

























**Paul Dubois, Director of Technical Permitting Ted Wooten, Chief Engineer** Austin Gaskamp, Engineering Specialist, UIC

May 22, 2025

### Today's Agenda

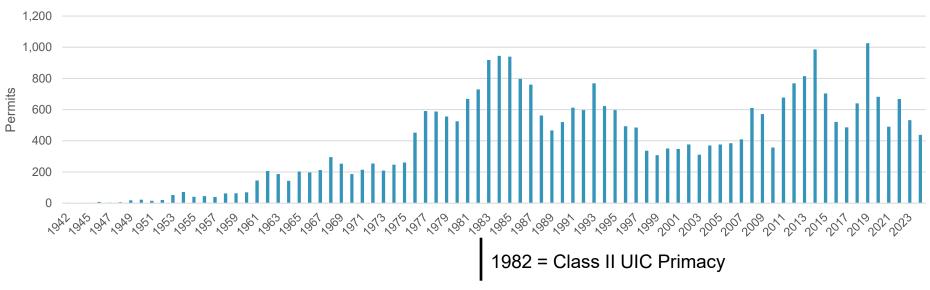


- History
- Applicability
- Elements of the Review
- Post-Permitting Requirements and Special Conditions
- Seismicity
- Resources

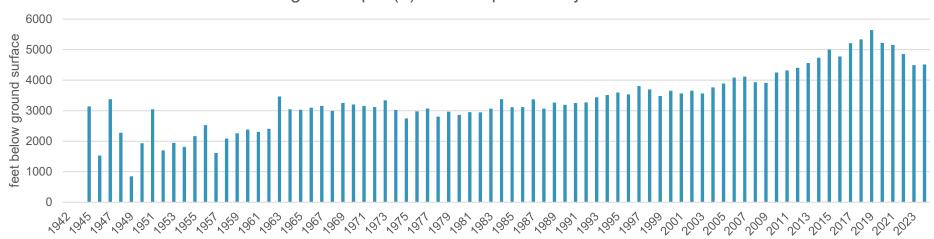
### Permian Basin Disposal Well Permitting History (1 of 3)



#### Number of Disposal Permits Issued per Year



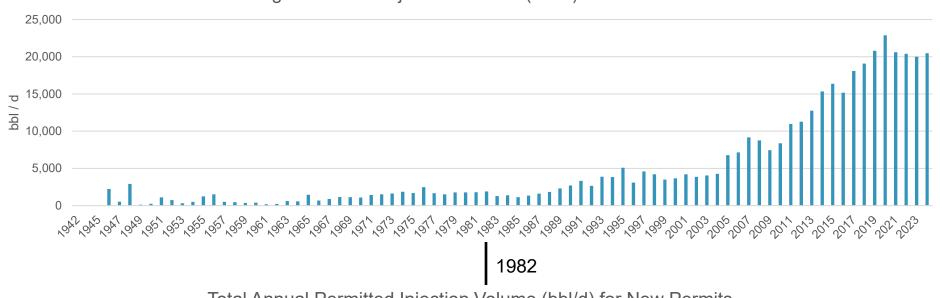
Average of Depth (ft) to the Top of the Injection Interval



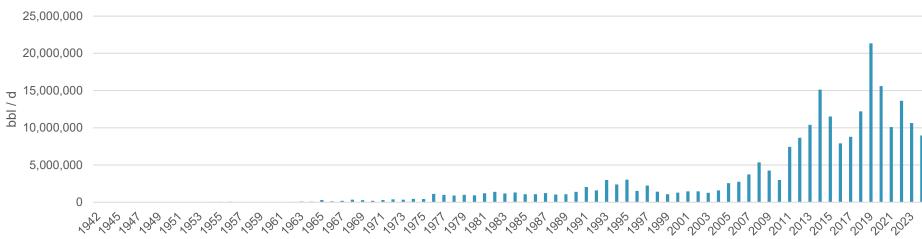
### Permian Basin Disposal Well Permitting History (2 of 3)



#### Average Permitted Injection Volume (bbl/d) for New Permits



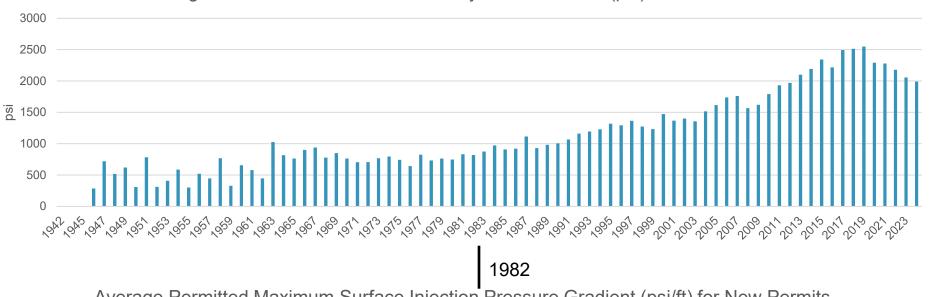
Total Annual Permitted Injection Volume (bbl/d) for New Permits



