

Enhanced Oil Recovery Screening in Wyoming

Final Report

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Prepared for Dr. Fu & the University of Wyoming

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Executive Summary:

An extensive review of Wyoming's oil and gas fields has been performed. A refined look at which fields could experience success in a downturn economy was the goal. A specific approach of utilizing low cost operations in regards to secondary oil recovery on ideal candidates was the focal point in this endeavor.

Introduction:

The project objective was to screen through field data to determine the best candidates for Enhanced Oil Recovery (EOR). The packet included parameters of fields throughout Wyoming. Some of the parameters included were viscosity, oil gravity, depth and thickness to name a few. The information received is from the Wyoming Oil and Gas Conservation Commission (WOGCC) and Enhanced Oil Recovery Institute (EORI). To determine the fields that have the most potential in regards to enhanced oil recovery, a thorough screening based upon ideal range of relevant parameters of fields/reservoirs currently utilizing EOR methods in the industry will be performed. The database is strictly for Wyoming fields so some assumptions can be made and these will be detailed later in the report.

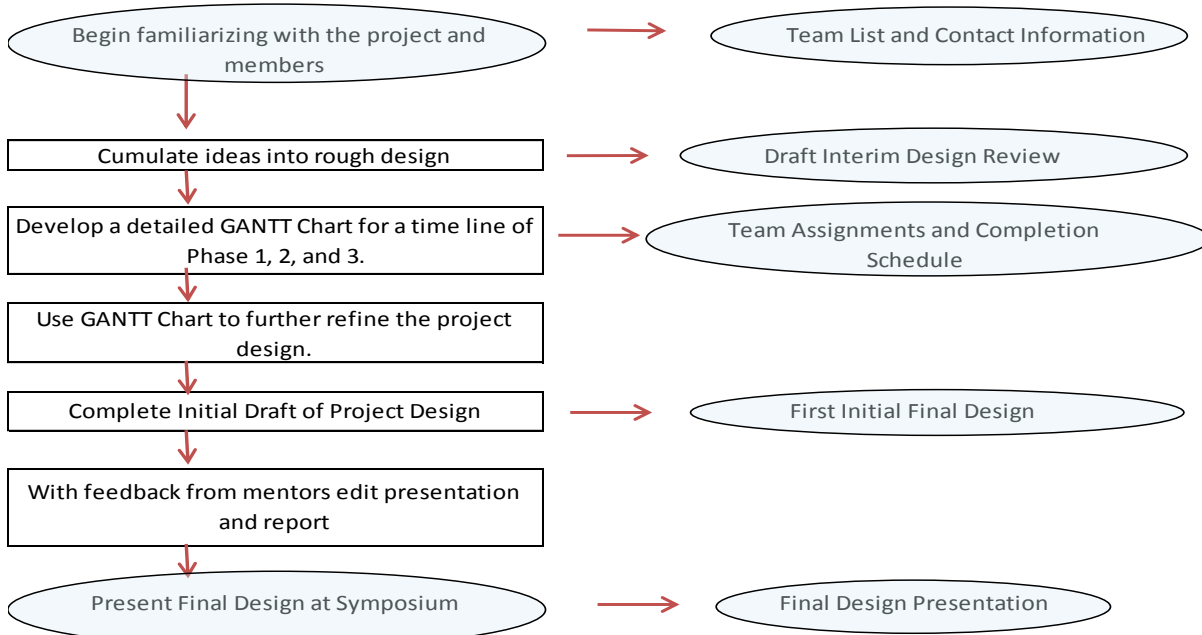
The work done for the project is broken down into four phases. The phases are summarized as follows:

- **Phase One:** Planning portion of the project. The majority of this phase occurred in the first semester portion of this course. Phase one consisted of determining steps in the project that could entail potential risks and setbacks. These will be outlined later in the project.
- **Phase Two:** Consisted of data accumulation, obtaining the data packets and eliminating missing information by checking other sources, as well as checking data consistency by the same means.
- **Phase Three:** Consisted of taking all the data acquired and running it through a screening algorithm that was modified for our specific project.
- **Phase Four:** This is where the ranking of the fields took place. The use of production history and proximity to Wyoming's CO₂ pipeline are the additional criteria used for ranking.

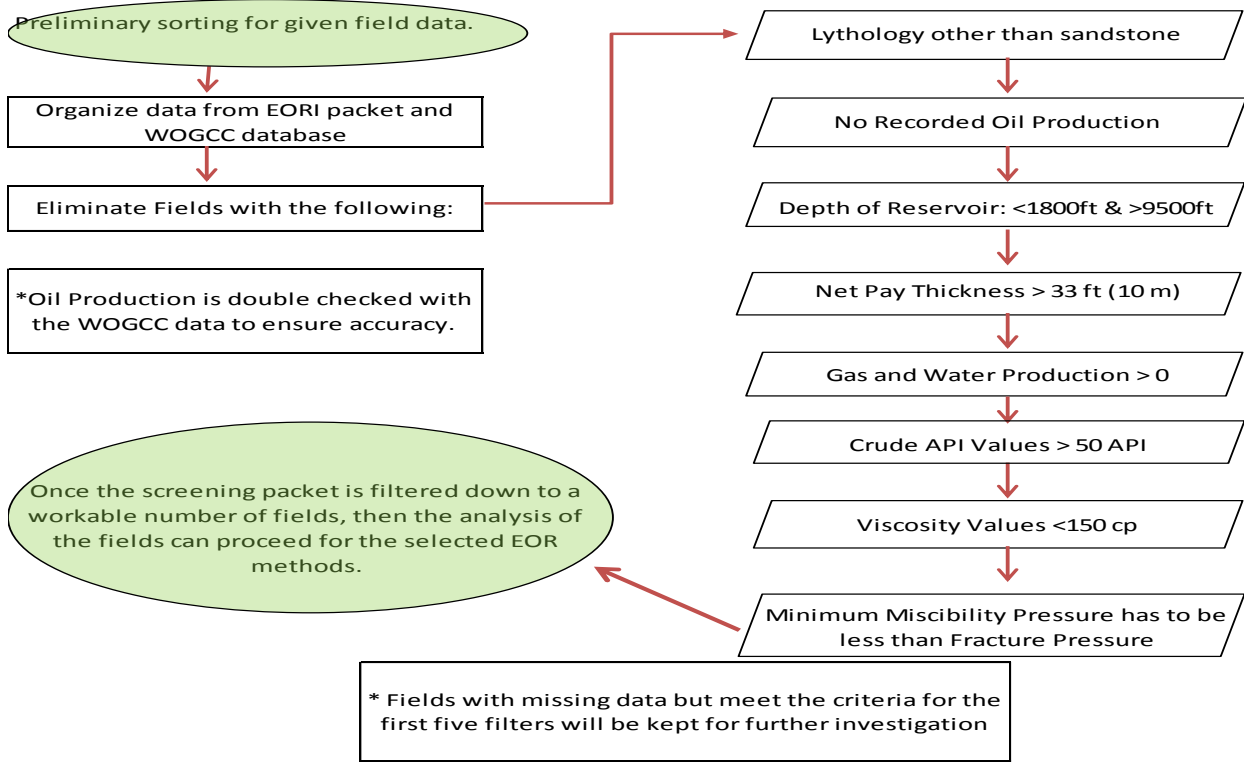
Phase One: Planning

A flowchart was utilized to illustrate the direction of the project along with each phase. The Gantt chart was also utilized for the purpose of the project timeline. The project timeline corresponded with the Gantt chart most of this semester, but the timeline of certain areas of the project were dynamic and sometimes difficult to predict.

