

Additional Information

Received: 12/21/2021

COG Operating LLC
Gunner Deep 5 Fee SWD #1
C-108 – Additional Attachment
December 6, 2021

Statement Regarding Injection Interval and Confining Layers

The injection interval for the Gunner Deep 5 Fee SWD 1 proposed well is within the Devonian and Silurian formations. This unit is made up of the Wristen Group and Fusselman Formation. The overall thickness of this interval is between 1,400 to 2,000 feet consisting of limestone and dolostone with significant primary and secondary porosity and permeability. Below the injection interval is the Montoya Formation, which is between 300 and 500 feet thick. Figure 1 shows the isopach map of the Wristen Group and Fusselman Formation along with known faults and proposed well location. Figure 2 shows the isopach map of the Montoya Formation.

Basement faults in the area are sourced from the Tectonic Map of Texas (Ewing, 1990). The Precambrian Basement Map (Frenzel et al, 1988) is the source of the Precambrian faults which is inferred from subsurface data. The proposed Gunner Deep 5 Fee SWD 1 well is located 7.6 miles to the west of the nearest Precambrian fault and 4.8 miles to the south of the nearest Basement fault.

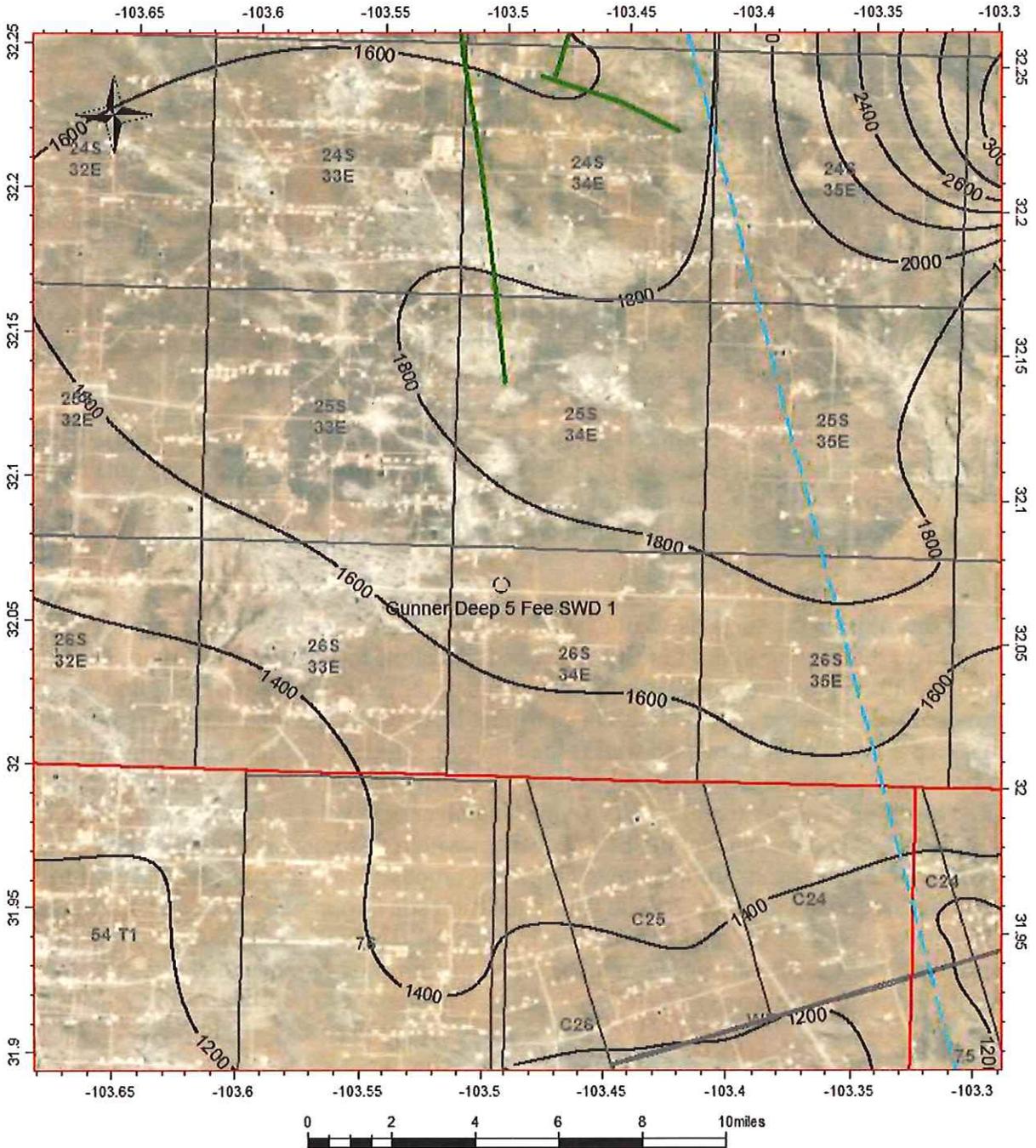
Overlying the Wristen Group is the Woodford Shale. The Woodford Shale in this area is between 150 to 250 feet thick, consisting of mostly shale and mudstone that act as a confining layer above the injection interval. Figure 3 shows the isopach map of the Woodford Formation, known faults and proposed well location. The underlying confining layer below the injection interval for the Gunner Deep 5 Fee SWD 1 proposed well is the Simpson Group. The Simpson Group in this area is between 800 to 900 feet thick and consists of a series of shales, carbonates, and some sand. The Simpson Group interval acts as a confining layer below the injection interval due to the large thickness and the amount of shale sequences within this interval. Figure 4 shows the isopach map of the Simpson Group, known faults and proposed well location. The Woodford Shale and the significant amount of shale within the Simpson Group will likely prevent fluids from migrating outside of the injection interval in this well. There is an additional 800 to 1000 feet of thickness of the Ellenburger Formation below the Simpson Group and above Precambrian Basement (shown in Figure 5).

