** | | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) |
| Lifting Costs ($M) | $ (24,398) | $ (23,309) | $ (22,589) | $ (22,220) | $ (22,056) | $ (21,994) | $ (22,077) | $ (22,133) | $ (22,004) | $ (21,840) | $ (21,684) | $ (21,513) |
| G&A | (13,802) | (13,585) | (13,440) | (13,367) | (13,334) | (13,321) | (13,338) | (13,349) | (13,324) | (13,291) | (13,260) | (13,225) |
| Total O&M Costs | $ (82,815) | $ (81,507) | $ (80,643) | $ (80,200) | $ (80,004) | $ (79,929) | $ (80,029) | $ (80,096) | $ (79,941) | $ (79,745) | $ (79,557) | $ (79,353) |
| Net Cash Flow ($M) | $ 150,513 | $ 122,918 | $ 99,658 | $ 72,194 | $ 56,453 | $ 58,560 | $ 62,085 | $ 66,415 | $ 71,059 | $ 61,469 | $ 51,433 | $ 39,003 |
| Cum. Cash Flow | $ (482,950) | $ (360,032) | $ (260,374) | $ (188,180) | $ (131,728) | $ (73,168) | $ (11,083) | $ 55,332 | $ 126,391 | $ 187,859 | $ 239,292 | $ 278,295 |
| Discount Factor | 0.11 | 0.09 | 0.07 | 0.05 | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 |
| Disc. Net Cash Flow | $ 16,161 | $ 10,559 | $ 6,848 | $ 3,969 | $ 2,483 | $ 2,060 | $ 1,748 | $ 1,496 | $ 1,280 | $ 886 | $ 593 | $ 360 |
| Disc. Cum Cash Flow | $ (614,227) | $ (603,669) | $ (596,820) | $ (592,851) | $ (590,368) | $ (588,308) | $ (586,561) | $ (585,065) | $ (583,785) | $ (582,899) | $ (582,306) | $ (581,946) |

**Field Cashflow Model**

**State**

**Field**

**Formation**

**Depth**

**Distance from Trunkline**

**# of Patterns**

**Miscibility:**

| | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 213,115 | 213,115 | 213,115 | 213,115 | 213,115 | 213,115 | 213,115 | 213,115 | 193,822 | 151,199 | 108,576 | 65,953 |
| $H_2O$ Injection (Mbw) | 71,396 | 71,396 | 71,396 | 71,396 | 71,396 | 71,396 | 71,396 | 71,382 | 81,042 | 102,354 | 123,665 | 123,136 |
| Oil Production (Mbbl) | 9,215 | 8,533 | 7,920 | 7,141 | 6,515 | 6,208 | 5,972 | 5,832 | 5,860 | 6,027 | 6,027 | 5,304 |
| $H_2O$ Production (MBw) | 76,115 | 75,975 | 75,711 | 75,725 | 75,586 | 75,112 | 74,667 | 74,277 | 74,862 | 81,669 | 95,463 | 92,498 |
| $CO_2$ Production (MMcf) | 144,220 | 146,456 | 148,787 | 151,047 | 153,118 | 155,058 | 156,703 | 158,028 | 161,507 | 156,880 | 137,216 | 108,452 |
| $CO_2$ Purchased (MMcf) | 68,895 | 66,659 | 64,328 | 62,068 | 59,997 | 58,057 | 56,412 | 55,087 | 32,315 | - | - | - |
| $CO_2$ Recycled (MMcf) | 144,220 | 146,456 | 148,787 | 151,047 | 153,118 | 155,058 | 156,703 | 158,028 | 161,507 | 151,199 | 108,576 | 65,953 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | $ 306,400 | $ 283,721 | $ 263,356 | $ 237,437 | $ 216,609 | $ 206,427 | $ 198,558 | $ 193,930 | $ 194,856 | $ 200,410 | $ 200,410 | $ 176,342 |
| Royalty ($M) | $ (38,300) | $ (35,465) | $ (32,919) | $ (29,680) | $ (27,076) | $ (25,803) | $ (24,820) | $ (24,241) | $ (24,357) | $ (25,051) | $ (25,051) | $ (22,043) |
| Severance Taxes ($M) | $ (13,405) | $ (12,413) | $ (11,522) | $ (10,388) | $ (9,477) | $ (9,031) | $ (8,687) | $ (8,484) | $ (8,525) | $ (8,768) | $ (8,768) | $ (7,715) |
| Ad Valorum ($M) | $ (6,703) | $ (6,206) | $ (5,761) | $ (5,194) | $ (4,738) | $ (4,516) | $ (4,343) | $ (4,242) | $ (4,262) | $ (4,384) | $ (4,384) | $ (3,857) |
| Net Revenue($M) | $ 247,993 | $ 229,637 | $ 213,154 | $ 192,176 | $ 175,318 | $ 167,077 | $ 160,708 | $ 156,962 | $ 157,711 | $ 162,207 | $ 162,207 | $ 142,727 |
| **Capital Costs ($M)** | | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (146,930) | $ (144,582) | $ (142,135) | $ (139,762) | $ (137,587) | $ (135,550) | $ (133,823) | $ (132,432) | $ (101,769) | $ (52,920) | $ (38,002) | $ (23,084) |
| **O&M Costs ($M)** | | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) | $ (44,614) |
| Lifting Costs ($M) | $ (21,332) | $ (21,127) | $ (20,908) | $ (20,716) | $ (20,525) | $ (20,330) | $ (20,160) | $ (20,027) | $ (20,181) | $ (21,924) | $ (25,373) | $ (24,450) |
| G&A | (13,189) | (13,148) | (13,104) | (13,066) | (13,028) | (12,989) | (12,955) | (12,928) | (12,959) | (13,308) | (13,997) | (13,813) |
| Total O&M Costs | $ (79,135) | $ (78,889) | $ (78,626) | $ (78,396) | $ (78,167) | $ (77,933) | $ (77,728) | $ (77,569) | $ (77,753) | $ (79,845) | $ (83,984) | $ (82,877) |
| Net Cash Flow ($M) | $ 21,927 | $ 6,166 | $ (7,607) | $ (25,982) | $ (40,436) | $ (46,406) | $ (50,843) | $ (53,039) | $ (21,811) | $ 29,442 | $ 40,221 | $ 36,766 |
| Cum. Cash Flow | $ 300,222 | $ 306,388 | $ 298,781 | $ 272,799 | $ 232,363 | $ 185,956 | $ 135,113 | $ 82,074 | $ 60,264 | $ 89,705 | $ 129,926 | $ 166,693 |
| Discount Factor | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Disc. Net Cash Flow | $ 162 | $ 36 | $ (36) | $ (98) | $ (122) | $ (112) | $ (98) | $ (82) | $ (27) | $ 29 | $ 32 | $ 23 |
| Disc. Cum Cash Flow | $ (581,785) | $ (581,748) | $ (581,784) | $ (581,882) | $ (582,004) | $ (582,117) | $ (582,215) | $ (582,297) | $ (582,324) | $ (582,295) | $ (582,263) | $ (582,240) |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 34 | 35 | 36 | 37 | 38 | Totals |
|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 23,330 | - | - | - | - | 6,564,324 |
| $H_2O$ Injection (Mbw) | 108,868 | 84,940 | 49,346 | 13,753 | - | 2,481,101 |
| Oil Production (Mbbl) | 4,162 | 3,007 | 1,712 | 459 | - | 337,490 |
| $H_2O$ Production (MBw) | 77,785 | 62,041 | 40,243 | 11,735 | - | 2,872,670 |
| $CO_2$ Production (MMcf) | 76,435 | 41,885 | 15,121 | 3,112 | - | 3,743,290 |
| $CO_2$ Purchased (MMcf) | - | - | - | - | - | 3,011,078 |
| $CO_2$ Recycled (MMcf) | 23,330 | - | - | - | - | 3,553,246 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ - | |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ - | |
| Gross Revenues ($M) | $ 138,389 | $ 99,973 | $ 56,929 | $ 15,274 | $ - | $ 11,221,556 |
| Royalty ($M) | $ (17,299) | $ (12,497) | $ (7,116) | $ (1,909) | $ - | $ (1,402,694) |
| Severance Taxes ($M) | $ (6,055) | $ (4,374) | $ (2,491) | $ (668) | $ - | $ (490,943) |
| Ad Valorum ($M) | $ (3,027) | $ (2,187) | $ (1,245) | $ (334) | $ - | $ (245,472) |
| Net Revenue($M) | $ 112,009 | $ 80,916 | $ 46,077 | $ 12,362 | $ - | $ 9,082,447 |
| **Capital Costs ($M)** | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ (234,069) |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ (60,214) |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ (47,050) |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ (309,739) |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ (651,072) |
| **$CO_2$ Costs ($M)** | | | | | | |
| Total $CO_2$ Cost ($M) | $ (8,165) | $ - | $ - | $ - | $ - | $ (5,459,145) |
| **O&M Costs ($M)** | | | | | | |
| Operating & Maintenance ($M) | $ (35,691) | $ (26,768) | $ (17,846) | $ (8,923) | $ - | $ (1,472,256) |
| Lifting Costs ($M) | $ (20,487) | $ (16,262) | $ (10,489) | $ (3,048) | $ - | $ (802,540) |
| G&A | (11,236) | (8,606) | (5,667) | (2,394) | - | $ (454,959) |
| Total O&M Costs | $ (67,413) | $ (51,636) | $ (34,001) | $ (14,365) | $ - | $ (2,729,755) |
| Net Cash Flow ($M) | $ 36,430 | $ 29,280 | $ 12,076 | $ (2,003) | $ - | $ 242,475 |
| Cum. Cash Flow | $ 203,122 | $ 232,402 | $ 244,478 | $ 242,475 | $ 242,475 | |
| Discount Factor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| Disc. Net Cash Flow | $ 18 | $ 12 | $ 4 | $ (1) | $ - | $ (582,206) |
| Disc. Cum Cash Flow | $ (582,221) | $ (582,209) | $ (582,205) | $ (582,206) | ######## | |

| | |
|---|---|
| **Basin** | **Permian (West Texas 8A)** |
| **Field** | **WASSON (BENNETT RANCH UNIT)** |
| **Formation** | **SAN ANDRES** |
| **Technology Case** | **MPZ + TZ / ROZ (Simultaneous)** |
| Depth (ft) | 5,305 |
| Total OOIP (MMBls) | 882 |
| Cumulative Recovery (MMbls) * | 312 |
| EUR (MMbls) * | 315 |
| Total ROIP (MMBls) | 567 |
| API Gravity | 33 |
| Patterns | 176 |
| Existing Injectors Used | 75 |
| Converted Producers Used | 0 |
| New Injectors Drilled | 101 |
| Existing Producers Used | 156 |
| New Producers Drilled | 48 |

