

It's Time For A Fresh Look At Berea and Clinton Secondary Recovery*

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Search and Discovery Article #51674 (2020)**

Posted August 3, 2020

*Adapted from oral presentation given at 2019 AAPG Eastern Section Meeting, Columbus, OH, United States, May 19-22, 2019

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Abstract

It is well known that recovery of original oil in place in the Berea and Clinton in Ohio is abysmally low, in the vicinity of 10%. It is also well known that there have been very few successful secondary recovery projects in the state, specifically over the past 50 years. In addition, there are numerous hurdles to implementing secondary recovery, some specific to our area. So, is this a lost cause? Secondary recovery, usually in the form of gas injection, was a common, successful process in Ohio in the first half of the 20th century. But when hydraulic fracturing arrived in the early 1950's, any momentum which might have existed was lost to the highly successful and simpler process of drilling wells and producing them after hydraulic fracturing. Fast forward to today; there is plenty of oil to go after, product prices are respectable, processes are better understood, and technology has advanced. Is it time to re-visit potential projects? My experience spans over three decades of work with Marathon Oil Company, including re-development of waterfloods in the Illinois Basin. This presentation will include some history on Ohio secondary recovery, hurdles to overcome, ideas and recommendations on best places to look for potential projects, and best practices on how to implement a successful project. Also, information and data on a modern, successful Ohio waterflood project will be reviewed. The Utica/Point Pleasant play has clearly taken center stage in Ohio's oil and gas business. However, certain old Berea and Clinton areas or fields, so important to the history of the industry in our state and an important benefactor to thousands of Ohio residents, are a pool of wealth just waiting to be exploited.

IT'S TIME FOR A FRESH LOOK AT BEREA AND CLINTON SECONDARY RECOVERY

AAPG Eastern Section 2019 Meeting

Columbus, Ohio

October 15, 2019

Robert D. (Bob) Winland

Why a re-look? The background....

- Began working Clinton fields in Hocking / Perry / Fairfield Counties at age 5
 - Father began working as a pumper for W. E. Shrider, Newark-based local operator
 - Sat my first frac job at age 9
 - Painter, rig hand, relief pumper
 - Always intrigued by why good wells were good, why bad wells were bad
 - “Numbers guy” --- also intrigued by economics

Why a re-look? The background....

- Began working Clinton fields in Hocking / Perry / Fairfield Counties at age 5
- Bob and his dad, James Ucker #2, 3407320943, Falls Twp., Hocking Co., c. 1962





Check out the shiny paint!! c. 1977

Hemlock 2-3 tank battery, Coal Twp., Perry Co.



Relief pumping days c. 1977

3412722300 Frank Howdyshell 1, Monday Creek Twp., Perry Co.

3412722616 Stanley Adcock 1, Jackson Twp., Perry Co.



Why a re-look? The background....

- Career with Marathon Oil Company
 - 36 years; engineering, geoscience, business jobs
 - US for first half, mix of International and US for second half
 - Early responsibilities were waterfloods in Illinois Basin and Michigan Basin
 - Infill drilling, step-out drilling, recompletions, stimulations, facility re-works
 - Well/acreage evaluation for expansions or new project implementations

Why a re-look? The background....



Illinois
and
Michigan
Basins

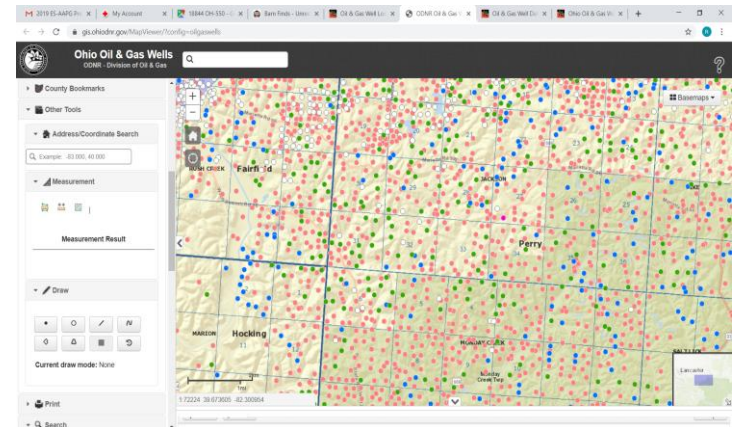


Why a re-look? Most other places....