Regards,



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Fusselman/Wristen Group Isopach and Faults Map

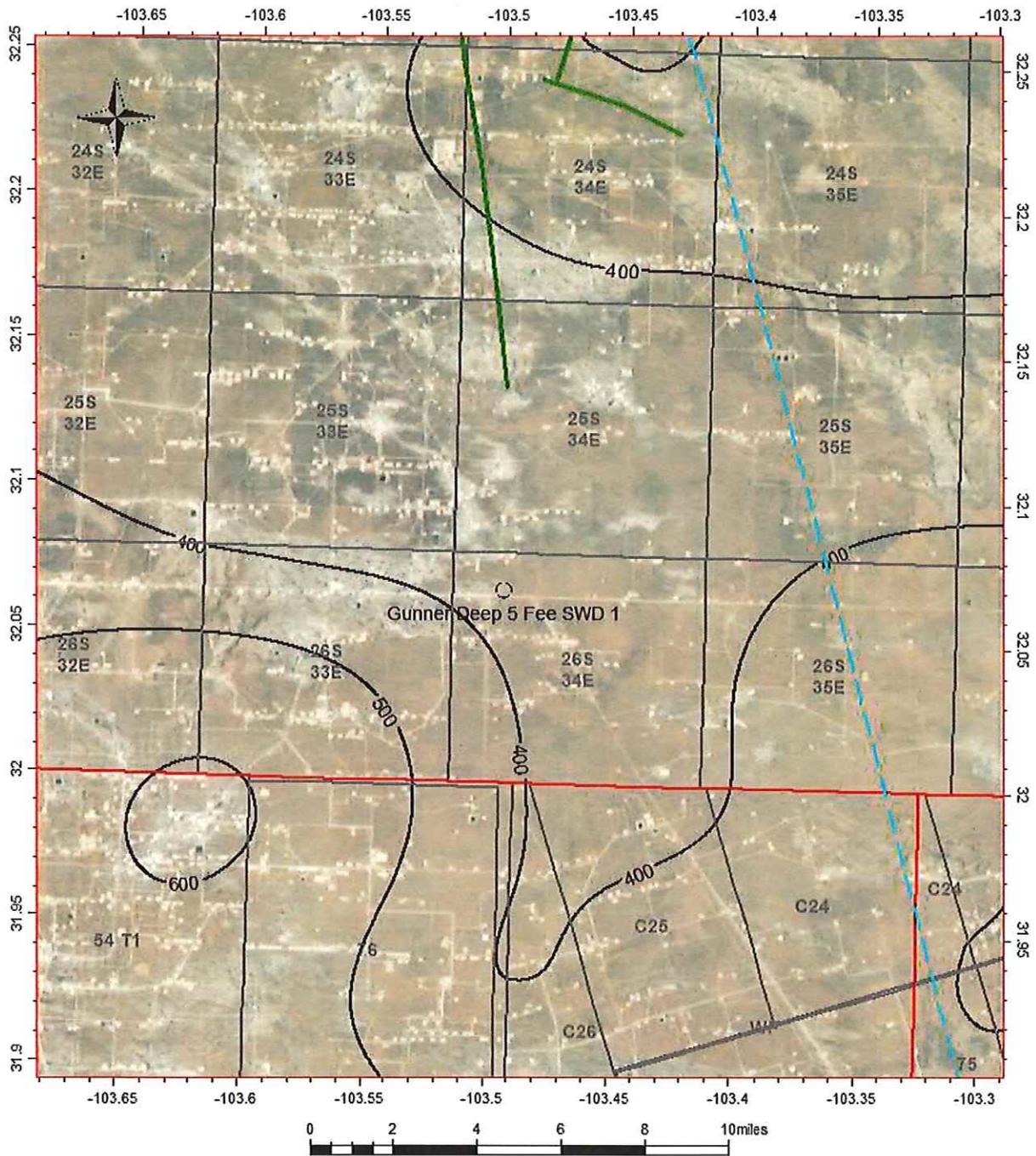


<i>Area</i>	Permian	<i>Surface name</i>	Silurian / Devonian Isopach
<i>Geographic datum</i>	GCS_North_American_1927	<i>Contour inc</i>	200
<i>Projection</i>	NAD27 / Texas Central (US ft)	<i>Scale</i>	1:200000

LEGEND	
—	NM TOWNSHIPS
—	TX BLOCKS
—	COUNTIES
- - -	Precambrian Faults
—	Basement Faults
○	Proposed well surface location

Figure 1: Silurian / Devonian (Fusselman Formation / Wristen Group) Isopach and Faults Map