**Pattern Detail**

| | | | |
|---|---|---|---|
| Cum Oil (Mbbl) | 1,018 | | |
| Cum H2O (Mbw) | 5,470 | 5.37 | Bw/Bbl |
| Gross CO2 (MMcf) | 14,029 | 13.78 | Mcf/Bbl |
| Purchased CO2 (MMcf) | 3,644 | 3.58 | Mcf/Bbl |
| Recycled CO2 (MMcf) | 10,385 | 10.20 | Mcf/Bbl |

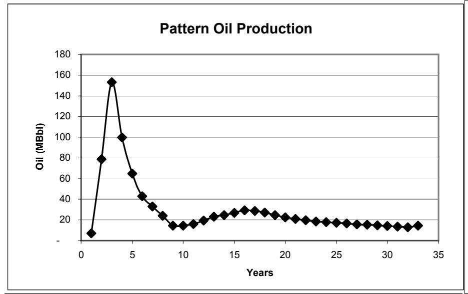
**Field Detail**

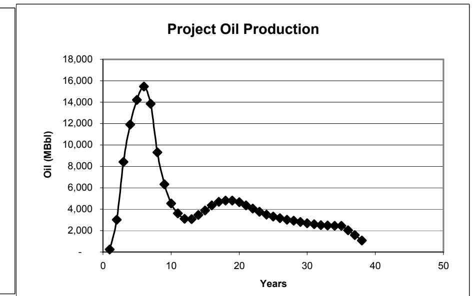
| | | |
|---|---|---|
| Cum Oil (MMbbl) | 179.13 | |
| % OOIP Recovered | 20.3% | |
| Cum H2O (MMbw) | 963 | |
| Gross CO2 (MMcf) | 2,469,139 | |
| Purchased CO2 (MMcf) | 627,746 | |
| Recycled CO2 (MMcf) | 1,841,393 | |
| Payback Period (per pattern) | 3 | years |
| Project Length | 40 | years |

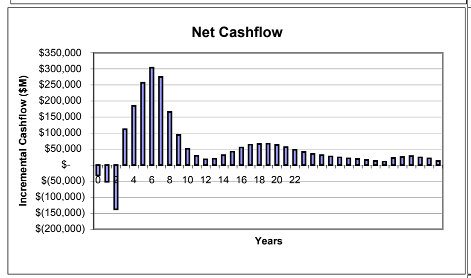
**Field Economics**

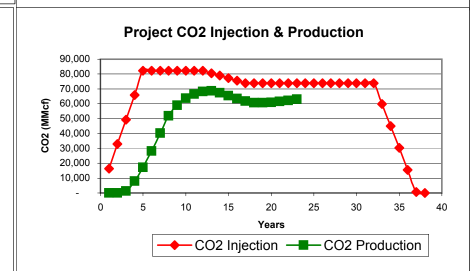
| | | | $/BBl |
|---|---|---|---|
| Total Net Revenue ($M) | $ | 4,820,772 | |
| Total Capital Investment ($M) | $ | (280,831) | $ 1.57 |
| Total CO2 Cost ($M) | $ | (1,523,332) | $ 8.50 |
| Total O&M Costs ($M) | $ | (860,855) | $ 4.81 |
| | $ | (2,665,018) | $ 14.88 |

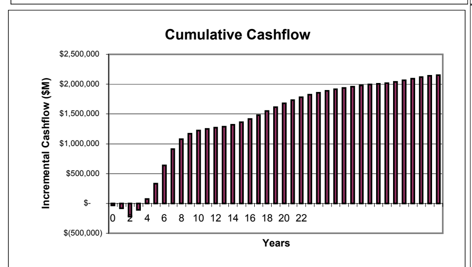
*Includes "Mother Nature's" waterflood oil displacement of 240 million barrels

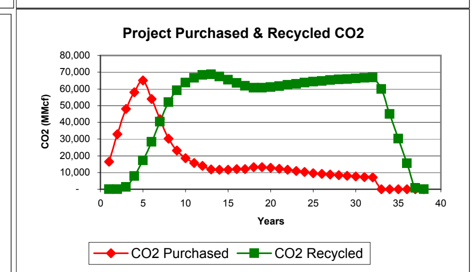


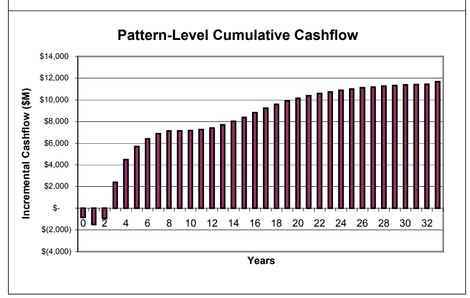




**Assumptions:**

| | |
|---|---|
| Oil Price | $ 35.00 |
| CO2 Purchase Cost | 4% of oil price |
| CO2 Recycle Cost | 1% of oil price |
| Recycling Plant Costs | 1 Year before Breakthru |
| Well O&M | Prod Wells Only |

**Field Cashflow Model**

| | | | Pattern | | Field | |
|---|---|---|---|---|---|---|
| **State** | Permian (West Texas 8A) | | Existing Injectors Used | 0.43 | Existing Injectors Used | 75 |
| **Field** | WASSON SAN ANDRES (BENNETT RANCH UNIT) | | Converted Producers Used | 0.00 | Converted Producers Used | 0 |
| **Formation** | SAN ANDRES | | New Injectors Needed | 0.57 | New Injectors Needed | 101 |
| **Depth** | 5305 | | New Producers Needed | 0.27 | New Producers Needed | 48 |
| **Distance from Trunkline** | 10 | miles | Existing Producers Used | 0.89 | Existing Producers Used | 156 |
| **# of Patterns** | 176.00 | | | | | |
| **Miscibility:** | Miscible | | | | | |

| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | | | 16,456 | 32,916 | 49,372 | 65,828 | 82,284 | 82,287 | 82,284 | 82,284 |
| $H_2O$ Injection (Mbw) | | | 4,115 | 8,230 | 12,341 | 16,456 | 20,571 | 20,571 | 20,571 | 20,574 |
| Oil Production (Mbbl) | | | 250 | 3,020 | 8,409 | 11,922 | 14,203 | 15,467 | 13,862 | 9,321 |
| $H_2O$ Production (MBw) | | | 10,261 | 17,892 | 22,260 | 26,576 | 31,113 | 25,474 | 22,454 | 22,641 |
| $CO_2$ Production (MMcf) | | | - | - | 1,369 | 7,895 | 17,146 | 28,244 | 40,297 | 51,983 |
| $CO_2$ Purchased (MMcf) | | | 16,456 | 32,916 | 48,002 | 57,932 | 65,138 | 54,043 | 41,987 | 30,300 |
| $CO_2$ Recycled (MMcf) | | | - | - | 1,369 | 7,895 | 17,146 | 28,244 | 40,297 | 51,983 |
| Oil Price ($/Bbl) | $ 35.00 | | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | **33** | | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | | | $ 8,310 | $ 100,420 | $ 279,609 | $ 396,414 | $ 472,256 | $ 514,274 | $ 460,904 | $ 309,922 |
| Royalty ($M) | **-12.5%** | | $ (1,039) | $ (12,553) | $ (34,951) | $ (49,552) | $ (59,032) | $ (64,284) | $ (57,613) | $ (38,740) |
| Severance Taxes ($M) | **-5.0%** | | $ (364) | $ (4,393) | $ (12,233) | $ (17,343) | $ (20,661) | $ (22,499) | $ (20,165) | $ (13,559) |
| Ad Valorum ($M) | **-2.5%** | | $ (182) | $ (2,197) | $ (6,116) | $ (8,672) | $ (10,331) | $ (11,250) | $ (10,082) | $ (6,780) |
| Net Revenue($M) | | | $ 6,726 | $ 81,278 | $ 226,308 | $ 320,848 | $ 382,233 | $ 416,240 | $ 373,044 | $ 250,843 |
| **Capital Costs ($M)** | | | | | | | | | | |
| New Well - D&C | | $ (15,572) | $ (15,572) | $ (15,572) | $ (15,572) | $ (15,572) | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | | $ (7,480) | $ (7,480) | $ (7,480) | $ (7,480) | $ (7,480) | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | | $ (2,472) | $ (2,472) | $ (2,472) | $ (2,472) | $ (2,472) | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | | $ (1,008) | $ (1,008) | $ (1,008) | $ (1,008) | $ (1,008) | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | | $ (2,746) | $ (2,746) | $ (2,746) | $ (2,746) | $ (2,746) | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | | $ - | $ - | $ (131,760) | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | | $ (2,679) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | | $ (31,958) | $ (29,278) | $ (161,038) | $ (29,278) | $ (29,278) | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | | | $ (23,038) | $ (46,082) | $ (67,682) | $ (83,868) | $ (97,194) | $ (85,545) | $ (72,885) | $ (60,614) |
| **O&M Costs ($M)** | | | | | | | | | | |
| Operating & Maintenance ($M) | | | $ (2,400) | $ (4,799) | $ (7,199) | $ (9,599) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) |
| Lifting Costs ($M) | | | $ (2,628) | $ (5,228) | $ (7,667) | $ (9,625) | $ (11,329) | $ (10,235) | $ (9,079) | $ (7,990) |
| G&A | **20%** | | (1,005) | (2,005) | (2,973) | (3,845) | (4,665) | (4,447) | (4,215) | (3,998) |
| Total O&M Costs | | | $ (6,033) | $ (12,033) | $ (17,840) | $ (23,068) | $ (27,993) | $ (26,680) | $ (25,293) | $ (23,986) |
| Net Cash Flow ($M) | | $ (31,958) | $ (51,624) | $ (137,875) | $ 111,508 | $ 184,634 | $ 257,046 | $ 304,015 | $ 274,866 | $ 166,242 |
| Cum. Cash Flow | | $ (31,958) | $ (83,581) | $ (221,457) | $ (109,949) | $ 74,685 | $ 331,731 | $ 635,746 | $ 910,612 | $ 1,076,855 |
| Discount Factor | **25%** | 1.00 | 0.80 | 0.64 | 0.51 | 0.41 | 0.33 | 0.26 | 0.21 | 0.17 |
| Disc. Net Cash Flow | | $ (31,958) | $ (41,299) | $ (88,240) | $ 57,092 | $ 75,626 | $ 84,229 | $ 79,696 | $ 57,644 | $ 27,891 |
| Disc. Cum Cash Flow | | $ (31,958) | $ (73,257) | $ (161,497) | $ (104,405) | $ (28,779) | $ 55,450 | $ 135,146 | $ 192,789 | $ 220,680 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 82,287 | 82,287 | 82,284 | 82,284 | 80,615 | 78,940 | 77,264 | 75,588 | 73,916 | 73,909 | 73,906 |
| $H_2O$ Injection (Mbw) | 20,571 | 20,571 | 20,571 | 20,571 | 21,405 | 22,246 | 23,084 | 23,918 | 24,756 | 24,760 | 24,760 |
| Oil Production (Mbbl) | 6,315 | 4,548 | 3,604 | 3,119 | 3,087 | 3,450 | 3,883 | 4,344 | 4,678 | 4,815 | 4,815 |
| $H_2O$ Production (MBw) | 23,024 | 23,056 | 22,929 | 22,753 | 22,827 | 23,158 | 23,595 | 24,052 | 24,552 | 24,900 | 24,872 |
| $CO_2$ Production (MMcf) | 59,059 | 63,719 | 66,570 | 68,327 | 68,703 | 67,345 | 65,539 | 63,610 | 61,899 | 60,632 | 60,713 |
| $CO_2$ Purchased (MMcf) | 23,228 | 18,568 | 15,713 | 13,957 | 11,912 | 11,595 | 11,725 | 11,979 | 12,017 | 13,277 | 13,193 |
| $CO_2$ Recycled (MMcf) | 59,059 | 63,719 | 66,570 | 68,327 | 68,703 | 67,345 | 65,539 | 63,610 | 61,899 | 60,632 | 60,713 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | $ 209,970 | $ 151,216 | $ 119,849 | $ 103,697 | $ 102,644 | $ 114,699 | $ 129,095 | $ 144,427 | $ 155,546 | $ 160,111 | $ 160,111 |
| Royalty ($M) | $ (26,246) | $ (18,902) | $ (14,981) | $ (12,962) | $ (12,831) | $ (14,337) | $ (16,137) | $ (18,053) | $ (19,443) | $ (20,014) | $ (20,014) |
| Severance Taxes ($M) | $ (9,186) | $ (6,616) | $ (5,243) | $ (4,537) | $ (4,491) | $ (5,018) | $ (5,648) | $ (6,319) | $ (6,805) | $ (7,005) | $ (7,005) |
| Ad Valorum ($M) | $ (4,593) | $ (3,308) | $ (2,622) | $ (2,268) | $ (2,245) | $ (2,509) | $ (2,824) | $ (3,159) | $ (3,403) | $ (3,502) | $ (3,502) |
| Net Revenue($M) | $ 169,944 | $ 122,390 | $ 97,003 | $ 83,930 | $ 83,078 | $ 92,835 | $ 104,486 | $ 116,896 | $ 125,895 | $ 129,590 | $ 129,590 |
| **Capital Costs ($M)** | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (53,190) | $ (48,297) | $ (45,298) | $ (43,454) | $ (40,723) | $ (39,803) | $ (39,354) | $ (39,033) | $ (38,489) | $ (39,810) | $ (39,720) |
| **O&M Costs ($M)** | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) |
| Lifting Costs ($M) | $ (7,335) | $ (6,901) | $ (6,633) | $ (6,468) | $ (6,479) | $ (6,652) | $ (6,869) | $ (7,099) | $ (7,308) | $ (7,429) | $ (7,422) |
| G&A | (3,867) | (3,780) | (3,726) | (3,693) | (3,695) | (3,730) | (3,773) | (3,819) | (3,861) | (3,885) | (3,884) |
| Total O&M Costs | $ (23,200) | $ (22,679) | $ (22,358) | $ (22,159) | $ (22,172) | $ (22,380) | $ (22,641) | $ (22,917) | $ (23,167) | $ (23,313) | $ (23,304) |
| Net Cash Flow ($M) | $ 93,554 | $ 51,414 | $ 29,347 | $ 18,317 | $ 20,183 | $ 30,651 | $ 42,492 | $ 54,946 | $ 64,239 | $ 66,467 | $ 66,566 |
| Cum. Cash Flow | $ 1,170,409 | $ 1,221,823 | $ 1,251,170 | $ 1,269,487 | $ 1,289,670 | $ 1,320,321 | $ 1,362,813 | $ 1,417,759 | $ 1,481,998 | $ 1,548,465 | $ 1,615,031 |
| Discount Factor | 0.13 | 0.11 | 0.09 | 0.07 | 0.05 | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 | 0.01 |
| Disc. Net Cash Flow | $ 12,557 | $ 5,521 | $ 2,521 | $ 1,259 | $ 1,110 | $ 1,348 | $ 1,495 | $ 1,547 | $ 1,447 | $ 1,197 | $ 959 |
| Disc. Cum Cash Flow | $ 233,237 | $ 238,757 | $ 241,278 | $ 242,537 | $ 243,647 | $ 244,995 | $ 246,490 | $ 248,036 | $ 249,483 | $ 250,680 | $ 251,640 |