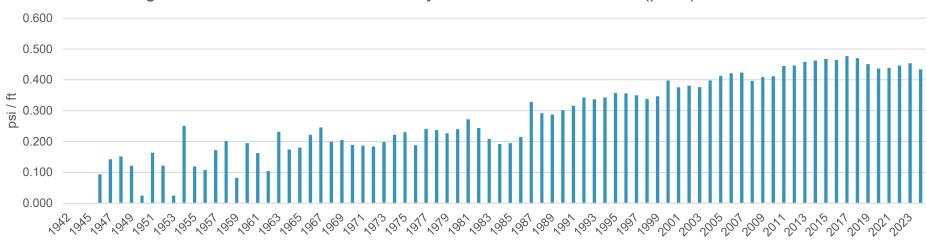
### Permian Basin Disposal Well Permitting History (3 of 3)



Average Permitted Maximum Surface Injection Pressure (psi) for New Permits



Average Permitted Maximum Surface Injection Pressure Gradient (psi/ft) for New Permits



#### **End Points**



- Current rules and permitting program do not adequately address these risk drivers and challenges.
- Water Code §27.051(b)(1-4)
  - "The Commission ...may issue the permit if it finds:"
  - The disposal well is in the public interest,
  - The disposal well will not endanger or injure any hydrocarbon resources,
  - With adequate safeguards, the disposal well will protect freshwater resources from pollution, and
  - The applicant has made a satisfactory showing of financial responsibility per Water Code §27.073.

### Overview of Changes



- Maximum Surface Injection Pressure (MSIP) limited by confinement zone in-situ stress and stress contrast.
- Maximum Daily Injection Volume (MDIV) limited by initial average reservoir pressure.
- Maximum Injection Rate (MIR) Instantaneous Rate limitation.
- 2-mile radial Area of Review (AOR):
  - Strict limits within ½ mile
  - MSIP reduction within 2-mile on condition

### **Applicability**



All disposal wells in the Permian Basin.

- All SWR 9 Applications

 All SWR 46 Applications with Line 21 box checked for "Disposal"

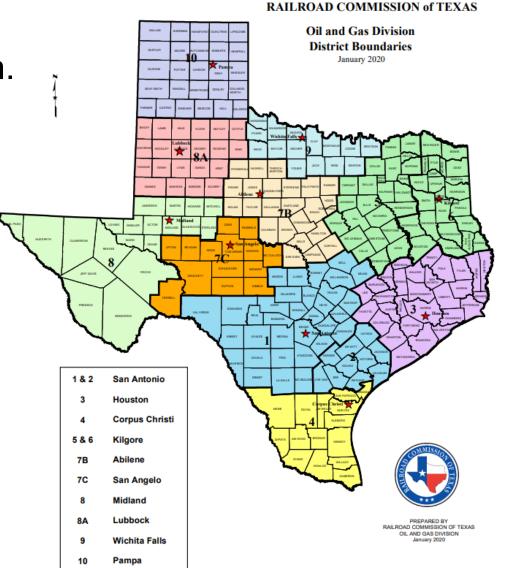
 Permian Basin is defined by RRC Districts 7C, 08, and 8A.

Title 16 ECONOMIC REGULATION

Part 1 RAILROAD COMMISSION OF TEXAS

Chapter 3 OIL AND GAS DIVISION

Rule §3.46 Fluid Injection into Productive Reservoirs



### Application Information and Excel Workbook





https://www.rrc.texas.gov/oil-and-gas/applications-andpermits/injection-storage-permits/oil-and-gas-wastedisposal/injection-disposal-permit-procedures/pb-disposalreview/

#### Checklist:

Completed UIC Permian Pressure Review V1.0 Workbook:

### Permian Basin Disposal Well Application Checklist



- Excel Application Workbook (available for download on the RRC Website, Permian Dasin Disposal Well Review Page):
  - Well Template
  - AOR Template
- Data Appendix and Report
  - Well Data
  - AOR Data
- Map
- Cross Section
- Seal of P.E./P.G.

### Well Template - Data Input



ALL DATA PROVIDED FROM AN OFFSET WELL, MUST BE EXPLAINED IN DETAIL BY APPLICANT IN SUPPLEMENTAL REPORT.