Upper Ordovician (Montoya) Isopach and Faults Map

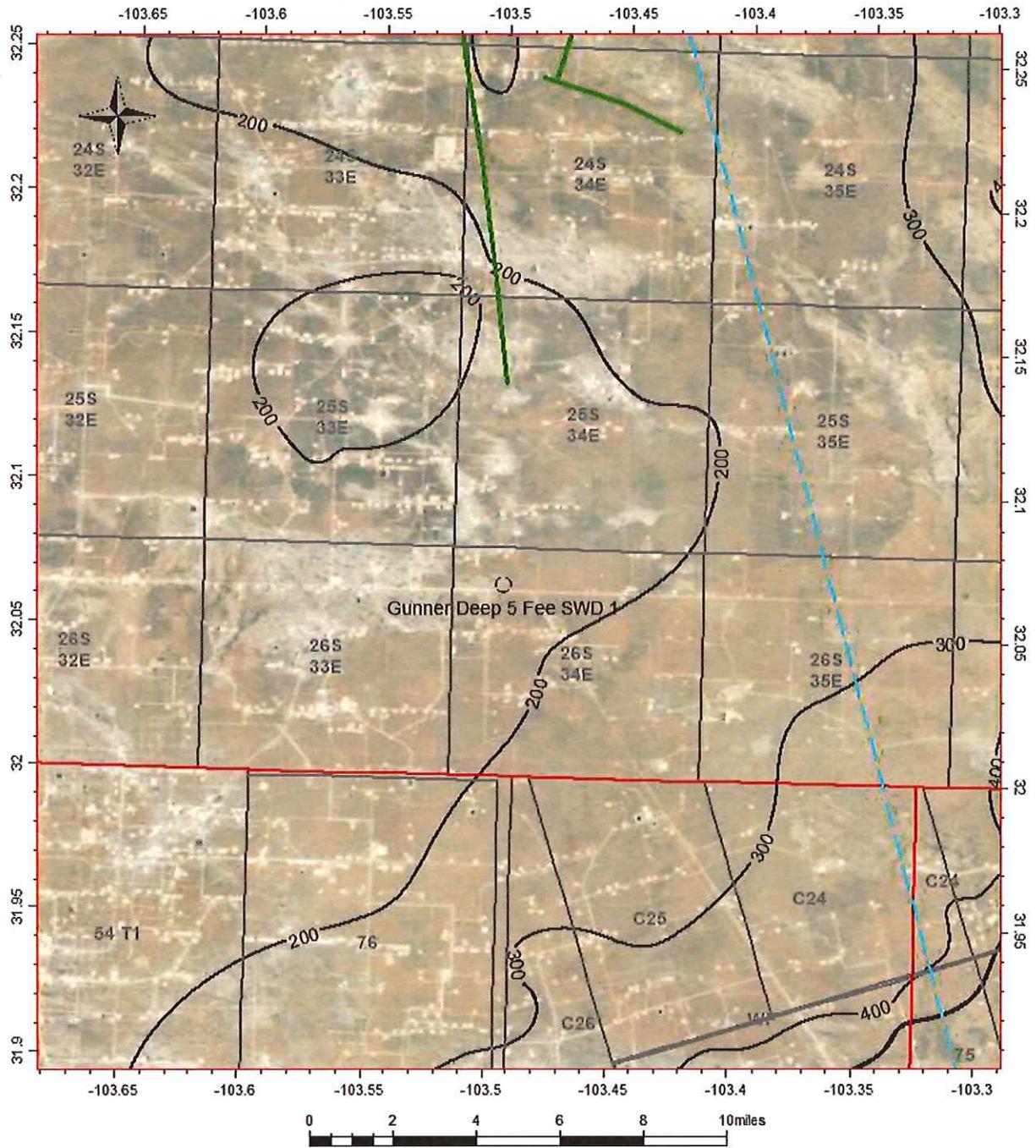


<i>Area</i>	Permian	<i>Surface name</i>	Upper Ordovician (Montoya) Isopach
<i>Geographic datum</i>	GCS_North_American_1927	<i>Contour inc</i>	100
<i>Projection</i>	NAD27 / Texas Central (US ft)	<i>Scale</i>	1:200000

LEGEND	
—	NM TOWNSHIPS
—	TX BLOCKS
—	COUNTIES
—	Precambrian Faults
—	Basement Faults
○	Proposed well surface location

Figure 2: Upper Ordovician (Montoya) Isopach and Faults Map

Late Devonian (Woodford) Isopach and Faults Map



Area	Permian	Surface name	Late Devonian (Woodford) Isopach
Geographic datum	GCS_North_American_1927	Contour inc	100
Projection	NAD27 / Texas Central (US ft)	Scale	1:200000

LEGEND	
—	NM TOWNSHIPS
—	TX BLOCKS
—	COUNTIES
- - -	Precambrian Faults
—	Basement Faults
○	Proposed well surface location