**Field Cashflow Model**

**State**

**Field**

**Formation**

**Depth**

**Distance from Trunkline**

**# of Patterns**

**Miscibility:**

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 73,909 | 73,909 | 73,906 | 73,909 | 73,909 | 73,906 | 73,909 | 73,909 | 73,906 | 73,909 | 73,909 | 73,909 |
| $H_2O$ Injection (Mbw) | 24,756 | 24,760 | 24,760 | 24,760 | 24,760 | 24,760 | 24,760 | 24,760 | 24,760 | 24,760 | 24,760 | 24,760 |
| Oil Production (Mbbl) | 4,657 | 4,368 | 4,048 | 3,749 | 3,506 | 3,326 | 3,168 | 3,027 | 2,915 | 2,805 | 2,696 | 2,591 |
| $H_2O$ Production (MBw) | 24,915 | 24,964 | 25,048 | 25,087 | 25,091 | 25,034 | 25,027 | 25,003 | 24,967 | 24,943 | 24,932 | 24,918 |
| $CO_2$ Production (MMcf) | 61,030 | 61,670 | 62,315 | 63,022 | 63,659 | 64,286 | 64,733 | 65,173 | 65,560 | 65,923 | 66,239 | 66,556 |
| $CO_2$ Purchased (MMcf) | 12,880 | 12,239 | 11,591 | 10,887 | 10,250 | 9,620 | 9,177 | 8,737 | 8,346 | 7,987 | 7,670 | 7,353 |
| $CO_2$ Recycled (MMcf) | 61,030 | 61,670 | 62,315 | 63,022 | 63,659 | 64,286 | 64,733 | 65,173 | 65,560 | 65,923 | 66,239 | 66,556 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 |
| Gross Revenues ($M) | $ 154,844 | $ 145,247 | $ 134,596 | $ 124,648 | $ 116,572 | $ 110,603 | $ 105,336 | $ 100,654 | $ 96,909 | $ 93,281 | $ 89,653 | $ 86,141 |
| Royalty ($M) | $ (19,355) | $ (18,156) | $ (16,825) | $ (15,581) | $ (14,571) | $ (13,825) | $ (13,167) | $ (12,582) | $ (12,114) | $ (11,660) | $ (11,207) | $ (10,768) |
| Severance Taxes ($M) | $ (6,774) | $ (6,355) | $ (5,889) | $ (5,453) | $ (5,100) | $ (4,839) | $ (4,608) | $ (4,404) | $ (4,240) | $ (4,081) | $ (3,922) | $ (3,769) |
| Ad Valorum ($M) | $ (3,387) | $ (3,177) | $ (2,944) | $ (2,727) | $ (2,550) | $ (2,419) | $ (2,304) | $ (2,202) | $ (2,120) | $ (2,041) | $ (1,961) | $ (1,884) |
| Net Revenue($M) | $ 125,327 | $ 117,559 | $ 108,939 | $ 100,887 | $ 94,350 | $ 89,519 | $ 85,256 | $ 81,467 | $ 78,436 | $ 75,499 | $ 72,563 | $ 69,721 |
| **Capital Costs ($M)** | | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (39,392) | $ (38,719) | $ (38,038) | $ (37,300) | $ (36,631) | $ (35,968) | $ (35,504) | $ (35,042) | $ (34,630) | $ (34,255) | $ (33,922) | $ (33,589) |
| **O&M Costs ($M)** | | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) |
| Lifting Costs ($M) | $ (7,393) | $ (7,333) | $ (7,274) | $ (7,209) | $ (7,149) | $ (7,090) | $ (7,049) | $ (7,007) | $ (6,970) | $ (6,937) | $ (6,907) | $ (6,877) |
| G&A | (3,878) | (3,866) | (3,854) | (3,841) | (3,829) | (3,818) | (3,809) | (3,801) | (3,794) | (3,787) | (3,781) | (3,775) |
| Total O&M Costs | $ (23,269) | $ (23,197) | $ (23,127) | $ (23,049) | $ (22,977) | $ (22,906) | $ (22,856) | $ (22,807) | $ (22,762) | $ (22,722) | $ (22,686) | $ (22,650) |
| Net Cash Flow ($M) | $ 62,666 | $ 55,642 | $ 47,774 | $ 40,538 | $ 34,743 | $ 30,645 | $ 26,896 | $ 23,619 | $ 21,043 | $ 18,522 | $ 15,954 | $ 13,481 |
| Cum. Cash Flow | $ 1,677,697 | $ 1,733,339 | $ 1,781,113 | $ 1,821,651 | $ 1,856,394 | $ 1,887,039 | $ 1,913,935 | $ 1,937,553 | $ 1,958,597 | $ 1,977,119 | $ 1,993,073 | $ 2,006,555 |
| Discount Factor | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Disc. Net Cash Flow | $ 722 | $ 513 | $ 353 | $ 239 | $ 164 | $ 116 | $ 81 | $ 57 | $ 41 | $ 29 | $ 20 | $ 13 |
| Disc. Cum Cash Flow | $ 252,362 | $ 252,875 | $ 253,228 | $ 253,467 | $ 253,631 | $ 253,747 | $ 253,828 | $ 253,885 | $ 253,926 | $ 253,955 | $ 253,974 | $ 253,988 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 32 | 33 | 34 | 35 | 36 | 37 | 38 | Totals |
|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 73,909 | 59,833 | 45,049 | 30,268 | 15,484 | 704 | - | 2,469,139 |
| $H_2O$ Injection (Mbw) | 24,760 | 31,796 | 39,188 | 46,580 | 43,652 | 38,699 | 26,710 | 935,528 |
| Oil Production (Mbbl) | 2,499 | 2,464 | 2,446 | 2,436 | 2,035 | 1,573 | 1,067 | 179,133 |
| $H_2O$ Production (MBw) | 24,908 | 26,625 | 32,021 | 38,034 | 34,904 | 29,920 | 23,221 | 962,650 |
| $CO_2$ Production (MMcf) | 66,838 | 66,510 | 56,890 | 45,679 | 32,497 | 19,033 | 6,100 | 1,919,403 |
| $CO_2$ Purchased (MMcf) | 7,072 | - | - | - | - | - | - | 627,746 |
| $CO_2$ Recycled (MMcf) | 66,838 | 59,833 | 45,049 | 30,268 | 15,484 | 704 | - | 1,841,393 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | |
| Gravity Adjustment | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ 33.25 | $ - | |
| Gross Revenues ($M) | $ 83,098 | $ 81,928 | $ 81,343 | $ 80,992 | $ 67,649 | $ 52,317 | $ - | $ 5,920,702 |
| Royalty ($M) | $ (10,387) | $ (10,241) | $ (10,168) | $ (10,124) | $ (8,456) | $ (6,540) | $ - | $ (740,088) |
| Severance Taxes ($M) | $ (3,636) | $ (3,584) | $ (3,559) | $ (3,543) | $ (2,960) | $ (2,289) | $ - | $ (259,031) |
| Ad Valorum ($M) | $ (1,818) | $ (1,792) | $ (1,779) | $ (1,772) | $ (1,480) | $ (1,144) | $ - | $ (129,515) |
| Net Revenue($M) | $ 67,258 | $ 66,310 | $ 65,837 | $ 65,553 | $ 54,754 | $ 42,344 | $ - | $ 4,792,069 |
| **Capital Costs ($M)** | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (77,862) |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (37,399) |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (12,358) |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (5,042) |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (13,731) |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (131,760) |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (2,679) |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (280,831) |
| **$CO_2$ Costs ($M)** | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (33,294) | $ (20,942) | $ (15,767) | $ (10,594) | $ (5,420) | $ (246) | $ - | $ (1,523,332) |
| **O&M Costs ($M)** | | | | | | | | |
| Operating & Maintenance ($M) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (11,998) | $ (9,599) | $ (7,199) | $ (424,735) |
| Lifting Costs ($M) | $ (6,852) | $ (7,272) | $ (8,617) | $ (10,117) | $ (9,235) | $ (7,873) | $ (6,072) | $ (281,611) |
| G&A | (3,770) | (3,854) | (4,123) | (4,423) | (4,247) | (3,494) | (2,654) | $ (141,269) |
| Total O&M Costs | $ (22,620) | $ (23,125) | $ (24,738) | $ (26,539) | $ (25,479) | $ (20,966) | $ (15,925) | $ (847,614) |
| Net Cash Flow ($M) | $ 11,344 | $ 22,244 | $ 25,332 | $ 28,420 | $ 23,854 | $ 21,131 | $ (15,925) | $ 2,140,291 |
| Cum. Cash Flow | $ 2,017,899 | $ 2,040,143 | $ 2,065,475 | $ 2,093,895 | $ 2,117,749 | $ 2,138,881 | ######## | |
| Discount Factor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| Disc. Net Cash Flow | $ 9 | $ 14 | $ 13 | $ 12 | $ 8 | $ 5 | $ (3) | $ 254,048 |
| Disc. Cum Cash Flow | $ 253,997 | $ 254,011 | $ 254,024 | $ 254,035 | $ 254,043 | $ 254,048 | $ 254,045 | |