ALL DATA PROVIDED MUST BE REFERENCED ON A CROSS SECTION THAT INCLUDES REFERENCE WELL EVEN IF IT FALLS OUTSIDE THE 2-MILE AOR
SUPPLEMENTAL REPORT, INCLUDING THE ANALYSIS CONDUCTED TO GENERATE DATA, MUST BE SIGNED BY A PROFESSIONAL ENGINEER/GEOLOGIST

			Today's date is 05/13/2025
			SOURCE OF DATA (PAGE
			REFERENCE FROM SUPPLEMENTAL REPORT)
RRC UIC TRACKING NUMBER		12345	
OPERATOR		WE HAVE WATER	
LEASE		ТОО МИСН Н2О	
LEASE/GAS ID NO.		DBM 54-1-40	
WELL NO.		5th 1	
API NO.		000-00000	
LATITUDE IN NAD83 COORDINATES		31.903859	NEED NAD83 COORDINATES
LONGITUDE IN NAD83 COORDINATES		-103.656344	NEED NAD83 COORDINATES
INJECTION TBG/CSG I.D.	(inches)	4.49	NOTE IT'S THE INTERNAL DIAMETER IN INCHES
TOP OF UPPER CONFINING ZONE	(feet)	4,880	
TOP OF PERMITTED INJECTION INTERVAL	(feet)	4,922	
BOTTOM OF PERMITTED INJ INTERVAL	(feet)	7,039	
BOTTOM OF LOWER CONFINING ZONE	(feet)	7,500	
FRAC GRADIENT ABOVE	(psi/ft)	0.75	
FRAC GRADIENT INJECTION INTERVAL	(psi/ft)	0.7	
FRAC GRADIENT BELOW	(psi/ft)	0.75	
PORE PRESSURE	(psi)	3,300	
DEPTH OF PORE PRESSURE MEASUREMENT	(feet)	4,922	
DATE OF PORE PRESSURE MEASUREMENT	(MM/DD/YYYY)	4/22/2025	
TOP OF PERFORATED INTERVAL	(feet)	4,922	
BOTTOM OF PERFORATED INTERVAL	(feet)	7,039	
ACTUAL FLUID DENSITY ( 0.468 ) psi/ft	lb/gal	9.00	
DAILY INJECTION VOLUME REQUESTED	(bwpd)	30,000	
MSIP REQUESTED	(psi/ft)	0.5	
POROSITY	unitless	12.00%	
PERMEABILITY	(millidarcy)	85	
CALCUL	ATED VALUES BELO	W	
NET INJECTION INTERVAL THICKNESS	(ft)	2,117	
NET UPPER CONFINEMENT THICKNESS	(ft)	42	
NET LOWER CONFINEMENT THICKNESS	(ft)	461	
AVERAGE PORE PRESSURE GRADIENT	(psi/ft)	0.670	

- Basic Info.
- Technical Data
- Source of Data,
   Page Numbers to
   Appendix

### Well Template - Confinement



- Upper and lower boundaries of the permitted injection interval must prevent fracture growth out the injection interval, as well as act as a permeability barrier.
- In-situ minimum stresses (frac gradients): step rate test, sonic log interpretation, diagnostic fracture injection test (DFIT).

Remember: add reference wells to cross-section.

Create report and appendix of source data (show your work).

### Well Template – Pore Pressure



- Average reservoir pressure: BHP measurements, injection / fall-off testing.
- Depth Reference for Measurement
- Date of Measurement

Remember: add reference wells to cross-section.

Create report and appendix of source data (show your work).

### Well Template – Permit Interval



### Continuous confining interval

- Bottom of upper confining interval is assumed to be top of permitted injection interval.
- Similarly, bottom of permitted injection interval is assumed to be top of the lower confinement.
- Permeability contrast
- Stress contrast
- Confining intervals above or below: minimum of 25 ft w/ adequate mechanical properties.