Figure 3: Late Devonian (Woodford) Isopach and Faults Map

Middle Ordovician (Simpson) Isopach and Faults Map

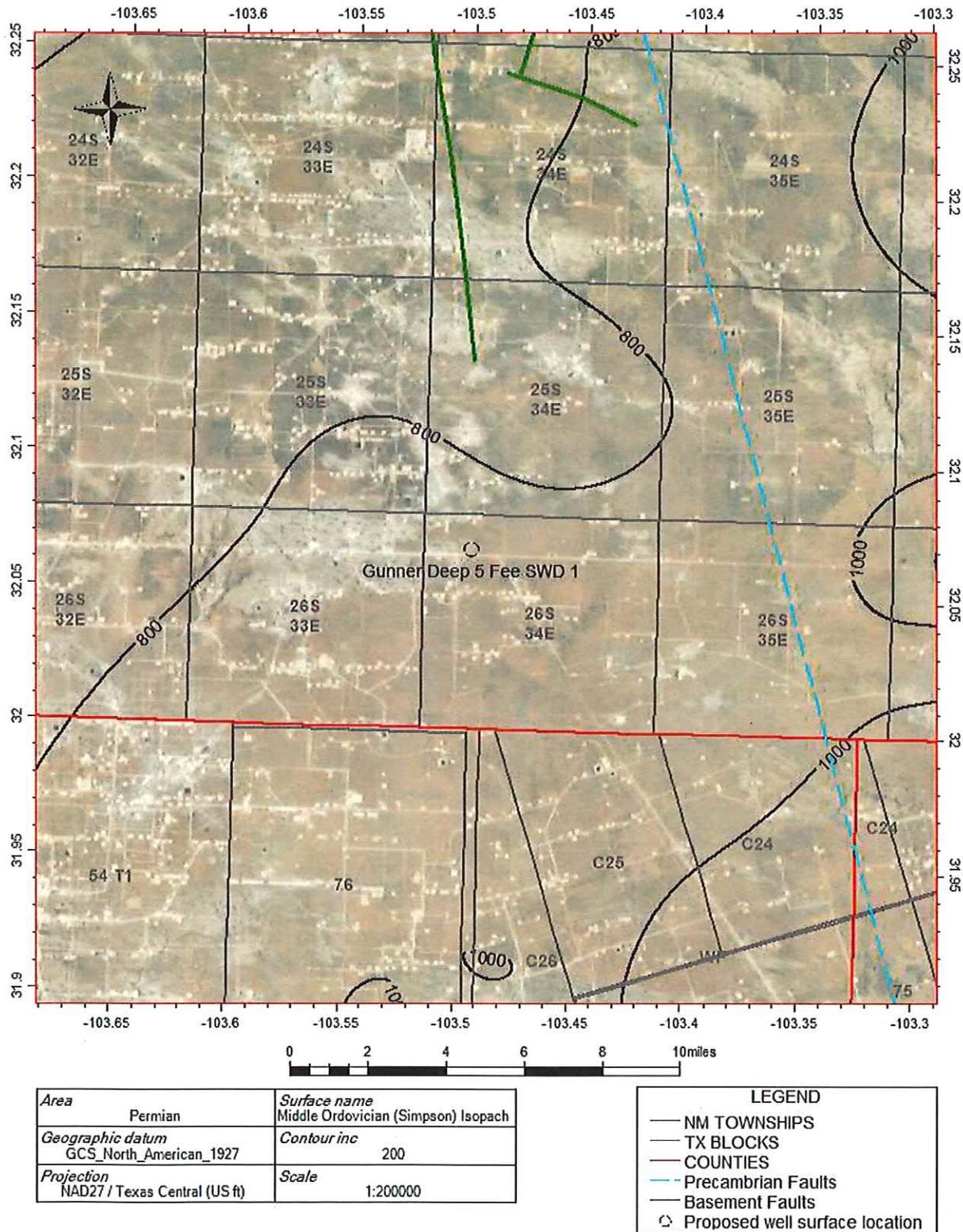


Figure 4: Middle Ordovician (Simpson Group) Isopach and Faults Map

Lower Ordovician (Ellenburger) Isopach and Faults Map

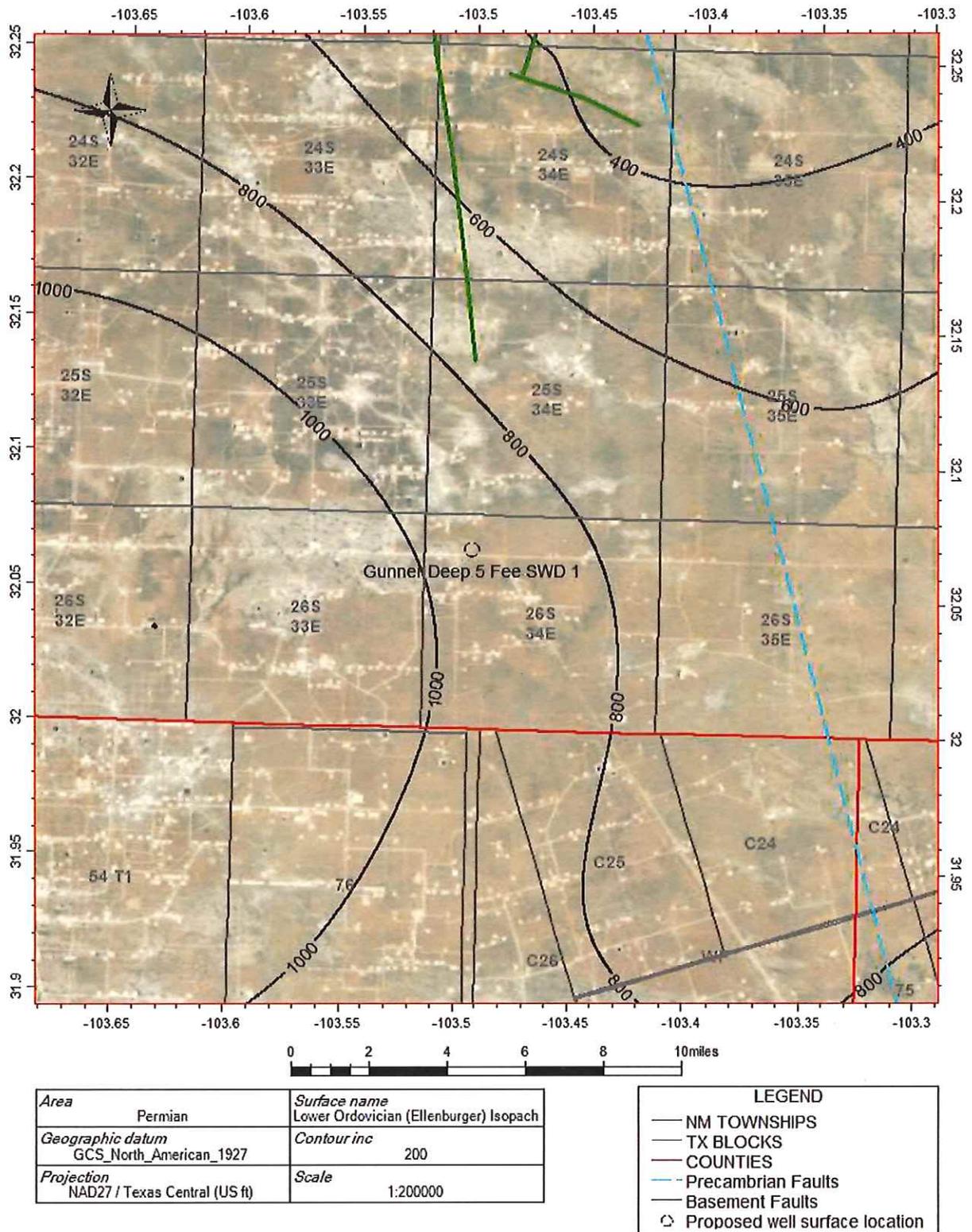


Figure 5: Lower Ordovician (Ellenburger) Isopach and Faults Map