| | |
|---|---|
| **Basin** | **Permian (East NM)** |
| **Field** | **VACUUM** |
| **Formation** | **GRAYBURG-SAN ANDRES** |
| **Technology Case** | **MPZ + TZ / ROZ (Simultaneous)** |
| Depth (ft) | 4,847 |
| Total OOIP (MMBls) | 3,360 |
| Cumulative Recovery (MMbls) * | 1,590 |
| EUR (MMbls) * | 1,609 |
| Total ROIP (MMbls) | 1,751 |
| API Gravity | 36 |
| Patterns | 480 |
| Existing Injectors Used | 200 |
| Converted Producers Used | 270 |
| New Injectors Drilled | 10 |
| Existing Producers Used | 525 |
| New Producers Drilled | 0 |

**Pattern Detail**

| | | | |
|---|---|---|---|
| Cum Oil (Mbbl) | 1,203 | | |
| Cum H2O (Mbw) | 6,300 | 5.24 | Bw/Bbl |
| Gross CO2 (MMcf) | 16,169 | 13.44 | Mcf/Bbl |
| Purchased CO2 (MMcf) | 4,208 | 3.50 | Mcf/Bbl |
| Recycled CO2 (MMcf) | 11,961 | 9.94 | Mcf/Bbl |

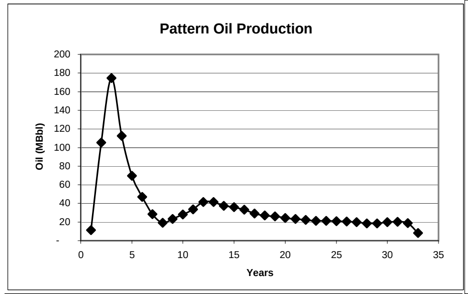
**Field Detail**

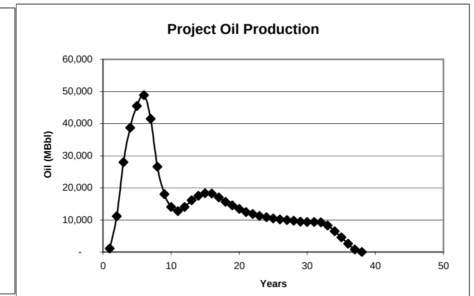
| | | |
|---|---|---|
| Cum Oil (MMbbl) | 577.44 | |
| % OOIP Recovered | 17.2% | |
| Cum H2O (MMbw) | 3,024 | |
| Gross CO2 (MMcf) | 7,761,312 | |
| Purchased CO2 (MMcf) | 1,970,256 | |
| Recycled CO2 (MMcf) | 5,791,056 | |
| Payback Period (per pattern) | 3 | years |
| Project Length | 37 | years |

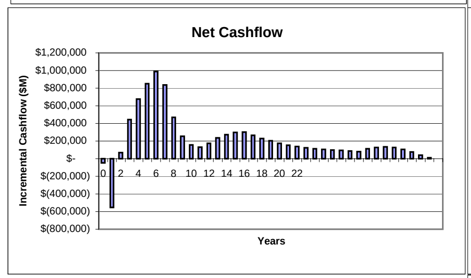
**Field Economics**

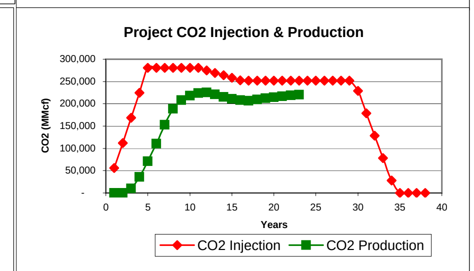
| | | | |
|---|---|---|---|
| | | | $/BBl |
| Total Net Revenue ($M) | $ | 15,857,787 | |
| Total Capital Investment ($M) | $ | (671,833) | $ 1.16 |
| Total CO2 Cost ($M) | $ | (4,785,228) | $ 8.29 |
| Total O&M Costs ($M) | $ | (2,239,089) | $ 3.88 |
| | $ | (7,696,150) | $ 13.33 |

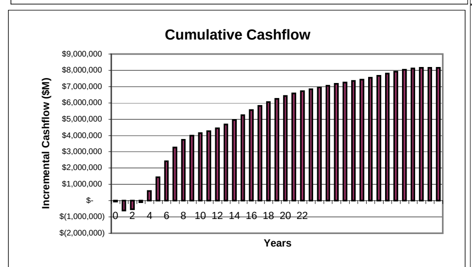
*Includes "Mother Nature's" waterflood oil displacement of 1,259 million barrels

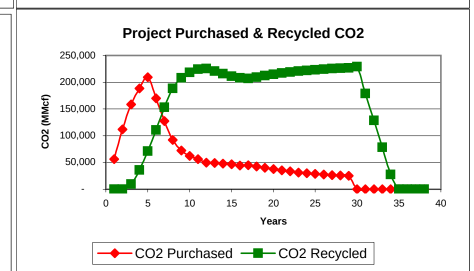


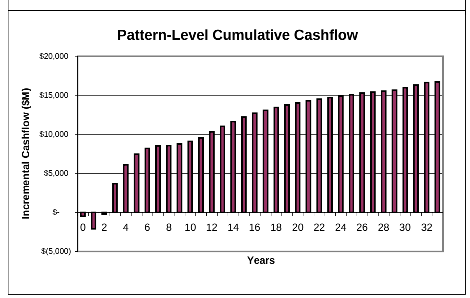




**Assumptions:**

| | |
|---|---|
| Oil Price | $ 35.00 |
| CO2 Purchase Cost | 4% of oil price |
| CO2 Recycle Cost | 1% of oil price |
| Recycling Plant Costs | 1 Year before Breakthru |
| Well O&M | Prod Wells Only |

**Field Cashflow Model**

| | |
|---|---|
| **State** | Permian (East NM) |
| **Field** | VACUUM |
| **Formation** | GRAYBURG-SAN ANDRES |
| **Depth** | 4846.75 |
| **Distance from Trunkline** | 10 miles |
| **# of Patterns** | 480.00 |
| **Miscibility:** | Miscible |

| Pattern | | Field | |
|---|---|---|---|
| Existing Injectors Used | 0.42 | Existing Injectors Used | 200 |
| Converted Producers Used | 0.56 | Converted Producers Used | 270 |
| New Injectors Needed | 0.02 | New Injectors Needed | 10 |
| New Producers Needed | 0.00 | New Producers Needed | 0 |
| Existing Producers Used | 1.09 | Existing Producers Used | 525 |

| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 Injection (MMcf) | | | 56,102 | 112,205 | 168,307 | 224,410 | 280,522 | 280,522 | 280,522 | 280,522 |
| H2O Injection (Mbw) | | | 14,026 | 28,051 | 42,077 | 56,102 | 70,128 | 70,128 | 70,128 | 70,128 |
| Oil Production (Mbbl) | | | 1,075 | 11,194 | 27,946 | 38,755 | 45,437 | 48,864 | 41,472 | 26,563 |
| H2O Production (MBw) | | | 35,040 | 60,605 | 75,456 | 89,962 | 105,216 | 86,208 | 77,078 | 78,634 |
| CO2 Production (MMcf) | | | - | 106 | 9,773 | 36,077 | 71,395 | 110,506 | 153,158 | 188,688 |
| CO2 Purchased (MMcf) | | | 56,102 | 112,099 | 158,534 | 188,333 | 209,126 | 170,016 | 127,363 | 91,834 |
| CO2 Recycled (MMcf) | | | - | 106 | 9,773 | 36,077 | 71,395 | 110,506 | 153,158 | 188,688 |
| Oil Price ($/Bbl) | **$ 35.00** | | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | **36** | | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 |
| Gross Revenues ($M) | | | $ 36,557 | $ 380,582 | $ 950,150 | $ 1,317,677 | $ 1,544,851 | $ 1,661,376 | $ 1,410,048 | $ 903,149 |
| Royalty ($M) | **-12.5%** | | $ (4,570) | $ (47,573) | $ (118,769) | $ (164,710) | $ (193,106) | $ (207,672) | $ (176,256) | $ (112,894) |
| Severance Taxes ($M) | **-3.2%** | | $ (1,008) | $ (10,490) | $ (26,189) | $ (36,318) | $ (42,580) | $ (45,792) | $ (38,864) | $ (24,893) |
| Ad Valorum ($M) | **-4.5%** | | $ (1,452) | $ (15,119) | $ (37,745) | $ (52,345) | $ (61,369) | $ (65,998) | $ (56,014) | $ (35,878) |
| Net Revenue($M) | | | $ 29,527 | $ 307,401 | $ 767,448 | $ 1,064,304 | $ 1,247,796 | $ 1,341,914 | $ 1,138,913 | $ 729,485 |
| **Capital Costs ($M)** | | | | | | | | | | |
| New Well - D&C | | $ (891) | $ (891) | $ (891) | $ (891) | $ (891) | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | | $ (32,658) | $ (32,658) | $ (32,658) | $ (32,658) | $ (32,658) | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | | $ (7,655) | $ (7,655) | $ (7,655) | $ (7,655) | $ (7,655) | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | | $ (1,513) | $ (1,513) | $ (1,513) | $ (1,513) | $ (1,513) | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | | $ (2,603) | $ (2,603) | $ (2,603) | $ (2,603) | $ (2,603) | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | | $ (156) | $ (156) | $ (156) | $ (156) | $ (156) | $ - | $ - | $ - | $ - |
| CO2 Recycling Plant | | $ - | $ (441,771) | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | | $ (2,684) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | | $ (48,160) | $ (487,247) | $ (45,476) | $ (45,476) | $ (45,476) | $ - | $ - | $ - | $ - |
| **CO2 Costs ($M)** | | | | | | | | | | |
| Total CO2 Cost ($M) | | | $ (78,543) | $ (156,976) | $ (225,369) | $ (276,293) | $ (317,765) | $ (276,699) | $ (231,914) | $ (194,608) |
| **O&M Costs ($M)** | | | | | | | | | | |
| Operating & Maintenance ($M) | | | $ (5,852) | $ (11,704) | $ (17,556) | $ (23,409) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) |
| Lifting Costs ($M) | | | $ (9,029) | $ (17,950) | $ (25,850) | $ (32,179) | $ (37,663) | $ (33,768) | $ (29,638) | $ (26,299) |
| G&A | **20%** | | (2,976) | (5,931) | (8,681) | (11,118) | (13,385) | (12,606) | (11,780) | (11,112) |
| Total O&M Costs | | | $ (17,857) | $ (35,585) | $ (52,088) | $ (66,705) | $ (80,309) | $ (75,635) | $ (70,678) | $ (66,672) |
| Net Cash Flow ($M) | | $ (48,160) | $ (554,120) | $ 69,365 | $ 444,516 | $ 675,830 | $ 849,722 | $ 989,580 | $ 836,321 | $ 468,205 |
| Cum. Cash Flow | | $ (48,160) | $ (602,280) | $ (532,915) | $ (88,399) | $ 587,431 | $ 1,437,153 | $ 2,426,733 | $ 3,263,054 | $ 3,731,259 |
| Discount Factor | **25%** | 1.00 | 0.80 | 0.64 | 0.51 | 0.41 | 0.33 | 0.26 | 0.21 | 0.17 |
| Disc. Net Cash Flow | | $ (48,160) | $ (443,296) | $ 44,394 | $ 227,592 | $ 276,820 | $ 278,437 | $ 259,413 | $ 175,389 | $ 78,552 |
| Disc. Cum Cash Flow | | $ (48,160) | $ (491,456) | $ (447,062) | $ (219,470) | $ 57,350 | $ 335,787 | $ 595,199 | $ 770,589 | $ 849,140 |

**Field Cashflow Model**

**State**

**Field**

**Formation**

**Depth**

**Distance from Trunkline**

**# of Patterns**

**Miscibility:**

| | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 280,522 | 280,512 | 280,512 | 275,184 | 269,472 | 263,770 | 258,058 | 252,346 | 251,962 | 251,962 | 251,962 |
| $H_2O$ Injection (Mbw) | 70,128 | 70,128 | 70,128 | 72,797 | 75,648 | 78,509 | 81,360 | 84,221 | 84,403 | 84,413 | 84,403 |
| Oil Production (Mbbl) | 17,981 | 14,016 | 12,749 | 14,006 | 16,157 | 17,530 | 18,269 | 18,221 | 17,021 | 15,629 | 14,525 |
| $H_2O$ Production (MBw) | 79,968 | 80,006 | 79,046 | 77,818 | 78,029 | 79,171 | 80,726 | 82,579 | 84,403 | 84,960 | 84,970 |
| $CO_2$ Production (MMcf) | 208,013 | 218,371 | 224,189 | 225,408 | 220,694 | 215,664 | 211,334 | 208,262 | 206,928 | 209,232 | 212,131 |
| $CO_2$ Purchased (MMcf) | 72,509 | 62,141 | 56,323 | 49,776 | 48,778 | 48,106 | 46,723 | 44,083 | 45,034 | 42,730 | 39,830 |
| $CO_2$ Recycled (MMcf) | 208,013 | 218,371 | 224,189 | 225,408 | 220,694 | 215,664 | 211,334 | 208,262 | 206,928 | 209,232 | 212,131 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 |
| Gross Revenues ($M) | $ 611,347 | $ 476,544 | $ 433,459 | $ 476,218 | $ 549,331 | $ 596,006 | $ 621,139 | $ 619,507 | $ 578,707 | $ 531,379 | $ 493,843 |
| Royalty ($M) | $ (76,418) | $ (59,568) | $ (54,182) | $ (59,527) | $ (68,666) | $ (74,501) | $ (77,642) | $ (77,438) | $ (72,338) | $ (66,422) | $ (61,730) |
| Severance Taxes ($M) | $ (16,850) | $ (13,135) | $ (11,947) | $ (13,126) | $ (15,141) | $ (16,427) | $ (17,120) | $ (17,075) | $ (15,951) | $ (14,646) | $ (13,612) |
| Ad Valorum ($M) | $ (24,286) | $ (18,931) | $ (17,219) | $ (18,918) | $ (21,822) | $ (23,676) | $ (24,675) | $ (24,610) | $ (22,989) | $ (21,109) | $ (19,618) |
| Net Revenue($M) | $ 493,793 | $ 384,911 | $ 350,110 | $ 384,647 | $ 443,702 | $ 481,402 | $ 501,702 | $ 500,384 | $ 467,429 | $ 429,202 | $ 398,883 |
| **Capital Costs ($M)** | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (174,317) | $ (163,427) | $ (157,319) | $ (148,579) | $ (145,532) | $ (142,830) | $ (139,380) | $ (134,608) | $ (135,472) | $ (133,053) | $ (130,008) |
| **O&M Costs ($M)** | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) |
| Lifting Costs ($M) | $ (24,487) | $ (23,506) | $ (22,949) | $ (22,956) | $ (23,546) | $ (24,175) | $ (24,749) | $ (25,200) | $ (25,356) | $ (25,147) | $ (24,874) |
| G&A | (10,750) | (10,553) | (10,442) | (10,443) | (10,561) | (10,687) | (10,802) | (10,892) | (10,923) | (10,882) | (10,827) |
| Total O&M Costs | $ (64,498) | $ (63,320) | $ (62,652) | $ (62,660) | $ (63,369) | $ (64,123) | $ (64,812) | $ (65,353) | $ (65,540) | $ (65,290) | $ (64,961) |
| Net Cash Flow ($M) | $ 254,978 | $ 158,164 | $ 130,140 | $ 173,408 | $ 234,801 | $ 274,448 | $ 297,511 | $ 300,422 | $ 266,417 | $ 230,859 | $ 203,914 |
| Cum. Cash Flow | $ 3,986,238 | $ 4,144,401 | $ 4,274,542 | $ 4,447,949 | $ 4,682,750 | $ 4,957,199 | $ 5,254,710 | $ 5,555,132 | $ 5,821,549 | $ 6,052,408 | $ 6,256,322 |
| Discount Factor | 0.13 | 0.11 | 0.09 | 0.07 | 0.05 | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 | 0.01 |
| Disc. Net Cash Flow | $ 34,223 | $ 16,983 | $ 11,179 | $ 11,916 | $ 12,908 | $ 12,070 | $ 10,468 | $ 8,456 | $ 5,999 | $ 4,159 | $ 2,939 |
| Disc. Cum Cash Flow | $ 883,363 | $ 900,346 | $ 911,525 | $ 923,441 | $ 936,349 | $ 948,420 | $ 958,888 | $ 967,344 | $ 973,343 | $ 977,502 | $ 980,440 |