### Well Template – Other



AVERAGE DENSITY of injection fluids

POROSITY / PERMEABILITY

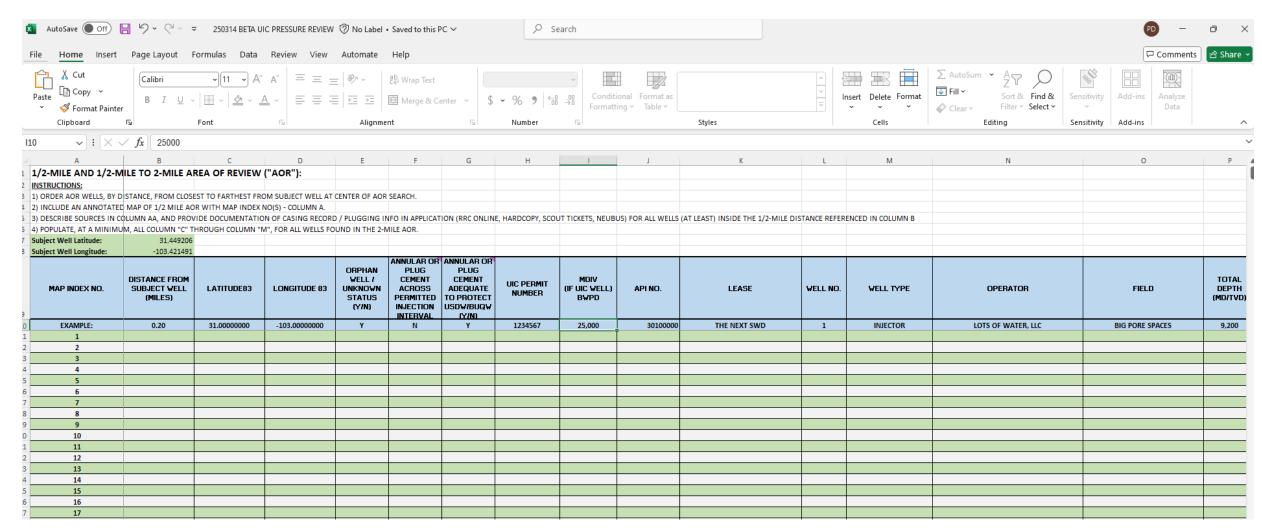
### Well Template – Data Appendix



- Well logs may be submitted as image files with the formation contact picks annotated.
- Most of the supplemental report documents and reference materials should be collated into a single .pdf file with a table of contents and page numbers.
- References on 'Well Template Sources of Data'

### AOR Template – Input Data (1 of 2)





### AOR Template – Input Data (2 of 2)



#### 'AOR Template' Worksheet:

- Sorted by distance
- Columns A-AD completed for ½-mile AOR
- Columns A-Q completed for 2-mile AOR
- If any information is unavailable or not applicable do not estimate, mark clearly as "unavailable" or "NA."

#### AOR Criteria: 0 to ½ mile



#### PASS/FAIL RADIUS OF REVIEW

- Operator is required to assess completion and cementing records of all known wells in the ½-mile radius. Offset wells must:
  - have cement across the injection interval and the cement in the offset wells is adequate to keep injected fluids in the injection interval.
  - have all applicable plugging records to indicate the BUQW is protected from injection in the subject well.
  - contain no orphan wells, improperly plugged or abandoned wells within the ½mile AOR.

#### AOR Criteria: ½ to 2 mile



#### WELLBORE DATA INTEGRITY RADIUS OF REVIEW

– If wells in the area between ½ and 2 miles are classified as orphan wells or have insufficient cementing, plugging or completion records, then the MSIP for that permit will automatically receive a 0.05 psi/ft reduction.

### AOR Data - Sources of Data



#### **Plugging Reports**

Plugging Record RAILROAD COMMISSION OF TEXAS
OIL AND GAS DIVISION

FORM W-3 Rev. 08/2019

				42-	o. (if availab	le)		1. RRC	District			
FILE IN DUPLI	CATE WITH DISTRIC	CT OFFIC	E OF DIS	TRICT	N WHIC	н		4. RRC	Lease or ID			
	OCATED WITHIN TH							Numb	er			
2. FIELD NAME (as per RRC records)		3. Lease Na		200	0			5. Well 1	Number			
6. OPERATOR		6a. Original	Form W-1 file	d in name of				10. Cour	nty			
7. ADDRESS		6b. Any sub	sequent W-1's	filed in name	of:			11. Date	Drilling Permi	it Issued		
8. Location of well, relative to nearest lea	ise boundaries	f	eet from	line an	ıd	feet	from	12. Perm	nit Number			
of lease on which this well is located	:-	l:	ine of the			leas	e	_				
9a. SECTION, BLOCK and SURVEY	9b. Distance and direction from nearest town in this county							13. Date Drilling Commenced				
16. Type Well (oil, gas, Total Depth	If multiple completion list all fi	ield names and	oil lease or gas	id no.'s	Gas ID or Oil Lease #	Oil - O	Well #	14. Date	Drilling Comp	oleted		
or dry)					Oil Lease #	Gas - G						
18. If gas, amt. of cond. on								15. Date	Well Plugged			
hand at time of plugging  CEMENTING TO PLUG AND	ARANDON DATA:	PLUG #1	PLUG #2	PLUG #3	PLUG #	ta PIII	G #5	PLUG #6	PLUG #7	PLUG #8		
*19. Cementing Date	ABANDON DATA.	7200#1	F 200 #2	7200#3	FEOGR		0 #0	FE00 #0	F 200 #/	7200#0		
20. Size of Hole or Pipe in which Plug P	laced (inches)					_						
21. Depth to Bottom of Tubing or Drill F						_						
*22. Sacks of Cement Used (each plug)					+	+						
*23. Slurry Volume Pumped (cu. ft.)												
*24. Calculated Top of Plug (ft.)												
<ol> <li>Measured Top of Plug (if tagged) (ft.</li> </ol>	.)											
*26. Slurry Wt. # / Gal.												
*27. Type Cement												
28. CASING AND TUBING RECORD	AFTER PLUGGING	•	29. W	as any non-d	lrillable mate	rial (other t	han casir	ng) left in this	well? Ye	s No		