Statement Regarding Historical Review of Earthquakes in the Area

Historical review of earthquakes was conducted within a 50 km area around the Gunner Deep 5 Fee SWD 1 proposed well. Seismic events were sourced from USGS earthquake catalog from January 1, 1970 to December 2, 2021 with a magnitude greater than 1.0. Table 1 shows all the seismic events within the 50 km area. There are a total 101 seismic events within this time-period ranging in magnitude from 1.0 to 4.6. Figure 6 shows the seismic event locations as red circles. The nearest earthquake to the Gunner Deep 5 Fee SWD 1 proposed well is 10.93 miles to the south.

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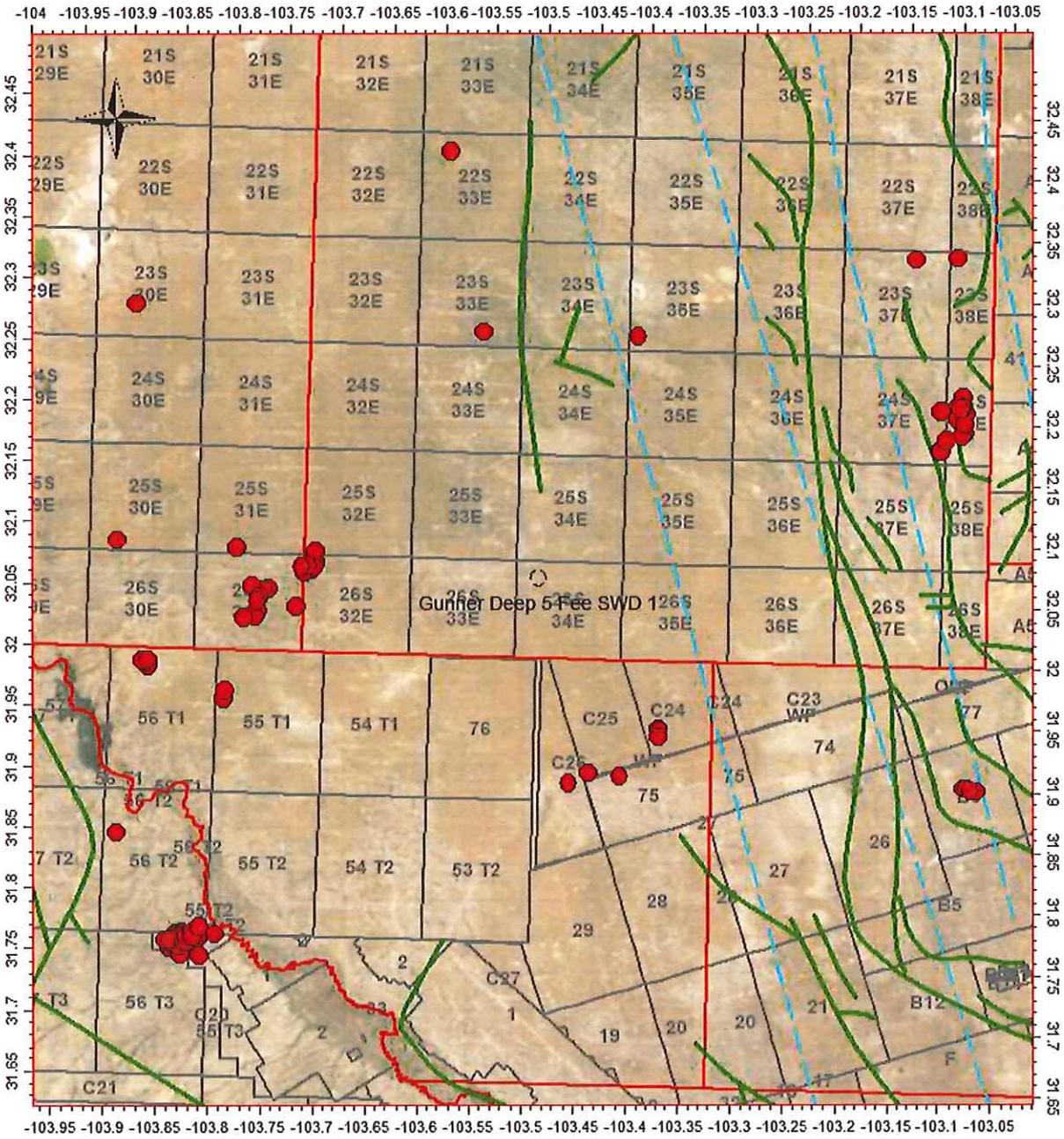
Table 1: Seismicity within 50 km of proposed SWD well (USGS source: Jan. 1970 – Dec. 2021)