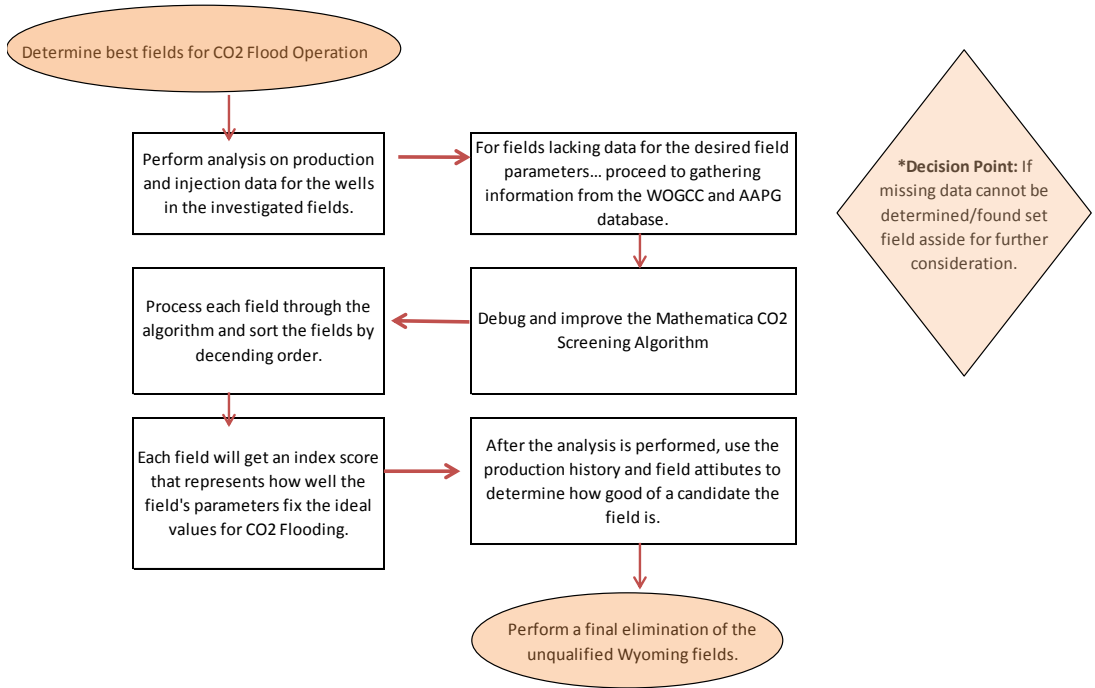
Project: Ranking Wyoming Fields for Enhanced Oil Recovery
Phase 1: Project Planning



Beginning Spring Semester:
Phase 2: Data Collection



Phase 3: Data Analysis



Begin after Phase 3

Phase 4: Selection of Top CO2 Candidates

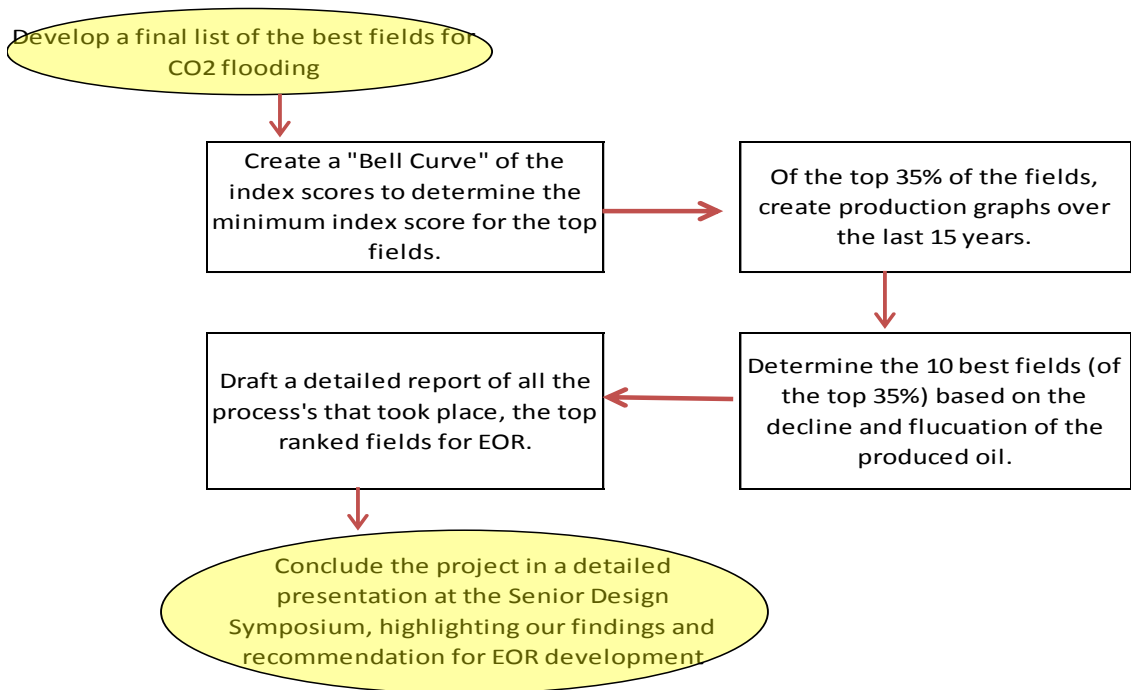
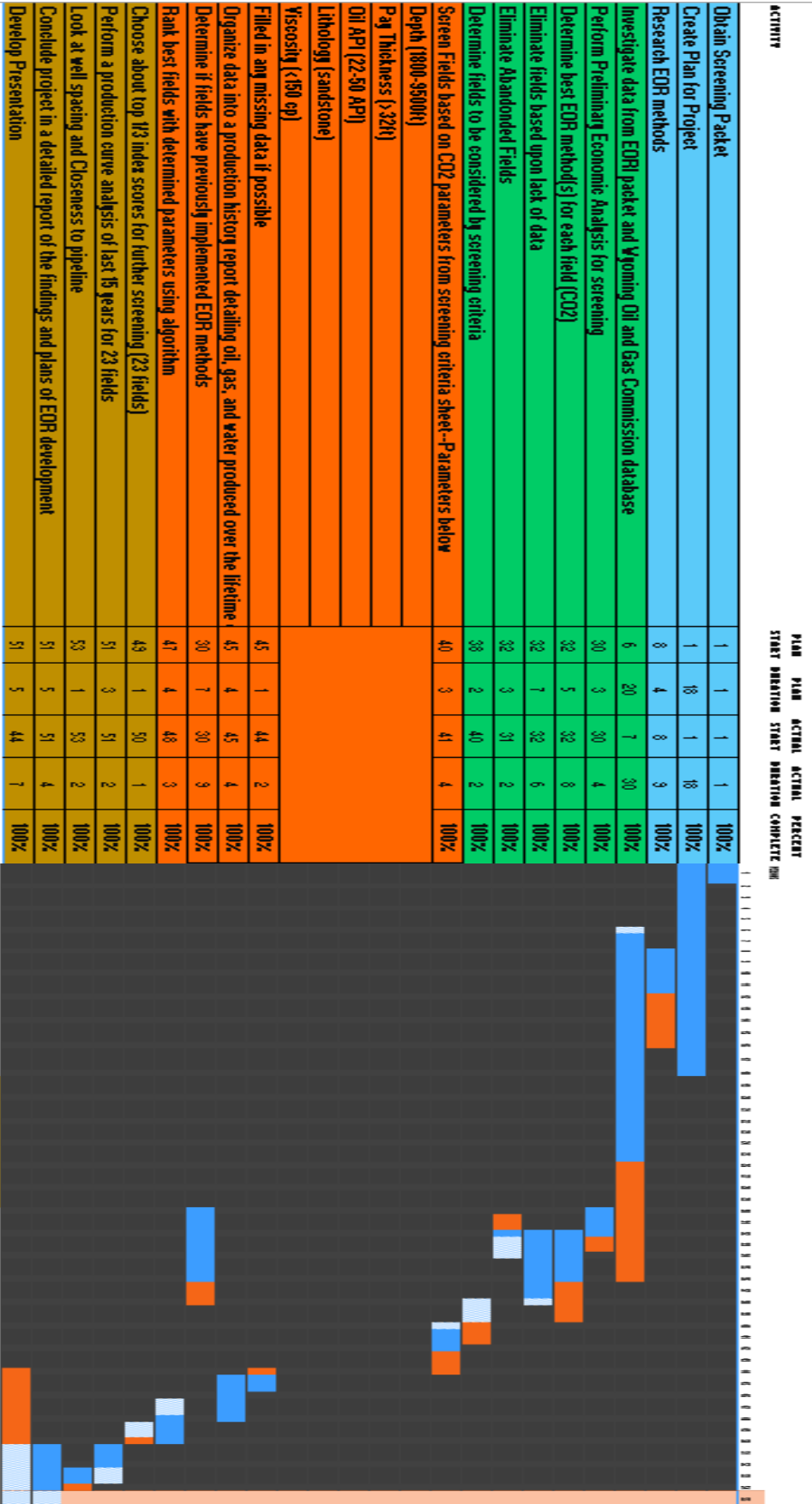