#### **Completion Reports**

Fo	rm W-2											API No.: 4			
36.						CASI	NG R	ECC	ORD			API No.: 4	2-		
	Type of Casing (conductor, surfa intermediate, conventional produ tapered production, or other)				le Size (in.)	Setting Depth (fl.)	Multi-S Tool De (ft.)	tage epth	Multi- Shoe Do		Cement Class	Cement Amount (sacks)	Slurry Volume (cu. ft.)	Top of Cement	Top of Cement Determined By
2															
4															
37.						LIN	ER RE	cco	RD						
Row	Liner Size (in.)	Но	ole Size (in.)	) Line	r Top (ft.)	Liner Botto	om (ft.)		ment lass		ement int (sacks)	Slurry Volume (cu. ft.)		Top of Cement	Top of Cement Determined By
1									$\Box$						
2															
38.		Т	UBING I	RECORD				39.		PRO	DUCING	J/INJECT	ION/DISI	POSAL INT	TERVAL
	this well currently have O & no SWR 13 Exception			SWR 13 Ex		NO ttach appro	val)	Indi	cate to	p and b	oottom mea	sured depth:	s of comple	tion interval(s	s) or open hole
(11.14)	Size (in.)	on obtain	Depth Set		Pacl	ker Depth/Ty	pe	Fron	n				To		
	. /			. ,				Fron					То		
$\vdash$								Fron	n				To		
								Fron	n				To		
								Fron	n				To		

Other Sources...

### **Additional Application Attachments**



#### Map showing permit location and offset well locations

 Map should include annotations on well locations that correspond to the index numbers on 'AOR TEMPLATE' in Column A.

#### Cross section across 2-mile AOR

 Operator will provide a cross section, using the best well control available, illustrating the continuity of the primary lithologic units (i.e., bounding layers, injection intervals) across the 2-mile circular area of review.

## AOR Data – Output



### **Impact of AOR Results:**

PRIMARY AOR+ SCORE FOR 0.5 MILE (TOC REVIEW)	PASS	1	FAIL	0
SECONDARY AOR+ SCORE FOR 0.5 MILE TO 2 MILE	PASS	1	REDUCE MSIP	0
MSIP PRESSURE GRADIENT DEDUCT BASED ON AOR SCORE	-0.05	psi/ft		
RADIUS OF REVIEW	2	Miles		
MAX ALLOWABLE PORE PRESSURE GRADIENT	0.75	psi/ft		
MAX POSSIBLE MSIP	0.5	psi/ft		
MINIMUM BARRIER ZONE THICKNESS	25	ft		

PRIMARY AOR+ SCORE FOR 0.5 MILE (TOC REVIEW)	PASS	0	FAIL	1	
SECONDARY AOR+ SCORE FOR 0.5 MILE TO 2 MILE	PASS	0	REDUCE MSIP	1	
MSIP PRASSURE GRADIENT DEDUCT BASED ON AOR SCORE	-0.05	psi/ft	0		
RADIUS OF REVIEW	2	Miles			
MAX ALLOWABLE PORE PRESSURE GRADIENT	0.75	psi/ft			
MAX POSSIBLE MSIP	0.5	psi/ft			
MINIMUM BARRIER ZONE THICKNESS	25	ft			