**Field Cashflow Model**

**State**

**Field**

**Formation**

**Depth**

**Distance from Trunkline**

**# of Patterns**

**Miscibility:**

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 251,962 | 251,962 | 251,962 | 251,962 | 251,962 | 251,962 | 251,962 | 251,962 | 251,962 | 251,962 | 229,248 | 178,858 |
| $H_2O$ Injection (Mbw) | 84,413 | 84,403 | 84,413 | 84,403 | 84,413 | 84,403 | 84,413 | 84,403 | 84,403 | 84,403 | 95,760 | 120,960 |
| Oil Production (Mbbl) | 13,411 | 12,461 | 11,808 | 11,251 | 10,800 | 10,464 | 10,195 | 9,965 | 9,706 | 9,446 | 9,350 | 9,331 |
| $H_2O$ Production (MBw) | 85,152 | 85,219 | 85,238 | 85,027 | 84,931 | 84,845 | 84,576 | 84,461 | 84,470 | 84,518 | 85,565 | 98,621 |
| $CO_2$ Production (MMcf) | 214,579 | 216,931 | 218,640 | 220,608 | 222,067 | 223,190 | 224,573 | 225,446 | 226,099 | 226,666 | 230,352 | 210,749 |
| $CO_2$ Purchased (MMcf) | 37,382 | 35,030 | 33,322 | 31,354 | 29,894 | 28,771 | 27,389 | 26,515 | 25,862 | 25,296 | - | - |
| $CO_2$ Recycled (MMcf) | 214,579 | 216,931 | 218,640 | 220,608 | 222,067 | 223,190 | 224,573 | 225,446 | 226,099 | 226,666 | 229,248 | 178,858 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 |
| Gross Revenues ($M) | $ 455,981 | $ 423,667 | $ 401,472 | $ 382,541 | $ 367,200 | $ 355,776 | $ 346,637 | $ 338,803 | $ 329,990 | $ 321,178 | $ 317,914 | $ 317,261 |
| Royalty ($M) | $ (56,998) | $ (52,958) | $ (50,184) | $ (47,818) | $ (45,900) | $ (44,472) | $ (43,330) | $ (42,350) | $ (41,249) | $ (40,147) | $ (39,739) | $ (39,658) |
| Severance Taxes ($M) | $ (12,568) | $ (11,677) | $ (11,066) | $ (10,544) | $ (10,121) | $ (9,806) | $ (9,554) | $ (9,338) | $ (9,095) | $ (8,852) | $ (8,762) | $ (8,745) |
| Ad Valorum ($M) | $ (18,114) | $ (16,830) | $ (15,948) | $ (15,196) | $ (14,587) | $ (14,133) | $ (13,770) | $ (13,459) | $ (13,109) | $ (12,759) | $ (12,629) | $ (12,603) |
| Net Revenue($M) | $ 368,301 | $ 342,201 | $ 324,274 | $ 308,983 | $ 296,592 | $ 287,365 | $ 279,983 | $ 273,656 | $ 266,537 | $ 259,419 | $ 256,783 | $ 256,256 |
| **Capital Costs ($M)** | | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (127,438) | $ (124,968) | $ (123,174) | $ (121,108) | $ (119,576) | $ (118,396) | $ (116,945) | $ (116,028) | $ (115,342) | $ (114,747) | $ (80,237) | $ (62,600) |
| **O&M Costs ($M)** | | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) | $ (29,261) |
| Lifting Costs ($M) | $ (24,641) | $ (24,420) | $ (24,262) | $ (24,070) | $ (23,933) | $ (23,827) | $ (23,693) | $ (23,606) | $ (23,544) | $ (23,491) | $ (23,729) | $ (26,988) |
| G&A | (10,780) | (10,736) | (10,704) | (10,666) | (10,639) | (10,618) | (10,591) | (10,573) | (10,561) | (10,550) | (10,598) | (11,250) |
| Total O&M Costs | $ (64,682) | $ (64,417) | $ (64,227) | $ (63,997) | $ (63,832) | $ (63,706) | $ (63,544) | $ (63,441) | $ (63,366) | $ (63,302) | $ (63,588) | $ (67,499) |
| Net Cash Flow ($M) | $ 176,181 | $ 152,816 | $ 136,873 | $ 123,879 | $ 113,184 | $ 105,263 | $ 99,494 | $ 94,187 | $ 87,830 | $ 81,369 | $ 112,958 | $ 126,157 |
| Cum. Cash Flow | $ 6,432,503 | $ 6,585,319 | $ 6,722,192 | $ 6,846,071 | $ 6,959,255 | $ 7,064,517 | $ 7,164,011 | $ 7,258,199 | $ 7,346,028 | $ 7,427,397 | $ 7,540,356 | $ 7,666,513 |
| Discount Factor | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Disc. Net Cash Flow | $ 2,031 | $ 1,409 | $ 1,010 | $ 731 | $ 534 | $ 398 | $ 301 | $ 228 | $ 170 | $ 126 | $ 140 | $ 125 |
| Disc. Cum Cash Flow | $ 982,472 | $ 983,881 | $ 984,891 | $ 985,622 | $ 986,157 | $ 986,554 | $ 986,855 | $ 987,083 | $ 987,253 | $ 987,379 | $ 987,518 | $ 987,643 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 32 | 33 | 34 | 35 | 36 | 37 | 38 | Totals |
|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 128,467 | 78,077 | 27,677 | - | - | - | - | 7,761,312 |
| $H_2O$ Injection (Mbw) | 146,160 | 148,666 | 131,779 | 103,546 | 61,459 | 19,382 | - | 2,948,688 |
| Oil Production (Mbbl) | 9,235 | 8,237 | 6,451 | 4,541 | 2,592 | 787 | - | 577,440 |
| $H_2O$ Production (MBw) | 117,754 | 118,176 | 101,232 | 83,242 | 53,462 | 17,395 | - | 3,023,760 |
| $CO_2$ Production (MMcf) | 175,997 | 133,546 | 88,022 | 39,418 | 13,430 | 2,957 | - | 6,043,200 |
| $CO_2$ Purchased (MMcf) | - | - | - | - | - | - | - | 1,970,256 |
| $CO_2$ Recycled (MMcf) | 128,467 | 78,077 | 27,677 | - | - | - | - | 5,791,056 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ - | |
| Gravity Adjustment | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ 34.00 | $ - | |
| Gross Revenues ($M) | $ 313,997 | $ 280,051 | $ 219,341 | $ 154,387 | $ 88,128 | $ 26,765 | $ - | $ 19,632,960 |
| Royalty ($M) | $ (39,250) | $ (35,006) | $ (27,418) | $ (19,298) | $ (11,016) | $ (3,346) | $ - | $ (2,454,120) |
| Severance Taxes ($M) | $ (8,655) | $ (7,719) | $ (6,046) | $ (4,255) | $ (2,429) | $ (738) | $ - | $ (541,133) |
| Ad Valorum ($M) | $ (12,474) | $ (11,125) | $ (8,713) | $ (6,133) | $ (3,501) | $ (1,063) | $ - | $ (779,919) |
| Net Revenue($M) | $ 253,619 | $ 226,201 | $ 177,164 | $ 124,700 | $ 71,182 | $ 21,618 | $ - | $ 15,857,787 |
| **Capital Costs ($M)** | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (4,455) |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (163,289) |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (38,275) |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (7,567) |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (13,013) |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (779) |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (441,771) |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (2,684) |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (671,833) |
| **$CO_2$ Costs ($M)** | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (44,964) | $ (27,327) | $ (9,687) | $ - | $ - | $ - | $ - | $ (4,785,228) |
| **O&M Costs ($M)** | | | | | | | | |
| Operating & Maintenance ($M) | $ (29,261) | $ (29,261) | $ (23,409) | $ (17,556) | $ (11,704) | $ (5,852) | $ - | $ (965,607) |
| Lifting Costs ($M) | $ (31,747) | $ (31,603) | $ (26,921) | $ (21,946) | $ (14,014) | $ (4,546) | $ - | $ (900,300) |
| G&A | (12,202) | (12,173) | (10,066) | (7,900) | (5,144) | (2,080) | - | $ (373,181) |
| Total O&M Costs | $ (73,210) | $ (73,037) | $ (60,395) | $ (47,403) | $ (30,862) | $ (12,477) | $ - | $ (2,239,089) |
| Net Cash Flow ($M) | $ 135,446 | $ 125,837 | $ 107,082 | $ 77,298 | $ 40,321 | $ 9,141 | $ - | $ 8,161,637 |
| Cum. Cash Flow | $ 7,801,959 | $ 7,927,796 | $ 8,034,878 | $ 8,112,176 | $ 8,152,496 | $ 8,161,637 | ######## | |
| Discount Factor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| Disc. Net Cash Flow | $ 107 | $ 80 | $ 54 | $ 31 | $ 13 | $ 2 | $ - | $ 987,932 |
| Disc. Cum Cash Flow | $ 987,751 | $ 987,831 | $ 987,885 | $ 987,916 | $ 987,929 | $ 987,932 | $987,932 | |

| | | |
|---|---|---|
| **Basin** | **Permian (West Texas 8A)** | |
| **Field** | **ROBERTSON** | |
| **Formation** | **SAN ANDRES** | |
| **Technology Case** | **MPZ + TZ / ROZ (Simultaneous)** | |
| Depth (ft) | 4,754 | |
| Total OOIP (MMBls) | 298 | |
| Cumulative Recovery (MMbls) * | 96 | |
| EUR (MMbls) * | 96 | |
| Total ROIP (MMbls) | 202 | |
| API Gravity | 32 | |
| Patterns | 150 | |
| Existing Injectors Used | 0 | |
| Converted Producers Used | 0 | |
| New Injectors Drilled | 150 | |
| Existing Producers Used | 4 | |
| New Producers Drilled | 171 | |

**Pattern Detail**

| | | | |
|---|---|---|---|
| Cum Oil (Mbbl) | 556 | | |
| Cum H2O (Mbw) | 1,937 | 3.49 | Bw/Bbl |
| Gross CO2 (MMcf) | 5,278 | 9.49 | Mcf/Bbl |
| Purchased CO2 (MMcf) | 1,792 | 3.22 | Mcf/Bbl |
| Recycled CO2 (MMcf) | 3,485 | 6.27 | Mcf/Bbl |

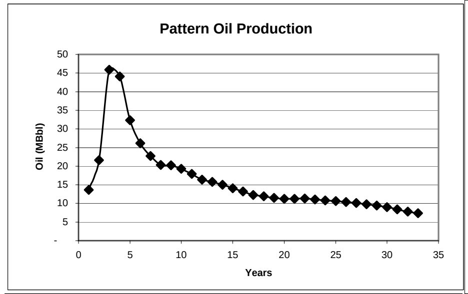
**Field Detail**

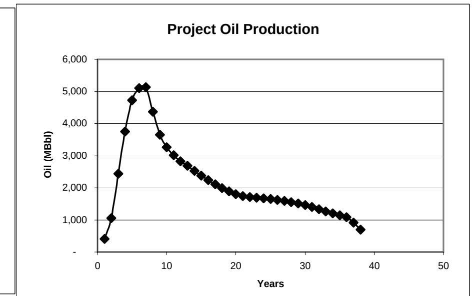
| | | |
|---|---|---|
| Cum Oil (MMbbl) | 83.39 | |
| % OOIP Recovered | 28.0% | |
| Cum H2O (MMbw) | 291 | |
| Gross CO2 (MMcf) | 791,625 | |
| Purchased CO2 (MMcf) | 262,746 | |
| Recycled CO2 (MMcf) | 528,879 | |
| Payback Period (per pattern) | 4 | years |
| Project Length | 41 | years |

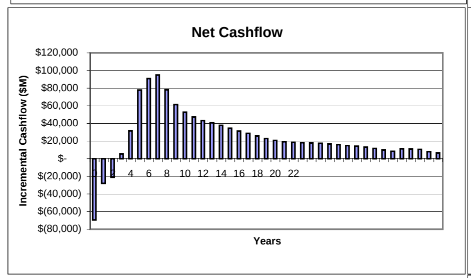
**Field Economics**

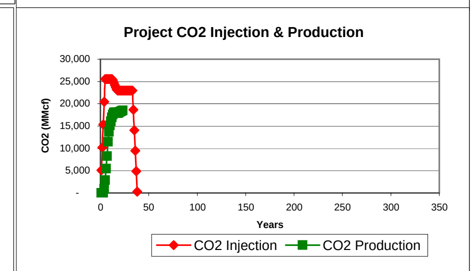
| | | | |
|---|---|---|---|
| | | | $/BBl |
| Total Net Revenue ($M) | $ | 2,227,161 | |
| Total Capital Investment ($M) | $ | (183,044) | $ 2.20 |
| Total CO2 Cost ($M) | $ | (552,952) | $ 6.63 |
| Total O&M Costs ($M) | $ | (536,857) | $ 6.44 |
| | $ | (1,272,853) | $ 15.26 |