Figure 1: Flow Chart

Group 7 Project Plan



* Even periods are mid week
 ** As stated in report, each group member will participate in each task

Legend

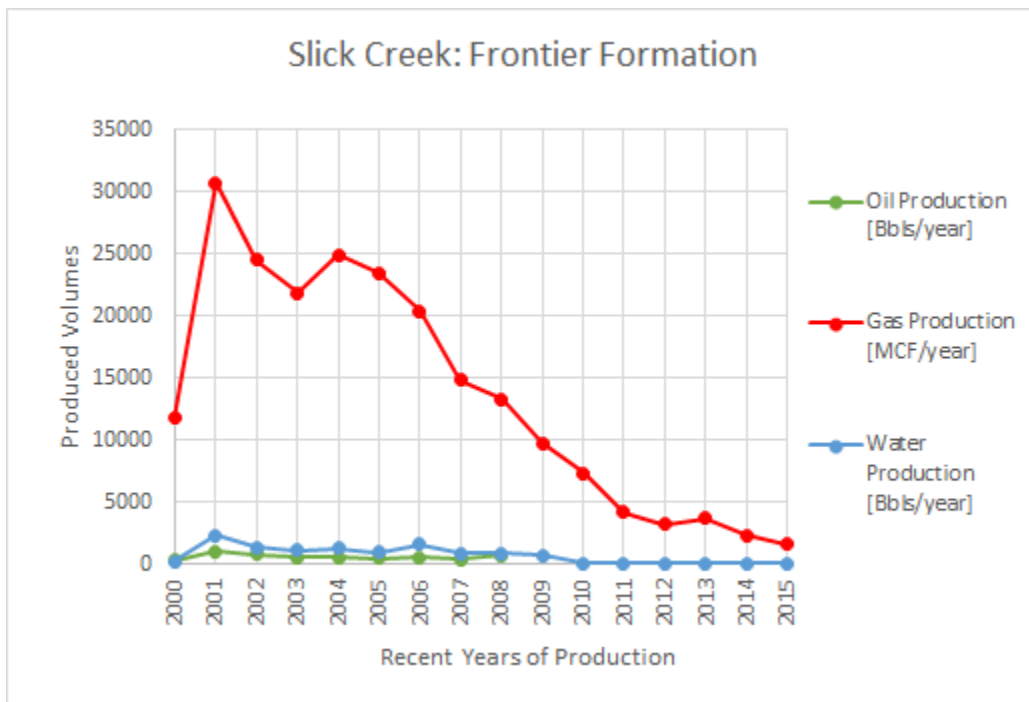
- Phase 1 -- Planning
- Phase 2 -- Data Collection
- Phase 3 -- Data Analysis
- Phase 4 -- Ranking

Figure 2: Gantt Chart

Phase Two: Data Collection

In the beginning of the data collection phase, the group relied on the WOGCC and AAPG for field/reservoir data. These websites contained the relevant and reliable information for the fields which were utilized for screening.

Production histories were also obtained from the WOGCC for the fields that were remaining after phase three. This was to compare performance of the fields and provide a better understanding of how effective EOR would be on a given field. The following illustrates an example of a field production history from field/reservoirs of final consideration. In the following figure; the red denotes gas production, blue denotes water production, and green denotes oil production.



Graph 1: Slick Creek Production History

The example above was among the top fields after index screening. The Slick Creek field's production history shows high gas production and not very much oil. When looking at this one trait, this field can easily be eliminated, since oil production is the top priority.

One other aspect researched was well spacing. In order to ensure proper spacing for a potential injection scenario, field maps were obtained along with other professional insight that helped support the final ranking.

There are fields in Wyoming that can be used as examples which have undergone an enhanced oil recovery process and shown great improvement in oil production.

Phase Three: Data Analysis

The original screening packet began with close to five-thousand field entries. To be able to accurately determine good EOR candidates, the data packet had to be screened, sorted, and reduced in size.

To do this, EOR methods had to be eliminated with viable reason. Surface mining methods were off the table as the field parameters did not meet the criteria that was required by those methods, such as, depth and viscosity. With the assistance of an industry professional, and from researching current EOR projects, the scope was narrowed down to water flooding and CO₂ injection. These methods were both effective on current projects and feasible in an economic downturn. Further research showed that most fields were already undergoing water injection, therefore, it was decided CO₂ injection would be the EOR method of choice.

The screening process utilized considered only miscible CO₂ flooding as the primary EOR method. The main reason for pursuing miscible CO₂ is due to the effectiveness of CO₂ on sweep efficiencies and increased recovery from maturing fields. Wyoming has a large number of sandstone reservoirs with oil of high API gravity values; both of which are recommended for efficient recovery with miscible CO₂. Other methods might be effective forms of EOR in Wyoming, but miscible CO₂ flooding has been proven to be a reliable recovery method in Wyoming. The breakdown of the screening process is explained below.

Parameters	Screening Criteria
Lithology	Sandstone
Cumulative Oil Produced (bbls)	>0
Average Depth Field (ft)	1800 < ft < 10000
Net Pay (ft)	<32
Oil Viscosity (cP)	<10
Oil API	<50

Table 1: Screening Parameters

Using the parameters in Table 1, which were based on the values from the initial screening packet in Table 3, the list of fields was decreased to around eighty remaining candidates. On top of this reduction, some of the fields listed in our current screened packet have multiple producing formations and show up more than once. This will have to be considered for ranking purposes.

A color coding system in excel was utilized to reduce the number of remaining Fields/Reservoirs to around eighty remaining entries. For each relevant parameter for CO₂ flooding, the ideal range of these values was determined from the look up table. Then in the

excel file, all Field/Reservoirs containing parameter values inside these ideal range of values was highlighted a specific color. This process was done for all four parameters. Once the color coding was completed, it was analyzed which fields contained a color for at least three parameters. Knowing fields with less than three ideal parameters could only achieve a maximum 0.5 index score, it was determined to be highly unlikely for this low of a score to end up in the final ranking of the highest index scores. Thus, these fields with less than three color coded parameters were eliminated. This is how this process left a remaining number of around eighty fields left to be ranked.

Fields were eliminated if there was no oil production illustrated in the screening packet or published in the WOGCC database. Upon investigating the formations of fields with no production history in the screening packet, the WOGCC database showed no history of such formations ever producing any fluids over time. These entries in the screening packet were sorted out of the remaining fields under consideration. In addition, if a field was published in the screening packet as abandoned at some point in time, the field was eliminated from the remaining candidates.

From reviewing literature, sandstone formations are the preferred lithology for miscible CO₂ flooding. In a sandstone reservoir, there is a good response in the increase of oil production during a CO₂ flood. Thus, oil and gas fields with lithology other than sandstone were eliminated out of the remaining candidates.

The oil API range used corresponded to CO₂ injection was limited to less than 50° API because higher API gravity is gas and/or gas condensate. The scope of the project is to only assess oil fields for enhanced oil recovery.

The depth range chosen reflects the constraints for CO₂ injection. Again, these ranges are the most efficient and allow CO₂ injection to deliver the highest volume of hydrocarbons.

The net pay has been filtered because of the effectiveness of the recovery process, primarily the sweep efficiency, a net pay less than 32 feet is the most effective. This was decided after reviewing literature about sweep efficiencies and conformance control for miscible CO₂ flooding.

The limitation of oil viscosity has been placed to optimize the amount of fluid that gets mobilized during the recovery process.

Wells that had a lower fracture pressure than minimum miscible pressure were eliminated. In these reservoirs, the pressures need to have a miscible CO₂ flood would fracture the formation. A fractured formation would result in a loss of conformance control and a loss of fluids during injection.