- Secondary recovery (waterflooding primarily, but also gas injection) is prevalent
 - Illinois, Michigan, Pennsylvania, Texas, Wyoming, et al
 - But not in Ohio?
 - How non-existent is it in Ohio?
- Remember, recovery of original oil in place is often only 10%
- My comments are primarily based on the southernmost, oily Clinton counties (Hocking, Perry, Fairfield, Licking), but likely apply elsewhere

Conventional wisdom about secondary recovery in Ohio

- Rocks are lousy – thin and tight
- In legacy areas, overdrilled
- Improperly plugged wells
- Few logs
- Few production records
- Land is chopped up
- Projects have not been successful



Conventional wisdom about secondary recovery in Ohio

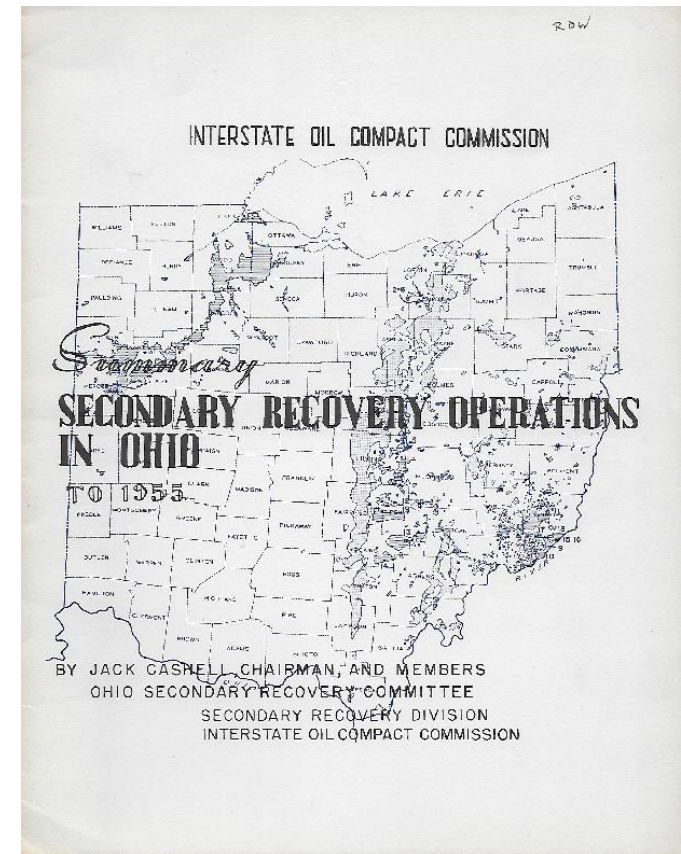
- Rocks are lousy – thin and tight
 - Generally true, but not everywhere
 - What about areas with high initial production rates and/or good recoveries?
- In legacy areas, overdrilled
 - true
- Improperly plugged wells
 - Sometimes true

Conventional wisdom about secondary recovery in Ohio

- Few logs
 - Generally more logs available starting in 1970's- 1980's (i.e. end of cable tool era)
- Few production records
 - Records since 1984 are generally good; perhaps 5% of wells have some records before then
- Land is chopped up
 - With wells on many leases having been plugged and abandoned, not as bad as it used to be
- Projects have not been successful
 - Generally true ??... but stay tuned

History of projects in Ohio

- 1955 report
 - Listed 20 active air or gas injection projects
 - List of 42 active waterflood projects (“project” may mean “lease”), almost all are the Chatham Berea project
 - Tone of report is that this was established, successful technology
 - Lots of early 20th century projects – mainly shallow sand air or gas injection
 - *“Just need to do more projects”*