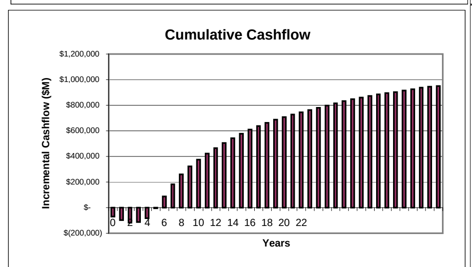
*Includes "Mother Nature's" waterflood oil displacement of 94 million barrels

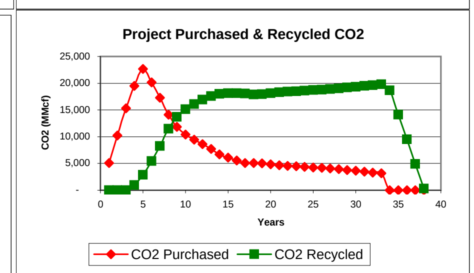


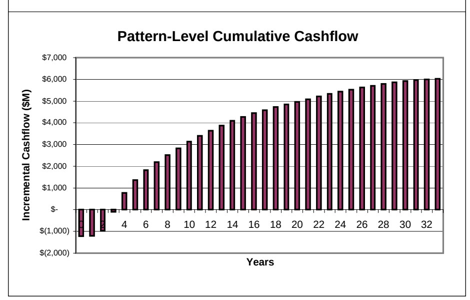




**Assumptions:**

| | |
|---|---|
| Oil Price | $ 35.00 |
| CO2 Purchase Cost | 4% of oil price |
| CO2 Recycle Cost | 1% of oil price |
| Recycling Plant Costs | 1 Year before Breakthru |
| Well O&M | Prod Wells Only |

**Field Cashflow Model**

| | |
|---|---|
| **State** | Permian (West Texas 8A) |
| **Field** | ROBERTSON |
| **Formation** | SAN ANDRES |
| **Depth** | 4754 |
| **Distance from Trunkline** | 10 miles |
| **# of Patterns** | 150.00 |
| **Miscibility:** | Miscible |

| Pattern | | Field | |
|---|---|---|---|
| Existing Injectors Used | 0.00 | Existing Injectors Used | 0 |
| Converted Producers Used | 0.00 | Converted Producers Used | 0 |
| New Injectors Needed | 1.00 | New Injectors Needed | 150 |
| New Producers Needed | 1.14 | New Producers Needed | 171 |
| Existing Producers Used | 0.03 | Existing Producers Used | 4 |

| | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|
| CO2 Injection (MMcf) | | | 5,115 | 10,227 | 15,342 | 20,454 | 25,569 | 25,566 | 25,569 | 25,566 |
| H2O Injection (Mbw) | | | 1,278 | 2,556 | 3,834 | 5,115 | 6,393 | 6,393 | 6,393 | 6,393 |
| Oil Production (Mbbl) | | | 408 | 1,056 | 2,433 | 3,756 | 4,725 | 5,103 | 5,136 | 4,368 |
| H2O Production (MBw) | | | 2,814 | 5,337 | 6,969 | 8,298 | 9,648 | 8,166 | 6,987 | 6,660 |
| CO2 Production (MMcf) | | | 24 | 24 | 27 | 939 | 2,892 | 5,427 | 8,283 | 11,454 |
| CO2 Purchased (MMcf) | | | 5,091 | 10,203 | 15,315 | 19,515 | 22,677 | 20,139 | 17,286 | 14,112 |
| CO2 Recycled (MMcf) | | | 24 | 24 | 27 | 939 | 2,892 | 5,427 | 8,283 | 11,454 |
| Oil Price ($/Bbl) | $ 35.00 | | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | 32 | | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 |
| Gross Revenues ($M) | | | $ 13,464 | $ 34,848 | $ 80,289 | $ 123,948 | $ 155,925 | $ 168,399 | $ 169,488 | $ 144,144 |
| Royalty ($M) | -12.5% | | $ (1,683) | $ (4,356) | $ (10,036) | $ (15,494) | $ (19,491) | $ (21,050) | $ (21,186) | $ (18,018) |
| Severance Taxes ($M) | -5.0% | | $ (589) | $ (1,525) | $ (3,513) | $ (5,423) | $ (6,822) | $ (7,367) | $ (7,415) | $ (6,306) |
| Ad Valorum ($M) | -2.5% | | $ (295) | $ (762) | $ (1,756) | $ (2,711) | $ (3,411) | $ (3,684) | $ (3,708) | $ (3,153) |
| Net Revenue($M) | | | $ 10,897 | $ 28,205 | $ 64,984 | $ 100,320 | $ 126,202 | $ 136,298 | $ 137,179 | $ 116,667 |
| **Capital Costs ($M)** | | | | | | | | | | |
| New Well - D&C | | $ (22,341) | $ (22,341) | $ (22,341) | $ (22,341) | $ (22,341) | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | | $ (126) | $ (126) | $ (126) | $ (126) | $ (126) | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | | $ (56) | $ (56) | $ (56) | $ (56) | $ (56) | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | | $ (5,832) | $ (5,832) | $ (5,832) | $ (5,832) | $ (5,832) | $ - | $ - | $ - | $ - |
| CO2 Recycling Plant | | $ (39,118) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | | $ (2,150) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | | $ (69,623) | $ (28,355) | $ (28,355) | $ (28,355) | $ (28,355) | $ - | $ - | $ - | $ - |
| **CO2 Costs ($M)** | | | | | | | | | | |
| Total CO2 Cost ($M) | | | $ (7,136) | $ (14,293) | $ (21,450) | $ (27,650) | $ (32,760) | $ (30,094) | $ (27,099) | $ (23,766) |
| **O&M Costs ($M)** | | | | | | | | | | |
| Operating & Maintenance ($M) | | | $ (1,913) | $ (3,826) | $ (5,739) | $ (7,652) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) |
| Lifting Costs ($M) | | | $ (806) | $ (1,598) | $ (2,351) | $ (3,014) | $ (3,593) | $ (3,317) | $ (3,031) | $ (2,757) |
| G&A | 20% | | (544) | (1,085) | (1,618) | (2,133) | (2,632) | (2,576) | (2,519) | (2,464) |
| Total O&M Costs | | | $ (3,262) | $ (6,509) | $ (9,707) | $ (12,798) | $ (15,789) | $ (15,458) | $ (15,114) | $ (14,786) |
| Net Cash Flow ($M) | | $ (69,623) | $ (27,856) | $ (20,952) | $ 5,471 | $ 31,517 | $ 77,653 | $ 90,746 | $ 94,966 | $ 78,115 |
| Cum. Cash Flow | | $ (69,623) | $ (97,479) | $ (118,430) | $ (112,959) | $ (81,442) | $ (3,789) | $ 86,957 | $ 181,923 | $ 260,038 |
| Discount Factor | 25% | 1.00 | 0.80 | 0.64 | 0.51 | 0.41 | 0.33 | 0.26 | 0.21 | 0.17 |
| Disc. Net Cash Flow | | $ (69,623) | $ (22,285) | $ (13,409) | $ 2,801 | $ 12,910 | $ 25,445 | $ 23,789 | $ 19,916 | $ 13,106 |
| Disc. Cum Cash Flow | | $ (69,623) | $ (91,908) | $ (105,317) | $ (102,515) | $ (89,606) | $ (64,161) | $ (40,372) | $ (20,456) | $ (7,351) |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 25,569 | 25,566 | 25,569 | 25,566 | 25,248 | 24,726 | 24,207 | 23,685 | 23,166 | 22,965 | 22,965 |
| $H_2O$ Injection (Mbw) | 6,390 | 6,390 | 6,390 | 6,393 | 6,552 | 6,813 | 7,074 | 7,335 | 7,593 | 7,695 | 7,692 |
| Oil Production (Mbbl) | 3,651 | 3,261 | 3,012 | 2,823 | 2,688 | 2,532 | 2,376 | 2,235 | 2,112 | 1,995 | 1,890 |
| $H_2O$ Production (MBw) | 6,642 | 6,549 | 6,468 | 6,369 | 6,321 | 6,372 | 6,588 | 6,810 | 7,038 | 7,263 | 7,386 |
| $CO_2$ Production (MMcf) | 13,713 | 15,141 | 16,107 | 16,932 | 17,556 | 18,027 | 18,111 | 18,120 | 18,057 | 17,895 | 17,922 |
| $CO_2$ Purchased (MMcf) | 11,856 | 10,425 | 9,462 | 8,634 | 7,692 | 6,699 | 6,096 | 5,565 | 5,109 | 5,070 | 5,043 |
| $CO_2$ Recycled (MMcf) | 13,713 | 15,141 | 16,107 | 16,932 | 17,556 | 18,027 | 18,111 | 18,120 | 18,057 | 17,895 | 17,922 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 |
| Gross Revenues ($M) | $ 120,483 | $ 107,613 | $ 99,396 | $ 93,159 | $ 88,704 | $ 83,556 | $ 78,408 | $ 73,755 | $ 69,696 | $ 65,835 | $ 62,370 |
| Royalty ($M) | $ (15,060) | $ (13,452) | $ (12,425) | $ (11,645) | $ (11,088) | $ (10,445) | $ (9,801) | $ (9,219) | $ (8,712) | $ (8,229) | $ (7,796) |
| Severance Taxes ($M) | $ (5,271) | $ (4,708) | $ (4,349) | $ (4,076) | $ (3,881) | $ (3,656) | $ (3,430) | $ (3,227) | $ (3,049) | $ (2,880) | $ (2,729) |
| Ad Valorum ($M) | $ (2,636) | $ (2,354) | $ (2,174) | $ (2,038) | $ (1,940) | $ (1,828) | $ (1,715) | $ (1,613) | $ (1,525) | $ (1,440) | $ (1,364) |
| Net Revenue($M) | $ 97,516 | $ 87,099 | $ 80,449 | $ 75,401 | $ 71,795 | $ 67,628 | $ 63,461 | $ 59,695 | $ 56,410 | $ 53,285 | $ 50,481 |
| **Capital Costs ($M)** | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **$CO_2$ Costs ($M)** | | | | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (21,398) | $ (19,894) | $ (18,884) | $ (18,014) | $ (16,913) | $ (15,688) | $ (14,873) | $ (14,133) | $ (13,473) | $ (13,361) | $ (13,333) |
| **O&M Costs ($M)** | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) |
| Lifting Costs ($M) | $ (2,573) | $ (2,453) | $ (2,370) | $ (2,298) | $ (2,252) | $ (2,226) | $ (2,241) | $ (2,261) | $ (2,288) | $ (2,315) | $ (2,319) |
| G&A | (2,428) | (2,403) | (2,387) | (2,372) | (2,363) | (2,358) | (2,361) | (2,365) | (2,370) | (2,376) | (2,377) |
| Total O&M Costs | $ (14,565) | $ (14,420) | $ (14,321) | $ (14,235) | $ (14,180) | $ (14,148) | $ (14,166) | $ (14,191) | $ (14,222) | $ (14,255) | $ (14,260) |
| Net Cash Flow ($M) | $ 61,553 | $ 52,785 | $ 47,243 | $ 43,152 | $ 40,701 | $ 37,792 | $ 34,422 | $ 31,372 | $ 28,715 | $ 25,669 | $ 22,888 |
| Cum. Cash Flow | $ 321,591 | $ 374,375 | $ 421,618 | $ 464,770 | $ 505,472 | $ 543,263 | $ 577,685 | $ 609,057 | $ 637,772 | $ 663,442 | $ 686,329 |
| Discount Factor | 0.13 | 0.11 | 0.09 | 0.07 | 0.05 | 0.04 | 0.04 | 0.03 | 0.02 | 0.02 | 0.01 |
| Disc. Net Cash Flow | $ 8,261 | $ 5,668 | $ 4,058 | $ 2,965 | $ 2,238 | $ 1,662 | $ 1,211 | $ 883 | $ 647 | $ 462 | $ 330 |
| Disc. Cum Cash Flow | $ 911 | $ 6,578 | $ 10,637 | $ 13,602 | $ 15,840 | $ 17,502 | $ 18,713 | $ 19,596 | $ 20,242 | $ 20,705 | $ 21,035 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO2 Injection (MMcf) | 22,965 | 22,965 | 22,965 | 22,965 | 22,965 | 22,965 | 22,965 | 22,965 | 22,965 | 22,965 | 22,965 | 22,965 |
| H2O Injection (Mbw) | 7,692 | 7,692 | 7,692 | 7,692 | 7,695 | 7,695 | 7,695 | 7,695 | 7,692 | 7,692 | 7,692 | 7,692 |
| Oil Production (Mbbl) | 1,803 | 1,743 | 1,713 | 1,689 | 1,668 | 1,650 | 1,626 | 1,590 | 1,551 | 1,509 | 1,461 | 1,401 |
| H2O Production (MBw) | 7,404 | 7,404 | 7,413 | 7,404 | 7,395 | 7,371 | 7,374 | 7,371 | 7,368 | 7,335 | 7,353 | 7,365 |
| CO2 Production (MMcf) | 18,135 | 18,327 | 18,396 | 18,501 | 18,582 | 18,699 | 18,765 | 18,885 | 19,005 | 19,215 | 19,320 | 19,470 |
| CO2 Purchased (MMcf) | 4,830 | 4,638 | 4,569 | 4,464 | 4,383 | 4,266 | 4,200 | 4,080 | 3,960 | 3,750 | 3,645 | 3,495 |
| CO2 Recycled (MMcf) | 18,135 | 18,327 | 18,396 | 18,501 | 18,582 | 18,699 | 18,765 | 18,885 | 19,005 | 19,215 | 19,320 | 19,470 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 |
| Gravity Adjustment | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 |
| Gross Revenues ($M) | $ 59,499 | $ 57,519 | $ 56,529 | $ 55,737 | $ 55,044 | $ 54,450 | $ 53,658 | $ 52,470 | $ 51,183 | $ 49,797 | $ 48,213 | $ 46,233 |
| Royalty ($M) | $ (7,437) | $ (7,190) | $ (7,066) | $ (6,967) | $ (6,881) | $ (6,806) | $ (6,707) | $ (6,559) | $ (6,398) | $ (6,225) | $ (6,027) | $ (5,779) |
| Severance Taxes ($M) | $ (2,603) | $ (2,516) | $ (2,473) | $ (2,438) | $ (2,408) | $ (2,382) | $ (2,348) | $ (2,296) | $ (2,239) | $ (2,179) | $ (2,109) | $ (2,023) |
| Ad Valorum ($M) | $ (1,302) | $ (1,258) | $ (1,237) | $ (1,219) | $ (1,204) | $ (1,191) | $ (1,174) | $ (1,148) | $ (1,120) | $ (1,089) | $ (1,055) | $ (1,011) |
| Net Revenue($M) | $ 48,157 | $ 46,554 | $ 45,753 | $ 45,112 | $ 44,551 | $ 44,070 | $ 43,429 | $ 42,468 | $ 41,426 | $ 40,304 | $ 39,022 | $ 37,420 |
| **Capital Costs ($M)** | | | | | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| CO2 Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| **CO2 Costs ($M)** | | | | | | | | | | | | |
| Total CO2 Cost ($M) | $ (13,109) | $ (12,908) | $ (12,835) | $ (12,725) | $ (12,640) | $ (12,517) | $ (12,448) | $ (12,322) | $ (12,196) | $ (11,975) | $ (11,865) | $ (11,708) |
| **O&M Costs ($M)** | | | | | | | | | | | | |
| Operating & Maintenance ($M) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) |
| Lifting Costs ($M) | $ (2,302) | $ (2,287) | $ (2,282) | $ (2,273) | $ (2,266) | $ (2,255) | $ (2,250) | $ (2,240) | $ (2,230) | $ (2,211) | $ (2,204) | $ (2,192) |
| G&A | (2,373) | (2,370) | (2,369) | (2,368) | (2,366) | (2,364) | (2,363) | (2,361) | (2,359) | (2,355) | (2,354) | (2,351) |
| Total O&M Costs | $ (14,239) | $ (14,221) | $ (14,215) | $ (14,205) | $ (14,196) | $ (14,184) | $ (14,177) | $ (14,166) | $ (14,153) | $ (14,130) | $ (14,121) | $ (14,107) |
| Net Cash Flow ($M) | $ 20,808 | $ 19,425 | $ 18,703 | $ 18,182 | $ 17,715 | $ 17,370 | $ 16,804 | $ 15,981 | $ 15,078 | $ 14,199 | $ 13,036 | $ 11,605 |
| Cum. Cash Flow | $ 707,138 | $ 726,563 | $ 745,266 | $ 763,448 | $ 781,163 | $ 798,533 | $ 815,338 | $ 831,318 | $ 846,396 | $ 860,595 | $ 873,630 | $ 885,236 |
| Discount Factor | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Disc. Net Cash Flow | $ 240 | $ 179 | $ 138 | $ 107 | $ 84 | $ 66 | $ 51 | $ 39 | $ 29 | $ 22 | $ 16 | $ 11 |
| Disc. Cum Cash Flow | $ 21,275 | $ 21,454 | $ 21,592 | $ 21,699 | $ 21,783 | $ 21,848 | $ 21,899 | $ 21,938 | $ 21,967 | $ 21,989 | $ 22,005 | $ 22,017 |