Two future parameters included in the final screening are well spacing and proximity to the CO₂ pipeline in Wyoming. Well spacing is important because fields work efficiently when well spacing is close and when injectors are close to producers, the optimal spacing is around 80 acres per well. The closeness to the pipeline allows our fields to be economical by not having to invest in infrastructure.

With all these considerations (neglecting well spacing and proximity to CO₂ pipeline for now), the remaining fields are now ready to be input and scored in the algorithm, which can be customized and altered based on CO₂ parameters. With this algorithm the most qualified fields will be determined and ranked for the selected tertiary recovery method.

Figuring out the complex algorithm was another huge step that was accomplished. The algorithm was run in the Mathematica computer program to do the index ranking; in Mathematica there is an ability to utilize an integral function. This function was used to find the overlapping area between the reference and field parameter triangles. The area overlap results in the index score for the field.

Phase Four: Ranking

The basis of the screening algorithm, obtained by Dr. Alvarado at the University of Wyoming, was used to help identify and score fields most suitable for CO₂ flooding. The algorithm originally contained coding errors, which resulted in a lack of outputs. The algorithm's code was corrected and improved upon in order for it to be utilized. In addition, the algorithm was adjusted to contain only the relevant parameters for CO₂ flooding as established by the screening criteria.

The code works by comparing parameters of a field against each other. Field parameters are inputted and are compared to screening parameters. Both the field parameter and the screening criteria are assigned a triangle. The area overlap of the triangles gives an output index score representing the amount of overlap. Below is an example of the algorithm coding.

```
CO2 - ResA =
Grid[{{InputField["VARIABLE", String, Enabled → False, FieldSize → 8], InputField["MINIMUM", St
InputField["MAXIMUM", String, Enabled → False, FieldSize → 8], InputField["INDEX", String, E
{InputField["Depth", String, Enabled → False, FieldSize → 8], InputField[dmmin, Number, Fields
{ar, br, cr} = {Log[10, drmin], Log[10, drmean], Log[10, drmax]};
{ai, bi, ci} = {Log[10, dmmin], Log[10, dmmean], Log[10, dmmax]};
dg = Plot[{fr[x], fi[x]}, {x, Min[ar, ai], Max[cr, ci]}, Filling → Axis];
(DepthI = NIntegrate[frxi[x], {x, Log[10, dmmin], Log[10, dmmax]}) / NIntegrate[fi[x], {x, Log
InputField["Thickness", String, Enabled → False, FieldSize → 8], InputField[thmin, Number, Fi
{ar, br, cr} = {thrmin, thrmean, thrmax};
{ai, bi, ci} = {thmin, thmean, thmax};
(thg = Plot[{fr[x], fi[x]}, {x, Min[ar, ai], Max[cr, ci]}, Filling → Axis]);
ThI = NIntegrate[frxi[x], {x, thmin, thmax}] / NIntegrate[fi[x], {x, thmin, thmax}], Show[thg,
{InputField["API Gravity", String, Enabled → False, FieldSize → 8], InputField[gmin, Number, I
{ar, br, cr} = {grmin, grmean, grmax};
{ai, bi, ci} = {gmin, gmean, gmax};
(Pg = Plot[{fr[x], fi[x]}, {x, Min[ar, ai], Max[cr, ci]}, Filling → Axis]);
(PI = NIntegrate[frxi[x], {x, gmin, gmax}] / NIntegrate[fi[x], {x, gmin, gmax}]), Show[Pg, Imag
InputField["Permeability", String, Enabled → False, FieldSize → 8], InputField[permmmin, Numb
{ar, br, cr} = {Log[10, perrmin], Log[10, perrmean], Log[10, perrmax]};
{ai, bi, ci} = {Log[10, permmmin], Log[10, permmmean], Log[10, permmmax]};
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(PermI = NIntegrate[frxi[x], {x, Log[10, permmmin], Log[10, permmmax]}) / NIntegrate[fi[x], {x,
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{ar, br, cr} = {Log[10, vrmin], Log[10, vrmean], Log[10, vrmax]};
{ai, bi, ci} = {Log[10, vmin], Log[10, vmean], Log[10, vmax]};
(vg = Plot[{fr[x], fi[x]}, {x, Min[ar, ai], Max[cr, ci]}, Filling → Axis]);
```

Figure 4: Algorithm Code

These input parameters were all modified to fit gas flooding techniques. The screening criteria for CO₂ are represented in the figure given below.

Detail Table in Ref. 16	EOR Method	Oil Properties			Reservoir Characteristics					
		Gravity (°API)	Viscosity (cp)	Composition	Oil Saturation (% PV)	Formation Type	Net Thickness (ft)	Average Permeability (md)	Depth (ft)	Temperature (°F)
Gas Injection Methods (Miscible)										
1	Nitrogen and flue gas	>35 / 48 /	<0.4 \ 0.2 \	High percent of C ₁ to C ₇	>40 / 75 /	Sandstone or carbonate	Thin unless dipping	NC	>6,000	NC
2	Hydrocarbon	>23 / 41 /	<3 \ 0.5 \	High percent of C ₂ to C ₇	>30 / 80 /	Sandstone or carbonate	Thin unless dipping	NC	>4,000	NC
3	CO ₂	>22 / 36 / *	<10 \ 1.5 \	High percent of C ₅ to C ₁₂	>20 / 55 /	Sandstone or carbonate	Wide range	NC	>2,500*	NC
1-3	Immiscible gases	>12	<600	NC	>35 / 70 /	NC	NC if dipping and/or good vertical permeability	NC	>1,800	NC
(Enhanced) Waterflooding										
4	Micellar/Polymer, ASP, and Alkaline Flooding	>20 / 35 /	<35 \ 13 \	Light, intermediate, some organic acids for alkaline floods	>35 / 53 /	Sandstone preferred	NC	>10 / 450 /	>9,000 \ 3,250	>200 \ 80
5	Polymer Flooding	>15	<150, >10	NC	>50 / 80 /	Sandstone preferred	NC	>10 / 800 / ^b	<9,000	>200 \ 140
Thermal/Mechanical										
6	Combustion	>10 / 18 →?	<5,000 ↓ 1,200	Some asphaltic components	>50 / 72 /	High-porosity sand/ sandstone	>10	>50 ^c	<11,500 \ 3,500	>100 \ 135
7	Steam	>8 to 13.5 →?	<200,000 ↓ 4,700	NC	>40 / 66 /	High-porosity sand/ sandstone	>20	>200 / 2,540 / ^d	<4,500 \ 1,500	NC
—	Surface mining	7 to 11	Zero cold flow	NC	>8 wt% sand	Mineable tar sand	>10 ^e	NC	>3:1 overburden to sand ratio	NC

Table 3: Summary of Screening Criteria for EOR methods (EORI)

Technical Screening Guides		
	Recommended	Range of Current Projects
Crude Oil		
Gravity, °API	>22	27 to 44
Viscosity, cp	<10	0.3 to 6
Composition	High percentage of intermediate hydrocarbons (especially C ₅ to C ₁₂)	
Reservoir		
Oil saturation, % PV	>20	15 to 70
Type of formation	Sandstone or carbonate and relatively thin unless dipping.	
Average permeability	Not critical if sufficient injection rates can be maintained.	
Depth and temperature	For miscible displacement, depth must be great enough to allow injection pressures greater than the MMP, which increases with temperature (see Fig. 7 of Ref. 1) and for heavier oils. Recommended depths for CO ₂ floods of typical Permian Basin oils follow.	
	Oil Gravity, °API	Depth must be greater than (ft)
For CO ₂ -miscible flooding	>40	2,500
	32 to 39.9	2,800
	28 to 31.9	3,300
	22 to 27.9	4,000
	<22	Fails miscible, screen for immiscible*
For immiscible CO ₂ flooding (lower oil recovery)	13 to 21.9	1,800
	<13	All oil reservoirs fail at any depth
At <1,800 ft, all reservoirs fail screening criteria for either miscible or immiscible flooding with supercritical CO ₂ .		