History of projects in Ohio – pre 1955

- 1955 report
 - “For over 50 years, producers have used air or gas repressuring and water flooding on a relatively moderate scale as a means of recovering oil from depleted fields.....
 - “.... Numerous Berea and Clinton Sand fields should respond satisfactorily to repressuring.”
- Late 40’s – early 50’s Pure Oil work in Licking Co.
- What happened then?
 - Hydraulic fracturing was new
 - Simpler, easier, cheaper, successful
 - momentum for secondary recovery was lost

History of projects in Ohio – since 1955

- Few designed and engineered projects
- Unfortunately, few comprehensive (or even partial) reports exist
- But successes (technical and economic) do exist
 - Tom Tomastik Oil and Gas Journal article 1999
 - Chatham, Medina Co.
 - Gratiot-Newcastle, Coshocton Co.
 - Union Furnace, Hocking Co.
 - Greasy Ridge, Lawrence Co.

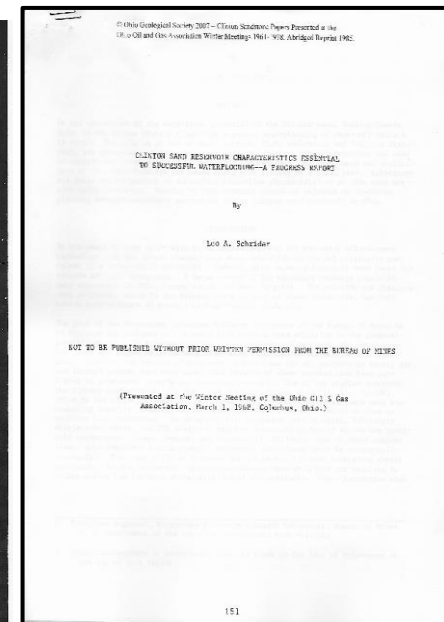
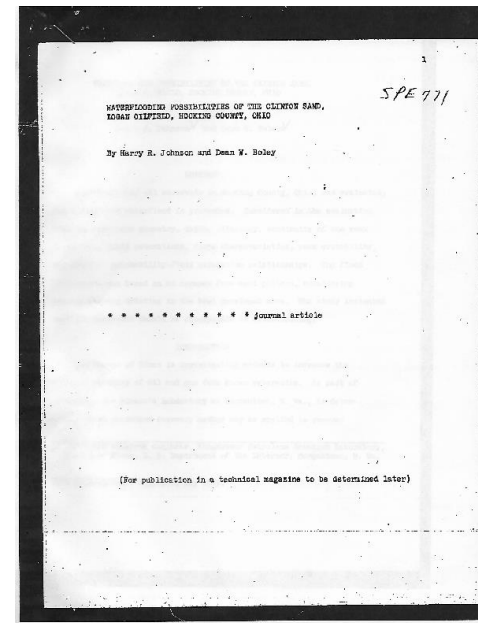


Anecdotal evidence

- Modern well in Perry County, in the middle of a bunch of 1910 vintage wells
 - Has produced 5+ bopd for over three decades
 - Cumulative approaching 60,000 bo
 - *50% water cut*
- Three examples of wells I am familiar with and/or worked on which produced, or are producing, way more oil than would be expected --- *with accompanying water production*
- Conclusion: dump flooding works!!
 - Just like how waterflooding got its start in Pennsylvania