### MSIP & MDIV: Dashboard



Α	В	C D	_	F	G	Н		J	K	L		M	N	0	Р	Q
RRC UIC TRACKING NUMBER		0	PRIMARY AOR+ SCORE FOR 0.5 MILE (TOC REVIEW)	PASS	1	FAIL	0									
OPERATOR		SVD OPERATOR	SECONDARY AOR+ SCORE FOR 0.5 MILE TO 2 MILE	PASS	1 7	REDUCE MSIP	0					CONFININ	G PRESSURE V	VS. DEPTH		
LEASE	LAR	GE VATER VOLUMES	MSIP PRESSURE GRADIENT DEDUCT BASED ON AOR SCORE		psilft	0					∘ ر−		$\overline{}$	$\overline{}$		$\neg$
LEASE/GAS ID NO.		0	RADIUS OF REVIEW		Miles								\	L		. I
VELL NO.		3	MAX ALLOWABLE PORE PRESSURE GRADIENT	0.75	psilft								MSIF	IP = 2,844 (psig) /	0.500 (psi/ft)	.)
API NO.		003-49114	MAX POSSIBLE MSIP		psilft								\	MAX INJ RATE	E = 20.8 (bpm)	0
LATITUDE IN NAD83 COORDINATES		32.142683	MINIMUM BARRIER ZONE THICKNESS	25	ft					16	000			MDIV = 1	30,000 (bwpd)	n
LONGITUDE IN NAD83 COORDINATES		-102.961589											\		,,	Ή
			MSIP DETERMINATION	ZONE DEPTHS FROM OPERATO R	FRAC GRADIENT FROM OPERATOR	CLOSURE / CONFINING PRESSURE	CLOSURE STRESS OF CONFINING INTERVAL - HYDROSTATIC HEAD	MSIP GRADIENT BASED ON UPPER CONFINING ZONE	PERMITTED MDIY	20	000		-			
INJECTION TBG/CSG I.D.	(inches)	5.5		(ft)	(psi/ft)	(psi)	(psi)	(psi/ft)	(bwpd)				,	1		
TOP OF UPPER CONFINING ZONE	(feet)	4,400	Top of Upper Confining Zone	4,400	1.1	4,840				€				1		- [
TOP OF PERMITTED INJECTION INTERVAL	(feet)	4,500	Bottom of Upper Confining Zone	4,500	1.1	4,950	2.044			₹ 30	000			1		$\dashv$
BOTTOM OF PERMITTED INJ INTERVAL	(feet)	6,000	Top of Permitted Injection Interval	4,500	0.65	2,925	2,844	0.500	30,000	9				1		- 1
BOTTOM OF LOVER CONFINING ZONE	(feet)	6,050	Bottom of Permitted Injection Interval	6,000	0.65	3,900	2.702			CAL						- 1
FRAC GRADIENT ABOVE	(psilft)	1.1	Top of Lower Confining Zone	6,000	1.10	6,600	3,792			ER						- 1
FRAC GRADIENT INJECTION INTERVAL	(psilft)	0.65	Bottop of Lower Confining Zone	6,050	1.10	6,655				<u> </u>	000			$\Box$		$\dashv$
FRAC GRADIENT BELOV	(psilft)	1.1								IR						
PORE PRESSURE	(psi)	2,700	MDIV vs. Reservoir Pore Pressure	А	В	С	D				$\vdash$					- 1
DEPTH OF PORE PRESSURE MEASUREMENT	(feet)	4,500		40,000	30,000	20,000	10,000						\			- 1
	(MM/DD/YY	4.500	AVE PORE PRESS FROM OPERATOR DATA = 0.600 psi/ft @ 4,500	<= 0.5 psi/ft	> 0.5 psi/ft &	> 0.6 psi/ft &	> 0.7 psi/ft			50	000	1				-
DATE OF PORE PRESSURE MEASUREMENT	YY)		ATE PURE PRESS FROM OPERATOR DATA = 0.600 psirt @ 4,300	t= 0.5 psirre	C= U.6 psirit	<= 0.7 psi/ft	> U.7 psirrc						\			- 1
TOP OF PERFORATED INTERVAL	(feet)	5,800			30000								\	\ \		- 1
BOTTOM OF PERFORATED INTERVAL	(feet)	4/22/2025										_	\ \	\ \ \		
ACTUAL FLUID DENSITY ( 0.468 ) psilft	lbłgal	9.00	FINAL MDIV BASED ON PORE PRESSURE	30,000	MAX INJ RATE	20.8				- 60	000		,			-
DAILY INJECTION VOLUME REQUESTED	(bwpd)	30,000		(bwpd)		(bpm)								( \ \)		
MSIP REQUESTED	(psi/ft)	0.5		,		(= p)								\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	\	
POROSITY	unitless	12.00%														- 1
PERMEABILITY	(millidarcy)	85								70	000 └					
CALCULATED VALUE	S BELOW										0	2000	9 400			8000
NET INJECTION INTERVAL THICKNESS	(ft)	1,500										Upper Barrier		Injection In		
NET UPPER CONFINEMENT THICKNESS	(ft)	100										Lower Barrier		M.S.I.P. PRI	ESSURE GRADIEN	T
NET LOVER CONFINEMENT THICKNESS	(ft)	50									_	- Perforation Inter	wal			
AVERAGE PORE PRESSURE GRADIENT	(psifft)	0.600														

### Output: Maximum Surface Injection Pressure (1 of 2)



MSIP will be determined by calculating confining stresses of barriers:

PRIMARY AOR+ SCORE FOR 0.5 MILE (TOC REVIEW)	PASS	1	FAIL	0		
SECONDARY AOR+ SCORE FOR 0.5 MILE TO 2 MILE	PASS	1	REDUCE MSIP	0		
MSIP PRESSURE GRADIENT DEDUCT BASED ON AOR SCORE	-0.05	psi/ft				
RADIUS OF REVIEW	2	Miles				
MAX ALLOWABLE PORE PRESSURE GRADIENT	0.75	psi/ft				
MAX POSSIBLE MSIP	0.5	psi/ft				
MINIMUM BARRIER ZONE THICKNESS	25	ft				
MSIP DETERMINATION	ZONE DEPTHS FROM OPERATOR	FRAC GRADIENT FROM OPERATOR	CLOSURE / CONFINING PRESSURE	CLOSURE STRESS OF CONFINING INTERVAL - HYDROSTATIC HEAD	MSIP GRADIENT BASED ON UPPER CONFINING ZONE	PERMITTED MDIV
	(ft)	(psi/ft)	(psi)	(psi)	(psi/ft)	(bwpd)
Top of Upper Confining Zone	4,400	1.1	4,840			
Bottom of Upper Confining Zone	4,500	1.1	4,950	2,844		
Top of Permitted Injection Interval	4,500	0.65	2,925	2,844	0.500	30,000
Bottom of Permitted Injection Interval	6,000	0.65	3,900	3,792		
Top of Lower Confining Zone	6,000	1.10	6,600	3,132		
Bottop of Lower Confining Zone	6,050	1.10	6,655			
MDIV vs. Reservoir Pore Pressure	Α	В	С	D		
	40,000	30,000	20,000	10,000		
AVE PORE PRESS FROM OPERATOR DATA = 0.600 psi/ft @ 4,500	<= 0.5 psi/ft	> 0.5 psi/ft & <= 0.6 psi/ft	> 0.6 psi/ft & <= 0.7 psi/ft	> 0.7 psi/ft		
		30000				
FINAL MDIV BASED ON PORE PRESSURE	30,000	MAX INJ RATE	20.8			
	(bwpd)		(bpm)			

### Output: Maximum Surface Injection Pressure (2 of 2)



MSIP will be determined using the following methodology:

MSIP determination	Depth	Closure stress	MSIP
Upper confinement Parameters	4000	1.00 psi/ft	2,140
Lower confinement Parameters	6000	0.80 psi/ft	2,010

capped at 0.50 psi/ft

Example Calculation  $-(1.00 - 0.465) \times 4,000 = 2,140 \text{ PSI (upper)}$ 

Example Calculation  $-(0.80 - 0.465) \times 6,000 = 2,010 \text{ PSI (lower)}$ 

MSIP (gradient) allowed = lower of the two values determined  $-\frac{2,010 \text{ PSI}}{2,010 \text{ PSI}}$  (this time the lower layer with a cap of 0.50 psi/ft times the top of the zone) will be divided by the depth to the top of the permitted injection interval.

Example Calculation:  $2,010 \div 4,000 = 0.5025 \text{ psi/ft} > 0.5 = MSIP = 0.5 \text{ psi/ft}$ 

## Output: Maximum Daily Injection Volume



- MDIV will be determined using the following methodology:
  - Maximum Daily Injection Volume (MDIV) will be determined using
    - Initial Average Reservoir Pressure

PRIMARY AOR+ SCORE FOR 0.5 MILE (TOC REVIEW)	PASS	1	FAIL	0		
SECONDARY AOR+ SCORE FOR 0.5 MILE TO 2 MILE	PASS	1	REDUCE MSIP	0		
MSIP PRESSURE GRADIENT DEDUCT BASED ON AOR SCORE	-0.05	psi/ft				
RADIUS OF REVIEW	2	Miles				
MAX ALLOWABLE PORE PRESSURE GRADIENT	0.75	psi/ft				
MAX POSSIBLE MSIP	0.5	psi/ft				
MINIMUM BARRIER ZONE THICKNESS	25	ft				
MSIP DETERMINATION	ZONE DEPTHS FROM OPERATOR	FRAC GRADIENT FROM OPERATOR	CLOSURE / CONFINING PRESSURE	CLOSURE STRESS OF CONFINING INTERVAL - HYDROSTATIC HEAD	MSIP GRADIENT BASED ON UPPER CONFINING ZONE	PERMITTED MDIV
	(ft)	(psi/ft)	(psi)	(psi)	(psi/ft)	(bwpd)
Top of Upper Confining Zone	4,400	1.1	4,840			
Bottom of Upper Confining Zone	4,500	1.1	4,950	2.044		
Top of Permitted Injection Interval	4,500	0.65	2,925	2,844	0.500	30,000
Bottom of Permitted Injection Interval	6,000	0.65	3,900	3,792		
Top of Lower Confining Zone	6,000	1.10	6,600	5,792		
Bottop of Lower Confining Zone	6,050	1.10	6,655			
MDIV vs. Reservoir Pore Pressure	Α	В	С	D		
	40,000	30,000	20,000	10,000		
AVE PORE PRESS FROM OPERATOR DATA = 0.600 psi/ft @ 4,500	<= 0.5 psi/ft	> 0.5 psi/ft & <= 0.6 psi/ft	> 0.6 psi/ft & <= 0.7 psi/ft	> 0.7 psi/ft		
		30000				
FINAL MDIV BASED ON PORE PRESSURE	30,000	MAX INJ RATE	20.8			
	(bwpd)		(bpm)			

### Output: Maximum Injection Rate



MIR will be determined by MDIV (barrels/day) ÷ 1,440 minutes/day = (bbl/min.)