Table 3a: Additional Screening Criteria (Taber)

Time had to be spent researching how Mathematica functioned in order to learn how to operate it effectively for the purpose of the project. In addition, after much trial and error, the entire group became proficient enough to utilize Mathematica adequately. Sample outputs are displayed in the results section. Table 3a illustrates the additional screening criteria used for our algorithm. By looking at varying API ranges we could create a more specific algorithm for various fields.

The screening criteria for CO2 was used in our algorithm. Index values obtained were a result of the algorithm and show the level of conformity a field has to a given type of enhanced oil recovery method, in this case CO2 flooding. The algorithm outputs a series of charts, which displays this comparison for each reservoir or fluid characteristic. Figure 5 shows some of these charts.

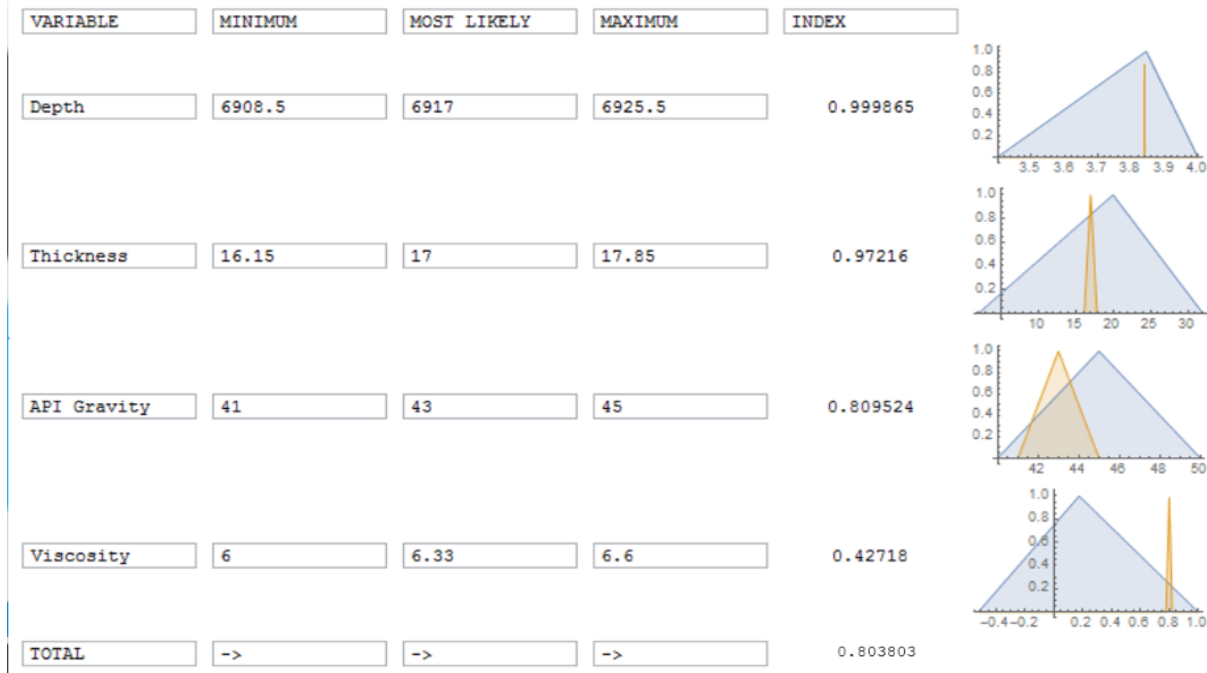


Figure 5: Sample Algorithm Output

Again, from the figure on the previous page, the greater overlap of the two triangles the better fit it is for that specific characteristic. Greater overlap between parameters results in a higher index score. The algorithm became the one of the main screening and ranking tool for the project, and represents a huge portion of time spent.

To further improve the algorithm, separate algorithms were created based upon an API Gravity value range. Referring to the screening criteria in Table 3, if a field/reservoir was in a specific API range, it had a minimum depth requirement. With this additional requirement, four separate algorithms were created corresponding to the four API gravity ranges. For instance, if a field/reservoir possessed an API value greater than 40, it was screened with the >40 algorithm. These additional algorithms allowed fields/reservoirs to achieve higher levels of distinction in the index scores.

Inputting the remaining 80 fields into the algorithm was simple, but one issue that arose was the fact that some fields lacked many of the necessary inputs such as viscosity and oil gravity. This could be overlooked if only one value was missing, but some fields were missing more than one. These values could not be solved for so given our allotted time, those fields had to be eliminated.

Again, it was a priority to reduce the number of fields to the top remaining candidates after the index scoring process. To do this, the top 1/3 of the remaining fields were isolated. This corresponded to an index score of around 0.7. The top 1/3 of the fields was decided because it included 22 (22 fields corresponds to about 35%) remaining fields to look at.

Finally, to obtain the best 5 candidates the production history graphs from the year 2000 to 2015 were analyzed for these 22 fields. This will show how oil production has declined over time and if there is a good response to a water flooding effort in this time period (i.e. increased water production). This was a step that helped determine which fields are the most promising. Of these fields the well spacing is given on an average spacing of the number of wells over the total area of the field, the closer the well spacing is, the more effective a CO₂ flood will be on production. Furthermore, the distance from the CO₂ pipeline to the field will be measured for the final ranking criteria. These final processes will determine the advantages and disadvantages of the top five candidates considered for miscible CO₂ flooding.

The EORI website contains an interactive map of Wyoming which has the capability to show the proximity of the CO₂ pipeline with respect to the final Fields of interest. This map was utilized to determine the distance of the fields to the pipeline. With the addition of this website and the interactive map to the project, the proximity to the CO₂ pipeline of the final 5 fields was calculated and these results were utilized in determining the final ranking of Fields.

Results:

Displayed in the following is a diagram detailing our remaining group of fields. A normal distribution curve was created showing the range of scores and how they stacked up against each other. The distribution plot shows the percentile that was chosen and how it corresponds to the normal curve. The top thirty-five percent was maintained for final ranking. This percentage was chosen due to the fact there was an ideal separation on the curve where index scores above .7 corresponded to the top thirty-five percent.