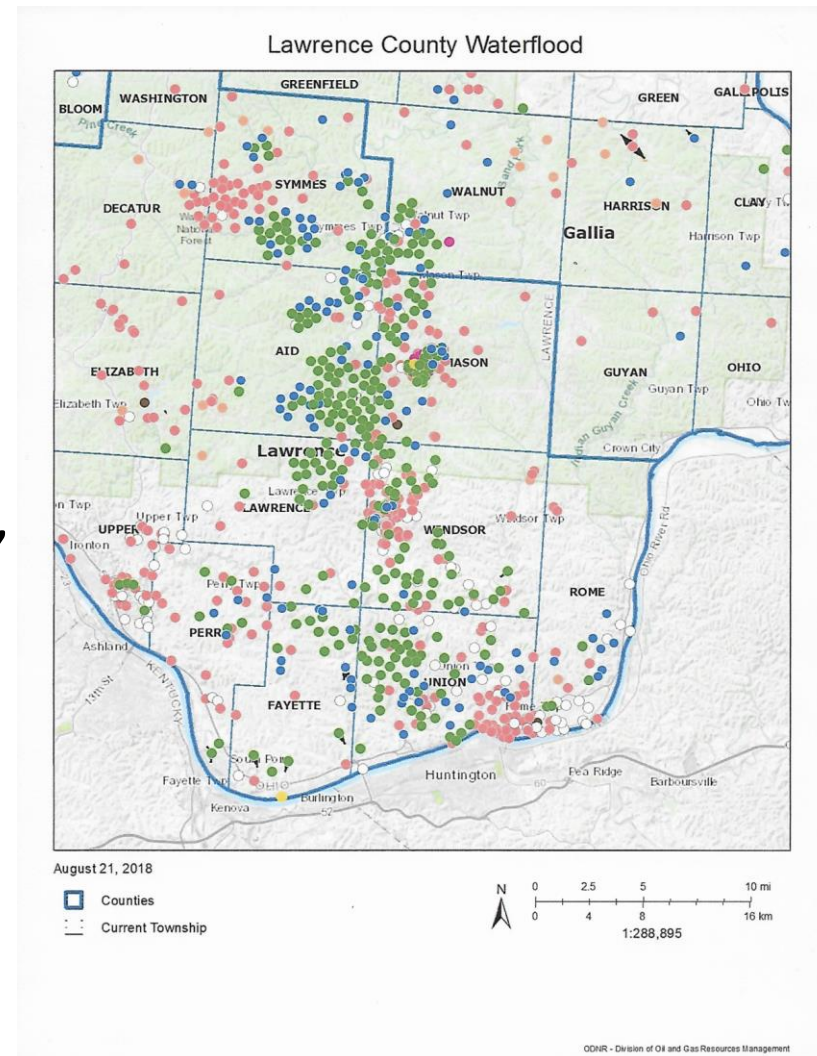
1965 Johnson/Boley desktop reservoir engineering study; 1968 Schrider follow-up

- Uses cores gathered from wells in Falls Gore, Marion, and Falls Townships, Hocking County
- Oxford Oil wells (near wells I worked on as a kid)
- Conclusions:
 - Waterflooding is technically feasible
 - Recoveries of 2500-2700 barrels per acre
 - I think this is too high by a factor of 2
 - But, *very encouraging overall*



Documented Success: Greasy Ridge Waterflood

- Best example of modern project
- Mason Township, Lawrence County
- Discovered in 1985, injection began in 1990
- Original operator Mitchell Energy, has changed hands over time
- Still in operation (barely)
- 1st Cow Run at less than 1000'
- 12 feet thick





- Pictures taken 6/1/2018
from OH Rt. 775





Greasy Ridge Waterflood

- 600 acres
- 1st Cow Run: 39 producers, 23 injectors, 9 dry hole or P&A
- 1st Cow Run original oil in place 3 mmbo +/-
- Cumulative recovery from 1st Cow Run 838 mbo (28%)
 - Best well 62,000 bo
- Cumulative injection 1.95 mmbw
- Analysis indicates primary recovery = secondary recovery (+/-)
 - A key waterflood rule-of-thumb
- Other data indicates the flood was produced to maturity but still may have late-life potential
 - E.g. Water cut is 90%; an end-of-life flood would typically be 98%+
 - Pore volume of injected water (about 0.4) is not overly high

Documented Failures

- Early 1960's small waterflood in Clayton Township, Perry County
 - High IP area
 - "1 million barrels of injected water with no response"
 - Unsuccessful? Rather, improperly engineered and/or managed
 - Water obviously not going in-zone
 - Have not found a report
- Otherwise, documentation is *very* sparse
 - Thus, only lots of 'hearsay'

But, but, but....

- Other issues
 - Main development criteria: “closeology”, convenience
 - Poorly constructed injection wells
 - Little to no geologic analysis
 - Too much cost-cutting-based design and operation

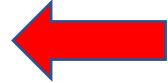


So, where might it work?

- Definitely not “everywhere”
- In fact, need to choose judiciously
- Let’s start with where to perhaps look



So, where might it work?