**Field Cashflow Model**

**State**
**Field**
**Formation**
**Depth**
**Distance from Trunkline**
**# of Patterns**
**Miscibility:**

| | 32 | 33 | 34 | 35 | 36 | 37 | 38 | Totals |
|---|---|---|---|---|---|---|---|---|
| $CO_2$ Injection (MMcf) | 22,965 | 22,965 | 18,681 | 14,088 | 9,495 | 4,902 | 309 | 791,625 |
| $H_2O$ Injection (Mbw) | 7,692 | 7,695 | 9,837 | 12,135 | 14,430 | 14,310 | 12,771 | 301,620 |
| Oil Production (Mbbl) | 1,332 | 1,260 | 1,203 | 1,140 | 1,080 | 915 | 693 | 83,385 |
| $H_2O$ Production (MBw) | 7,377 | 7,407 | 7,668 | 8,853 | 10,500 | 10,230 | 8,730 | 290,610 |
| $CO_2$ Production (MMcf) | 19,647 | 19,806 | 20,397 | 18,774 | 15,990 | 12,294 | 8,274 | 562,590 |
| $CO_2$ Purchased (MMcf) | 3,318 | 3,159 | - | - | - | - | - | 262,746 |
| $CO_2$ Recycled (MMcf) | 19,647 | 19,806 | 18,681 | 14,088 | 9,495 | 4,902 | 309 | 528,879 |
| Oil Price ($/Bbl) | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | $ 35.00 | |
| Gravity Adjustment | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ 33.00 | $ - | |
| Gross Revenues ($M) | $ 43,956 | $ 41,580 | $ 39,699 | $ 37,620 | $ 35,640 | $ 30,195 | $ - | $ 2,728,836 |
| Royalty ($M) | $ (5,495) | $ (5,197) | $ (4,962) | $ (4,703) | $ (4,455) | $ (3,774) | $ - | $ (341,105) |
| Severance Taxes ($M) | $ (1,923) | $ (1,819) | $ (1,737) | $ (1,646) | $ (1,559) | $ (1,321) | $ - | $ (119,387) |
| Ad Valorum ($M) | $ (962) | $ (910) | $ (868) | $ (823) | $ (780) | $ (661) | $ - | $ (59,693) |
| Net Revenue($M) | $ 35,577 | $ 33,654 | $ 32,131 | $ 30,449 | $ 28,846 | $ 24,439 | $ - | $ 2,208,652 |
| **Capital Costs ($M)** | | | | | | | | |
| New Well - D&C | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (111,706) |
| Exisiting Well Deepening | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (630) |
| Reworks - Producers to Producers | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (282) |
| Reworks - Producers to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Reworks - Injectors to Injectors | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Surface Equipment (new wells only) | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (29,159) |
| $CO_2$ Recycling Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (39,118) |
| Water Injection Plant | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Trunkline Construction | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (2,150) |
| Total Capital Costs | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ (183,044) |
| **$CO_2$ Costs ($M)** | | | | | | | | |
| Total $CO_2$ Cost ($M) | $ (11,522) | $ (11,355) | $ (6,538) | $ (4,931) | $ (3,323) | $ (1,716) | $ (108) | $ (552,952) |
| **O&M Costs ($M)** | | | | | | | | |
| Operating & Maintenance ($M) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (9,564) | $ (7,652) | $ (342,405) |
| Lifting Costs ($M) | $ (2,177) | $ (2,167) | $ (2,218) | $ (2,498) | $ (2,895) | $ (2,786) | $ (2,356) | $ (90,149) |
| G&A | (2,348) | (2,346) | (2,356) | (2,413) | (2,492) | (2,470) | (2,001) | $ (86,511) |
| Total O&M Costs | $ (14,090) | $ (14,077) | $ (14,139) | $ (14,475) | $ (14,951) | $ (14,821) | $ (12,009) | $ (519,064) |
| Net Cash Flow ($M) | $ 9,965 | $ 8,222 | $ 11,454 | $ 11,043 | $ 10,572 | $ 7,903 | $ (12,117) | $ 953,591 |
| Cum. Cash Flow | $ 895,201 | $ 903,423 | $ 914,877 | $ 925,920 | $ 936,492 | $ 944,394 | $932,277 | |
| Discount Factor | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | |
| Disc. Net Cash Flow | $ 8 | $ 5 | $ 6 | $ 4 | $ 3 | $ 2 | $ (3) | $ 22,046 |
| Disc. Cum Cash Flow | $ 22,024 | $ 22,030 | $ 22,035 | $ 22,040 | $ 22,043 | $ 22,045 | $ 22,043 | |