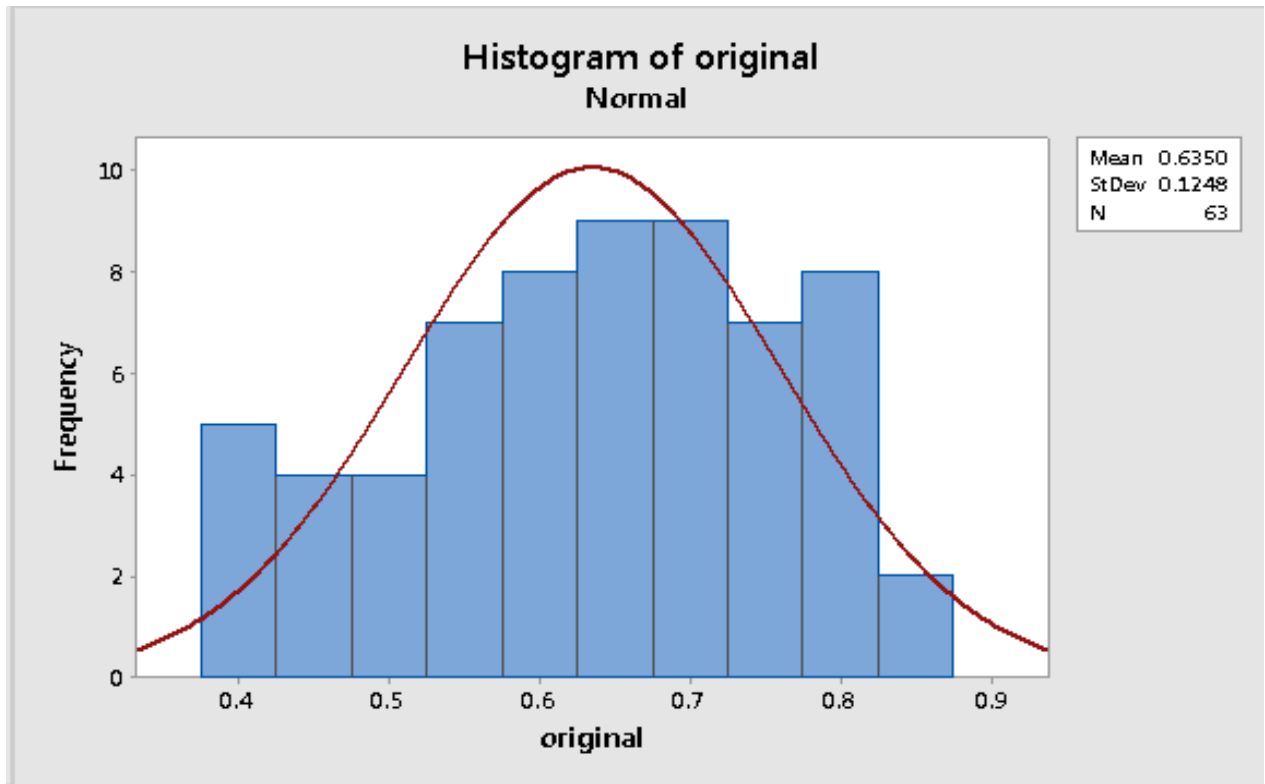


Figure 6: Bell Curve

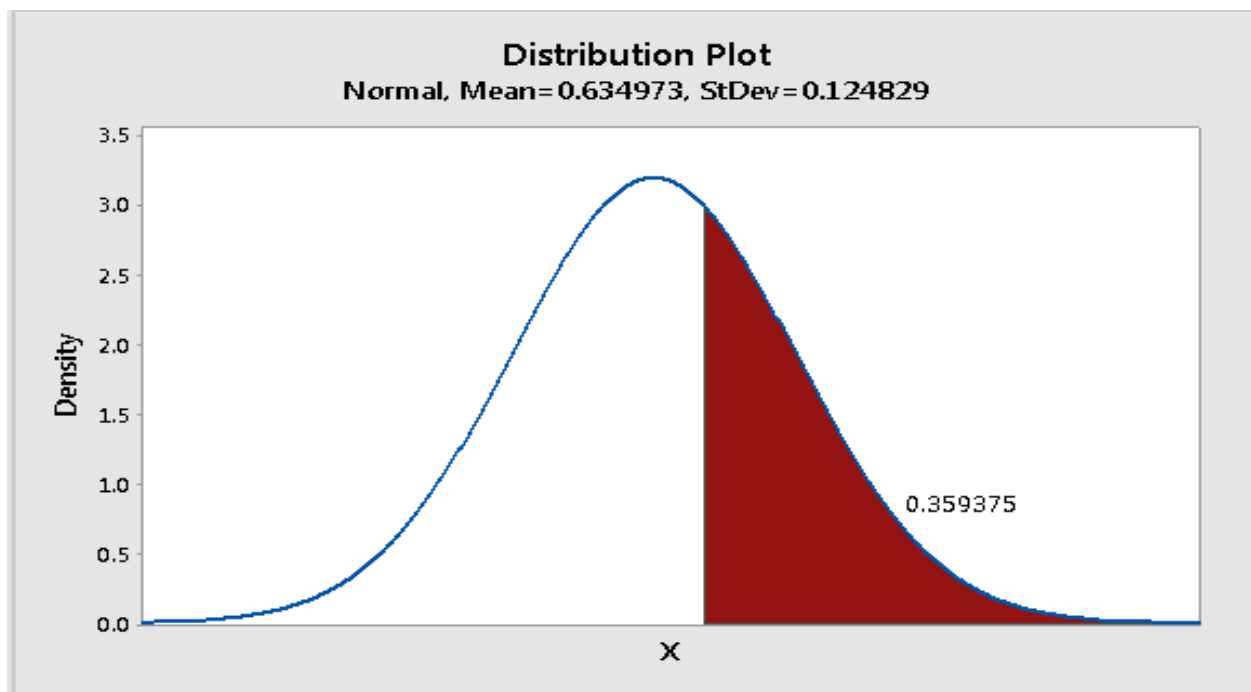


Figure 7: Distribution Plot

The fields were slimmed down based upon the algorithm and the top percentile of the distribution. The next step is to determine the top 5 fields based on production curves and proximity to the CO₂ pipeline in Wyoming. An ideal production curve for EOR is a decline in oil production that is still producing a reasonable amount that would make recovery efforts economic. This shows that the field would respond well to EOR to keep production up. As for the closeness to the pipeline, the closer the better. Our top 5 fields came out to be (not in any specific order) Well Draw – Teapot Reservoir, Flat Top – Teapot Reservoir, Salt Creek East – Lakota Reservoir, Big Hand – Dakota Reservoir, and Barber Creek – Ferguson Reservoir.

CO₂ Index Score	Field Name	Reservoir	Basin/Regional Setting
0.803803	WELL DRAW	TEAPOT	POWDER RIVER BASIN
0.803425	FLAT TOP	TEAPOT	SOUTH FLANK POWDER RIVER BASIN
0.787608	SALT CREEK EAST	LAKOTA	EAST FLANK CASPER ARCH
0.766509	BIG HAND	DAKOTA	EAST CENTRAL POWDER RIVER BASIN
0.757462	BARBER CREEK	FERGUSON	WEST CENTRAL POWDER RIVER BASIN

Table 4: Top Five Fields

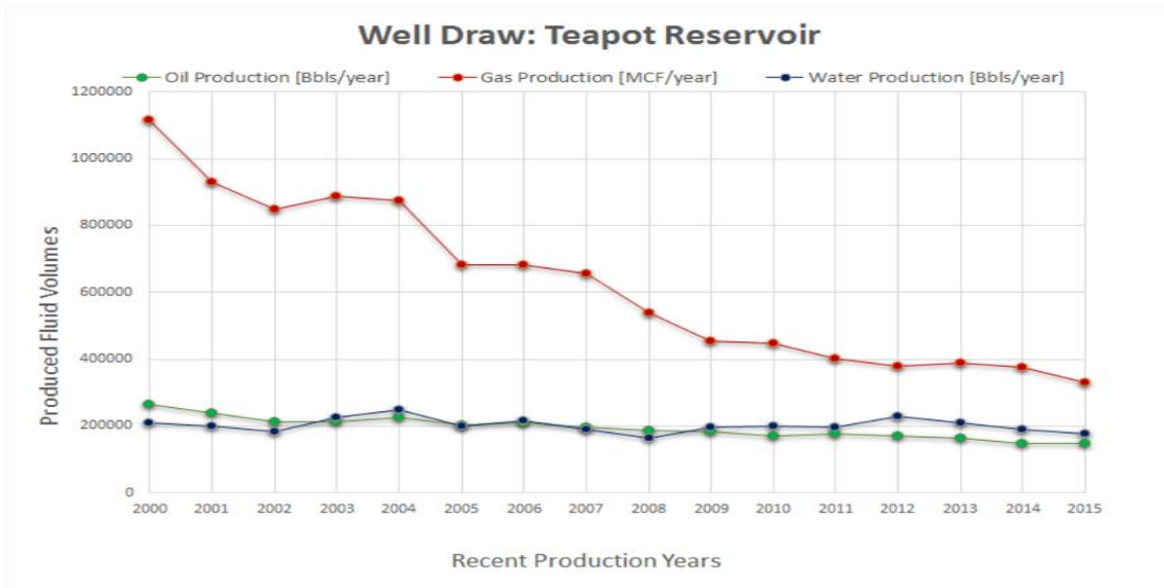
The above figure shows the index score that corresponded to our top five. Again, these top five were based upon the index scoring (not necessarily the highest scores), production curves, well spacing, and closeness to the CO₂ pipeline. Each field will be described in detail.

Well Draw – Teapot Reservoir



Figure 8: Well Draw – Teapot Reservoir (EORI)

Figure 8 shows the closeness of Well Draw to the CO₂ pipeline that runs through Wyoming. The distance is around 70 miles from the pipeline. This distance is reasonably far but other parameters make it a good candidate. The index score for Well Draw is 0.804 which was one of the highest scores achieved. The high index score makes this field a very good candidate. Well Draw is currently under water injection and is an EORI CO₂ flood target. This means that the EORI deemed this project a CO₂ project in the future. The top five fields were all EORI CO₂ flood targets. This shows that the screening methods were effective.