Date	Origin Time GMT	Latitude	Longitude	Depth (km)	Magnitude
2021-12-01	8:56:17	31.9846	-103.8697	7.73	3
2021-11-13	4:53:34	32.4132	-103.5923	5.00	3.2
2021-10-25	5:08:04	32.2083	-103.0893	2.45	2
2021-10-19	18:49:23	31.9882	-103.8719	7.83	2.3
2021-10-19	11:45:27	31.9892	-103.8751	7.52	2
2021-10-14	22:05:11	31.9901	-103.8697	7.52	3.3
2021-10-14	4:26:18	31.7546	-103.8412	6.16	2.1
2021-10-13	21:02:19	32.2220	-103.0925	2.23	2.2
2021-10-05	11:55:04	31.7583	-103.8401	6.57	2.6
2021-10-05	11:53:02	31.7583	-103.8412	6.16	2.1
2021-09-30	7:39:56	31.7491	-103.8304	6.57	2
2021-09-27	11:12:05	31.7647	-103.8326	6.16	2.1
2021-09-26	23:01:42	31.7659	-103.8361	6.49	2.4
2021-09-26	8:57:30	31.7675	-103.8294	6.16	3
2021-09-26	8:48:37	31.7638	-103.8380	6.16	1.8
2021-09-22	21:37:17	31.7592	-103.8412	6.16	2.2
2021-09-22	21:21:13	31.7585	-103.8431	6.70	2.3
2021-09-22	21:17:58	31.7592	-103.8401	6.57	3.4
2021-09-22	18:49:12	31.7608	-103.8458	6.13	2.8

2021-09-22	0:25:44	32.0694	-103.7176	7.62	1.7
2021-09-21	8:15:44	32.0726	-103.7116	8.24	2.3
2021-09-21	4:19:43	32.0680	-103.7159	8.91	3.2
2021-09-20	23:31:46	32.2128	-103.0989	3.55	1.9
2021-09-20	17:46:29	32.2037	-103.0968	4.43	2.7
2021-09-18	9:08:13	31.7624	-103.8353	6.31	2.5
2021-09-17	17:59:06	31.7629	-103.8337	6.26	2
2021-09-14	21:52:41	32.1927	-103.0903	6.04	1.8
2021-09-13	14:58:03	31.7650	-103.8297	6.13	2.4
2021-09-12	23:20:22	31.7641	-103.8329	6.90	3
2021-09-12	11:47:22	31.7629	-103.8348	6.16	2
2021-09-12	10:21:53	31.7636	-103.8383	6.13	2.5
2021-09-10	11:51:14	32.0870	-103.9025	8.34	2.3
2021-09-10	11:20:39	32.1780	-103.1139	8.00	1.9
2021-09-10	2:44:26	32.1780	-103.1118	5.99	1.9
2021-09-09	22:04:39	32.1909	-103.0925	5.70	2.5
2021-09-09	21:47:19	31.9451	-103.3775	7.91	1.7
2021-09-09	14:47:54	31.9432	-103.3764	8.21	2.7
2021-09-09	10:51:06	31.9382	-103.3770	10.12	1.6
2021-09-07	8:29:09	32.2028	-103.0957	1.61	2.2
2021-09-05	11:59:29	32.1872	-103.1075	6.24	2
2021-09-03	8:47:54	32.2037	-103.0968	5.26	2
2021-09-01	17:52:40	32.2137	-103.0914	3.18	2.4
2021-09-01	8:54:10	32.2000	-103.0903	1.64	2
2021-09-01	7:19:23	32.2128	-103.0946	5.01	2.5
2021-09-01	2:38:25	31.7583	-103.8197	7.60	2.7
2021-08-31	10:17:19	32.2101	-103.1129	7.09	2.1
2021-08-27	2:53:18	31.7615	-103.8385	6.21	1.8
2021-08-27	1:48:08	31.7610	-103.8412	6.47	2.1
2021-08-18	7:54:54	31.7647	-103.8305	6.16	1.7
2021-08-17	22:24:07	32.0722	-103.7170	7.42	2
2021-08-15	14:56:22	32.0740	-103.7116	7.83	3.2
2021-08-11	23:29:25	31.7565	-103.8326	6.16	2.4
2021-08-04	6:53:57	32.0754	-103.7132	7.52	1.9
2021-08-04	3:06:21	32.0731	-103.7116	7.73	2.3
2021-07-31	11:29:49	32.0648	-103.7224	8.39	2.5
2021-07-28	23:50:22	32.0703	-103.7132	8.70	2.7
2021-07-28	19:20:39	32.0830	-103.7124	7.29	2.2
2021-07-19	11:23:25	32.0712	-103.7192	7.83	4
2021-07-15	8:13:04	32.0510	-103.7559	7.42	1.6
2021-07-01	19:49:12	31.9594	-103.7962	6.75	2.3