- One of the best criteria: initial production
 - Usually available
 - I contend that, while not perfect, it is a good to very good indicator
 - In general, high IP wells are good wells, and vice versa
 - Not as much “hype” as has existed in the horizontal well world
 - i.e. historically, more “honest”
- Supplement with cumulative production, when available
- I have databases for five counties
 - 21,000 wells
 - 1,900 with IP > 35 bopd *i.e. Look Here!!* 

Best practices

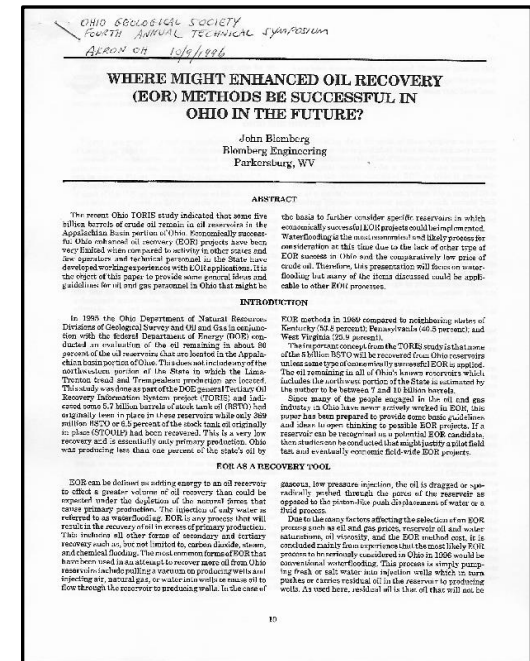
- Wells, especially injection wells, need to be optimally placed. How can this be done? First and foremost, detailed geology needs to be employed.
- Reservoir data needs to be gathered, such as modern electric logs and whole cores.
- Water sources need to be checked for fluid and rock compatibility.
- Injection water must be clean and kept oxygen-free, as much as possible, to minimize corrosion problems and to keep the reservoir from turning sour.
- Operating practices need to include periodic injection fluid surveys, especially if issues are suspected.
- Detailed, by-well production data is essential to reservoir monitoring.
- Completion design must be such that injection water stays in-zone. Could horizontal wells play a part?
- Perhaps seismic can be employed, if there is expectation it can be cost-effective and useful.
- Reservoir modeling can be very beneficial, but to do this requires data.
- Avoid gassy reservoirs.

Best practices – maybe the most important:

- Wells, especially injection wells, need to be optimally placed. How can this be done? First and foremost, detailed geology needs to be employed.
- Reservoir data needs to be gathered, such as modern electric logs and whole cores.
- Water sources need to be checked for fluid and rock compatibility.
- Injection water must be clean and kept oxygen-free, as much as possible, to minimize corrosion problems and to keep the reservoir from turning sour.
- Operating practices need to include periodic injection fluid surveys, especially if issues are suspected.
- Detailed, by-well production data is essential to reservoir monitoring.
- Completion design must be such that injection water stays in-zone. Could horizontal wells play a part?
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- Reservoir modeling can be very beneficial, but to do this requires data.
- Avoid gassy reservoirs.

Best practices

- John Blomberg report, 1996
- Given to Ohio Geologic Society
- “Where Might EOR Methods Be Successful In Ohio In The Future?”
- Good overview of important criteria

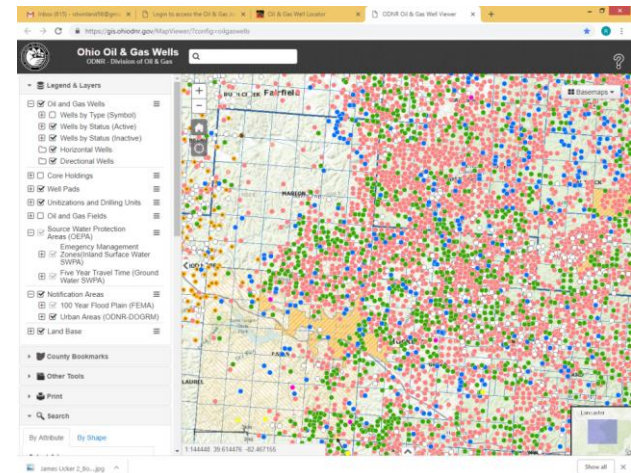


My work: systematic data gathering and analysis

- Based on the IP data gathering exercise.....
- Review of areas which look interesting
 - Often, collections of high IP wells
- Additional data gathering
- Then, more detailed analysis -- **geology work**
- Static data and production data-focused
- Little geology, so far