Graph 2: Well Draw – Teapot

Graph 2 shows the production for Well Draw for the previous fifteen years. This field has an advantage over the other fields because of the high production. The production follows the decline goal and has high production.

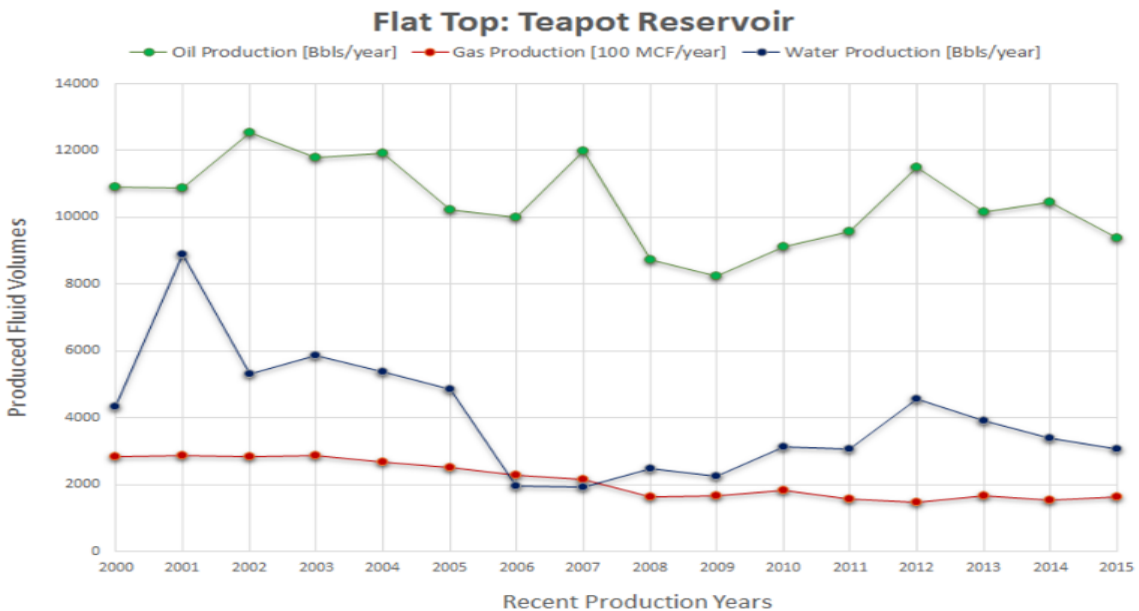
For the top five candidates well spacing was also a consideration. The idea well spacing for CO₂ EOR is around 80 acres per well. For Well Draw the spacing is 160 acres per well which is pretty far. This creates some issues with sweep efficiency and production.

Flat Top – Teapot Reservoir



Figure 9: Flat Top – Teapot Reservoir (EORI)

Figure 9 shows the proximity of Flat Top to the CO₂ pipeline. This is the farthest of our Top Five from the pipeline. It is 74 miles away. Again, this is a disadvantage of this field because it makes obtaining CO₂ more difficult. Again, this field is a CO₂ flood target. This field is currently under water flood.



Graph 3: Flat Top – Teapot

Looking at Graph 3, the production for Flat Top is very good. The oil production shows good response to water flood attempts which indicates EOR methods should have a good effect. There is decent yearly production as well which plays in to the economics.

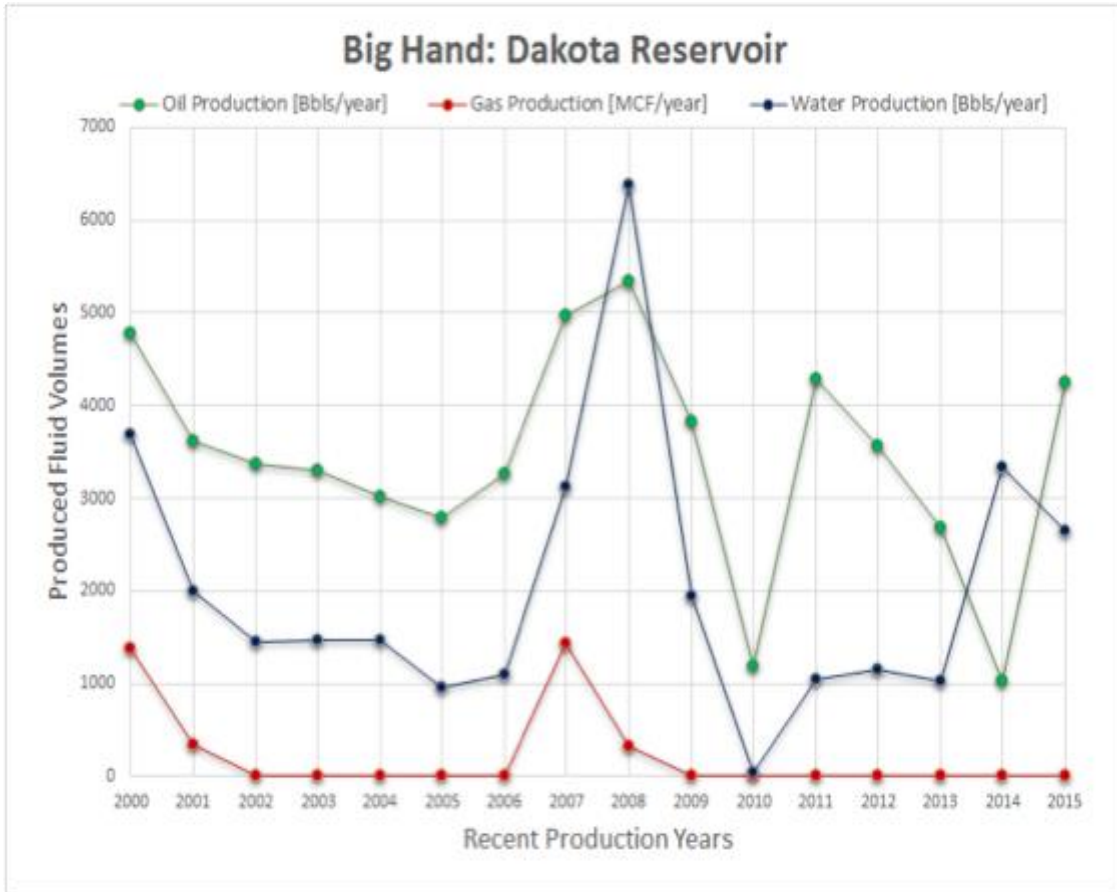
The well spacing is very poor for this field. It is 320 acres per well. The ideal is 80. This would make it very difficult for sweep efficiency and injection. This is still a top field because of production but the distance from the pipeline and well spacing are huge disadvantages.

Big Hand – Dakota Reservoir



Figure 10: Big Hand – Dakota Reservoir (EORI)

Figure 10 shows the closeness of Big Hand to the CO₂ pipeline that runs through Wyoming. The distance is around 29 miles from the pipeline. This distance is reasonably far but other parameters make it a good candidate. The index score for Well Draw is 0.766 which is a decent index score. Well Draw is currently under water injection and is an EORI CO₂ flood target. This means that the EORI deemed this project a CO₂ project in the future.



Graph 4: Big Hand - Dakota

Graph 4 shows the production for Big Hand for the production fluid indicating that this was most likely water injected. This is pretty evident in 2008, since the water production jumped, and helped remove more oil. This deems the reservoir as applicable to an enhanced oil recovery method. Specifically, CO₂ since we screened for the previous fifteen years. This field has an advantage over the other fields because of the high production. The production follows the decline goal and has high production.

Well spacing is 160 acres per well. This is pretty far away from the idea 80. This is a disadvantage for this field. However, the production and closeness to pipeline make it a very good candidate.