PRIMARY AOR+ SCORE FOR 0.5 MILE (TOC REVIEW)	PASS	1	FAIL	0		
SECONDARY AOR+ SCORE FOR 0.5 MILE TO 2 MILE	PASS	1	REDUCE MSIP	0		
MSIP PRESSURE GRADIENT DEDUCT BASED ON AOR SCORE	-0.05	psi/ft				
RADIUS OF REVIEW	2	Miles				
MAX ALLOWABLE PORE PRESSURE GRADIENT	0.75	psi/ft				
MAX POSSIBLE MSIP	0.5	psi/ft				
MINIMUM BARRIER ZONE THICKNESS	25	ft				
MSIP DETERMINATION	ZONE DEPTHS FROM OPERATOR	FRAC GRADIENT FROM OPERATOR	CLOSURE / CONFINING PRESSURE	CLOSURE STRESS OF CONFINING INTERVAL - HYDROSTATIC HEAD	MSIP GRADIENT BASED ON UPPER CONFINING ZONE	PERMITTED MDIV
	(ft)	(psi/ft)	(psi)	(psi)	(psi/ft)	(bwpd)
Top of Upper Confining Zone	4,400	1.1	4,840			
Bottom of Upper Confining Zone	4,500	1.1	4,950	2,844		
Top of Permitted Injection Interval	4,500	0.65	2,925	2,844	0.500	30,000
Bottom of Permitted Injection Interval	6,000	0.65	3,900	3,792		
Top of Lower Confining Zone	6,000	1.10	6,600	3,732		
Bottop of Lower Confining Zone	6,050	1.10	6,655			
MDIV vs. Reservoir Pore Pressure	А	В	С	D		
	40,000	30,000	20,000	10,000		
AVE PORE PRESS FROM OPERATOR DATA = 0.600 psi/ft @ 4,500	<= 0.5 psi/ft	> 0.5 psi/ft & <= 0.6 psi/ft	> 0.6 psi/ft & <= 0.7 psi/ft	> 0.7 psi/ft		
		30000				
FINAL MDIV BASED ON PORE PRESSURE	30,000	MAX INJ RATE	20.8			
	(bwpd)		(bpm)			

## Well Completion & Permit Conditions – Page 1 of 2



- Initial Bottomhole Pressure (BHP): data point prior to injection.
- Initial fracture gradient: DFIT or STEP RATE TEST, prior to injection, submitted via sealed report to UIC & to TexNet - analysis to be included with a digital (i.e., txt, csv, EXCEL) copy of the entire test including time, rate, pressure.
- Radial CBLs on long string casing.
- Log Suite, or best available data source, with annotation of upper and lower confinement (if possible) and lithologic units, and net pay highlighted, confirming porosity-height product for entire permitted injection interval.

# Well Completion & Permit Conditions – Page 2 of 2

- Bottomhole Pressure Reporting:
  - Annual Frequency.
  - Instantaneous shut-in pressure measurement.
  - 24-hour shut-in time.
  - BHP: Downhole gauge, Dip-in measurement, Calculated.
  - Reported to TexNet and UIC.
- TexNet Volume Reporting Daily measurement /Monthly Reporting.

### Seismicity – Page 1 of 2



- In the Permian Basin, we will continue to observe the "Shallow/Deep" conventions as currently practiced:
  - Delaware Basin: Shallow is above the base of the Wolfcamp; deep is below.
  - Midland Basin: Shallow is above the top of the Strawn; deep is below.
- Applications in seismically active areas will need to provide data required by seismic guidelines (ex. maps and cross sections)

### Seismicity – Page 2 of 2



- "Shallow" applications will
  - Generally, not need Fault Slip Potential analysis.
  - Be evaluated under the Permian Review rubric, not the Seismic Guidelines (i.e. MDIV and MSIP determined by min. stress and Ppi.)
- However, the State Seismologists may identify an area in which seismicity from shallow injection is a concern and subject applications in such an area to evaluation under the seismic guidelines.

### Demonstration





- <u>UIC Permian Pressure Review V1.0 Workbook</u>
  - uic-permian-review-v1-0