2021-07-01	2:51:28	32.0840	-103.7879	8.09	1.6
2021-06-25	10:04:25	32.0699	-103.7257	7.42	2
2021-06-16	16:10:53	31.9051	-103.4137	9.50	1.6
2021-06-08	6:34:48	31.9668	-103.7957	7.52	2.1
2021-05-10	4:36:40	32.0372	-103.7294	8.70	1.8
2021-04-28	14:56:38	32.0317	-103.7672	7.93	1.9
2021-04-19	8:44:03	31.7610	-103.8402	6.88	1.7
2021-04-15	10:07:32	31.7620	-103.8251	6.16	2
2021-04-11	8:35:15	31.7602	-103.8218	6.16	1.8
2021-04-05	1:16:17	31.7592	-103.8272	6.16	1.7
2021-04-04	13:02:13	31.9074	-103.4434	6.05	1.9
2021-04-04	5:55:15	31.7592	-103.8251	6.16	2
2021-03-31	22:05:32	31.7666	-103.8186	7.29	1.8
2021-03-19	14:18:19	32.0326	-103.7656	8.60	2.7
2021-03-19	8:02:15	32.0503	-103.7616	8.68	2.2
2021-03-19	2:43:27	32.0284	-103.7683	8.34	3.4
2021-03-18	2:45:25	31.7638	-103.8251	6.77	1.8
2021-03-13	14:53:13	31.7666	-103.7981	7.19	1.5
2021-03-10	9:22:56	31.7629	-103.8143	6.05	2
2021-03-09	9:28:20	31.7651	-103.8138	7.24	1.7
2021-03-08	17:08:14	31.7666	-103.8175	6.16	1.7
2021-03-08	15:58:16	31.7675	-103.8197	5.95	2
2021-03-08	15:48:48	31.7638	-103.8197	6.05	2.5
2021-03-08	9:40:00	31.7721	-103.8132	6.16	2.1
2021-02-19	16:41:25	31.8473	-103.8954	3.69	1.8
2020-11-08	21:19:55	31.8986	-103.4622	5.98	2.7
2020-07-14	4:44:04	32.0528	-103.7722	11.84	2.5
2020-04-23	4:34:53	32.0439	-103.7650	9.81	2.6
2020-03-13	6:07:33	31.7484	-103.8129	5.00	2.7
2019-12-30	3:01:14	32.0402	-103.7668	5.00	2.5
2019-11-28	12:52:42	32.0263	-103.7789	9.65	2.7
2019-10-21	11:58:57	32.2659	-103.4070	5.00	2.7
2017-05-03	17:47:21	32.0819	-103.0226	5.00	2.6
2012-03-18	10:57:22	32.2810	-103.8920	5.00	3.1
2001-06-02	1:55:54	32.3340	-103.1410	5.00	3.3
1992-01-02	11:45:36	32.3360	-103.1010	5.00	4.6
1984-12-04	20:36:36	32.2660	-103.5560	5.00	2.9
1977-04-26	9:03:07	31.9020	-103.0830	4.00	3.3
1976-01-25	4:48:28	31.9020	-103.0800	2.00	3.9
1976-01-22	7:21:57	31.9000	-103.0710	1.00	2.8
1976-01-19	4:03:31	31.9000	-103.0770	1.00	3.5

Historical Seismicity and Faults Map



Area	Permian	Points	Historical Seismicity
Geographic datum	GCS_North_American_1927	Scale	1:488281
Projection	NAD27 / Texas Central (US ft)		

LEGEND	
—	NM TOWNSHIPS
—	TX BLOCKS
—	COUNTIES
—	Precambrian Faults
—	Basement Faults
○	Proposed well surface location

Figure 5: Historical Seismicity (Jan. 1, 1970 to Dec. 2, 2021) and Faults Map