Barber Creek – Ferguson Reservoir



Figure 11: Barber Creek - Ferguson (EORI)

Figure 11 shows the proximity of Barber Creek to the CO₂ pipeline that runs through Wyoming. The distance is around 7.18 miles from the pipeline. This distance is extremely suitable and building a pipeline is an affordable option. The index score for Barber Creek is 0.757 which was one of the higher scores achieved. The high index score makes this field a very good candidate. Barber Creek is currently under water injection and is an EORI CO₂ flood target.



Graph 5: Barber Creek – Ferguson Production

Graph 5 shows the production from Barber Creek. It is obvious water was injected this field until the end of the year 2015. It can be seen, there is steady water production as the oil is declining. The group determined that utilizing a CO₂ flood would help stimulate the production. Rebuilding reservoir pressure shouldn't be the problem, using a different fluid phase to move the oil would help, and CO₂ would achieve this.

The well spacing for Barber Creek is 80 acres per well. This is very ideal and a big advantage for this field. The closeness to pipeline and well spacing are big advantages for this field.

Salt Creek East – Lakota Reservoir

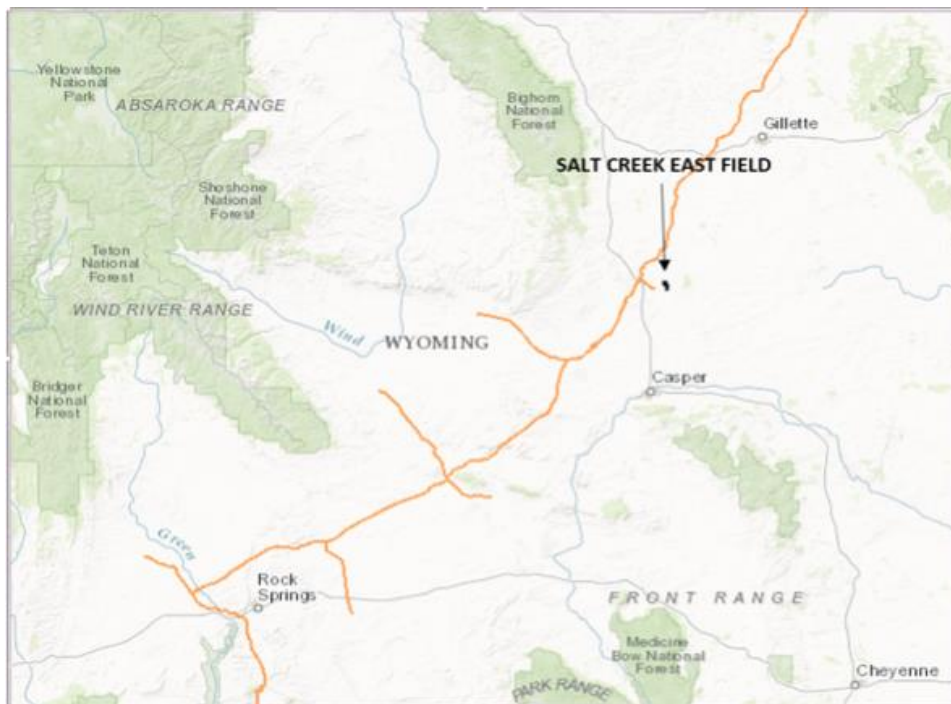
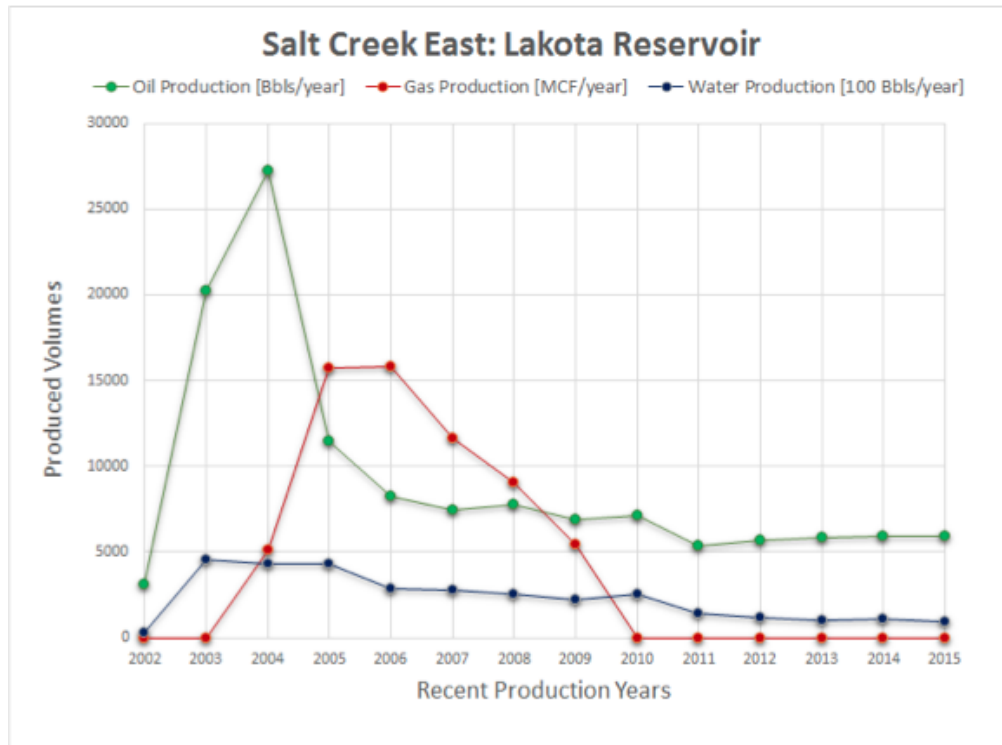


Figure 12: Salt Creek East - Lakota (EORI)

Figure 12 shows the closeness of Salt Creek East to the CO₂ pipeline that runs through Wyoming. The distance is around 5 miles from the pipeline. This was the closest field of the remaining five to the CO₂ pipeline, making it a great contender. The index score for Salt Creek East was .788 which is a good index score. Salt Creek East is currently under water injection, and was under CO₂ injection.



Graph 6: Salt Creek East – Dakota Production

Graph 6 shows the production for Salt Creek East. In 2003 there is a large spike in the production of oil and gas. This is mainly due to Anadarko stimulating the field. Anadarko picked up acreage from Howell Petroleum and by utilizing a 3D seismic data set, and CO₂ injection, they brought the production up to 7000 BOPD. Since this field has already been developed it is a good idea to probably avoid this specific field. However, the integrity of this screening method was confirmed here. The fact that Salt Creek East received a high index score and saw a huge boom in production from CO₂ injection, this group is confident in the obtained results.

The well spacing for this field is 44 acres per well. This is really good spacing. Many attributes of this field make it a very good candidate. The closeness to pipeline, ideal well spacing and previous success make this a great field.

Discussion:

The project determined which Wyoming Fields/Reservoirs are the most suitable for CO₂ flooding based upon listed EORI database data and ideal parameter value ranges as established in the look up tables. Our top five candidates coincide with the EORI CO₂ flood targets, which raises confidence as there are other professionals who agree with our list. Due to the limited scope of this project, further considerations should be examined in order to perform a more in depth and complete screening.

Further considerations consist of analyzing the geological formations of each field and reservoir to determine how conducive the associated traps would be with miscible CO₂ flooding. In addition, further economic considerations should be performed such as price of CO₂ as compared to price of crude to evaluate whether at that certain period of time is an economical opportunity to utilize CO₂ flooding or not.

Reservoir simulations of the final field/reservoirs would provide a very accurate and more insightful determination on how the field/reservoir would respond to a CO₂ flood. With implementing the combination of all of these further considerations, a very appropriate determination can be made on whether to initiate a CO₂ flooding project or not.

Conclusion:

This project was a very challenging endeavor to take on due to the fact that the process of EOR screening is very subjective in many areas. This project forced us to collaborate efficiently as a cohesive unit to complete the project. The group utilized the collection of all of our Petroleum Engineering, problem solving, presentation, and time management skills. In the end, the entire group feels very comfortable and knowledgeable on how to perform a basic EOR screening for any method out in the field.

At the conclusion of Undergraduate Research day, the group felt the project and presentation put forward was an excellent and polished product which demonstrates two semesters of hard, diligent work.

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