Example area: ABC Township, Hocking County

- 2800 acres
- Total of 90 Clinton wells, vintage late 1950's-early 1960's, with about 20 pieces of information assembled for most
- 18 wells with IP ≥ 35 bopd (20%)
- Estimated cumulative oil for the area 1.2 to 1.4 million barrels
- Equates to 13,000 to 15,000 bo per well, or around 500 barrels per acre
- Fairly average, however.....

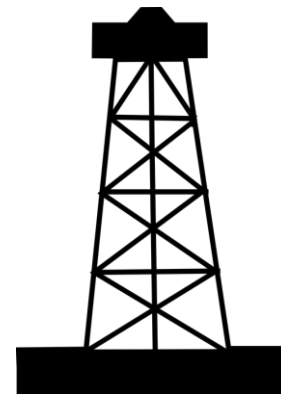


Example area: ABC Township, Hocking County

- 2 wells with cumulatives over 40,000 bo
- 2 wells with cumulatives between 30,000 and 40,000 bo (not surprisingly, these four wells are fairly close to each other)
- 11 wells with cumulatives between 20,000 and 30,000 bo
- 12 wells with cumulatives between 15,000 and 20,000 bo
- 4 operators; 18 active and producing wells with 2016 production of a measly 2.4 bopd
- 11 page report
- **A COUPLE AREAS OF A FEW HUNDRED ACRES EACH WHICH WOULD BE FLOODABLE?**

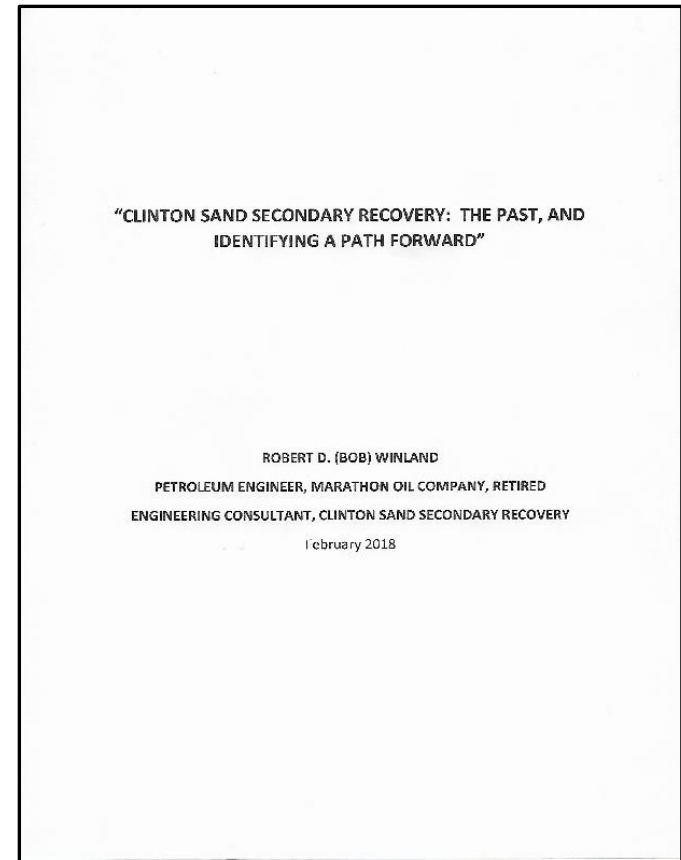
Operators with legacy wells.....

- Might some wells / areas have come to mind which are candidates for more study?
- Your wells aren't going to get any better without some attention!!



More info

- “White paper” of sorts by yours truly
 - 14 pages
 - Expands on the themes in this presentation
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 - 713-305-6274



Thanks...

- To AAPG
- To you, the listener